

Excerpt from Design Memorandum No. 5

New Melones Project  
Water Quality Control  
June 1965

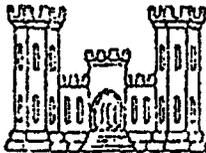
**“Water quality control releases from new Melones storage project will contribute significantly to the solution of the overall pollution problem in the lower San Joaquin River but should not be considered as a complete solution of this problem.”**

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DESIGN MEMORANDUM NO. 5

JUNE 1965

## NEW MELONES PROJECT

Stanislaus River, California

# WATER QUALITY CONTROL

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DESIGN MEMORANDUM NO. 5  
NEW MELONES PROJECT  
STANISLAUS RIVER, CALIFORNIA  
WATER QUALITY CONTROL  
JUNE 1965

REVISIONS

Date	New Pages or Drawings
29 Sep 65 1 Feb 66	Revised pages 5 and 6 Revised list of Design Memorandums; revised pages 1, 5 and 7

DESIGN MEMORANDUM NO. 5  
NEW MELONES PROJECT  
STANISLAUS RIVER, CALIFORNIA

WATER QUALITY CONTROL

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LIST OF CHARTS

CHART 1 Sketch Map

ATTACHMENTS

- 1 Public Health Service Report on Water Quality Control, dated January 1965
- 2 U. S. Bureau of Reclamation Letter, dated 19 March 1965

DESIGN MEMORANDUM NO. 5  
NEW MELONES PROJECT  
STANISLAUS RIVER, CALIFORNIA

WATER QUALITY CONTROL

PERTINENT DATA

1. General data

Location	On Stanislaus River, about 38 miles east of Stockton, California.
Purpose	Flood control, irrigation, power, general recreation, fish and wild-life, and water quality control.
Average annual runoff at damsite	1,130,000 acre-feet
Maximum peak natural flow of record at damsite	102,000 c.f.s.
Maximum peak flow of record below existing dam	62,800 c.f.s.
Drainage area, above dam	897 square miles

2. Reservoir data

<u>Feature</u>	<u>Elev. (ft.)</u>	<u>Area (acres)</u>	<u>Storage capacity (ac.-ft.)</u>	<u>Length of shoreline (miles)</u>	<u>Length of pool (miles)</u>
Minimum power pool	808.0	3,320	310,000	60	15.0
Normal recreation pool	1,021.0	9,705	1,650,000	90	22.0
Gross pool	1,088.0	12,200	2,400,000	100	23.6

3. Dam

Type (tentative)	Earth and rockfill
Maximum height above streambed	600 feet
Crown width and length	20 ft. and 1,500 ft.

PERTINENT DATA (contd)

6. Power facilities .

Installed capacity	150,000 kw.
Number of units	3
Maximum gross head	583 ft.
Minimum gross head	303 ft.
Critical gross head on turbines	466 ft.
Hydraulic capacity of all turbines at critical head	4,470 c.f.s.
Approximate minimum tail water elevation	505 ft.

NEW MELONES PROJECT, STANISLAUS RIVER, CALIFORNIA  
DESIGN MEMORANDUM NO. 5  
WATER QUALITY CONTROL

1. Authority. - The New Melones Project was authorized by the Flood Control Act of 1944 (Public Law 78-534) and modified by the Flood Control Act of 1962 (Public Law 87-874). The project would consist of a dam, reservoir, and powerplant. Location of the project is shown on chart 1. The dam, about 600 feet high, would provide a reservoir with a gross capacity of 2,400,000 acre-feet. The powerplant would be located immediately below the dam and have a capacity of about 150,000 kilowatts. The project, as presented in the authorizing document (HD No. 453/87/2), would be used for flood control, power, irrigation, recreation, fish and wildlife, and other purposes. Upon completion of construction of the project by the Corps of Engineers, the project will become an integral part of the Central Valley Project and will be operated and maintained by the Bureau of Reclamation. Authority to investigate the need for water quality control is contained in the Federal Water Pollution Control Act Amendments of 1961 (Public Law 87-88, approved 20 July 1961), that provide ". . . in the survey or planning of any reservoirs of the Corps of Engineers, Bureau of Reclamation, or other Federal agency, consideration shall be given to inclusion of storage for regulation of streamflow for the purpose of water quality control. . ." In addition, the 1962 Flood Control Act provides ". . . That the Secretary of the Army give consideration during the preconstruction planning for the New Melones Project to the advisability of including storage for the regulation of streamflow for the purpose of downstream water quality control."

