# WATER QUALITY STANDARDS FOR SALINITY

# COLORADO RIVER SYSTEM

Prepared by
Colorado River Basin Salinity Control Forum

1981

NOTE – This Review is composed of two parts, namely:

1) Proposed Report on the 1981 Review, *Water Quality Standards for Salinity, Colorado River System*, dated July 9, 1981

2) Supplement Including Modifications to the *Proposed Report on the 1981Review, Water Quality Standards for Salinity, Colorado River System,* dated October 27, 1981

July 9, 1981

Proposed

Report on the

1981 Review

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Colorado River Basin Salinity Control Forum

MEMBER OF THE COLORADO RIVER BASIN
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SUMMARY

Section 303 of the Clean Water Act of 1977 requires that water quality standards be reviewed from time to time, but at least once during each 3-year period. The seven-state Colorado River Basin Salinity Control Forum (Forum) has reviewed the existing state-adopted and Environmental Protection Agency (EPA) approved numeric salinity criteria and plan of implementation for salinity control for the Colorado River system. Changes in hydrologic conditions and water use within the Colorado River Basin have been evaluated and this report presents the recommended revisions to the plan of implementation which are to be submitted to each of the Basin states for adoption.

The Forum finds no reason to recommend changes in the numeric salinity criteria at the three lower main stem stations. Those values are:

| | Salinity in mg/L |
|---|---|
| Below Hoover Dam | 723 |
| Below Parker Dam | 747 |
| Imperial Dam | 879 |

The revised plan of implementation comprises a number of federal and non-federal measures to maintain the adopted salinity criteria while the Basin states continue to develop their compact-apportioned waters. The Forum recommends that the plan of implementation described in this report be carried out. The principal components of the plan are:

1. Prompt construction by the Department of the Interior of two salinity control units authorized by Section 202, Title II, of Public Law 93-320, namely the Paradox Valley and Grand Valley Units.

2. Expeditious authorization and construction by the Department of the Interior of the Meeker Dome Unit and 10 of the units listed in Section 203(a)(1), Title II of Public Law 93-320, or their equivalents after receipt of favorable planning reports.

3. Expeditious implementation by the Department of Agriculture of onfarm and related improvement measures for salinity control.

4. Implementation of salinity control measures by the Bureau of Land Management to reduce salt contribution from public domain lands.

5. The placing of effluent limitations, principally under the National Pollutant Discharge Elimination System (NPDES) permit program, provided for in Section 402 of the Clean Water Act of 1977 on industrial and municipal discharges based on the Forum's 1977 policy on salinity control through the NPDES permits.

6. Implementation of the 1980 Forum policy for the use of brackish and/or saline waters for industrial purposes.

7. Inclusion of the 208 Water Quality Management Plans. Individually, the Basin states have developed water quality management plans to conform to the requirements of Section 208 of the Clean Water Act. The water quality management planning process is continuing. As the plans are refined or new elements added and after such changes have been adopted by the states and approved by EPA, those portions of the plans dealing with salinity control will become part of the implementation plan.

The plan also contemplates programs by water users to cope with higher salinity water, improvements in irrigation systems and management to reduce salt pickup, studies of means to minimize salinity in municipal discharges, and studies of future possible salinity control programs not now included in the plan.

Many natural and manmade factors affect the river's salinity. Consequently, the actual salinity will vary above and below the adopted numeric criteria.

Therefore, the approved standards permit temporary increases above the 1972 levels if control measures are included in the plan. Should water development projects be completed before control measures are brought on-line, temporary increases above the criteria could result and these increases will be deemed in conformance with the standards.

Increases above the criteria as a result of unfavorable reservoir conditions or periods of below normal annual river flows will also be in conformance with the standards provided that, with satisfactory reservoir conditions and when river flows return to normal, concentrations can be expected to be at or below the criteria level.

Salt routing studies for salinity projections were made for the 1975 and 1978 Forum reports using a model developed by the U.S. Bureau of Reclamation (Bureau). This model was also used for projecting future salinity concentrations for this standards review using current information as regards future development. For this review, modifications were made to the procedures used in estimating the amount of salt entering the river system under 1979 (base level) conditions of development. These changes were the result of an analysis of salt tonnages associated with inflow to Lake Powell, ungaged inflow from Lees Ferry to Grand Canyon, gains and losses in Lake Powell and bank storage in Lake Powell. Using the results of these studies, the revised salt load estimate for a virgin flow at Lee Ferry of 14 million acre-feet per year and 1979 conditions is 741,000 tons less than using procedures used for the 1978 review. The Forum believes that the new model inputs more accurately reflect present conditions.

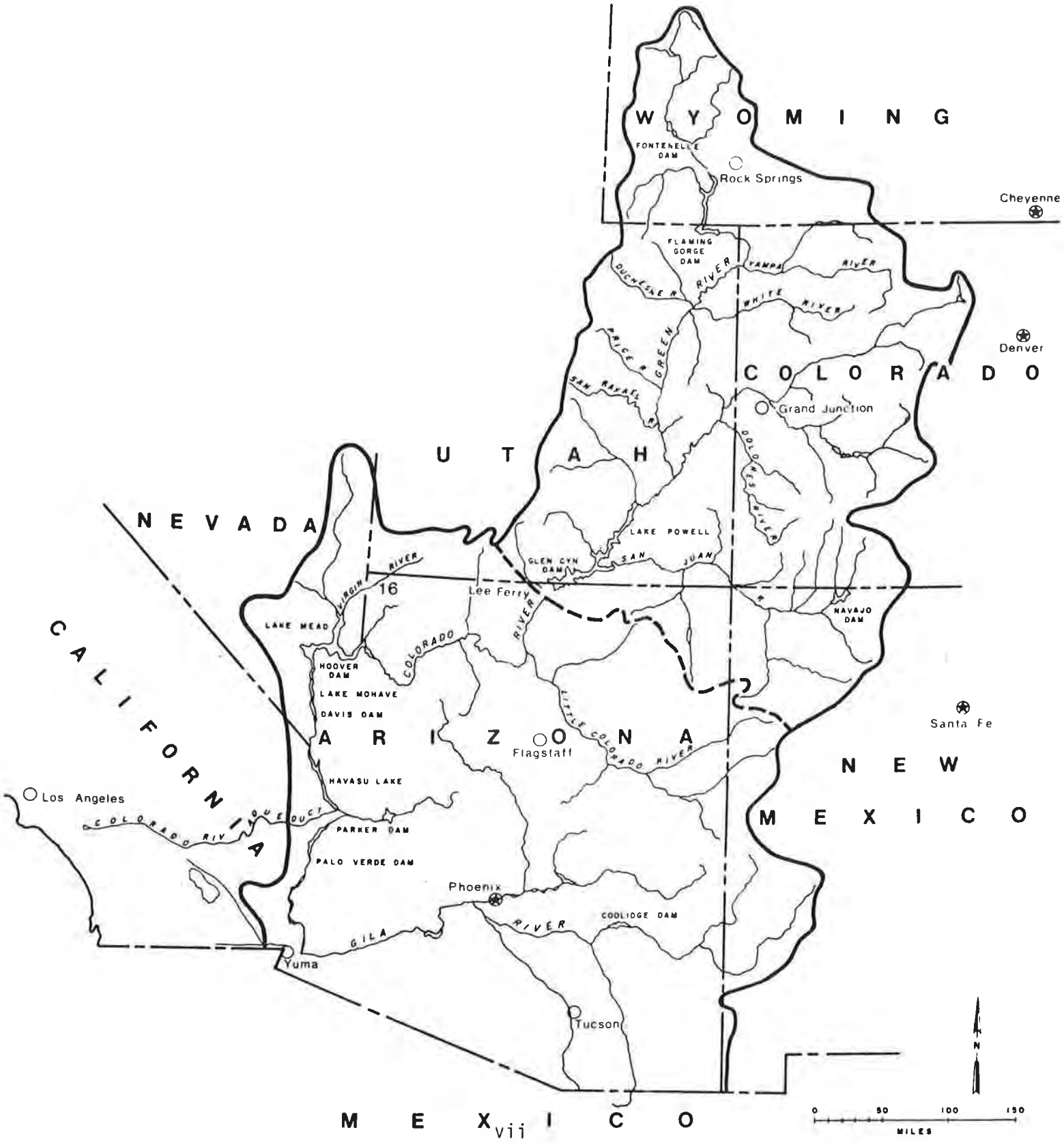
Salinity concentrations at each at the three lower main stem stations for which numeric criteria have been established have generally been decreasing since 1972. Currently, salinity concentrations at the three stations are:

| | Numeric criteria in mg/L | 1980 salinity concentration in mg/L | Salinity concentration below numeric criteria in mg/L |
|---|---|---|---|
| Below Hoover Dam | 723 | 707 | -16 |
| Below Parker Dam | 747 | 703 | -44 |
| Imperial Dam | 879 | 755 1/ | -124 |

1/ The low salinity concentration for Imperial Dam is the result of excess flows that occurred in 1980.

There is no reason to believe that the numeric criteria would be exceeded during the next 3-year review period. Because of the extremely long lead time required to conduct salinity studies, complete feasibility reports, authorize and complete construction, and achieve full impact at lower main stem stations, it is necessary to continue efforts to implement all feasible salinity control measures.

# COLORADO RIVER BASIN



CONTENTS


| | Page |
|---|---|
| Summary | iii |
| List of Abbreviations Used in Report | xiii |
| Chapter I - INTRODUCTION | 1 |
| Purpose of Report | 1 |
| Forum Activities Since 1978 | 3 |
| Legislative Action Since 1978 | 5 |
| Chapter II - SALINITY OF THE RIVER | 6 |
| Salinity: 1972-1980 | 7 |
| Projections of Future Water Use | 7 |
| Salt Routing Studies | 12 |
| Modifications to Salt Routing Model Input Data | 14 |
| Inflow to Lake Powell | 15 |
| Inflow From Lees Ferry to Grand Canyon | 16 |
| Salt Gain or Loss in Lake Powell | 16 |
| Bank Storage in Lake Powell | 17 |
| Comparison with 1978 Procedures | 17 |
| Projected Salinity Concentrations | 18 |
| Baseline Values | 27 |
| CHAPTER III - WATER QUALITY STANDARDS FOR SALINITY | 32 |
| Criteria | 32 |
| Uses | 33 |
| Salinity Monitoring Points | 33 |
| CHAPTER IV - PLAN OF IMPLEMENTATION | 36 |
| Federal Programs | 37 |
| Status of Colorado River Basin Salinity Control Projects - Bureau of Reclamation | 41 |
| Paradox Valley Unit | 41 |
| Grand Valley Unit | 42 |
| Las Vegas Wash Unit | 43 |
| Colorado River Water Quality Improvement Program | 44 |
| Lower Virgin River Unit | 45 |
| Lower Gunnison Basin Unit | 45 |
| Uinta Basin Unit | 46 |
| McElmo Creek Unit | 46 |
| Meeker Dome Unit | 47 |
| Glenwood-Dotsero Springs Unit | 48 |
| Big Sandy River Unit | 48 |

CONTENTS - (continued)


| | Page |
|---|---|
| Price-San Rafael Rivers Unit | 49 |
| Dirty Devil River Unit | 49 |
| LaVerkin Springs Unit | 49 |
| Saline Water Use and Disposal Opportunities | 50 |
| Department of Agriculture | 51 |
| Grand Valley Unit | 52 |
| Unita Basin Unit | 54 |
| Lower Gunnison Basin Unit | 55 |
| Virgin River Unit | 55 |
| Big Sandy River Unit | 55 |
| McElmo Creek Unit | 56 |
| Price-San Rafael Rivers Unit | 56 |
| San Juan River Basin Unit | 56 |
| Colorado River Indian Reservation Unit | 57 |
| Little Colorado River Basin Unit | 57 |
| USDA Rural Clean Water Program | 57 |
| Bureau of Land Management | 58 |
| Ground Water Investigations | 58 |
| Salt From Surface Runoff | 59 |
| Total Salt Yield | 59 |
| Future Studies | 60 |
| Point Source Control Programs | 61 |
| Environmental Protection Programs Activities | 61 |
| State Programs - Effluent Limitations | 62 |
| Effluent Limitations - Industrial Discharges | 62 |
| Arizona | 62 |
| California | 63 |
| Colorado | 63 |
| Nevada | 63 |
| New Mexico | 64 |
| Utah | 65 |
| Wyoming | 66 |
| Effluent Limitations - Municipal Discharges | 67 |
| Arizona | 67 |
| California | 67 |
| Nevada | 67 |
| New Mexico | 68 |
| Utah | 68 |
| Wyoming | 68 |

CONTENTS - (continued)


| | Page |
|---|---|
| State Programs - Water Quality Management (208) Planning | 69 |
| Arizona | 69 |
| California | 70 |
| Colorado | 71 |
| Nevada | 72 |
| New Mexico | 74 |
| Utah | 75 |
| Uintah Basin Association of Governments | 76 |
| Southwestern Utah-Five County Association of Governments | 76 |
| Southeastern Utah Association of Governments | 76 |
| The Six County Commissioners Organization | 77 |
| Wyoming | 77 |
| Education and Public Involvement | 78 |
| Other State Salinity Control Implementation Activities | 80 |
| Arizona | 80 |
| California | 80 |
| Colorado | 81 |
| Nevada | 81 |
| New Mexico | 81 |
| Utah | 82 |
| Wyoming | 82 |
| Other Non-Federal Measures to Control Salinity | 83 |
| Minimizing Salinity Increases Caused by Powerplants | 83 |
| Use of Agricultural Drainage Water for Powerplant Cooling | 84 |
| Industrial Uses of Saline Water | 84 |
| Use of Saline Water in Oil Shale Development | 84 |
| Use of Saline Water in Coal Slurry Pipelines | 85 |
| Non-Federal Efforts to Cope With Salinity of Colorado River Water Supply | 86 |
| Land Drainage | 86 |
| Treatment and Blending | 87 |

CONTENTS - (continued)


Page

Research and Analysis on Salinity Control . . . . . 87

Studies Underway . . . . . 87
Additional Studies Needed . . . . . 88

Ion Constituent Analysis . . . . . 88

CHAPTER V - MEANS OF MAKING PLAN OPERATIONAL . . . . . 89

Legislation Needed to Carry Out Programs . . . . . 89

Federal Programs . . . . . 89

Bureau of Reclamation Water Quality Improvement Program . . . . . 89
Department of Agriculture Program . . . . . 92
Bureau of Land Management and Forest Service Programs . . . . . 92

State Programs . . . . . 93

Financing Salinity Control Projects . . . . . 93
Responsibility for Accomplishing Salinity Control Measures . . . . . 94
Identifying and Evaluating Progress in the Salinity Control Program . . . . . 95
Standards Review Procedure . . . . . 110

CHAPTER VI - FUTURE POSSIBLE SALINITY CONTROL PROGRAMS . . . . . 111

Agricultural Return Flow and Other Saline Water Utilization . . . . . 111
Grand Valley Collection System, Colorado . . . . . 112
Weather Modification . . . . . 113
Irrigation Efficiency . . . . . 114
Rangeland Management Practices . . . . . 115

CHAPTER VII - PROVISION FOR REVIEWING AND REVISING STANDARDS . . 116

## TABLES


| No. | | Page |
|---|---|---|
| 1 | Summary of Estimated Water Use in Colorado River Basin | 10 |
| 2 | Comparison of Salt Loads for 1979 Conditions Used for the 1981 Standards Review with Those Used for the 1978 Standards Review | 18 |
| 3 | Projected 1985 Salinity Levels | 19 |
| 4 | Projected 1990 Salinity Levels | 20 |
| 5 | Projected 1995 Salinity Levels | 21 |
| 6 | Timing and Responsibility for Accomplishing Implementation Plan | 96 |


## FIGURES


| | | |
|---|---|---|
| 1 | Colorado River Basin Flow and Quality of Water Data, 1941-1980 | 8 |
| 2 | Historical and Projected Upper Basin Depletions at Lee Ferry | 11 |
| 3 | Projected Salinity at Hoover Dam | 22 |
| 4 | Projected Salinity at Parker Dam | 23 |
| 5 | Projected Salinity at Imperial Dam | 24 |
| 6a | Total Dissolved Solids vs. Flow | 29 |
| 6b | Total Dissolved Solids vs. Flow | 30 |
| 7 | Monitoring Points | 35 |
| 8 | Location of Proposed Salinity Control Projects - Colorado River Basin | 39 |


## APPENDICES


| | |
|---|---|
| Appendix A - Total Dissolved Solids vs. Flow | A-1 thru A-25 |
| Appendix B - Policy for Use of Brackish and/or Saline Waters for Industrial Purposes | B-1 thru B-3 |
| Appendix C - New Legislation - Excerpt from Public Law 96-375, October 3, 1980 | C-1 |
| Appendix D - Table D-1, Summary Estimated Total Use, Colorado River Basin | D-1 |
| Table D-2, Estimated Increases Over Base, Colorado River Basin | D-2 thru D-4 |

## LIST OF ABBREVIATIONS USED IN REPORT

ACP - Agricultural Conservation Program

ADHS - Arizona Department of Health Services

AOG - Association of Governments

ASCS - Agricultural Stabilization and Conservation Service

ARS - Agricultural Research Service

AWT - Advanced Wastewater Treatment

Basin - Drainage Area of the Colorado River System

BLM - Bureau of Land Management

BMI - Basic Management Industries

BMP - Best Management Practices

Bureau - Bureau of Reclamation

COG - Council of Governments

CRBC - Colorado River Board of California

CRSP - Colorado River Storage Projects

CRWQIP - Colorado River Water Quality Improvement Program

CSU - Colorado State University

DEQ - Department of Environmental Quality

DPR - Definite Plan Report

DRI - Desert Research Institute

EDF - Environmental Defense Fund

EIS - Environmental Impact Statement

EPA - Environmental Protection Agency

ES - Extension Service (USDA)

FmHA - Farmers Home Administration

$ft^3/s$ - cubic feet per second

LIST OF ABBREVIATIONS USED IN REPORT (continued)

Forum - Colorado River Basin Salinity Control Forum

IMS - Irrigation Management Services

lin.ft. - lineal feet

Mgal/d - million gallons per day

mg/L - milligrams per liter

MW - megawatts

MWD - Metropolitan Water District

NPDES - National Pollution Discharge Elimination System

ORV - off-road vehicle

RCWP - Rural Clean Water Program

SCS - Soil Conservation Service

T/AF - tons per acre-feet

TDS - Total Dissolved Solids

USDA - U.S. Department of Agriculture

USGS - U.S. Geological Survey

UIC - Underground Injection Control

WQA - Water Quality Association

# CHAPTER I. INTRODUCTION

## Purpose of Report

This report is in response to Section 303(c) of the Clean Water Act of 1977 (Public Law 92-500 as amended by Public Law 95-217) referred to in this report as the Clean Water Act.

