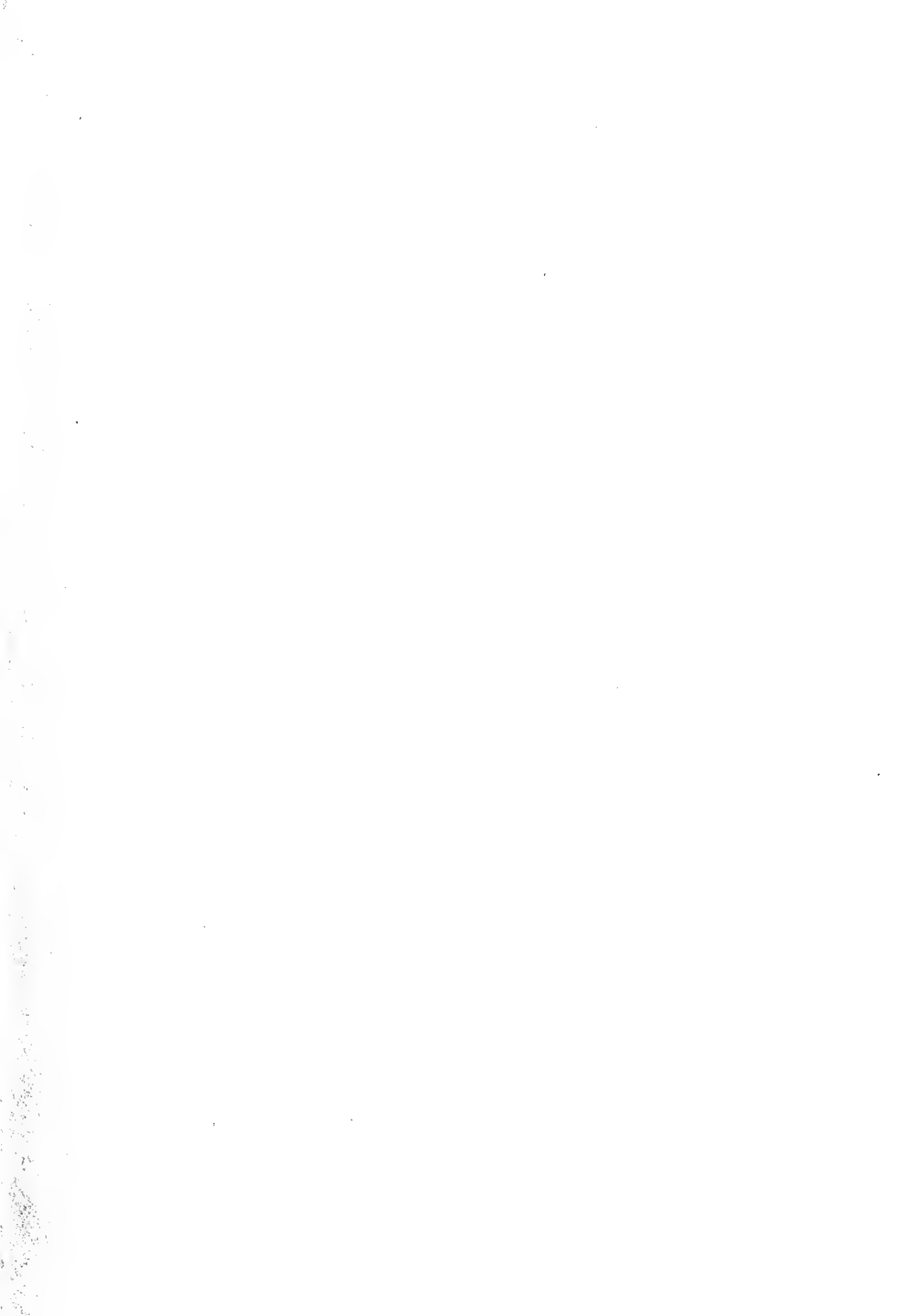


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Sidney T. Harding

A LIFE IN WESTERN WATER DEVELOPMENT

Vol. II

Edited by Gerald J. Giefer

Statewide Water Resources Center, University of California
in cooperation with the
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CENTRAL VALLEY PROJECT,
MISCELLANEOUS MATTERS

My investigations for the state in the 1920's on investigations in Kern and Tulare counties can be considered to be within the scope of the CVP, although there was no plan for such a project at the time this work was done. This earlier work has been described. When what became the CVP began to take shape the state had organized a substantial staff for its water resources investigations and the need for the individually directed investigations such as I had made in Kern and Tulare counties had passed. After Hyatt became state engineer he set up a general consulting board for advice on engineering and policy matters. I continued to handle other work for the state engineer such as the water storage district procedure, but did not have as much direct activity in the general water resources investigations. From time to time, however, I was asked for comments on specific matters.

Some of these matters which arose are covered in the following discussion. Some resulted in reports to which reference is made. Many were informal staff discussions. I was probably the individual engineer, in these years, available to the state engineer who had the most detached acquaintance with the physical conditions in the area the CVP was planning to serve. I had also had experience in the organizational phases of project development which was a new field for the state.

Some of the items relating to the CVP in which I participated are described in the following discussion. These may have some interest in illustrating the subjects that arose in the development

of the CVP and **current** thinking in regard to them. In relation to the final results, these items **generally** represent stepping stones along the way.

POSSIBLE **SURPLUS** WATER FROM KINGS RIVER

In Nov. 1924, I prepared a brief memorandum on the above subject for the state engineer. It had been requested by Paul Bailey then in charge of the state's Water Resources Investigations.

The need for additional water to meet the general water overdraft in the east side area of the San Joaquin Valley south of Kings River had become generally recognized. No plan had then been developed for importing water from distant sources; such a plan later became the CVP. It was hoped that there might be enough surplus water in Kings River which could be developed at a cost and in an amount which could meet this overdraft or reduce it until some larger source could be secured. I was working for the state engineer on other Kings River matters and was asked to report on any surplus flow that might be obtainable.

It was my conclusion that there was unused water in Kings River, but that storage would be required to make this surplus water **usable**. Storage plans for its use in Kings River were then under way. I concluded that any additional Kings River supply made available by such storage would belong to and be used on Kings River and that there was no exportable surplus. No efforts to secure surplus Kings River water for use outside of its own area were made by the state nor have any such efforts been made later by the USBR. It is possible that, in the development of the plans of the East Side Canal, there may be some exchanges of water between rights of Kings River and the East Side Canal, but these

are not expected to involve a net exportation from Kings River.

Some Kings River areas may be purchasers of East Side Canal water.

It was early recognized that the east side of the San Joaquin Valley south of Kings River did not have a sufficient water supply within its own area to meet the needs of its existing development in the 1920's and that the relief from the overdraft would require importation of water from some distant source.

My report is No. 9 in Item 47 of my bibliographical file.

C.V.P. REPORT FOR U.S.B.R. IN 1930

In June 1930, I prepared a report on "Tentative Areas and Water Requirements of Lands Now Developed and Deficient in Ground Water Supply in Southern San Joaquin Valley." This was done for the state engineer for use by C.A. Bissell of the USBR. Bissell was then stationed in Sacramento reviewing the results of the state's investigations. The USBR was working on cooperative studies with the state seeking to find a project for the relief of the southern San Joaquin Valley which would be within the scope of what the Bureau could then undertake.

This report considered areas of overdraft, their extent of development and the amount of overdraft. If a source of water supply could have been secured and made available to these lands in 1930 it was estimated that a supply of about 330,000 acre-feet per year would have met the overdraft. To maintain a ground water balance with such an additional supply would have required some means for preventing the development of additional irrigated areas.

These areas were scattered and would have been difficult to serve at feasible cost. There was also no basis on which other overlying lands could have been prevented from drawing on the ground water supply.

This report was made to furnish an estimate of the extent of the problem involved in this area and a starting point from which other projects could be studied. It served this purpose.

This report is Item 50 in my bibliographical file. Its title is "Memorandum on Tentative Areas and Water Requirements of Lands

Now Developed and Deficient in Ground Water Supply in Southern San Joaquin Valley." It is dated June, 1930.

This report includes a map showing the lands irrigated in the overdraft areas. This 1930 map together with later maps showing the irrigated areas in the same general area illustrate how the problem of ground water overdraft in this area has grown as additional water supplies have become available. The first stage **Friant-Kern** Canal supply has now become insufficient and the East Side Canal is now being sought as an additional source. Eventually, there will be a demand for water for the full development of all of the suitable land on the east side of the southern San Joaquin Valley. California has lacked the legal means to restrict overlying owners from adding to the overdraft by increasing their use. There was no indication that such restrictions would have had popular support in this area in the 1920's and 1930's even if a legal means for their accomplishment had been available.

CENTRAL VALLEY PROJECT, AFTER 1935

PROCEDURAL REPORTS

My earlier work for the state relating to what became the state's Central Valley Project has been described. By 1933, it was apparent that the state's project could not be financed from the sale of the revenue bonds that had been voted in 1930. The period of construction and of the development of the use of water was too long for this project to be feasible for revenue bond financing.

Efforts began to be made in 1933 to secure federal financing. These were successful in 1935 when President Roosevelt made an allotment from the available emergency funds with which to start the project. These funds had been appropriated to fight the depression and were subject to allotment by the president. The funds were allotted to the U.S. Bureau of Reclamation. Thus, the C.V.P. became and has remained a federal project.

Prior to 1935, the USBR had had only limited activity in California. It had its Klamath Project on the north and its Colorado River work on the southeast. Internally its only project was the small Orland unit in the Sacramento Valley. Consequently, Californians generally lacked experience with the practices of the Bureau. This applied both to the local engineers and the attorneys. The state engineer had had contracts with the Bureau in the joint studies of a salt water barrier and of a dam on the Sacramento River, but neither of these involved contracts with local units.

In my own work, prior to 1935, I had both worked for the Bureau directly and also for local organizations on some of its

projects. This work had given me a familiarity with their methods and procedures. I became a readily available source of information on such matters and was quite active in this field until others here had acquired similar experience.

When Hyatt was seeking to secure federal funds for the C.V.P. in April, 1933, I prepared for him a comparison of the repayment record of the USBR projects and the California Irrigation districts. This report is Item 134 of my bibliographical file. This 1933 comparison was favorable to California. Both types of projects had many defaults later in the 1930's. Hyatt used this report to emphasize the better repayment capacity of California projects.

The Reclamation Law permitted term contracts to be made concerning payments prior to the completion of project and before the final charges became known. Such shorter contracts had been made without including the acreage limitation. I made a report on such term contracts for the Tulare Lake Basin W.S.D. in 1939. This report is No. 13 in Item 135 in my bibliographical file.

The Reclamation Law enables the Bureau to define its own projects and units of projects. This has importance in the allocation of costs. The average cost of delivery of water to the Madera I.D. would be lower than that under the Friant-Kern Canal. In May, 1936, I made a report for the Madera I.D. supporting the authority of the Bureau to contract separately with these parts of the project. This position was not accepted by the Bureau. This was followed by a report in January, 1938, also for the Madera I.D., on the practice of the Bureau in dividing its projects into units. The first report had also covered the separation of charges for repayment of construction and for operation and maintenance costs. These reports are Nos. 4

State Division of Water Resources dinner, Fresno, November 4, 1939
Engineers who had worked on the Central Valley Project investigations

Seated, left to right: Edward Hyatt, State Engineer; Paul Bailey, former State Engineer; B.A. Etcheverry, member of Consulting Board; R.L. Jones, Chief Assistant Engineer; Fred Hermann, member of Consulting Board; J.B. Lippincott, Consulting Engineer L.A.; George Hawley, in charge of safety of dams; George D. Louderback, Professor of Geology, U.C.; John D. Galloway, Consulting Engineer, on Consulting Board.

Standing, left to right: Roy Matthews, staff, author Delta reports, Bulletins 27 and 28; W.A. Perkins, State Engineer staff. unidentified; Jerry Jones, later State Reclamation Board; Roy Meikle, Chief Engineer Turlock Irrigation District, Consulting Board; A.D. Edmonston, later State Engineer; S.T. Harding, Special Investigations; Irving Althouse, Engineer, Porterville; P.H. Van Etten, State Engineer staff; Gilbert Mellin, later State Reclamation Board; Lester S. Ready, Consulting Engineer, Consulting Board; Tom B. Waddell, State Engineer staff; H.M. Crocker, State Engineer staff.



State Division of Water Resources dinner, Fresno, November 4, 1939

and 5 in Item 37 of my bibliographical file. When the Repayment Commission of the Bureau was appointed in 1937, Geo. T. Cochran wrote to me asking for my suggestions. I replied on Nov. 23, 1937, and again on Feb. 3, 1938, after receiving his reply of Jan. 29, 1938. This correspondence is No. 14 in Item 134 of my bibliographical file. It applied to the USBR in general as well as to the C.V.P. As previously discussed, I had worked with Cochran for Oregon on the Walla Walla case.

The Fresno I.D. had made some filings on the San Joaquin River which were affected by the Bureau's plan to build Friant Reservoir. On March 10, 1940, I made a report for the Fresno I.D. on the general relationship of project organizations to the Bureau. This is No. 12 in Item 47 of my bibliographical file.

The Reclamation Law permits the Bureau to operate partially completed projects on an annual water rental basis until they are ready for their repayment contract. On Sept. 28, 1943, I made a report for the Madera I.D. on such water rentals and their possible use in this district. This is No. 2 in Item 37 of my bibliographical file. This was followed on Oct. 14, 1943 by a report on the effect of the use of interim water by the Madera I.D. This is No. 1 in Item 37 of my bibliographical file.

THE BARROWS C.V.P. STUDIES

In 1942, Dr. Harlan H. Barrows, Prof. of Geography at the University of Chicago, proposed and promoted a group of studies of various features of the C.V.P. by a total of 24 committees on the separate problems. Dr. Barrows had conducted a similar type of study of the Columbia Basin Project.

Dr. Barrows had outlined his plan, secured the support of the

USBR and had appointed the various committees. He was asked to discuss his program at a meeting of the Natural Resources Section of the State Chamber of Commerce in Los Angeles on Dec. 2, 1942. I was asked to comment on his program under the title of "The State's Interest in the Central Valley Project." I prepared such comments. A copy is No. 12 of Item 135 of my bibliographical file.

I had met Dr. Barrows in 1936 when I was working on the Upper Missouri River Report for the National Water Resources Committee. He was a consultant to that committee. He had been mainly responsible for securing the funds for the investigation of the Rio Grande River for use by the three states involved in their negotiations of the Rio Grande Compact. I had known of his work in the Columbia Basin and had read several of the committee reports there. In his report outlining the Columbia Basin Studies, Dr. Barrows had stated that "Provision must be made for many poor or even destitute settlers. Both public opinion and official opinion demand it. The possibility of setting up a system under which settlers could pay over a relatively long period for the land and for essential improvements much as they would repay water right charges under the Reclamation Project Act of 1939 should be explored thoroughly."

Although the World War II was under way with its resulting manpower shortages, Barrows' C.V.P. program involved 132 members of the committees and 28 additional advisors. No direct need for such a review had been demonstrated in the C.V.P.

In the remarks which I prepared I took issue with the need for any such extensive study committees and asserted that the whole job could be done in less time by a half dozen experienced members of the

USBR staff. I opposed the program both during the War or at any time.

When the audience was gathering for the meeting I went over and greeted Dr. Barrows and told him that I would oppose his program. He seemed to be surprised that anyone would have the temerity to question his recommendations.

The meeting started and as often occurs soon got behind schedule. When Dr. Barrows' time to talk came, this was mentioned. He knew that my comments would follow his. However, he overran his own time so that when I was reached little time was left. I discarded my prepared remarks and lit into his program with both feet. When I stopped there was time for a few questions, but Barrows excused himself saying he had to catch a train. Rightly or wrongly I have thought that he extended his remarks in order to reduce my time for criticism.

The usual committee reports were complete in due time and published. Little action was taken on their recommendations. No particular changes in the C.V.P. either physically or in matters of policy resulted from this voluminous work. In my opinion, it was money and time wasted. This work has now largely been forgotten.

Some correspondence relating to my comments on the Barrows program is included with the copy of the comments in No. 12 of Item 135 of my bibliographical file.

Dr. Barrows was a very tall and imposing person. He had a resonant voice and could use more long words and roll them off his tongue better than anyone I had met. I have no doubt but that in his own mind he was doing a good public service in his actions in the water resources field. I have never overcome my resentment to his

belief that American farmers should be reduced to the type of tenure he advocated for the Columbia Basin.

HEARINGS ON C.V.P. IN JULY, 1944

In 1944, the Senate Sub-committee on Irrigation and Reclamation held a series of hearings in California on S. Res. 295 relating to the C.V.P. The material presented related largely to the applicability of the acreage limitation to the C.V.P. Up to the time when this issue arose in relation to the C.V.P., the Bureau had not enforced this acreage provision and there was a natural opposition to its enforcement in the C.V.P.

I testified at the hearing held in Hanford on July 28, 1944. Senator Downey presided. My statement is in the published report of the Hearings on S. Res. 295, 78 cong, 2d Sess. on pp. 256-366. A copy is Item 138 of my bibliographical file. I discussed the history of the lack of enforcement of the acreage limitation.

Senator Hatch of New Mexico, who was a member of the group of senators holding these hearings, had introduced S. 1948 of that session in rebuttal to an amendment Congressman Alfred J. Elliott of Tulare had introduced to H.R. 3961 which would have abolished the acreage limitation. Hatch's bill had been prepared within the Bureau of Reclamation.

It would have put the Bureau in the land settlement business and had other objectionable features. The Hatch bill had been so vigorously opposed at the preceding hearings that Senator Hatch had announced that he would not seek its enactment. However, I presented further objections citing the experience of California with Delhi and Durham. No specific legislation resulted from these hearings.

TESTIMONY ON S912 - 80th CONGRESS FIRST SESSION, ON ACREAGE LIMITATION

This was Senator Downey's bill to exempt certain projects from the land-limitation provisions of the federal reclamation laws. Extended hearings were held in Washington in May, 1947, and a lengthy record has been published (1327 pages).

At that time, I was the consulting engineer of the Tulare Lake Basin W.S.D. The land owners in this district were very much concerned with the question of the application of the 160 acre limitation to the overflow lands in Tulare Lake.

I went to Washington to attend part of the hearing on S 912 and to testify in its support. My main testimony is on pages 59 to 79 of the published report. A copy of the published report on this hearing is Item 139 of my bibliographical file.

The USBR appeared in force in opposition to this bill. Later at Senator Downey's request I sent him telegrams rebutting some of the Bureau's testimony. These are on pages 1130 and 1219.

One of the main points I made in my testimony was that the acreage limitation would not be enforceable against an excess landowner who had an underlying ground water supply. Even if his natural ground water supply was being overdrawn, there would be no way to identify the natural recharge from the ground water that might be received from the deep percolation of Bureau water. In rebuttal to this position the Bureau presented a witness who proposed that the Bureau could put offset wells around its areas of service and prevent the travel of its water to excess lands. The physical absurdity of this position was easily recognizable.

Senator Downey worked very hard on this bill, but was not able to secure its passage. Eventually, it was a major factor in the

deterioration of his health and his decision not to seek a third term. In my opinion, the opposition to this waiver of the acreage limitation in areas where the Bureau would supply supplemental water to existing developments was based on adherence to an outmoded style of farming. Much of the opposition, in my opinion, lacked sincerity.

This hearing was my first close contact with Senator Downey. Like many Californians I had wondered about his qualifications for the position when he was elected with the support of the Townsend group. He was originally favorable to the 160 acre limitation in the Reclamation Law. When in California on a Senate Committee hearing relating to agricultural labor he saw the conditions in the C.V.P. and recognized that the statutory limitation was not suited to this project. Having become convinced of this, he became a strong supporter of its change, although this resulted in opposing the position of the groups largely responsible for his election. As I came to know Senator Downey I acquired an admiration for his adherence to what he thought was right rather than merely what appeared to be expedient. We could use more with his strength of principle over politics in the present Congress.

The "family sized farm," as assumed to be represented by the 160 acre limitation in the Reclamation Law, has now become so strongly imbedded by its support by the federal administration that it has become a position from which a retreat would represent a major admission of error. Such admissions are not made voluntarily by politicians. It has received so much attention that the Bureau cannot operate without attempting to enforce it. Various subterfuges have been proposed. The only consistent remedy is its renewal so that each new project can have its own terms defined in its authorization

act. There does not appear to be any reasonable chance in sight of securing its repeal. Its advocates have aroused extensive opposition to its change among those who are guided by their emotions rather than their recognition of facts. Neither political party is liable to sponsor its repeal against the opposition it would now have to face.

A prominent claim of advocates of the acreage limitation is that the unearned increment resulting from the construction of Bureau projects should be distributed among many smaller farmers rather than going to fewer large owners. This position assumes that there are such unearned returns to the land owners whose lands may be included in Bureau projects.

No landowner would be interested in a project whose costs would absorb all of its benefits. Unless there is a prospect of benefits in excess of costs the only agency which might gain from the construction of the project would be the constructing agency desiring to keep itself employed. A profit incentive is an essential to any new development. Any such profit should be recognized and equitably divided between those who furnish the capital for construction and those who use the project. This is now done in projects privately financed without subsidy.

Landowners in USBR projects secure the advantage of interest free funds for costs allocated to irrigation. They have a liberal repayment period. The present law permits limiting the charge for water to the irrigators ability to pay if surplus repayment can be secured from other project features. These are all substantial advantages to the landowner. There is no reason why such advantages, if excessive in an individual project, should be made available to

either small or large landowners. There are now few remaining unbuilt irrigation projects in the western states which can meet their actual costs without material amounts of subsidy. We are approaching and may have passed the point when the remaining projects exceed the costs which can be justified.

The USBR has the means for controlling the unearned increment on any project. If the ability to pay for irrigation water is set to absorb nearly all of the payment capacity there will be little unearned increment remaining for the landowner. Such prices for water would remove the main incentive for the landowners to place their lands in Bureau projects. The ability to pay rates as defined by the USBR, have been fixed to leave a large part of the net returns from the use of project water with the landowner. In practice "ability to pay" has been interpreted to mean "ability to collect."

THE HASSLE OVER THE C.V.P.

I was asked to talk to the Commonwealth Club's Friday luncheon meeting on May 22, 1953, on the above subject. I based my talk on a prepared paper which is No. 11 in Item 135 of my bibliographical file. It was generally well received, but did not change the course of human events to any noticeable extent.

This talk covered the various problems of the C.V.P. and their status. The principle hassle then current was in regard to the taking over of the C.V.P. by the state. The USBR in California, as well as elsewhere, had deteriorated under its management during the 1940's, but improvements were under way by 1953. The taking over of the C.V.P. by the state is the subject of another portion of these memoirs.

I was a member of the Commonwealth Club from my early years in California until the early 1930's. My interest and activity were mainly in its Water Resources section. When the weekly luncheons of the whole club were changed from Saturday to Friday, I had little opportunity to attend. The Water Resources section sessions were largely taken over by lengthy talks by J.R. Mason and Louis Bartlett. I lost interest and resigned from the club. I have talked several times in later years to this section on various water matters, but have not rejoined the club. It is a worthwhile organization, but it has the common problem of avoiding, without appearing to censor discussion, use by those who have difficulty in securing audiences.

REPORT IN 1936 FOR NATIONAL WATER RESOURCES COMMITTEE
ON MISSOURI RIVER DOWN TO AND INCLUDING THE PLATTE RIVER

In 1936, the National Water Resources Committee undertook to prepare a six-year plan for national water development. The country was divided into regions and a consultant appointed to prepare the report for each region. I was asked to undertake this work for region 8 which was the Missouri River Drainage area down to and including the Platte River.

Chas. Eliot was the Executive Officer of the National Water Resources Committee. Abel Wolman was chairman of the group in charge of this study. Ed Hyatt was a member of this group. Fred Fowler of S.F. was appointed the Director for the actual work of preparing the report. Donald Baker was an assistant director for the western states.

The program called for selecting regional consultants for the preparation of the report for each region who had not had previous experience in their region. The theory of this was that the consultants would not have been connected with any projects in their region and consequently would be neutral in regard to the projects that might be proposed. The fact that the consultants would also be unacquainted with the conditions in their regions, and that the time for the completion of the reports was fairly short, was not apparently given weight.

Ralph I. Meeker of Colorado was appointed as consultant for the California area. He did not spend much time here, and Hyatt practically wrote his report. Hyatt's main interest at that time was the C.V.P., and it received favorable comment. Jack Stevens

of Portland had the Colorado River Basin which he said he took because he wanted to get acquainted with it. I came nearer knowing the background conditions of my region than the others as I had previously worked in Montana and Colorado and had had contacts in the other states.

In April, 1936, I took a once-over trip over Region 8 with Don Baker. Baker made the appointments and handled meeting the brass. I did what I could in talking to the engineers whose help I would need in assembling the material for the report.

As a result of this trip, I outlined to Fowler what I thought could be worked out in the time available in Region 8. Region 8 including parts of eight states. It figured out that, at the maximum, I only had an average of 10 days work to spend on the report on projects in each state. I agreed to go ahead with my work on Region 8 with the understanding that the results would be what could be accomplished under the time limits of the work.

The particular function and responsibility of Don Baker in relation to my report was indefinite. To clarify this I advised Fowler that I would be glad to have Baker handle the outside contacts in Region 8 so I could concentrate on the essential field work, but that I was not willing to have Baker review and possibly modify the engineering conclusions which I might reach.

Baker had done a lot of work for the Water Resources Committee on the adequacy of existing programs for stream measurements and related subjects, and had been given the appointment on the 1936 survey in recognition of this work. He was also active in the California Planning Commission and apparently hoped to be made its

chairman. Others with similar desires secured control of the California Commission and Baker lost out. He was given another assignment in 1936 by the National Water Resources Committee and did not participate in my work in Region 8.

The purpose of this 1936 survey was to assemble a list of available water projects on which work could be started promptly if further public works to relieve the Depression should be undertaken. Each region was to prepare a list of such projects listed in the order of their recommended priority. All types of water projects were included. In Region 8 there were numerous small town water supply projects, but the main problems in my work related to the proposed irrigation projects.

While no adequate report could be made in the time available, I pitched in to do the best I could. My personal acquaintance with the USBR personnel was a material aid in getting the essential information quickly. The states had some form of planning agencies which usually had information on the municipal projects. There was practically no industrial use of water proposed in this area in 1936.

I worked over available reports until the end of the University term. I made field trips in May, and from June 17 to July 12 and from July 20 to Aug. 14 I travelled over the area using my own car. Time was also spent in the Denver office of the USBR.

At Berkeley, I had a secretary and an office engineer. I did not use any field engineers as there was not time to collect our own information, and I had to use my own judgment in appraising the proposed projects.

I spent my available time in late August and in September in

preparing my report. It was completed under date of Oct. 15, 1936, and transmitted to the Committee. It is Item 69 in my bibliographical file. The main report contained 171 pages. Included were 9 appendices on individual projects. The appendices had been prepared by Vincent A. Palmer, a Cal graduate of 1936 who had been the office engineer. Mrs. Betty Dunlap of Berkeley was the secretary in my office.

The general committee had the job of coordinating the regional reports. They did this and made some revisions in my order of priority for Region 8. These revisions were sent to me for my acquiescence together with the portion of the report giving the names of the regional consultants and credit for their work.

There were two irrigation projects in Region 8 which were controversial in 1936. One was the Casper-Alcova project, now the Kendricks in Wyoming, and the other was the present Colorado-Big Thompson project in Colorado. I had put the Casper-Alcova project at the bottom of my priority list and the Colorado-Big Thompson at the top. The Committee reversed this order.

Senator Kendricks of Wyoming had been one of the group which had been for F.D.R. before Chicago. This term was in use to describe those who supported F.D.R. before his first nomination. They outrated those who joined later. When F.D.R. was given emergency funds to allocate to combat the Depression, he made available \$18,000,000 to Wyoming with Senator Kendricks to select the projects.

Oil had been found near Casper and it was a thriving town. There was concern, however, over its permanence if the oil field declined. There was a strong desire to construct an adjacent irrigation project to broaden the supporting base. Senator Kendricks approved putting all

of this emergency allotment into the Casper-Alcova project. This was done.

When I did my work in 1936, about \$3,000,000 had been spent on the project. This had been used on the diversion dam and some canals. The project had been reported on unfavorably by the USBR. It was opposed by the prior water rights on the North Platte who claimed there was not sufficient unappropriated water for its needs. The project included about 60,000 acres. This was located about 20 miles from Casper. The soils were generally derived from shales similar to those which have been difficult to reclaim on the Riverton and Shoshone projects. The altitude is high and the climate limits crop adaptability. I recommended that the project be abandoned and the expenditures to-date written off.

The Colorado-Big Thompson project was then under investigation by the USBR. It proposed to direct water from Grand Lake on the upper Colorado River by a tunnel to the Big Thompson River, a tributary of the South Platte. The project would provide supplemental water to the highly developed and productive lands in the South Platte Valley. The increase in ground water pumping had begun to show its effect on the return flow to the South Platte. This return flow was the source of the water supply of the lower diversions. A difficult situation was developing unless additional water could be secured. Estimates of cost indicated that a feasible project could be developed to meet this need. There was an available water supply in Colorado's share of the Colorado River run-off. I put this project at the head of my priority list.

When I received the results of the changes made in my results by the Committee, I wrote expressing my disagreement and requesting

that my name be omitted from any report that approved the Casper-Alcova project. I had further correspondence with Abel Wolman in which he sought to find some wording that would meet my objections. However, no change in the Casper-Alcova project was proposed, and I maintained my position. My request was granted, and my name is not included in the published report.

The general report is entitled "Drainage Basin Problems and Programs - Dec. 1936, National Resources Committee." This was a high powered committee of which Ickes was Chairman. The letter of transmittal to this committee is signed by Abel Wolman as Chairman of the Water Resources Committee. The Casper-Alcova was listed, (p. 62) for immediate consideration, and the Colorado-Big Thompson was in the deferred list, (p.64).

It is my understanding that the presidential approval given to the Casper-Alcova project made the committee unwilling to consider the project on its merits. It is also my understanding that Secretary Ickes was reported to have expressed a personal dislike for intermountain diversions and that the committee was unwilling to oppose what they may have taken to be an official opinion. I considered such reasons political rather than factual and did not care to be a party to any report on other than an engineering basis.

It is now (1965), nearly 30 years since all this activity took place and perhaps the issues can be reviewed in perspective. The National Water Resources Committee made several reports which were contrary to practical conditions, and was eventually abolished by the New Deal which had created it. It has now been generally forgotten. In my opinion, it missed the opportunity to assist in directing national water policy along sound lines in the public

interest. It could have been constructive, but it was dominated by those lacking practical experience and influenced by those those who had projects of their own to promote. Its reports are still available in reference libraries.

The results on the Casper-Alcova and the Colorado-Big Thompson project can also now be reviewed. The distribution system on the Casper-Alcova project was completed for part of the area and the project was placed in operation. For some years it had the lowest value per acre for the crops produced of any of the Bureau's projects. The area to be served has been reduced by about one-half. A power plant has been built at the diversion dam to recover its construction cost. The effect of the project on the city of Casper has been very limited. At the time of my work I commented that Senator Kendrick could have selected three project in Wyoming of the size of the Casper-Alcova which could have been built for \$18,000,000 and would have produced over three times the benefits to the state. Wyoming has been the main loser by the selection of this project. In later years, its name was changed to its present title, the Kendricks project. This name appropriately recognizes the responsibility for its selection.

The Colorado-Big Thompson project has been constructed and has been in successful operation for several years. Its actual costs exceeded those estimated at the time the project was authorized, but the project is meeting the terms of its repayment. Power is developed on the East Slope as the water descends to the South Platte Valley.

The preceding account of this work in 1936 has been quite lengthy. This length is greater than the present importance of any of the matters that are discussed justifies. This represented a

very interesting assignment on my part and a chance to see how water policies were handled on a national scale in the 1930's. While the condition under which the program was set up made it impossible to produce worthwhile reports, I gave it a good try in Region 8. I feel that, at least, I did as thorough a job as the conditions would permit.

It is also interesting to compare the present program of development on the Missouri River Drainage Basin with the planning in 1936. In 1936, Fort Peck Dam was under construction. Reports that had been made on the potential power development of other dams lower on the river had been generally unfavorable, partly as a result of a predicted lack of market for the power they could produce. Flood control had only been accepted as a federal responsibility very recently and had not been generally applied. In 1936, no program such as that authorized in the 1944 Flood Control Act had ever been proposed. The Pick-Sloan Plan was created after 1936.

This record illustrates the rapidity with which water resources policies may change and the scale of work undertaken may be enlarged. The individual and generally local projects on which I reported in 1936 are still in the picture, but they have been overshadowed by the larger projects since undertaken. This situation could have value to the 50 year planners who think they can foresee and forecast the future.

WORK IN ARIZONA

From 1934 into the 1950's, I worked on several matters in Arizona in the Salt and Gila River areas. The principal item was as negotiator for the Buckeye Irrigation Company in the settlement of the general adjudication case involving all rights on the Salt and Gila Rivers above their junction. All of these activities in Arizona are discussed together as a matter of convenience, although they extended intermittently over about 20 years.

WORK FOR VERDE IRRIGATION DISTRICT

The Verde Irrigation District covered lands north of Phoenix. It had made an application for storage on the Verde River at the Bartlett site and desired to proceed with its construction. This application had been recognized by the Arizona Land Commissioner as being prior to other storage rights on Verde River.

When the Emergency Relief Funds were made available to the President in 1934, he assigned funds for the construction of the Bartlett reservoir on Verde River by the USBR for the Verde Irrigation District. This resulted in a protest by the Salt River Valley Water Users Association. By that time it was becoming recognized that the Salt River Valley already was attempting to irrigate more land than its water supply could support.

At the recommendation of Richard Coffey, then the regional counsel of the USBR, the Verde Irrigation District asked me to investigate their situation and advise them on the actions they should take. I undertook this work. R.B. Williams of the USBR was already assigned to this project and had established his office in Phoenix.

The Arizona Congresswoman at this time had secured this grant and expected to receive the support and commendations of the area. When the S.R.V.W.U.A. opposed it, there was a change of view in Washington. Means were sought to find grounds for withdrawing the grant. These actions were underway when I started my work.

I went over the records and concluded that if the Verde Irrigation District had a valid prior permit to storage on Verde River they could develop a dependable supply for a district of about half their area. I reported this verbally to the District with the added recommendation that they limit their expenditures until they had a binding agreement with the USBR.

This ended my direct work on this matter. My activities extended intermittently from March to June, 1934.

The Verde Irrigation District incurred costs during the period the grant of funds was in effect. When the U.S. cancelled the grant, the District made a claim for reimbursement of these costs. The District had issued warrants for its expenditures. I was paid in such warrants, but I sold them as I received them under arrangements made by the District with a local bank. Eventually, the U.S. reimbursed the District for much of the costs it had incurred in the period the grant was in effect.

An interesting incident in this work was the ground water investigation that the S.R.V.W.U.A. sought to arrange with the U.S.G.S. The Verde Irrigation District was not on this program. The Association was to supply the U.S.G.S. with its records and the U.S.G.S. was to report on the ground water conditions, the safe yield and the overdraft, if one was found to exist. I got wind of this program and the date at which Mr. N.C. Grover, then chief of the water division

of the U.S.G.S., would arrive in Phoenix. In those days, arrivals in Phoenix could be expected to stay at the Adams Hotel. By chance, I was in the lobby when Grover arrived. I had met him previously at state engineers meetings. I greeted him and told him what I was doing. I offered, for the Verde Irrigation District, to supply all their records in such an investigation and asked to have the area of the Verde Irrigation District included. This evidently was not included in the program which had been discussed between the U.S.G.S. and the Association, and Grover did not give me a definite answer. I then reminded him that the USBR working in this area had not been consulted in his program and that it would be unusual for two agencies in the same federal department to be working independently in the same area.

My comments evidently got to the Association, as I was invited to attend a dinner at the Arizona Club to discuss this program. The Verde Irrigation District was accepted as a party. It was to make available its records similarly to the Association. The Verde Irrigation District could offer its records freely because it did not have enough to count. With the withdrawal of the grant to the Verde Irrigation District, the ground water program was not carried out.

From today's point of view it is fortunate that the Verde Irrigation District did not proceed with its project. Its result would have been to increase the water using area when the existing use already exceeded the available supply. It would have aggravated the overdraft.

Shortly after the Verde Irrigation District plan was shut off, the S.R.V.W.U.A. built the Bartlett reservoir and the water it made

available went into the supply of the association.

Much of the overall benefit that resulted from not building the Verde Irrigation District system in 1934 has been lost by the extension of Phoenix into the southern part of the former Verde Irrigation District. This has increased its total demand on the water supply, as such extension serves lands formerly dry. When Phoenix expands in other directions on land previously served by the S.R.V.W.U.A., one use replaces another.

My work for the Verde Irrigation District might be classed as political rather than technical engineering. It was interesting and resulted in no lasting actions adverse to the local public interest. The grant of emergency funds in 1934 to the Verde Irrigation District is an illustration of the basis on which funds were distributed. The initial funds to the USBR for the Central Valley Project in California in 1935 came from this same fund.

WORK FOR BUCKEYE IRRIGATION CO.

The Buckeye Irrigation Company diverts from the Gila River just below its junction with the Salt River. It irrigates almost 16,000 acres on the north side of Gila River around the town of Buckeye.

The company had a pre-1900 water right. Its diversion was around 230 second feet. In the very dry years in about 1900, it had a full water supply, coming mainly from the "rising water" in Salt River. At that time the ground water in the Salt River Valley was high enough to supply return water to the River. In the later procedure this return flow was generally designated as "effluent flow."

The Buckeye Canal continued to receive an adequate water supply as long as the ground water in the area served by the Salt River Valley Water Users Association remained high. In the 1920's, the

S.R.V.W.U.A. made contracts with the Roosevelt Water Conservation District under which the District lined some of the canals of the association in return for a right to the salvaged water. It also made contracts with the Roosevelt Irrigation District permitting the District to construct wells in the association area and have title to the water pumped. Both of these projects were beneficial to the S.R.V.W.U.A. at the time they were made as the lands of the association were being damaged by high ground water. The association also installed wells of their own both for drainage and to supplement the river supply.

When the years of deficient stream flow occurred in the 1930's, the combined effect of the ground water pumping began to show on the return flow and the supply of the Buckeye Canal diminished below its needs.

A general adjudication suit was brought by Buckeye against all users from the Salt and Gila Rivers above its point of diversion. This included the Indian reservation on the Gila River. In order to secure jurisdiction to sue their diversion without suing the U.S. who operated the system, each individual Indian was made a defendant. As a result, there were 3500 named defendants.

It was recognized that such a suit would be difficult to try. Necessarily, much time and cost would be involved in any contested court action. Efforts to compromise the issues were started and considerable progress had been made when I was retained on the case by the Buckeye Irrigation Company in August, 1941.

Some personality conflicts had developed among some of the representatives of the parties and a fresh start appeared to be advisable.

I undertook the work and began the preparation of a report on the Buckeye position. I completed this report and it was argued at a meeting of the representatives of the parties in October, 1941. Naturally, my claims were not accepted by the other side, but there was a sufficient recognition that Buckeye's rights had been invaded that there was agreement that further efforts should be made to reach an out of court settlement of the case.

The U.S. Bureau of Reclamation was indirectly involved through its work for the S.R.V.W.U.A. and agreed to provide a mediator to preside at the meetings of the parties. Judge Clifford Stone of Denver was appointed as mediator. The USBR also provided an engineering advisor for Judge Stone. M.E. Bunger was this engineer in the earlier part of the proceeding. The Chief Engineer of the Indian Service Walthen also represented that Service.

The other interests had their engineers and lawyers. The lawyers attended the initial meetings of the mediator. As the discussions were mainly on engineering facts, the lawyers soon dropped out. The attorney for Buckeye did not attempt to direct their position, so I was left practically alone to attempt to reach a settlement. The staff of Buckeye was helpful on background material and Thornton Jones, their manager, was of material help in my work.

In these meetings there were differences between the engineers. There were about a half dozen who were active for the defendants. I was the only engineer for Buckeye. Judge Stone did not grasp the physical conditions involved and did not understand why, in the discussions, it was usually one against all of the others. He kept proposing that the engineers involved settle their differences by a majority vote, apparently without realizing that I would be out-

voted by about six to one. He resented by refusal to accept a majority decision and became critical of my attitude. After this had occurred three or four times, I stopped the discussion of the issues and unloaded myself of the facts of life. After this Judge Stone appeared to recognize the conditions of the case. This difference might have been avoided if Bunger had been more aggressive in advising Judge Stone. Bunger appeared to regard himself as an observer for the USBR to report progress to them.

Raymond Hill represented the S.R.V.W.U.A. The association had nearly all of the essential records. Salt River was the main stream involved. Tentative terms of a settlement had been reached with Gila River before I began my work on the case. The S.R.V.W.U.A. made their records available and I used them to make my case. This was the only case in my experience in which I had to use the opponents records to support my conclusions. The Buckeye record was limited to their own use.

We argued along for a couple of years. We would meet and present additional engineering results and argue for a few days and then adjourn to catch our breath and prepare for the next meeting. The war came along and I had trouble travelling to Phoenix for these meetings, but made it after the usual train delays.

Finally, in December, 1943, I reached an agreement with Hill on terms of settlement with the S.R.V.W.U.A. These were approved by the principal parties and a stipulated judgment was prepared and entered on these terms. This broke the deadlocks, and settlements were made with the Roosevelt Irrigation District and the Aqua Fria users. My work on this case was completed in Phoenix in September, 1944.

This case is a good example of what can be accomplished by **negotiation** of controversies over **water** rights. If this case had gone to trial, Buckeye could not have financed its costs for the necessarily lengthy and costly trial. The case might have been in **court** yet. The court could only consider the legal issues involved and had no basis for **compelling** the parties to consider compromises. All lawyers in this case recognized the situation and supported the out of court **settlement**. They are entitled to credit for this action. Their work was limited to the drafting of the agreements that were reached.

The settlement that was made with the S.R.V.W.U.A. could not have been secured in court. Buckeye had only a direct flow right. In the settlement, Buckeye accepted a smaller amount of water to be made available by the S.R.V.W.U.A. from their regulated supply, thus giving Buckeye the advantages of the Association storage. Buckeye received 1.1% of the total supply of the association to be taken as desired by Buckeye.

Settlements with the Aqua Fria were on a lump sum single payment basis. They had only an occasional and limited effect on Buckeye. The Roosevelt Irrigation District agreed to a continuing payment each year of specified costs of pumping which would replace the District's depletion of the effluent flow.

The Indian Service made a single lump sum payment for the depletion of the Gila River flow. This depletion was relatively small compared to the depletion on the Salt. The amount of this settlement had been agreed prior to my work on the case.

Everyone concerned expressed **approval** of the terms of this settlement at the time it was made. Based on the results to its date

it was in everyone's interest and avoided court procedures of uncertain outcome. It was recognized that the depletions might increase in the future, but the actual record since 1944 was not foreseen.

The last spill from the Salt Verde River reservoirs occurred in 1942, until some spill occurred in 1966. The 24 years between these surpluses were ones of diminished runoff and increased use. From a condition of ground water pumping to avoid high ground water damage the Salt River Valley changed to pumping for survival with a ground water lowering of over 100 feet. This practically prevented return flow except in a small amount near the junction of the Salt and Gila. Buckeye has survived on its own ground water pumping and, in recent years, on some increased use for irrigation of the discharge of the Phoenix sewage treatment plant.

The work on the adjudication case consisted primarily of meetings and negotiations. No lengthy reports were made and there are no items on this case in my bibliographical file. Both sides prepared and exchanged numerous exhibits. My file of these was given to Buckeye on the completion of my work for them in 1958.

