96-002 - 008 SALT RIVER

### ORIGINAL

R(3-30-96)D

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August 30, 1996

Arizona Navigable Stream Adjudication Commission 1700 West Washington West Wing Executive Tower, Suite 404 Phoenix, AZ 85007

ATTENTION: Christina Waddell, Executive Director

Re: ANSAC Public Hearing on the Salt River

Dear Commission Members:

Pursuant to the Notice of Agenda and Public Meeting dated August 14, 1996, we are enclosing for your review a report prepared by James Dorsey & Associates, Land and Boundary Consultants, entitled "The Nonnavigability of the Salt River from Granite Reef Dam to the Confluence with the Gila River, Arizona." We believe that this report will provide you with valuable information in making your initial determination as to the navigability/non-navigability of the Salt River at your September 24, 1996, meeting.

To briefly summarize, the Report concludes that the Salt River was non-navigable on February 14, 1912, for a variety of reasons. First, the Report analyzes federal surveying standards in effect at the time. Those standards required that all navigable bodies of water be meandered; the Salt River was not meandered. Second, the Report analyzes physical conditions and stream flow records, as well as historical accounts of life in the Salt River Valley from the time of the

Maricopa County, Lower Salt River 03-005-NAV 4/7/03

Evidence Item No. 008

Arizona Navigable Stream Adjudication Commission August 30 1996 Page Two

Hohokam Indians to statehood. All of these analyses lead to the conclusion that the Salt River was not used, or usable, for navigation. Third, the Report reviews the implementation of the federal Desert Land Act, which required that lands in desert areas be placed under irrigation before the land could be sold and federal patents issued. The Act required that the water source for irrigation had to be from a non-navigable river. Land within the Salt River Valley was patented under the Desert Land Act on the basis that the Salt River was a non-navigable river which provided the source of irrigable water. As the Report concludes in its Summary Review section:

"It would therefore appear that for the [Salt River] to be found navigable, it would require the demonstration that the federal government erred in not meandering the river; the federal government erred in issuing patents to many parcels of land based on the Desert Land Act; the federal government erred in building Roosevelt Dam as it aided the further development of an irrigation system to make productive land that was patented on the basis that the Salt River was a non navigable river." (Report at page 20.)

Because we believe that this Report contains much new and valuable information regarding the non-navigability of the Salt River as of February 14, 1912, we respectfully submit this Report to the Arizona Navigable Stream Adjudication Commission to assist in its determination and discussions at the September 24, 1996, public hearing.

Very truly yours,

Burton Levinson, Esq.

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Arizona Navigable Stream Adjudication Commission August 30, 1996 Page Two

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James R. Dorsey, P.L.S. Consulting Land Surveyor



96-002 - 008

SALT RIVER

California P.L.S. No. 4253 Arizona R.L.S. No. 11275 Nevada P.L.S. No. 11766

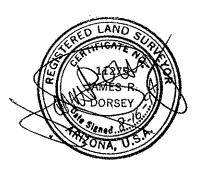
James Dorsey & Associates
Land & Boundary Consultants

ORIGINAL

THE NONNAVIGABILITY OF THE SALT RIVER FROM GRANITE REEF DAM TO THE CONFLUENCE WITH THE GILA RIVER, ARIZONA

# THE NONNAVIGABILITY OF THE SALT RIVER FROM GRANITE REEF DAM TO THE CONFLUENCE WITH THE GILA RIVER, ARIZONA

Prepared by:



James R. Dorsey, RLS

James R. Dorsey, RLS 1275

August 16, 1996

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#### **PREFACE**

This report on the Salt River, while thorough and complete, as to information reviewed, recognizes the possibility that additional information may still be discovered.

While this report is now considered final, should any additional information be discovered subsequent to the date of this report, the right is reserved to update same.

# THE NONNAVIGABILITY OF THE SALT RIVER FROM GRANITE REEF DAM TO THE CONFLUENCE WITH THE GILA RIVER, ARIZONA

#### THE QUESTION:

Is the Salt River a navigable river with title vested in trust for the people of the State of Arizona as sovereign lands? Or, expressed in other terms, was the Salt River, at the subject location, navigable under federal rule on February 14, 1912? There are additional questions of boundary location and possible public interest rights that are less than sovereign title. These are: Has there been any avulsive movement of the river, or movement caused by artificial means so that the legal boundaries of the Salt River are at some location other than that occupied by the present river? Have any rights in favor of the public been established for use of the river where said rights are less than sovereign title?

It is suggested that an additional question also be asked concerning the test of navigability to be applied contemporary to the time of survey and the patenting of the lands by the federal government. Since the river by the federal survey and patent process shows the Salt River to be non navigable, this then is not a question of where are the limits of the Salt River and a State right to define that. For the State right to make the definition, title to the river must first be vested in the State. Also, the title to a large portion of the lands is based on the Desert Land Act, which requires irrigation as a requirement before patent can issue, and also requires the irrigation source be from a nonnavigable river. The additional question is therefore: Is the claim of navigability as sovereign lands by the State of Arizona a State or Federal question? Can a State Court defeat a federal patent? Can only a federal court decide what the federal government conveyed?

A question not yet answered, to my knowledge, is: Can Arizona enjoy an easement on

behalf of the people that is not in the chain of title? Expressed in other terms, does Arizona recognize a prescriptive dedication such as Gion-Dietz in California?

#### **CONCLUSION:**

The Salt River, at the subject location, is a nonnavigable river, that is, it is not sovereign lands of the State of Arizona. There is evidence that suggests avulsive changes have occurred in various locations of the Salt River. An avulsive change may not change boundaries or ownership. Therefore, existing boundaries of the Salt River may include lands that are in a location other than the present physical location of the banks of the Salt River. That is, there may have been avulsive changes in the river location caused by works of man. The fixed works effect upon the physical location of the banks of the river is an ongoing process.

#### SUBJECT LOCATION:

The subject location or study area of the Salt River is from Granite Reef Dam, located in Section 13, T. 2 N., R. 6 E., G. & S.R.M., in the county of Maricopa, State of Arizona; thence down stream along the Salt River with its confluence with the Gila River, located in Section 31, T. 1 N., R. 1 E., G. & S.R.M., in the county of Maricopa, State of Arizona.

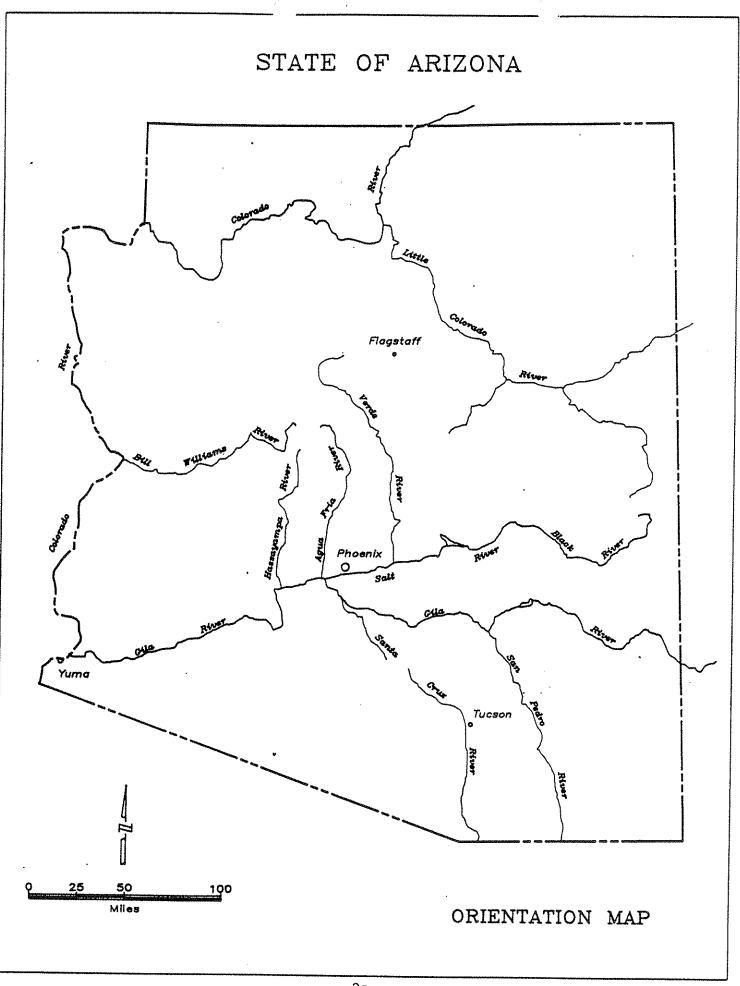
#### **DISCUSSION:**

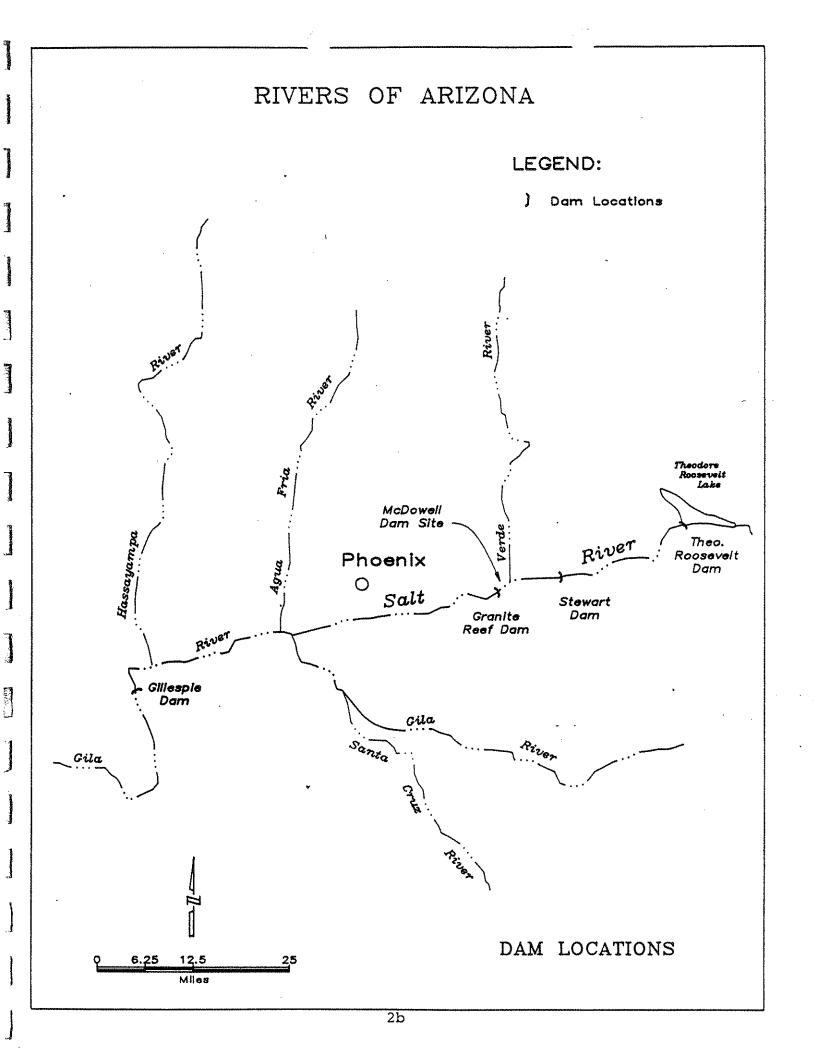
This report includes a study of the instructions for the survey of the public lands by the then General Land Office, with emphasis on the meandering of navigable bodies of water; the federal field notes, including the descriptive reports; the federal township plats; historical maps; present day maps, including modern day topographical maps; historical documents and reports; and various water supply papers from the U. S. Geological Survey, Water Resource Division; the U. S. Army Corps of Engineers and the U. S. Bureau of Reclamation.

#### Wetland Boundaries:

Where the State of Arizona is the owner of sovereign lands, as with the east half of the Colorado River where there is no prior Indian Reservation, Arizona ownerships extend from the high water mark waterward. Where there is no sovereign ownership, the adjacent upland owners' title extends to the center or thread of the nonnavigable river.

A study of the location of the historic river channels has been done. We have used the data in the original township plats, the early or historic U.S.G.S. Quad sheets and the current or latest edition Quad sheet to compare against each other. It is noted that the





current quad sheet at the area of the confluence of the Gila and Salt Rivers is out of stock. The information it contains as to the river location will be supplemented when a copy of the quad map "Tolleson, Arizona" is obtained.

We note that there have been some rather significant changes in the section lines from early quad sheets to the current editions. To completely resolve those differences, a study of the surveys and the record maps for those areas will be required. However, we still note some dramatic changes and have presented those here. What ever inaccuracies may exist between the early and latter quad sheets is still less than the changes in the location of the bed of the Salt River.

Before any man made structures were placed on or in the river, the river had a rather nominal flow and a flood stage. The extent of the flow and the magnitude of the flood stage were erratic and would vary greatly from year to year. In some years the flood flow would be significant and the river would overflow its banks. This often would then leave the receding river in a new channel location.

After the Salt River Project, the flood flows were all but eliminated. Additionally, the water flowing downstream from the various dams carries far less sediment than the natural river would contain. The dam takes the water from a point above the base or stream bed. The dam also impounds the water or brings the stream flow to almost zero.

The amount of sediment suspended in flowing water is a factor of the velocity of the water. Therefore, when the river flows into a dam and current stops, the sediment falls to the bottom. The water then flows through the penstocks or over the spillway and into the stream bed. This is clean water, but now it is flowing. It will pick up off the bottom of the stream bed in order to match the sediment carried to the velocity of the flowing water. This process is called "scouring." This results in a deeper or scoured stream bed. The flood flows are gone so that the bed is not "flushed" by the annual flood flow.

There have also been many instances where man has artificially altered the stream bed. The sand and gravel operations are a good example of this. Small wing dams, jetties, etc. are often built to protect the excavation area from when water might flow in the channel. These diversions would be asserted to be avulsive. The changes in the river after the dams were built will no doubt also be asserted to have been avulsive.

Therefore, a statement to the "current bed" of the river, by definition excludes avulsive changes. As a result of this, the current bed of the Salt River for the study area may include lands that are beyond and or outside the current physical location of the river.

Stream Flow Data:

We have compiled stream flow data on the Salt River. If this area requires further development then it is recommended that a hydrologist be retained. There does not appear to be any ready stream flow records prior to Statehood for the study area. Therefore, such data will need to be extrapolated from other hydrologic data, which in my opinion, requires a hydrologists to do so.

What we have done demonstrates the rather minimal flow of the river for most of the year and the short lived flood flow.

The location with the oldest records is just above Roosevelt Dam which the records began in 1913. Those records show an average peak flow of 2,075 cfs and an average minimum flow of 350 cfs. Given a channel capacity of 50, 000 cfs it is apparent that there is not much water. It is rather obvious that it will not support navigation.

Another set of records exist for a site just downstream from Stewart Dam with records that date back to 1934. Those records show an average peak flow of 1,510 cfs and a minimal flow of 206 cfs. Note how river flow decreases as the location progresses downstream from Roosevelt Dam.

The last set of observations is just down stream of Granite Reef Dam. Those records go back to 1989. We note the almost complete 0 cfs flows. This shows that almost all of the water is diverted into the irrigation system and does not reach the former natural channel.

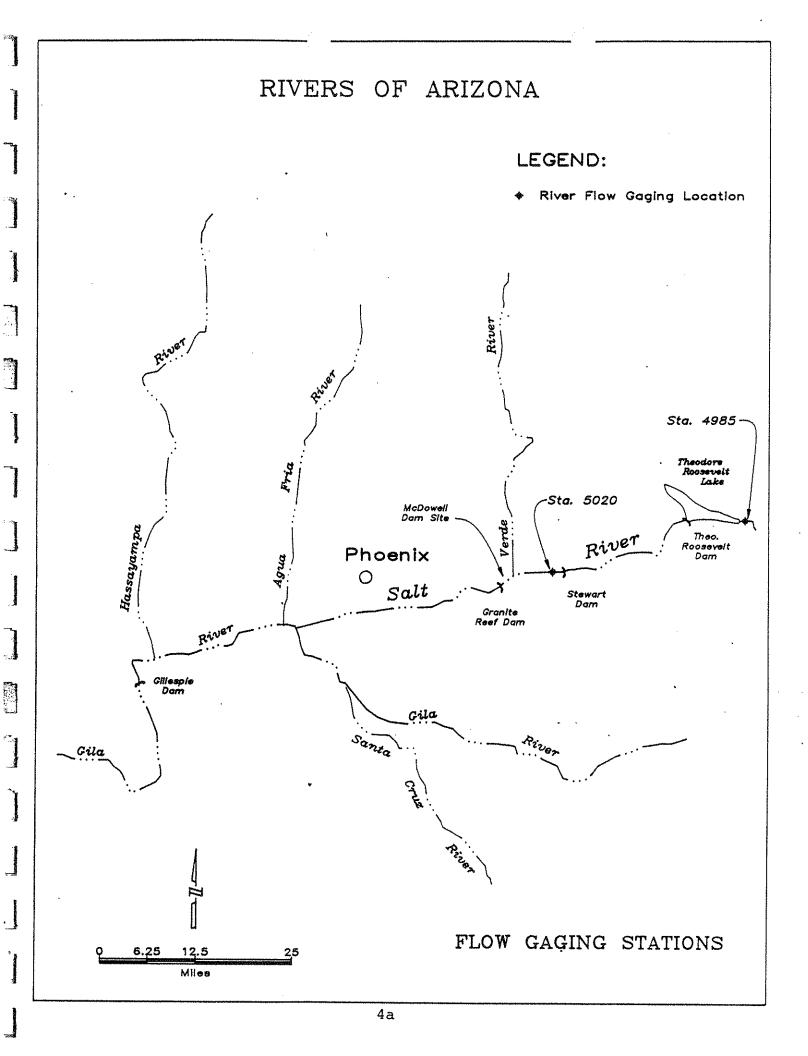
Again, if more development is required for this aspect, a hydrologist should be retained. He would take these records, plus the records for all of the tributaries and build a hydrologic model. From that data we surmise he would convert to annual flow. By then taking the record annual flow estimates made by the Bureau of Reclamation prior to the Salt River Project, the stream flow data could be backed in.

We have compiled the data into a graph as well as daily flows and have presented them for reference.

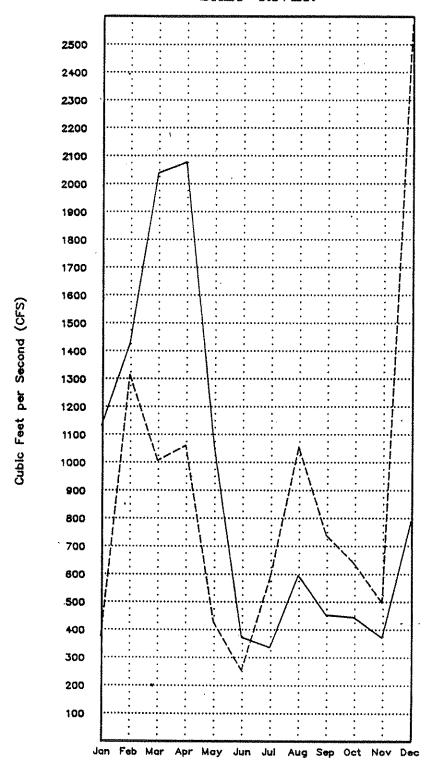
#### The Federal Survey Instructions:

The United States, Bureau of Land Management, has published "A History of the Rectangular Survey System" by C. Albert White and is available through the Government Printing Office under Superintendent of Documents No. I 53.2: Su7/2; Stock No. 024-011-00150-6. This book contains the reported collection of instructions for the survey of the public lands from the first set of instructions that began with the Act of May 18, 1796 to the current time. Appropriate portions of the book are contained in the appendix.

The first mention of navigability is in Section 9 of the Act of May 18, 1796 which states:



#### RIVER FLOW DATA SALT RIVER



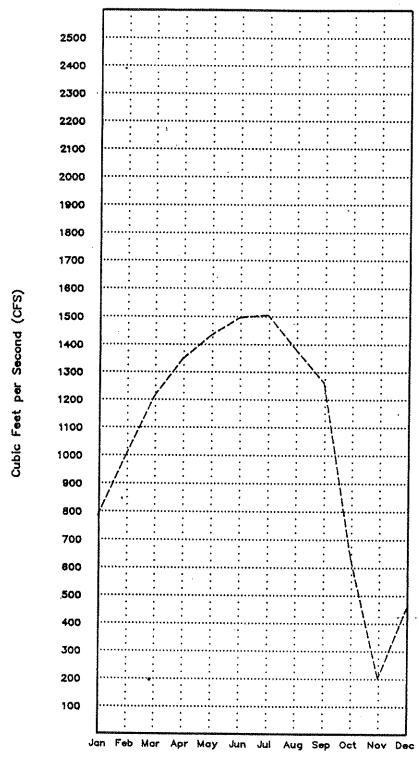
#### LEGEND:

---- Average Monthly Flows - 1914 ----- Average Monthly Flows - 80 Years

#### Data based on:

United States Dept. of Interior — Geological Survey — Arizona District Sta. No. 09498500 Salt River near Roosevelt, Ariz.

#### RIVER FLOW DATA SALT RIVER



#### LEGEND:

---- Average Monthly Flows - 59 Years

#### Data based on:

United States Dept. of Interior — Geological Survey — Arizona District Sta. No. 09502000 Sait R. BL Stewart Mountain Dam

"And be it further enacted, That all navigable rivers, within the territory to be disposed of by virtue of this act, shall be deemed to be, and remain public highways: And that in all cases, where the opposite banks of any stream, not navigable, shall belong to different persons, the stream and the bed thereof shall become common to both."

The next act to direct the surveyors on navigability is the Act of March 26, 1804, 2 Stat. 277. Section 6 of said act states:

"That all navigable rivers, creeks, and waters, within the Indiana territory, shall be deemed to be, and remain public highways."

The text of the manual goes on to state:

"The addition of "creeks and waters" in this act is perplexing. It was not in the *Acts of May 18, 1796 and March 3, 1803*. Does it mean that all creeks and waters are declared navigable, or does it mean that all navigable creeks and waters, including lakes, are public highways? Probably the latter. But who is to determine whether a creek is navigable? The result was that all streams large enough to be used as a means of travel through the territory were meandered by the surveyors, creating many more fractional sections than had been created in Ohio."

This is a strong inference that all questionable bodies of water were meandered.

The first set of instructions to be placed in a Manual form is the "Instructions to the Surveyor General of Oregon: Being a Manual for Field Operations, and are dated 1851. At Section 24 of the 1851 Manual it states:

#### "THE MEANDERING OF NAVIGABLE STREAMS.

- 1. Standing with the face looking down stream, the bank on the left hand is termed the "left bank," and that on the right hand the "right bank." These terms are to be universally used to distinguish the two banks of a river or stream.
- 2. Both banks of navigable rivers are to be meandered by taking the courses and distances of their sinuosities, and the same are to be entered into the "meander field book."

At those points where either the township or section lines intersect the banks of a navigable stream, POSTS, or where necessary, MOUNDS of earth or stone, are to be established at the time of running these lines. These are

called "meander corners"; and in meandering you are to commence at one of those corners on the township line, coursing the banks, and measuring the distance of each course from your commencing corner to the next "meander corner," upon the same or another boundary of the same township; carefully noting your intersection with all intermediate meander corners. By the same method you are to meander the opposite bank of the same river."

There then follows more detail on meander procedures through and inclusive of Section 28 of last said manual

Next comes the manual entitled "INSTRUCTIONS TO THE SURVEYORS GENERAL OF THE PUBLIC LANDS OF THE UNITED STATES, FOR THOSE SURVEYING DISTRICTS ESTABLISHED IN AND SINCE THE YEAR 1850; CONTAINING, ALSO, A MANUAL OF INSTRUCTIONS TO REGULATE THE FIELD OPERATIONS OF DEPUTY SURVEYORS, ILLUSTRATED BY DIAGRAMS." and published in 1855.

The 1855 Manual, for the most part repeats the 1851 Manual. It requires the meandering of both banks of a navigable river.

Next comes the *Act of May 30, 1862,* 12 Stat. 409, which is entitled "An Act to reduce the Expenses of Survey and Sale of the Public Lands in the United States." The act in Section 8 thereof gave the Surveyor General of New Mexico (Territory of, including what became Arizona) the additional duties of Register and Receiver. He was then in effect the entire land office in that large territory.

Next comes the manual entitled "INSTRUCTIONS TO THE SURVEYORS GENERAL OF THE UNITED STATES, RELATING TO THEIR DUTIES AND TO THE FIELD OPERATIONS OF DEPUTY SURVEYORS" and published in 1864.

The 1864 Manual has a most significant addition to it concerning meandering. It provides at Section 9 that:

#### "9. CERTAIN RIVERS TO BE MEANDERED ON ONE BANK ONLY.

Rivers not embraced in the class denominated "navigable" under the statute, but which are well defined natural arteries of internal communication, and have a uniform width, will only be meandered on one *bank*. For the sake of uniformity, the surveyor will traverse the right bank when not impracticable; but where serious obstacles are met with, rendering it difficult to course along the right bank, he may cross to the left bank and continue the meanders as far as necessary; but all changes from one bank to the other will be made at the point of intersection of some line of the public surveys

with the stream being meandered."

The text then goes on to give details on field procedures and in note keeping. What is most significant here is the recognition by the federal government of their understanding of the federal statute concerning navigable rivers, contemporary to the time of our subject surveys is that there may exist rivers that are "arteries of internal communication" that are non navigable under the federal statute.

#### The Beginning of the Arizona Surveys:

It is observed that in the latter part of March 1865, John A. Clark, Surveyor General of New Mexico, took an inspection trip through Arizona. He visited the area southwest of Phoenix at the junction of the Gila and Salt Rivers. On a conical hill just south of the junction and south of the Gila River, a boundary monument had been erected by the Mexican Boundary Commission in 1851, which marked the U. S. - Mexico boundary prior to the Gadsden Purchase in 1853. Clark reported on May 24, 1865, that he had adopted this monument as the initial point for the Gila and Salt River Meridian in Arizona, but he had no funds, so no surveys were from that monument until two years later.

In January 1867, William H. Pierce, Deputy Surveyor, began the Survey of the Gila and Salt River Baseline in Arizona, starting from the initial monument selected by Clark. The surveys of the township and range lines were extended from the baseline by Wilfred F. and George P. Ingalls, under contract with the Surveyor General of California.

By the Appropriations Act of March 2, 1867, 14 Stat. 440 and 457, Arizona was attached to the California Surveying District.

By the *Act of July 11, 1870,* 16 Stat. 230, Arizona was made a separate surveying district. John Wasson was commissioned Surveyor General on July 12 but notification did not reach him until November 5, 1870, when he opened his office in Tucson. He traveled to California, brought back the Arizona records, and began contracting for surveys in that territory in March 1871.

Next comes a circular from the General Land Office dated July 13, 1874 that outlines the procedure "... in regard to the survey of the beds of meandered lakes or other similar bodies of water in districts where the office of the Surveyor General has been discontinued ... " The text of the circular goes on to state:

"The beds of lakes, (not navigable) sloughs and ponds over which the lines of the public surveys were not extended at the date of the original survey, but from the presence of water at the date of such survey were meandered . . . "

There is an important distinction here. The circular gives procedure on how to include land

that was once meandered in the original survey, therefore, the water course so meandered did not pass with a patent for the adjacent uplands, to now have the former excluded lands brought within the survey. Once brought within the survey, the former meandered lands would pass with the patent for the adjacent uplands.

Expressed in other words, the lines within the original survey and the acreage so returned determine the lands patented by the United States.

#### The Federal Surveys:

The field notes and plats are the best evidence of the surveys. The first surveyor to extend the base line, which precedes the subdivision of the townships into sections was William H. Pierce, U. S. Deputy Surveyor. Most of his early work was done in January of 1867. His field notes describe the Salt River as follows:

"Salt River is, at this season of the year at least, a large stream, nor do I think it ever entirely dries. It has moreover a very heavy fall of, I should think, twelve to fifteen feet to the mile which renders it especially valuable for irrigating. I consider this valley - - six to ten miles wide and extending from its mouth upwards to the mountains about forty miles - - as containing some of the best agricultural land I have yet seen in the Territory and would recommend that it be subdivided at an early day."

The first surveyors to subdivide the townships into sections were Wilfred F. and George Ingalls. A historic account of this was found in a manuscript by **James M. Barney** in the Arizona State Library. The manuscript describes how the two Ingalls came to Arizona to perform the survey is as follows:

"... In the land to be surveyed under these early contracts, was included the greater portion of the Salt River Valley. Three separate contracts were entered into by the California official the performance of this work; the first with Wilfred F. Ingalls, bearing the date of February 18, 1868; the second with George P. Ingalls, bearing the date of February 29, 1868, while the third -- called a joint contract -- was with both of the above - named, and bore the date of July 10, 1868; each of the above contracts was for the sum of \$7500.00;

Wilfred F. Ingalls was a brother, and George P. Ingalls a cousin, of Hon. Frank S. Ingalls, now and for many years past, United States Surveyor General for the district of Arizona. (1915).

After being awarded these contracts Messrs. Ingalls who then resided near Oakland, California, had a wagon especially constructed for use in the work

contemplated; one of the principal features of this conveyance was a box like compartment built in the rear for the carrying of firearms, to be used in case of attack by roving bands of Indians while in Arizona.

When completed, this wagon - - together with four horses and other luggage - - was shipped on board the coast steamer "Crizaba", bound for the Southern California port of "Wilmington", called also at that time, "San Pedro", which latter name the locality still bears. . .

From Wilmington or San Pedro, the surveyors drove overland to Yuma where they arrived in due time and, after having their outfit overhauled at the shop of Chris Horner, a well - known blacksmith and wheelwright, they continued up the Gila, along the **overland road** (emphasis mine), with Maricopa Wells as their destination . . . "

The field notes of Ingalls and the other surveyors who subdivided the townships into sections for the study area all call both banks of the Salt River as they ran the Section lines and the said lines as run are straight lines along the section line across the river. Also, called out in the field notes are canal crossings.

In his general description of the country embraced within the boundaries of Township 1 North, Range 3 East, Gila and Salt River Meridian, the Phoenix Township, Deputy W. F. Ingalls made the following remarks about the settlement located therein:

"A settlement called "Phoenix" was formed in the northeast part of the township, during the winter of 1867 and 1868. It now contains about fifty persons who have displayed great energy in the construction of their "Irrigation ditches" and the clearing of their land and will this year bring under cultivation a large extent of country. The settlement, though Young, bears every evidence of thrift and prosperity."

In his general description for Township 1 North, Range 4 East, Gila and Salt River Meridian, Deputy W. F. Ingalls made the following entry:

"There are two acequias taking water from the Salt River in Section 7, and run thence westward into T. 1 N., R. 3 E., and which are used by the farmers for irrigating their land. The settlers propose constructing another acequia to take water from the river in Section 15 and leading thence westerly to the adjoining township. In the southwest corner of section 7 were discovered the remains of an ancient adobe house and wall. The wall is a parallelogram in shape and is about 100 feet long and 60 feet wide and is situated on a slight elevation. This ruin, from all appearances, must have been designed for a fortification but when and by whom, we of course, have no

means of knowing."

The federal survey process, as evidenced by the field notes of the Deputy Surveyors performing the field work, first recognized the Salt River as a great source for irrigation, did not meander the Salt River and, second, observed the Salt River as having been utilized as irrigation water by the uses of "acequias" which is Spanish for ditches or canals.

#### Land Sales by the GLO: \

By the Act of March 3, 1877, c. 107, 19 Stat. 377, 43 U.S.C.A., Section 321, Congress approved the Desert Land Act. Provided a means for Desert Lands to be patented where the process provides irrigation to the land under application. The Act requires that the water source for the irrigation be from a nonnavigable body of water.

There were many parcels of land in the subject study area where the patent was based on the provisions of the Desert Land Act. Also, Section 327 of U.S.C.A. required that"

"At the time of the filing of the declaration required in section 321 of title the party shall also file a map of said land, which shall exhibit a plan showing the mode of contemplated irrigation, and which plan shall be sufficient to thoroughly irrigate and reclaim said land, and prepare it to raise ordinary agricultural crops, and shall also show the source the water to be used for irrigation and reclamation . . "

The requirement that the irrigation source be from a nonnavigable body of water cannot be claimed to be a vague or generic statement where the actual water source was not actual knowledge to the government agencies involved in the patent process. The act is specific in its requirement that the water course be shown and the government agencies had actual knowledge of same.

It is also observed that there are many "DLEs'," Desert Land Entries, that take place after Arizona Statehood. The Salt River Project and the development of the irrigation system that supplied water for the crops in the Salt River Valley were famous and notorious contemporary to Arizona Statehood. We cannot find anywhere in the record any objection to the Salt River being a nonnavigable river.

#### U. S. Army Corps of Engineers:

The United States Army Corps of Engineers, Office of the District Engineer, Los Angeles District, dated December 4, 1957 issued an "Interim report on survey for flood control, Gila and Salt Rivers, Gillespie Dam to McDowell Dam Site, Arizona." A copy of said report is contained in the appendix.

Under the heading "Stream Characteristics," the report states:

"in general, stream slopes in the Gila River Basin are not excessive. The gradients of Gila River and of most of the secondary streams are steep near the headwaters and decrease progressively downstream. The average slopes of Gila and Salt Rivers from headwaters to their mouths are 13 and 25 feet per mile respectively. The average slope of the Salt River from McDowell Dam site to its junction with Gila River is about 9 feet per mile; the average slope of Gila River from Salt River to Gillespie Dam is about 5.5 feet per mile.

The channel capacity of Salt River from McDowell Dam site to its mouth is about 50,000 cubic feet per second. Normal flows meander over the bottoms of wide channels of various depths; major floods overflow the banks and spread over an area from 1 to 3 miles blocked by sandbars and river bottom growth.

In the area along the Gila River from the mouth of Salt River to Gillespie Dam, the flow meanders over the flat bottom of a trench 5 to 20 feet deep and 1/2 to 1 mile wide. However, most of the channel bottom is overgrown with phreatophytes, principally salt-cedar. This river-bottom growth has increased the aggradation of the channel and has restricted the channel to such an extent that flows in excess of 20,000 cubic feet per second will overflow and inundate the adjoining cultivated area. The overflow area of the standard project flood would range from 1 to 2 1/2 miles in width."

Under the heading "Occupations and Industry," the report states in part:

"The principal activities in the Salt and Gila River Valleys from McDowell dam site to Gillespie Dam are agriculture and stock raising. About 300, 000 acres were irrigated in the area in 1956, providing an annual gross crop value of about \$85,000,000. The gross value of livestock in December 1953 was about \$15,000,000. The city of Phoenix is the trade and service center for most of the State of Arizona . . . "

Under the heading "Land Use and Development," the report states in part:

Irrigation of the Salt River Valley by white settlers began in 1867 soon after Arizona was given territorial status. Water was diverted to lands on the north bank of Salt River, near the site of the city of Phoenix. By 1871, staple crops were being produced on about 1, 700 acres, and the new town of Phoenix had a population of about 300. The Santa Fe railroad was completed across northern Arizona to Colorado River in 1883, and in 1887

this line extended a branch to Phoenix. In 1900, Phoenix, with a population of 5, 544, was the seat of the territorial government.

During the period 1890 to 1910, agriculture and associated industries expanded rapidly but spasmodically. Although the annual flows of the stream were more than adequate to supply the areas then irrigated, wide variations in flows accrued. Sudden rains would swell the streams to flood proportions, from which they would dwindle to meager streamlets during the dry period. The agricultural economy was one of alternate prosperity and failure. Time after time, floods carried away the diversion dams, many of which had to be replaced every year. By the time structures were repaired, the stream flow would in many cases be insufficient to irrigate crops in the area, or the crops had withered and died from the intensity of the desert sun. After the passage of the Reclamation Act of 1902, the Salt River Project was constructed by the Bureau of Reclamation from 1903 to 1911. Granite Reef diversion dam was completed in 1908, and Roosevelt Dam was completed in 1911 with resultant impetus to agricultural development and stability for urban and industrial growth. Further developments by the Salt River Valley Water Users' Association from 1920 to 1930 provided relatively cheap electric power. As a result, irrigation of new lands by pumping from wells expanded rapidly . . . "

Under the heading "Irrigation," the report states:

"Agriculture along the Salt and Gila Rivers from McDowell Dam site to Gillespie Dam is entirely dependent on irrigation. Most of the irrigated lands have gentle slopes; they are favorable for the distribution of water and for surface and underground drainage. The extensive irrigation works constructed by the prehistoric occupants of the basin and the existing development both emphasize the favorable conditions for growing crops by irrigation."

Under the heading "Water Rights," the report states:

"The water code of Arizona recognizes that both surface flow and underground waters flowing in definite channels belong to the public and are subject to appropriations governed by beneficial use. Percolating water in undefined channels is the property of the overlying land and is not subject to appropriation.

Water rights within the Salt River Project are adjudicated under the Kent Decree, entered March 1, 1910. The Benson-Allison Decree of November 14, 1917, adjudicated water rights between the various users of water

diverted by several ditches, including the Buckeye canal, from the Salt, Agua Fria, and Gila Rivers. Various arrangements have been made between the water users under these rights and the Salt River Project for the delivery of their waters. A court decree effective January 1, 1944, fixed the amount of water that should be delivered to the Buckeye district by the Salt River Project as 1.1 percent of the water actually diverted at Granite Reef Dam."

Under the heading "Adequacy of Streamflow for Multiple Purpose Users," the report states:

"The daily surface runoff in Salt and Gila Rivers varies greatly during the year, and the annual surface runoff varies greatly from year to year. Flow in the river is erratic and out of phase with irrigation requirements. As a result, many large reservoirs have been constructed upstream from Gillespie Dam to store the runoff until needed. The effect of these structures has been to conserve nearly all flow of the Salt river upstream from McDowell Dam site except during some flood seasons. During the period 1923 - 57, if existing reservoirs had been in operation during the entire period, flow would have been available for conservation at McDowell Dam site for only 4 of the 35 years of record . . . "

Under the heading "Floods of Record," the report states:

"Historical reference to floods on Salt and Gila Rivers from McDowell Dam site to Gillespie Dam extends back to 1833, but estimates of discharge measurements are for only the period 1888 to date. Large floods during this period occurred in 1891, 1905, 1916, 1920, and 1938.

The greatest flood of record occurred in February 1891. The peak discharge of this flood was estimated at 300, 000 cubic feet per second on Salt River at Arizona Dam (approximately same location as the present Granite Reef Dam). Other major floods of record for which adequate estimates of peak discharge along Salt River below Verde River are available, include: February 1920, 130, 000 cubic feet per second; January 1916, 120, 000 cubic feet per second; April 1905, 115, 000 cubic feet per second; and March 1938, 95, 000 cubic feet per second . . . "

In summary, the Corps of Engineers report show that the flow for the Salt River was intermittent. That more water was appropriated than the average annual flow. The bottom was full of sandbars and further down on the Gila River, the bed also contained growth including salt-cedar. While major floods occurred, they were not annual events.

#### HISTORY:

A review of the history of the area shows that the birth of the City of Phoenix, the settlement of the Salt River Valley and the use of the waters of the Salt River for irrigation is inseparable.

#### The Magnificent Experiment:

One source that places this in perspective is the doctoral thesis of Karen L. Smith entitled: "The Magnificent Experiment, Building the Salt River Reclamation Project, 1890 - 1917.", published by the University of Arizona Press, Tucson. In her opening comments Ms. Smith states:

"As a child living in Phoenix in the early 1960s, I knew little about the problems of water in the desert and nothing at all about the Salt River Project. I simply assumed that water would come out of the tap when I turned the faucet and out of the control valve in the middle of the yard when it was our turn in the neighborhood to irrigate. I left the valley for more humid regions of the country and soon forgot about irrigating altogether. It was only when I returned to Phoenix as a graduate student that the connection between Phoenix and water became more important.

On the face of it, the growth of metropolitan Phoenix from a dusty village located near the Salt River to the ninth-largest city in the United States has been something of an anomaly. There was no major railroad connection to Phoenix until the 1920s, no harbor or navigable river to spawn commerce, and no major trail or crossroads to lure tired travelers to stop. Farmland was rich and would grow any number of crops year-round if there was an artificial way to put water on the soil. But water supply was uncertain; deserts are flashy and unpredictable, one year sending torrents of water to flood and the next hardly providing sufficient amounts to grow crops. The key to sustained growth had to be insuring the water supply."

Of particular importance is the statement that: "... no harbor or navigable river to spawn commerce...," in her historical research she did not find any evidence of navigation on the Salt River.

The Smith thesis goes on to describe the early irrigation efforts, the formation of the Salt River Water Users Association, the petition to the federal government to provide help in reclamation, how the water rights were adjudicated by the Kent Decree, how the Salt River Water Owners Association were to pay back the federal government for the construction of the Salt River Project.

Pertinent portions of the Smith thesis are included in the appendix.

#### U.S. Bureau of Reclamation, Draft Environmental Impact Statement:

Another document containing useful information is the "DRAFT ENVIRONMENTAL IMPACT STATEMENT, MANAGEMENT PLAN, LOWER SALT RIVER RECREATION AREA, NUMBER R3 - 78 - 02". The document was prepared by the U.S.D.A., Forest Service. Pertinent portions of the report are contained in the appendix.

The report discusses the need for water oriented recreation on the lower Salt River. One statement in the report is:

"The Lower Salt River has a continuous flow of water in the summer as a result of releases from an upriver reservoir system. An outstanding river recreation environment is created, unique to the Southwest."

It is observed that the "continuous flow" is made possible by the reservoirs added to the system after Roosevelt Dam was completed. These added reservoirs were constructed after Statehood.

The report also contains some hydrology data that shows the flow for the Salt River reaches a maximum of 1, 400 cubic feet per second (cfs) in July and a low of 150 cfs in January. This data is based on a 41-year average from 1937 to 1978.

The report also deals with land ownership issues and acquisitions necessary to complete the recreation project. There is no mention or consideration of a possible sovereign interest. The report also shows which agencies were coordinated with. Included on the list is the Arizona State Lands Department.

#### A Valley Reborn:

A booklet put out by the Bureau of Reclamation entitled "A VALLEY REBORN, The Story of the Salt River Project," contains much historical information. A copy of pertinent portions of the booklet are contained in the appendix.

Concerning the early history of the Salt River Valley, the booklet states:

"As early as 200 B.C., an ancient people known as the Hohokam began to settle in the fertile Salt River Valley. As their culture developed, the Hohokam used stone hoes to dig canals that carried water from the Salt River to their vegetable and cotton fields.

Archaeologists estimate that the Hohokam may have built as many as 250

miles of canals in the valley. Surprisingly, the routes of their canals are similar to those of modern canals which were aligned by engineers using precision surveying instruments. The Hohokam irrigation system is considered one of the greatest irrigation achievements by ancient man on this continent.

After 1, 400 years, the Hohokam began to move out of the valley toward the Gila River. By A.D. 1400, for reasons that are still unclear, the Salt River Valley was abandoned."

Under the heading "Birth of the Salt River Project," some early history of Phoenix and the surrounding area is given:

"The city of Phoenix got its start in 1867 as a hay camp for the cavalry at Ft. McDowell.

At that time, John Y. T. Smith supervised harvesting and hauling of hay which grew wild along the Salt River near what is now 40th Street. But it wasn't long before Smith, his wagon driver, John W. "Jack" Swilling, and others realized the ancient irrigation canals could be cleared and used to grow valuable crops for the military post.

The Swilling Irrigation Canal Co. was organized in 1867, and in December of that year, a 17 man party began building the first modern canal, known as the Swilling Ditch. Success came quickly; the first crops were harvested by Frenchy Sawyer and Capt. John Adams in March 1868.

Homesteaders began to arrive in the Valley and by year's end there were 100 permanent residents. They settled in an area that William A. Hancock, a lawyer and a surveyor, had staked out as the townsite of Phoenix. Hancock, recognizing the potential of the Valley, also surveyed new ditch lines.

More settlers migrated to the Valley and by 1888 more than 100, 000 acres were being farmed. New canals were built to carry water to the freshly cleared farmland.

Other canals and the years that their construction began are: Maricopa Canal, 1868; San Francisco Canal, 1870; Tempe Canal, 1871; Utah Canal, 1877; Grand and Mesa Canals, 1878; Arizona Canal, 1883; Highland Canal, 1888; Arizona Crosscut Canal, 1891; Consolidated Canal, 1892; South Canal, 1908; Eastern Canal, 1909; New Arizona Crosscut, Western and Highline Canals, 1912.

Today, SRP manages 132 miles of laterals and ditches deliver the water directly to users."

Water problems arose due to lack of any water storage. Heavy rains would often wash out the rock and brush dams built to divert the water into the canal system. Often the river would dry up and crops died. Many settlers left the Valley.

At the turn of the century the Maricopa County Board of Trade named a committee to investigate the feasibility of a water storage system. A plan was developed and the cost of such an undertaking was estimated from \$2 million to \$5 million. Arizona, as a Territory of the United States was prohibited from assuming such a large scale debt. private investors could not be induced to take on the financial risk necessary to build the dam.

In 1902 the National Reclamation Act was passed. The act provided that money from the sale of western public lands would be made available for reclamation projects. Initially, the money was to be paid back to the federal government out of project water revenues. Repayment with the power revenues was added by 1906.

The federal government required assurance of repayment before it would lend money for the project. This caused the landowners to resolve their differences over water rights and they formed a water users association. On February 9, 1903, the Salt River Valley Water Users Association was incorporated. The association guaranteed repayment of construction costs to the government, and enforced collection of each installment of these costs from individual land owners.

The agreement to construct what became the Salt River Project between the federal government and the water users association was signed on June 25, 1904. Construction began in 1905 and was completed in 1911. During construction, electric power generation was added to the project.

One point of historical note is the effort to build a road, then known as the Apache Trail, from Mesa to the Dam site. This was necessary as all the machinery and materials for the construction of the project was shipped from Mesa. The road crossed mountains and canyons and covered a length of 60 miles. The road cost close to a half million dollars and was completed in 1904.

Granite Reef Dam was completed in 1908. It is about 50 miles downstream from Roosevelt Dam, just below the confluence of the Verde and Salt Rivers, and is to divert water from the river into the canals north and south of the river to deliver water to the water users in the project. Granite Reef Dam does not store water or generate electricity, it diverts water into the canals. The dam is only 29 feet high.

There was still unrest among the water users over the water rights. On March 1, 1910,

after five years of gathering and studying evidence, Judge Edward Kent, sitting as district judge, handed down a decision concerning the water rights. Kent was the Chief Justice of the Arizona Territorial Court. The Kent Decree established the relative rights of the Projects lands to the waters of the Salt River.

In 1917, after controversy over the operation of the project by the Bureau of Reclamation, operation of the Project was turned over to the Salt River Valley Water Users Association. The contract added the provision that the water users association could sell the electricity generated by the dam and use that revenue to help pay back the federal government for the construction of the Project.

Other dams were added to the Project. Morman Flat Dam was completed in 1925. Horse Mesa Dam was built in 1927. Stewart Mountain Dam was built in 1930 and Horseshoe Dam was built in 1946.

Another important point is the participation by the Arizona legislature aided the water users association to help in paying back the costs to the federal government.

During the 1920s and 1930s, Valley farmers were hard pressed to make payments on the federal loans. To help reduce payments on the outstanding loans, the Arizona legislature allowed the formation of the Salt River Project Agricultural Improvement and Power District in 1937.

As a political subdivision of the State, the new District secured certain rights and privileges, exemptions and immunities. The most important was that the District could refinance outstanding bonds at a lower rate with tax exempt, municipal type bonds.

#### SUMMARY REVIEW:

The Salt River, for the study area was not meandered by the federal surveyors. There were explicit instructions for navigable bodies of water to meandered and stream of certain size, regardless of navigability, were to be meandered. Lesser streams were to be meandered on one bank only. The Salt River was not meandered at all.

There are physical conditions, including the slope or fall of the river of about 9 to 15 feet per mile. This information is consistent with present day 7.5 minute U.S.G.S. quadrangle maps of the area. Stream flow records, though the study on this is not yet complete, show a flow, on an average of less than a thousand cfs. This ranges from a high of about 1500 cfs to almost nothing. This is particularly significant in that the flood flow data would tend to push the averages up.

The Army Corps of Engineers reported that the channel capacity of the Salt River is about 50, 000 cfs. This is not to suggest that this would be a normal or average flow. The

channel capacity is created as the result of flood flow. The largest flood being in 1891 with a flow of about 300, 000 cfs and several lesser floods in excess of 100, 000 cfs. Such floodflow would carve and deepen the river channel. Other reports by the Bureau of Reclamation state the high flow is about 1500 cfs and many times falls below 100 cfs.

The historical accounts of early times in the Salt River Valley never mention even a hint of river navigation. They talk instead of the hard work to build roads and to entice the railroad to build a line to Phoenix so that crops can get to market. If it were at all possible to barge crops down river to the Colorado River someone would have surely tried it.

When the surveyors came to survey the Salt River Valley, they came from Yuma, up the Gila River along a road. Again, no thought or suggestion of navigation.

When ancient times are discussed, the Hohokam irrigated, dug canals and raised crops. Again no mention of navigation.

As the Salt River Valley grew, a large amount of the land was sold by the federal government under the provisions of the Desert Land Act. The act provided that the land had to be placed under irrigation before patent could issue. That a plan had to be prepared to show how and from where the water was to be brought to the land. One most significant feature was that the water source had to be from a non navigable river. Consequently, title based on DLEs, Desert Land Entries, is dependent on their irrigation source with the requirement that it be from a non navigable river.

Based on appropriated water rights from the Salt River, the Salt River Valley Water Users Association agree to pay back the cost of construction of the Salt River Project. The Arizona legislature provides a means to make the water users a political subdivision of the State which provides an easier and more economic means of paying off the federal loans.

It would therefore appear that if the State of Arizona were to be successful in obtaining sovereign ownership of the bed of the Salt River, the title to the federal patents under the DLE process would fail. To project this forward, the construction of Roosevelt Dam to be paid for by the water users association and their appropriated water rights as the source of their revenue would be on the basis of at least a claim of fraudulent title as the water source was navigable and not non navigable as required by the act.

It is also observed that the Salt River, for the study area, was made absolutely non navigable by the Salt River Project. This is not to suggest that the river ever was navigable. The water in the river is diverted to run not in the river channel, but to run in the canals and ditches of the irrigation system.

Water flow data downstream of Granite Reef Dam show the bulk of the entries to be at 0 cfs.

Based on the foregoing, we repeat our conclusion that the Salt River is a non navigable river based on the federal test for the equal footing doctrine.

Assuming arguendo, that an argument could be made for navigability, Arizona treated the Salt River as a non navigable river and supported instead the irrigation development of the river resource.

It would therefore appear that for the river to be found navigable it would require the demonstration that the federal government erred in not meandering the river; the federal government erred in issuing patents to many parcels of land based on the Desert Land Act; the federal government erred in building Roosevelt Dam as it aided the further development of an irrigation system to make productive land that was patented on the basis that the Salt River was a non navigable river.

It is important to remember that the test for navigation for a river to be navigable is a federal definition. Otherwise, it could not be an "Equal Footing Doctrine." It is observed that in all the cases that I have found where the State asserts sovereign land ownership as a State issue is where the river in question had been meandered by the Public Land Survey process. With a river meandered, the presumption is that the patent did not carry title beyond the high water mark of the body of water. A State was then free to assert or to relinquish their claim of sovereign rights.

In the instant matter, the river was not meandered. The State did not yet exist. Congress had the absolute right to regulate commerce. It is my understanding that the regulation of commerce is at least part of the authority for congress to have passed the Reclamation Act.

The first Reclamation Act project was the Salt River Project. That project was based on the assumption of the Salt River being a nonnavigable river. Otherwise, title could not have been based on the Desert Land Act. Based then on title acquired by provisions of the Desert Land Act, the owners of those lands also acquired certain appropriated water rights. A contract is entered into between the patentees of the federal government and the federal government that the revenue from the sale of said water rights will be used to pay back the cost of construction of the Salt River Project.

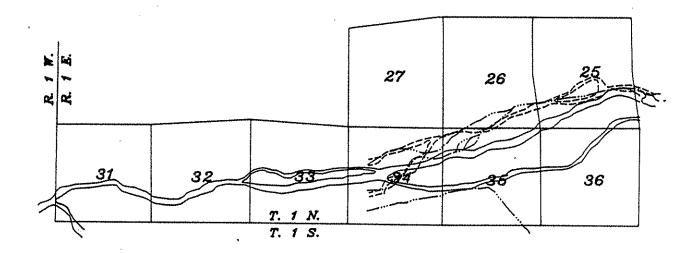
It would therefore appear that Arizona alone cannot put aside the actions of the federal government and declare the land that is already patented by the federal government, including the lands beneath the Salt River her sovereign lands. It would appear that it would first require a finding that the federal government acted incorrectly in the survey and patent process.