Section 303(c)(1) of the Clean Water Act requires that:

> The governor of a state or the state water pollution control agency of such state shall from time to time (but at least once each three-year period beginning with the date of enactment of the Federal Water Pollution Control Act Amendments of 1972) hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. Results of such review shall be made available to the Administrator.

This report, prepared by the seven-state Colorado River Basin Salinity Control Forum (Forum) is a review of the water quality standards including numeric criteria and plan of implementation previously developed by the Forum. This is the third report prepared by the Forum. This report includes the modifications or revisions to the 1978 Forum report and December 8, 1978 supplement that have become necessary as a result of changed conditions and the availability of better information.

The Forum is composed of water resource and water quality representatives from each of the seven Colorado River Basin states of Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming. The Forum was established for the purpose of providing the states with the necessary information to meet the Environmental Protection Agency's (EPA) previous regulation, 40 CFR, Part 120, entitled "Water Quality Standards - Colorado River System: Salinity Control Policy and Standards Procedures," and Section 303(a) and (b) of the Clean Water Act. The 1978 Forum report was prepared by the Forum in response to Section 303(c), as is this report.

The 1975 Forum report includes a detailed discussion of the legislation and events leading up to the establishment of salinity standards for the lower main stem of the Colorado River. The standards were adopted by all of the Basin states and subsequently approved by the EPA. The 1978 report reviewed the numeric criteria included in the 1975 report and concluded that no change was indicated; however, the plan of implementation was updated to reflect the circumstances at that time and changes that had taken place in the salinity control projects' status since 1975.

The plan of implementation, as set forth in both the 1975 and 1978 Forum reports, included effluent limitations for industrial point source discharges with the objective of no-salt return whenever practicable. In February 1977, the Forum adopted the "Policy for Implementation of Colorado River Salinity Standards Through the NPDES Permit Program." The policy provides detailed guidance in the application of salinity standards developed pursuant to section 303 of the Clean Water Act and through the NPDES permitting authority in the regulation of municipal and industrial point source discharges. The complete policy is presented in Appendix A of the 1978 report.

This report is written as a complete document. Background information regarding historical actions relative to the adoption of salinity standards is contained in the 1975 report and not repeated here. The 1978 report contains information pertaining to the 1975-1978 period which is not repeated here.

Nothing in this report shall be construed to alter, amend, repeal, construe, interpret, modify, or be in conflict with the provisions of the Boulder Canyon Project Act (45 Stat. 1057), the Boulder Canyon Project Adjustment Act (54 Stat. 774), the Colorado River Basin Project Act (82 Stat. 885), the

Colorado River Compact, the Upper Colorado River Basin Compact, or the Treaty with the United Mexican States (Treaty Series 994).

This report is consistent with the EPA-approved 1975 and 1978 reports and deals only with the portion of the Colorado River Basin above Imperial Dam. As used in this report, the lower main stem of the Colorado River system is defined as that portion of the main river from Hoover Dam to Imperial Dam.

Below Imperial Dam, the river's salinity will be controlled to meet the terms of the agreement with Mexico on salinity in Minute 242 of the International Boundary and Water Commission, entitled "Permanent and Definitive Solution to the International Problem of the Salinity of the Colorado River." This agreement states that measures will be taken to assure that the waters delivered to Mexico upstream from Morelos Dam will have an annual average salinity concentration of no more than 115 ppm ($\pm$30 ppm) total dissolved solids greater than the annual average salinity concentration of Colorado River water arriving at Imperial Dam. Title I of Public Law 93-320 is the legislation which implements the provisions of Minute 242. Minute 242 and Title I constitute a federal numeric criterion and plan of implementation for the river below Imperial Dam.

## Forum Activities Since 1978

During the 1978-1980 period the Forum has developed baseline values for 13 monitoring sites and adopted a policy for the use of brackish and/or saline water for industrial purposes. The 1975 report called for the development of the baseline values. Copies of the baseline values and the Forum policy for the use of saline water for industrial purposes and the baseline values developed are included in Appendices A and B to this report.

The baseline values will assist in evaluating changes in river salinity and in assessing effects of development, salinity control measures, and/or other changes upstream from the baseline station, as discussed in Chapter II.

The policy relative to the use of saline waters for industry recommends an inventory of saline water sources and the encouragement and promotion of their use for industrial purposes where it is environmentally sound and economically feasible and where their use would not significantly increase consumptive use of Colorado River system water.

In early 1980 it became apparent that to expedite the necessary salinity control activites, an executive director was needed. In November 1980 the Forum hired its first executive director, Jack Barnett. His activities, which are under the direction of the Forum, are to coordinate and promote salinity control activities which would achieve the objective of maintaining water quality standards for salinity.

Since the 1978 review two annual progress reports, numbers 3 and 4, which summarize salinity control activities have been prepared by the Forum.

The Environmental Defense Fund (EDF) brought suit against Douglas Costle, Administrator, EPA; Cecil Andrus, Secretary, Department of the Interior; and R. Keith Higginson, Commissioner, Bureau of Reclamation, on August 22, 1977. The civil suit in general sought that: (a) the EPA's approval of state salinity standards be set aside, (b) EPA be required to promulgate "effective and enforceable" water quality standards and implementation plans and pollutant loads for salinity, and (c) the defendants be required to implement necessary salinity controls to maintain salinity at the 1972 levels.

The Basin states intervened as defendants. In October 1979, the motion for summary judgment on all six counts was granted to the defendants. The

Federal District Court for the District of Columbia dismissed all six claims brought by the plaintiff, EDF.

On November 28, 1979, EDF filed notice of appeal of the District Court decision. On April 21, 1981, the District of Columbia Court of Appeals upheld the District Court's decision.

## Legislative Action Since 1978

Several proposed amendments to Public Law 93-320, the Colorado River Basin Salinity Control Act, have been considered during the 1978-1981 period. After the Bureau Solicitor advised that Public Law 93-320 did not authorize feasibility level studies, legislation was enacted, Public Law 96-375, in 1980, which authorizes the Bureau to prepare feasibility reports on the units listed in Section 203(a)(1) of Public Law 93-320 and other identified units. See Appendix C for Public Law 96-375.

Legislation, S. 2545, was introduced in 1980 to substitute closed pipes for lined laterals on the Grand Valley Unit and to authorize fish and wildlife mitigation on authorized units. Since Congress did not act on S. 2545, and in order that construction might proceed on Stage I of the Grand Valley Unit, the Bureau submitted, on August 4, 1980, a letter to Congress requesting that they be allowed to use pipes instead of lined laterals for the Grand Valley Unit. Congress did not object to the Bureau's request and construction may commence in 1981.

## CHAPTER II. SALINITY OF THE RIVER

The Colorado River system drains 244,000 square miles of the western United States and a small portion of northern Mexico. Its waters serve some 2.25 million people within the United States portion of the Basin and through export provide full or supplemental water supply to another 12 million people. The regional economy is based on irrigated agriculture, livestock grazing, mining, forestry, manufacturing, oil and gas production, and tourism. About 2.5 million acres are irrigated within the Basin and hundreds of thousands of acres are irrigated by waters exported from the Basin. The Colorado River also serves about 1.5 million people and 425,000 irrigated acres in Mexico.

Salinity has long been recognized as one of the major problems of the river. The Colorado, like most western rivers, increases in salinity from its headwaters to its mouth. This is the result of both natural and manmade causes. Natural causes include salt contribution of saline springs and other ground waters, erosion and solution of sediments, and the concentrating effects of evaporation and transpiration. Man-caused increases in salinity result from the diversion, consumptive use, out-of-basin exports of water, and salt loading. The largest man-induced increase in salinity is caused by the concentrating effect of, and salt loading associated with, irrigated agriculture.

In addition to the comprehensive studies conducted by the Forum in 1975, 1978, and for this review, evaluations of the salinity of the Colorado River have been made by the Bureau, U.S. Geological Survey (USGS), EPA, Bureau of Land Management (BLM), and the Colorado River Board of California (CRBC).

Water quality and streamflow data are being obtained on a daily, weekly, monthly, or quarterly basis at various points on streams throughout the Basin by the USGS in cooperation with the states and other federal agencies. Gaging stations in the Basin that are of significance to this report and for which streamflow and water quality records are available are listed on Figure 1. This figure shows the availability of streamflow and water quality data for key stations during the period 1941-1980 and the current frequency of sampling as classified by the USGS. Where the water quality information is not complete, the missing data have been estimated by correlation with data from other stations.

## Salinity: 1972-1980

The flow-weighted annual average salinity at the stations for which numeric criteria have been set are shown in the following table:

Flow-weighted annual* average salinity
(Total dissolved solids in milligrams per liter)

| Station | 1972 (Numeric criteria) | 1973 | 1974 | 1975 | 1976 | 1977 | 1978 | 1979** | 1980** |
|---|---|---|---|---|---|---|---|---|---|
| Hoover Dam | 723 | 706 | 686 | 689 | 675 | 667 | 686 | 694 | 707 |
| Parker Dam | 747 | 726 | 700 | 703 | 689 | 681 | 681 | 703 | 703 |
| Imperial Dam | 879 | 846 | 836 | 829 | 823 | 821 | 812 | 809*** | 755*** |

* Calendar year.
** Provisional, subject to change.
*** The low salinity concentration is due to surplus flows which occurred in 1979 and 1980.

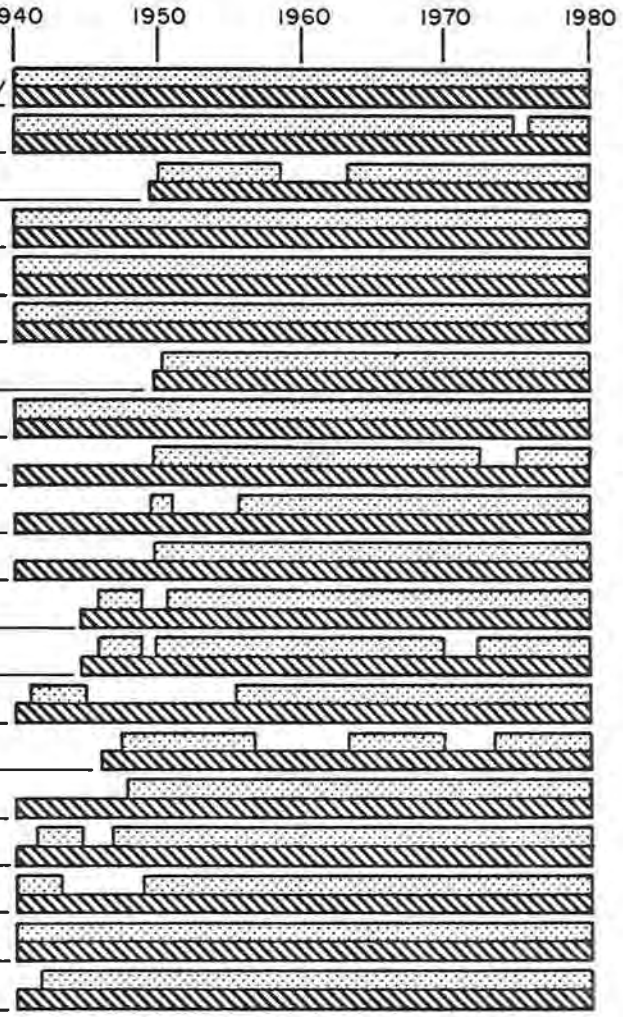
## Projections of Future Water Use

One of the significant factors affecting salinity concentrations is water use. The depletion of Colorado River water by the Upper Basin States in 1979 was estimated at 3,362,000 acre-feet exclusive of Colorado River

FIGURE I

COLORADO RIVER BASIN
Flow and Quality of Water Data
1941-80

| | Current Sampling Frequency[1] | |
|---|---|---|
| | Flow | Quality[2] |
| Colorado River near Cameo, Colorado | Daily | Daily[3] |
| Gunnison River near Grand Junction, Colorado | Daily | Daily |
| Dolores River near Cisco, Utah | Daily | Daily |
| Colorado River near Cisco, Utah | Daily | Daily |
| Animas River at Farmington, New Mexico | Daily | Daily |
| San Juan River near Bluff, Utah | Daily | Daily |
| Green River near Green River, Wyoming | Daily | Daily |
| Green River at Green River, Utah | Daily | Daily |
| Yampa River near Maybell, Colorado | Daily | Daily |
| Duchesne River near Randlett, Utah | Daily | Daily |
| White River near Watson, Utah | Daily | Daily |
| Price River at Woodside, Utah | Daily | Daily |
| San Raphael River near Green River, Utah | Daily | Daily |
| San Juan River at Shiprock, New Mexico | Daily | Daily |
| Little Colorado River near Cameron, Arizona | Daily | Intermittent |
| Virgin River at Littlefield, Arizona | Daily | Daily |
| Colorado River at Lee's Ferry, Arizona | Daily | Daily |
| Colorado River below Hoover Dam, Arizona-Nevada | Daily | Biweekly |
| Colorado River below Parker Dam, Arizona-California | Daily | Every 5 days |
| Colorado River at Imperial Dam, Arizona-California | Daily | Daily |




1/ Sampling frequency as classified by the U.S. Geological Survey.
2/ Electrical conductivity measurements. Frequency of complete chemical analyses varies from station-to-station.
3/ Sampled quality data
Measured flow record

Storage Project (CRSP) reservoir evaporation.1/ In addition there are a number of water development projects now under construction and on some of the recently completed units water use is building up to project capacities. Several projects have been authorized for construction but work has not yet been initiated. In addition, studies are being made of numerous in-Basin projects that would develop water for irrigated agriculture, coal and oil shale development, thermal-electric generation, and municipal and industrial purposes. Some of the projected future developments provide for increased transmountain diversions to the eastern slope of the Rocky Mountains in Colorado, to the Bonneville Basin in Utah, to the Rio Grande Basin in New Mexico, and to the Platte River Basin in Wyoming.

Estimates of both 1979 water use and projected future use through the year 1995 for each of the seven states were furnished by the states. Since future water use is subject to many uncertainties and will be dependent on many variables, three possible future water depletion levels were developed for use in salt routing studies. These were identified as low, moderate, and high. The three projected possible levels of depletion were based on anticipated demand and are independent of physical limitations on water supply. The terminology of "low, moderate, and high" is not to be taken as implying that the projection designated as "moderate" is the most probable one. Rather, the three terms merely reflect the relative rate of increased use for one projection as compared to the others.