GATE STORAGE AT HORSESHOE DAM

The settlement with the S.R.V.W.U.A. included the effect of any additional storage that the association might construct. Storage on the Verde had been built at the Bartlett site and another reservoir was planned at Horseshoe. The Horseshoe reservoir was later built and its storage came within the terms of the settlement with Buckeye.

The spillway at Horseshoe Dam was about 50' deep below the top of the dam. The city of Phoenix constructed gates in this spillway and was given title to the additional storage that these gates might

provide. This gate storage was filled in 1952. Buckeye did not receive any part of this gate storage and filed suit to enjoin its operation.

I was asked by Buckeye to try to work out a settlement of this controversy. I negotiated with the city intermittently until 1958.

I finally reached an agreement with Mr. Dario Travaini, then head of the Phoenix Water Department, that we would recommend to our principals a settlement in which Buckeye would receive a small percentage of the water supply made available by the gate storage. It would have been necessary for the S.R.V.W.U.A. to have conveyed this water to Buckeye through its canal system as it would have been lost if it had been released into the dry Salt River. It was thought that this could have been worked out with the Association.

Although Buckeye's position in this case had weaknesses, the Board of the Buckeye Irrigation Company rejected the terms of settlement I had agreed to recommend. In 1958 Buckeye voted to proceed to trial of the case. I advised the company that I would not be available for such a trial. I turned my records concerning all of my work for Buckeye over to Leonard Halpenny, an engineer in Arizona, who took over the work I had been doing.

This concluded my work for the Buckeye Irrigation Company extending intermittently over some 17 years. It was an interesting combination of engineering and human relations. I made a number of good friends in Arizona.

WORK FOR THE SAN CARLOS IRRIGATION & DRAINAGE DISTRICT

In 1944, as the Buckeye case was being wound up, Carl Anderson, the engineer of the San Carlos Irrigation and Drainage District asked me to investigate and report on the effect of the increasing

ground water draft in the Safford and Duncan Valleys on the inflow to the Coolidge Reservoir.

The San Carlos I. & D.D. is the system of the whites which participates with the Indians in the use of Coolidge storage. I made the investigation desired and reported I could not at that time find direct evidence of any reduction in the Coolidge inflow. The effect, if any, was obscured in the large losses in the extensive area of ~~tamarisk~~ in the upper end of Coolidge Reservoir. My report was made Sept. 1, 1945, and is entitled "Effect of Pumping for Irrigation in Duncan & Safford Valleys on Water Supply of San Carlos Reservoir." A copy of this report is Item No. 159 in my bibliographical file.

WORK FOR SAFFORD MUNICIPAL UTILITIES

In 1953, the Gila Valley Irrigation District sued the city of Safford regarding damage to the ground water supply of the Safford Valley claimed to result from the diversion of water from Bonita Creek, a tributary of the Gila River. I was asked by Mr. Fred N. Rosenfeld of Phoenix, who was attorney for Safford, to investigate this situation.

I went over the area involved and participated in a conference in Mr. Rosenfeld's office on October 8, 1953. The water supply conditions relating to the contested use did not appear to me to indicate that the draft by Safford might not have an effect on the water supply of the Safford Valley. I expressed this view at the conference. No written report on this work was prepared.

The case later went to trial. I was not asked to testify.

WORK FOR THE MADERA IRRIGATION DISTRICT

Means for securing water for the Madera area had been an active subject of local discussion for many years. The early history of these efforts is well covered in Bulletin 21 of the State Division of Engineering and Irrigation. An irrigation district for this area had been organized in 1888 under the original Wright Act. This district was unable to proceed and was dissolved in 1896.

In 1916, I made a preliminary office report for the Irrigation Investigations of the U.S.D.A. on the possibilities of forming an irrigation district in Madera County. A copy of this report is Item 9 of binder 37 in my bibliographical file. This report was intended to aid the local interests in their consideration of forming such a district by assembling some of the pertinent factual material.

The present Madera Irrigation District was organized in 1920. As organized, the district included about 350,000 acres. The history of the reduction of this area in the proceedings of the San Joaquin River W.S.D. has been discussed elsewhere in the account of this W.S.D.

The Madera Irrigation District voted \$28,000,000 of bonds, but only sold enough of this issue to meet the costs of litigation and the acquirement of the Millerton (now Friant) dam site. Borings were made at the site and an area of gravel lands bought to supply aggregate for the proposed dam.

The Madera Irrigation District was engaged in efforts to secure title to the unappropriated waters of the San Joaquin River from its organization until its merger with the San Joaquin River W.S.D.

(See page 97 for account of this storage district.) After the dissolution of this storage district, the Madera Irrigation District resumed its efforts to secure water for a separate project for its area. These efforts continued until the USBR undertook the construction of the C.V.P. The plans of both the state and the USBR for the C.V.P. included a canal extending northerly from Friant to serve the Madera area.

Much of the land in the Madera area was irrigated in the 1920's. The main water supply was secured from wells. The draft on the ground water exceeded the recharge and ground water lowering occurred. The Madera C. & I. Co. was a public utility furnishing an irregular service to some lands by diversion from the Fresno River. Increasing development made it essential that an additional outside water supply be secured.

WORKING WITH BARNES

Harry Barnes had been the engineer of the Madera C. & I. Co. prior to the organization of the Madera I. D. He later worked for the state and assisted me in the Kern County investigations in 1920. After the completion of that work, he returned to Madera as engineer for the Madera I.D. The district also retained consulting engineers to make the report on which the bond issue was based. These consulting engineers included Louis Hill and Thomas Means.

Barnes was the engineer for the Madera I.D. who represented the district in its procedure relating to the compromise which resulted in the organization of the San Joaquin W.S.D. in the late 1920's. When the storage district dissolved, Barnes returned to the Madera I.D. as its engineer. He continued with the district through the investigations relating to the C.V.P. by the state and the USBR and

the negotiation of the sale of the district properties at Friant to the USBR. Internal differences resulted in his replacement prior to the completion of the contract with the USBR for the construction and repayment for the Madera Canal of the C.V.P. and the local distribution system.

After the completion of my work for the state relating to the procedure of the S.J.R.W.S.D. I had no further direct contact with the Madera area until 1936 after the C.V.P. project had been begun by the USBR.

When the USBR took over the C.V.P. it was a new agency in the area. The local units had not had experience dealing with the USBR and were not familiar with the Reclamation Act and the procedure of the Bureau. I had had such experience in my work in other states and served as the source of information on USBR practices. Much of my activity in this regard was informal advice to the state engineer or to friends who represented local units.

I was asked to begin work as consulting engineer for the Madera I.D. in January, 1936, and continued intermittent activity for the district until August, 1947. My work was mainly in supplying material for use by Barnes in his reports to his Board of Directors. I made some reports which are included in Binder 37 of my bibliographical file and are discussed later.

To understand the record of the Madera I.D. during these years it is necessary to understand the procedures and policies under which Barnes operated. He was English with a stubborn adherence to the principles which he considered should control his relations with his Board of Directors. He regarded his duty to be the compiling of the information essential to making sound decisions, to present reports

containing this information to the Board and leaving it to the members of the Board to study the reports and make the decisions for which they had the final responsibilities.

In theory Barnes' program was sound, but it overlooked the practical conditions involved. The members of the Madera Board were local individuals anxious to serve the interests of the district, but lacking in the background to analyze the problems the district faced. In addition to the information in Barnes' reports the Board needed his conclusions on what should be done, presented, fully explained and advocated by Barnes. The result of his procedure was indecision in district matters. The failure of the Board to act in some instances forced Barnes to proceed on his own. This was contrary to Barnes' theory of how the district should function, but was essential to meet the necessities of daily actions.

In all my working experience I have not found a more sincere person than Barnes. He leaned over backwards to be sure he did not withhold any information, even though it might be unfavorable to his interest.

While Barnes' method of district operation was theoretically sound and would work with experienced directors devoting adequate time to district matters, in my opinion it was not adapted to the conditions in the Madera I.D. in the early years of the C.V.P. operations by the USBR. The directors should not only receive adequate information regarding the matters on which they need to act, but they should be told the action they should take on technical matters rather than be left to their own conclusions. A district board needs engineering and legal advice on which it can rely for the technical decisions the board members may not be qualified to make for themselves.

Working with Barnes on Madera I.D. matters was a frustrating experience. The larger part of my work consisted of Barnes coming to my office to review matters then under discussion, my advice to him on what should be done; his reporting to his board without strongly supported recommendations; and uncertain action by the board. I seldom had an opportunity to present my conclusions directly to the board and to support them by my recommendation. Stephen Downey of Sacramento who was the attorney for the district tried to operate on legal advice, submitted through Barnes, similar to my efforts on engineering matters.

This continued for about 10 years. I accepted it because of my close friendship with Barnes and my high regard for his integrity. Finally, after some 10 years, I insisted on meeting with the board on some matters relating to the proposed draft of a contract with the USBR. Such a meeting was held. The board was generous in their thanks to me for having taken the time to meet with them and explain the matters then under consideration. It apparently did not occur to the members of the board that I had been in their employment for 10 years and was being paid for my attendance at their meeting.

Soon after this meeting I concluded that I was not useful to the district under the program that was being followed. I terminated my work for the district in August, 1947.

REPORTS FOR MADERA IRRIGATION DISTRICT

I made some memorandum reports for the Madera I.D., usually on items relating to general USBR policies. The USBR tended to claim that practices they desired to follow in the C.V.P. represented general past USBR policies. As I was acquainted with their previous policies

and actions on their other projects, I was able, in some instances, to contradict such claims.

In May, 1936, I prepared a memorandum for the Madera I.D. on the "Basis of Repayment of Projects of the U.S. Bureau of Reclamation." This traced the history of the reclamation law on this subject. Its conclusions were based on the form of the Reclamation Law. This was prior to the passage of the Reclamation Project Act of 1939. In 1936, there were no provisions in the reclamation law for the 9e types of contract. Also in 1936, the draft of contract under discussion was that then proposed where the state water project authority would make an overall repayment contract with the USBR and then make its own contracts with the areas to be served.

In this 1936 memo for the Madera I.D., I concluded that the terms of the reclamation law would be applicable to the C.V.P. The main purpose of the memo was to analyze the support that might be found in the reclamation law for treating the Madera I.D. as a separate division or unit of the C.V.P. and only liable for its share of joint costs such as Friant storage and the actual cost of its own canal system. This would have resulted in a lower cost to the Madera I.D. than the average cost of all service from Friant.

By the time the repayment contracts in the C.V.P. were finally executed, the 1939 Act was in effect. As repayment of the main delivery works was to be made under the 9e form of contract with the price per acre foot of water delivered based on the ability to pay, arguments regarding allocation of main system works between different irrigated areas or project divisions were no longer pertinent.

A reading today (1966) of this 1936 memo emphasizes how much change has occurred in repayment policies of the USBR in the last 30

years. The larger part of the memo is a history of USBR repayment with examples of the practices used on named projects. This history is still valid, but the practices followed to 1939 are no longer applicable.

This 1936 memo was also made while the fiction of the C.V.P. being built for the state Water Project Authority was still being followed under the general terms of the state's C.V.P. Act. This fiction now seems like ancient history.

I made another memorandum for the Madera I.D. in January, 1938, on the practice of the USBR in dividing its projects into divisions. This subject had also been included in my May, 1936 memo. In the 1938 memo, the conditions on each existing USBR project were analyzed. No projects were found in conflict with the position that the Madera I.D. should be a separate division. Ten projects having separate divisions under conditions comparable to those of the Madera I.D. were listed. This memo was also made prior to the passage of the Reclamation Project Act of 1939 providing for the type of contracts with the price based on ability to pay. The ability to pay may not vary in the different divisions of a project while the cost of service may differ. This memo served a purpose at the time it was made in supporting the claim of the Madera I.D. that it should only be charged with the cost of the Madera Canal and not the average cost of all areas to be served from Friant.

One of the issues in the contract negotiations of the Madera I.D. and the USBR related to the amount of water Madera needed. I prepared notes on the water requirements of the Madera I.D. in November, 1942. These notes reviewed the results available on

individual crops in areas comparable to the Madera I.D. The results were expressed in terms of the consumptive use. With the recovery of any percolation losses by pumping from the ground water the requirement for the imported supply could be based on the consumptive use.

These notes represent a reasonable consensus of the available records. In my opinion, they would still represent rates of use that are applicable under similar conditions. Changes in conditions have occurred, however.

Since 1942, the average yields in this area have increased materially. This is the result of the greater use of fertilizers and the better general standards of practice. The consumptive use results I derived in 1942 are lower than the similar results that are being used now for consumptive use. The results in my 1942 notes, in my opinion, correctly reflect the requirements for the areas to which they were applicable.

The results used in 1942 were from areas having generally only limited ground water movement into or out of the areas for which values were derived. Consequently, the overall consumptive use could be derived from the difference in inflow and outflow and the total crop area for periods when there was no change in the underlying ground water. Depths to ground water were generally relatively small in the periods used.

This condition has now changed in some of the areas used in these 1942 notes as overdraft has lowered the local ground water. The large ground water lowering that has occurred on the west side of the Valley has induced a ground water outflow in some areas that did not exist in the 1930's.

My notes on water requirements in 1942 are still, in my opinion, a useable assembly of the information then available on this subject. Their present use, if any, should be limited to their value as a basis of comparison with results that represent present conditions.

In 1943 Friant Reservoir was ready to divert into the Madera Canal and the Canal was about ready for use to Fresno River. The Friant Kern and Delta Mendota Canals were not ready for operation. Madera proposed that it should receive deliveries into the stream channels available for such use for purposes of percolation until more complete service could be received. No distribution system had been built in the Madera area at that time.

Under date of September 28, 1943, I prepared a report on "Water Rentals on Projects of U.S. Bureau of Reclamation." This discussed the practice on the other projects relating to such water rental service.

Madera contended that the charge for such water should be based on the cost of operation only without any repayment toward construction. While the 9e form of contract was then in the reclamation law, all past practice had been under the 9d form of contract. The results in my report for other projects represented 9d experience.

This report had some usefulness at the time it was made. It applied to a temporary condition which no longer exists. It may have some historical interest in its compilation of the practice of the USBR.

GROUNDWATER FROM THE SAN JOAQUIN RIVER

Originally the ground water in the southern part of the Madera I.D. sloped toward the San Joaquin River on the south. The river was

a gaining stream receiving water from both sides in this area. As pumping from wells in the area north of the river lowered its ground water, there was a reversal of ground water slope and the river contributed seepage into the area. This condition continued until the beginning of delivery of C.V.P. water.

In 1943 Barnes assembled the records on this situation with his comments which he sent to me for review. I replied under date of October 14, 1943 in a letter memorandum which is Item 1 in Folder 37 of my bibliographical file.

The contribution from the San Joaquin River was a factor in the water supply and requirements of an area that grew to about 40,000 acres. This item of supply would be replaced by a loss if enough C.V.P. water was used to restore the original slopes toward the river. This matter was still under discussion at the time I ended my work for the Madera I.D. It was not settled when Barnes was replaced. The form of contract accepted by the Madera I.D. after Barnes left gave the District no future credit if it should restore the ground water and produce a return flow to the river.

OTHER MATTERS

One of the early negotiations between the Madera I.D. and the USBR involved the sale to the USBR of the Friant Dam site and the gravel pits. I did not participate in these negotiations directly, but at various times went over the items involved with Barnes. A sale was eventually negotiated. Out of these negotiations, in addition to payment of money, the Madera I.D. secured an agreement that the Madera Canal from Friant would be constructed and put into operation at least as soon as the Friant Kern Canal. There was concern that the larger area to be served under the Friant Kern might be able to

influence the USBR to build that canal first.

Another early matter under discussion between Madera I.D. and the USBR was the capacity of the Madera Canal. The Bureau desired to build a smaller capacity than Madera considered would be needed. A compromise was reached in which the Bureau built the canal as it desired, but all pipes and crossings that would be expensive to enlarge were built to Madera's size. I helped Barnes on these matters, but did not participate in his negotiations with the USBR.

The delays in progress by the Madera I.D. finally led to the northern part of the Madera I.D. withdrawing from the district and forming the Chowchilla Water District in 1949. This occurred after the end of my work for the Madera I.D. The initiative and leadership of the Chowchilla area is largely the result of the work of Harold V. Eastman who has been the secretary of the Chowchilla Water District since its organization. The Madera I.D. and the Chowchilla W.D. make joint use of the Madera Main Canal of the C.V.P. which remains under the operation of the USBR.

Contract negotiations for the purchase of water from the Madera Canal and for the construction of the Madera distribution system were begun during the period of my work for the Madera I.D. I helped Barnes assemble material for use in these negotiations such as the amount of water to be purchased and the lay out of the distribution system. These matters did not reach a final contract during my work. Here again, I did not take a direct part in the negotiations as Barnes preferred to handle such matters alone.

The Madera Canal and Irrigation Company system served some lands from Fresno River. It was essential that its system be acquired and incorporated in the distribution system to be built to deliver C.V.P.

water. The negotiations for this purpose dragged along for several years, mainly because the Madera I.D. would not take specific action. I worked with Barnes informally on the valuations of the Madera C. and I. property, but did not participate directly in the purchase negotiations.

The contract negotiations of the Madera I.D. and the USBR reached the stage where the USBR offered the district the choice of three contracts in 1950. These differed in some optional features. The district selected one of the three contracts and put in motion the procedure for its adoption.

Some of the Madera land owners objected to the terms of the accepted contract. One of the objectors was Arnold Sallaberry who owned a large area of generally hardpan land in the northeasterly portion of the district.

Sallaberry had been a director of the Madera I.D. He protested the approval of the contract by the California District's Securities Commission and asked me to appear at their hearing in support of his position. I did this and argued that the resulting costs of service under the distribution system contract would be more than such hardpan type of lands could meet. The hearing was held in Sacramento on September 25, 1950. These hardpan lands had been dry farmed for grain. They would require levelling for irrigation unless sprinkler systems should be used.

On October 2, 1950, the California District's Securities Commission made its Order No. 5, Report upon examination of Contract to the Board of the Madera I.D. In this decision the Commission disapproved without prejudice to later contracts that might meet the objectives to the one reviewed in this decision. The

Commission found that all lands in the Madera I.D. had acquired a claim on water for their irrigation under the 1939 contract with the USBR for sale of the Friant Dam site and other District property, and that the class 3 lands in the northeasterly part of the District should be recognized as participating in this right, to be used at some future time when service at a cost they could afford might be made available. The Commission also found that the area in question could be excluded from the Madera I.D. without an adverse economic effect on the District, but that if these lands should be excluded, they should have preserved to them a right to later participate in the use of C.V.P. water from the Madera Canal.

My only part in these proceedings was the one appearance before the Commission. It assisted in securing recognition of the conditions affecting these lands and the disapproval of the contract under review which did not meet these conditions. Later the Sallaberry lands were excluded from the Madera I.D. and a contract for the distribution system for the remaining lands was approved.

GENERAL COMMENTS

My work for the Madera I.D. extended over a period of 12 years from 1936 to 1947. I came back into the picture briefly in 1950 in the Sallaberry proceedings. This was the period when the areas in the C.V.P. were having to deal with the USBR and were learning the procedures applicable to Bureau projects. The Madera I.D. was in a better position in negotiating with the Bureau than the units under the Friant Kern Canal, as Madera owned properties at Friant essential to the C.V.P. To some extent, Madera secured advantages from this position. In my opinion, a better

organized and more assertive representation of the Madera I.D. might have secured even better terms.

The Madera I.D. was organized in 1920. It took 30 years to secure a contract for its canal system as a part of the C.V.P. This 30 year period included the efforts to fight Miller and Lux, to work with them in the San Joaquin River W.S.D., to fight them again until the USBR came into the C.V.P. Even holding its organization together over this long period represents a creditable performance by the Madera I.D. In this Barnes played a leading part.

In my opinion, it is regrettable that when the USBR took over the C.V.P. the organization of the Madera I.D. did not, or could not, adapt itself to the new conditions and proceed more actively and aggressively in its own behalf. The failure of the Madera I.D. to meet these new conditions resulted in the separation of the Chowchilla area, the replacement of Barnes and the acceptance of a less favorable C.V.P. contract than might have been secured.

When I worked on Sallaberry's exclusion I found the Madera I.D. staff lacking background in such procedures and operating without adequate advice, either engineering or legal, in making its decisions. The changes made after Barnes had been replaced, in my opinion, did not improve the situation.

My own attempts to be of assistance to the District were ineffective under the program on which Barnes operated. This is the only employment in which I have worked under such limitation. I remained in it longer than I would have with anyone else because of my long association, friendship and high regard for Barnes. We had worked together in 1912 on the investigation of the state's water resources resulting in U.S.D.A. Bulletin 254. Barnes had worked

with me on the Kern County investigations for the state in 1920. We had gone through all of the San Joaquin River W.S.D. where he was engineer for the district and I represented the state. I was willing to undertake anything I could to help in the solution of the problems of the Madera I.D. as an aid to Barnes.

Barnes was probably the only one who could have held the Madera I.D. together during its long period of frustration from 1920 to 1935. In my opinion, it is regrettable that when the opportunity to proceed in the C.V.P. became available, the Madera I.D. did not adapt itself more effectively to the changed conditions.

WORK ON UTAH LAKE

In 1935, Utah Lake went dry for the first time in its recorded history. This was the result of a series of years of below average runoff and of the increased use of its inflow. The resulting shortages in water supply for those pumping from the lake led to the filing of a general adjudication case to determine the rights of all users of its surface inflow and outflow. The plaintiffs in this case were the Associated Canals. This term is used for the five main users of the outflow from the lake who own the pumping plant at the outlet. The Associated Canals include Salt Lake City, the East Jordan Canal Co., the North Jordan Canal Co., the Utah & Salt Lake Canal Co., and the South Jordan Canal Co. The Associated Canals operate through a Board of Canal Presidents consisting of the presidents of the boards of each of these four canals and the city engineer of Salt Lake City. The city engineer has been the president of this Board.

In 1934, I had been a witness for Oregon in the interstate case involving Washington and Oregon over the use of the waters of Walla Walla River. Mr. William W. Ray of Salt Lake City was the special master for the U.S. Supreme Court who heard this case. Mr. Ray was also the attorney for the South Jordan Canal Co. When the Utah Lake adjudication case reached the stage in 1936, that testimony was being planned, Mr. Ray wrote to me regarding my availability to prepare the case on its water requirements for his client. I met Mr. Ray in San Francisco on November 27, 1936, and we discussed a program for this work. We agreed that field work should not be undertaken until the irrigation season of 1937.

I met with the attorneys of the Associated Canals in Salt Lake City on April 8, 1937, and later with the Board of Canal Presidents. I was employed to direct the preparation of testimony for all of the five systems working under the direction of the Board. Each canal had its own attorney. Philo T. Farnsworth had been retained as chief attorney. Salt Lake City had an engineering staff, but the other four canals operated with a superintendent whose main duties were the delivery of water to each user. David I. Gardner had recently been appointed as water master under an older decree to administer the division of the outflow from Utah Lake.

The program had two main parts. Each canal would have to establish its own water requirements to support its case. The water supply obtainable from Utah Lake would also need to be established so that the lake could be managed to meet the needs of those using its outflow. The users of the inflow to Utah Lake were the defendants in this case. Their rights and priorities would also need to be defined so that Utah Lake could be administered as one water system.

We selected fields under the Associated Canals of representative soils and crops and measured their use of water and yield in 1937. We also measured use under selected laterals as a whole in 1938. Gardner with an assistant handled this part of the work.

Utah Lake received inflow from nearly 100 sources varying from Provo River to small tributary springs and drains. A inflow-outflow balance for the lake was needed. We established measuring stations on the inflows and secured records of these stations for four seasons through 1940. Henry R. Watson was employed to handle this portion of the field work. I had general charge and spent such

time as was needed or available on this work through the season of 1940. Completion of the reports extended into 1941.

The preceding description illustrates the complexity of the organizational set-up. I received full cooperation from all of the four canals and received all of their records. Wm. M. Beers was the city engineer of Salt Lake City and controlled the city's records. I never did succeed in securing their records relating to the use of water from Utah Lake from the city and had to meet my needs by indirect approaches.

During this work the USBR was building Deer Creek Reservoir on Provo River. Salt Lake City was to be a major user of the new water supply made available. The USBR dealt with a group representing those who would use Deer Creek water. On this group Mr. Beers represented Salt Lake City. One of the main issues of the Utah Lake adjudication was the extent to which the flow of Provo River should be allowed to come down to Utah Lake before there was storable water for Deer Creek Reservoir. This divided interest by Mr. Beers affected the decisions of the Canal Presidents. I was caught in the middle.

The five Associated Canals had defined their relative rights in Utah Lake as between each other and had operated the pumps at the outlet successfully for many years. Success in the pending general adjudication required that internal difference between the five plaintiffs should be avoided. If I had made an issue of some of Beers' actions such internal harmony would have ended. I agreed with Mr. Farnsworth that conflict among the five canals should be avoided. My work was basically to secure the records needed in the trial of the case. I kept out of policy matters unless they

directly affected my work. The field work was completed harmoniously and the records secured and compiled.

When the four years records of inflow to Utah Lake had been secured, I recommended reducing the field work to a few major stations. Reports had been prepared on separate matters as the work on them was ended. In 1941 we had the wind-up reports to prepare. I also planned a general report summarizing the results and including the conclusions I had reached.

In order to put on record the results of our work a series of reports was prepared. A list of these is Item 70 in my bibliographical file. There were about 15 reports totaling about 1500 pages. These were prepared to present the record. It was the intention to place them on file for future reference.

In addition, I planned a summary report which would be filed with each canal company. When I was about ready to start on this summary, Beers had the Board of Presidents direct me not to make any report stating conclusions on the matters at issue in the case. This was a surprise to me as such conclusions are the normal objective of such investigations.

I had five copies typed of each report on separate parts of the work we had done. One copy was sent to Gardner as each report was completed. The Board instructed me to purchase a filing case and to retain the reports and supporting records in my office in Berkeley. In 1947 when it did not appear that the case would go to trial, I took three copies of the reports and the other records to Salt Lake City and delivered them to the office of the Board of Canal Presidents. I retained one set as my office file.

At the time I began this work it was the intention to press the

case to trial. There was delay in completing service to the large number of defendants. A motion was made to transfer the adjudication procedure. This took time and the motion was granted. Then a motion was made to include all users of ground water in the area as parties on the ground that their ground water draft affected the ground water inflow to Utah Lake. This motion was finally granted. This has been the end of the adjudication as far as results are concerned although the state engineer has done some further work in securing proofs of use from the well owners.

A general decree involving both surface and ground water users in the area tributary to Utah Lake would not be enforceable. Control of surface can be made with measurable results as to its effect in protecting the supply available to prior rights. Ground water users would not be curtailed prior to a period of shortage in inflow to Utah Lake. Curtailment after the shortage had occurred might and probably would not benefit the users of Utah Lake water within the time period of their shortage.

Another factor that has affected the time program of this case has been the generally improved water supply in the years since Utah Lake went dry in 1935. Succeeding years raised the lake and removed the shortage. At one time there was talk of another suit because the lake had been allowed to get too high. More recently the lake has been very low and dredging to get more water to the pumps was required. The adjudication has not been reactivated however.

It is now over 30 years since the shortage in 1935. At that time, an adjudication of the surface rights could have been made and all inflow to the lake put under water master control. In the years since 1935, Deer Creek has been built and its use established.

Work is under way on the importation of water from the Colorado River drainage. It is improbable that a general adjudication suit will ever be tried in this area.

On several occasions over the years since this work was completed, I urged the Associated Canals to file one set of the reports with the state engineer to assure that our results would remain available in the future. The Reclamation Service made measurements on Utah Lake in its early years. All that was obtainable of these results in our work was a brief record in the annual reports of the U.S.R.S. I offered to make my office file copy available for this purpose. Consent to such action was not secured.

In 1963, the Board requested that I deliver to them my file copy. I had no further use for these reports (see exception later), and as they were the property of the Board, I delivered them to Dave Gardner when he was here on October 11, 1963. This ended my connection with this work. I had been on a stand-by basis over the years if there had been any action on the case.

Among the reports made in our work were two relating to the evaporation from Utah Lake. A class A pan was in use with a factor of 0.8. In earlier years they had used a buried pan at Nephi. By measuring the inflow we were able to measure all items in the inflow-outflow balance except the discharge of the springs in the lake bed and the evaporation. In the winter months when the evaporation was small we derived the inflow from springs as the remaining items in the balance. As the inflow from the springs is relatively constant we could use the winter results on the inflow for all the year to derive the evaporation. Consistent results were secured. The inflow from springs had been observable in 1935.

It was, and is, a fairly large item.

I had worked on the evaporation of other Great Basin Lakes. At my request the Board approved my retaining my office copy of these reports. These reports are now Items 71, 72, and 74 in my bibliographical file.

As I anticipated that my results would not be known beyond the office of the city engineer while Mr. Beers held that position, I prepared a summary of the reports which I filed, together with an index of the reports and the records, with each canal system. No objection to this action was made by the Board. The summary report is Item 70 and the index is Item 73 in my bibliographical file. Some pertinent correspondence is also included in Item 70.

In 1953 there was some dispute regarding the operation of Utah Lake at its high stage. I was asked to examine the situation. I made a three day trip for this purpose and made a verbal report to the Board. This matter was not pressed to court action.

These investigations on Utah Lake were an interesting hydrologic study. In my opinion, we secured results whose usefulness extended beyond the issues of the litigation for which they were obtained. This usefulness has not been secured to date and may never be. It will not be unless the results are made available for use in presently pending matters.

The Central Utah project is just getting under way to bring additional water into this area. The former talk of a project to conserve evaporation on Utah Lake by a dike to restrict its area is being revived. Former irrigated areas under the four canals are being urbanized. All of these changed conditions will have to be

reconciled with the old. The records we secured in 1937-40 can be a helpful factor in these adjustments.

EAST BAY WATER CO. vs. MCLAUGHLIN

This case involved the tax on the sale in 1928 of the properties of the East Bay Water Co. to the East Bay Municipal Utility District.

McLaughlin was the U.S. Collector of Internal Revenue. He had set the tax on this sale and the suit was brought against him to reduce its amount. The U.S. was represented by the U.S. attorney in San Francisco, Frank J. Hennessy. The case was tried for the U.S. by Esther B. Phillips, a deputy U.S. attorney. My work on the case was arranged with Mr. Clack of the Internal Revenue Field Division.

In its purchase of the properties of the East Bay Water Co. the East Bay M.U.D. had agreed to pay any income taxes resulting from the sale which might be assessed to the East Bay W.C. This made the E.B.M.U.D. the active plaintiff in this case. The District was represented by its attorney T.P. Wittschen.

The District had paid \$647,602.87 in taxes on June 24, 1931. It sued to recover the whole tax with interest from the date of payment. The E.B.W.C. had acquired its main properties in 1917. The tax was based on the claimed profit upon the sale of these properties in 1928 at a price in excess of its value in 1917.

The price paid by the E.B.M.U.D. was known and not at issue. The case turned on the value of the properties of the E.B.W.C. at the time of their acquirement by that company. The E.B.W.C was the result of combining several early small companies serving parts of the local area. The tax at issue depended on the difference in value of the properties of the E.B.W.C. when acquired by it and the price at which they had been sold to the E.B.M.U.D.

The Commissioner of Internal Revenue had found a value of the

properties of the E.B.W.C. as of January 1, 1917 of \$16,548,541,000. This was his finding on the "fair market value" of the "fixed capital assets." The tax had been computed on this value, less later retirement and allowed the depreciation plus additions. January 1, 1917 was adopted as the date of the acquirement of the purchased properties by the E.B.W.C. The parties had agreed on a 1917 valuation of the lands and interest in land of \$7,558,731.95. This left the valuation of the physical system and, in general, the intangibles to be determined in the trial.

My work was limited to an appraisal of the value of the water rights. The East Bay M.U.D. used J.B. Lippincott and Fred C. Hermann as its witnesses on the value of the water rights. They found a value of \$100,000 per M.G.D. for 18.4 M.G.D. safe yield of developed sources and \$50,000 per M.G.D. for 17.6 M.G.D. owned, but undeveloped sources. San Pablo Dam had not been built in 1917.

The total valuation by Lippincott and Hermann for the total water rights sold was \$2,720,000 as of January 1, 1917. My appraisal of the 1917 value of the water rights involved was \$500,000. The difference in these two results was caused by different methods of appraisal that were applied to the water rights involved. The values found by the witnesses for the U.S. for the water rights varied from \$340,000 to \$530,000 depending on the basis used. I recommended \$500,000 as a fair value for the purposes of this case.

In my work on this case I assembled the results of sales of water rights or other procedures from which the values used for the water rights could be derived. These results and their applications to the water rights involved in this case were included in a report on the "Value of the Water Rights of the East Bay Water Co." which

I made in June, 1938. This 104 page report also discusses the different methods which were in use in the valuation of water rights. A copy is Item 69A in my bibliographical file.

The E.B.W.C. secured its water supply from a variety of local sources, so that the appraisal of the value of the water rights required more detail work than would be usual in such cases.

The E.B.M.U.D. purchased the E.B.W.C. system in 1928. The trial of this case took place in 1938. The time between these dates represents the time taken to assess the tax, that spent in efforts to compromise the issues, and delays in actually getting to trial.

The trial was held before Judge Lindley of Chicago who had been assigned to this case, apparently without his approval. Judge Lindley was very critical in his attitude, restricted the witnesses to yes or no answers whenever such answers could be made, and ruled severely on questions of admission of evidence. In his favor it can be said that he was equally discourteous to both sides.

Miss Phillips had been active in admiralty cases and had little background in the subject matter of this case. Wittschen had been attorney for Miller and Lux and was at home in the subject matter here. Miss Phillips had difficulty phrasing her questions in a form which the judge would sustain over Wittschen's objections. The U.S. witnesses had to adjust what they could cover in their testimony to this condition.

The E.B.M.U.D. had voted bonds for the construction of the Mokelumne system to bring water to the area of the District. It later voted additional bonds to cover the cost of local distribution either by the purchase of the E.B.W.C. or by the construction of a

new system. There was the usual bargaining resulting from this situation, the E.B.M.U.D. seeking to buy the E.B.W.C. system as cheaply as possible, and the Water Co. seeking to get as much of the funds which the District had available as it could.

Dr. Geo. Pardee was the president and the dominant individual on the Board of Directors of the E.B.M.U.D. He made many speeches on the purchase of the E.B.W.C. He claimed it would be bought for much less than the available funds and that the remainder of the funds would be used for improvements in the distribution works.

Meanwhile, the construction of the Mokelumne system was approaching completion. The E.B.W.C. had been meeting an increasing delivery demand without enough new sources of supply and might not have enough water to meet its load until the Mokelumne water arrived. It appeared for a while that the E.B.M.U.D. might have to deliver Mokelumne water into San Pablo Reservoir in order to avoid a shortage in its area even if it had not acquired or built a distribution system.

Finally, the situation became sufficiently critical that the District and the Company reached an agreement on the purchase of the Company system. In substance, the E.B.W.C. sold everything which it owned to the District for all of the funds which the District had available for the purchase. These funds were nearly twice as large as the price for which Dr. Pardee had predicted the system could be secured.

In view of the overall conditions this purchase of the E.B.W.C. worked out advantageously for both parties. The District paid a relatively good price, but it could not have secured the local

distribution system by condemnation within the time available.

The E.B.W.C. had acquired large areas of land in its water sheds to protect the quality of its supplies. The E.B.M.U.D. acquired these lands. Some of these areas which were no longer needed for watershed purposes have been sold to the Regional Parks system. Tilden Park is an example of this. The E.B.M.U.D. still owns large areas of land. As the treatment of the water supplies is extended, these lands may no longer be needed for water supply protection and may be sold for parks and other uses.

Comments on the acquirement of the properties of the East Bay Water Co. are contained in the Annual Reports of the East Bay Municipal Utility District. The report for 1928 (p.65) states the \$26,000,000 in bonds were voted in November, 1927 to be used for the acquisition of a local distribution system. As the District had been unable to secure a price for their properties from the Company, the amount of this bond issue was based on the estimated cost of constructing an independent system, so that the District would be in a position to buy or to duplicate the existing system. The District report states, "Every consideration of economy and public conscience, as well as urgent public necessity, dictated the acquisition of the existing properties of the Water Co., if it were possible to do this. It had become increasingly evident that if a purchase were made, it must be for all of the properties of the Water Company." Negotiations continued to August 19, 1928, and a compromise was reached on September 26, 1928, when the District agreed to buy the entire assets of the Water Company. The title was transferred on December 8, 1928, and the District took over the operation of the system.

The first Mokelumne water reached the District on June 23, 1929. At that time the storage on hand in the District's local system was only sufficient for 21 days use in the East Bay area. This was a close margin.

This tax case was tried in June, 1938.

The decision is dated August 21, 1938 and is reported in 24 Fed. Supp. 222. Judge Lindley commented, "Evidence of historical cost and various other elements, all competent and relevant in determining valuation, were submitted and a formidable amount of testimony on both sides presented."

"The parties are in sad disagreement as to the value of the water rights. Plaintiffs witnesses testified to a valuation of \$100,000 for each million gallon per day of developed water and \$50,000 per million gallons per day of undeveloped supplies, or a total of \$2,720,500. The witnesses for the Government testified to a minimum value of \$340,000 and a maximum of \$530,000. That consideration must be given to such water rights is evident from the decisions." Cases are then cited. The decision then states that the Government attacked the validity of some rights, but its objections were not sustained.

The decision states:

"Again I am of the opinion that plaintiffs witnesses were too liberal, and those of the defendant too conservative in their estimates of the value of water rights. That they had value is admitted, but prior to 1917 it was contemplated that some of these rights should be superseded by various others. Considering all of the evidence bearing upon this subject offered by both parties, I find that the fair value of the water rights, both developed and

undeveloped, on January 1, 1917, was \$1,320,000. In reaching this conclusion, I have valued the undeveloped water rights at one-third of the developed price. While these rights had not been fully developed they had actual existence. They were property rights in the nature of chattels real, and plaintiff had a right to include them in the value of its property, though necessity for their enjoyment had not yet come into existence."

The decision on the value of the water rights involved in this case was nearer to the value claimed by the Government than that claimed by the E.B.M.U.D.

If the decision is applied to the extent of these rights claimed by Lippincott and Herrmann with the judge's valuation of undeveloped rights at 1/3 of developed rights, it results in a value of \$53,300 per M.G.D. for developed rights. The E.B.M.U.D. claimed 18.4 M.G.D. developed supply and 17.6 M.G.D. undeveloped in 1917. San Pablo Reservoir was constructed after 1917. Giving the above amount of undeveloped supply a value of 1/3 of the developed water and applying the judge's total value of \$1,320,000 for both types of supply gives the above value per M.G.D. of developed supply of \$53,300.

This case is one of the few cases involving the value of water rights in which the decision enables the value per unit of supply found in the case to be derived.

On the overall issue in this case, the total value of the acquired properties on January 1, 1917, the court found \$18,373,732. The Government had based its tax on a value of \$16,548,574. This increase in the total value reduced the tax based on the difference between the 1917 value and the 1928 sales price so that the E.B.M.U.D. secured a reduction in the tax as a result of this suit.

My work in this case is my only experience in trying to work with a woman attorney. While the confusion that occurred cannot be blamed entirely on the sex of Miss Phillips, it was more difficult to argue out differences of opinion, or to explain matters not understood by the attorney, under the restrictions that are usual in discussion with ladies. Miss Phillips was a good lawyer who was working outside her field of experience in this case.

The wide difference in the conclusions reached by the different witnesses testifying on the value of water rights illustrates the difficulty of placing market values on a commodity not free to move to an open market and seldom sold. Water rights are rarely moved from one use to another. Sales are infrequent except under individual factors which limit the application of the price paid to other proposed sales. Isolated sales can be found over a wide range of values, but seldom represent the required willing seller and informed buyer standards required to establish real market value.

WATER CONSERVATION CONFERENCE,

CHICAGO SEPT. 7-8, 1944

This conference was held at the Stevens Hotel in Chicago. It was attended by representatives of 29 states. It resulted from the common interest of the western and the eastern states in two bills then pending in Congress.

The adoption of flood control as a federal responsibility by Congress in 1936 led to many problems in federal-state relationships and in competition between the federal agencies having activities in the development of water resources. There was fear among the western states that flood control would be combined with navigation to restrict the use of water for irrigation. There was also concern that flood control projects might be authorized on interstate streams which might be opposed by some of the states involved. The most definite example of this fear of injury to some of the states was illustrated by the Missouri River where the large reservoirs to be built by the Army Engineers for flood control might be operated to maintain navigation. The superior right of navigation over consumptive uses could be used to prevent use of water from such streams in the upper states in the Missouri Basin. The Pick-Sloan Plan had not yet been adopted by the U.S.E.D. and the USBR.

In the eastern states in 1944, Vermont was opposed to some proposed flood control reservoirs in Vermont which would submerge some large areas of land then in use. The state under procedures obtaining had no ready means for asserting its interests in such federal projects.

The Interstate Commission on the Delaware River Basin (popularly known as Incodel) was also concerned with the federal position

relating to the plans of the states comprising this Commission. Incodel was anxious to have a greater state say regarding federal projects.

The National Reclamation Association had an active Committee on Preservation of Integrity of State Water Laws. Judge Clifford H. Stone of Denver was the Chairman of this committee. The Secretary-Manager of the NRA, F.O. Hagie, handled much of the organizational work preparatory to the Conference.

As the result of the interests in these issues, the basis for the Chicago Conference that is stated in its notice calling the meeting was worked out. There were four sponsoring organizations as stated in the call. There were five items on the agenda as follows:

1. To assure local and state participation in plans for water resources development;
2. To preserve the integrity of state water laws;
3. To perfect amendments to the Omnibus Rivers and Harbors Bill (H.R. 3961) and the Omnibus Flood Control Bill (H.R. 4485) now pending before the United States Senate;
4. To insure adoption of such amendments by the Congress; and
5. To consider such other matters as may properly come before the Conference.

The record of the Conference is well presented in the report of Raymond Matthews who was Secretary of the California delegation and in Senator O'Mahoney's report to the U.S. Senate. These and other materials relating to California's part in the Conference are included in Item 160 of my bibliographical file. The comments included here are a supplement to that record.

California had a particular interest in H.R. 3961 because of its

inclusion of the so-called Elliott Amendment which would exempt the Central Valley Project from the provisions of the 160 acre land ownership limitation. This rider had been attached to H.R. 3961 in the House by Congressman Elliott. It had no direct connection to the main purpose of H.R. 3961 (an Omnibus River and Harbors authorization act). H.R. 3961 had passed the House with this rider and was then before the Senate.

California also had a direct interest in securing recognition that irrigation took precedence over navigation in arid states. While there were no pending projects in California in which this was a direct issue at the time, it was a potential point of conflict in the C.V.P.

California was also directly interested in the amendment to H.R. 4485 which had been proposed by Senator Millikin of Colorado. These amendments would require federal agencies proposing projects for authorization to submit their reports on such projects to the states involved. The states would be given 90 days in which to comment on such reports and their comments would accompany the department's report when it was transmitted to Congress.

In California, there was an informal working committee of water interests which Hyatt had brought together so that a single California position might be presented on Congressional matters. This committee later became the California Water Council and then the present California Reclamation Association. Hyatt's committee met when meetings were needed. Hyatt's working committee was functioning when the Chicago Conference was proposed. Meetings were held to formulate the position California would take at the Conference.

The California committee had considered the earlier forms of

the Millikin Amendment. There were some differences of opinion regarding its wording. These were ironed out among the California members before the Chicago meeting so that the Californians had their own program to propose. The committee also agreed upon and adopted a position on the other matters at issue that would be discussed at the Chicago Conference. I was a member of the working committee and helped Hyatt draft its statement of position which was used at Chicago. I do not have a copy of this statement in my files. It should be available in the state engineer's records.

I participated in these procedures directly as representing the Tulare Lake Basin Water Storage District. I also acted as an informal assistant to Hyatt in drafting statements of position, etc. I attended the Chicago Conference as a representative of the T.L.B.W.S.D. Due to the war restrictions on travel, the U.S.E.D. secured permits enabling me to get to Chicago.

