A DRAFT OF PROPOSED AMENDMENTS TO WATER QUALITY STANDARDS FOR STREAMS IN ARIZONA

APRIL 1968

RULES AND REGULATIONS

FOR

WATER POLLUTION CONTROL

WATER QUALITY STANDARDS FOR STREAMS IN ARIZONA

Article 6
Part 2

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DEFINITIONS

The following definitions appear in Chapter 16 of Arizona Revised Statutes 36-1851 and apply thoughout this document:

1. "Board" means the state board of health.

2. "Commissioner" means the commissioner of public health.

3. "Council" means the water quality control council established by this chapter.

4. "Department" means the state department of health, which for the purposes of this article includes the council.

5. "Disposal system" means a system for disposing of wastes, either by surface or underground methods, and includes sewerage systems, treatment works, disposal wells, and other systems.

6. "Hearing officer" means any individual appointed by the council or board to perform the duties of a hearing officer at any hearing.

7. "Permit" means a certificate or letter issued by the department stating the conditions and restrictions governing the discharge of a pollutant into any waters of the state.

8. "Person" means the state or any agency or institution thereof, any municipality, political subdivision, public or private corporation, individual, partnership, association, or other entity, and includes any officer or governing or managing body of any municipality, political subdivision, or public or private corporation.

9. "Pollution" means such contamination, or other alteration of the physical, chemical, or biological properties of any waters of the state, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance into any waters of the state as will or is likely to create a public nuisance or render such waters harmful, detrimental, or injurious to public health, safety, or welfare, or to domestic, agricultural, commercial, industrial, recreational, or other beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life.

10. "Sewerage system" means pipelines or conduits, pumping stations, and force mains, and all other structures, devices, appurtenances, and facilities used for collecting or conducting wastes to an ultimate point for treatment or disposal.

11. "Treatment works" means any plant or other works used for the purpose of treating, stabilizing, or holding wastes.

12. "Wastes" means sewage, industrial wastes, and all other liquid gaseous, solid, radioactive, or other substance which may pollute or tend to pollute any waters of the state. The term "wastes" does not include agricultural irrigation and drainage waters for which water quality standards shall have been established pursuant to this article.

13. "Waters of the state" means all waters within the jurisdiction of this state including all streams, perennial or intermittent, lakes, ponds, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, public or private, situated wholly or partly within or bordering upon the state.

The following terms and symbols which appear in this document are defined as follows:

14. "Biocide" means a material applied to plants or soil as a growth regulator or pest control agent. These include, but are not limited to, insecticides and weedicides.

15. "BOD" means the 5 day arithmetic average of the 20^{o} C biochemical oxygen demand in mg/l as determined by the method described in the current edition of <u>Standard Methods of Examination of Water, Sewage and Industrial Wastes</u>.

16. "Eutrophication" means the enrichment of a body of water by the addition of nutrients that stimulate aquatic growth which may cause taste, odor and esthetic problems.

17. "mg/l" means milligrams per liter of water.

18. "Millequivalents per liter" means the concentration of an ion in mg/l divided by the equivalent weight.

19. "ppm" means parts per million parts of water by weight. This term is being replaced by the more popular term mg/liter although the two terms are nearly equivalent.

20. "Fecal Coliform" means those bacteria of the coliform group commonly found in the intestinal tract of warm blooded animals.

21. "Primary contact recreation waters" means waters in which body contact with the water is made such as swimming and water skiing.

22. "Secondary contact recreation water" means water in which only minor body contact with the water is made such as fishing and boating.

23. "Cold water fishery" means waters having an environment suitable for salmonids.

24. "Warm water fishery" means waters having an environment suitable for species of fish other than salmonids.

25. "Colorado River", "Colorado River System", and "Colorado River Basin"; these terms are used interchangeably throughout the document. They are meant to include all waters within the Colorado River Basin with the exception of the Gila River Drainage. Comments specific to a given portion of the basin are so identified by using the name of the tributary, reference to the main stem or other appropriate designation.

26. "Gila River", "Gila River System", and Gila River Basin"; these terms are used interchangeably throughout the document. They are meant to include all waters within the Gila River Basin. Comments specific to a given portion of the basin are so identified by using the name of the tributary, reference to the main stem or other appropriate designation.

RULES AND REGULATIONS FOR WATER POLLUTION CONTROL

WATER QUALITY STANDARDS FOR STREAMS IN ARIZONA

Article 6

Part 2

SEC. 6-2-1 Waters Controlled

REG. 6-2-1.1 General

This Water Quality Control Policy applies to all waters of the State. This includes both interstate and intrastate waters. Interstate waters are identified for the convenience of the Federal Water Pollution Control Administration. These standards are Federal standards as well as State standards for interstate streams upon approval by the Secretary of the Interior.

REG. 6-2-1.2 DESIGNATION OF INTERSTATE WATERS

A. Colorado River from the Utah-Arizona border to the southerly international boundary with the Republic of Mexico.

B. Little Colorado River from the New Mexico-Arizona border to its confluence with the Colorado River.

C. Virgin River for the entire reach within the State.

D. Chinle Wash from its source to the Utah-Arizona border.

E. East main canal from its source to the Arizona-Mexico border.

F. Gila River from the New Mexico-Arizona border to Ashurst-Hayden Dam.

G. San Francisco River for the entire reaches within the State.

H. San Pedro River from the Mexico-Arizona border to its confluence with the Gila River.

I. Santa Cruz River from the Mexico-Arizona border to its confluence with the Gila River.

REG. 6-2-1.3 MINOR BASINS

There are several minor basins within the State that are not within the Colorado River Basin. These include the Willcox Playa and several minor drainages along the Arizona-Mexico border. They fall within the definition of the waters of the State and are controlled by this document.

SEC. 6-2-2 DESCRIPTION OF AREA AND FINDINGS

REG. 6-2-2.1 COLORADO RIVER

A. The Main Stem of the Colorado River: The gross watershed of the Colorado River encompasses portions of the states of Wyoming, Colorado, Utah, New Mexico, Arizona, Nevada, and California, as shown on Plate 1. The upper portions of the watershed are drained by the Green, Colorado, and San Juan Rivers. These main tributaries in turn flow into Lake Powell, which is located behind Glen Canyon Dam near the Utah-Arizona boundary. Flows of these major tributaries into Lake Powell provide approximately 90 percent of the total waters available to the lower main stem of the Colorado River. The average annual undepleted flow of the Colorado River is approximately 15 million acre-feet.

Enroute to Lake Powell, river waters in the Upper Basin (that portion upstream of Lee Ferry) are diverted, used, and returned to the system. The major such diversions and returns are regulated by control structures which are operated under the United States Department of the Interior, Bureau of Reclamation. Many of the Bureau's authorized projects in the Upper Basin remain to be constructed, and many existing projects are not yet fully developed.

Waters released from Glen Canyon Dam flow in the main stem to Lake Mead which is located behind Hoover Dam. Lake Mead provides most of the storage and regulation in the Lower Colorado River Basin. Hydroelectric power is generated at both Glen Canyon and Hoover Dams. Lake Mead will serve as the supply reservoir for the Southern Nevada Project. Return flow from the Southern Nevada Project will reach Lake Mead through Las Vegas Wash.

Water released from Hoover Dam flows into Lake Mohave behind Davis Dam which is located just north of the Nevada-California boundary. Lake Mohave is used for re-regulation of releases from Hoover Dam. Hydroelectric power is generated at Davis Dam.

Water released from Davis Dam crosses the Nevada-Arizona-California boundary and flows through the broad Mohave Valley for 33 miles before reaching the upper end of Lake Havasu. Lake Havasu, which is a widened portion of the Colorado River behind Parker Dam, is about 45 miles in length. The Metropolitan Water District of Southern California diverts water from Lake Havasu for transport to the coastal regions of Southern California. The Central Arizona Project plans to divert water from Lake Havasu for transport to Central Arizona. Hydroelectric power is generated at Parker Dam.

Proceeding downstream, Headgate Rock Dam, located near Parker, Arizona, is used to divert water for irrigating the lands of the Colorado River Indian Reservation in Arizona. There is essentially no storage behind this dam, and no hydroelectric power is generated. Some returns from drainage of the reservation lands reach the Colorado River north of Palo Verde Diversion Dam, but the principal drain empties into the river south of this dam.

Palo Verde Diversion Dam, which also has essentially no storage, is used to divert water just north of Blythe, California, for irrigation in the Palo Verde Valley of California. While there are some minor drainage returns to the Colorado River from Palo Verde Valley along the adjacent reach, the predominate farm drainage returns from Palo Verde Valley are via Palo Verde Lagoon-Outfall Drain at the most southerly end of the Valley.

Cibola Valley, on the Arizona side, is located near the southern tip of Palo Verde Valley. River water is pumped into Cibola Valley for irrigation.

Imperial Reservoir is located behind Imperial Dam, approximately 15 miles north of Yuma, Arizona. Imperial Dam is the major diversion structure for irrigation projects in the Imperial and Coachell Valleys and Yuma areas. Releases made to the mainstream below Imperial Dam are essentially for the purpose of satisfying treaty obligations with the Republic of Mexico. There is only minor river water storage behind Imperial Dam. No hydroelectric power is generated.

Senator Wash Dam and Reservoir are located on the California side of the Colorado River immediately upstream from Imperial Dam. The reservoir provides offstream regulatory storage and has a maximum available capacity of 12,250 acre-feet. To provide regulation, water is either pumped from the Colorado River into the reservoir or released back to the river. Water released from the reservoir generates hydroelectric power. The Bureau of Reclamation estimates that approximately 170,000 acre-feet of water can be saved annually by short-term storage of releases from upstream dams in excess of downstrem requests for water deliveries.

Laguna Dam, which is located about six stream miles below Imperial Dam, serves as somewhat of a foundation support for Imperial Dam. There is a storage capacity of 1,500 acre-feet behind Laguna Dam. Ability to utilize this storage and to fluctuate the water level at Laguna Dam is essential to movement of sediment downstream from the sluiceway channel at Imperial Dam and for operational control of the river. The area between Imperial and Laguna Dams serves as a depository for silt removed by the desilting works at Imperial Dam. The importance of this desilting operation is covered in Reg. 6-2-3.5.

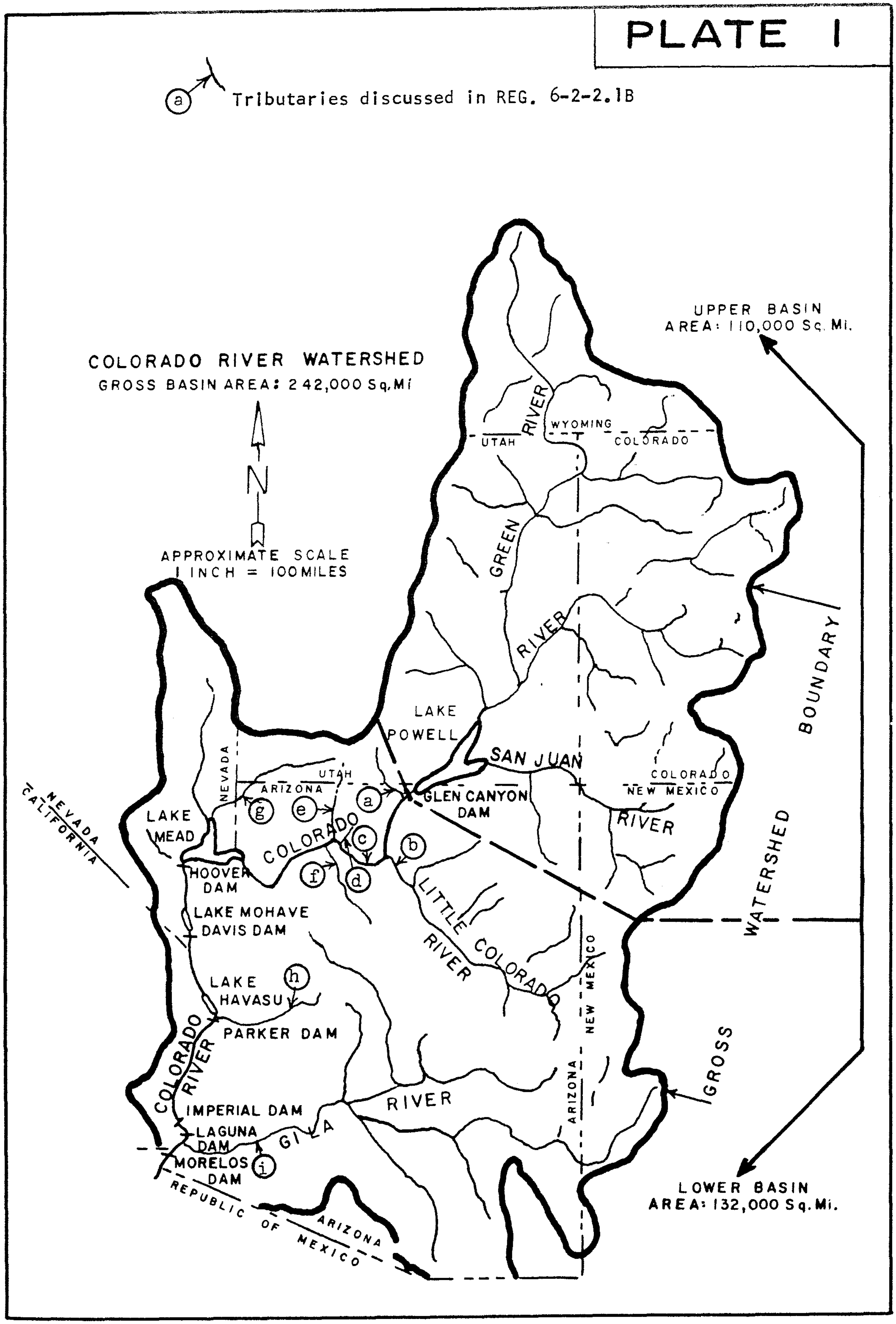
The routing of water diverted from Imperial Dam and measured surface return flows to the Colorado River between Imperial Dam and the Republic of Mexico Boundary is difficult to describe verbally, and is better explained schematically in Plate 2.

Waters reaching Morelos Dam, just south of the Northerly International Boundary with the Republic of Mexico, are diverted into the Mexicali Valley for domestic, irrigation and other beneficial uses.

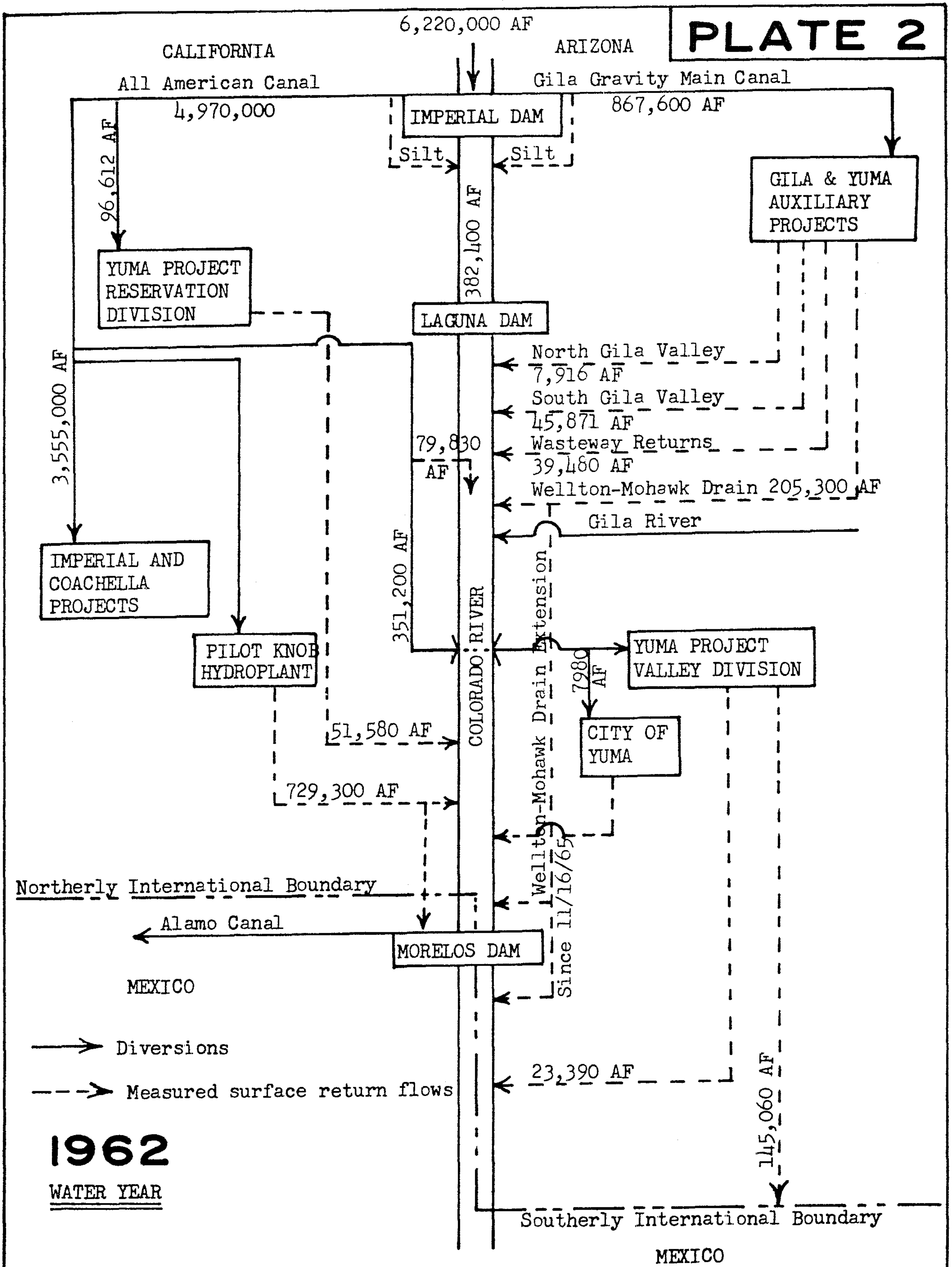
AT PRESENT ESSENTIALLY NONE OF THE COLORADO RIVER WATER IS WASTED DIRECTLY INTO THE OCEAN. The management afforded by the present system of storage reservoirs permits delivery of the highest quality water now economically possible considering that the supply is fully utilized. Water will be wasted to the ocean only after all of the upstream reservoirs are filled to storage capacity and all beneficial uses have been satisfied. This condition is not anticipated in the foreseeable future.