Projected depletions in the Upper Basin under 1995 conditions of development, exclusive of CRSP reservoir evaporation, range from a low of about 4,175,000 to a high of 4,867,000 acre-feet. Not included in these figures is

---

1/ Evaporation from Navajo Reservoir is included as a part of New Mexico's water use.

the annual CRSP reservoir evaporation, estimated by the Bureau to average about 520,000 acre-feet per year.1/

Projected consumptive use 2/ from the main stem in the Lower Basin in 1995 varies in a narrow range from 7,398,000 to 7,500,000 acre-feet.

Table 1 presents a summary of projected water use in the Colorado River Basin. Figure 2 presents this same information in graphical form. As can be seen, even the low projection of depletions exceeds the historical rate of increase. Presented in Appendix D are data on 1979 base conditions and projected future uses by state and by specific categories of use.

Table 1. - Summary of estimated water use in Colorado River Basin 1/
(1,000 acre-feet)

| | 1979 base condition | Assumption as to level of use | 1985 | 1990 | 1995 |
|---|---|---|---|---|---|
| Upper Basin 2/ | 3,362 | Low 4/ | 3,498 | 3,935 | 4,175 |
| | | Moderate 4/ | 3,534 | 4,017 | 4,412 |
| | | High 4/ | 3,737 | 4,640 | 4,867 |
| Lower Basin 3/ | 6,083 | Low | 6,375 | 7,358 | 7,398 |
| | | Moderate | 6,509 | 7,389 | 7,439 |
| | | High | 6,813 | 7,418 | 7,500 |
| Total | 9,445 | Low | 9,873 | 11,293 | 11,573 |
| | | Moderate | 10,043 | 11,406 | 11,851 |
| | | High | 10,550 | 12,058 | 12,367 |

1/ Does not include deliveries to Mexico.
2/ Depletions at point of use. Does not include CRSP reservoir evaporation estimated by the Bureau to average 520,000 acre-feet per year.
3/ Diversions from the main stem less returns. Does not include main stem reservoir evaporation and stream losses.
4/ The terminology of "low, moderate, and high" is not to be taken as implying that the projection designated as "moderate" is the most probable one. Rather, the three terms merely reflect the relative rate of increased use for one projection as compared to the others.

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1/ Id.
2/ Consumptive use as defined by the U.S. Supreme Court in (276 U.S. 340) means diversions from the stream less such return flow thereto as is available for consumptive use in the United States or in satisfaction of the Mexican Treaty obligation.

# HISTORICAL AND PROJECTED UPPER BASIN DEPLETIONS AT LEE FERRY

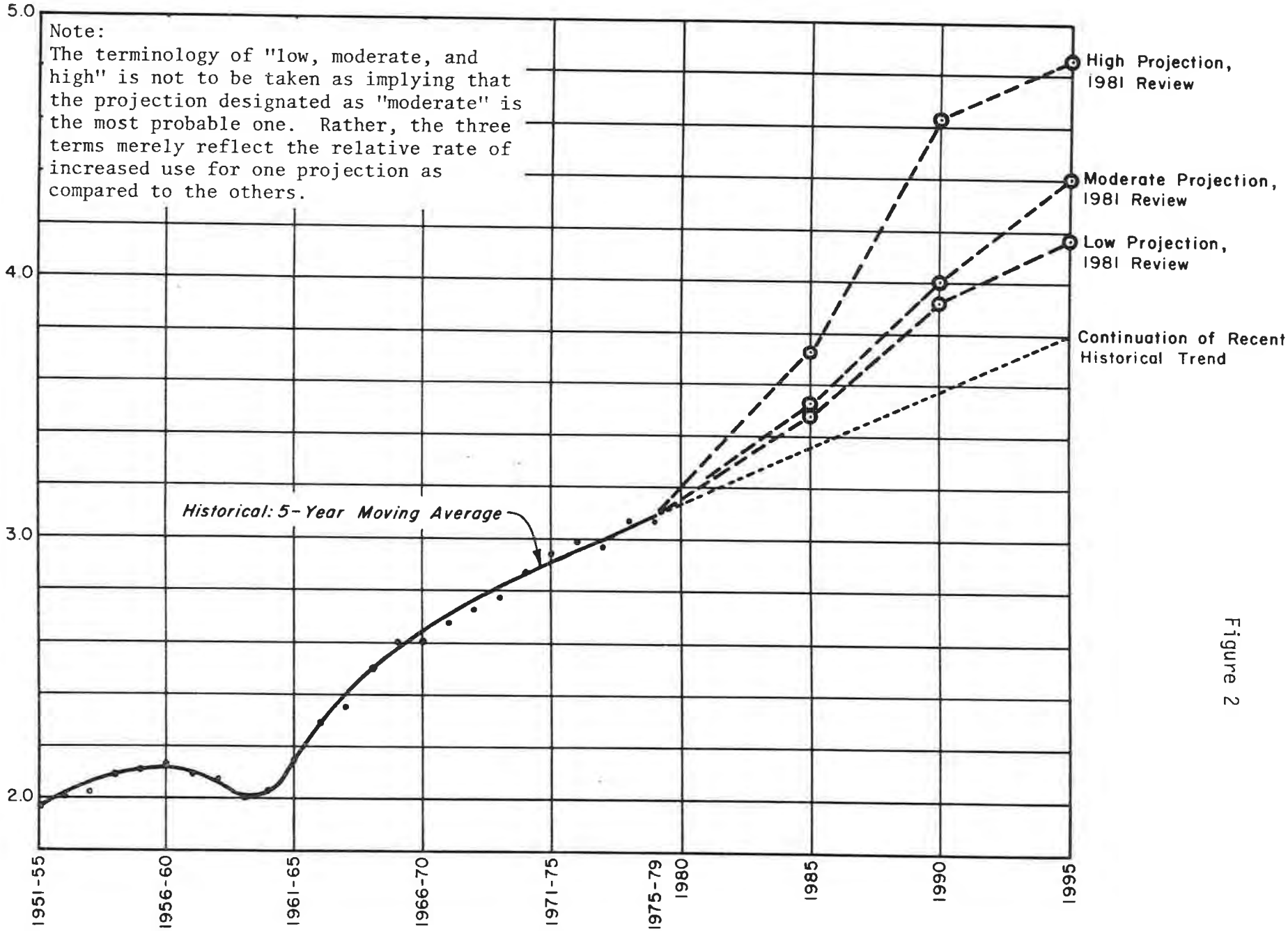


Figure 2

## Salt Routing Studies

Extensive salt routing studies were made for the 1981 review using a computer model developed by the Bureau of Reclamation.1/ The salt routing studies were conducted to provide estimates of future flow-weighted average annual salinity concentrations for each year of the 1980 through 1995 study period at selected points in the Lower Basin under differing assumptions as to both the available water supply and future water uses. The studies were designed to provide estimates of salinity concentrations both with and without the implementation of salinity control projects.

One of the parameters needed to evaluate possible future salinity levels is an estimate of the expected water supply. Three water supply conditions were used: virgin flows of 13, 14, and 15 million acre-feet per year at Lee Ferry, Arizona.2/ It is expected that this range of flows would most likely encompass the actual future flow that will occur in the study time frame. The estimated 1896-1979 average annual virgin flow at Lee Ferry is 14.7 million acre-feet. The estimated 1922-1979 average annual virgin flow at Lee Ferry is 13.9 million acre-feet.

To regulate the erratic flows of the Colorado River, a large volume reservoir storage system has been constructed. During 1980, Lake Powell reached maximum capacity and by the end of 1980, reservoir storage in the entire system exceeded 90 percent of available capacity. This reservoir system dampens the variations in both the annual flow and salinity concentrations in the lower main stem.

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1/ Detailed information on the model is presented in: "Application of a River Network Model to Water Quality Investigations for the Colorado River," Richard Ribbens and Robert F. Wilson, Bureau of Reclamation, U.S. Department of the Interior, Denver, Colorado (1973).

2/ The Colorado River Compact defines Lee Ferry as a point on the mainstream of the Colorado River 1 mile below the mouth of the Paria River.

Using the salt routing model, projections of future salinity levels were made to determine the impact on salinity concentrations in the lower main stem for the full range of assumed water supply conditions and the three projected water use levels and under each of the following conditions:

1. No salinity control projects would be undertaken, but other salinity control measures would be fully implemented. These measures include no-salt return for industrial development within the Basin, as set forth in the Forum-adopted and EPA-approved "Policy for Implementation of the Colorado River Salinity Standards Through the NPDES Permit Program," February 28, 1977, and reformulation of authorized federal water projects to minimize salt contribution;

2. The three authorized salinity control projects described in Chapter IV would be constructed in combination with implementation of the other salinity control measures identified in item 1 above; and

3. Twelve salinity control projects as described in Chapter IV would be constructed in combination with implementation of the other salinity control measures identified in item 1 above.

The salinity control projects consist essentially of those projects described in Title II, Public Law 93-320, with some modifications as described in Chapter IV. The initial year of operation of a particular salinity control project was determined after estimating the time required for planning, authorization, and construction. The individual projects and estimated year of initial operation are described in Chapters IV and V.

The Basin states and federal agencies are investigating salinity control measures other than those cited above and employed in the salt routing model studies. For example, industrial use of saline water, implementation of 208 water quality management plans, potential reductions in salt loading from

BLM-administered public domain lands and other potential onfarm programs have not been taken into account. As more information on these and other salinity control measures becomes available, these measures can be incorporated in future salt routing studies.

The policy set forth in the 1975 report calls for maintenance of salinity concentration in the lower main stem of the river at or below the 1972 flow-weighted average annual value while the Basin states continue to develop their compact-apportioned waters although temporary variations may occur as described in Chapter III.

Modifications to Salt Routing Model Input Data

A major factor influencing the results of the salt routing analyses is the amount of salt entering the river system under 1979 conditions of development. When work on the Forum's 1978 report was near completion, it became apparent that the input data to the model used in both the 1975 and 1978 reports to estimate future salinity concentrations gave results that were too high when compared with the most recent information available in 1978. A preliminary investigation indicated that the salt load entering the river system under 1976 levels of development was overestimated by 500,000 to 1 million tons per year. Time limitations precluded the reevaluation of salinity projections for the 1978 report; however, the estimated impact of a 500,000-ton-per-year salt load reduction on projected salinity levels at Imperial Dam was shown on Figures 2 and 4 of the 1978 report.

After completion of the 1978 report, a study was undertaken to develop model inputs which would more accurately reflect present conditions. Investigation was centered on four areas: inflow to Lake Powell, inflow from Lees Ferry to Grand Canyon, salt gain or loss in Lake Powell, and bank storage in Lake Powell.

Inflow to Lake Powell. - With regard to inflow to Lake Powell, the relationships between the 1976 present modified salt load and flow at the four gaging stations measuring inflow into Lake Powell were analyzed to determine if significant changes in the relationships had occurred during the 1941 through 1976 period.

Results of the study show that for the Colorado River, there is a 90 percent or greater probability that the salt load versus flow relationship for the 1968 through 1976 period is different than the relationship for the 1941 through 1967 period. These studies also indicate the change in relationship began in 1968. For a virgin flow of 14 million acre-feet per year, the estimated salt load to Lake Powell is 363,000 tons less when based on the 1968 through 1976 relationship than when based on the 1941 through 1976 relationship.

For the Green River, the salt load versus flow relationship during 1941 through 1976 has periods of relatively higher salinity followed by periods of relatively lower salinity. The relationship resulted in a lower level of salinity for the period 1970-1976. Because of this variable nature of the relationship, the period of record is too short, however, to determine whether a statistically significant change in relationship has actually occurred and whether the recent lower trend will continue into the future. Until additional data become available, it was assumed that the relationship has not changed and the relationship based on the entire 1941-1976 period of record was used for the 1981 review.

Slight increases in salinity after 1962 are indicated for the San Juan River. However, statistical analyses indicate the periods before and after 1962 are not significantly different. Therefore, as with the Green River, it

was assumed that no change in the salt load versus flow relationship had occurred.

The San Rafael River contributes only 1 percent of the water and 2 percent of the total salt load to the river system. Because the river's contribution to the total infow is relatively very small, only a brief analysis of the relationship was made. This analysis did not reveal an obvious change in the relationship.

Inflow From Lees Ferry to Grand Canyon. - Analysis of the river reach from Lees Ferry to Grand Canyon for the period 1941-1976 was made to determine if a change in salt load has occurred in this reach. The studies indicate a change in the salt load relationship beginning in 1955. For a virgin flow of 14 million acre-feet per year, the salt load based on the 1955-1976 relationship is 243,000 tons less than when based on the 1941-1976 relationship.

Salt Gain or Loss in Lake Powell. - The 1975 and 1978 salinity projections assumed there were no gains or losses of salt in Lake Powell. A mass-balance analysis of historical inflows into and outflows from Lake Powell for the 1963 through 1976 period, assuming complete mixing of inflows with water already in the reservoir, indicated an average annual loss of salt in the reservoir of 135,000 tons. The analysis also showed a relationship between salt gain or loss and change in reservoir water level. This relationship indicated a net loss of salt for reductions in storage and for increases in storage of less than 1.5 million acre-feet per year and a net gain of salt for increases in storage greater than 1.5 million acre-feet per year. Because the relationship was based on the period during which Lake Powell was in its initial filling cycle (only 4 years during the 1963 through 1976 period experienced a reduction in reservoir storage), it was concluded,

following consultation with the Bureau that the relationship may not adequately represent future conditions and that a longer period of analysis, including both falling and rising reservoir cycles, is needed to test the validity of the relationship. It was, therefore, decided not to incorporate the relationship into the mathematical model but to use the average annual salt loss of 135,000 tons.

Bank Storage in Lake Powell. - The amount of water going into or coming out of bank storage in Lake Powell was, in the previous salt routing studies, assumed to be 10 percent of reservoir storage changes. A mass-balance analysis covering the period 1963 through 1976 indicated the percentage of water going into bank storage can be considerably greater. This period, however, encompassed the initial filling cycle of Lake Powell during which the soils within the reservoir experienced their initial saturation. It is reasonable to expect that future bank storage will be less than occurred in the past. It was decided, therefore, that until additional data become available, the 10 percent value for bank storage will continue to be used.

Comparison With 1978 Procedures. - Using the revised salt load estimate and a virgin flow at Lee Ferry of 14 million acre-feet per year, the salt load under 1979 conditions is 741,000 tons per year less than it would have been using the earlier relationships and procedures. A comparison of the salt loads estimated by the two procedures for the model input items that were modified is shown in table 2.

Table 2. - Comparison of salt loads for 1979 conditions used for the 1981 standards review with those used for the 1978 standards review (in 1,000 tons per year)

| Model input item | Using 1981 standards review procedures | Using 1978 standards review procedures | Difference |
|---|---|---|---|
| Salt inflow to Lake Powell | 8,174 | 8,537 | -363 |
| Salt loss in Lake Powell | -135 | 0 | -135 |
| Salt inflow, Lees Ferry to Grand Canyon | 841 | 1,084 | -243 |
| Total | 8,880 | 9,621 | -741 |

In addition to the studies discussed in this report, other studies are underway to more accurately define the salt load versus flow relationship and to ascertain the physical relationships for other changes which may be occurring.

## Projected Salinity Concentrations

Projected 1985, 1990, and 1995 flow-weighted average annual salinity concentrations both with and without salinity control measures, for Hoover, Parker, and Imperial Dams are presented in Tables 3, 4, and 5. Projected salinity concentration for a 14 million acre-feet virgin flow at Lee Ferry and the low depletion level are presented graphically on Figures 3, 4, and 5.

Future salinity concentrations will depend not only upon man's activities but upon natural phenomena, including periods of high and low annual precipitation, variations in distribution of precipitation over the Basin, variations in the time of year precipitation falls, variations in natural evapotranspiration, and other variables. Also, within the major storage reservoirs, salts precipitate, dissolve, and are mixed. Except for deviations caused by factors beyond the control of man, average annual salinity levels can be

Table 3. - Projected 1985 salinity levels
(mg/L)
Numeric criteria: Hoover Dam 723, Parker Dam 747, Imperial Dam 879

| Average virgin flow (maf) | Location | Without salinity control projects | | | With three authorized salinity control projects | | | With all 14 salinity control projects | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Low depletion | Moderate depletion | High depletion | Low depletion | Moderate depletion | High depletion | Low depletion | Moderate depletion | High depletion |
| 13.0 | Hoover Dam | 739 | 743 | 747 | 736 | 740 | 744 | 736 | 740 | 743 |
| | Parker Dam | 748 | 754 | 760 | 745 | 751 | 756 | 744 | 750 | 756 |
| | Imperial Dam | 903 | 913 | 931 | 899 | 909 | 927 | 898 | 908 | 926 |
| 14.0 | Hoover Dam | 718 | 722 | 727 | 714 | 718 | 724 | 714 | 718 | 723 |
| | Parker Dam | 724 | 730 | 737 | 721 | 727 | 734 | 720 | 726 | 733 |
| | Imperial Dam | 851 | 862 | 889 | 847 | 858 | 885 | 846 | 857 | 884 |
| 15.0 | Hoover Dam | 697 | 701 | 706 | 694 | 698 | 703 | 693 | 697 | 702 |
| | Parker Dam | 702 | 708 | 715 | 699 | 704 | 711 | 698 | 704 | 711 |
| | Imperial Dam | 809 | 819 | 844 | 805 | 815 | 840 | 805 | 814 | 839 |

* The Colorado River System is subject to highly variable annual flows which affect the river's salinity. Although reservoir storage tends to dampen the effects of variable flow, it is probable that actual salinity levels will exceed or fall below the values shown on this table even though the conditions upon which the projections are based, such as average virgin flow and future level of development, are met.