When the Conference opened in Chicago there appeared to be general agreement on the objectives of the meeting, but not much coordination or planning on how to define and secure them. After it began to look as if the meeting might talk for two days without concrete action, the previously prepared California program was presented by Hyatt. It expressed the position and purposes of the other states. It received general approval and the succeeding discussions were directed toward adapting it to the needs of all of the states.

As this was a grass roots meeting, federal representatives were not admitted to the general sessions. The federal agencies had been asked to have representatives available for conference at the Stevens Hotel. This was done, but their participation

was limited to conferences with them outside of the main meetings. There were numerous factual questions which they were helpful in answering, but it was the purpose of the meeting to reach positions on policy matters independently of the ambitions of the federal agencies concerned.

I have compiled correspondence and items relating to this conference in a folder in my bibliographical file. This is Item No. 160. It does not contain anything that I had written except some correspondence. Judge Clifford H. Stone of Colorado had been active in calling the Conference. He was then serving as mediator in the Buckeye Case in Arizona. I was the negotiator for Buckeye in this case. I used this contact to secure for the California committee additional information regarding the Conference.

There was a good representation of the eastern states at the Chicago Conference. Alban J. Parker of Vermont was particularly active and served as Chairman of the meetings. Representatives of Incodel were also active.

The Chicago Conference had two particular features that differed from previous similar meetings. One was the exclusion of federal speakers to allow direct expression of local views. The other was the inclusion of eastern and western water interests having and interest in water policy in a joint session.

While the Chicago Water Conference has now been largely forgotten, it served a useful and constructive purpose while it operated. The final wording of H.R. 4485 followed generally the recommendations of the Conference. Senators Millikin of Colorado and O'Mahoney of Wyoming attended and worked with the group on what became known as the O'Mahoney, Millikin Amendment to H.R. 4485.

The Chicago Conference had an essential part in drafting and in securing the passage of Sec. 1a and 1c. of H.R. 4485. These are the sections covering state review of federal reports. It has been in effect since 1944 with varying results in the different states. It gives the states an opportunity to express their views on federal projects before they are authorized by Congress. California made much use of this provision. Under Hyatt, when he was State Engineer, federal reports were reviewed carefully on both engineering and policy matters. His reports were effective in presenting the state's position. At one time Strauss is reported to have told Governor Warren that Hyatt's comments were delaying authorization of California projects as a result of his criticism. Considering the quality of some of the reports put out by the Bureau when Strauss was Commissioner, Hyatt's criticisms probably prevented actions which would not have served the states interest. They did not hold up authorization or appropriations.

Other states generally have tended to rubber stamp approval of federal reports that would authorize federal expenditures in their areas. California's more critical attitude under Hyatt did not result in any essential loss of federal funds for California and secured projects better adapted to the needs of the state. Since Hyatt's time his standards have not been fully maintained.

Sec. 1b of H.R. 4485 was also extensively discussed at the Chicago Conference and wording satisfactory to all participants worked out. This wording was used in the act as passed. This section related to the preference for irrigation over navigation in the states partly or wholly west of the 97th Meridian.

The Chicago Conference was not successful in securing the inclusion

of the Elliott Amendment in H.R. 3961. The exemption of the C.V.P. from the acreage limitations was a single state action. The Conference actions were limited to matters of national scope. The U.S. Senate removed the Elliott Amendment from H.R. 3961. In the Conference on the Senate and House versions of H.R. 3961, the House accepted the Senate's action. This was not a repudiation of the purpose of the purpose of the Elliott Amendment. The desire to pass H.R. 3961 and to secure the authorizations it contained was too wide-spread for other states to be willing to delay passage of H.R. 3961 by arguing over any local matters.

A second Water Conservation Conference was held in Kansas City on September 18 & 19, 1947. I attended. A more definite organization with a constitution was adopted. There was a California group in attendance. This Conference did not have as specific objectives as the one in Chicago. The main objectives of the Chicago Conference had been accomplished in the passage of H.R. 4485. The lack of specific items on which to press for action was apparent at Kansas City and little definite result was secured.

The Chicago Conference resulted in the appointment of a Continuing Committee to follow up on its recommendations. Each state had a member on this committee. W.R. Bailey, then of Visalia was the California member. This working committee was active for a few years. It called the Kansas City meeting. Other organizations gradually replaced the one formed at Kansas City and it ceased to function.

The Chicago Water Conservation Conference is a fairly typical example of a need for concerted action by some group of interests, action in meeting that need and gradual loss of interest after the need has

been met. The Conference was a success in meeting the needs it sought to solve. The gradual loss of interest later represents a painless method of avoiding the perpetuation of organizations beyond the period when they are needed.

REPORT ON WAGON WHEEL GAP RESERVOIR
ON RIO GRANDE IN COLORADO

A reservoir on the Rio Grande in Colorado at the Wagon Wheel Gap site and one on the Conejos River had been found to be feasible in a report by the U.S. Bureau of Reclamation published as H.D. 693, 76th Congress 3d Sess. in 1940. The Conejos is a tributary of the Rio Grande entering a short distance above the New Mexico line.

The Wagon Wheel Gap Reservoir would serve lands in the San Luis Valley. This is a large area noted for the production of high quality potatoes. Its irrigation practice included the sub-irrigation of crop lands by raising the ground water by excess diversions in the early season and maintaining it through the growing season. This practice had resulted in damaging areas of lower lands, but was successful in the lands in which the ground water was controlled. Unlike most areas similarly sub-irrigated, the amount of diversion required was relatively small, averaging about 2 acre feet per acre per year.

Opinion in the San Luis Basin regarding the Wagon Wheel Gap Reservoir was divided. The engineering reports had been based on making available additional water by storage of surplus flows and also by changing the practice by reregulating the then early season diversion for use in the later season. A Joint Investigation Committee had been established including members from the different parts of the Valley to represent the land owners in negotiations regarding the project.

This Committee was not satisfied with the available report

which recommended construction of the reservoir on the basis of the joint benefits of the new water and the regulation of existing use. It desired a report which would analyze the project on the basis of the new water only, leaving the local practice to remain as it had been.

I was asked to make a report on the Wagon Wheel Gap Project by the Joint Committee. An agreement was reached and I began work on the report in 1944.

An interesting item in the agreement to make the report was a clause, insisted upon by the Committee, that the report be written in language the land owners could understand. The previous reports had discussed the results that might be obtained from the project without too much attention on the items which the land owners could use to compare their preproject and project conditions. The local interests also wanted to continue their present practices.

I made a trip to Monte Vista June 12 to 14, 1944. I signed the agreement to make the report. I mailed my report on October 7 and was in Monte Vista on October 16 and 17. My report was accepted, and I discussed it at an open meeting.

I had some hesitation in agreeing to prepare a report subject to a requirement that unnamed individuals could or would understand it. However, the Committee were high type individuals, and I was in sympathy with their position. I wrote the report with a non-technical summary and conclusions at the start and followed with the water supply analyses in usual engineering form. No complaint was made that I had not met the terms of the agreement. I have had other occasions when a non-technical discussion of technical results has been desired, but this is the only instance in which it was a point of

the employment agreement.

The Rio Grande compact between Texas, New Mexico, and Colorado had been made in the 1930's. The need for this compact resulted from the increased diversions in New Mexico and Colorado depleting the water supply for Elephant Butte Reservoir in Texas. Under the compact, Colorado was obligated to deliver a defined amount of water at the Colorado-New Mexico line. There were provisions for credits and debits to take care of excess or deficiencies in the delivery in any year. This compact requirement reduced the remaining water available for new development in Colorado and was a major factor in the storable water at Wagon Wheel Gap.

War time restrictions were in effect on travel and I had difficulty in getting to the San Luis Valley. After I had collected the information needed, I did my work on the report in Berkeley. I was able to work in side trips to Monte Vista when I was in Denver on other matters.

The remaining water supply available for storage at Wagon Wheel Gap was limited mainly to surplus flows in years of excessive runoff. This made the safe yield a relatively small per cent of the constructed storage capacity. I estimated the new water supply obtainable to average 82,000 acre feet per year from a storage capacity of 960,000 acre feet to be available for irrigation.

The benefits from the regulation of the past diversions were debatable. The local users did not accept the estimates that had been made by the USBR. I found such benefits to be limited as much of the soils to be served were coarse and would require heavy, late irrigations if the sub had not been raised by heavy early use.

In general, I concluded that the project was marginal. It might

be justified if its costs were low enough, but did not represent a necessity for the Valley.

My personal relations with the Committee were very pleasant, I received their full support and retained the friendship of some of the members over the years.

There was an opportunity to increase the water supply at Wagon Wheel Gap by diverting water from the drainage area of Weminuche Creek at costs which appeared to be feasible. The water supply obtainable by such a diversion was analyzed in my report. Weminuche Creek is in the drainage area of Pine River. Such a diversion was discussed in H.D. 693. If Wagon Wheel Gap Reservoir should be constructed, the Weminuche diversion would be a feasible addition to its water supply under 1944 condition.

In my report on the Wagon Wheel Gap Reservoir, I did not make a direct recommendation regarding whether it should be built or not. The previous reports had shown the benefits it was claimed could be secured from the reregulation of the then diversions. The Committee desired results showing what service could be secured without changing the current practices. I derived such results. My conclusions in my report were as follows:

"It is concluded that Wagon Wheel Gap without the Weminuche diversion can make available 68,000 acre feet per year without disturbing or changing present uses. With the Weminuche diversion the similar usefulness is 82,000 acre feet per year. In addition, voluntary modifications in present diversion practices may make available an additional 20,000 acre feet per year. Other smaller items, not included in the main studies in this report, may add as much as 10,000 to 15,000 acre feet more.

"These amounts of usefulness of storage at Wagon Wheel Gap should be used in comparison with the costs of storage which may be charged to irrigation in determining the desirability of the project. These results apply to the operation of Wagon Wheel Gap without changing present methods and amounts of use of the natural or unregulated flow and do not include reregulation of present uses."

At the time of my report the cost allocation between flood control and irrigation had not become final and the costs that would be charged to irrigation were indefinite. I covered only the water supply features of the project and did not attempt to express a conclusion on its economic feasibility. At the meeting with the committee to discuss my report, I made this clear. I did state that the project was marginal as nearly all of the runoff at the Wagon Wheel Gap site was already in beneficial use. My conclusion appears to have agreed with that of the local interests as the project has not received sufficient local support to result in its construction.

At the time I made this report, the Rio Grande Compact was in effect. Both Colorado and New Mexico had met their delivery requirements, and Texas had received its compact supply. Later, both Colorado and New Mexico fell behind in their deliveries and Texas brought suit to enforce the Compact. I reviewed the issues of this case for New Mexico. My results are discussed in another item in these memoirs covering this subject.

The Conejos storage was constructed after my work on Wagon Wheel Gap. It was built for flood control without a contract for its use for irrigation. For several years the Conejos irrigators received the benefits of the improved stream flow without cost. The waters stored

for flood control were released after their storage at rates which improved the divertability over that obtainable under the previous natural flow.

Since my work in the San Luis Valley on the Wagon Wheel Gap Reservoir, there have been efforts to get the project constructed. None of these efforts have been successful. In the meantime the irrigators have turned to ground water pumping from wells on the irrigated lands. This has lowered the ground water in some areas and reduced the sub, but to date it is my understanding that no serious overdrafts have developed.

Colorado is now in material arrears on her required deliveries at the New Mexico line under the terms of the Compact. Any storable water at Wagon Wheel Gap would now have to be delivered to the New Mexico line until the deficiency in delivery there had been met. This condition makes the Wagon Wheel Gap even less attractive to the local users as its use for their benefit would be deferred until the Compact terms had been met. To date there have not been attempts to restrict use in Colorado to meet the Compact deliveries.

I drove through the Valley in 1962 on the way to sites of my earlier work. I was there on a Sunday and took to the water master the various materials I had collected in my work. I did not anticipate that I would have further use for these results. The only records I retained were copies of my report. A copy is Item 80 in my bibliographical file.

STATE OPERATION OF THE C.V.P.

When the state was unable to finance its plan for the C.V.P. and the federal government began its construction in 1935, the project passed from state control to the USBR. Initially the state tried to treat the USBR as a contractor building the project for the state. In the earlier years the Water Project Authority passed on and approved the USBR's plans and programs. Gradually the realities of the situation became clear and the C.V.P. was recognized as being a federal project being built and operated in accordance with the terms of the reclamation law.

The state did not reconcile itself to this loss of control of the C.V.P. and efforts were made to have the project turned over to the state for operation as its several parts were completed. These efforts were most active while the C.V.P. remained essentially the same project proposed by the state. When the original C.V.P. became merely the nucleus of a general water resources plan for the Central Valley, it became even more apparent that transfer to the state would be unworkable.

The proposals for transferring the C.V.P. back to the state were most active in the latter 1940's. They were mainly sponsored by A.D. Edmonston both while he was in charge of the state's water resource investigations and later when he became state engineer. Ed Hyatt also supported such a transfer while he was state engineer.

There was much general support for the return of the C.V.P. to the state. This was based on various grounds. One was the hope that such a transfer could be made under conditions so that the C.V.P. would not be subject to the acreage limitation. Another was the general dissatisfaction with those then in control of the USBR.

A third reason was the general preference for local control.

The interest in the return of the C.V.P. to the state led the State Chamber of Commerce to appoint a committee in 1945. I was asked by Chairman Carl F. Wente of the Chamber's State-wide Committee on Utilization and Control of Water Resources to act as Chairman of a subcommittee on this subject. I accepted and acted as the Chairman for the next five years. The other members were Harold Hedger of the Los Angeles Flood Control District, George Henderson of the Kern County Land Co., Burnham Enerson, a San Francisco attorney, and Ronald B. Harris, a Fresno attorney.

My records relating to the activities of this subcommittee are included in my bibliographical file in the folder entitled, "Proposed Transfer of the Central Valley Project to the State, 1945-52." This is Item No. 158 in my bibliographical file.

The State Chamber had adopted a policy favoring the transfer of the C.V.P. to the state prior to the appointment of the subcommittee. The editor of the San Francisco News, Mr. Frank Clarvoe, sent a copy of the Chamber's statement to Secretary Ickes. Ickes replied on October 31, 1945, expressing his opposition to such a transfer. Ickes' letter includes some of the record relating to previous dealings with the state relative to such a transfer.

Hyatt replied to Ickes' letter of October 31, 1945, to Clarvoe on December 12, 1945. Ickes replied on January 11, 1946, and Hyatt wrote Ickes again on February 8, 1946. These letters did not produce an agreement between their authors.

I made a progress report to the entire state-wide committee at its meeting on March 28, 1946. The committee instructed the subcommittee to prepare its report and that the state proceed as quickly

as possible to complete arrangements for state control and authority to make repayment contracts.

The subcommittee made a progress report for the Annual Meeting of the State Chamber on Dec. 2, 1947. It reviewed progress and recommended that the Chamber continue to advocate the early completion of the C.V.P. It also recommended that further consideration of the feasibility of transfer to the State be deferred until the completion of the state's report on this subject. This state report was then in the process of preparation.

I continued as chairman of the subcommittee in 1949 and 1950. There was much public support for the idea of state operation of the C.V.P. if a workable basis could be found.

The State Water Project Authority had been created in the C.V.P. Act and would represent the State in any transfer of the C.V.P. and in its operation by the state. The Authority consisted of designated state officials having other major duties. Such a group has never been found to be effective in matters outside of their major responsibilities.

After a preliminary meeting of the subcommittee, I prepared a ten page statement of the matters which I thought the committee should consider and the background information available on them. This was dated February 20, 1946.

I considered that the first step needed in preparation for the state's possible taking over of the C.V.P. was a revision of the membership of the Water Project Authority. I proposed to Hyatt that he support state legislation which would provide for representation of the areas to be served by the C.V.P. as the members of the Authority. Hyatt felt that to remove the members of the Authority would be considered by them as a personal expression of disapproval. He would

only agree to support legislation enlarging the membership of the Authority to include representatives of the areas to be served. He would have gone along on increasing the membership of the Authority to ten or more, thus making available a majority of local representatives. I felt that any serious attempt to transfer the C.V.P. to the state should have as its first objective an adequate state board for its administration. When the efforts to secure such a board did not develop sufficient support for its accomplishment, I lost interest in the program.

I also felt that the state should only take over the C.V.P. if such a takeover was favorably advocated by the area to be served. The activity relating to such a transfer had been mainly sponsored by the state engineer and such public organizations as the State Chamber of Commerce.

I expressed my views in a letter to Hyatt on April 20, 1950. Enerson and Stewart attended the meeting of April 28, 1950, which I could not attend, and from then on took over the main activities of the committee. I finally resigned as Chairman on November 28, 1950. Mr. Enerson presented the 1950 report of the subcommittee at the meeting of the state-wide committee on December 1, 1950. The pending report of the state engineer had not been issued.

My last item on this subject is a letter to Stewart on May 12, 1952 replying to his notice of a meeting to be held in Fresno on June 20, 1952. In this letter I reminded him of my resignation from the committee in 1950.

Later progress on the taking over of the C.V.P. included reports by the state. The major state report was published as Bulletin 2 of the State Water Project Authority in March, 1952, entitled, "Feasibility

of State Ownership and Operation of the Central Valley Project of California."

In Bulletin 2 the state engineer found that the transfer of the C.V.P. to the state would be feasible and desirable. He recommended that the Project Authority should adopt a policy favoring acquisition by the state and that it should seek Congressional action directing the USBR to enter into negotiations for such acquisition.

The work of the state engineer on the acquisition by the state of the C.V.P. had been conducted mainly from the point of view of the state regarding the desirability of the transfer of the project to the state. The state had not maintained close contact with the units which were contracting for C.V.P. water and did not recognize that the transfer would be desirable only if it resulted in advantages to such units.

After Bulletin 2 was completed and distributed, a meeting was called in Fresno on June 20, 1952, with the C.V.P. contracting units to secure their reaction to the state's acquiring the project. At that meeting nearly all of the contracting irrigation districts indicated that they preferred to have the USBR continue to construct and to operate the project. This ended active efforts to secure the transfer of the C.V.P. back to the state.

Looking back now it is easy to see that a transfer back to the state of the C.V.P. would not have been practicable. If the C.V.P. had remained as the project adopted by the voters of the state in 1933, its transfer to the state after its completion would have given a greater extent of local control and could have had advantages. However, the C.V.P. has now become a regional plan both importing water to the Central Valley and planning exports from the Valley (San

Felipe Unit). It would be very difficult and impracticable to transfer the present extended project unless the state assumed the responsibility for financing the remaining costs of construction.

For all practical purposes the questions relating to transferring the C.V.P. back to the state appear now to be dead issues. The adoption of the cooperative basis for the construction of the San Luis Unit of the C.V.P. and the state's Feather River Project has established the pattern which future federal-state relations will follow.

Part of the interest in the possibility of the transfer of the C.V.P. in the 1940's was the result of the deterioration in the organization of the USBR in this period. Relations with the administrative heads of the USBR were difficult and made any alternate additionally attractive.

WORK FOR THE PALO VERDE IRRIGATION DISTRICT

The Palo Verde Irrigation District includes about 100,000 acres in the vicinity of Blythe. It has the earliest priority of any of the recognized diversions from the Colorado River in California. It had the usual difficulties in its early history. This history, to 1928, is covered in Bulletin 21 of the Division of Engineering and Irrigation, page 327, by Frank Adams.

The District had issued bonds for irrigation canals, for levees for flood protection and for an interval drainage system when the depression of the 1930's occurred. The total financial load was more than the landowners could carry and the District went through re-financing under the various programs then available. As a result the District compromised its bonded debt in the form of a single general bond issue of reduced amount.

The depression of the 1930's was followed by the restrictions of the period of World War II. The District managed to keep its canals in operating condition, but neglected its drainage system, in the 1930's for lack of funds and during the war from restrictions on the availability of essential equipment.

By 1946, the drainage system had become only partly effective. An expansion in irrigation during the favorable crop price years resulted from the then moderate land prices and the expected favorable returns.

In 1946, Travis who owned a tract which had been developed at the north end of the district, brought suit against the district alleging negligence in providing drainage in its area. Under the irrigation district law in California, an irrigation district is

responsible for both water service and drainage of its included land. This suit focused attention on the drainage problem of the entire district.

In 1946, I was asked to assist the district in its defense against Travis and to advise it regarding policy and actions which the district should take to rehabilitate and extend its drainage system. I undertook this work. Arvin B. Shaw, Jr. was the attorney of the district and in charge of the defense against the Travis case.

C.P. Mahoney was the engineer-manager of the district and in charge of the general operations including drainage.

My first work was directed toward the Travis case. This consisted of observations to develop the factual situation. Travis claimed damage from seepage of the district canals in or adjacent to his land. Losses from his own distribution systems and percolation from his irrigation appeared to be more important sources. After field work to develop the facts, the Travis case was settled by negotiations. Travis had built drains in his own land. These were included in the district system and a cash payment made to Travis. This settlement, over all, was to the benefit of both parties in avoiding expensive litigation of uncertain outcome.

The Travis case served to alert the district board to the district's liability if it should be negligent in providing drainage. The board desired to adopt a drainage program which would be adequate to avoid any claims of negligence and also restrict the costs to what the district could afford. I was asked to act as consultant for the district in developing such a program.

The district had secured equipment and was proceeding on the rehabilitation of its drains when I began my work on their general

drainage system. A reasonably adequate drainage system had been constructed in the early district work and the obvious first need was to clean out and restore the effectiveness of this system. This work was under way in 1948. My work consisted mainly in advising regarding the scale at which it should be done and recommending the sequence in which the various drains should be cleaned. I became in effect an engineering auditor of the district's budget for drainage, reviewing what had been accomplished and proposing the next year's budget. I made annual reports of this type each on this basis. The earlier reports were less formal. Copies of my annual reports from 1949 to 1956 are in Item 110 of my bibliographical file. This item also includes other reports which I made during this period. In addition to the actual drainage work accomplished during these years, my work for the district provided a defense for the board against claims of negligence that might be made by any landowner whose lands needed drainage. The board could assert that it had a drainage program actively under way on which they were following the recommendations of their consultant. This was probably the major consideration of the board in having me make my earlier reports. In the later years when the drainage had become more nearly adequate, my reports also served to avoid internal differences regarding what drain should be built next.

Mr. C.C. Tabor, who had been assistant engineer for the district, was appointed engineer following Mr. Mahoney's death on November 18, 1948. O.E. Simmons was appointed superintendent. No general manager was appointed. This division in the organization worked reasonably effectively as long as Tabor and Simmons made it work. Later some conflicts resulting from this divided authority resulted in the

resignation of Mr. Tabor. This occurred after my work for the district had ended. I worked directly with Tabor in my drainage reports.

While I was the consulting engineer on drainage, I did only limited actual engineering work. Tabor would prepare the drainage program for each year, I would spend a week in the area reviewing it, prepare and present my recommendations to the board, they would adopt my report, and it would be the program and budget for the coming year. My report usually agreed essentially with what Tabor had proposed.

Among the actions of the board in the early part of my work for the district was the formulation and adoption of a statement on district policy on drainage. I participated in the drafting of this statement. It was printed and a copy mailed to each landowner.

When the drainage program was begun the district had only limited funds available. It was the general opinion that not over \$1 per acre per year could be afforded for drainage. I used this as a guide in my annual plans. This limit was met during my work for the district. It enabled a reasonable rate of progress to be maintained. This resulted from having the original drainage system already available. Its cleaning and extension could be handled within the \$1 per acre limitation.

I also worked on and testified in a case brought against the district by a former president of its Board. The district had enlarged a canal across the plaintiff's land. It was claimed that this enlargement destroyed the silt seal of the canal and increased the seepage. Claims regarding payment for the enlarged right of

way were also involved. In general, the plaintiff won on his right of way claim and lost on the drainage claim. This case was tried in Riverside in April, 1955. Mr. Shaw had died and had been succeeded as attorney for the District by Frank Jenney. Mr. Harry Horton of El Centro was the principal attorney for the District in this trial.

When I first began work for the P.V.I.D. the district area presented an unfavorable appearance. Water logged areas were interspersed with lands being irrigated. There were large areas of alkaline land not in use. Much of this was unlevelled and overgrown. The contrast that occurred in the years after 1946 was quite marked. The irrigated area has increased, the eye-sore areas have been improved, and the district presents a well kept and successful appearance. The former river levee had been set back for as much as a mile or more from the actual river channel to shorten the length of the levee and to leave room for the shifting river channel. With storage at Hoover Dam, the danger of floods has been largely removed. Lands outside of the old levee have been cleared and cultivated.

The silts deposited in the Palo Verde Valley by the Colorado River are coarser than those that have reached the Imperial Valley. The Palo Verde soils leach more readily and can be reclaimed from alkali that make the raw lands appear to be hopeless.

There is an area to the west of the P.V.I.D. known locally as the Mesa. This has attractive soil and favorable temperature conditions. It has been planned for irrigation for a long time. The land title has been sought by means of desert land entries. The water rights of the P.V.I.D. recognized by other Colorado River users in California include water for the Mesa. The distribution system

for the Mesa has not been built as yet and may be further delayed by the terms of the decision in Arizona vs. California.

When Hoover Dam began operation it stored the silt in the Colorado River flow. The clear water below the dam had eroding capacity and lowered the downstream river bed. This lowering extended to the diversion of the Palo Verde I.D. Diversion had previously been made without requiring a diversion dam to raise the water into the District canal. A temporary rock weir, dumped from a cable across the river, was first used. The USBR was finally authorized by Congress to build a permanent weir to overcome the result of its storage at Hoover. The P.V.I.D. paid part of the costs for the additional benefits it received. I made one trip to Washington for the District in the procedure relating to this permanent weir.

The excess diversion by the Palo Verde I.D. returns to the Colorado River within or just below the district area. There has always been flow in the river at the point of diversion in excess of the needs of the district. As a result, diversions have been made liberally and the amounts diverted per acre have been large. Lower divertors had not objected to such large rates of use as they considered that the excess returned to the river. The apparent return flow has been about one-half of the diversion. Such return flow occurs both as canal spills and general ground water discharge from the drains. There has also been surface water which has been discharged into the drains. As a result, diversions have been at the rate of 8 to 10 acre feet per acre irrigated.

Various efforts were made to improve this practice. Rules were passed prohibiting surface waste to the drains. Enforcement of such

rules would have required night patrolling of the canals and drains. The district did not feel it could afford the cost of such additional ditch rider service and these rules were not enforced. In one field investigation that was made the worst violators of the no surface waste rule were found to be some of the district directors.

At various times it was suggested that I should investigate and recommend to the board means by which the amounts of water being diverted could be reduced. I generally evaded these suggestions as I felt that any regulations relating to the use on the lands would not be enforced. Also, efforts to improve canal operation methods would not be effective under the then superintendent. I did recommend that the diversion record of the district should be secured as a cooperative station with the U.S.G.S. so that this record would have greater standing. The conditions for measurement near the headgate involved submergence of the flow through the gates and the methods of measurement used benefitted from this outside impartial cooperation.

Finally in 1957, I was asked by the president of the board to investigate and report on methods of reducing the amount of water diverted by the district. The Arizona vs. California case was under trial at that time. I declined to make such a report telling the president that it would necessarily show a high rate of use which would be adverse to the district in this trial and that in my opinion any recommendations regarding changes in the local practice that I might make would not be enforced. My conclusions were recognized to have a sound basis, but my frankness in stating them was resented. I was not asked to make further annual drainage reports or do other work for the district. Since January, 1957, I have not engaged in further activity for the Palo Verde Irrigation District.

My personal relations with the members of the staff and the board of the district have remained cordial. There have been numerous personnel changes and I have worked with only a part of the present staff and directors. Mr. Simmons died and Mr. Tabor is now the manager of the Wellton Mohawk I.D. in Arizona.

The land in the Palo Verde I.D. slopes to the west from the Colorado River to the trough of the valley. Like other alluvial streams subject to overflow the Colorado River has built a ridge on which it flows. The drainage of the trough in the district discharges into a trough channel which is known locally as the Lagoon. This channel discharges into the Colorado River several miles south of the south line of the district. As a result of backwater conditions from the Imperial Dam or other factors there has been a rise in the Colorado River in the area in which the Lagoon discharges. This had raised the elevation of the flow in the Lagoon and restricted its usefulness for drainage. The USBR has a project for rectification of the Colorado River in this area (the Cibola cut) which is expected to lower the river channel and improve drainage conditions in the district. Since 1957, the district has dredged the Lagoon in an effort to secure a better outfall for its drainage. I had no part in planning or carrying out this program and have not observed its results.

No account of my work for the Palo Verde I.D. would be complete without a reference to Mr. Ed. Williams. He was a pioneer in the valley who was the district assessor when I first worked for the district. He was regarded with affection by all who knew him. He had high and unbending standards of personal conduct that influenced all who worked with him. His death on June 17, 1954, was a distinct loss.

Williams had been a cowboy in his earlier years and had participated in many early phases of the cattle industry throughout the West. He was a most interesting narrator of these experiences. It is unfortunate that his reminiscences were not put in written form before his death.

WORK FOR MONTEREY COUNTY FLOOD CONTROL
AND WATER CONSERVATION DISTRICT

INTRODUCTION

Late in 1948, I was asked to become the consulting engineer of this district. I accepted and remained in this position until April, 1959. I have also assisted on a few minor matters for the district in later years.

At the time of my appointment Mr. Howard Cozzens was County Engineer and also acted as engineer for the district. On his retirement in 1954, he was succeeded by Chester Dudley. Early in my work Loran Bunte Jr. became assistant engineer and was appointed District Engineer when Mr. Dudley retired. The greater part of my work for the district was in association with Mr. Bunte.

My work for the Monterey County FC & WSD began in Dec. 1948. I signed an employment contract which the supervisors had had drafted. The work in 1949 consisted in getting myself up to date on Salinas River reports and results, meetings with the U.S.E.D. on flood control, and preparation of applications to appropriate the water supplies that would be needed in plans for the development of the Salinas River runoff.

In 1950, my work was related mainly to a study of the ground water conditions. In August, 1950, arrangements were made with State Engineer Edmonston to have the state make a flood control report on the Salinas River. The state report recommended storage at the San Lucas site. As there was no gaging station with a long record of the total flow of the Salinas River above San Lucas, a constructed flow was designed which all parties used. This work extended into 1951.

In 1951 and 1952, progress was slow as we were waiting on the Army Engineers for their San Lucas report. August Kempkey was retained to review the cost estimate in 1952.

In 1953, my work was more active. The main item was the preparation of a general report on "Water Supply of the Salinas Valley and Storage Project for its Additional Use." This was the supporting material for the brief Sec. 10 report on the Nacimiento project. The detail report was dated Oct. 1953 but the letter I transmitted to the district is dated Dec. 28, 1953. This report is Item 98 of my bibliographical file.

The principal work I did for the district related to storage and led to the selection of the Nacimiento reservoir on the river of that name as the first project to be constructed. My work included the water supply studies and the procedural matters relating to the selection of this site for the first construction project of the District and continued until its completion and the acquirement of the lands in the reservoir site. I advised the District that I did not care to participate in the design or the construction of Nacimiento Dam. Mr. A. Kempkey was appointed the District's consulting engineer for this work and the Bechtel Corporation selected to do the design and supervise the construction. The Nacimiento River is the largest tributary of the Salinas River.

I also made the water supply studies and did preliminary work relating to the San Antonio Reservoir. This included extensive activities relating to the controversy with San Luis Obispo County over securing a permit for this storage.

These activities are described in more detail in the discussion which follows.

BULLETIN 52 AND CONTINUING GROUND WATER INVESTIGATIONS

Prior to the time of my appointment, the Division of Water Resources had completed its Bulletin 52 in 1946. This report covered the results of a two year field investigation of the water supply of the Salinas River. T. Russel Simpson has been state's engineer on this work and was the author of Bulletin 52. He had lived in the area during this work and had become familiar with the local conditions.

Simpson found an overdraft in the ground water and salt water intrusion in the strata from which the pumping draft near the ocean was then occurring. The District desired a review of these results and the preparation of plans for increasing the ground water supply. My earlier work for the District related largely to these questions.

Simpson had recommended that a comprehensive adjudication under the water code should be initiated covering both surface and ground water rights. One of my first recommendations to the District was adverse to this conclusion by Simpson.

The Salinas Valley is a narrow area extending along the Salinas River for over 100 miles in Monterey County. It has been divided into five ground water divisions for convenience in discussion but these are not separate basins. Any restriction on the use of a late priority well in one part of the valley would have a limited, if any, proveable effect on wells in the other divisions.

An effort to adjudicate the ground water rights would have placed each land owner in competition with the other owners and have led to internal controversies. An adjudication would not add to the available supply. I urged all owners to pull together toward securing additional water so that an adjudication would not be needed. This was done and storage was built to provide water which was spread to increase the

ground water supply.

If an adjudication had been started after 1948, it is doubtful if it would have been concluded by the time Nacimiento became operative in 1957 and relieved the need for it. In addition the entire area has worked together on a general water plan for the present and future need of the Valley.

Prior to 1948, salt water intrusion had occurred in the north in the 180 foot aquifer near the coast at the mouth of the Salinas River. This is a valuable area growing artichokes and other crops. The search for a substitute water supply for this area was a first order of business. As the Salinas River becomes dry in the summer season such a substitute supply required storage. Storage investigations were made of the sites which had been proposed.

My work on the water supply of the Salinas River occurred during the period the State was making its studies of a state water plan. The state's work extended to all parts of the state, including the Salinas Valley.

STORAGE INVESTIGATIONS

It was generally recognized that any additions to the use of the Salinas River would require storage of its surplus winter flows. This need had been foreseen in the earlier reports on the Salinas Valley even though at the time such early reports were made no overdraft existed.

The Army Engineers had an authorized channel improvement project on the Salinas River. This was planned to reduce overflow and bank erosion. This project might not be needed if adequate flood control storage could be secured. The Army Engineers also conducted storage investigations in this period.

State Engineer Edmonston became convinced that the best overall storage could be secured at the San Lucas site on the Salinas River. A report on this site was made by the state in November, 1950 which found an estimated cost of about \$15,000,000. The state was expected to contribute \$2,500,000 for rights of way and movement of the railroad and highway in the reservoir site. A state appropriation of this amount was secured for this purpose in the 1951 legislature. The state estimated that the Army Engineers would recommend a federal contribution of \$7,500,000 leaving \$5,000,000 for the local interests.

The Army Engineers made a study of the San Lucas storage. Their report in March, 1953 increased the estimated cost to \$25,000,000 of which they recommended a federal contribution for flood control of \$7,716,000. This would have increased the local cost to about \$15,000,000.

When the results of the Army Engineers relating to the San Lucas reservoir site became available to the District it was recognized that the proposed project had local costs larger than would be voted. The San Lucas site also would flood a large area of valuable land. The then prospective San Ardo oil field also extended into the area that would be submerged.

Preliminary studies of storage on the Nacimiento, San Antonio and Arroyo Seco had also been made. Further study was given to the Nacimiento site. I recommended the construction of a reservoir there for joint use for conservation, flood control and recreation. Water supply studies were made to derive the desirable capacity and operation program of such a reservoir. As previously stated, Mr. A. Kempkey was retained in 1952 to check the cost estimates.

There were two available dam sites for the proposed storage on Nacimiento. One, the lower one, was within the Camp Roberts military reservation. Federal legislation was secured granting the use of this site to Monterey County. This grant included some reservations regarding future use of the area within the reservation. The upper site was about two miles upstream from the lower one and was outside of the reservation. Bechtel Corporation was employed to supervise drilling at the upper site. Some drilling was also done at the lower site. Cost estimates were prepared for both sites. Little difference was shown. As the upper site was free of any military restrictions it was recommended.

The flood control and water conservation act under which the District was organized is a special act for Monterey County. Local improvements can be built by zones within the district. Zone 2, covering the Salinas Valley, had been established to carry out any work in its area. The costs would be assessed against the lands in the zone only as they would receive the benefits.

The Army Engineers held a hearing on Feb. 24, 1954 on their report on the San Lucas project. I appeared for Monterey County and stated that the district considered that it had a more feasible project in storage on Nacimiento River. The San Lucas report of the Army Engineers was placed on file without action.

Prior to this hearing I had heard that the U.S. Soil Conservation Service planned to appear and propose a plan they had prepared consisting of a number of smaller and scattered reservoirs. Such a plan for part of the drainage area had been submitted to the state some time previously. The state review of this plan was unfavorable. I secured copies of the state's review and made my own analysis of it. Prior to the

hearing I advised Col. Walker, district engineer of the U.S.E.D. who was to conduct the hearing, that if the S.C.S. opposed the district's project, I would be prepared to take them on and oppose their plan.

At the hearing about a half dozen S.C.S. staff entered their appearances. When called upon to present their position, their spokesman stated they were there as observers only. Any controversy with the S.C.S. that might have developed was thus avoided.

NACIMIENTO PROJECT

The basis for the Nacimiento Project had been worked out in 1953. Plans for the dam were authorized to be prepared in 1954. The report on the project in accordance with Sec. 10 of the MCFC and WCD act was submitted by Kempkey and myself in Jan. 1955. The District's hearing on this plan was held March 8, 1955. The bond election was held on April 26, 1955, and carried by a vote of 11 to 1. The construction contract was let in October, 1955. The project was completed on time late in 1956 within the estimated cost.

The district act requires in Section 10 that an engineer's report shall be submitted on the district projects before they can be adopted by the district board and an election called on the issuance of bonds for the projects costs. The County Board of Supervisors are the board of directors of the MCFC and WCD.

I prepared the Section 10 report in joint authorship with Kempkey. It was a condensed version of the report containing the supporting material previously referred to. The supporting material report was in detail (214 pages). A copy is Item 90 in my bibliographical file. The Section 10 report was entitled "Water Supply of Salinas Valley and Storage Projects for Its Additional Use," dated Jan 10, 1955. A copy (56 pages) is Item 104 in my bibliographical file.

Recognizing the wide spread interest in the recreational features of such projects, provisions were made for a minimum pool in Nacimiento of 10,000 acre feet. This pool was secured by setting the outlets so that the lake could not be drawn below this level except by installing pumps and pumping it out. At the minimum pool elevation the lake area is 420 acres. At this elevation the lake has a length of 45 miles.

In support of this recognition of recreation in the project, I prepared a report on "Recreational Opportunities at Proposed Nacimiento Reservoir of the Monterey County Flood Control and Water Conservation District." This report was dated Dec. 1954, and discussed recreational features at other existing reservoirs. The recommendations of this report regarding recreational features at Nacimiento have been generally followed. A copy of this report is Item 161 in my bibliographical file.

An election on the issuance of the bonds for the construction of Nacimiento was called on April 26, 1955. As the major vote in Zone 2 was in the Salinas area which would receive limited conservation benefits from the project, the favorable vote on the bonds has generally been credited to the sportsmen groups that were in support of the project based on its recreational features.

An unique feature of the Nacimiento project is the lack of any federal or state contribution toward the cost of the reservoir. A federal contribution for its flood control benefits could have been adequately supported and probably obtained. However, it would also have taken several years to secure the necessary reports and authorization. I urged that no effort be made to secure such federal aid and was supported by the District in this position. The amount of federal

contribution that might have been obtained for storage on a tributary of the Salinas River would have been much less than the Army Engineers had recommended for San Lucas on the main stream. Preliminary discussions indicated that about \$2,000,000 might eventually be secured as a federal flood control contribution at Nacimiento. It was my conclusion that the time that would be required to secure such a federal contribution and the restrictions that would be imposed on the storage operations did not justify attempting to secure such federal aid. Nacimiento was completed within 2 years of the date of its bond election and has been in full use under local control ever since.

There were no state facilities within the Nacimiento site and no state contribution to its cost was sought. The cost of relocation of county roads, telephone lines, etc., were met from the bond issue. The Nacimiento project was completed at a cost within the amount of the bond issue voted for its construction. The Bechtel Corporation was retained to supervise the construction. They had also prepared the plans. Favorable contract bids were secured. The construction was completed on time and free from controversy.

Nacimiento reservoir got off to a favorable start. It was completed in time to catch the flood runoff that occurred in the late spring of 1957. This runoff filled the reservoir practically to the spillway level. It occurred late enough in the season that it was stored in the top 150,000 acre feet of storage space reserved for flood control. This started the project with a full water supply in the first year of its operation. The visible results in this first year in flood control, conservation and recreation secured strong local support for the project which has continued to date.

This fortuitous result contrasts with the experience of the state in its construction of its Whale Rocks project near San Luis Obispo which was not completed in time to store the 1957 runoff and has not filled for several years after its completion.

When Nacimiento was completed, I prepared a report entitled "Operation Program for Nacimiento Reservoir" dated Feb. 21, 1956. A copy of this report is Item 108 in my bibliographical file. This report was designed to serve as a general guide to the operations for flood control and conservation until experience with the actual operation under varying conditions of runoff could be secured. It served this purpose.

Nacimiento is operated by the release of storage to maintain percolation from the Salinas River at times when the runoff from the remainder of the drainage area is insufficient to maintain flow to Spreckels Bridge near Salinas. The absorption capacity of the Salinas River is about 400 second feet. The conservation storage space at Nacimiento exceeds the release that can be absorbed in years of better supply. This increases the storage and improves the recreational usefulness of the reservoir.

RELATIONS WITH SAN LUIS OBISPO COUNTY

Nacimiento Reservoir is in San Luis Obispo County. Its construction required the relocation of some county roads. A joint meeting of the Board of Supervisors was held in 1954 in Paso Robles to discuss such road matters. At this lunch, San Luis Obispo County expressed a desire to secure water from Nacimiento for use in Paso Robles and the adjacent areas. Without consulting their engineers, Monterey County spokesmen indicated a willingness to supply some such water. The San Luis Obispo County representatives claimed that the offer

to supply this water was made for delivery at Nacimiento without cost to San Luis Obispo County.

Articles were published in the San Luis Obispo County papers regarding this free supply. When clippings of these articles were shown to me, I urged an immediate action by the Supervisors of Monterey in explaining their lack of authority to give away any part of the Nacimiento supply. Such action was not taken by the Monterey County Supervisors. I understand that Arnold Frew tried to correct this misunderstanding at a Farm Bureau meeting in Paso Robles but this was not an official statement.

This matter did not come to my attention again until another joint meeting of the two boards of supervisors was held in Paso Robles on June 28, 1955. This was after the Nacimiento bonds had passed. I was asked to attend. The San Luis Obispo board wanted to secure an understanding regarding how much Nacimiento water they were to receive. I started explaining that there was no provision in the Nacimiento bond issue or in its plans for the operation for any service to San Luis Obispo County. In response, they showed me a copy of a letter they had written to the Monterey board shortly after the first meeting accepting the offer that had been made. In reply, the secretary of the Monterey board had written that the matter had been called to the attention of the Monterey board and would receive their early attention. A year had elapsed between the two meetings. The SLO County board naturally wanted an answer and my statement regarding Nacimiento water being limited to use in Monterey County did not receive a friendly reception. I had not known of this correspondence.

No Nacimiento water was made available to SLO County. The project

had proceeded too far to change its program of operation. The statements made by representatives of Monterey County at the first meeting and the failure to answer the SLO County letter left bad feelings in SLO County when they were told the facts of the situation. This feeling extended to and affected the proceedings later relating to the San Antonio reservoir.

ACQUIREMENT OF NACIMIENTO RESERVOIR LANDS

The acquirement of the lands in the Nacimiento reservoir site was handled by the local staff. I assisted in two cases in which condemnation had to be used. In some of its earlier negotiated purchases the district acquired only **flowage** easements. With the increased interest in recreation it was found to be essential to acquire fee title to the land below the high water line and for a reasonable margin above.