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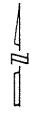


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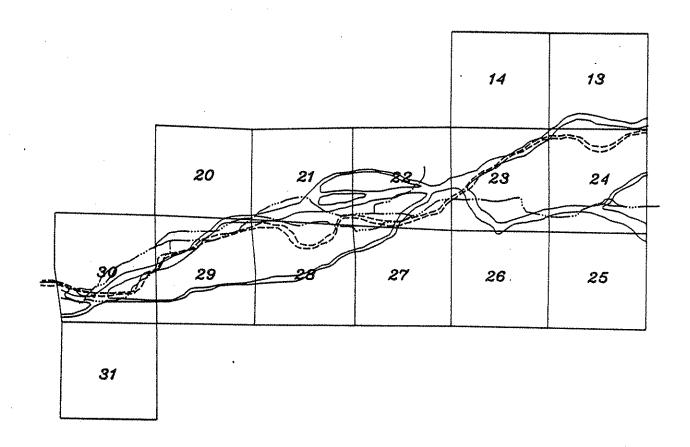
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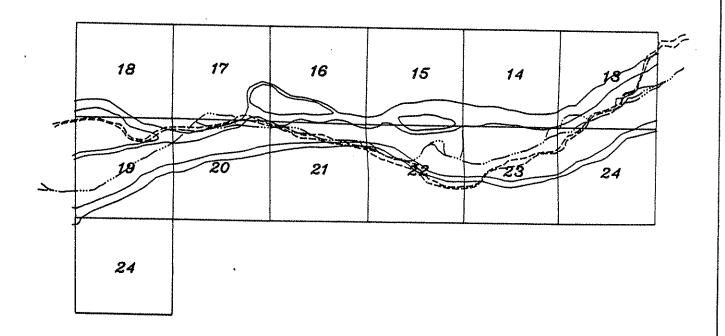
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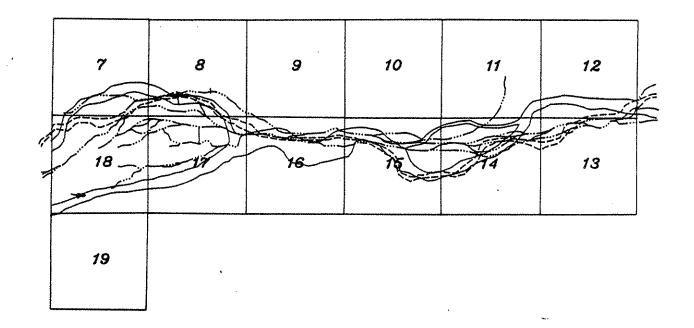
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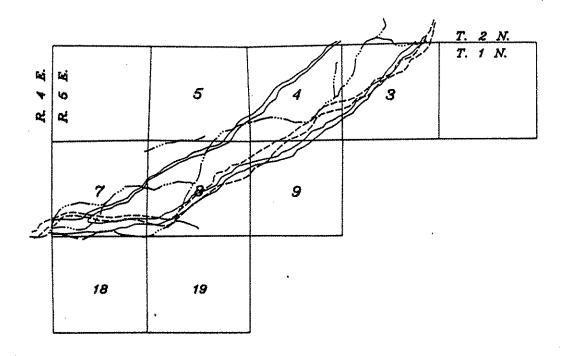
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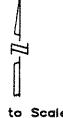


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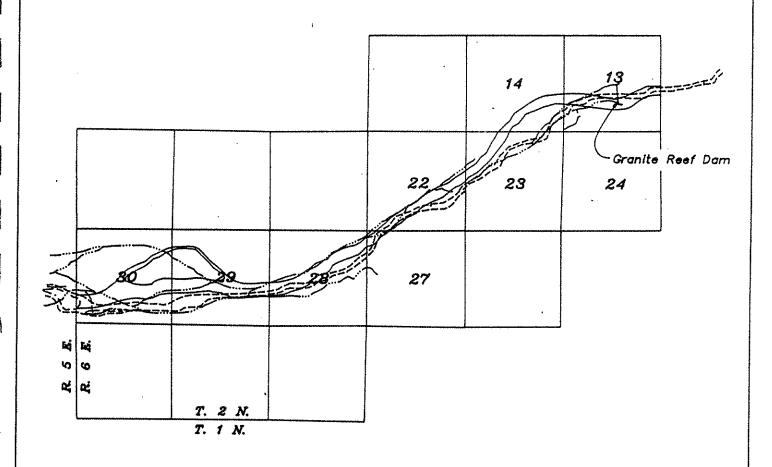
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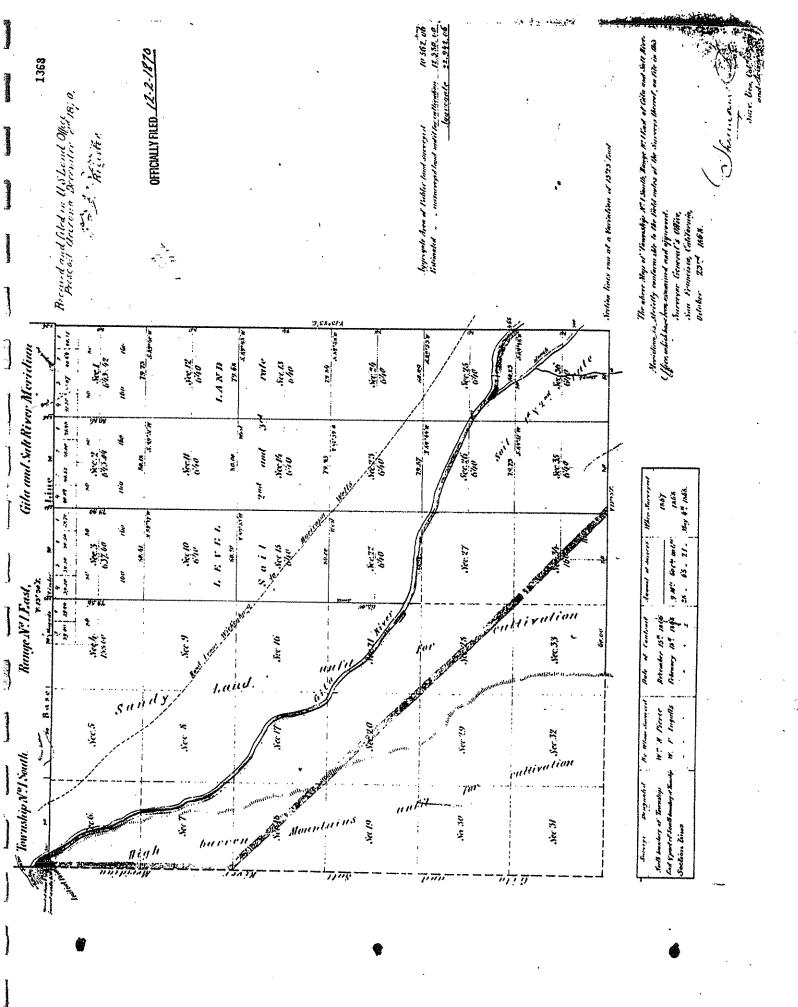
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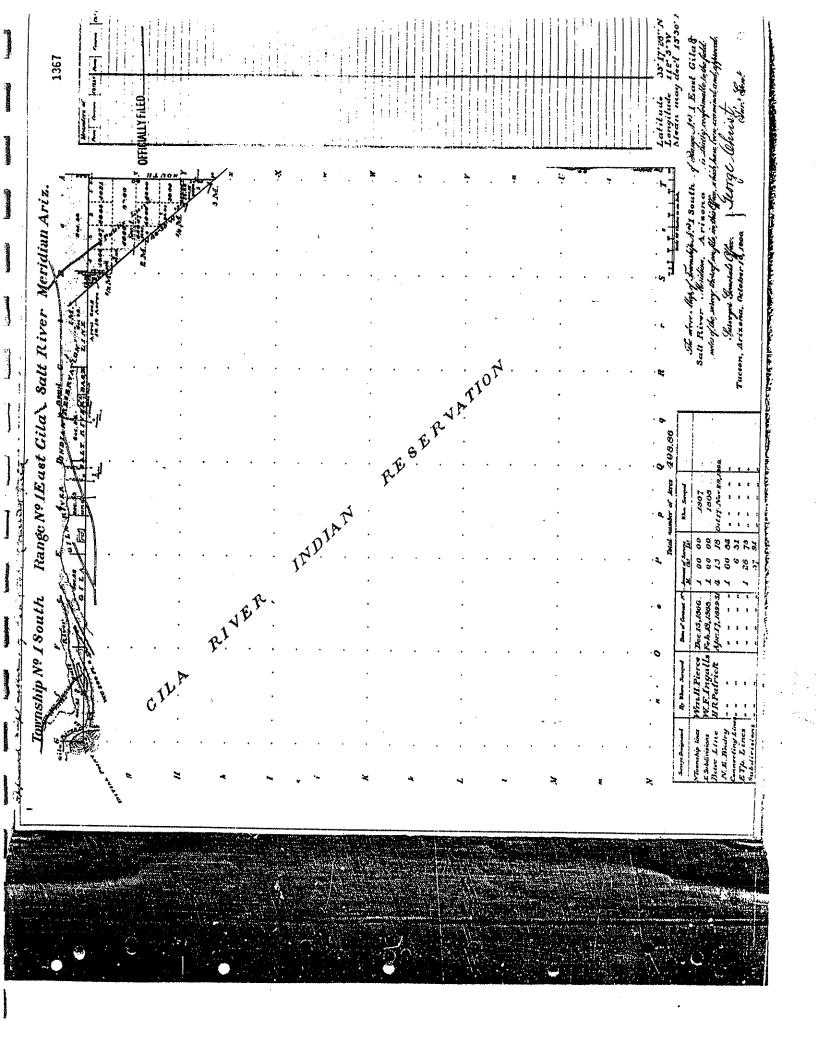


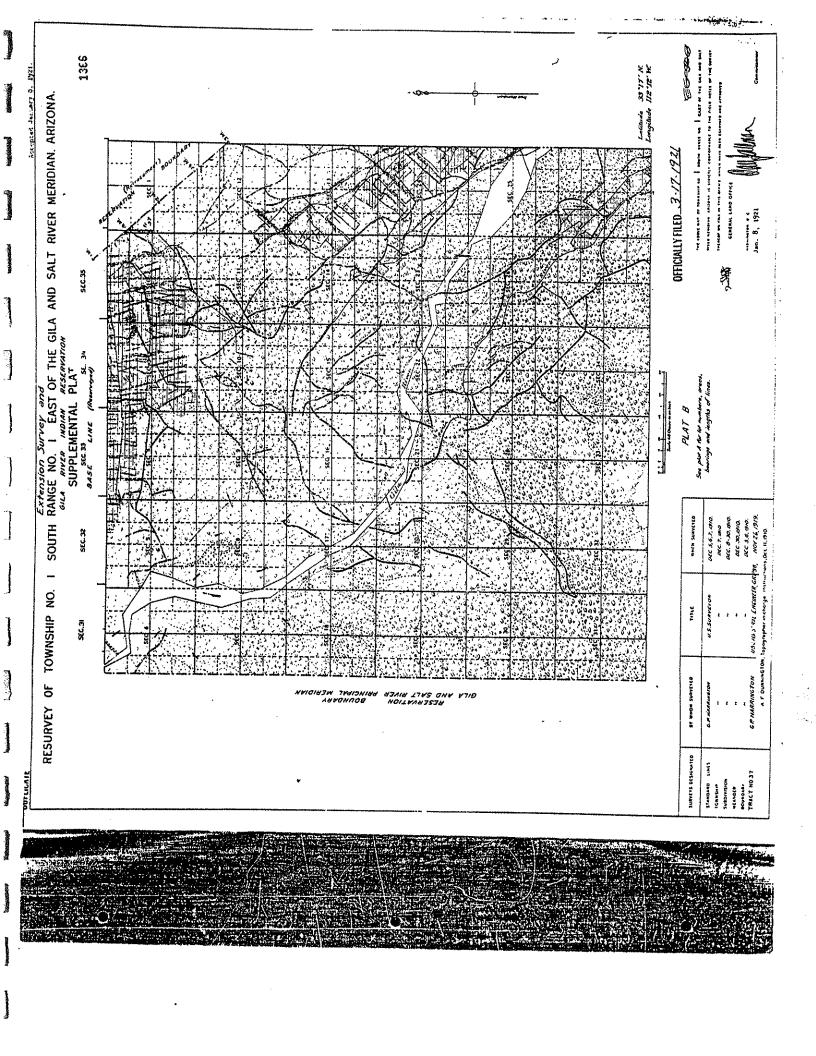
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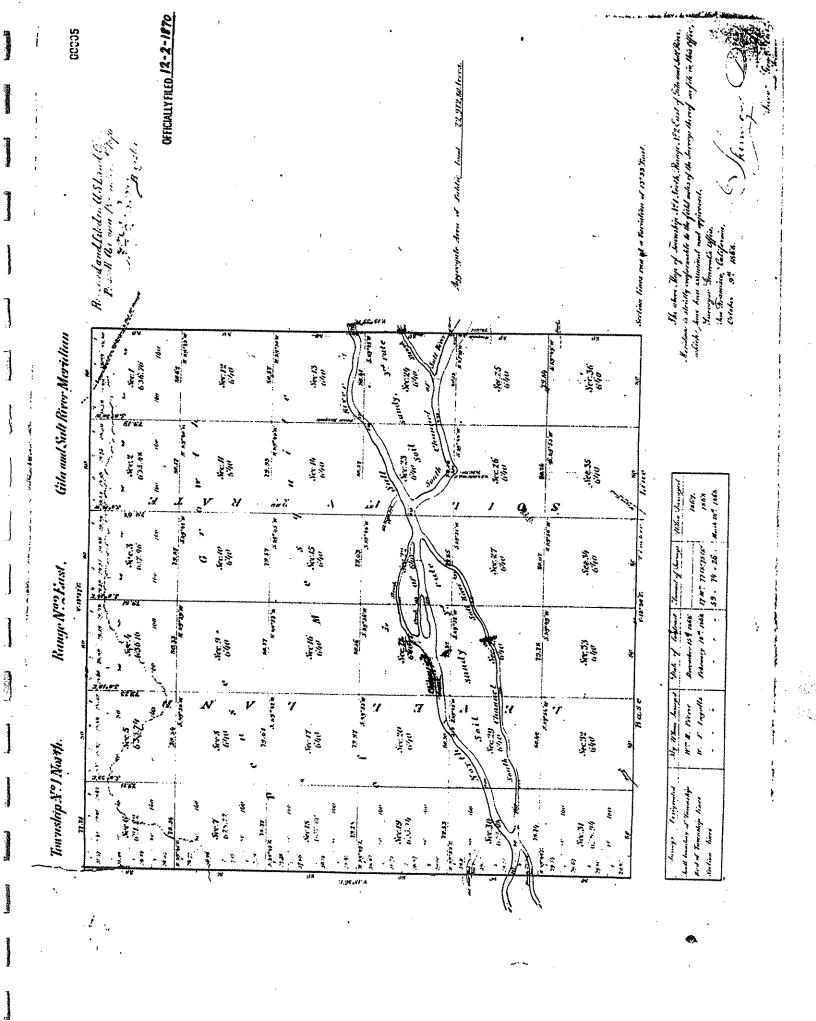


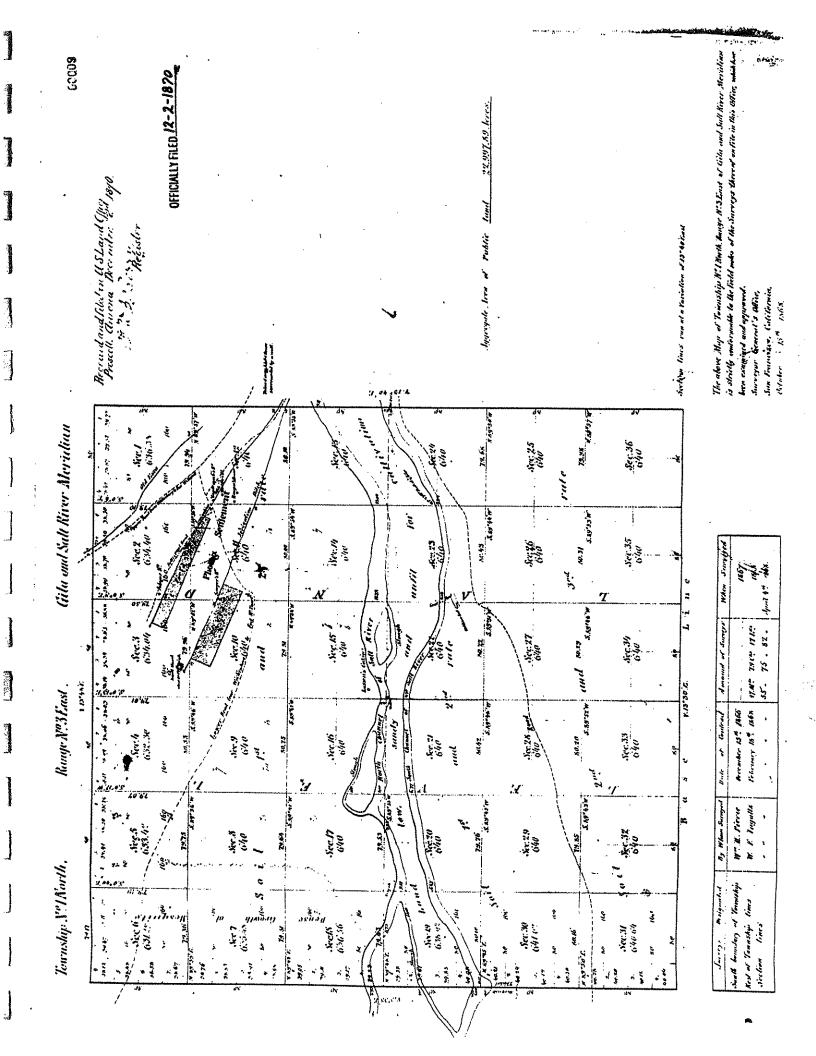






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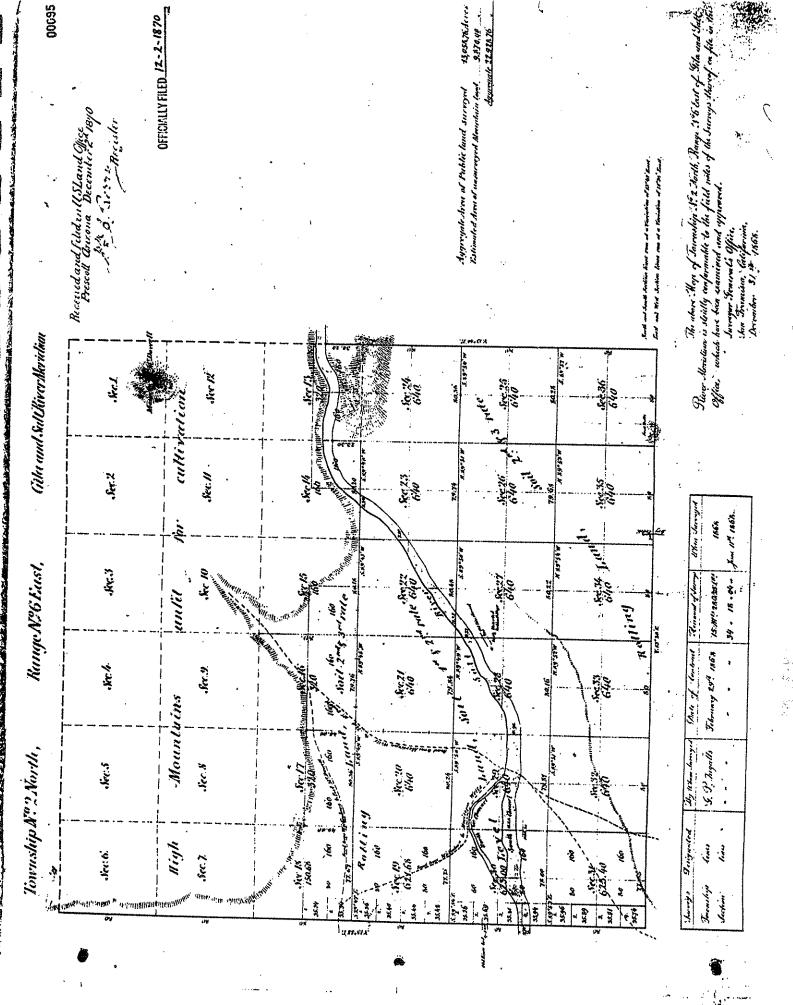
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ARIZONA RIVERS Salt River - Sta. 4985

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Year	0ct	Nov	Dec	. Jan	Feb	Har	Apr	Yay	Jun	Jul	Aug	Sep
1913	215.00	256.00	340.00				***				,	,
1914	642.00	501.00	2,574.00	380 00	1,319.00	1.010.00	1.065.00	432.00	257.00	593.00	1,059.00	743.00
1915	318.00	375.00		2,291.00					1,229.00	1,461.00	602.00	386.00
1916	1,410.00	453.00		15,990.00				1,772.00	820.00	459.00	692.00	940.00
1917	231.00	247.00		1,512.00				1,208,00	478.00	479.00	450.00	298.00
							375.00	376.00	293.00	367.00		
1918	183.00	244.00	297.00			2,030.00					392.00	194.00
1919	469.00	2,149.00	4,595.00	254.00		1,632.00		1,233.00	378.00			803.00
1920	293.00	496.00	326.00		9,014.00			1,625.00	641.00	305.00		299.00
1921	320.00	243.00	318.00		369.00	395.00	318.00	290.00	224.00		3,607.00	
1922	189.00	229.00	475.00		1,041.00			919.00	389.00	330.00	492.00	247.00
1923	406.00	1,006.00	3,262.00	272.00		1,295.00		639.00	247.00	361.00		1,852.00
1924	176.00	196.00		1,197.00	526.00			1,095.00	384.00	245.00	263.00	197.00
1925	405.00	294.00	247.00	203.00	227.00	967.00	640.00	260.00	195.00	259.00	572.00	898.00
1926	25100	255.00	376.00	239.00	269.00	1,305.00	4,246.00	2,013.00	465.00	328.00	333.00	327.00
1927	223.00	213.00	250.00	350.00	4,550.00	2,300.00	2,159.00	1,306.00	528.00	338.00	435.00	616.00
1928	254.00	262.00	251.00	219.00	628.00	819.00	658.00	507.00	254.00	301.00	361.00	232.00
1929	418.00	267.00	224.00	271.00	279.00	663.00	1,714.00	436.00	203.00	309.00	1,096.00	1,022.00
1930	159.00	280.00	235.00	297.00	573.00	1,749.00	1,660.00	593.00	282.00	544.00	941.00	261.00
1931	1,101.00	653.00	1,092.00	139.00		816.00		983.00	264.00	310.00		1,207.00
1932	277.00	219.00	263.00	709.00		3,489.00			438.00	480.00	816.00	505.00
1933	443.00	280.00	294.00	261.00		1,559.00		996.00	522.00	474.00	453.00	382.00
1934	181.00	204.00	210.00	240.00	245.00	411.00	319.00	198.00	121.00	179.00	751.00	423.00
1935	214.00	242.00	239.00		2,291.00					225.00	556.00	518.00
1936	238.00	296.00	319.00		1,934.00				356.00	234.00	384.00	475.00
1937	198.00	192.00	232.00		4,296.00				386.00	287.00	274.00	245.00
1938	155.00	162.00	212.00	211.00		2,077.00		439.00	192.00	231.00	597.00	395.00
								515.00	157.00	129.00	361.00	226.00
1939	188.00	221.00	199.00	216.00		1,358.00						
1940	475.00	477.00	2,999.00		580.00	912.00	925.00	438.00	222.00	220.00	340.00	433.00
1941	711.00	469.00		3,530.00				5,047.00	1,365.00	669.00	593.00	566.00
1942	257.00	241.00	322.00	994.00		1,281.00		938.00	294.00	210.00	393.00	286.00
1943	245.00	203.00	210.00	900.00		2,786.00		606.00	211.00	165.00	383.00	327.00
1944	281.00	250.00	250.00	205.00		1,183.00		650.00	251.00	184.00	262.00	368.00
1945	264.00	170.00	256.00	273.00		1,638.00		1,155.00	266.00	193.00	504.00	197.00
1946	293.00	493.00	501.00	267.00	245.00	489.00	581.00	238.00	109.00	173.00	608.00	1,612.00
1947	702.00	259.00	295.00	324.00	435.00	572.00	483.00	337.00	127.00	103.00	372.00	686.00
1948	132.00	173.00	442.00	269.00		1,074.00		803.00		207.00	265.00	120.00
1949	208.00	190.00	208.00	1,856.00	987.00	2,415.00	2,754.00	1,237.00	467.00	534.00	603.00	238.00
1950	116.00	133.00	152.00	219.00	312.00	575.00	562.00	230.00	116.00	220.00	214.00	176.00
1951	154.00	217.00	923.00	169.00	192.00	243.00	329.00	373.00	118.00	112.00	1,064.00	248.0C
1952	151.00	237.00	225.00	6,245.00	725.00	2,259.00	5,184.00	2,252.00	672.00	236.00	434.00	232.00
1953	101.00	139.00	152.00	257.00		1,157.00	598.00	350.00	201.00	289.00	235.00	104.00
1954	139.00	139.00	148.00	164.00		2,215.00	978.00	366.00	131.00	354.00	680.00	283.00
1955	139.00	153.00	188.00	171.00	173.00	233.00	211.00	155.00	129.00		1,615.00	259.00
1956	85.50	122.00	127.00	225.00	388.00	736.00	645.00	371.00	121.00	138.00	187.00	77.90
1957	223.00	363.00	240.00	764.00	925.00	760.00	617.00	500.00	320.00		1,048.00	352.00
1958	670.00	232.00	206.00	186.00	723.00	3,137.00	3,915.00	1,825.00	407.00	147.00	296.00	571.00
1959	552.00	1,259.00	2,675.00	181.00	203.00	230.00	240.00	127.00	78.70		1,331.00	237.00
1950	236.00	191.00	178.00		1,008.00		1,644.00	677.00	285.00	131.00	172.00	136.00
1961	147.00	274.00	562.00	180.00	195.00	339.00	540.00	198.00	108.00	131.00	286.00	241.00
1962				1,124.00				1,188.00	310.00	183.00	151.00	
	254.00	234.00						298.00				234.00
1963	325.00	310.00	203.00		1,286.00	783.00	900.00		104.00		1,031.00	925.00
1964	295.00	190.00	208.00	161.00	168.00		- 956.00	369.00	138.00	279.00	634.00	800.00
1965	161.00	507.00		1,862.00		•		1,483.00	556.00	397.00	521.00	233.00
1966	222.00	212.00	445.00	1,768.00	700.00	3,216.00	4,498.UU	877.00	268.00	200.00	459.00	579.00

1967	214.00	195.00	1 157 00	240 00	222 00	200 00	305.00	172 ለለ	100.00	277 ለለ	1 220 40	607.00
1968			1,167.00		223.00			172.00	129.00	377.00	1,338.00	687.00
	229.00	207.00		1,859.00		2,839.00	2,799.00	1,346.00	458.00	282.00	701.00	232.00
1969	231.00	293.00		-1,299.00	694.00		2,395.00	1,021.00	312.00	213.00	348.00	494.00
1970	252.00	172.00	184.00		229.00		931.00	670.00	205.00	163.00	337.00	830.00
1971	2,147.00	727.00	1,575.00		221.00		259.00	180.00	100.00	123.00	860.00	529.00
1972	4,732.00	1,229.00	1,418.00		332.00		257.00	151.00	190.00	149.00	179.00	209.00
1973	180.00	222.00	229.00		•	5,512.00	•	5,933.00	1,329.00	557.00	370.00	200.00
1974	530.00	479.00	225.00		235.00		510.00	290.00	121.00	173.00	284.00	168.00
1975	149.00	163.00	207.00			2,144.00	2,968.00	1,750.00	477.00	324.00	181.00	335.00
1976	189.00	177.00	168.00		1,174.00	574.00	1,204.00	872.00	240.00	297.00	295.00	236.00
1977	232.00	197.00	161.00	210.00	216.00	241.00	608.00	322.00	142.00	225.00	397.00	318.00
1978	187.00	2,009.00	5,943.00	258.00	1,837.00	10,390.00	3,081.00	.1,035.00	320.00	191.00	360.00	177.00
1979	200.00	268.00	254.00	3,695.00	3,071.00	5,053.00	6,281.00	2,960.00	1,281.00	403.00	414.00	223.00
1980	311.00	372.00	300.00	1,466.00	9,072.00	2,701.00	3,848.00	2,742.00	879.00	369.00	461.00	316.00
1981	354.00	231.00	244.00	250.00	283.00	763.00	1,280.00	580.00	230.00	269.00	336.00	278.00
1982	206.00	233.00	1,842.00	448.00	1,405.00	2,842.00	1,945.00	1,210.00	388.00	202.00	429.00	476.00
1983	4,832.00	486.00	1,627.00	1,164.00	2,895.00	5,229.00	4,265.00	3,208.00	1,190.00	446.00	558.00	683.00
1984	1,206.00	527.00	4,146.00		579.00		922.00	575.00	190.00	329.00	730.00	662.00
1985	535.00	585.00	580.00			5,155.00	3,361.00	2,147.00	648.00	323.00	458.00	451.00
1986	509.00	944.00	1,090.00				1,715.00	609.00	270.00	393.00	386.00	350.00
1987	242.00	490.00	317.00		1,037.00		3,104.00	1,339.00	400.00	222.00	532.00	220.00
1988	308.00	247.00	252.00		1,589.00		1,785.00	1,215.00	322.00	313.00	1,231.00	1,440.00
1989	183.00	186.00	191.00				583.00	232.00	118.00	141.00	277.00	143.00
1990	239.00	291.00	1,171.00		225.00		414.00	250.00	113.00	484.00	462.00	268.00
1991	194.00	287.00		1,811.00		6,408.00		1,615.00	557.00	219.00	298.00	447.00
1992	235.00	245.00				2,742.00	3,019.00	1,429.00	811.00	279.00	1,427.00	445.00
1993	358.00	595.00	•	13,470.00		•	•	2,296.00	718.00	294.00	371.00	443.00
****	444.44	*****	242.00	well14464	1 1001100	41244144	.,,,,,,,,,	-1444.44	120.00	851.44	2,1,00	110.00

TOTALS 36,280.50 30,329.00 64,192.00 90,966.00114,377.00163,402.00166,428.00 85,423.00 30,089.70 27,164.30 48,106.00 36,547.90

## Monthly Averages:

Nov Dec Jan Peb Mar Apr Xay Jun Jul Aug Sep 792.49 1,137.08 1,429.71 2,042.53 2,080.35 1,067.79 447.91 374.43 376.12 339.55 601.33 456.85

80 Year (Monthly) Average Overall: 928.85

ARIZONA RIVERS Salt River - Sta. 5020

Salt Riv	ver – Sta.	5020											
Year	0ct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	TOTAL
1934	956.0	408.0	53.0	•									
. 1935	1,077.0	646.0	375.0	9.6	21.9	32.4	684.0	1,215.0	1,771.0	1,899.0	919.0		10,122.9
1936	992.0	669.0	294.0	400.0	31.6	624.0	1,188.0	1,620.0	2,055.0	1,866.0	1,313.0	1,940.0	12,992.6
1937	1,157.0	651.0	218.0	24.0	99.8	20.2	807.0	1,953.0	2,062.0	2,510.0	2,737.0	2,451.0	14,690.0
1938	1,044.0	641.0	123.0	190.0	1 296.0	295.0	1,578.0	1,614.0	2,025.0	2,003.0	1,721.0	2,114.0	13,644.0
1939	680.0	494.0	373.0	33.0	230.0	473.0	1,103.0	1,255.0	1,472.0	1,539.0	1,115.0	196.0	8,963.0
1940	77.5	123.0	11.9	72.3	21.0	737.0	935.0	955.0	1,129.0	1,119.0	602.0	564.0	6,346.7
1941	1,111.0	771.0	472.0	10.8	8.8	8.9	2,438.0	5,716.0	1,692.0	1,636.0	1,746.0	1,602.0	17,212.5
1942	1,226.0	759.0	729.0	404.0	1,061.0	831.0	917.0	1,366.0	1,551.0	1,722.0	1,765.0	1,909.0	14,240.0
1943	1,177.0	902.0	528.0	69.3	452.0	431.0	952.0	1,336.0	2,036.0	1,864.0	1,009.0	1,510.0	12,266.3
1944	1,314.0	606.0	519.0	208.0	326.0	242.0	294.0	1,009.0	1,245.0	1,373.0	1,089.0	1,732.0	9,957.0
1945	1,228.0	1,082.0	648.0	34.5	403.0	319.0	616.0	1,115.0	1,306.0	1,384.0	1,114.0	1,808.0	11,057.5
1946	1,149.0	525.0	662.0	39.4	762.0	1,423.0	989.0	1,317.0	1,677.0	1,191.0	1,200.0	1,141.0	12,075.4
1947	562.0	304.0	339.0	397.0	479.0	705.0	911.0	749.0	1.016.0	910.0	852.0	992.0	8,216.0
1948	630.0	483.0	352.0	161.0	394.0	447.0	673.0	907.0	1,062.0	1,042.0	1,030.0	1,154.0	8,335.0
1949	538.0	571.0	222.0	10.8	13.0	9.7	9.5	10.2	830.0	1,202.0	1,073.0	884.0	5,373.2
1950	619.0	253.0	287.0	17.5	42.2	737.0	1,114.0	1,002.0	1,247.0	1,092.0	1,138.0	1,164.0	
1951	4.4	1.4	298.0	57.2	56.2	769.0	634.0	402.0	1.243.0	1,404.0	983.0	10.3	5,862.5
1952	63.9	1.4	0.0	3.0	1.8	3.9	3.5	241.0	346.0	1,041.0	1,356.0	1,018.0	4,079.5
1953	396.0	317.0	537.0	0.0	279.0	969.0	1,010.0	770.0	1,491.0	1,498.0	1,576.0	1,339.0	10,182.0
	399.0	294.0	605.0	143.0	361.0	892.0	786.0	728.0	1.097.0	854.0	1,264.0	993.0	8,416.0
1954		0.5	6.0	4.8	221.0	909.0	1,169.0	934.0	1,318.0	1,232.0	1,031.0	1,504.0	8,763.3
1955	434.0					1,011.0	885.0	801.0	1,441.0	1,654.0	1,495.0	1,460.0	9,722.3
1956	291.0	94.4	366.0	80.9	0.4	62.1	465.0	1.1	908.0	1,201.0	1,341.0	1,231.0	5,277.6
1957	65.3	0.4	0.0	2.3		102.0	46.6	582.0	803.0	963.0	1,211.0	899.0	4,671.3
1958	62.8	1.0	0.2	0.0	0.7		709.0	717.0	1,229.0	1,426.0	889.0	1,085.0	7,756.9
1959	285.0	43.7	48.0	0.0	40.2	1,285.0 137.0	305.0	530.0	935.0	1,302.0	1,314.0	1,077.0	6,116.7
1960	232.0	3.4	65.1	206.0	10.2		867.0	1,231.0	1,481.0	1,650.0	1,174.0	979.0	9,359.4
1961	261.0	47.3	8.0	5.1	316.0	1,340.0		1,122.0	1,320.0	1,315.0	1,926.0	1,363.0	8,534.7
1962	66.5	112.0	0.0	36.2	151.0	152.0	971.0			1,969.0	1,134.0	1,038.0	10,171.1
1963	132.0	6.9	104.0	0.0	91.2	1,465.0	1,050.0	1,359.0	1,822.0		590.0	517.0	7,547.9
1964	349.0	90.9	1.6	26.4	199.0	1,206.0	928.0	999.0	1,298.0	1,343.0 749.0	535.0	652.0	
1965	164.0	191.0	1,823.0	1.2	29.7	104.0	4.5	266.0	569.0				5,088.4
1966	299.0	29.5	1,193.0	3,984.0	1,238.0	1,600.0	1,607.0	775.0	818.0	1,253.0	1,213.0	1,125.0	15,134.5
1967	824.0	8.0	389.0	77.0	22.6	940.0	821.0	867.0	993.0	848.0	1,167.0	1,147.0	8,103.6
1968	924.0	423.0	799.0	12.0	5,110.0	4,980.0	3,660.0	2,110.0	1,600.0	1,460.0	1,560.0	2,220.0	24,858.0
1969	866.0	13.6	796.0	188.0	475.0	611.0	1,388.0	2,147.0	2,269.0	1,129.0	205.0		11,397.6
1970	315.0	6.2	4.4	172.0	757.0	649.0	1,445.0	1,605.0	2,048.0	1,603.0	1,283.0	1,108.0	10,995.6
1971	140.0	7.0	8.5	4.1	578.0	1,324.0	1,113.0	1,213.0	1,061.0	1,288.0	608.0	585.0	7,929.6
1972	697.0	45.9	8.9	5.4	5.2	466.0	1,204.0	1,344.0	1,492.0	1,482.0	1,166.0	860.0	8,776.4
1973	1,207.0	84.2	9.7	7.9	156.0	3,273.0	6,452.0	5,261.0	1,911.0	1,785.0	1,831.0	1,881.0	23,858.8
1974	38.3	0.1	3.1	1.7	1.2	942.0	1,313.0	1,414.0	1,762.0	1,632.0	1,749.0		10,166.4
1975	327.0	1.3	1.2	2.8	15.8	517.0	334.0	1,258.0	1,661.0	1,669.0	1,680.0	1,434.0	8,901.1
1976	391.0	5.3	2.1	198.0	108.0	18.7	400.0	810.0	1,236.0	1,445.0	1,742.0	1,219.0	7,575.1
1977	416.0	2.0	0.5	0.0	0.0	457.0	1,156.0	1,254.0	1,904.0	2,067.0	1,940.0		10,294.5
1978	734.0	155.0	7,169.0	0.0	1.1	980.0	1,115.0	1,517.0	1,714.0	1,694.0	1,681.0		18,322.1
1979	962.0	6.8	0.0	9,747.0	1,489.0	6,874.0	4,851.0	2,993.0	2,026.0	2,088.0	2,067.0		34,937.8
1980	455.0	3.2	2.8	109.0	18,950.0	1,592.0	3,118.0	2,803.0	2,124.0	2,590.0	2,208.0		36,238.0
1981	269.0	5.5	3.6	408.0	748.0	1,319.0	1,485.0	1,139.0	1,742.0	1,763.0	1,801.0		11,927.1
1982	377.0	5.9	244.0	3.6	1.5	1.5	114.0	919.0	1,811.0	1,767.0	1,679.0	1,463.0	
1983	7,128.0	150.0	986.0	916.0	4,213.0	5,313.0	4,332.0	2,698.0	1,664.0	1,494.0	1,430.0		31,355.0
1984	204.0	15.6	3,501.0	1,650.0	743.0	668.0	489.0	773.0	1,485.0	983.0	1,291.0		13,145.6
1985	261.0	5.8	1,397.0	3,410.0	2,492.0	5,460.0	2,567.0	2,325.0	1,767.0	1,711.0	1,761.0	1,258.0	24,414.8
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1986 1987 1988 1989 1990 1991 1992 1993	18.3 48.4 379.0 263.0 304.0 865.0 25.1 721.0	7.0 10.6 42.2 1.7 12.7 19.0 105.0 97.8	7.6 9.2 3.1 69.5 6.6 378.0 459.0	514.0 708.0 10.8 27.6 -0.0 4.3 1,491.0 20,240.0	5.1 686.0 540.0 0.0 61.0 179.0 2,448.0	574.0 1,153.0 1,487.0 1,031.0 53.1 1,000.0 3,296.0 7,397.0	1,815.0 1,791.0 718.0 1,531.0 705.0 1,315.0 3,052.0 4,852.0	1,486.0 1,539.0 1,130.0 1,906.0 1,035.0 1,425.0 2,846.0 4,503.0	1,719.0 1,739.0 1,721.0 2,122.0 1,569.0 1,835.0 2,322.0 961.0	1,625.0 1,648.0 1,744.0 2,106.0 1,305.0 1,952.0 1,665.0 1,359.0	1,625.0 1,631.0 1,617.0 1,838.0 967.0 1,809.0 2,216.0 1,737.0	473.0	12,218.2 10,750.1 12,158.8 6,491.4 11,974.3 21,583.1
TOTALS	38202	12363	27523	46540	59415	71719	79785	84917	88553	89108	81744	74631	
MONTH AVE	637	206	459	789	1007	1216	1352	1439	1501	1510	1385	1265	
59 Year (	Monthly) A	Average Ove	erall:	1064									

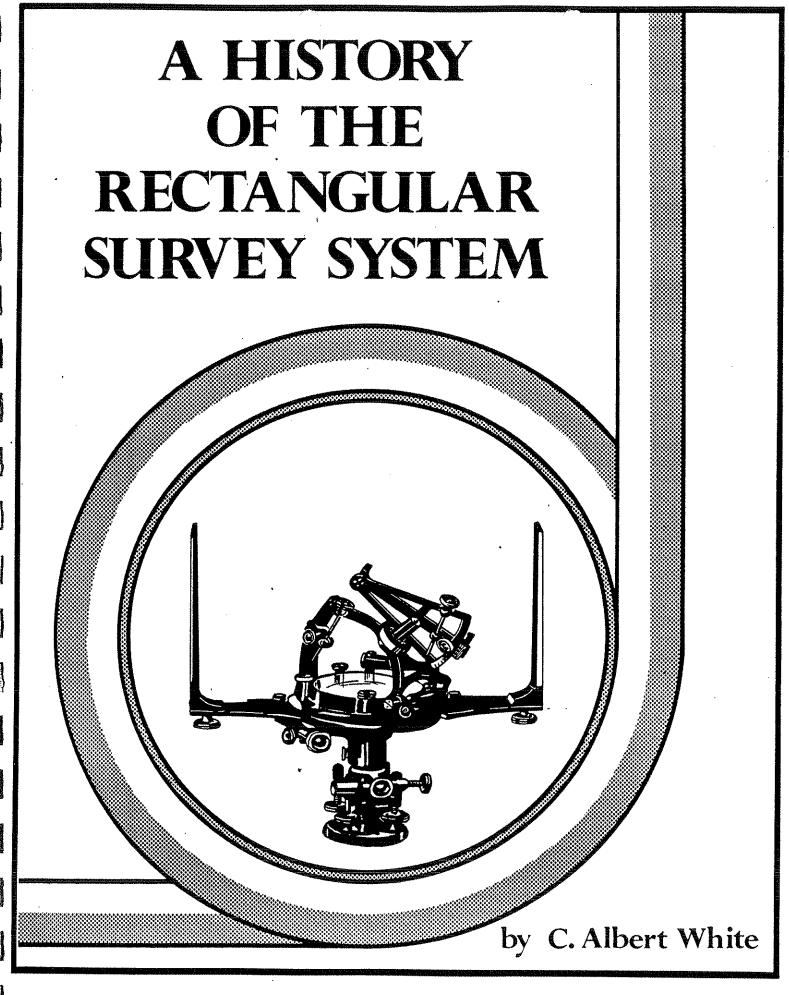
STATION NUMBER 09512190 SALT RIVER AT 24TH STREET AT PHOENIX STREAM SOURCE AGENCY USGS LATITUDE 332456 LONGITUDE 1120145 DRAINAGE AREA 13263 DATUM 1100. STATE 04 COUNTY 013 FROM DCP,

# DISCHARGE, CUBIC FEET PER SECOND, WATER YEAR OCTOBER 1989 TO SEPTEMBER 1990 DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	* MAY	מטנ	JUL	AUG	SEP
1	.00	.00	.00	e.00	e2.0	.00	.00	.00	.00	.00	.00	.00
2	.00	.00	.00	e.00	e29	:00	.00	.00	.00	.00	.00	.00
3	.00	.00	.00	e.00	e2.0	.00	.00	.00	.00	.00	.00	.00
4	.00	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	103
5	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
6	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
7	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
8	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
9	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
10	.00	.00	.00	.00	.00	.00	.00	:00	.00	.00	.00	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
12	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
13	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
14	.00	.00	e.Q0	.00	.00	.00	.00	.00	.00	.00	20	.00
15	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	442	14
16	.00	.00	e.00	.00	.00	.00	.00	.00	.00		e25	.00
17	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	e1.5	.00
18	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
19	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
20	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
21	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
22	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
23	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
24	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
25	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
26	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
27	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
28	.00	.00	e.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
29	.00	.00	e.00	.00		.00	.00	.00	.00	.00	.00	.00
30	.00	.00	e.00	.00		.00	.00	.00	.00	.00	.00	.00
31	.00	W- W-	e.00	.00		.00		.00	~~*	.00	.00	****
TOTAL	0.00	0.00	0.00	0.00	33.00	0.00	0.00	0.00	0.00	0.00	488.50	117.00
MEAN	.000	.000	.000	.000	1.18	.000	.000	.000	.000	.000	15.8	3.90
MAX	.00	.00	.00	.00	29	.00	.00	.00	.00	.00	442	103
MIN	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
AC-FT	.00	.00	.00	.00	65	.00	.00	.00	.00	.00	969	232

WTR YR 1990 TOTAL 638.50 MEAN 1.75 MAX 442 MIN .00 AC-FT 1270

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# UNITED STATES DEPARTMENT OF THE INTERIOR

James G. Watt, Secretary .



# BUREAU OF LAND MANAGEMENT



Robert F. Burford, Director

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lost the decisive battle at Fallen Timbers in August 1794. The result was a treaty, signed at Greenville, ( ), on August 3, 1795, 7 Stat. 49, which gave title to the United States for about three-fourths of the present state of Ohio and a small part of Indiana. The Greenville Treaty boundaries will be discussed later in this book.

## Analysis of the Period

Although many details were still to be worked out, this period proved beyond a doubt that the rectangular system of townships and ranges was far superior to the indiscriminate location method of disposing of large land areas. The complete simplicity of land description cannot be overstressed. Compare the first patent description, "Lot No. 20, Township 7, Range 4," against the complexity of a many-sided metes and bounds location. There is only one possible location for that section in all of the Ohio River Base surveys which can be easily and quickly spotted on any map of sufficient scale. Theoretically, it can also be divided by aliquot part description down to a parcel the size of this page and that small piece could only be situated in one place in the whole country. This huge advantage must have been obvious to anyone concerned with land surveys and sales, even Alexander Hamilton. It would be a few years and arguments later before the six-milesquare township was fixed as the final unit. Ten-mile townships were never adopted but five-mile townships would be used for special reasons only.

The details of execution, monumentation, subdivision, and sales were still in an evolutionary stage in 1796, but the foundation was laid. Indian title had been extinguished, the country was at peace at home and abroad, the economy was looking up, the Ohio Company and Symmes had about run their course and the public lands were there with settlers ready and willing to buy, given the chance. The time was ripe for the next step.

#### THE PERIOD 1796 — 1812

#### AMERICAN ST. 1796

Congress debated but failed to pass legislation on the public lands question from 1789-1792. A scandal involving the Ohio Company, the questionble activities of Symmes, and the final defeat of the Indians caused action in January 1796. Finally the *Act of May 18, 1796,* 1 Stat. 464, was approved, a milestone in any history of the public land surveys, and at the time was the instructions for the conduct of those surveys. An analysis of the act by section is appropriate here.

- ec. 1. A Surveyor General shall be appointed. He shall engage skillful surveyors as his deputies. He shall survey the lands northwest of the Ohio River and above the mouth of the Kentucky River (in Kentucky) in which Indian title has been extinguished (Greenville Treaty). He shall frame regulations and instructions for his deputies and they shall take an oath (to do proper work) and he may remove (fire) them for negligence or misconduct. (Hopefully this would give the Surveyor General the power to achieve properly executed surveys.)
- Sec. 2. The lands not already surveyed or patented (in the

Seven Ranges, Ohio Company, Symmes Purchase) ng appropriated for military and lands not bounties (Virginia Tract and U.S. Military Reserve) are to be divided into townships six miles square by north-south lines run according to true meridian (restoring that requirment) and by lines crossing them at right angles (east-west), except where the Indian boundary or navigable rivers make full townships impossible. (Only the Greenville treaty line, Ohio, Scioto, Great and Little Miami Rivers and private land claims created fractional townships as referred to in the act.) The corners of the townships and the section corners will be distinctly and differently marked. (The appropriate numbers, township, range, and section so that a purchaser could find his land.) Onehalf of the townships, taken alternately, shall be subdivided into sections (first use of that term), by running through the townships parallel lines at the end of every two miles, with section corners at every mile on all lines surveyed. (This was another economy measure.) The sections will be numbered beginning with number one in the northeast corner of the township, proceeding west and east alternately (the method still in use, but no one knows why the new numbering system was adopted). Bearing trees will be taken at each corner and all lines will be plainly blazed (the commong practice). The lines will be measured with chains containing two perches of 161/2 feet each, subdivided into 25 equal links, adjusted to a standard to be kept for that purpose. (This specifically calls for a Gunter's chain and leaves no doubt that accurate measurements are to be made.) The Surveyors are to keep detailed field notes (vital for mapping information) and return them to the Surveyor General for permanent records. The Surveyor General will make three plats; one for his office, one for use at the place of sale, and one for the Secretary of Treasury; he will make out a description of the township for the use of the officers making sales, and will give a description on the plat of the lands and the corner monumentation. (The field note books were kept by the Surveyor General and only descriptive notes went to Washington and the land offices.)

Sec. 3. Reservations: 36 contiguous sections surrounding a salt spring east of the Scioto are reserved (this spring is located in section 29, T. 7, R. 18, and the 36 sections are in Tps. 6 and 7, R. 19, and Tps. 6 and 7, R. 18, where Jackson, Ohio, is now located). If other salt springs are found, the section containing it is also reserved (salt was a vital element to the settlers and no one was allowed to monopolize it). The four sections at the center of each township are resreved (sections 15, 16, 21, and 22) except in fractional townships which are less than three-fourths of full size, but the salt reservation applies. (No mention is made of a section 16 school reservation.)

4. When seven ranges are surveyed (1) below the Great Miami, (2) between the Scioto and Ohio Company Purchase, (3) between the Connecticut Reserve and the Seven Ranges, and the plats returned, etc., the sales will be held at Cincinnati and Pittsburg. (This wording had the effect of establishing surveying districts.) The townships subdivided will be offered for sale in sections, and those not subdivided will be sold at Washington in quarter townships. The minimum price is raised to two dollars per acre (raised from the old price of \$1).

Sec. 5. Provides for notice and advertising of the sales.

This section is complex and directs that the unsold Sec. 6. lands in the Seven Ranges, including lands drawn by the Army, and the lands sold but unpaid for, thereby forfeited, and the townships that were to be sold entire under the Land Ordinance are to be sold. The whole townships are to be sold in quarter township blocks in Philadelphia, reserving the four sections at the center of the township. The townships that were to be sold by sections under the Ordinance are to be sold at Pittsburg, again reserving the four sections in the center of the township. But the reserved lots in the townships already sold under the Ordinance are still reserved, which was very confusing because of forfeited lands, scattering of plats and records of sale, etc. It was really hard to tell whether the old reserves were abolished or the new four-section reserve was added to the old in certain townships.

This section turned out to be a mistake and wasn't corrected until 1820. It provides for credit purchases under a complicated formula. The highest bidder is to pay 1/20th of the purchase price as down payment, to be forfeited if one-half the price including the 1/20 is not paid within 30 days. If he pays the half, he then has one year to pay the other half. If he doesn't pay the remaining half within one year, he forfeits the half he has paid and the government forecloses. If and when he pays the full amount, he will receive a patent which is to be signed by the President and Secretary of State, the latter to record the patent. Thus, the Secretary of the Treasury was in charge of credit sales but the Secretary of State recorded the patent. Credit sales, forfeitures, and scattering of records caused problems and confusion for the next 40 years or more.

Sec. 8. Provides for recordkeeping by both the Territorial Governor (St. Clair) and the Secretary of the Treasury.

Sec. 9. The wording of this section probably caused more litigation and misunderstanding than any other section of the act. It follows, in full:

And hait further enacted, That all navigable

rivers within ...e territory to be disposed of by virtue of this act, shall be deemed to be, and remain public highways: And that in all cases, where the opposite banks of any stream, not navigable, shall belong to different persons, the stream and the bed thereof shall become common to both."

What is a navigable river is how is navigable river is how is navigability determined? Non-navigable streams have a common ownership, i.e., if there are different patentees on opposite banks they own the bed in common. But nothing is said about non-navigable lakes, and that caused many problems during the 1800's. This important section of the act is now codified in 43 U.S.C. 931.

Sec. 10. Provides for the Surveyor General's salary (but no office help) and that the President of the United States may fix the compensation of the assistant surveyors, chain carriers and axe men: provided that the whole expense of surveying shall not exceed \$3 per mile for every mile actually run or surveyed. This seems to imply that assistant surveyors and crew members would be hired on a salary, but if so, how would it be possible to assure that the cost of surveying would not exceed \$3 per mile? The increase to \$3 (the Land Ordinance called for \$2) would not assure speed on the part of the surveyors.

Sec. 11. Provides for the fees to be paid the Treasurer or receiver for handling the sales.

Sec. 12. Requires that the Surveyor General, assistant surveyors, and chainmen must take an oath to faithfully perform their duties. The receiver is to furnish a bond as security. These stipulations were an effort to assure honesty in the surveys and money handling.

#### Act of June 1, 1796, 1 Stat. 490

Passage of this act was anticipated in the Act of May 18, 1796. The title is a little misleading, "An Act regulating the grants of land appropriated for Military Services, and for the Society of the United Brethren, for propagating the Gospel among the Heathen."

In the Land Ordinance, the Army was to select townships to satisfy the military bounties granted to the Revolutionary War soldiers by the Continental Congress. None were selected; instead, the Congress agreed to set aside a specific tract to be used to satisfy those outstanding warrants, i.e., the U.S. Military Reserve.

The "United Brethren" were the Moravian missionaries who had established missions on the Tuscarawas branch of the Muskingum River and had converted many Indians to Christianity. These missions were settled Indian towns within the Military Reserve. The missionaries had a strong influence on the Indians and had brought a measure of peace in the area before the Greenville Treaty. Congress granted 4,000 acres for each town to the Moravians in appreciation,

ing the Mississippi Territory, which had been created by the Act of April 7, 1798, 1 Stat. 549. It provided for the stablishment of two land offices, Registers and Receivers, a board of land commissioners to handle private land claims, and how the claims were to be recognized. Sec. 10 of this act established the office of Surveyor of Lands South of Tennessee. The public land surveys were to be made the same as in Ohio, allowing a maximum of \$4 per mile for surveying by deputy surveyors, and private land claims were to be surveyed by deputy surveyors paid by the claimants.

Isaac Briggs, was appointed "Surveyor of the Lands South of Tennessee" about April 1, 1803. Gallatin wrote to Briggs on April 8th, directing him to begin the surveys in Mississippi and to purchase instruments. He was to run a meridian line from a monument on the south boundary of the United States and lay off townships to the east and west thereof in ranges numbered east and west and townships numbered north from the boundary. These townships could only extend north to the then Indian boundary. Briggs established his office at Washington, Mississippi Territory, in August 1803.

In 1799-1800, Andrew Ellicott had surveyed the Line of Demarcation between the United States and Spanish Florida along the 31st parallel; he began the line at the Mississippi River and ran east. The first 21 miles were carefully surveyed. Ellicott then ran a compass line and at various intervals made latitude observations, measured a falling to the true parallel, and then corrected the compass line back, moving his mile posts to the true line. The Ellicott line was the south boundary of the United States referred to by Gallatin.

On July 25, 1803, Gallatin wrote instructions to Briggs concerning the private land claims. The following is part of that letter:

"Sir,

Although by my letter of the 8th April, ult. you were generally instructed to divide the whole of the two tracts to which the Indian title has been extinguished into Ranges & Townships, yet, as that mode may present some difficulties which might induce you to prefer another, I have thought it necessary to repeat particularly that a deviation from that plan would be attended with great confusion in the several offices connected with yours and particularly in this Department. But. although the whole country shall without exception be divided into regular Ranges & Townships, the lands for which Certificates shall have been granted by the Commissioners must nevertheless be surveyed in conformity to such Certificates. It will only result that a person will often have a part of his tract in one and the remainder in another Township & that the tract will be returned by you as consisting of two or more Sections lying contiguous but in different Townships. But as a single patent will nevertheless issue for the whole tract. neither inconvenience nor additional expense will be experienced by the party. The outlines of all of the Townships must, however, be surveyed at the expense of the United States, though running amongst lands for the expense of surveying which Individuals must pay, and..."

The use of the term "Sections" to designate the private land claims was unfortunate because all the private land claims in

the lands south of Tennessee were labeled and called sections thereafter. As a result, a nship may contain over 100 sections; this caused a great deal of confusion, which will be seen later.

On December 12, 1803, Briggs reported to Gallatin that he had started a meridian line at Washington, Mississippi, and had two deputies extend the line due south; they intersected Ellicott's line near the 19th-mile post. They then remeasured a part of Ellicott's line and found unacceptable errors in the distance between mile posts. Briggs then had two meridian lines surveyed due north, one from the 18th-mile post and another from a point "6 miles and 12 perches" east of that mile post. He proposed to use the line which ran over the smoothest country as his "Basis Meridian." Gallatin replied that he was sorry to hear Ellicott's measurements were so poor and gave Briggs permission to use his best judgment, but Briggs did little or nothing with the rectangular surveys during the next two years.

#### Act of March 3, 1803, 2 Stat. 236

Sec. 5 of this act directs that all of the unappropriated lands in the U.S. Military Tract were to be subdivided into sections according to the *Act of May 10, 1800*. Putnam had his surveyors subdivide those five-mile townships into 25 sections, with number 1 in the northeast corner and number 25 in the southwest corner in the manner used since 1796. Few of the townships were whole, most had military warrant lots within them, and in some, quarter townships had been taken up, the result being many half sections were against the alienated lands (see Fig. 14).

### 1803 — Jared Mansfield Takes Office as Surveyor General

Jared Mansfield was born on May 23, 1759, at New Haven, Connecticut. He was expelled from Yale in 1777 for misconduct but was later readmitted and received a degree in 1787. He taught school thereafter and was rector of an advanced school in New Haven from 1796-1802. In 1802, he wrote his Essays, Mathematical and Physical in the subjects of algebra, geometry, calculus, and astronomy, which brought him immediate notoriety. He was appointed acting Professor of Mathematics at the Military Academy at West Point and served in that position until his appointment to the office of Surveyor General in July 1803; along with his new job he received the rank of Lt. Colonel in the army. He visited New Haven and then travelled to Ohio, arriving in Marietta where he officially took the oath of office on November 3, 1803. In July, he had written to the Secretary of the Treasury, Albert Gallatin, inquiring on how to acquire from London, England, a list of instruments including an astronomical clock, astronomic zenith sector, astronomic quadrant, transits, sextants, and other items. He repeated these requests again in December and in later years and eventually purchased a few of the instruments at his own expense. Jefferson and Gallatin had in Mansfield a well-educated man and an acknowledged mathematician. It was during Mansfield's tenure of office that the rectangular system of surveys was developed into a system closely approaching that in use today.

## Act of March 26, 1804, 2 Stat. 277

This was the first major act affecting the public land sur-

veys after the surveys were extended to the Mississippi Territory and Briggs and Mansfield took office.

- Extends the Surveyor General's authority to all the lands north of the Ohio and east of the Mississippi River, to which Indian title had been extinguished or "shall hereafter be extinguished." At that time, west of Ohio, only the Vincennes Tract and a few thousand acres of French claims had been cleared of Indian title by the Fort Wayne Treaty of June 7, 1803, 7 Stat. 74. But the Federal government made no pretense that all the lands would not eventually be acquired from the Indians and everybody knew it, except maybe the Indians themselves. The Surveyor General was also made responsible for surveying the Indian boundary lines "as have not yet been surveyed." Thomas Freeman had already surveyed the boundaries of the Vincennes Tract in 1802. The Surveyor General was to determine with the approval of the President, using astronomical observation, the positions of such places as were necessary for the "Correctness of the Surveys." This was clearly aimed at Mansfield's abilities in astronomy; unfortunately, Mansfield didn't have his astronomical instruments, and Congress did not bother supplying them.
- Sec. 2. Establishes three new land offices at Vincennes, Detroit, and Kaskaskia and Registers and Receivers to man them. Those three communities were the centers of the French settlements and therefore the location of most of the private land claims north of the Ohio River.
- Sec. 3. Deals with the French claims, evidences, etc.
- Sec. 4. Makes the Registers and Receivers land commissioners to handle the claims.
- Sec. 5. Makes the reservation of section 16 for schools, three townships for a college, and salt springs. It also provides for land sales and patenting procedures
- waters, within the Indiana territory, shall be deemed to be, and remain public highways." The addition of "creeks and waters" in this act is perplexing. It was not in the Acts of May 18, 1796 and March 3, 1803. Does it mean that all creeks and waters are declared navigable, or does it mean that all navigable creeks and waters, including lakes, are public highways? Probably the latter. But who is to determine whether a creek is navigable? The result was that all streams large enough to be used as a means of travel through the territory were meandered by the surveyors, creating many more fractional sections than had been created in Ohio.

- Secs. 7 and 8. Deal with the lands and preemptions between the Miami Rivers sold by John Cleves Symmes.
- Sec. 9. Provides for sale of fractional sections.
- Provides that the public lands will be offered for Sec. 10. sale in half sections or in quarter sections. If sold in half sections, the dividing line is to be run "due north and south; and the half sections shall be divided into quarter sections by lines running due east and west." The purchaser is to pay for the subdivision of any section bought by quarter or half section. The problem with these provisions was the due north and south and due east and west wording. If the section boundaries weren't "due" north and south or "due" east and west, subdividing in that manner would be an impossibility. And no quarter corners had been established on any of the north-south section lines. How are the quarter corners on those lines to be established and who is to pay for the cost of that work? About half the six-mile-square townships in Ohio had been subdivided by alternate section lines. If a man bought a quarter section in one of those townships, how was it to be surveyed?
- Sec. 12. This section placed the reserved sections up for sale. These were the three or four sections in each township reserved by Congress for future disposal. All the other public lands both north of the Ohio and south of Tennessee were directed to be sold in quarter sections. Congress used the expressions "north of the Ohio" and "south of Tennessee" because at that time there was an undetermined amount of public land in Tennessee; by this wording, the public lands in Tennessee were excluded from these laws.
- Sec. 13. This section is complex and divides responsibility for the surveys. The entire section follows with certain points emphasized:

"Sec. 13. And be it further enacted, That whenever any of the public lands shall have been surveyed in the manner directed by law, they shall be divided by the Secretary and the Treasury into convenient surveying districts, and a deputy surveyor shall, with the approbation of the said secretary, be appointed by the surveyorgeneral for each district, who shall take an oath or affirmation truly and faithfully to perform the duties of his office; and whose duty it shall be to run and mark such lines as may be necessary for subdividing the lands surveyed as aforesaid, into sections, half sections or quarter sections, as the case may be; to ascertain the true contents of such subdivisions; and to record in a book to be kept for that purpose, the surveys thus made.. The surveyor-general shall furnish each deputy surveyor with a copy of the plat of townships and fractional parts of townships contained in his district, describing the subdivisions thereof, and the marks of the corners. Each

#### THE PERIOD 1849 — 1910

The first major act of Congress affecting the public land surveys under the new Department was passed on September 9, 1850, 9 Stat. 452, admitting California to the Union, which was never organized as a territory. The new State received sections 16 and 36 in each township as well as other grants.

Also on September 9, 1850, 9 Stat. 453, the Territory of Utah was established, which included the lands between California and the Continental Divide and between 37° and 42° north latitude.

On September 20, 1850, 9 Stat. 466, Congress passed the first major act granting land to subsidize the construction of railroads. Lands had previously been granted to aid in construction of roads and canals. The railroad was the NEW method of transportation. The act granted the even-numbered sections, 6 and/or 15 miles each side of the right-of-way in Illinois, Mississippi, and Alabama for constructing the Chicago and Mobile Railroad, which later became the Illinois Central. Most of the lands had already been surveyed so this large grant did not in itself immediately affect the surveyors.

The Act of September 27, 1850, 9 Stat. 496, created the Office of Surveyor General in Oregon and extended the rectangular system to that Territory. It also allowed the "geodetic method" for executing the surveys.

This geodetic method was meant to be surveying by use of an alidade and plane table, making a topographic map at the same time as the survey of township and section lines. The method was never used, except that a special set of geodetic notes were made along the Willamette Meridian. A transit was used to cut in peaks and other topography so that the surveys could first be made in the best agricultural areas.

The act also granted donations of 320 acres to a single man and 640 acres to a man and wife who were settlers in the Oregon Territory. The boundaries of these Donation Land Claims (DLC's) were supposed to follow section subdivision lines wherever possible. Similar donations had been made to settlers in Florida in 1848 and 1849. Most of the DLC's were taken up in what is now the State of Oregon; fewer were taken in Washington. After the State boundary between Oregon and California was officially surveyed, one claim was found to be partly in California, but was honored anyway.

On October 11, 1850, William Gooding was appointed Surveyor General of Oregon; he refused the job. On November 26, 1850, John B. Preston in Chicago, Illinois, was notified of his appointment to the position. Preston travelled to Washington, D.C., and was briefed in March 1851. He gathered equipment, four solar compasses which were diverted from Michigan, transit, sextant, and chains. Preston travelled over the Isthmus of Panama, where he wrote to Butterfield on April 30, and arrived in Oregon City in May. where he established his office. He made a reconnaissance of the Columbia and Willamette Rivers, established the initial point for the Willamette Meridian in the hills west of Portland at the end of May, and let contracts for the initial surveys. This meridian controls all the surveys in Oregon and Washington. The meridian line, running south, was surveyed by James E. Freeman from Wisconsin. The meridian running north and the baseline east to the Cascade Mountains and west to the Coast. Inge were surveyed by William Ives. Freeman was from Wisconsin and Ives from Michigan. All of the early surveys were made with a solar compass.

The Appropriations Act of September 28, 1850, 9 Stat. 515, states in part: "That hereafter the meridian of the observatory at Washington shall be adopted and used as the American meridian for all astronomical purposes, and the meridian of Greenwich, England shall be adopted for all nautical purposes." The Washington Meridian was used to describe State, territorial, and Indian boundaries until repealed August 22, 1912, 37 Stat. 342. The Washington Meridian is 77° 03' 02.3" in longitude west of Greenwich.

Another major act was passed on September 28, 1850, 9 Stat. 519; the so-called Swamp Lands Act. The Act of March 2, 1849, 9 Stat. 352, had granted the swamp lands in Louisiana to that State only. The 1850 act extended the grant to Arkansas and all other States then in the Union and granted all "legal subdivisions" (sixteenth, section or fractional lot), the greater part of which was "wet and unfit for cultivation." If less than half the legal subdivision was swamp land, no part of it was granted. The Swamp Lands Act was extended to Minnesota and Oregon on March 12, 1860, 12 Stat. 3. It placed a large burden on the Deputy Surveyors and Surveyors General. They were not always able or inclined to carry it out faithfully within the intent of the law. As already briefly described, the act was difficult to administer; the States involved were supposed to pay the costs inherent with the determinations, and making up of the lists. Various methods were to eventually develop; for example, Florida set up a "Board of Internal Improvement" by an act of its legislature on January 24, 1851. This board was to handle the swamp lands, make examinations, determinations, and lists. Arkansas set up a "Board of Swamp Land Commissioners" with basically the same function. Illinois and Missouri appointed commissioners for the purpose. In some cases, the plats were used to determine the swamp and overflowed lands, in others the field notes.

The Secretary of the Interior and Commissioner insisted that this was a land grant of public lands and that title could not be passed to the States until the lands were surveyed and properly identified. Yet, on July 12, 1858, Commissioner Thomas A. Hendricks admonished Warner Lewis, the Surveyor General at Dubuque, for having surveyed an island which was mostly swamp even though Wisconsin paid for the survey of it. Hendricks told Lewis he had no authority to survey such lands because they would pass to the State anyway. It is a strong probability that many swamp lands were granted to some States, especially, Louisiana and the Everglades in Florida, without being actually surveyed. The lists made up by the State Surveyor General of California were in certain cases proven fraudulent.

Although the swamp and overflowed lands were a massive headache, they did not have any effect on the system of rectangular surveys, only the information to be obtained while doing those surveys in the field. The present rules for swamp and overflowed lands are well described in the 1973 Manual of Surveying Instructions, Sections 7-95 through 7-99; only incidental mention will be made of them hereafter in this book.

On December 13, 1850, the Territory of New Mexico was

created by Presidential Proclamation, which included what now Arizona, New Mexico, and part of Nev

The Appropriations Act of March 3, 1851, 9 Stat. 598, provided for a Surveyor General of California; on March 24, 1851, Samuel D. King was appointed to the position. King also travelled to Washington, D.C., for briefing and received three solar compasses, transit, and other equipment. King followed Preston across the Isthmus and arrived in San Francisco on June 19, 1851, where he established his office. He contracted with Leander Ransom on July 8, 1851, for the establishment of the Mount Diablo Meridian. Ransom reached the summit of Mount Diablo on Thursday, July 17, 1851, and excavated or drilled a hole in the "haycock shaped" solid rock of the highest pinnacle on the mountain to mark the initial point of the Mount Diablo Meridian, but he couldn't measure and run line off the mountain peak. He got on line south of the initial point approximately 12 miles from it, and through a series of offset lines running east and north, established the corner of townships 1 north and 1 south, ranges 2 and 3 east. He then ran the baseline west toward the initial point and the surveys in California were underway.

The Act of March 3, 1851, 9 Stat. 631, provided for appointment of commissioners to handle the multitude of private land claims in California. After the commissioners verified the claims, the surveys were to be made under the supervision of the Surveyor General.

The most signficant action taken in 1851 affecting the rectangular system of surveys also occurred on March 3; the first Manual of Surveying Instructions was officially issued. It was written to the Surveyor General of Public Lands in Oregon and was prepared by John M. Moore, Principal Clerk of Surveys. It isn't certain just what Moore's true position was at that time. A private act of Congress dated February 1, 1849, 9 Stat. 759, titled "An Act to Compensate John J. Moore," refers to Moore as "late Chief Clerk in the General Land Office." Moore became Chief Clerk about 1815; he may have retired but was hired to write the 1851 and 1855 Manuals because of his vast knowledge of the public surveys. There can be very little doubt that Moore actually wrote most of the opinions on and instructions for the surveys to the Surveyors General and others, even though they were signed by the current Commissioner or himself as Acting Commissioner during his employment as Chief Clerk.

John Preston and Samuel King were issued a supply of the 1851 Oregon Manuals for their use in Oregon and California, so it was immediately entirely applicable in those States. On March 13, 1851, a supply was sent to Boyd at Donaldsonville, Louisiana, with instructions to construct mounds at corners in accordance with the Manual. On July 16, 1851, a supply was sent to Lorenzo Gibson at Little Rock with similar instructions. On April 23, 1851, Manuals were sent to George B. Sargent at Dubuque, Iowa, with instructions to run his range lines north to intersections with the correction lines and establish closing corners according to the Manual.