B. <u>Tributaries to the Colorado River from Arizona</u>: There are numerous tributaries to the Colorado River from Arizona in the 700 river miles between

PLATE I



Tributaries discussed in REG. 6-2-2.1B
COLORADO RIVER WATERSHED
GROSS BASIN AREA: 242,000 Sq.Mi
N
APPROXIMATE SCALE
1 INCH = 100 MILES
UPPER BASIN
AREA: 110,000 Sq. Mi.
LOWER BASIN
AREA: 132,000 Sq. Mi.
GROSS WATERSHED BOUNDARY
GREEN RIVER
WYOMING
UTAH
COLORADO
LAKE POWELL
SAN JUAN RIVER
GLEN CANYON DAM
NEW MEXICO
ARIZONA
NEVADA
CALIFORNIA
LAKE MEAD
HOOVER DAM
COLORADO
LITTLE COLORADO RIVER
LAKE MOHAVE
DAVIS DAM
LAKE HAVASU
PARKER DAM
COLORADO RIVER
IMPERIAL DAM
LAGUNA DAM
MORELOS DAM
GILA RIVER
REPUBLIC OF MEXICO



SCHEMATIC DIAGRAM OF DIVERSIONS AND RETURN FLOW IN THE LOWER COLORADO RIVER AREA BELOW IMPERIAL DAM. THE INFLOW-OUTFLOW FIGURES DO NOT BALANCE BECAUSE OF SIZEABLE UNMEASURED SURFACE AND SUB-SURFACE RETURN FLOWS TO THE RIVER.

Page (Glen Canyon Dam) and Yuma. A brief description of the significant streams follows, and available specific data on quantity and quality of water contributed appears in Exhibit 1 where applicable. The Total Dissolved Solids (TDS) change given for each tributary is for present conditions. As the flow from the Upper Basin decreases, the effect is expected to increase by up to one-third from each tributary.

1. Paria River - The Paria River joins the Colorado River just downstream of the Lees Ferry USGS gaging station. The river flows through remote country from southern Utah. The water has a high mineral content, but is relatively free of other contamination. The TDS load at the Colorado River is increased less than 2 mg/l by flow from this tributary. (See Exhibit 1)

2. Little Colorado River - The Little Colorado River joins the Colorado River about 55 miles below Lees Ferry. The river essentially starts in eastern Arizona near Greer, although there are some minor intermittent flows in creeks from New Mexico. The water has a medium to high salinity, depending on the flow rate. A major problem is the contribution of salts from Blue Springs, about 13 miles upstream from its mouth on the Navajo Indian Reservation. These springs contribute about 547,400 tons of salt per year to the Colorado River. The TDS load of the Colorado River is increased by about 28 mg/l by this tributary, with about 20 mg/l attributable to the Blue Springs. This problem is being investigated at the present time by the Arizona Interstate Stream Commission. (See Exhibit 1)

3. Bright Angel Creek - The Bright Angel Creek enters the Colorado River from the north in Grand Canyon National Park. The flow is mostly from springs near the North Rim of the Grand Canyon, and the quality of the water is good. The TDS load of the Colorado River is decreased about one (1) mg/l by the dilution effect of this tributary. (See Exhibit 1)

4. Tapeats Creek - Tapeats Creek is fed by springs on the north side of the Colorado River in the northwest portion of Grand Canyon National Park, a very remote and primitive area. The meager data indicate the discharge is of low mineralization, and the dilution would reduce the TDS load of the main stem flow of the Colorado River by about 2 mg/l. (See Exhibit 1)

5. Kanab Creek - Kanab Creek has a drainage area of about 1,600 square miles, of which about 1,000 square miles is in southern Utah. The river crosses the border between Kanab, Utah, and Fredonia, Arizona. The water is fairly high in mineralization, but the total flow is relatively small. The TDS load of the Colorado River is increased less than one (1) mg/l by this tributary. (See Exhibit 1)

6. Havasu Creek - Havasu Creek drains the Coconino Plateau south of the Colorado River and enters the river about 13 miles downstream from Kanab Creek. This is a remote area, and is inhabited by the Havasupai Indians. The very meager water flow and quality data indicate good quality water of low mineralization. The TDS load of the Colorado River is decreased by about 0.5 mg/l by dilution from this tributary. (See Exhibit 1)

7. Virgin River - The Virgin River begins in Utah, and flows into Arizona near Littlefield, then into Nevada near Mesquite, and then into Lake

Mead. The Virgin River contributes about 350,000 tons of salts per year to the Colorado River System, and the quality of the water is extremely poor. The TDS load of the Colorado River is increased 14 mg/l as a result of this tributary. See Plate 1 and Exhibit 1 for location and details. It appears that one major source (about one-fourth) of these salts is LaVerkin Springs (Dixie Hot Springs) in southern Utah upstream from St. George. Other specific sources are not known at this time.

8. Bill Williams River - The Bill Williams River discharges into Lake Havasu just above Parker Dam. The river is erratic in flow since it drains a desert area with sparse rainfall. Flash floods are commonplace, and these are controlled by Parker Dam, and will be further controlled by the Alamo Dam now under construction about 35 miles upstream from the mouth of the river. There is some irrigated acreage in this project. Water Pollution Surveillance System (WPSS) data on water quality near the Alamo Dam site between October 1963 and October 1964 indicates that the TDS of the Bill Williams water is within the range of 535 to 698 mg/l, or less than that of the Colorado River arriving at Parker Dam.

9. Gila River - The Gila River joins the Colorado River just upstream of Yuma, and below Laguna Dam. The Gila River is now almost completely controlled by upstream dams, and the water is completely utilized, often many times. Floodwaters have never exceeded the present capacity of the Gila River storage system upstream of its confluence with the Salt River and floodwaters have exceeded the capacity of the Salt-Verde System only twice in the last 25 years. Painted Rock Dam, northwest of Gila Bend, is the final flood control structure on the Gila River, and has only been used once since completion in 1959. During calendar year 1964, only 103 acre-feet of water flowed past Dome, 12 miles upstream from the mouth of the Gila River near Yuma, and all of this flow originated downstream of Painted Rock Dam.

10. Other tributaries - There are many small streams that flow for a short period of time after rainstorms, but the flow is so intermittent that very little data is available on total flow and water quality.

Many small springs and spring-fed tributaries, mostly in the reach between Glen Canyon Dam and Lake Mead, contribute small quantities of water and dissolved salts. Since most of these tributaries are in very remote uninhabited areas, very little data on them is available. The data that is available is shown in Exhibit 1.

There are some intermittent creeks flowing from Arizona into Utah above Glen Canyon Dam, and ultimately these may reach the San Juan or Colorado Rivers. Most of these streams are in remote areas of the Navajo Indian Reservation.

C. Tributaries to the Colorado River from Utah: In addition to tributaries to the Main Stem of the Colorado River upstream of the Utah-Arizona border, there are several streams that cross the Utah-Arizona border and flow through Arizona before reaching the Colorado River. The significant ones are as follows:

1. Paria River - This river is covered in Reg. 6-2-2.1 B under Arizona tributaries.

2. Kanab Creek - This creek is covered in Reg. 6-2-2.1 B under Arizona tributaries.

3. Virgin River - This river is covered in Reg. 6-2-2.1 B under Arizona tributaries.

D. Tributaries to the Colorado River from Nevada: There are a few tributaries to the Colorado River along the common Nevada-Arizona border. The significant ones are as follows:

1. Virgin River - This river is covered in Reg. 6-2-2.1 B under Arizona tributaries since it flows through the northwest tip of Arizona.

2. Las Vegas Wash - Las Vegas Wash drains the Las Vegas Valley and flows into Lake Mead just above Hoover Dam. Although the present flow is not great (about 15,000 to 20,000 acre-feet per year), the salt burden is high, and the flow is expected to increase severalfold upon completion of the Southern Nevada Project. The TDS load of the Colorado River is increased about 4 mg/l by this tributary at the present time.

E. Tributaries to the Colorado River from California: The area within California which drains naturally to the Colorado River is a narrow strip of land varying in width from about 10 to 40 miles. This strip extends from the Nevada-California border to the California-Mexico boundary.

The area is essentially semidesert, and stream flows are intermittent. Although rainfall is sparse in this area, the intensity of rainfall may be great when it occurs, and flash floods have occurred. Flow and quality data is almost non-existent.

F. History of the Colorado River Basin Development: The history of the development of the Colorado River Basin is important to the consideration of water quality.

1. General History - Irrigation development of the Colorado River Basin started with the beginning of settlement about 1860. The Upper Basin (above Lee Ferry) irrigated about 800,000 acres by 1905, and about 1,400,000 acres by 1920. Development slowed down after 1920 because of both physical and economic limitations in the availability of water. In the Lower Basin irrigation began in the Palo Verde Valley in 1879, and development of the Yuma area and Imperial and Coachella Valleys followed. Irrigation on the Colorado River Indian Reservation was attempted in 1870, but inadequate flood control almost stopped this development until 1942.

Early development of river control centered around the agricultural economy of the area. The river flow was very erratic and undependable. Tremendous floods occurred in the Lower Basin around the Yuma area when both the Colorado and Gila River Systems reached high flow stages. The Colorado River carried huge silt loads, and led to the statement that the Colorado River was "too thick to drink and too thin to plow". The salt burden was low at high flow, but very high when the flow was low.

The construction of dams on the Colorado River and its tributaries, especially the Gila, Salt, and Verde Rivers, brought the river under control, reduced the silt load, evened out the salt burden, and made agricultural operations in the Lower Basin stable.

This development of the Colorado River has had considerable political problems, and further development, including quality control, will have some more political and legal problems.

2. Water Compacts and Treaties - The development of the Colorado River has necessitated a number of compacts and treaties to protect the rights of individuals and states to the use of water. The following are certainly important when considering water quality criteria that could affect water use under existing rights.

a. Colorado River Compact - The water of the Colorado River was divided between the Upper and Lower Basins by the Colorado River Compact of 1922, with the division point at Lee Ferry. The compact recognized the potential obligation of the United States to the Republic of Mexico.

b. Mexican Treaty - The treaty with Mexico, signed in 1944, provides for annual delivery by the United States to Mexico of 1,500,000 acre-feet of Colorado River water, with certain exceptions due to river flow conditions.

c. Upper Colorado River Basin Compact - This compact of 1948 apportioned the waters of the Upper Basin states (including 50,000 acre-feet to Arizona annually) to allow for orderly and proper development of the Upper Basin.

d. Boulder Canyon Project Act - This Act of Congress apportioned the waters of the Lower Basin among the Lower Basin states and was subsequently interpreted by the United States Supreme Court in Arizona v. California, 373 U.S. 546.

e. Water Quality - None of the agreements or compacts have specifically mentioned water quality. The treaty with Mexico provides that Mexico will take from any and all sources....whatever their origin, the waters to which she is entitled. Water quality is recognized as a factor to be considered in recent legislation authorizing the construction of projects in the Basin.

G. Diversions of Water Along the Arizona Reach: Major United States projects divert and use water from the Colorado River along the Arizona reach. A description of these diversions, by states, follows, and data is summarized in Exhibit 2.

1. Arizona Projects:

a. City of Page - Page receives its municipal water supply from Lake Powell. Sewage is treated in sewage lagoons with minor effluent return to the Colorado River.

b. Colorado River Indian Reservation - This project has 99,375 acres in Arizona with assigned water rights as set forth in Arizona vs. California Supreme Court Decree, and about one-third is presently being irrigated by diversions at Headgate Rock Dam. About 60% of the water diverted is returned to the river as measured surface return flows. In addition, there are unmeasured surface and sub-surface returns to the river.

c. Yuma Project, Valley Division - About 52,000 acres in this project are served by diversion at Imperial Dam via the All American Canal to the Yuma Main Canal by a siphon under the Colorado River. A portion of the water diverted passes through measured surface drains and wasteways back to the Colorado River south of the Northerly International Boundary or to Mexico over the Southerly International Boundary near San Luis, Sonora. Additional drainage facilities are needed in portions of the valley, particularly in the area adjacent to the mesa.

d. Gila Project - Water is diverted at Imperial Dam via the Gila Gravity Main Canal to service an authorized project area of 115,000 acres. This project consists of the following units:

1. North Gila Valley Irrigation District
2. Yuma Mesa Irrigation and Drainage District
3. Yuma Irrigation District (South Gila Valley)
4. Wellton-Mohawk Irrigation and Drainage District

Surface drainage from the Gila Projects is returned to the Colorado River above the Northerly International Boundary except that the Wellton-Mohawk drainage facilities include a bypass channel which extends past Morelos Dam. This bypass channel was put into operation on November 16, 1965, and the Mexican Government has the option of deciding whether the drainage waters shall be discharged above or below Morelos Dam. About 30% of the water diverted is returned to the river as measured surface drainage or control water.

e. Yuma Auxiliary Project - Water is diverted at Imperial Dam via the Gila Gravity Main Canal to irrigate 3,406 acres in this project, which includes certain Warren Act Lands. There is no measured return flow.

f. City of Yuma - The City of Yuma presently receives most of its water through the Yuma Main Canal. The city's contract with the Secretary of the Interior provides for delivery of the water from the river. Sewage from Yuma is now discharged untreated to the river north of the Northerly International Boundary, but plans are progressing for a sewage treatment plant.

g. Cibola Valley - Water is pumped from the Colorado River for irrigation of the Cibola Valley.

h. Central Arizona Project - When authorized and built, this project will divert water from Lake Havasu to provide much needed supplemental water for domestic, industrial and agricultural purposes in Central Arizona. There will be no return flows from this project. The economic impact and importance of this project is discussed in Reg. 6-2-2.1 H.

i. Fort Mohave Indian Reservation - This project has 14,916 acres in Arizona with assigned water rights as set forth in the Arizona vs. California Supreme Court Decree.

j. Miscellaneous Diversions - These include domestic, agricultural and industrial waters, and consist of direct diversions or by groundwater pumping in the vicinity of the Colorado River. Water is used by cities, recreational centers, small farms, power plants, etc.

2. Nevada Projects: The Southern Nevada Project is authorized to divert from Lake Mead, 300,000 acre-feet of water for use in the Las Vegas area. The water will be used for domestic, agricultural and industrial purposes. The Bureau of Reclamation anticipates a return flow of approximately 50,000 acre-feet of water to Lake Mead annually.

3. California Projects:

a. Metropolitan Water District of Southern California - The Metropolitan Water District aqueduct provides capacity for the annual diversion of 1,212,000 acre-feet of water for domestic, industrial and agricultural use on the coastal plain of southern California. There is essentially no return flow.

b. Palo Verde Irrigation District - About 900,000 acre-feet of water is diverted annually at Palo Verde Diversion Dam near Blythe for agricultural purposes. Approximately 60% is returned to the Colorado River either as measured surface drainage or excess diverted water, mostly in a main drain at the lower end of the project.

c. Imperial Irrigation District and Coachella Valley County Water District - Approximately 3,500,000 acre-feet of water is diverted annually at Imperial Dam via the All American Canal for various uses within the Districts. There is no return flow (other than seepage from the All American Canal and flow regulation water) to the Colorado River. Agricultural drainage water, canal seepage, and any excess water diverted flows to the Salton Sea in California.

d. Yuma Project, Reservation Division - About 96,000 acre-feet of water is diverted annually at Imperial Dam via the All American Canal for agricultural use in the Bard Valley. A portion is returned as drainage and flow regulation water to the Colorado River between Yuma and the Northerly International Boundary.

H. Economy and Natural Resources of Arizona: The economy of the entire State of Arizona is intimately associated with the development of the Colorado River. Arizona is semiarid in character with a low average annual rainfall and limited natural water supplies. Since 1947, the population of the State has more than doubled, with more than 70% of the population residing in Maricopa and Pima Counties. These two counties, along with Pinal County, comprise the core area of the Central Arizona Project. This area is now supplied with water by surface water systems on the Salt, Verde and Gila Rivers and by pumping from the groundwater basins. The agricultural, domestic and industrial users of this area are consuming all of the surface water available and are pumping approximately 3,000,000 acre-feet of water per year more than the natural groundwater replenishment. This annual overdraft is clearly evidenced by the accelerated decline of groundwater levels and by land subsidence in some areas.

The central Arizona area desperately needs the additional water to be delivered by the Central Arizona Project Aqueduct from Lake Havasu, but the supply available is still far short of the present overdraft, and the needs of the area are still growing. The quality of the presently available water is not always good with respect to its salt content. This quality is further degraded by multiple reuse since almost all beneficial uses of water add salts of some variety to the water.

The remaining areas of the State face similar problems of short supply and/or quality of water, and it is impossible to separate these factors completely in any proposed program of supply or regulations on quality. The total problem can only be solved by a major water augmentation program for the Lower Colorado River Basin.

The people of Arizona have been striving to improve the quality of their water and extend the supply for many years, long before a Federal program for pollution control was initiated. The quantity of water available has been extended and the quality of the water has been enhanced by the following practices and programs.

1. Farming practices have been steadily improved so that less water is applied to the land per unit of crop yield. A report on this phase of water conservation and quality enhancement is appended as Exhibit 11.

2. Delivery systems for both surface and groundwater have been improved through redesign, lining and conversion to pipelines to reduce seepage, evaporation, salt pick-up, consumptive use by non-crop plants, and delivery waste. Statistics on past and future programs are presented in Exhibit 12.

3. Extensive watershed planning and control programs have been initiated to increase the yield and improve the quality of water delivered by the surface water systems. The Arizona Water Resources Committee, representing wildlands, banking, ranching, water authorities, timber, irrigation, power, mining, game and recreation and municipalities, has an annual symposium (10th in 1966) to present and discuss experimental results and plan larger scale experiments. A summary of watershed improvement accomplishments and future programs is appended as Exhibit 13.