2. Purpose and scope. - This Design Memorandum presents the results of cooperative studies by the Public Health Service, Bureau of Reclamation, and Corps of Engineers of water quality requirements in Stanislaus River and lower San Joaquin River for irrigation, fish and other purposes. These studies were made to determine the feasibility of adding water quality control as a function of the New Melones Project. The Public Health Service report (attachment 1) presents a comprehensive analysis of water quality problems in the Stanislaus and lower San Joaquin Rivers, and establishes water quality objectives which can reasonably be expected from storage and releases of water from the New Melones Project. The report includes the estimated releases which would be required to meet the objectives, and evaluates the water quality benefits which would be credited to the New Melones Project if the objectives were met. It is recognized that there would be a nominal benefit to the water quality in the Sacramento-San Joaquin Delta from any improvement in the quality of water in lower San Joaquin River; however, such improvement is negligible for the purpose of evaluation.

3. Water quality under existing conditions. -

a. Stanislaus River. - The flow Stanislaus River averages 1,125,000 acre-feet per year with the annual distribution of runoff about as follows: 2.7 percent during August, September, and October; 31.6 percent in November through March; and 65.7 percent in April through July. Several reservoir projects have been developed in the basin by Pacific Gas and Electric Company and by local irrigation districts. The major diversions occur at Goodwin Dam where about 520,000 acre-feet are diverted each year for irrigation. Flows in Stanislaus River below Goodwin Dam vary from a few cubic feet per second from return irrigation water to flows of 40,000 c.f.s. or more during flood periods. Floodflows occur between November and June. From June to November, the average flow below Goodwin Dam is usually less than 5 c.f.s. The quality of water in Stanislaus River at Tulloch Reservoir is very high, meeting U.S. Public Health Service drinking water chemical standards in all respects and with adequate treatment, is capable of meeting the physical and bacteriological standards at all times. Below Oakdale, return flows from irrigation and effluent from sewage treatment plants along the river have added solids to the stream which not only increase the dissolved solids in the water but also reduce the dissolved oxygen in the water. The dissolved oxygen concentration (hereafter called DO) in Stanislaus River is over 6 ppm most of the year, however, during the canning season, the DO concentration may drop below 1 ppm. Total dissolved solids in this stream reach, on an annual flow-weighted basis, average about 40 ppm. In the lower reaches, near the confluence with the San Joaquin River, the average annual total dissolved solids concentration (hereafter called TDS) has varied from 60 to 167 ppm, with a medium of 140 ppm during years of normal runoff. During periods of low flow in 1964 (July through October), the TDS concentration reached a maximum of 226 ppm, with the average about 200 ppm. This is a very good quality of water for irrigation use, for which purpose most of this water will be consumptively used. With New Melones in operation, it is believed that low flow conditions in lower Stanislaus River would remain essentially the same as at the present time with the exception of supplementary releases to be made specifically for fishery purposes. The following minimum flows below Goodwin Dam would be provided by release of water from New Melones Dam.