On October 8, 1851, Sargent was instructed to resurvey T. 90 N., R. 3 W., Fifth Principal Meridian, Iowa. The original surveys had been made in 1836 and 1837, many of the corners were missing, and in places, mounds called for at corners where "timber abounds." Most of the township was sold, but the residents petitioned for a resurvey. The township was to be resurveyed, all found corners honored and held, and all

missing corners restored by double proportion. Sargent was to tie in all improvements — d lines of occupancy as a basis for "an exchange of deeds" by the settlers if they desired, where the resurvey put improvements onto someone else's land.

In the 1851 Annual Reports, Charles Noble in Detroit recommended hiring an "Inspector of Surveys" to help prevent frauds and grossly erroneous surveys. Sargent in Dubuque reported that he was withholding a small percentage (10 percent) of each contract to pay for examiners of surveys; thus, the deputy was indirectly paying for the examination of his work.

On March 8, 1852, Noble was instructed to hire an examiner of surveys on a per-diem basis. That letter also started to classify the different types of resurveys being made in Michigan. Part of that letter follows:

"The surveys about to be undertaken will be designed to remedy two classes of defects and frauds.

FIRST CLASS. Incomplete Surveys. — Where a portion only of the lines in a township is found to have been actually surveyed—and wherein some lines have been run and some corners established, which lines and corners can now be found. That portion of such original surveys which shall have been determined to be thus available, by retracing the same, is to remain undisturbed, and be respected whether there have been sales made therein, or not — and the residue of such townships must be surveyed, as if originally, but made to connect in all particulars with the former.

SECOND CLASS. Fraudulent Surveys — Where there is no evidence found in the field of any good intent on the part of the Deputy Surveyor to comply with the terms of his contract — No system being manifest in the field work, and an entire absence of marks and monuments whereby to designate the corners, and where no lines are traceable—.

In this class of cases the lines will have to be run and corners established, as if originally, and all the old irregular lines and corners must be most carefully and thoroughly obliterated, but their connections with the true survey must be taken and exhibited in the notes so that they may be represented on the township plats and thus be never likely to mislead — but in cases where, amongst such irregular surveys, there has been any tract of land sold which is settled upon and occupied according to the irregular lines of the original survey, if the same are found, they are to be particularly respected, provided the occupant insists on having the same preserved; but, in case he shall not so insist, then, with his expressed written consent, duly attested, the Deputy Surveyor may disregard such old irregular lines, and establish new regular lines as the boundaries of such section — But when an old irregular section corner is insisted on being maintained by the occupant of the tract, such, as a necessary consequence, will have also to be respected as governing the boundary of the adjacent sections, the lines of which will close on such corner. The marks on all such "bearing trees" as are not adopted, must be most effectually and indelibly, obliterated - and the new "bearing trees" will of course be marked with the usual initials, N. B. T."

tween 37° and 40° north latitude between the lating of Missouri and the Continental Divide.

The Act of July 17, 1854, 10 Stat. 305, extended the Donation Land Claims to Washington Territory and established the office of Surveyor General there.

On August 12, 1854, James Tilton was notified of his appointment to be Surveyor General of Washington. His instructions were sent on August 31; to continue with the surveys west of the Cascades and the Willamette Meridian network. He was to get manuals from Gardner in Oregon and use the same platting style. Tilton was especially warned to "secure" his office against fire. "No explosive fluid is ever to be used in lighting the office, and the hearth of the fireplace or stove should be so guarded as to the possibility of fire coming into contact with the floor."

After the Florence fire in 1827, orders were issued to all Surveyors General to rent separate buildings for their offices, not connected to or closely adjoining any other building. No one was allowed to live in the same building that the Surveyor General's office occupied. Several plans were devised for constructing fireproof buildings and metal-encased vaults to house the records, but none of those plans were ever funded. The Surveyor General had to rent space at the lowest reasonable rate, which was about \$500 per year. The warning to Tilton was prophetic. He opened his office in Olympia by March 1855. From Charles K. Gardner in Oregon he got the Washington plats, field notes and supplies, and continued the established survey operations in Washington.

of Surveyor General in New Mexico and another for the territories of Kansas and Nebraska. It also granted Donation Land Claims, similar to the Oregon donations, to actual settlers in New Mexico. It isn't immediately known how many such claims were taken up in New Mexico which included what is now Arizona. In 1880, Donaldson reported 135 such claims, which were to be taken by legal subdivisions.

Surveyor General of New Mexico was given double duty—he had to examine and determine the validity of private land claims under Spanish and Mexican grants. In effect, he was Land Commissioner as well as Surveyor General.

On August 5, 1854, William Pelham was notified of his appointment to be Surveyor General of New Mexico. He was a good choice because he had been Surveyor General of Arkansas from 1841 through 1849 and was experienced with the system and private land claims. Further instructions were sent on August 21, 1854; Pelham was to establish a meridian and baseline to govern the New Mexico Territory surveys. He was to fully acquaint himself with the Spanish laws and court decisions relating to them, and collect the documents on which the claims were based. It was a horrendous job that Pelham never fully accomplished, but he jumped in with both feet. He arrived in Santa Fe on December 28, 1854, and immediately opened his office; on his way he made a reconnaissance of the Rio Grande Valley. In his 1855 Annual Report, Pelham said,

"Agreeable to your instructions I selected a hill about six miles below the mouth of the Puerco River, which is two hundred feet high and of a rocky formation. This hill is nearly round, and is washed at its base by the Rio Grande. I have therefo established this hill as the initial point, and have caused a suitable monument to be erected on its summit."

On March 9, 1855, Pelham contracted with John W. Garretson for the survey of the New Mexico Principal Meridian and baseline. In April, Garretson actually erected the initial monument and began the surveys of the meridian from it: this meridian system controls all the surveys in New Mexico and southwestern Colorado. The New Mexico surveys were to be done in accordance with the Oregon Manual.

John Calhoun was appointed Surveyor General of Nebraska and Kansas. Wilson sent him instructions on August 26. 1854. The parallel of 40° north latitude was to be surveyed west from the Missouri River as a baseline of the Sixth Principal Meridian for a distance of 108 miles or, 18 townships, where the initial point of the Sixth Principal Meridian was to be established. A "durable" monument was to be established on the Missouri River as the southeast corner of T. 1 N., R. 18 E., Sixth Principal Meridian. From this baseline, the township boundaries were to be surveyed north and south in accordance with the Oregon Manual. Since 40° north latitude was the boundary between the two territories and later the State line, it was to be carefully surveyed and monumented.

Calhoun established his office in Fort Leavenworth, Kansas Territory, and on November 2, 1854, contracted with J. P. Johnston for the survey of the 108 miles of baseline. He contracted with Charles A. Manners for erecting the durable monument on the Missouri River and examination of Johnston's work. A castiron post was set 52.55 chains west of the river to keep it from washing away. Johnston's survey upon examination proved to be "grossly in error." In April 1855. Calhoun contracted with Manners for the resurvey or correction of the baseline, which Manners did in July of that year. However, because of sickness and the delay caused by the corrective survey, the initial point of the Sixth Principal Meridian was established 60 miles west of the river instead of 108 miles. Manners surveyed the meridian line north into Nebraska and other deputies went to work on the township lines in Kansas and Nebraska in August 1855. Work progressed rapidly in the open prairies of those territories, hampered only by the Indians.

Purchase to the Territory of New Mexico and many more private land claims.

Surveyor General Gardner of Oregon complained in his annual report of the problems he was having with the Donation Land Claims (DLC), which were supposed to be taken as nearly as possible by legal subdivisions of sections. But in fact, the occupied claim lines laid in all directions, or if generally east and west, they didn't conform to the subdivision lines. Not very many settlers were coming in and filing their claims so Gardner didn't know where they were located. The township and section line surveys were being held up as a result. If Gardner surveyed the claims as staked on the ground, many small fractions would be left within a section.

As it turned out, the solution was quite simple. Gardner and his successors surveyed all of the township and section lines first without regard to the claims, but made notes of where the lines apparently entered and left an occupied claim. Later, as the claims were actually filed and verified, the DLC boundaries were surveyed and tied to the existing rectangular surveys. The first claim surveyed ... a township was designated No. 37, the second No. 38, and so on. When all claims in a township were surveyed, a DLC plat was made. The fractions remaining in a section were lotted with a lot number and area, which could then be sold by the land office. A separate set of field notes were made, called simply the "DLC Notes." It eventually worked out quite well; one interesting item, however, did occur. In 1859, Surveyor General William W. Chapman reported that he had surveyed a DLC which laid across a naxigable river, the Umpqua, without meandering the river through it, and returned the portion within the river as part of the total area of the DLC. the bed of a navigable river was patented; it is presumed that this could pose an interesting legal problem of ownership, especially if accretion was involved.

The DLC plats in Oregon were basically on the same plan as the system used in Florida, except that the claims were not called sections. An 1849 Florida plat is shown in Fig. 40.

An Oregon DLC plat of T. 23 S., R. 7 W., Willamette Meridian, is shown in Fig. 41. Comparison of these plats readily reveal the similarities.

The Appropriations Act of March 3, 1855, 10 Stat. 643, provided funds for the Surveyor General and for surveys of Utah Territory. David H. Burr was appointed Surveyor General and established his office in Salt Lake City on July 27, 1855; he designated the southwest corner of the "Temple Block" as the initial point for the Salt Lake Meridian. The survey of the baseline and meridian was begun by Deputy Surveyor Frederick H. Burr in 1856. By the end of September, he had surveyed the baseline four miles east and 36 miles west and the meridian had been run 84 miles north and 72 miles south. Not much more was done before 1857.

The same appropriations act provided funds for the survey of the "Outlines of Indian Reservations" in Kansas and Nebraska. During the later part of 1855 and most of 1856, Calhoun had most of his deputies working on the exterior boundaries of Indian reservations so that he could avoid them in the regular rectangular work. In the ensuing years, more and more reservation boundaries were surveyed in Nebraska, Kansas, and Minnesota territories, but the responsibility was divided between Indian Affairs and the GLO for nearly ten more years.

The 1855 Manual of Surveying Instructions, an expansion of the Oregon Manual of 1851, again prepared by John M. Moore, Principal Clerk of Surveys, was officially issued on February 22, 1855. It established the present system of baselines, principal meridians, spacing of standard parallels, and guide meridians.

Although technical details of monumentation, rectangular and closing limits, equipment, and the like have evolved since that time, the basic system of rectangular surveys has remained the same since this manual was issued. The 1855 Manual, Diagram B, shows the unusual numbering of lots bordering on the north and west boundaries of the township. Those we now call lots 1 and 2 are labeled No. 2, and those we now call lots 3 and 4, are also labeled No. 2. It is unknown why this method of designating those lots was used; it was a change from that used after 1832 and it continued until 1866. Fig. 42 is a copy of Diagram B, from the 1855 Manual.

gable streams were to be andered on both banks. Perhaps only one bank of a non-nagable river was to be meandered; only the field notes of a particular township surveyed during the period would reveal the true policy adopted. This manual does indicate that a true line across meandered streams was only surveyed on township boundaries and meridional section lines. On latitudinal lines (east-west section lines) the line was run west from a section corner to the meandered stream and east from the section corner (a mile to the west), to the meandered stream and meander corners established, with a tie made across the stream. This practice almost invariably created a kink in the section line crossing the stream. For other details, the Manual should be consulted, including the specimen field notes.

Thomas A. Hendricks was appointed Commissioner of the GLO on August 8, 1855; he was the first commissioner who apparently had no background or qualifications for the job. He was born near Zanesville, Ohio, on September 7, 1819, and graduated from South Hanover College, Indiana in 1841. He was elected successively to both houses of the Indiana Legislature and to the U.S. House of Representatives in 1851. Hendricks was a politician of the Democratic Party with no real background in surveying and the land laws. He later became a U.S. Senator, Governor of Indiana, and ran for President in 1868, 1876, 1880, and 1884, when he was elected Vice President and died in 1885. Some of the rulings and letters during Hendrick's tenure were not always correct.

On February 6, 1856, Hendricks replied to Leander Chapman at Detroit regarding the proper method of restoring the lost quarter corners on the east and west boundaries of section 4, T. 34 N., R. 10 E., Second Principal Meridian, Indiana. The original survey had returned the east line as 79.96 chains and the west line as 79.90 chains. The County Survevor had found those lines to measure 72.84 chains and 73.71 chains respectively, between found section corners. The local Circuit Court had ruled that because the 1800 law said the excess or deficiency was to be placed in the last half mile going into the north and west boundaries, the quarter corners should be restored exactly 40 chains north of the southeast and southwest corners of Section 4. That, of course, put all the error in the last or north half mile. Chapman and the County Surveyor disagreed with the decision by the court and asked Hendricks' opinion. He replied that the Act of February 11, 1805, controlled because the lengths of the lines returned on the plat were by law the true length, and therefore the lost quarter corners should be restored by single proportionate measure. This would place the east quarter corner at 36.44 chains north and the west quarter corner at 36.90 chains north of the section corners.

This letter is included here to illustrate the type of questions or problems which began flooding the Commissioner's office after the suspension of resurveys in 1853. It also illustrates the gross misunderstanding of the various surveying laws by many surveyors and even the courts. There were no rules for restoring lost corners by Congress; they had to be developed as they had been in part by the Commissioner and the courts. The Commissioner rendered these rulings without any legal authority to do so; they could only be opinions unless public lands were involved. However, the reader should always keep in mind that the Commissioner was a

very busy man with many activities under his pervision. The opinions written were probably written by the Principal Clerk of Surveys; unless litigation was pending, they were probably signed by the Commissioner without careful analysis.

In the spring of 1856, John Loughborough, Surveyor General of Illinois and Missouri, prepared his Instructions to Deputy Surveyors. He sent a draft of these instructions to Hendricks for approval and requested permission to have them printed. Hendricks approved and requested Loughborough to send him 200 copies when they came off the press, which Loughborough did later in the year. These Instructions were basically in agreement with the 1855 official Manual, but in conflict in the limits of closure for a township (Manual, 3½ chains; Instructions, 5 chains). Also, the Manual required lines into the north and west boundaries to be runrandom and true with closing corners only on standard parallels. The Instructions called for closing (double) corners against the north and west boundaries, which was the "old practice" before 1846. Much more importantly, however, was athe appendix to Loughborough's Instructions, pages 47 through 64, which outlined an opinion on the proper method of restoring lost corners and subdividing sections. Basically, section corners are to be restored by single proportion between found corners to the north and south of the missing corners, but there is some hedging and, depending upon interpretation, suggests a double proportion under certain circumstances. Under Item [23] on page 55, the following statement is made, "None of the Acts of Congress, in relation to the Public Lands, make any special provision in respect to the manner in which the subdivisions of Sections should be made by Deputy Surveyors." This seems incredible in view of the fact that all Surveyors General were supplied with copies of the acts of Congress, including the Act of February 11, 1805, and the Act of April 5, 1832, which most certainly states how sections are to be subdivided. These Instructions should be studied in their entirety to fully understand what the suggested methods of subdividing sections were. The most controversial was that the center quarter-section corner should be established at midpoint on the east-west centerline and the center of the quarter sections (NE 1/16) should be established in the same manner.

After receiving the 200 copies of Loughborough's Instructions, Hendricks began immediately to send a copy to County Surveyors who generally inquired about how to subdivide sections; he referred them to pages 47-62 of the Instructions. This policy continued until about 1863 when the supply of the 1856 Instructions became exhausted. The policy of restoring lost section corners primarily by single proportion between found corners to the north and south was continued until 1882. The argument for the method was usually given about as follows: It is well known that the meridional section lines are actually run in the field, due north, with quarter and section corners established at 40 and 80 chains. These lines are always run. It is also well known that most deputies do hot run the east-west section lines all the way, instead they stub out from a section corner just 40 chains and set the muarter corners on the east-west lines, but return field notes with the quarter corner as being at midpoint and on a true line. Therefore, a quarter corner to the east or west would not be a proper basis for restoring a lost section corner in its

original position. The sai basic argument was used for establishing the center quarter corner at midpoint on the east-west centerline and connecting the north and south centerlines therefrom to the original quarter corners on the north and south sides of the section. The method outlined was believed to make a more equitable division of the section into quarter sections, and on down into one-sixteenth sections.

Looking at the subject from a point of equity, the argument has some understandable merit, but to scholars of the law, as enacted by Congress, the method of subdividing sections was erroneous. It was this whole argument that prompted the now famous letter of opinion written by Abraham Lincoln on January 6, 1859, in which he said the center quarter corner should be placed at the intersection of straight centerlines connecting the original quarter-section corners.

On January 6, 1857, Loughborough was instructed to prepare the Illinois and Missouri records for transmittal to the State authorities and close the St. Louis office by June 30, 1857. The surveys in those States were still not complete and no State legislation had been passed for acceptance of the records. The order was not implemented.

The Legislative, Executive, and Judicial Appropriations Act of March 3, 1857, 11 Stat. 206, under "Surveyors General and their Clerks." directs the Secretary of the Interior to cause the "Surveyor General northwest of the Ohio" (at Detroit, Michigan) to be moved to St. Paul, Minnesota. On March 27, 1857, Charles L. Emerson was notified of his appointment to be Surveyor General of Minnesota at Detroit; he actually replaced Chapman on April 12, 1857, and closed the Detroit office on May 11. He opened the Minnesota office in St. Paul on May 23, 1857 and he transferred most of the Michigan records to the State at that time. After bringing all arrears up to snuff, he completed transfer of the Michigan records in May 1858. He received the Minnesota survey records from Lewis in Dubuque and continued the Minnesota surveys without any particular trouble.

In July 1857, David H. Burr, Surveyor General of Utah, was run out of Salt Lake City by militant Mormans. John C. Hays from California was appointed to officially fill the vacant post but apparently never went to Utah. Burr eventually sent his son to Salt Lake City, who turned over the Utah records to the Territorial Governor on April 5, 1858. The Utah office remained vacant until September 29, 1859, when Samuel C. Stambaugh took over the post; but he quit in 1861 and for all practical purposes, no rectangular surveys were made in Utah until 1869.

The 1857 Annual Report indicated that some 17,000 miles of survey lines had been run in Kansas and 7,000 miles in Nebraska, which is indicative of the speed in which those plains were being surveyed.

On May 25, 1857, Hendricks gave approval and instructions to William J. McCulloh, Surveyor General of Louisiana, for the survey of dried-up "Spanish Lake" in townships 9 and 10 north, range 9 west, Louisiana Meridian. The lake had then meandered during the original survey but had dried up due to drainage, and the plat was approved October 27, 1857. This is the first of the dried-up lake surveys that were discovered.

The Commissioner considered all non-navigable lakes to be public land subject to survey and disposal the same as any other unsurveyed public land. Prior to 1825, only the very

Large lakes were meandered; after 1825, lakes of 40 acres and ly, because upward in size were meandered, and these settlers didn't want to pay for land they couldn a farm. So the lakes were meandered and left unsold, but were still public land subject to survey and disposal when and if they dried up, or if the government chose to survey and sell them. Surveying a body of water wasn't very practical until after it dried up, for whatever reason. The States tried to claim lakes under the Swamp Lands Act, but the claims were rejected because they weren't "swamp land," nor "overflowed," under the meaning of those acts. The position was that shallow lakes, ponds, and marshes were to be surveyed whenever the Commissioner chose to approve a survey, because they were mot navigable and were not streams as defined by Sec. 9 of the According 18, 1796. Therefore, the abutting owners could not own them in common to the center of the stream. Since the government had merely meandered them to segregate them from lands being sold, the adjoiners could not and did not have any riparian rights.

In retrospect, knowing the basis of the elimination of these small lakes from land sales, the argument was valid. Ironically, the 1851 and 1855 Manuals had lowered the size of lakes to be meandered to 25 acres, but then cautioned that "shallow ponds, readily to be drained, or likely to dry up, are not to be meandered." Perhaps John Moore harbored doubts about the validity of the contention that dried-up meandered lakes would remain public land. The survey of some of the more important dried-up lakes will be mentioned herein as they occurred. With very few exceptions, only lakes that were completely dried up were surveyed.

Minnesota was admitted to the Union on May 11, 1858, 11 Stat. 285, with its present boundaries.

The Acts of May 18, 1858, 11 Stat. 289-290, pertain to California. The first act makes authenticated copies of the Surveyor General's records admissable as evidence in a court of law. The second act makes it a crime to falsify documents to establish land claims, which was precipitated by persons faking papers and documents in attempts to enlarge or establish claims under Spanish or Mexican laws.

The Act of May 29, 1858, 11 Stat. 293, extended the public land laws and surveys to the lands east of the Cascade Mountains in Washington and Oregon territories. In late 1858, David P. Thompson, Deputy Surveyor, extended the Willamette Baseline across the mountains to the southeast corner of T. 1 N., R. 32 E., and ran the Columbia Guide Meridian north for 25 miles. The large area east of the Cascades was finally being opened for survey and settlement.

100 miles

The 1858 Annual Report indicates that 20,000 miles had been surveyed during the year in Kansas-Nebraska, the solar compass was being used on all surveys in New Mexico, and all land offices had been ordered to police the public timber lands and stop the stealing of timber, especially pine, from the public domain. Timber thefts were particularly great in Wisconsin, Minnesota, and parts of Florida.

On July 23, 1858, Hendricks issued Special Instructions to a County Surveyor in Michigan for the survey of some islands in Thunder Bay. The letter contains the following statement:

"I would inform you in reply, that upon the terms proposed you can proceed to survey those islands and for

your guidance in the work I herewith enclose a copy of the Instructions that "e issued some years ago to the United States Deputy Surveyors in the District of Illinois and Missouri and which instructions are applicable to all of the other Surveying Districts."

The Instructions referred to are those by Loughborough in 1856. The 1855 Manual contained some instructions and field note examples for the survey of islands. The 1856 Instructions, page 33 [85] and [86], are better written and easier to understand concerning island surveys, but the letter does not mention the 1855 Manual and implies that the 1856 Instructions are applicable in full to all surveying districts. Perhaps it was meant to be only so in relation to island surveys. Incidentally, the authority for this survey was revoked because the County Surveyor wanted half interest ownership of the islands from the applicants in payment for doing the survey. The Commissioner considered such arrangements illegal.

On August 12, 1858, Hendricks wrote to a man in Ohio who reported a hiatus, 40 to 50 rods wide, between T. 10 N., Rs. 1 and 2 E., Michigan Meridian, and wanted the strip surveyed so he could buy it. The man reported two separate and distinct range lines. Hendricks refused the request on the grounds that the original survey plats did not show any unsurveyed strip; therefore there was none.

On February 7, 1859, Surveyor General Henry M. Rector in Little Rock, Arkansas, resigned. The Little Rock office was closed on March 12, 1859, and the records were turned over to the Register and Receiver of the Land Office for safekeeping. In 1876, many of the Arkansas records were in the Washington office being properly filed and organized; the remainder were in Little Rock. Donaldson reported that the Register turned over the Arkansas records to the State in 1861 during the Civil War.

Oregon was admitted to the Union on February 14, 1859, 11 Stat. 383, with its present boundaries.

In August 1859, the west boundary of Minnesota was surveyed south from Big Stone Lake by Chauncey Snow and Henry Hutton to the Iowa line, under contract with the Commissioner. Iron posts were used in places on that boundary.

In 1859, the parallel of 43° 30' latitude, the south boundary of Minnesota, was extended west into the Dakota Territory, under contract with the Surveyor General of Wisconsin and Iowa, and township boundaries north of that line were surveyed, which began the surveys in a virgin area.

On October 18, 1859, Samuel A. Smith, a politician, became Commissioner of the GLO, replacing Hendricks. In the 1859 Annual Report, Smith discussed the proposed Homestead Law being debated in Congress. Rumors of this law, which Smith opposed, were greatly reducing land sales.

On February 23, 1860, Joseph S. Wilson, who had been Chief Clerk in the GLO until his appointment, replaced Smith as Commissioner of the GLO.

The Swamp Lands Act was extended to the states of Minnesota and Oregon by the Act of March 12, 1860, 12 Stat. 3. There of the states admitted after this date are "swamp land states"

On October 27, 1860, Wilson wrote the following letter in regard to dried-up lakes:

Commissioner of the GLO. Wilson returned to the osition of Chief Clerk in the GLO.

On June 20, 1861, Edmunds notified William Cuddy, the new Surveyor General in St. Louis, that no appropriation had been made for the operation of his office and it would probably have to close by the end of June. On September 15, Cuddy was notified that \$6,800 was allotted to him "for preparing the records to be turned over to the States." Cuddy operated for the next two years on "slush fund" moneys.

On February 17, 1862, the Supreme Court of the United States rendered the final decision in the case of Johnston vs. Jones, 66 U.S. 117, which involved a dispute over the division and ownership of lands formed by accretion along the waterfront in Chicago, Illinois. The court ruled that the accretion should be divided along the new waterline in proportion to the original holding along the old. The case is the basis of the "apportionment of frontage" rule, the method used today when applicable. The rule is well described in Sections 7-58 and 7-59 of the 1973 Manual.

On March 3, 1862, John A. Clark, Surveyor General of New Mexico, fled from Santa Fe because it had been invaded by Texas soldiers of the Confederacy. Clark packed up most of the records, except some of the Spanish Archives, and sent them to Fort Union. He returned to Santa Fe on May 20, 1862, and found almost everything in good order; the Texans had taken most of the furniture but had left the records unmolested.

By Sec. 4 of the Act of March 14, 1862, 12 Stat. 369, Nevada was made part of the California surveying district under the Surveyor General in San Francisco. The office in Carson City was closed after operating only six months. Confusion in the Nevada surveys followed.

The Act of May 15, 1862, 12 Stat. 387, created the Department of Agriculture, which would one day take administrative control of large areas of the public lands, and, in some cases, survey parts of those lands.

The Homestead Law was enacted by Congress on May 20, 1862, 12 Stat. 392. The law applied to persons over 21 years of lage, "who has never borne arms against the United States Government or given aid and comfort to its enemies." The homesteader could acquire patent to 160 acres, upon proof of settlement and cultivation, conforming to legal subdivisions, after the lands had been surveyed. An original township survey in Nevada in 1948 was executed to allow patent on a homestead, filed on in 1923. The homestead patent could not issue until the land was officially surveyed. Patent to surveyed homesteads could be accelerated by a cash entry payment of \$1.25 or \$2.50 per acre. Although the Homestead Law was amended many times in later years, the basic law remained the same; 160 acres of agricultural land was given ato anyone who would settle on it and plant a crop there. The law greatly increased the need for extension of the rectangular public land surveys.

to reduce the Expenses of Survey and Sale of the Public Lands in the United States."

Sec. 1 of the act states that contracts for surveys would not be binding on the United States until approved by the Commissioner of the GLO. Great delays in execution of the fieldwork resulted because of the lapse in time between a contract being negotiated by a Surveyor General, transmittal to and approval by Washington, urn to the Surveyor General, and then finally a party outfitted and sent to the field. The fieldwork was usually executed the following field season, perhaps a year or more after the initial signing of the contract. But all subsequent contracts were approved in Washington until the contract system was abolished in 1910.

Sec. 2 of the act made the 1855 Manual of Surveying Instructions part of every contract. The Manual, Special Instructions of the Surveyor General, when not in conflict with the Manual, and Instructions from the Commissioner, were also made part of the contracts. Thus, in theory at least, the conflicts between the 1855 Manual and the 1856 Instructions for Illinois and Missouri, were eliminated by law. The 1855 Manual was the controlling document and the Surveyors General could not issue instructions in conflict with it. But, as previously noted, the 1855 Manual contained no instructions for restoration of lost corners and subdivision of sections. Those rules continued to be formulated by the Commissioner with little consistency.

Sec. 3 gave the Commissioner full power to establish surveying fees within the maximum allowed and also required that the cost of surveying and platting private land claims be paid by the claimant before a patent could be issued.

Sec. 4 combined Utah and Colorado into one surveying district under the Surveyor General of Colorado; it also combined Nevada and California, as previously noted.

Sec. 8 gave the Surveyor General of New Mexico the additional duties of Register and Receiver. He was then in effect the entire land office in that large territory.

Sec. 10 of the act provided for the first of the "deposit surveys." Settlers wishing to speed up the surveys could apply and deposit a sum sufficient to pay the cost. The Surveyor General could then survey the township at the expense of the settlers; however, not many settlers chose to pay the costs this would incur.

The Act of June 14, 1862, 12 Stat. 427, was entitled "An Act to protect the Property of Indians who have adopted the habits of civilized life." The act provided for protection of those Indians who had received an allotment of tribal lands according to treaty stipulations. The Indian agent was to protect the allottee from trespass, etc. Nothing was said about how the agent was to determine the boundaries of an allotment and thus prove a trespass occurred. The method of surveying allotment boundaries was not spelled out by statute until the Act of April 8, 1864.

The Act of July 1, 1862, 12 Stat. 489, added another duty to the hard-pressed Surveyors General. The act was the huge railroad land grant to subsidize the construction of the Union Pacific and Central Pacific Railroads from the Missouri River to the Pacific Ocean. A right-of-way 200 feet in width on each side of the track and all odd-numbered sections for 10 miles each side of the track were granted. The grant did not apply to mineral lands. If necessary, the railroad was given the right of eminent domain (they could condemn private lands). Sec. 7 of the act required that the lands be surveyed as soon as any portion of track was completed.

This act and subsequent, similar, railroad grants placed a heavy burden on the surveyors. It also caused the partial survey of many townships. The act is very long and complex, prohibiting a synopsis here. For full details of this and other railroad grants, the acts themselves should be reviewed.

October 8, 1862, Thomas A. Townsend, the Surveyor General at Dubuque, suddenly died. James Edmunds directed Isaac N. Higbee, the Chief Clerk to operate the office, but Higbee could not approve surveys or enter into contracts. The law did not allow for an "acting" Surveyor General. Higbee conducted the business until Henry A. Wiltse was appointed to the post on January 29, 1863.

The Act of February 24, 1863, 12 Stat. 664, established the Territory of Arizona and the office of Surveyor General. All of the New Mexico Territory lying west of the present Arizona-New Mexico boundary, including part of present Nevada, was included in Arizona Territory. Levi Bashford was appointed Surveyor General in August 1863 and opened an office in Tucson on January 25, 1864. Apparently he never executed any surveys for there is no record of any. The Appropriations Act of July 2, 1864, 13 Stat. 344, attached Arizona to New Mexico under Clark at Santa Fe. Bashford was terminated and closed the office on July 4, 1864. The same act attached Nevada and Idaho to the Colorado surveying district and made Montana part of the the Dakota surveying district.

Some confusion may have resulted. Colorado was so remote from Nevada that John Pierce in Denver could hardly contract for surveys there. Plats of Nevada surveys were approved by Lauren Upson, Surveyor General of California, from 1864 to 1866.

The Act of March 3, 1863, 12 Stat. 754, required the President to reserve lands for townsites on rivers, harbors, and other prospective centers of population. The townsites were to be surveyed by the government into "urban and suburban lots of suitable size." This act was the origin of the so-called "Presidential Townsite", now codified in 43 U.S.C. 711-712. The first townsite surveyed and lots sold under this act was the Townsite of Port Angeles in the present State of Washington.

The Act of March 3, 1863, 12 Stat. 808, established the Territory of Idaho, and included the area which is now the States of Idaho, Montana, and Wyoming. No provision was made for surveys.

On March 24, 1863, Edmunds replied to John Cross, County Surveyor of Page County, Iowa, on how to subdivide sections. Edmunds stated that the center quarter corner should be at the intersection of centerlines run between original quarter-section corners, with the exception of sections on exterior boundaries or where the sections were otherwise not normal. This letter was the first step away from the method used according to the 1856 Instructions.

On June 29, 1863, the following letter was written, probably by J. H. Hawes, who was the Principal Clerk of Surveys, in regard to the restoration of lost corners.

D. W. Maxon, Esq., June 29th, 1863. Cedar Creek, Washington, Co., Wis.

Sir:

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Your letter of the 12th inst., asking for information as to the proper mode of establishing lost corners of the public surveys, etc., is received. As stated in my communication of the 2d inst., this office does not assume to exercise any control over the surveying operations of county surveyors.

For the information of surveyors who may be called upon to re-establish le orners of the public surveys or subdivide sections, the following general principles, based upon the laws of Congress and the regulations of the land department in accordance therewith, may be stated:

1st. Section and quarter section corners as established by the government survey, must, by law of Congress, stand as the true corners.

2d. Missing corners must be re-established at the identical point where the original posts were planted by the U.S. deputy surveyors.

3d. The legal presumption is, in the absence of any evidence to the contrary, that lost section and quarter section posts were originally established at the distances indicated in the field notes.

4th. Half quarter section corners must be established equidistant from the section and quarter section posts.

The first proposition above is in accordance with a law of Congress approved February 11th, 1805. To divide a section into quarters a *right line* should be run from the quarter section posts in one section line to the corresponding quarter section post in the opposite section line, even though one or more of these posts may have been established nearer to one section corner than the other, thereby giving to one quarter section more than 160 acres and to another less.

The second proposition grows out of the first, and is in accordance with the laws of Congress. It is the duty of the surveyor to re-establish missing posts in the exact locality where they were originally placed in the government survey. The proof of locality first sought to be obtained should be the "witness trees," or any other means of identification contained in the field notes, and next, clear and unquestionable testimony of any other kind. If no bearing trees, or other evidences in the field notes or elsewhere exist, by which the locality of the missing posts can be identified or determined in the field, then, as stated under the third head, the legal presumption is, that the missing section or quarter section corners were originally established in conformity with the distances expressed in the field notes, and the surveyor should so re-establish them.

Extinct quarter section corners, except on fractional section lines, when they cannot be identified as above, should be re-established equidistant between the section corners, in a right line between the nearest noted "line trees" each side of it, if there are any, but if none are found, then in a right line between the section corners. Extinct quarter section posts on section lines which close on the north and west, boundaries of townships, should be re-established, according to the original measurement there of, at 40 chains from the last interior section corner.

Extinct section corners may be re-established by running a right line between the nearest noted "line trees" north and south and east and west of the lost corner, if there be any such trees within the distance of the nearest quarter section, or section corners; but if no "line trees" be found, then between the nearest quarter section or section corners, and at the point of intersec-

stand as the true corners they were intended to designate, even though the intervals do not corread with the measurements in the field notes.

2d. All boundary lines of legal subdivisions which shall not have been actually run and marked in the field, shall be ascertained by running straight lines from the established corner to the opposite corresponding corner.

It will be seen from the foregoing rules that the correct mode of dividing sections is by running straight lines from quarter post to opposite quarter posts, the common center being determined by the intersection of the lines so run. Great care should be taken in running such subdivisional boundaries to first identify the existing corners as the true original corners established by the U.S. surveyor.

Very respectfully, etc.,
Joseph S. Wilson,
Acting Commissioner.

An identical letter was sent to L. M. Dyer at White Hull, Green County, Illinois, on April 13, 1864. Although signed by Chief Clerk Wilson, they were no doubt written by J. H. Hawes, Principal Clerk of Surveys.

The Act of April 8, 1864, 13 Stat. 39, was entitled "An Act to provide for the better Organization of Indian Affairs in California." The main part of the act deals with Indian reservations and affairs in that State. But Sec. 6 of the act states:

"That hereafter, when it shall become necessary to survey an Indian or other reservations, or any lands, the same shall be surveyed under the direction and control of the general land-office, and as nearly as may be in conformity to the rules and regulations under which other public lands are surveyed."

This section is now codified in 25 U.S.C. 176.

The act clearly places the survey of Indian and other reservations under the regulations and methods of the regular public land surveys. After passage of the act, the boundary surveys were made under contracts with the Surveyors General or under contract with the Commissioner of the GLO. When township, sections, and section subdivisional lines were surveyed within reservations, it was nearly always by contract with a Surveyor General, except for those made in the Indian Territory (Oklahoma).

On April 28, 1864, Edmunds wrote to the Chairman of the Committee on Public Lands. He was proud of a departure from the rectangular system in mountains and valleys, done in accordance with Sec. 4 of the *Act of March 3*, 1853, 10 Stat. 244, which allowed such departure; he recommended the idea.

Edward F. Beale in California had contracted for the survey of lands around Honey Lake in California and in the Humboldt River Valley in Nevada. These were deemed to be "lands fit for agriculture" and were also along the route of the Pacific Railroad. Mineral lands and lands "unfit for cultivation" were precluded by law from the surveys. Desert mountains certainly were unfit for cultivation and may have contained minerals as well. How were the surveys to be extended into Honey Lake and Humboldt Valley? Using the provisions of Sec. 4 of the 1853 law, Beale told the deputies to run an

offset by traverse lines. The Fourth Standard Parallel North was extended into Honey ke by 52 miles of traverse along the eastern base of the Sierra Nevada. The Sixth Standard Parallel North was extended easterly for 115 miles by traverse around the base of the mountains into Humboldt Valley. But, no corners were established along those traverse lines. Ironically, the Commissioner would not allow a \$1,725 payment for those 167 miles of "line" because of no corners being set to monument them. That didn't make the deputies very happy, nor the new Surveyor General, Lauren Upson. Had corners been established, perhaps payment would have been allowed.

mountains was later used in California and Nevada, but the method was used in New Mexico, at least in 1873. There a meander line? (actually a traverse) was run along the base of the mountains and fractional lots returned against the meanders as though the mountains were similar to a lake. Where the section lines intersected the base of the mountains, "Fractional Section Corners" (marked FS) were set and the meanders run between them. Careful research has not found a law specifically approving this procedure; perhaps the Committee on Public Lands didn't consider it necessary or if a law was recommended, Congress declined to enact it.

The Act of May 26, 1864, 13 Stat. 85, established the Territory of Montana, greatly reducing the Idaho Territory, and authorized appointment of a Surveyor General for Montana. But on July 2, 1864, Montana was attached to the surveying district of Dakota. No Surveyor General was appointed until 1867.

on June 1, 1864, Commissioner Edmunds issued instructions to the Surveyors General relating to the surveys that updated the 1855 Manual in many respects.

The main changes by item number were:

- 7. Small islands were to be surveyed at cost to the applicant and procedures were given for obtaining such survey.
- 8. Notes and procedures were to be kept for determining "swamp lands."
- Noninavigable rivers were to be meandered along only one bank, the right bank if possible.
- 10. Increase the size of lakes to be meandered to 40 acres; long narrow lakes were not to be meandered and payment was not to be allowed for measuring across or offsetting around a lake.
- 18. Correcting back on true line is to be by bearing instead. of a change in variation.
- 20. Prescribes closing limits and limits on length of section lines in clearer form than the 1855 Manual.

These instructions or manual modifications were reissued in 1871 in the same form and are included in the Appendix for full review.

The Act of July 1, 1864, 13 Stat. 343, placed the coal lands that had been reserved since 1841 on sale by legal subdivision at a minimum price of \$20 per acre. Sec. 2 and the remainder of the act are general townsite laws pertaining to townsites on the surveyed or unsurveyed public lands. Townsites up to 640 acres with boundaries conforming to the rectangular surveys were authorized. It is probable that most of the townsites on public lands were made under this act. It is codified in 43 U.S.C. 713-717.

1986	18.3	7.0	7.6	514.0	5.1	574.0	1,815.0	1,486.0	1,719.0	1,625.0	1.625.0	1 055 0	10.451.1
1987	48.4	10.6	9.2	708.0	686.0	1.153.0	1.791.0	1,539.0	1.739.0	1.648.0	1.631.0		12.219.3
1988	379.0	42.2	3.1	10.8	540.0	1.487.0	718.0	1,130,0	1,721.0	1,744.0	1.517.0	1.358.0	10.750.1
1989	263.0	1.7	69.5	27.6	0.0	1.031.0	1.531.0	1,906.0	2,122.0	2.106.0	1,338.0		12.158.3
1990	304.0	12.7	6.6	.0.0	61.0	53.1	705.0	1,035.0	1,569.0	1,305.0	967.0	473.0	6,491.4
1991	865.0	19.0	378.0	4.3	179.0	1.000.0	1,315.0	1,425.0	1,835.0	1,952.0	1,809.0		11.974.3
1992	25.1	105.0	459.0			3,296.0	3,052.0	2,846.0	2,322.0	1,665.0	2.216.0	1.658.0	
1993	721.0	97.8	3.4	20,240.0	,	7,397.0	4,852.0	4,503.0	961.0	1,359.0	1,737.0	.,	54,983.2
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59 Year (Monthly) Average Overall: 1064

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986	18.3	7.0	7.6	514.0	5.1	574.0	1,815.0	1,486.0	1,719.0	1,625.0	1,625.0	1,055.0	10.451.0
1987	43.4	10.6	9.2	708.0	686.0	1,153.0	1,791.0	1,539.0	i.739.0	1,648.0	1.631.0	1,255.0	12,218.3
1988	379.0	42.2	3.1	10.8	540.0	1,487.0	718.0	1,130.0	1,721.0	1,744.0	1.517.0	1,358.0	10,750.1
1989	263.0	1.7	69.5	27.6	0.0	1,031.0	1,531.0	1,906.0	2,122.0	2,106.0	1,338.0	1,263.0	12,158.8
1990	304.0	12.7	6.6	0.0	61.0	53.1	705.0	1,035.0	1,569.0	1,305.0	967.0	473.0	6,491.4
1991	865.0	19.0	378.0	4.3	179.0	1,000.0	1,315.0	1,425.0	1,835.0	1,952.0	1,809.0	1,193.0	11,974.3
1992	25.1	105.0	459.0	1,491.0	2,448.0	3,296.0	3,052.0	2,846.0	2,322.0	1,665.0	2,216.0	1,658.0	21,583.1
1993	721.0	97.8	3.4	,	11,850.0	•	4,852.0	4,503.0	961.0	1,359.0	1,737.0	1,262.0	
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Year (Monthly) Average Overall:

1064

≒1ZONA RIVERS alt River - Sta. 5020 Jul TOTAL Year 0ct Nov Dec Jan Feb Mar Apr May Jun Aug Sep 53.0 1934 956.0 408.0 9.6 1935 1,077.0 646.0 375.0 21.9 32.4 684.0 1,215.0 1,771.0 1,899.0 919.0 1,473.9 10,122.9 1,940.0 12,992.6 1936 992.0 294.0 400.0 31.6 624.0 2,055.0 669.0 1,188.0 1,620.0 1,866.0 1,313.0 1937 1,157.0 651.0 218.0 24.0 99.8 20.2 807.0 1,953.0 2,062.0 2,510.0 2,737.0 2,451.0 14,690.0 296.0 295.0 1938 1,044.0 641.0 123.0 190.0 1,578.0 1,614.0 2,025.0 2,003.0 1,721.0 2,114.0 13,644.0 1939 680.0 494.0 373.0 33.0 230.0 473.0 1,103.0 1,255.0 1,472.0 1,539.0 1,115.0 196.0 8,963.0 1940 77.5 123.0 11.9 72.3 21.0 737.0 935.0 955.0 1,129.0 1,119.0 602.0 564.0 6,346.7 1941 1,111.0 771.0 472.0 2,438.0 5,716.0 1,692.0 1,636.0 10.8 8.8 8.9 1,746.0 1,602.0 17,212.5 942 1,226.0 759.0 729.0 404.0 1,061.0 831.0 917.0 1,366.0 1,551.0 1,722.0 1,765.0 1,909.0 14,240.0 943 1,177.0 902.0 528,0 69.3 452.0 431.0 952.0 1,336.0 2,036.0 1,864.0 1,009.0 1,510.0 12,206.3 326.0 1944 1,314.0 606.0 519.0 208.0 242.0 294.0 1,009.0 1,373.0 1,245.0 1,089.0 1,732.0 7,957.0 945 1946 1,228.0 1,082.0 648.0 34.5 403.0 319.0 1,306.0 1,384.0 1,808,0 11,057.5 616.0 1,115.0 1,114.0 1,149.0 525.0 39.4 662.0 762.0 1,423.0 989.0 1,317.0 1,677.0 1,191.0 1,200.0 1,141.0 12,075.4 1947 562.0 304.0 339.0 397.0 479.0 705.0 911.0 749.0 1,016.0 910.0 852.0 992.0 8,216.0 1948 630.0 483.0 352.0 161.0 394.0 447.0 673.0 907.0 1,062.0 1,042.0 1,030.0 1,154.0 8,335.0 949 538.0 571.0 222.0 10.8 13.0 9.7 9.5 10,2 830.0 1,202.0 1,073.0 384.0 5,373.2 4950 619.0 253.0 287.0 17.5 42.2 1,002.0 1,092.0 737.0 1,114.0 1,247.0 1,138.0 1,164.0 8,712.7 1951 4.4 1.4 298.0 57.2 56.2 769.0 634.0 402.0 1,243.0 1,404.0 983.0 10.3 5,862.5 952 953 63.9 0.0 1.4 3.0 1.8 3.9 3.5 241.0 1,041.0 1,356.0 1.018.0 4.079.5 346.0 396.0 317.0 537.0 0.0 279.0 969.0 1,010.0 770.0 1,491.0 1,498.0 1,576.0 1,339.0 10,182.0 294.0 1954 399.0 605.0 143.0 361.0 892.0 786.0 728.0 1,097.0 854.0 1,264.0 993.0 8,416.0 1955 434.0 0.5 6.0 4.8 221.0 909.0 1,169.0 934.0 1,318.0 1,232.0 1,031.0 1,504.0 8,763.3 956 291.0 94.4 366.0 80.9 143.0 1,011.0 885.0 801.0 1,441.0 1,654.0 1,495.0 1,460.0 9.722.3 1957 65.3 0.4 0.0 2.3 0.4 62.1 465.0 1.1 908.0 1,201.0 1,341.0 1,231.0 5,277.6 1958 62.8 1.0 0.2 0.0 0.7 102.0 582.0 803.0 1,211.0 899.0 4,571.3 46.6 963.0 959 285.0 43.7 48.0 1,285.0 1,229.0 7,756.3 0.0 40.2 709.0 717.0 1,426.0 889.0 1,085.0 .1960 232.0 3.4 65.1 206.0 . 10.2 137.0 305.0 530.0 935.0 1,302.0 1,314.0 1,077.0 6,116.7 1961 261.0 47.3 8.0 5.1 316.0 1,340.0 1,231.0 867.0 1,481.0 1,650.0 1,174.0 979.0 9,359.4 1962 66.5 112.0 0.0 152.0 36.2 151.0 971.0 1,122.0 1,320.0 1,315.0 1,926.0 1,363.0 8,534.7 963 132.0 6.9 104.0 0.0 91.2 1,465.0 1,050.0 1,359.0 1,822.0 1,969.0 1,134.0 1,038.0 10,171.1 1964 349.0 90.9 1.6 26.4 199.0 1,206.0 928.0 1,298.0 999.0 1,343.0 590.0 517.0 7,547.9 965 966 164.0 191.0 1,823.0 1.2 29.7 104.0 4.5 266.0 569.0 749.0 535.0 652.0 5,088.4 299.0 29.5 1,193.0 3,984.0 1,238.0 1,600.0 1,607.0 775.0 818.0 1,253.0 1,213.0 1,125.0 15,134.5 ≟1967 824.0 8.0 389.0 77.0 22.6 940.0 821.0 867.0 993.0 1,147.0 848.0 1,167.0 . 8,103.6 1968 924.0 423.0 799.0 12.0 5,110.0 4,980.0 3,660.0 2,110.0 1,600.0 1,460.0 2,220.0 24,858.0 1,560.0 969 866.0 13.6 796.0 188.0 475.0 611.0 2,147.0 1,388.0 2,269.0 1,129.0 205.0 1,310.0 11,397.6 3 970 315.0 4.4 6.2 172.0 757.0 649.0 1,445.0 1,605.0 2,048.0 1,603.0 1,283.0 1,108 0 10.995.5 1971 140.0 7.0 8.5 4.1 578.0 1,324.0 1,113.0 1,213.0 1,061.0 1,288.0 608.0 585.0 7,979.6 **3**972 697.0 45.9 8.9 5.2 5.4 1,344.0 466.0 1,204.0 1,492.0 1,482.0 1,166.0 860.0 3,776.4 973 1,207.0 84.2 9.7 7.9 156.0 3,273.0 6,452.0 5,261.0 1,911.0 1,785.0 1,831.0 1,881.0 23,853.8 1974 38.3 0.1 3.1 1.7 1.2 942.0 1,313.0 1,414,0 1,762.0 1,632.0 1,749.0 1.310.0 10.166.4 1975 1976 327.0 1.3 1.2 2.8 15.8 517.0 334.0 1,258.0 1,661.0 1,669.0 1,680.0 1,434.0 8,901.1 391.0 5.3 2.1 198.0 108.0 18.7 400.0 810.0 1,236.0 1,445.0 1,742.0 1,219.0 7,575.1 -1977 416.0 2.0 0.5 0.0 0.0 457.0 1,156.0 1,254.0 1,904.0 2,067.0 1,098.0 10,294.5 1,940.0 1978 734.0 155.0 7,169.0 0.0 1.1 980.0 1,115.0 1,517.0 1,714.0 1,694.0 1,681.0 1,562.0 18,322.1 979 962.0 6.8 0.0 9,747.0 1,489.0 6,874.0 4,851.0 2,993.0 2,026.0 2,088.0 2,067.0 . 1,834.0 34,937.8 980 455.0 3.2 2.8 109.0 18,950.0 1,592.0 3,118.0 2,803.0 2,124.0 2,590.0 2,208.0 2,283.0 36,238.0 1981 269.0 5.5 3.6 408.0 748.0 1,319.0 1,485.0 1,139.0 1,742.0 1,763.0 1,801.0 1,244.0 11,927.1 1982 377.0

5.9

150.0

15.6

5.8

983

1984

1985

7,128.0

204.0

261.0

244.0

986.0

3,501.0

1,397.0

3.6

916.0

1,650.0

3,410.0

1.5

4,213.0

2,492.0

743.0

1.5

5,313.0

5,460.0

668.0

114.0

489.0

4,332.0

2,567.0

1,811.0

1,664.0

1,485.0

1,767.0

1,767.0

1,494.0

1,711.0

983.0

1,679.0

1,430.0

1,291.0

1,761.0

1,463.0

1,343.0

8,386.5

13,145.6

1,031.0 31,355.0

1,258.0 24,414.8

919.0

773.0

2,698.0

2,325.0

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1967
1968
                    195.00 1.167.00
          214.00
                                        210.00
                                                  223.00
                                                            298.00
                                                                     305.00
                                                                             172.00
                                                                                         129.00
                                                                                                   377.00 1,338.00
                                                                                                                       587.00
                    207.00
                              224.00 1,859.00 3,130.00 2,839.00 2,799.00 1,346.00
          229.00
                                                                                         458.00
                                                                                                   282.00
                                                                                                                       232.00
 1969
          231.00
                    293.00
                              261.00 1,299.00
                                                  694.00
                                                         1.222.00 2,395.00 1,021.00
                                                                                         312.00
                                                                                                   213.00
                                                                                                             348.00
                                                                                                                      494.00
31970
          252.00
                    172.00
                              184.00
                                        229.00
                                                  229.00
                                                           605.00
                                                                    931.00
                                                                              670.00
                                                                                         205.00
                                                                                                   163.00
1971
         2,147.00
                    727.00 1,575.00
                                        216.00
                                                  221,00
                                                           262.00
                                                                     259.00
                                                                               180.00
                                                                                         100.00
                                                                                                   123.00
                                                                                                             860.00
                                                                                                                       529.00
         4,732.00 1,229.00 1,418.00
 1972
                                        645.00
                                                  332.00.
                                                           494.00
                                                                     257.00
                                                                               151.00
                                                                                         190.00
                                                                                                   149.00
                                                                                                             179.00
                                                                                                                       209.00
1973
1974
1975
                                        984.00 2,654.00 5,512.00 6,195.00 5,933.00 1,329.00
          180.00
                    222.00
                              229.00
                                                                                                   557.00
                                                                                                             370.00
                                                                                                                      200.00
          530.00
                    479.00
                              225.00
                                        331.00
                                                  235.00
                                                            559.00
                                                                     510.00
                                                                               290.00
                                                                                         121.00
                                                                                                   173.00
                                                                                                             284.00
                                                                                                                      168.00
          149.00
                    163.00
                              207.00
                                        221.00
                                                  475.00 2,144.00 - 2,968.00
                                                                            1,750.00
                                                                                         477.00
                                                                                                   324.00
                                                                                                             181.00
                                                                                                                      335.00
 1976
          189.00
                    177.00
                              168.00
                                        187.00 1,174.00
                                                           574.00 1,204.00
                                                                               872.00
                                                                                         240.00
                                                                                                   297.00
                                                                                                             295.00
                                                                                                                      236.00
1977
          232.00
                    197.00
                              161.00
                                        210.00
                                                  216.00
                                                           241.00
                                                                     608.00
                                                                                       142.00
                                                                               322.00
                                                                                                   225.00
                                                                                                             397.00
Y1978
          187.00 2,009.00 5,943.00
                                        258.00 1,837.00 10,390.00 3,081.00 1,035.00
                                                                                         320.00
                                                                                                  191.00
                                                                                                             360.00
                                                                                                                      177.00
 1979
                              254.00 3,695.00 3,071.00 5,053.00 6,281.00 2,960.00 1,281.00
          200.00
                    268.00
                                                                                                   403.00
                                                                                                             414.90
                                                                                                                      223.00
                              300.00 1,466.00 9,072.00 2,701.00 3,848.00 2,742.00
31980
          311.00
                    372.00
                                                                                         879.00
                                                                                                   369.00
                                                                                                             461.00
                                                                                                                      316.00
 11981
          354.00
                    231.00
                              244.00
                                        250.00
                                                283.00
                                                           763.00 1,280.00
                                                                              580.00
                                                                                         230.00
                                                                                                   269.00
                                                                                                             336.00
                                                                                                                      278.00
 1982
          206.00
                    233.00 1,842.00
                                        448.00 1,405.00 2,642.00 1,945.00 1,210.00
                                                                                         388.00
                                                                                                   202.00
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                                                                                                                      476.00
 ,1983
        4,832.00
                    486.00 1,627.00 1,164.00 2,895.00 5,229.00 4,265.00 3,208.00 1,190.00
                                                                                                   446.00
                                                                                                             558.00
                                                                                                                      683.00
 1984
        1,206.00
                    527.00 4,146.00
                                      946.00
                                                579.00
                                                          815.00
                                                                   922.00
                                                                              575.00
                                                                                         190.00
                                                                                                   329.00
                                                                                                            730.00
                                                                                                                      662.00
 1985
          535.00
                    585.00
                              580.00 2,371.00 2,399.00 5,155.00 3,361.00 2,147.00
                                                                                         648.00
                                                                                                   323.00
                                                                                                             458.00
                                                                                                                      451.00
 1986
          509.00
                    944.00 1,090.00
                                        350.00 1,509.00 2,380.00 1,715.00
                                                                             609.00
                                                                                         270.00
                                                                                                   393.00
                                                                                                             386.00
                                                                                                                      350.00
 1987
          242.00
                    490.00
                              317.00
                                        446.00 1,037.00 2,685.00 3,104.00 1,339.00
                                                                                         400.00
                                                                                                   222.00
                                                                                                             532.00
                                                                                                                      220.00
 1988
          308.00
                    247.00
                              252.00
                                        580.00 1,589.00 1,125.00 1,785.00 1,215.00
                                                                                         322.00
                                                                                                   313.00
                                                                                                          1,231.00 1,440.00
 1989
          183.00
                    186.00
                              191.00
                                        327.00
                                                 483.00 1,158.00
                                                                     583.00
                                                                              232.00
                                                                                         118.00
                                                                                                   141.00
                                                                                                            277.00
                                                                                                                      143.00
                    291.00 1,171.00
1990
          239.00
                                        208.00
                                                  225.00
                                                           247.00
                                                                   414.00
                                                                             250.00
                                                                                         113.00 -
                                                                                                  484.00
                                                                                                             462.00
                                                                                                                      268.00
1991
          194.00
                    287.00
                             774.00 1,811.00
                                                 714.00 6,408.00 3,674.00 1,615.00
                                                                                         557.00
                                                                                                   219.00
                                                                                                            298.00
 1992
          235.00
                    245.00 1,964.00
                                       891.00 2,325.00 2,742.00 3,019.00 1,429.00
                                                                                         811.00
                                                                                                   279.00 1,427.00
                                                                                                                      445.00
1993
          358.00
                              339.00 13,470.00 7,867.00 5,153.00 4,864.00 2,296.00
                    595.00
                                                                                         718.00
                                                                                                   294.00
                                                                                                             371.00
$ OTALS 36,280.50 30,329.00 64,192.00 90,966.00114,377.00163,402.00166,428.00 85.423.00 30,089.70 27,164.30 48,106.00 36,547.90
Monthly Averages:
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Nov

374.43

30 Year (Monthly) Average Overall: 928.85

447.91

Dec

Jan

Peb

Har

792.49 1,137.08 1,429.71 2,042.53 2,080.35 1,067.79 376.12

Apr

Hay Jun

Aug

601.33

Sep

Jul

339.55

ARIJONA RIVERS Salt River - Sta. 4985

Tear	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Hay	Jun	Jul	Aug	Sep
1913	215.00	256.00	340.00				•	•				•
1914	642.00	501.00	2,574.00	380.00	1,319.00	1,010.00	1,065.00	432.00	257.00	593.00	1,059.00	743.00
1915	318.00	375.00	378.00	2,291.00	3,374.00	3,725.00	6,023.00	3,694.00	1,229.00	1,461.00	602.00	386.00
1916	1.410.00	453.00	309.00	15,990.00	4,487.00	8,350.00	4,310.00	1,772.00	820.00	459.00	692.00	940.00
1917	231.30	247.00	242.00	1,512.00	1,575.00	1,196.00	2,402.00	1,208.00	478.00	479.00	450.00	298.00
1918	183.00	244.00	297.00	275.00	447.00	2,030.00	375.00	376.00	293.00	367.00	392.00	194.00
1319	469.30	2,149.00	4,595.00	254.00	985.00	1,632.00	3,658.00	1,233.00	378.00	3.276.00	1,512.00	803.00
1920	293.00	495.00	326.00	2,607.00	9,014.00	2,865.00	2,124.00	1,625.00	641.00	305.00	480.30	299.00
1921	320.00	243.30	318.30	317.00	369.00	395.00	318.00	290.00	224.00	699.00	3.607.00	1,076.00
1922	189.00	229.00	475.00	592.00	1,041.00	1,994.00	1,911.00	919.00	389.00	330.00	492.00	247.00
1923	406.00	1,006.00		272.00		1,295.00	1,225.00	639.00	247.00	361.00	882.00	1,852.00
1924	176.00	196.00		1,197.00	526.00	966.00	3,162.00	1,095.00	384.00	245.00	263.00	197.00
1925	405.00	294.00	247.00	203.00	227.00	967.00	640.00	260.00	195.00	259.00	572.00	898.00
1926	251.00	255.00	376.00	239.00		1,305.00	4,246.00	2,013.00	465.00	328.00	333.00	327.00
1927	223.00	213.00	250.00			2,300.00	2,159.00	1,306.00	528.00	338.00	435.00	616.00
1928	254.00	262.00	251.00	219.00	628.00	819.00	658.00	507.00	254.00	301.00	361.00	232.00
1929	418.00	267.00	224.00	271.00	279.00	663.00	1,714.00	436.00	203.00		1,096.00	1,022.00
1930	159.00	280.00	235.00	297.00		1,749.00	1,660.00	593.00	282.00	544.00	941.00	261.00
1931	1,131.00		1,092.00		2,550.00	816.00	1,300.00	983.00	264.00	310.00		1,207.00
1932	277.06	219.00	253.00			3,489.00		1,198.00	438.00	480.00	816.00	505.00
.1933	443.00	230.00	294.00	261.00		1,559.00	1,148.00	996.00	522.00	474.00	453.00	382.00
1934	181.00	204.00	210.00	240.00	245.00	411.00	319.00	198.00	121.00	179.00	751.00	423.00
1935	214.00	242.00	239.00			2,575.00	3,150.00	1,097.00	664.00	225.00	556.00	518.00
1936	238.60	296.00	319.00			1,934.00	3,259.00	1,134.00	356.00	234.00	384.00	475.00
1937	198.00	192.00	232.00			3,454.00	3,440.00	1,228.00	386.00	287.00	274.00	245.00
1938	155.00	162.00	212.00	211.00		2,077.00	828.00	439.00	192.00	231.00	597.00	395.00
1939	188.00	221.00	199.00	216.00		1,358.00	1,902.00	515.00	157.00	129.00	361.00	226.00
1943	475.00	477.00	2,999.00	240.00	580.00	912.00	925.00	438.00	222.00	220.00	340.00	433.00
1941	711.00	469.00	700.00		2,995.00	8,335.00	4,794.00	5,047.00	1,365.00	669.00	593.00	566.00
1942	257.00	241.00	322.00	994.00		1,281.00	2,292.00	938.00	294.00	210.00	393.00	286.00 327.00
1943 1944	245.00 281.09	203.00 250.00	210.00	900.00 205.00		2,786.00 1,183.00	1,653.00 1,327.00	606.00 650.00	211.00 251.00	165.00 184.00	383.00 262.00	327.00. 368.00
1045	264.00 264.00	170,00	250.00 256.00	273.00		1,183.00	2.575.00	1,155.00	266.00	193.00	504.00	197.00
1946	293.00	493.00	501.00	267.00	245.00	489.00	531.00	238.00	109.00	173.00		1,612.00
1947	702.06	259.30	295.00	324.00	435.00	572.00	483.00	337.00	127.00	103.00	372.00	686.00
1948	132.00	173.00	442.00	269.00			3,136.00	803.00	210.00	207.00	265.00	120.00
1949	208.00	190.00		1,856.00		2,415.00	2,754.00	1,237.00	467.00	534.00	603.00	238.00
1950	115.00	133.00	152.00	219.00	312.00	575.00	562.00	230.00	116.00	220.00	214.00	176.00
1951	154.00	217.00	923.00	169.00	192.00	243.00	329.00	373.00	118.00	112.00		248.00
1952	151.00	237.00	225.00			2,259.00	5,184.00	2,252.00	672.00	236.00	434.00	232.00
1953	101.00	139.00	152.00	257.00		1,157.00	598.00	350.00	201.00	289.00	235.00	104.00
1954	139.00	139.00	148.00	164.00		2,215.00	978.00	366.00	131.00	354.00	680.00	283.00
1955	139.00	153.00	188.00	171.00	173.00	233.00	211.00	155.00	129.00		1,615.00	259.00
1956	85.50	122.00	127.00	225.00	388.00	736.00	645.00	371.00	121.00	138.00	167.00	77.90
1957	223.00	363.00	240.00	764.00	925.00	760.00	617.00	500.00	320.00		1,048.00	352.00
1950	670.00	232.00	206.30	186.00	723.00	3,137.00	3,915.00	1.325.00	407.00	147.00	295.00	571.00
1959		1,259.00	2.675.00		203.00	230.00	240.00	127.00	78.70		1.331.00	237.00
1963	236.99	191.00	178.00		1,008.00	2,936.00	1,644.00	677.90	285.00	131.00	172.30	136.00
1961	147.00	274.00	562.00	180.00	195.00	339.00	540.00	198.00	108.00	139.00	286.00	241.00
1962	254.00	234.00		1,124.00			3,999.00	1,188.00	310.00	183.00	151.00	234.00
1963	325.00	310.00	203.00		1,286.00	783.00	900.00	298.00	104.00	78.30		925.00
1964	295.00	190.00	208.00	161.00	168.00	220.00	956.00	369.00	138.00	279.00	634.00	800.00
1965	161.00	507.00	6,327.00	1,862.00	1,410.00	1,685.00	3,381.00	1,483.00	556.00	397.00	521.00	233.00
1966	222.00	212.00	445.00	1,768.00	700.00	3.216.00	2,498.00	877.00	268.00	200.00	459.00	579.00

S. W. quarters, desire the boundary line between them established. The law in this case is plain, the line must be run from the 1/4 post in the north boundary, and to establish this line in pursuance of the law the surveyor must cross the north half of the section.