4. Means of evaporation control or reduction of evaporation on reservoirs and streams have been investigated since evaporation of water from the surface of reservoirs and streams not only reduces the supply but also increases the salt content of the water remaining. A summary of activities in this field is presented as Exhibit 14.

5. Extensive phreatophyte investigation and control programs have been carried on to eliminate or reduce waste by certain types of vegetation growing in or near streams. Evapotranspiration by these plants concentrates salts in the soils and contributes to the salinity problems of

the basin, so reduction of such growth would enhance water quality. A summary of the phreatophyte control program is presented in Exhibit 15.

6. Programs to supply water of the best available quality for domestic needs in exchange for treated sewage effluents for needs with lesser quality requirements are being studied. Other water exchanges have been implemented between areas of need and surplus, and more are needed. Examples are presented in Exhibit 16.

7. Buckeye has been a pioneer in providing desalinized water for domestic use. An expensive electrodialysis process was put in operation in 1962 to remove excessive salts from the only water available to the community, making Buckeye the first town in the U.S.A. to have its entire water supply treated by a demineralization plant. This was a local community program, and no Federal or State funds were involved in this project. A report on this project is presented in Exhibit 17.

It should be pointed out that all of the currently available methods of desalinization separate the influent water into two streams, one relatively pure, and one very salty. Disposal of the salty brine is a problem for an area isolated from the oceans where most of the desalinization programs are promoted and tested.

8. The Arizona Water and Pollution Control Association meets annually (the 40th annual meeting was held in 1967) to hear and discuss papers presented by both local and out-of-state people involved in water supply and disposal problems. Educational programs are sponsored by the Association along with other programs designed to upgrade the quality of Arizona water. The Association is affiliated with the Water Pollution Control Federation and the American Water Works Association. A report of the Association is included in Exhibit 18.

9. The Soil Conservation Districts of Arizona, both individually and through their Association, have been actively engaged in projects aimed at soil and water conservation and water quality improvement. A summary report of the Association is presented as Exhibit 19.

10. River channelization projects in the lower Colorado River below Hoover Dam have been in progress for several years by the Bureau of Reclamation to reduce consumptive losses, erosion and quality degradation. This work is generally opposed by fish and wildlife interests alleging it destroys natural habitat areas. Stabilized river flow and storage impoundments made possible by dam construction have, however, enhanced some fish and wildlife areas.

I. <u>Natural Resource Values to be Protected</u>: The following natural resources of Arizona, although presently utilized effectively through good management practices, shall be protected by Arizona's water quality control policy, and the tabulation is not intended to designate the order of importance:

1. <u>Agriculture</u> - Arizona's principal crops (alfalfa, citrus, cotton, grains, and vegetables) are grown on 1,160,000 acres scattered around the

State, with some additional acreage for minor crops. Almost all of this acreage is dependent on irrigation, and over 300,000 acres in addition to that stated above are out of production due to water shortage. Growing conditions, and particularly climatic conditions, are well adapted to crop production under irrigation on a year-round basis, and many high value crops such as cotton, winter vegetables and citrus fruits are produced in addition to staple crops and feeds. The gross value of Arizona crops was $344,400,000 in 1965. The continued production of these crops is dependent upon our total water resources in Arizona, considering both quantity and quality. The quantity of flow must not be unnecessarily reduced by unrealistic quality considerations. Statistics on various phases of agriculture are shown in Exhibit 3.

2. Urban Development - Urban development of Arizona has been growing rapidly, and this growth has demanded increased recognition of the need for a dependable supply of good quality water. Although the growth has been highest in the Phoenix and Tucson areas, there has also been considerable growth in cities adjacent to the Colorado River. An inventory of cities along the Colorado River with pertinent water supply and disposal data is shown in Exhibit 4. The growth of urban areas has accompanied increased activity in tourism (due to climate, recreational facilities and natural attractions), manufacturing and service industries for all State activities, including but not limited to agriculture, construction and mining. Manufacturing statistics are shown in Exhibit 5.

3. Grazing and Livestock Feeding - This industry is extensive in Arizona, including the area along the Colorado River. The gross value of livestock and products was $237,900,000 in 1965. Livestock production requires water and also produces waste which must be controlled. Statistics are included in the Agricultural Exhibit 3.

4. Mining Industry - There are only limited mining operations along the Colorado River, but mining is a major factor in the economy of Arizona and this industry requires huge quantities of water. Reuse of water in all phases of mining has been practiced for many years, and pollution of streams has not been a major problem. The minor problems are being corrected.

The gross value of mineral production was $580,170,000 in 1965. The principal metals were copper, gold, silver, lead and zinc, but substantial quantities of sand, gravel, molybdenum, stone, uranium, lime, pumice and other miscellaneous minerals were produced. Copper produced about 86% of the total value. Statistics are shown in Exhibit 6.

5. Fish and Wildlife - Although much of Arizona is arid or semiarid, the State is blessed with fish and wildlife resources. Protection of this important natural resource is vital in the development of the Basin's water resources. Over 3,400,000 man-days of fishing and hunting were enjoyed by Arizona sportsmen during 1965. Additional man-days of hunting and fishing were enjoyed on the Colorado River by license holders of adjacent states. The Colorado River provides excellent feeding and resting areas for migratory waterfowl, particularly in those portions of the river where oxbows and sandbars exist. Additional value is created by shoreline vegetation which provides habitat for numerous species of mammals and birds.

Both the State and Federal Government have responsibilities under existing law to preserve and develop the fish and wildlife resources of the Colorado River, and cooperation among the states is vital and necessary. The Federal Government by virtue of existing treaties with Great Britain and Mexico, is responsible for management of the nation's migratory bird resource. This responsibility is implemented along the Colorado River by the Bureau of Sports Fisheries and Wildlife of the U. S. Fish and Wildlife Service. Both National and State Wildlife Refuges have been established to preserve waterfowl wintering habitats.

The natural habitat has been constantly changing since the area was settled by man. A significant portion of the habitat no longer exists due to river control and land development, and the wildlife has decreased accordingly in species and numbers. Channelization and controlled flows have eliminated many of the productive backwaters, bypasses, and oxbows that served as spawning and nursery areas for warm water fishes, and have reduced angling potential for these species.

In contrast, the vast reservoir storage system created by the construction work of the Bureau of Reclamation has virtually eliminated flood flows, reduced turbidity, and lowered summer water temperatures so that extensive reaches of the Colorado River are now more suitable for trout. Fish are supplied by a National Trout Hatchery at Willow Beach and by the three State Game and Fish Departments involved in the Arizona reach of the Colorado River.

6. Recreational Use - In addition to the natural recreational resources in Arizona, the controlled river flows resulting from the operation of dams and related water projects have created stable recreational resources in the Colorado River. For the most part, this recreational potential still remains to be developed. Stable water impoundments behind the dams attract fishermen, boaters, water skiers, campers and persons interested in being near the attractive water during the pleasant fall, winter, and spring seasons. Recreation is a year-round activity, however.

Public recreation is permitted on substantial portions of the accessible land along the Colorado River from the Utah-Arizona border to the Mexican border. There are numerous public forests, parks, marinas and other points of interest not only to residents of the adjacent areas, but also to national and international visitors. The major facilities are listed in Exhibit 7.

It is difficult to determine the overall recreational use of the Colorado River because of the variety of developments spread out over the 745 mile reach of the river in Arizona. The recreationists who come on peak weekends for special events in some sections jam commercial and public facilities and overflow onto every available piece of land along the river. Somewhat uncontrolled use has occurred on other reaches of the river and adjacent lands. Individuals and commercial interests have moved onto the Federal lands, and have built structures varying from shacks to well-established motels, trailer parks, fishing camps, and resort developments.

Recreational use of the river has created some serious pollution problems because of the lack of adequate sanitation facilities. Adequate facilities will have to be provided, and the recreationists themselves are going to have to cooperate in making the river areas safe and esthetically enjoyable.

Recreational use of the Colorado River area will expand along with the population growth in the contributing metropolitan areas and as the physical features are developed. The major recreation objective will be reached if the quantity and quality of water are maintained, and the esthetic values of the area are preserved.

7. Forest Products Industry - The four million acres of commercial forest land, out of the total of 21 million forested acres in the State, are largely situated in the northern, higher altitude areas. Managed for multiple use the commercial forest area provides not only timber, but has important values for water production, recreation, livestock, forage, and wildlife. Arizona's forest lands play a big role in providing water to the consumer. Much of the surface water consumed annually originates within the State as runoff from the relatively high water-yielding forest.

The forest industry in Arizona annually harvests about 66 million cubic feet of sawtimber and produces in excess of 300 million board feet of lumber. The pulp and paper segment annually uses 100,000 cords of pulpwood and chips from sawmill residual equivalent to an additional 150,000 cords. It produces about 150,000 tons of newsprint and kraft linerboard annually. The paper industry requires a significant quantity of good quality water.

J. Water Quality Considerations: THE QUALITY AND QUANTITY FACTORS OF COLORADO RIVER WATER ARE SO INTERRELATED THAT IT IS IMPOSSIBLE TO SEPARATE THESE PARAMETERS. Typical main stem flows, major diversions and return flows are shown along with pertinent salinity data on Plate 3 for reference. The Colorado Basin States Conferees, in drafting the Guidelines for Formulating Water Quality Standards for the Interstate Waters of the Colorado River System*, recognized that water quality standards could drastically restrict present and future uses of the Colorado River water under existing compacts. The following data on the quality of water in the Arizona reach of the Colorado River is presented to provide the basis for stream standards listed in Sec. 6-2-6 of this Water Quality Control Policy for the Colorado River in Arizona:

1. Quality of Water Reaching Arizona - Historically, the water reaching Arizona in the Colorado River at Lees Ferry has been high in both salt and silt burden. Other pollutants have been negligible. The salinity has been steadily increasing due to both increased use in the Upper Basin and to depletions by trans-mountain diversion of the best quality water near the headwaters of the Colorado River. The quality of the water at Lees Ferry has been monitored diligently by the USGS, and excellent published records for the 1941-1964 period are available for comparison with other stations on the Colorado River. The Total Dissolved Solids (TDS) in milligrams per liter (mg/l) is probably the best single parameter defining the quality of the water.

*See Exhibit 20

Examination of the record indicates a wide variation in daily, weekly, monthly and yearly figures for TDS, and any water quality standards proposed will have to recognize this feature. In general, the TDS is low at high water flows and high at low water flows. This variation is discussed under sources of salinity. Variations in TDS at Lees Ferry are shown in Exhibit 8.

Further development of the Upper Basin and increased use of the water upstream is expected to further degrade the water as far as TDS is concerned. In addition, further control of the flow of the river upstream will cause variation of the quality of the water. As an example, the effect of the closing of the gates at Glen Canyon Dam is seen in the TDS record for Lees Ferry in Exhibit 8. A partial explanation is shown in TDS variations in Lake Powell, Exhibit 9.

Future storage in upstream reservoirs will ultimately decrease the flow in the Colorado River without appreciably changing the total salt burden, so this will increase the TDS. The present predictions are that the present TDS content will increase by 22 to 43% by 1990 (7) (15). Other authorities prognosticate a somewhat lesser increase in TDS accompanied by a deterioration in sodium and chloride content (16). These estimates are not keyed to the year 1990 and hence a direct comparison is difficult.

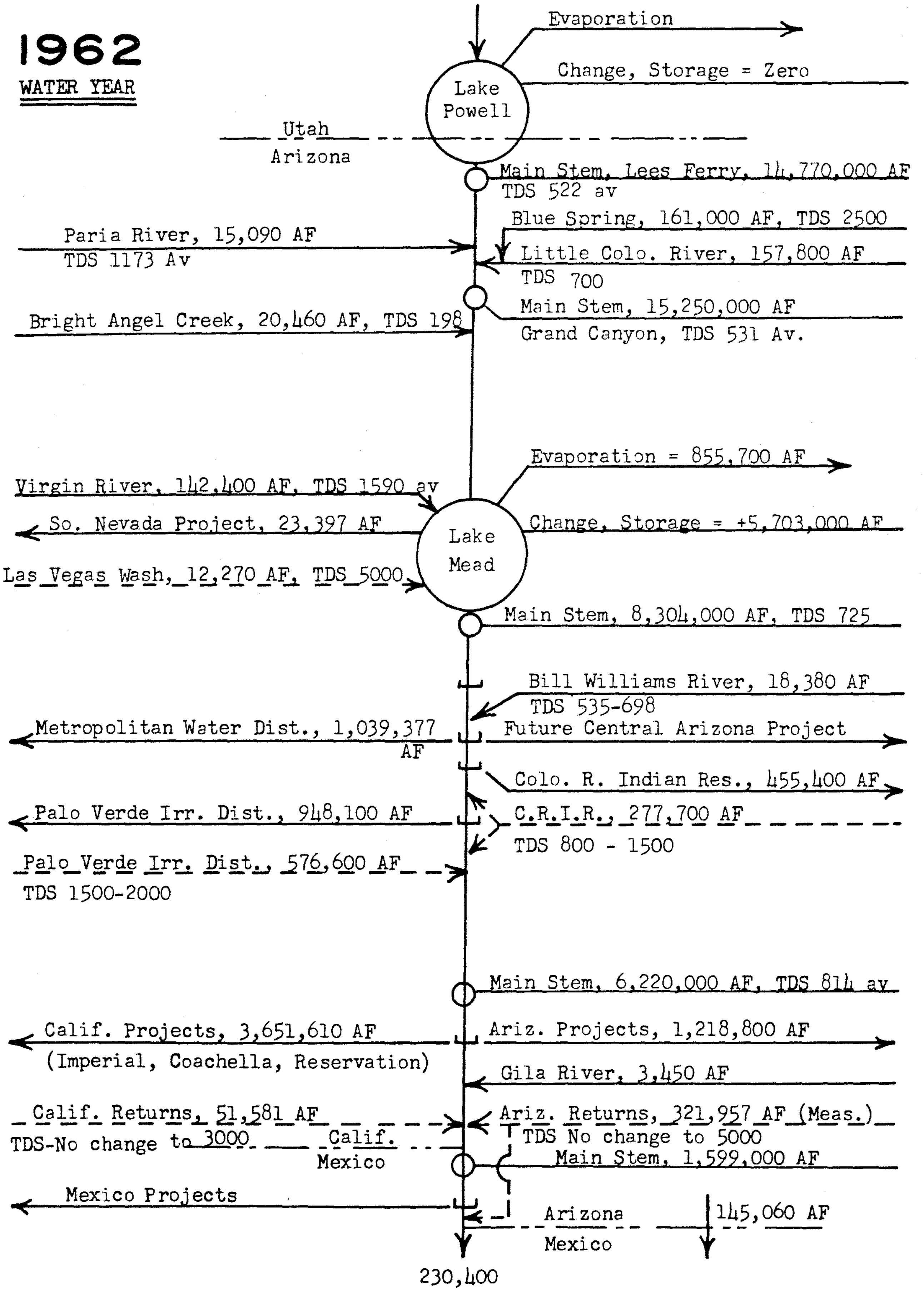
2. <u>Quality of Water Released from Lake Mead</u> - The water record for water released at Hoover Dam shows higher average TDS for water than that at Lees Ferry, but with much less fluctuation in quality because of the storage in Lake Mead. The TDS content appears to be gradually increasing.

The higher TDS can be attributed mainly to the increased TDS at Lees Ferry and natural sources of salinity between Lees Ferry and Lake Mead since there is negligible use of the Colorado River water in this reach. Some of these natural sources of salinity were discussed in Reg. 6-6-2.1 B,C, with further data in Exhibit 1. Control of these natural sources of salinity should be investigated as a means of enhancing water quality, not only in this reach, but in the Upper Basin.

Evaporation from the surface in the main stream and reservoirs is a contributing factor to the increased TDS. For example, the record shows that 907,200 acre-feet evaporated from Lake Mead in Water Year 1963, leaving behind approximately 800,000 tons of salt. Some of this salt is believed to have been precipitated out (7), but much of it undoubtedly contributes to downstream TDS. TDS comparisons at various points in the river are shown in Exhibit 10.

Future river salinity like future streamflow can be predicted only from statistical records of past salinity and from knowledge of the changes in the river caused by impoundment and diminution of flow due to consumptive use. The most recent predictions on future salinity vary somewhat, but all indicate that progressive deterioration will occur. The Department of Interior study (7) and the Hill study (15) represent the most probable conditions. Hill predicts that the TDS load by the year 1990 will increase to 735 mg/l at Lees Ferry and to 926 mg/l at Lake Havasu, compared to the

PLATE 3



Schematic diagram of the Colorado River main stem flow with major tributaries, diversions and return flows. The inflow-outflow figures do not balance because of sizeable unmeasured surface and sub-surface return flows to the river.

Department of Interior figures of 663 mg/l and 865 mg/l at these same stations. These figures represent increases of 22 to 43% by 1990, and assume that current practices are not changed, a water augmentation program will not be implemented, future Upper Basin developments and trans-mountain diversions will be made, and that natural sources of salinity will not be controlled.

3. Quality of Water at Parker Dam - There is little TDS change in the quality of water between Hoover and Parker Dams. Increased population in this area, and increased recreational use could degrade the present quality, especially bacteriologically. Increased control of sanitary waste disposal from boats and recreational areas will be necessary.

4. Quality of Water at Imperial Dam - The TDS of the water reaching Imperial Dam shows a steady increase. A substantial part of this increase is due to agricultural drainage from the Colorado River Indian Reservation, the Palo Verde Valley, and probably some from the Cibola Valley. Reduced flow in the river due to consumptive use and diversions out of the basin has substantially reduced the assimilative and dilution capacity of the stream. A part of the increased TDS can be traced to evaporation from the water surface and phreatophyte growth along the river. The TDS record is shown in Exhibit 10.

There is apparently little bacteriological deterioration in this section of the river, but new habitation along the river could become a source of pollution.