Two owners refused to accept a negotiated sale and condemnation suits were brought. One owner was De Vries who owned land on the south side of the reservoir. De Vries contested the necessity to condemn all of the land sought and I was asked to present expert testimony on the need for the taking. I prepared and presented such testimony. The court approved the extent of the taking that was sought and then proceeded to a jury trial to determine the price to be paid. I also testified before the jury on the need for the taking. The jury's award was in agreement with the District's appraisal. Only an easement had been sought for part of the area in the complaint. An effort to amend to full fee taking was unsuccessful.

The other owner taken to condemnation was Hughes on the north side of the reservoir. He resisted the right to take and the price offered. Here again I testified on the need to take above the high

water line for access and maintenance. The court again accepted the taking sought by the District and the award of the jury was in agreement with the District's appraisal. Hughes took an appeal and eventually lost.

These cases illustrate the changing conditions resulting from the recreational use of reservoirs. Flowage easements may be adequate where there is no use of the water for recreation, more complete control is needed for policing and clean up if there is recreational use. The district may be liable for the damage in accidents to users of the reservoir even if they secure access over easement lands which the district may not control. The district cannot enforce regulations on easement lands where the main purpose of the residual estate may not be affected.

NACIMIENTO WATER RIGHT

An application to appropriate the water to be stored in Nacimiento Reservoir was made. It was advertised and some protests were filed. Some of these were by the owners of land in the reservoir site objecting to its acquirement. These protests were rejected by the Division of Water Rights in the State Department of Water Resources. A protest by a riparian owner below the dam in the Salinas Valley was also rejected without a hearing on the ground that he would be benefited rather than injured.

The way was thus cleared for the issuance of a permit without having to have a hearing. The Division of Water Rights discussed with the engineers of the district the terms which should be included in the permit. Mr. Harvey O. Banks was then head of the Division of Water Rights and William Gianelli, the chief administrator. The Division wanted to include requirements regarding the records to be

kept. There was no objection to this as the district wanted to maintain adequate records for its own use. These records related to the operation of the reservoir and the effect on the ground water of the percolation from the released storage. An engineer of the state came to the field and a list of observation wells was agreed upon.

The Division also wanted to include in the permit its approval of the plan of operation each year. The district was to submit the record of the storage available for release and its plan for its use. I bucked on such terms. The district was paying for the storage with its own funds and would be in the best position to judge how to get its money's worth from its operations. After considerable argument such terms were omitted from the permit.

The Nacimiento Application is no. 16124, the Permit is no. 10137 and the license secured in 1965 is no. 7543.

As the full capacity had been used in 1957, when the reservoir filled, the District could make the proof of use needed in applying for a license. The conditions relating to the license and the provisions that might be included in it were discussed with the State Water Rights Board. Such matters as the definition of the area of service were worked out and the license was issued in 1965.

The issuance of the license for storage at Nacimiento completes the procedure relating to its water right over which the Water Rights Board has jurisdiction. The license is the deed to the water right. Any future controversies that may arise regarding the water rights of Nacimiento will be within the jurisdiction of the courts, rather than the administrative discretion of the Water Rights Board.

Although I had ended my active work for the District in 1959,

I assisted the District in its procedure relating to its license in 1964 and 1965, thus completing the process from the original application through to the final license.

GENERAL INVESTIGATIONS OF WATER RESOURCES OF MONTEREY COUNTY

On March 12, 1956, the Board of Supervisors passed a resolution authorizing me to make a preliminary study of the present and future water supply of Monterey County. Previous work had been limited to the Salinas River. Working with Bunte the investigations were widened to include the coastal streams from the Carmel River south and the Pajaro drainage on the north. A draft of a report was prepared. This was not presented to the Board and remains unofficial.

Overall we found that the total water supply of Monterey County was about equal to its estimated future needs except for some of the higher areas in the eastern portion of the county and perhaps for some areas in the Pajaro drainage. Interest in irrigation had not been shown by the dry farming areas in the eastern valleys. If such interest should develop, these areas could be served physically from the state's project middle coastal branch if water could be delivered at a price irrigation could pay. The Pajaro areas also were within the prospective service area of the San Felipe Unit of the USBR Central Valley Project.

Other than these two areas, Monterey County will not need to secure imported water to meet its ultimate needs. Its local supplies are adequate for its own needs and can be developed more economically than any of the imported sources so far proposed. Monterey County, however, does not have surplus supplies within its area which can be made available for export without causing a deficiency in its own

ultimate demands.

BULLETIN 19

The District had made an agreement with the State Department of Water Resources under which the Department would prepare a report on the water resources of the county. This work was under way while I was preparing my results on the need for storage and the reservoir recommended for first construction. When the District decided not to construct the San Lucas project but to build the Nacimiento, the state's report was nearing completion.

The state prepared its report mainly in Sacramento with only limited field contacts. Edmonston, the state engineer, felt strongly that the San Lucas reservoir should be built. He had found the site and was, in my opinion, prejudiced in its favor.

The agreement for the state report included a provision that any published report was to have the approval of the county. Howard Cozzens was the county engineer, a member of the State Water Resources Board, an experienced and competent engineer and greatly respected by all. He was generally mild mannered. We had tried to get an opportunity to examine the draft of the state's report before it was finished so that any views we might have could be considered in its preparation. We had been assured that we would be given such an opportunity.

One Monday, Cozzens received a phone call from Sacramento asking us to be there on Thursday to approve the report so it could be presented to the Water Resources Board at their meeting to be held on Friday. This is about the only occasion on which I have seen Cozzens blow his top. We agreed to be there Thursday but Cozzens assured Bill Berry we would take adequate time to examine the report.

We received a copy of the draft of the report. I made an analysis of its results and found several items with which I disagreed. I prepared a list of these. A meeting was arranged with Banks and his staff to discuss these differences. Banks had succeeded Edmonston as state engineer. The differences were discussed at the meeting. Banks asked me to put my criticisms in writing which I did after the meeting. These were sent to Banks.

This report would have been known as Bulletin 19 of the State's Department of Water Resources. We asked that it either be materially revised or else not published. No essential action was taken for some time. Finally I proposed to Banks that I thought the county would relieve the state from the obligation to complete and publish this report if he would agree not to publish Bulletin 19 in its then form. Banks made a request on this basis and this procedure was followed.

The draft of Bulletin 19 has remained as an office report of the Department not having standing as an official publication. It has been quoted in some controversies but does not commit the Department. The time when a good report could have been useful has passed and Bulletin 19 should now be forgotten.

My statement of disagreements with the draft of Bulletin 19 was a report by itself. The draft of Bulletin 19 contained a report on the San Lucas site proposing an increased state contribution in order that the local cost could be kept within reach of that in the earlier estimates. Such an increased state contribution would have been difficult to support and to secure if it could have been secured at all. The draft attempted to derive the county of origin of the flow at Nacimientos although this issue had not arisen in local procedures.

There were other matters in which the draft indicated the unfamiliarity of its author with local conditions.

Monterey County and the state have maintained cooperative ground water observations ever since the completion of Bulletin 52. This work has been beneficial to both agencies. It has been free of controversy as it is a fact recording operation. Both agencies are free to draw their own conclusions from these records.

The cooperative work represented by Bulletin 19 is the only instance in which Monterey County has had difficulty with the state engineer's office. Joint securing of records has been of benefit to both parties. The work on Bulletin 19 was done at a time when the Department of Water Resources was making several similar reports for other areas. In my opinion, the volume of such work undertaken by the Department exceeded the capacity of the staff for adequate consideration of the local conditions involved in the different areas. This condition was aggravated by the concentration of the preparation of these local reports in Sacramento without close contact with the local water interests.

SAN ANTONIO PROCEDURE

In my earlier work for Monterey County, storage had been investigated on the San Antonio and Arroyo Seco as well as at San Lucas and on the Nacimiento. Storage on the Nacimiento was selected as the first reservoir to be constructed. It controlled about 40% of the total stream flow and was the lowest in cost in relation to its capacity. It was always recognized that storage on San Antonio would be needed later. Storage on the Arroyo Seco would be desirable. However, there were so many summer residences in the available storage sites on the Arroyo Seco that a feasible project did not appear to

be available.

When the controversy with San Luis Obispo County over Nacimiento arose, rumors reached Salinas that SLO County was planning to make an application to appropriate for storage on the San Antonio. An application for such storage was hurriedly prepared by Monterey County and Loran Bunte Jr. was sent to Sacramento to file it. He arrived after closing time but was at the door when the office opened the next morning. He succeeded in filing the Monterey County application prior to the one later filed by SLO County. In later proceedings Bunte's trip to make this filing has been referred to as a modern ride of Paul Revere. In any event, it accomplished its purpose in securing a priority for the Monterey County application.

SLO County also filed an application on the same San Antonio reservoir site. Their project would have conveyed the water supply to Paso Robles for municipal use there and irrigation of adjacent lands. SLO County also has a county wide flood control and water conservation district and a zone was established to handle this proposed project.

Both San Antonio applications were processed. Each county protested the others application. In an effort to avoid conflict a series of meetings were held by the two counties seeking to reconcile their differences. I was brought into these meetings and SLO County engaged Harold Conkling as their consulting engineer. Conkling claimed Monterey County did not need storage in addition to Nacimiento. We argued ground water and other matters without reaching any agreement. Several meetings were held in 1958. A preliminary hearing on the contested applications was held in Sacramento on June 10, 1958.

Eventually, a full hearing was set at Sacramento on the conflicting San Antonio applications. This hearing extended over about three weeks in January and February, 1959.

The State Water Rights Board at the time of this hearing consisted of Henry Holsinger, Chairman, Penn Rowe and Ralph J. McGill. They had just completed a lengthy hearing on San Joaquin River applications. Holsinger's health was not good; he was approaching retirement and wanted to complete the San Joaquin decision before he retired. He advised us that he would not sit in the San Antonio hearing.

That left us with Rowe and McGill. Rowe had done work for San Luis Obispo County which could have been used to disqualify him from sitting in the San Antonio case. If Rowe had been disqualified we would have had only McGill left. McGill at that time was a fairly recent appointment on the Board. His background had not been in water matters. Rather than have the hearing conducted by McGill alone, Monterey County did not object to Rowe sitting in this case.

As it was recognized that the legal issues might be complicated, Monterey County desired special counsel for this hearing. On my recommendation, Ralph Brody was appointed to assist the county attorney in this case.

Gov. Brown had just been elected to his first term and was actively pushing to secure legislation for the state's Feather River project. He recognized his need for an experienced advisor on water matters and appointed Brody to this position.

Brody had been an assistant regional counsel for the USBR for Region 2. I had dealt with him in Kings River negotiations and had found him well informed. I had also found that reliance could be

placed on any statements he might make. This was quite different from some of those in the USBR in the 1949-51 period when I was active on Kings River negotiations. On this basis I had recommended Brody to Monterey County.

The San Antonio hearing got under way in an atmosphere of conflict between the two counties and difficulty with its conduct. Rowe presided. He interrupted witnesses and injected his personal views. In my testimony Rowe would ask me questions, would interrupt my answers and then complain that I had not answered his question. I had to assert that I would be glad to answer his questions if I could have a chance to do so. His questions were generally partisan in favor of SLO County.

After I had completed my main testimony and a succeeding witness was on the stand a question arose regarding a comparison of my position and that of this witness. Rowe made a statement regarding my position in my testimony that was contrary to my actual evidence. I was in the audience. To prevent such a statement by Rowe remaining in the record, I interrupted to state that Rowe's statement was not in accord with my testimony and that the record of my testimony should be used for my position. Rowe said his comment should be stricken from the record but it was in the transcript.

The main factual conflict in the hearing involved the need for more ground water storage in the Salinas Valley. Conkling asserted that the ground water along the Salinas River was filled and no additional storage to that at Nacimiento was needed. I presented the records relating to this issue. The witness for the state engineer also presented the point of view of the state.

After SLO County had completed its case I presented rebuttal

testimony and summed up the physical situation. Monterey County had need for the San Antonio water for additional flood control and to provide additional ground water recharge. I also commented on the proposed use in SLO County.

As the hearing reached its end, the Board recommended that the parties meet off the record and see if they could not reach a compromise. It was suggested that the engineers should not take part in this meeting so that the arguments over the engineering items might not interfere with the other discussions. I expressed my desire to be omitted from any such meeting. I could see no basis for a compromise which could only take something from Monterey County as SLO County, in my opinion, did not have valid claim in this proceeding. I did not participate in any further San Antonio proceedings after the close of this hearing.

Meetings of the parties were held. It was reported that the parties were advised by representatives of the Water Rights Board that unless a compromise was reached both applications would be rejected. As the availability of unappropriated water had been conceded by all parties, it was my opinion that there was no basis for such a denial of any permit under these applications.

As a result of the meetings of the counties an agreement was later reached under which SLO County was given an option to acquire part of the new water supply to be developed at the San Antonio site. A permit was issued to Monterey County which included the terms of this agreement. The San Antonio reservoir was completed late in 1965. SLO County still has a period of time in which to exercise its option. To date (early 1967) SLO County has not acted on this option.

There is one item in the San Antonio agreement for which I may

be mainly responsible. In the discussions it was recognized that SLO County had no claim on the storage at Nacimiento. To secure San Antonio water, SLO County would have to convey such water practically past Nacimiento storage. I agreed that if SLO County should become entitled to any San Antonio storage the equivalent water should be delivered to them from Nacimiento. There was no need of incurring the additional costs of conveyance from San Antonio as Monterey County would use the storage from both Nacimiento and San Antonio for artificial recharge in the Salinas River.

How San Antonio will be operated remains to be seen. It has a larger capacity in relation to its inflow than Nacimiento and will be the more economical site to use for carry-over storage. While the cost to SLO County of conveying its option water to Paso Robles will be relatively high, such a supply may have a lower cost than water from the state's project. If SLO County should exercise its San Antonio option my forecast is that it will be done in a project in which the use is mainly, if not wholly, municipal. This could include conveyance to the coastal portion of SLO County.

From the point of view of Monterey County the SLO County compromise represents the end result of a few carelessly spoken words at a friendly luncheon called to discuss other matters. Any water SLO County may secure from San Antonio or Nacimiento will reduce the supply available to Monterey County.

While Monterey County is generally self sufficient in her local water supplies, the margin for future demand is limited. The San Antonio supply represents a more favorable source than other alternate sources available to Monterey County.

APPOINTMENT TO WATER RIGHTS BOARD

When Rowe's term on the Water Rights Board was approaching its end, I tried to find a good man who could be interested in accepting appointment on the Board and someone whom the governor might appoint. I had no influence with the administration and any direct approach to Gov. Brown on my part would have been useless. In such situations it is necessary to have an available and competent replacement. After several discussions, W.A. Alexander of the Lower Tule River Irrigation District agreed to serve if appointed. I had worked with him on Lower Tule District matters and had formed a high opinion of his ability and integrity. Support for Alexander's appointment was secured from the Irrigation District's Association and other water groups and he was appointed. His replacement of Penn Rowe, in my opinion, was a major item in retaining the standing of the Water Rights Board. Alexander was reappointed at the end of his first four year term. While any such appointments are the result of group action, I was glad to have had a part in securing the results. Without support for a new appointee, Rowe might have been reappointed. While this activity on my part was the result of my work for Monterey County, it was entirely personal and had no official support from Monterey County.

JOINT PROJECT PROCEDURE

The details of the Water Rights Board procedure relating to San Antonio storage have been discussed. The securing of the permit for Nacimiento has also been described.

In the early studies of the ground water conditions in the Salinas Valley it was recognized that it would probably be necessary to convey water directly to the wider valley area lying east of Salinas. Plans for such a diversion were made. I prepared an application to

appropriate water for this use. This application is discussed elsewhere.

An East Side diversion would have no dependable surface water supply until upper storage was available. To maintain diligence on the East Side application I suggested that all Monterey County applications should be considered to be a joint project where work on any unit would be considered as diligence on the whole. The water code has provisions for such proceedings.

This suggestion was discussed with the Executive officer of the Water Rights Board at different times. It was not favorably received and no joint project has been recognized.

The advantage to Monterey County in having all of its water development on the Salinas River treated as a joint project would be the avoidance of the need to apply for extensions of time on the applications for deferred units. There is little danger that applications conflicting with the East Side diversion will be filed.

In my opinion, Monterey County has a sound basis for having Nacimiento and San Antonio combined with an East Side diversion in a joint project permit, but the advantages to be gained did not justify making it an issue with the Water Rights Board.

THE STATE WATER PLAN AS RELATED TO MONTEREY COUNTY

The 1945 legislature directed the state engineer to prepare a comprehensive plan for the development of the waters of the state. This work was to be done by the state engineer under the general direction of the State Water Resources Board. The investigations were made and Bulletin 3 on the resulting plan was completed in 1955.

In the publicity and the publications relating to the results of this work the references were to 'THE' state water plan. Monterey County is nearly self sufficient for its water needs

by the use of its own local water supplies. There was concern that a rigid state water plan might be used to place the state in full control of all water development in the state. It was considered that any state plan could only be a guide to what appears to be desirable at the time of its adoption. No plan made at any one time can be expected to be carried out without change in the future.

This concern expressed itself in opposition to designating the results of the work in Bulletin 3 as THE state water plan. I had appeared as an individual at an earlier meeting of the Water Resources Board in Sacramento and protested this term. There was only partial attendance of the members of the Board at this meeting.

The Water Resources Board later held meetings around the state to hear comments on Bulletin 3. A meeting for the central coast area was held in Santa Barbara on Sept. 14, 1956. I attended and presented a statement for the Board of Supervisors of Monterey County in which I again objected to the adoption of any fixed water plan for our water development. At that time it was proposed that the legislature should adopt Bulletin 3 as THE water plan for the state. I raised the question of whether such an adoption by the legislature would require future legislative action whenever any change was made in THE plan. I had an interesting discussion of this question with Phil Swing who was then a member of the Board. He admitted he did not know what such an adoption would mean.

When Bulletin 3 came before the legislature for its consideration it was approved with sufficiently broad wording to avoid the issue I had raised.

This matter would probably have taken care of itself without my protest. However, Monterey County had had some unfavorable experiences

in regard to state attempts to direct its water development and wanted to be sure that the point was not overlooked.

SALT WATER INTRUSION

Salt water intrusion in the 180 foot aquifer started over 20 years ago. It was restricted by shifting the draft in the intruded area from the 180 foot to the 400 foot aquifer.

Adequate records are secured to keep informed on any progress that may occur in the intrusion. These records are secured in cooperation with the state. Readings of ground water elevation are secured in the Spring and Fall at the times similar records are secured in the whole valley. Special observations are made in the threatened area in August of each year. These include the elevation of the ground water to define the trough in both the 180 and 400 foot aquifers. Samples of the ground water are analyzed to define the area having water with a content in excess of 500 ppm of chlorides. The annual reports made by the district include the results of these observations.

The salt water intrusion in the Salinas River area has been discussed in the reports of the state on this subject. Fears regarding its consequences have been expressed and this area has been included in the problem areas subject to such intrusion.

Locally the danger of damaging salt water intrusion has been fully recognized since it was first found to have occurred. Plans have been made to counteract its effect should such steps become necessary. To date salt water intrusion has not been a material cause of crop damage in the coastal area of the Salinas Valley.

When I began work for the County, Bulletin 52 had recently been published. It presented the salt water intrusion as it had occurred

to that time. Pumping in the affected area had been shifted to the 400 foot aquifer. The situation appeared to be under control, at least temporarily. Work was undertaken to determine what might be done if the situation should become adverse.

There did not appear to be practical opportunities to increase the ground water supply in the intruded area by any local works. The ground water in the area occurs in pressure strata. There were not absorbent overlying areas even if there was no underlying impervious strata. The recharge in this area comes from distant movement from upper areas of recharge. Such movement is slow and the records indicate a time lag of a year or more between increased upper input and its effect near the coast.

To supply additional water in the intruded area will require some form of surface delivery to replace the present overdraft. Plans have been made for diversions which could supply such surface service. These could be constructed on an emergency basis should the need arise.

Such a surface water supply obviously requires some source other than the surface flow of the Salinas River which is dry for the summer irrigation period. Water could be secured by a battery of wells in the forebay area. Such a source near Soledad was suggested in Bulletin 52. I investigated this in 1950 and found that such a supply could be secured. I was rather promptly advised locally that any such concentrated draft would not be permitted by the overlying owners who would be affected.

This made it necessary to seek some other source. This meant storage at some upstream site. Nacimiento was built for general ground water recharge along the Salinas River and to provide a new source of

of supply which could be used to supply surface flow for diversion or to replace ground water which might be pumped to the coastal area. Since the completion of Nacimiento there has been a source from which the area of salt water intrusion could be given a surface delivery either by direct diversion of surface flow released from Nacimiento or by exchange with forebay ground water.

No actual construction to deliver surface service in the coastal area has been undertaken as salt water intrusion has not advanced in the 400 foot aquifer. Such an advance is a continuing menace but direct intrusion has not, as yet, occurred. Until it may occur other sources of supply can be deferred. There is little danger that extensive intrusion will occur suddenly and there should be time to take remedial steps when the need for them may arise.

RECREATION

No account of the Nacimiento project would be complete without comment on its recreational features. Public interest in such water recreation was becoming strong when the bond issue for Nacimiento was planned and recreational use was included in the project plans. This has previously been described. It was recognized that the large majority by which the bond issue carried included the votes of many whose interest was in its recreational features.

The expectations regarding the recreational use of Nacimiento have been exceeded. To date recreation has not conflicted with conservation use of the reservoir. An interesting situation might arise if the conservation use resulted in the reservoir remaining at or near the minimum pool levels for an extended period of time. To date the run off has been sufficient so that the reservoir has generally been above the minimum pool elevation.

Grants from the state have been received for recreational facilities at Nacimiento. These are the only outside funds contributed to this project. They have provided facilities that were not planned in the original project. As the records show a large proportion of the users of the recreational facilities are from outside of Monterey County such a state or federal contribution has a more valid basis than similar contributions for local benefits.

PAJARO RIVER AREA

The Pajaro River is the north boundary of Monterey County. Lands in its valley are dependent on this river for their ground water supply. The areas near the coast are subject to a menace of salt water intrusion if heavy overdraft occurs.

During my work for Monterey County records were secured in this area but plans were not made for any local works. An Army Engineers channel improvement and levee project had been built to restrict overflow.

The so-called Tri-County Water Authority act was passed to enable Alameda, Santa Clara and San Benito counties to participate in joint water projects. Later Santa Cruz County was added and Monterey has become a member on a limited basis. It is known as the Tri-County district. At my suggestion, Monterey County kept in touch with its operations as it might develop sources of water supply useful in the Pajaro Valley part of Monterey County.

Since my work for Monterey County the U.S. Bureau of Reclamation has developed plans for the San Felipe Division of the CVP which would convey CVP water under Pacheco Pass into the Pajaro River drainage. Authorization for this project is being sought (1967).

If constructed, the San Felipe Unit would be a potential source of supply for the northern part of Monterey County.

CONCLUSION OF MY WORK

The hearing and actions of the Water Rights Board and the negotiations with San Luis Obispo County regarding the San Antonio project were in such a contrast with the procedures relating to Nacimiento that I concluded that I did not desire to continue with work on San Antonio. I remained with the District until the acquirement of the lands in the Nacimiento site had been completed.

On April 7, 1959, I wrote to the Board stating I was terminating my work under the 1948 employment agreement. I expressed my appreciation for the cooperation I had received from all with whom I had worked in Monterey County. The Board accepted my resignation with regret at its meeting on April 13, 1959. In transmitting this action to me the clerk of the Board stated: "The Board expressed the opinion that outstanding progress has been made in the District under your supervision and your services have been invaluable."

SUMMARY

My experience as consulting engineer for Monterey County was one of my most pleasant professional engagements. I always received full support from the Board of Supervisors. There was a Water Committee which consisted of prominent individuals in the county, formed to advise the supervisors on matters of water policy. My relations with this committee were also most pleasant.

My original employment was arranged by Howard F. Cozzens, then County Engineer and C.L. Pioda, then Chairman of the Water Committee. Mr. Pioda died soon after I started my work. Mr. Cozzens was always a strong supporter of my efforts. After his retirement I received

equally good support from Chester Dudley, his successor. When the water work expanded, Loran Bunte Jr. became assistant engineer and later engineer for the WC and FCD. Bunte and I have worked together closely.

The Nacimiento project has some claims to distinction other than its direct usefulness as a source of water supply. Its construction was entirely locally financed by its initial bond issue. Not only was no state or federal contribution made to the cost of the original project, but the project as presented to the voters was completed at a cost slightly less than the \$7,000,000 bond issue.

Projects should be built within their estimated costs although many are not. Those participating in the preliminary and construction stages of Nacimiento have the satisfaction that they were not subject to restrictions based on state or federal funds and that they made good to the voters on the costs that were presented in the bond issue.

Nacimiento has been in operation since 1957. This period has included years of both large and small run off. Over these years, the project has delivered the service for which it was planned. It has provided ground water recharge which has reduced overdraft on the ground water. It has also provided partial flood control in the years when flood flow has occurred. Its recreational use has exceeded all expectations. The project has been a good investment for the county. It is now generally recognized for these results.

Other matters of particular satisfaction to myself relating to Nacimiento are the water right permit that was secured and more recently the water right license. In these days of increasing effort to intrude the state into local affairs, a permit was secured which limited the

state requirements to the securing of adequate records. The project can be used each year in the way which the local people think will produce the best results without interference from the outside. Those who paid for the project would decide on its use. The license which was secured in 1965 is similarly free from outside restriction. The Nacimiento license may be the last one issued by the State Water Rights Board for a project of this size that is as free from outside restrictions. To me, this is as gratifying as the success in the construction of the project.

NATIONAL WATER POLICY

INTRODUCTION

The following discussion of this subject covers my participation in this field from 1949 to 1954. It begins with my appointment as a member of a Board of Direction Committee of the ASCE in 1949. It includes my activity on the Engineers Joint Council report of 1950 and continues with the follow-up procedures resulting from that report through 1954.

The effort of the EJC to make a constructive contribution in the field of national water policy has historical interest as a public service by engineers who were in the best position from their training and experience to appraise the existing practices and recommend changes that were needed.

The efforts of the professional engineering societies to define and support a sound public policy relating to national water resources represents, in my opinion, a creditable attempt by the profession in the best position to formulate such policies and to propose criteria for the use of public funds in this field.

This account of the activities in 1950 needs to be reviewed in the light of the conditions existing at that time. There was much public concern among those active in the field of national water policy in regard to the extensive efforts made by federal departments to expand their activities and control. The diversion of the interest earned in power rates on the costs allocated to power to increase the subsidies for other uses was a perversion of the intent and meaning of the reclamation law. The agitation for the creation of Valley authorities under Federal control to supersede the states in their functions relating

to water resources in their areas was another item of concern.

The Federal agencies concerned with the development of water resources had been rapidly expanded in the depression years after 1933. The Army Engineers had begun to realize their possibilities under the flood control legislation of the 1930's. The Bureau of Reclamation was using its power developments to carry the irrigation features of its projects. The Soil Conservation Service was the youngest Federal agency in this field and was seeking to find a place for itself in which it could expand its activities.

The lowered standards in the reports of these agencies resulting, at least in part, from this competition was a cause for concern among engineers operating in the water resource field. It was also becoming a cause for general public concern.

Recognizing these conditions the engineering societies began to give consideration to actions which might be taken to improve the policies and practices in the field of national water policy. These activities resulted in the report on "Principles of a National Water Policy" published by Engineers Joint Council in 1951. A major part of what follows describes my part in this program.

This effort has historical interest for itself as it represents the conditions relating to national water policy. These conditions can be compared with the present (1966) standards. This comparison can best be made at the end of this discussion after the 1950 conditions have been described.

Sometime there may be interest in a definitive account of the development of the national water policy in the United States. If this is done the record of the EJC's part in the period 1950-1954 will be an essential item.

As I had an active part in this procedure, both from my membership on the ASCE Committee and as chairman of the sub-committee on Irrigation of the EJC, this account attempts to record the history of this effort and its results.

The main effort of the EJC activity was directed toward improving the economic standards used in project selection. This was a needed change in existing federal practice. This effort had some chance of acceptance in 1950. However, the work done by EJC did not secure the hoped for results. Even so, it was, in my opinion, a worth while effort. Its history is worth preserving as an example of team work by the engineering profession which succeeded in presenting a united front until federal engineers were able to blunt its conclusions.

One of the main recommendations of the EJC report was the creation of some form of board of impartial review to screen the projects proposed for federal financing. To be impartial the members of such a board should not include engineers who were working or had worked for the promotional departments whose projects were being reviewed. Some federal engineers opposed such an independent review of their reports and were able to split the force of the EJC recommendation.

Like other similar efforts this record is a mixture of correspondence, committee reports, policy adoptions and compromises of conflicting points of view. It is arranged generally as a chronological recital of my part in it. As the individual items vary, the result is a collection of miscellaneous material bearing on the main subject.

Two volumes of the supporting material arranged by date from 1949 to 1954 have been included in my bibliographical file, although only a portion of the contents were written by myself. These volumes include preliminary drafts which were used in the preparations

of the final report, correspondence relating to the programming and preparations for the organization of the Task Committee on Irrigation, and some brief reference materials. The items included from 1951 to 1954 relate to the follow-up activities after the completion of the EJC report.

During my work on the EJC report, I also accumulated various reference materials such as the report of the President's Commission, etc. These have been assembled and are being given to the Water Resources Center Archives in Berkeley.

The account of the various parts of this EJC activity in which I had a part follows. As previously stated, this is arranged generally in chronological order.

THE 1949 ASCE COMMITTEE

At its meeting in Mexico City in July, 1949, the Board of Direction of the ASCE authorized the appointment of a Committee on National Water Policy. This committee was appointed. Henry J. Sherman, then a vice-president of the ASCE, was its first chairman. Four directors of the ASCE, Edmund Friedman, S.T. Harding, Julian Hinds, and H.C. Woods were the other members. This was the beginning of my activity in the ASCE's efforts in this field.

The EJC had a temporary Committee on National Water Policy Study in 1949 which made a report recommending a \$1,000,000 study of both water policy and an inventory of the water resources of the country. The ASCE had been asked to endorse this project and to participate in its program. This was the basis for the authorization of the ASCE Committee.

The first activity of the ASCE Committee was to review the report of the EJC temporary Committee. I submitted my comments to Chairman

Sherman on Aug. 29, 1949. I objected to the costly inventory of water resources proposed by the EJC Committee. In my opinion the principal need was the definition of a national water policy. A lengthy invoice of water resources would detract from the emphasis on policy.

The ASCE Committee met and prepared a report dated Oct. 29, 1949. This report reviewed the EJC proposal and disagreed with the regional form of organization to prepare the inventory of water resources proposed by EJC and recommended that efforts be made to secure federal funds for a report on water policy prepared either by a special commission or by the National Research Council.

During the same period there was under discussion the appointment of a federal commission to prepare a report in the national water resources policy field. This resulted in the appointment by President Truman of what became known as the President's Water Resources Policy Commission. This was created by an Executive Order on Jan 3, 1950. Its report is dated December 11, 1950. Morris L. Cooke was the chairman of this Commission. There were six other members, well selected for experience and geographical distribution. Samuel Morris was the only California member of this Commission.

The appointment of the President's Commission precluded EJC from securing federal funds for a concurrent similar report and it was necessary to consider some different program. The time when the President's Commission expected to report also set the time limits of any report that the EJC might undertake to develop.

Whether the Jan. 3, 1950 appointment of the President's Commission was an effort to beat the EJC in this field or not is immaterial. It may have been stimulated by the EJC activity. Both reflect the general interest at that time in matters of national water policy and the



SIDNEY T. HARDING DIRECTOR DISTRICT XT ASCE
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recognition that some reasonable standards of feasibility were needed.

The EJC appointed a panel on a National Water Policy Study in Jan. 1950 and provided a limited fund for its expenses. The societies in EJC were expected to augment this fund from their own budgets. W.W. Horner, a past president of ASCE, was the chairman of the EJC panel. Each of the founder societies had a member on this panel.

Further discussion of these matters continued in the EJC. I wrote to Julian Hinds, who was on the ASCE committee participating in these discussions, on Feb. 1, 1950 covering my opinion on the organization of the EJC study. Hinds replied on Feb. 10, 1950, thanking me for my comments and stating I had been the only one so far that had supplied such a statement.

On Jan. 27, 1950, Chairman Sherman of the ASCE committee wrote to me regarding the tentative program then proposed by EJC. He enclosed two letters from Horner for my comment. I replied on Feb. 3, 1950 expressing disagreement with some features then proposed.

The EJC program took shape as a result of the comments made on the original proposal. Early in 1950 the EJC had decided to proceed on an independent report of its own to be submitted to the President's Commission for their consideration. It was hoped that such a report would be influential in the recommendations of the President's Commission.

THE EJC NATIONAL WATER POLICY REPORT OF JUNE, 1950

Horner wrote to me on Feb. 6, 1950 asking that I serve on the Task Committee on Irrigation in the organization being set up to carry out the EJC program. I replied on Feb. 10, 1950 stating my views on some of the matters then under consideration and suggesting that Horner should reconsider his request for me to serve on the Irri-

gation Committee if he felt my views were in conflict with the EJC objectives. Horner replied on Feb.17, 1950 asking me to serve as chairman on the Task Force Committee on Irrigation and asking me to suggest other members for the Committee. I accepted this chairmanship.

The EJC set up its National Water Policy Project under the direction of its panel including a member from each of the four larger founder societies with Mr. Horner as chairman and a coordinating committee of seven members with Abel Wolman as chairman. The EJC announced its program and schedule. Its purpose was to develop the views of the engineering profession on desirable national water policy. It was anticipated that engineers would be willing to accept service on the necessary committees and to donate the required time. The schedule called for completion of the task force committee reports by June 1, 1950 in order that they could be assembled and presented to the President's Commission by July.

The selection and securing of acceptances from the members of the Irrigation Committee proceeded, and on March 6, 1950 I was able to write to the members outlining our assignment and exploring available dates for a committee meeting. Horner wanted to include drainage with irrigation. After considerable discussion a separate drainage committee was appointed. I felt that drainage was a proper subject in the EJC program, but that it was a national rather than a regional one limited to the arid areas. I did not want to dilute the membership of the Irrigation Committee with members from non-irrigated areas.

On March 6, 1950 I called a meeting of the Irrigation Committee at Denver for March 25 and 26. The meeting was held with all members present. The members were J.H. Bliss, State Engineer of New Mexico,

R.A. Hill, Consulting Engineer of Los Angeles, G.S. Knapp, Chief Engineer, Kansas Division of Water Resources, H.P. Rollins, member Texas Board of Water Engineers, R.J. Tipton, Consulting Engineer of Denver, and W.R. Young, former Chief Engineer of the USBR. Julian Hinds acted as contact member with the EJC Coordinating Committee.

I had approached this assignment with much doubt whether any group representing diverse interests in irrigation could produce a report which all members would sign without making its content so general that it would have little meaning or effectiveness. It was a most gratifying experience to find at our first meeting that each member of the Committee put aside his local interests and joined in an effort to define the basic issues and the policies which were in the general public interest.

We had plenty of argument over the content of our report. Our differences resulted from the variations in our thinking. We all sought and eventually reached agreement on a report which was specific and definite.

At the start of the work of the Committee I thought that the chances of such a result were relatively small. It is to the credit of all of the members of this Committee that they were able to concentrate on basic issues without trying to include something that would promote their local interests.

As chairman of the Irrigation Committee I was asked to attend meetings of the EJC Coordinating Committee. These were held in New York. The first such meeting was held March 28, 1950. I went from the meeting of the Irrigation Committee in Denver to this New York meeting. The discussion at this meeting was very helpful in coordinating the effort of the various task committees. The Irrigation Committee was the only one that had met prior to this New York

meeting. I found that our Committee had a material head start over the others both in coordinating our thinking and in progress on the reports.

At the March 25 meeting of the Irrigation Committee we discussed the topics to be included in our report and expressed our individual views regarding the position that should be taken. We then assigned the preparation of a draft on each of the selected topics to be covered to the various committee members. On April 3, 1950 I sent a list of these assignments to the Committee members and also reported on the meeting in New York on March 28. Some of the drafts by members of the Committee on the topics assigned to them are in the correspondence file.

Horner was in Los Angeles in April, 1950 and discussed with Hill the statement of the fundamentals of a national water policy which Hill had prepared for use by the Irrigation Committee. Horner was so favorably impressed with this statement that he secured copies to be distributed to others in the EJC program. These were sent by Horner under date of April 25, 1950.

The Irrigation Committee had its second meeting in Denver on May 13 to 15 and completed its report. Prior to this meeting I had asked Raymond Hill to prepare an introductory statement to our report and to coordinate the drafts being prepared by individual members of the Committee. I had intended to undertake this, but was involved in other matters at this time. Hill did a very good job and his draft was accepted with only limited changes by the Committee. A copy of Hill's draft of May 10, 1950 is included in my EJC National Water Resources Correspondence File.

At its May 15, 1950 meeting in Denver the Irrigation Sub-committee

completed its report. This was signed by all members of the Subcommittee. Copies were mimeographed dated May 16, 1950 under the title, "Report of Irrigation Task Force." A copy of this report is also in the National Water Resources Correspondence File.

One of the matters that received much attention in the committees was where general principles relating to national water policy should be placed on the general EJC report. A separate committee on General Economic Principles was appointed and prepared a report under this title. This report was circulated under a letter of transmittal suggesting that, "only in special instances," should the separate committee treat general policies. The Irrigation Committee did not approve all of the report of the General Economic Principles Committee. Also it considered that a discussion of irrigation policy would have little meaning if it excluded the applicable economic policies. Following the discussion of these matters at the second meeting of the Irrigation Committee I wrote to D.L. Erickson of Lincoln, Nebr., the chairman of the Economic Policies Committee, on May 16, 1950 stating the position of the Irrigation Committee and objecting to the report of the Economic Principles Committee.

The Irrigation Committee transmitted its report to the EJC panel with an introductory statement of two paragraphs stating the national interest in water policy and the desirable division between projects which should be handled, locally by the state, or by the federal government. This statement was accepted and used by the panel in the general EJC report. This statement was prepared by Raymond Hill.

Following the completion of the report of the Irrigation Committee at Denver, I went on to New York to a meeting of the Coordinating Committee on May 18, 1950. The Irrigation Committee was the only one

which had completed its report. I received a number of favorable comments on the report.

When I wrote to the members of the Irrigation Committee on May 23, 1950 I reported on the New York meeting. I commented that having given Hill the credit for the actual drafting of our report, I felt free to praise it. This I did and found much agreement from others. This completed the specific work of the Irrigation Committee within the scheduled date of June 1, 1950.

The Water Policy Panel of EJC in June, 1950 issued a mimeographed report on "National Water Policy, A Statement of Desirable Policy with Respect to the Conservation, Development, and Use of the National Water Resources." This consisted of a 24 page first section containing a foreward by the panel, the list of those participating in the preparation of the report and a statement of the Coordinating Committee. The reports of the individual task committees were included as appendices. Irrigation was Appendix IV of 16 pages. This report was given limited distribution. Its principal purpose was its submission to the President's Commission for their information. A press release on this report for July 2, 1950 was used to secure attention to it outside of the engineering groups. The report was also summarized in the July, 1950 issue of Civil Engineering.

This statement of desirable water policy was submitted to the President's Commission in June, 1950. The full report went through the process of editing and completion and was published in printed form in July, 1951 under the title of "Principles of a Sound National Policy," with a subhead, "Prepared under the Auspices of the National Water Policy Panel of Engineers Joint Council." It consists of 233 pages 5 1/2 x 8 1/2. The report of each sub-committee was included. That of the Irrigation

Committee is on pages 97-116. We kept within the 25 page limit that had been set for each sub-committee report. The report also contains a single paragraph biography of 81 of the engineers who participated in its preparation.

The statement of the Coordinating Committee which opens the EJC report states the general conclusions that were accepted by all of the committees. This statement is that prepared by Raymond Hill for the Irrigation Committee and is credited to Hill.

Task Committee Nine had as its assignment "Policies of General Applicability." Their report states 21 basic policies. The report of this Committee in July, 1951 made some revisions in its June, 1950 report. Some of these changes brought the report on general policies more nearly into line with the position of the Task Committee on Irrigation.

The Board of Direction of the ASCE asked its Water Policy Committee to prepare a short statement on national water policy which it might adopt. Louis Howson undertook to draft such a statement. I prepared a draft of what I termed a "code of national water policy," under date of Aug. 10, 1950. I also asked Raymond Hill to prepare a one page statement. He did this under the heading "Fundamentals of National Water Policy," and sent copies to Howson on Aug. 3, 1950. Howson prepared a two page statement entitled, "Fundamental Principles of a Sound National Water Policy." Howson sent out his statement for comment on Sept. 22, 1950. The ASCE committee made a short review of the EJC report for the information of the Board of Direction of the ASCE. This was published in Civil Engineering for Nov. 1950.

Water interests in California also took an interest in the work of the President's Commission and prepared and submitted statements

of their views on what the national water policy should be. Among these was the State Engineer. In June, 1950, Edmonston submitted a statement of the "Views of California on Elements of a National Water Resources Policy" to the President's Water Resources Commission. This consisted of a 10⁴ page statement of the views of the State. The problems advocated in the views of the state were in broad agreement with those in the EJC report. The Colorado River Board of California filed a statement dated June 7, 1950 with the President's Commission discussing its interest in national water policy in relation to the Colorado River as well as generally.

The Irrigation Districts Association of California took an active interest in the discussions of national water policy and presented a statement at the hearing of the President's Commission in Berkeley. It also had filed a statement of principles previously with the Commission.

While I had no direct part in these comments of either the state or the Irrigation Districts Association, I was in touch with both groups while they were preparing their reports and kept them informed on the progress on the EJC report.

COMMENTS ON REPORT OF PRESIDENT'S COMMISSION

The President's Commission made available for comment a draft of its proposed report dated Dec. 11, 1950. I prepared a draft of comments that might be made by the Irrigation Sub-committee of EJC and circulated it among the members of the Irrigation Sub-committee.

The final report of the President's Water Resources Policy Commission was issued in three volumes. Vol. 1 was entitled, "A Water Policy for the American People." It was issued in December, 1950. Vol. 2 was a discussion of a selected list of river basins. Vol. 3 was entitled,

"Water Resources Laws." It was also dated in 1950.

The report of the President's Water Commission was sent to each task committee for comments. These comments were prepared in the early months of 1951. As soon as a copy of Vol. 1 of the Dec. 11, 1950 report of the President's Commission was received, I had prepared a draft of comments for the consideration of the members of the Irrigation Committee. This was circulated to the members of the Committee with copies to Wolman and Horner on Jan. 8 and 10. While the members of the Irrigation Committee generally approved my draft of the comments on the report of the President's Commission, we were not able to have a meeting and prepare a Committee report. Consequently, the response to the request for comments remained my individual reactions to the report. I so advised Horner on Feb. 2, 1951.

There was discussion of whether EJC should defer its comments on the report of the President's Commission until the Commission drafted and released the legislation it stated it would propose to carry into effect the recommendations in its report. The Commission had stated its intention to prepare such legislation. I supported delaying the EJC comments until drafts of the legislation were available. To comment on the report first would not reach the members of Congress as directly as comments on pending legislation which each member of Congress would have to consider.

The review of the report of the President's Commission by the EJC, originally planned to be issued early in 1951, was not issued. The EJC marked time expecting that the Commission would issue its proposed legislation. This would be specific and easier to analyze than the lengthy and over worded report of the Commission. The

President's Commission did not draft the expected legislation. In July, 1951, the National Water Policy Panel of EJC issued a five page statement entitled "A Water Policy for the United States" with a subtitle "A Critique of the Report of the President's Water Resources Policy Commission." The stated authors are the five members of the EJC panel namely E.L. Clark, R.D. Hoak, C.W. Mayott, W.F. Uhl with W.W. Horner. It was my understanding at that time that the critique had been written by Abel Wolman, who was the chairman of the EJC Coordinating Committee. That Wolman was preparing this statement is indicated by his letter to me of April 30, 1951.