Table 4. - Projected 1990 salinity levels
(mg/L)
Numeric criteria: Hoover Dam 723, Parker Dam 747, Imperial Dam 879

| Average virgin flow (maf) | Location | Without salinity control projects | | | With three authorized salinity control projects | | | With all 14 salinity control projects | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Low depletion | Moderate depletion | High depletion | Low depletion | Moderate depletion | High depletion | Low depletion | Moderate depletion | High depletion |
| 13.0 | Hoover Dam | 770 | 776 | 793 | 746 | 752 | 768 | 740 | 745 | 761 |
| | Parker Dam | 781 | 789 | 809 | 756 | 763 | 782 | 749 | 757 | 775 |
| | Imperial Dam | 953 | 968 | 994 | 923 | 937 | 962 | 915 | 929 | 953 |
| 14.0 | Hoover Dam | 742 | 750 | 766 | 720 | 728 | 743 | 714 | 722 | 737 |
| | Parker Dam | 752 | 762 | 781 | 728 | 738 | 756 | 722 | 732 | 750 |
| | Imperial Dam | 918 | 935 | 960 | 890 | 906 | 931 | 882 | 899 | 923 |
| 15.0 | Hoover Dam | 712 | 720 | 738 | 690 | 698 | 716 | 684 | 692 | 710 |
| | Parker Dam | 720 | 730 | 750 | 697 | 707 | 727 | 691 | 701 | 721 |
| | Imperial Dam | 858 | 878 | 922 | 831 | 851 | 894 | 825 | 844 | 887 |

* The Colorado River System is subject to highly variable annual flows which affect the river's salinity. Although reservoir storage tends to dampen the effects of variable flow, it is probable that actual salinity levels will exceed or fall below the values shown on this table even though the conditions upon which the projections are based, such as average virgin flow and future level of development, are met.

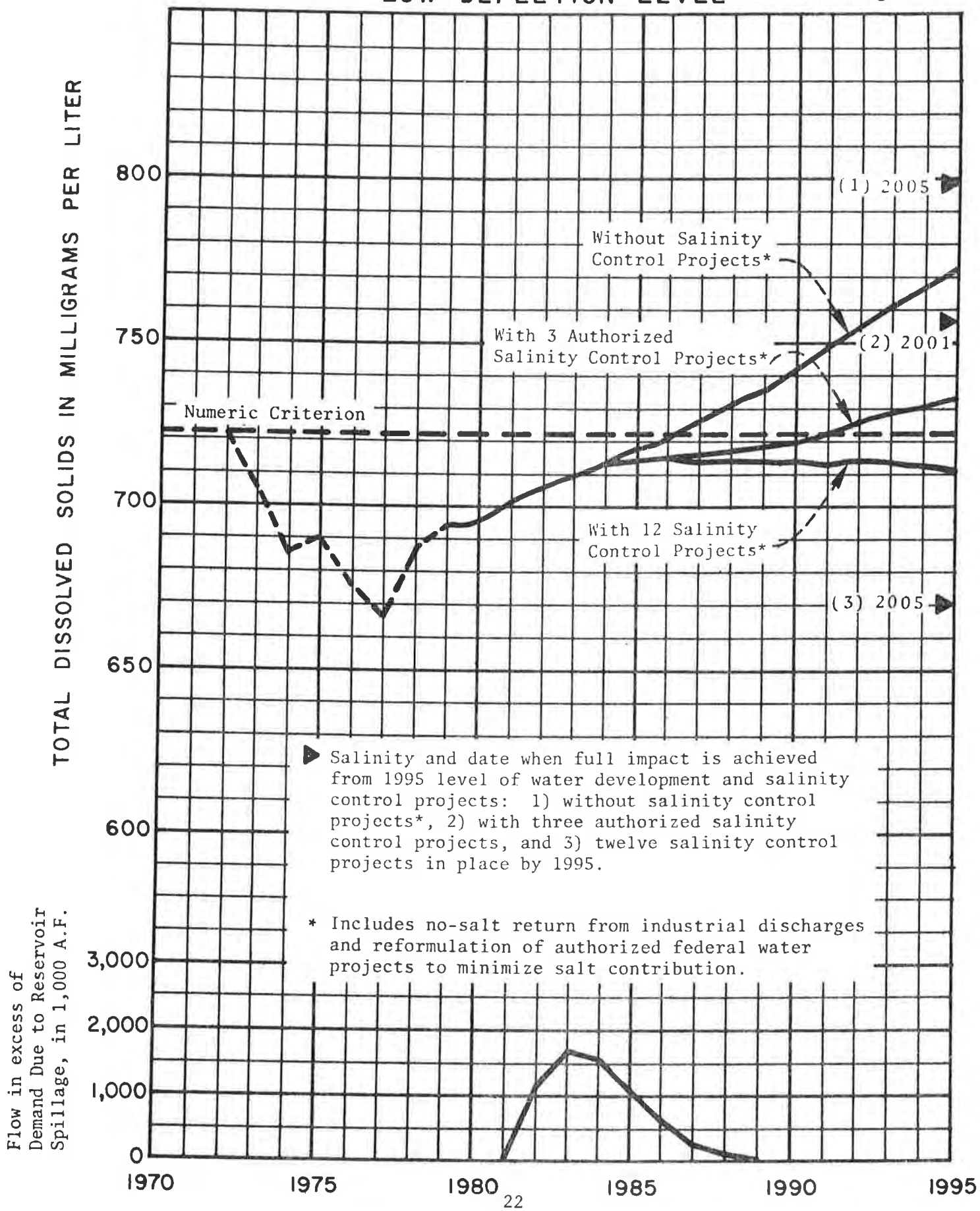
Table 5. - Projected 1995 salinity levels
(mg/L)
Numeric criteria: Hoover Dam 723, Parker Dam 747, Imperial Dam 879

| Average virgin flow (maf) | Location | Without salinity control projects | | | With three authorized salinity control projects | | | With all 14 salinity control projects | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Low depletion | Moderate depletion | High depletion | Low depletion | Moderate depletion | High depletion | Low depletion | Moderate depletion | High depletion |
| 13.0 | Hoover Dam | 801 | 816 | 853 | 757 | 771 | 804 | 730 | 744 | 774 |
| | Parker Dam | 813 | 831 | 872 | 767 | 784 | 821 | 739 | 755 | 788 |
| | Imperial Dam | 992 | 1,018 | 1,070 | 937 | 962 | 1,008 | 904 | 927 | 969 |
| 14.0 | Hoover Dam | 772 | 787 | 818 | 733 | 747 | 776 | 710 | 723 | 751 |
| | Parker Dam | 783 | 800 | 835 | 742 | 758 | 791 | 718 | 734 | 764 |
| | Imperial Dam | 957 | 981 | 1,026 | 907 | 931 | 972 | 878 | 901 | 940 |
| 15.0 | Hoover Dam | 739 | 755 | 788 | 702 | 718 | 750 | 680 | 696 | 727 |
| | Parker Dam | 748 | 767 | 804 | 710 | 728 | 763 | 687 | 705 | 740 |
| | Imperial Dam | 898 | 932 | 988 | 853 | 885 | 939 | 826 | 859 | 911 |

* The Colorado River System is subject to highly variable annual flows which affect the river's salinity. Although reservoir storage tends to dampen the effects of variable flow, it is probable that actual salinity levels will exceed or fall below the values shown on this table even though the conditions upon which the projections are based, such as average virgin flow and future level of development, are met.

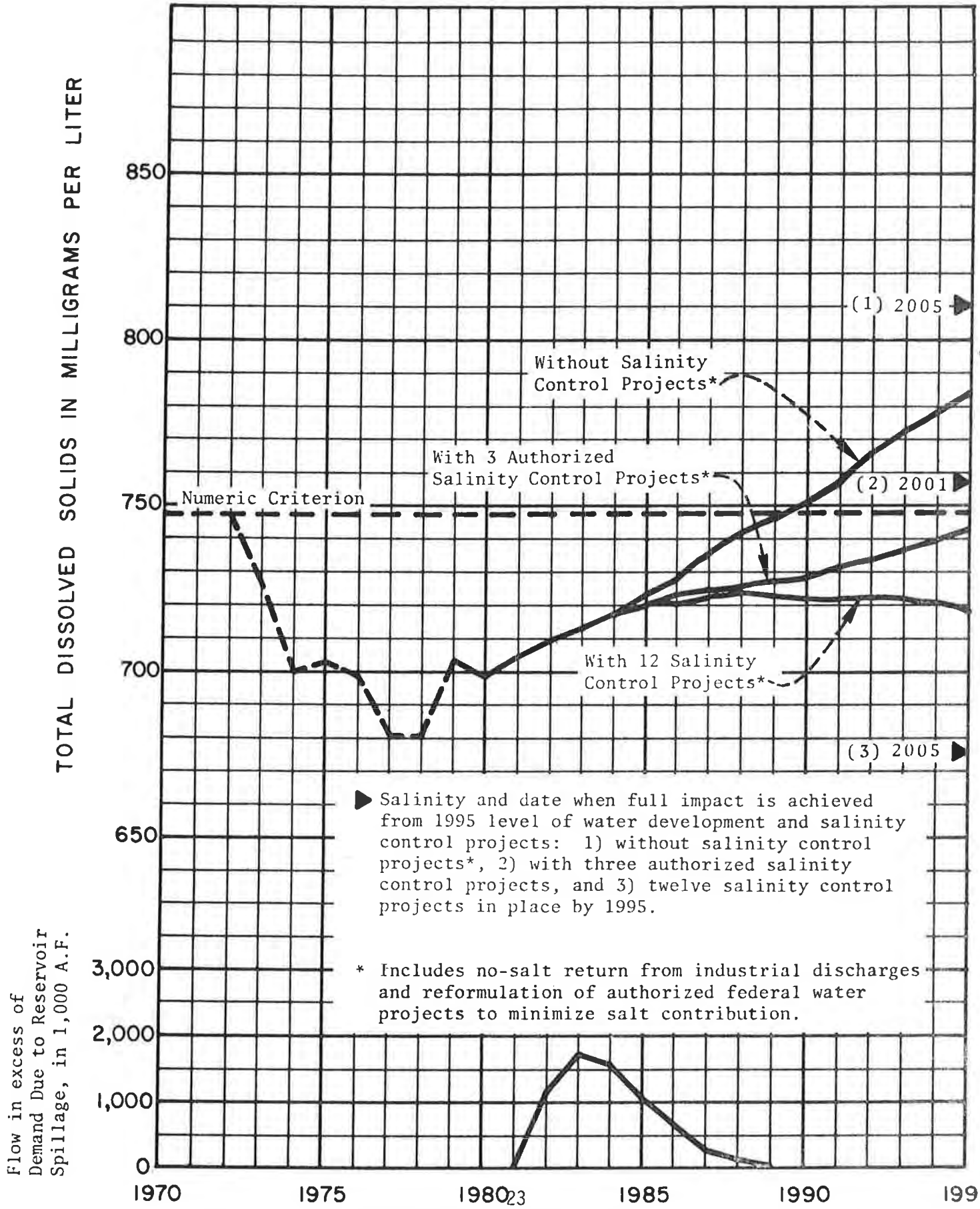
# PROJECTED SALINITY AT HOOVER DAM
## 14.0 MAF/YR VIRGIN FLOW AT LEE FERRY
## LOW DEPLETION LEVEL

Figure 3



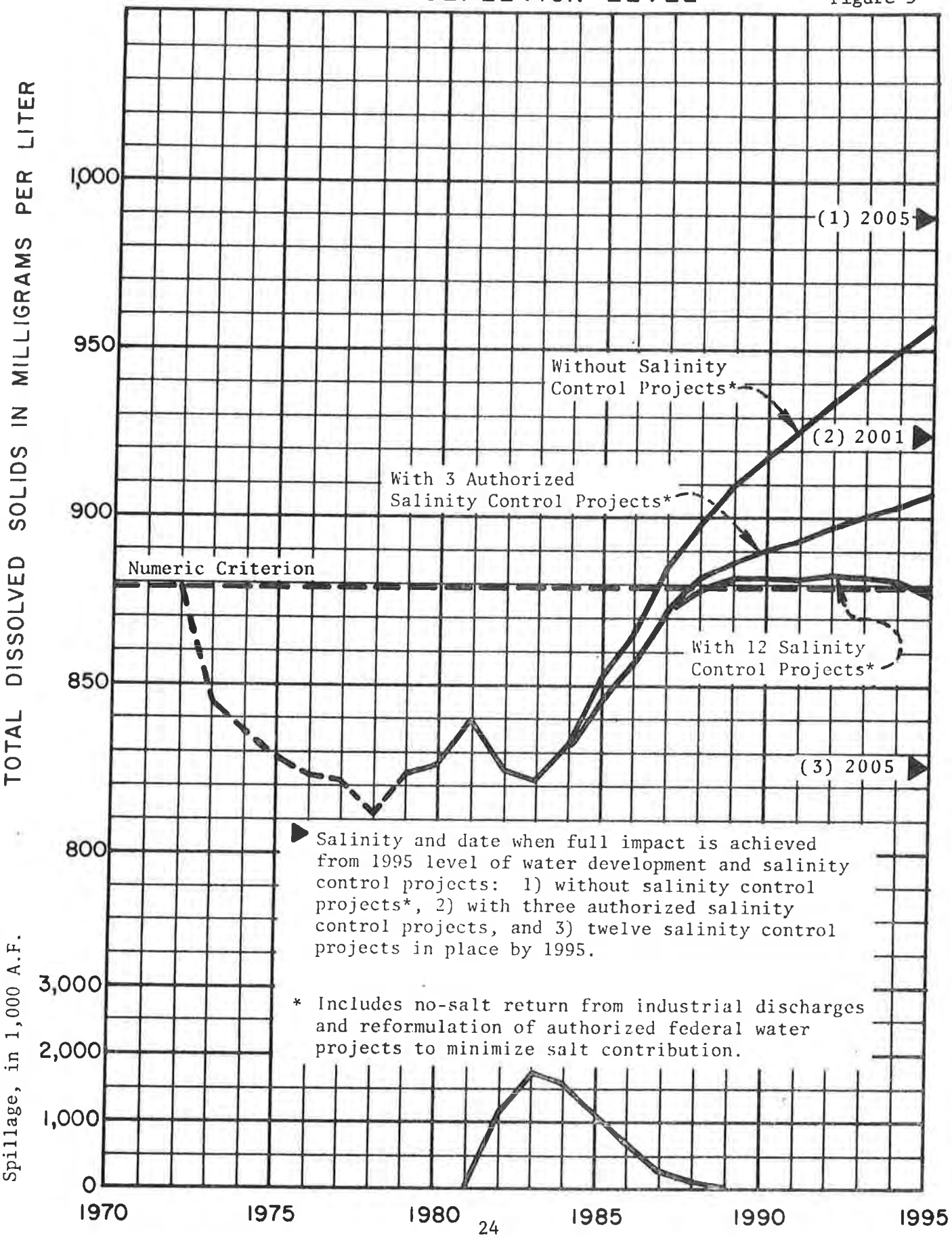
# PROJECTED SALINITY AT PARKER DAM
## 14.0 MAF/YR VIRGIN FLOW AT LEE FERRY
## LOW DEPLETION LEVEL

Figure 4



# PROJECTED SALINITY AT IMPERIAL DAM
## 14.0 MAF/YR VIRGIN FLOW AT LEE FERRY
## LOW DEPLETION LEVEL

Figure 5



maintained at or below the 1972 levels at the following lower main stem stations through 1995 with full implementation of salinity control measures for the following water supply and depletion rates:

Hoover Dam. - Virgin flow at Lee Ferry of 14 million acre-feet per year or more with a low, moderate, and high depletion level.