5. Quality of Water at Morelos Dam - The flow of the Colorado River has been reduced to a minimum at this point, and except for occasional storm flows, only enough flow is maintained to supply the Mexican Treaty requirements. The TDS fluctuates somewhat because of change of demand as compared with volumes of return flows. This problem is of international concern, and some relief has been afforded by the construction of the Wellton-Mohawk drain extension shown on Plate 2. The final solution of this problem is of total Basin concern, and the entire burden should not be placed on the local area or on one State of the Basin.

The City of Yuma is presently discharging untreated sewage to the river above Morelos Dam, and measures are being taken by the State Department of Health and the City of Yuma to eliminate this pollution at the earliest possible date.

REG. 6-2-2.2 GILA RIVER

A. The Main Stem of the Gila River: The gross watershed of the Gila River System upstream of Dome, Arizona (12 miles upstream of the confluence with the Colorado River) is approximately 57,477 square miles, excluding all closed basins upstream. The main stem of the Gila River upstream of the last U. S. Geological Survey gaging station in New Mexico near Virden (16 miles upstream of the New Mexico-Arizona border) has a drainage area of 3,203 square miles. There are no major control structures on the Gila River in New Mexico, although Hooker Dam has been proposed. The watershed of the

Gila River System in Arizona is shown in Plate 4.

The Gila River enters Arizona near Duncan, flows through Duncan Valley, is joined by the San Francisco River near Clifton, and flows westward through Safford Valley to the San Carlos Reservoir behind Coolidge Dam, the first major control structure on the river. Water released from Coolidge Dam flows westward through remote mountain country until it reaches the San Pedro Valley where the San Pedro River joins the Gila River. The combined rivers flow through more remote mountains past the Buttes Damsite to Ashurst-Hayden Dam near Florence.

All of the water reaching Ashurst-Hayden Dam, with the exception of rare flood flows, are diverted for beneficial use in the San Carlos Project. Sluicing of the heavy sediment load at Ashurst-Hayden Dam has been replaced by mechanical sediment removal equipment, so there is essentially no flow in the Gila River below this dam. All of the water in the mainstream Gila River, from a point ten miles upstream from the eastern boundary of Arizona to the Gila Crossing (near the confluence of the Salt and Gila Rivers), is allocated under the Globe Equity No. 59 Decree of June 29, 1935 (17). The provisions of that Decree are enforced by the Gila Water Commissioner appointed by the Arizona District Court of the United States.

The Gila River below Ashurst-Hayden Dam is situated in an arid desert area. Intense desert storms contribute some flow to the Gila River at infrequent intervals for short periods of time. There are small diversion dams near Olberg (Sacaton Diversion Dam) and Gila Crossing before the Salt River joins the Gila River near Avondale. Annual flow data for Water Year 1965 at various points on the Gila River are shown on Plate 2.

The Salt River System contributes very little water to the Gila River because of upstream use. This facet is discussed in Reg. 6-2-2.2 B under tributaries to the Gila River.

Almost all of the water which accumulates in the Gila River below Ashurst-Hayden Dam is diverted at the Buckeye Irrigation Company diversion dam, the Arlington Canal Company diversion works, and at Gillespie Dam for irrigation. Except for storm flows and gate leakage at the dam, there is no surface flow between Gillespie Dam and Painted Rock Dam approximately 60 miles downstream. Painted Rock Dam was completed in 1959 as a flood control dam to protect the Yuma area from flash floods following intense desert rainstorms.

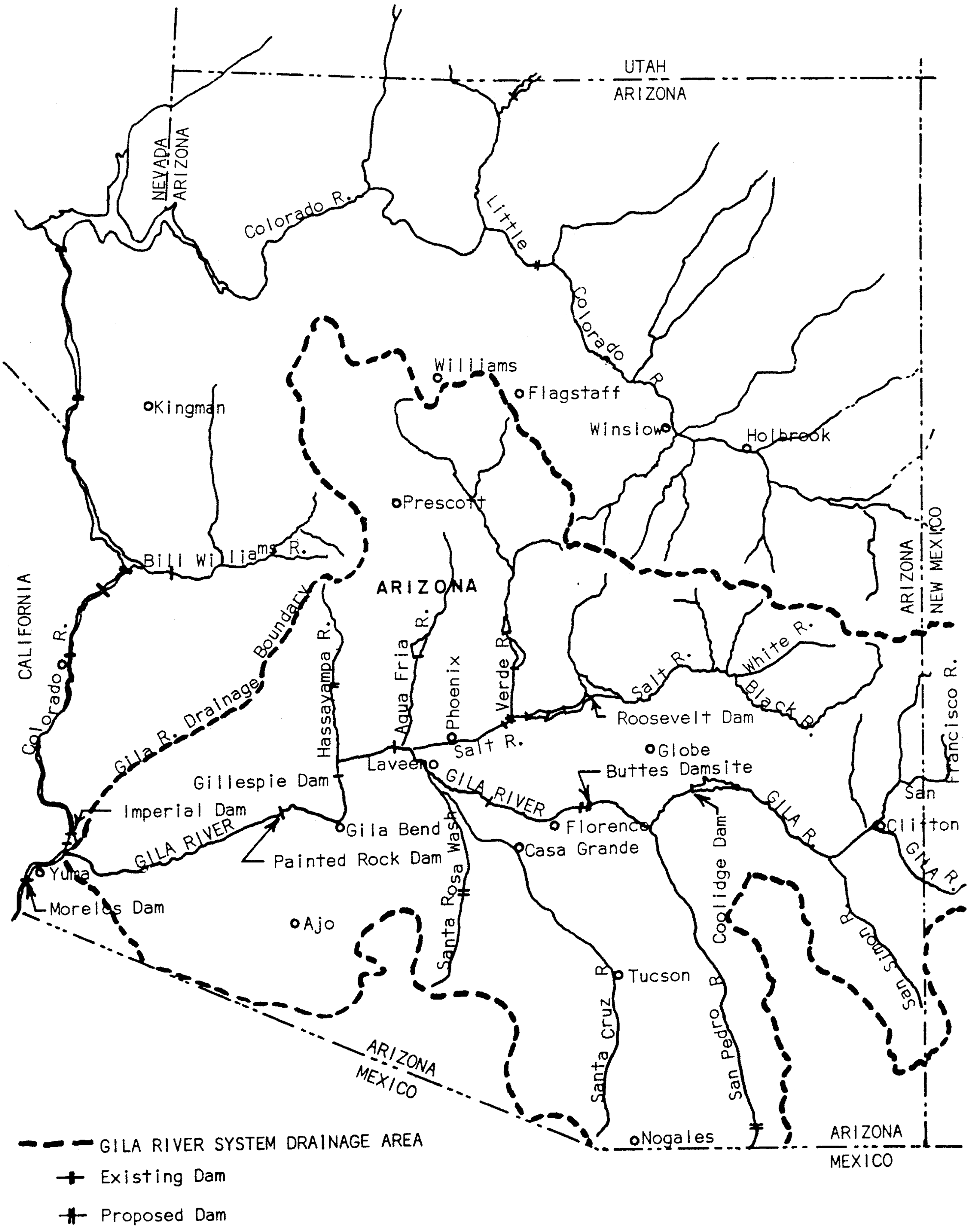
Below Painted Rock Dam, the Gila River channel is dry except for occasional storm flows. Irrigation drainage water from the Wellton-Mohawk Valley has contributed some flow at Dome (12 miles upstream from the confluence of the Gila River with the Colorado River) in the past, but a new drainage system completed in 1961 has steadily decreased the contribution.

In addition to the annual flow data for Water Year 1965 presented in Plate 5, flow data at various points in the Gila River System is given in Exhibit 22.

B. Tributaries to the Gila River: There are numerous tributaries to the Gila River in the 508 river miles between the New Mexico-Arizona

PLATE 4

GILA RIVER SYSTEM



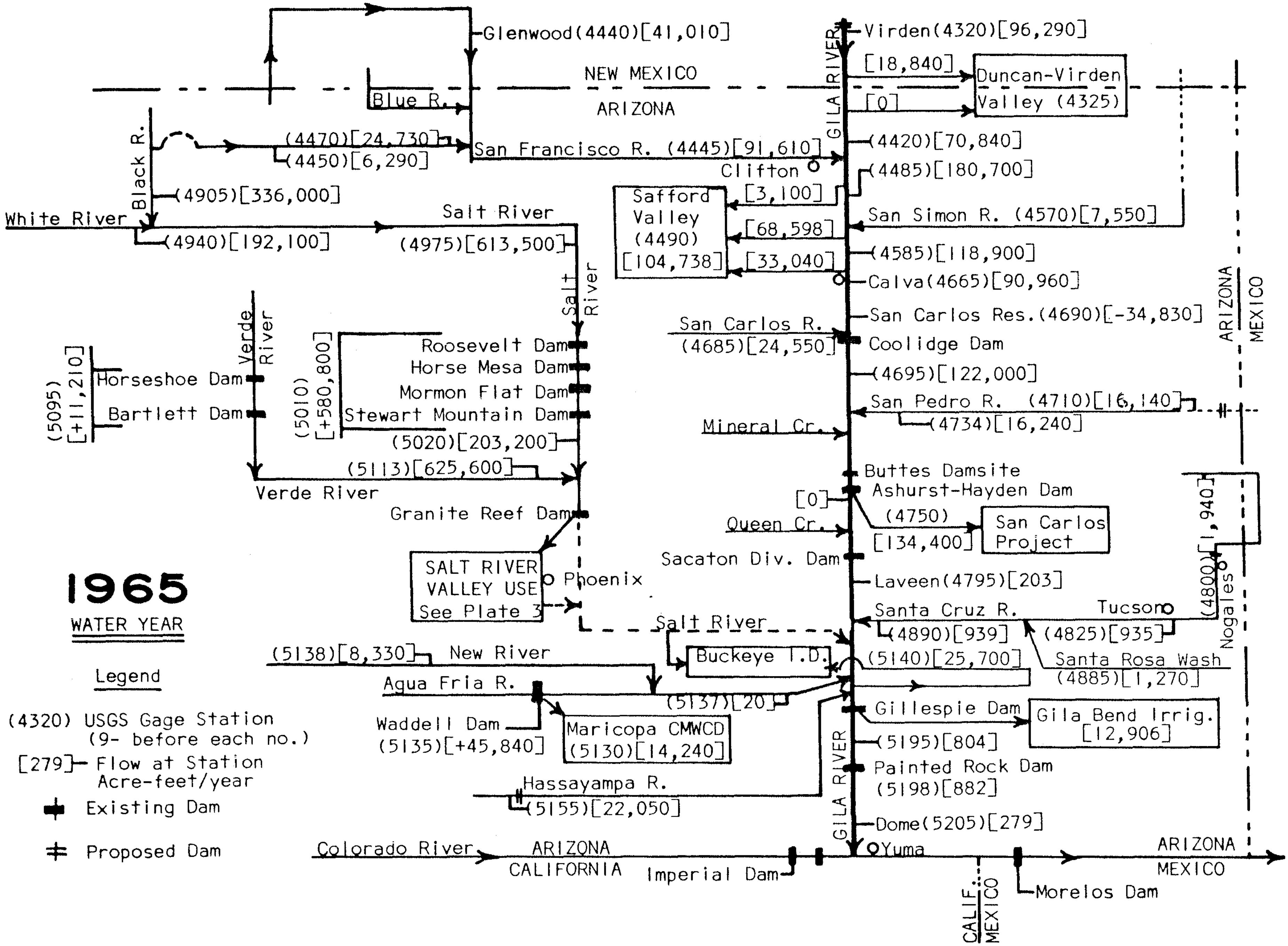


PLATE 5

GILA RIVER SYSTEM SCHEMATIC

boundary and the confluence with the Colorado River near Yuma. Flow data for the major tributaries is given for Water Year 1965 on Plate 5, and expanded flow data is presented in Exhibit 22. Descriptions of the significant tributaries are as follows:

1. San Francisco River - The San Francisco River has its headwaters in Arizona near Alpine. It flows eastward through Luna Lake into New Mexico and back into Arizona northeast of Clifton. The gross drainage area of the San Francisco River above the last gaging station near Clifton (9.9 miles upstream from mouth) is 2,766 square miles. The salt load of the San Francisco River varies with the flow rate. Available data shows the TDS (Total Dissolved Solids) load ranges from 200 to 1200 mg/l. Diversions are made for mining, municipal and irrigation use upstream of the confluence with the Gila River. The Clifton Hot Springs is a source of salt which degrades the water quality of the river.

2. Eagle Creek - Eagle Creek drains a 377 square mile area on the north side of the Gila River. In addition, water is pumped into Eagle Creek from the Black River in the Salt River watershed. A large portion of the water flowing in Eagle Creek is diverted by pumping for industrial and municipal use in and near Morenci and Clifton. The water is of excellent quality.

3. San Simon River - The San Simon River drains a 2,192 square mile area in the San Simon Valley. There are some minor intermittent flows from New Mexico into the valley. The San Simon River joins the Gila River between Solomon and Safford. There is very little rainfall in this drainage basin, and the river usually flows only during storm periods, and available data shows a TDS load of 500 to 900 mg/l in the floodwater. The sediment load is also high. Flood flows are partly regulated by six flood control detention structures.

4. San Carlos River - The San Carlos River drains a 1,027 square mile area north of San Carlos Reservoir. Although the 36-year average discharge of this tributary is 32,070 acre-feet per year, there are periods of no flow each year. The meager data on quality indicates fair quality during high flows to poor quality during low flows.

5. San Pedro River - The San Pedro River drains an area of 4,449 square miles, of which 696 square miles are in Mexico. The first gaging station in Arizona is near Palominas, approximately 4.5 miles from the Arizona-Mexico border. The total flow at this point has averaged 21,000 acre-feet per year for the 23-year record, but the flow rate has varied from 0 to 22,000 cubic feet per second (cfs). Diversions above Charleston, where a dam is proposed as a part of the Central Arizona Project, are mostly by groundwater pumping. Downstream of Charleston, surface flow decreases. Diversions, both by surface flow and groundwater pumping, are made for irrigation, domestic and industrial use. The San Pedro River joins the Gila River near Winkelman. Quality records on the San Pedro River are meager. Records of quality on the Gila River at Kelvin, 17 miles downstream of the confluence is the best index available.

6. Mineral Creek - Mineral Creek drains approximately 98 square

miles of area north of the Gila River at Kelvin. This creek was named Mineral Creek in 1846 by a military scouting party because of its saline qualities and brown color. The flow varies from zero to approximately 30,000 cfs. There is one flood control structure which has silted up and is no longer effective. Another structure is being considered. A large open pit copper mine is situated on this creek, and the natural channel is being replaced to allow for mine expansion.

7. Queen Creek - Queen Creek drains a desert foothills area north of the Gila River, and flow is restricted to periods of heavy rainfall, usually during the summer and fall. The flow is controlled by Whitlow Dam, and it is doubtful if any surface flow would ever reach the Gila River.

8. Santa Cruz River - The Santa Cruz River drains 8,581 square miles before it reaches the Gila River near Laveen. There is a 348 square mile drainage area in Mexico. The 23-year record shows an average annual flow at the mouth of 14,550 acre-feet, with no flow at all for the majority of the time. There was a measured flow during 54 days of the 1965 water year, and 60% of the flow occurred during 3 days. There are many diversions, mostly by groundwater pumping, for irrigation, municipal and industrial use.

9. Salt River System - The Salt River System physically joins the Gila River System west of Laveen. The Salt River System includes the Salt and Verde Rivers and their tributaries. The Salt and Verde River flow is controlled by dams except for periods of extreme flooding (the capacity has been exceeded only twice since 1941), and essentially all of the flow is diverted for irrigation, municipal and industrial use at Granite Reef Diversion Dam east of Phoenix. The Salt River Valley area, including parts of the water distribution system, is shown on Plate 6. There are 13,000 square miles of drainage area above Granite Reef Dam. Water in the Salt River System is adjudicated under various court decrees (18), (23), (24).

There is very little contribution of surface water to the Gila River System by the Salt River System. Irrigation return flow, mostly excess diversion, is utilized in the immediate area. There is considerable groundwater pumping in the area. There is a sewage effluent flow to the Salt River from Phoenix, and complete reclamation of this sewage effluent for reuse is being studied. This effluent is being delivered by the Buckeye Irrigation Company for irrigation of non-edible crops.

10. Aqua Fria River - The Aqua Fria River drains an area of 1,459 square miles upstream of Waddell Dam. Except for flood flows, all of the water is diverted for irrigation use by the Maricopa County Municipal Water Conservation District No. 1 before it reaches the Gila River. The average flow for the 37-year record period is 59,440 acre-feet per year.

11. Hassayampa River - The Hassayampa River drains an area of 1,470 square miles before it reaches the Gila River upstream of Gillespie Dam. The average flow for the 19-year record at Box Damsite near Wickenburg is 7,820 acre-feet per year, with many periods of no flow. There are diversions for irrigation and mining operations along the river. The river below Wickenburg is alternately wet and dry, and most diversions are by


HORSESHOE DAM
and Lake
BARTLETT DAM
and Lake
GRANITE REEF DIVERSION DAM
CAVE CREEK DAM
SALT RIVER PROJECT
PHOENIX
GILA RIVER
INDIAN
RESERV
PAPAGO

PLATE 6

groundwater pumping. Flow records at the confluence with the Gila River are very poor, but the total flow in the Gila as measured at Gillespie Dam indicates negligible contribution from the Hassayampa.

12. Centennial Wash - Centennial Wash joins the Gila River just upstream of Gillespie Dam. Flow consists of storm runoff, and the record is extremely poor.

13. Miscellaneous Tributaries - There are numerous small tributaries to the Gila River, most of them intermittent in flow. It is beyond the scope of this policy document to discuss each of them.

C. History of the Gila River Basin: Part of the area of the Gila River Basin was ceded to the United States in 1848 after the Mexican War and the southern area was included in the Gadsden Purchase of 1853. In 1870, valuable mineral deposits were found in the area of Clifton, and this area is now one of the most important copper producting areas in the United States.