The critique of the report of the President's Commission reviews the recommendations of the report. This is almost wholly a reprint of the draft of the comments which I had prepared for the consideration of the members of the Irrigation Task Force. While this acceptance of my comments was gratifying, I did not receive any acknowledgment of my material from either Wolman or the EJC panel.

SCHEIDENHELM COMMITTEE

Mr. F.W. Scheidenhelm had been an active member of the group which worked on the EJC report, particularly its power policies. After the completion of the 1950 EJC report he continued to press for using the report to secure Congressional action. He circulated a letter to those who had worked on the 1950 EJC report dated Dec. 20, 1951, urging contacts with Congressmen and explanations of the EJC report. I joined as one of the signers of this letter.

Scheidenhelm repeated this effort in Nov. 1952. I did not participate actively in his second attempt although Scheidenhelm sent his proposals to me.

The correspondence on this matter is in the file of the EJC committees.

ACTIONS IN 1951 BY EJC

Activity in early 1951 by the EJC panel consisted of plans for issuing its 1950 report in a more formal volume and the consideration by each sub-committee of whether any revisions should be made in its 1950 statement. The Irrigation Committee approved my recommendation that no changes should be made in our 1950 report. There was also discussion regarding the extent, if any, to which the second issue of the EJC report should include discussion of the report of the President's Commission. It was concluded that comments on the report of the President's Commission be handled separately.

The EJC report was reissued dated July, 1951 under the title of "Principles of a Sound Water Policy" with the subtitle "Prepared under the Auspices of the National Water Policy Panel of Engineers Joint Council." This is a 5 1/2 x 8 1/2 volume of 233 pages. It contains the reports of each of the nine sub-committees or task forces. A 22 page foreward by the EJC panel reviews the background of the report and includes a statement of fundamental principles and their application. Copies were sent to each member of Congress.

Prior to the issuance of the July, 1951 edition of the EJC report of 1950, each task committee was asked to review its 1950 report and make such changes as it thought might be desirable. The Irrigation Committee considered this request and replied that there were no changes it desired to have made in its 1950 report. Abel Wolman handled the July, 1951 edition of the EJC 1950 report. My views are expressed fairly fully in my letter to Wolman of April 11, 1951.

While the 1951 edition of the EJC report and the critique of the report of the President's Commission are both dated July, 1951, they did not clear the EJC for distribution until Oct. 1951.

Late in 1951 those who had worked on the EJC report were asked to stand by to be available for work in support of its recommendations. I agreed to such continuing activity to such extent as other matters would permit.

Civil Engineering for December, 1951 reprinted the EJC letter to members of Congress transmitting the EJC report. A talk by Horner before the Sanitary Division of ASCE was also summarized.

In the latter part of 1951 the EJC panel organized a Hearings Committee to handle the presentation of the EJC report and to support its conclusions in any Congressional hearings that might be held. Mr. Richard D. Hoak of Pittsburg, Pa. who was with the Mellon Institute was the chairman of this hearings committee. I had considerable correspondence with Mr. Hoak and assisted to such extent as I could in the work of this committee. I was a member of the Hearings Committee. The pertinent correspondence is in the Correspondence File.

ASCE ACTION ON EJC REPORT

The District of Columbia Section of the ASCE prepared a review of the 1950 EJC report. Copies were sent to the Board of Direction of ASCE and to all ASCE local sections. The D.C. section attacked the proposal in the EJC report regarding the composition of the Board of Impartial Analysis proposed in the EJC report. The EJC group had recognized that to be impartial such a board would have to be independent of the federal agencies whose projects were being reviewed. The EJC report provided for a board of Impartial Analysis which would be composed of members who had not been identified with the projects to be reviewed. The Washington D.C. Section took this as a reflection on the abilities of federal engineers. The technical qualifications

of federal engineers for membership on such a board were not in question in the EJC report. It is obvious that a board will not be impartial if it is composed of members who have served with the agencies whose projects are being reviewed. The disqualification rule for judges who have been connected with cases reaching their court is well recognized and there should be no reasonable objection to its application to the type of impartial board that EJC was proposing.

The protest of the D.C. Section was presented to the Board of Direction of the ASCE at its meeting in Louisville in June, 1951. It had been referred to the Executive Committee of ASCE who reported some recommended changes in the 1950 report. It had not been referred to the Board's own Water Policy Committee prior to its consideration by the Executive Committee. When presented to the ASCE Board it was referred to the Water Policy Committee which made an attempt to reconcile the differences. The Water Policy Committee's suggested revisions were unacceptable to the D.C. members of the Board. After lengthy discussion the revision of the Executive Committee was adopted by a divided vote by the ASCE Board.

This issue was referred to the Committee IX of the EJC report to try to find wording that might be generally acceptable. This Committee made some changes from its 1950 report, but stood its ground on the general specifications for membership on the Board of Impartial Analysis. In the July, 1951 edition of the 1950 report of EJC this revision is on page 216 with a star to a footnote that, "Engineers Joint Council does not concur in the statement in the last sentence."

The correspondence file includes comments on this matter by Howson and myself. To some extent it was a tempest in a tea pot. In my opinion, the opposition arose entirely from the federal engineers.

It was, also in my opinion, promoted and stirred up by Gail Hathaway, the 1951 President of ASCE. Hathaway was a civilian engineer with the U.S. Corps of Engineers. Some of the Corps' flood control projects were among those that some of the EJC group felt were in need of impartial review in the interests of the general taxpayer.

ACTIVITIES AFTER 1951

My term as a director of the ASCE expired in 1951 and I was no longer a member of the Board's Committee on Water Policy. My participation in water policy procedure after 1951 was mainly through Hoak of the EJC panel. I continued as a member of Hoak's Committee.

Activities in 1952 by EJC consisted of follow-up on its 1951 report. Work was done on a summary of the EJC position for publicity purposes. A presentation was made at one Congressional hearing by eastern members of EJC. I participated in correspondence relating to these matters. As 1952 was an election year and a change in administration was anticipated, work in 1952 consisted mainly in holding the EJC group together preparatory for activities in 1953. It was recognized that Congress could not be expected to give serious attention to water policy definitions in 1952.

In 1953, I spoke on the EJC report at a meeting of the Division of Water, Sewage, and Sanitation Chemistry of the American Chemical Society in Los Angeles. Mr. Hoak had requested me to make such a talk. He represented the chemical engineers on the EJC panel.

BUREAU OF RECLAMATION REORGANIZATION IN 1953

It was expected that the Eisenhower administration would meet its pre-election promise of cleaning up the mess in the Bureau of Reclamation. Commissioner of Reclamation Strauss was sure to be replaced. We were relieved of the Regional Director Richard Boke and Asst.

Regional Director Phil Dickinson in California. Satisfactory replacements of Boke and Dickinson were made. For Commissioner the selection of a successor to Strauss became involved in petty politics. Ralph Tudor had been appointed Assistant Secretary of the Interior under McKay. Tudor was a good engineer, formerly with the Corps of Engineers and primarily a bridge engineer. When appointed, Tudor was not acquainted with top men in the irrigation field.

What was needed in the USBR was a tough commissioner who would unload the political appointees and reduce the over-expanded publicity personnel. To do this required someone who knew the Bureau, would not be dependent on remaining as Commissioner and who could do the job needed without fear or favor. I recommended Raymond Hill to Tudor, but he had never heard of Hill. I had found that Hill would accept an appointment as Commissioner for a year or two to complete the reorganization needed. While Hill was in private practice, his father had been an early Bureau engineer and later one of their consultants. Raymond practically grew up in the Bureau, worked for it for several years and had been the consultant for various Bureau projects.

Various names were suggested, but anyone who might do the job that was needed was actively opposed by the "in group" who naturally opposed a house cleaning. Finally, the situation reached the point where no one having the stature needed for the job who was not a part of the Bureau would accept the appointment. This led by necessity to the appointment from within the Bureau. W.A. Dexheimer was appointed Commissioner of Reclamation in 1953. He had had responsible positions in the Bureau and was a competent commissioner. Dexheimer had the Bureau attitude toward securing additional project authorizations to maintain the Bureau operations. His most significant contribution

was his reduction in Bureau personnel. During his term while the volume of work handled by the Bureau increased, the number of employed personnel was reduced by over one-fourth. The reduction fell heaviest on the public relations group.

An illustration of the willingness of the Eisenhower administration to clean up the mess against pressure was the case of Goodrich Lineweaver, the then Assistant Commissioner of the USBR. Lineweaver was an eastern newspaper man, good at running errands for Congressmen and securing their good will. He had sufficient support from Republican Congressmen that he was not replaced. Lineweaver remained with the Bureau until Congress had a Democratic majority when he shifted over to adviser to a Congressional committee.

THE OCTOBER, 1953 MEETING WITH MCKAY

The EJC Panel sought and secured an appointment with Secretary of the Interior Douglas McKay to discuss some of the principles of the EJC report which could be put in effect without further Congressional action. A group of four for this meeting was worked out on which I was a member. The others were Abel Wolman, Scheidenhelm, and Raymond Hill. I flew east for this meeting on Oct. 21, 1953. We met with McKay, Asst. Secy. Aandahl and Dexheimer.

Each of the four EJC representatives had his part of the total presentation assigned to him and prepared before the meeting. Mine related to the incompleteness of USBR feasibility reports on proposed projects. These had become more largely promotional rather than impartial presentations of all of the facts. I reported to Horner on Oct. 24, 1953 on my reactions to the meeting.

We were cordially received and stayed for about an hour and a half. We took about an hour for our assigned material. My report to Horner

states, "In my opinion, we made a consistent and well supported case, but did not dent the stone wall of resistance to any practice that will or may restrict the volume of work available to the USBR.

Dexheimer asked how many projects we thought the eastern members of Congress would vote to approve if all subsidies involved were set up in the reports. Getting approval in order to maintain the Bureau is evidently his controlling principle. No objection to Dexheimer's remarks was made by McKay. McKay referred to our presentation as 'idealistic.' While he did not directly condemn idealism, I gathered that it was something to be considered only if expedient."

I was reimbursed by EJC for my travel costs to the meeting with McKay on Oct. 21, 1953. This expense was not justified by any results which were accomplished. I secured personal value from the trip and my presentation as it gave me an insight to the inner thinking of the USBR and its commitment to its own self interests that would have been difficult to secure in any other way open to one not a member of the establishment.

This interview with McKay illustrates how deeply the principle of bureau perpetuation had become established in the USBR by 1953. It has grown since 1953. No recent administration has been willing to install and enforce standards for the protection of the general taxpayers who are to be taxed to finance the present and proposed projects. Circular A-47 was prepared by the Bureau of the Budget in 1952 in an attempt to standardize the criteria for project feasibility. This was approved and issued on Dec. 31, 1952 by the Bureau of the Budget. It was generally attacked as too restrictive by proponents of proposed projects. Circular A-47 was replaced in 1962 by S.-Doc 97 approved by President Kennedy. S-97 is even more liberal in its standards than

A-47. Under S-97 about the only thing that can prevent a proposed irrigation project from being able to show a benefit-cost ratio of over unity is the absence of a water supply. Repayment capacities are similarly liberally treated in areas having development funds supported by excess power revenues.

RESOURCES FOR THE FUTURE CONFERENCE

Resources for the Future held a conference in Washington Dec. 2 to 4, 1953. Such a conference had been proposed earlier, but it was delayed in order to complete the plans for the meeting and the availability of some pending reports. RFF is financed by the Ford Foundation. It is still active.

I attended this conference and was asked to attend and participate in the section meetings on cost allocation and feasibility standards, etc. I did attend these sessions and tried to urge approval of sound policies such as those in the EJC report. The majority in this section were planners, largely academic, and not much progress was made along constructive lines. The general attendance was good and the interest of those attending was generally well sustained. The meetings did not produce much tangible result. It gave many who were dabbling in the water policy field a chance to think that they were being recognized and contributing to decisions on the matters at issue.

THE SECOND HOOVER COMMISSION REPORT

In late 1953, the second Hoover Commission on Organization of the Executive Branch of the Government was appointed. Admiral Ben Moreell was appointed chairman of the Task Force on Water Resources. Some members of this task force had been on the EJC report committees. The EJC committees were asked to review their 1950 reports and to

consider any changes that should be made for presentation to Moreell's committee. The Irrigation Committee stayed with its 1950 report. Time was not available in which to have a meeting of the committee to work out and agree on changes. I declined the suggestion that I make any such revisions for the committee. The 1950 report had been agreed to unanimously, and I was not going to make any individual revisions. I did prepare a draft of a restatement of the Irrigation Task Force of EJC for use in submission to present Hoover Commission with a brief on the 1950 EJC report. This was dated Jan. 11, 1954. It was a shortening of the 1950 report to meet the program of the proposed brief. The preparation of this brief was assigned to R.D. Hoak. My draft of Jan 11, 1954 was sent to Hoak. I rewrote my draft under date of Feb. 15, 1954 as a restatement of the 1950 report of the EJC Irrigation Committee. Replies to my earlier draft on this subject had been generally approved in correspondence by the members of the Irrigation Committee.

Congressman Aspinall of Colorado had introduced H.R. 4443 in April, 1953. This bill would authorize the Colorado River storage project and participating projects in the upper Colorado River states. No action was taken on this bill in 1953, but hearings and probable passage were expected in 1954. This project fell so far short of meeting the standards of feasibility which Adm. Moreell's committee expected to recommend that the committee was concerned that it might be passed before their report was completed and thus largely nullify the hoped for results of their report. Moreell was anxious to have the EJC send a representative to one of the hearings he was conducting around the country to present a statement pointing out the defects in this project. On March 20, 1954 President Eisenhower issued a statement

endorsing the Upper Colorado River Project. This was prior to the completeness of feasibility reports on some of the units.

The Moreell Committee held a hearing in San Francisco on May 3 and 4, 1954. I was the most readily available member of the EJC group to attend and did so on both days. I entered an appearance and asked for permission for EJC to file a later statement covering developments since the 1950 report. I mentioned particularly the replacement of the interest waiver by the Collbran formula and the proposal to authorize projects before feasibility reports were completed. I was cordially received and the requested permission was granted.

The Moreell Committee held another hearing in Denver on May 17, 1954. I was in Denver at that time on other matters and had a chance to attend part of this hearing. Moreell had sent me some figures on the Upper Colorado River Project and would have liked to have had me present an attack on the feasibility of the participating units. I declined to get drawn into such a presentation. The EJC effort had been directed toward matters of water policy. To attempt to analyze any individual project in rebuttal to the USBR without adequate time for an engineering study of the project would have been suicidal for such a witness. By arguing regarding details of the facts relating to the project, the principles of water policy would be obscured. I had neither the time or staff to make a report on these units. Moreell's Committee had both. I knew enough concerning the participating units to recognize that they were marginal, but such general knowledge would have been no defense against specific items the USBR could claim.

I had prepared a draft of a statement which I could have presented

to Moreell's Committee on May 17, 1954. I did not present it as it had not been fully cleared with EJC. I recommended that EJC complete a statement to file with the Committee or to be presented at a later hearing of the Committee. In talking with Adm. Moreell I concluded that what the committee wanted was a statement from an organization having the standing of EJC which they could quote in their own report where it supported the conclusions which the Committee expected to reach. I did not care to take this responsibility at Denver. It was my opinion that any such statement should carry the approval and signature of the top EJC panel.

The report of Moreell's Task Force was printed in three volumes under the title of "Water Resources and Power." These volumes are dated June, 1953. This task force report was made to the Commission. The second Hoover Commission made its own report on water resources and power in two smaller volumes.

The Denver meeting concluded my activities in relation to the Moreell Committee. The second Hoover Commission, including Moreell's Committee, completed their reports. These were published, but did not lead to any specific revisions in national water policy. By the time the report of the second Hoover Commission became available (1955), the bureaucrats in federal water agencies had become sufficiently well entrenched that they were able to override the Hoover recommendations in the water field. There was not sufficient support in the Eisenhower administration for any controversial action to have been successful.

REPORT OF PRESIDENTIAL ADVISORY COMMITTEE ON WATER RESOURCES POLICY -
DECEMBER 22, 1955

Before the second Hoover Commission had completed its report, President Eisenhower appointed a cabinet committee on May 26, 1954 to

report on matters of water policy. This was an apparent effort to secure a report from this cabinet committee before the Hoover Commission could report, thus detracting from the recommendations of the Moreell Committee in the water policy field. Public protest resulted in a delay in the completion of the cabinet committee's report. Eisenhower had appointed the second Hoover Commission. This action regarding the cabinet committee appears strange. It may illustrate a lack of deep understanding of the issues involved.

The President's Advisory Committee consisted of the Secretaries of Interior, Defense, and Agriculture. Their report was relatively short (35 pages). It did not receive extensive attention. By the end of 1955 there had been so many reports on national water policy made that the President's Advisory Committee's report hardly created a ripple in the pond.

THE EJC REPORT - HINDSIGHT

My participation in the EJC activity on national water policy extended from 1949 through 1954. It was a most interesting and profitable experience to me. The eighty engineers who worked on the 1950 EJC report were able to put aside their local and personal interests and to prepare a report based on the public interest. This is an illustration of the use of those best trained in such a field to formulate the most desirable overall policy.

In 1950, many of those working on the EJC report felt that there might be sufficient desire on the part of the public to be advised regarding public policies in their interest, so that some beneficial action could be secured. In this hope they were disappointed.

In 1950, it looked as if the country was getting ready to turn from the strong tendency to have the federal government do and control

everything. The expected change in the administration occurred in 1953, but the standards of national water policy have continued their all federal trend. The entrenchment of the federal water agencies was too strong to be overcome by the good intentions, but feeble actions of the Eisenhower administration.

Since 1955, the standards of national water policy, particularly in regard to project feasibility, have continued to deteriorate. Circular A-47 has been succeeded by S-97. The benefits that can now be included enable a benefit-cost ratio of over unity to be derived for practically any project that has a water supply. The laws governing repayment requirements are now about the only restraints remaining. Where basin development funds, using power revenues which it is being contended will accrue, can be used, there is now no practical limit to the costs of units which it can be claimed are feasible. Power revenues are being claimed which will pay out the costs allocated to irrigation within the statutory time limits.

Looking back one can wonder whether the effort expended by EJC in its 1950 report was justified by the results secured. In tangible terms a negative answer to this question can be supported. In intangible benefits to those participating this effort was worthwhile. A good try was made in a good cause. Not to have tried would have left a sense of shirked responsibility on the profession best qualified to advise the public in its own interest.

Similar future efforts by EJC or other interested groups in the field of national water policy offer little chance of usefulness under the present public attitude and the active promotional efforts of the federal agencies benefitting from the present practices. The two recent Pacific Southwest Water Plan reports, in my opinion, represent

a new low in presenting the full story of what would be involved if the recommendations in the reports should be carried out. Until the public demands complete and impartial reporting on the projects seeking authorization, there is little chance that the present conditions will be improved. In my opinion, there is no present indication that such a public demand is developing. The aggressiveness of those benefitting from federal water projects at the present time far outweighs the effectiveness of the efforts of those still supporting public policies in the water field that are in the interest of the whole public. The federal taxpayer appears to be the only one in this field who has no one to speak in his interest. As long as the general taxpayer does not rebel there is scant chance for any improvement.

Someday interest in the U.S. may develop in having a sound national water policy. This result may come about from a revival of better standards in all federal practices. It could come about as the result of the bankruptcy of projects now being authorized under claims they cannot expect to realize. The second of these causes appears more likely to occur than any popular moral resurgence sufficient to have public impact.

The record of the 1950 EJC work and its results, insofar as I participated in these activities, has been assembled in binders on a chronological basis. Following through these procedures to trace the progress that was made is heavy reading. However, this material may have some reference interest if the same issues should again become active. It is not popular reading, but it may aid a serious student in gaining an understanding of the issues involved and the political processes by which our public policies are established.

The materials relating to national water policy in which I participated are collected in Items 169, 170 and 171 of my bibliographical file. This includes my own writings, correspondence and other pertinent materials.

WORK FOR THE TULARE LAKE BASIN WATER
STORAGE DISTRICT 1938-1952

From 1938 into 1952 I was the consulting engineer of the Tulare Lake Basin Water Storage District on its water supply and some other matters. This work included the 1949 Kings River Agreement; procedure relating to Pine Flat storage, the general water supply of the district; and the acreage limitation of the reclamation law. The history of my part in these matters has been prepared similar to that of other work included in this history. However, the account of this work is so lengthy that it has been made a separate report with its own separate table of contents and page numbers.*

My work for the TLBWSO included the controversy between the USBR and the Army Engineers regarding which agency would build Pine Flat. This is an interesting example of federal bureau competition.

This history of the Kings River procedure from 1938 to 1952 has not, to my knowledge, been adequately covered elsewhere. My participant's account may have interest for this reason as well as to supply a record of these events.

*Harding, Sidney T., History of work on Kings River 1938-1952, May 2, 1967. 122 p. typescript.

AGREEMENT BETWEEN LOWER TULE RIVER IRRIGATION DISTRICT
AND CROCKET AND GAMBOGY

Crocket and Gambogy owned lands which were in the western portion of the Lower Tule River I.D. Wells had been constructed on these lands by Elmer Von Glahn, their previous owner, and the water pumped had been conveyed to lands in Tulare Lake then owned by Von Glahn and in 1950 owned by Crocket and Gambogy. This draft had resulted in a lowering of the ground water in the area of the wells.

As early as 1946, suit against Von Glahn regarding these operations had been threatened by some of the adjacent overlying land owners claiming that the ground water supply was insufficient for the overlying lands and that there was no surplus for distant taking.

In 1950, the Lower Tule River I.D. was organized to buy CVP water to supplement its other water supplies. The boundaries of the District included the lands containing the wells used by Crocket and Gambogy in supplying water to lands in the Tulare Lake area. Crocket and Gambogy had acquired these lands prior to 1950.

The Lower Tule River I.D. in its first assessment wanted to place a higher value on the Crocket and Gambogy lands than on similar lands nearby on which there was no pumping. This led to threats of litigation by both the District and Crocket and Gambogy. I was asked by Crocket and Gambogy in July, 1950 to investigate the situation and to advise them regarding the actions they should take. There had already been some preliminary discussions of these issues between the parties. William A. Alexander, formerly an engineer for the USBR working in this area had become engineer for the LTR I.D.

A meeting with the District was held July 20, 1950. It was cordial

with both parties expressing their desire to settle any conflict of interest by negotiations. I discussed the results of this meeting in a letter dated July 21, 1950 to Albert Armor, the secretary of Crocket and Gambogy. I recommended exchange of records with the district and an effort to negotiate the conflict involved, with any agreement that might be reached limited to a contract with the LTR I.D. without any discretionary participation by the USBR.

Exchange of records took some time as the parties had to assemble the ones needed. A second meeting was held Sept. 13, 1950 in which a main topic of discussion was the rate at which the Crocket and Gambogy lands should be assessed for water used in 1950 and 1951. Alexander suggested an assessment based on the value of the land Crocket and Gambogy had irrigated with the exported water. I made a short report on this meeting. On Oct. 25, 1950 Alexander and I met with Frink, a geologist of the USBR working in this area on ground water. It was Frink's work which developed much of the information on which the identity of the Corcoran clay was based.

In the meantime, the district had gone ahead and made its assessment for 1950 and 1951. The Crocket and Gambogy lands were assessed at a higher rate than had been discussed at our September meeting. This fixed the taxes on these lands for 1951. I used this to defer action of my part prior to Dec. 15 when payment to the USBR for water received in 1950 was due. In 1952, Tulare Lake received a substantial inflow which reduced the draft Crocket and Gambogy needed to make on its wells in the LTR I.D. Negotiations of a permanent agreement covering the draft of the Crocket and Gambogy wells was dormant until 1955.

Alexander and I met April 30, 1955, in Fresno, to discuss engineering

matters relating to Crocket and Gambogy's pumping. Both expressed a desire to agree on a permanent basis for the amount and charges for such pumping and agreed to proceed on factual studies needed to determine equitable results.

On Dec. 13, 1955, I prepared notes on alternate terms that might be used in a permanent agreement with the LTR I.D. These were sent to Alexander and to Albert Armor. Crocket and Gambogy had paid taxes to the LTR I.D. from 1951 to 1955 which represented an average cost of \$1.81 per acre foot for the draft they had made in these years from wells in the district.

Negotiations were continued and finally agreement was reached on the terms under which export pumping from these lands in the LTR I.D. would be operated. This agreement was completed and signed by the parties July 23, 1956. This was prior to the purchase of Crocket and Gambogy by the J.G. Boswell Co. later in 1956.

In general, this agreement recognized the right of Crocket and Gambogy to pump a defined average amount of water from its wells on the lands it then owned in the LTR I.D. each year with provisions that a surplus resulting from a smaller draft in any year may be carried forward for use in later years up to a maximum of the charges for such postponed draft of \$30,000. The resulting payments for such landowners are defined and are similar to the cost of water to the district for use on their district lands.

This agreement has now been in effect for over 10 years. It has operated to the mutual satisfaction of the parties and without further controversy. In my opinion, it is an example of how such situations should be handled by negotiations between the parties rather than by litigation.

If the LTR I.D. had brought suit to enjoin this pumping the case could very well still (1967) be in court at large cost to both parties.

There were issues in this case which could not be fully defined from the available knowledge of the physical conditions affecting this pumping. The court would have to make a specific finding on what part of the variable annual draft had become prescriptive through past use. A definition would also be needed of the amount of the draft which was supplied from the naturally available ground water and of the effect of the added CVP water on the ground water at these wells. Expert testimony in such a case could be lengthy and different experts could reasonably differ in their conclusions.

The wells involved were generally deep. The deeper water supply was subject to less fluctuation than that in the more shallow strata. When these wells were drilled the Corcoran clay had not been recognized and the physical separation of the upper and lower ground water was not fully understood. The early artesian character of deeper wells in this area indicated that there were some relatively impervious formations which formed overlying clays and caused the artesian pressure. It was the experimental drilling by the USBR which identified the Corcoran clay.

The Corcoran clay extends under the lands at issue in this area. Its eastern boundary appears to be somewhere near the eastern boundary of the LTR I.D. so that there was uncertainty whether the use of CVP water in the LTR I.D. would replenish the ground water below the Corcoran clay or whether its recharge comes from further east.

Since the agreement was made it is understood that Boswell has found a more active response of the upper strata to the recharge resulting from the use of CVP water than the response of deeper ground water. They have met this condition by installing more shallow wells and pumping a larger part of their draft from above the Corcoran clay.

This was one of the most satisfactory procedures in which I have participated. I had a client whose instructions to me were to seek an equitable settlement of the controversy without specifying detail results that might have prevented agreement. I also had on the other side of the negotiations a competent and fair-minded engineer seeking an equitable settlement that would be to the advantage of both the district and C & G. The Board of Directors of the LTR I.D. supported Alexander throughout these negotiations and deserves credit for their attitude.

The negotiations were conducted by the engineers of the parties. Contact with their principals was limited to that required to keep them informed on progress and results, and to be sure of their continued support. The lawyers were kept advised of progress but did not participate actively until called in to review the draft of the agreement reached by the engineers. After Alexander and I had reached an understanding and agreement on the terms of the settlement, I prepared a draft of a formal agreement expressing our results which Alexander approved. This draft was then reviewed by the attorneys and its wording put in proper legal form. The essential terms to which Alexander and I had agreed were not changed.

A copy of the final agreement is in Item No. 176 of my bibliographical file. This item also contains correspondence, etc. leading to the agreement. This indicates the progress made in reaching final agreement after discussions extending over a period of six years.

WORK FOR THE VISTA IRRIGATION DISTRICT

The Vista I.D. in San Diego County is an interesting example of an area originally developed for agriculture, gradually changing to a residential basis. The individual land ownerships were generally small and this change has occurred by their subdivisions by their owners. The larger types of subdivisions with their mass housing developments were not well adapted to the topography and ownerships in the Vista I.D.

This change in residential development has had a major effect on the Vista I.D. over the years. Its irrigation system has been converted into a pressure domestic system. This has involved financial problems which the district has met successfully.

The district has also had problems with its water supply. The area which it proposed to serve at the time of its organization was larger than the area for which the available water supply was considered by the state engineer to be adequate. As the district had already been organized the district met the state engineers requirement by securing waivers of service from part of its included lands. This avoided the dissolution of the original district and the reorganization of a smaller more compact area.

The history of the Vista I.D. to 1928 is well covered in Bulletin 21 of the State Division of Engineering and Irrigation by Frank Adams. Since the date of this bulletin, the district has purchased the Warner Ranch of about 43,000 acres which includes the Lake Henshaw dam and reservoir. These lands are leased for grazing and the area of the lake is used for recreation.

The record of the Vista I.D. in its change from agriculture to

residential use is an interesting contrast from the wholesale scale of change that has occurred in some areas. An interesting comparison could be made of these different processes of urbanization. Wholesale subdivision eliminates irrigation in its area. What may be termed retail subdivision reduces irrigation to the small areas of each lot. The irrigation of an acre or less is still practical in the Vista I.D. on many of the residential lots.

My work for the Vista I.D. began in 1951 and extended intermittently until 1960. It related entirely to matters affecting the water supply operations and policies.

As a result of a sustained drought, the Vista I.D. in 1950 had begun a program of well drilling in the ground water basin in which its Henshaw reservoir is located. The first production from these wells occurred in late 1950 and enabled some storage to be accumulated in Lake Henshaw in the winter of 1950-51.

The runoff of the drainage area of Lake Henshaw was very deficient in 1950-51. By May, 1951, it became apparent that increased draft would be required on the wells and more wells might be needed if the district was to avoid material shortages in 1951. I was asked by the district to review its program and to advise it regarding the additional wells needed to meet its 1951 demands.

In 1951 the first barrel of the San Diego Aqueduct was in operation but the Vista I.D. had not become a member of the San Diego County Water Authority. A small amount of aqueduct water was secured by exchange for water pumped from wells above Lake Hodges. Steps were taken to initiate joining the Authority.

The problem facing the district in 1951 was how to meet its 1951 demands without damaging shortages in its water deliveries. It was

recognized that 1952 might also be a critical year but there remained the chance that the runoff into Lake Henshaw in 1951-52 might be favorable. As usual, the immediate problem dominated the actions taken.

Lake Henshaw first became operative in 1923. To 1951 it had never spilled and had never failed to meet the demands on its storage. The Escondido Mutual Water Co. has an interest in its water supply under the terms of a complicated agreement and its demands under this interest had to be considered.

The availability of a ground water supply in the Lake Henshaw area had been recognized prior to its actual development. It had been held as a reserve to be utilized should conditions arise under which the district required additional water. Springs in the lower area indicated artesian conditions there. No investigations had been made relating to the total volume of such ground water storage and there was uncertainty regarding the total draft that could be supplied without depleting the basin.

When I began this work, pumping was under way on the completed wells and other wells were in various stages of progress. I concluded that the volume of the available wells was enough to meet the 1951 demand but that four to six additional wells might be needed to secure a high enough rate of draft to meet the 1951 peak demand. I recommended the construction of such wells. In two letter reports dated May 26, 1951 I made these recommendations and discussed the preferable location for additional wells. These reports are in Item 96 of my bibliographical file.

These wells were constructed. The Vista District found it necessary to ration their deliveries in the latter part of the 1951

season but escaped serious damage in that year.

In September, 1951, I reviewed the results to date and made two letter reports under date of Sept. 28, 1951 similar to those made in May. These later reports used the additional records obtained in the operation of the wells to support a forecast of what could be secured in 1952. These reports are also in Item 96 of my bibliographical file.

Lake Henshaw has a large evaporation loss when it contains much storage as it has a relatively long carryover period in years of large runoff. While its topography is representative of that of usual reservoirs, there have been suggested plans for reducing its area by various systems of levees which would prevent the flooding of the more shallow areas. These proposals resulted in my being asked to review the records of evaporation from the lake and the suggested plans for its reduction in area. I did this in a report dated March 8, 1952 entitled "Conservation of Evaporation in Lake Henshaw." I found that the proposed reductions in area would have costs that made them unattractive. They could, of course, produce no salvage of evaporation until years of large runoff might occur. They would not be useful while Henshaw remained nearly empty.

Such salvage works have not been constructed to date as the years since 1952 (to 1966) have had only limited inflow into Lake Henshaw. With water now available through San Diego Water Authority, it is doubtful if their construction will ever be justified.

The operation of Lake Henshaw requires computations of the natural runoff at the dam in order to compute entitlements in such flow. This requires allowances for the evaporation from the lake. I reviewed the procedures being used in a letter dated Aug. 7, 1952.

The work under way on the safe draft that Lake Henshaw could supply was also reviewed. It was pointed out that the draft on the Lake Henshaw wells came from the runoff of the same drainage area that supplied the surface inflow. In future years the replenishment of this draft would be an added burden on the surface supply reaching Lake Henshaw.

In 1953, the drought had prevented any material storage in Lake Henshaw. This naturally led to consideration of what could be expected in the future. I prepared a report in August, 1953 entitled "Safe Net Yield from the Water Supply of Lake Henshaw." A copy of this report is in Item 96 of my bibliographical file.

It was my conclusion, based on the records to 1953, that a sustained regulated draft of 16,000 acre feet per year plus the free releases could be secured without resulting in shortages in excess of the estimated capacity obtainable from the adjacent ground water. The free releases represent prior rights to the natural flow. They are a relatively small item. I also found that in years when Lake Henshaw held a relatively large amount of storage, the draft could be increased by 1000 to 2000 acre feet per year without naturally increasing the shortages in a succeeding deficient period. This increase would be supplied, in part, from the reduction in evaporation from the reduced area of the lake during the relatively long period of carryover.

The conclusions in this 1953 report were based on an estimate of the inflow to Lake Henshaw for the preceding 81 years in which the measured and derived inflow had an average of 25,200 acre feet per year. The continued drought to date (1966) has exceeded in severity any similar period in the preceding 81 years. On the favorable side,

the available ground water supply obtainable from the Lake Henshaw wells has been larger than was expected in 1953. With the present availability of San Diego Co. W.A water Henshaw can be used to whatever extent the runoff may make available and the remaining requirements secured through the San Diego County Water Authority. Future variations in the Lake Henshaw supply will affect the cost of the total supply rather than its availability, as long as water to meet the remaining part of its demand can be secured from the San Diego County Water Authority.

In 1953, when my report on the safe yield of Lake Henshaw was made, the supply obtainable by the Vista I.D. from the San Diego County Water Authority was limited by restrictions resulting from the one barrel of the then constructed aqueduct. Such limitations have since been removed by the construction of additional aqueduct capacity. It is now practically assured that state water will be available before any sustained shortages may occur in the Colorado River supply of the M.W.D.

If there should be need for the Vista I.D. to consider the safe yield of its Henshaw system, including the wells, in relation to the amount of water it should commit itself to take from the San Diego Co. W.A., the result to 1953 will need to be reviewed and revised using the additional years of record. The years from 1953 to 1966 have been more deficient than was found to have occurred in any period in the preceding 81 years.

The Vista I.D. operated its existing system of wells to meet its requirements to 1956. The drought at Henshaw continued. In late 1956, I was asked to report on a proposed project to increase the pumping capacity. I did this in a report entitled "Expanded Pumping

Project of Vista Irrigation District." A copy of this report is Item 109 in my bibliographical file.

The Vista I.D. had become a member of the San Diego County W.A. by 1956 through its inclusion in the Bueno Colorado M.W.D. It was expected that in 1957 the S.D.C.W.A. supply delivered to its site would be prorated to its members on the basis of their preferential rights which in turn were proportional to their total taxes paid to the Authority. On this basis the Vista I.D. could only count on an annual supply of about 3,000 acre feet of Authority water. In 1957 the second barrel of the first aqueduct was in use but the proposed second aqueduct was not then scheduled for completion until 1958.

I reviewed the ten additional wells proposed by Burzell, the Vista I.D.'s engineer, and agreed generally with his selection of their locations. I also recommended a revision of the agreement with the Escondido Mutual Water Co. which then prevented the Vista I.D. installing wells in the southern part of the Lake Henshaw area.

I estimated that in 1957 the Vista I.D. would require a well draft of 17,500 acre feet to meet its own needs and the deliveries to others, mainly the Escondido M.W.Co. By prompt installation of the additional wells, I concluded that this demand could be met in 1957. The program for additional wells was carried out and the district met its 1957 demands.

In the latter part of 1957 the Vista I.D. was faced with the problem of whether their existing sources of supply were adequate to meet their needs until the second aqueduct could be completed. This completion was then expected to occur in July, 1959. There was also the problem of whether the district should undertake to

serve additional area when the second aqueduct was completed.

I was asked to make a study of these situations and to prepare a report with recommendations regarding the policies the district should adopt. I did this jointly with L.R. Burzell, the district engineer, in a report dated Feb. 28, 1958. This report reviewed the results at Lake Henshaw and analyzed the extent of the water supply the district could expect to receive from the San Diego Co. W.A. interest in the M.W.D. It was a lengthy report of 136 pages of supporting material for 20 pages of summary and recommendations. A copy is Item 113 in my bibliographical file.

On the adequacy of the Lake Henshaw supply to meet the district's demands to July, 1959 our conclusion was favorable. The experience with the wells at Lake Henshaw supported the conclusion that there remained sufficient ground water which the pumps could secure for this purpose. This conclusion was borne out by the experience to July, 1959. Actually the completion of the second aqueduct was delayed until late in 1960. The Lake Henshaw sources met the district's demands to this later date.

In this report it was contemplated that the draft on the Henshaw wells should be maintained at whatever rate was needed to meet the district's demand until July, 1959. The main problem involved was to attempt to estimate whether the ground water supply could supply such a draft. There were no records from which the capacity of the Henshaw ground water basin could be determined. The results of the past well draft had to be projected to cover the draft needed to July, 1959. It was concluded that the district demands could be met to July, 1959, but it was expected that additional aqueduct water would be secured when the second aqueduct supply became available with a corresponding

reduction in the well draft.

The amount of the entitlement to Colorado River water of the Vista I.D. is the result of a division of the total supply available to the individual units of the M.W.D., next to the division of the supply of the San Diego Co.W.A. of its share of the M.W.D. water among its units and next to the division of its share of the San Diego Co. W.A. supply by the Bueno Colorado M.W.D. among its areas of which the Vista I.D. is one.

All of these divisions of the available supply at times of full demand are based on what is termed the "preferential rights" of each unit. This preferential right is the percentage of the total taxes paid by each unit to the agency making the division. This would be to the advantage of the older units if only current taxes paid after annexation of new units were used. However, a condition of annexation of new units has been that they pay the accumulated back taxes that would have been paid by the annexed unit if it had been a member of the larger agency from its organization.

In the Feb. 1958 report, we traced back the preferential right of the Vista I.D. to the source of the Colorado River supply and estimated the amount of Colorado River water that would be available to Vista when the total demands of the M.W.D. equalled its supply. This supply plus the surface inflow to Henshaw indicated that any increase in the Vista usage should be restricted to minor areas. Further expansion of the area to be served would be dependent on additional imported water such as the Feather River supply. In 1958 a definite Feather River Project had been proposed but its financing and construction was still indefinite.

There was another factor affecting the amount of Colorado River

supply which the Vista I.D. might secure temporarily. Some M.W.D. units were not using their preferential right and their unused portion of these rights thus became available to other units. The largest unit not using its preferential supply was Los Angeles. The San Diego Co. W.A. could anticipate securing water up to the capacity of its aqueducts for a period of years but would expect to have this reduced to its preferential right when other M.W.D. uses increased. This preferential right would then be less than the capacity of the San Diego aqueducts.

These conditions presented a difficult problem to the Board of the Vista I.D. There was pressure from additional lands desiring to be served by the district when the second aqueduct was completed. There would be available water for some such areas for a few years until full use of the available Colorado River water supply was made by the other M.W.D. units. Unless additional imported water became available by that time, the supply of the Vista I.D. might be insufficient to meet its enlarged demand if a material area of additional service should be approved.

In 1958, the pressure on the Vista I.D. to adopt a liberal policy on additional service was strong. Charges for such services could have been secured which would have helped to meet the district's need for financing improvements in its distribution system.

Other units in the San Diego Co. W.A. were undertaking service in their areas in excess of what their permanent preferential rights in Colorado River water could supply. Some of these units had no other sources of supply.

Our report recommended a conservative policy on increased services by the Vista I.D. until the plans and program for additional imported

water had progressed to the point where an assured date of completion could be foreseen.

I did a small amount of work for the Vista I.D. on improvement methods and policies for their distribution system in 1958 after the completion of the Feb. 1958 report. This work was not carried through to participation in the planning of the enlarged distribution system.

In June, 1960, I made a memorandum on "Proposed Changes in the Warner Ranch which will Affect the Water Supply of the Lake Henshaw Drainage area." The lease of the Warner Ranch lands was about to expire and it was suggested that better terms could be secured if a new lease included the use of some of the well water in the area for irrigation. It was proposed that the water for such irrigation should be replaced by salvage secured by removing brush from an area of 8,000 acres and water using vegetation removed from within the reservoir site. I concluded that the rental returns from any such water used for irrigation in the leased area would need to exceed the cost of Colorado River replacement water in order to make such irrigation profitable to the district.

The Escondido Mutual Water Co. has rights in both the Lake Henshaw surface runoff and the draft on the wells. On April 15, 1960, the Escondido M.W. Co. wrote to the Vista I.D. urging a reduction in the draft on the Henshaw wells and the replacement of the reduced supply by the purchase of additional water from the San Diego Co. W.A. At that time there was water available for such purchases resulting from the completion of the second San Diego aqueduct. I was asked to comment on this letter which I did in my memorandum of June 10, 1960. A copy is included in Item 96 of my bibliographical file. I discussed the several factors involved and recommended that the Vista I.D. should

review and revise its well operation plan. For conditions of depletion in both surface and underground storage, reduction in the well draft was not considered to be advisable until some selected reasonable amount of reserve storage had been reserved. The recreation lease at Lake Henshaw brings increased revenue when a minimum area is maintained.

This June 10, 1960 memorandum was the last report which I have made for the Vista I.D.

Through 1959, the total draft on the Lake Henshaw wells was about 105,000 acre feet. This exceeds the estimate of the supply that might be available when this draft began although there was hope that 100,000 acre feet might be available. Over 60,000 acre feet additional have been pumped through 1965 at a fairly steady rate. Since 1960, water has been obtainable from the San Diego Co. W.A. on demand. From 1961 to 1965, the Vista I.D. purchased an average of about 8,000 acre feet of aqueduct water. Its gross pumping from 1961 to 1965 averaged about 10,000 acre feet per year. Its delivery at the head of its main conduit of an average of about 3,200 acre feet for these five years was about 28% of its use, the other 72% being purchased Colorado River water.

The work which I did for the Vista I.D. was all interesting. The personal relations with the staff and board were friendly and cooperative. This work was a pleasant part of my practice in the 1950's.

WORK ON BECHTEL'S 1955 REPORT
ON THE FEATHER RIVER PROJECT

The 1955 legislature felt the need for an independent report on the state's Feather River Project as it was then being proposed by the state engineer. Funds for the cost of such a review were provided. The legislature's Joint Committee on Water Problems retained the Bechtel Corporation to prepare such a review. The contract for this work was dated Aug. 19, 1955 and the report was to be completed by Dec. 31, 1955.

The short time available in which to prepare the report restricted selection of the group to undertake it to those large engineering staffs already available. There were only two groups in California who sought this assignment. They were the Kaiser Engineers and Bechtel. Both sought agreements for assistance from other available consulting engineers who might be needed. It was understood that such consultants would be available to work with the group which would secure this contract. I was one of the consultants on the lists of both Bechtel and Kaiser.

I was asked by Bechtel to review the part of the state's report dealing with the water requirements and the rate at which the demand for water would develop in the several areas the project proposed to serve. I reviewed the land classification I had made for the state in 1929 (Bulletin 29) and prepared estimates of the rate at which the demand for water would develop in the areas proposed to be irrigated by the project.