Period	Flow	
	Normal year	Dry year
1 Oct to 31 Dec	200 c.f.s.	150 c.f.s.
1 Jan to 31 May	125 c.f.s.	100 c.f.s.
1 Jun to 30 Sep	100 c.f.s.	60 c.f.s.
Total annual flow	98,000 acre-feet	69,000 acre-feet

It was assumed that water released from New Melones would have a TDS concentration of 50 ppm, which is about 20 percent higher than now measured at Tulloch Reservoir. The Public Health Service studies indicate that the dissolved oxygen, with adequate treatment of wastes discharged to the lower reach of the river, would exceed 5 ppm until about year 2000 when releases to maintain an adequate DO concentration would be required.

b. San Joaquin River. - The average annual unimpaired runoff of the San Joaquin River at the Vernalis gage is about 5,560,000 acre-feet. Considering the reduction due to diversions with the present and proposed developments on Tuolumne, Merced, Chowchilla and Fresno Rivers, it is estimated that the flow at Vernalis gage would be about 1,890,000 acre-feet per year. Flow from the Stanislaus River now comprises about 25 percent of the mean annual flow at Vernalis gage, and during the low-flow period from 1 to 15 percent of flow at this gage. The summer flows in lower San Joaquin River are comprised mainly of irrigation return flows and, during dry years, there is increased upstream re-use of the water for irrigation. The TDS concentration is highest in periods of low flow; during the unusually dry year of 1961, the concentration reached 1,220 ppm and was not under 780 ppm for a 120-day period from early June to early October. It is expected that future quality of water in lower San Joaquin River will remain about the same as present conditions.

c. Ground water. - The California Department of Water Resources, in cooperation with the U. S. Geological Survey and several county and local agencies, has conducted an extensive continuing survey for determining the quality of ground water throughout the State of California. Results of that survey, published periodically in Department of Water Resources Bulletin No. 66, indicate that ground water in the Stanislaus River Basin has an average TDS concentration of 200 ppm and is of good quality. All the towns and cities along Stanislaus River obtain their municipal supply from ground water supplies, and some irrigation water is obtained from the ground water supply. It is estimated that about 130,000 acre-feet is pumped annually and that the storage capacity of the ground water reservoir is probably in excess of 1,000,000 acre-feet. Since the ground water has not been overly developed, a high water table has prevailed for several years, which is responsible in part for accretions to Stanislaus River below Goodwin Dam. No studies have been made of anticipated future use of ground water, however, considering the large available supply and the probability of adequate treatment of municipal wastes in the future, it is believed that ground water will remain essentially the same quality as under present conditions.

4. Objectives of water quality control. - The extent of quality control to be provided at New Melones Dam would depend principally on establishment of acceptable levels of TDS and DO concentrations in

downstream reaches of the Stanislaus River and in the San Joaquin River below the confluence of the two streams that could reasonably be expected to be attained by use of New Melones Project and that would be economically justified. The agricultural water users along lower San Joaquin River need a relatively high quality water. The Public Health Service has determined that a mean monthly concentration of 500 ppm TDS would permit continuation of present cropping patterns without an increase in operating costs or decrease in yield. In view of the above, one of the objectives of water quality control would be to provide releases from New Melones Reservoir that would prevent TDS concentrations in the San Joaquin River at Vernalis gage from exceeding 500 ppm. A second objective would be to provide sufficient DO concentrations to support a warm water fishery in the downstream channels. The California State Department of Fish and Game considers a minimum DO concentration of 5 ppm necessary to maintain a stream fishery, and the Central Valley Regional Water Pollution Control Board also uses 5 ppm as a minimum allowable level. This 5 ppm DO concentration was selected as the objective level for this study.