The first irrigation of the land in the basin above the Coolidge Dam area was begun about 1872 by Mexican immigrants and Mormon pioneers in the Safford Valley, and irrigation in the Duncan-Virden Valley followed shortly. Below the Coolidge Dam area, early development centered around agriculture. The Hohokam Indians irrigated lands more than a thousand years ago. This civilization vanished. Irrigation practices were resumed in the lower Gila and Salt River Valleys by subsequent Indian inhabitants at dates unknown and by non-Indian settlers in the 1860's. Varying flows made irrigated agriculture a very risky affair, and storage systems were planned. Picacho Reservoir was built for irrigation storage water in 1890. The Federal Reclamation Act of 1902 paved the way for construction of many more storage dams for irrigation water. The Salt River Valley Water Users' Association, the first organization of its kind formed to take advantage of the act, was incorporated in 1903. Roosevelt Dam on the Salt River was begun in 1905 and completed in 1911. More dams on the Salt and Verde Rivers followed. Coolidge Dam on the Gila River was completed in 1928 by the Bureau of Indian Affairs. The Buckeye Canal Company was formed and the first 5 miles of the diversion canal was constructed in 1885, and the Arlington, Enterprise, and Citrus Valley diversions and canals were functioning before Gillespie Dam was constructed. Gillespie Dam on the Gila River was completed as a private venture in 1921 to irrigate 10,000 acres in the Gila Bend and Theba areas, but this area has suffered from a shortage of water. The remainder of the Gila River Valley has sparse irrigation except for the area around Wellton and Yuma served with Colorado River water.

Pumping of groundwater began in the 1920's and became widespread throughout the basin by about 1940.

The surface storage system was developed primarily for agriculture, but domestic and industrial needs are now also supplied. The use of water in Arizona, especially surface water, is covered by legal water rights. Expanding population and changes from a strictly agricultural and mining economy have caused many water problems.

D. Major Diversions from the Gila River System: As described in

Reg. 6-2-2.2 A, all of the water in the mainstream Gila River, from a point ten miles upstream from the eastern boundary of Arizona to the Gila Crossing (near the confluence of the Salt and Gila Rivers), is allocated under the Globe Equity Decree. Diversions from the San Pedro River upstream of its confluence with the Gila River have not been adjudicated. There are numerous withdrawals of water from these rivers upstream of Ashurst-Hayden Dam both by surface diversion and by pumping of groundwater. The Globe Equity Decree provided for irrigation diversions of 1/80 of a cubic foot per second per acre of land, with a total of 6 acre-feet for each acre annually. The areas defined by the Globe Equity Decree are chronically and critically short of water and even supplemental pumping does not add enough water to the surface diversions to provide an adequate supply to the lands. The major diversions from the Gila River under the Globe Equity Decree are as follows:

1. Duncan-Virden Valley - The decreed area for irrigation in this valley in both New Mexico and Arizona is 8,061 acres. Between 8,000 and 20,000 acre-feet per year has been diverted during the past five years, and the additional water required has been pumped from the groundwater. Almost all of the return flow to the river is subsurface.

2. Safford Valley - The decreed area for irrigation in the Safford Valley is 32,512 acres. Water is diverted through thirteen canal systems, and supplemental water is diverted by pumping, both from the river and from the groundwater. The diversion from the river during the last five years has varied from 39,630 to 104,700 acre-feet per year depending on the river yield. Most domestic water is supplied by pumping from the groundwater.

3. San Carlos Project - The decreed area for irrigation in this project is 100,546 acres. There are two sections to this project--the "Indian Lands" and the "White Lands" as given in the Globe Equity Decree. The acreage is approximately equal. Surface flow is supplemented by pumping from the groundwater. The diversion from the river has ranged from 42,450 to 247,820 acre-feet per year during the past five years. There is some storage on the project in the Picacho Reservoir. Domestic needs in the area are served by pumping from the groundwater.

4. Miscellaneous Diversions - There are numerous diversions for irrigation, domestic and industrial uses along the river. These uses are covered in the Globe Equity Decree.

Other decrees have adjudicated waters of the Gila River System, and there are other diversions. Under the Haggard Decree (1903), 1,080 acres of Indian lands at the confluence of the Gila and Salt Rivers were decreed diversion rights (24). Under the Benson-Allison Decree (1917), 19,865.5 acres of land served by the Buckeye Canal were decreed diversion rights, 6,033 acres served by smaller canal systems were decreed diversion rights, and rights of the 1,080 acres of Indian lands were reaffirmed (23). The Arlington Canal diversion is between the Buckeye Heading and Gillespie Dam. Diversions at Gillespie Dam were adjudicated to lands of Enterprise Ranch (Enterprise Canal) and to Gila River Ranches and Narramore Ranch (Gillespie Canal), under a 1922 Court Decree.

E. Economy and Natural Resources of the Gila River System: The economy of the entire area of the Gila River System is limited by the water supply. The economy and natural resources discussed in Reg. 6-2-2.1 H of the Colorado River apply equally to the Gila River System, and will not be repeated except to emphasize that the Central Arizona Project is vitally needed to help sustain the economy and to help reduce the quantity of the more mineralized groundwater being pumped to supply various needs.

F. Water Quality Considerations: THE QUALITY AND QUANTITY FACTORS OF THE WATER SUPPLY OF THE GILA RIVER SYSTEM ARE SO INTERRELATED THAT IT IS IMPOSSIBLE TO SEPARATE THESE PARAMETERS. The flow data on the main stem of the Gila River and its tributaries for the 1965 Water Year is shown schematically on Plate 5 and expanded for other years in Exhibit 22 to illustrate the variable flow parameters.

The variable flow in the Gila River is due mainly to storm runoff which carries a considerable silt load. Flow from the Gila River is first controlled at the San Carlos Reservoir which acts as a silt control works. Water released from Coolidge Dam is relatively clear, but inflow from the San Pedro River and other tributaries is uncontrolled and the silt load at Ashurst-Hayden Dam is again appreciable, causing silt control problems in the San Carlos Project. The silt load requires constant canal cleaning and prevents a canal lining program vital to water conservation. Buttes Dam, when authorized and built, will reduce the silt load in the canals so that a lining program will be feasible.

The variable flow rates also contribute to the salinity problem. In general, the salt concentration increases as the flow decreases, but the watersheds of different tributaries contribute different quantities and types of salts. To illustrate, the Total Dissolved Solids (TDS) and sodium concentrations in the Gila River water at Kelvin are plotted against flow rate in Plate 7 for the 1962 to 1964 period. The different pattern of the data for the total salt content and single ion content illustrates the effect of different watersheds on the quality of water.

The TDS content of the water entering Arizona in both the Gila and San Francisco Rivers historically varies between 200 and 500 mg/l. The fluoride content has been consistently high, normally above one (1) mg/l even in periods of high flooding (9). The fluoride content of many of the groundwaters of the entire Gila River Basin is high, probably due to redeposition of these salts washed downstream from the upper basin. The groundwater in the Duncan-Virden Valley varies from very low to over 5000 mg/l of dissolved salts, and some salt load is added to the Gila River water before it is joined by the San Francisco River.

The Clifton-Morenci area contributes considerable salt to the San Francisco River, some from solution pick-up from the saline soils and some from the highly mineralized hot springs. Long term continuous data on quality is not available for this area.

Downstream of the confluence of the Gila and San Francisco Rivers, the tributaries contain varying salt loads. Eagle and Bonita Creek water contains about 300 mg/l of salts. The San Simon River contributes water with a TDS of 500-900 mg/l during flood stage. There are some artesian flows in the Safford Valley which contribute a variety of salts to the Gila River flow. The groundwater in the Safford Valley is generally highly mineralized.

The San Carlos Reservoir acts somewhat as an equalizing reservoir for the salt content of the Gila River water, but downstream flow is again influenced by hot springs and runoff from other watersheds as seen in Plate 7. By the time the water reaches Kelvin, the TDS load varies between 400 and 2000 mg/l. Generally speaking, the TDS load is below 1000 mg/l if the flow remains above 200 cubic feet per second.

Very little quality data exists for flows below Kelvin. Except for occasional flood flows, all of the water reaching Ashurst-Hayden Dam (19.5 miles below Kelvin) is diverted for use in the San Carlos Project, and there is no return flow to the river as a surface stream. The proposed Buttes Dam, in addition to its function as a silt control structure, would contain the flood flows which enter the Gila below Coolidge Dam, particularly from the San Pedro River. There is considerable groundwater pumping in the area, and the Central Arizona Project is needed in this area for supplemental water and quality control.

The Salt River System waters vary in quality, but not quite as drastically as the Gila River and its other tributaries. The extensive reservoir systems on the Salt and Verde Rivers tend to equalize the extremely high and low salt waters. The TDS of the Salt River below Stewart Mountain Dam has varied from 361 to 1300 mg/l during the period of 1950 to 1964. The TDS of the Verde River below Bartlett Dam has varied from 158 to 550 mg/l during the same period. The quality of water delivered to the users in the Salt River Valley depends on how much water is available from each of the rivers. The ratio varies from year to year as seen in Exhibit 22 for Stations 5020 and 5100.

The surface flow of the Salt River System is not sufficient to satisfy the needs of the Salt River Valley, and there is considerable groundwater pumping. The amount pumped in the valley greatly exceeds the annual recharge. In addition, the groundwater is quite saline in most areas. The Central Arizona Project is desperately needed in this area to allow for water importation. Such importation would help with respect to both the quality and quantity.

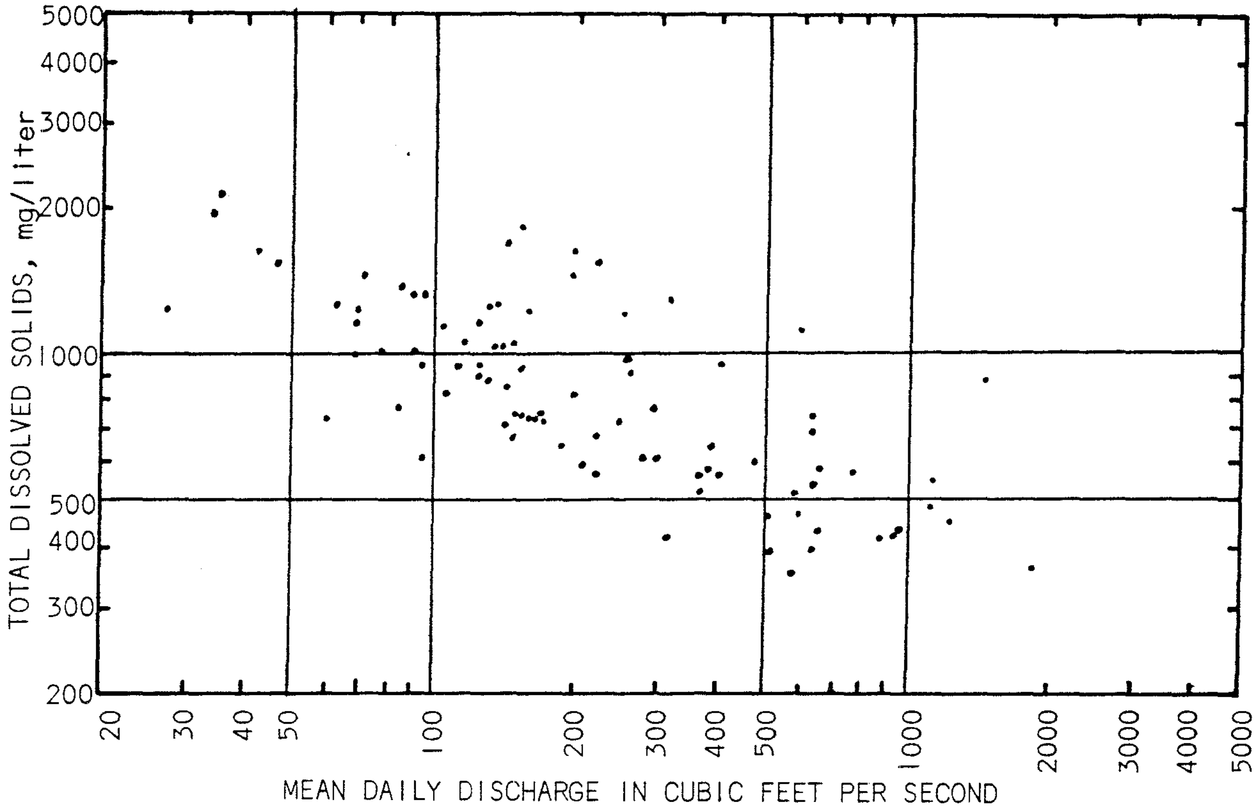
The next surface flow in the Gila River is at Gillespie Dam. The TDS load at this point averages 5,000 to 6,000 mg/l. This water is diverted for irrigation purposes. The water usually has a fluoride concentration of 2 to 4 mg/l.

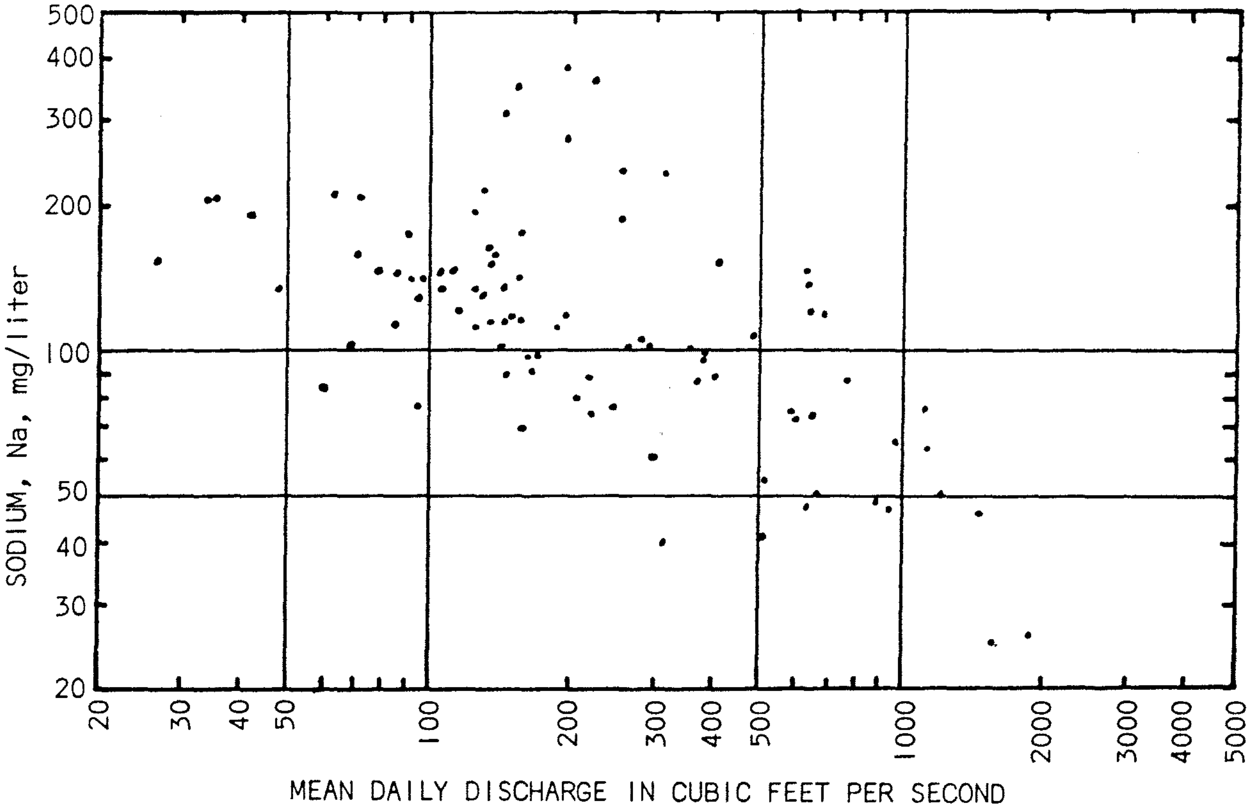
With the meager amount of quality data available in the Gila River System, it is difficult to isolate any single source of gross degradation of the water. It appears that much of the degradation is the result of natural sources of salinity.

Some drainage water from agricultural facilities downstream of Painted Rock Dam and occasional floodwaters reach the Colorado River near Yuma.

PLATE 7

SALT CONTENT VARIATION WITH FLOW
1962-1964
GILA RIVER AT KELVIN





The drainage water is now almost completely contained in the concrete lined drainage channel of the Wellton-Mohawk Irrigation and Drainage District. The effect of this drain is seen in the data for U.S.G.S. Station 5205 (Dome, Arizona) in Exhibit 22. The flow in the Gila River has decreased to less than an acre-foot per day since Water Year 1963. The subject of salinity below this point of the Gila River is discussed in the Colorado River Policy Document. It should be pointed out, however, that rate of floodwater release from Painted Rock Dam can drastically affect the salinity problem in the lower Gila and Colorado Rivers. Floodwater has been released only once since completion of the dam in 1959.

SEC. 6-2-3 WATER USES

REG. 6-2-3.1 GENERAL

All of the surface waters of Arizona are subject to either the appropriative rights doctrine or to water use contracts with the Secretary of the Interior. There are no riparian water rights in Arizona. Some of Arizona's decreed entitlement to main stem waters of the Colorado River is not now diverted and is being used by other states until additional Arizona facilities are authorized and built. The following beneficial water uses are being made of waters in the Colorado River and Gila River Basins in Arizona. This tabulation is not intended to designate order of importance or rights to such use.

REG. 6-2-3.2 AGRICULTURAL

A. Colorado River - Diversions for agricultural use are made throughout the basin. The major diversions are below Parker Dam. Crops grown include citrus, vegetables, forage, feed, grains and cotton.

B. Gila River - Diversions for agricultural use are made throughout the basin. Boron content from natural sources limits the use on some crops. In some cases, the TDS and Sodium percentage also limit crop use.