Bechtel had also retained the Stanford Research Institute to prepare a report on the "Demand for Water in Service Areas of the

Feather River Project." The report of the Institute is Appendix A of the Bechtel report. It was completed in Nov. 1955. My report to Bechtel was made as comments on the report of the Institute as I was covering the same general field. My report was dated Nov. 30, 1955. A copy is Item 106 in my bibliographical file.

My comments on the report of the Stanford Research Institute were made similar to those that would be made in an across the table discussion of the points of variation. My comments were adopted by Bechtel and included as their discussion of the items covered in the draft of the Bechtel report which was assembled for review by the consultants. Naturally the phrasing of my more informal comments needed editing before they were used in the final report. This editing was accomplished in meetings with Neil T. Houston, who had had a major part in the preparation of the Institute's report, Mr. John Buehler of Bechtel, and myself.

The portion of the Bechtel report on which I worked is Chapter V - Water Demand. This follows my report generally. The differences between my results and those of the Stanford Research Institute in most items were within the range of differences in judgment regarding uncertain future events.

I also was one of the group that reviewed the draft of the Bechtel report and determined its final wording. My part in this group consists of occasional general comments except for Chapter V.

The Bechtel report, in my opinion, was a creditable job accomplished under close time limits. It confirmed generally the state's cost estimates. This was an item that had concerned the legislature which desired assurance that the project could be built at the cost estimated by the state. The actual cost estimates of 1955 have now (1966)

been made inapplicable by the inflationary trend.

One of the main results of the Bechtel report was the change proposed in the project financing. For the state's CVP and for the earlier reports on the Feather River Project, revenue bond financing had been proposed by the state. This failed for the CVP and would have failed for the Feather River Project. Revenue bonds are not suitable for projects having limited revenues in their earlier years before the demand for their product builds up.

Bechtel proposed a different schedule for the project bonds which deferred the initial repayments of principal until project demands for water could be developed. This would reduce materially the contributions by the state that were then proposed to meet the bond charges until the project revenues became adequate for this purpose.

The 1955 Bechtel report served a useful purpose at the time it was made. Like all such reports on projects such as the Feather River Project, it is superseded by progress on the project. The project now under construction is physically similar to the plan reviewed by Bechtel. Costs and some other features have changed as the preliminary plans have been superseded by detail design and changes in direction.

The estimates which I made in 1955 of the rate at which the demand for water in the general west side areas of the San Joaquin Valley would need to be reviewed to conform with the present conditions. These areas have no present irrigation development. They lack present or prospective urbanization with its municipal and industrial type of water demand and ability to pay. These areas lack cotton history and are, as yet, unproven for orchard crops. Expensive concrete pipe line distribution systems are planned.

Some recent (1967) bond sales for the costs of such distribution systems have been on about a 7% interest rate for tax exempt district bonds. The development of new irrigation under such conditions is outside of our past experience. Units at the south end of the valley having present ground water developments have a material advantage over underdeveloped areas. Where the cost of land development has already been incurred, operation can, and usually will, be continued as long as annual costs, exclusive of interest on the owner's investment, can be secured. The effort of a landowner, who already has his capital committed to his past development, to continue to operate is essentially different from that of a prospective land owner who is under no compulsion to undertake a new development.

WORK FOR SAN BERNARDINO VALLEY CONSERVATION DISTRICT

From 1956 to 1958 I did some intermittent work for the San Bernardino Valley Water Conservation District on pending litigation seeking to restrict the exportation of water from the Bunker Hill Basin of the Santa Ana River. I was asked to undertake this work by the attorney, William Jennings, and the engineer, E.F. Dibble, of the district with the concurrence of the board. I was 73 in 1956 and cautioned the district against retaining me for this work if the litigation would be extended. My work here ended in 1958 so my age was not a final factor.

In 1956, what was then known locally as the Orange County suit, was under trial. In this suit, Orange County sought to restrict use on the upper Santa Ana River. I reviewed the testimony in this case and made my own analysis of ground water use. I also derived preliminary results from the Bunker Hill Basin draft. My work was done mainly in June, 1956 and February, 1957. Other activity included conferences with the attorneys and meeting with the District Board.

The Bunker Hill Basin is formed by the Bunker Hill dike across the course of the Santa Ana River. In earlier years there was rising water at the lower end of the basin which supplied stream flow to the lower river. Wells above the dike were artesian in periods of better runoff. In 1956, the preceding dry years had changed these conditions. The rising water no longer occurred and wells above the fault had eliminated the artesian condition there.

The litigation contemplated by the SBVWCD had for its purpose restricting further increase in exportation from the basin. Some

past exportation had become prescriptive. The main issue involved the question of whether the basin was overdrawn leaving no surplus for taking to non-overlying land. The amount of the export which had become prescriptive would also have to be defined.

The proposed suit by the SBWCD was filed. Action on it was not pressed through 1957. The Superior Court decision in the Orange County suit was made by Judge Ross in 1957. Its appeal was under discussion and action during its remainder of 1957.

The board of the SBWCD appointed a committee to represent it in matters relating to its suit. This committee undertook negotiations with the defendants seeking an out of court settlement of the case leading to a stipulated judgment. The chairman of the SBWCD board, Mr. Don Anderson, headed the earlier negotiations. The terms of settlement were sufficiently favorable to the defendants that Mr. Jennings wrote to the board on Jan. 13, 1958, cautioning them on their proceeding without close contact with their own lawyers and engineers.

On March 25, 1958, the board of the SBWCD passed a resolution authorizing Mr. Jennings and myself to discuss a settlement of the case with representatives of the defendants regarding a mutually agreeable stipulated judgment. The board wrote to the defendants regarding this action.

Mr. Jennings explored the matter of a meeting with the defendants. It was indicated that the terms that had already been proposed by the SBWCD board were thought to be more favorable to the defendants than terms to which their attorney and engineer might agree. I did not take part in any of the negotiations with the defendants in spite of the board's resolution.

Later, a settlement was reached with some of the defendants, a new suit against them was filed and a stipulated judgment entered in accordance with the terms of this settlement. Another suit was then filed against the original defendants who did not agree to the stipulated judgment. I had no part in these later proceedings and do not have a record of their final outcome.

Since my work for the SBWCD, the Orange County suit has been appealed and decided. It covered only part of the uses in the upper valley. A new suit has been filed which will result in a general adjudication of all rights to the water of the Santa Ana River if it ever reaches completion.

My work for the SBWCD did not produce constructive results. My relation with the engineer of the district, E.F. Dibble and the attorneys, Jennings, Engstrand, and Henrickson, were very cordial and pleasant. I undertook this work in the hope that I could assist the district in reaching a settlement of the issues without extended litigation. Apparently some members of the board did not approve of my part in these proceedings and I was only able to assist the attorney of the district in the preparation of the complaint.

The only written report which I made to the board was a brief memorandum in Jan. 1958 in joint authorship with Mr. Dibble. It covered our conclusions regarding the issues of the case. My other results were transmitted verbally or in correspondence.

WORK FOR ALAMEDA COUNTY WATER DISTRICT

Early in 1957, I was asked by the Alameda County Water District to assist them on several water problems of the district. This district is located in southern Alameda County and includes the area generally referred to as the Niles Cone. The district was a principal party in the arbitration by the state of the controversy relating to the effect of storage at the Calaveras site by the Spring Valley Water Company in 1916 to 1920. This was the first major project in the state in which up river storage was allowed with provisions for the release of storage for later percolation to compensate for the reduction of the natural percolation that occurred from the natural flow before storage.

I had testified for the Spring Valley Water Company in the Patterson Case in 1922 in which Patterson sought to nullify the arbitration decision of the State Water Commission. The state's decision was sustained and the Calaveras storage was operated on the state's basis. There had been some differences between the district and the city of San Francisco, the successor of the Spring Valley Water Company, over the operation of this decision.

The Alameda County Water District also had a storage application to appropriate water on Arroyo del Valle, a tributary of Alameda Creek. This procedure was pending in 1957. A small project loan from the USBR was also being sought. The South Bay Aqueduct of the Feather River Project was approaching its final planning stage. The district also had internal activities in the expansion of its services to meet the demands of its rapidly increasing population. Salt water intrusion was a threat on Niles Cone.

These matters were discussed with the manager and attorney of the district and a form of agreement for my employment was worked out. This provided for the usual retainer and per diem terms. In addition, it had a provision that I was to perform services deemed to be necessary by the district's manager and attorney. This separation of my service from the Board of Directors of the district was unusual. I did not meet the board until I had been working for the district for some six months. I did not object to this provision as the contract provided for the termination of my services by either party. If disagreements should arise with the manager or engineer, I could terminate my work at any time.

At my request, the employment contract included a provision that if I should terminate my work within its first year, I should rebate my retainer fee proportionally to the time I had been employed. I did terminate my work after 10 1/2 months and returned one-eighth of my retainer fee.

While it was not a part of my employment contract it was agreed with the manager of the district that the district would employ a competent full time engineer to work on its water problems and to relieve me of the detail work which such an engineer could handle. This was not done. This failure to supply the expected assistance was one of the reasons I ended my work for the district.

STATE BULLETIN 81

The water matters pending were reviewed and their problems outlined in my early work for the district. At the 1957 session of the legislature an appropriation was secured for the state engineer to conduct an investigation of the ground water conditions in Niles Cone, particularly in relation to the intrusion of salt water. This work

was carried out and resulted in Bulletin 81 of the Department of Water Resources published in December 1960. While Bulletin 81 stresses the policing of defective wells, it also included much information regarding the general formation of Niles Cone. I participated in securing the state appropriation and in urging that a competent staff be assigned to this work by the state and left there full time until its completion. This was done. The local work was directed by Robert E. Thronson, Associate Engineering Geologist. The results secured in this investigation, in my opinion, show the value of having a good staff which concentrates on one job at a time. In some other investigations of the state, in my opinion, the personnel has tried to handle too many jobs at once to acquire an adequate familiarity with the local conditions in each area.

STORAGE ON ARROYO DEL VALLE

After getting the state's ground water work under way, it was decided to concentrate on the Arroyo del Valle procedure. I prepared a report on "Storage on Arroyo del Valle" dated July 1, 1957. A copy of this report is Item lll in my bibliographical file.

Arroyo del Valle is a main tributary of Alameda Creek above Pleasanton. Its runoff contributes to the ground water along its course both in the Livermore Valley and below Sunol. The proposed storage would reduce this natural percolation. The Pleasanton Township County Water District also had an application for storage on del Valle. The two districts cooperated in the procedure relating to this storage.

The State Water Rights Board held a hearing on these applications on Sept. 11 and on Dec. 2 to 5, 1957. Protests were made by various down stream claimants to the use of the percolation from the flow of

Arroyo del Valle. The applicants agreed to replace any reduction in the natural percolation that would result from the storage. The difficulty at the time of the hearing was that no adequate records were available regarding the amount of such natural percolation.

Permits were secured in 1958 after I had ended my work for the Alameda County Water District. I assembled the material in support of the district's application, participated in negotiations with the Pleasanton Township County Water District and the state and testified in the hearing.

The Water Rights Board approved the applications in its decision 894 on March 15, 1958 and issued permits subject to terms and conditions designed to protect the protestants. The two applications were given the same priority. The storage was not to exceed 60,000 acre feet per year. The board retained jurisdiction to modify the terms of the permit to prevent waste or unreasonable use. Permittee is to release sufficient storage to compensate for any effect on the natural percolation. Records relating to the natural percolation were to be secured while the natural runoff was unaffected by storage. The permit was to be subject to revision within a 15 year trial period.

Tentative terms were defined in the permit for operation for the first three years if the reservoir should be constructed before adequate records had been obtained.

The State's Bulletin 3 Water Plan included storage at the del Valle site as a part of its proposed South Bay Aqueduct. The Department of Water Resources appeared in the hearings to represent its interest in using this site. The state requested that the applicants stipulate that the state might make joint use of the reservoir in its South Bay Aqueduct. As the applicants would be users of the water supply of

the South Bay Aqueduct and had been urging the state to build the del Valle storage, such stipulation was readily made. Exhibit No. 1 dated Nov. 1, 1957 in the hearing on these applications is an agreement between the state, the Pleasanton Township County Water District and the Alameda County Water District covering such joint operation. As the Water Rights Board lacked jurisdiction to enforce the future terms to be agreed upon regarding such operation of the storage, it was not included in the permit terms.

A copy of the Water Rights Board decision 894 is included with other matters relating to this procedure in the binder of miscellaneous material relating to the Alameda County Water District in my bibliographical file, Item 174.

This procedure was an example of interested parties with diverse interests working together to derive a plan that could conserve the unused waters of the Arroyo del Valle without damage to existing uses. A harmonious result was secured without harm to any interests.

WORK RELATING TO THE SAN FRANCISCO WATER DEPARTMENT

The decision in the arbitration of the operation of the Calaveras Reservoir by the Spring Valley Water Company provided for the securing of the essential records by the Water Company and supplying the results to the state and the Alameda County Water District. Over the years since 1920 these records had been kept. The terms of the arbitration were not followed at all times. After the Spring Valley Water Company had been acquired by San Francisco the relations between the city and the district had become somewhat strained. In some years of below average runoff water in excess of the arbitration requirements had been delivered but there was no well defined definition of the status of this water account when I began my work in 1957. One of my efforts

was directed toward trying to secure past records and to find out the status of the operation of Calaveras Reservoir. The Water Department of San Francisco was approached and several meetings of the parties were held. Apparently, San Francisco did not want this question raised and these meetings were merely exercises in futility. No progress was made during my work for the Alameda County Water District.

At this period, San Francisco was faced with the problems related to its sales of water outside of San Francisco. The Alameda County Water District had been purchasing a limited amount of water from San Francisco. The state had issued its preliminary draft of Bulletin 13, "Alameda County Investigation." San Francisco then issued its statement relating to the furnishing of competing service by the state. San Francisco opposed the entrance of state service into what it considered to be its service area and in which it announced its readiness to meet the demands. The area of the Alameda County Water District was in this proposed service area.

On July 10, 1957, I submitted a report to the Alameda County Water District entitled "The Alameda County Water District and the San Francisco Water Department." In this report I discussed the status of Calaveras Reservoir operation and the purchase of water from San Francisco by the Alameda County Water District. The terms of the Raker Act prevent San Francisco from selling water in the Bay area except for municipal purposes. This eliminated agricultural use in the Alameda County Water District from securing San Francisco water. The other difference between Alameda County Water District securing an increased water supply from San Francisco or the state was the cost. San Francisco was ready to contract; in 1957, the state

could not assure its time of delivery. San Francisco felt it could not sell water outside the city for less than its price in the city without creating internal problems and their proposed price was then materially higher than the expected cost of the state's supply.

There was some intimation that San Francisco might not increase its delivery to the Alameda County Water District unless the district agreed to secure its full supply from the city. Under these conditions I recommended that the Alameda County Water District seek to find a solution for partial service from San Francisco to meet its needs through the district's distribution system which served only a part of the district's area. A copy of this report is in Item 174 of my bibliographical file. Copies of some related correspondence are included in this file.

THE SOUTH BAY AQUEDUCT

Salt water intrusion had occurred in some wells on the Niles Cone and was a serious threat to additional areas. The construction of the South Bay Aqueduct was expected but the voters approval of the Feather River Project had not been secured in 1957.

The fears aroused over the threat of salt water intrusion in Niles Cone by the local state water pollution control engineer and the state engineer had led to a state program for starting the South Bay Aqueduct ahead of the Feather River Project schedule. This aqueduct would enable new water to be delivered to Niles Cone at an earlier date than the general construction program of the Feather River Project. The state recognized that there might be a need to expedite the construction of the South Bay Aqueduct in order to meet the threat of salt water intrusion.

The Alameda County Water District was directly interested in the early construction of enough of the South Bay Aqueduct to enable perco-

lation water to be delivered to Niles Cone ahead of the general construction schedule. Such delivery could be secured by getting water to Altamont Pass and using natural channels of Alameda Creek and its tributaries. I outlined plans for such a crash program.

This matter was discussed with both the USBR and the state. Early operation would have to use water from Delta-Mendota Canal of the USBR. Such a crash program might be able to get into operation within a year of its start.

The authorized South Bay Aqueduct of the state included pumping from the main canal of the Feather River project to the Brushy Creek Tunnel at an elevation of about 700 feet, storage on Brushy Creek at the lower end of the tunnel and a conduit around the south side of the Livermore Valley with storage at the Airpoint and Evergreen sites. Both of these reservoir sites were beyond the Niles Cone. There was also a conduit planned around the north side of the Livermore Valley with storage at the Doolan site. Only limited use of storage on Arroyo del Valle was included in Bulletin 3 as the initial geological report of the state had been unfavorable for a reservoir of the capacity that would be needed. Water from the aqueduct would have to be pumped into the del Valle reservoir.

I submitted comments to the state engineer on the authorized South Bay Aqueduct recommending changes in its plan. I recommended a conduit through Altamont Pass as a substitute for the Brushy Creek Tunnel of about the same elevation as the Pass. I also urged the use of the storage site on Arroyo del Valle in order to have storage above Niles Cone. Any tunnel in the local formations involves uncertainty in the ground it will encounter and it did not appear necessary to take this chance at Brushy Creek.

Banks replied to my June 6, 1957 letter on July 25, 1957. Questions had already arisen regarding the feasibility of the dam site at Airpoint. The state was reviewing its previous work relating to a tunnel through or a conduit around Brushy Peak.

I prepared a memorandum for the Alameda County Water District dated Aug. 23, 1957 entitled "Emergency Project for Pumping Over Altamont Pass." The water would be secured from the Delta-Mendota Canal of the USBR. Such a supply would be available from the canal for much of the year.

The state had an item of \$10,000,000 which it planned to include in the 1958 state budget for early work on the South Bay Aqueduct. Whether this could be obtained was not known in 1957. The Alameda County Water District was seeking a loan for the construction of the del Valle Reservoir from the USBR under the terms of the recently passed Small Project Acts. With so many working in this area, coordination of actions and decisions was clearly needed. The USBR had not restricted the capacity of the del Valle site. To expedite matters a field trip was arranged on Nov. 12, 1957 in which the state, the USBR and the two local districts participated. We started at the proposed diversion from the Delta-Mendota Canal and followed the proposed South Bay Aqueduct to the del Valle site. At the del Valle site the geologists of the USBR and the state agreed that higher storage appeared to be feasible. The leakage through the ridge on the north side of the site at higher stages, which the state had used to restrict the proposed reservoir capacity, did not appear to be a material factor. The state agreed to drill the dam site to secure more definite information there.

I wrote Banks on Nov. 18, 1957 discussing the results of this

trip and the emergency situation on Niles Cone.

Matters remained status quo after this trip until I ended my work for the Alameda County Water District in Jan. 1957. On April 21, 1958, Greydamus made an "Office Report on South Bay Aqueduct Route Studies" for the state. In the meantime, other routes had been suggested for delivering water to Santa Clara County. The principal alternate was a tunnel under Pacheco Pass to deliver water from the San Luis reservoir to San Benito and Santa Clara Counties. Plan III in Greydamus' report would end the South Bay Aqueduct at the del Valle reservoir. Water for northern Santa Clara County would be secured by division--under Pacheco Pass and a conduit to the Anderson Reservoir. No final recommendation was made in this report as the demands for service had not been completed.

Since the end of my work for the Alameda County Water District the state has constructed much of the South Bay Aqueduct. Water has been secured by pumping from the Delta-Mendota Canal into the state's conduit until the state's works have been completed. Water is pumped up the slope of Brushy Peak to somewhat above the elevation of Altamont Pass and conveyed around Brushy Peak in a conduit which extends around the east and south sides of the Livermore Valley. The Doolan Canyon reservoir site was found to be unsuitable, the main area to be served by the branch conduit on the north side of the Livermore Valley has secured service from the East Bay M.U.D., and the state's north side conduit from the South Bay Aqueduct has been dropped from the state's plan.

The results of drilling at the del Valle site in 1958 were favorable. Additional drilling later at the spillway site disclosed some foundation conditions which resulted in revisions in the design

and a substantial increase in its estimated cost. Work on the del Valle dam is now under way (1966).

The state purchased the Airpoint reservoir site and later decided construction of a reservoir there was not feasible. The site has been sold to the county for use as a park. Northern Santa Clara County has contracted for South Bay Aqueduct water. As an offset for not constructing storage at Airpoint, the state has extended its South Bay Aqueduct to Penetencia Creek as the point of delivery to Santa Clara County. Service to this point is now being made.

The letters and reports which have been referred to are included in Item 174 of my bibliographical file.

While the construction of the South Bay Aqueduct occurred after the end of my work for the Alameda Water District, the procedure resulting in the revision of its plans was started in 1957. While much of the changes in the plan originally authorized would probably have been made during the progress of the work, the review of these early plans in 1957 can, at least, be credited with an assist in these changes.

REMARKS

When I began work for the Alameda County Water District early in 1957, there had been little activity on the district's water supply plans and problems since the completion of the procedures relating to the Calaveras reservoir in the 1920's. I tried to get work started on the several water problems confronting the district. Without engineering help from the district this required more of my time than my other work permitted me to spend and I terminated my work in Jan. 1958. On leaving the district the Board expressed its deep appreciation for the services I had rendered to the district over

the past year in a letter dated March 13, 1958. This letter included the statement, "It is our firm belief that the fundamental work that you have done will be of tremendous service to the District for many years to come."

Soon after the end of my work for the district it employed a full time engineer to work on its water problems. The district still has (1966) the same attorney and general manager.

REPORT ON SUPPLEMENTAL WATER SUPPLIES FOR
NORTH SANTA CLARA VALLEY AND RELATED SERVICE IN
SAN BENITO AND SANTA CRUZ COUNTIES

In November, 1959, the Santa Clara-Alameda-San Benito Water Authority and the Santa Clara County Flood Control and Water Conservation District entered into an agreement to employ a Board of Review to make a study of water importation with particular reference to the supplemental requirements of water deficient areas of Santa Clara County. Each party to this agreement was to select an engineer and these two were to select a third member to comprise this Board of Review. The Santa Clara-Alameda-San Benito Water Authority (called tri-county for short) selected Mr. Samuel Morris of Los Angeles as its member of the Board and the Santa Clara County Flood Control and Water Conservation District selected Mr. John Longwell of Oakland. These two asked me to be the third member of the Board.

At the time of the Board's appointment the state had its reports on its South Bay Aqueduct far enough along so that estimates were available on the costs and conditions under which it could deliver water to Santa Clara County. The City of San Francisco had also defined the conditions and terms under which it would serve areas outside of San Francisco but within an area which the city had selected which it considered it could serve with its Hetch-Hetchy supply. The USBR had been working for about a year on a three-year cooperative study with the tri-county on the costs and conditions under which it could deliver CVP water by means of a tunnel under Pacheco Pass. The Santa Clara Valley Water Conservation District had storage and spreading works on a number of the local streams in the

northern Santa Clara Valley.

There was general agreement that additional water was needed to meet the overdraft on the ground water in the northern Santa Clara Valley. This term was used to distinguish this area from the valley lands in the southern part of Santa Clara County having their outlet through Pajaro River.

When the results of the USBR's investigations had become available, there would have been a natural opportunity for the use of a Board of Review to consider all alternatives and recommend a program for the area. As the USBR results were not then available, the Board, of necessity, had to forecast their results in order to have a basis for a comparison of seeking to secure water from the CVP or the State South Bay Aqueduct. The Board began its work by reviewing the then available information. Mr. Longwell died suddenly on March 25, 1959. At our recommendation, Mr. Morris and I became a board of two to complete the report instead of appointing a successor to Mr. Longwell who would have started behind the Board's state of progress.

The instructions issued by the Santa Clara County F.C. and W.C. District to Longwell illustrate the purpose of this review. Longwell was asked to:

1. Review all available applicable reports and information and recommend the most feasible method of bringing water into Santa Clara County as indicated by such reports and information.
2. List further studies which are necessary to develop information necessary to arrive at the answer required by no. 1 above.

As shown in no. 2, it was anticipated that the Review Board might find further studies would be needed to enable it to complete its assignment under no. 1. Other functions of these instructions relieved the board of making any such further studies as there were existing organizations in the area staffed to secure additional operational results. The Santa Clara Valley W.C.D. had a relatively complete ground water record in the northern Santa Clara Valley area and had made reports analyzing the past results in this area.

Among the early activities of the Review Board were discussions with San Francisco regarding the water supply the city would have available for sale to outside areas, the price and form of contract under which water could be purchased. San Francisco is limited to selling Hetch Hetchy water in the coastal area to M & I users. The Raker Act prohibits sales outside of the San Joaquin Valley for agricultural uses. San Francisco, in such outside sales of water, is acting, in effect, as a public utility but is not subject to regulation by the State P.U.C. The means by which the purchasing cities might secure similar protection in rates and service to those available to consumers under public utilities were also discussed.

On December 11, 1959, the Engineering Review Board made a progress statement on the uses that might be obtainable from the state's South Bay Aqueduct. Only general conclusions could be stated at that time. The need for additional definitions and costs of the service from the South Bay Aqueduct was pointed out.

Discussion with the USBR indicated that their report on bringing water into this area by the Pacheco Pass route was scheduled for completion in July, 1962. As the Review Board was expected to complete its report in 1960, this meant that the program for the Review Board

should either be suspended for two years, or that it would have to proceed on the information obtainable from other sources. After discussion among the parties, it was decided to follow the 1960 schedule for the Review Board report. The tri-county had had reports on features of the Pacheco Pass route prepared for it by its own consulting engineers, Creegan and D'Angelo.

Longwell died suddenly from a heart attack on March 25, 1959. The Review Board had a meeting scheduled for March 30 to discuss its program. This was to be followed by a meeting with engineers of the local district to decide on a schedule for the work of the Board adjusted to the date the USBR report was expected to be completed. There was discussion regarding securing borings along the line of the proposed Pacheco Pass Tunnel. The USBR planned some such boring, but did not have this work scheduled for 1960. The tri-county considered advancing the costs of borings so that they could be made in time for their results to be used by the Review Board. It was finally agreed that the amount of such borings that might be made would aid in determining the formations to be encountered in the tunnel, but would be insufficient to reduce materially the uncertainties inherent in any tunnel projects in the Coast Range. In 1960, it was proposed that water would be pumped from the San Luis Reservoir to an elevation which would result in a tunnel about six miles long. The present (1967) plans are for a ten mile tunnel to avoid the pumping lift for a higher tunnel. The Review Board used the results of Creegan and D'Angelo for the six mile tunnel except that it based its cost estimates on having to line the full length of the tunnel. The formations encountered in tunnels in the Coast Range have been found difficult to predict and generally bad.

The information available for review by the Board relating to San Benito and Santa Cruz Counties was much less extensive and conclusive than that relating to the north Santa Clara Valley. The Board reviewed the available materials and made such recommendations as the available information permitted. In the absence of the completed report of the USBR, final decisions relating to these areas were necessarily deferred.

Mr. Morris and I were asked by the two employing districts on April 18, 1960 to proceed as a two man board on our original program without waiting for the report of the USBR, scheduled for completion in July, 1962, and without preliminary exploration of the Pacheco Pass tunnel site.

As additional reports on different matters relating to the work of the Review Board continued to become available, it was necessary for the Board to set a cut-off date for reports which it would use in the preparation of its own report. September 1, 1960 was set as the cut-off date with the Board's report scheduled for completion in 1960.

The report of the Review Board was completed in December, 1960. It consisted of the main report and a separate volume containing the material supporting the conclusions and recommendations of the main report. The main report was mainly a summary of the Board's conclusions and was relatively short (22 pages). The volume of supporting material contained the Board's review and analysis of the available reports on the various items used in its main report. These materials related largely to items of supply and demand for water in the areas involved and the physical conditions relating to ground water in the northern Santa Clara Valley. The volume of supporting material consisted

of 184 pages.

A copy of the main report of the Review Board is Item 119 in my bibliographical file and a copy of the supporting material is Item 120. The various reports which we reviewed were listed in the supporting material volume. The copies of many of these reports which had been loaned for our use were returned to those who had made the loans. These reports are preserved in the files of the districts in this area. Other reports which I retained are being made available to the Water Resources Center Archives.

The report of the Review Board was necessarily incomplete, as the report of the USBR with their conclusions regarding securing a water supply by using the Pacheco Tunnel route had not become available. The Board attempted to forecast what the results in the USBR would be, in order that this source of supply could be compared with the other proposed sources. A more satisfactory report could have been made if the appointment of the Review Board had been deferred until the USBR report had been completed. As this completion was not scheduled until July, 1962, and the decisions regarding securing water from the state's South Bay Aqueduct needed to be made before 1962, the Review Board met the requests of the local district to complete its report, using the available material, in 1960. The USBR report on its proposed San Felipe Division of the CVP was not completed until May, 1963.

During Mr. Longwell's work on the Review Board, he was active in local contacts and in analyzing the available reports. I was also doing similar work. Longwell and I had frequent contacts in which we compared results. Morris lived in Pasadena and was involved in other matters which limited the time he could use on this review board. However, he was always ready to help and attended the meetings of

the Board with the local districts.

After Longwell's death, the main burden of the detail work on the Board's report fell on me. This was the result of the conditions then existing. I had made reports on the ground water supply of the Santa Clara Valley in the 1930's and had volunteered to do the detail work in this field for the Review Board. Morris' other commitments resulted in my drafting the volume of supporting material and preparing a draft of the general report. Morris reviewed both of these and we met to go over their contents in detail. The volume of supporting material was left practically in the form of my draft. Changes were made in the main report. These were mainly changes in the form of presentation and in emphasis, rather than in the substance of the recommendations. While I did the main work on the preparation of the report, Morris reviewed my results in sufficient detail so that he could appropriately concur in it as a joint author.

Of the three members of the Review Board, I am the only survivor. Mr. Longwell's death during the progress of the work of the Board has been discussed. Mr. Morris died March 6, 1962. Both Longwell and Morris were very high type engineers, both professionally and ethically. Their deaths were a loss to the engineering profession. Mr. Longwell had been with the USBR for many years and with the East Bay M.U.D., becoming its chief engineer and manager when A.P. Davis left for other work. Longwell had left the E.B.M.U.D. and was practicing as a consulting engineer at the time of this work. Mr. Morris had been manager of the Pasadena Water System, Dean of Engineering at Stanford and later manager of the Los Angeles Department of Water and Power. He had retired from the DWP at the time of the Review Board's work and was practicing as a consulting engineer.

Since the completion of the Review Board's report, the northern Santa Clara Valley has secured delivery from the state's South Bay Aqueduct in 1966 following construction of a cross valley pipe line to enable water to be delivered to the west side of the Valley. Additional purchases of water from San Francisco have been contracted for by some of the municipalities within their area of service. The USBR has completed its feasibility report on its proposed San Felipe Division of the CVP and is seeking authorization of the unit. The water supply problems of this area appear to have been met to date (1967) with optional sources of water supply available to meet future needs.

Purchase of water from the state's South Bay Aqueduct was recommended by the Review Board in an amount sufficient to meet the then demand and its expected growth over the next twenty years. The quantity of water representing such a purchase recommended agreed with the state's estimate of 88,000 acre feet per year.

The Review Board concluded that the ground water in the northern portions of the Pressure Area of the northern Santa Clara Valley could not be replenished by ground water movement from recharge in the Forebay Area at a rate sufficient to meet the 1960 draft from wells in the Pressure Area. This conclusion resulted in a recommendation that the demand in the Pressure Area should be met by surface service with a reduction in the draft on the ground water.

The report of the Review Board is one of the items that had an effect on the actions taken to secure an imported water supply for the northern Santa Clara Valley. Many other items entered into the decisions which produced this result, and it is difficult to appraise what separate effect the Review Board's report may have had. Its recommendations were in harmony with the actions which have been taken.

In my opinion, the report of the Review Board had sufficient usefulness to justify its costs. Such influence as it may have had on the actions of the local agencies was beneficial. The report did not, and could not, meet all of the hopes of those responsible for establishing the Board of Review. Had circumstances permitted, it would have been preferable to have deferred such a review until reports on all prospective sources of supply were available. Decisions could not be deferred until the completion of the USBR report and the Review Board could only base its report on the materials available to it at the time it completed its work.

BULLETIN 58 - NORTHEASTERN COUNTIES INVESTIGATIONS

Item 249 in the Budget Act of 1954 provided funds for, and directed that an investigation should be made by the Department of Water Resources of, the water resources and the water requirements of the Northeastern Counties of California. This was started by Assemblywoman Pauline Davis for the four counties comprising the upper Feather River drainage area to determine the future water requirements for which an area of origin preference might be claimed. Assemblyman Lowery added the eleven counties having all or part of their area in the remainder of the drainage area of the Sacramento River. This total of fifteen counties was designated as the Northeastern Counties and these investigations resulted in the preparation and publication of Bulletin 58 of the Department of Water Resources. A preliminary edition of Bulletin 58 was prepared in 1957 and circulated for comments. The final Bulletin 58 was published in 1960.

The investigations covered a portion of the state having runoff in excess of its expected ultimate demands. One item in the resulting report would be an estimate of the surplus runoff which might be available for export.

The Department of Water Resources undertook a classification of the lands in the northeastern counties, investigations and applications of the several methods then in use estimating consumptive use, and an inventory of the available water supplies. The water supply derived was the unimpaired natural runoff prior to present uses but without consideration of existing water rights.

When the results of these investigations began to be available,

the DWR considered that it would be desirable to have the methods used reviewed by a Board of Advisors before the results were published. Consequently, such a board was appointed July, 1957, consisting of Daniel G. Aldrich, Jr., Chairman, Department of Soils and Plant Nutrition, University of California, Davis; Sterling A. Taylor, Professor, Agronomy Department, Utah State University, Logan, Utah; and myself, S.T. Harding, Consulting Civil Engineer, Berkeley.

The letter of instructions to the Board included the following statement:

The purpose of the Board will be to review the methods and procedures utilized by the Department and to report such findings as it may find desirable. The principal points which require review are: land classification standards, the probable future ultimate cultural pattern, unit values of consumptive use, and the relation of the probable water demands to the physically available water supply, particularly as regards the economics involved.

A further service which we desire is assistance in setting up a program for future studies of factors involved in determination of consumptive use and water requirements.

Aldridge and Taylor directed their work more largely to the items relating to land classification and consumptive use. I participated also in these items, but reviewed the results relating to water supply to a greater extent than the other two members of the board.

The board was supplied with copies of a "Preliminary Report on

Water Supply, Land Use, and Water Requirements," dated July, 1957. The board made a field trip over the areas involved to review the results of the land classification and to visit the experimental work of the DWR relating to consumptive use. Sessions of the board were held to work out its report. This was completed and filed under the date of September 13, 1957 (81 pages). The report discussed "Land Classification Standards, Consumptive Use and the Relation of the Probable Future Water Demands to the Physically Available Water Supply." The latter discussion considered selected local areas in the North-eastern Counties.

Some changes were made in the August, 1957 Preliminary Report. A "Preliminary Edition Subject to Revision of Bulletin 58" was issued and given circulation for comment in December, 1957. The members of the board were asked to comment on the December, 1957 edition of Bulletin 58. This was done individually as time and the other commitments of the members of the board prevented meetings and joint action. My comments (11 pages) were dated August 8, 1958. Both these comments and the September 13, 1957 report of the board are in Item 112 of my bibliographical file. Some pertinent correspondence relating to the work of the board is also included in Item 112.

In the letters of appointment of July 29, 1957, the term, "Consulting Board" was used. In the December, 1957 edition of Bulletin 58, we were called a Review Board. In a letter to the Director of the DWR, dated August 8, 1958, I suggested a change in the title and acknowledgement to our board. I urged the use of Board of Advisors as more correctly describing our function. We merely advised, but had no control over the extent to which our advice was followed. In letters to members of the board dated October 9,

1958, Mr. Banks, Director DWR, stated the change of name and the explanatory statement I had suggested would be used. This was done in the June, 1960 final edition of Bulletin 58. This is as follows:

BOARD OF ADVISORS

"The Department of Water Resources engaged a board of advisors to review the work accomplished during the Northeastern Counties investigations and to appraise the conclusions that were reached prior to publication of this bulletin. Many of the suggestions proposed by the Board of Advisors have been incorporated in the bulletin. The review board consisted of the following members..."

This statement met the essential purposes of my suggested change from the December, 1957 edition of Bulletin 58 which I had discussed in my letter to Banks, of August 8, 1958.

The last activity of the Board of Advisors was the attendance of its members at a meeting of the California Water Commission on November 6, 1958. This meeting had been called to hear comments on the December, 1957 edition of Bulletin 58. Representatives of several local areas made presentations of their local conditions, but there was time for each member of the Board of Advisors to make a brief statement. In my comments, I pointed out that Bulletin 58 represented, in effect, two independent estimated inventories, one of ultimate demand and one of total water supply. However, there was no consideration of how to get the water to the areas of demand or of the cost. Until the inventories had been converted into economically feasible projects,

the results in Bulletin 58 did not represent a useful estimate of the ultimate demands of areas that might claim preferences as areas of origin, or of the exportable water supply. No one disputed this position, but no action was taken on it.

The report of the Board on the December, 1957 edition of Bulletin 58 was not included in the June, 1960 edition. This was agreed to and approved by the board. We, in effect, made suggestions regarding the content of a preliminary edition. These suggestions were considered and, where considered pertinent, used in the revision of the December, 1957 draft of Bulletin 58. No useful purpose would have been served by printing the reasons why recommendations for change were made where such recommendations had been followed.

Similarly, the responsibility for Bulletin 58 rested with the DWR, and it would not have served a useful purpose to include recommendations that were not followed.

While Northeastern California, overall, is a region in which the available total water supply exceeds the foreseeable future demands, the supplies in some areas are less than the probable demand. The future demands which can be met in some areas will be limited by the extent of the locally available water supplies. This condition is discussed in the report of the board, supported by examples of areas in which potential uses exceeded the available water supplies. Such areas include Madeline Plains and parts of the Upper Pit River areas.

After the board's report on the 1957 edition of Bulletin 58 had been submitted, a new section was added to the 1960 edition entitled, "Limited Seasonal Water Requirements" (pp.177-182). This section recognized and discussed the lack of available water supply to meet the prospective demands in some areas. In earlier portions of

Bulletin 58, total "Probable Ultimate Mean Seasonal Water Requirements Within the Northeastern Counties" (Table 54) of 13,364,300 acre feet per year had been derived. The limited seasonal water requirements as restricted by the available water supplies, had a total requirement of 12,179,600 acre feet per year (Table 55). This was a recognition that future use in the areas of origin will be limited in some areas by deficiencies in the available local water supplies.

This recognition in Bulletin 58 of the effect of the limitations of local water supplies upon the ultimate local water requirements is, in my opinion, an improvement over the larger figure derived on the basis of ultimate demand. However, Bulletin 58 does not include considerations of the economics of making available local water supplies to meet local demands. In my opinion, the ultimate reservations of water that might need to be made to satisfy the area of origin preference in the Northeastern Counties will be much less than the 12,180,000 acre feet per year derived on the basis of water supply alone. The costs of making available these water supplies to the areas of demand will, in some cases, exceed the value of the use. For the areas on the floor of the Sacramento Valley, full future use in the areas of demand can be expected, as these areas are below the areas of runoff and can be served within the limits of feasible costs. Some foothill areas may approach ultimate uses similar to those forecast in Bulletin 58. For the higher areas, costs for additional development will be the more generally controlling item.

The work with the other members of the board and with the staff of the DWR was very pleasant and enjoyable. The results of the Board of Advisors were, in my opinion, used to a sufficient extent to justify the appointment of the board. However, in my opinion,

Bulletin 58 did not contribute, materially, to the settlement of the area of origin problems in the fifteen counties covered. A more down to earth consideration of the practical factors involved will be required before the extent of any reservations of water supply for later use by areas of origin can be quantitatively defined. When the effect of already existing rights of lower areas and the generally high costs of development in the rougher portions of the areas of origin are included in the plans for their development, the amount of water that might be reserved for areas of origin will shrink materially from the results derived in Bulletin 58.

CONSULTING BOARD ON DAM AT BIDWELL BAR SITE

As a result of the studies made by the Weber Foundation and local agitation by A. J. Chaffin, the desirability of controlling the Feather River by one large reservoir at the Oroville site had become a matter of controversy. Senate Resolution no. 4, Chapter 6, Statutes of 1958 requested the Department of Water Resources to investigate and report on the construction of a dam at Bidwell Bar on the Feather River to be constructed in cooperation with the U.S. A report to the legislature at the convening of the 1959 Regular Session was also requested.

Oroville Reservoir would submerge the Bidwell Bar site, but a dam there could be built to a higher elevation than was planned at Oroville. It was proposed that the Bidwell Bar dam should be built first, while the site was accessible. Later, when additional storage might be needed, Oroville or a combination of upper drainage area sites could be developed. The full capacity of a Bidwell Bar reservoir would be useful until Oroville was built. With Oroville dam constructed, the net usefulness of storage at Bidwell Bar would be limited to its capacity above the Oroville high water line.

To assist in meeting the terms of Senate Resolution no. 4, the Director of the Department of Water Resources appointed a Board of Consultants to advise him regarding the matters at issue. This Board consisted of General Paul D. Barrigan, John A. Cotton, and myself. Barrigan was the chairman of the board. The board was appointed in August, 1958 and made its report in January, 1959. This report has the title, "Report of Board of Consultants to Department of Water Resources on Proposed Bidwell Bar and Oroville Reservoirs for Control and Development of Feather River." A copy of this report is Item 115 in

my bibliographical file.

Former assemblyman Charles M. Weber of Stockton had established the Weber Foundation to make independent studies of the development of California's water resources. This foundation was financed by Mr. Weber and a small staff was employed. The foundation was furnished space in the State Capitol for its use. A report was prepared under the title, "An Approach to a California Public Works Plan, Comprehensive Coordinated Public Works Planning and a Step-by-Step Water Plan for California." This report was dated January 28, 1960. This main report had been in preparation since 1957.

Mr. Weber had made a Special Interim Report in January, 1958 entitled, "A Modified Plan for Development of the Water and Power Resources in the Yuba, Feather and Upper Sacramento River Basins."

A review of the Weber Foundation's proposed plans was also assigned to the Bidwell Bar Board of Consultants.

I had known Mr. Weber from the time of his membership in the Legislature and had formed a high opinion of the sincerity of his interests in the water resources of the state. He was a man to whom the term "dedicated" in this interest was really applicable. It was reported that he had spent about \$250,000 of his own funds on the preparation of his Plan. Whether the conclusions Mr. Weber reached are accepted or not, he is, in my opinion, entitled to much credit for the sincerity of his effort to be constructively helpful in solving the water problems of the state.

The Board met and organized and outlined the results it desired to have prepared for its use. Staff work was performed by the Department of Water Resources. The Board also requested information from the U.S. Army Engineers regarding their position on contributing to the

cost of a dam at Bidwell Bar for the flood control benefits it could provide and also regarding the feasibility of higher levees along the Feather River, instead of control of floods by storage. The board was advised that the Army Engineers did not consider further raising of the Feather River levees near Marysville and Yuba City to be feasible and that they would not favor federal contribution to the cost of storage at Bidwell Bar for the benefits of the partial flood control which it could provide.

The board visited the Bidwell Bar dam site and also the sites of the other reservoirs proposed on the Upper Feather River. It held a joint meeting with the state's consulting board for the Oroville Dam, particularly to inquire regarding the feasibility of constructing Oroville Dam in stages. Such stage construction might provide flood control on the Feather River during the period until Oroville storage would be needed to provide regulated water supply for the then proposed state's Feather River Project. The Oroville Dam Board advised the Bidwell Bar Board that stage construction at Oroville would not be practical.

The board also held an informal hearing in Oroville to enable it to hear any local presentations that might be made. Mr. Chaffin made a statement at this hearing and was questioned by the board. He did not have any substantial support for his opposition to Oroville Dam.