In the opinion of this office the corners established on the section lines should govern the subdivision of sections, and the boundaries of all legal subdivisions should be determine by running straight lines through the section from one corner to its opposite corresponding corner.

Your application . . . .

Very respectfully Your Ob't Ser't J. M. Edmunds Commissioner

Although signed by Edmunds, these letters were undoubtedly written by J. H. Hawes, Principal Clerk of Surveys. In them, Hawes correctly quoted and pointed out the principles given by the Act of February 11, 1805, which specifically dealt with the subdivision of the old two-mile blocks into individual sections and the subdivision of sections into half or quarter sections, the smallest legal subdivision at that time. What Hawes completely overlooked was the Act of April 5, 1832, which specifically stated that the "contents of quarter-quarter sections, which may thereafter (after May 1st) be sold, shall be ascertained as nearly as may be, in the manner, and on the principles, directed and prescribed by the second section" of the Act of 1805. The quarter sections are also to be subdivided in the same manner as the sections were subdivided. Butler was advocating the proper method of subdividing a quarter section on different grounds-equity and economy (only one mile of survey instead of two miles to subdivide a given quarter section). Although equity and economy are good reasons, even though the result be the same, they were not the basis for the law, which was written to settle boundary disputes by statute and end contentions. Yet, as we see in this exchange, only 30 or 60 years later, different individuals interpreted the law as they chose to view it, rather than look to its roots for the answers. This improper method of subdividing a normal quarter section pervailed, as a general policy until 1871.

By Sec. 3 of the Appropriations Act of March 2, 1865, 13 Stat. 460, Nevada was reattached to the surveying district of California. Upson was instructed to extend the surveys along the line of the Pacific Railroad but received no money for the work.

In the latter part of March 1865, John A. Clark, Surveyor General of New Mexico, took an inspection trip through Arizona. He visited the area southwest of Phoenix at the junction of the Gila and Salt Rivers. On a conical hill just south of the junction and south of the Gila River, a boundary monument had been erected by the Mexican Boundary Commission in 1851, which marked the U.S.-Mexico boundary prior to the Gadsden Purchase in 1853. Clark reported on May 24, 1865, that he had adopted this monument as the initial point for the Gila and Salt River Meridian in Arizona, but he had no funds, so no surveys were run from that monument until two years later.

On April 10 and April 20, 1865, John Pierce in Denver

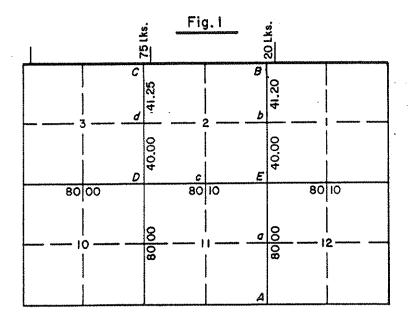
contracted with Joseph Clark, Deputy Surveyor, for the survey of the exterior bound — is and subdivisional lines of the Spanish Fork, Cow Creek, San Pete, and Deep Creek Indian reservations in Utah. Clark began these surveys in July 1865 and completed them in October 1866. He first ran the exterior boundaries, setting a monument every 20 chains, then subdivided them into 40-acre tracts, again setting monuments every 20 chains, the first of the Indian Allotment surveys that were discovered. The reservations were not subdivided into regular sections first, however, and in fact were not tied to the rectangular surveys until three years later. Clark reported that all the rectangular corners had been destroyed by either time, weather, or the settlers.

On July 30, 1865, Anson G. Henry, Surveyor General of Washington Territory, drowned when the steamship Brother Jonathan struck the Point St. George Reef near Crescent City, California, and sank. One hundred and ten people including Henry were lost. The Olympia Office was operated by E. Giddings, Chief Clerk, until Selucius Garfield was appointed and filled the vacancy in April 1866.

In the 1865 Annual Report, Edmunds reported that since no appropriation for surveys had been made, very few were done except those in the Indian reservations, and what few had been made, were done with leftover funds. He also reported that the California-Nevada boundary had been surveyed north from Lake Bigler, now Tahoe, and southeast for 102 miles along the oblique line, but that these boundary lines were not acceptable to the GLO. The line north from Lake Tahoe is still in dispute.

On April 9, 1866, the following instructions were sent to H. M. Cankin at Greenville, Michigan, in reply to his request about the proper method to be used in restoring lost corners. These instructions were a stock answer being used at that time in reply to such requests.

"The following examples will illustrate some of the more difficult of the rules for restoring corners.



Example 1. — Required to restore the missing section corners B, C, D, E, and the quarter sections corners a, b, c, d. Fig. I.

When the rectangular surveys were extended through a mining claim area, it was done in the normal manner without regard to the claims themselves, which were then segregated from the sections.

Sec. 8 of the act reads:

"That the right-of-way for the construction of highways over public lands, not reserved for public uses, is hereby granted."

This section is the basis of many thousands of miles of roads and highways built across the public domain. All that really had to be done to acquire a highway right-of-way under this act was to build one. Subsequent patents were automatically subject to an existing highway across the land. If a State or territory passed legislation accepting the grant and specified the location and width of a right-of-way for highways, all subsequent patents were subject to it. For example, in 1871 the Dakota Territory declared by law a road right-of-way 66 feet in width along all section lines. All subsequent patents were taken subject to that reservation. Sec. 8 of this important act is now codified in 43 U.S.C. 932.

Sec. 9 made reservation for construction of ditches and canals across public lands. Miners were allowed to construct ditches to bring water to their claims. Further legislation on ditches and canals came in 1890.

Secs. 10 and 11 of the act allowed preemption and homestead on the agricultural lands in the known mineral areas if the lands were shown to be nonmineral bearing. This provision would later require mineral segregation surveys.

Sec. 16 of the act extends the rectangular system over the mineral lands, which had been excluded from survey since 1853.

The Act of July 28, 1866, 14 Stat. 339, legalized the metric system of measurements in the United States; however, as of 1980, the metric unit has not been used in the Public Land Surveys in this country.

Another Act of July 28, 1866, 14 Stat. 344, directed that the Surveyor General's office for Iowa and Wisconsin at Dubuque, Iowa, should be closed and moved to Nebraska with a new surveying district to include Nebraska and Iowa. The closure had already occurred, as previously noted. Phineas W. Hitchcock was appointed the new Surveyor General on April 4, 1867; he got the furniture from Johnson in Dubuque and established his office in Plattsmouth, Nebraska, in June. Kansas became a separate surveying district and the Surveyor General remained at Leavenworth.

On July 28, 1866, Edmunds issued a Circular to all Surveyors General which amended Diagram B of the 1855 Manual. The system of lot numbering was changed to that still used today; the odd system of having two Lots 1 and two Lots 2 in a section was eliminated.

On September 1, 1866, Joseph S. Wilson again became Commissioner of the GLO; he was the only Commissioner ever to serve two separate terms in that office.

On December 1, 1866, Wilson sent a Special Agent to New Orleans with instructions to recover the Louisiana records from the State authorities, inventory them, and prepare lists.

On December 11, 1866, Wilson ordered Thornburgh to nove the Nevada Office from Carson City to Virginia City. Perhaps Thornburgh refused, because on May 27, 1867, Anson P. K. Safford became Surveyor General of Nevada and

made that move.

began the survey of the Gila and Salt River Baseline in Arizona, starting from the initial monument selected by Clark. The surveys of township and range lines were extended from the baseline by Wilfred F. and George P. Ingalls, under contract with the Surveyor General of California. The Arizona surveys were finally under way.

The Act of February 9, 1867, 14 Stat. 391, enabled Nebraska to become a state and was admitted by Presidential Proclamation on March 1, 1867, 14 Stat. 820.

The Act of February 25, 1867, 14 Stat. 409, granted lands for three miles on each side of a military road which was to be constructed from The Dalles, Oregon, to Boise, Idaho. Again as in the railroad grants, the Surveyor General had to survey the section lines as soon as possible after any portion of the road was completed. This was just one of many such wagon road grants.

The Appropriations Acts of March 2, 1867, 14 Stat. 440 and 457, provided funds for, and authorized, topographical and geological surveys to be made in Nebraska, and between the Rocky Mountains and the Sierra Nevada in California. These geological surveys were made under supervision of the GLO and were made by expeditions under the direction of Ferdinand V. Hayden. In 1869, further explorations were authorized, which were conducted by John Wesley Powell from 1869-1875. The Hayden and Powell surveys were the forerunners of the U.S. Geological Survey (USGS). By this act, Arizona was attached to the California surveying district.

The Act of March 2, 1867, 14 Stat. 542, again authorized the appointment of a Surveyor General for Montana Territory and made it a separate district; Soloman Meredith was appointed on April 18, 1867, and subsequently established the office at Helena. Commissioner Wilson had directed Meredith to establish a Principal Meridian on Beaver Head Rock about 12 miles north of Dillon, Montana. Instead, Meredith established the initial point on a limestone hill, 800 feet high, about 12 miles southwest of the junction of the three forks of the Missouri River. The Principal Meridian and Baseline surveys were begun by Benjamin F. Marsh in August 1867. The Principal Meridian in Montana has no given name or number; it is identified just as the Principal Meridian, Montana, and controls all of the rectangular surveys within that State and none other.

Another Act of March 2, 1867, 14 Stat. 541, was another law for townsites on the public lands. It is the basis of what is now called a Trustee Townsite, and is codified in 43 U.S.C. 718-721. The maximum of 2,560 acres could be taken up by legal subdivision as a townsite under this act.

On March 13, 1867, Wilson dispatched a Special Agent to Florida with instructions to gather and inventory the Spanish Archives on private land claims. On August 5, he ordered the agent to get the Surveyor General's records from the State Register, inventory and list them, and then turn them over to the U.S. Attorney for safekeeping.

On March 30, 1867, the United States purchased Alaska from Russia, adding that huge territory to the public domain.

A slight softening of the former hard stand on dried-up lakes occurred in 1867, as indicated by the following letter:

to retain some water. But this was the first admission by the ChO that owners adjoining a non-navigable lake may have riparian rights. This "temporary use" policy remained in effect to the end.

After Wilson became Commissioner for the second time, J. H. Hawes left the GLO. In 1867, he began writing his Manual of United States Surveying and had it published in 1868. Several inquiries were received in the GLO about the book requesting a copy of it. Each inquiry received a reply which denied at first any knowledge of the work and that it was not an official publication and was not recognized as having any authenticity. Actually, the Hawes Manual is an excellent reference to the policies in effect while Hawes was Principal Clerk of Surveys. Several of the same letters used in this book were printed in Hawes' Manual.

The 1867 Annual Report indicated that after passage of the Lode Mining Law in 1866, the mineral States were organized into Mineral Districts by the Surveyors General. These were not miners' mining districts, they were simply geographic areas set up by the Surveyor General for filing and recording surposes, and appointment or commissioning of Mineral Surveyors. Nevada was organized into eight mineral districts; California was divided into nine districts.

On June 10, 1868, Commissioner Wilson issued Circular No. 22, detailing the process to be used in surveying small, unsurveyed islands which had been omitted in the original jurveys. No change in policy was made; the islands were leemed public land subject to survey and disposal. The applicant had to deposit the money necessary to pay for the survey under the Deposit Survey Law of May 30, 1862, but received to rights to the island because of such payment. These instructions are given in the Appendix.

On July 13, 1868, L. M. Frierson of Booneville, Missouri, ipplied for the survey of an island in the Missouri River. Frierson alleged that the island had always been in existence but that at low water it was attached to the mainland which was patented. Wilson denied the application and ruled that he island inured to the riparian owner because of the accretion which caused the connection. This decision is indicative of the misunderstanding and confusion which prevailed with espect to riparian rights.

espect to riparian rights.

The Act of July 25, 1868, 15 Stat. 178, established the Territory of Wyoming. The territorial boundaries were the lame as the present State boundaries.

On August 22, 1868, Wilson entered into a contract with and issued Special Instructions to Theodore H. Barrett, a gurveyor from St. Cloud, Minnesota. Barrett was to survey he exterior boundaries, township and section lines, and subdivision of sections of the Sissiton and Warpeton Indian Reservation, located west of Lake Traverse in the Dakota Terribry, now South Dakota. Barrett surveyed the exterior boundaries of the reservation first, then subdivided it into regular townships and sections of the Fifth Principal Meridan. Barrett then subdivided the sections into 40-acre allothents by the so-called "Three Mile Method", as instructed by the Commissioner, which simply means that he ran the north one-sixteenth line, the east-west centerline and south oneexteenth line across the section (three miles total) and set the one-sixteenth section corners and center quarter corner at equidistant positions. None of the north-south lines hrough the section were surveyed. In every other respect the surveys were made in accordance with the public land laws on surveying.

This Three Mile Method of subdividing sections was used only on Indian reservations. All reservations subdivided into allotments were done by this method and variations of it until about 1920. When subdivided into 40-acre allotments, the one sixteenth corners were usually referred to as "1/8 corner." If subdivided into 20-acre allotments the one-sixty-fourth corners were usually called "1/32 corner." The Bureau of Indian Affairs (BIA) allotting agents devised a number and letter designation for the corners around the exterior boundaries and interior corners of a section. Fig. 45 is a sketch showing the system used to designate the corners and the lines surveyed. Fig. 46 is the plat of T. 119 N., R. 52 W., Fifth Principal Meridian, Dakota, as surveyed by Barrett.

Be aware that if interior corners of sections subdivided in this manner are now lost and are to be restored during a resurvey, they must be restored by proportionate measurement in the same manner that they were originally established, not by the rules of subdivision of sections as required by the 1973 Manual. More discussion of Indian allotments will appear as they occurred, especially after 1887.

On July 28, 1868, John A. Clark was commissioned Surveyor General of Utah and opened the office in Salt Lake City. Benjamin C. Cutler replaced Clark as Surveyor General at Santa Fe on August 26, 1868. But Clark only stayed in Salt Lake City until July 1869, at which time Courtland C. Clements took charge of the Utah office.

On November 18, 1868, Wilson replied to an inquiry from Silas Reed at Stanton, Missouri, on how to subdivide a section two. The north quarter corner of the section had not been established in the original survey and the north boundary of the township had double corners. Wilson advised Reed to survey the east-west centerline between the original quarter corners (normal) and run the north-south centerline due north from the south quarter corner to an intersection with the north boundary of the township and establish the north quarter corner at said point of intersection. Where the centerlines had been run and would intersect is where the center of the section would be established. Most other letters written in 1868 on the same subject received similar replies.

On December 24, 1868, in reply to W. P. Hobson of Savannah; Missouri, Wilson stated that whenever a meandered stream "entirely forsakes the former bed" then the land left exposed and the streambed were public land and subject to survey and sale. This was a case of avulsion of a stream, not the drying up (reliction) of a lake, and the expressed opinion was obviously contrary to law.

Wilson held very strong and somewhat biased opinions on riparian rights. The 1868 Annual Report contains more than ten pages on riparian rights in which Wilson very strongly stresses his stand on the subject; it also indicates that dried-up lake surveys were made at cost to the applicant, the money was to be deposited before the survey would be ordered.

A letter dated March 11, 1869, addressed to Myron McLaren, Mt. Pleasant, Michigan, advised McLaren to establish the quarter-quarter (one-sixteenth) corners of sections against the north and west boundaries of the township (north one-sixteenth and west one-sixteenth) "at precisely 20 chains from the ½ posts," placing the excess or deficiency in the last quarter mile. All others should be placed at equidistant posi-

tory to the credit of the U.S. on account of the appropriation for surveying the public lands, the Commissioner will forward at the earliest day practicable the necessary instructions for survey in accordance with the public land system.

Lands of this class when surveyed become subject to the operation of the homestead and preemption laws, or after due notice by the local land officers, pursuant to instructions from the Commissioner as contemplated by Sec. 5, Act of Aug. 3, 1846, may be sold for cash to the highest bidder and if not disposed of in this way will then become subject to private cash entry, warrant, or scrip location

> I have the honor to be Very respectfully Jos. S. Wilson Commissioner

Copies of the decision were sent to George Landers and the Rev. Van Raalte, but no "order" to Finkham was ever sent. In June 1871, (then) Senator Ferry again inquired about the matter. Willis Drummond replied that Lander must have misunderstood the decision (very understandable) and sent a copy of the decision to Lander. Lander then again requested the survey on September 4, 1871, but once again no order was issued. On February 14, 1872, in reply to another inquiry from Ferry, Drummond declined to order the survey. He explained that there were many cases pending before the Department in which the survey of lands, where the water had receded, were contested on the grounds of riparian rights. Drummond had recommended to the Committee on Public Lands that Congress pass legislation on the matter of dried-up lakes and relicted lands. Drummond thought that this class of lands should be granted to the States (similar to the swamp land grants). As far as can be determined, no survey was ever made, and there was no indication that Lander ever got his deposit back.

Oddly enough, in the above letter a policy change was made—to survey relicted land even though the water had not completely disappeared. The letter was also contrary to common sense. Wilson decides that Van Raalte had riparian rights to a small strip of omitted land, between the meander line and actual shore of the lake, but that he had no riparian rights to the relicted land in front of the old shoreline, even though there was water remaining, the Black River, which was a stream, not a lake.

One other item of interest seems appropriate at this time. Before any dried-up lake or island survey could be made, the applicant had to "prove" to the Commissioner that the application was legitimate, such as the fact the island was actually omitted and not formed by accretion or avulsion after the original survey, or that a lake was all dried up, not just partly so. To submit such proof, a map was frequently made by a local or County Surveyor at the request of the applicant, and this map would be sent to the Commissioner along with all of the affidavits. Nine times out of ten, the applicant would suggest that the survey be made by the Surveyor who made the map for him. If the Commissioner approved the application, he would then contract with the Surveyor for the "official" survey and field notes. In this manner a great many County Surveyors and others became

"U.S. Deputy Surveyors" and that title carried considerable prestige among the local control of an island survey was made in the same county by someone else, he would most likely hire the same "Deputy Surveyor" to make the map to accompany the application; this map would be nicely drawn, very similar to an official survey plat, and signed by "John A. Doe, Deputy Surveyor."

After examining all the evidence presented, the Commissioner might reject the application and often sent the materials submitted back to the applicant. Years later, the map, signed by "John A. Doe, Deputy Surveyor" would show up in some litigation as being a "plat" of the survey of the island, showing that so-and-so had title to it or at least color-of-title. Sometimes it takes an abnormal amount of research and digging to find out where these phony "plats" originated because the original parties are long dead, but when the origin is found, it can settle a dispute in short order; the main clue is that these "plats" were not approved by the Commissioner or a Surveyor General. Also, do not be confused by a marginal notation such as "Rec'd with Sur. Gen'ls letter, June 10, 1873."

The Act of July 9, 1870, 16 Stat. 217, added sections 12 thru 17 to the Mining Act of July 26, 1866. By this act, placer claims were added to the mining law. Placer claims could not exceed 160 acres, were to conform to the rectangular surveys, could be legal subdivisions of 40 acres, or in 10-acre aliquot parts. Sec. 16 of this act repealed part of the Act of March 3, 1853, and directed that the rectangular system should extend over all public lands, regardless of their mineral content, but that "waste or useless lands" were not to be surveyed.

Sec. 16 concludes with these words and is now codified in 43 U.S.C. 766:

"Provided, That all subdividing of surveyed lands into lots less than one hundred and sixty acres may be done by county and local surveyors at the expense of the claimants: And provided further, That nothing herein contained shall require the survey of waste or useless lands."

This act officially allowed county and local surveyors to subdivide public lands, when in actual practice they had been subdividing sections since before 1830. It isn't known when the "District Surveyors" had ceased being appointed by the Surveyors General. This act actually gave official notice of something that had been routine for a long time, and especially so after 1853.

The stipulation that wastelands not be surveyed caused further "piecemeal" township surveys. Many townships in the West are incomplete because of this elimination of "waste or useless lands" from the regular extension of the rectangular system.

By the Act of July 11, 1870, 16 Stat. 230, Arizona was made a separate surveying district. John Wasson was commissioned Surveyor General on July 12 but notification did not reach him until November 5, 1870, when he opened his office in Tucson. He travelled to California, brought back the Arizona records, and began contracting for surveys in that territory in March 1871.

On July 25, 1870, the Secretary of the Interior contracted with Ehud N. Darling and Theodore H. Barrett for the survey of the Chickasaw lands in the Indian Territory (now Oklaho-

Baseline in Wyoming, which was established to control the surveys in the Shoshone Indian Reservation. Miller surveyed the exterior boundaries, township, and subdivisional lines. This system of surveys covers a small area in west-central Wyoming; the remainder of the State is surveyed with reference to the Sixth Principal Meridian.

On August 30, 1875, Charles L. Dubois, a Deputy Surveyor under a contract dated August 12, 1875, with the Surveyor General of Utah, established the initial point of the Uintah Meridian and Baseline, a meridian set up for the surveys in the Uintah Indian Reservation. Dubois had executed many of the surveys in the Indian Territory. The rectangular surveys, based on this initial point, are confined to a relatively small area in the northeastern part of Utah.

In the 1875 Annual Report, Commissioner Burdett reported that the GLO had been organized into 11 separate divisions, each identified by a letter of the alphabet. The divisions, assigned different duties and responsibilities in the operations of the GLO, were as follows:

# Division

- A Chief Clerk (Communications, general business)
- B Recorder (Patents and related business)
- C Public Lands (Tract books, disposals, etc.)
- D Private Land Claims (Matters relating to private claims)
- E Surveying (Surveyors General, public land surveys)
- F Railroads (Railroad grants, wagon roads, etc.)
- G Pre-emption (Preemptions, townsites, Indian lands)
- K Swamp Lands (Administration of swamp land grants)
- L Drafting (Plats, maps, etc.)
- M Accounts (Registers and Receivers, payments)
- N Minerals (Administration of mineral lands and

The duties of the division "E" were given in detail as follows:

#### Division E.

In charge of the principal clerk of surveys. This division is charged with the supervision of all work relating to the public surveys. Instructions to the surveyors-general relative to the extension of surveys or the examination and correction of erroneous surveys are here prepared. All contracts for surveys by deputy surveyors are here examined and passed upon, and the adjustment of accounts for surveying service made and submitted to the Treasury Department for payment. All returns of surveys are referred to this division for examination as to correctness, and after approval are filed in the division. All records and correspondence relating to Indian, military, light-house, live oak, or other reservations are in charge of this division.

To this division are also referred matters pertaining to the establishemnt of boundary lines, by astronomical surveys, between States and Territories of the United States.

The plats and field-notes of all surveys are retained on

the files of this division, in charge of a principal draughtsman, who supervises all work of draughting or copying plats of surveys, and who compiles and prepares the official map of the United States. There are in this division more than 50,000 plats or maps of township and other surveys.

If a division corresponded, the letter would be identified by the alphabetical designation of the division, such as, "Letter E, dated June 4, 1881." In later years, there were minor reorganizations of the divisions. Eventually, Divisions "P" and "O" were added. The surveying division was always "E."

Burdett also requested funds for the purchase of iron posts or quarried stone monuments to mark the public surveys. The loss of corners in the Plains States and California was very great. He thought the monuments should be set at alternate section corners or at least, at every township corner to preserve the surveys.

In a letter to Richard S. Hall, Oconto, Wisconsin, dated February 9, 1876, Hall was advised to restore lost closing corners along the north boundary of a township at proportionate distance from the corners controlling the township line. Prior to this time, surveyors had been advised to place the closing corners at record distance (usually a short distance) from the controlling or regular corners.

On June 24, 1876, James A. Williamson was appointed Commissioner of the GLO.

The Civil Appropriations Act of July 31, 1876, 19 Stat. 102, provided that the initial points of the rectangular surveys could be established by triangulation; however, none were so determined in the continguous 48 States. The act also abolished the Office of Surveyor General in Kansas, which was closed June 30, 1876.

The Act of July 31, 1876, 19 Stat. 121, required that railroads had to pay for the costs of surveying the lands to be conveyed under their grants. An accurate account had to be kept of the costs of survey and patent could not issue until the cost was paid into the Treasury. The Commissioner had been charging the railroads, the railroad companies appealed, and the law was passed, backing up the Commissioner.

Commissioner Williamson issued his first Annual Instructions to the Surveyors General on August 23, 1876, which were very lengthy; they made several changes in policy and procedures. In succeeding years, they were referred to in much the same manner as were circulars.

Among other things, the instructions listed the order of priority in the surveys in accordance with the *Apprópriations Act*:

- (1) Agricultural land
- (2) Irrigable land
- (3) Timber land
- (4) Coal land
- (5) Exterior boundaries of townships
- (6) Private land claims

The deputies were not to begin any survey until after the contract had been approved by the Commissioner. Triangulations made to establish a remote township corner would not be paid for, effectively stopping the permission given in the Appropriations Act. The township lines were to be extended in the normal manner, from south to north. If at all possible, a whole township must be surveyed, not just a part of it. The

circular of June 1, 1864, was modified. Both hinks of navigable streams were to be meandered. All form or or old corners started from or tied to were to be fully described in the field notes. The Special Instructions for any contract were to be sent to the Commissioner along with the contract for approval.

In a letter to a man in Minnesota, dated September 28, 1876, Williamson stated that the survey of dried-up lakes had been suspended in April 1876 and that island surveys in "closed" States (those with no Surveyor General) were also suspended, pending legislation on the matters by Congress. The Wolf Lake case was having its effect.

In the 1876 Annual Report, Williamson complained that the entire Washington staff of the GLO had been reduced to only 145 people, who were all overworked and underpaid, and who had no space to work in. People and files were occupying hall space. During the year, 59,192 letters had been received and 54,127 letters written, which filled 42,315 pages of folio records.

Williamson also commented that he couldn't see any good reason why dried-up lake beds should be allowed to go to the adjacent owners and he urged legislation on the matter.

On February 17, 1877, in a letter to William Vincent, the County Surveyor in Manistee, Michigan, Williamson stated that riparian rights in a lake could only be determined by a proper court, which was a clear backing-off on the lakes issue.

The Act of February 16, 1877, 19 Stat. 231, appropriated \$2,500 for and directed the Commissioner to have resurveyed Tps. 18 and 19 N., R. 1 W., Michigan, because they had never been "properly surveyed."

These resurveys were made by T. Gale Merrill, Deputy Surveyor, under contract dated March 3, 1877. Work began April 16, 1877, and was completed July 17, 1877. The resurveys were approved August 3, 1877. During the resurveys, many of the original corners were found and adopted by Merrill who then restored the lost corners by the current single proportion, north-south rules. The areas on the plats were changed to fit the returns of the resurvey, which caused some problem as the following letter indicates:

Department of the Interior General Land Office Washington, D.C., June 24, 1878

E. G. Goddard
East Saginaw, Michigan
Sir:

10 to 10 to

I have received your letter dated the 14th instant, requesting information as to the subdivision of Section 6, Tp. 18 N., Range 1 West, Michigan, especially as to the N. E. ¼ of N. W. ¼ and N. W. ¼ of the N. E. ¼ which you say was purchased from the State by you prior to the resurvey of said Township in 1877.

By the original plat the tracts referred to were represented as containing 80.72 acres, while by the resurvey they contain but 69.73 acres, and you ask in view of the fact that the lands were purchased by the original plat, how the section is to be subdivided.

In reply I have to say that evidence having been submitted to Congress that the survey of the section line in said township was never made, a law was passed authorizing a resurvey which was therfore made and approved, and the recurvey will govern both as to boundaries and areas cracts.

Enclosed herewith is a diagram of said Sec. 6, showing the areas of tracts therein together with the length of the lines. The land having been purchased by you from the State, you will have to look to the State for indemnity for the deficiency.

Very Respectfully J. A. Williamson Commissioner

Resurveys caused many headaches and misunderstandings, so few, if any, had been done for over 20 years. Now the citizens were again pressing for resurveys, claiming that the original surveys were fraudulent or "grossly" in error, which was not always true, with the costs to be borne by the government, and with the idea that a government resurvey would be "official," ending arguments. In doing a dependent resurvey today, the BLM would never return a new area on patented lands, but this wasn't true 100 years ago. It isn't known when the practice of assigning new areas on the plats of resurveys for patented lands ceased.

The Act of March 3, 1877, 19 Stat. 377, is known as the "Desert Land Act." It allowed homesteading of up to 640 acres of irrigable desert land and dealt with water rights. To "prove up" on a desert homestead, the settler had to bring water to the land and irrigate and farm a portion of it; this proved difficult to do. Many of the so-called "wastelands" would now demand surveys.

On March 9, 1877, Williamson informed a man in Michigan that islands formed in a navigable lake following state-hood belonged to the State under Federal Court rulings on that subject.

On December 17, 1877, Williamson replied to E. R. Robinson, County Surveyor in Boyne Falls, Michigan, in response to an inquiry about how to resurvey the meander line along a lake. The pertinent portion of that letter follows:

"... you state that having commenced at the meander corner on the East line of Sec. 32, T. 33 N., R. 6 W., you ran as the field notes require, N. 77° W., for a distance less than one call, and found the departure of the meander line from the lake beach so great as to cause dissatisfaction to the interested parties, and ask how the difficulty is to be remedied.

The examination in the field made in this case or the data furnished by you is insufficient to lead to a solution of the question.

Upon examination of the field notes, it is found by computation that the meander line will close on the meander corner on the North line of Sec. 32 within reasonable limits.

Having by reference (if possible) to a known line of the meander survey adjusted your compass and chain to correspond with the same, you will retrace the meander line in the same direction in which it was originally run from the corner on the direction in which it was originally run from the corner on the East line of Sec. 32, through its various bearings and distances to a known point on the line, and if necessary to the meander corner

surveyed by traversing along accessible trails, ridge tops, along river canyons, and "stubbing in" corner calculated positions. These "stub jobs" were usually done in areas where actual settlers and miners were located, which gave them the appearance that a survey was being made, however crude and poorly done. But on the whole, no Deputy went to the field at all.

While the Deputy was supposed to be or actually was in the field, the field notes of these surveys were being written up, and plats prepared in a "boiler room" in San Francisco by the support personnel or deputies of the syndicate. If any field work was done, it would be incorporated into the record. The remainder of the topographic calls would be sketched in from any source available, USGS maps and the like. Much of the California coast had been or was being mapped by the U.S. Coast Survey (USCS), and there is no doubt that their triangulation stations and other data were used to full advantage.

The rates per mile for these surveys were always the highest rate allowed by law. Often supplemental contracts were let for the survey of intervening townships and township lines to enable the Deputy to extend the survey lines to a deposit survey township. Although allowed by Congress, the Commissioner did not allow triangulation as a method for extending the lines. The government ended up paying from the regular appropriations for many thousands of miles of fictitious or fraudulent work.

The deposit certificates were sold to timber companies, land speculators, and possibly even to legitimate settlers, perhaps at a small discount, who in turn used them at full face value to pay for public lands which they wanted to acquire. Most of the Redwoods area of northwestern California were purchased with deposit certificates or cash under the Timber Lands Act of June 3, 1878.

The Benson Syndicate Frauds extended to several other Western States. No direct evidence exists that Benson operated the swindle in other States, but the Annual Report of 1887 reported that the syndicate also extended into Nevada, Oregon, Colorado, Arizona, New Mexico, Idaho, Montana, Utah, and Washington. It is probable that after California, Colorado suffered the worst.

The fraudulent surveys scheme operated until about 1885 during the tenure of Commissioner William A. J. Sparks. During this five-year period, most the surveys contracted for were under the deposit system. The annual appropriations for all the surveying districts for surveys was only \$300,000 per year. Congress was very tight with the funding and as a result, got what they paid for, but the scheme could not have worked without collusion on the part of trusted government employees, underpaid or otherwise, all the way up to the GLO in Washington.

Lands Commission to study the public land laws and make recommendations to Congress on legislation to improve the system or to formulate policies. Thomas Donaldson, a former Register of the Boise, Idaho, Land Office, was appointed to the Commission. He prepared the first report in 1880; it was revised twice, the last time in 1883. The third revision, current to December 1, 1883, is titled The Public Domain, Its History, with Statistics, by Thomas Donaldson. The copy which this writer used for reference material was originally printed in 1884. While "Donaldson" contains many inaccur-

acies, it is a good reference for most of the history of the public land laws and operation to the end of 1883.

The Civil Appropriations Act of March 3, 1879, 20 Stat. 377, created the U.S. Geological Survey (USGS), a new bureau within the Department of the Interior. Among other duties, the USGS was made responsible for the classification of the public lands and examination of the geologic structure. mineral lands, and other resources; eventually it would execute some of the rectangular surveys of the public lands.

On April 2, 1879, Williamson replied to M. Spear, Deputy County Surveyor in Roscoe, Kansas, in regard to his request for a resurvey of Tps. 6-8 S., Rs. 23-25 W., Sixth Principal Meridian, or 9 townships. Spear was told to investigate thoroughly to see if any corners existed and how the topography fit. If the surveys were indeed fraudulent, the owners could have deposited under the deposit law the estimated cost of resurveying the townships, and Williamson would have appointed a Deputy to execute the work. If not fraudulent, the County Surveyor should do the work, based on the original corners, receiving payment from the settlers. An identical letter was sent on April 7 in regard to a similar request for T. 17 S., R. 9 W. The Surveyor General's office in Kansas had only been closed three years, and none of the surveys could have been more than 25 years old, but resurveys were already being requested.

On April 17, 1879, Commissioner Williamson issued a Circular that said the plats of the rectangular surveys did not become official until accepted by the Commissioner of the GLO. Prior to this time, the plats became official when approved by the Surveyor General. Under this order, the triplicate plat was not officially filed in the local land offices until after official acceptance of the survey in Washington. This acceptance date was usually noted on the margin of the plat but was not evidenced by certification on the face of the plat until July 1, 1925. Both approval and acceptance dates were shown on the plats from 1925 until June 30, 1948; since 1948, only the acceptance date has been shown.

A letter to Raphael Pumpelty, Oswego, New York, dated May 19, 1879, was a portent of things to come. Pumpelty had requested survey of some land (where isn't known, but not in New York) containing standing timber which laid between the original meander line and a lake. The letter said in part:

"... and stating that the tract of land referred to in your former letter is not of recent formation but was omitted by an error in the original survey — which fact is shown by the existence of trees outside the meander line. I have to state that in my opinion the tract is Government land."

Williamson declined to take any steps pending legislation by Congress. This statement on omitted lands outside a meander line was a reversal of Wilson's stand on the same issue at Black Lake in 1870, but no action was taken.

In a letter to E. K. Robinson, Boyne Falls, Michigan, dated September 27, 1879, Acting Commissioner J. M. Armstrong, advised him to proportion the record distances to the original bearing trees, to reestablish the corner point at a quarter corner, because the record didn't agree with the actual position of the trees. This advise was a reversal of the former policy of restoring the corner point at intersection of the record bearings.

"designing persons," then it had to stand in place. But if it was more than one chain out of position (i.e., n. ethan one chain out of midpoint or more than one chain off-line), and could not be positively identified as being in the original position, then the quarter corner should be treated as lost and be restored at midpoint and on line. This, of course, was the answer on regular lines, not those against the north and west boundaries of the township, in which case appropriate modifications were made. The whole rationale of the one-chain criteria was the Manual closing limits of a section.

The repeated requests for funds to purchase iron post monuments were made to correct the described problem. But so far, the only place they had been used was the Public Land Strip (Cimarron Meridian surveys).

In a letter dated June 2, 1882, C. B. Magruder, County Surveyor, Rockledge, Florida, was advised to establish a one-sixteenth corner on a section line at proportionate position between a quarter corner and meander corner. This method (principle) was probably followed until about the 1930's when a hiatus in the policy took place.

On September 6, 1882, Special Instructions, were issued to Jacob R. Meyers, County Surveyor, West Branch, Michigan, for the extension of the public land surveys over approximately 100 acres of omitted lands between the original and actual meander line of "Peach Lake" in section 15, T. 22 N., R. 2 E., Michigan. The land was from 5 to 200 feet in elevation above the lake level. The survey was made and approved. Patent was issued to Lots 7, 8, 9, and 10 (the omitted land) to W. R. Meyers. The owner of Lot 2 (adjoining the original meander line) sued for possession of the land patented to Meyers. The local court ruled in 1883 in favor of the owner of Lot 2 and ejected Meyers. The outcome of the case is unknown. The original plat and omitted lands survey are shown in Figs. 50 and 51.

The survey of nonexistent lakes began in 1882. Evidence was produced to the satisfaction of the Commissioner that a tract of land in sections 22 and 23, T. 40 N., R. 4 W., Wisconsin, which had been meandered and shown on the original plat as being a lake, was in fact high, dry land and no lake had ever existed where shown. The Commissioner had plats constructed, protracting the section line across the lake and the section subdivision lines, completing the survey. The original plat of this survey was sent to Wisconsin authorities on November 11, 1882. Pertinent portions of the original survey and completion (protractions) are shown in sketches (see Figs. 52 and 53).

On December 9, 1882, P. T. Curran, Deputy County Surveyor, Wausau, Wisconsin, was advised to restore the lost corner of sections 3, 4, 9, and 10, T. 30 N., R. & E., by double proportionate methods. No mention is made of single proportion north and south, nor the one-chain test.

that island surveys could no longer be made under the deposit survey system. Those surveys, when made, had to be paid for from the regular appropriations for public land surveys, a special examination had to be made to determine that the island had been in existence since before statehood or the original survey, and adjacent land owners had to be notified 30 days prior to the survey that a survey was going to be made of it. Those are still the basic rules today.

The Appropriations Act of March 3, 1883, 22 Stat. 603,

provided \$15,000 for the rourvey of poorly or fraudulently surveyed townships in Ka Las.

On March 19: 1883, McFarland issued a Circular to all Surveyors General that in the future, all Supplemental Diagrams (plats) had to be made on the regular township-sized paper. Up until this Circular, supplemental plats had been made any size, from a few inches square up to the uniform township plat size.

On March 13, 1883 the first full Circular was issued by the GLO, titled Restoration of Lost and Obliterated Corners. These instructions are published in 1 LD 339 or 671. By this Circular, the single proportion north-south method of restoring a lost interior section was forever put to rest. Double proportioning, based on the law, was adopted and still remains. The subdivision of sections was not included; that part remained in the 1879 Circular. The Restoration of Lost and Obliterated Corners Circular was reissued in identical form in 1885 and on September 25, 1891. It was sent to all the Surveyors General on May 7, 1883, with instructions that it superseded the 1881 Manual, especially p. 40 (see Appendix).

In June 1883, the Department of the Interior began publishing the more important Land Decisions, relating to the public lands administration and surveys. These volumes are numbered consecutively and are referred to as the "LD's." Reference is by volume and page, such as 1 LD 339, 2 LD 115, etc. For several years previous to this, the more important LD's were printed in the Annual Reports.

In the Annual Instructions to the Surveyors General (sent out in June 1883), McFarland directed that in the future all calls of topography entered in the field notes would be given along the true line, not the random line as was the practice in many districts. Tangent lines could not be run for more than 12 miles and offsets to the true line had to be carefully made. McFarland prohibited the use of open sight or needle compasses in the survey of Standard Parallels and other "principal" lines (presumably township lines). Bearing trees marked south of the Standard Parallel at Standard Corners must be marked to refer to the sections north of the standard, not south of it as was the former practice. He again reminded them that the Special Instructions for every survey had to accompany the contract when sent to him for approval. These Annual Instructions were almost a manual in themselves.

On July 31, 1883, McFarland issued Special Instructions to Henry C. F. Hackbush, Deputy Surveyor, Leavenworth, Kansas, for the resurvey of Tps. 6 through T. 10 S., Rs. 23 and 24 W., Sixth Principal Meridian. Part of those instructions reads as follows:

"According to the best evidence obtainable it appears that the returns of the original subdivisional survey of said townships were fraudulent, and that, in fact, no subdivisional lines were run and marked in the field by the U.S., hence the survey to be made by you although termed a resurvey will, in fact, be a survey de novo, and you will disregard any corners which you may find in the interior of said townships."

The instructions directed Hackbush to dependently restore all lost corners on the exterior boundaries of these ten townships in accordance with the Manual and Circular of March 13, 1883, then survey the interior section lines as though it was an original survey. Those ten townships contained settlers on patented lands, so anyone can visualize the complaints that could have arisen, but no evic e was found that they did.

On September 6, 1883, McFarland rejected applications for survey and entry on large areas of omitted lands bordering meandered lakes in Florida. He said they were large in area, high and dry, but "under present circumstances" he would not permit the survey of them.

At 2 a.m., Wednesday, September 12, 1883, the Surveyor General's office in Olympia, Washington, burst into flame and burned; none of the plats, field notes and records were saved. The fire department deduced that the cause was a smoldering cigar butt thrown into a waste basket or trash can, which finally burst into flame and destroyed the building. The warning to Tilton about fire protection when he took office in 1854 had not included cigar butts! All the field notes and plats were replaced over the next few years from the Washington, D.C., copies. The only records irretrievably lost were internal records and the field notes of surveys just brought in from the field and in the process of being copied and platted, which had to be done over. As a result, the Washington field notes are all in legal sized books.

On December 13, 1883, in reply to Surveyor General Malachi Martin of Florida, McFarland refused to consider a survey of a reported hiatus between Tps. 19 S., Rs. 21 and 22 E. Martin reported two separate township lines were monumented on the ground. McFarland said the plats and field notes called for only one line and therefore there could be no hiatus. The naivete with regard to hiatuses would last another 15 years.

In the 1883 Annual Report, McFarland asked for a general authority to execute resurveys and recommended establishing a civil government in Alaska. He also asked that fire extinguishers be supplied to all Surveyors General and that their offices be equipped with fireproof vaults.

The Act of March 13, 1884, 23 Stat. 4, established the standard time of the 75th Meridian as the standard time to be used in Washington, D.C. The railroads had already gone to a standard time system and this action recognized the standard time by the government; in a few years it prevailed throughout the country. This system was a real help to the surveyors in timing their observations and regulating their clocks.

On April 30, 1884, Special Instructions were issued to Henry Hackbush for the resurvey of seven townships and parts of two other townships in Kansas. Unlike the previous contract, Hackbush was to dependently resurvey these townships, accept all found corners, and restore lost corners in accordance with the Circular of March 13, 1883. Nearly identical instructions went to William Tweeddale, Topeka, Kansas on May 9, 1884, who was to restore all township boundaries and dependently resurvey the subdivisional lines in 16 townships. If he found no corners at all within a township, he was to subdivide that township as though it were an original survey. Tweeddale interpreted that provision very liberally and actually did original surveys within townships that really did have original corners in them. The residents complained, an examiner was sent out who found Tweeddale's work improper in many places, and the corrections of the work dragged on for several years.

The Act of May 17, 1884, 23 Stat. 24, established a civil

government in the District of Alaska and a Land Office at Sitka. No provision was ade for surveys, but U.S. Marshal Munson C. Hillyer was made ex officio Surveyor General with his office at Sitka. The mining laws were also extended to Alaska in pursurance with this act.

The following Circular letter was sent to all Surveyors General on May 31, 1884:

CIRCULAR

Department of the Interior General Land Office Washington D.C., May 31, 1884

Sir:

This office has received information that it is the practice of Deputy Surveyors to furnish, for a compensation, copies of their plats and notes to settlers and others, who apply for them in advance of their approval by the Surveyor General and acceptance by this office.

The practice is *objectionable* and you are hereby directed to notify all Deputy Surveyors in your district that in the future they must not furnish plats or field notes to any parties whatever, prior to the final acceptance of their surveys by this office.

Approved H.M. Teller 31 May 1884 Secretary Very Respectfully N. C. McFarland Commissioner

As far as is known, that Circular has never been rescinded. No cadastral engineer could for any reason give to anyone any information regarding a survey being made, which irritated many local and County Surveyors who wanted information, and the request was refused. Over the years, there was a relaxation of this regulation and the office would furnish a limited amount of information, always stamped "Unofficial Records." Since passage of the Freedom of Information Act in 1973, more relaxation of this Circular has been made.

The Act of July 5, 1884, 23 Stat. 103, placed all of the abandoned military reservations under the Secretary of the Interior and provided for the survey and disposal of those lands. Surveying abandoned military reservations would become a heavy workload for the surveyors in ensuing years. The Act of February 24, 1871, 16 Stat. 430, had provided for the survey of certain military reservations in the West; with the 1884 act, all surveys were to be handled by the GLO.

The Civil Appropriations Act of July 7, 1884, 23 Stat. 194. provided \$5,000 for the purchase of iron posts to be used to monument survey corners on nontimbered lands; \$50,000 was provided for examinations of surveys and \$300,000 for surveys, not to exceed \$9, \$7 and \$5 in ordinary country, and \$13, \$11 and \$7, in heavily timbered and brushy country: \$75,000 was appropriated for timber protection and \$10.000 for resurveys.

In the Annual Instructions dated July 25, 1884, McFarland made some significant changes:

- (1) The \$50,000 for examinations would be expended by the Commissioner only.
- (2) All resurveys would be made under contract with the Commissioner.
- (3) The iron posts would be distributed as the Commissioner saw fit, but would be used at all mineral monuments established in the future.
- (4) Both banks of all non-navigable streams, three chains, or

greater in right angle width would be meanded. Those already meandered on only one bank would have the areas of lots abutting them calculated on the basis of a uniform width.

\$5) Slope chaining would be adopted in steep terrain, with the slope angle determined by the vertical arc of the surveying instrument, and reduced to horizontal with the tables provided (sets of tables were sent).

(6) The angle and elevation of all slopes over 3° would be

given in the field notes.

(7) All improvements and lines of occupation of nonreservation Indians would be noted and entered in the field notes.

(8) No deputy could be given a contract for both the subdivisions and the exterior boundaries of a given township. If he did the exteriors, he could not have a contract for the interiors and vice-versa.

On March 26, 1885, William A. J. Sparks, an attorney, was appointed Commissioner of the GLO; he resigned November 17, 1887.

In his Annual Instructions of September 15, 1885, Sparks directed that in the future, all survey contracts would be examined; any found faulty would be rejected until corrected in every respect. The \$15,000 appropriation for resurveys would be used only with his express permission. Retracements of old lines to effect a closure would not be paid for because that work was a necessary part of any contract. The result was that many retracements were just a paper job and were never done. When a survey was to be made, an invitation for bids had to be advertised and the contract let to the lowest competent bidder.

In the 1885 Annual Report, Commissioner Sparks reported that an average of six examiners had been on duty in the field in the previous three years. Many faulty and incomplete surveys were found. To prevent further fraudulent work in the field and acceptance of fictitious surveys by the government, Sparks directed the suspension of all examinations of the plats and field notes in his office on surveys already contracted for and supposedly executed until after the surveys were examined in the field. Some of the surveys were ater cancelled and some that had been suspended, were hever officially cancelled or reinstated. In any case, the examination program did not completely eliminate fictitious or [fraudulent surveys, though they were reduced. The Surveyor General of Washington reported on bad surveys found in his district and suggested that all surveyors should be government employees paid at a regular salary. This Annual Report contains a lengthy report on the fraudulent surveys, how the frauds worked, and reports on land frauds.

The Appropriations Act of 1886 provided only \$50,000 for surveys in all the districts, except Nevada, which received \$30,000. Appropriations in 1887 were also \$50,000. The country was in a depression and the fraudulent survey scandals induced Congress to cut appropriations to the bone. Most States did no original work at all except on Indian reservations. Some resurveys of the fraudulent work were done, but they weren't really resurveys. When a township was found to be fraudulent, the work was done over as an original survey. The rationale was that a survey not done in fact, was not a survey at all. The result was many hiatuses and overlaps.

The 1886 Annual Report contains long lists of fraudulent, cancelled, and suspended townships. With no work being done, the Surveyor General of Louisiana sent a lengthy report on the bad surveys and ensuing problems in that State. The Surveyor General of Colorado suggested that the USGS (i.e., government employees) should be used to execute the rectangular surveys at the same time they did the topographic mapping, a convincing argument.

The Act of February 8, 1887, 24 Stat. 388, is known as the "General Allotment Act of 1887" or "Dawes Act." It provided for patenting of allotments to Indians either living on or off a reservation. In all probability, most of the Indian allotment patents were made under the provisions of this act.

The survey of most of the Indian reservation boundaries had been made by surveyors under contract with the Surveyors General, beginning with Ludlow's survey of the Greenville Treaty boundary in 1797.

The Act of April 8, 1864, had placed the survey of Indian lands under the GLO. Each Indian treaty, Presidential Proclamation, Executive Order, or resolution pertaining to the lands of specific Indian tribes, might have contained some provision for the survey and the division of those lands, and now patent to individual Indians. For example, an Executive Order issued by President Grover Cleveland on May 1, 1886 reads as follows:

"It is hereby ordered that all that portion of country in Washington Territory, withdrawn from sale and settlement, and set apart for the permanent use and occupancy of Chief Moses and his people, and such other friendly Indians as might elect to settle thereon, with his consent and that of the Secretary of the Interior, by Executive Orders dated April 19, 1879 and March 8, 1880, respectively, and not restored to the public domain by Executive Order, dated February 23, 1883, be, and the same is, hereby, restored to the public domain, subject to the limitations, as to disposition, imposed by the act of Congress, approved July 4, 1884, (23 Stat. pages 79 and 80) ratifying and confirming the agreement entered into July 7, 1883, between the Secretary of the Interior, and the Commissioner of Indian Affairs, and Chief Moses and other Indians of the Columbia and Colville Reservations, in Washington Territory.

And it is hereby further ordered that the tracts of land in Washington Territory, surveyed for and alloted to Sar-sarp-kin, and other Indians, in accordance with the provisions of said act of July 4, 1884, which allotments were approved by the Acting Secretary of the Interior, April 12, 1886, be and the same are hereby set apart for the exclusive use and occupation of said Indians; the field notes of said allotments being as follows:"

The field notes of 20 or more allotments were then given. This Executive Order is the sole known source of the field notes of these allotments; most of which were for rectangular tracts, about 160 acres in area, lying in all directions and in no way conforming to the rectangular surveys. It isn't known who surveyed the allotments nor when, but they were shown on the rectangular survey plats and the sections around them were lotted in fractional lottings when the rectangular surveys were extended through the area.

By the Act of March 2, 1889, 25 Stat. 854, Co. ess withdrew all of the public lands (except in Missouri and a few other exceptions) from further private entry.

By the end of 1889, the Commissioner of the GLO was practically running the "Surveying Service," telling the Surveyors General what to do and when. By early 1890, a diagram showing the surveys to be executed had to be included with every set of Special Instructions issued.

On September 16, 1889, Lewis A. Groff, a former judge, was appointed Commissioner of the GLO.

On January 1, 1890, the Manual of Surveying Instructions, 1890, was officially issued. The new Manual updated and revised the 1881 issue and required the use of a solar instrument on all major survey lines. The Act of October 1, 1890, 26 Stat. 650, made the new Manual part of every contract by law. This Manual is quite an improvement over the 1881 Manual but contained some insignificant errata. The lists of errata were sent to the Surveyors General, along with a copy of a corrected Manual on October 2, 1890.

The Act of April 10, 1890, 26 Stat. 53, authorized the appointment of a Surveyor General in both North and South Dakota. Erastus S. Williams was appointed Surveyor General of North Dakota and opened his office in Bismark on July 16, 1890. The Dakota office in Huron, under Boetius H. Sullivan, became the office of Surveyor General of South Dakota.

The Act of May 2, 1890, 26 Stat. 81, created the territory of Oklahoma, which included the Public Land Strip (Cimarron Meridian surveys) but not the Indian Territory. An unusual feature of this act was that it reserved a roadway, four rods wide, along every section line in the territory. The public lands in the territory were also opened to entry. Another item of interest is that the Registers and Receivers in some of the Oklahoma land offices issued patents for diagonal quarter sections. Instead of the "east half" or "west half" of a quarter, they were issued for the "diagonal NE ½ of the NE ¼ of section \_\_\_\_, containing 80 acres." The southwest boundary of such patent would run from the north quarter corner to the east quarter corner of the section. It is unknown why the patents were issued in that manner.

The Act of July 3, 1890, 26 Stat. 215, admitted the State of Idaho to the Union.

On July 10, 1890, 26 Stat. 222, the State of Wyoming was admitted. Colorado and Wyoming are the only two States whose boundaries are entirely described by lines of longitude and parallels of latitude, the same number of degrees in each. Colorado contains 104,247 square miles, whereas Wyoming contains 97,914 square miles, which shows the effect of convergency of meridians. The two States are the only ones which are laid out similar to the original plan put forth by Thomas Jefferson.

The Appropriations Act of July 11, 1890, 26 Stat. 228, at 261-262, provided funds for Surveyors General in 16 States and territories, which were Arizona, California, Colorado, North Dakota, South Dakota, Minnesota, Florida, Idaho, Louisiana, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

The Act of August 30, 1890, 26 Stat. 391, made a reservation of right-of-way for ditches and canals on all lands west of the One Hundredth Meridian. All patents for public lands west of that meridian issued subsequent to this act contain a reservation for ditches and canals, to provide for irrigation. The Act of September 25, \_890, 26 Stat. 467, directed the Secretary of the Interior to have surveyed the Seventh Standard Parallel North of the Fifth Principal Meridian, which was the State boundary between North and South Dakota. Thus, a line of the regular rectangular survey system again became a State boundary and was surveyed in 1891 and 1892 by Charles H. Bates. The line was monumented with quarried stones, 7 feet long, 10 inches square, set halfway into the ground.

The Act of October 1, 1890, 26 Stat. 650, set aside and established Forest Reserves in the State of California. These first reserves were placed under the authority of the Secretary of the Interior as were the reserves to follow, the beginning of what would become the National Forests.

The Act of March 3, 1891, 26 Stat. 854, provided for the survey of Small Holding Claims in New Mexico and Arizona, which did not follow the rectangular system and were surveyed as numbered metes and bounds tracts, somewhat similar to any other private claim.

The Act of March 3, 1891, 26 Stat. 1095, repealed the old timber culture laws and amended the Desert Land Act of March 3, 1877. It required irrigation before patent could be issued on desert homesteads and also repealed the preemption laws, stopped the sale of public lands at public sale (except military reservations and other lands of a special nature), provided for Trustee Townsites in Alaska, provided for Trade and Manufacturing sites in Alaska, withdrew the coal lands and other lands containing precious metals (except mining claims), and native lands in Alaska from entry. Sec. 18 to 21 of the act grants rights-of-way for ditches, canals, and reservoirs on the public lands. Plats of these rights-ofway had to be filed with the land office, showing the locations. These plats are frequently incorrect and do cause some problems when the sections are resurveyed. Sec. 24 of the act provides that the President may set aside Forest Reserves by Presidential Proclamation.

The first Forest Reserve set aside by President Benjamin Harrison was in Wyoming by proclamatin dated *March 30*, 1891, 26 Stat. 1565. It adjoins Yellowstone National Park. Harrison subsequently reserved over 13 million acres of forest lands by proclamation in 1891 and 1892, all in the States and territories west of the Mississippi River. All of the Forest Reserves were under the Secretary of the Interior and in turn the GLO.

Later administrations reserved many more millions of acres. President Grover Cleveland withdrew nearly 27 million acres, McKinley seven million, and President Theodore Roosevelt withdrew over 18 million acres for forests.

On March 31, 1891, Thomas H. Carter was appointed Commissioner of the GLO.

Between October 26 and November 7, 1891, Charles W. Garside, Deputy Surveyor, surveyed a Trade and Manufacturing Site claimed by the Alaska Oil and Guano Company on Kenasnow Island (now Killisnoo Island) south of Angoon, Alaska. This claim was designated "U.S. Survey No. 5," and was the first of the Alaska Special Surveys now commonly referred to as "U.S. Surveys." It was approved by Orville T. Porter, ex officio Surveyor General of Alaska in November 1892 and was accepted April 23, 1893.

Between April 11 and June 2, 1892, George W. Garside, Deputy Surveyor, surveyed the Juneau Townsite, designated included, such as  $\frac{1}{4}$  S 16 BT, not just  $\frac{1}{4}$  S BT as in the old practice.

The Act of July 24, 1897, 30 Stat. 215, provided for the appointment of a Surveyor General in the District of Alaska; William L. Distin was appointed and established his office at Sitka, November 5, 1897. Distin moved the office to Juneau in the fall of 1906 where it remained until abolished.

The Act of April 29, 1898, 30 Stat. 367, is known as the "Arkansas Compromise Act." Arkansas relinquished her claim to all of the remaining unclaimed swamp lands in that State.

The Act of May 14, 1898, 30 Stat. 409, extended the homestead law to Alaska but restricted the claims to 80 rods along navigable waters, with a shore space of 80 rods between claims; granted right-of-way to railroads; defined navigable waters and tidelands; and provided for 80-acre trade and manufacturing sites.

The following item was reported by the Surveyor General of North Dakota in his 1898 Annual Report:

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"August 8, 1898, at 7.30 p.m., fire broke out in the Northern Pacific Railway Company's freight house, and, owing to the character of the building and the wind prevailing at the time, the fire was beyond control in a very few minutes, and spread rapidly to the main business portion of the city. This office was situated on the third floor of the First National Bank building, and it was impossible to save but a small portion of the records."

Williams then went on to list the few records saved. Once again the Washington copies were called on to replace the burned records at considerable expense.

The Civil Appropriations Act of March 3, 1899, 30 Stat. 1074, restricted the USGS surveys in the Forest Reserves to the survey of the boundaries of those reserves. The survey of all regular township and section line surveys within the reserves was returned to the GLO. The act also provided for metes and bounds Homestead Entry Surveys (HES) in the Black Hills Reserve in South Dakota on lands classified as agricultural, a departure from the rectangular system. Actually, settlers had been taking up homesteads in the Black Hills under the Placer Mining Law.

By this act, the rectangular system of surveys was extended to the District of Alaska; none were made until 1905.

The Act of June 6, 1900, 31 Stat. 327, extended the mining laws of the United States to Alaska.

On January 1, 1902, the Manual of Surveying Instructions, 1902, was officially issued and was made part of all surveying contracts by the Act of April 26, 1902, 32 Stat. 120.

The Act of June 17, 1902, 32 Stat. 388, provided for the reclamation and irrigation of arid lands in the West. Under this act and amendments which followed, the Bureau of Reclamation was established in the Department of the Interior; eventually, it would execute some rectangular surveys and resurveys on lands under their authority. The first employees of the Reclamation Service were men from the hydrographic branch of the Geological Survey.

The Act of July 1, 1902, 32 Stat. 728 and January 10, 1903, 32 Stat. 767, authorized the resurvey of 25 townships in San Diego County, California, and 84 townships in Wyoming without requiring a petition by the settlers. Up to this time

the Congress had provided funds for resurveys in most of the appropriations acts. The resurveys were usually at the request of settlers who couldn't find the corners. Congress was generally moving toward the necessary legislation allowing resurveys. The resurveys provided for, when executed, were done almost as original surveys and caused much contention.

On January 26, 1903, Binger Hermann was removed from office and William A. Richards was appointed Commissioner of the GLO. Hermann was involved in timber land frauds in the West and it was alleged that he burned 43 letter books of correspondence before he left office; he was later elected Congressman from Oregon. On February 13, 1905, Hermann, Senator Mitchell from Oregon, and several other men were indicated on charges of land frauds involving 150,000 acres of timber lands in the Blue Mountain Forest Reserve in Oregon.

The Act of March 3, 1903, 32 Stat. 1028, enlarged homesteads in Alaska to 320 acres to be surveyed in a rectangular form if no rectangular system surveys existed near the homestead. There were no rectangular surveys at that time in Alaska.

The Act of February 1, 1905, 33 Stat. 628, transferred the Forest Reserves to the Department of Agriculture and established the bureau known as the Forest Service within that department. Thus, the GLO was the origin of the USGS. Bureau of Reclamation, and the Forest Service.

The Act of April 16, 1906, 34 Stat. 116, provided for Reclamation Townsites on lands administered by that Bureau.

On April 17, 1905, Alfred B. Lewis, Deputy Surveyor, under Contract No. 3 with the Surveyor General of Alaska, William L. Distin, set a stone monument on the north side of Stuck Mountain for the initial point of the Copper River Meridian. The point was near the Military Trail and telegraph lines which later became the Richardson Highway. Lewis then surveyed some 72 miles of the Copper River Meridian, 18 miles of the baseline, and the exterior boundaries of several townships. These surveys were approved by Distin on January 28, 1908, and the rectangular surveys were underway in Alaska. The first township subdivided in Alaska was T. 3 N., R. 1 W., Copper River Meridian, around the community of Copper Center in the Copper River Valley. That survey was made by Thomas A. Haigh, Deputy Survevor, in 1910. The returns were approved by Distin on April 11, 1912. These surveys were hard to contract for at the low prices allowed by law.