5. Water requirements. - To determine the water requirements necessary to meet the foregoing objectives, the Public Health Service investigated the dissolved solids conditions in the San Joaquin River and the DO concentration in the Stanislaus River. In cooperation with Public Health Service, the Bureau of Reclamation prepared operation studies of the New Melones Project to meet the objective of 500 ppm, or less, of TDS criteria. The flow regulation required to control the concentration of TDS was determined using hydrologic data developed by the Bureau of Reclamation for the historical period 1921-1946, adjusted to project conditions. These data indicated the magnitude of the adjusted historical flows of San Joaquin River at Vernalis gage on a month by month basis and, by use of a flow versus TDS curve, the TDS concentrations were derived for lower San Joaquin River under project conditions. Appendix A of the PHS report describes the procedures used in determining the needs for water quality control. Bureau of Reclamation studies show that an average annual release of 10,900 acre-feet would be required to control the TDS concentration at Vernalis gage to 500 ppm, or less. This release would be in addition to other project releases, including those for fishery purposes, and would vary from 0 to 48,500 acre-feet per year. The PHS study of DO was projected over a 100-year period by 25-year increments to the year 2075, and considered future population and industrial growth, and adequate treatment of sewage. Such study, covered in detail in appendix A of the PHS report, indicates the following increasing releases required at intervals to maintain the desired DO levels in lower Stanislaus River. These releases would be in addition to those required for fish and for control of dissolved solids in lower San Joaquin River.

<u>Year</u>	<u>Required release in acre-feet</u>
1975	240
2000	380
2025	4,100
2050	13,300
2075	25,100

6. Effect of water quality releases on authorized project purposes. -

Releases for water quality control would not enhance the downstream trout fishery. Due to the fact that water for irrigation could be diverted from the San Joaquin Delta for delivery via the Delta-Mendota Canal of the Central Valley Project or the California Aqueduct, and water quality control releases from New Melones Dam would reach the Delta, there would not be a loss to irrigation, although some additional re-regulation or exchange of water between other projects may be necessary to achieve the desired result. Because of the change in water release patterns imposed by requirements for water quality releases, the head on the New Melones Powerplant would be slightly reduced with a minor detrimental effect on power production. Also, routing of irrigation water to the Delta then delivering via canals would increase pumping costs. The Bureau of Reclamation has estimated that, with the inclusion of water quality control as a project purpose, the equivalent annual loss in power would be about 4,100,000 kw.-hr. of saleable energy and about 1,275 kw. of dependable capacity. Evaluated at 2.88 mills per kw.-hr. of energy and \$16.85 per kw. of dependable capacity the losses would result in a decrease of about \$33,000 in the average annual equivalent power benefits accruing to the New Melones Project. Except for the minor decrease in power accomplishments of the New Melones Project, modification of the project operation to accommodate the water quality control purpose would have no adverse effect on the purposes for which the project was authorized. The inclusion of water quality control would not delay the realization of project benefits since the project is now being designed and there would not be changes in the design due to water quality control which would delay construction of the project.

7. Benefits. - The Public Health Service, in cooperation with the Bureau of Reclamation and the U. S. Fish and Wildlife Service, has evaluated the benefits which would accrue to water quality control at New Melones Project. The benefit to the downstream fishery was evaluated as the additional number of fisherman-days of use which would be made possible by eliminating periods of low DO concentration with specific water quality control releases. It was assumed that the fishery would not be damaged with 5 ppm of DO but would be completely destroyed if the DO concentration dropped to 3 ppm. The rate of recovery for the damaged fishery was assumed to be as much as 50 percent of the fishery in a single year; therefore, complete destruction would be recovered in two years. On the basis of the above, the preservation of the fishery resource would result in an increase in use of the expected downstream fishery of 300 fisherman-days by 1975 and 201,000 by 2075. Evaluated at \$1.00 per fisherman-day, and determining the present value of future benefits,

the Public Health Service report shows an annual equivalent benefit of \$26,000. The benefits accruing to water quality control for irrigation were evaluated as the cost of providing water from another source to accomplish the same result. A value of \$20 per acre-foot was used as the cost of this replacement water. This water might be obtained from either the Central Valley Project or the California Aqueduct at a cost ranging from a few dollars to \$60 per acre-foot. Since the water would be needed on an intermittent basis in odd amounts, the \$20 per acre-foot used is believed to be a reasonable unit value. Applying this unit value to the volume of water needed over the next 100 years, the Public Health Service report presents an average annual water quality benefit to irrigation of \$158,000, for a total annual equivalent benefit to water quality control of \$184,000. Details of these benefit determinations are contained in the Public Health Service report. In addition to the evaluated benefits, certain intangible benefits would accrue to water quality control. The maintenance and improvement of water quality in Stanislaus River would enhance the stream for recreational use other than fishing. The same is true along lower San Joaquin River and, to a lesser degree, in the Delta. Minor benefits would also accrue to the resident and anadromous fishery in the streams, as well as to the municipal and industrial users of groundwater. Releases for water quality control in lower San Joaquin River would alleviate, to a small degree, the pollution problems in the Delta.