The board completed its report in January, 1959. Copies were transmitted to the members of the legislature by the Director of the Department of Water Resources under the date of February 2, 1959. This completed the work of the board.

In his letter of transmittal of the report to the legislature,

Director Banks quoted the conclusions of the board as stated in its report. These were as follows:

C O N C L U S I O N S

"The Board concludes that Bidwell Bar Reservoir is not needed for sound water resource development of the Feather River Basin and that the large Oroville Reservoir is economically feasible and it is needed for such development. The Board recognizes that as water needs increase, upstream developments, not now justified, can be undertaken to conserve additional water supply in this basin."

R E C O M M E N D A T I O N S

"The Board recommends that Bidwell Bar Dam and Reservoir not be included in the state's development plans of the Feather River Basin."

Mr. Banks stated that he concurred with the conclusions and recommendations of the Board.

Since the completion of the Board's report, there had been no further demand for the construction of a dam at the Bidwell Bar site. Construction is now (1967) well under way on the large capacity reservoir at Oroville.

This was an interesting assignment. I had worked with Mr. Chaffin previously in matters relating to the Berkeley Olive Association. He was a good agriculturalist, but was in over his head in this controversy. This work also renewed my contacts with Garfield Stubblefield who had

done most of the engineering work for the Weber Foundation. Mr. Stubblefield and I had worked together in Lassen County in 1915.

AGREEMENT OF MAY 16, 1960 BETWEEN U.S.B.R. AND
THE STATE D.W.R., TO DIVISION OF WATER IN THE DELTA

The more complete title to this agreement is, "Agreement between the United States of America and the Department of Water Resources of the State of California, for the Coordinated Operation of the Federal Central Valley Project and the State Feather River and Delta Diversion Project." This is the agreement by which these two agencies sought to divide the use of the unappropriated water in the Delta.

Both the USBR and the state based their plans for the export of water from the Delta on having available the unregulated surplus waters of the Delta during parts of the year. When the State Water Rights Board served notice that it would hold hearings on the Applications relating to these Delta water supplies, it was realized that there would not be enough unappropriated water for both projects at the same time. A contested hearing between the USBR and the state relating to these waters would have been detrimental to both. The USBR had the prior application and could have raised questions relating to the available water supply of the Feather River Project, if a contest had developed.

To avoid such a controversy, negotiations were begun between the USBR and the state seeking an amicable solution before the time set for the water rights hearing. Progress was made and a draft of an agreement dated December 28, 1959 had been prepared by the D.W.R. This draft expressed the understanding reached between the parties up to that time.

On January 12, 1960, I was enroute to Reno by plane on a flight which stopped in Sacramento. Banks boarded this flight there. We were

both going to a meeting of the Nevada-California Compact Commission.

Banks came back and sat with me. He said he would like to have me review the draft of this agreement, but that my comments would have to be completed in time for a meeting during the following week. I declined to undertake such an involved matter on such short notice. Banks then urged me to give it such study as I could in the time available and to participate in the staff meeting on January 21, 1960. I agreed to do this. Banks stated he was concerned with the possibility that some essential provisions might have been overlooked, rather than with a detail review of the draft as worded.

Material for my use was sent to me on January 15, 1960 with an accompanying letter by Wayne MacRostie. I had little time to read this material prior to January 20. On January 20, I went to Sacramento and spent the day with MacRostie, Dewey and others going over the draft and trying to acquire an understanding of the purposes of its parts. I continued by study of the draft on January 21 until 3PM when the staff meeting was held. I participated in this meeting.

My brief study had led me to the conclusion that the draft was not explicit regarding how the available water would be divided under some conditions which might arise, particularly in years of deficient supply. I urged that before it was approved, the available water supply in some one or more years should be routed with the proposed projects in operation to see how much each party would secure under the terms of the draft and to develop areas of uncertainty, if any, that might be found in such a routing. Banks stated that there would not be time to make such a routing as the agreement had to be completed and signed quickly. I did not commit myself further on whether the state should accept this draft.

On February 1, 1960, I was in Sacramento again on other matters. I had prepared a one page comment on the proposed agreement, dated January 29, 1960. I took a copy of this comment to MacRostie and left it with him. I again urged that an operation study should be made. I had no further part in the preparation of this agreement. I spent only two days of my time on my review of this agreement.

Agreement between the USBR and the state was reached and signed on May 16, 1960. This delay from January 21 of nearly four months represented good progress for such complex matters. It would have allowed adequate time for the type of routing I had proposed.

There has been no occasion as yet to test this agreement in actual operation. It is generally conceded that it is primarily an agreement to agree, without including all of the details of its operation. It will need to be supplemented by such details when it comes into operation.

The agreement was used by the Water Rights Board in its decision 990 on the applications involved. This decision is dated February 9, 1961. Further hearings were held by the Water Rights Board in 1966.

The materials relating to this matter, insofar as I participated in it, are assembled in Item No. 153 of my bibliographical file, although the only part of which I was the author is the one page of written comment which I made on January 29, 1960.

The division of the surplus waters of the Delta between the USBR and the D.W.R. may become controlling in the future operations of these agencies. Both agencies expect to increase the water supply of the Delta by importation of water from the north coastal area. When such increases may be needed will be dependent on when each agency has put its full supply within the Central Valley to full use. How much of the

present surplus supply in the Delta each agency may be entitled to use will control the time when additional sources may be needed.

The demands of the proposed projects of both of these agencies exceed the supply which will be available from the drainage areas of the Sacramento River. The USBR has already begun the importation of water from the Trinity River. The May 16, 1960 agreement and its later supplements, if revisions are made, may affect, materially, the plans and their timing by both of these agencies.

WORK FOR THE STATE RECLAMATION BOARD

From 1958 to 1962 I did some consulting work for the State Reclamation Board. The projects involved were the Cache Creek and the Colusa Weir settling basins of the state and federal government flood control plan for the Sacramento Valley. In this work, the engineering and legal staffs of the Reclamation Board supplied the engineering results and the legal opinions needed in my work. The Reclamation Board is the state agency that represents the state in its operation of the Sacramento and San Joaquin Drainage District.

In the flood control project for the Sacramento Valley, surplus flows are carried in by-passes. The channel of the Sacramento River, even with levees of practical height, does not have sufficient capacity to carry its floods. When tributaries discharge into these by-passes, the debris can be deposited. The Cache Creek Settling Basin on the lower Cache Creek received the debris that would otherwise enter the Yolo By-Pass. The Colusa Weir discharges into Butte Basin to relieve the channel of the Sacramento River of the flow in excess of its capacity. An area in which the debris carried by this overflow is deposited has been provided.

My work on the Cache Creek Settling Basin related mainly to a law suit resulting from a break in the south levee of the settling basin. On the Colusa Weir overflow, litigation was threatening as a result of the deposit of debris on areas in excess of those for which easements for such deposits has been secured.

WORK ON CACHE CREEK SETTLING BASIN

During the 1956 flood on Cache Creek, the south levee had broken and flooded adjacent areas. Suits were brought against the

Reclamation Board by the owners of these lands to recover damages for the injuries alleged to have resulted from this flooding. These suits were Rasmussen et al vs. Sacramento and San Joaquin Drainage District, and Evans vs. the same district, numbers 15390 and 15389 in the Superior Court for Yolo County.

The basic issue involved was whether the Reclamation Board had been negligent in its maintenance of this levee. Also involved was the extent to which the settling basin had become filled, thus increasing the height of water against the levee. Work had been done in preparation for the trial of this case prior to my employment by the Reclamation Board in April, 1958. I reviewed the results of the previous work with the staff of the Reclamation Board working with Joseph I Burns and others. The trial was delayed by negotiations attempting to settle the claims by negotiation. My work in 1958 consisted of investigations of the physical conditions and a study of past records. I did little work on this case in 1959. In 1960, preparations were made for the first court hearing on the liability of the Board resulting from the construction of the channel controlling the flow in the settling basin. This trial was held without a jury on September 20 and 21 in Woodland. I testified for the Board. The trial of the final issues including the fixing of damages, was set for November 1961. November 6 and 7 were spent in selecting a jury. On the evening of November 7, 1961, an agreement was reached between the plaintiffs and the state on terms of settlement and the trial was suspended. On November 16, 1961, a stipulation was signed by the parties settling the issues of this case. The state paid \$57,500 damages and secured additional flowage rights which would protect it against similar future claims.

Under date of August 28, 1961, Joseph Burns and I prepared a report entitled, "Flooding of Rasmussen Lands under Pre-1937 and Post-1950 Conditions." The first construction of the settling basin works began in 1937 and the present training levees were built in 1950. A copy of this report is Item 122 in my bibliographical file. Other materials relating to this case are included in this item.

Eventually the Cache Creek Settling Basin will have performed as designed to the extent that it will become filled and additional settling areas will be required. The time when this may occur may be delayed if additional storage is constructed on Cache Creek which removes part of the debris and reduces the flood flows. The remaining flood flows may receive a new load of debris by erosion along the course of Cache Creek above the settling basin. These conditions were foreseen in the plans for the settling basin.

WORK ON COLUSA WEIR SETTLING BASIN

Relief from the excess flood flows in the Sacramento River above Colusa is secured by the operation of the Moulton and Colusa Weirs. These weirs are designed so that stream flow in excess of the capacity of the Sacramento River below the Colusa Weir is diverted over these weirs into Butte Basin. The total flood control plan for the Butte Basin includes its reclamation by confining the overflow of these weirs in a by-pass channel. This plan has not as yet been constructed.

The overflow over the Colusa Weir includes the debris which the water contains. As the velocities of overflow are reduced as this overflow spreads out below the weir, this debris is deposited on the area of overflow. This condition was foreseen and some land where such deposits would occur was acquired as a part of the flood control project.

In 1959, the Butte Creek Farms filed a claim for damages to their land, resulting from the deposit of debris outside of the area which had been acquired by the state. In November, 1959, I was employed by the Reclamation Board to report on this matter and to advise the Board on the action it should take. I looked the situation over and suggested some observations to be made. This matter was generally dormant until September, 1960 when I made a report to the Reclamation Board on, "Present Conditions at Colusa Weir and Claims of Butte Creek Farms." I did little further work until April, 1962 when I made a report on, "Acquirement of Additional Lands for the Deposit of Debris Discharged Over Colusa Weir." A copy of both of these reports are in Item No. 124 of my bibliographical file. Some correspondence and supporting material is also included in this item.

I have done no further work on this situation since June, 1962. It is understood that additional lands were acquired for the deposit of debris and that litigation relating to damages from past deposits has been avoided. No plan for the permanent reclamation of Butte Basin has as yet (1967) been adopted.

WORK FOR DENVER WATER DEPARTMENT, 1953-55

In June, 1953, I was asked to undertake work for the Denver Water Department on its water supplies and water rights. Some source or sources of additional supply were needed to meet the increasing demands of Denver's area. Alvord, Burdick and Howson of Chicago had been retained to report on a general program for securing additional water and the works needed for its development and distribution. In their negotiations regarding this report, Mr. Louis Howson of this firm had advised the Department that they would need to be furnished with help on the city's water rights as this was a field outside of their usual practice.

In the discussions regarding my undertaking this work, I was informed that it would consist of any analysis of available records and reports of the Department with conclusions regarding the sources of supply from which Denver might secure additional water. The basic material for such an analysis was stated to be available for my use. I undertook this work with the expectation that I could make the report desired within a few months time. When I got into the available materials I found that little had been done on water supply planning since the retirement of Geo. Bull, their planning engineer, about 20 years before and that it was necessary to make extensive stream flow studies before I could assemble the basic results for use in my reports.

Denver had acquired its water system in 1911 from a private company. It had secured additional water from time to time as sources, such as the Moffat Tunnel, became available. No program had been prepared which represented a comprehensive review of all potential sources.

A tunnel to the Blue River had been proposed and diligence work was being done on its lower end. Litigation was in progress relating to the rights of Denver to divert into this tunnel when completed.

Fortunately for me, my work had been arranged to be on a per diem basis rather than a lump sum. Much more time on my part was required than I had anticipated with the consequent delay in the completion of my reports.

In 1953, what became the Upper Colorado Storage Project was actively before Congress. Colorado was divided between its western and eastern slopes of the Rocky mountains. There was active and organized opposition on the western slope to any additional trans-mountain diversions out of the Colorado River Drainage area. In an effort to determine whether the Colorado River in Colorado had adequate run-off available for use in Colorado to enable full development of projects in its area as well as provide water for the proposed trans-mountain diversions, the Colorado legislature had provided funds to meet the costs of an independent engineering report. Leeds, Hill and Jewett had been employed to make such a report at the time I started work for Denver.

I was asked to participate in the presentation to Leeds, Hill and Jewett of the claims and plans of Denver for its water supply. This was the first priority in my work as the Leeds, Hill and Jewett report was in preparation. I undertook to meet this request but found that Denver did not have an official position regarding its program and claims. Raymond Hill was the main author for his firm of this report. He requested such a statement of Denver's position. This request panicked the staff and Earl L. Mosley, the manager of the Denver Water Department,

had to prepare the statement, putting it together to avoid conflict with the position Denver had taken in the pending litigation. I had not had time to get into the situation to a sufficient extent to prepare such a statement at the time this request was received.

I tried to assemble support for Denver's position to use in discussions with Hill but could make only limited progress prior to the time the report was completed. I later prepared comments on Hill's report for use by Denver.

When I got into this work I found that there was practically open warfare between the engineering and legal staffs of the Department. The legal counsel had stated that he was a better engineer than any engineer of the staff. Mr. D.D. Gross, the retired chief engineer, was a fine gentleman whose work had been continued after he reached the retirement age. He assisted me in every way he could but did not have the material I needed in form for my use. John Burgess had the title of chief engineer but interested himself in the daily operation of the water system. Harry Potts had been the water supply engineer for many years. He kept close watch to see that Denver received its full entitlements under the operation of its streams by the water masters and division engineers of the state. While Potts was also supposed to make plans for Denver's future sources of supply I found that he had been fully occupied with the daily administration of the supplies then in use. Mr. Mosley, the manager of the Department, was a capable engineer but had not been able to control the internal conflict in the staff.

The Denver Water Department had a Board of Water Commissioners acting as a board of directors. These were all good men who had been

successful in their own line of work but none of them had technical background in water matters. They were conscientious and devoted adequate time to their work as Water Commissioners but generally accepted the recommendations of their counsel.

I undertook this work totally unprepared for the conditions described above. I dug into the available records and prepared lists of the additional materials I would need. The engineering staff gave me full cooperation in their efforts to assemble the materials I needed. This support became even more complete when, after I had gotten fairly well into the situation, I told the board that the completion of the work I had undertaken would require more time than had been anticipated and that I was willing to go ahead or to drop out as they might desire. I also stated that if I did go ahead, I had found that I could not work satisfactorily with the attorney of the department and did not care to proceed unless it was agreed that my work would be free from any limitation by the attorney. This made me high man with the engineering staff.

This somewhat lengthy discussion of the conditions under which my work for the Denver Water Department was carried out consists largely of matters of personality which should be separate from engineering results. These conditions affected the extent of the work I had to do and the procedure under which I had to do it. The recognition of these conditions is an essential part of the understanding of the results of my work.

My work for the department was the basis for five items in my bibliographical file. These are: Item No. 99, "Review of Report of October 31, 1953 Depletion of Surface Water Supplies of Colorado West

of the Continental Divide, by Raymond Hill." The review is dated Nov. 17, 1953, 42 pages; Item No. 100 "Office Report on Moffat Tunnel Water Supply of the Denver Water Department," June 5, 1954, 135 pages and 15 tables; Item No. 101 "Office Report on the Water Supply of the Blue River Project of the Denver Water Department," June 15, 1954, 178 pages plus 54 tables; Item No. 102 "Office Report on South Platte Sources of Water Supply of the Denver Water Department," July 15, 1954, 227 pages plus 52 tables; Item No. 177 "Binder containing correspondence and miscellaneous materials relating to my part in these proceedings.

In both the Moffat Tunnel and the South Platte sources, Denver secured water from a number of individual rights. For the proposed Blue River supply it was necessary to consider the existing rights that might be affected by Denver's diversion. This condition explains the length of the reports in Items 100, 101, and 102. These reports were inventories of the stream flows involved, the existing rights to their use and my conclusions on the extent of the water supply Denver might secure from each source.

Hill made a good report on the extent to which available projects using Colorado's share of the run-off of the Upper Colorado River Basin might be expected to deplete the available water supply. Hill found that the 3,855,375 acre feet of mean annual supply by which Colorado could deplete the Upper Basin stream flow under the terms of the Upper Colorado Compact would not be available to Colorado. The terms of the 1922 Colorado River Compact requiring the Upper Basin to deliver 75,000,000 acre feet to the Lower Basin in each 10 year period could not be met with feasible amounts of carryover storage if Colorado used its full supply. Hill concluded that Colorado's usable share of

of the water supply would be limited to an average of 3,100,000 acre feet per year. He found that the extent to which Colorado might eventually use its available supply would depend on the extent to which costs for irrigation projects might be subsidized. Hill concluded that if subsidies to agriculture, for either western slope use or trans-mountain diversion, should be as large as \$600 per acre, Colorado could use its full compact supply. Larger subsidies could result in developments having water requirements in excess of the compact supply. For cyclic regulation to enable full use to be made of Colorado's water supply, carry over storage for periods longer than 20 years would be required.

In my review of Hill's report I agreed generally with his method of analysis. Hill found a water supply available for Denver's proposed Blue River project without damage to the western slope unless subsidies for western slope projects exceeded \$600 per acre. In 1953, a subsidy to irrigation exceeding \$600 per acre was generally considered to be above the limit of possibility.

Hill's report was made in 1953 and reflected general views regarding limiting costs of irrigation projects and of the subsidies to irrigation which would be justified. It is interesting to compare Hill's results with present (1967) conditions. Authorizations for projects in western Colorado have been included in the bills before Congress in 1966 and 1967. Five projects have been proposed having costs allocated to irrigation varying from \$630 to \$1710. The interest subsidies proposed under the terms of repayment to be used would average about 75% of these costs. Congressman Wayne Aspinall is the chairman of the House. He represents a western Colorado district. These projects were included in bills which started out to authorize

development in the lower basin, particularly the Central Arizona Project. There are grounds for concluding that the inclusion of these projects in Western Colorado was related to the approval of the lower basin projects by the chairman of the House Committee.

Hill's report served a useful purpose at the time it was made. His conclusion that Denver's Blue River project could divert Blue River water without preventing feasible projects on the western slope from obtaining a water supply removed much of the heat from the eastern-western slope controversy. The result of Hill's report, in my opinion, is still (1967) sound on the extent of subsidies which can be justified for irrigation in areas of generally short growing season and limited returns.

The report on the Moffatt Tunnel Water Supply brought together estimates of the extent of the supply which could be obtained from the various interception canals on the western slope in both directions from the western portal of the Moffatt Tunnel. Estimates of cost were included so that the relative economy of the separate sources could be compared. Specific recommendations regarding additional construction were not made as such conclusions depended on the similar results for the Blue River and South Platte sources.

My work on the Moffatt system supplies had an added interest to me as I had worked in the area for the U.S.G.S. in 1910. Some of the stream gauging stations I had established in 1910 were on the sources of supply of the Colorado Big Thompson project of the USBR as well as sources diverted through the Moffatt Tunnel.

The report on the Blue River system was completed in June, 1954 before the final decision of the Colorado Supreme Court on the appeal of the Blue River adjudication had been made. Consequently, assumptions

had to be made regarding the relative priority of Denver's projects and the Green mountain storage of the USBR.

Originally, Denver's Blue River project had been based on an upstream portal at an elevation above Blue River with a collection canal intercepting the main tributaries above Dillon. The computed capacity of the tunnel under the grades resulting from this location was 788 second feet. I proposed lowering the upstream portal to the elevation of Blue River and constructing a diversion dam only on Blue River as the first stage. The reduction in tunnel grade would reduce the tunnel capacity for this first stage to about 500 second feet. This capacity would meet Denver's needs for several years. When a greater supply became needed, storage could be built at Dillon to submerge the tunnel inlet and restore the tunnel capacity by the pressure head created by the adopted storage. This program would have deferred the cost of storage for a substantial period with a material saving in interest costs.

The Blue River tunnel has been constructed on its original grade and the initial construction has included a reservoir at Dillon of sufficient depth of storage to submerge the tunnel inlet. The decisions relating to these matters were made after the completion of my work on the project.

The Colorado Supreme Court decided that the change in Denver's plan from collection canals to storage at Dillon represented a new appropriation and gave it a priority of the time of the change. This change had been made in the plans to replace the collection canals after the date of the federal appropriation for Green Mountain Dam. This made Denver's appropriation junior to Green Mountain storage. The original application by Denver was senior to Green Mountain. Procedure

to make the substitution of storage at Dillon an amendment of its earlier project without loss of priority, might have given Denver a senior right to Green Mountain and placed Denver in a much better bargaining position with the USBR.

The USBR also had a suit to establish its senior right in Green Mountain over Denver's Blue River project pending in the federal court. Efforts to negotiate a settlement of this suit

were made in 1955. At the request of the Denver Water Department, I attended a meeting in Washington involved in these negotiations on September 12 and 13, 1955.

This case being in the federal court, the Department of Justice was in charge rather than the counsel of the USBR. Justice was represented by J. Lee Rankin, its solicitor, and Wm. H. Veeder, an attorney of the department. Both were advocates of federal control of water. At the session which I attended in Washington the discussion related largely to restriction which Denver was being asked to accept as a condition of any concessions relating to the Blue River supply by the U.S. These restrictions generally would require Denver to use its other sources first to their full extent. This would not be out of line with Denver's natural operations. The proposed restrictions went further and would have made the U.S. the judge of when Denver might need and could take Blue River water. After extended discussion on this basis at the meeting, I suggested that the subject of discussion was Denver's rights in the Blue River supply and that the question of whatever other water rights Denver might have was irrelevant. I was promptly sat on by Rankin. I was not invited to later meetings.

The Washington meeting lasted 2 days and ended without final

agreement. We went back to Denver. Mosley and I prepared a joint memorandum on Denver's position which we supplied to Harold D. Roberts, the attorney in charge of these negotiations for Denver. In this memorandum, Mosley and I stressed that any stipulated decree on Blue River should be limited to water rights on Blue River without restrictions on Denver's use of its Moffatt Tunnel and South Platte sources. Roberts agreed with our position and said he would litigate the case before he would concede any such restrictions. This discussion was on September 29, 1955 in Denver. I had returned to Denver at Mr. Roberts request.

I offered to arrange my other matters so I could stay over for meetings scheduled for the following week if Mr. Roberts felt that I could be useful. Roberts said he thought this would be unnecessary and I returned to Berkeley.

My next contact with this matter was a letter from Mosley dated October 10, 1955 stating that a stipulation in the federal court case had been signed. On October 20, 1955 Mosley sent me a copy of the stipulated decree with a letter stating that the board desired me to review the decree in detail and to prepare a supplemental report on the effect of its terms.

I read the decree and replied to Mosley on October 24, 1955 declining to review the decree as it practically placed the control of Denver's several sources of water supply in the discretion of the U.S. I suggested that as the USBR would operate this decree that the best report Denver could secure would be to arrange to have it made by the USBR as this would represent the nearest available interpretation of the decree by the agency that would direct its operation. This letter was the last work I did for Denver on its water supply problems.

Mr. Roberts had been retained for these negotiations. His work was not under the direction of Glenn Saunders, the full time attorney of the board. My difficulties had been with Saunders. Roberts was a member of one of Denver's largest law firms, a thorough gentleman and competent lawyer and negotiator. Roberts suffered a heart attack about half an hour before the stipulations were signed and died shortly thereafter. The Blue River Tunnel was named the Harold D. Roberts Tunnel by the board in recognition of his work on this project.

To me, the change of position by Denver in the last week of these negotiations has never been understood. I had no part in the closing procedure and have no detailed account of the negotiations. In view of Mr. Roberts' high standards I can only conclude that he was not in the physical condition to stand up under the strain that was involved. That he exhausted himself in this matter is indicated by his heart attack at its conclusion.

Much of the correspondence and other material relating to my part in the 1955 negotiations is in Item 177 of my bibliographical file. In my opinion, the results of this procedure is an illustration of the confusion and difficulties that result when self seeking attorneys attempt to negotiate engineering matters. In this case, the attorneys for the U.S. appeared to be more interested in asserting their authority than in finding an equitable solution of the controversy. I was not in on the final meetings and have not heard of the reasons why the Denver Water Board accepted this stipulated decree. Some of its provisions were not physically determinable or enforceable.

Since 1953, the Roberts Tunnel has been built and a reservoir at Dillon has been constructed. It is understood that some amendments have been secured to the stipulated decree clarifying some of its

provisions. Water has been diverted through the Roberts Tunnel in recent years.

The third source of water supply for Denver on which I reported in 1954 was the South Platte River. Denver had substantial rights in the run-off of the South Platte above Denver. The main rights were in the supply of its storage reservoirs. I reviewed all existing uses above Denver in an effort to find some of such uses which could be acquired and transferred to Denver. I found no substantial amount of unappropriated water remaining available. Conditions for purchase and transfer of some existing uses by others offered some promise but did not represent enough water to meet Denver's future needs.

Denver had been inactive in the acquirement of additional water from the South Platte since the 1930's. In the meantime, the towns along the South Platte had been growing and had acquired rights for their own use. There had been a material increase in the pumping from the ground water in the area above the point of discharge of Denver's treated sewage into the South Platte. This pumping had reduced the return flow in this portion of the river. However, Denver's sewage returns had been increasing so that lower uses had not felt the effects of the reduction in return flow.

When I found these conditions and reported them verbally during the preparation of my report I found that the staff of the department had been unaware of what had been occurring. Denver was rationing its service in order to conserve its supplies but no efforts had been made by Denver to participate in the general water use from wells along the South Platte in its vicinity. I urged active investigations of such sources and some work was done. The status of rights to the use of percolating ground water in Colorado were too uncertain in 1954

for procedures to prevent such pumping to become effective promptly.

Such a supply might have carried Denver over its period of deficiency.

The three main reports which I made for Denver were necessarily lengthy as the extent of the sources at the point of diversion had to be developed with consideration of existing rights in order to estimate the supplies which Denver might secure. These reports were labelled "Office Reports" to distinguish them from the overall official report to be prepared by Mr. Howson's firm. The results in my reports were used by Howson in his report with adequate credit given to me for the use of the results of my work. I did not participate in the drafting of Howson's report.

My work for Denver was interesting and, in my opinion, worthwhile. Much of what I did or was able to get done by the department staff should have been prepared and ready for my analysis as a part of the regular work of the department in securing full recognition of Denver's existing rights and in making plans for additional supplies. Except for my difficulties with the attorney of the board all of my personal relationships in this work were very pleasant. The spirit of helpfulness was good although the results in some instances were not all that I had expected would be available.

Opinions at this time on how Denver might have handled its water planning and program prior to 1955 are now beside the point. The stipulated Blue River federal decree is an existing fact. The Roberts Tunnel has been completed and the terms under which Blue River water may be diverted by Denver are established by such terms and their later clarifications. A report on Denver's sources of water supply made at present (1967) would start on an essentially different basis than the

conditions under which I made my 1954 reports and would reach essentially different conclusions on the conditions controlling such sources. Any present usefulness of my reports is in their assembly of water supply records and estimates for the critical period of 1931-1952. Essential changes have occurred in the conditions of 1954 which affect any present conclusions regarding Denver's future water supply program.

REPORT OF CONSULTING BOARD ON DRAINABILITY
OF LAND IN THE MISSOURI - SOURIS PROJECT IN NORTH DAKOTA

Late in 1951 I was asked to serve on a consulting board to review the reports that had been made on the drainability of the lands that had been included west of the Des Lacs River in the Missouri - Souris project of the Pick-Sloan plan for the Missouri River. Water for these lands would be diverted from the Missouri River near the Montana line. The lands involved were north of the Missouri River extending to the Canadian line. To the east of the Des Lacs River the project included lands west of the Souris River and within the Souris River loop.

The lands west of the Des Lacs River had been generally recognized as controlling the feasibility of this project. Without the inclusion of these lands the cost of service to lands further east would have been increased. The Crosby-Mohall unit, as this western area was named, included the Bowbells area in which the USBR had concentrated its investigations as a representative area for the whole unit.

This project was a part of the development of the Missouri River authorized in the 1944 Flood Control Act. This plan was a compromise plan agreed to by the USBR and the USED, to separate and define the work of these two agencies relating to the use and control of the Missouri River. This plan has been known popularly as the Pick-Sloan Plan. Its terms are understood to have been worked out by Gen. Lewis A. Pick, then Division Engineer at Omaha of the USED and W.G. Sloan, an engineer representing the USBR. It has been referred to as a "shot-gun wedding" of these two agencies. It had for its purpose, defining the functions of each agency in this area so that appropriations

could be sought by each without conflict with the other. In broad terms, the U.S.E.D. was to build the main Missouri River reservoirs and handle navigation. The USBR was to control the irrigation projects and the disposal of power to be generated at the U.S.E.D. dams.

The details of the Pick-Sloan Plan had been hastily worked out without adequate investigations. Appropriations were secured from 1945 to 1950 by both the U.S.E.D. and the USBR for some units. Garrison Dam was well along in construction by 1951.

Support locally for the Missouri-Souris unit has been stimulated and the project had been actively supported by interests in the towns within the project area. Delegations had been sent to Congress in support of appropriations for this project. To 1951 these efforts had been unsuccessful.

Doubts regarding the feasibility of this unit appeared to have arisen in the USBR. A special report had been made on the Bowbells Block of the Crosby-Mohall unit in August, 1950. This report was prepared by USBR staff personnel. Its conclusions were unfavorable to this unit.

In September, 1951 W.G. Sloan made a report for the North Dakota State Water Conservation Commission rebutting the conclusions of the August, 1950 report of the USBR. Sloan had been employed by this Commission to advise it regarding the feasibility of this unit.

The differences between the USBR and Sloan led to an agreement between North Dakota and the USBR to sponsor jointly a review of the issues involved and particularly to report regarding the drainability of the glacial till soils that would comprise the area to be irrigated.

This board was to consist of members who had not had any previous direct connection with the problems of the Bowbells or Crosby-Mohall

area. The members appointed consisted of: J.L. Burkholder, formerly drainage engineer for the USBR and then engineer of the San Diego County Water Authority; H.E. Selby, then of the U.S. Department of Commerce, Census Bureau, formerly with the agricultural colleges of Oregon and Montana; and myself. Mr. Selby was in charge of the irrigation census in the Department of Commerce.

The appointments of the members of the board were completed on December 3, 1951. As little could be accomplished in the field during the winter in the project area, the first meeting of the board was held in Salt Lake City on February 6 and 7, 1952. This meeting was attended by representatives of the USBR and North Dakota, the board was supplied with copies of past reports and a program for its procedure was worked out. Later, April 21 to 30 and May 26 to June 4, 1952, were spent in the project area and in office studies in Minot and Bismarck. The conclusions of the board were generally worked out by the end of our second session in North Dakota and I was asked to prepare a draft of our report. I did this on my return to Berkeley and the report was completed by correspondence. A copy of the pertinent correspondence is bound with the report.

California does not have soils similar to the glacial tills of the lands in this project. These are compact, have only limited permeability and have what we would call a hog wallow type of surface. There are many enclosed areas in which ponds form, either temporarily after rains or permanently. This soil has weathered to a depth of 12 to 18 inches. If levelled for irrigation much of the unweathered subsoil would be exposed giving a variable rate of absorption under flooding methods. Sprinkling had been proposed but its costs could not be met by the crop returns obtainable under the local climatic conditions.

The title of the board's report is "Suitability for Sustained Irrigation of Lands in North Dakota West of the Des Lacs River." The irrigation of about 1,000,000 acres was involved in the decision whether the Missouri - Souris project should be built. All of this area was not west of the Des Lacs River. However, the omission of the western area made the proposed canal through the Missouri Bad Lands to reach the remaining area impractical.

The board concluded that because of conditions relating particularly to drainage but including also consideration of such factors as soils, topography, alkalinity and cost of works, the lands were unsuitable for sustained irrigation. The board defined sustained irrigation as permanent irrigation successfully maintained over an indefinitely long period. The board also concluded that an attempt to change the present dry farming to an irrigated agriculture would culminate in eventual losses to the land owners resulting from inability to successfully maintain an irrigated agriculture, from losses of expenditures made by the farmers to convert present dry lands to irrigation and from losses due to a reduction in the value of a large part of the lands as a consequence of alkali accumulations in the surface soils.

The conclusions in our report were approved and adopted by the North Dakota State Water Conservation Commission. There have been no further efforts made to secure the construction of the Missouri - Souris unit as originally included in the Pick-Sloan Plan.

Some lands further east which were included in the original project consist of reworked till in lake deposits and have better permeability. As a replacement for the original Missouri - Souris project a plan had been worked out for the Garrison Project for which authorization is now (1967) being sought. This project would divert by pumping from an arm

of the Garrison Reservoir and carry the water pumped east and north to the eastern portion of the Missouri - Souris area and to land further east.

The report of our board was the final stroke that killed the Missouri - Souris project. The patient was in dying condition before our board was appointed and had only been revived by Sloan's effort to justify his original plan. The unusual feature involved is that the irrigation of these lands, with their necessarily high costs for irrigation, should have been included in the first place.

The board requested that Sloan meet with them and present his position. This was done on May 29 and 30, 1952 in Minot. Sloan contended that the Missouri - Souris unit having been authorized by Congress, there was not authority below Congress to change it. If this contention was correct there would have been no purpose in the appointment of a board. We rejected Sloan's position.

I kept requesting the USBR to supply the board with the report on which the Missouri - Souris unit had been included in the Pick-Sloan Plan. My insistence finally secured this report. It showed that the inclusion of some 1,000,000 acres as irrigable had been based on a total of some 19 soil borings.

After 1944 and prior to the work of our board the USBR had made very extensive land classifications and soil investigations. They had used equipment to excavate what amounted to shafts in the glacial till. We were lowered in these holes so that we could observe the character of the subsoil in place. The USBR had also operated an experimental farm at Bowbells to demonstrate the results of irrigation of these lands. This had not been in operation long enough to produce conclusive results at the time of our work.

Our board conceded that, if irrigated, it might take some time for the lack of drainability of these soils to have its effect. We consequently inserted the term "sustained irrigation" in the title of our report.

The present agricultural practice of this area is adjusted to the local conditions. Grain is dry farmed, generally successfully, with occasional loss of crops in period of drought. The results of the drought of the 1930's were still vivid memories locally in 1952. We concluded that an attempt to irrigate these lands might ruin a fairly successful dry farming area to be replaced by alkaline wastes resulting from irrigation.

In going over these lands the absence of livestock on the farms was very noticeable. Grain is seeded by tractor, hooking a disk plow behind the tractor followed by a harrow and a seeder. Once over prepares the ground and plants the crop. The owner is then free to spend the winter in Florida if he does not have any livestock on the place to require attention. Even if these lands were irrigable it would be very hard to convert those operating under such practices to the more intensive requirements of irrigation. A population turnover usually follows such a radical change in agricultural practices.

I found this a most interesting assignment. The board received a very cordial reception from all local interests. The agencies involved were all cooperative. I had covered the Missouri River area in 1936 for the National Water Resources Committee (see Item No. 69 of my bibliographical file entitled "General Report on District 8 comprising the Drainage Area of the Missouri River down to and including the Platte River.") In 1936, Fort Peck reservoir was under construction and the proposed projects in the Dakotas were generally local municipal

supplies of small local irrigation projects on the tributaries of the Missouri. The concept of a chain of major flood control reservoirs generating power had not been conceived or proposed in 1936. Between 1936 and 1944 the large amounts of federal funds that had been made available for construction to relieve unemployment had changed public thinking on water resource development and plans to meet the large scale development had begun to take shape. Congress had accepted federal responsibilities for flood control which opened the door to secure such non-reimbursable funds. By 1944, these changes had enabled the U.S.E.D. and the USBR to put together the Pick-Sloan Plan and to secure its authorization.

This complete change in the public concept of the federal function in water development in the eight years from 1936 to 1944 should serve to raise doubts in the minds of present day planners who are so sure they can predict the future for the next 50 years or more. We will not know the form our future water development may finally take until it has been practically completed. By that time planning will have reduced to improvements in the details of the existing developments.

While the correct decision was finally reached on the Missouri-Souris unit, it is, in my opinion, unfortunate that it was recommended by the USBR and included in the 1944 authorization of the Pick-Sloan Plan. From 1944 to 1952 much promotional effort was expended by the local interests in attempting to secure appropriations for the project. The larger part of this local support came from the towns in the areas rather than from those actually farming. This type of chamber of commerce promotional effort is not unusual in areas having an established dry farm economy when a change to irrigation is proposed. The west side of the Sacramento Valley is an illustration in California of this condition.

REPORT ON DRAINABILITY OF LANDS IN THE OaHE UNIT
OF MISSOURI RIVER BASIN PROJECT

In September, 1954, I was appointed as a member of a three man consulting board to report on the drainability of about a half million acres in the then proposed Oahe Unit. These lands consisted generally of glacial till subsoils having very low permeability.

The other members of the board were J.R. Iakisch and C.E. Jacob. Mr. Iakisch had been drainage engineer for the USBR for many years. I had known him when he was making a report on Kings River in 1940 for the USBR. Jacob was on the faculty of Brigham Young University at this time. He had been with the U.S.C.S. His particular specialty was the mathematics of ground water movement relating to formulas for the spacing of drains. The USBR desired someone working in this field on this board.

The board met in Huron, So. Dakota on September 27, 1954. The board worked in Huron to October 8 reviewing reports and examining conditions in the area involved. Later meetings were held in Denver. The report was completed on December 31, 1954.

The proposed Oahe Unit would pump from the backwater of the Oahe Dam and convey the water pumped easterly to the areas to be served. Three general classes of land were included. These had been classified by the USBR as (1) glacial till extending to bed rock; (2) lands of glacial till materials containing aquifers above the bed rock and (3) lake plain lands derived from lacustrine deposits. There were about 300,000 acres of the first class, 110,000 acres of the second class and 140,000 acres of the third class.

The board reached unfavorable conclusions regarding the drain-

ability of the first class. This land had not weathered to a sufficient depth to furnish drainage above the more dense till and drains would have to be spaced too closely in the till to be feasible. For the lands containing aquifers above the bed rock it was proposed to construct wells in the aquifers and pump them heavily enough to permit vertical drainage through the overlying till. The board also reached an unfavorable conclusion regarding the permanence of successful irrigation on such lands.

The lake plain soils were reworked till and alluvial deposits which had a better permeability than the other two classes of land. The board agreed that these lands could be tile drained. The USBR was proposing drains at a nine foot depth. The main item for the board became a decision on what spacing of such drains would be required to be effective.

The USBR had derived a spacing of 360 feet from the use of mathematical formulas which attempted to select numerical values for the factors involved. Much judgment was required in the selection of these values of these factors and the members of the board differed in their individual conclusions.

All of the board's report except the spacing of drains in the lake plain soils was worked out without disagreements between the members. A final meeting was set to attempt to resolve the differences on spacing. As the conclusions of the members of the board differed relatively widely the members were not willing to use the average of the three results. The situation was finally resolved by agreement on all features of the report except this drain spacing. Each member of the board agreed to prepare the support for his own conclusion to be attached to the report. Iakisch and I did this. Jacob agreed to do it but did

not submit his material by the time the report was due so the other results were filed without Jacob's support or his conclusions. Provision was made for Jacob to file his results later but this was not done.

In discussions Jacob stated he had concluded that the tile would need to be on a 225 foot spacing to provide effective drainage. My conclusion was 240 feet. The difference in these two results could have been compromised. Takisch concluded that a spacing of 330 feet would be effective. All these results were the result of the judgment of each member of the board based on his experience and the results of the USBR studies. We were not able to find other areas of till soils in which drains at nine foot depths had been installed.

The instructions to the board limited its work to matters of the drainability of the lands involved. We were not asked to report our conclusions of the general feasibility of the project. I was very glad to have this limitation. The project costs will necessarily be relatively high as a result of the distance water has to be conveyed. To add \$200 per acre or more for the cost of a drainage system would, in my opinion, result in total costs in excess of the benefit. The area to be served in the Oahe Unit was revised to exclude the first two classes of land and other lands of better quality were added. Efforts to secure authorization of the project have continued and are still (1967) pending.

While the board was working in Huron we met with the governor and other sponsors of the project. We were given a booster's dinner attended by the South Dakota U.S. Senators and Representatives of the towns to be included in the project. It was noticeable at this dinner that the speeches in support of the project were made almost wholly by business interests in the towns. Only one or two actual farmers who would use

the water spoke.

As a result of my work on this board I reached the conclusions on the items assigned to the board which are expressed in its report. On matters not assigned to the board I reached the conclusion that an attempt to irrigate the lakeplains lands would not have a value to these lands equal to the cost of the irrigation system. I also concluded that the irrigation of these lands involved risking that the final result would be the replacement of a generally successful and well established dry farming agricultural practice, with an eventual reduction of the total returns from the area.

The title of the board's report is that used as the title for their comments. A copy is Item No. 103 in my bibliographical file. Copies of pertinent correspondence are included with the report.

The work on this board was interesting. We had full cooperation from all of those with whom we worked. Even the differences among the members of the board regarding the spacing of tile drains never became personal. Each member of the board recognized the difficulty of reaching a specific conclusion on this item and was willing to recognize that the other member could differ from his conclusions sincerely.

The net result of the report of this board was the exclusion of the two classes of land from the project. This result could well have been reached by the USBR without having such a consulting board. However having such a board made it easier to present the results to the local interests.

WORK IN WESTERN KANSAS IN 1912

The work I did in western Kansas has been mentioned in Part I (p. 9). These results have been long forgotten but may be worth some discussion as an illustration of the way in which some federal investigations originated in that period.

Senator Curtis of Kansas was up for re-election in 1912. Prior to the Kansas primaries he secured the insertion in the appropriation bill for the U.S. Department of Agriculture's Irrigation Investigations of a provision that the availability of the money appropriated for these investigations should be conditional on the preparation of a report on irrigation from reservoirs in western Kansas. This provision remained in the appropriation bill as it was passed. To meet this requirement R.D. Robertson and I were transferred from California to western Kansas in August 1912 after we had completed our work on the report on the land and water resources of California. (Bulletin 254 mentioned on p.8 and 9 of this history.)

Looking for reservoir sites in western Kansas resembles seeking storage on a pool table. The area was flat, local streams had only limited runoff and, except for the over developed Arkansas River, there were few streams from the west flowing through Kansas.

By the time we reached Kansas on this work Senator Curtis had already been defeated in the primaries so he had no further interest in this work and we had no interference by him in our results.

Robertson and I covered western Kansas searching for possible reservoir sites. We found a few possibilities. These were insufficient to form the basis of a storage report as we discussed everything else

relating to the climate and water supply. Our report was published in 1913, as S.D. 1021 of the 62d Cong. 3d Sess. It met the requirement of the appropriation act but had little other usefulness. A copy is Item No. 2 in my bibliographical file.

One interesting result to me was the opportunity to examine the conditions in the Garden City Project of the Reclamation Service. The original Reclamation Act required the receipts of the U.S. Land Office used in the Reclamation Fund to be spent in the states from which they are received. As there was still much activity in acquirement of public lands in Kansas it was necessary for the U.S.R.S. to find a Kansas project. They selected one based on using ground water pumped from wells in the Arkansas Valley near Garden City and conveyed to adjacent mesa lands.

The plans for the spacing of these wells and the conclusions regarding the adequacy of the replenishment of the ground water were based on the results of work by C.S. Slichter of the U.S.G.S. Slichter was a professor of mathematics at the University of Wisconsin. His method is described in WSP140 on "The Rate of Movement of Underground Waters," 1905.

Slichter used the time it took injections into a central well to reach surrounding wells to determine the direction and velocity of the ground water movement. From his tests at Garden City he concluded that there was an available supply with limited drawdown for the proposed project.