At 5:16 a.m., April 18, 1906, the great San Francisco earthquake hit that city, with a subsequent fire that burned for days. The Surveyor General's office and all his records, plats, maps, etc. were destroyed. The rectangular plats and field notes were once again replaced over several years from the Washington copies. Many of the mineral survey records were, however, destroyed forever. There were thousands of claims and most of their records were recovered through the claimants and land offices but, California still suffers many difficulties with mining claims because of the loss. The San Francisco fire was the last of the series, beginning with Symmes in Ohio. The GLO (and BLM) have never provided safe, fireproof storage for these vital records where the reliability of an original document versus a copy is so important. Ironically, many of the "Washington copies" are now

housed in a flammable wooden structure in Denver, Colora-

The Act of April 28, 1904, 33 Stat. 545, declared the corners of mineral surveys the best evidence of the true position of a mining claim. In other words, the mineral survey corners assumed the same legal status as the rectangular survey corners, they were unchangeable, and the Surveyor General had to honor them.

The Act of May 17, 1906, 34 Stat. 267, enabled Oklahoma, Arizona and New Mexico to become States. Oklahoma formed a government and was admitted to the Union on

November 16, 1907.

The Act of June 11, 1906, 34 Stat. 233, provided for Homestead Entry Surveys on agricultural lands within most of the Forest Reserves. The previous act had applied only to the Black Hills. Under this act the lands classified by the Forest Service as best suited for agriculture were surveyed by metes and bounds. These surveys were made by Forest Service surveyors under instructions from the Surveyors General and were approved by and filed in the GLO in about the same manner as any other survey. Homesteads in the Black Hills Reserve were denied riparian rights under an unusual provision, Sec. 3 of the act. This act was repealed October 23, 1962, 76 Stat. 1157.

On January 28, 1907, Richard A. Ballinger was appointed Commissioner of the GLO.

The Act of March 2, 1907, 34 Stat. 1232, directed the Surveyor General of Alaska to furnish survey numbers to the land offices at Nome and Fairbanks. The numbers were those used in the official surveys known as the "U.S. Surveys" of metes and bounds claims in that State.

On January 14, 1908, Fred Dennett was appointed Commissioner of the GLO and took charge in March. Ballinger became Secretary of the Interior.

The Civil Appropriations act of May 27, 1908, 35 Stat. 317, provided \$25,000 for the purchase of iron posts to be used to monument the corners of the public land surveys. Iron posts have been the standard monument ever since. The act also abolished the offices of Surveyor General in Minnesota, North Dakota, and Florida. Rates of up to \$25 per mile were allowed in the land surveys at that time.

The Act of March 3, 1909, 35 Stat. 845, is the "Resurvey Law." It provides by statute for the necessary resurveys of the public lands and is codified in 43 U.S.C. 772. Resurveys had been made for many years but this act authorized them whenever and wherever they were necessary to mark the boundaries of the remaining public lands.

The Civil Appropriations Act of March 4, 1909, 35 Stat. 945, abolished the Office of Surveyor General in Louisiana. The Act of June 20, 1910, 36 Stat. 557, again enabled Arizona and New Mexico to become States. New Mexico was admitted January 6, 1912, and Arizona on February 14, 1912. Both States received sections 2, 16, 32, and 36 in each township for school lands. The 48 contiguous States were completed.

The Civil Appropriations Act of June 25, 1910, 36 Stat. 703, provided that, "The surveys and resurveys to be made by such competent surveyors as the Secretary of the Interior may select, at such compensation not exceeding two hundred dollars per month as he may prescribe..." It was the end of the contract system of surveys begun by Rufus Putnam in 1797. The system had surveyed millions of acres of public lands by good, bad and indifferent surveyors. Most of the easy surveying had been done, so not even the Deputy Surveyors themselves were sorry to see the contract method go.

# THE PERIOD 1910 — 1946

As organized at the beginning of the direct system of sureying and resurveying the public lands, the GLO consisted six units:

1) Washington Headquarters Office (GLO and divisions therein)

Offices of the Surveyors General

3) District Land Offices

A Field Service

Surveying Service

ਰੀ Logging Service

The Commissioner of the GLO, the Assistant Commissionthe Surveyors General, and the Registers and Receivers of he district land offices were appointed by the President.

Surveyors General and their offices were located at neau, Alaska; Phoenix, Arizona; San Francisco, Californa; Denver, Colorado; Boise, Idaho; Helena, Montana; Reno, Ievada; Santa Fe, New Mexico; Portland, Oregon; Huron, Luth Dakota; Salt Lake City, Utah; Olympia, Washington; Il Cheyenne, Wyoming.

Division "E" in the Washington Headquarters office had peral supervision of all cadastral surveys on public lands, ardless of who managed those lands. All instructions for urveys issued in the field were examined and approved in Division "E."

The Civil Appropriations Act of March 4, 1911, 36 Stat. 53, permitted the Secretary of the Interior to appoint two upervisors of Surveys. Frank M. Johnson and Arthur D. der had already been appointed to those positions.

The Field Surveying Service was organized with Johnson s Supervisor of Surveys; his office was located in Denver, clorado. Kidder later became Associate Supervisor of Survey in Washington, D.C. Ten surveying districts were established with an Assistant Supervisor in charge of each district, scept the Eastern States District, which was under the sociate Supervisor. The Districts and their numbers were:

District 1 — Montana,

District 2 — Colorado and Wyoming

District 3 — South Dakota and Nebraska

District 4 — New Mexico

District 5 — Arizona and California

District 6 — Utah and Nevada

District 7 — Washington and Idaho

District 8 — Oregon

District 9 - Alaska

District 10 — Eastern States, at Washington, D.C.

(not numbered until 1918)

Under this organization, the technical direction of the ual field work was controlled by the Supervisor of Sursys, through the Associate and Assistant Supervisors. The ajor office work was done under the Surveyors General, o were under the Chief Clerk in Washington. They issued Special Instructions, prepared the plats and approved the eld returns prepared by the field surveyors; but the plats did become official until accepted by the Commissioner. The recyors General remained custodians of the survey recds and also received and disbursed monies deposited by ttlers for surveys and resurveys. This splitting of the re-

sponsibilities for the surveys ...as unsatisfactory at best, but continued for 15 years until the offices of Surveyor General were abolished in 1925.

The first cadre of surveyors was made up primarily of men who had been field examiners of the contract surveys and from the known reliable Deputy Surveyors who had proven themselves when executing their contracts. The titles given them were either "U.S. Surveyor" or "U.S. Transitman." They were selected very strictly on the basis of ability. All were government employees, paid a monthly salary, and provided with food and lodging (tents) when in the field. All instruments and equipment were furnished by the government, although like most surveyors, they had and used personally owned equipment as well.

The Surveyors General grouped the proposed field work together by type and classification; i.e., railroad, coal, and forest lands, settler's application (deposit) surveys, and resurveys. If the proposed work program was approved by Division "E," the Surveyor General prepared Special Instructions under a Group Number. A "group" might be a few miles of a special type of survey, but most often was for the survey or resurvey of a township or group of townships. The township was the usual unit used. The Special Instructions were approved in either Division "E," or if more expedient, by a Supervisor. The work would then be assigned to a U.S. Surveyor or U.S. Transitman for execution in the field. Assignment instructions were issued by the appropriate Assistant Supervisor of Surveys. The surveyor assigned would hire his field assistants, gather his camp and surveying equipment and head for the field.

At first, some of the Examiners of Surveys remained on that duty until all of the outstanding contracts were completed, examined, and approved. These men then became U.S. Surveyors or Assistant Supervisors. In the early years of the direct system, while the organization was being perfected, the field surveyors were placed in the field and moved around by the Supervisor of Surveys. A set amount of time was allowed for preparing field returns and in effect the field surveyors were per-diem employees, furloughed between jobs. The system was gradually refined and later the surveyors were assigned to a district and worked within that state or states as the responsibility of the Assistant Supervisors increased. Surveyors could not transfer from one district to another without the approval of the Supervisor of Surveys.

Annual Instructions were issued on July 20, 1910, outlining in detail the procedures to be used in hiring surveyors, procurement, and use of equipment, duties of responsible persons, and other details of expending the appropriation for surveying. The surveyors Weekly Progress Report was installed and is still used in only slightly modified form. The Standard Field Tables and The Ephemeris (of the sun and selected stars) were issued in 1910 and are still being supplied to all BLM surveyors.

The changeover to the direct system was apparently a rather smooth operation and had been in the planning and preparation stage for more than a year. Much of its early success was due to the superb organizational ability of the Supervisor of Surveys, Frank M. Johnson, and his selection of able Assistant Supervisors.

After field work was completed on a group, the surveyor

(This copy of the "Oregon Manual" is taken from an original volume now in the possession of the National Archives.)

# INSTRUCTIONS TO THE SURVEYOR GENERAL OF OREGON; BEING A MANUAL FOR FIELD OPERATIONS.

WASHINGTON: GIDEON AND CO., PRINTERS. 1851. from these rules in respect to the "pits," the course and distance to each is to be stated in the Field Books.

Perpetuity in the mound is a great desideratum. In forming it with light alluvial soil the surveyor may find it necessary to make due allowance for the future settling of the earth, and thus making the mound more elevated than would be necessary in a more compact and tenacious soil, and increasing the base of it. In so doing, the relative proportions between the township mound and other mounds is to be preserved as nearly as may be.

The earth is to be pressed down with the shovel during the process of piling it up. Mounds are to be *covered* with sod, grass side up, where sod is to be had; but, in forming a mound, sod is never to be wrought up with the earth, because sod decays, and in the process of decomposing it will cause the mound to become porous, and therefore liable to premature destruction.

#### POSTS IN MOUNDS

Must be squared, and show above the top of the mound some ten or twelve inches, and if the mound be a township or section corner common to *four* townships, or common to *four* sections, or if the same be a corner common to *two* townships or to *two* sections, the post therein must be planted, marked, and notched, in mode and manner prescribed for ordinary *posts* in similar situations.

In quarter section mounds the posts will bear the designation  $\frac{1}{4}$  S.

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# MOUND MEMORIALS.

Beside the charcoal, stone, or charred stake, one or the other of which must be lodged in the earth at the point of the corner, the deputy surveyor is specially enjoined to plant midway between each pit and the trench, seeds of some tree, (those of fruit trees adapted to the climate being always to be preferred,) so that, in course of time, should such take root, a small clump of trees may possibly hereafter note the place of the corner. The facts of planting such seed, and the kind thereof, are matters to be truthfully noted in the Field Book.

# WITNESS MOUNDS TO TOWNSHIP OR SECTION CORNERS.

If a township or section corner, in a situation where bearing or witness trees are not found within a reasonable distance therefrom, shall fall within a ravine, or in any other situation where the nature of the ground, or the circumstances of its locality, shall be such as may prevent, or prove unfavorable to, the erection of a mound, you will perpetuate such corner by selecting, in the immediate vicinity thereof, a suitable plot of ground as a site for a bearing or witness mound and erect thereon, a mound of earth in the same manner and conditioned in every respect, with charcoal, stone, or charred stake, deposited beneath, as before directed; and measure and state, in your Field Book, the distance and course from the position of the true corner of the bearing or witness mound so plased and erected.

#### DOUBLE CORNERS ON STANDARD PARALLELS.

One being called "Standard Corners" and the others "Closing Corners."

Such corners are to be found nowhere except on the Standard Parallels or Corrrection lines, whereon are to appear both the corners which mark the intersections of the lines which close thereon, and those from which the surveys start in the opposite direction. Those lines are to be parallels to the principal base line, and therefore parallels of latitude. On those lines, and at the time of running the same, the township, mile, and half-mile, corners are to be planted, and each of these is a corner common to two, [whether township or section corners,] and must be so marked. [As remarked under the proper head, the quarter sectional corner is to be a flattened post protruding two feet from the surface with no other mark than ½ S.]

The corners which are established on the standard parallel, at the time of running it, are to be known as "Standard Corners," and, in addition to all the ordinary marks, (as herein prescribed,) they will be marked with the letters S. C.

The standard parallels are designed to be run in advance of the contiguous surveys, but circumstances may exist which will impede, or temporarily delay, the due extension of the standard; and when, from uncontrollable causes, the contiguous townships must be surveyed in advance of the time of extending the standard, in any such event, it will become the duty of the deputy who shall afterwards survey any such standard

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lying north of the principal base line, to plant thereon the double sett of corners, to wit, the standard corners to be marked S. C., and the closing ones which are to be marked C. C.; and to make such measurements as may be necessary to connect the closing corners, and complete the unfinished meridional lines of such contiguous and prior surveys, on the principles herein set forth, under the different heads of "Exterior or Township Lines," and "Description of the mode of laying off and surveying Interior or Section Lines."

You will recollect that the corners, (whether township or mile corners,) which are common to two, (two townships, or two sections,) are not to be planted diagonally like those which are common to four, but with the flat sides facing the cardinal points, and on which the marks and notches are made as usual. This, it will be perceived, will serve yet more fully to distinguish the standard parallels from all other lines

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#### THE MEANDERING OF NAVIGABLE STREAMS.

1. Standing with the face looking down stream, the bank on the *left* hand is termed the "left bank," and that on the *right* hand the "right bank." These terms are to be universally used to distinguish the two banks of a river or stream.

2. Both banks of navigable rivers are to medered by taking the courses and distances of their sinussities, and the same are to be entered in the "meander field book."

At those points where either the township or section lines intersect the banks of a navigable stream, POSTS, or, where necessary, MOUNDS of earth or stone, are to be established at the time of running these lines. These are called "meander orners;" and in meandering you are to commence at one of those corners on the township line, coursing the banks, and measuring the distance of each course from your commencing orner to the next "meander corner," upon the same or nother boundary of the same township; carefully noting your intersection with all intermediate meander corners. By the same method you are to meander the opposite bank of the ame river.

When establishing the MEANDER CORNERS on one

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tank of a navigable stream, sight must be taken across to letermine the precise spot for planting corresponding corners in line, on the opposite bank thereof; and such spot must be signalized by a substantial, temporary STAKE, square across top; and whenever, at any subsequent period, the surveyor hall meander the opposite bank of such stream, a permanent POST or MOUND, as already prescribed, will then and there le planted, in lieu of such temporary stake.

When surveying to the river, in the opposite fraction of same township, such pre-established meander corner must be reached by first running a random line thereunto, ascertaining the amount of its deviation from the corner, and correct-

the accordingly.

The crossing distance between the MEANDER CORNERS, in same line, is to be ascertained by triangulation, in order that the river may be protracted with entire accuracy. The particulars to be given in the field notes.

3. You are also to meander, in manner aforesaid, all lakes and deep ponds of the area of twenty-five acres and upwards; also navigable bayous; shallow ponds, readily to be drained.

or likely to dry up, are not to be meandered.

You will notice all streams of water falling into the river, rake, or bayou you are surveying, stating the width of the same at their mouth; also all springs, noting the size thereof and depth, and whether the water be pure or mineral; also the lead and mouth of all bayous; and all islands, rapids, and bars are to be noticed, with intersections to their upper and wer points to establish their exact situation. You will also

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bte the elevation of the banks of rivers and streams, the neights of falls and cascades, and the length of rapids.

4. The precise relative position of islands, in a township ade fractional by the river in which the same are situated, to be determined trigonometrically—sighting to a flag or other fixed object on the island, from a special and carefully leasured base line, connected with the surveyed lines, on or ear the river bank you are to form connexion between the neander corners on the river to points corresponding thereto, and direct line, on the bank of the island, and there establish

the proper meander corners, and calculate the distance across.

- 5. In meandering lakes, ponds, or bayous, you are to commence at a meander corner upon the township line, and proceed as above directed for the banks of a navigable stream. But where a lake, pond, or bayou lies entirely within the township boundaries, you will commence at a meander corner established in subdividing, and from thence take the course and distance of the entire margin of the stream, noting the intersection with all the meander corners previously established thereon.
- 6. To meander a pond lying entirely within the boundaries of a section, you will run and measure two lines thereunto from the nearest section or quarter section corner on opposite sides of such pond, giving the courses of such lines. At each of the points where such lines shall intersect the margin of such pond, you will establish a witness point, by fixing a post in the ground, and

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raising a mound around it, and taking bearings to any adjacent trees. The relative position of these points being thus definitely fixed in the section, the meandering will commence at one of them, and be continued to the other, noting the intersection, and thence to the beginning. The proceedings are to be fully entered in the field book.

- 7. In taking the connexion of an island with the main land, when there is no meander corner in line, opposite thereto, to sight from, you will measure a special base from the meander corner nearest to such island, and from such base you will triangulate to some fixed point on the shore of the island, ascertain the distance across, and there establish a special meander corner, wherefrom you will commence to meander the island. When surveying on the opposite side of such river, you will there take another connexion with the island, but no corner need be planted.
- 8. Your field notes of meanders in any one township are to follow immediately after the notes of the subdivision thereof. They are to state and describe particularly the meander corner from which they commenced, each one with which they close, and are to exhibit the meanders of each fractional section separately; following, and composing a part of such notes, will be given a description of the land, timber, depth of inundation to which the bottom is subject, and the banks, current, and bottom of the stream or body of water you are meandering.
- 9. No blazes or marks of any description are to be made on the lines meandered beteen the established

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corners, but the utmost care must be taken to pass no object of topography, or *change therein*, without giving a particular description thereof in its proper place in your meander notes.

OF FIELD BOOKS.

(This copy of the 1855 manual is taken from ... original volume now in the possession of the National Archives.)

# INSTRUCTIONS TO THE SURVEYORS GENERAL OF PUBLIC LANDS OF THE UNITED STATES, FOR THOSE SURVEYING DISTRICTS ESTABLISHED IN AND SINCE THE YEAR 1850; CONTAINING, ALSO, A MANUAL OF INSTRUCTIONS TO REGULATE THE FIELD OPERATIONS OF DEPUTY SURVEYORS, ILLUSTRATED BY DIAGRAMS.

PRESCRIBED, ACCORDING TO LAW, BY THE PRINCIPAL CLERK OF SURVEYS, PURSUANT TO ORDER OF THE COMMISSIONER OF THE GENERAL LAND OFFICE.

WASHINGTON: A. O. P. NICHOLSON, PUBLIC PRINTER. 1855.

#### DOUBLE CORNERS.

Such corners are to be nowhere except on the base and standard lines, whereon are to appear both the corners which mark the intersections of the lines which close thereon, and those from which the surveys start on the north. On these lines, and at the time of running the same, the township, section, and quarter section corners are to be planted, and each of these is a corner commmon to two, (whether township or section corners,) on the north side of the line, and must be so marked.

The corners which are established on the standard parallel, at the time of running it, are to be known as "standard corners," and, in addition to all the ordinary marks, (as herein prescribed,) they will be marked with the letters S. C. Closing corners will be marked with the letters C. C. in addition to other marks.

The standard parallels are designed to be run in advance of the contiguous surveys on the south of them, but circumtances may exist which will impede or temporarily delay the due extension of the standard; and when, from uncontrollable causes, the contiguous townships must be surveyed in advance of the time of extending the standard, in any such event it will become the duty of the deputy who shall afterwards survey any such standard to plant thereon the double set of corners, to wit, the standard corners, to be marked S. C., and the closing ones which are to be marked C. C.; and to make such measurements as may be necessary to connect the closing corners and complete the unfinished meridianal lines of such contiguous and prior surveys, on the principles herein set forth, under the different heads of "exterior or township lines," and of "diagram B."

You will recollect that the corners, (whether township or section corners,) which are common to two, (two townships or two sections,) are not to be planted diagonally like those which are common to four, but with the flat sides facing the ardinal points, and on which the marks and notches are made as usual. This, it will be perceived, will serve yet more fully to distinguish the standard parallels from all other lines.

# THE MEANDERING OF NAVIGABLE STREAMS.

1. Standing with the face looking down stream, the bank in the left hand is termed the "left bank," and that on the right hand the "right bank." These terms are to be universally used to distinguish the two banks of a river or stream.

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2. Both banks of *navigable* rivers are to be meandered by taking the courses and distances of their sinuosities, and the same are to be entered in the field book.

At those points where either the township or section lines intersect the banks of a navigable stream, POSTS, or, where necessary, MOUNDS of *earth* or *stone*, are to be established at the time of running these lines. These are called "meander

corners;" and in meandering you are to commence at one of those corners on the township line, coursing the banks, and measuring the distance of each course from your commencing corner to the next "meander corner," upon the same or another boundary of the same township, carefully noting your intersection with all intermediate meander corners. By the same method you are to meander the opposite bank of the same river.

The crossing distance between the MEANDER CORNERS on same line is to be ascertained by triangulation, in order that the river may be protracted with entire accuracy. The particulars to be given in the field notes.

3. You are also to meander, in manner aforesaid, all *lakes* and deep ponds of the area of twenty-five acres and upwards; also navigable bayous; *shallow* ponds, readily to be drained, or likely to dry up, are not to be meandered.

You will notice all streams of water falling into the river, lake, or bayou you are surveying, stating the width of the same at their mouth; also all springs, noting the size thereof and depth, and whether the water be pure or mineral; also the head and mouth of all bayous; and all islands, rapids, and bars are to be noticed, with intersections to their upper and lower points to establish their exact situation. You will also note the elevation of the banks of rivers and streams, the heights of falls and cascades, and the length of rapids.

- 4. The precise relative position of islands, in a township made fractional by the river in which the same are situated, is to be determined trigonometrically—sighting to a flag or other fixed object on the island, from a special and carefully measured base line, connected with the surveyed lines, on or near the river bank, you are to form connexion between the meander corners on the river to points corresponding thereto, in direct line, on the bank of the island, and there establish the proper meander corners, and calculate the distance across.
- 5. In meandering lakes, ponds, or bayous, you are to commence at a meander corner upon the township line, and proceed as above directed for the banks of a navigable stream. But where a lake, pond, or bayou

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lies entirely within the township boundaries, you will commence at a meander corner established in subdividing, and from thence take the courses and distances of the entire margin of the same, noting the intersection with all the meander corners previously established thereon.

6. To meander a pond lying entirely within the boundaries of a section, you will run and measure two lines thereunto from the nearest section or quarter section corner on opposite sides of such pond, giving the courses of such lines. At each of the points where such lines shall intersect the margin of such pond, you will establish a witness point, by fixing a post in the ground, and taking bearings to any adjacent trees, or, if necessary, raising a mound.

The relative position of these points being thus definitely fixed in the section, the meandering will commence at one of them, and be continued to the other, noting the intersection, and thence to the beginning. The proceedings are to be fully entered in the field book.

In taking the connexion of an island with the main land,

when there is no meander corner in line, opposite thereto, to sight from, you will measure a special base from a meander corner nearest to such island, and from such base you will triangulate to some fixed point on the shore of the island, ascertain the distance across, and there establish a special meander corner, wherefrom you will commence to meander the island.

The field notes of meanders will be set forth in the body of the field book according to the dates when the work is performed, as illustrated in the specimen notes annexed. They are to state and describe particularly the meander corner from which they commenced, each one with which they close, and are to exhibit the meanders of each fractional section separately; following, and composing a part of such notes, will be given a description of the land, timber, depth of inundation to which the bottom is subject, and the banks, current, and bottom of the stream or body of water you are meandering.

9. No blazes or marks of any description are to be made on the lines meandered between the established corners, but the utmost care must be taken to pass no object of topography, or change therein, without giving a particular description thereof in its proper place in your meander notes.

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# OF FIELD BOOKS.

The FIELD NOTES afford the elements from which the plats and calculations in relation to the public surveys are made. They are the source wherefrom the description and evidence of locations and boundaries are officially delineated and set forth. They therefore must be a faithful, distinct and minute record of every thing officially done and observed by the surveyor and his assistants, pursuant to instructions, in relation to running, measuring, and marking lines, establishing boundary corners, &c.; and present, as far as possible, a full and complete topographical description of the country surveyed, as to every matter of useful information, or likely to gratify public curiosity.

There will be sundry separate and distinct field books of surveys, as follows:

Field notes of the MERIDIAN and BASE lines, showing the establishment of the township, section or mile, and quarter section or half mile, boundary corners thereon; with the crossings of streams, ravines, hills, and mountains; character of soil, timber, minerals, &c.

Field notes of the "STANDARD PARALLELS, or correction lines," will show the establishment of the township, section, and quarter section corners, besides exhibiting the topography of the country on line, as required on the base and meridian lines.

Field notes of the EXTERIOR lines of TOWNSHIPS, showing the establishment of corners on lines, and the topography, as aforesaid.

Field notes of the SUBDIVISIONS OF TOWNSHIPS, into sections and quarter sections.

The field notes must in all cases be taken precisely in the order in which the work is done on the ground, and the date of each day's work must follow immediately after the notes

thereof. The variation of the needle must always occupy a separate line preceding to lotes of measurements on line.

The exhibition of every mile of surveying, whether on township or subdivisional lines, must be *complete in itself*, and be separated by a black line drawn across the paper.

The description of the surface, soil, minerals, timber, undergrowth, &c., on each mile of line is to follow the notes of survey of such line, and not be mixed up with them.

No abbreviations of words are allowable, except of such words as are constantly occurring, such as "sec." for "section;" "in. diam," for

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"inches diameter;" "chs." for "chains;" "lks." for "links;" "dist." for "distant," &c. Proper names must never be abbreviated, however often their recurrence.

The nature of the subject-matter of the field book is to form its title page, showing the State or Territory where such survey lies, by whom surveyed, and the dates of commencement and completion of the work. The second page is to contain the names and duties of assistants. Whenever a new assistant is employed, or the duties of any one of them are changed, such facts, with the reasons therefor, are to be stated in an appropriate entry immediately preceding the notes taken under such changed arrangements. With the notes of the exterior lines of townships, the deputy is to submit a plat of the lines run, on a scale of two inches to the mile. on which are to be noted all the objects of topography on line necessary to illustrate the notes, viz: the distances on line at the crossings of streams, so far as such can be noted on the paper, and the direction of each by an arrow-head pointing down stream; also the intersection of line by prairies, marshes, swamps, ravines, ponds, lakes, hills, mountains, and all other matters indicated by the notes, to the fullest extent practicable.

With the instructions for making subdivisional surveys of townships into sections, the deputy will be furnished by the Surveyor General with a diagram of the exterior lines of the townships to be subdivided, (on the above named scale,) upon which are carefully to be laid down the measurements of each of the section lines on such boundaries whereon he is to close, the magnetic variation of each mile, and the particular description of each corner. P. in M. signifies post in mound. And on such diagram the deputy who subdivides will make appropriate sketches of the various objects of topography as they occur on his lines, so as to exhibit not only the points on line at which the same occur, but also the direction and position of each between the lines, or within each section, so that every object of topography may be properly completed or connected in the showing.

These notes must be distinctly written out, in language precise and clear, and their figures, letters, words, and meaning are always to be unmistakable. No leaf is to be cut or mutilated, and none to be taken out, whereby suspicion might be created that the missing leaf contained matter which the deputy believed it to be his interest to conceal.

#### XXXIII.

(This Instructions Circular is copied from an original document now in the possession of the National Archives. It was reprinted in 1871 with only the printing style changed and Roman numerals used in paragraphing in place of Arabic numerals.)

# INSTRUCTIONS TO THE SURVEYORS GENERAL OF THE UNITED STATES, RELATING TO THEIR DUTIES AND TO THE FIELD OPERATIONS OF DEPUTY SURVEYORS.

PRESCRIBED, ACCORDING TO LAW, BY THE COMMISSIONER OF THE GENERAL LAND OFFICE.

WASHINGTON: GOVERNMENT PRINTING OFFICE. 1864. notice is received from this office that the a ropriations have been made. You will be promptly notific by mail or telegraph, as circumstances may determine, when the appropriations are passed, and no surveying chargeable to such appropriations must be done before receiving this notice.

# 4. CONTRACTS MUST BE APPROVED BY THE COMMISSIONER.

The first section of the act of May 30, 1862, provides that contracts for the survey of the public lands shall not become binding upon the United States until approved by the Commissioner of the General Land Office, except in such cases as the Commissioner shall otherwise especially order.

# 5. REVENUE STAMPS TO BE ATTACHED TO CONTRACTS AND BONDS.

The requirements of the internal revenue law make it necessary that five *separate stamps* be attached to the several parts of every contract and of a deputy surveyor, to wit:

1. To the *contract*, five-cent stamp; 2. To the *affidavit* of the deputy surveyor, five cents; 3. To the *bond*, fifty cents; 4. To the *certificate* as to the sufficiency of the bond, ten cents; 5. To the *oath* of allegiance, five cents.

Surveyors general are reminded that the sufficiency of the sureties to the bonds of deputy surveyors must be certified BY THE PROPER OFFICER OF A COURT HAVING A SEAL.

# 6. WHEN DESIRED BY SETTLERS, SURVEYS MAY BE MADE BY THE SURVEYOR GENERAL AT THEIR EXPENSE IN CERTAIN CASES.

By section 10 of an act entitled "An act to reduce the expenses of the survey and sale of the public lands in the United States," approved May 30, 1862, it is provided, "That when the settlers in any township or townships, not mineral or reserved by Government, shall desire a survey made of the same under the authority of the surveyor general of the United States, and shall file an application therefor in writing, and deposit in a proper United States depository, to the credit of the United States, a sum sufficient to pay for such survey, together with all expenses incident thereto, without cost or claim for indemnity on the United States, it shall and may be lawful for said surveyor general, under such instructions as may be given him by the Commissioner of the General Land Office, and in accordance with existing laws and instructions, to survey such township or townships, and make return thereof to the general and proper local land office: Provided, The townships so proposed to be surveyed

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are within the range of the regular progess of the public surveys embraced by existing standard lines or bases for the township and subdivisional surveys."—(Sec. 10, p. 410, vol. 12, U. S. Laws.)

Applications for surveys under this law must be made to the surveyor general in writing, upon the receipt of which he will furnish the applicant with an estimate of how much the desired survey will cost. receiving a certificate of deposit of a United States deposit...y, showing that the required sum has been deposited with him in a proper manner to pay for the work, you will contract with a competent United States deputy surveyor, and have the survey made and returned in the same manner as other public surveys are.

You are especially enjoined in all cases to state explicitly in your letters furnishing estimates to applicants, that the payment of the amount required for the survey will not give the depositor any priority of claim or right to purchase the land, or in any manner affect the claim or claims of any party or parties thereto; and that, when surveyed, it will be subject to the same general laws and regulations in relation to the disposition thereof as other public lands are.

The money should be deposited to the credit of the Treasurer of the United States on account of the proper appropriations. A separate estimate is required and a separate deposit must be made for office work and field work; one to be placed to the credit of the appropriation "for compensation of the surveyor general and the clerks in his office," and the other to the credit of the appropriation "for continuing the public surveys." The depositary will issue certificates in triplicate, one of which will be transmitted to this office with the contract and bond of the deputy surveyor.

The account will be adjusted and paid in the same manner as other surveying accounts. Should the amount deposited exceed the cost of survey and all expenses incident thereto, including office work, an account setting forth the fact of such excess may be rendered by the depositor, certified by the surveyor general, and transmitted to this office with the final surveying returns, to be reported for payment.

Where a township is surveyed under the provisions of the aforesaid act, the survey must include all the *surveyable* public land in such township.

# 7. SMALL ISLANDS MAY BE SURVEYED AT THE COST OF APPLICANTS.

Many applications are received at this office for the purchase of small unsurveyed islands which were omitted when the adjacent lands were surveyed. These islands are usually of too little value to justify the Government in incurring the expense of survey; but where a party desires the survey made and is willing to pay the cost thereof in advance, upon the conditions set forth in these instructions, it may be done under the provisions of the tenth section of the act of May 30, 1862.

The party desiring the survey to be made must file a written application with the surveyor general, giving an intelligible description of the locality of the island, its distance from the main shore, the width

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of the narrowest channel between it and the main land, with an estimate of its area.

Upon receiving such application, made in the manner indicated, you will examine the records and data in your office, and if it appears that the island is public land and has not already been surveyed, you will furnish the applicant an estimate of the cost of surveying it, as directed under the

sixth head in these instructions, stating explicitly that the depositing of the money will not in any manner affect the rights of parties in said lands, nor give any priority of claim to the depositor.

You will observe particularly that two separate deposits are to be made—one on account of the appropriation for field work, and one on account of the appropriation for office work—a separate certificate for each to be transmitted to this office with the contract and bond of the deputy surveyor.

It will be understood that these instructions relate only to isolated islands, or islands that were omitted when the public surveys were extended over the adjacent lands, and do not apply to islands falling within the regular course of current surveys, which must be included in the contracts for surveying the public lands.

As a general rule, a body of land separated from the main land by a *perpetual* natural channel may be regarded as an island for the purposes contemplated in these instructions.

#### 8. SURVEY OF SWAMP LANDS.

Contracts with deputy surveyors must of course embrace any "swamp and overflowed" lands which, in alluvial regions, are intermingled with the arable or fast lands. Over all such lands the lines of the public surveys must be extended, as the selections in such cases are made according to the character of the smallest legal subdivision. If the greater part of such subdivision is "swamp and overflowed," it goes to the swamp grant; if otherwise, it is excluded from such grant, and is retained by the Government.

In the survey of all lands of this mixed character, the deputies must be charged to give in their field notes a specific and full description of the land, indicating the causes of its being unfit for cultivation in its natural condition, with the character of the timber, shrubs, or plants growing on the tract, and the contiguity of the premises to rivers, water-courses, or lakes, naming them respectively. The swamp grant does not embrace tracts in which the inundation is casual, but only those where the overflow would totally destroy crops and prevent the raising of the same without artificial means, such as levees, draining, &c. The essentiality must be obvious to you of the requirement of full data in these respects, in order to enable the Department properly to adjust swamp and other interests.

Where the State authorities desire to have swamp lands surveyed at their expense, the same may be done in accordance with instructions on page 5 for surveys under the provisions of the tenth section of the act of May 30, 1862; but all applications for separate surveys

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of swamp lands must be submitted to this office, with a full report and a diagram illustrating the locality, and the approval of the Commissioner first obtained.

# 9. CERTAIN RIVERS TO BE MEANDERED ON ONE BANK ONLY.

Rivers not embraced in the class denominated "navigable"under the statute, but which are well-defined natural arteries of internal communication, and have a uniform width, will only be meandered on one bank. For the sake of uniformity, the surveyor will traverse the right bank when not impracticable; but where serious obstacles are met with, rendering it difficult to course along the right bank, he may cross to the left bank and continue the meanders as far as necessary; but all changes from one bank to the other will be made at the point of intersection of some line of the public surveys with the stream being meandered.

The subdividing deputies will be required to establish meander corners on both banks of such meanderable streams at the intersection of all section lines, and the distances across the river will be noted in the field book.

In meandering water-courses, where a distance is more than ten chains between stations, even chains only should be taken; but if the distance is less than ten chains, and it is found convenient to employ chains and links, the number of links should be a multiple of ten, thereby saving time and labor in testing the closings both in the field and in the surveyor general's office.

# 10. WHAT LAKES ARE NOT TO BE MEANDERED.

Paragraph numbered three, on page 13 of the Manual, in regard to the meandering of lakes, &c., is modified as follows:

Lakes embracing an area of less than forty acres will not be meandered. Long, narrow or irregular lakes of larger extent, but which embrace less than one-half of the smallest legal subdivision, will not be meandered. Shallow lakes or bayous, likely in time to dry up or be greatly reduced by evaporation, drainage, or other cause, will not be meandered, however extensive they may be.

Deputy surveyors will be allowed pay for the distance across lakes or ponds not meandered, where they are required to continue the lines of the public surveys across them; but no offsets or lines run in triangulating will be paid for.

Where the distance across a lake or other body of water is ascertained by offsetting, it is not enough to say in the field notes "8.65 over lake and set a meander corner," but the *mode* by which the distance is ascertained must be stated and described in full.

Posts will be established by the subdividing deputy at the intersections of all the public lines with these lakes the same as if they were to be meandered.

# 11. CORNER POSTS AND CORNER STONES.

In loose or alluvial soil, section, quarter-section, or meander posts may be driven into the ground, instead of digging holes and planting

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them as required in the Manual; but no posts will be so driven unless, from the character of the soil, they will thereby be rendered more firm and enduring.

All corner stones fourteen inches long, or more, and less than eighteen inches in length, should be set two-thirds of their length in the ground; if more than eighteen inches long, they should be set three-quarters of their length in the ground.

# XXXVI.

(This Circular is copied from the original, Microcopy No. 27, National Archives. A copy of it was sent to all Surveyors General.)

CIRCULAR.

# Department of the Interior

# GENERAL LAND OFFICE,

Washington, D. C., July 13, 1874:

As inquiries arise in regard to the survey of the beds of meandered lakes or other similar bodies of water in districts where the office of Surveyor General has been discontinued, the following is communicated as defining the conditions under which such lake beds are regarded as surveyable, and as giving the proper mode of proceeding to have the same surveyed and to obtain title thereto:

The beds of lakes, (not navigable,) sloughs, and ponds over which the lines of the public surveys were not extended at the date of the original survey, but which from the presence of water at the date of such survey were meandered, are held to be the property of the United States; and whenever, by evaporation or the operation of any other cause, natural or artificial, the waters of such lake, slough, or pond have so permanently receded or dried up as to leave within the unsurveyed area dry land fit, in ordinary seasons, for agricultural purposes, such dry land is subject to survey and sale under the general laws regulating the disposal of the public domain.

Such surveys will be ordered and, upon approval, disposition proceeded with in the following cases:

1st. Where the waters have so far permanently receded or disappeared as to permit, during the ordinary surveying season, (not on the ice,) the actual extension of the lines of survey, and the establishment and marking of corners in the manner required by law, over the whole area of the bed of such former lake.

2d. Where the waters have not generally disappeared, but where they have so far permanently receded as to leave a margin of dry land fit for cultivation between the original meandered lines and the remaining waters of sufficient area to admit of the survey and of the estabishment of at least three of the corners of a quarter-section.

3d. The Commissioner of the General Land Office will consider the question of ordering a survey of margins not admitting the laying off of one hundred and sixty acres, but not less than forty acres.

Parties desiring the survey of such lands may make application in writing to the Commissioner of the General Land Office therefor, stating the approximate area, and the situation of the tract with reference to the section, township, and range of the public surveys, the same to be illustrated by a diagram; the fact that the waters have disappeared in the manner or to the extent as specified in one of the three several above-specified cases—such statement to be accompanied

with the affidavit of at least two credible and disinterested witnesses as to the disappearance of the waters, the probable quantity of land capable of being surveyed in the whole area lying between the original meandered line and the then margin of the waters, and showing what proportion of such area is fit for agricultural purposes. To insure prompt attention and decision by this Office, both the statement and affidavits required must be full and specific.

If, upon examination of such statement, diagram, and proof, it is found that such survey my be properly allowed, the parties applying will be so notified, and upon their designating to this Office the name and residence of some competent and reliable surveyor, together with a statement from him in writing of the amount for which he is willing to execute the field-work of the survey, and a certificate of some United States depositary that the amount specified has been deposited to the credit of the United States "on account of individual depositors," the Commissioner will then issue the necessary instructions to the surveyor to enable him to execute the field-work of survey in accordance with the public land system.

To correct what seems to be a very general misapprehension as to the manner in which persons may proceed to perfect title who have made actual settlement on lands of the character herein designated, and who claim or propose to claim under the pre-emption laws of the United States, it is remarked that in no event and at no stage of the proceedings can their declaratory statements be received or filed in this Office. Such declaratory statements must be filed in the local land office, and cannot be there received until after such survey has been made and the approved plat thereof filed in the local office.

It is proper to further state that the fact of having borne the expense of survey will give no priority of claim or right, under existing laws, to purchase the land, or in any manner affect the vested interest of any party thereto, should such exist, as the land, when surveyed, will be subject to disposal according to the laws of Congress and the regulations of this Office relative to the disposal of lands embraced in fragmentary surveys.

In case the lake bed is small and is so situated that no township, section, or quarter-section corners will need to be established by reason of such lake being situated within a given section or sections fully surveyed, no deposit will be required; and upon proof being furnished this Office as above of the disappearance of the water, the premises will be platted, and the land can then be disposed of under the existing laws.

Respectully,
S. S. BURDETT,
Commissioner



BARNEY, JAMES M.
MANUSCRIPTS.

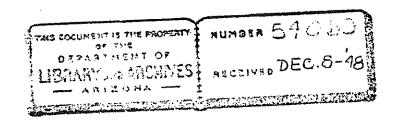
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The settlement of the Salt River Valley.

In the southern part of old Yavapai County, nearing the junction of the Gila and Salt Rivers, long years ago, there burst upon the view of the traveller, as he went south along the stage road from Prescott to Tucson, the beautiful Salt River Valley. This great valley, spreading away to the East, furnished, at that time, a striking panorama of desert beauty, carpeted, as it was, with an almost unbroken stretch of desert growth — low branching mesquites; gnarly palo-verdes; scraggy bushes of aromatic grease wood; clusters of gray sagebrush; cacti of various kinds, while, in every clearing, a rank growth of wild 'galleta' grass waved and tossed with every passing breeze.

The Salt River, a clear, glassy stream -- now overshadowed by dropping willows of stately cottonwoods, now open to the gleam of the sunlight -- wound its tortuous course through the centre of this valley. On a calm clear day in the springtime it was, indeed, a splendid sight -- at once quiet and full of peace.

In the year 1867 all this was changed. Then, for the first time, the white man came to settle within the borders of the valley and broke its entrancing solitude with the sound of his toil; then, for the first time, the rude ploughshare — that harbinger of civilization — was thrust into its historic soil, rich in the ruins and relics of a departed race, whose fate and legends seem forever locked within its safe embrace; then canals were built and lands cleared of their desert growth; then the wilderness f primitive beauty gave way to a landscape of waving fields of grain and corn while the rude abodes of these early tillers of the soil commenced to rise here and there.

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Before this reclamation of the valley, however, there had existed for several years a number of flourishing white settlements in the southern portion of Yavapai County, which then extended to the Gila River on the south.

A primitive settlement which was later called Wickenburg had been started on the west bank of the Hassayampa in 1863, by Henry Wickenburg, the discoverer of the now famous Vulture Mine, while Camp McDowell, on the west bank of the Verde, had been established by troops of the California Volunteers in the year 1865.

Between these two enterprising communities and a little to the south, and right in the very heart of the populated section of Arizona, laid this sunny and salubrious Valley of Salt River.

This valley was no little dell or tiny spot of green surrounded by rugged mountains, but a vast stretch of almost level plain measuring over fifty miles in length from east to west, with an average width of fifteen miles, and containing approximately an area of seven hundred and fifty square miles, or four hundred and eighty thousand acres of cultivable land.

Doubtless the first Americans to traverse this section were trappers and Indian traders who, commencing about 1830, were in the habit of coming down the Gila River, and working their way up its several tributaries, of which the Salt River has always been a principal one.

About 1850 these pioneer pathfinders were followed by government explorers who began to lead well fitted expeditions throughout this portion of the national domain, then a vast region of unknown worth.

agage in the wine business.

A man by the name of Cook, f. m Prescott, started the f. ;t ctograph gallery, while C. R. Heyne was the first assayer.

Among other early business establishments in Phoenix was blacksmith shop of Ford & Ware, with a carriage making annex n connection, and the carpenter shop of Pearson & Barber, which rned out excellent work.

The Weekly Arizona Miner, of Prescott, was for many years, le official publication of Maricopa County. It had been established in 1864, and when Maricopa County was created, was wred by John H. Marion, an able and fearless writer, and the cal agents were at first, Jack W. Swilling, and John T. Alsap. ter, the firm of E. Irvine & Co., newsdealers, was substituted r Wr. Swilling, who had sold out his interests in the Valley. East Phoenix, or Mill City, W. B. Hellings & Co., looked after the Miner interests; at Wickenburg, Barnett & Block, merchants, Abe Peeples, owner of the Magnolia Brewery and saloon, were tents, while at Camp McDowell, the representative was James A. Indinson, the post trader.

#### FARLY TRANSPORTATION.

From the earliest settlement of this section, and until ailroads were constructed, many freighting outfits made regular trips to and from the Salt River Valley. They came in usually caded with lumber or merchandise, and departed with cargoes of rain, flour, and other farm products. Oxen, mules, and horses were equally useful in hauling the heavy wagons necessary in this

Jake, of Prescott; of Dr. W. W. Jones, and J. H. Bryan, kn a prete, of Wickenburg; of Cosgrove & Cavaness, Murphy & Dannis, Eeach, and Charles W. Rusk, of Phoenix; of A. Daguerra, howith & Fenter, Stanfield, Rogers, Garfield, Lutgerding, lers, Hayden, and many others, whose names were familiar upon highways of Arizona in the 'vanished days.'

In the spring of 1879, the Scuthern Pacific, building eastrd from Yuma, reached Maricopa station (to the southwest of
Maricopa Wells) and through Phoenix, for many years thereafter,
owed the entire commerce of northern and central Arizona. Dusty
ight trains were almost continuously on the road bearing supless to the mines around Prescott and Florence, then enjoying a
mierful degree of activity. Fast freight to Prescott, which
Int making the one hundred and seventy miles in two weeks,
st the shipper four cents a pound.

July 4th, 1887, the Maricopa and Phoenix Railroad gave the ley steam connection with Southern Arizona, and the outside ld, while on March 12th, 1895, the completion of the Prescott heenix line, solved the transportation problem to the northern of the Territory. The construction of these railroads erfered greatly with overland transportation, and gradually the surely, the picturesque freighter was crowded out from the lines of his early triumphs.

# AGRICULTURAL COUDITIONS IN THE SALT RIVER VALLEY DURING THE EARLY 70° 3.

In many ways the year 1870 was an interesting one to the little group of farmers around the Phoenix Gottlement. property of importance, as well as a rapid increase of propulation during the period, augured well for the certain and permanent Although the future of the isolated but promising community. agricultural area brought under cultivation throughout the whole of Yavapai County was continually increasing, the farming acreage in the Salt River Valley was expanding more rapidly than elsewhore--various kinds of fruit trees and vines being planted during the season of 1870. These vines and trees were brought overland from Southern California, and it required a great deal of care on the part of the men bringing them, to have the young plants reach their destination in fairly good condition, as once set in I the ground, but little loss was experienced on account of the extreme fertility of the soil. Having come into the valley with but slender means, however, the early settlers had, during the first years of farming, but little opportunity to undertake any soil experimentation for the purpose of finding cut what crops J or trees were especially adapted to this locality, as the preparation of the ground and the laying of seed, cuttings, or young rees, required the expenditure of some little money. middle of 1870, however, there were perhaps a hundred fruit trees of various kinds, indluding fig, quince, plum, peach, English

malnut, apricot and orange-set out in the valley with but little knowledge, at that time, of how they would flourish.

Crape cuttings were first set out in 1868 by Jack Smilling and the Starar Brothers, and, doing well from the start, were cultivated by most of the early residents. Of the cereals, barley was the favorite crop and yielded heavily each season, while corn was also planted extensively during the first years; the latter crop, however, was gradually supplanted by wheat which has always done well in this section. In 1870, only 16 acres were planted to alfalfa in the valley, being on the farms of Barnum, Duppa, Gray and Swilling, while but two and a half acres of cats had been sowed, a couple of acres on the ranch of Darrell Duppa, and a half acre on that of the Starar brothers.

Cordon A: Wilson was the first to experiment with pecans, peanuts and tobacco, having, in 1870, about fifteen trees of the former, about a quarter of an acro of peanuts, and some hundred plants of the latter. J. G. Young was the first to try the cultivation of orange trees in the valley and, in 1870, had three trees of that variety upon his farm. In the latter part of 1872, Jack Swilling had quite a number of these trees upon his ranch, which did not do very well, on account of the exposed nature of the land. This industry, however, on better and more protected ground, proved more successful in later years.

The acreage in the staple crops increased steadily year by year, and, from some 250 acres in the spring of 1868, the cultivated area expanded to something less than a thousand acres in 1869, and to approximately 1700 acres in 1870.

During the latter year only twenty farmers had planted crops of various kinds, mostly barley and corn, although the water supply available at that time was sufficient to irrigate a far greater amount of land than was then under tillage.

These pioneer tillers of the soil were the following:

John T. Alsap and Um: L. Osborn, John Ammarman, Thomas Barnum,	with	about	57 225 103 82	acres
Jacob Denslinger, Darrell Duppa Columbus H. Gray	*	*	175	*
George James John Largen	#	19	724 86 60	**
John B. Hontgomery Frank Hetzler	18	18 18	78	# # # # # # # # # # # # # # # # # # #
 James Murphy and John T. Donnis Benjamin F. Patterson,	\$ \$	18 18	98 61	# ##
John W. Swilling	# #	# #	100	# ·
Jacob and Andrew Starar Gordon A: Wilson J. G. Young	*	*	78 52	*
A A A A A A A A A A A A A A A A A A A				<b>-</b> !

In the San Francisco Weekly Bulletin, of California, there appeared in 1870, a well written article by a prominent pioneer, entitled Wanderings over Arizona, from which the following portion, relating to the early Salt River settlement, is taken:

engaged exclusively in agriculture. The whole neighborhood is entitled "Phoenix" and extends some miles along the river bottom, on the north side of the stream, and lies several miles above its junction with the Gila. The land is very rich and was evidently cultivated years agone, for the channels of ditches are not whelly filled up, and may be traced for many miles through over-

\*Careful estimates give the amount of good land in this vicinity at 50,000 acres, only 1200 of which are under cultivation, and a comparatively small amount is claimed. Salt River is larger than the Gila above the junction, and is supplied from the Thite Mountains where snow falls deep, and oprings are abundant; and Mr. Swilling, an intelligent farmer, is of the opinion that by carefully managing the water of this stream, the entire arable land of the valley could be brought under cultivation. This body of land lies several miles from any mountains and therefore is comparatively safe from Indian depredations. But few raids have been made, and the raiders rarely got away with their booty, being overtaken as a rule, on the plains intervening between the valley and Mountains. The first settlements were made in December, 1867. Only two, of all, went there with money, and they with but little:

\*Many are now in easy circumstances and all are \*gathering gear, \* happy and contented. A few rent their lands for a fine income and do nothing but oversee their business. The crops are a full average this year and small grain sells on the farm at from h to 5 cents per pound. Sweet potatoes are produced to perfection, and one farmer has sixteen across growing. Fruit trees are to be obtained soon, and the mildness of the climate is a guaranty that all the delicate fruits will grow excellently. For the farmer and fruit grower there is no more inviting bady locality in Central Artzona, and I doubt if in any other portion of the territory.\*

And soon after, there appeared in the Prescott Miner, the following equally interesting remarks:

\*Phoenix, A: T. Aug. 13, 1870.

"Upwards of 30 Pimas and Maricopas, with one citizen of this neighborhood, named Eugene Cartor, passed here yesterday on their return from a raid of a week against the Pinal Apaches. report one fight in which they killed two Pinels and destroyed a large rancheria. One of the party had a large bundle of tannod buckskins, and much other property, of more or less value, and in possession of various ones. It is well known that these raids are quite dommon and to them and Camp HoDowell, this flourishing settlement feels indebted for the security of life and ropertyenjoyed; They have made this section unsafe for Apaches and the latter have rarely attempted depredations therein. are many similar illustrations of the great practical value of the hostility of one tribe towards another: This settlement is receiving constant accessions of working people. Within a few weeks some thirty new ranches have been located and four. families have taken up their abode on as many farms. The older settlers have become well attached to their new homes: grape vines were planted here, two years ago and as those who did it had no confidence in their production, they were uncared for; but this season Mesers. Swilling and Starar each had a fine crop of as delicious grapes as ever grew in California and they, as well as others, have determined to henceforth plant and properly ultivate vineyards. The common belief has been that Irish poTHE FIRST PUBLIC SURVEYS IN THE SALT RIVER VALLEY.

1858.

One of the first persons to formally recognize the "avail-ability of the Salt River Valley for the purposescol irrigation, was a government surveyor by the name of William H. Pierce, who performed the first public land surveying to be executed within the boundaries of Arizona.

Although, by the Act of Congress, approved February 24, 1863,— authorizing the organization of the Territory of Arizona — it was made a separate surveying district, yet, the work performed by Deputy Pierce was not commenced until the very early part
of 1867. In filling the offices created by the formation of the
Territory, President Lincoln chose Levi Bashford, then a resident of
Wisconsin, for the first Surveyor-General of the Arizona District.

This official journeyed hither in the Company of other appointed territorial officers and on May 6th, 1864 was prepared to open his office in Tucson. No money having been appropriated by Congress, however, to meet the expense necessary in organizing such an office, General Bashford found himself unable to perform the principal duties required of him.

On the 2nd day of July, 1364, Congress passed an Act attaching Arizona to the surveying districts of New Mexico, then presided over by General John A. Clark, and making provision, at the same time, for the carrying on of necessary surveying operations within this Territory. Upon the 15th day of December, 1366, (about a year before the coming of the Swilling Party), General Clark entered

into a contract with Deputy Pierce for the survey of certain lands in Arizona, at a sum not to exceed \$7500.00. Commencing at the "Initial Point", located near the junction of the Gila and Salt Pivers, when the military protection which had been furnished him was withdrawn and he was compelled to quit the filed, the Indians infesting the country rendering it unsafe and impracticable to continue the work without a military excert. In view of these conditions the contract with Deputy Pierce was later concelled.

The "Initial Point" which Deputy Pierce was instructed to select for the starting place of the Arizona surveys consisted of a substantial monument of stones, eight feet in diameter at the base, four feet around the top and eight feet in height, which stood upon the summit of a conical hill, some 150 feet in elevation, on the south side of the Gila, opposite the mouth of the Salt, in latitude 33° 22° 57° north and longitude 1120° 18° 24° west.

General Clark had been the first to recognize the suitableness of this point for the initiation of the Arizona surveys and touched
upon the matter in his official report of 1865. Joseph S. Wilson,
then Commissioner of the General Land Office, replying to the various
suggestions contained in that report thus wrote to General Clark on
September 11, 1866:--

"AS it is deemed expedient to initiate surveying operations in the Territory of Arizona, the recommendation made in your report to this office, under date of May 24, 1865, suggesting that the monument erected in 1851 by the Mexican Boundary Commission, situated at the confluence of the Gila and Salt Rivers, be used as the initial point, is concurred in by this office; from that point you will

establish the Ease and peridian Lines for the public surveys in Arizona, calling this special meridian by the name of the Gila and Salt River Meridian."

With one or two exceptions all of the public surveys in Arizona are initiated from this point, which lies within the present boundaries of Maricopa County.

Deputy Pierce performed most of his work during the month of January, 1867, and among his assistants were Andrew Mapier, Pobert Johnson, Albert Ashly, Charles H. Gray, Jesse Wilsey and George Henderson, all of whom took an oath for the faithful performance of their duty before Bohn H. Archibald, at Tucson, then Clerk of the First Judicial District, comprising the county of Pima. In describing the country along the Salt River, near which some of his lines extended, Deputy Pierce wrote as follows:

"Salt River is, at this season of the year at least, a large stream, nor do I think that it ever entirely dries. It has more-over a very heavy fall of, I should think, twelve to fifteen feet to the mile which renders it especially valuable for irrigating. I consider this valley — six to ten miles wide and extending from its mouth upwards to the mountains about forty miles — as containing some of the best agricultural land I have yet seen in the Territory and would recommend that it be subdivided at an early day."

As these observations took place in January, of 1867, the possibilities for irrigating this valley were thus definitely noted almost a year before the first settlers arrived.

Before any further surveying operations could be inaugurated by General Clark, the Territory of Arizona was taken from his jurisdiction by an Act of Congress, approved March 2, 1867, and tached to the surveying district of California, then under the supervision of General L. Upton, and all original archieves relating to the surveying service in Arizona were transmitted from New Mexico to California. The constant demand of the settlers in Arizona for the survey of their lands, induced General Upton, soon after assuming charge of the Arizona district, to let several contracts for that purpose.

In the land to be surveyed under these early contracts, was included the greater portion of the Salt River Valley. Three separate contracts were entered into by the California official for the performance of this work; the first with Wilfred F. Ingalls, bearing the date of February 18, 1868; the second with George P. Ingalls, bearing the date of February 29, 1868, while the third — called a joint-contract — was with both of the above-named, and bore the date of July 10, 1868; each of the above contracts was for the sum of \$7500.00;

Wilfred F. Ingalls was a brother, and George P. Ingalls a cousin, of Hon. Frank S. Ingalls, now and for many years past, United States Surveyor General for the District of Arizona. (1915).

After being awarded these contracts Yessrs. Ingalls who then resided near Cakland, California, had a wagon especially constructed for use in the work contemplated; one of the principal features of this conveyance was a box-like compartment built in the rear for the carrying of fire-arms, to be used in case of attack by roving bands of Indians while in Arizona.

h.

When completed, this wagon -- together with four horses and other luggage -- was shipped on board the coast steamer "Crizaba", bound for the Southern California port of "Wilmington", called also at that time, "San Pedro", which latter name the locality still bears.

Before the surveyors left San Francisco, General Upton called upon Ceneral McDowell, then military commander of the Department of of the Department of the Pacific, and, after explaining to him the mission of his deputies in Arizona and the probably attendant dangers, requested that the protection of a military escort be afforded them while in the duscharge of their duties within that Territory.

The commanding General, realizing the justness of this request, thereupon issued the necessary order, addressed to the various commanding officers in Arizona and the full text of which was as follows:-

San Francisco, Cal., February 19, 1868.

Special Orders,

No. 25.

The commanding officers of Sub Districts in Arizona will furnish escerts to parties engaged in surveying United States lands in that Territory, under instructions from the Surveyor General of the California and Arizona Surveying Districts, whenever, in their judgment, such are necessary, and can be furnished without neglecting other duties.

By command of Brevet Major-General McDowell; .

E. R. Platt,

Acting Assistant Adjutant General."

From Wilmington or San Pedro, the surveyors drove overland to Yuma where they arrived in due time and, after having their outfit

overhauled at the shop of Chris Horner, a well-known blacksmith and wheelwright, they continued up the Gila, along the overland road, with Waricopa Wells as their destination.

They made no request for a military escort tefore leaving Yuma -- where the 14th Infantry was then stationed -- as they had first planned, but made the journey along the Gila accompanied only be a few men.

Upon reaching Maricopa Wells, Messrs. Ingalls established their headquarters at that place which was, at the time, the most important station between Arizona City and Tucson.

The two deputies conducted their surveying work in the Salt River Valley under many difficulties, the Indians stealing several horses from them and retarding the progress of their work. At the close of the day's labor, the party of surveyors would make camp near the river, where the only available water supply could be found, and, after they had disposed of their evening meal, would extinguish the camp fires and, in the darkness, would move the entire outfit onto the higher ground, in order to mislead any prowling Indians who might have marked, by the fires the location of the river camp.

Many times during their stay in the valley great numbers of Indian tracks would be found the next morning around the camp-fires of the early evening but no open attack, was ever made upon the surveying party.

On the 27th day of March, 1868, Deputy W. F. Ingalls commenced the work of sub-dividing the township around the Phoenix Settlement, completing the same on the 4th day of April. From April 3th to 16th, he sectionized the township to the east, in which the City of Tempe is now

located. During the performance of this work his principal assistants were Pobert Bryant, Thomas L. Taylor, Faustino Gonzales and Antonio Espinosa. During this time, Deputy G. P. Ingalls was also at work in the vicinity, his party consisting of Edward Livingston Bridges, Ridgely Tilden, Canuto Soto and Louis Ganalo, the first two coming with him from California. Young Bridges had gone to that state with his family when quite young and after attending the public schools, had taken up the atudy of the law at Brayton College, in Cakland, a pioneer educational institution of that State. (This seat of learning, as well as the old College of California, were later merged with the University of California.)

Attorney General of wain for a number of years and was a lawyer of marked ability. The sone was later killed in Nevada. It was said some years ago that Ridgely Tilden was still a resident of Arizona, living somewhere around the Globe country. Sherman Pay, under whose direction the surveys of Deputies Ingalls and Ingalls were completed. By an Actrof Congress, approved July 11, 1870, Arizona was again made into a separate surveying district, John Wasson, a pioneer journalist of California and Nevada, receiving the appointment of Surveyor General.

In his general description of the country embraced within the boundaries of Township 1 North, Range 3 East, the Phoenix township, Deputy W. F. Ingalls made the following remarks about the settlement located therein:-

"A settlement called "Phoenix" was formed in the northeast part of the township, during the winter of 1867 and 1868. It now contains about fifty persons who have displayed great energy in the construction of their "Irrigation Ditches" and the clearing of their land and will this

year bring under cultivation a large extent of country. The settlement, though young, bears every evidence of thrift and prosperity."

In his general description of Township 1 North, Range 4
East, the following is found:

There are two acequias taking water from the Salt River in Section 7, and run thence westward into T. 1 N., R. 3 E, and which are used by the farmers for irrigating their land. The settlers propose constructing another acequia to take water from the river in Section 15 and leading thence westerly to the adjoining township. In the scuthwest corner of Section 7 were discovered the remains of an ancient adobe house and wall. The wall is a parallel ogram in shape and is about 100 feet long and 60 feet wide and is situated on a slight elevation. This ruin, from all appearances, must have been designed for a fortfication but when and by whom, we of course, have no means of knowing."

These brief remarks from the earliest description at hand of the Phoenix Settlement and vicinity -- only a few months after the arrival of Jack Swilling and his companions.

## LAND OFFICE EXTRACTS.

Surveyor-General's Office, Santa Fs, New Mexico, July 19th, 1867.

I have the honor to submit herewith my annual report with statements marked from "A" to "F", inclusive, showing the condition and wants of the surveying district service in this district.

Statement marked \*A\* shows the public surveys made during the year ending June 30th, 1.87. Statement "B\* shows the surveys of private land claims made during the same period. Statement "C\* exhibits the surveys directed to be executed during the fiscal year ending June 30, 1868.

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A contract was entered into with Deputy Surveyor William H. Pierce on the 15th day of December, 1866, for the survey in Arizona of 96 miles of the Gila and Salt River Meridian; 36 miles of the base line and standard and exterior township boundary lines, to amount in the aggregate to a sum not exceeding \$7500. Mr. Pierce completed the survey of the meridian from the initial corner north 34 miles, the base line from the same corner east 36 miles, and the first standard line from the same corner east 36 miles, and the first standard parallel north along the south boundary of Township 5 north, east 42 miles, and west 42 miles, when the military protection which had been furnished him was withdrawn, and he was compelled to quit the field, the Indians infesting the country rendering it unsafe and impracticable to continue the work without a military escort. At his request, and by your order, Mr. Pierce has been released from further obligation to prosecute the work under his contract.