REG. 6-2-3.3 DOMESTIC WATER SOURCES

A. Colorado River - The volume used for domestic water is minimal, however, the use is scattered from Page to Yuma along the Colorado main stem. There is only one known domestic use of surface flows in the Little Colorado Basin at the present time.

Water for domestic purposes is of prime importance throughout the Arizona Reach of the Colorado River. Although the application of conventional water treatment including flocculation, coagulation, filtration and disinfection to Colorado River water will generally not provide a water meeting the recommended drinking water standards of the U.S. Public Health Service, such treatment does provide a water meeting the mandatory requirements of the drinking water standards. Since a better alternate source of supply is usually not readily available, Colorado River water is used as a source of raw domestic water.

B. Gila River - High fluoride content from natural sources restricts the use of the Gila River above its confluence with the Salt River as a domestic water source if alternate sources are available. There is some use of surface water of the Gila River as a raw domestic source. Use of the water has resulted in mottled teeth in children, and an alternate source of water is recommended.

Surface water of the Salt River system is extensively used as a raw domestic source for the metropolitan Phoenix area.

There is negligible direct use of surface water as a raw domestic source below the confluence of the Salt and Gila Rivers.

On most of the other tributary streams, the surface flow is so undependable and variable in quality that domestic water is supplied from groundwater. Future demands in certain areas are dependent upon augmentation from outside sources.

REG. 6-2-3.4 INDUSTRIAL

A. Colorado River - Industrial uses currently are minor. Major use is for hydroelectric power generation. Several steam generating plants are being proposed. Water when diverted through the Central Arizona Project will be partially used for industrial purposes.

B. Gila River - Waters are diverted all along the flowing streams for industrial purposes such as mining, manufacturing and cooling water.

REG. 6-2-3.5 PROPOGATION OF AQUATIC AND WILDLIFE RESOURCES

A. Colorado River

1. The Colorado River System contains aquatic and wildlife resources. Such resources include production of organisms, both plant and animal, that contribute to the food chain supporting a fish population, and populations of other animal life including waterfowl and shore birds.

The reach between Imperial and Laguna Dams is used primarily as a silt depository for the desilting works at Imperial Dam and for operational control. Measures for the protection of aquatic and wildlife resources in this section will be practiced to the fullest extent possible consistent with the normal operation of the facility as a desilting works. Prior to the construction of the Imperial Dam and desilting works, most of the silt load of the Colorado River flowed through the canal system onto the irrigated fields, and silt control cost about one million dollars annually. Although the amount of silt decreased with the completion of Hoover Dam, channel degradation, bank erosion and storm runoff still contribute a heavy silt load at Imperial Dam (about 805,000 tons in calendar year 1965). The bulk of this silt is removed continuously in six classifier type basins on the California side and by a single basin with periodic sluicing of silt on the Arizona side of the river. The sediment from the basins is sluiced downstream to a sediment retention basin for removal by dredging. Removal of this sediment from the sluiceway channel is required for satisfactory operation of the desilting basin and overall sediment control measures at Imperial Dam.

This operation results in a varying but heavy silt deposition in the area between the dams, and a rapidly varying water depth. The operation is absolutely essential in maintaining a low silt content water delivery into the canal systems of both Arizona and California.

2. Water is used in the operation of the National Wildlife Service Refuges, the Havasu Lake, Cibola and Imperial Wildlife Refuges. This water use is covered by the Arizona vs. California Supreme Court Decree. Consideration is being given to dedication of a portion of the Lower Palo Verde-Cibola Valley region to waterfowl management purposes, to provide

enough buffer lands to protect the waterfowl and to provide for future related recreational needs.

3. Water is used at Mittry Lake, an Arizona State waterfowl area in the downstream area from Imperial Dam. A State Wildlife area is being farmed for waterfowl habitat preservation and feed in the Cibola Valley.

B. Gila River - The Gila River System contains aquatic and wildlife resources in most of the flowing streams and impoundments. Such resources include production of organisms, both plant and animal, that contribute to the food chain supporting a fish population, and populations of other animal life, including waterfowl and shore birds.

REG. 6-2-3.6 RECREATION

A. Colorado River - The Colorado main stem is used for a variety of recreational pursuits, including primary body contact uses, between Page and Yuma. The remainder of the river and the various tributaries are used for secondary body contact uses with the exception of some impoundments which may be used for primary body contact sports.

B. Gila River - The Gila is used for a variety of recreational pursuits, including primary body contact uses. Some uses are restricted in certain areas due to conflicting water rights and uses, but are generally available in most areas in which sufficient flowing or stored water is available.

REG. 6-2-3.7 FUTURE USES OF SURFACE WATER

Future consumptive uses of surface water of the Colorado and Gila Rivers, other than those specifically mentioned as allocated, are of necessity restricted until a major water augmentation program is realized. It is probable that some uses will have to be replaced by a higher priority use under due process of law with full recognition of legal water rights.

REG. 6-2-3.8 CLASSIFICATION OF WATERS ACCORDING TO USE

Specific classification of waters by designation through finite geographic boundaries cannot be made. The uses of the waters of the State vary to a much greater extent than they normally do in more humid climates. This is due to the fact that the majority of our streams are intermittent and nearly all streams having a perennial flow are completely regulated. Thus varying uses are made of these waters depending upon the amount of flow available, either from natural precipitation or releases from storage. For example, most releases for agricultural purposes are made on a demand basis, however when sustained flows are anticipated, plantings of fish may create a fishery where none normally exists. A delineation of major cold and warm water fishing areas on interstate waters in Arizona is shown in Exhibit 23. Nearly all perennial waters are used for recreational pursuits. Use of surface waters for domestic and industrial purposes are necessarily limited to those areas having a dependable supply. Numerous wells for domestic and industrial supplies are located in or adjacent to the stream bed and are greatly influenced by the surface waters that may flow sporadically, therefore protection of such supplies is essential even though the stream may not properly be classified as a surface water source of such supplies.

All waters of the State governed by this document are protected for esthetic values. This includes perennial, intermittent and ephemeral streams, and intermittent lakes.

REG. 6-2-3.9 ENHANCEMENT OF WATER QUALITY

In view of the present quality of Colorado River water and the prospect of further degradation by upstream development, it is imperative that a major water augmentation program be instituted for the Colorado River System. Since this program would entail interstate cooperation and Federal sponsorship, the efforts of other appropriate State and Federal agencies are necessary to effectuate it.

The Gila River is completely utilized by consumptive uses at the present time. A water augmentation program would enhance these waters as well. Control of natural sources of salinity and discharge requirements for waste systems can be used to maintain or improve the present quality of the water.

SEC. 6-2-4 RATIONALE

REG. 6-2-4.1 GENERAL

Although the water quality indicators under consideration are numerous, they may effectively be grouped in:

1. The consideration of present conditions and contributing factors, and

2. Quality requirements for specified uses.

REG. 6-2-4.2 CONSIDERATION OF PRESENT CONDITIONS AND CONTRIBUTING FACTORS

A. Bacteriological - The objective is to keep waters of the State bacteriologically safe for beneficial uses. The contributory sources of pathogens are disposals of sanitary wastes from communities, from private establishments, and from boats.

The need for water conservation in the Southwest indicates that beneficial reuse of sewage effluents should be encouraged. The increased recreational use of the entire area could contribute human pathogens to offset the effect of the elimination of properly treated effluents. This objective will be met by establishment of effluent discharge requirements on sanitary wastes from private and community sewage systems, organic processing plants, recreational facilities and boats.

B. Chemical Characteristics - Discharge from future Upper Basin developments may increase contributions of chemicals to waters entering Arizona. In addition, further development in adjacent states could cause the same problem. Should such occur or threaten, corrective measures would be initially sought through cooperative efforts with the Basin States.

1. Natural sources of salinity in the Arizona reach of the Colorado River - Some of the natural sources of salinity have been enumerated in previous sections. The Arizona Interstate Stream Commission is currently funded to conduct a study of the Little Colorado River Basin potential which includes Blue Springs to ascertain its optimum role in control and development for the water resources program in Arizona.

Interstate cooperation will be necessary to evaluate and reduce the salinity of waters reaching the Colorado River from adjacent states as covered previously. The soils of the Colorado River Basin closely resemble the geological formations of their origin, namely igneous, sedimentary and metamorphic. The silts removed by constant erosion of the upper areas have been deposited in the Lower Basin to form the great delta of the Colorado River. These silts contain large quantities of salts such as sodium, calcium, and magnesium combined with chlorides, carbonate, bicarbonate and sulfates. Thus the soils of the Colorado River Basin are the basic source of the salinity in the water. Only limited areas have been leached sufficiently to remove these soluble salts, and most lands of the Basin must be leached before they will become productive.

Efforts to control the natural sources of salinity between Lees Ferry and Lake Mead may meet with opposition from certain conservation groups who have been attacking further development of the Colorado River in this area. Every effort must be made to reconcile the many differences of opinion on river development.

Gypsum reefs are quite common in the Lake Mead area, and there is no feasible method of isolating these areas. Fortunately, they do not appear to contribute a large amount of total salt as evidenced by U.S.B.R. reports on Lake Mead and the Colorado River. The answer could be found in deposition of silts and/or precipitation of calcium carbonate as a crust over the gypsum beds.

2. Natural sources of salinity in the Gila River drainage area - There are numerous natural sources of salinity in the drainage area. The alluvial soils and rocks contain soluble salts. Although this source is difficult to control, water management and watershed manipulation may help reduce the effect of this source in the future. Salt springs and salt beds in the vicinity of rivers and creeks are being sought out and methods of control studied and more work must be done.

3. Agricultural sources of salinity - An operational salt balance must be established in all agricultural operations. In general, all of the salt entering the root zone of an agricultural project must be removed from the area if a sustained operation is to be possible. Failure to resolve this problem may have contributed to the destruction of great civilizations in the past, including the Hohokam Indian civilization in the Salt River Valley of Arizona a few hundred years ago. With efficient irrigation practices, about two-thirds of the water applied to crops is removed by transpiration from the plants, use by the plants, and by evaporation from the soil itself, concentrating all the salts originally present in the remaining one-third of the water. This water must be drained away from the root zone to prevent salt damage to future crops. Thus agricultural drainage water will have a higher concentration of dissolved salts or TDS than is present in the applied water. It is obvious that the incremental increase of TDS in drainage waters of the lower basin will be much higher than for a similar operation in the upper basin because of the higher TDS in the applied water.

The TDS concentration of drainage water resulting from the leaching of new lands can be higher than the concentration resulting from a salt balance operation. The effect, however, diminishes rapidly.

The programs outlined in Reg. 6-2-2.1 (canal lining, pipe installation, land levelling, phreatophyte removal, watershed improvement, etc.) are the current methods of water conservation which contribute to water quality enhancement. These programs should be continued, giving consideration to their effect on other beneficial uses (recreation and fish and wildlife propagation). New, practical processes for reducing the salinity of irrigation return flows should be applied as they are developed.

The water tables in the Gila River System are generally quite low, and there is very little return flow to the rivers by surface drainage systems. Canal lining, pipe installation, land levelling, phreatophyte removal, watershed improvement, etc. are the current methods of water conservation which contribute to water quality enhancement. These programs should be continued, giving consideration to their effect on other beneficial uses (recreation and fish and wildlife propagation). New, practical processes for reducing the salinity of irrigation return flows should be applied as they are developed.

It should be recognized that such programs, while beneficial in preserving and enhancing water quantity and quality, may produce undesirable effects on recreation and wildlife values.

4. <u>Industrial sources of salinity</u> - There are a few minor sources of salinity in industrial operations along the Arizona reach of the Colorado River. Most of these can be held to a minimum by proper discharge requirements.

5. <u>Municipal sources of salinity</u> - Salts are added to water used for domestic purposes. Domestic sewage generally has a TDS increase of about 300 mg/l over the supply water. This increase can be attributed to a number of factors such as, but not limited to human waste, water softener operation, washing clothes and dishes, garbage disposals, etc. The most significant increase is in sodium chloride.

Return flows from lawn and garden watering follows the pattern set forth for agricultural drainage previously discussed.

Light industrial and commercial operations in cities usually contribute salts to the municipal sewage or to the groundwater eventually returning to the river. Although the individual contribution may be small, the collective total can become appreciable, and all sources should be evaluated for effective control.

6. <u>The total salinity problem</u> - The salts added by the natural and beneficial use sources listed above combine with diminishing flows due to consumptive use and diversions out of the Colorado River Basin to present a serious salinity problem for all of the users of the Colorado River water downstream of Lake Mead. The Bureau of Reclamation and Geological Survey are cooperating in an electric analog study of the diversions, use and returns for the area downstream of Imperial Dam, but this study is far too limited in scope and tends to convey the idea that the salinity problem is the responsibility of this one area alone, whereas it is a total Basin problem. This concept of a localized problem as set forth in Minute 218 (Exhibit 21) is totally unacceptable to Arizona, and the temporary alleviation procedure effective until November 16, 1970 must be replaced by a more acceptable procedure which recognizes total Basin responsibility. The Council will cooperate with the above agencies in working out a satisfactory policy on salinity control.

A report on the study and suggestions on the problem solution by the Bureau of Reclamation and the Geological Survey is due on May 16, 1970.

7. <u>Heavy metals and associated chemicals</u> - The concentrations of

these chemicals in waters of the State are historically very low. Wastes containing these elements are widely scattered and can be controlled by discharge requirements on the individual waste stream. Each discharge requirement will be based on appropriate factors such as, but not limited to the dilution capacity of the stream and beneficial uses of the stream.

The setting of stream standards at USPHS drinking water limits could be interpreted by a discharger as meaning that he could discharge these chemicals into the stream up to the limit. In effect, then, standards could be unjustly used to discriminate against downstream users because there is no dilution capacity left. This problem of apportionment of dilution capacity of the stream must be solved on an entire basin level before specific limits can be placed on the main stem of the Colorado and Gila. This task is expected to take one to three years.

Until specific limits are set, the policy of the Council through the State Department of Health is to minimize any discharge of these chemicals to the river in accordance with the Statement of Policy. Generally, industry is the source of disposals containing these chemicals; and also generally, these wastes are contained in relatively small volumes of water which could be economically disposed of elsewhere.

8. Biocides - Biocides have been the subject of much discussion in the past, and probably will be discussed for many years. Prudent use of biocides has enabled our agricultural industry to provide ample food and fiber products for our high standards of living. Esthetically, we can have better gardens and a more healthful existence because of biocides. Uncontrolled use of biocides is not beneficial, and should not be allowed. Generally speaking, biocides are expensive, and over applications are seldom made. Discharges of wastes containing biocides from manufacturing and tank cleaning operations must not be allowed.

More research and study of the cumulative effects of biocides on humans and wildlife must be made, and appropriate safeguards applied as standards for the waters of the State.

Types and effects of biocides are too numerous and varied for tabulation. Further, the intricacies and variations of technical analysis for biocides presently defy the prescription of any one or a few tests for their detection or determination. Bio-assay tests can be used to establish allowable limits for biocides.

Application of biocides in agricultural operations which could result in biocide levels in waters of the State which are deleterious to human, animal, plant or aquatic life shall be subject to abatement. Mere detection of a biocide in the water is not cause for abatement.

9. Radioactivity - Radioactivity in waters of the State is contained within satisfactory limits. There are no wastes containing radioactivity being discharged into the Arizona reaches. Future problems will be controlled by discharge requirements.

10. Other chemical characteristics - Boron reduction will be con-

sidered along with reduction of salinity in agricultural return flows.

Eutrophication, although not a major problem at this time, could become a problem if the nutrient concentration in the water increases. Minimization of nutrient contributions to the river systems is mandatory.

Phenols and organic chemical concentrations are not now a problem, and there are no known discharges. Any proposed discharges will be subject to regulations commensurate with timely technology.

REG. 6-2-4.3 PROBLEMS ASSOCIATED WITH METHODS OF REDUCING POLLUTANTS

The major problem associated with control of pollutants in the waters of the State is that the method chosen may reduce the quantity of water available to downstream users, or may adversely affect the user downstream by a chemical or physical change in the water. Factors such as the following should be considered in setting numerical stream standards.

1. Hardness in domestic water is undesirable, and can be removed by several processes. Ion exchange or precipitation methods can alter the cation balance of the water to the extent that the change can adversely affect penetration rates of water in agricultural operations.

2. Disposal of sewage effluents outside of the river area can reduce the total flow of the river and reduce the assimilative capacity of the river downstream, denying the downstream user of his legal entitlement to use of the water.

3. When waters containing considerable dissolved salts are being considered for discharge to the river, total resource effects should be determined, and the decision should not be made on the basis of the concentration of the discharge alone. This concept is vital in the conservation of total water supply in the stream. Unwarranted depletions could deprive downstream users of valuable rights to water use.

4. In view of the fact that water disposed of on land in a basin could return to the river underground in worse condition than when "disposed of", careful consideration of requirements for disposal on land must be made. In effect, such disposal could be similar to reclamation of new land for agricultural purposes as far as salinity buildup is concerned.

REG. 6-2-4.4 ADDITIONAL MEASURES TO ENHANCE WATER QUALITY

A. Water augmentation - The need of a major water augmentation program for the Colorado River System is immediate. Institution of this important program requires cooperative actions and representations between local, state, interstate and federal agencies. The Council and the State Department of Health will do all that it can to expedite the institution of such water augmentation program to improve water quality in the Colorado and Gila River Systems.

B. Investigations - In view of the changing topography and increasing intensity of multiple use of waters of the State, it is necessary that periodic investigations be conducted in the river or on the watershed to remain apprised of the most recent conditions which may degrade water quality, and which may affect any particular beneficial use of the river waters. The scope of such investigations will vary from cursory field inspections to technical studies of water quality conditions. The investigations will be conducted under the direction of the Council by the State Department of Health staff either alone or in cooperation with other agencies. However, where specialty is required, the State Department of Health will either request or contract the necessary services.

Special emphasis will be placed on finding practical means of reducing the salinity of agricultural drainage water, since this beneficial use requires that large quantities of water be returned to the river in order to maintain a salt balance.