Parker Dam. - Virgin flow at Lee Ferry of 13 million acre-feet per year with low depletion level and 14 million acre-feet per year with low and moderate depletion levels and 15 million acre feet per year with low, moderate, and high depletion levels.

Imperial Dam. - Virgin flow at Lee Ferry of 14 million acre-feet per year with low depletion level and 15 million acre-feet per year with low and moderate depletion levels.

Due to the dampening effect of reservoir storage, the full impact on salinity of development and of salinity control actions occurring above Hoover Dam is not felt at the lower main stem stations until several years after such actions are implemented. Therefore, because projected depletions and projected salt load reductions by salinity control projects increase throughout the 1980-1995 study period, projected 1995 salinity concentrations do not reflect the full impact on salinity of either the projected future development or of the salinity control projects.

In order to demonstrate whether or not the salinity control projects incorporated into the plan of implementation are sufficient to offset the impact of projected 1995 levels of development, the period used in the salt routing studies was extended beyond the 1980 through 1995 study period to the year 2015. Trial model runs indicated that this extended period was long enough to determine the maximum impact on salinity of 1995 levels of development and the full impact on salinity concentrations of the salinity control

projects. The impact of the salinity control projects was determined by subtracting projected salinity concentrations resulting from model runs which included salinity control projects from projected salinity concentrations resulting from model runs which did not include salinity control projects. The maximum achievable impact of the salinity control projects occurs when the incremental reduction in salinity concentration approached zero.

For the purposes of this study, it was assumed that full impact of the salinity control projects is achieved when the salinity reduction is 95 percent of the maximum achievable reduction. This assumption was made because the incremental annual change after 95 percent of the maximum impact is achieved becomes very small and a relatively long period of time is required to achieve the remaining 5 percent. On the basis of this assumption, full impact of the three authorized salinity control projects occurs in 2001 and of the 12 salinity control projects in 2005.

In extending the salt routing period, depletions were assumed to remain at 1995 levels and no additional salinity control projects were implemented after 1995. Salinity concentrations, when full impact is achieved from 1995 level of water development and salinity control projects, are indicated on Figures 3, 4, and 5.

The results obtained from the extended routing period, 1995 to 2015, indicate that if the 12 salinity control projects, described in Chapter IV, were implemented by 1995, these units would provide more salinity reduction than required to offset salinity increases estimated to be caused by the 1995 low and moderate levels of development with 13 million acre-feet per year virgin flow and low, moderate, and high levels of development with 14 or more million acre-feet per year virgin flow.

## Baseline Values

Baseline values are a relationship between salt load and flow at selected sites. There is no intent to make baseline values standards nor are they to be considered or interpreted as standards for salinity.

The 1975 report called for the development of baseline values for monitoring points on the main stem and major tributaries as part of the process of identifying and evaluating changes in river salinity. The baseline values will be used to assess the effects of development, salinity control measures, and/or other changes in the area upstream from the baseline station. They may be used to adjust the parameters used in the river salt routing models.

Because salinity concentrations at any point are influenced by a number of factors, it has been concluded that baseline values would be best represented by a range of values rather than a single value. This range is represented by a broad band superimposed on a best-fit curve of the relationship between annual salt load and annual flow at a given station. The initial baseline values are based on historical data for the period 1941-1972, adjusted to 1972 levels of development.

If, in the future, the value expressing the relationship between salt load and flow at a selected site falls within the band for that site, it may be assumed that no significant changes in the relationship have taken place. However, if the points continue to fall outside the band without this being the result of known actions, an investigation will be made to determine the cause of the change.

If the investigation reveals that the change is not temporary, a new range of values will be prepared.1/ However, the baseline values based on the 1972 level of development may continue to be used to determine the effects on salinity from activities within the area since 1972. The procedure for preparing the new baseline values will be similar to that used to prepare the initial baseline value.

Salt load/flow relationships have been developed at the following 13 stations in the Colorado River Basin:

Colorado River near Cameo, Colorado
Gunnison River near Grand Junction, Colorado
Colorado River near Cisco, Utah
San Juan River near Archuleta, New Mexico
San Juan River near Bluff, Utah
Colorado River at Lees Ferry, Arizona
Duchesne River near Randlett, Utah
Green River near Green River, Wyoming
Green River at Green River, Utah
San Rafael River near Green River, Utah
Dolores River at Cisco, Utah
White River at Watson, Utah
Virgin River at Littlefield, Arizona

These relationships are based on annual flow and annual salt load for each of the 32 years (1941-1972). Data were obtained from the Bureau and modified to reflect 1972 conditions.

A standard linear regression analysis was run on data from each station. This produced a best-fit straight line relating salt load to flow and a value for the standard deviation of the data. A residual mass curve was plotted and examined visually for consistency of the input data.

A double mass curve was plotted and successive 10-year data periods were compared for statistically significant changes in slope. At the 95 percent confidence level, there were no significant changes in slope.

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1/ Examples of causes of permanent changes in salinity requiring determination of new salinity ranges would be large water using projects or salinity control projects upstream from a monitoring station.

FIGURE 6 a

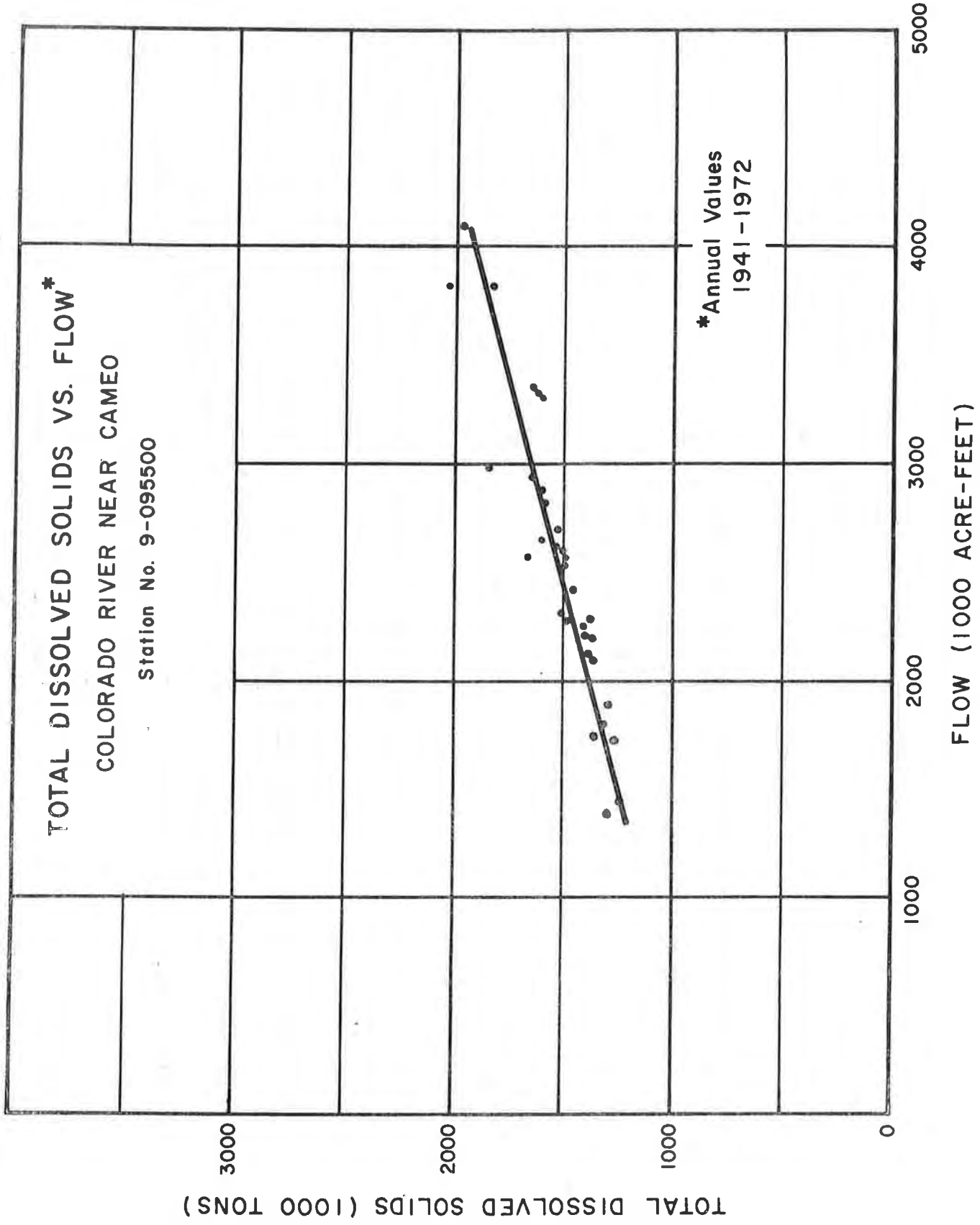
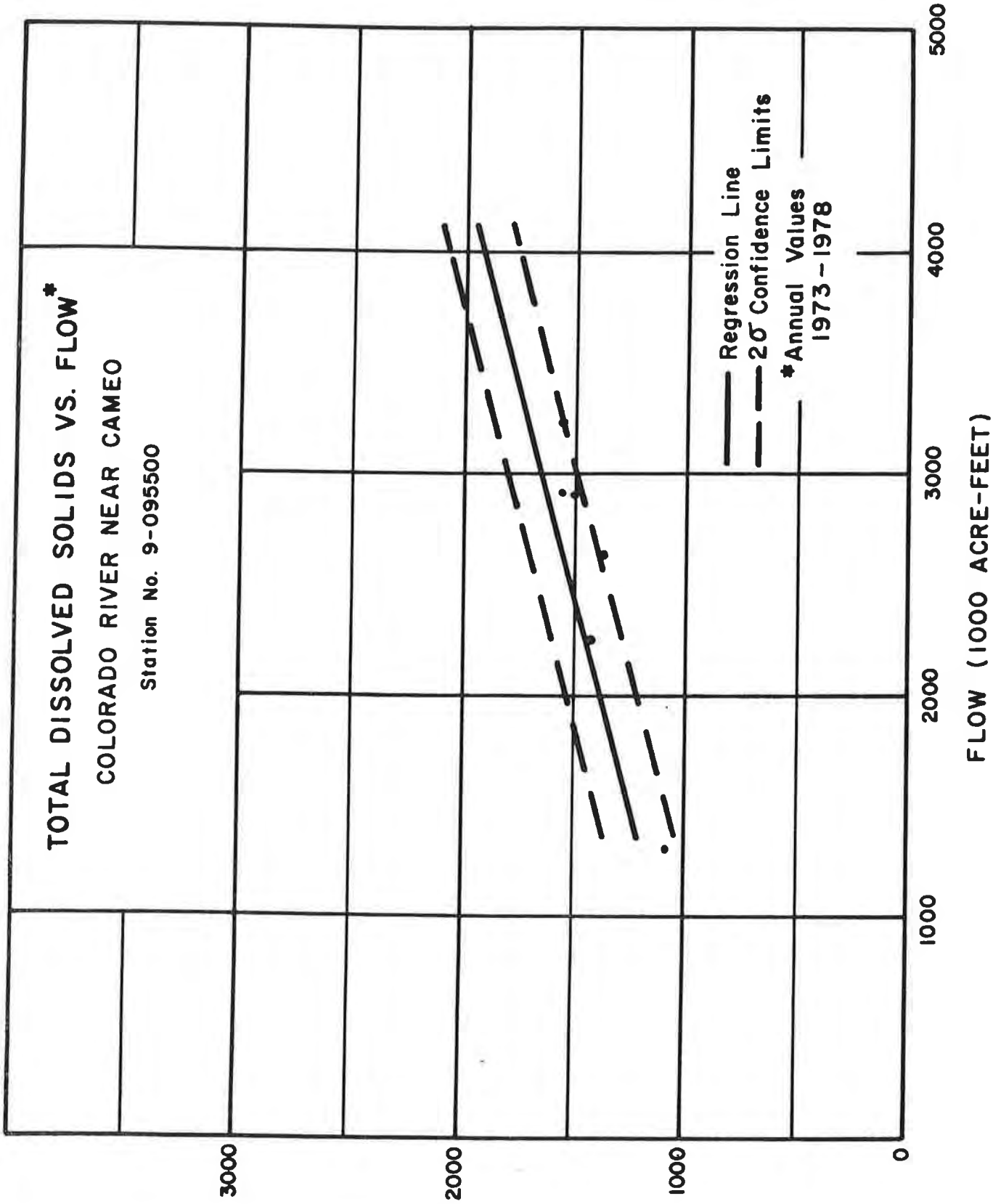

TOTAL DISSOLVED SOLIDS VS. FLOW*
COLORADO RIVER NEAR CAMEO
Station No. 9-095500
*Annual Values
1941-1972
TOTAL DISSOLVED SOLIDS (1000 TONS)
FLOW (1000 ACRE-FEET)
0
1000
2000
3000
1000
2000
3000
4000
5000

FIGURE 6 b


TOTAL DISSOLVED SOLIDS VS. FLOW*
COLORADO RIVER NEAR CAMEO
Station No. 9-095500
Regression Line
20 Confidence Limits
*Annual Values
1973-1978
TOTAL DISSOLVED SOLIDS (1000 TONS)
FLOW (1000 ACRE-FEET)
0
1000
2000
3000
4000
5000

As an example, Figure 6 shows the salt load/flow relationships developed for one of the 13 stations. The (a) figure includes the data points used to develop the relationship, while the (b) figure shows the two-standard deviation band 1/ and additional annual data points collected since 1972. The baseline values are presented in Appendix A.

The two-standard deviation band is obviously very wide. This is because a large part of the variation in salt load cannot be explained by variations in streamflow alone. As yet, there is no practical method of accounting for all factors affecting salinity concentrations.

The Forum adopted the baseline values on September 12, 1980, and transmitted them and the concept to the respective Regional Administrators of the EPA offices covering the Colorado River Basin on September 30, 1980.

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1/ When the aggregated salt load/flow data for a given year results in a data point which falls outside the two-standard deviation band, there is a 95 percent probability that the change did not result by chance.

# CHAPTER III. WATER QUALITY STANDARDS FOR SALINITY

## Criteria

The Forum developed and agreed upon basinwide water quality standards for salinity, including numeric criteria and a plan of implementation for salinity control in 1975 (1975 Forum report). Each of the Basin states adopted the 1975 Forum report as its standards for salinity. The state-adopted water quality standards were subsequently approved by EPA. The 1975 report described the rationale for the selection of the criteria stations.

In response to Section 303(c) of the Clean Water Act, the Forum in 1978 reviewed the standards. The Forum determined that the 1975 criteria were appropriate. The Forum also reviewed and modified the plan of implementation in 1978. Appropriate documents were adopted by the states.

Again, in 1981, the Forum in response to Section 303(c) reviewed the criteria and determined that the 1975 criteria are still appropriate. The numeric criteria are:

| | |
|---|---|
| Below Hoover Dam | 723 mg/L |
| Below Parker Dam | 747 mg/L |
| Imperial Dam | 879 mg/L |

As in 1978, the plan of implementation was reviewed and modified to reflect changes that have occurred since 1978. The plan is described in Chapter IV.

The river system is subject to highly variable annual flow which affects the salinity of the river. Although carryover storage tends to dampen the effects of variable flow in the lower main stem, salinity levels may exceed the numeric criteria in some years and may be below the criteria in others.

The approved standards provide for temporary increases above the 1972 level if salinity control measures are included in the plan. Should water development projects be completed before control measures are brought

on-line, temporary increases above the criteria could result and these increases will be in conformance with the standards, provided that, with completion of salinity control projects, those now in the plan or those to be added subsequently, salinity would return to or below the criteria level.

Increases above the criteria as a result of unfavorable reservoir conditions or periods of below normal annual river flows also will be in conformance with the standards, provided that, with satisfactory reservoir conditions and when river flows return to normal, concentrations are expected to be at or below the criteria level.

## Uses

The Colorado River, from its headwaters in the Rocky Mountains to its mouth in the Gulf of California, is extensively used for a wide variety of uses. A portion of the flows is transported out of the Colorado Basin for use in adjacent river basins. The major uses in the Colorado River Basin are irrigation, municipal and industrial, powerplant cooling, fish and wildlife, and recreation.

Each state under its laws and regulations has defined the beneficial uses of the waters of the Colorado River within its boundaries.

## Salinity Monitoring Points

The salinity control program includes a water quality monitoring and analysis program that will provide information on a basinwide basis for plan evaluation. This system is essential to establish a data base for future studies, support state and regional planning activities, and evaluate the effectiveness of salinity control measures. The monitoring points are not locations at which numeric criteria are now set or contemplated, except for those located below Hoover and Parker Dams and at Imperial Dam.