By the 4th section of the Act of Congress entitled, 'An Act to Create the office of Surveyor-General in the Territory of Montana, and establishing a land office in the territories of Montana and Arizona,' approved March 2nd, 1867, the territory of Arizona was attached to the surveying district of California.

In accordance with your instructions dated March 25th, 1867, I have transmitted to the Surveyor-General of California all of the original archives in this office relating to the surveying service in Arizona, receipts for which, when received, will be forwarded to your office.

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I am,

Respectfully your obsdient servant,
John A. Clark,
Surveyor General of New Maxico.

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Non. Joseph S. Wilson,

Commissioner of the General Land Office,

Washington, D. C.

in pursuance of law, I, John B. Allen, of the First Judicial District in the Territory of Arizona, have pre-empted a tract of land containing one humined and sixty xxxxxx (160) acres, lying about two miles west of the southwest corner of the Firms and Maricopas reservation, and enclosing what is known and designated as the Maricopa Wells.

Tucson, July 27th, 1864.

John B. Allen."

General Land Office, July 5th, 1863.

Lavi Bashford, Esq.,
Surveyor General of Arizona.
Oshkosh, Wisdonsin.

Sir:

I have to advise you that the Secretary of the Interior directs that the office of the Surveyor-General of Arizona be established at Tucson.

Very respectfully, Yours Obedient Servant,

J. M. Edmunds,

Commissioner.

## MORTH SIDE CAMALS IN THE VICINITY OF PHOENIX in 1872.

In the early part of 1872 there were six main ditches or irrigating canals taking water from the north side of the Salt Piver in the vicinity of Phoenix, named as follows:

- 1. The Swilling Irrigating Canal.
- 2. Wilson's Ditch.
- 3. The Juan Chiavria, often called The Criffin Ditch.
- 4. The Salt River Ditch, later called The Farmer's Canal.
- 5. The Monterey Ditch.
- 6. The Mexican Ditch.

Of all these ditches that of the Swilling Company was the first to be constructed, and was commenced, as has already been tated, in the early part of December, 1867. In April of 1868, it had a total length of about two and three quarter miles, and a width of some twenty feet. Its preliminar y cost was equivalent to about \$10,000.00, and every year after 1868, it was enlarged and improved. In 1871 a portion of new ditch, with its head nearly three quarters of a mile durther up the river, was dug, intersecting the old channel at a point 3300 feet from the river in a straight line.

This last stretch of canal was 20 feet wide on the bottom, with an average depth of about ten feet, and cost some \$9000.00. Each the old and the new ditches were used, and were capable of supplying, in 1872, about 5000 inches of water, although they could have been made to supply much more than this if the dams cross the river at their heads had been raised. The original

later augmented by an additional claim of 7000 inches, making a total appropriation of 12,000 inches. The first head of the Swilling Ditch 'was intended for a mere temporary affair to enable the first farmers to bring water upon the land, while the more difficult work of opening a permanent water head was being actively prosecuted. The water in the old Swilling Ditch was brought to the surface of the ground about a mile from the head of the ditch, and near this pointmit was divided into three principal divisions, as follows:

The Dutch Ditch, which ran westward and down the river;

The Extension, which ran northwest for about a mile and then turned westward, and was, in reality, the main canal, and

The North Extension, which ran maxximaxi northwest about three and a half miles, being divided there again into smaller ditches.

The first two ditches supplied the farms nearest to the river for something like two miles cut, while the last was intended to furnish water to farms out on the plain in the direction of Wickenburg. It was hoped in 1872 that crops would be raised as far away as 5 miles from the river, on the plains to the northwest. Forms had already been located in that section, and the owners were engaged in clearing and putting their ground in condition for the planting of corn and sorghum during the season of 1872:

The Dutch Ditch was the principal lateral to the south from the main Swilling Canal, and was so named on account of the large number of persons of German descent who helped in its construction. It left the main channel about a mile above the old Hellings Flour

Mill, and carried water upon those ranches situated along the river: Its construction was commenced in the year 1868, and, when completed, passed along the southern boundary of the original townsite, ending upon the ranch of John Montgomery:

:

The canal referred to as The Extension, was the main stream of the Swilling Canal, which ran almost parallel to the Eutch Ditch, and about a mile to the north of the latter. It is to-day known as the Salt River Valley Canal, and flows in a westerly direction, passing in its course through the City of Phoenix, where it is called the Town Ditch. It is owned at present by the Federal Government, and is under the supervision of the Reclamation Service: Plans have been suggested at various times for eliminating, in some manner get to be decided, that section of the canal which passes between the easterly and westerly limits of the city as, in many places, the banks are caving in and, in general, the old ditch has become unsightly and a decided inconvenience: It flowed near the northern boundary of the original townsite, but as the growth of residential Phoenix has been northward, it was not many years until the canal was flowing through the most populated districts, often underneath dwelling houses, and across private yards. In early years it furnished the residents of Phoenix with water for domestic purposes, 'sending a rippling stream through every street, so that, instead of the usual gutter seen in eastern cities, there was a running riverlet between the sidewalks and the roadways:

It has now served its purpose for well nigh half a century, and if obliterated through the city, as often contemplated, the

'amiliar sight of this artificial waterway will be missed, not only by the pioneer resident who looks upon it as a valued friend, but also by the newest arrival who will no longer find at hand an actual demonstration of how water is carried from river to land in the irrigated districts of the arid, west.

Years after its construction, when the stockholders in the old Swilling Company decided to divide their interests, this branch became known as the Salt River Valley Canal, and on the 16th day of September, 1875, articles of incorporation for The Salt River Valley Canal Company were filed in the office of the Territorial Secretary. In the papers field it was stated that this company proposed to take water from the river 'near the head of the old ditch' of the Swilling Company; that it had a apital stock of \$20,000, divided into 40 shares, valued at \$500 each, and that the headquarters of the company would be located at Phoenix.

The ditch noted as The North Extension, was the north lateral of the Swilling Canal, and carried its waters on a parallel, and about a mile to the north of The Extension, or main canal.

This branch canal was constructed in 1872 by stockholders of the Swilling Canal Company, who had become dissatisfied with the management of the company's affairs. On February 19th, 1872, the following was written from Phoenix:

'Some of our honest farmers, among them Dr. Alsap, William Osborn, Tom Barnum, Captain Hancock and others, are taking out what is called 'The North Extension of the Swilling Canal.' It uns to the east of Swilling's Castle, and to the north of Barnum

and Alsap, and covers a large scope of country heretofore without water. The extension is twenty feet wide so, you will see, it will carry some water.

Swilling's Castle was the name given to the large adobe residence of Jack Swilling, which was among the first of the more commodious buildings to be erected in the valley.

Later on the relations between the shareholders in the old company became so strained that the difficulties were adjusted by the formation of two caparate companies, the Worth Extension calling itself the Maricopa Canal, and carrying the waters on a parallel one mile north of the Swilling Canal.

On the 14th of September, 1875, there were filed in the Secretary's office, of this Territory, articles of incorporation for the Maricopa Canal Company. This company proposed to take its water from the river, 'near the head of the new ditch' of the Swilling Company; the amount of its capital stock was given as \$25,000, divided into 50 shares valued at \$500 each, while its principal place of business was designated as Phoenix.

The officers of the Swilling Company were at first elected for six month terms, and its first Secretary was the scholarly, but peculiar, Englishman, Darrell Duppa. He was followed by Major James S. McKinnie, who had come to the valley in the early part of 1869. Following Major McKinnie as Secretary of the Company, came John T. Alsap, who was one of the most popular residents of the Valley, being a man of great honesty and fairness, and ever ready to lend his support to any worthy cause.

On September 2, 1872, the Swilling Company elected the late

Francis A. Shaw as 'Ditch Overseer for the ensuing year,' in place of Dan Twomey, later killed by Indians near Camp McDowell, who had previously discharged the important and often trying duties of that position. The ditch overseer of that early period has now been supplanted by the Water Commissioner of the Valley, and a set of individuals known as 'zanjeros' who attend to the distribution of irrigation water throughout the valley.

In time a large lateral was constructed as a north branch of the old North Extension or Maricopa Canal, which took in higher lands still further to the north.

This last lateral was given the name of The Big Maricopa Canal, while from the point of division the first lateral was known as The Little Maricopa Canal.

Next came the Wilson Ditch which was the second large acequia to be excavated and put in operation by the early settlers of the valley on the north side of the Salt. It left the river just below the original Swilling head, and irrigated lands to the south of the Phoenix Settlement and near the river. In 1872 it was owned and used entirely by four farmers for the degordon livery of water upon their several farms, these being Secret A. Wilson, Benjamin F. Patterson, Charles Davies and John Aversch, known to his neighbors as 'Go' John', and noted for his generosity. The ditch took its name from Gordon A. Wilson, one of the prominent men of that day, who had taken up a ranch in the Valley about the middle of 1868. This ditch carried, in 1872, about 400 inches of ater, and had cost up to that time about \$2500.

The next ditch down the river was the Juan Chiavria, which

covered some of the bost mesquite land in the valley, and carried Lout 2000 inches of mater. This ditch was named after Juan Chiavria, a noted chief of the Pima and Maricopa Indian tribes, and a man of influence among his people, but was more commonly referred to by the settlers as the Griffin Ditch, and headed at a point on the river about where the Center Street bridge now spans the stream. It is said that this ditch was started in 1869 by a rancher known as Frenchy Sawyer, who had a section of land to the west of the Underwood ranch, and about two miles further down the lriver. He did not succeed in obtaining water from it for his first crop, and had to depend on the Swilling ditch, which was about a mile to the north of him: In 1870 Martin P. Griffin bought in with Sawyer, and the following year the ditch was completed and incorporated by Griffin and A. Barnett: In the middle 1 1872 it was enlarged from a ditch with a four foot bottom with twenty shares, to one with a twenty-five foot bottom, with sixty Then this work had been completed in the first part of shares. December, the canal proper was then extended into the valley for some miles further.

When M. Wormser came to the Valley, he purchased the local interests of Earnett, and thus became interested in the Griffin Ditch, the company being re-organized and consisting of the following stockholders: William D. Fenter, Michael Tormser and Martin P. Griffin.

This ditch was about three and a half miles in length, and after the early 80's was much of the time idle on account of a shortage of water in the river.

Proceeding on down the king river, we come to the 'Salt River Ditch.' This was partly owned by persons living at Wickenburg, among whom were number A. H. Peeples, J. M. Bryan, more commonly known as Crete, and George Bryan. It was, at the time of its construction, the largest ditch in the valley, being 25 feet wile on the bottom, and could supply in the early part of 1272 about 12000 inches of water.

At the period with which we are dealing this ditch was about three miles long and had cost up to this time \$22,000. The company's intentions were to carry on the ditch some eight or ten miles further during the season of 1872, or, more definitely speaking, to the Agus Fria Piver, in order to cover the large body of the land in that locality:

In the 'Miner' of Saturday, June 29th, 1872, the following article about the Salt River Ditch appears:

'Pheenix, June 21, 1872.

Captain Hancock, J. A. Chenowith, Mr. Cavaness, I. L. Dickinson and E. Irvine, made an excursion to the lower part of the Valley, along the surveyed route of the Salt River Irrigating Canal. This country is very level, not having an eminence a foot high for miles around, except old adobe ruins or ditch borders, remains of the works of a people who cultivated this valley in ages gone by, and who have passed away,— their history shrouded in oblivion, their noble braves, fair women, and noble deeds forgotten. The farthsst point reached by the party was about ten miles from the present terminus of the ditch, and must have been at least twenty miles from the nearest foothills. Salt

River Valley lay to the east; the Gila Valley, above the junction of Salt River lay to the scutheast; the Agua Fria Valley lay to the Northeast, and the apparent uniting of these three valleys into one, lay to the west; following the course of the Gila to the Gulf.

The soil is rich, yet, for the lack of water, the country, at present, looks very much like a desert, but no worse than the land around the lower part of Mesquite did last December, that is now loaded x down withgrain, some of which will pay, at least, 540 per acre this year above all expenses. This immense tract of land will support a large population when properly irrigated, but while Salt Piver will supply a great deal of water, artesian rells will be needed.

'This Salt River Ditch is a grand affair, and the Company is greatly benefitting the public while making a private fortune. The ditch has a width of 25 feet on the bottom, with very slanting sides, and a sufficient depth to carry, at least, 10,000 inches of water, which will be divided into 200 water rights, one water right being considered sufficient to irrigate one quarter section.

AThe Company, last year, at an expense of \$22,000 mide three miles of ditchm and now have six teams at work, intending to increase this number to 20 after harvest; they will have completed ten miles farther in a few months, which will give it a length of 13 miles in all. The first six miles constitute the ditch proper, one right in which is valued at \$350. The other seven miles contitute an 'Extension;' parties wishing to use it, will have to purchase a right in it also. Then each person will have to convey

his water to his own ranch in a private ditch or, perhaps, two or three will unite and carry their water together. As all this part of the valley inclines slightly to the southwest, the water can be made available on one side only. The land on the north east side xilk of the ditch will have to be irrigated by ditches taken cut further up.

This canal was later more commonly known and referred to as 'The Fermers' Ditch,' and left the river at a point about south of what is known as Hurley's Slaughter House, the main portion of the canal taking a northwesterly trend after leaving the river. It was completed about July of 1872, and during the second week of August, the stores, tools, etc., remaining at the breaking up of the camp, were sold at public auction and brought the sum of \$1089.

The Monterey was one of the smaller ditches and carried in 1872 about 1000 inches of water. It left the river but a very short distance down stream from the head of the Salt River Company's Canal, and flowed practically due west for its entire length, about 4 miles. It was dug deeper and extended half a mile further in 1872.

The Mexican Ditch was also small in dimensions and carried like the Monterey, about 1000 inches of water:

The acreage actually under cultivation and watered by the ditches above mentioned was as follows:

Swilling Irrigating Canal,		acres,
Wilson's Ditch,	700	32
Juan Chiavria Ditch,	1300	17
Salt Piver Ditch,	1300 600	37
Monterey Ditch,	150	19
Mexican Ditch,	250	

This amount of land, totalling 7000 acres, comprised the entire area under cultivation on the north side of the Salt in 1872.

The following orief summary of irrigation conditions all over the valley in the latter part of 1872, is worthy of notice:

At that time Frank Rowe was engaged in taking a ditch out of the Verde, above the McDowell reservation. This made the second ditch in that vicinity.

A new ditch, named the Buffum Ditch, had been taken out of Salt River on the south side, near the Miller Ditch.

The Tempe Ditch had been dug out deeper and a new dam had been put in, and it had otherwise been permanently improved.

The Prescott Ditch on the south side was repaired by the building of a new dam and its channel thoroughly cleaned out, and could carry at that time much more water than formerly.

In the fall of 1372 the Mexicans living on the Mexican Ditch had enlarged the same; were clearing land and preparing to put in a much larger crop than they had sowed the previous year.

A new dam had been constructed at the head of the Swilling Ditch, which had been thoroughly cleaned out, and which then carried an abundance of water.

The Watson Ditch, Maddox Ditch, Van Arman Ditch and Mexican Ditch No. 2, had each been cleaned and improved, more or less, in preparation for the spring season of 1873.

All of these were main ditches which were fed directly from the river, some of which had several extensions and side ditches, through which the water was distributed over the country. These extensions and side ditches were all in good repair in the latter part of 1872.

The Miller Ditch, Savery Ditch, Fowe Ditch and California Ditch were not yet completed at this time, and were not ready for service until the following year.

The uncompleted Barnum Ditch was awaiting capital in 1872.

NOTE: In 1878, fourteen miles of the Crand Canal were built and other extensions made in 1880, 1881 and 1882, being completed in the latter year. The Arizona Canal was begun in 1884, and finally completed in 1887. What was known as the Fermers' Canal was completed in January of 1892.

There is much reason to believe that for back in the dim and distant days of a prohistoric civilization, there existed mamorous towns and villages in many section s of the great Salt fliver Valley. Then the first white men came, however, in 1867, they found only the ruins of long described buildings to mark the site of former settlements.

The first houses of a permanent character to be built by thits softlers in the valley were erected near the Swilling Ditch, to a point about a mile from the river. Among these were the houses of Charles 3: Adams, P. L. (Jack) Walters, Lolovic Vandemark, "Franchy" Samyer and John Hoague, standing but a short dismance from the place where the lower road from Wickenburg to Camp McDowell crossed the Swilling Ditch, in the northeast part of the late, T. 1 N., R. 3 E.

Then the first Covernment surveyors went over the Velley a row menths after the coming of the Swilling party, they found this liteter of rude abodes comprising what was then known as the "Phoenix Settlement."

The agricultural possibilities of the valley had been so well proven that it seen became evident that, senswhere in this section, there has destined to grow a large city: On account of the great size of the valley and the many suitable places for townsites, the task of selecting the best location for a future metropolis became

nd as its other members, James Frant and Guorge Coulter, the latter having come to Arizona with the Walker Party:

Those members met for organization on the 20th day of January, 7566, and colocted James Crant as Chairman, he receiving two votes to one for George Coulter, while Follett G. Christia was the first lork at a colory of \$200.00 per year:

Judge Berry was also appointed the first register of the Land bffice at Prescott, and in October, 1873, became editor of the Yuma Sentinel, when the publication was the property of Col. James U. Durney, who sold it in 1875 to John W. Dorrington.

The following written information with reference to the Phoenix Townsite is also found in the press of that day:

\*Scarcely a week passes that we are not called upon to chronlicle something new regarding the growing settlements on Salt River, in this county, all of which settlements are known and come under name of "Phonnix."

\*The Valley, one of the largest and most productive on the Pacific Coast, was once the seat of empire of the semi-sivilized Indians of Arizona, as the numerous ruins of houses, water ditches, cooking utensils, etc., attest, and it may be that the seat of government of the Territory will soon be located thers. its agricultural resources, which are unexcelled here or elsewhore, I it has great manufacturing rescurces, and, as manufactories must soon be established at proper points in this Torritory, the fourders of these settlements will be certain to pay due attention to the latent power of the immense volume of water which flows down Salt River, past Phoenix:

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#### REPORT OF THE DISTRICT ENGINEER

ON

INTERIM SURVEY FOR FLOOD CONTROL, GILA AND SALT RIVERS,
GILLESPIE DAM TO McDOWELL DAM SITE, ARIZONA

#### SYLLABUS

The district engineer finds that a flood menace exists along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam. He also finds that the river-bottom growth within the channels of the Salt and Gila Rivers not only greatly adds to the flood hazard but also, by transpiring large volumes of water annually, greatly depletes the ground-water supply.

The district engineer investigated several flood-control and multiple-purpose projects in this area. He finds that the most justifiable project at the present time would provide for short levees along the Salt River between 40th Street, Phoenix, and Tempe Butte, Tempe, and for channel improvements along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam.

The district engineer estimates the total Federal first cost of the improvement at \$3,300,000 (October 1957) and the total non-Federal first cost at \$210,000 (October 1957). He estimates the total average annual charges at \$176,800, including an average of \$53,000 annually for maintenance and operation of the levee and channel improvements. He estimates the average annual benefits that would accrue from flood control and incidental water conservation at \$354,000. He states that the ratio of average annual benefits to average annual charges would be 2.00 to 1. He concludes that the project would be justified on the basis of the tangible benefits. Consideration of the intangible benefits would add weight to the justification.

The district engineer investigated the feasibility of the addition of flood-control storage to a terminal-storage reservoir at the McDowell site on Salt River. He concludes that the addition of sufficient flood-control storage to control a standard project flood at a reservoir at the McDowell site is justified at such time as the reservoir at this site is required for terminal storage. Such storage would provide an adequate degree of flood protection for the fast-growing urban area in the vicinity of Phoenix.

The district engineer is of the opinion that, because of the water-conservation benefits that would result from construction of the recommended project, local interests should be required to reimburse the United States for that part of the project construction

cost allocated to water conservation, and such reimbursement should be made in 40 equal annual payments without interest. On the basis of October 1957 prices, the estimated amount of \$825,000 would be repaid in 40 equal annual payments of \$20,625.

The district engineer recommends that a flood-control project comprising levee and channel improvements along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam, as outlined above, be authorized for construction by the Corps of Engineers, United States Army, subject to the condition that local interests furnish assurances satisfactory to the Secretary of the Army that they will pay for the cost of highway and utility relocation; provide necessary lands, easements, and rights-of-way; repay, to the United States, 25 percent of the total construction cost in 40 equal annual payments without interest (the exact amount of the annual payments, presently estimated at \$20,625, to be adjusted on the basis of actual costs of constructing the project; annual payments to be made to the Secretary of the Interior who, in turn, will deposit such funds in the Treasury of the United States as miscellaneous receipts); maintain and operate the levee and channel improvements in accordance with regulations to be prescribed by the Secretary of the Army; keep the flood channel of the Gila and Salt Rivers free from encroachment; hold and save the United States free from all damages arising from construction and operation of the work; and adjust all water-rights claims resulting from construction, operation, and maintenance of the improvements.

The district engineer also recommends that, because of the special circumstances wherein the water-conservation benefits would be realized, the 160-acre limitation in ownership of lands benefiting from the water-conservation features of the project should not be applied as a prerequisite for this project's qualifying for interest-free funds.

The district engineer further recommends that, in the event McDowell Reservoir, proposed in House Document 136, 81st Congress, 1st session, is adopted for construction, the design be modified to provide such additional flood-control storage as is determined to be needed and justified at that time.

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# LIST OF APPENDIXES MADE IN CONNECTION WITH REPORT

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9.	Letter from United States Fish and Wildlife Service

UNITED STATES ARMY CORPS OF ENGINEERS,
OFFICE OF THE DISTRICT ENGINEER,
LOS ANGELES DISTRICT,
Los Angeles, Calif., December 4, 1957.

Subject: Interim report on survey for flood control, Gila and Salt Rivers, Gillespie Dam to McDowell Dam site, Arizona.

Through: The Division Engineer, United States Army Engineer Division, South Pacific, San Francisco, Calif.

To: The Chief of Engineers, United States Army.

#### AUTHORITY

1. This report is submitted pursuant to act of Congress, Public Law 761, Seventy-fifth Congress, approved June 28, 1938, which reads in part as follows:

SEC. 6. The Secretary of War is hereby authorized and directed to cause preliminary examinations and surveys for flood control including floods aggravated by or due to tidal effect at the following-named localities, and the Secretary of Agriculture is authorized and directed to cause preliminary examinations and surveys for run-off and waterflow retardation and soil-erosion prevention on the watersheds of such localities; \*\*\*:

\* \* \* \* \* \* \*

Gila River and tributaries, Arizona and New Mexico.

\* \* \* \* \* \*

- 2. A preliminary examination report on Gila River and tributaries, Arizona and New Mexico, dated January 10, 1939, was submitted by the district engineer in accordance with the act mentioned in the preceding paragraph. The report, which was reviewed by the Board of Engineers for River and Harbors, is the basis of authorization, dated April 18, 1939, by the Chief of Engineers for a report on a flood-control survey of the entire Gila River Basin.
  - 3. The survey for the entire basin is being covered in seven interim reports, two review reports, and a final comprehensive report. Interim reports have been submitted as follows: Tucson, Ariz., and vicinity, dated November 20, 1945; Queen Creek, Ariz., dated February 2, 1946; Gila River and tributaries below Gillespie Dam, Ariz., dated September 1, 1948; and lower Agua Fria River and vicinity, Arizona, dated December 10, 1952. Two additional interim reports covering (a) Pinal Creek and tributaries and (b) Gila River, Camelsback Reservoir site to Salt River, Ariz., have recently been started.

This interim report, the seventh, considers the area along Gila River from Gillespie Dam to the mouth of Salt River and the area along Salt River from its mouth to the McDowell Dam site. Review reports to consider the Gila River and tributaries, Arizona, downstream from Painted Rock Reservoir site, and Gila River and tributaries in the vicinity of Tucson, Ariz., were authorized in 1954 and 1955, respectively. Work on these review reports is under way. The final comprehensive report will include summaries of findings and conclusions in all interim and review reports, consideration of problems in area not covered in any interim report, and analysis of the interrelation of problems and plans of improvement in all parts of the Gila River Basin.

#### SCOPE OF SURVEY

- 4. General. -- The survey described in this interim report was made to consider (a) the need for flood control and (b) the solution of the flood problems in that part of the Gila River Basin, Ariz., that is along Gila and Salt Rivers between Gillespie Dam and McDowell Dam site. Consideration was given to the preservation and protection of established and potential uses of water and to the development of comprehensive and coordinated projects for improvement.
- 5. Topographic surveys and mosaics.—Aerial surveys of Gila and Salt Rivers from Gillespie Dam to McDowell Dam site were made by the Corps of Engineers in 1949. Cross sections of the river channel were taken at intervals of approximately 1 mile. Reconnaissance surveys of McDowell Dam site were made; detailed topographic surveys of the dam site were made by the United States Bureau of Reclamation.
- 6. Site investigations and explorations.—Geological reconnaissance of the McDowell Dam site was made by the Corps of Engineers. Logs of holes drilled at the site were supplied by the United States Bureau of Reclamation. Power-auger borings along the alinement of the Salt River levees considered were made by the Corps of Engineers. Samples of existing gravel pits near the city of Phoenix were analyzed. Adjacent areas from which adequate quantities of suitable embankment material for the levees considered and of suitable soils and aggregates that might be feasibly transported to McDowell Dam site were explored. Details of the subsurface explorations are given in Appendix 2: Geology and Soils.
- 7. Economic and other investigations.—Newspaper accounts of past floods were analyzed to determine the extent of overflow and damage from past floods. Field investigations were conducted to determine the extent of overflow from future floods and the type and value of property in the overflow areas. Assessed valuations of properties in the overflow areas were obtained and true valuations were estimated. Economic studies included analyses of crop values and farming costs. Local interests were interviewed about property values, agriculture, use and availability of water, and flood damage. A field inspection of the area was made by the district engineer.

#### PRIOR REPORTS

8. No prior survey reports on flood control in the Gila River Basin between Gillespie Dam and McDowell Dam site have been submitted to Congress by the United States Army Corps of Engineers.

#### DESCRIPTION

- 9. Location and extent.—The Gila River Basin, the largest drainage area tributary to lower Colorado River, includes the southern half of Arizona and a part of southwestern New Mexico. (See pl. 2.) The drainage area of the basin comprises about 58,200 square miles, 5,600 of which are in New Mexico, 51,500 in Arizona, and 1,100 in Sonora, Mexico.
- 10. The part of the Gila River Basin under consideration in this report comprises the Salt River Valley between McDowell Dam site (river mile 46) and the mouth of Salt River, and the Gila River Valley from the mouth of Salt River (river mile 198) to Gillespie Dam (river mile 164). The drainage areas of Salt River at McDowell Dam site and at the mouth are 12,900 and 13,700 square miles, respectively. The drainage area of Gila River at Gillespie Dam is 49,600 square miles. The Gila River Valley between Gillespie Dam and the upper end of the authorized Painted Rock Reservoir (now under construction) was also considered in this report because of the effect of a dam at the McDowell site on this area. (See index map, pl. 1, and map of Gila River Basin, pl. 2.)
- 11. Streams .- Gila River, the main stream in the drainage area. rises on the west slope of the Continental Divide in southwest New Mexico and flows generally westward about 650 miles to a point on Colorado River about 11 miles upstream from the California-Mexico boundary. The principal tributaries that join the main stream upstream from Salt River include the following streams: San Francisco and San Carlos Rivers, which enter the main stream from the north; and San Simon Creek and San Pedro and Santa Cruz Rivers, which enter from the south. The principal tributaries that join the main stream in the area under consideration in this report include Salt, Agua Fria, and Hassayampa Rivers, and Centennial Wash, which enter Gila River from the north. The principal tributaries of Salt River upstream from McDowell Dam site include Tonto Creek and Verde River. No major streams enter Salt River downstream from McDowell Dam site. The headwaters of Salt and Gila Rivers are perennial. Surface flow in other parts of the drainage area is mostly intermittent.

12. Topography. -- The area along Gila and Salt Rivers from Gillespie Dam to McDowell Dam site is part of an alluvial valley that is very favorable for agricultural development. In the drainage area above Gillespie Dam, the mountains, in the headwaters of Verde River, rise to a maximum elevation of 12,600 feet. The divide, in general, ranges in elevation from 3,000 to 9,000 feet along the south side of the basin, and from 7,000 to 9,000 feet along the north and

northeast sides. The mountains are rugged and precipitous, and the valleys are sufficiently level to be favorable for agriculture.

- Rivers is part of the Basin and Range Province, which covers a large part of southwestern United States. The surface of the area is a series of broad, connected desert valleys and plains, from which rise numerous hills and short, isolated mountain ranges. South of the area, a highland with similar topography extends many miles into Mexico. On the north, rugged mountains separate the area from the upland province known as the Colorado Plateau.
- the valleys and plains are chiefly great masses of Pre-Cambrian, metamorphose granites and volcanics, with which occur minor amounts of sedimentary rocks. During the Tertiary period, much block faulting occurred in this region and structural valleys were formed between the upthrown mountain blocks.

- 15. The intermontane valleys and plains are deeply filled with alluvium consisting of poorly assorted, coarse sediments interbedded with silt and clay. The soil in the valleys is fertile; and, where water without a high saline content is available for irrigation, the crop yields are high. The areal extent of sediments in the Salt River Valley and adjacent parts of the Gila River Valley totals several thousand square miles and includes the broad plain extending southward from Mesa and Chandler to Gila River. The maximum thickness of these sediments has not been determined but is known to exceed 1,300 feet at one point. Additional information on geology and soils in the Gila River Basin and detailed information on geology and soils at the McDowell Dam site and at the site of recommended levee and channel improvements are given in Appendix 2: Geology and Soils.
- Gila River Basin are not excessive. The gradients of Gila River and of most of the secondary streams are steep near the headwaters and decrease progressively downstream. The average slopes of Gila and Salt Rivers from the headwaters to their mouths are 13 and 25 feet per mile, respectively. The average slope of Salt River from McDowell Dam site to its junction with Gila River is about 9 feet per mile; the average slope of Gila River from Salt River to Gillespie Dam is about 5.5 feet per mile.
- 17. The channel capacity of Salt River from McDowell Dam site to its mouth is about 50,000 cubic feet per second. Normal flows meander over the bottoms of wide channels of various depths; major floods overflow the banks and spread over an area from 1 to 3 miles wide. Large flows are infrequent and the channel is partially blocked by sandbars and river-bottom growth.
- 18. In the area along Gila River from the mouth of Salt River to Gillespie Dam, the flow meanders over the flat bottom of a trench

- 5 to 20 feet deep and 1/2 to 1 mile wide. However, most of the channel bottom is overgrown with phreatophytes, principally salt-cedar. This river-bottom growth has increased the aggradation of the channel and has restricted the channel to such an extent that flows in excess of 20,000 cubic feet per second will overflow and inundate the adjoining cultivated area. The overflow area of the standard project flood would range from 1 to 2-1/2 miles in width.
- 19. The channel capacity of Gila River from Gillespie Dam to the upper end of the authorized Painted Rock Reservoir (now under construction) is about 50,000 cubic feet per second. Flows in excess of this amount will inundate adjoining land and spread over an area from 1/2 to 2 miles wide.
- 20. Vegetation. -- The type, density, and distribution of vegetation in the Gila River Basin reflect the differences in elevation, temperature, and precipitation. In general, the desert vegetation is sparse. The principal desert vegetation is cacti, creosotebush, and sagebrush. Saltcedar, mesquite, and arrowweed grow in dense thickets in stream bottoms and other areas where the water table is near the surface of the ground. Grasses interspersed with desert and semidesert shrubs grow at elevations ranging from 3,000 to 8,000 feet, but the density of vegetal cover is low below 4,500 feet and only fair at higher elevations. Overgrazing has destroyed much grass, which has been replaced by rabbitbrush and snakeweed over large areas. Chaparral, oak, pinon, and juniper grow at elevations ranging from 4,000 to 7,000 feet. Aspen and conifers, such as fir, spruce, and pine, are common above elevations of 6,000 feet.
- 21. Maps.--Maps of the Gila River Basin that were prepared by agencies of the Federal Government, by the State of Arizona, and by local interests were used in the preparation of this report. Maps included as plates to this report are as follows: Plate 1, Index Map, Gila and Salt Rivers, Gillespie Dam to McDowell Dam site, Arizona; and plate 2, Gila River Basin. Additional maps prepared for special use in connection with this report accompany appendixes to this report.

#### ECONOMIC DEVELOPMENT

22. Population. -- The area affected by improvements considered in this report lies entirely in and includes most of Maricopa County, Ariz. Population in this area has increased steadily from 1900 to 1950 and has continued to increase at a rapid rate since that date. According to the United States census, the Maricopa County population was about 20,000 in 1900, 90,000 in 1920, 186,000 in 1940, and 332,000 in 1950. A local agency estimates the 1957 population of the county at 550,000. A number of cities, including Phoenix, the capital and largest city in the State of Arizona, would be affected by the improvements considered. The following table gives the 1950 population for these cities, for the Phoenix urban area, and for Maricopa County. Population estimates for 1957, where available, are also given.

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1950 and 1957 populations in area affected by the improvements considered in the interim report on survey, flood control, Gila and Salt Rivers, Gillespie Dam to McDowell Dam site, Arizona

City or area :	Population	
· · · · · · · · · · · · · · · · · · ·	1950	: 1957
Maricopa County  Phoenix  Phoenix urban area  Mesa  Glendale  Tempe  Chandler  Tolleson	*106,818 **230,000 16,790 8,179 7,684	: (***) : (***)

- \* A special census for the city of Phoenix made in March 1953 indicated a population of 128,840 in the city.
  - \*\* Estimate made by Valley National Bank, Phoenix, Ariz. \*\*\* Estimate not available.
- 23. Occupations and industries.—The principal activities in the Salt and Gila River Valleys from McDowell Dam site to Gillespie Dam are agriculture and stock raising. About 300,000 acres were irrigated in the area in 1956, providing an annual gross crop value of about \$85,000,000. The gross value of livestock in December 1953 was about \$15,000,000. The city of Phoenix is the trade and service center for most of the State of Arizona. The estimated value of retail sales in Maricopa County in 1956 was \$705,000,000, which was over 50 percent of the State total. The estimated manufacturing production in Arizona in 1956 was \$400,000,000, of which about 50 percent accrued in Maricopa County. Several large sand-and-gravel plants are located in the riverbed of Salt River.
- 24. Land use and development.—Irrigation of the Salt River Valley by white settlers began in 1867 soon after Arizona was given territorial status. Water was diverted to lands on the north bank of Salt River, near the site of the city of Phoenix. By 1871, staple crops were being produced on about 1,700 acres, and the new town of Phoenix had a population of about 300. The Santa Fe railroad was completed across northern Arizona to Colorado River in 1883, and in 1887 this line extended a branch to Phoenix. In 1900, Phoenix, with a population of 5,544, was the seat of the territorial government.
- 25. During the period 1890 to 1910, agriculture and associated industries expanded rapidly but spasmodically. Although the annual flows of the stream were more than adequate to supply the areas then irrigated, wide variations in flows occurred. Sudden rains would swell the streams to flood proportions, from which they would dwindle to

meager streamlets during the dry period. The agricultural economy was one of alternate prosperity and failure. Time after time, floods carried away the diversion dams, many of which had to be replaced every year. By the time these structures were repaired, the streamflow would in many cases be insufficient to irrigate crops in the area, or the crops had withered and died from the intensity of the desert sun. After the passage of the Reclamation Act of 1902, the Salt River project was constructed by the Bureau of Reclamation from 1903 to 1911. Granite Reef diversion dam was completed in 1908, and Roosevelt Dam was completed in 1911 with resultant impetus to agricultural development and stability for urban and industrial growth. Further developments by the Salt River Valley Water Users' Association from 1920 to 1930 provided relatively cheap electric power. As a result, irrigation of new lands by pumping from wells expanded rapidly. Development of the Salt River project, which comprises most of the irrigated lands along Salt River, is shown by the following table:

#### Area in cultivation, Salt River project (1910-56)

Year :	Area in cultivation
1910	Acres 106,000 193,000 217,000 227,000 225,000 192,600

- 26. Development of lands along Gila River below the mouth of Salt River started at the same time as development of lands along Salt River. The first irrigation canal in this area was built in 1886, and the settlement of Buckeye was founded about the same time. In 1921, the Gillespie diversion dam was built to serve about 16,000 acres of land, mainly on the left bank in the vicinity of Gila Bend.
- 27. Agriculture. -- The agricultural economy of the valleys along Salt and Gila Rivers is well stabilized, and the farmers are generally prosperous, although they experience serious losses because of floods and water shortages. The supply of irrigation water under present conditions is not sufficient to provide a full supply of good quality water to the entire acreage under cultivation. The excess acreage has been kept in production temporarily by overdrafts on ground-water storage and by failure to make adequate releases to maintain a suitable salt balance in the area. A reduction in use to fit the yield and salt-balance requirements would greatly reduce the production of agricultural crops.

- 28. Facilitated by the mild winters and a long growing season, the area is adapted to a wide range of agricultural crops. Principal crops include alfalfa, barley, cotton, flax, sugar beets, citrus crops, and truck crops, such as lettuce, cantaloupes, watermelons, and carrots. Many acres are double-cropped. During 1956, the gross value of crops in the Salt River project was about \$55,300,000 for 192,600 acres, or about \$287 per acre.
- 29. Irrigation.—Agriculture along the Salt and Gila Rivers from McDowell Dam site to Gillespie Dam is entirely dependent on irrigation. Most of the irrigated lands have gentle slopes; they are favorable for the distribution of water and for surface and underground drainage. The extensive irrigation works constructed by the prehistoric occupants of the basin and the existing development both emphasize the favorable conditions for growing crops by irrigation.
- 30. In the area under consideration, irrigation water is obtained by surface diversions supplemented by pumping from the underground supply. Along Salt River, water is diverted from the river to the two main canals at Granite Reef Dam, which is downstream from the confluence of Verde and Salt Rivers. The combined capacities of the Arizona canal, serving the north side, and the Southern canal, serving the south side, permit the diversion of all flows up to 4,000 cubic feet per second. The irrigation flow is regulated by Bartlett and Horseshoe Dams on Verde River, and Roosevelt, Horse Mesa, Mormon Flat, and Stewart Mountain Dams on Salt River. Lands in the Roosevelt Water Conservation District and the Roosevelt Irrigation District are also served by the diversion at Granite Reef Dam. Along Gila River, Buckeye and Arlington diversion structures and canals serve the Buckeye and Arlington Valleys, respectively. Gillespie Dam diverts the surface flow to lands of the Gillespie Land and Water Co. on the left bank and to lands supplied by the Enterprise canal on the right bank. Minor diversion structures, canals, and pumps serve the small irrigation districts along the Salt and Gila Rivers.
- 31. Use of ground water for the irrigation of lands in this area has increased rapidly since 1935. In 1956, about 45 percent of the total supply was obtained from wells. In the Salt River project in 1956, a total of 517,000 acre-feet were delivered from 264 wells.
- 32. The quantity of water applied annually to an acre of irrigated land varies with type of soil, kind of crops, efficiency of farm management, and amount of water available. The net duty of water varies from about 2.3 acre-feet per acre for truck crops to about 5.0 acre-feet per acre for alfalfa and grain. The average net duty of water is estimated at about 4.0 acre-feet per acre, measured at the farmer's headgate.

- 33. Water rights. -- The water code of Arizona recognizes that both surface flow and underground waters flowing in definite channels belong to the public and are subject to appropriations governed by beneficial use. Percolating water in undefined channels is the property of the overlying land and is not subject to appropriation.
- 34. Water rights within the Salt River project are adjudicated under the Kent Decree, entered March 1, 1910. The Benson-Allison Decree of November 14, 1917, adjudicated water rights between the various users of water diverted by several ditches, including the Buckeye canal, from the Salt, Agua Fria, and Gila Rivers. Various arrangements have been made between the water users under these rights and the Salt River project for the delivery of their waters. A court decree effective January 1, 1944, fixed the amount of water that should be delivered to the Buckeye district by the Salt River project as 1.1 percent of the water actually diverted at Granite Reef Dam.
- 35. One of the most significant features in the use of irrigation water, and one that has grown in importance during the recent years of deficient water supply, is the increasing amount of pumping from underground storage to compensate for deficiencies in streamflow. Many pumping installations have been made indiscriminately according to individual requirements. Extension of this practice has led to overdevelopment and overdraft from ground-water sources of supply. In 1918, the Arizona Legislature passed an act authorizing the State Land Commissioner to designate critical ground-water areas for which adequate factual data indicate that the ground-water supply has been overdeveloped. After establishment of a critical area, no person is permitted to construct any irrigation well in that area without a permit, and no permit is to be issued for construction of any well that would tend to increase the acreage irrigated.
- 36. Power.--Most of the power used in the area under consideration is obtained from local sources. Power is obtained from the Salt River Project Agricultural Improvement and Power District and from the Arizona Public Service Company. To develop power, advantage is taken of the entire 723-foot fall on Salt River from high water level at Roosevelt Lake to tailwater below Stewart Mountain Dam. The combined generating capacity at the 4 structures is about 62,800 kilowatts. A standby diesel plant and modern steam plants are the other local sources of supply. In addition, the 2 local distributing agencies have contracts with the Arizona Power Authority and the United States Bureau of Reclamation, which obtain power from Parker and Davis Dams on Colorado River. A complete transmission and distribution system provides power for domestic use (including city and rural use) and for irrigation pumping. In general, the power supply (existing and contemplated) is adequate for the needs of the area.
- 37. Transportation facilities.—Arterial highways and railroads connect the areas along Gila and Salt Rivers with centers of manufacturing and commerce throughout the nation. United States

Highways Nos. 60, 70, and 80 cross the area on their routes from the Pacific coast to the Eastern States. United States Highway No. 89, which also crosses the area, extends from the Canadian to the Mexican border. Arizona State highways supply connecting links, and many local roads complete a network that adequately serves present needs. One of the main lines of the Southern Pacific railroad traverses much of the area under consideration. A branch line of the Atchison, Topeka and Santa Fe railway connects Phoenix with the main line to the north. The Sky Harbor Airport provides daily airmail, passenger, and freight service in and out of Phoenix. Many transcontinental bus routes pass through the area.

#### CLIMATOLOGY

- 38. General.--The climate of the area along Gila and Salt Rivers from Gillespie Dam to McDowell Dam site is subtropical and arid. Wind velocities are low to moderate. The average length of the season between frosts is about 300 days in Phoenix, Ariz. Recorded extremes of temperature for a 45-year period at Phoenix are 16° and 118° above zero Fahrenheit.
- 39. Precipitation records.—Precipitation records are available for more than 600 stations in and near the Gila River Basin. Many of these stations were established since 1935 in connection with projects of the United States Soil Conservation Service. The longest continuous record is for Yuma, Ariz., where precipitation was first measured in 1870; and the earliest records are for Fort McDowell, Ariz., and Prescott, Ariz., where precipitation was first measured in July 1866 and September 1866, respectively. Autographic records are available for more than 40 of the stations, most of which were established since 1939. The longest continuous autographic record is for Phoenix, where an automatic gage was installed in 1906.
- 40. For the 71-year period prior to about 1938, the average annual precipitation at stations in the Gila River Basin above Gillespie Dam ranged from about 33 inches at Carr's ranch (elev. 5,410 feet), about 14 miles northeast of Roosevelt Dam, to less than 7 inches at Saddle Mountain (elev. 1,125 feet), 20 miles northwest of Gillespie Dam. The mean annual precipitation in the Gila River Basin upstream from Gillespie Dam is about 15 inches. The largest annual precipitation recorded in the region was 58.45 inches, which occurred in 1905 at Pinal ranch (elev. 4,520 feet), about 6 miles east of Superior, Ariz. Precipitation data for the Gila River Basin are discussed in detail in Appendix 1: Hydrology. Pertinent data on representative stations in the Gila River Basin ahove Gillespie Dam are given in the following table:

Precipitation data, representative stations in the Gila River Basin above Gillespie Dam, Ariz. and N. Mex.

Name of Street

1 C

Contraction of the last

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	Location	tion		Period of	Complete	Mean
nornanc	Latitude	Longitude	TOTAL PACE COLOR	record	record	precipitation*
		••	•			
•	Decrees-	: Degrees-	**		**	•
	minutes	: minutes	. Feet :		: Years :	Inches
Luna ranger station. N. Mex.	33-50	: 108-56	7,050 :	1900-57	: 57 :	91.91
Red Rock, N. Mex.	32-12	: 108-ll	: 1,150 :	1905-57	<u>양</u>	11,99
Ashfork Arts	35-13	: 112-29	5,110:	1902-57	 ??	12,92
Prescott, Ariz	3/1-33	: 112-28	5,354	1866-1957	: 81:	18,75
Phoenix, Ariza	33-28	: 112-04	1,083	1876-1957	. T	7,58
Gila Bend, Ariz	32-57	: 112-13	: 737 :	1889-1957	: 89 :	5,87
Roosevelt, Ariz.	33-10	: 111-09	2,230 :	1905-57	22	16,50
Fort Apache, Ariz.	33-48	: 109-59	5,300 :	1872-1934	: 62 :	24.81
Tueson, Ariz,	32-15	: 110-58	2,123 :	1891-1957	: 99 :	11,46
Pinal Ranch, Ariz	33-20	: 111-00	: 4,520 :	1893-1957	: †19 :	25,04
•		**	••		**	

<sup>\*</sup> Computed for 71-year period (1868-1938) by index-of-wetness method. Data for period subsequent to 1938 were not considered necessary for adequate determination of mean annual precipitation.

- hl. Storms.--Most precipitation in the Gila River Basin occurs in two seasons: July through September, and December through March. Precipitation during the winter usually results from general winter storms associated with extratropical cyclones of North Pacific origin. During the months from December to March, such storms move south over the ocean and then inland to southern California, Arizona, and New Mexico and result in precipitation over areas of up to thousands of square miles. Precipitation during general winter storms may be more or less continuous for several days. Relatively localized showers near the end of such storms are common. In general, precipitation is small during spring and autumn. Most precipitation during the summer results from showers of short duration and small areal extent or from general summer storms. Storms of the thunderstorm type may occur separately or in conjunction with general storms. Detailed information on storms in the Gila River Basin is given in appendix 1.
- 42. Snow.--Many precipitation records since 1900 for stations in the area include information on snowfall. Snow-course observations have been made since about 1937 at several points in the drainage areas of Verde, Salt, and upper Gila Rivers. In winter, snow may accumulate to considerable depths at elevations above 4,000 feet but practically never falls at elevations below 2,000 feet. Heavy snowfalls in the drainage basin of Gila River are limited to areas tributary to Agua Fria, Verde, upper Salt, and San Francisco Rivers.

#### RUNOFF AND STREAMFLOW DATA

- 43. Streamflow records. -- Streamflow records are available for 95 stations on Gila River and tributaries. Records of discharge at most stations during flood periods generally are inadequate. The earliest gagings for which records are available were on Salt River during 1888 near the site of Granite Reef Dam.
- hh. Records of stream discharge on Gila and Salt Rivers between Gillespie Dam and McDowell Reservoir site are available for four locations. Pertinent data for these locations are given in the following table:

Stream-gaging stations, Gila and Salt Rivers, Gillespie Dam to McDowell Reservoir site, Arizona

Location	Drainage	Period	Maximum re	ecorded flow
100401011	area	of record	Peak	: Date
	: Square : miles :		: Cubic feet : per second	
Salt River near McDowell.	6,280	1895-99; 1901-10; 1934-57.		Nov. 27, 1905.
Verde River near McDowell.	6,620	1889; 1895-99; 1901-9; 1913-57.	96,000 :	Do
Salt River near Granite Reef Dam.	12,900	1888-91; 1895; 1913-57.	300,000	: Feb. 24, 1891.
Gila River below Gillespie Dam.	19,600		; 70,000 ;	Dec. 28, 1923.

LIS. Adequacy of streamflow for multiple-purpose uses.—The daily surface runoff in Salt and Gila Rivers varies greatly during the year, and the annual surface runoff varies greatly from year to year. Flow in the river is erratic and out of phase with irrigation requirements. As a result, many large reservoirs have been constructed upstream from Gillespie Dam to store the runoff until needed. The effect of these structures has been to conserve nearly all flow of the Salt River upstream from McDowell Dam site except during some flood seasons. During the period 1923-57, if existing reservoirs had been in operation during the entire period, flow would have been available for conservation at McDowell Dam site for only 4 of the 35 years of record. Preliminary estimates made by the United States Bureau of Reclamation show the following flow as being available at McDowell Dam site:

Flow available for conservation at McDowell Dam site, Salt River, Ariz. (1923-57)

. Year	Available flow
1927 1932 1937	Acre-feet 80,600 204,000 188,800 387,300
Total Say:	860,700 860,000

#### FLOODS

- 46. Floods of record.—Historical reference to floods on Salt and Gila Rivers from McDowell Dam site to Gillespie Dam extends back to 1833, but estimates of discharge measurements are for only the period 1888 to date. Large floods during this period occurred in 1891, 1905, 1916, 1920, and 1938.
- 17. The greatest flood of record occurred in February 1891. The peak discharge of this flood was estimated at 300,000 cubic feet per second on Salt River at Arizona Dam (approximately same location as the present Granite Reef Dam). Other major floods of record, for which adequate estimates of peak discharge along Salt River below Verde River are available, include: February 1920, 130,000 cubic feet per second; January 1916, 120,000 cubic feet per second; April 1905, 115,000 cubic feet per second; and March 1938, 95,000 cubic feet per second. Additional information on floods is given in Appendix 1: Hydrology; and in Appendix 5: Benefits from Improvements.
- 48. Flood characteristics .-- Major floods along Salt and Gila Rivers from McDowell Dam site to Gillespie Dam result from general winter storms over the Gila River Basin. Many of the streams in the Gila River Basin rise in steep mountain areas where the rate of runoff is relatively high. During major storms, the water concentrates quickly in the channels and results in violent and destructive floods. The peak discharges of floods are relatively high in comparison with the total volume of floodwater. Channel storage and losses reduce the flood peaks when no additions are made by side drainage. Because Salt and Gila Rivers flow westward and winter storms usually move eastward over the basin, the probability of synchronization of peaks of winter floods from the different tributaries is small. Peaks from downstream (western) tributaries usually pass on before the runoff from the area farther east arrives. The base flow, made up of contributions from ground water, melting snow, and surface runoff from rain prior to rain of flood-producing intensities, is relatively small in comparison with the peak floodflows.
- 49. Flood frequencies.—The frequencies of floods considered in detail were determined under the assumption that all existing reservoirs in the Gila River Basin and the proposed Buttes and Charleston Reservoins (see subsequent heading "Proposed Improvements Affecting the Problem") would be in operation. Records of peak flows and peak-flow estimates, based on data for the 69-year period 1889-1957, were used in preparing discharge-frequency curves. Detailed information on flood frequencies is given in Appendix 5: Benefits from Improvements. The estimated frequencies of floods of various magnitudes for Salt River at McDowell Dam site and Gila River at Painted Rock Dam site are listed in the following table:

Estimated frequencies of floods of various magnitudes, Salt River at McDowell Dam site and Gila River at Painted Rock Dam site, Arizona

Number of times that	Peak discharge		
flood would be equaled or exceeded in 100 years	Salt River at McDowell Dam site	Gila River at Painted: Rock Dam site	
0.6	Cubic feet  per second  *290,000  240,000  175,000  108,000  68,000  **50,000  (***)	Cubic feet per second *320,000 261,000 195,000 120,000 74.000	

<sup>\*</sup> Standard project flood.

- 50. Standard project flood.—A standard project flood may be defined as a large hypothetical flood that would be exceeded only on rare occasions. It could occur in the Gila River Basin if a storm equivalent in magnitude to the largest general storm or storms of record in the region were to center over the basin when ground and climatic conditions were conducive to a high rate of runoff. Estimates of the magnitude of such a flood serve not only as a reasonable yardstick for determining the flood-producing potentialities of the basin but also as a reasonable upper limit in determining the size of the flood that should be considered in designing flood-control improvements.
- 51. Estimates of the magnitude of the standard project flood for points on Salt River from McDowell Dam site to the mouth are based on calculations of runoff that would have resulted if a storm having characteristics of both the January 1916 and March 1938 storms were centered over the area above the McDowell Dam site. Estimates of the magnitude of the standard project flood for points on Gila River are based on the assumed occurrence of the January 1916 storm, centered over the area above Gillespie Dam, and assuming that the proposed Buttes and Charleston Reservoirs were in operation. Detailed information on the determination of the standard project flood is given in Appendix 1: Hydrology. The peak discharges of the standard project flood are given in the following table:

<sup>\*\*</sup> Minimum damaging flood.

<sup>\*\*\*</sup> Not determined.

Estimated peak discharges, standard project flood, Gila and Salt Rivers, Gillespie Dam to McDowell Dam site, Arizona

Stream	Location	River mile	Peak discharge
Do	McDowell Dam site  Mouth,	198	250,000 370,000

52. Maximum probable flood.—The maximum probable flood is that flood that would result from the most severe combination of meteorological and ground conditions considered possible of attainment in the drainage area. The peak discharge of the maximum probable flood at McDowell Dam site is estimated at 600,000 cubic feet per second. This flood is used only for spillway-design purposes. Detailed information on the determination of the maximum probable flood is given in Appendix 1: Hydrology.

# EXTENT AND CHARACTER OF OVERFLOV AREA

53. Location and extent.—The overflow areas considered in detail are as follows: (a) 44,000 acres along Salt River from McDowell Dam site to the mouth; (b) 41,000 acres along Gila River from Salt River to Gillespie Dam; and (c) 17,000 acres along Gila River from Gillespie Dam to the upper end of Painted Rock Reservoir site. The last area was considered because of the effect that McDowell Reservoir would have on floodflows of Gila River below Gillespie Dam. The overflow areas investigated in detail are described more fully in Appendix 5: Benefits from Improvements, and are shown on map, plate 1 of that appendix.

- 54. Type and value of improvements.—Developed areas subject to overflow by floods along Salt and Gila Rivers are mostly agricultural. However, the value of residential, business, industrial, and public properties in the cities of Phoenix and Tempe greatly exceeds the total value of other properties in these areas. Pertinent information on the type and value of improvements in overflow areas is given in the following subparagraphs.
- (a) Overflow area along Salt River, McDowell Dam site to mouth.—The 1957 cultivated acreage in the overflow area of Salt River, McDowell Dam site to mouth, is estimated at 16,000 acres. In addition, about 4,000 acres of residential, commercial, and public property in Phoenix, Tempe, and South Phoenix are subject

to inundation. Other improvements subject to damage include highways, roads, two long highway bridges, one railroad bridge, irrigation works, and utilities including the Phoenix and Tempe sewage disposal plants.

- (b) Overflow area along Gila River, Salt River to Gillespie Dam.—About 15,000 acres of the overflow area of Gila River, Salt River to Gillespie Dam, were cultivated in 1957. This acreage is mostly along the right bank of the river. The community of Liberty and many rural residences are subject to damage. The headings of the Buckeye and Arlington canals and the canals themselves are subject to overflow and repeated damage. Other property subject to damage includes short sections of highways and roads, the Buckeye sewer farm, and some utility crossings of Gila River.
- (c) Overflow area along Gila River, Gillespie Dam to upper end of Painted Rock Reservoir site.—About 1,300 acres of irrigated land in the overflow area along Gila River, Gillespie Dam to the upper end of Painted Rock Reservoir site, are subject to inundation. Damage in this area will occur mainly to agricultural property, irrigation works including Gillespie Dam, and highways and roads.
- (d) Summary.—A summary of information on the type and 1957 value of property in the overflow areas considered in detail is given in the following table:

#### PROPOSED IMPROVEMENTS AFFECTING THE PROBLEM

- 68. Three reservoirs of significance to the problems discussed in this report have been recommended by the United States Bureau of Reclamation as part of the central Arizona project now pending for consideration in Congress (see H. D. 136, 81st Cong., 1st sess.). Action by Congress on the project is being held in abeyance pending settlement in the Supreme Court of the controversy between the States of Arizona and California regarding rights to Colorado River water. Those reservoir units of the proposed central Arizona project that affect the problems considered in this report are described according to location in the following subparagraphs:
- (a) Gila River Basin above Salt River. -- Two multiple-purpose reservoirs, providing flood-control storage, have been proposed for construction upstream from the area under consideration, as follows: Buttes Reservoir on Gila River at river mile 287 and Charleston Reservoir on San Pedro River at river mile 121 (see pl. 2). In general, although the overall effect of the two reservoirs on the flood problems in the area under consideration in this report is small, some significant effects in that part downstream from the mouth of Salt River would result from the reservoirs during large floods originating from the Gila River Basin above Salt River. In the studies for this report, these two reservoirs have been assumed to be in operation.
- (b) Salt River Basin. -- The proposed Bureau of Reclamation's central Arizona project provides for the importation of water from the Colorado River to the Gila River Basin. A portion of this imported water, in excess of immediate demands, would be stored in a proposed reservoir to be constructed at the McDowell site on Salt River (see pl. 1). A capacity of 188,000 acre-feet, designated in this report as "terminal" storage, would be required under the proposed project to store the imported water. In addition to such terminal storage, the proposed project would provide for flood-control storage of 390,000 acre-feet, making a total proposed capacity for the McDowell Reservoir of 578,000 acre-feet. The McDowell Dam proposed by the Bureau of Reclamation in House Document 136, 81st Congress, 1st session, would be 126 feet in height. The dam, which would be of concrete slab and buttress construction with earthfill wings, would contain a power plant as an integral part of the dam with a capacity of 4,100 kilowatts. The estimated construction cost for the dam and reservoir based on July 1947 prices as shown in the document is \$16,326,000. The estimated construction cost of the power plant on the same basis is \$1.012.000. Consideration is given in this report to the need and justification for including additional capacity for flood-control storage in the ... proposed reservoir.

#### IMPROVEMENTS DESIRED

- 69. Public hearing. -- A joint public hearing on flood control in the entire Gila River Basin was held at Phoenix, Ariz., on October 20, 1938, by the Departments of Army and Agriculture with the district engineer, United States Army Engineer District, Los Angeles, Calif., presiding. The hearing was attended by 111, persons including representatives of various agencies of the Federal Government, officials of the State of Arizona and its political subdivisions, representatives of local civic organizations, and interested private citizens.
- 70. Improvements desired by local interests.--Information obtained at the public hearing indicated that local interests desire clearing and straightening the channels of Gila and Salt Rivers to prevent flood damage along those streams. Since the public hearing, local interests have expressed grave concern about the deteriorated condition of the channels of Gila and Salt Rivers.
- Representatives of local interests stressed the necessity of flood control on Gila and Salt Rivers between Gillespie Dam and McDowell Dam site to (a) prevent flooding and inundation of rural and urban properties in the cities of Phoenix and Tempe, in the communities of South Phoenix and Liberty, and in the project lands of the Salt River Valley Water Users' Association, the Buckeye Irrigation District, the Arlington Irrigation District, and on other lands; (b) prevent erosion of land; (c) prevent damage to cropland because of interruption of irrigation; and (d) prevent interruption of railroad and highway communication and of utility services. Representatives of local interests also stressed that control of floods by clearing the channel would result in reducing the evapotranspiration losses from the growth within the channel and thereby would increase the safe yield of the ground-water supplies.

#### FLOOD PROBLEMS AND RELATED PROBLEMS

- 72. Flood problems.—Salt River below Granite Reef Dam and Gila River below the mouth of Salt River and above Gillespie Dam flow through developed commercial and agricultural areas that have been subjected to flooding by these streams in the past. The cities of Phoenix and Tempe and the communities of Lehi, South Phoenix, and Liberty are subject to inundation. The most noteworthy of past floods occurred in 1891, 1905, 1916, 1920, and 1938.
- 73. During the 1891 flood, floodwaters eroded the right bank of Salt River near 40th Street, Phoenix, and then following a course along Henshaw Road (one-half mile south of the Southern Pacific railroad) inundated the developed area south of that road. Although extensive regrading of the area has taken place in

connection with construction of the Sky Harbor Airport, a recurrence of such an overflow probably would take place on the occurrence of a flood approaching the magnitude of the standard project flood.

- 74. Reservoirs on Salt and Verde Rivers have impounded much of the floodflows of recent years. The total storage space provided amounts to about 2,000,000 acre-feet. Since water-conservation storage has been provided, some flood control has been gained, especially in years of low flow or in years immediately following a depleted water supply. However, because of the great need for stored water for irrigation and for power, all reservoirs are filled to maximum capacity whenever possible, thus eliminating most of the flood-control features.
- 75. Since most floodflows were reduced by storage, the combination of a comparatively dry river channel and a high water table has resulted in an infestation of water-loving plants (phreatophytes) that have achieved in some places almost maximum density. With the channel thus choked, the occurrence of even a small flood on Salt and Gila Rivers could result in serious damage to highly improved rural and urban areas.
- 76. Water-conservation problems. -- Flood problems in the Gila River Basin are related closely to the problems of water conservation and water utilization. The construction of the existing waterconservation reservoirs on Salt and Verde Rivers has conserved for use most of the flow of these streams. However, because of the nature of the streamflow, utilization of the runoff is incomplete. During the calendar years 1923-57, about 3,200,000 acre-feet have spilled over Granite Reef Dam. This amount is about 10 percent of the undepleted flow at Granite Reef Dam. During this period, Horse Mesa, Mormon Flat, Stewart Mountain, Bartlett, and Horseshoe Dams were constructed. Studies by the United States Bureau of Reclamation indicate that if these reservoirs had been in operation during the entire period they would have conserved all Salt River flow and most' of Verde River flow. The amount of water that would have spilled under existing conditions of development is estimated at 860.000 acre-feet for the 35-year period, or an average of about 25,000 acre-feet per year. This water would have come during four flood seasons--1927, 1932, 1937, and 1941. In order to conserve the flow, large holdover storage would be required with attendant severe evaporation rates.
- 77. Phreatophytic growths within the channel area transpire and evaporate tremendous amounts of water annually. According to the United States Geological Survey, the annual use of water per acre by plants in the channel area, assuming 100 percent density, is estimated as follows: Saltcedar, 7.2 acre-feet; cottonwood and willow, 6.0 acre-feet; baccharis, arrowweed, and miscellaneous brush, 4.7 acre-feet; and mesquite and paloverde, 3.3 acre-feet. The minimum average annual transpiration by phreatophytes from a 2,000-foot-wide channel extending from Gillespie Dam on Gila River to Granite Reef

home life, public affairs, business transactions, and industrial activity; and (c) improvement of drainage conditions. Intangible benefits from water conservation would include a stabilization of property values by partially alleviating the existing water shortage and a general improvement in the long-term social and economic welfare. The project is justified.