C. Coordination with other agencies - The Council and the State Department of Health, in the pursuance of their water quality control activities will at all times remain in advisement and consultation with the several interested agencies, and will work cooperatively with these agencies to produce the most effective water quality control program.

REG. 6-2-4.5 QUALITY REQUIREMENTS FOR SPECIFIED USES

Each beneficial water use requires certain indicators of water quality as desirable or essential. Pertinent indicators are investigated for adequate protection of each beneficial use. Water quality objectives are formulated in consideration of these indicators, and effects upon the economy of the area which may result from various levels of control. Where more than one level of an indicator is under consideration in the protection of various beneficial uses, preferential selection is given to that level which represents the superior water quality.

In the selection of standards for a particular water quality objective, consideration must be given to the economic and social effects which may result therefrom.

General water quality objectives are:

1. To provide the highest quality water practicable for all beneficial uses.
2. To protect the public health.
3. To preclude pollution of the waters of the State.

REG. 6-2-4.6 AGRICULTURE

The most important water quality indicators for protection of irrigated agriculture are salinity, sodium relationships, boron and bicarbonate effects. These indicators are as follows:

1. Salinity - Excessive salinity in the root zone causes adverse effects upon plant life, ranging from leaf-burn to death of the plant. Salinity characteristics of water for agricultural applications are most

effectively indicated by measuring the:

a. Total Dissolved Solids (TDS), in mg/l.
b. Electrical Conductivity ($EC \times 10^6$), micromhos.

The records indicate some increase of salinity in Colorado River water released towards Arizona, as well as continuing increase in total quantities of salts returned to the main stem from farm drainage on both sides of the river along the Arizona reach.

The use of waters of the State for irrigation requires special management for salinity control. Adequate drainage must be provided, and crop selection must be limited to those crops which will tolerate the existing salt content at the point of use.

TDS limits for stockwatering are far more liberal than are those for irrigation. Therefore, salinity control is oriented towards irrigation requirements.

2. Sodium relationships - The predominance of sodium salts in soil is detrimental to maintenance of proper tilth and structure for agricultural purposes. High concentrations of sodium in agricultural supply waters (relative to calcium and magnesium) will cause cationic exchange whereby sodium will replace calcium and magnesium in the soil. The water quality indicator which expresses the level of sodium, relative to calcium and magnesium, is called "percent sodium" and is expressed mathematically as

$$\frac{Na \times 100}{Na + Ca + Mg + K}$$

where the basic constituents are expressed as milliequivalents per liter.

The sodium percentage of a water can change as water concentrates by evaporation. For this reason, the "alkali factor", or ratio of sodium to chloride plus sulfate, in milliequivalents per liter, could be a more definitive term for sodium hazard, and its use is gaining in popularity. An alkali factor of 1.0 or greater represents a "black alkali" condition (an excess of bicarbonate over calcium plus magnesium), which is more damaging than the "white alkali" which is essentially sodium chloride and sodium sulfate. An alkali factor less than 0.70 would be satisfactory for irrigation use. A lower limit of 0.40 to 0.50 would probably be suitable for the benefit of non-agricultural users.

Percent sodium in Colorado River water ranges from approximately 28 at Lees Ferry to approximately 51 at Imperial Dam. The recommended safe limit of this characteristic for continuous applications is 50. The alkali factor increases from about 0.49 to 0.55 between Lees Ferry and Imperial Dam. In view of the low soil permeability of many Lower Basin areas being irrigated with this water, every effort should be made to control sodium content in Colorado River waters, such that the present level of this indicator will not be increased at Imperial Dam. Sodium and alkali figures vary widely in the Gila River Basin.

3. <u>Boron</u> - The symptoms of boron injury, particularly in trees which are less tolerant to this constituent, are leaf yellowing and burning, premature leaf drop, and reduced yield. Citrus trees are among the crops most sensitive to boron. The critical concentration is accepted as 0.4 to 0.5 mg/l in irrigation waters. Citrus is one of the main crops in both the Yuma area of Arizona and the Coachella Valley of California. Both of these areas draw water from Imperial Dam. During 1964, the average boron content of Colorado River water at Imperial Dam was 0.2 mg/l and the maximum content was 0.4 mg/l.

To protect the extensive citrus industries cited, the quality of Colorado River water at Imperial Dam, as represented by boron concentrations, must be at least maintained, and this quality should be enhanced if at all possible. Boron concentrations in the Gila varies widely and this restricts its use for some crops.

4. <u>Bicarbonate effects</u> - Bicarbonate in irrigation water adds to the sodium hazard by precipitating out the calcium and magnesium salts, with the resultant proportional increase in sodium content. This effect is usually expressed in terms of the "residual sodium carbonate" (RSC), defined as

$$RSC = (CO_3 + HCO_3) - (Ca \div Mg)$$

These ionic constituents are expressed as milliequivalents per liter. Waters containing 1.25 - 2.5 meq. per liter of RSC are of marginal quality for irrigation purposes. Waters containing over 2.5 meq. per liter of RSC are not suitable for irrigation purposes.

The RSC levels of Colorado River water in Arizona are as follows (1962 water year, the last data available before the filling of Lake Powell)

Station	RSC Level
Lees Ferry	- 3.7 meq/l
Hoover Dam	- 4.1 meq/l
Imperial Dam	- 3.8 meq/l

Similar negative RSC levels are found in Gila River water.

In view of the negative values, it appears that the bicarbonate level of the waters of the State are well within the safe range for agricultural purposes.

REG. 6-2-4.7 RAW DOMESTIC WATER

The State Department of Health is the unit of State Government with primary responsibility for formulating and enforcing quality of water delivered for domestic purposes. This responsibility also includes consideration of the quality of raw water being diverted for domestic use. The USPHS Drinking Water Standards are applicable, but liberal interpretation must be used because of the high natural salinity of Arizona waters.

It is recognized that USPHS Standards apply to treated drinking water supplies. However, since many of the indicators cannot be removed by conventional or reasonable treatment, the USPHS limits for most of the indicators are applicable to raw domestic water supplies. Bacteriological, physical, chemical and radioactivity indicators must be considered as follows:

1. Bacteriological Quality - Published records show that existing coliform counts in certain reaches of the Colorado River are appreciable. Coliform counts at WPSS Stations in the Upper Colorado River Basin have been consistently higher than those at Page, Arizona. The long stretches of the river in remote, inaccessible areas with no sewage discharges account for the die-off of these organisms. There has not been sufficient time to determine the effects of storage and increased recreational use by the formation of Lake Powell.

All surface waters must receive treatment to be in compliance with State Department of Health regulations before delivery to individual domestic users.

2. Physical Characteristics - Turbidity, color and suspended matter, if present at the point of diversion, will generally be carried to the municipal treatment plants where removal is difficult and expensive. Also, in place, the presence of these indicators detracts from esthetic and recreational appeal, and it reduces the transmission of sunlight needed for propagation of aquatic life.

Further investigations are needed before turbidity, color, and suspended matter from natural conditions and from necessary river control operations may become objects of water quality control. However, turbidity and suspended matter that result from construction and dredging operations in the main stem of the river will be considered for control, except in the reach between Imperial Dam and Laguna Dam.

3. Chemical Characteristics - Section 5.21 of the USPHS Drinking Water Standards (9) reads as follows:

"The following chemical substances should not be present in a water supply in excess of the listed concentrations where, in the judgment of the Reporting Agency and the Certifying Authority, other more suitable supplies are or can be made available.

Substance	Concentration in mg/l
Alkyl Benzene Sulfonte (ABS)	0.5
Arsenic (AS)	0.01
Chloride (Cl)	250.
Copper (Cu)	1.
Carbon Chloroform Extract (CCE)	0.2
Cyanide (CN)	0.01
Fluoride (F)	(See 5.23)
Iron (Fe)	0.3
Manganese (Mn)	0.05
Nitrate (NO_3)	45.

Phenols	0.001
Sulfate (SO_4)	250.
Total Dissolved Solids.	500.
Zinc (Zn)	5. "

Section 5.23 of said USPHS Standards sets allowable fluoride concentrations in drinking water in accordance with the annual average of maximum daily air temperatures of the area.

It is necessary to strive towards lowering of the concentrations of constituents which contribute towards increase of salinity; but it is realized that the only practical means at present by which the concentrations of these constituents in the river as a whole can be controlled within limits that approach drinking water standards is through the institution of a major water augmentation program for the Colorado River System.

In some areas, municipalities desiring better quality water than is naturally available must use special methods such as distillation, dialysis or other suitable means to reduce the salinity. This must be a local choice until a major water augmentation program is developed.

Concentrations of heavy metals and toxic substances are historically low in Colorado River water. Increases in concentrations of these substances are most often attributable to discharges from commercial and industrial operations. Controlled minor increases in concentrations of copper and zinc may be acceptable, as concentrations of these metals, up to 1 mg/l in drinking water, are beneficial to humans. Essentially no increase may be allowed in the remaining heavy metals or toxic substances.

4. Radioactivity - Under said PHS Standards, approval of water supplies containing radioactive materials shall be based upon the judgment that the radioactivity intake from such water supplies, when added to that from all other sources, is not likely to result in an intake greater than the radiation protection guidance recommended in the Federal Radiation Council's Memorandum to the President, September 13, 1961, and approved by the President.

Water supplies are approved without further consideration of other sources of radioactivity intake of Radium-226 and Strontium-90 when the water contains these substances in amounts not exceeding 3 and 10 picocuries (pCi/liter), respectively.

In the known absence of Strontium-90 and alpha emitters, a water supply is acceptable when the gross beta concentrations do not exceed 1000 pCi/liter. Gross beta concentrations in excess of 1000 pCi/liter are grounds for rejection of a supply.

The following data indicates existing levels of radioactivity in Colorado River waters during the most recent years.

Typical Radioactivity Levels in Colorado River Waters

Station	Radium-226	Alpha	Gross Beta	Strontium-90
	Average values in pCi/l, and statistical error			
Davis Dam	No Data	7 ± 5	35 ± 29	1.70
Parker Dam	0.37	7 ± 5	36 ± 29	1.48
Yuma, Arizona	0.17	6 ± 13	87 ± 9	0.88

Concentrations of radioactive substances in Colorado River Basin water are historically low. Disposals of wastes containing radioactive substances are monitored in the basin by the Colorado River Basin Water Quality Control Project.

REG. 6-2-4.8 RECREATION

Recreational uses include fishing, boating, swimming, water skiing, hunting, and esthetic enjoyment. The recreational uses are varied in character, and in their corresponding water quality needs. The rationale for protecting certain of these uses overlap into other main categories of beneficial uses; and accordingly are discussed elsewhere in this chapter. For example: hunting and fishing are dependent entirely upon the main category "Propagation of Aquatic Wildlife Resources".

1. Swimming and Water Skiing - Waters used for these purposes must be:

a. Esthetically enjoyable - that is, free from obnoxious floating or suspended substances, objectionable color and foul odors.
b. Free from substances that are toxic upon ingestion, or irritating to the skin.
c. Reasonably free from pathogenic organisms.

2. Fishing and hunting - Levels of water quality indicators needed to adequately protect fishing and hunting are all included within the indicators and their levels as necessary for "Propagation of Aquatic and Wildlife Resources", and are explained below under that title.

3. Boating and esthetic enjoyment - Water quality requirements for boating and esthetic enjoyment as beneficial water uses are somewhat similar to those required for protection of water-contact sports, hunting, and fishing. Explanations of rationale for protection of these latter uses are made elsewhere and are not repeated here.

Other conditions of water quality that affect boating and esthetic enjoyment are visible floating, suspended, or settled solids arising from disposal of sewage or garbage; sludge banks; slime infestations; heavy growths of attached plants or animals; blooms or high concentrations of plankton; discoloration or excessive turbidity, evolution of odorous gases; visible oil or grease; excessive acidity or alkalinity that lead to corrosion or delignification of boats and docks; foaming; and excess water temperatures that cause high rates of evaporation and cloudiness over the water.

Biological growths and heavy plankton blooms are fertilized by excessive inorganic nutrients, such as nitrates, phosphates, carbonates and silicates. Surfactants are esthetically objectionable when they contribute to foam.

Boats themselves may be a source of esthetic degradation of recreational waters. Uncontrolled boating activities cause significant coliform concentrations in waters, along with visible quantities of refuse, fecal matter, and toilet paper of boat origin.

REG. 6-2-4.9 PROPAGATION OF AQUATIC & WILDLIFE RESOURCES

Requirements of water quality for protection of the propagation of aquatic and wildlife resources cover a broad range of environmental factors, which are variable dependent upon individual species to be protected. Consideration must be given to protection of entire food chains and factors of habitat that contribute towards the desired end product.

The following levels of water quality indicators and criteria will adequately support the general freshwater aquatic and wildlife environment. The listing is not complete, and cannot presently be made complete; but it is sufficiently comprehensive to serve the present purpose.

1. Dissolved oxygen content about 5 mg/l.
2. pH between 6.5 and 8.6.
3. Free carbon dioxide content below 3 cc per liter.
4. Ammonia not over 1.5 mg/l.
5. Suspended solids such that the millionth intensity of light penetration will not be less than 5 meters.
6. Essentially complete absence of toxic substances. These substances tend to accumulate in concentrations along the food chain.

Existing quality of Colorado River Basin water is superior in comparison to the above listed indicators.

Aquatic life is very sensitive to concentrations of copper and zinc. Also, these metals appear to exhibit mutual synergistic effect on toxicity towards aquatic life. Therefore, the objective limits for concentrations of these metals in waters of the State are governed by the need to preserve the aquatic life, and accordingly, the objective below those needed to preserve water quality for domestic use is to maintain concentrations.

REG. 6-2-4.10 INDUSTRIAL

The waters of the State are used in such a variety of industrial processes that it is impossible to organize the quality requirements for all of the processes into a single set of standards. Fortunately, this problem can be circumvented to a great extent because industries are generally willing to accept, for most processes, water that meets drinking water standards. Where particular industries require water of higher quality, industry recognizes that additional treatment is the responsibility of the water user. However, it is of primary importance to all industries that the quality of the water supply remain relatively constant.

Therefore, the rationale which is explained above for formulating water quality standards to protect raw domestic water will govern in protection of water for industrial purposes, with the added consideration that the quality of industrial water supply must remain relatively constant.

SEC. 6-2-5 STATEMENT OF POLICY

The policy of the Department will require the maximum practical degree of treatment for all waste sources under the jurisdiction of the Board. For domestic wastes and those industrial wastes containing dissolved and suspended organic materials, this shall be secondary treatment, its equivalent or better, and effluent chlorination or disinfection where these wastes contain organisms pathogenic to warm blooded animals. Chlorination is required except when in the opinion of the Department, the discharge of waste without chlorination does not constitute a public health hazard or interfere with any beneficial use. For industrial wastes containing inorganic suspended solids, primary treatment, its equivalent or better, will be required. Other methods and degrees of treatment will be required, as appropriate, to remove nutrients, oily constituents and other polluting materials from wastes before discharge.

The discharge of wastes containing toxic substances to any waters of the State is prohibited without a valid permit issued by the Department. If it can be shown that the discharge of such wastes after the best practicable treatment or control will not create adverse conditions or interfere with any beneficial uses of surface or ground waters the Department may issue a permit for such discharge.

Degradation of water quality will result from increased intensity of beneficial usage of water within the State System. Minimization of this degradation without unreasonably restricting any beneficial use is mandatory. The setting of numerical standards on Total Dissolved Solids (TDS), chlorides, sulfates and sodium, which in effect would be allocating the dilution capacity of the stream, could be construed as reallocating water rights and appropriations under existing compacts and treaties. Therefore, until this issue is resolved, no numerical values for these items will be established, but all identifiable sources of salinity increase in the waters of the State will be managed and controlled to the degree reasonably practicable with available technology.

Waters whose existing quality is better than the established standards will not be lowered in quality unless and until it has been affirmatively demonstrated to the State Water Quality Control Council that such change is justifiable as a result of necessary economic or social development and will not interfere with or become injurious to any assigned uses made of, or presently possible in, such waters. Any industrial, public or private project or development which could constitute a new source of pollution or an increased source of pollution to high quality waters will be required, as part of the initial project design, to provide the highest and best degree of waste treatment practicable under existing technology. In implementing the policy of this paragraph as it relates to interstate streams, the Secretary of Interior will be kept advised and provided with such information as he will need from time to time to protect the interests of the United States and the authority of the Secretary in maintaining high quality of interstate waters.

anti degradation statement

SEC. 6-2-6 WATER QUALITY STANDARDS

REG. 6-2-6.1 BASIC STANDARDS APPLICABLE TO ALL WATERS

All waters of the State shall be:

1. Free from substances attributable to domestic or industrial waste or other controllable sources that will settle to form sludge or bottom deposits in amounts sufficient to be unsightly, putrescent or odorous, or in amounts sufficient to interfere with any beneficial use of the water.

2. Free from floating debris, oil, grease, scum, and other floating materials attributable to domestic or industrial waste or other controllable sources in amounts sufficient to be unsightly or in amounts sufficient to interfere with any beneficial use of the water.

3. Free from materials attributable to domestic or industrial waste or other controllable sources in amounts sufficient to produce taste or odor in the water or detectable off-flavor in the flesh of fish, or in amounts sufficient to change the existing color, turbidity or other conditions in the receiving stream to such degree as to create a public nuisance, or in amounts sufficient to interfere with any beneficial use of the water.

4. Free from toxic, corrosive, or other deleterious substances attributable to domestic or industrial waste or other controllable sources at levels or combinations sufficient to be toxic to human, animal, plant or aquatic life or in amounts sufficient to interfere with any beneficial use of the water.

REG. 6-2-6.2 ADDITIONAL WATER QUALITY STANDARDS FOR WATERS THAT HAVE ANY OF THE FOLLOWING USES

A. Domestic & Industrial Supply

1. Bacteriological Quality - In all waters except those used for primary contact recreation, the fecal coliform content shall not exceed a geometric mean of 1000/100 ml nor shall more than 10% of the samples during any 30-day period exceed 2000/100 ml; as determined by either multiple-tube fermentation or membrane filter techniques.