8. Cost of providing water quality control. - There would be no direct costs of providing water quality control of the magnitude proposed herein. There would be no specific facilities required for water quality control, and since there would be multiple use of the storage space in the reservoir and the released water would be used for other purposes, there would be no incremental construction costs associated with inclusion of water quality control as a project purpose. The only operational requirement would be to make the additional releases necessary to meet the downstream objectives of water quality, which would occur only during the low-flow months of the very dry years.

9. Beneficiaries. - The Public Health Service report indicates the beneficiaries of water quality control operation would be widespread. The following is quoted from the report.

Benefits resulting from providing water for water quality control in the New Melones Project will be widespread. They will accrue to hundreds of thousands of people utilizing, for a wide variety of purposes, the reach of the Stanislaus River from the proposed damsite to its mouth and the reach of the San Joaquin River from Vernalis to its mouth, a total stream distance of 148 miles. The estimated irrigation diversions from the San Joaquin River in the year 2025 of 1,000,000 acre-feet is equivalent to a full supply of irrigation water for about 330,000 acres. Recreational and sport fishery use of the Sacramento-San Joaquin Delta is currently estimated at 2,780,000 recreation days annually and

is projected to reach 13,878,000 recreation days annually by the year 2020. Over half of this recreational use may be attributable to the San Joaquin River portion of the Delta. Although it is impossible to identify benefits accruing to any single individual, such benefits are likely to be very small. The reaches of the streams affected provide outdoor recreation for visitors residing in other areas of California and in other states of the Nation as well as local residents. Agricultural and industrial commodities produced in the area are distributed throughout the Nation.

10. Justification. - Inclusion of water quality control as a function in the New Melones Project would provide additional benefits amounting to \$184,000 per year and would decrease other project accomplishments by only \$33,000 annually, leaving a net benefit to the project of \$151,000 per year. As indicated in a preceding paragraph, the cost associated with providing this benefit would be negligible

11. Views of Public Health Service. - The Public Health Service report contains the following conclusions:

a. The population of the urbanized areas in the Stanislaus River Basin study area is projected to increase to 53,000 by the year 2000 and to 235,000 by 2075. Population of Stanislaus and San Joaquin Counties is projected to increase to 1,323,000 by 2000 and to 4,739,000 by 2075.

b. The initial mean annual draft on storage water in New Melones Reservoir, required to maintain the dissolved oxygen concentration in the Stanislaus River at or above 5 mg/l and to limit the concentration of total dissolved solids in the San Joaquin River at Vernalis to 500 mg/l on a mean monthly basis, during the irrigation season, is 11,100 acre-feet. The increasing municipal and industrial waste load (after adequate treatment is provided) will cause the mean annual draft on storage water to increase to 15,000 acre-feet by the year 2025 and to 36,000 acre-feet by 2075. These quantities are in addition to fish releases.

c. With provision of storage for streamflow regulation for water quality control purposes, significant economic and social benefits will accrue to the large and growing population using Stanislaus and San Joaquin River waters for fishing, recreation, agricultural, municipal, and industrial purposes.

d. Water quality control benefits evaluated in monetary terms, which will accrue to the fishery and agricultural interests during the 100-year evaluation period, are estimated to have a total present worth of \$5,617,000. The annual equivalent value of these benefits is \$184,000.

e. Significant intangible water quality control benefits will also accrue to recreationists using the Stanislaus River and to sport and commercial fishermen, recreationists, industrial and municipal users of the lower San Joaquin River waters.