- 135. Allocation of costs between flood control and water conservation was arrived at by use of the separable costs-remaining benefits method. Costs of the recommended plan allocated to flood control and water conservation were further apportioned in accordance with the general policies expressed in acts of Congress. Under this apportionment, local interests would repay, to the United States, 25 percent of the total construction cost in 10 equal annual payments without interest. Based on the present (October 1957) estimated construction cost for the project of \$3,300,000, the total local reimbursement in consideration of water-conservation benefits would amount to \$825,000 and the annual payments by local interests for the 40-year period would amount to \$20,625. The actual amount of local reimbursement would be adjusted on the basis of actual construction costs. In addition to such annual payments, local interests, at their own expense, would (a) pay for the cost of highway and utility relocations and provide necessary lands, easements, and rights-of-way at a cost estimated at \$210,000 (October 1957), and (b) maintain and operate the completed project at an average annual cost estimated at \$53,000. Because of the special circumstances wherein the waterconservation benefits would be realized, the district engineer is of the opinion that the 160-acre limitation should not be applied as a prerequisite for this project's qualifying for interest-free funds.
- 136. The plans of improvement and the general requirements of cooperation were discussed with local interests. The Board of Supervisors of Maricopa County, Ariz., has expressed its willingness to participate in the costs of the project and in meeting other items of local cooperation.

#### CONCLUSIONS

- 137. The district engineer concludes that:
- (a) A flood menace exists along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam.
- (b) River-bottom growth within the channels of the Gila and Salt Rivers is a major flood hazard and transpires large amounts of water annually.
- (c) Complete protection to most of Tempe against the standard project flood, partial protection to Phoenix and the adjacent commercial and agricultural areas, and partial protection to other

areas along the Gila and Salt Rivers between Gillespie Dam and Granite Reef Dam can be provided by construction of short levees along Salt River between 40th Street, Phoenix, and Tempe Butte, Tempe, and channel improvements along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam.

- (d) The proposed improvement would result in the salvage of at least 16,000 acre-feet of water annually, which would be available for beneficial use. To assure this saving, adequate maintenance would be required.
- (e) In consideration of the water-conservation benefits that would result from construction of the recommended project, local interests should be required to reimburse the United States for that part of the project construction cost allocated to water conservation, and such reimbursement should be made in 40 equal annual payments without interest.
- (f) The total first cost of the proposed improvement would be \$3,510,000 (October 1957), and the total annual charges would be \$176,800. The average annual tangible benefits from this improvement would be \$354,000.
- (g) The ratio of tangible benefits to cost would be 2.00 to 1. The proposed project is feasible from an engineering standpoint and is well justified by the tangible and intangible benefits.
- (h) The addition of sufficient flood-control storage to control a standard project flood at a reservoir at the McDowell site is justified at such time as the reservoir at this site is required for terminal storage. Such storage would provide an adequate degree of flood protection for the fast-growing urban area in the vicinity of Phoenix.

#### RECOMMENDATIONS

- 138. The district engineer recommends:
- (a) That the United States adopt a flood-control and water-conservation project for the construction of short levees along the Salt River between 40th. Street, Phoenix, and Tempe Butte, Tempe, and channel improvements along the Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam at a total first cost estimated at \$3,510,000 (October 1957) and an average annual maintenance and operation cost estimated at \$53,000.
- (b) That the Corps of Engineers, United States Army, construct the levee and channel improvements at a Federal first cost estimated at \$3,300,000 (October 1957) subject to the condition that local interests furnish assurances satisfactory to the Secretary of the Army that they will (1) pay for the cost of highway and utility

#### PROPOSED IMPROVEMENTS AFFECTING THE PROBLEM

- 68. Three reservoirs of significance to the problems discussed in this report have been recommended by the United States Bureau of Reclamation as part of the central Arizona project now pending for consideration in Congress (see H. D. 136, 81st Cong., 1st sess.). Action by Congress on the project is being held in abeyance pending settlement in the Supreme Court of the controversy between the States of Arizona and California regarding rights to Colorado River water. Those reservoir units of the proposed central Arizona project that affect the problems considered in this report are described according to location in the following subparagraphs:
- (a) Gila River Basin above Salt River. -- Two multiple-purpose reservoirs, providing flood-control storage, have been proposed for construction upstream from the area under consideration, as follows: Buttes Reservoir on Gila River at river mile 287 and Charleston Reservoir on San Pedro River at river mile 121 (see pl. 2). In general, although the overall effect of the two reservoirs on the flood problems in the area under consideration in this report is small, some significant effects in that part downstream from the mouth of Salt River would result from the reservoirs during large floods originating from the Gila River Basin above Salt River. In the studies for this report, these two reservoirs have been assumed to be in operation.
- (b) Salt River Basin. -- The Bureau of Reclamation's proposed central Arizona project provides for the importation of water from the Colorado River to the Gila River Basin. A portion of this imported water, in excess of immediate demands, would be stored in a proposed reservoir to be constructed at the McDowell site on Salt River (see pl. 1). A capacity of 188,000 acre-feet, designated in this report as "terminal" storage, would be required under the proposed project to store the imported water. In addition to such terminal storage, the proposed project would provide for floodcontrol storage of 390,000 acre-feet, making a total proposed capacity for the McDowell Reservoir of 578,000 acre-feet. The McDowell Dam proposed by the Bureau of Reclamation in House Document 136, 81st Congress, 1st session, would be 126 feet in height. The dam, which would be of concrete slab-and-buttress construction with earthfill wings, would contain a power plant as an integral part of the dam with a capacity of 4,100 kilowatts. The estimated construction cost for the dam and reservoir based on July 1947 prices as shown in the document is \$16,326,000. The estimated construction cost of the power plant on the same basis is \$1,012,000. Consideration is given in this report to the need and justification for including additional capacity for flood-control storage in the proposed reservoir.

#### IMPROVEMENTS DESIRED

- 69. Public hearing. -- A joint public hearing on flood control in the entire Gila River Basin was held at Phoenix, Ariz., on October 20, 1938, by the Departments of Army and Agriculture with the district engineer, United States Army Engineer District, Los Angeles, Calif., presiding. The hearing was attended by 114 persons including representatives of various agencies of the Federal Government, officials of the State of Arizona and its political subdivisions, representatives of local civic organizations, and interested private citizens.
- 70. Improvements desired by local interests. -- Information obtained at the public hearing indicated that local interests desire clearing and straightening the channels of Gila and Salt Rivers to prevent flood damage along those streams. Since the public hearing, local interests have expressed grave concern about the deteriorated condition of the channels of Gila and Salt Rivers.
- Representatives of local interests stressed the necessity of flood control on Gila and Salt Rivers between Gillespie Dam and McDowell Dam site to (a) prevent flooding and inundation of rural and urban properties in the cities of Phoenix and Tempe, in the communities of South Phoenix and Liberty, and in the project lands of the Salt River Valley Water Users' Association, the Buckeye Irrigation District, the Arlington Irrigation District, and on other lands; (b) prevent erosion of land; (c) prevent damage to cropland because of interruption of irrigation; and (d) prevent interruption of railroad and highway communication and of utility services. Representatives of local interests also stressed that control of floods by clearing the channel would result in reducing the evapotranspiration losses from the growth within the channel and thereby would increase the safe yield of the ground-water supplies.

# FLOOD PROBLEMS AND RELATED PROBLEMS

- 72. Flood problems. -- Salt River below Granite Reef Dam and Gila River below the mouth of Salt River and above Gillespie Dam flow through developed commercial and agricultural areas that have been subjected to flooding by these streams in the past. The cities of Phoenix and Tempe and the communities of Lehi, South Phoenix, and Liberty are subject to inundation. The most noteworthy of past floods occurred in 1891, 1905, 1916, 1920, and 1938.
- 73. During the 1891 flood, floodwaters eroded the right bank of Salt River near 40th Street, Phoenix, and then following a course along Henshaw Road (one-half mile south of the Southern Pacific railroad) inundated the developed area south of that road. Although extensive regrading of the area has taken place in

flood-control storage or flood-control and water-conservation storage in addition to the storage required for a terminal reservoir.

- 81. Detailed consideration was given to three plans of improvement, as follows: (a) The recommended plan, which would provide for short levees along Salt River between 40th Street, Phoenix, and Tempe Butte, Tempe; and channel improvements along Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam; (b) a plan for short levees along Salt River between 40th Street, Phoenix, and Tempe Butte, Tempe; channel improvements along Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam; and flood-control storage added to the proposed terminal-storage reservoir at the McDowell site; and (c) a plan for levees along Salt River between 27th Avenue, Phoenix, and Tempe Butte, Tempe; and channel improvements along Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam.
- Short levees along Salt River between 40th Street, Phoenix, and Tempe Butte, Tempe; and channel improvements along Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam (recommended plan) .--The recommended plan provides for 32 miles of levees along Salt River between 40th Street, Phoenix, and Tempe Butte, Tempe; and channel improvements along Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam. As discussed under the subsequent heading "Benefits from prevention of flood damage," improvements under this plan would provide complete protection against the standard project flood for most of the city of Tempe and a part of the city of Phoenix, but only partial protection for an additional area in the city of Phoenix, for the adjacent developed areas, and for other areas along Gila and Salt Rivers from Gillespie Dam to Granite Reef Dam. The average annual damages prevented would be 34 percent of the total average annual damages in the area under consideration. The short levees would consist of (a) a levee along the left bank of Salt River for about 2,000 feet from Tempe Butte to the Southern Pacific railroad bridge embankment and (b) a levee along the right bank of Salt River for about 16,700 feet from the Southern Pacific railroad bridge embankment to 40th Street, Phoenix. Construction of the major part of the right-bank levee would consist of enlarging the existing canal levee and of placing rock facing. The right-bank levee would incorporate the existing Joint Head Dam. The levees would be compacted earthfill structures that would range in height from 7 to 22 feet above the natural ground and from 23 to 28 feet above streambed. Slopes on both sides of the levee would be 1 on 2. The width of crown would be 18 feet. The levees were designed to accommodate the standard project flood of 270,000 cubic feet per second (290,000 cubic feet per second at McDowell Dam site) with a minimum freeboard allowance of 3 feet. Computed velocities would, in general, vary from 8 to 12 feet per second. The river side of the levees would be revetted with rock facing 1.25 feet thick on a gravel filter blanket 6 inches thick. The levee revetment would extend to a minimum depth of 5 feet below the existing streambed. Two ramps over the rightbank levee would be provided - one at Delano Avenue and the other at 40th Street.

STATE LAND DEPARTMENT STATE OF ARIZONA PHOENIX, ARIZONA

December 4, 1951

Colonel W. R. Shuler District Engineer Corps of Engineers, U. S. Army 751 South Figueroa Street Los Angeles 17, California

Dear Sir:

Reference is made to your letter of November 23d with respect to your report on flood control, Gila and Salt Rivers, Gillespie Dam to McDowell Dam site, and forwarding to me the changes that have been made since the original interim report was made June 8, 1951.

In connection with this report I wish to advise that I have reviewed the interim report together with the changes recently forwarded to me, and I have no suggestions to make with respect to it. I think the work as outlined in the report, when completed, will afford protection to the area with the possible exception of extreme conditions. Even under such extreme conditions the protection afforded will be of material advantage.

Thanking you for sending me copies of the report, I am

Very truly yours,

/s/ W. W. Lane
W. W. Lane
State Land Commissioner

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# The Magnificent Experiment

Building the Salt River Reclamation Project 1890-1917

KAREN L. SMITH

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The University of Arizona Press
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# Preface

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As a child living in Phoenix in the early 1960s, I knew little about the problems of water in the desert and nothing at all about the Salt River Project. I simply assumed that water would come out of the tap when I turned the faucet and out of the control valve in the middle of the yard when it was our turn in the neighborhood to irrigate. I left the valley for more humid regions of the country and soon forgot about irrigating altogether. It was only when I returned to Phoenix as a graduate student that the connection between Phoenix and water became more important.

On the face of it, the growth of metropolitan Phoenix from a dusty village located near the Salt River to the ninth-largest city in the United States has been something of an anomaly. There was no major railroad connection to Phoenix until the 1920s, no harbor or navigable river to spawn commerce, and no major trail or crossroads to lure tired travelers to stop. Farmland was rich and would grow any number of crops year-round if there was an artificial way to put water on the soil. But the water supply was uncertain; desert rivers are flashy and unpredictable, one year sending torrents of water to flood and the next hardly providing sufficient amounts to grow crops. The key to sustained growth had to be insuring the water supply.

The history of metropolitan Phoenix and much of the growth of Arizona is, thus, linked inseparably to an assured, developed water supply; this association is true for much of the West. When Paul G. Weimann asked me to return to Phoenix from the University of California at Santa Barbara to help him with a historical research project

he had undertaken at the Salt River Project, I jumped at the chance to explore further the history of the federal reclamation project and water institution which has meant so much to Arizona.

As I began to examine the early history of the Project, I found that it was interwoven with the history of social reform in the United States during the period of time generally known as the Progressive Era (roughly dating from the 1890s to the 1920s). The relationships between the Salt River Valley water users and the government's Reclamation Service seemed to me to tell an important story about the false starts and early successes of implementing a national reform policy—federal reclamation—at a local level. Instead of simply writing a history about the early years involved with building the Salt River Project, the significant story, I thought, lay in the shifts in policy and institutions which resulted from the local water users' hammering out a means to live with the federal reclamation requirements. The resulting compromise provided the framework for city-building in the Salt River Valley and served as a model for reclamation projects throughout the arid West.

There is a poignant human story involved with the building of the Salt River Project as well. Men who believed firmly in the social goals of the reclamation reform movement became bitter when others throughout the West did not share their crusading spirit. Strong friendships were made and broken as engineers and farmers attempted to build their dreams into a realistic reclamation project. The engineers of the United States Reclamation Service, the agency charged with implementing national reclamation, were eager to have a successful project to demonstrate the virtues of conservation. The excellent physical conditions and the organized landowners in the valley made the Salt River Project a likely candidate. Moreover, the valley's population of cautious, small-acreage-holding farmers seemed ideal. For Salt River Valley landowners, however, government subsidy through the reclamation program also meant federal control. The reconciliation of federal reclamation principles with local irrigation practices shaped the direction the reclamation program would follow, both within the Salt River Valley and across the arid West. Conflict between the engineers and the farmers over project control, accountability for construction costs, repayment policy, and conservation philosophy highlighted both the strengths and weaknesses of national reclamation as it was implemented at Salt River. The resulting compromise suggested that reclamation as progressive reform would become less a crusade than a business, driven more by politicians than technical experts.

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The history of the Salt River Project from 1890 to 1917 is the story of the implementation of federal reclamation policy. It shows the process by which reclamation as progressive reform became reclamation as bureaucracy and it suggests how local leaders adapted, rebelled, and adapted again to the marriage of their traditional irrigation practices and government reclamation policy. It also traces the origin of the special relationship that the Salt River Project and the Department of Interior have maintained since the turn of the century. This case study of one reclamation project cannot suffice as evidence of the program's success or failure, but those interested in the reclamation movement and the development of western water resources will find Salt River's story revealing.

In the 1980s the Salt River Project has been a controversial institution, supplying electrical energy and managing the water resources for most of metropolitan Phoenix. This history of its early years points out the deep roots that the project has in central Arizona and, indeed, in the national reclamation scene. As city and farm continue to compete for greater shares of an already scarce resource, it will become increasingly important to understand why the Salt River Project was built.

#### ACKNOWLEDGMENTS

This history of the Salt River Project from 1890 to 1917 would not be possible but for some extraordinary support from friends, family and colleagues. Paul Weimann served as both inspiration and sounding board as I shifted the setting and focus of the book. I am certain that this story would not have been written without him. My doctoral committee at the University of California at Santa Barbara reviewed its arguments and logic at an early stage: G. Wesley Johnson, Jr., Carroll Pursell, Jr., Patricia Cline Cohen, and Dean Mann. Carroll

# The Campaign for Water Storage

The need for a secure water supply is a timeless one in the arid lands of the world. Arizona's Salt River Valley, which extends along the Salt River from the Verde River to the Gila River, is typical of the arid American Southwest; no crop will grow without the artificial application of water to the soil. Desert rivers, which seem at first the antidote to the region's limited rainfall, complicate southwestern agriculture because they are not reliable sources of water; their sometimes violent flood and drought cycles make water supply chaotic.

The campaign for a stable water supply in the Salt River Valley dominated economic and political affairs in the area since the time of the first American settlements in the 1860s. It was clear to farmers and landowners as early as the 1880s that a water-storage system was the essential ingredient in maintaining the valley's growth.

# NATIONAL IRRIGATION POLICY AT THE TURN OF THE CENTURY

In 1889 the United States Senate created the Committee on Irrigation and Arid Lands; its stated purpose was "to consider the subject of irrigation and the best means of reclaiming the arid lands of the United States." The members of the newly formed committee traveled throughout the West, gathering information and prompting local communities to explore various reclamation proposals. In the Salt River Valley of south-central Arizona, farmers and landowners had recognized the importance of obtaining a water-storage dam to

articles of incorporation requiring appurtenance of water to the land, determination of prior rights and acreage to be served water under the project, and retention of title to the storage works by the government until provided for otherwise. Section Eleven, however, proposed a new twist to government reclamation on the Salt River Project:

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promulgate rules and regulations for the administration of the water to be supplied from said proposed irrigation works, such rules and regulations, and such modifications thereof as the Secretary may, from time to time, approve and promulgate, shall be deemed and held to be obligatory upon this Association as fully and completely and to every intent and purpose, as if they were now made, approved, promulgated and written out in full in this memorandum, and are to be read and construed as if so done.<sup>17</sup>

As Gifford Pinchot had struggled to centralize control of the nation's forests within his bureau of the federal government, Frederick Newell had quietly taken steps to consolidate authority over the uses of reclamation-project water, at least on Salt River, in the hands of the Secretary of Interior.

The contract of 1904 was one which favored the government, although the water users on Salt River had no criticism of this. The earlier concern of owning and controlling the storage works "for ourselves" seemed to dissipate in the anxiety about receiving stored water. Submitted to the water users in May, and lobbied for hard by Fowler, the contract was ratified by more than the required two-thirds of the small vote cast, winning 24,662 votes out of a total of 24,902 (one acre one vote). Heard and his group may have taken control of the Board of Governors, but Fowler seemed to still engender confidence in his administration, as indicated both by ratification of the contract and by the low voter turnout. 18

If the contract with the United States favored the government, it also offered advantages to the Association, for it committed the Reclamation Service irrevocably to the successful construction, operation, and maintenance of the Salt River Project. Fowler, who advocated the conservation principles set forth by Pinchot and Newell of the Roosevelt administration, welcomed the centralized authority of the Service, and saw in it the end of water problems in the West. So committed was Fowler to this set of principles that he was often asked by Newell and others in the Reclamation Service to travel with them to other projects, so that he could give the many water users in the West his first-hand experience with federal reclamation. In fact, the Recla-

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mation Service requested, over the course of almost a year, that Fowler visit some of the northern projects to explain government requirements for federal reclamation and to assist the water users there in preparing the framework of organization. He was, as the Reclamation Record reported, "one of the loyal friends of the Service." 19

Fowler understood what the Reclamation Service was trying to create on the arid lands west of the 100th meridian, and in many instances he brought the Service the support of the Salt River Valley Water Users' Association when no other group of landowners would step forward. His relationship with Frederick Newell had been critical to securing the selection of Salt River as a reclamation project; it would remain important for expansion of the original plans. Yet the close relationship between Fowler and the Reclamation Service—focused as it was on the large, national picture—excluded others in the Association who were more concerned with the local situation at Salt River. As a result, few within the Association understood just what the Reclamation Service might expect of them. As long as construction of the project proceeded smoothly and the cost remained low, most valley landowners had no quarrel with Fowler or his philosophy, and seemed content to let him lead as he wished.

Title to the Tonto damsite still belonged to the Hudson Reservoir and Canal Company, and before actual construction could begin on the project, it had to be purchased by the water users for the government. Henry H. Man, president of the Hudson Company, demanded \$200,000 for the site; when the Reclamation Service refused, he reduced this to \$100,000. In early 1904 the government appointed a board to appraise the holdings of the company at the Tonto site; the appraisal board recommended \$40,000 as the purchase price, and the Hudson Company accepted this figure. Many landowners in the valley, however, thought this amount generous:

Few people believe that the Hudson Reservoir Company has a moral right—as to the legality they know nothing—to a single dollar of the money raised by mortgaging the farms of the Salt River Valley; few people can be induced to believe that these New Yorkers with a Phoenix assistant have any moral right to recover from the people of this section the money they spent in promoting a scheme of which they made a failure; few people will appreciate the generosity which prompted them, when they were flatly told they could not have \$200,000 or \$100,000, to accept \$40,000 "rather than delay construction of the reservoir."<sup>20</sup>

In a deed dated July 19, 1904, the Hudson Company conveyed to the United States all of its rights associated with the Tonto damsite.<sup>21</sup> Most of the land within the flood lines of the reservoir had been purchased by 1905, and the remainder, estimated to be about fifteen percent of the total, would be condemned because of bad title or excessive price.<sup>22</sup> Finally, the Tonto reservoir site which Maricopa County surveyor W. M. Breakinridge had reported upon so favorably in 1889 belonged to the government. Those who complained about the amount paid to the Hudson Company forgot the tremendous excitement generated when the company had first come to the valley. Although there had been great disappointments, the company had completed valuable hydrology and engineering studies without which the government would not have been able to start construction of the project as quickly as it did, and without which the Salt River Project might not have been selected in the first place.

#### BUYING THE NORTHSIDE CANAL, SYSTEM

With the reservoir land and the title to the damsite out of the way, discussion within the water-users' association centered upon the restructuring of the canal companies. As early as May 1903 the Board of Governors had suggested that preliminary steps be taken to adjust each water-user's respective rights to the carriage of water and to apportion individually the cost of the canal from which each took his water. This was necessary so that the Salt River Valley Water Users' Association could begin its supervision of all the canals in the valley as required by the articles of incorporation. The great obstacle to this effort was the private canal company which controlled most of the northside water distribution, the New York—based Arizona Water Company (successor to the Arizona Improvement Company and the Arizona Canal Company).<sup>23</sup>

While Fowler, Kibbey, and the Reclamation Service had discussed government purchase of the northside system during the writing of the articles of incorporation and the 1904 contract, both documents had been ratified and adopted without seriously planning for that possibility. The water users left the question of purchase of the northside system to those provisions in the articles which called for the levying of special assessments. In this manner, water users under the various canals to be purchased—not the Association—would bear the cost of their acquisition.<sup>24</sup>

Probably because the price was too high, the water-users' organization made no effort to purchase the Arizona Water Company's interests in the northside system, including the Arizona Dam, until the floods of 1905 made the need for their inclusion in the Association more immediate and the price more negotiable. As the Salt River

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the water-users' organiizona Water Company's the Arizona Dam, until ion in the Association hable. As the Salt River raged during the months of January and February 1905, a section of about 100 feet washed out of the 1,100-foot-long Arizona Dam, the timber-crib diversion dam 28 miles northeast of Phoenix which normally sent water into both the northside and southside canal systems. Damage to the dam and to the canal headworks made irrigation of lands under the Arizona Canal difficult. The cost of repair to the dam alone would be great, and the Arizona Water Company hesitated. After conferring with Joseph Kibbey and George Christy of the Board, Fowler asked the Arizona Water Company if it would sell to the Association.<sup>25</sup>

Sometime during the spring Benjamin Fowler, in the East on Association business, suggested to Newell that the government appoint a commission to appraise the value of the northside system and the Arizona Dam. Although the water company had mentioned no price, it was clearly struggling to recover the amount of its indebtedness—nearly a million dollars. Since the Arizona Water Company was a nonresident corporation, most people in the valley resented its lack of consideration of local interests and needs; an independent view of the appropriate purchase price was thus necessary to persuade the water users to buy. Similarly, the stockholders in the Arizona Water Company received from its management an inflated view of how much the company was worth; even though the company was in receivership, they, too, needed an independent opinion on what was a fair price.

Fowler believed that a permanent, masonry, diversion dam needed to be constructed as soon as possible for the benefit of the whole valley, and that the Arizona Water Company should not assess the northside for repairs to the 28-year-old Arizona Dam prior to an Association assessment for permanent construction at a later date. On May 6, 1905, Fowler formally requested that Frederick Newell consider the possibility of appointing a competent board "to study the situation, investigate the conditions, measure the rights and equities of both parties, appraise the property and fix the price and terms which are reasonable and just and within our power to meet."<sup>26</sup>

In his response Newell ignored Fowler's suggestions regarding the appointment of an advisory board to determine the value of the Arizona Water Company, focusing, instead, on the question of a permanent diversion dam. Noting that Salt River had already received more money from the reclamation fund than it should have been allotted under Section 9 of the Reclamation Act (which stated that the Secretary of Interior should expend money derived from each state or territory within such state or territory), Newell hedged as to whether the Reclamation Service could construct a new dam. He next

reasoned that the Salt River Valley Water Users' Association still needed to determine judicially the water rights within the valley, and that a "proper adjustment of these rights [is required] before any new expenditures are undertaken in the Valley or any stored water is

furnished for irrigation."27

For those who had dragged their feet on the friendly suit to determine water rights in the valley—the Hurley v. Abbott suit—here was yet another reason (besides determining the basis for allocating membership shares in the Association) to push forward with the adjudication. Newell had linked further construction on Salt River to this resolution of valley water rights and, by requesting that the service engineers investigate the feasibility of a masonry dam, he had also hinted that the Reclamation Service could come through for Salt River despite Section 9. Debate over the best means to secure the adjustment of water rights—through continuation of the Hurley v. Abbott suit instituted in 1904 or by contract—persisted throughout 1905—1906.

Newell must have informally relayed Fowler's request to Charles Walcott, director of the Geological Survey, because Walcott asked Interior Secretary Ethan A. Hitchcock to consider appointing a disinterested commission to appraise the property of the Arizona Water Company; Hitchcock agreed just twelve days after Fowler's request to Newell. Writing Fowler in New York, Walcott told the president of the association that the Secretary had agreed to appoint the commission upon the "distinct understanding that the United States does not at this time assume the obligation to pay the amount appraised nor to purchase the property at any price or in any event, this question left for future decision when the value of the property . . . shall become

known."28

The Department of Interior suggested to Fowler, in a letter to him dated June 1, 1905, that he prepare a formal request, and Fowler and Judge Hiram Steele, vice-president and receiver of the bankrupt Arizona Water Company, responded on June 7. In their request they asked the Secretary to appoint three disinterested engineers to appraise the property of the Arizona Water Company, including:

- (1) the Arizona Canal, with all dams, headgates, cross-cuts, laterals, equipment, and all vested rights;
- (2) the franchises and established businesses of the company;
- (3) its controlling interest in the capital stock of the Grand, Salt River, Maricopa, and Water Power Canal Companies;
- (4) all water rights owned by the company, with a complete description of all its land.

Hitchcock formally approved the request on June 10, 1905.29

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Judge Joseph Kibbey came to Arizona from the Midwest in 1893. Throughout his career, he held many positions within the political structure of the Arizona Territory: he was an Arizona Supreme Court Justice, a Territorial Councilman, Territorial Attorney General and Territorial Governor in 1905. The time that he devoted as attorney for the Salt River Valley Water Users' Association was indicative of his commitment to solving the problems of water use in the area.



it. Fowler followed closely advice from the Reclamation Service, while Kibbey, in Phoenix, attuned his ear to the opinions of the Association's Board of Governors. The fact that they were guided by these two different viewpoints created some tension between the two men on how the Association should proceed in purchasing the canal system.<sup>32</sup>

Although the commission had been appointed in June 1905, engineering commitments on other reclamation projects kept the three men from meeting in Phoenix until November 1905. During the interim six months, while the Reclamation Service gathered data concerning the canals, Fowler and Judge Hiram Steele, of the Arizona Water Company, attempted to carry on their own negotiations. Little was done between June, when the commission was authorized, and September, when Fowler again returned to Washington. Fowler believed that time was the most critical element in the sale; the Reclamation Service had many demands from other projects to consider besides those of Salt River. If the Association was unable to come to terms with the Arizona Water Company quickly, Fowler feared that the Salt River Valley group might be passed over in its request for additional funds. Of some significance, too, was the threat of winter storms as severe as the preceding years, and the importance of starting repair work immediately.33

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Fowler was willing to discuss the price with Steele, however, whereas Kibbey stoically believed that the Association must be prudent and indifferent to the entire sale. When Fowler wrote Kibbey that he had some idea what price would be acceptable to both the government and the water company, but could not give an exact figure, Kibbey was irritated that the Board of Governors had been left out of the discussion. Kibbey wrote Fowler that it seemed "strange to us that it could be made known to you about what price Judge Steele would accept, and what price the Department would approve, and that could not be made known to the Board."35 Judge Steele had hinted, when he was in Phoenix in October, that \$700,000 would be acceptable to the company; this was an amount equal to their first mortgages and defaulted interest, plus fifty percent of the income bonds, and repairs to dams. Kibbey thought this figure absurd. "The Board is entirely indifferent about further negotiations," the Association's attorney wrote Fowler, for "it has lost confidence in them and will not renew them, or even encourage their renewal . . . "36 Expedition of the sale was more advantageous to the company, Kibbey thought, than to the water users.

Fowler answered Kibbey on October 23, 1905, with confidential information he had received that \$350,000 would secure the water company's interests (he did not tell Kibbey that he had met with Hiram Steele and Frederick Newell). Fowler seemed to view his role as more educator than negotiator; he tried to inform both the bondholders of the Arizona Water Company and officials within the Geological Service of the depreciated conditions of the physical property of the company. He believed that if the water company shareholders were given a little time "to adjust themselves to the new conditions in which they are so unceremoniously plunged," they would treat the Association fairly. Fowler, who understood Steele and the conditions

he faced in New York, wrote Kibbey that the water users were "just at the crucial moment; ... everything looks favorable for our interests." Instead of closing off negotiations, as Kibbey suggested, Fowler believed that it was in the Association's power to close negotiations soon at favorable figures. Still, Fowler, the man in Washington, was providing little detailed information to the group in Arizona that he represented.

If Fowler was confident and cheered by the \$350,000 figure, the Board of Governors and Kibbey were not. The Arizona Dam should be considered a liability, rather than an asset, Kibbey argued, and the Association should pay no more for the system than what it might cost to replace it, an amount Kibbey estimated at \$250,000, exclusive of the dam. The only positive element Kibbey and the Board saw in purchasing the system from the water company was "the advantages we may obtain by ease of terms of payment if the Government should buy . . . . "38"

Coupled with the general problem of treating with the water company were the demands of the minority stockholders in three of the canals on the north side controlled by the Arizona Water Company: the Grand, Maricopa, and Salt River canals. Led by Phoenix attorney Louis Chalmers and Dwight Heard, these local shareholders believed that they should also be paid for their minority interests in the canals; they were, thus, demanding compensation if the sale proceeded.

On November 6, 1905, Judge Hiram Steele wired Phoenix's Home Savings Bank and Trust Company (C. F. Ainsworth, president, was attorney for the water company) that \$350,000 was an acceptable purchase price, provided that the government would take immediate charge of the works. The bank made an effort to promote the fairness of this price, and Ainsworth tried to persuade the Association's Board of Governors to pay it. Fowler advised just a few days later that the Board should wait for the results of the engineering commission, which was scheduled to meet in Phoenix on November 25, 1905, before agreeing to the sale. This behavior seems somewhat odd for Fowler, committed as he was to a quick sale and to his previous belief that \$350,000 was acceptable to the Reclamation Service as a purchase price. It is not improbable that his friends in the Service, possessing information collected for the commission, suggested to him that the \$350,000 figure might, indeed, be too high. Perhaps Fowler now also felt less rushed to complete the sale, as the Service surely would have indicated to him by this time whether Salt River retained a chance to secure further appropriations from the reclamation fund.39

The report of the commission was submitted to U.S.G.S. director Charles Walcott on December 8, 1905, after the three engineers had heard testimony in Phoenix and had reviewed engineering reports

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tted to U.S.G.S. director he ihree engineers had d engineering reports prepared by Jay Stannard for the Reclamation Service and H. F. Robinson, a local civil engineer employed by the Arizona Water Company; interestingly, the estimates were similar. Because of Judge Kibbey's decision in Wormser v. Salt River Valley Canal Company, which stated that a canal company is a carrier of water but does not have rights to the water it carries for other appropriators, the commission considered the claimed water rights of the company nonexistent; that the Arizona Water Company possessed no water rights had always been the Association's position. All franchises and contracts were termed liabilities for the government, rather than assets. As a result, the only items appraised were physical properties. The commission recommended that the value of the Arizona Water Company hold-

ings be set at \$304,161.40

Not surprisingly, Benjamin Fowler and the Reclamation Service strongly supported the report of the commission as "being fair and just." It would now be the Secretary of Interior's decision whether the government would accept the price for the purchase of the northside water system. Floods in November had further damaged the headworks of the Arizona Canal and washed away even more of the Arizona Dam. Lands under the northside system were now without effective irrigation, and many cultivated farms were endangered as a result. The need for a new, permanent, diversion dam was never more apparent, and Fowler wrote the Association's Board of Governors that Salt River's chances of success were about even. Relating that their prospects "would surely have gone aglimmering at this time had not the matter been brought to the Secretary's attention last May and the Government in a measure committed to the purchase," Fowler believed that this commitment alone was "the peg on which our hopes now hang."41 Other projects had been making "great and special demands on the reclamation fund and bringing powerful. influences to bear on the Secretary which would undoubtedly have resulted in leaving us entirely out in the cold but for our timely action over seven months ago."42

Secretary of Interior E. A. Hitchcock's legal assistant had several questions regarding the validity of certain aspects of the proposed contract between the Arizona Water Company and the government; as a result of these questions and of other pressing government business, a final contract from Interior was delayed until February 17, 1906. Part of the delay stemmed from the water company's position that it could not give a complete and perfect title to the government (which was necessary before the Reclamation Service would begin construction work on the new diversion dam, approved by Walcott and Hitchcock January 9, 1906) without the cooperation of the minority stockholders. The water company contended that this group—the

Chalmers-Heard group—should contribute gratis its interests in the northside canals, and that the entire appraisal sum of \$304,161 should be paid to the New York corporation. The government's position was that the sum should be paid to both groups, with any adjustment left to them. Judge Steele also argued that the company's alleged water rights should be made a part of the assessment, although Fowler, the Reclamation Service, and even Judge Steele knew that under Arizona law this claim was preposterous. The Arizona Water Company further argued that insufficient consideration had been given its right-of-way along the Arizona Canal. After much discussion, Charles Walcott, Arthur Powell Davis, and Morris Bien, along with Fowler, agreed to pay \$10,000 more to the water company in order to expedite mat-

ters, for a total price of \$314,161.43

W. J. Murphy, the original contractor for the construction of the Arizona Canal, a shareholder in the earlier companies controlling the northside system, and the owner of a sugar-beet factory served by the Arizona Canal, came to Washington late in the contract negotiations to urge the government to pay the water company \$50,000 more to hurry things along. Fowler vowed to pay no more than the appraised price, and told Murphy he was ruining things; rather than pay more, the government was prepared to institute condemnation proceedings against the Arizona Water Company. Hiram Steele was irritated that he was forced to accept terms which he considered unfavorable to the company, but was prepared to sign the contract, as the company really had little choice in the matter. Yet the night before the contract was to be executed, Murphy offered to trade the company 200 unspecified acres of his land, with a paper value of \$40,000, in exchange for the nonexistent water rights of the company. In this offer Steele saw a means to save face with his people in New York, and he accepted Murphy's proposal; Murphy perhaps saw a way to enlarge his own position at home.44

As for Murphy, Fowler wrote the Board of Governors that before the contract was executed "a dispatch was sent to Phoenix saying that the 'Government had closed contract by W. J. Murphy putting up the difference.' " The facts of the matter were, Fowler explained, that Murphy's name did not appear in the documents, "and so far as the Government is concerned they did not know of this trade until agreement was reached with the Water Company." The contract had already been struck, and the Arizona Water Company had little choice but to sign; Murphy's deal simply allowed Steele to report to

his people a larger dollar figure than before.45

On March 7, 1906, Secretary of Interior Ethan A. Hitchcock approved the contract for government purchase of the northside canal system for the Salt River Project, although the water rights in

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Than A. Hitchcock of the northside gh the water rights in the valley had yet to be adjusted. Combined with the promise to build a new diversion dam at Granite Reef in place of the deteriorating Arizona Dam, this contract provided a \$700,000 additional allotment to the project from the reclamation fund, bringing the project total to \$4.5 million. The government did not include any provision within the new contract to change that part of the 1904 contract calling for equal assessments among all members to repay the costs of the facilities. As the matter stood, the cost of the northside system would be included in the total government costs, rather than be assessed only against landowners within the northside system.46

#### THE 1906 ELECTION

Benjamin Fowler's success had been complete. He had managed to turn a 1905 springtime thought into reality. Like Frederick Newell and the engineers at work building the project, Fowler had thought of the possibilities for efficient reclamation on Salt River. The Salt River Project would function more efficiently with control of the northside system and a new diversion dam, and he had managed to convince the Reclamation Service of their necessity. He had done this alone, often at odds with the association which he represented, and despite Murphy's unsolicited efforts to help close the sale of the Arizona Water Company. Yet what seemed to Fowler to be his most successful achievement nearly cost him the presidency of the water users' association in 1906. His tendency to focus on the big picture of national reclamation led many in the valley to believe he ignored local concerns, particularly the issue of project cost and repayment.

To Fowler's surprise, he and his administration were the key issue in the 1906 election. Dwight Heard, Fowler's main antagonist throughout the early years of the Association, had decided, after two years, that Fowler did not have the businesslike acumen necessary to carry the Association past the water-promotion period. Heard again helped line up a slate of conservative candidates headed by Dr. E. W. Wilbur as the presidential candidate, to defeat Fowler's friends. In a 1906 pamphlet distributed to the Association's members, Heard

stated that:

Mr. Fowler's supporters, in their efforts to change the conservative character of the Board of Governors, and to dictate to the farmers of the valley, have forced this contest for the presidency, and it should be clearly understood that a vote for Dr. Wilbur is a vote in favor of the Farmer's Ticket.47

Heard, Wilbur, and others opposed to Fowler's administration charged that Fowler had aligned himself with "speculative interests,"

mands for changes in reclamation policy were not completely accepted, but Secretary Lane set in motion a process to include project landowners in reclamation decision making; their increased par-

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ticipation seemed to satisfy all but the most disgruntled.

The reexamination of reclamation policy and practices which Lane directed his department to carry out also included a review of the government's relationship to the projects. The change in federal reclamation in the post-Newell years was one of both substance and style. The reclamation crusade with its "gospel of efficiency" tended to look out of place next to cost overruns and expensive acreage costs for project participants. The use of agricultural and economic experts in planning the projects seemed more important by 1915 than it had thirteen years earlier. The water-users' associations rejected the engineers' earlier perceptions that reclamation projects were merely technical undertakings requiring only technical expertise to make them successful. Instead, the farmers and landowners paying the reclamation charges asked the Reclamation Service to treat them as full partners.

John Orme and the rest of the Salt River Valley Water Users' Association welcomed the "new" reclamation policy of Franklin Lane because it promised to give greater attention to farmers' actual problems. They were negotiators with the Reclamation Service now, not their puppets. The Salt River Valley Water Users' Association fashioned the debate on what its relationship with the Service would be: it focused on whether the government was a contractor or a benefactor. Although this question seemed impossible to resolve to everyone's satisfaction, both Secretary Lane and the Association indicated their

determination to maintain their newly found harmony.

#### THE KENT DECREE

On the Salt River Project, the completion of both the Roosevelt Dam in 1911 and the power facilities in 1912–1913 meant that by the time of the conference the project should officially open; the opening would signify the beginning of repayment. Before the project could be opened and public notice issued, however, the government had to resolve the nagging problem of the amount of acreage to be included within the project and how much of the final costs the water users would have to repay. In order to find answers to these questions, the Interior Department authorized the formation of two independent boards; the Board of Survey, to determine the politically sensitive issue of which lands to include within the project boundaries, and the Board of Cost Review, to examine the accounting books

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of the Reclamation Service at Salt River and fix the final cost of the project.

When the Association's creators first developed their plans in 1902-1903, they intentionally left the designation of member lands to the Secretary of Interior. The Articles of Incorporation of the Salt River Valley Water Users' Association provided only for inclusion of sufficient acreage which could be irrigated from the estimated water supply; cultivation of land was the dominant criterion. The Association itself did not have the power to allot shares; this successfully removed from the group political responsibility for admitting or excluding lands within the valley. Any criticism from landowners for the exclusion of subscribed land from the final boundaries of the project would have to be directed at the Secretary, not the leaders of the Association. As Benjamin Fowler had written in 1909, "the whole risk of the chance was left to the subscriber as the Association obviously could neither guarantee that he would be allotted shares or object to allotment of shares to him."3

In 1905 the Board of Governors of the water-users' association began to believe that priority of water right should play an important role in allotting membership shares. The Hurley v. Abbott suit, initiated in 1904 – 1905 to adjudicate the rights to use the Salt River, might also apply to the lands in the valley. By date of earliest cultivation, the government could decide upon the member lands. The Association determined to press for the conclusion of the suit as its chief means of collecting the information necessary for the Secretary of Interior to decide membership priority.<sup>4</sup>

Not everyone in the valley supported the *Hurley v. Abbott* suit as the best means to determine either water rights or membership shares in the Association. Many landowners believed the friendly suit to settle the issue of water rights was too expensive, too time consuming, and ill considered. They thought the final result of the litigation would only resolve Patrick Hurley's claim, not all rights to the river.<sup>5</sup> In this view at least two prominent valley attorneys, Judge Webster Street and Judge C. F. Ainsworth, supported them.<sup>6</sup>

Benjamin Fowler, recognizing the "active and bitter opposition" to the suit, wrote Arthur Davis of the Reclamation Service that he sought to find "some other way, if it is possible, by which these rights can be adjudicated." For this purpose, the Association's Board of Governors appointed a Committee of Ten "to ascertain the best means of adjusting the rights to the use of irrigating water . . . irrespective of the present action brought by Hurley v. Abbott." The Committee of Ten recommended forming a Committee of Sixteen, to be appointed by the president of the Association and chairman of the

Council, which would thoroughly investigate the claims of water users within, or in the vicinity of, the project. With this information, the Committee of Sixteen would suggest stipulations to the court for the Hurley v. Abbott suit. Inclusion of the Committee's proposal as a stipulation in the court decision would give the authority of law and save a considerable expense.

The Committee's plan, in brief, based water rights on how much of the water received between 1890 and 1905 had actually been used. Using a "stepladder plan," the various canals would receive from the Association the amount of water due the lands irrigated from them; the landowners under each canal would have to adjust among themselves their "carriage rights" in the canal. The Pima Indians living on the north side of the river, whose reservation contained lands irrigated from the Arizona Canal, were entitled to and received under this plan 500 inches of water at all stages of the river. They had taken this amount of water for cultivation of their land for more than forty years, and the Committee believed this prior right to be above all others.

Despite this attempt to achieve consensus, the Committee of Sixteen's plan received little support from individual water users because, among other reasons, it paid scant attention to individual claims to flood water, and landowners refused the required three-fourths approval. The water users in the valley could not agree whether to press the friendly suit, defer to the government by having the Secretary of Interior determine all rights claimed (which the government did not want to do), or work out the various claims by individual contract with the Association.

The Reclamation Service was quite concerned with the apparent inability of the water users to stop their bickering; the government had to be protected against litigation if it was to continue developing the project. Both Arthur P. Davis and Morris Bien of the Service went to Phoenix in late July 1906 to discuss the situation with the Association's Board of Governors. Although both men thought an adjustment of the water rights by contracts was preferable to the lawsuit, both were also convinced it would be impossible to secure a binding adjustment of rights from them. The Reclamation Service thought the Hurley v. Abbott suit the only available means to safeguard the United States in its operations under the Reclamation Act; without it, the Service could not store any water behind the gates of Roosevelt Dam. "The matter is of extreme importance to the Reclamation Service," Davis wrote Benjamin Fowler, "as the progress in this case must guide its future policy."11 In February 1907, the Board of Governors again endorsed the continuation of the Hurley v. Abbott suit.12

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one of the 4,800 defendants besides Charles Abbott had to file a statement with the court regarding the amount of land each had cultivated and the year in which each had first put water to a beneficial use upon the lands. Many had to hire attorneys, and for those who were nonresident landowners, the suit required a trip to Phoenix. It was no surprise to Judge Edward Kent, who was sitting as district judge of the Third Judicial District Court in Maricopa County, that he had received so few statements, while the number of disclaimers, which a defendant used to show that he was not obligated to answer, grew.

Kent was an outsider to the valley, and this may have contributed to the reluctance on the part of some to become involved in the case. President Roosevelt had selected Edward Kent, a successful lawyer (educated at Harvard and Columbia universities) and a leading Colorado Republican, to be Chief Justice of the Arizona Territory Supreme Court in 1902. Roosevelt had been unhappy with the political quarreling among Republicans in Arizona and had turned to Kent to restore order. Although nearly everyone in the valley grew to respect Judge Kent's decisions, he had faced much skepticism at the outset of the *Hurley v. Abbott* suit.<sup>13</sup>

While many in the valley believed the suit would only resolve Patrick Hurley's claim, Judge Kent believed he could determine the rights of all the parties who were defendants in the suit and enter a decree resolving these rights. A number of valley attorneys, however, advised their clients that a final adjudication could not be had in the Hurley v. Abbott case. Since a decree of the court would deprive the many who were not filing of their rights because they had acted in good faith upon the advice of their attorneys, Judge Kent suggested to Louis Hill and C. S. Witbeck of the Reclamation Service that the government file an interpleader in the case. This action by the United States would technically compel all the parties to assert their rights. Since the government had purchased the northside canal system on behalf of the Association for the Salt River Project, it was an interested party, although it claimed no right to water. Joseph Kibbey also urged the government to interplead. Hill and Kent called in for consultation J. L. B. Alexander, the U. S. Attorney for Arizona, and Alexander agreed with the two men that it was appropriate for the government to become involved. On June 10, 1907, Alexander filed with the court, on behalf of the United States, a motion to interplead; Kent granted the motion.

What Judge Kent, Louis Hill, and Joseph Kibbey had hoped for slowly began to take shape: more answers were filed, due to the government's involvement, and the case was brought to trial in 1907 -

1908. Judge Edward Kent handed down his decision in the Hurley v. Abbott case, known as the Kent Decree, on March 1, 1910. In what was to become the most important water-rights case in the Salt River Valley, Kent not only determined each acre's prior right to use the normal flow of Salt River, but also classified the land in the valley

according to date of cultivation.14

Kent's method for classifying lands was simple. Those lands with old water rights, which had been continuously cultivated, were termed "Class A"; owners of these lands would have the first opportunity to become members of the Salt River Project. Kent placed those lands with some right to flood water, which had been cultivated prior to (but not after) 1903, next in line for inclusion within the project; these lands were termed "Class B." Those lands which had no right to the water and which had never been cultivated were termed "Class C"; these lands would be considered for inclusion last. Judge Kent's arrangement of the valley lands into three classes did not automatically give the Class A and B lands a project reservoir right, but, according to the Judge, it did allow them preference. 15

#### THE BOARD OF SURVEY

The Kent Decree provided a framework for selecting project lands, but it did not completely settle the membership dispute. In August 1913 Assistant Secretary of Interior A. A. Jones wrote the Association that recent Reclamation Service maps showing the irrigable area of the valley as determined by the Kent Decree revealed a larger acreage than could be served water from the storage reservoir. "It is therefore necessary," noted Jones, "to somewhat arbitrarily select certain lands which will be watered and reject others." Jones suggested creation of a small committee or board to review the situation and mark on the maps which lands would be included. The following principles, he suggested, should guide the board:

- (1) Lands selected should be in as compact a body as possible;
- (2) Preference should be given to lands of highest productivity;
- (3) In the case of the small landowners, the man living upon his land and cultivating it should be given first consideration.<sup>17</sup>

The Association's Board of Governors agreed with Assistant Secretary Jones's suggestion in principle, and offered its own idea on how to compose the board: the Board of Governors should select one representative, the Reclamation Service another, and the third member, acting as chairman, would be a mutual selection from outside the state. Secretary of Interior Franklin Lane agreed to this proposal.

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The Board selected Frank Parker, former secretary of the Association, as its representative. 18

Although the chairman of the board was to be impartial in all matters pertaining to the project (hence the requirement that he be from another state), John Orme suggested to both Frederick Newell and Secretary of Interior Lane that Frank Hanna fill this position.<sup>19</sup> Hanna, previously the Reclamation Service's project engineer at Yuma and chairman of the 1913 Reclamation Service Inquiry Board investigating the administration of the Salt River Project, was now manager on the Boise, Idaho, project. While he fit the requirement of being a nonresident, the Association's solicitation somewhat thwarted the spirit of the provision. Lane, however, agreed to Orme's request and appointed Hanna as chairman of the Salt River Project Board of Survey.<sup>20</sup>

The Reclamation Service originally intended to appoint J. E. Sprague, an engineer on Salt River, as its representative to the Board. Further discussions with Charles Fitch, project manager at Phoenix, persuaded Arthur Davis and Frederick Newell to select William Farish instead.<sup>21</sup> What Fitch said is not known, but it is likely that the project manager was concerned that the representative be acceptable to the Association. Since the majority of the Board of Governors at that time was composed of "prior righters," whose main concern was limiting the acreage to a low figure, the selection of Farish, who supported the position of that group, was likely to be well regarded.<sup>22</sup>

Farish was indeed acceptable to the Board of Governors. "This appointment will meet with the hearty endorsement of the Board of Governors," Orme wrote Arthur Davis in late October 1913. The Board had considered "unofficially" asking the Service to appoint Farish, but "felt they would not be justified in formally naming any more members than they had done." Although the water users technically had only one representative on the Board of Survey, in reality they approved of all three members. Secretary Lane's new spirit of cooperation between the water users and the Reclamation Service was evident at last.

Louis Hill, former project manager at Salt River and now supervising engineer of the Service's southern division, and Frederick Newell expressed some concern, however, over the Survey Board's bias in favor of prior righters. Hill strongly recommended to Newell that the first meeting of the Board of Survey be postponed until after the rainy season; otherwise, with the reservoir low, the landowners with old water rights might pressure the Survey Board into excluding from irrigation more acreage than necessary. "I hardly think that you could get the prior righters today to use good judgement in studying

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the question," Hill wrote Newell; "they only realize that the amount has been depleted [in the reservoir] and do not seem to have any idea that this will ever be replenished."<sup>24</sup> While Newell seemed to agree with Hill on the matter of postponing the meeting of the Survey Board, the Reclamation Service acknowledged a scheduling conflict; Hanna was already on his way to Phoenix. The Board of Survey would meet at the end of November 1913, as planned, and Hill would have to send all his material on the valley's water supply to Phoenix by then.<sup>25</sup>

The Board of Survey held daily meetings from November 18 through December 9, 1913. Although it prepared a preliminary report on its findings, Hanna believed the inquiry to be incomplete. He believed the Board needed more information regarding the cultivated and occupied lands, the size of the individual holdings, and their water rights classification before a final delimiting of the project took place. The chairman of the Survey Board recommended adjourning until this information became available. At the same time, several legal questions bothered Hanna, and he thought the Board needed to anwer them before selecting or rejecting any lands. Fundamentally, they all focused on the legal and moral strength of the Kent Decree as the basis for choosing lands entitled to participate in the project. 27

The Reclamation Commission, which consisted of Frederick Newell and Arthur Davis as the engineers, I. D. O'Donnell as superintendent of irrigation, Will R. King as chief counsel, and W. A. Ryan as comptroller (the last three were Secretary Lane's appointees), reviewed Hanna's report and questions, and formulated new selection guidelines to submit to the water users for comments: The Survey Board had initially favored limiting the total acreage to 170,000; the Reclamation Commission raised the limit to 175,000 acres.<sup>28</sup>

The most controversial of all the Commission's recommendations, however, was its response to Hanna's questions regarding whether it was appropriate for the Reclamation Service to implement the Kent Decree. The Reclamation Commission created new guidelines, using Judge Kent's land classification system, a notion of fair play, and the cultivation criterion of the Association's Articles of Incorporation.<sup>29</sup> Basically, the Commission wanted to limit landowners of cultivated Class A and B lands to project membership for 160 acres. In this way the Reclamation Commissioners hoped to defuse a potentially volatile situation by spreading the membership lands among many landowners holding various classes of land. They hoped this course would prevent landowners holding lands for speculative purposes from becoming project members before those who

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Delimiting the project was destined to be unpopular with some, but the Board of Survey and the Reclamation Commission were optimistic about their actions. While they eliminated from the project lands not fitting the government requirements, they also recommended that the Association develop new sources of supply. By building Horseshoe Dam on the Verde River and by constructing pumping plants, eventually there would be enough water to serve all the subscribed land in the valley.<sup>31</sup>

The Board of Survey published these guidelines for selecting lands under the Salt River Project on January 15, 1914, and distributed copies to landowners in the valley. Public meetings to discuss the limitation plan with I. D. O'Donnell and Arthur Davis of the Reclamation Commission as well as with the Board of Survey and officers of the Association were set for March 13 and 14, 1914. The only significant change that the Board of Survey made in the Reclamation Commission's recommendations was to increase the total estimated project acreage to about 180,000 acres including townsite and school lands; of the 211,000 acres of irrigable land subscribed to the Association and within the Board of Survey boundaries at that time, 31,000 would have to be excluded. The excluded lands included those not fitting the Reclamation Commission's guidelines, those not cultivated within the previous three years, and state school lands.<sup>32</sup>

Fewer landowners in the valley turned out for the meetings than either John Orme or Arthur Davis expected; they interpreted this lack of response to mean that there was little dissatisfaction with the arrangements of the Board of Survey. It was predictable that those holding uncultivated lands—largely for speculative purposes—would be unhappy with the preferences outlined by the Board, and a few, like Ralph Murphy, complained that the project should be held open until an adequate water supply was developed for all the lands. But in the main, valley landowners were satisfied that the best job possible had been done, given the nature of the task.<sup>33</sup>

It was the beginning of an era of collaboration between the water users and the Reclamation Service. No one expressed this new feeling

better than Arthur P. Davis:

There has been too much disregard of the water users; we do not mean of their material interests, but of their personal interest in the project. They have been asked to take too much for granted The state of

and to trust blindly to the scientific skill and technical knowledge of the members of the service.

Many things have been done which they have not understood, though they have been done right. And some things have been done wrong which might have been avoided if the water users had been taken into the confidence of the reclamation officials. If a man is having a house built, though he may know nothing of architecture and little of construction, he has certain ideas, for reasons which the architect may not appreciate, he would like to have incorporated into the structure.34

Both Davis and I. D. O'Donnell of the Reclamation Commission enjoyed the water users' hearty welcomes, and farmers particularly appreciated O'Donnell's visit, as he provided them with advice on better farming and securing larger markets for their crops.<sup>35</sup>

If there was one person responsible for the changed relationship between the Reclamation Service and the Salt River Valley Water Users' Association, which had deteriorated in the last years of Newell's tenure as director, it was Secretary of Interior Franklin Lane. Lane was an ambitious man, determined to put his own imprint on the department. Two themes underlay Lane's conservation philosophy: greater development and greater democracy. While not fundamentally different from the beliefs of Walter Fisher or Gifford Pinchot, whom he continued to consult on matters of concern to them, Lane's ideas regarding the public domain were tested not by the rational, scientific method, but by their political acceptance in the West. For this reason, as well as for his personality, which was described as "magnetic," President Wilson's first Secretary of Interior was very popular with westerners in all walks of life and especially with the water users on the federal projects.36 He "shaped the affairs of the reclamation service so as to give the fullest hearing to the expression of the wishes and desires of . . . the water users."37 Work had been undertaken and policies decided upon without consultation between the officers of the government and those of the Association before Lane came to office; now, "by direct orders of the Secretary," the administrative bodies of the water-users' associations reviewed all of these matters.38

The local leadership of the Salt River Valley Water Users' Association delighted in the turn of events, as did most of the landowners under the project. Even C. B. Wood, the former candidate for president of the water users on the Landowners' Protective Association ticket, approved the Board of Survey report and the new cooperative efforts of the Service.<sup>39</sup> The Board of Governors enthusiastically endorsed the government recommendations to construct a storage reservoir on the Verde River and to install pumping plants to increase

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rer Valley Water Users' Assois did most of the landowners is former candidate for presiwrites' Protective Association in and the new cooperative Governors enthusiastically attions to construct a storage all pumping plants to increase the developed water supply, and agreed to put them to an immediate vote by the water users.40

The Secretary of Interior reviewed the final report of the Board of Survey, which essentially followed the same form as the preliminary one except for small modifications of the boundary line, in August 1914, and approved it on November 14, 1914.<sup>41</sup> From this date to the early 1920s, those owners of uncultivated land within the reservoir district boundaries that were not included in the project petitioned the Association and the Secretary of Interior for admittance. When the reservoir was full, the owners of these lands rented water for irrigation of their crops, but this supply was only temporary water; rental contracts were subject to renewal or cancellation each year. Owners of fragmentary Class A lands—small, odd-shaped parcels adjacent to member lands, but not included in the final report because of their erroneous classification as uncultivated lands—were successful in having a second Board of Survey include them permanently within the project in 1916.<sup>42</sup>

In addition to the fragmentary Class A lands, there were about 23,000 acres of land that were not included within the project, although they were located within the reservoir district boundaries. The owners of these so-called "dry lands" also appealed to the Association and the Secretary of Interior for admittance to the project, but were not accepted until an additional water supply was developed in the early 1920s.<sup>48</sup>

Fixing 180,000 acres as the amount of land to be served reservoir water on a continuing basis finally resolved the conflict over membership priorities that had been raised in 1903 by Dwight Heard and the minority report. Although it had been a bitter issue between those with old water rights and new landowners in the early years of the Association, by 1914 it ceased to have the same emotional appeal. This change was due in large part to Secretary Lane's board of review procedure. By bringing the water users into the decision-making process through representation on the board and through public hearings, the landowners directly participated in the delimiting of the project. The final decision, of course, was the Secretary's, but in this instance, Lane successfully eliminated the water users' complaints of Reclamation Service tyranny.

#### THE BOARD OF COST REVIEW

In the same spirit of cooperation which imbued the proceedings of the Board of Survey, Secretary of Interior Lane decided to review the costs of constructing the projects; this process would satisfy the

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# DRAFT ENVIRONMENTAL IMPACT STATEMENT NUMBER R3-78-02

Tonto National Forest Maricopa County, Arizona

Lead Agency - U.S.D.A. Forest Service P.O. Box 13705 Phoenix, Arizona

Responsible Official - Bruce B. Hronek, Forest Supervisor

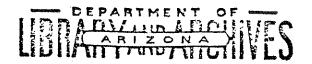
For Further Information Contact: Ted Oliver

Recreation Planner Tonto National Forest 102 S. 28th Street P.O. Box 13705 Phoenix, AZ 85002 (602) 261-6591

#### Abstract:

This environmental impact statement describes four alternatives for recreation development of 12 miles of the Lower Salt River on the Tonto National Forest. The draft statement discusses the estimated effects of implementing each of the alternatives. Alternative D has been identified as the Forest Service preferred alternative. The rationale for this identification is shown in the text of the Statement.

Comments regarding this environmental impact statement should be sent to the Forest Supervisor, Tonto National Forest by May I, 1979.



#### SUMMARY

DRAFT ENVIRONMENTAL IMPACT STATEMENT

MANAGEMENT PLAN

LOWER SALT RIVER RECREATIONAL AREA

NUMBER R3-78-02

TYPE OF ACTION: ADMINISTRATIVE

Responsible Federal Agency - USDA - Forest Service P.O. Box 13705 Phoenix, Arizona

Responsible Official - Bruce B. Hronek, Forest Supervisor

For Further Information Contact: Ted Oliver

Recreation Planner Tonto National Forest 102 South 28th Street P.O. Box 13705 Phoenix, AZ 85002

(602) 261-6591

Date of Transmission to EPA and the Public: Draft EB 15, 1979

#### SUMMARY

#### INTRODUCTION

The environmental impact statement describes a proposed management plan for the Lower Salt River Recreation Area located on the Tonto National Forest, Maricopa County, Arizona.

The Lower Salt River has a continuous flow of water in the summer as a result of releases from an upriver reservoir system. An outstanding river recreation environment is created, unique to the Southwest.

nicking, water play, fishing and social gathering being the ractivities. Recently increased use has created overcrowding congestion which has far exceeded the capacity of the existing health and safety and social conflicts.

As part of the Central Arizona Project the area has been cons the Bureau of Reclamation as a site for a major facility. The issue is pending and only minimum development necessary for re tection, sanitation and safety would be implemented until this resolved.

Major issues developed as a result of input from the general p other agencies included: high volume of recreation use, confl use with other uses, (e.g., water storage, grazing), user group and activity preference, public safety, wildlife habitat, prote and vehicular congestion.

## II. ALTERNATIVES CONSIDERED

- A. Alternative A Represents current management ext
- B. Alternative B Provides for limited development access. There would be three major parking lots and a hike/bike would provide the only access to many picnic areas. This altern would primarily serve the river floater, although trip options a

Erosion control, soil stabilization and vegetation rehabilitation would be initiated. Domestic livestock control would be institut immediate vicinity of the river. Zoological and botanical areas protected by physical design and implementing regulations.