2. pH - The pH shall remain within the limits of 6.5 and 8.6 at all times. The maximum change permitted as a result of waste discharges shall not exceed 0.5 pH units.

3. Temperature - Heat added to any water shall be the lowest practical value. In no case shall heat be added in excess of that amount that would raise the temperature of the minimum daily flow of record for that month more than 5° F above the monthly average of the maximum daily water temperature prevailing in the water or stream section under consideration; nor shall heat be added in excess of that amount that would raise the stream temperature above 93° F. This provision shall not apply to lakes

or impoundments owned by a firm or individual for the express purpose of providing and/or receiving heat wastes.

4. Turbidity - Turbidity of the water will be maintained at the lowest practicable values possible, but in no case shall:

a. Turbidity in the receiving waters due to the discharge of wastes exceed 50 Jackson units in warm water streams or 10 Jackson units in cold water streams.

b. Discharge to warm water lakes cause turbidities to exceed 25 Jackson units, and discharge to cold water or oligotrophic lakes cause turbidities to exceed 10 Jackson units.

A violation of the above numerical turbidity standards resulting from construction, mining, logging, and related land uses shall be grounds for abatement in accordance with ARS 36-1851 to 1868 inclusive.

5. Biocides - Biocide concentrations shall be kept below levels which are deleterious to human, animal, plant or aquatic life, or in amounts sufficient to interfere with this beneficial use of the water.

6. Radioactivity - The concentration of radioactivity in the surface waters of the State shall not:

a. Exceed 1/30th of the MPC_w values given for continuous occupational exposure in National Bureau of Standards Handbook No. 69.

b. Exceed the Public Health Service Drinking Water Standards for waters used for domestic supplies.

c. Result in the accumulation of radioactivity in edible plants or animals that present a hazard to consumers.

d. Be harmful to aquatic life.

Since any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural waters will be maintained at the lowest practicable level.

B. Recreation

1. Bacteriological Quality - The fecal coliform content of primary contact recreation waters shall not exceed a geometric mean of 200/100 ml, nor shall more than 10% of the total samples during any 30-day period exceed 400/100 ml, as determined by multiple-tube fermentation or membrane filter procedures, and based on a minimum of not less than five samples taken over not more than a 30-day period.

In all waters except those used for primary contact recreation, the fecal coliform content shall not exceed a geometric mean of 1000/100 ml nor shall more than 10% of the samples during any 30-day period exceed 2000/100 ml; as determined by either multiple-tube fermentation or membrane filter techniques.

2. pH - The pH shall remain within the limits of 6.5 and 8.6 at all times. The maximum change permitted as a result of waste discharges shall not exceed 0.5 pH units.

3. Temperature - Heat added to any water shall be the lowest practical value. In no case shall heat be added in excess of that amount that would raise the temperature of the minimum daily flow of record for that month more than 5° F above the monthly average of the maximum daily water temperature prevailing in the water or stream section under consideration; nor shall heat be added in excess of that amount that would raise the stream temperature above 93° F. This provision shall not apply to lakes or impoundments owned by a firm or individual for the express purpose of providing and/or receiving heat wastes.

4. Turbidity - Turbidity of the water will be maintained at the lowest practicable values possible, but in no case shall:

a. Turbidity in the receiving waters due to the discharge of wastes exceed 50 Jackson units in warm water streams or 10 Jackson units in cold water streams.

b. Discharge to warm water lakes cause turbidities to exceed 25 Jackson units, and discharge to cold water or oligotrophic lakes cause turbidities to exceed 10 Jackson units.

A violation of the above numerical turbidity standards resulting from construction, mining, logging, and related land uses shall be grounds for abatement in accordance with ARS 36-1851 to 1868 inclusive.

5. Biocides - Biocide concentrations shall be kept below levels which are deleterious to human, animal, plant or aquatic life, or in amounts sufficient to interfere with this beneficial use of the water.

6. Radioactivity - The concentration of radioactivity in the surface waters of the State shall not:

a. Exceed 1/30th of the MPC_w values given for continuous occupational exposure in National Bureau of Standards Handbook No. 69.

b. Exceed the Public Health Service Drinking Water Standards for waters used for domestic supplies.

c. Result in the accumulation of radioactivity in edible plants or animals that present a hazard to consumers.

d. Be harmful to aquatic life.

Since any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural waters will be maintained at the lowest practicable level.

C. Fish and Wildlife

1. Bacteriological Quality - In all waters except those used for

primary contact recreation, the fecal coliform content shall not exceed a geometric mean of 1000/100 ml nor shall more than 10% of the samples during any 30-day period exceed 2000/100 ml; as determined by either multiple-tube fermentation or membrane filter techniques.

2. pH - The pH shall remain within the limits of 6.5 and 8.6 at all times. The maximum change permitted as a result of waste discharges shall not exceed 0.5 pH units.

3. Dissolved Oxygen - The discharge of wastes that lower the dissolved oxygen content below 6 mg/l is prohibited where the receiving body of water is a fishery.

4. Temperature

a. Warm water fisheries - Heat added to any warm water fishery shall be the lowest practical value. In no case shall heat be added in excess of that amount that would raise the temperature of the minimum daily flow of record for that month more than 5° F above the monthly average of the maximum daily water temperature prevailing in the water or stream section under consideration; nor shall heat be added in excess of that amount that would raise the stream temperature above 93° F. This provision shall not apply to lakes or impoundments owned by a firm or individual for the express purpose of providing and/or receiving heat wastes.

b. Cold water fisheries - Heat added to cold water fisheries shall be the lowest practical value. In no case shall heated wastes be discharged in the vicinity of spawning areas. In other areas, winter temperatures (November through March) shall not be raised above 55° F and summer temperatures (April through October) shall not be raised above 70° F. In both winter and summer, heat shall not be added in excess of that amount that would raise the temperature of the minimum daily flow of record for that month more than 2° F above the monthly average of the maximum daily water temperatures prevailing in the water or stream section under consideration. These provisions shall not apply to lakes or impoundments owned by a firm or individual for the express purpose of providing cooling water and/or receiving heat wastes.

c. Wildlife - In any area where fisheries are not a consideration, the temperature of wastes discharged to any watercourse shall not interfere with any wildlife use, or esthetic values.

5. Turbidity - Turbidity of the water will be maintained at the lowest practicable values possible, but in no case shall:

a. Turbidity in the receiving waters due to the discharge of wastes exceed 50 Jackson units in warm water streams or 10 Jackson units in cold water streams.

b. Discharge to warm water lakes cause turbidities to exceed 25 Jackson units, and discharge to cold water or oligotrophic lakes cause turbidities to exceed 10 Jackson units.

A violation of the above numerical turbidity standards resulting from construction, mining, logging, and related land uses shall be grounds for abatement in accordance with ARS 36-1851 to 1868 inclusive.

6. Biocides - Biocide concentrations shall be kept below levels which are deleterious to human, animal, plant or aquatic life, or in amounts sufficient to interfere with this beneficial use of the water.

7. Radioactivity - The concentration of radioactivity in the surface waters of the State shall not:

a. Exceed 1/30th of the MPC_W values given for continuous occupational exposure in National Bureau of Standards Handbook No. 69.

b. Exceed the Public Health Service Drinking Water Standards for waters used for domestic supplies.

c. Result in the accumulation of radioactivity in edible plants or animals that present a hazard to consumers.

d. Be harmful to aquatic life.

Since any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural waters will be maintained at the lowest practicable level.

D. Agriculture

1. pH - The pH shall remain within the limits of 6.5 and 8.6 at all times. The maximum change permitted as a result of waste discharges shall not exceed 0.5 pH units.

2. Biocides - Biocide concentrations shall be kept below levels which are deleterious to human, animal, plant or aquatic life, or in amounts sufficient to interfere with this beneficial use of the water.

3. Radioactivity - The concentration of radioactivity in the surface waters of the State shall not:

a. Exceed 1/30th of the MPC_W values given for continuous occupational exposure in National Bureau of Standards Handbook No. 69.

b. Exceed the Public Health Service Drinking Water Standards for waters used for domestic supplies.

c. Result in the accumulation of radioactivity in edible plants or animals that present a hazard to consumers.

d. Be harmful to aquatic life.

Since any human exposure to ionizing radiation is undesirable, the concentration of radioactivity in natural waters will be maintained at the lowest practicable level.

SEC. 6-2-7 IMPLEMENTATION & SURVEILLANCE

REG. 6-2-7.1 IMPLEMENTATION

Preservation and enhancement of water quality in Arizona is a primary function of the State Water Quality Control Council. The Council's implementation plan is a comprehensive program of surveillance, control of discharges to the rivers, enforcement and special activities relating to investigations, research coordination with other agencies concerned with water quality control, and support of a water augmentation program for the State.

The Council maintains an up-to-date list of pollution sources requiring treatment and treatment facilities in need of expansion. Included in this list are degree of treatment needed to comply with water quality standards and time schedules of compliance.

The Council recognizes that some degradation in quality of water results from each beneficial use. Some forms of degradation, such as salt degradation, are irreversible in a practical and economical manner under present technology. The Council also recognizes the absolute need for return flows to the rivers to create a proper balance of water resource development in agricultural, municipal and other uses and to fulfill requirements of downstream users. The Council authorizes return flows to the river even though the return flows might decrease the quality of the river water so long as such degradation is the necessary result of a reasonable use of the water. Because of this reasonable use, until new technology is available and/or water augmentation programs are implemented, the quality of the waters of the State will continue to be degraded with respect to certain parameters at a given point on the river as more upstream users in other states and Arizona are added, and that no single standard for any one parameter can n be applied to all points in the river. Factors such as the quality of the water available to the beneficial user of river water, the type and efficiency of use, and the type of practical treatment methods available will determine how much the return flow will be degraded by each use. All future numerical standards set on the river must reflect these facts. The Council will determine the allowable degradation resulting from each beneficial use, and after appropriate public hearings, will set specific stream standards downstream of such use. Emphasis on equitable apportionment of allowable degradation will be paramount in the determination of these numerical standards. Under no circumstances however shall this provision be construed to waive the right of the State of Arizona to object to the quality of water in the Colorado River reaching this State from upstream sources.

None of the provisions of this Water Quality Control Policy, including specific criteria, measures or methods of implementation shall be construed as an exemption or a modification of the Rules and Regulations of the State Board of Health governing waste treatment and/or waste discharge requirements. The policy of the Department will require the maximum practicable degree of treatment for all waste sources under the jurisdiction of the Board and treatment methods shall comply with the applicable rules and regulations.

REG. 6-2-7.2 SURVEILLANCE

Surveillance is the continued observance of waters of the State, including measurement of water quality indicators and evaluation of water quality factors. It also includes the continuous review of monitoring data supplied by waste dischargers for compliance with requirements prescribed by the Council and the State Board of Health. The surveillance program should produce sufficient water quality data at key stations for continued, effective appraisal of water quality conditions in the Colorado and Gila Rivers.

1. <u>Colorado River</u> - At the present time the Geological Survey (USGS) maintains water quality and stream flow gaging stations at various points on both the main stem of the Colorado River and major tributaries. The Federal Water Pollution Control Administration has also established several water quality surveillance stations at key locations under the Water Pollution Surveillance System (WPSS). The Colorado River Basin Project (CRBP) maintains a monitoring system for radioactive elements, and plans additional sampling at existing quality stations. The WPSS and CRBP parameter coverage is more comprehensive than the USGS.

The following table shows stream locations to be monitored to insure compliance with water quality standards.

Station	Parameter & Sampling Frequency						
	Temp	DO	pH	Rad	Turb	Biocides	Fecal Coliform
Lees Ferry	No	set frequency					
Topock	bwk (bwk)	bwk (bwk)	bwk (bwk)	mon (none)	bwk (bwk)	mon (mon)	bwk (bwk)
Parker Headgate Rock Dam	bwk (bwk)	bwk (bwk)	bwk (bwk)	(none)	bwk (bwk)	mon (mon)	bwk (bwk)
Yuma Northerly Border	bwk (wk)	bwk (wk)	bwk (wk)	mon (wk)	bwk (bwk)	mon (mon)	bwk (wk)
Cameron* below Moenkopi Wash	bwk (bwk)	bwk (bwk)	bwk (bwk)	Qrr (Qrr)	bwk (bwk)	Qrr (Qrr)	bwk (bwk)

* - Little Colorado River
( ) - indicates sampling frequency by FWPCA
bwk - biweekly
mon - monthly

Qrr - Quarterly
Temp - Temperature
DO - Dissolved Oxygen
Rad - Radioactivity
Turb - Turbidity

2. <u>Gila River</u> - At the present time the USGS maintains water quality and stream flow gaging stations at various points on both the main stem of the Gila River and major tributaries. The FWPCA does not have any water quality surveillance network on the Gila River System. The existing surveillance network on the Gila River System consists of the following stations with published data:

USGS STATION	DATA AVAILABLE Flow	Sediment	Temp.	Chemical	Spec.Cond.
4445-San Francisco River at Clifton	X	X			
4708-Garden Canyon, (Upper San Pedro River)	X	X		X*	X
4710-San Pedro River at Charleston	X	X	X		X
4734-San Pedro River near Winkleman	X	X	X		X
4739-Mineral Creek				X	
4740-Gila River at Kelvin	X	X	X	X	X
4985-Salt River near Roosevelt	X		X		X
5020-Salt River below Stewart Mountain Dam	X		X	X	
5045-Oak Creek near Cornville	X		X		
5053.5-Dry Beaver Creek near Rimrock	X	X	X		X
5100-Verde River below Bartlett Dam	X		X	X	X
5113-Verde River near Scottsdale	X		X*		
5195-Gila River below Gillespie Dam	X		X	X	X

* Discontinued Sept. 1946

Considerable State money is now being spent on the monitoring program which has provided much useful data but which does not supply the data necessary for the pollution control program. The present program must be studied and the various agencies contacted to determine if the existing procedures can be altered to fulfill the need. If alteration is not possible, the existing Federal monitoring program should be replaced by an adequate State or Federal system. Such an evaluation program, which should be discussed with the agencies involved, will require a study period of one to three years.

Until a workable and realistic program is implemented, the State Department of Health will initiate a program of sampling for bacteriological quality and other special conditions not covered by the existing monitoring programs. It is anticipated that the Department's monitoring schedule will be a comprehensive but flexible program capable of identifying special conditions such as seasonal variations in pollution loads. Monitoring on a rigid schedule will be established as the need arises. Other State agencies, such as the Game and Fish Department, will assist in the sampling and monitoring program.

In conjunction with the above, a program is underway to:

a. Determine the existing water quality.
b. Identify the sources of pollution.
c. Determine beneficial uses to be protected for various stretches of the river.
d. Make recommendations for remedial actions, including time schedules.
e. Ascertain the number and location of monitoring stations required.

3. Miscellaneous studies - Water quality studies have been made by numerous State, Federal and local agencies and by private groups in Arizona. Some of these studies covered a specific water use over a relatively short period of time, but some studies were of a monitoring type to gather long term data. Typical groups who have made such studies are the University of Arizona, Bureau of Reclamation, Soil Conservation Service, irrigation districts and cities.

The present monitoring system was primarily designed to gather data on the quality of water in the river basin system, not as a surveillance system to detect or control pollution. There are no specific procedures for rapid dissemination of data necessary for a pollution surveillance system. Integration of the present system into a satisfactory surveillance network would require changes in policy and procedures. For example, USGS data on water quality in Arizona for water year 1965 (October 1, 1964 to September 30, 1965) was not available on June 1, 1967. Changes in stream quality should be immediately transmitted to the responsible agency if pollution is to be controlled effectively.

The presence of large storage reservoirs in the river system delays and generally diminishes the effects of pollution on downstream detectors. Therefore, discharge monitoring is essential in reservoir areas.

Sampling and examination of water samples should be conducted in accordance with the procedures contained in the latest edition of "Standard Methods for the Examination of Water and Wastewater", or by other acceptable procedures.

REG. 6-2-7.3 WASTE DISCHARGE REQUIREMENTS

The State Board of Health of Arizona has the authority to prescribe waste discharge requirements under ARS Section 36-1855, subject to the limitations contained therein.

The discharge requirements will be set in keeping with the stream standards established by the Council.

The State Department of Health will propose additional rules and regulations for adoption by the State Board of Health. Such regulations have not been written at this time due to a shortage of staff. Such regulations should be adopted within twelve months after these standards become effective. The regulations may include, but not be limited to the following considerations:

1. Effluent standards as required to meet the stream standards and protect the public health.

2. Minimum sanitation facilities for recreational areas such as marinas, parks, and picnic areas.

3. Practices such as logging, highway construction, livestock pen operations, solid waste disposal, etc.

4. Degradation due to consumptive and non-consumptive usage of water for cooling, ore leaching, conveyance, etc.

The State Department of Health may require a permit for each discharge of waste to the waters of the State. Where considered necessary, the permit shall specify a monitoring schedule, requiring that the discharger periodically obtain and report various technical data concerning the disposals. A discharger may not modify an existing disposal system or increase the volume or strength of any wastes under an existing permit.

REG. 6-2-7.4 GENERAL ENFORCEMENT

Enforcement activities are directed mainly towards obtaining compliance with prescribed waste discharge requirements. Generally, enforcement is initiated on staff level. Here attempt is made to obtain correction by informal discussion of the problem. Where such informal procedures fail to produce adequate correction, the alleged violation will be considered by the State Department of Health to determine whether the discharge is taking place contrary to the prescribed requirements.

Upon finding affirmatively, the State Department of Health will cause a written complaint to be served upon the alleged violator, specifying the regulation violated, and shall order that corrective action be taken within a specified reasonable time, affording opportunity for a fair hearing as prescribed by law. Upon failure of the discharger to comply with the cease and desist order, the State Department of Health will certify the facts to the Attorney General. Thereafter, the State Department of Health will assist the Attorney General or the court.

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23. Benson-Allison Decree, Superior Court of Maricopa County, 1917.

24. Haggard Decree, in the District Court for the 3rd. Judicial District of the Territory of Arizona in and for the County of Maricopa, 1903.