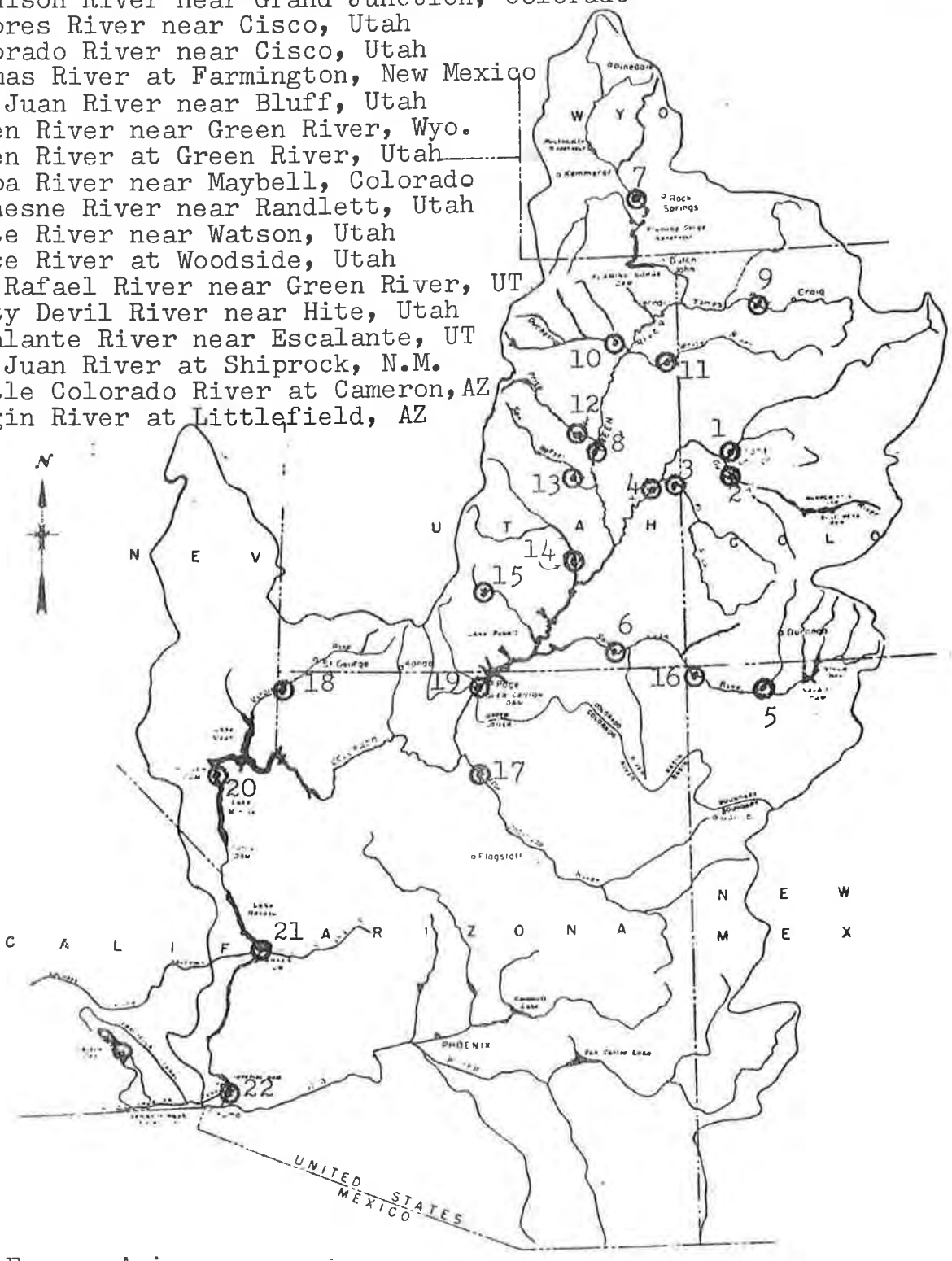
Salinity monitoring is being conducted by the USGS and at the stations listed and shown on Figure 7. Measurements are made on a periodic, rather than a continuous, basis because reliable equipment for continuous measurement has generally not been available.

In addition to cooperative programs with the USGS, some states maintain individual networks of salinity monitoring stations. As an example, the Utah Bureau of Water Pollution Control monitors 28 sites in the Colorado River Basin. These sites are sampled bimonthly and samples are analyzed for chemical constituents, nutrients, 5-day biochemical oxygen demand, suspended solids, dissolved solids, and coliform. In addition to routine samples collected at these stations, continuous recordings of temperature and specific conductivity are taken at four stations.

In general, there has not been a sufficient accumulation of data nor have water-related activities changed to the extent that the adequacy of the monitoring system can be determined.

FIGURE 7

1. Colorado River near Cameo, Colorado
2. Gunnison River near Grand Junction, Colorado
3. Dolores River near Cisco, Utah
4. Colorado River near Cisco, Utah
5. Animas River at Farmington, New Mexico
6. San Juan River near Bluff, Utah
7. Green River near Green River, Wyo.
8. Green River at Green River, Utah
9. Yampa River near Maybell, Colorado
10. Duchesne River near Randlett, Utah
11. White River near Watson, Utah
12. Price River at Woodside, Utah
13. San Rafael River near Green River, UT
14. Dirty Devil River near Hite, Utah
15. Escalante River near Escalante, UT
16. San Juan River at Shiprock, N.M.
17. Little Colorado River at Cameron, AZ
18. Virgin River at Littlefield, AZ




19. Lees Ferry, Arizona
20. Below Hoover Dam, Arizona-Nevada
21. Below Parker Dam, Arizona-California
22. Imperial Dam, Arizona-California

MONITORING POINTS

## CHAPTER IV. PLAN OF IMPLEMENTATION

The plan of implementation is designed to maintain the salinity concentration of the river below numeric criteria principally by reducing the salt contribution to the river from existing sources and minimizing future increases in salt load by the most cost-effective means at a rate commensurate with the expected increase in future Basin water use after consideration of environmental and social aspects. It also includes measures that water users have adopted or will adopt to cope with the use of relatively saline water, such as water softening and treatment and installation of tile drains in agricultural areas.

The principal components of the plan are listed below:

1. Prompt completion of construction now underway and operation of two salinity control units authorized by Section 202, Title II of Public Law 93-320, namely the Paradox Valley and Grand Valley Units.

2. Expeditious authorization and construction of 10 units listed in Section 203(a)(1), Title II of Public Law 93-320, and the Meeker Dome Unit, or their equivalents after receipt of favorable planning reports.

3. Expeditious implementation by the Department of Agriculture of onfarm and lateral improvement measures in cost-effective salinity control units.

4. Implementation of salinity control measures by the Bureau of Land Management to reduce salt contribution from public domain lands.

5. The placing of effluent limitations, principally under the National Pollutant Discharge Elimination System (NPDES) permit program provided for in Section 402 of the Clean Water Act of 1977, on

industrial and municipal discharges based on the Forum's 1977 policy on salinity control through NPDES permits.

6. Implementation of the Forum-recommended policy for use of brackish and/or saline waters for industrial purposes.
7. Inclusion of the 208 Water Quality Management Plans. Individually, the Basin states have developed water quality management plans to conform to the requirements of Section 208 of the Clean Water Act. The water quality management planning process is continuing. As the plans are refined or new elements added and after such changes have been appropriately adopted by the states and approved by EPA, those portions dealing with salinity control will be a part of the implementation plan.

The plan also contemplates programs by water users to cope with higher salinity water, improvements in irrigation systems and irrigation management to reduce salt pickup, studies of means to minimize salinity in municipal discharges, and studies of future possible salinity control programs.

## Federal Programs

In the authorizing legislation for the Colorado River Storage Project (Public Law 84-485), the San Juan-Chama and Navajo Indian Irrigation Projects (Public Law 87-483) and the Fryingpan-Arkansas Project (Public Law 87-590), Congress directed the Secretary of the Interior to study the quality of water of the Colorado River system and to investigate all possible means of improving the quality of such waters. The Bureau has published 10 reports on a biennial basis which summarize the existing water quality conditions in the Basin and include projections of future conditions.

The Bureau should include in its future biennial reports a discussion of the Forum's activities related to projected future water use and salinity concentrations and a comparison of and reason for any differences.

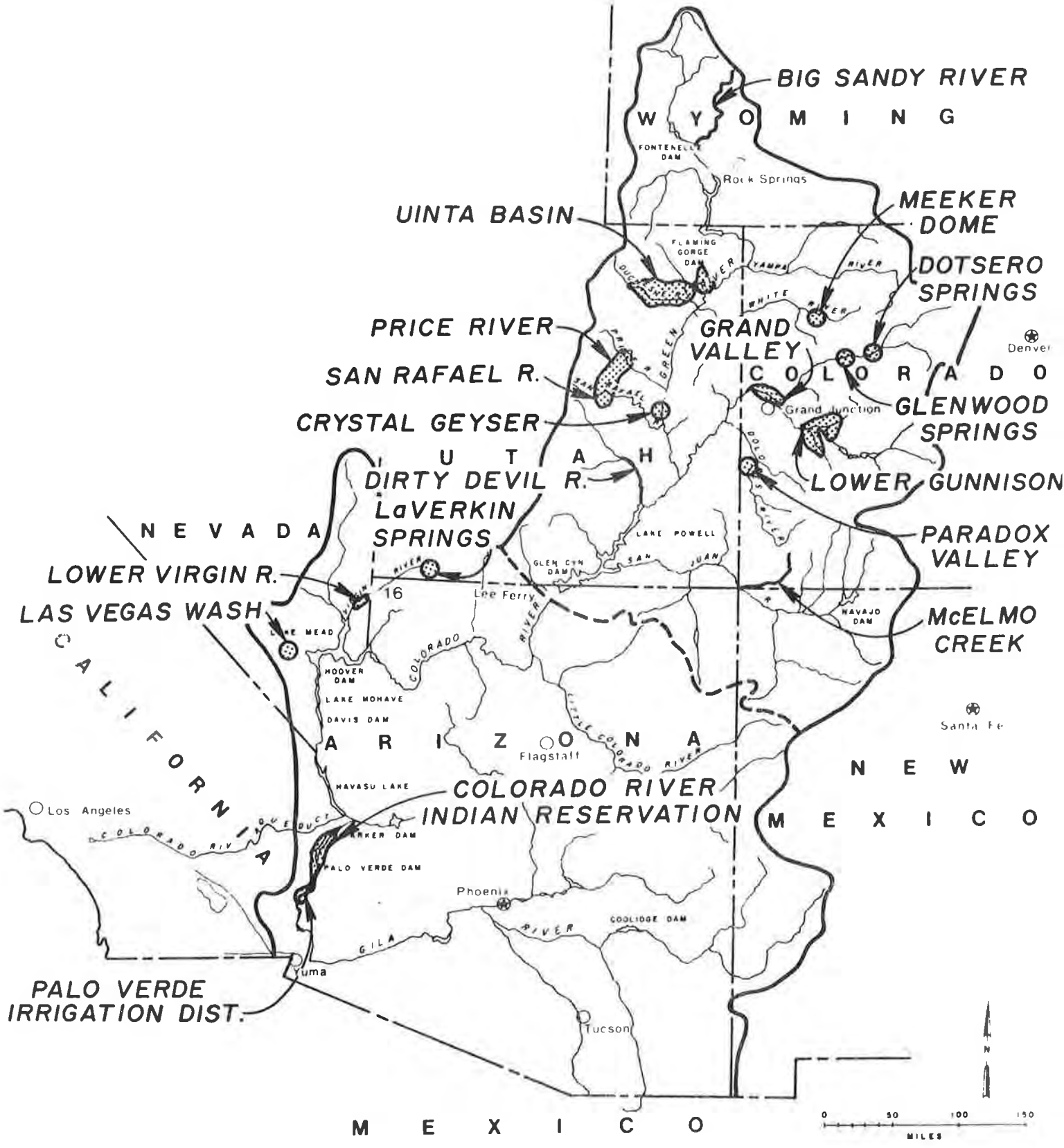
The comprehensive Colorado River Water Quality Improvement Program (CRWQIP) was initiated in 1971 based on the authorization contained in these acts. The intent of the program is to evaluate the means by which salinity control goals can be most efficiently attained from the standpoint of cost effectiveness and time.

Public Law 93-320, Title II, directed the Secretary of the Interior, by reference to the recommendations of the Seventh Session of the Conference in the Matter of Pollution of the Interstate Waters of the Colorado River and Its Tributaries (1972), to expedite the investigation, planning, and implementation of the salinity control program defined by the CRWQIP. The location of the salinity control program units is shown on Figure 8. The Act established the program objective of treating salinity as a Basinwide problem to be solved in order to maintain salinity concentrations at or below 1972 levels in the lower main stem of the river while the Basin states continue to develop their compact-apportioned waters. Specifically, the Act authorized the construction, operation, and maintenance of four salinity control projects: the Paradox Valley Unit, the Grand Valley Unit, the Las Vegas Wash Unit, and the Crystal Geyser Unit and the expeditious completion of planning reports on 12 other projects listed below:

Irrigation Source Control

Lower Gunnison Basin Unit
Uinta Basin Unit
Colorado River Indian Reservation Unit (deferred)
Palo Verde Irrigation District Unit

# LOCATION OF PROPOSED SALINITY CONTROL PROJECTS - COLORADO RIVER BASIN



Point Source Control

LaVerkin Springs Unit
Lower Virgin River Unit (replaces Littlefield Springs Unit)
Glenwood-Dotsero Unit

Diffuse Source Control

Price River Unit
San Rafael River Unit
Dirty Devil River Unit
McElmo Creek Unit
Big Sandy River Unit

The Secretary of the Interior, Secretary of Agriculture, and Administrator of the Environmental Protection Agency were directed to cooperate and coordinate their activities to meet the program objective.

The U.S. Department of Agriculture (USDA) is actively involved in the planning process on those units having an irrigation source control component and has initiated implementation of onfarm salinity control activities in the Grand Valley, Colorado, and the Uinta Basin, Utah. The Bureau of Land Management is involved in the study of diffuse sources from public domain lands in the watershed.

In October 1980, Congress passed Public Law 96-375, which authorized the Secretary of the Interior to engage in feasibility level studies of 10 units:

Lower Gunnison Basin Unit
Glenwood-Dotsero Springs Unit
Meeker Dome Unit
McElmo Creek Unit
Uinta Basin Unit
Dirty Devil River Unit
Price-San Rafael Rivers Unit
LaVerkin Springs Unit
Lower Virgin River Unit
Big Sandy River Unit

It should be recognized that some of the salinity control units now under study by the Bureau may not prove to be cost-effective and other projects and/or salinity control measures will have to be developed in order

to maintain the numeric criteria while the Basin states continue to develop their compact-apportioned waters. Two projects, Crystal Geyser Unit, Utah, and Colorado River Indian Reservation, Arizona, have been indefinitely postponed because of poor cost effectiveness.

The onfarm salinity control measures being planned and implemented by the USDA appear to be among the most cost-effective measures for salinity reduction. The Forum is encouraging implementation of these measures as rapidly as possible. Further, the Forum encourages the use of brackish and/or saline waters for industrial purposes as an additional measure of reducing salt contribution to the river system.

Status of Colorado River Basin Salinity Control Project - Title II, Public Law 93-320 - U.S. Bureau of Reclamation

Paradox Valley Unit. - The Paradox Valley is a collapsed salt anticline in southwestern Colorado. Several brine seeps enter the Dolores River along a 1.2-mile reach within the valley. The brine is highly concentrated (260,000 mg/L) and contributes about 205,000 tons of salt to the river system each year.

The proposal for salinity control involves lowering the freshwater-brine interface below the river channel by ground water pumping. The brine would be pumped to a nearby hydrogen sulfide stripping plant, treated, and pumped to the proposed Radium evaporation pond. A second alternative for disposal would be deep well injection in Paradox Valley. About 180,000 tons of salt would be removed annually by this project.

The original plan assumed a pumping rate of 5 $ft^3/s$; however, testing of the well field indicates a lower pumping rate in the range of 1.0 to 2.0 $ft^3/s$ is adequate for brine control. Brine extraction in this lower range makes deep well injection a viable alternative.

Construction of the well field began in 1979. The well field pump tests confirm that salt pickup by Dolores River is significantly reduced compared to past years. The Definite Plan Report (DPR) was issued in January 1979.

At the request of principally the EPA, the Bureau is investigating the feasibility of brine disposal by deep well injection. A deep well injection study using a professional services contract has been completed and an injection test well will be constructed beginning in early 1982. A meeting was held with representatives of the Bureau and EPA in August 1980 to discuss the impacts of new regulations dealing with Underground Injection Control (UIC) and Hazardous Wastes Program. The Bureau has the responsibility for determining if brine is a hazardous waste at this site.