f. Water quality control releases from New Melones storage project will contribute significantly to the solution of the overall pollution problem in the lower San Joaquin River but should not be considered as a complete solution of this problem.

g. In view of the substantial benefits which will result from storage water releases from New Melones Reservoir, it is recommended that provision for such releases, to the extent feasible and in harmony with other uses of the project, be included in New Melones Project.

h. Benefits resulting from providing storage water for quality control will accrue to hundreds of thousands of people utilizing, for a wide variety of purposes, the waters of the Stanislaus and San Joaquin Rivers. Benefits are, therefore, considered widespread and in harmony with the intent of the Federal Water Pollution Control Act.

i. Municipal and industrial water use, along the Stanislaus River below New Melones, is projected to increase from 3 million gallons per day (3,000 acre-feet/year) in 1960 to 72 million gallons per day (81,000 acre-feet/year) in 2075. The portion of this additional water need that develops in the Stanislaus River Basin should be supplied by the New Melones Project unless a study indicates that ground water resources, of satisfactory quality, and/or decreasing agricultural usage will satisfy this anticipated need.

12. Views of the Bureau of Reclamation. - The Regional Director of the Bureau of Reclamation has reviewed the Public Health Service

report draft and by letter dated 19 March 1965, included as attachment 2, expressed his view that water quality control is needed both in the Stanislaus and San Joaquin Rivers, and that operation of New Melones Reservoir could materially improve present conditions. He recommended that water quality objectives be incorporated into the New Melones Project to limit the total dissolved solids in lower San Joaquin River to 500 ppm on a mean monthly basis and to maintain a dissolved oxygen level of at least 5.0 mg/l in the Stanislaus River, providing these objectives will not require releases exceeding 70,000 acre-feet in any one year.

13. Views of local interests. - A local committee, composed of representatives of irrigation and reclamation districts located along both sides of the lower San Joaquin River, reviewed a draft of the Public Health Service report on water quality control for the New Melones Project. The views of this committee were contained in a letter dated 8 March 1965, to the Regional Director of the Bureau of Reclamation. That letter is an inclosure to the Bureau of Reclamation letter included as attachment 2. The committee expressed its full accord and approval of the following findings and conclusions in the draft of report: (a) that a certain amount of storage will be needed for water quality control in the New Melones Reservoir so that, when released along with other amounts required to be made available for downstream prior vested water rights and for fish and wildlife benefits, the TDS of the water at Vernalis gaging station on San Joaquin River will not exceed 500 ppm; (b) that the water quality benefits are of sufficient magnitude that these releases should be made from storage as needed for water quality control; and (c) that the benefits are so widespread that, in accordance with the intent of the Water Pollution Control Act (PL 87-88), the costs should be non-reimbursable.

14. Conclusions and recommendations. - Based upon the studies and data presented herein, it is concluded that:

- a. There will be continued need in the future for water quality control in channels downstream from New Melones Project in addition to adequate treatment of wastes at the source.
- b. Releases of water for water quality control will have only a minor effect on other accomplishments and benefits of the project.
- c. There will be a substantial increase in benefits of the project from water quality control without increase in project cost.
- d. Water quality control has sufficient economic justification to be included as a project purpose.
- e. Due to the widespread and diverse beneficiaries of water quality control and the resulting impracticability of assigning

repayment of an equitable share of any costs that would be allocated to this activity as a project function, any such costs should be non-reimbursable.

15. In view of the foregoing, it is recommended that:

a. The New Melones Project include water quality control as a project purpose.

b. The water quality objectives be established as follows: (1) In San Joaquin River immediately below the mouth of the Stanislaus River total dissolved solids are to be limited to less than 500 parts per million, and (2) in Stanislaus River dissolved oxygen concentration is to be maintained to a level of at least 5 milligrams per liter.

c. Releases from New Melones Dam for water quality control purposes be made as necessary to maintain the objectives listed above, but not in excess of 70,000 acre-feet in any one year.

d. The cost allocated to the water quality control function be considered non-reimbursable.