- of Blue Point Bridge and limited development west of this bridge. Plan would provide opportunities for a wide range of recreation activity and an alter to the automobile. A hike/bike trail would provide additional activity west of Blue Point would still be river floating. Erosion control measures, river base lization and vegetation rehabilitation projects would be undertakent to the river. Zoological and botanical areas would be protected by design and implementing regulations.
- D. Alternative D Describes the plan recommended for i mentation. This alternative provides access to the most frequently recreation spots by paved roads and parking lots. A hike/bike trail provided for additional access. A non-mandatory public transportations system is provided to reduce the number of vehicles required by the



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#### SUMMARY OF ENVIRONMENTAL EFFECTS

In general, Alternatives B, C and D will improve the overall quality of the human environment in the area. Vehicular management, live-Jblic and stock control, soil and vegetation rehabilitation projects, wildlife habitat et of thi protection, threatened and endangered species considerations should improve lidentity the long-term productivity of the land base. In Alternative C, commercial ction of development east of Blue Point Bridge would cause the loss of some wildlife clopment habitat. The Blue Point Cottonwoods, which include the historic Bald Eagle Nesting Site, would be protected under all three development alternatives although Alternative D offers the best protection.

> Although Alternative C has intensive commercial development east of Blue Point Bridge, the highest recreation use would occur in Alternative D. A social analysis indicates that this alternative best serves the user needs by providing many access points to the river. Even though the largest capacity of visitors is expected in Alternative D, a public transportation system, paved roads and parking lots should mitigate the environmental pressures currently caused by the vehicle.

> There would be some development in the historic floodplain in Alternatives B, C and D. Each facility would be considered on an individual basis to assess flood compatibility and compliance with Executive Order 11988, . "Floodplain Management"。

In most instances, Alternative D appears to satisfy the most concerns raised during initial input sessions while enhancing environment quality.

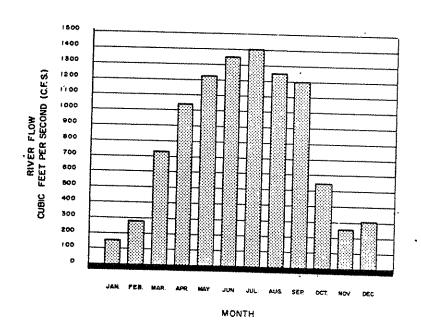
#### ١٧. CONSULTATION WITH OTHERS

Following is a list of the federal, state and local agencies, organizations and individuals from which written comments have been requested.

of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains".

The potential for large flows along the Lower Salt River is greater below its confluence with the Verde. This can be explained by the unbalanced storage capacity of the reservoir system. The four reservoirs on the Salt River have a large storage capacity - roughly two and one half times the average annual runoff from upstream watersheds. The two reservoirs on the Verde River, however, are only large enough to contain about 90% of their average annual upstream runoff.

It should be noted that the highest flows on the Lower Salt River have not occurred during the summer season, when the demand for recreational activities is the greatest. This fact, coupled with the highly regulated nature of the river, greatly reduces the hazard to the recreating public. Of greater concern during the summer months, are the highly unpredictable flashfloods that occasionally occur in normally dry desert washes during intense thunderstorms.

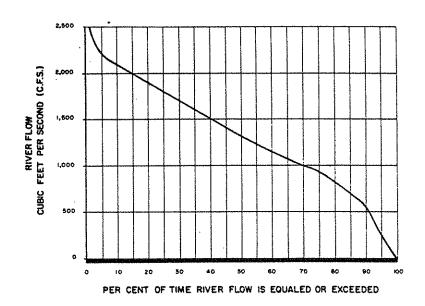


#### AVERAGE MONTHLY FLOW FOR LOWER SALT RIVER

NOTE: THESE FLOWS WERE MEASURED BELOW STEWART MOUNTAIN DAM AND ARE BASED ON 41 YEARS OF RECORD.

SOURCE: U.S. GEOLDGICAL SURVEY

Figure 5



#### FLOW LEVELS FOR LOWER SALT RIVER - MAY THRU SEPT.

NOTE: THIS GRAPH IS BASED ON DAILY FLOWS MEASURED BELOW STEWART MOUNTAIN DAM DURING THE PAST 41 YEARS.

SOURCE U.S. GEOLOGICAL SURVEY

#### Figure 6

#### b. Water Quality

Water is never found in its pure state in nature. Essentially, all water contains substances derived from the natural environment or from the waste products of man's activities.

It is these substances (such as chemicals and bacteria) as well as certain physical characteristics (such as temperature) that determine water quality.

For water to be useful, it must be of adequate quality. Consequently, it is important that our water resources be protected against excessive pollution. In recognition of this need, the State of Arizona has adopted water quality standards. Any time water quality deteriorates to the point that standards are being violated, corrective action and/or protection of the user should take place.

For the Lower Salt River, State standards have been set to protect the recreation user, fish, aquatic life and wildlife. In addition, standards have been set to protect the downstream domestic, industrial and agricultural uses. By comparing the existing water quality of the Salt River to these standards, we can determine if the river is meeting user needs.

#### 14. Land Uses and Restrictions

Most of the Lower Salt River Recreation Area is included in a First Form Reclamation Withdrawal, under the provisions of act of June 17, 1902, and a Water Power withdrawal effected by the act of June 20, 1910. These withdrawals give the Bureau of Reclamation and i agent, the Salt River Project (SRP), specific rights on the withdrawn lands for reclamation and power purposes. On those lands actually being used for these purposes, the Bureau of Reclamation and the Project have primary jurisdiction. On those lands not actually being used, however, even though they are within the withdrawn areas, the Forest Service retains the responsibility of managing the lands for multiple resource use These uses would become secondary to the purposes of the withdrawals if and when the withdrawn lands were to be actually used for reclamation or power purposes.

There are several other outstanding rights on portions of the area, all authorized by Special Use Permits. Both the Bush Highway and the Usery Pass road are under permit to Maricopa County. The Salt River Project has a permit for a 100 foot right-of-way for the 115 KV Goldfield/Stewar Mountain transmission line, and another permit for a 20 foot right-of-wafor the 12 KV Saguaro Lake distribution line. Mountain States Telephone has a joint-use permit with SRP on the Saguaro Lake Line. Finally, the Saguaro Lake Guest Ranch is under permit to Mr. and Mrs. John Kissinger for operation as a resort.

Other uses are occasionally authorized, such as apiary sites or harvesti forest products. These are considered a minimum impact type of  $commitm\varepsilon$  and are of short duration.

#### 15. <u>Landownership</u>

There is a single private inholding within the Lower Salt River Recreation Area, the 102.94 acre Goldfield Ranch. This property was patented in 1954 under the provisions of the Homestead Act of 1862.

All of the remaining lands in the Salt River Recreation Area are National Forest, reserved from the public domain by proclamations in 1908 and 1908. There are no outstanding pre-establishment rights or reservations on the lands, except for power and reclamation withdrawals discussed previously (under Land Uses and Restrictions).

#### 16. Minerals

There is an abandoned barite mine in the vicinity of Coon Bluff which produced about 300,000 tons of ore during World War II. The extent of current reserves is not now known. There are no other kno valuable mineral deposits within the area being proposed for development and intensive management, and no known mining claims. Common variety materials, such as sand, rock, and gravel, are present in the area, but

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)acent by physiAmerican Camping Association Central Arizona District 2700 N. 15th Avenue Phoenix, AZ 85007

Arizona Conservation Council Wilderness and Land Use Committee 1505 E. Cherry Lynn Rd. Phoenix, AZ 85014

Arizona Conservation Council 3039 E. Bacus Dr. Mesa, AZ 85203

Arizona Daily Star Box 5846 Tucson, AZ 85703

Arizona Environmental Educational Association 4700 N. 12th St. Phoenix, AZ 85014

Arizona Environmental Education Council, Inc. Suite 325, Luhrs Bldg. Phoenix, AZ 85003

Arizona Federation of Garden Clubs 4861 Hidden Valley Rd. Tucson, AZ 85715

Arizona Federation of Women's Club P.O. Box Drawer 528 Pinetop, AZ 85035

Arizona Game and Fish Department 2222 W. Greenway Rd. Phoenix, AZ 85023

Arizona Habitat Association 2452 North Indian Ridge Dr. Tucson, AZ 85715

Arizona Department of Transportation Environmental Planning Services 206 S. 17th Avenue, Rm. 309 Phoenix, AZ 85007 Arizona Motorcycle Dealers Assn 6717 E. McDowell Rd. Scottsdale, AZ

Arizona Outdoor Recreation Coordinating Commission 4433 N. 19th Ave., Suite 203 Phoenix, AZ 85015

Arizona Outdoor Writer's Association 3128 North Willow Avenue Phoenix, AZ 85029

Arizona Republic 120 E. Van Buren Phoenix, AZ 85004

Arizona State Department of Health Services 1740 W. Adams, Room 101 Phoenix, AZ 85007

Arizona State Archaeologist Arizona State Museum Tucson, AZ 85721

Arizona Roads and L Aails 222 N. Central, Suite 800 Phoenix, AZ 85004

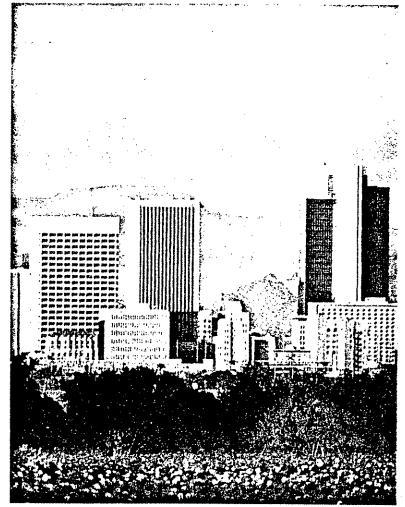
President
Arizona State Horseman's
Association
2931 E. Danbury
Phoenix, AZ 85032

Arizona State Lands Department Administration of Natural Resource Conservation 1624 W. Adams Phoenix, AZ 85007

Arizona State University
Dr. Duncan T. Patten
Assistant Academic Vice-President
Professor Botany
Administration Bldg., Room 205
Tempe, AZ 85281

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# A VALLEY REBORN

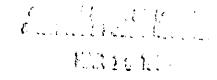


The Story of the Salt River Project

Through the centuries, this desert valley has seen a parade of settlers, from prehistoric Indians to the white man, attempt to survive by quenching the thirst of the land with the life-giving water of the Salt River. But time and again the desert sun unblinkingly stared the river down to a thin rivulet and the crops withered. There had been a time, which lasted for centuries, in which the Valley of the Sun bloomed. That successful reclamation effort was at the hands of the Hohokam Indians who began imigating the land two or three hundred years before the time of Christ. Then, just before Columbus discovered America, these Indian farmers vanished—and the desert reclaimed their crop lands.

Building on the ancient idea, early white settlers tried irrigating the land with water from the river. But its flow was erratic. Torrential rains caused the river to wash away much of what man had established. At other times, the merciless sun brought droughts, denying the thirsty crops. Many of the settlers left. But some stayed . . . and it is they who eventually succeeded in seeing a valley reborn.





# A valley reborn

#### Foreword

The Salt River Project is the oldest and most successful multi-purpose reclamation development in the United States. For decades, SRP has been the largest deliverer of water in Arizona. In recent years SRP has grown to become one of the five largest public power utilities in the country.

During fiscal 1983-84, SRP sold 13.9 billion kilowatthours (kWh) of electricity to almost 400,000 customers. (This was enough power to serve the entire state of Montana during 1981.) Of the 13.9 billion kWh, 11.6 billion were generated by the Project, and an additional 2.3 billion were purchased from other utilities. Electric use in SRP's service territory is expected to total 15.8 billion kWh by 1989.

The six Salt River Project lakes are a major source of water for urban and agricultural use in the metropolitan Phoenix area and also provide a variety of recreational activities. Keystone of this water storage and delivery system is Theodore Roosevelt Dam, which was completed in 1911. The Project also operates a 1,300-mile water delivery system.

Following the long-standing reclamation principle, the Project uses a small portion of electric revenues to help resport water operations. This helps keep water costs low.

At the same time, the Project maintains electric rates competitive with the rates of Arizona's other major utilities. This combination of dependable supplies of power and water has promoted the economic growth of this desert valley.

#### Valley residents manage SRP

As a not-for-profit organization, SRP is managed by landowners in its water service area. Officers of the SRP are the president, vice president and members of the boards and councils.

With the exception of four at-large board members, representatives are elected by a "debt-proportionate" voting system. The four at-large members are elected by a one person, one vote method.

The debt-proportionate method started in 1903 when founders of the Salt River Valley Water Users' Association pledged their private lands as collateral for a government loan to build Roosevelt Dam and related facilities. Under the debt-proportionate concept a landowner with 20 acres owns 20 "shares" of SRP. The person, therefore, is responsible for 20 shares worth of SRP's debt, and is allowed 20 votes in an SRP election. In comparison, a resident with a one-fifth acre lot is responsible for only one-fifth of a share, and may cast one-fifth of a vote. This method has been upheld by the U.S. Supreme Court.

Board members set specific policies and, through SRP's management, operate the Project in accordance with the articles of incorporation, bylaws and state statutes. For instance, the board approves major fuel contracts, authorizes the purchase of major equipment items and sets water and power rates.

Council members set broad policy by adopting, amending and enforcing bylaws relating to the management and conduct of SRP business.

# The Salt River Valley

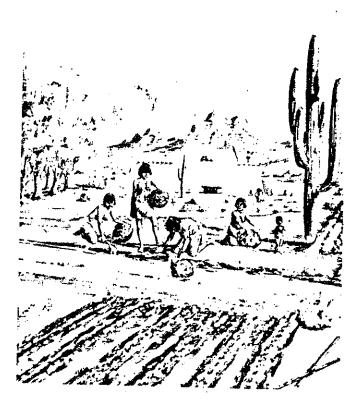
The Salt River Project is situated in a large alluvial valley in south-central Arizona. At one time, the Project area consisted mainly of irrigated farmland. The rapid growth of Phoenix, the nation's ninth largest city, has eliminated a large portion of farming, replacing it with new subdivisions, businesses, and high-tech industry.

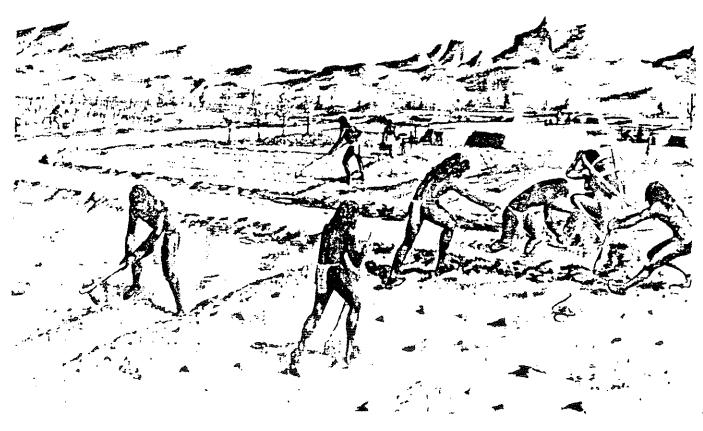
As early as 200 B.C., an ancient people known as the Hohokam began to settle in the fertile Salt River Valley. As their culture developed, the Hohokam used stone hoes to dig canals that carried water from the Salt River to their vegetable and cotton fields.

Archaeologists estimate the Hohokam may have built as many as 250 miles of canals in the Valley. Surprisingly, the routes of their canals are similar to those of modern canals which were aligned by engineers using precision surveying instruments. The Hohokam irrigation system is considered one of the greatest irrigation achievements by ancient many on this continent.

After 1,400 years, the Hohokams began to move out of the Valley toward the Gila River. By A.D. 1400, for reasons that still are unclear, the Salt River Valley was abandoned.

Right and below: Ancient Hohokam Indians built crude canals from the Salt River to irrigate their crops. These canals helped lay the groundwork for SRP's intricate 1,260 mile canal system.





## Birth of the Salt River Project

## Irrigation creates a green valley again

The city of Phoenix got its start in 1867 as a hay camp for the cavalry at Ft. McDowell.

At that time, John Y.T. Smith supervised harvesting and hauling of hay which grew wild along the Salt River near what is now 40th Street. But it wasn't long before Smith, his wagon driver, John W. "Jack" Swilling, and others realized the ancient irrigation canals could be cleared and used to grow valuable crops for the military post.

The Swilling Irrigating Canal Co. was organized in 1867, and in December of that year, a 17-man party began building the first modern canal, known as the Swilling Ditch. Success came quickly; the first crops were harvested by Frenchy Sawyer and Capt. John Adams in March 1868.

Homesteaders began to arrive in the Valley and by year's end there were 100 permanent residents. They settled in an area that William A. Hancock, a lawyer and surveyor, had staked out as the townsite of Phoenix. Hancock, recognizing the potential of the Valley, also surveyed new ditchlines.

More settlers migrated to the Valley and by 1888 more than 100,000 acres were being farmed. New canals were built to carry water to the freshly cleared farmland.

Other canals and the years that their construction began are: Maricopa Canal, 1868; San Francisco Canal, 1870; Tempe Canal, 1871; Utah Canal, 1877; Grand and Mesa canals, 1878; Arizona Canal, 1883; Highland Canal,

Turn-of-the century irrigation methods often were crude.

1888; Arizona Crosscut Canal, 1891; Consolidated Canal, 1892; South Canal, 1908; Eastern Canal, 1909; New Arizona Crosscut, Western and Highline canals, 1912.

Today, SRP manages 132 miles of main canals. Another 1,131 miles of laterals and ditches deliver the water directly to users.

#### Water problems arise

Water handling methods were crude and diversion into various canals was inconsistent. Often, the rock and brush dams that farmers built to divert water into their canals were washed out during heavy rains. There were no facilities to store excess water from spring runoff, so water flowed past the Valley and was lost.

Conversely, during the summer months the Salt River sometimes dwindled to a trickle and crops died. During these dry periods, conflicts between settlers arose over water rights.

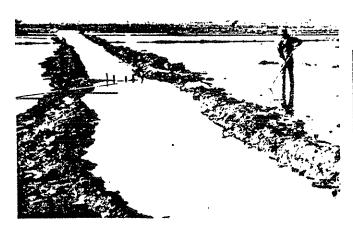
The settlers realized if they were to prosper in the Valley they would have to find some way to regulate the river's flow, and eliminate the constant conflicts and litigation about the water supply.

These water problems became so critical at the turn of the century that many settlers left the Valley.

However, there were those who believed farming could become highly productive in the area. So the Maricopa County Board of Trade named a committee to investigate the feasibility of a water storage system.

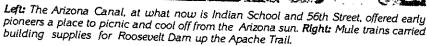
Committee members presented a detailed report to a mass meeting of Valley citizens. The reservoir site which seemed the most practical was located 80 miles from Phoenix where Tonto Creek flowed into the Salt River. Construction of such a reservoir, the committee announced, would cost from \$2 million to \$5 million. As a Territory of the United States, Arizona was prohibited from assuming such a large-scale debt. And private investors could not be induced to take on the financial risk necessary to build the dam.

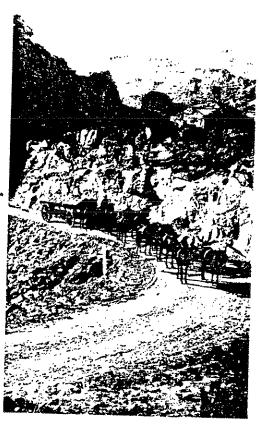












## National Reclamation Act becomes law in 1902

President Theodore Roosevelt realized water development in the West was essential to the future prosperity of the nation. He also recognized that the federal government would have to finance any large reclamation program.

Through the lobbying efforts of George H. Maxwell and Benjamin A. Fowler, and by virtue of government ownership of most land in the West, the United States Congress approved a National Reclamation Act on June 17, 1902. The act, originally known as the Hansbrough-Newlands Bill, provided that money from the sale of Western public lands would be made available for reclamation projects. Initially, the money was to be paid back to the federal government out of project water revenues. Repayment with power revenues was added by 1906.

## Landowners form Water Users' Association

Before the federal government would lend money for reclamation projects, it required assurance of repayment. To accomplish this, all local differences between landowners over water rights had to be settled. The government also was unwilling to deal with the landowners individually. The solution to settling the problems and

getting the loan was formation of a landowners' association.

Valley landowners formed a 25-member committee to solve the almost impossible problem of bringing all concerned into agreement.

Judge Joseph H. Kibbey worked with the committee to prepare a document that would benefit Valley landowners. Judge Kibbey's document was the framework for the articles of incorporation of the Salt River Valley Water Users' Association. The Association was incorporated on Feb. 9, 1903. Landowners who would benefit from Association memberships pledged their lands as collateral for the federal loan.

The Association ensured that the rights to water stored by Roosevelt Dam (known since 1961 as Theodore Roosevelt Dam) would be equally available to all members. Construction costs and assessments were distributed on a per-acre basis, proportionate to the debt of the land, irrespective of the use or non-use of water.

The organization also provided a central body which could assume responsibility for the operation and management of the Project at a future date. Landowners now had an organization to represent them in negotiations with the U.S. Reclamation Service (USRS). The Association also guaranteed repayment of construction costs to the government, and enforced collection of each installment of these costs from individual landowners.

The agreement with the government was signed June 25, 1904, by B.A. Fowler, first elected president of the Salt River Valley Water Users' Association, Frank H. Parker, Association secretary, and U.S. Secretary of the Interior Ethan H. Hitchcock.

### osevelt Dam construction begins

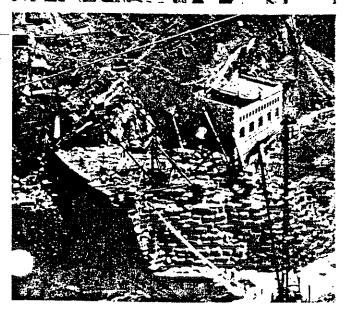
Construction of Roosevelt Dam began in 1905, but was halted by several floods that washed out the foundation. Construction was completed in 1911. The dam was built with a technique called modified cyclopean rubble. The faces of the dam were built from stones which were handcut from nearby cliffs by Italian stonecutters. This gave the dam a finished appearance. In between the faces, the dam was filled with large boulders and mortar. Louis C. Hill, USRS engineer, supervised actual construction of the dam, including the cutting of about 350,000 cubic yards of stone from the side of the mountain.

Roosevelt Darn, the world's highest masonry darn, is 184 feet thick at the base, 16 feet wide at the crest, and 280 feet high. It receives its strength from the "keystone" effect. The fuller the reservoir, the tighter the rocks fit together.

Originally, Roosevelt Lake had a capacity of 1.28 million acre-feet (af). Spillway modifications and the addition of spillway gates increased the capacity of the lake to 1.34 million af, enough water to fill SRP's other five lakes to capacity two times. When full, the 23-mile-long lake has a shoreline of more than 88 miles.

Workers laid stone for Roosevelt Dam by hand.





Roosevelt Dam is the world's highest masonry dam.

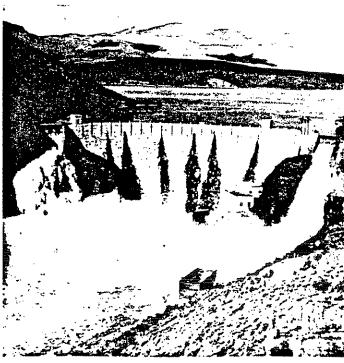
# USRS anticipates need for electrical power

The original concept of Roosevelt Dam was solely for storage and control of water. However, it soon became apparent that hydroelectric power could be developed. In 1904, the USRS began building a a 20-mile power canal to furnish electricity for use during construction of the dam. Two years later the USRS installed a temporary 900-kilowatt (kW) hydroelectric generator. Most of this power was needed for operation of a cement mill at the dam site. In 1907, the USRS installed a permanent 900-kW unit, and the first power from the dam site was sent to Phoenix on Sept. 30, 1909. The USRS recommended additional generating capacity to operate wells in the Valley which supplemented water stored behind the dam.

Surveys indicated that only about 180,000 acres of the 250,000-acre Salt River Project land area could be irrigated with both normal river flows and flood waters stored behind Roosevelt Dam. It was estimated that 40,000 more acres could be irrigated by pumped underground water.

Between 1905 and 1912, the 900-kW generator on the power canal was moved to the dam and four more 900-kW generating units were installed, bringing the total capacity to 4,500 kW. The dam's generating capacity was increased three more times and today it has one 36,000-kW generating unit.

Theodore Roosevelt Dam



# Workers carve the Apache Trail

Before work could begin on a dam, roads had to be built to carry supplies. One road was built to a sawmill in the Sierra Ancha Mountains, where pines were logged to provide lumber for construction work.

The most difficult road-building task was the Mesa-Roosevelt Road (now called the Apache Trail). The road was mandatory because all machinery needed for dam construction was carried from the town of Mesa to the dam site 60 miles away. Building this road through rugged canyons and across mountains was an engineering feat itself. The road was completed in 1904 at a cost of more than a half-million dollars. Still, it was little more than a two-rut trail used by mule teams pulling huge wagons.

Today, the Apache Trail is a highway that connects three of SRP's dams on the Salt River.

## Costs exceed expectations

During the building of Roosevelt Dam and related facilities (which included Granite Reef Diversion Dam, and the acquiring of transmission canals and laterals), costs far surpassed the USBR estimate of \$3.75 million. By 1912, expenses already totaled \$9.5 million, and they were still growing.

Members of the Water Users' Association complained so bitterly that the Secretary of the Interior appointed a Central Board of Review to study the costs. By 1917, it was agreed that the Association would pay the federal government \$10,166,021. In the end, the dam cost more than \$10.3 million.

Despite the fact that costs to shareholders amounted to about \$40 per acre—twice as much as the original estimate—the loan was repaid, with interest, by Oct. 1955.

# Granite Reef Diversion Dam diverts water to users

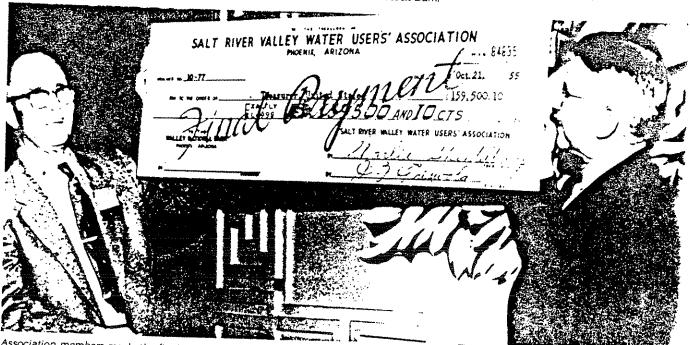
Granite Reef Division Dam was built about 50 miles down river from Roosevelt Dam, at a rock outcrop or "reel directly below the confluence of the Salt and Verde rivers.

The purpose of the dam is to divert water from the river into the canals north and south of the river for delivery to water users within the Project. No water is stored, and no power is generated at Granite Reef Dam.

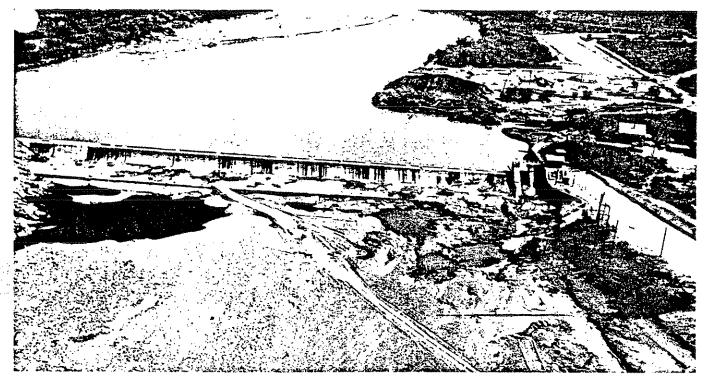
Granite Reef Dam was completed in 1908. It is only 29 feet high and is 1,000 feet long.



President Theodore Roosevelt was present for the dedication of Roosevelt Dam.



Association members made the final payment on Roosevelt Dam Oct. 21, 1955, 50 years after construction began.



Granite Reef Diversion Dam

### '^'ater rights controversy rages

Disputes over water rights continued, even after the Water Users' Association was formed. The Association's articles of incorporation did not determine the prior water rights of individual landowners; nor were these rights defined in the contract between the Association and the federal government.

Because all landowner members of the Association signed a water right application with the United States, they had equal rights to water stored behind the dam and water from deep wells drilled by SRP for use in the Project area.

There were separate water rights for lands designated as townsite lands by the Secretary of the Interior. These rights were firmed up under the Act of April 16, 1906.

As a result, cities and towns within the Project could obtain water under a special contract. The Project would provide water in an amount considered necessary. The charges to the cities were not to be less nor the terms more favorable than for other lands in the Project.

Landowners with old water rights were concerned about their possible loss of previous rights. These landowners believed they should receive more water than other landowners, based on their prior use of the water. In 1905, Patrick T. Hurley brought this problem to a head by filing a suit against Charles F. Abbott and some 4,800 other landowners.

Hurley sought to establish the water rights pertaining to the parcel of land and the date each landowner first used her for irrigation. The federal government intervened as a party in the suit.

#### Kent Decree settles water disputes

On March 1, 1910, after five years of gathering and studying evidence, Judge Edward Kent, sitting as district judge, handed down a decision on the case. Kent was the Chief Justice of the Arizona Territorial Court. The Kent Decree established the relative rights of Project lands to the water of the Salt River. The decree formally stated the principle of normal flow rights and reaffirmed the long-standing legal principle of prior appropriation.

Normal flow water rights are the rights to water that naturally flows down a river. Kent's decree concerns lands which used water from the Salt and Verde rivers from 1869 to 1909.

Generally, prior appropriation adheres to a legal concept developed in early Western water courts—"first in time, first in right." Land where water first was used beneficially has first rights to water flowing in the river. In the Kent Decree, all rights were set chronologically from 1869 through 1909 based on continuous beneficial use of water. For example, land which used water in 1869 had the first right to water in the river, then land which used water in 1870, and so on up to 1909.

When the river flows were low, only lands with the earliest water rights could use the so-called normal flow water. Normal flow water rights, which still are in use today, are in addition to rights to stored and developed water which all Association members share equally.

Kent's decree satisfied the landowners holding old water rights because it reaffirmed their rights to additional water by virtue of prior use. Even today, owners of these older lands have access to whatever normal flow water is available.

# Salt River Project comes of age

# Landowners' Association assumes operation of the Project

Early in the Salt River Project history, members of the Water Users' Association became concerned with the USRS' operational procedures. A meeting was set for Feb. 20, 1917 to discuss the situation.

At the meeting, Interior Secretary Alexander T. Vogelsang told the delegation the government was willing to turn over operation of the Project to the Association. He suggested that a contract be drawn up so the Association could assume all future operation and control expenses, and repay the entire cost of the Project to the federal government.

He added that the Association could use all power receipts in any way it saw fit. A delegation composed of Congressman Carl Hayden, Association President John Orme, and Judge Joseph H. Kibbey, who acted as counsel for the Association, agreed to the proposal.

The contract was drawn up Sept. 6, 1917, and the Association took over operation of the SRP on Nov. 1, 1917, and assumed full responsibility for its care, operation, maintenance and management. At that time, the Project primarily consisted of Roosevelt Dam, Granite Reef Diversion Dam, irrigation canals, laterals and ditches.

A fisherman and his best friend relax at an SRP lake.



### Landowners seek to lower costs

Economy and efficiency became the goals of the Association as it took over operation of the Project.

The importance of electric power revenues already was obvious. Five 900-kW generators were in operation at Roosevelt Dam, two 1,200-kW generators were at the South Consolidated Canal power plant, one 500-kW generator was at the Arizona Canal at Arizona Falls, and six 800-kW generators were at the Crosscut Canal Power Plant in what now is northwest Tempe.

Mormon Flat Dam





Water skiers and other recreation enthusiasts flock to SRP's lakes during the Valley's warm summers.

One of the first moves the Association made when it assumed control of the SRP was to acquire a 600-kW hydroelectric generating unit for the Chandler Power Plant on the Tempe Canal north of Mesa. This helped increase revenues from sale of electricity and increased the power available to pump water.

The Project had studied various methods for increasing a available supply of irrigation water; additional pumping racilities was one. Another method was to create additional storage capacity.

in 1922, the SRP decided to build two more dams on the Salt River.

Additional land reclamation—and more recently large scale urban and commercial development—was not possible until storage dams were built on the Salt and Verde rivers. SRP's dams, built principally in the first 40 years of this century, now help to regulate water releases from Roosevelt Dam and provide hydroelectric power for SRP power customers.

### New construction begins on the Salt

SRP's second dam, Mormon Flat, was built between 1923 and 1925 for \$25 million. The dam was financed with general obligation bonds. It is located downstream from Roosevelt Dam, and named for a small Mormon community once located at the site. Mormon Flat Dam impounds Canyon Lake which has a water storage capacity of 57,852 af. A single 10,000-kW generating unit was installed at the dam.

In 1971, SRP added a pumped-storage generating system at Mormon Flat Dam. This increased the generating capability of the dam to 54,000 kW and mabled SRP to reuse water for generating electricity.

Before Mormon Flat was built, water from Roosevelt was released only when farmers needed it. If water releases were low, little power was generated. Mormon Flat allowed a re-regulation of water so improved generating procedures were possible at Roosevelt.

### Horse Mesa Dam built by 1927

In 1924, shortly after the Project began building Mormon Flat Dam, construction started on a third dam. This dam was named Horse Mesa Dam because it was built near a mesa once used as a hiding place for stolen horses.

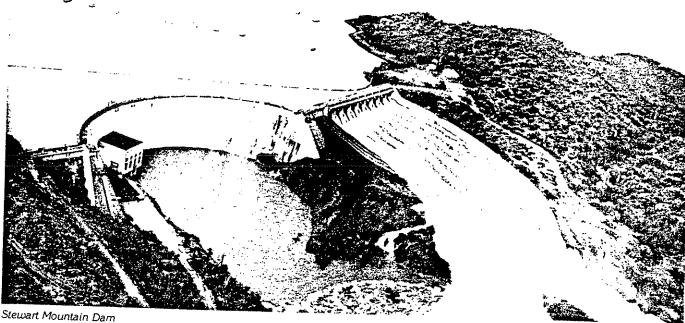
Horse Mesa Dam, located between Roosevelt and Mormon Flat dams, forms a reservoir with a storage capacity of 245,138 af. This 17-mile long impoundment is called Apache Lake.

The three 11,000-kW hydroelectric generating units at the dam made it the largest generating station then in the Project's hydroelectric system. The power primarily was developed for the Inspiration Consolidated Copper Co., in Miami, Ariz.

In 1972, a pumped storage generating system was completed at Horse Mesa Dam, adding 93,000 kW to its generating capability.

The original \$5.3 million cost of the dam was financed through the sale of government obligation bonds.





## Stewart Mountain Dam provides water storage and regulation

Stewart Mountain Dam was built between 1928 and 1930. It provided more water storage facilities and more sophisticated regulation of water used to generate power at the three dams already built.

The dam, which cost \$2.8 million, was named for its proximity to Stewart Mountain, landmark of the old Stewart Ranch. The reservoir created by the dam is named Saguaro Lake and has a capacity of 69,765 af.

Stewart Mountain Dam was built with a 10,500-kW hydroelectric generating unit. The unit was upgraded to 13,000 kW in 1963.

This electric development was financed privately through the sale of general obligation bonds. Principal and interest payments on the bonds were assured by revenues from the sale of power to Central Arizona Light and Power Co., a predecessor of Arizona Public Service Co.

## Pumped-storage systems increase SRP generating capability

Before 1970, a limiting factor for the amount of hydroelectric generation produced at the Project's dams on the Salt River was the amount of water ordered each day for municipal and irrigation purposes. If water wasn't required by users, none would be released to turn the hydroelectric generators.

Now, the pumped-storage hydroelectric generating ystems, installed in Mormon Flat and Horse Mesa dams, have changed that limitation. The pump/turbine at each dam is similar to a conventional hydroelectric generator, in that falling water from the reservoir is used to generate electricity.



SRP's lakes provide recreation and a place to cool off.

However, during off-peak periods when there is electricity to spare from other generating stations, the pumped-storage system reverses the process. The generator becomes a giant electric motor which turns the turbine in the opposite direction. As a result, water is pumped from the lower reservoir into the upper reservoir.

In this way, water can be used more than once for generating electricity. In addition, the \$45 million system increases SRP water control flexibility. It now is possible to move water upstream to gain maximum storage or to help cope with local storm conditions.

As part of the installation program, many of the Project's generating facilities at the dams were increased and modernized. SRP's total hydroelectric generating capability expanded from 69,690 kW, which includes Crosscut Generating Station, to 233,000 kW. This total includes conventional generating capability of 96,000 kW. The remainder is from the pumped-storage units.

#### . ower use spreads

In the late 1920s, farmers in the rural areas of the Valley sought the same electric service that private utilities furnished residents in the cities. It was too expensive, however, for the private utilities to build power lines to serve a few customers in sparsely settled rural areas.

Responding to the requests of its farmer-members, SRP began to build lines in 1928-29 to supply those customers with electricity. At the same time, power from the dams also was sold to copper mines in the Globe-Miami area and wholesaled to private utilities serving the Salt River Valley.

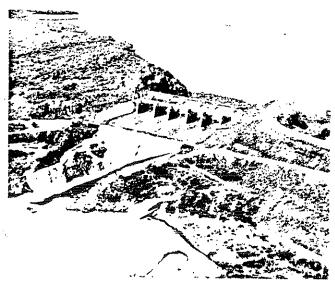
## Arizona legislature forms Power District

During the 1920's and 1930s, Valley farmers were hard-pressed to make payments on the federal loans. To help reduce payments on the outstanding loans, the Arizona legislature allowed the formation of the Salt River Project Agricultural Improvement and Power District in 1937 at the Association's request. The Power District had boundaries and interests practically identical to those of the Association.

As a political subdivision of the state, however, the District secured certain rights, privileges, exemptions and munities. The most important was that the District ald refinance outstanding bonds at a lower rate with tax-exempt, municipal-type bonds.

Under contract, all Association properties were transferred to the District, but the Association continued to operate all of the Project as agent of the District. In 1949, the contract was amended to allow the District to assume operation of the electrical system.

The Association still operates the irrigation system for the District. Although legally there are two separate organizations, the Water Users' Association and the Power District function as one, commonly know as the Salt River Project.

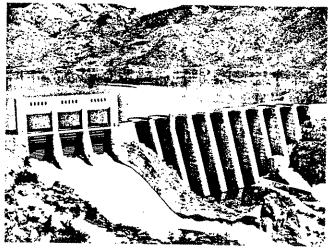


Horseshoe Dam

#### USRS builds first dam on Verde

Bartlett Dam was built on the Verde River between 1936 and 1939. The dam was named after Billy Bartlett, an old-time USRS employee. Bartlett Dam was the first step to control the flow of the Verde. The dam was built by the federal government, but SRP agreed to pay 80 percent of the total cost of \$4,735,064.

Bartlett Lake has a maximum storage capacity of 178,186 af. Due to the erratic flow of the Verde, it wasn't economical to install hydroelectric generating facilities when the dam was built.



Bartlett Dam

### Phelps Dodge finances Horseshoe Dam

Horseshoe Dam, above Bartlett on the Verde River, was built between 1944 and 1946 at a cost of about \$2.5 million. It is named for a horseshoe-shaped bend in the river.

Phelps Dodge Copper Corporation paid for construction under a contract with the Salt River Project. In exchange for the financing, Phelps Dodge earns water credit for part of the runoff impounded behind Horseshoe Dam. Phelps Dodge takes the credited amount of water from the Black River (a tributary of the Salt River) for use in its mining operations at Morenci.

Similarly, Phelps Dodge later financed construction of Show Low Dam on Show Low Creek, and Blue Ridge Dam on East Clear Creek. Water from the two lakes is pumped over the Mogollon Rim to the SRP watershed. Phelps Dodge takes a similar amount of water from the Black River for use at Morenci.

In 1949 the city of Phoenix paid to have spillway gates added to the dam at a cost of \$925,000. These gates increased storage capacity to 131,427 af. As a result, the city supply increases through "water credits," whenever the water level is high enough to accumulate behind the spillway gates. Water drawn from those credits can be used by the city for areas outside SRP's boundaries. Horseshoe Dam has no generating capacity.

# Growth of the Salt River Project

## Lawns begin to replace crops

Just after World War II, the Valley and the Project entered a period of unequaled growth that continues to this day. As Valley cities grew, subdivisions began to replace farmland and lawns began to replace agricultural crops as irrigation users. This sudden spurt of growth affected water distribution patterns.

By the year 2000, about 90 percent of the SRP territory will be urbanized. Estimates are that no substantial amount of agricultural land will remain in production after 2034.

## Project sets pump water rights

In 1948, due to a continuing drought and a scarcity of stored water, the Project advanced a program to develop underground water supplies. Known as the SRP Pump Water Priority Proposal, the program furnished funds to provide more groundwater for many Project landowners who wanted a pump right.

This program still is in effect. The pump water right is a permanent right to buy water from pumps if and when it is needed. The cost of pump water is based on the actual expense of pumping and delivery.



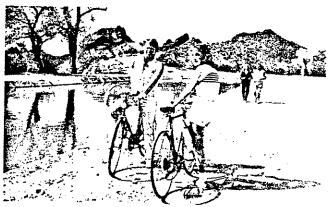
An SRP zanjero releases water into a lateral.

# SRP, City of Phoenix establish domestic water supply contracts

As the metropolitan development in the Valley grew, lands went out of agricultural useage and the need for city water began to expand. In 1952, the SRP entered into a contract with the city of Phoenix. The city pays SRP the annual assessment for urban acreage which no longer is irrigated. In turn the Project delivers to Phoenix the water to which this urban acreage is entitled. After treatment by the city, which acts as agent for SRP, the water is delivered to users.

Other cities with similar domestic water supply contracts for surface and underground water are: Tempe, Glendale, Mesa, Scottsdale, Chandler, Peoria and Gilbert.

These contracts have provided cities within the Project boundaries with a stable water supply at the same rate paid by irrigation customers. In this way, cities avoid the added costs of transporting the water from a distant source or of additional pumping.



Many people use SRP canals for running and biking.



As the Valley grows, agricultural irrigation decreases.

## SRP develops power for Valley customers

In 1947, there were only 12,400 SRP electric customers; by 1984 there were about 400,000. Naturally, new sources of electricity were needed for these new power customers.

In the late 1930s and early 1940s, the Crosscut Generating Station was expanded to a generating capacity of 47,000 kW, a total which included hydroelectric, steamand diesel-powered generation.

But this was not enough to meet growing electricity demands. The situation was complicated by an extended drought that reduced SRP's ability to produce hydroelectrically. In the late 1940s SRP installed a fourth steam unit at Crosscut, with a capability of 8,000 kW.

Some units were retired later and Crosscut now has a generating capability of 35,000 kW, including 3,000 kW of

hydroelectric power.

In 1941, the USRS completed transmission lines from Parker Dam on the Colorado River to Phoenix. The Project then received 30,000 kW of additional power to provide for the growing needs of SRP electric customers.

The Project began building Kyrene Generating Station in south Tempe in 1952 to keep up with the Valley's growth. The station had two natural gas-fired generators—

34,000-kW unit and a 70,000-kW unit.

Foday, Kyrene Generating Station has a total capability or 300,000 kW. This includes four combustion turbine generators. The station can burn either natural gas or oil, depending upon availability and cost.

In 1957, the Project began construction of the Agua Fria Generating Station, west of Glendale. Initially, two 111,000-kW steam turbine generators were installed; a 180,000 kW unit was added in 1961. By 1984, the station had a total generating capability of 599,000 kW, including 197,000 kW from three combustion turbines.

## SRP signs agreement to purchase power

In 1961, the Project signed an agreement with the Colorado-Ute Electric Association, Inc., for the purchase of power from a coal-fired generating station being built in Hayden, Colo. SRP was construction manager of the station, which delivered its first power in 1965.

Today, the station has two units. Colorado-Ute owns the 184,000-kW first whit and 50 percent of the second 262,000-kW unit; SRP owns the remaining 50 percent of

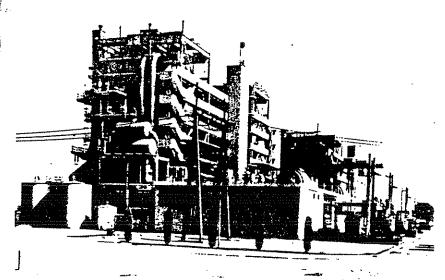
The Project also purchases power generated at Hoover Dam from the Arizona Power Authority; and from Parker-Davis and Glen Canyon dams from the Western Area Power Administration. These purchases total more than 200,000-kW.

## **Project benefits** from regional planning

SRP, like many utilities, takes part in extensive regional planning of generating and transmission facilities and coordination of its investments. Such joint planning helps utilities have the economic benefits of larger-scale projects. It also lets them use regional natural resources more wisely and achieve greater over-all environmental

The Project and five other Southwestern utilities invested in the construction of two large coal-fired units at the Four Corners Station, near Farmington, N.M. The Project receives 155,000 kW from this source.

SRP also is a participant in the 1.58 million kW Mohave Generating Station, located in southern Nevada across the Colorado River from Bullhead City. SRP receives 158,000 kW from this coal-fired station.



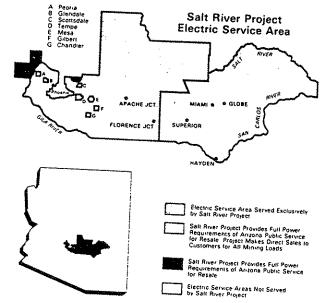
Left: Agua Fria Generating Station in Glendale. Right: An employee checks his work in the Crosscut hydrology lab.







Left: An SRP employee monitors equipment in a power plant control room. Right: Palo Verde Nuclear Generating Station.



And SRP receives 248,000 kW from Craig Generating Station in northwestern Colorado. Craig, along with Hayden Generating Station, is operated by Colorado-Ute.

SRP is station manager of the Navajo Generating Station near Page. The massive station produces 2,250,000 kW from three coal-fired units, with SRP receiving 488,250 kW.

# SRP builds electric resources

SRP has constructed four 72,000-kW combined-cycle generating units at the Sarıtan Generating Station near Gilbert. Generators at the station are powered by both a

combustion turbine and a steam turbine on a common shaft. The extremely hot exhaust of the combustion turbine is used to produce steam for the second turbine; that heat is wasted with conventional combustion turbines.

To meet the anticipated growth of the Valley and residents' demand for power in the early 1990s, the Project is completing construction of the third 350,000-kW unit at the coal-fired Coronado Generating Station near St. Johns. The first unit at Coronado began commercial operation on Dec. 31, 1979 and the second unit began operation Oct. 31, 1980. The third unit is scheduled to begin commercial operation in 1991.

SRP is station manager and 70 percent owner of the first two units and 100 percent owner of the third unit. Los Angeles Department of Water & Power (LADWP) is 30 percent owner of the first two units.

# Nuclear power helps meet growing electricity demand

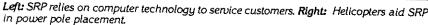
SRP and five other utilities are participating in the construction of the Palo Verde Nuclear Generating Station near Wintersburg, 40 miles west of Phoenix.

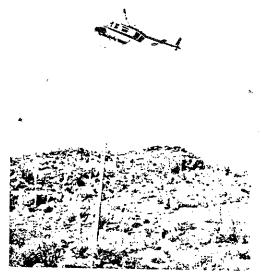
The station will have three 1,270,000 kW pressurized water nuclear reactor units.

The current schedule calls for Unit 1 to begin operating in 1986. It originally was scheduled to begin commercial operation in 1983, but construction problems delayed its startup. The final two units are expected to begin commercial operation in 1986 and 1987.

When Unit 1 becomes operational, SRP will exchange 5.7 percent of Palo Verde for the LADWP's 30-percent interest in Coronado units 1 and 2. After the transfer, SRP will own 17.49 percent of Palo Verde and 100 percent of Coronado.







# Research and development efforts help utilities meet future demands

Over the years, the Project has contributed to utility research and development in two main areas: the search for new energy sources and efforts to make electric generating transmission and distribution systems cheaper and more environmentally acceptable.

Between 1977 and 1985, SRP contributed \$10.7 million to the Electric Power Research Institute (EPRI) to fund efforts to improve production, transmission, distribution and utilization of electric power. EPRI is the research and development arm of the electric utility industry.

Through EPRI, SRP maximizes its return on every research and development dollar by pooling its resources with 497 other utilities nationwide to fund projects beyond the financial capability of a single utility, and to avoid duplication of efforts.

SRP also is involved locally in solar projects, storing cold and hot water to cool or heat the home (thermal energy storage), and cold-storage air conditioning.

# Environmental protection policy guides SRP

Designs of SRP facilities are chosen to ensure environmental protection. In this effort, Salt River Project is guided by the following policy when it builds, maintains and operates water and power facilities.

- Conduct those studies necessary to gain a complete understanding of how any new facility or activity may affect the environment. Take any appropriate action to protect the environment.
- Inspect and survey all new facility sites so any historic or archaeological materials can be saved.
- 3. Install the necessary air pollution control equipment at

SRP facilities so emissions of particulate matter and gases will meet or be less than established limits.

- Construct generating stations so stack effluents, however small, will be adequately dispersed.
- 5. When it is necessary to return water to lakes, rivers or streams, design facilities so there will be no negative effect to the area's ecology from heat, dissolved solids, or chemicals, as determined by ecologists, biologists and controlling agencies.
- Provide protection against pollution by dust.
- Design, build and landscape all new facilities so they will be compatible with the surrounding area.
- Work closely with all federal, state and local agencies and groups responsible for or interested in protecting the environment.

As a participant in several power projects, SRP's costs for environmental protection are substantial. For example, more than \$200 million were spent on air quality control equipment for Coronado units 1 and 2, placing them among the cleanest burning, coal-fired generating units in the country. Another \$200 million were spent at the Navajo Generating Station.

Other environmental costs involve equipment for water pollution control, solid waste disposal, noise reduction and archaeological and aesthetic considerations.

The money is spent for such items as electrostatic precipitators and scrubbers that remove particulate matter and chemicals from stack gases. Other investments include studies of meteorology, dust control, nitrogen oxides and emissions and equipment for those studies.

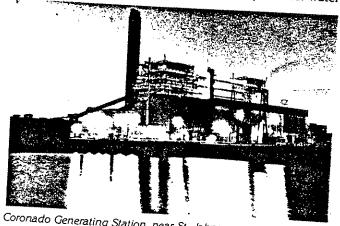
In addition, about \$30 million has already been spent by participants in the Navajo and Mohave power projects toward the testing and development of sulfur dioxide removal equipment for generating stations which burn low-sulfur coal.

One new design which was tested at the Mohave station was incorporated into the Coronado Generating Station's environmental protection system, improving its efficiency.

## SRP makes commitment to conserve Arizona's water

An average of 20 inches of precipitation falls on the SRP watershed every year; in contrast, the Phoenix area receives 7.2 inches annually. Average runoff received in SRP reservoirs has decreased in recent years. This decrease is partly a result of increasing density of timber and other vegetation. As a result, much of the precipitation on the watershed is wasted. Further decreases occur as a result of increasing diversions by upstream water users. To reduce these losses, the Project has requested the rights of all users on the watershed be adjudicated by the court.

Interested in conserving its limited water supply, the Project began a long-range program in 1950 to modernize the canal and lateral water distribution system. The program calls for the eventual concrete lining of all canals and the lining or piping of laterals to help control water



Coronado Generating Station, near St. Johns

SRP's Office of International Affairs offers tours and workshops to many foreign visitors each year.

losses through seepage and evaporation. SRP aiready has lined more than half of its canals, contributing to a 10percent reduction in water losses.

In 1974, the Project completed installation of water supervisory control facilities. This advanced system permits remote operation and monitoring of canal gates and automatic gauging of water levels anywhere on Project canals. Run from a master console, this precision water handling equipment saves manhours and helps reduce water losses.

Recognizing the need for development of new water sources, not only for the Valley, but in the state as a whole, the Project actively supports the Central Arizona Project. SRP will receive a portion of the water to supplement its supply of underground and lake water.

## Office of International Affairs shares knowledge with other countries

Because of SRP's prominence in the field of water operations, hundred of foreign visitors come to the Project each year for training and observation. In 1984, SRP established an Office of International Affairs which offers tours, seminars and technical workshops for foreign dignitaries and water officials.

SRP's first formal efforts in international affairs began in 1982, when SRP officially started an employee exchange program with Egyptian water officials to help rehabilitate the Egyptian irrigation system. The Project Employees Exchange Program (PEÉP) was rated the top exchange program in 1983 by the U.S. Agency for International Development, founder of the project.

Today, the Office of International Affairs annually serves hundreds of visitors, primarily from the Middle East, Asia, Africa and South America.



# ↑ P supports Safety of Dams, . .an 6

When SRP's dams were built in the early decades of this century, information available at that time indicated they were strong enough to withstand major floods. In recent years, however, the government has produced new data showing a need for additional flood protection and it has called for modifications to some of the Project dams.

In mid-1984, the U.S. House of Representatives and the Secretary of the Interior took a step closer to providing funding for darn safety repairs, flood control and water storage.

Horseshoe

Cliff

New Waddell

Control Arizona Arogona

Phoenix

Modified

Stewart Mountain

Plan 6 proposals

A young fisherman patiently waits for the fish to bite at an SRP lake.

Secretary of the Interior William Clark endorsed SRP-favored Plan 6 in April 1984, with the exception of Cliff Dam. He is awaiting further environmental studies on the dam site. Developed by the Central Arizona Water Control Study, Plan 6 would provide needed safety, flood control and conservation storage. Plan 6 calls for (see map):

- An enlarged Roosevelt Dam to provide flood control and safely handle the maximum credible flood on the Salt River.
- Modifications to Stewart Mountain Dam on the Salt River that would improve flood-handling capabilities and protect the dam from the maximum credible earthquake.
- Construction of Cliff Dam on the Verde River to control floods and provide dam safety and water storage.
- Construction of New Waddell Dam on the Agua Fria River to store Central Arizona Project water.

SRP, the U.S. Bureau of Reclamation and the U.S. Army Corps of Engineers are continuing their studies.

Pre-construction data gathering began on Stewart Mountain, Roosevelt and New Waddell dams during 1984. Construction, however, will not begin until a financing plan is approved by Congress.

## SRP pursues excellence

SRP management and employees work together to provide a reliable source of water and power for customers. Through technology and ongoing research and development, SRP strives to keep the cost of water delivery and power generation reasonable.



# Salt River Project technical information Dams on the Salt River

on the Salt River			
HORSE MESA DAM			
Lake			
Name	···· Apache		
Location	£		
Capacity	245 120 (105 kilometers)		
Surrace area	2.600 - acre reet (302 million cubic meters)		
Shoreline	acres at full capacity (1052 hostons)		
Length of lake	(or Mometers)		
₽am	(a. varanticueta)		
Constructed	1924-27		
Height			
Length	(m : 11/c/ce12)		
Generating capability	(=0 * !!!C'C!S)		
, , , , , , , , , , , , , , , , , , , ,	The state of the s		
	33,000 kilowatts conventional units		
	93,000 kilowatts pump turbine unit (began operation 1972)		
MORMON FLAT DAM	( Serialion 1972)		
Lake			
Name	•		
Location	A		
Location	"" "" " " " " I I I I I I I I I I I I I		
Capacity	11,002 acre-leet (/) million cubic		
Surface area	950 acres at full capacity (384 hectares)		
Shoreline	28 miles (46 kilometers)		
Length of lake	10 miles (16 kilometers)		
Constructed	1923-25		
Height	224 feet (68 meters)		
Length	380 feet (116 meters)		
Generating capability	54,000 kilowatts total		
	10,000 kilowatts consent.		
	44,000 kilowatts pump turbine unit (1971)		
STEWART MOUNTAIN DAM	(19/1)		
Lake			
Name	Sague		
Location	Saguaro		
Capacity	41 miles east of Phoenix (66 kilometers)		
Surface area	os, os acre reet (86 million cubic		
Shoreline	",200 acres at full capacity (519 hards)		
Length of lake	(JO Miometers)		
Dam	10 miles (16 kilometers)		
Constructed			
Height	1928-30		
Height	207 feet (63 meters)		
Length	1,260 feet (384 meters)		
Generating capability	13,000 kilowatts		
THEODORE ROOSEVELT DAM			
Lake			
Name	Danson, h		
I Ocatia-	Roosevelt		
	80 miles east of Phoenix at the conflux of the		
•	Salt River and Tonto Creek (129 kilometers)		
	· <b>- /</b>		

Dam

Constructed ...... 1905-11

Generating capability ..... 36,000 kilowatts—original eight generators

retired in 1973 and new unit installed

## Dams on the Verde River

#### BARTLETT DAM

Lake

Name ..... Bartlett

Dam

Constructed . . . . . . . . . 1936-39

Generating capability..... none

#### HORSESHOE DAM

Lake

Name ..... Horseshoe

Dam

 Constructed
 1944-46

 Spillway gates added
 1949

Generating capability..... none

# Below the confluence of the Salt and Verde rivers

#### GRANITE REEF DAM

Dam

Constructed . . . . . . 1906-08

Purpose . . . . . . to divert water released from storage to

Project canals on the north and south side of

the Valley.

# Electric generating stations

scriciating stations	
AGUA FRIA GENERATING STATION	
Location 2 miles west of	Unit No. Two
Glendalo (2 Lui	Completed
Total constitution 1957-1961	Converted to 60 hertz 1949
Total generating capability 599,000 kilowatts Unit No. One	Capability 8,000 kilowatts
Completed	Unit No. Three
( anahilin )	Completed
Unit No. Two	Converted to 60 hertz 1949
Completed 1958	Capability
Canabilib	Completed
Unit No. Three	Converted to 60 to
Completed1961	( anahilta.
Capability	Hydroelectric generating
Unit No. Four	
Completed 1973	
Capability	SOUTH CONSOLIDATED CANAL PLANT
Crite 1.10' L.IAG	Location
Completed 1973	Constructed 1981
Capability	Total hydroelectric
Chirc 170. Six	generating capability 1,000 kilowatts
Completed	NAVAJO GENERATING STATION
Capability	told is station manager and 21 7 percent and 21
KYRENE GENERATING STATION	Location
I Ocation	(6 kilometers)
	Constructed
Original construction	rotal generating capability . 2250 000 kiloway
(OIS) conserved	Unit No. One
Unit No. One	Completed
Completed 1952	Capability
Capability 34 000 kilowaya	3RP's snare
Unit No. Two	Citit 130, 1WO
Completed 1954	Completed
Capability	Capability
Unit No. Three	SRP's share
Completed 1972	
Capability 51 000 Line	Completed
unit No. Four	Capability 750,000 kilowatts
Completed	SRP's share
Capability	SANTAN GENERATING STATION
Unit No. Five	l Ocation
Completed	Cilbert (5 Lit
Capability	Constructed
Gille 130. SIX	Ofal general
Completed	unit No. One
Capability	Completed
CROSSCUT GENERATING STATION	Capability72 000 Li
I OCATION	Chit No. Iwo
(2 bilomatana)	Completed
1941.40	Capability 72,0000 kilowatts
Plant generating capability 35 000 billions	Chit No. Three
Unit No. One	Completed 1974
Completed	Capability
Converted to 60 hertz 1949	- in Fig. 1 our
Capability 8,000 kilowatts	Completed
20	Capability

DRONADO GENERATING	STATION
SRP is station manager and	70-percent participant in
units One and Two.)	

Location	5 miles north of St.
	Johns (7 kilometers)
	1075

Construction started . . . . . 1975

Total generating capability . . 1,050,000 kilowatts

Unit No. One

Completed . . . . . . . . . . . 1979

Unit No. Two

Completed . . . . . . . . . . . . . 1980

Unit No. Three

Scheduled completion .... 1991

 Capability
 350,000 kilowatts

 SRP's share
 350,000 kilowatts

(SRP will have 100 percent ownership of units One and Two when Palo Verde Nuclear Generating Station is in firm operation.)

#### PALO VERDE NUCLEAR GENERATING STATION

(SRP is a 23.19 percent participant, decreasing to 17.49 percent when Unit 1 is declared in firm operation.)

ocation	40 miles west of
	Dhaoniy (64

Phoenix (64 kilometers)

Construction started . . . . . 1976

Total generating capability .. 3,810,000 kilowatts

Unit No. One

Scheduled completion ... 1986

Unit No. Two

Scheduled completion . . . 1986

Capability . . . . . . . 1,270,000 kilowatts

Unit No. Three

Scheduled completion.... 1987

 Capability
 1,270,000 kilowatts

 SRP's share
 222,123 kilowatts

# SRP contract power purchases

Arizona Power Authority U.S. Bureau of Reclamation Colorado River Storage	56,200 kilowatts
Project	134,484 kilowatts (lower during winter months)
Parker-Davis	31,700 kilowatts (lower during winter

107,163 kilowatts

# SRP participation in other power projects

FOUR CORNERS GENERATING STATION, UNITS NO. FOUR AND FIVE

(SRP is a 10.0-percent participant.)

(32 kilometers)

Total generating capability . . 1,550,000 kilowatts

Unit No. Four

Completed...... 1969

Capability 775,000 kilowatts SRP's share 77,500 kilowatts

Unit No. Five

#### MOHAVE GENERATING STATION

(SRP is a 10.0-percent participant.)

Location ...... Clark County, Nev.,

one mile west of Bullhead City (2 kilometers)

Constructed...... 1967-1971

Total generating capability . . 1,580,000 kilowatts

Unit No. One

Completed . . . . . . . . . . . 1970

Unit No. Two

Capability ...... 790,000 kilowatts

## HAYDEN GENERATING STATION, UNIT NO. TWO (SRP is a 50.0 percent participant.)

(SRP is a 50.0-percent participant.)

## CRAIG GENERATING STATION, UNITS NO. ONE AND TWO

(SRP is a 29.0-percent participant)

Location ..... Craig, Colo.

Construction started . . . . . 1975

Total generating capability . . 856,000 kilowatts

Unit No. One

SRP's share . . . . . . . . . 124,000 kilowatts

Unit No. Two