Grand Valley Unit. - Grand Valley Unit plans call for increasing the efficiency of irrigation in the Grand Valley area of western Colorado by improving distribution systems and water management techniques.

Approximately 70,000 acres are irrigated in the area, mostly from unlined canals and laterals. The Grand Valley area contributes between 650,000 and 850,000 tons of salt per year to the Colorado River. These salts are derived from deep percolation and irrigation system seepage coming in contact with the weathered marine shales underlying the region. Water and salt budgets indicate that this project, including the USDA onfarm salinity control measures, can prevent 410,000 tons of salt from entering the river system.

Stage I covers approximately 10 percent of the unit area and is designed to provide information to analyze the effectiveness of the proposed plan. The DPR for Stage I was published in March 1980. The operation and maintenance contract for the Stage I area between the United States and Grand Valley Water Users Association was signed March 11, 1980. A contract for

construction of the field station was awarded July 8, 1980, to Leon Parkerson for $363,000 and scheduled for completion in July 1981. The field station would be used as construction headquarters and permanent operating facilities for the entire unit.

A $7.4 million contract for lining the 6.8-mile section of the Government Highline Canal was awarded to Peter Kiewit Sons, Inc., on August 6, 1980. Although the contract called for completion by August 1983, the contractor completed lining the canal in March 1981 and the remaining structures are expected to be completed in July 1981.

On August 4, 1980, the Acting Assistant Secretary for Land and Water transmitted a letter to Congress informing them of the Department's intent to use pipe laterals in the Stage I area unless directed otherwise by Congress. Since that proposal has been sustained, the Bureau is preparing final specifications with the objective of awarding a contract in 1981. Construction of the pipe laterals is expected to take about 2 years.

Planning for Stage II is being initiated which includes the monitoring of Stage I canal lining results, possible early canal construction in the area west of Stage I, and evaluating the cost effectiveness of alternative canal and lateral configurations for the remainder of the valley.

Las Vegas Wash Unit. - The Las Vegas Wash is a natural drainage channel which traverses the Las Vegas Valley, Nevada. The lower portion is now a perennial stream as a result of secondary wastewater effluent and groundwater discharges. Flow in the Wash has increased steadily in recent years due primarily to increased sewage discharges resulting from a rapidly growing population. The average discharge carries approximately 208,000 tons of dissolved solids annually.

A DPR was drafted in 1977. Due to EPA enforcement efforts, highly saline industrial flows began to be disposed of in lined ponds, instead of the unlined ponds, and the saline ground water mounds began dissipating more rapidly than expected. Consequently, the construction of the unit was delayed until further study was completed.

Recently completed activities include drilling and testing several shallow and deep ground water wells to verify water movement assumptions and refine water and salt movement budgets. Analysis of the data shows two mechanisms are causing the salt loading in the Wash: physical contact between wastewater and salt-bearing soils and saline ground water movement in the lower wash being caused by increased freshwater infiltration.

An agreement with Basic Management, Inc., has been reached for leasing a 20-acre site to be used for evaporation pond research. The possible inclusion of solar gradient salt ponds at the site is also being considered. A contract award is pending for the construction of these facilities.

A comprehensive planning program is underway including participation by state and local entities for both salinity control and wastewater management. The objective is to have a joint multipurpose recommended plan completed by the end of 1981.

Colorado River Water Quality Improvement Program. - In addition to the investigation of specific salinity control projects named in Section 203 of Public Law 93-320, the CRWQIP includes supporting studies of economic evaluation of salinity damages, return flow and hydrologic modeling, and research into salinity control techniques. The investigations of the individual units are at a feasibility level and are discussed below in the expected order in which the feasibility reports are scheduled for completion. Subsequent to the passage of Public Law 93-320, the Meeker Dome Unit was added to the

program and is also discussed below. An appraisal level study is also included - Saline Water Use and Disposal Opportunities. In October 1980, Congress passed Public Law 96-375 which authorizes feasibility level studies on 10 salinity control units. See Appendix C for Public Law 96-375.

Lower Virgin River Unit. - This project is located in southeast Nevada and northwest Arizona and includes both the natural saline springs near Littlefield, Arizona, and the irrigated areas along the Virgin River between the springs and Lake Mead. The salinity control potential could be as much as 80,000 tons per year.

The surface and subsurface flows along the river and under flood plain lands are being analyzed to determine the amount of salt that reaches the river system and its source. A contract with Desert Research Institute (DRI) has been extended to conduct a water and salt balance study of the unit.

Present information does not appear to justify a water quality improvement project. The DRI study is scheduled for completion in July 1981 which will enable the Bureau to complete studies by the end of 1981.

Lower Gunnison Basin Unit. - The Lower Gunnison Basin Unit encompasses those irrigated areas on the Uncompaghre River and the North Fork of the Gunnison River. There are approximately 160,000 acres of irrigated land included in the study area, contributing an estimated 1,100,000 tons of salt annually. The Stage I study area is the Uncompahgre Valley and the Stage II Study area is to be centered around the community of Hotchkiss.

It is estimated that with an improved distribution system and improved onfarm water management the salt loading from the area could be reduced by about 300,000 tons per year.

The recommended plan for reducing salt contribution was adopted following extensive public involvement and technical and economic analyses. The

plan, consisting of lining about half of the existing unlined canals and laterals, could eliminate approximately 80 percent of seepage-related salt loading.

The feasibility design and estimates are being prepared and the appendices to the feasibility report are being drafted. The Regional Director's proposed report and draft environmental statement are scheduled in late calendar year 1981, and the Commissioner's report for seeking authorization is due in early 1983.

Uinta Basin Unit. - The Uinta Basin contributes about 450,000 tons of salt annually to the Colorado River system through the Duchesne and Green Rivers in northeastern Utah. Return flows from 170,000 acres of irrigated land account for much of the salt contribution.

By improving distribution systems, onfarm facilities, and water management techniques, an annual reduction of 100,000 tons in salt loading appears possible. Water and salt budgets have been completed and a public involvement program to help identify a recommended plan is now underway. The Regional Director's proposed feasibility report and draft environmental statement are scheduled for early 1983.

McElmo Creek Unit. - McElmo Creek drains 350 square miles in southwestern Colorado including the Montezuma Valley where over 40,000 acres are irrigated. The creek carries an average annual salt load of 115,000 tons, most of which comes from irrigation return flows and a lesser amount from natural runoff. In the past, McElmo Creek has been considered a diffuse source unit; however, recent studies have shown that the salt loading is coming principally from irrigation sources.

Increased irrigation efficiency in the Montezuma Valley and improved conveyance facilities appear to be a viable means of decreasing salt load.

Another alternative would be selective withdrawal of saline lands from service. This would require the agreement of the irrigators in the area. A combination of alternatives could be used, including the potential to use the saline waters for industrial purposes.

An extensive data collection program is continuing to identify as accurately as possible the source of the salt loading. The studies have not progressed far enough to determine a recommended plan. Ponding and desalting alternatives are not being considered due to the high cost and poor public acceptance. Public involvement programs are continuing.

Meeker Dome Unit. - An oil exploration well was drilled into the localized anticlinal structure known as the Meeker Dome in 1915. The well is located near the bank of the White River, 3 miles east of Meeker, Colorado. The well tapped a supply of warm, salty water (19,000 mg/L) and increased the Colorado River's salt load by about 57,000 tons per year. As a result of the well discharge, many natural springs in the area dried up. The well was flowing at a rate of 3 $ft^3/s$ in 1968 when it was plugged by the Bureau. After plugging, all discernible flow from the well stopped; however, several other wells and seeps in the area began discharging after a few months.

Planning investigations are being conducted through a professional services contract with CH2M Hill of Denver, Colorado, administered by the Bureau. CH2M Hill and their subcontractors have reopened and plugged three abandoned oil wells. These wells are believed to be the primary source of saline water. Results of plugging these wells will be used to verify the hypothesis that the wells act as saline water conduits. The State of Colorado has been most helpful in expediting consideration and processing of permits needed for the Meeker Dome verification effort.

Glenwood-Dotsero Springs Unit. - The largest point source of salinity in the Upper Basin is a series of thermal springs located along a reach of the Colorado River between the Eagle River and the Roaring Fork River near Glenwood Springs, Colorado. Approximately 500,000 tons of dissolved solids are added to this reach annually, about half of which comes from 18 springs.

If the flow of these surface springs was collected and disposed of, the salt load of the river would be reduced by about 250,000 tons per year. Interception of the springs in the bed of the river, if feasible, may allow additional salinity control.

The Colorado Geological Survey, in conjunction with the Department of Energy and the Colorado Department of Highways, is making geothermal investigations of the area. The data obtained will be made available to the Bureau to aid in developing a salinity control strategy.

A $1.0 million contract for performing feasibility investigations was awarded to URS Corporation of Denver, Colorado, in September 1980 to evaluate the various alternatives. The Bureau has formed the planning team which is developing alternatives and conducting the public involvement program.

Big Sandy River Unit. - Approximately 180,000 tons of salt are contributed annually to the Big Sandy River from natural seeps, flowing wells, and irrigation return flows. Most of the salt load enters through seeps in a 15-mile reach of the river west of Eden, Wyoming. Salinity of the seeps varies from 3,000 to 5,500 mg/L with a total annual contribution of over 110,000 tons of salt to the river. Salinity control measures are estimated to remove about 80,000 tons of salt annually.

A professional services contract to complete feasibility investigations on the unit is being awarded. The feasibility study includes the potential for industrial use of the saline water as well as other possibilities.

Price-San Rafael Rivers Unit. - The Price and San Rafael Rivers originate in the mountains of the Wasatch Plateau and provide tributary flows to the Green River in east-central Utah. The combined salt output of the two rivers is about 430,000 tons per year.

Investigations, currently at a data gathering stage, will examine a combination of irrigation improvements, vegetation and watershed management, and selective withdrawal of poor quality stream flow for the most cost-effective control project. The tentative plan is to selectively remove the higher concentrated flows and evaporate or desalt them or make them available for energy-related industrial uses.

Control programs could remove an estimated 100,000 tons of salt from the Price River and 80,000 tons from the San Rafael River.

A contract will be awarded to determine sources of salt loading and evaluate the feasibility of alternatives for salinity control.

Dirty Devil River Unit. - The Dirty Devil drainage area originates in the mountains of Wasatch, Fishlake, Awapa, and Aquarius Plateaus of Utah and discharges into the Colorado River at the upper end of Lake Powell. The estimated total dissolved solids contributed by the Dirty Devil River is 200,000 tons annually. The estimated annual removal of salt by a potential salinity control program might be as much as 80,000 tons annually.

Current data collection is locating areas of salt loading. Additional studies will be made to determine the cause of salt loading and possible alternatives to decrease the salt loading.

LaVerkin Springs Unit. - The LaVerkin Springs are located in a canyon reach of the Virgin River in southwest Utah. These springs discharge about 109,000 tons of salt annually. A feasibility study shows 103,000 tons of this salt could be removed.

The Bureau developed an alternative plan which called for the construction of a diversion dam upstream from the springs to divert normal river flows around the springs. A control dam located just below the springs would form a pool from which flows would be pumped to the proposed LaVerkin Desalting Plant. The desalted water would be returned to the Virgin River and brine would be pumped to an evaporation pond formed by diking a natural depression about 3-1/2 miles away. Cost effectiveness of this plan is not encouraging.

A deep well injection Phase I study was completed in mid-1980 by contractor Jordan/Avent, Inc. The report indicates that the limestone formation would take the type and amount of brine from a LaVerkin Springs Desalting Plant but it is uncertain whether the brine would travel through the fractured formations and possibly reemerge in the river system.

It now appears that even if brine injection were followed, the project would have a poor cost effectiveness. Consequently, other alternatives are being considered including use of the spring flow for powerplant cooling and disposal of the spring flow in a dry lakebed. Water rights or a substitute water supply would be needed to replace water removed from the river system.

A status report was issued in December 1979. Further work on the unit is being deferred pending completion of the Saline Water Use and Disposal Opportunities study.

Saline Water Use and Disposal Opportunities. - The Bureau is studying alternatives to current methods of onsite brine disposal. The appraisal study has two thrusts: one is the investigation of using saline water for energy development, and second is the feasibility of a pipeline collection and disposal system for saline water and other collected wastewaters, such as wastewater from powerplants and oil shale development.

About 582,000 acre-feet per year of saline water containing 2.5 million tons of salt could be collected for disposal or for use in energy development, such as for cooling coal-fired powerplants and for use in slurry lines which transport coal. Of special concern in this study are legal and institutional, environmental, and cost-sharing issues. Public involvement activities are being conducted throughout the study.

Water Quality Improvement Program
Estimated Completion - Regional Director's Draft Feasibility Reports

| Unit | March 6, 1979 schedule | Revisions October 1980 |
|---|---|---|
| Lower Virgin River | 10-81 | |
| Lower Gunnison | 12-81 | |
| Uinta Basin | 3-83 | |
| McElmo Creek | 9-83 | |
| Meeker Dome | 2-83 | 1-84 |
| Glenwood-Dotsero Springs | 5-84 | |
| Big Sandy River | 5-84 | |
| Price-San Rafael Rivers | 3-86 | |
| Dirty Devil River | 2-87 | |
| LaVerkin Springs Status Report Unit deferred pending special studies | | 12-79 issued |
| Saline Water Use and Disposal Opportunities - Appraisal | | 7-81 |

U.S. Department of Agriculture

Average onfarm irrigation and distribution system efficiencies, especially in the Upper Basin, are generally low. Low irrigation efficiencies generally indicate high surface runoff and/or overirrigation. Overirrigation can result in excessive deep percolation. This greatly contributes to the salinity problem. Irrigation contributes some 37 percent of the total salt load to the river in the Upper Basin. There are approximately 1 million acres of irrigation in 17 selected salt source units in the Upper Basin. It is estimated that onfarm salinity control measures in at least seven of these units (600,000 acres) may be cost effective.

In response to Public Law 93-320, USDA uses its ongoing programs to study and provide implementation assistance on needed salinity control measures. Presently, the Soil Conservation Service (SCS) is using River Basin funds for surveys, investigations, and the resulting study reports, while Conservation Operations-Technical Assistance funds are used for implementation and technical assistance. The latter are supplemented with a 5 percent transfer of Agricultural Stabilization and Conservation Service's (ASCS) Agricultural Conservation Program (ACP) funds. ASCS is using ACP funds for cost-sharing salinity control measures. The Agricultural Research Service (ARS) and Extension Service (ES) are providing funds from their appropriations for research, demonstration, information, and education. The Farmers Home Administration (FMHA) is providing loan assistance for landowner's non-federal share of improvements.

USDA, in cooperation with concerned state agencies and other federal agencies, has completed studies in three irrigated salt source units. These are the Grand Valley Unit, Colorado, the Uintah Basin Unit, Utah, and the Big Sandy Unit, Wyoming. Studies in three additional irrigated units are nearing completion. These are the Lower Gunnison and McElmo Units, Colorado, and the Virgin River Unit, Nevada, Utah, and Arizona.

Grand Valley Unit. - The USDA report for Grand Valley was completed in December 1977 and entitled "Onfarm Program for Salinity Control." This report was supplemented in March 1980 to cover the lateral improvements needed to support the onfarm system measures.

The total Grand Valley treatment program, both onfarm systems and off-farm laterals, is estimated to have a total construction cost of $38,088,000 including $10,900,000 for some 190 miles of off-farm lateral

improvements (October 1979 prices). These salinity control measures are very cost effective.

Initial USDA implementation funding was provided by the Agricultural Appropriations Act, Public Law 95-448 (October 11, 1978). The Conference Report recommended that ASCS use $1,772,000 of FY 1979 ACP funds to cost share the installation of salinity control practices in Grand Valley. The Conference Report also recommended that SCS use $170,000 of its Conservation Operation funds to provide the technical assistance for planning, designing, and installing the practices needed for salinity control.

For FY 1980 the Conference Report recommended that $1.7 million of ACP funds be used for cost sharing in Grand Valley. For FY 1981, the Conference Report recommended that $2.0 million of ACP funds be made available.

SCS provided conservation technical assistance to a total of 380 farmers in Grand Valley during FY 1980, which include carrying out irrigation water management planning on 3,329 acres. Some 140 farmers completed one or more practices during 1980. Planning has been initiated on five wildlife mitigation practices that include ponds, tree plantings, food plots, fencing, and grass seeding.