The Garden City project had been built and had operated for a year or two prior to 1912. The draft on the wells resulted in a greater drawdown and a slower replenishment than had been expected. The increased lift increased the pumping costs and the cost of water became

greater than the land owners were willing to pay. The operation of the project had been stopped in 1912.

In this area generally profitable results can be secured from dry farming except in years of deficient rainfall. The landowners preferred to take their chances on the weather rather than incurring the costs of the irrigation project. Irrigation was being practiced from this ground water supply in 1912 by the local sugar company which had spaced its wells farther apart and was not pumping them as heavily as the U.S.R.S. had attempted.

The water users in the Garden City project had contracted to repay the costs of the project. After operation closed, these contracts were clouds on the land titles until Congress eventually wrote off the cost of the project and released the land owners from their liability under their contracts.

I visited this area 50 years later in 1962. The sugar company wells were still operating on the river valley floor and the U.S.R.S. project was a distant memory.

WORK IN OWENS VALLEY FOR LOS ANGELES

From 1928 to 1940 I did some work for Los Angeles on the suits brought against it by landowners in the Owens Valley. My work was supplemental to that of the other expert witnesses of the city and occurred only intermittently.

In 1928, suits had been brought against L.A. by Dodge and Dearborn alleging damage to the ground watersupply under their lands resulting from the draft on the city's wells for export to Los Angeles. I was called in after the cases were approaching trial on the classification of the lands involved. Chas. Shaw, head of the soils department at U.C. had been sought for this work. As the rules of the College of Agriculture did not permit such work by its faculty members, Shaw recommended me. I made an examination of these lands in Sept. 1928, worked up my results in October and testified briefly at Bakersfield on October 13, 1928. Later some questions arose regarding damage to trees in the orchards on these lands and I was asked to find a plant pathologist and take him over the area. I secured Wyatt and accompanied him on his field work in Dec. 1928 and attended court again in Bakersfield on Dec. 20 and 21, 1928. I attended court again on Jan. 8 and 9, 1930, and testified for about 15 minutes.

These cases were handled for L.A. by multiple attorneys each tending to follow his own views of how to try the case and by several engineering and geological experts each pursuing his own investigations. By the time the case had progressed to the point where my testimony would have followed in order, it had become apparent that the judge was becoming weary with the excess of proof presented. I was asked to curtail my material and I testified only on the general climatic variations to

which this area was subject. With so many prima donnas in the case, I still remember the embarrassment of the city's attorneys when they requested that I shorten my testimony. They had expected that my feelings would be hurt and were relieved when I expressed full agreement with their request. The city lost their cases as they had the other similar cases in the valley.

In 1939, I was asked to prepare testimony for the city in the Hillside Water Co. case. This company alleged that the pumping from wells by L.A. lowered the ground water under their lands and that this resulted in their having to irrigate earlier in the season. They claimed that the use of cold stream flow in these earlier irrigations retarded their plant growth and reduced their yield. The case had been tried in the lower court. L.A. had lost and had appealed and won a retrial. My work was in preparation for the retrial.

I went over the lands involved in Sept. 1939 and reviewed the records of the earlier trial in the L.A. office. I made another field trip in April, 1940 to observe early season growing conditions.

In the period of my work on this case, there were indications that the plaintiffs were receptive to a settlement out of court. The payment suggested for such a settlement was less than the city's cost of a retrial would be. I urged Van Norman to make such a settlement. L.A. had taken such a beating in every damage suit tried against them by a jury that Van Norman very understandably wanted to win at least one case. He thought the Hillside case could be won and wanted to have it tried. He finally consented to a settlement and the case did not go to trial. This ended my work on the case.

While I was working in the field on the Hillside case, the suit initiated by interests in Owens Lake over the inflow to the Lake in 1938

was under trial in the valley. On one of my trips, I was asked to testify in the case without having time for proper preparation. I was asked what my answers would be to certain hypothetical questions. I stated my opinions and was headed for court that morning until I asked how I was to handle my cross-examination as I had only a hearsay basis for my answers. This ended any plan to use me in this case as it was expected that the trial would be finished before I would have time for adequate preparation. Actually the trial dragged along and I could have prepared myself for testimony. This was the case in which L.A. was sued for permitting waters to reach Owens Lake in a year of large runoff after all inflow had been diverted for several years. The court found that those using the lake had had reasonable grounds for expecting L.A. to prevent further inflow and that L.A. was liable for the damages resulting from inflows in excess of the needs of L.A. This decision was appealed and upheld. It is the only case I know of in which damages were assessed against a defendant for not diverting water. Suits for wrongful and excessive diversions have been common. This case is the reverse of the usual cause for damage.

REPORT FOR CARLSBAD MUNICIPAL WATER DISTRICT

In 1955, I was asked to make a report on the water supply and distribution system for this district. The district included the city of Carlsbad and adjacent areas. The Carlsbad Mutual Water Co. secured water from wells. The municipal water district had been organized as a unit in the San Diego County Water Authority. Its only prospective source of an adequate water supply was through the Authority as a member of the M.W.D. In 1955, the only source of water supply of the M.W.D. (Metropolitan Water District) was the Colorado River.

I completed my report on Jan. 30, 1956. At that time there was a relatively heavy promotional urge to expand irrigation and other uses of water in San Diego County in order to secure the speculative returns then obtainable in land prices based on the expectation of securing the additional water supplies.

The Colorado River water supply from the Colorado River available to the M.W.D. would all be needed in a few years by the units in the M.W.D. While surplus water could be obtained in San Diego County up to the capacity of its constructed aqueduct until other demands in the M.W.D. increased, such a surplus would not be a basis for permanent development. In 1955, water from northern California was only a proposed project and the time when it might become available was unknown.

On the basis of these conditions, I advised against constructing any larger distribution system than could be supplied by the Carlsbad M.W.D.'s share of the Colorado River water supply on which it could count. In my opinion, this was sound advice to follow until an additional source of water supply was sufficiently definite that it could be relied upon to be available at a defined time.

My advice was not what promotional interests in the area desired. The completion of my report ended my work for this district.

Since the date of my report, bonds for the construction of the state's Feather River Project have been voted and the project is under construction with a delivery date of 1972 in southern California. The additional water which will be obtainable from this project will enable San Diego County to receive a sufficient water supply to meet its needs for an increased development over that which can be supplied from the Colorado River.

My report for the Carlsbad M.W.D. in 1957 is Item No. 107 in my bibliographical file.

WORK FOR SUBURBAN WATER SYSTEMS

The Suburban Water Systems is a public utility supplying water service to areas in the vicinity of Whittier. It owned lands and wells in the area of the Whittier Narrows flood control reservoir of the U.S. Corps of Engineers from which it pumped water to non-overlying lands for municipal use.

The Whittier Narrows Dam is on the San Gabriel River below the San Gabriel Valley area. Its purpose is the control of floods from the drainage areas below the upper San Gabriel reservoirs and possible spills from such upper storage. Such regulation will be needed only infrequently to prevent flooding in the coastal plain below the Narrows. Any water stored at the Narrows would be released as quickly as it could be carried by the Rio Hondo and San Gabriel channels without damage. The period of storage at the Narrows would be relatively short, generally only a few days. The storable flows at the Narrows since the construction of the dam there have been relatively small. The Whittier Narrows dam represents insurance against the infrequent major floods on the San Gabriel drainage area. Its cost would not have been economically justified on most streams. The extensive development of the coastal plain below the Narrows and the great damage that would result from overflow was found by the Corps of Engineers to justify the project cost. This conclusion was questioned at one time by state engineer Edward Hyatt.

The depth of storage in the Narrows Reservoir is small enough that wells can be protected by earth mounds extending above high water. Such protection was planned for the wells of the Suburban Water Co. When the company and the army engineers were unable to agree on the value

of the flowage easement on the company lands and the cost of the protection of its wells, a condemnation suit was brought to determine the value to be paid. The army engineers did not seek to condemn the water rights of the company. It was recognized that the flooding of the proposed mounds around the wells would be too infrequent to justify condemning the ground water supplies.

I was asked by the Suburban Water Co. to prepare testimony for them on the value of the water right of their wells in the area being condemned. As these water rights were not being condemned, at first, I did not see any need for their valuation. However, the procedure being used required the valuation of the total property involved before condemnation and after, the difference representing the damage to the owner. Although the value of the water rights would be the same in both of these valuations, if they were not taken or damaged by the condemnation, it was necessary to have such valuations in this form of procedure.

I undertook to prepare such testimony. I was involved only in the valuation of the water rights. Costs of construction of the protective mounds and land values were handled by others.

The valuation of water rights as separate properties is difficult, since there is no established market for water rights similar to the market for lands. The value of water rights is usually individual depending on the dependability of their supply and the opportunity to transfer their use. Individual sales that may be found vary widely.

I did the usual assembling of sales of water rights for which prices could be derived where conditions resembled those involved in this case. I found supported sales varying generally from \$800 to \$2000 per miners inch (1/50 of a sec. ft.). I concluded that the water supply

of the wells at issue was dependable and title to its use was established. I placed a value of \$1500 per M.I. on these rights if they were to be sold for other uses.

The mounds proposed to protect these wells represented some problems in access at time of storage in the reservoir. I concluded that a willing buyer having the choice of buying either these water rights or another otherwise equivalent source not subject to much storage would be willing to pay 10% more for the alternate sources. Consequently I reduced my appraisal of these rights with the reservoir by 10% from their value without the reservoir.

I began work on this case in January, 1957. The trial was held in June, 1960. The condemnation had been filed in 1951. I did preliminary work in 1957, made my appraisal in 1958, had various conferences with the attorneys and other appraisers in 1958. I was then inactive for about 18 months until I was asked to testify in June, 1960. In 1958, I had presented my conclusions which did not appear to agree with the plans and policies of the company in this case and I had understood that no further work on my part would occur. I was in agreement with this conclusion. In a letter to the attorney for the company dated May 16, 1960, I continued to recommend that I should not testify. When my testimony was restricted to the basis previously stated I agreed to participate. Having incurred costs to the company on this work, I felt obligated to testify if my evidence was kept within the work I had done and the conclusions I had reached. The company concluded that the testimony I would give would aid their case.

My work on this case introduced me to what had become almost a separate branch of legal practice in southern California. With the extended program of freeway construction, condemnation cases for rights

of way had become numerous. Various law firms had specialized in this branch of practice as it had its own rules and precedents. Business for the appraisers of the value of the lands to be taken was also active. These conditions carried over into the Suburban Water Co. case.

I have had no further connection with this case since 1960. The award was made and I understood was paid. Its amount was about what the army engineers had offered. It is my understanding that submersible pumps in sealed wells were installed by the company in its wells instead of constructing the proposed mounds around the wells. In the years since 1960, there has been only limited amounts of storage in Whittier Narrows Reservoir.

ECONOMIC REPORT ON CAWELO WATER DISTRICT

In April, 1965, I was asked by the Cawelo Water District in Kern County to make a report on their ability to pay for water from the state project. Such water was to be purchased through the Kern County Water Agency. At that time, applications to the Agency for such a water supply were expected to be made by July 1, 1965. It was considered by the district that my report would need to be completed by June 1, 1965. This restriction on the time available to make such a report made it necessary for me to adopt the results that had been made on other comparable projects to the conditions in the Cawelo District. Time was not available for me to make my own economic studies of local conditions in the district. I had worked in Kern County previously for the state both in water supply investigations and in water storage district procedures and was familiar with the general physical and economic conditions in the district.

Boyle Engineering was the engineer of the Cawelo district. Their Bakersfield office was directed by T.S. Mattock. Robert E. Price had done most of the work on the Cawelo District. Leeds, Hill and Jewett were the consulting engineers of the Kern County Water Agency with Myron Holburt as resident in charge.

Boyle Engineering had proposed an estimate of the location and cost of a conveyance conduit from the state aqueduct near Tupman across the valley and its extension into the southern part of the Cawelo District. At that time it was not planned to extend the local distribution system into the northern part of the district until development there resulted in a need for additional water.

I received copies of various reports that had been made by the USBR on its C.V.P. units, by the state on other proposed units of its project and by local interests. David Weeks had made reports on some of the proposed Kern County units of the Agency and Leed, Hill and Jewett had made reports on the overall agency service. I found eleven reports of these types whose results could be compared and applied to the Cawelo District.

Interpretation of the results in these reports was needed in applying them to the Cawelo District. The USBR had used a different basis for their estimate of ability to pay than other agencies. Because it would be inconsistent to base its estimates on farm sizes in excess of 160 acres as long as the USBR supports the use of the 160 acre limitation of the reclamation law, the USBR develops its result on a farm budget basis for such farms. Other agencies usually estimate the acres of the different crops to be grown and derive a price for water which they conclude each crop can afford to pay. The USBR results are usually somewhat lower than those of the other agencies as a result of the method they have felt compelled to use.

My report was completed by June 1, 1965. A copy is Item No. 146 in my bibliographical file. I met with the members of the board of directors of the Cawelo Water District on June 10, 1965 for a lengthy and frank discussion of the results of my report and the problems of the district.

The Cawelo District included about 47,000 acres lying north and east of the areas under Kern River Canals. It had about 30,000 acres under regular irrigation from wells and an additional area of about 10,000 acres was dry farmed. The soils are good. In 1965, cotton and alfalfa were the principal crops. Pumping from its underlying ground

water began about 1934. Overdraft soon developed. Good yielding wells were obtainable in all parts of the area. By 1950, the existing wells had depths of 1400 feet or over. The static lifts varied from 150 to 350 feet. By 1965, the average lift was about 410 feet.

In 1965, the Cawelo District represented a well developed area with an overdraft on its only available ground water supply. This development had been profitable to date. The practice could be continued for some undefined length of time with a rapid rate of ground water lowering and eventual exhaustion. To prevent such a result some imported source of water supply was needed.

The state project water would be available in 3 or 4 years and offered the only source of imported supply then definitely in prospect. The area in the district is also within the service area of the proposed USBR East Side Canal. This canal is a definite project of the USBR but had not been authorized in 1965. It could well be 20 years before deliveries from it would be available in this area.

The alternates faced by the district in 1965 consisted of (1) continuing to use their lowering ground water for perhaps the next 20 years in the hope that the East Side Canal would then make available water at a lower cost than bringing water from the state's canal on the west side of the valley, or (2) avoiding such ground water depletion by buying enough state water to meet its overdraft during the next 20 years, with the anticipation that the additional water can be purchased to meet the ultimate needs of the district from the East Side Canal. Water purchased from the USBR would include acceptance of the 160 acre limitation unless a change in this law is made. This should not be a serious problem in this district by the time the East Side Canal supply may be secured as the supplemental supply from the

USBR could be used on the acreage within the acreage limitation.

I presented these alternatives to the board at a meeting on July 10, 1965. I pointed out that it was their property which was involved and that the decision on what action should be taken should be made by them. My report included results on what water from the state's project would cost and my conclusion regarding their ability to meet such costs from the crop returns obtainable from its use. As the present operators are generally well organized business enterprises, I told the directors that their own books could give them a better answer regarding what they could afford to pay for water than conclusions I might reach from general cost and return studies.

I advised the board that based on the information then available, if I was a land owner in the Cawelo District, I would support application for state water and the cost of its conveyance to the district. Before a final contract for such a supply should be made further cost and other studies should be undertaken. These conclusions are discussed in my report.

The cost of state project water to the Cawelo District will be higher than to the lower lying units on the west side located more nearly along the main state canal. This larger cost to the Cawelo District is, in my opinion, more than offset by the extent of present development. The land owners in the Cawelo District have already incurred the cost of development of their own lands. This cost cannot be recovered except by continued operation. These land owners can and probably would continue their operation as long as they can earn their operating costs. They can forego interest on their investment as the investment would be lost if operation is abandoned. The early development of the Cawelo area has resulted in

its lands having a good cotton history so that the continued growth of this crop can be anticipated. This may be a major advantage in comparison with the undeveloped west side units lacking cotton history for their lands. There has been enough citrus planting in the Cawelo District to indicate that much of its area is adapted to such crops. Citrus plantings have been increasing rapidly in recent years.

In my report, I derived an estimated payment capacity of lands in the Cawelo District of \$42.25 per acre foot for the conditions of full development. I also derived an estimated cost of state water delivered at the farm headgate of about \$33 per acre also delivered at the farm headgate. The cost of state water would be higher than the estimated cost of continued ground water pumping.

These are all relatively high costs in comparison with the similar estimates prepared when the plans of the C.V.P. were made. They are several times the \$3.50 per acre foot for Class 1 water under the Friant-Kern Canal. This \$3.50 price was derived on the basis of the ability of the irrigators to pay in the same general area.

This wide difference is due to the effect of several factors. Inflation between 1940 and 1965 is one. The USBR Class 1 water price also represents the ability to collect rather than to pay. A third factor is the increase in acreage yield that has occurred between these dates.

In the work for the state in Kern County in the early 1920's, a yield of 3.5 to 4.0 tons per acre for alfalfa was a good project average. In 1964, the report of the Agricultural Commissioner of Kern County reports an average alfalfa yield for the county of seven tons per acre. A similar result is shown for cotton yields.

As a result of my report for the Cawelo Water District, I was

asked in July, 1965 to make a similar economic report on the Sunflower Valley Water District. This is a small district on the west side, west of Devil's Den, which planned to secure water from the state canal. It was entirely undeveloped at this time. I advised the person desiring this report that the conditions there were quite different than in the Cawelo District and a similar favorable conclusion on my part could not be relied upon. It was arranged that I should make a brief preliminary investigation and report and that a decision of my making a more complete investigation should be deferred until my preliminary results were available. I made a brief report on July 29, 1965 based on a three day investigation. I was paid for this report and have heard nothing further from those for whom my report was made. It is my understanding that an option had been taken on these lands in the hopes that they could be sold to some Hollywood interests. When my report was received, this plan was not completed. The arrangements for my work were made by telephone and correspondence and I did not meet any of the principals involved. My local work was aided by Mr. Glen Stoller, Agr. Lab of Bakersfield, who had made soil tests of the district lands and took me over the area as well as supplying me with the results of his tests. A copy of my preliminary report on the Sunflower Valley District is bound with my report on the Cawelo Water District (Item 146 in my bibliographical file.) While my report on the Sunflower District has not been released for general use, it was made on a public district and should not be classified.

APPRAISAL OF VALUE OF WATER RIGHTS OF BOULDER CREEK

DIVISION OF CITIZENS UTILITIES CO. OF CALIFORNIA

In November, 1962, I was asked by John Lynch, attorney for the San Lorenzo Valley County Water District, to prepare an appraisal of the above water rights for use in the pending condemnation suit of the District seeking to acquire the properties of the Citizens Utilities Co. used in the service of lands in the District. I had worked with Lynch on the appraisal of the water rights of the Nigger Hill ditch in the Folsom Reservoir area when he was an assistant U.S. Attorney in the office of the U.S. Attorney for Northern California. I undertook to make such an appraisal. I went over the properties involved in late 1962 and reviewed available reports and other records in early 1963. Work was then suspended pending a decision regarding procedure to be followed in which the Citizens Utilities Co. sought to have the District's complaint in condemnation dismissed. When the District was sustained in its form of procedure I resumed work in March, 1964 and continued intermittently until June, 1965 when the case was settled by negotiation. I made a deposition at the request of the Citizens Utilities Co. on Dec. 8, 1964 and a report to the District in January, 1965.

The Citizens Utilities Co. secured its water supply for its Boulder Creek Division from different sources. The most important issue in the appraisal of the value of the water rights were the supplies secured from several local streams where the Utilities Co. owned the watershed lands. These lands had been dedicated to public service as protection to the quality of their runoff. The value of these lands for rate purposes had been determined by the P.U.C. based

on this dedication. The P.U.C. rate base used the cost to the utility of these lands.

As the runoff of these lands had also been dedicated to public use, it was not available for sale in the open market. A purchaser, other than a local district which could relieve these waters from their obligation of public service, could only use this water supply for the continuation of its present use and could not transfer it to other uses. This limited the available purchasers to an organization, such as the San Lorenzo Valley CWD, which could relieve the utility of its obligations for public service or to a succeeding utility whose earnings would be limited by the value of these lands which might be included in the rate base.

The ownership of watershed lands as a means of protection of the quality of their runoff was an early California practice. Both the Spring Valley Water Co. serving San Francisco and the East Bay Water Co. serving the East Bay area acquired extensive areas of the watershed lands which they used for this purpose. These acquisitions were made when land values were low and the dependability of water treatment less fully accepted by the public.

Both of the above companies have been acquired by public agencies by negotiated purchase. The valuation of such lands subject to their dedication for public use in condemnation proceedings has not been directly before the courts. As population increases and general land values increase, a point will be reached eventually where lands become too valuable for other purposes to be used only for the protection of the quality of their runoff.

The Citizens Utilities Co. had not sought to be relieved of its dedication of its watershed lands from their obligation of public

service. As long as this dedication continued, I considered that their value in a sale to a succeeding public utility would be based on the value used in the rate base. I also considered that a purchasing public agency should not be penalized by being required to pay more for these lands than their earning value under their existing uses.

The issue involved in the valuation of the water rights based on the ownership of the watershed lands in this case is a difficult one. The purchasing public agency should not be required to pay more for the properties to be acquired than their worth to their present owners under their obligations for public service. The utility should be entitled, by some means, to service similar recognition of the increase in land values that other lands have received. When the amounts

at issue become large enough, the remedy where available would generally be to secure a substitute water supply or to treat the local runoff and thus release the lands from their dedication to public service.

My report is entitled "Appraisal of the Water Rights of the Boulder Creek District of the Citizens Utilities Co. Prepared for the San Lorenzo Valley County Water District." A copy of this report is Item 144 in my bibliographical file. In this report I attempted to discuss their conditions and issues.

I did not participate in the negotiations in which a settlement of this case was reached. The price agreed to be paid by the district was higher than the sum of the valuations placed on the parts by the appraisers for the District of the different parts of the property to be acquired. I have not to date (1967) learned of the basis on which the terms of the settlement were reached.

"WATER IN CALIFORNIA"

This 231 page book was published in July, 1960, prior to the voting of the \$1,750,000,000 of state bonds to construct the Feather River Project. Its history goes back into the 1940's.

When California was approaching the end of its 100 years of statehood in the 1940's, a program was developed by the University for a series of books covering different phases of California's history. Prof. Herbert Bolton was in charge of this program. Some 18 subjects were outlined. One of these subjects was water.

Prof. Bolton asked me to prepare an outline of what should be included in such a book on the history of water in California. I did this. The outline appeared to fit the program that was in mind and Bolton asked me to prepare this volume. I accepted this request and completed such a manuscript in 1949.

My manuscript had been written to include chapters on the history of the different uses of water in California. It also included material on the extent of California's water supply and some comments on its future use. This brought out the difference between the treatment of such a subject by an historian and an engineer. My manuscript was not accepted for the centennial series. The University's plan for an extensive series was also not completed.

I dropped any plans for using the material I had assembled in preparing my 1944 manuscript for several years. Finally in the later 1950's, I resumed work on this material as an individual project. In the intervening years the state had proposed its state water plan and there were additional matters in the water field in which there was increased public interest.

I completed my later manuscript in 1959 and submitted it for comment to some of those active in its field. Eventually, I made arrangements with the National Press of Palo Alto for its publication. Its publication was completed in July, 1960. About 1500 copies were printed. These had all been sold by 1963. It has not been reprinted or revised.

In writing the published volume I was free of the historian's restrictions of being only a reporter of facts. I included material on the extent of California's water supply in relation to its ultimate needs and my own analyses and opinions on the matters of public interest in its subject field.

The reviews of the book were all favorable. However, such reviews did not result in enlarged sales. The book has been well distributed in libraries and among those active in water matters. It was prepared mainly as a factual treatment of the matters discussed. It lacks the glamour of threatened catastrophies if unrestricted water developments are not undertaken. It was not intended to promote an increased rate of development of individual projects that were being proposed. It attempted to discuss the water conditions of the state and the pending problems relating to water on a factual basis.

In my opinion, the book has met its purpose. It will be used mainly as a reference source for its subject and time of publication. Its historical background will remain useful regardless of the character of our future development.

In the seven years since the publication of this book, rapid progress has been made in the construction of water projects. These have been largely by state and federal agencies. No book in this field can remain up to date for any lengthy period of time. This is

true of this book and it should be revised before it should be re-issued at this date (1967) or later. When the state has completed the construction of its Feather River Project and the USBR has received authorizations of its proposed additional projects may offer a good time for such a review of the conclusions expressed in 1960. The time when the completion of present active projects may occur is too far in the future for any consideration on my part of preparing such a revision.

In any later discussion of water matters in California, a greater extent of attention will need to be given to sources of water supply outside of California which it is being proposed should be imported. The proposed Pacific Southwest Water Plan has injected much different standards of feasibility than those considered in our projects in 1960. Such a regional approach is mainly a development since 1960.

One of the gratifying results of publishing such a book as "Water in California" is the unexpected expressions of appreciation to which it may lead. The following is a copy of a letter I received in May 1967 from an engineer I did not know:

"This is just a note to thank your for having made the effort to write "Water in California" back in 1960. Quite by accident I found the book in our public library and have just finished reading certainly with pleasure and, I trust, with profit. It feels good to gain the historical perspective the book affords."

ENCLOSED LAKES OF THE GREAT BASIN

Work which I was doing in the western Great Basin beginning in 1915 aroused my interest in its enclosed lakes. Over the years, as time was available, I made field trips to these lakes trying to work out their fluctuations over periods longer than those covered by our direct stream flow records. I also made library searches for reports from which the past stages of these lakes could be identified.

The results of my work in this field were prepared in typed reports on each lake. Copies of these reports have been filed with the Water Resources Center Archives. Copies are also in my bibliographical file. The results for the lakes in the western Great Basin were combined in a report entitled, "Recent Variations in the Water Supply of the Western Great Basin." This was published in 1965 as Water Resources Center Archives Series Report No. 16. The purpose of this publication was to make available the results of my observations. Some of these results, such as the ring counts on trees killed by the rise of some of the enclosed lakes, cannot be duplicated now as the trees have decayed.

This publication also includes my own conclusions regarding the variations in their water supply that have occurred in the recent past that can be applied to the extent of variation that should be provided for in present projects in this area. Anyone interested in this field can use the records presented to reach their own conclusions. The factual material I had found is presented; others may reach different conclusions using this material.

The area covered extends from Goose Lake to Mono Lake, a distance of about 300 miles along the eastern face of the Sierras. It extends

eastward into the Great Basin as far as Humboldt Sink.

The records indicate variations within the area.

Some parts may have excess runoff at times when others have a deficiency. This is to be expected as the more southern parts of the area are within the area of influence of storms from the southwest while the northern parts reflect the effect of more northerly climatic conditions. The overall picture is one of extensive variations, both annually and for a series of years, in all parts of the area.

Publication no. 16 also contains comparisons of the water supply variations found in the western Great Basin with those in the different areas surrounding this area. The adjacent variations are generally similar to those in the Great Basin. This publication also compares the available results of tree ring observation in the area covered with the results based on fluctuations of the enclosed lakes. The tree ring observations available were generally made in the 1930's and may not represent as careful results in the selection of trees in critical locations as present practice in this field. It was found that different tree ring results may not be consistent with each other. While the width of the tree rings may be a general indication of the extent of the annual precipitation, other factors affect tree growth. The available tree ring results did not appear to represent a directly useful basis for estimating the annual stream flows.

From the records assembled in Publication 16, I concluded that the seven years, 1923 to 1935, were probably the most deficient period in water supply in the past 300 to 400 years in this area. Any project now proposing to use the water supplies of this area should be planned on the basis of limiting its shortages to amounts which can be endured in such a seven year period.

The records in this area also indicate a long period of deficiency extending into the 1840's. The details of the records during this period are not adequate to define the shortages that may have occurred in parts of this longer period. It does not appear to be probable that any seven years prior to the 1840's had as severe a deficiency as 1928 to 1935.

While the interest in individual projects is mainly in the periods of deficiency, the periods of excess also have interest in this area. The length of the periods of deficiency are too long to enable the variations to be equalized by storage even if sites above the areas of use which could be built at low cost were available. Such storage would be subject to evaporation, and the surplus runoff stored in periods when it was available might be lost before it was needed in periods of deficiency.

The enclosed lakes into which the streams of the western Great Basin discharge represent carryover storage of the variable runoff which nature has provided without costs for construction. The extent of the present uses of this inflow is resulting in a marked lowering in nearly all of these lakes. However no extent of diversion of this inflow which can now be foreseen will result in intercepting all of this inflow and the excess years will continue to maintain enclosed lakes in their present areas. Such lakes will have smaller areas than those in the pre-development period and their water will continue to have an increase in dissolved solids as it becomes more concentrated. The present water in the enclosed lakes is too high in dissolved solids to be usable for irrigation. In time this content may become high enough to affect fish life in these lakes. This condition has already been reached in Mono Lake.

My work on the enclosed lakes of the western Great Basin represents a very rewarding part of my experience. The field of water supply and water rights in which much of my engineering practice was involved is necessarily one of controversy in an arid area where the supply is almost always less than the demand. It was a relaxation to try to work out the past history of the enclosed lakes from the clues which nature had left regarding their fluctuations. Nature does not talk back to those who try to read her history. Nature will not disclose all of her record but she will not deceive the investigator. Nature will let the investigator mislead himself without protest. These conditions provide a pleasant stimulus to efforts to read nature's records of the past. This stimulus is generally free from the conflicts of individual self interest in the results. I am glad I had the opportunity to do the work I have done in the field on the enclosed lakes. This occurred at a time when the conditions were more nearly those existing prior to development than they will be in the future.

EVAPORATION FROM WATER SURFACES

In 1936, I was appointed chairman of a research committee of the American Geophysical Union on evaporation from water surfaces. This appointment probably resulted from the work I had done on the evaporation from Tulare and Buena Vista Lakes in California. These, with later results on some of the enclosed lakes in Nevada and California, represented the use of the lake fluctuations at times of measured or zero inflow to define the evaporation. The results were the evaporation from large water surfaces as distinguished from results from observations with various forms of evaporation pans or computations based on heat budgets.

This committee had 12 members from various parts of the U.S. We were never able to have a committee meeting. In June, 1937, six members attended a meeting of the Hydrology Section of the AGU in Denver and held an informal partial meeting of the committee there.

The membership of the committee was as follows: Harry F. Blaney, N.W. Cummings, Robert Follansbee, J.A. Folse, Robert E. Horton, Ivan E. Houk, R.E. Kennedy, G.F. McEwen, Carl Rohwer, C.M. Saville, Thorndike Saville, and S.T. Harding, Chairman.

Several of the members had their own formulas or methods of deriving evaporation. As chairman I handled most of the work of the committee by correspondence and acted as moderator in arguments relating to the views of the members.

Cummings was a physicist on the faculty of the San Bernardino Valley Junior College. He was an advocate of determining evaporation from records of solar radiation. He had been the joint author with

Burt Richardson using I.S. Bowen's approach based on this method. Cummings applied his method by observations for one season on Bear Lake in Utah made in cooperation with the Utah Light and Power Co. It took him as long to work up his computations as the period during which he made his observations. A manuscript copy of his results which he made available to me has been given to the Water Resources Center Archives.

Folse was with the Museum of Science and Industry in Chicago and had a method based on his work with Hayford for deriving the evaporation from the Great Lakes. Some of his results have also been given to the Water Resources Center Archives.

Horton was retired from the U.S.G.S. and had his own hydrology laboratory at Voorheesville, N.Y. which he operated as an experiment station at his own expense. He was a vigorous supporter of his views. Our correspondence and meetings were always interesting.

Kennedy had been state Engineer of North Dakota and was then working for the USBR on special studies. He had also developed individual ideas on evaporation.

McEwen was with the Scripps Institute of Oceanography at La Jolla and was working on evaporation from the oceans.

Blaney was with the Irrigation Investigations of the U.S. Dept. of Agriculture. He had done extensive work on the consumptive use of irrigated lands and have been associated with A.A. Young in the same organization on his work on evaporation from water surfaces.

Follansbee was the District Engineer of the U.S.G.S. at Denver and had worked on evaporation in that area. Houk was with the USBR and had compiled the available results on the USBR projects. Rohwer was also with the U.S. Dept. of Agriculture, stationed at Fort Collins,

Colo. He had continued Sleight's work there. C.M. Saville was the engineer of the Hartford Water Co. in Connecticut; Thorndike Saville was a member of the faculty of New York University.

The committee had a wide and extensive background in its field. Evaporation was a subject of widespread interest in the 1930's resulting from the increasing use of storage projects in which it was a factor.

While there was much divergence in the opinions of the individual members of the committee we all agreed that some publicly supported and extensive program should be undertaken in an attempt to secure comparisons of the different methods being proposed. The first need in such a program was some large water surface where the records of the other elements of inflow and outflow enabled the evaporation to be computed as the missing item in the water supply balance.

The Committee prepared a report on such a proposed program of investigations in March, 1938. This was published in the Transactions of the 19th Annual Meeting of the A.G.U. Both Walker Lake in Nevada and Lake Elsinore in California were suggested as lakes where the evaporation could be derived from the inflow records. Neither lake had appreciable inflow.

The program proposed by the committee was not undertaken at that time. It probably had some influence later on the undertaking of the similar program at Lake Hefner in Oklahoma. In my opinion, there is still a need for a similar program undertaken within the arid areas of the western U.S.

In the 1930's there was an active awakening of general interest in the field of hydrology. No adequate book on this subject was then available. With the support of the National Research Council, Oscar E. Meinzer undertook the editing of such a volume. Meinzer was then

in charge of ground water investigations for the U.S.G.S. The resulting volume entitled "Hydrology" became Vol. 9 in the Councils' Physics of the Earth Series. The first edition was published in 1942. The third impression was printed in 1949.

Recognizing the broad coverage of the field of Hydrology, Meinzer prepared an outline of the chapters to be included and asked different individuals to prepare the chapters. There were 24 co-authors of the book as published.

In 1936, Meinzer asked me to prepare the chapter on evaporation from water surfaces. I undertook to do this using the availability of the evaporation committee to secure comments and suggestions regarding what should be included. I prepared a draft of this chapter and circulated it in the committee. The final draft as published consisted of 26 pages in the volume.

About all that could be done in a chapter on evaporation completed in 1940 was to report "on the state of the art." None of the methods of computing evaporation from solar radiation had been established by comparison with actual results on large water surfaces. All types of pan observations required the use of factors to convert the results to the evaporation for open water surfaces. Such coefficients were fairly well established for the amounts of annual evaporation but results applicable to monthly losses were lacking. The extent of the effect on the evaporation from shallow and deep water resulting from heat storage in the deeper lakes and reservoirs had not been determined. Some of this information is still incomplete.

The chapter on evaporation in Meinzer's Hydrology, in my opinion, represents a reasonably good progress report for the time at which it was prepared. It would not be recommended being a similarly adequate

treatment to be prepared at the present time.

Meinzer also asked me to prepare the chapter on Lakes for his Hydrology. This request was the result of my work on the enclosed lakes of the Great Basin. I agreed to prepare this chapter. As it needed to cover lakes in general, I included material I could assemble from other areas. In my opinion, this chapter did not contribute much to the quality of the volume except for the portion relating to lakes in the Great Basin where I was more at home.

No book with 24 separate authors will have an even quality in its several parts. Meinzer's authors were well selected. Some did a better job than others. A few of the original authors selected failed to submit their assignments on time and late replacements were made. Some chapters read as if they had been dictated without detail study of their subject matter. Overall the volume served a useful purpose. It probably stimulated interest as well as understanding in its field. At present, it represents one step in the development of this field. Its usefulness has now been reduced by more recent publications.

The most distinctive contribution which I consider I have made in the field of evaporation was a short paper published in the Journal of Irrigation and Drainage Division of ASCE in March, 1962. This is entitled "Evaporation from Pyramid and Winnemucca Lakes." It compares the results for the monthly evaporation from Winnemucca Lake just before it became dry and had a shallow depth with that from the deeper Pyramid Lake. The amounts of annual evaporation for these two adjacent lakes are in good agreement but the monthly results vary. Winnemucca Lake had about a foot greater evaporation in the early season months and about the same amount of lesser evaporation in the late season months. This is the result of heat storage in Pyramid

Lake with later release. This comparison was made possible by the observations made by E.P. Osgood on Winnemucca Lake as it was going dry. I made the computations to derive the evaporation results used in this paper.

In the 1950's, extensive investigations relating to evaporation were made at Lake Hefner in Oklahoma. Results obtained by heat budget methods were compared with the evaporation from the lake derived as the unmeasured item in its water supply budget. Generally satisfactory results were secured.

The USBR has been attempting to determine the evaporation from Lake Mead as a part of its operation of the Boulder Canyon Project. Unmeasurable bank storage prevents the computation of evaporation as the only missing item in the water supply balance. The methods used at Lake Hefner were tried at Lake Mead. It is understood that the extent of the observations and computations required in this method has resulted in the continued use of evaporation pan records.

The methods based on solar radiation and sometimes referred to as "heat budget" determinations **involve** measurement of the incoming heat supply. Available instruments enable such records to be secured. Not all the incoming solar heat is absorbed by the water and a less certain item for back radiation to the sky needs to be included. While the heat budget methods have a sound theoretical basis, they have not been developed for convenient use in the usual practices of reservoirs.

The usual present practice in the measurement of evaporation is based on the observations of the loss from pans. Several different types and sizes of pans have been used. At present the Class A U.S.

Weather Bureau pan has been generally adopted. This is a 4 foot in diameter pan set on the ground surface. It has a water surface area of about 12 sq. ft. Floating pans have been used but have been found to be difficult to maintain. If floating pans are adequately protected from wave action they will also be, at least partially, protected from wind action.

Reservoir areas from which evaporation occurs may have areas of several square miles. A Class A pan has an area of about one-23 millionth of a square mile. The evaporation pan is, in effect, a model of the evaporation from the larger water surface. The model scale is very small and too close agreement between the model and the prototype should not be expected. However, the results of observations with evaporation pans usually show consistent annual results with the evaporations from adjacent large water surfaces.

U.S. Weather Bureau Class A pan results are now generally available in the general vicinity of nearly all areas where evaporation results are needed. J.E. Christiansen at the State University of Utah has made and sponsored extensive studies of the relationship of evaporation from Class A pans and other climatic factors measured by the U.S.W.B., particularly temperature and wind movement. Such results can be used to estimate what the evaporation from a Class A pan should be for areas for which the other items have been recorded. These methods enable the probable evaporation from Class A Weather Bureau pans to be derived for nearly all areas in the United States. They do not remove the need for interpreting such derived or directly observed pan results in terms of the evaporation from large water surfaces.

While the annual results from evaporation pans are usually

found to give a consistent result in comparisons with the evaporation from adjacent larger water surfaces, similar agreement is not found in the monthly results. This is the effect of the difference in heat storage in the shallow pan and in the deeper water of a reservoir or lake. The annual evaporation from the Class A Weather Bureau pan needs to be reduced by a factor of 0.7 to 0.8 to give comparable results with large water surfaces.

Efforts have been made to reduce the evaporation from water surfaces by covering them with mono-nuclear films which prevent or reduce the vapor movements in evaporation. Such layers have been successful where used on small undisturbed areas. Wind movements tend to destroy the continuity of the film on open water surfaces subject to wind action. To date the problems involved in such methods have been economic. The cost of maintaining such a film on large water areas has been high in comparison with the value of the reduction in evaporation accomplished.

The water supply available on land surfaces has its origin in evaporation from the oceans. Evaporation is an essential item in the water supply cycle. Wherever evaporation from water surfaces or land areas can be reduced, useful water can be conserved which increases the available useful supply. It is not probable that evaporation suppression methods will ever be found that will be economically applicable to large water areas. There are however, means of reducing evaporation such as storing water in deeper reservoirs of smaller areas which may reduce the measureable evaporation losses.

Evaporation losses are a major factor in the economy of long time carryover storage. The complete regulation by storage of the usually widely variable runoff of streams in the arid area may not

produce as much net usable water supply as some lesser extent of regulation. The evaporation from the water supply stored in years of large runoff may exceed the supply stored if the period before it is needed for use is extended. On some western streams not over 80 per cent of the mean annual runoff can be conserved for a uniform annual use.

THE PACIFIC SOUTHWEST WATER PLAN

Following the decision of the Supreme Court in the Arizona-California case, Secretary of the Interior Udall made his first report on a Pacific Southwest Water Plan in August, 1963. The comments by the affected states were so generally unfavorable to this report that a second report was issued in January, 1964 making changes in the plan proposed in the first report.

Bills were introduced in Congress seeking the authorization of the Central Arizona Project which included various parts of the proposed Pacific Southwest Water Plan. California opposed the authorization of any new projects on the Colorado River in the Lower Basin unless she received a recognition of a prior right for 4,400,000 acre feet per year. After extensive meetings, hearings and discussions H.R. 4671, 89th Cong. was introduced by Congressman Udall of Arizona on February 9, 1965. Hearings were held on this bill in 1965 and 1966, it was reported out favorably by the House Committee on Interior and Insular Affairs in 1966 but did not reach the floor for action.

In 1967 various bills have been introduced in the 90th Cong. and hearings have been held by both the House and Senate Committees. To date (June, 1967) agreement on any bill which can be passed does not appear to have been reached.

On February 1, 1966, I completed a report entitled "The Pacific Southwest Water Plan, The Record through 1965." This report conforms to its title except that at the time I prepared it I had not secured a copy of the 1965 printed report of the hearing on H.R. 4671. I had general information, however, on the results of this hearing. This

report is 96 pages and reviews the record to its date. It is Item 156 in my bibliographical file. I may prepare a supplement to this report covering 1966 and 1967 at the end of 1967.

I was chairman of the subcommittee on regional planning of the Water Resources Committee of the State Chamber of Commerce through 1965 and am still a member (1967). I asked to be relieved of the chairmanship in 1966 as my difficulty in hearing was a handicap in conducting committee meetings. I was, and am, a member of the similar committee of the Irrigation District Association of California.

On these two committees I opposed H.R. 4671. I was alone in this opposition. I discussed my objections to the bill in the committee meetings rather fully although it was apparent that both committees would yield to southern California pressure and approve the bill. I took the position that the members of these committees should at least know what they were doing when they acted on the bill.

The issues involved in the Pacific Southwest Water Plan are too complex to be discussed here. They are covered in my report on the 1965 version of H.R. 4671 which is Item 156 of my bibliographical file. To date (June, 1967) I have not released or made any use of Item 156. No individual can expect to accomplish useful results opposing the extensive and well organized position of southern California. My lack of activity in opposing the P.S.W.P. bills was also based on my conclusions that any such self seeking legislation could not expect to pass and that individual opposition would not affect the outcome. To date (June, 1967) this conclusion has also been justified.

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December 11, 1967

Mr. S. T. Harding
2734 Russel Street
Berkeley, California

Dear Mr. Harding:

~~1960~~¹⁹⁴⁹. I am returning herewith the negative of your portrait taken in 1960. We have made copies which we will use in the front of your manuscript.

We would be pleased to include more pictures--yourself at a younger age, you with your colleagues, the Harding family (including Helen, I hope).

As we discussed during your visit to our office, we will deposit copies of your manuscript as follows:

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Many thanks for all the work you have done on this project.

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(Mrs.) Willa Baum, Head
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cc: Mr. Gerald Giefer

WB/be

Gerald J. Giefer

Born in St. Paul, Minnesota; undergraduate degree (1950) in English literature from the College of St. Thomas, St. Paul; graduate degree (1951) in Library Science from the University of Minnesota; has worked with the libraries of Highlands University, Las Vegas, New Mexico (1951-53); University of Minnesota (1953-55); Air Force Academy, Colorado Springs, Colorado (1955-59); and, since 1959, Water Resources Center Archives, University of California, Berkeley. Publications in the Archives series include, among others, Water wells: an annotated bibliography; Water: a subject heading list; and Index to periodical literature on aspects of water in California.