The major practices installed and cost shared to October 1980 are as follows:

| Item | Total |
|---|---|
| Pipeline lateral (lin ft) | 138,036 |
| Concrete lateral (lin ft) | 57,813 |
| Lined ported ditch (lin ft) | 33,873 |
| Gated pipeline (lin ft) | 56,107 |
| Land leveling (acres) | 881 |
| Drip/sprinkler system (number) | 6 |
| Structures (number) | 242 |

ARS initiated a monitoring program to study the effects of onfarm irrigation improvements. The initial monitoring report is due in 1981. Work is proceeding on development of a long-range onfarm monitoring program.

Studies have been made on the practicality of level basin irrigation in the Grand Valley for the past 4 years. Gross irrigation water applications are approximately 50 percent of those used on the traditional graded surface irrigation systems in the valley. Surface runoff is completely eliminated and uniformity of water distribution is increased. As a result of the encouraging production on the small experimental basins, three new level basins were completed in the spring of 1980. These basins are each approximately 4.5 acres in area, a size that could be practical for many farms. Because of the encouraging research results, several small level basins, about 12 acres total, have been installed by a group of private irrigators with assistance from USDA's onfarm improvement program.

Uinta Basin Unit. - The USDA onfarm salinity control report was completed in January 1979. An addendum was issued in November 1980. A supplement to the existing program Environmental Impact Statement (EIS), originally issued by Bureau/SCS in May 1977, is being prepared. A supplemental study of lateral improvements needed to support the onfarm measures is scheduled for completion in September 1981.

Implementation of onfarm measures was initiated in FY 1980. Some 119 farmers, covering 6,028 acres, were provided technical assistance by the SCS. ASCS provided cost sharing for the installation of onfarm salinity control measures in 1980 through ASCS's ACP. This was based on the Congress' recommendation that $2 million be made available for such work. Practice cost sharing totaling $3,900,000 was requested by 119 farmers. The participating farmers earned a total of $678,000 in FY 1980 for completed practices.

The major activities during FY 1980 were installation of 155,000 feet of pipelines, 30 sprinkler systems, 16,000 feet of gated pipe, 6 ponds, 11 pumps, and 33 acres of land leveling. Wildlife measures are planned but not yet installed.

Lower Gunnison Basin Unit. - Eight alternative plans have been developed by SCS for salinity control in the Basin. These plans provide for estimated salt reductions ranging from 65,000 to 420,000 tons per year. A draft report is scheduled for 1981. A supplement to the existing program EIS originally issued by Bureau/SCS in May 1977 is scheduled for completion in 1981. The major environmental impact of some alternative plans will be their effect on wildlife habitat in the area. Presently, some 14,820 acres of wetlands supported by irrigation water sources are located within the study area.

Virgin River Unit. - The Virgin River Unit is divided into three studies: the Moapa Valley, the Virgin Valley, and the Upper Virgin River subevaluation units. A USDA report for the Moapa Valley, some 5,000 irrigated acres, has been completed.

A draft report identifying an implementation plan was prepared for the 3,500-surface-irrigated-acre Virgin Valley. A report for the 15,000-irrigated-acre Upper Virgin River subevaluation unit is to be completed in September 1981.

Big Sandy River Unit. - The Big Sandy Salinity Control Study Report has been completed. The report describes a range of alternatives, including retirement of some irrigated lands. Three of the eleven alternatives studied are very cost effective and show significant salt reduction. State and local controversy involving the alternative plans was substantial. The report does

not contain a USDA recommendation because off-farm alternatives are still being evaluated by the Bureau.

USDA is working with personnel from the State of Wyoming and the Bureau in the formulation of off-farm alternative plans. USDA will supply pertinent information developed during the onfarm studies.

McElmo Creek Unit. - Field inventories, including wetlands, are generally complete. An inventory of the laterals has been completed. These data are being analyzed to determine what areas can be supplied with sufficient gravity pressure to operate sprinkler systems. Preliminary data indicate that the most efficient way to improve onfarm irrigation systems in the area is to convert them to sprinklers in a joint venture in which the Bureau provides gravity head through its water systems improvements. The study report is scheduled for completion by September 1981.

Price-San Rafael Rivers Units. - Irrigation field tests were conducted in the late 1979 irrigation season and during the 1980 irrigation season. These tests included a representative cross section of soils, crops, and irrigation methods. Results will be used to verify onfarm irrigation efficiencies for use in the water budgets. Electrical conductivity has been measured on water entering and leaving a number of irrigated fields. These tests indicate that most of the salt comes from the water that percolates below the root zone and reenters the drainageways. Work is progressing on water and salt budgets. The report is scheduled for completion in FY 1982.

San Juan River Basin Unit. - A review of available data for the San Juan River Basin indicated two major source areas of irrigation-induced salt loading. The Mancos Valley in Colorado, with approximately 10,000 irrigated acres and the San Juan River Valley in New Mexico, with approximately

43,000 irrigated acres (in addition to the Navajo Indian Irrigation Project under developoment), are the major areas that should be studied. This study will exclude the McElmo Creek and the Navajo Indian Irrigation Project areas. Very little information on water quality or diversion data exists for the irrigated land in New Mexico. A study schedule has not been developed.

Colorado River Indian Reservation Unit. - Data available indicate this unit does not appear to be a significant salt contributor to the Colorado River. Therefore, the USDA study underway is being performed with irrigation water management as the primary objective rather than salinity control. It is a USDA Cooperative River Basin Study carried out under Section 6 of Public Law 83-566, at the request of the Tribal Council and the Parker Valley Natural Resource Conservation District. This study is scheduled for completion in December 1984. If the study shows significant potential for salinity control, then a separate salinity control report will be issued by USDA.

Little Colorado River Basin Unit. - This study is being performed as a USDA Cooperative River Basin Study under Section 6 of Public Law 83-566, in response to requests from the Arizona Water Commission, the New Mexico State Engineer's Office, and the involved Natural Resource Conservation Districts in the Basin. If the study shows significant potential for salinity control, then a separate salinity control report will be issued by USDA. To date the study shows that salt loading from range and irrigated land in the Basin is quite small. The study report is scheduled to be completed in 1981.

USDA Rural Clean Water Program. - The Rural Clean Water Program (RCWP) was established under provisions of Section 208(j) of the Clean Water Act. To date, Congress has not appropriated funds for program implementation. However, through the Agricultural Appropriations Act, Congress appropriated $50 million in 1980 and $20 million in 1981 to carry out an experimental

RCWP. The program provides for technical assistance and cost sharing for installing and maintaining best management practices to control rural non-point sources of water pollution. RCWP projects are selected by a National Coordinating Committee and are administered through the ASCS with technical assistance coordinated by the SCS. To be eligible for RCWP funding a proposed project must be consistent with the certified and approved agricultural portion of a Water Quality Management (208) Plan. The Talmage Project in the Uinta Basin in eastern Utah was submitted for RCWP funding as were two projects in Colorado. The Colorado projects were the Mancos Valley in the San Juan Basin and Tongue Creek, a tributary of the Gunnison River. Funding requests were also submitted for the Muddy River in Nevada. However, the initial 13 projects selected for funding under RCWP did not include any projects within the Colorado River Basin.

Bureau of Land Management

The BLM is continuing to study processes of salt pickup and transport in surface runoff from rangelands and ground water. The 1978-1979 Salinity Status Report presents results and conclusions of BLM's efforts through 1979 fiscal year.

Ground Water Investigations. - The USGS conducted an extensive ground water study for BLM in that part of the Upper Basin above the confluence of the Green and Colorado Rivers. This large region was divided into nine sub-regions or basins for study.

The area covered by this investigation yields 74 percent of the water and 77 percent of the salt contributed by the Upper Basin. Ground water contributed 55 percent of the total annual salt load of this part of the Upper Basin. The percent of total salt load contributed by ground water was

higher for subbasins in the Colorado River Region, an average of 69 percent, than for subbasins in the Green River Region, an average of only 38 percent.

Salt From Surface Runoff. - A number of activities, including livestock grazing, off-road vehicle (ORV) use, oil and gas activity, mining claim exploration and development, and coal mining activity, can be contributing factors to increased salt concentration in surface runoff from public domain lands. Each of these factors must be dealt with on a site-specific basis to determine the extent of salt contribution and to plan measures necessary to reduce the concentration to acceptable levels.

Improper livestock grazing can have a significant influence on the amount of sediment and salt yielded in surface runoff from rangelands. The importance of controlling the period and intensity of grazing, the kind of animal, and the need for rest from grazing to improve range condition is stressed. Light to moderate grazing during the season when plants or soils are least likely to be damaged, periodic rest from grazing through the use of grazing management systems, and total removal of livestock from areas with unstable soils or little potential to support a protective cover of vegetation are specific ways livestock can be managed to reduce salinity.

Salinity control through grazing management will vary with the concentration of salts in the soil. Specific management techniques have been proposed for three types of soils: nonsaline to slightly saline lands, moderately saline lands, and highly saline lands.

Total Salt Yield. - The 1977 BLM Report estimated the salt load contributed by the surface runoff from public domain lands in Colorado, Wyoming, and the Upper Basin portion of Utah. Salt loads from these lands amounted to 8 percent of the total from that area. Surface runoff from similar lands owned or administered by private individuals, states, Indian tribes, and

other federal agencies because of similarities were estimated to probably contribute an additional 7 percent. These estimates account for 15 percent of the total salt load.

In summary, salt contributions from Colorado, Wyoming, and the Upper Basin portion of Utah can be approximated as follows:

| | Percent |
|---|---|
| Natural ground water (diffuse and point sources) | 38 |
| Surface runoff from rangelands (BLM, private, and state) | 15 |
| Surface runoff from forests | 5 |
| Irrigation return flow | 41 |
| Industrial and municipal | 1 |
| Total | 100 |

Future Studies. - The conclusions in BLM's 1977 and 1978-1979 Salinity Status Reports regarding effects of man's activities on salinity suggest a relationship between increased salinity and increased runoff and soil loss. However, studies relating to the effects on salinity of oil-gas activities, mining, ORV, and grazing are needed to prove these relationships. Additional studies are also needed on the feasibility of controlling natural and man-caused point sources of salinity from ground water.

The following studies are suggested for future consideration in order to better understand the factors influencing salinity and the best means of reducing salt yields from public domain lands.

1. Continue research on the effects of grazing on hydrologic responses, and ultimately on salinity.

2. Collect water quality data necessary for preparing and monitoring success of land use and activity plans (i.e., allotment management plans).

Point Source Control Programs. - Construct a point source salinity control unit on Salt Creek in Colorado. This unit would consist of a cutoff wall and sump, pumping station, pipeline, and a series of evaporation ponds.

Environmental Protection Agency Activities

The key EPA programs dealing with salinity control (Water Quality Management Planning and NPDES permits) are generally operated by the states. Therefore, they are discussed in other sections of this report. Additional relevant EPA activities have been in the areas of program support and guidance for state and Forum salinity control activities.

Regions VIII and IX allocated 208 funds to help create and support an Executive Director position for the Forum. EPA has been working and will continue to work with the Basin states to assist the states in implementing state salinity control activities. Some states are developing implementation activities as part of the state/EPA agreements.

In cooperation with the Basin states, EPA has developed regional Agriculture Nonpoint Source Control Strategies. Components of the strategies range from the identification of priority problem watersheds to the development of a reporting system to monitor progress on implementation. Some states have approved Agricultural Nonpoint Source Control Strategies and management plans while others are in the process of developing such strategies and plans. Strategies should expedite the addressing of salinity problems associated with irrigated agriculture in the Basin.

Region VIII has adopted an "Energy Policy Statement" which includes the following:

> "The Region will strongly encourage that, when possible, energy development facilities utilize poorer quality water not suitable for domestic, municipal, or agricultural purposes as opposed to higher quality water. An example would be the use of high saline water for energy development/conversion activities.

"In the Colorado River Basin, the Enforcement Division will review industrial effluent discharges for consistency with the Salinity Control Forum adopted and EPA-approved 'Policy for Implementation of the Colorado River Salinity Standards Through the NPDES Permit Program.' In essence, this policy has the primary objective of no-salt discharge whenever practicable."

These statements are in support of the policies adopted by the Forum.

## State Programs - Effluent Limitations

A principal component of the plan of implementation is the control of discharge of total dissolved solids from point discharges through the NPDES Permit program. To facilitate the issuance of discharge permits, the Forum developed, in 1977, a "Policy for Implementation of the Colorado River Basin Salinity Standards Through the NPDES Permit Program," which was approved by EPA and adopted by all of the Basin states. During the period 1977-1980, the status of implementation was as follows:

### Effluent Limitations - Industrial Discharges

Arizona. - Authority for issuing NPDES permits has not been delegated to the State and still resides in the Region IX office of EPA. Arizona is currently operating under an "interim" plan, in which the State prepares the permit, solicits public comments and involvement, and forwards the final draft to EPA for signatures and issuance.

There are presently three industrial dischargers above Imperial Dam: a fish hatchery, a lumber products mill, and a small sanitary district with a pretreatment need caused by an industrial plant.

Arizona, in drafting NPDES permits for industries throughout the Colorado River watershed within the state above Imperial Dam, follows the Forum's policy regarding salinity control. Reuse of treated wastewater is encouraged as a general principle.

California. - The State Water Resources Control Board has been granted the authority for the NPDES permit program. The Regional Water Quality Control Board, Colorado River Region, issues the NPDES permits and waste discharge requirements within the Colorado River drainage portion of the state. No NPDES permits were issued or reissued during the period 1978-1980.

In implementing the objectives of the Colorado River water quality control plan for the East Colorado River Basin, the California Regional Water Quality Control Board has included in its discharge permit requirements a prohibition of brine backwash from water softeners into ground waters which are in hydraulic continuity with the Colorado River System.

Colorado. - The State gives the Colorado River Basin Salinity Control Program a high priority. The Water Quality Control Program focuses mainly on two functions: (1) point source control through the NPDES program and (2) nonpoint source control through the 208 areawide wastewater management plans.

The Colorado Water Quality Control Division has been delegated responsibility by EPA for state administration of the NPDES permit program. Applications for new permits or renewal of discharge permits in the Colorado River Basin are evaluated under the "no salt return where practicable requirement." The February 1977 Forum policy calling for no discharge wherever practicable has been adopted as a regulation by the Water Quality Control Commission.

Nevada. - Authority for issuing NPDES permits was delegated to the state by EPA in September 1975. Prior to program delegation, EPA issued permits in compliance with EPA Region IX policy and the 1975 Forum report. The State Division of Environmental Protection has reissued most of the EPA-issued permits.

An effort is being made by Basic Management Industries (BMI) to eliminate all industrial wastewater by evaporation in lined ponds and delivery of the waste to those ponds by pipe. Pipe and pond lining material have deteriorated and caused some problems, but the effort has been largely successful. Permits have been issued to two of the companies, Titanium Metals and Kerr-McGee, which allow discharge of cooling water with no more than 75-mg/L increase over the water supply. A permit to the Stauffer Chemical Company allows discharge of surface storm runoff.

Nevada Power Company is currently discharging brackish cooling water from both the Clark and the Sunrise Generating Stations. A contingency plan has been submitted by Nevada Power Company to the Public Service Commission which will result in zero discharge by 1982. The plan was rejected as being too costly and is being restudied. Two plans are being evaluated, both of which involve evaporation of the brackish water with no return to Las Vegas Wash.

New Mexico. - Authority for issuing permits has not been granted to the state, and the program is being administered by EPA, Region VI. EPA is following the Forum policy in the administration of the permit program. In the Colorado River Basin within the state the following industrial permits have been issued: electric power - 3, coal mines - 3, uranium mines - 8, and gravel plants - 4.

EPA has determined that discharges covered by the uranium mine permits will contribute less than 350 tons of salt per year to the nearest perennial stream segment of the Colorado River. The electric power permits are for the Four Corners plant (operated by the Arizona Public Service Company for a consortium), the San Juan Generating Station (operated by Public Service Company of New Mexico), and the city of Farmington plant. The

State of New Mexico, relying on the EPA-approved Colorado River salinity standards and plan of implementation, sought a condition in the NPDES permit for the 2175-MW Four Corners Powerplant requiring the elimination of the discharge of fly ash sluicing water to the San Juan River by 1981. Construction has been in progress during the past 3 years to eliminate this discharge. By a progress letter dated January 11, 1980, to EPA and the state, Arizona Public Service announced that discharges to the Chaco Wash were reduced to less than 0.5 Mgal/d on December 22, 1979. Since December 23, 1979, there have been no discharges from the ash ponds to Chaco Wash with the exception of a 1-day accidental discharge to the Wash.

With the powerplant operating as it has in recent years, at a load factor of 0.60, the elimination of discharges of fly ash sluicing water will result in a reduction of about 7,500 tons of salt discharge per year to the Colorado River system.

The NPDES permit issued to the San Juan Generating Station, operated by Public Service Company of New Mexico, requires the development of a program to ensure compliance with the Forum policy.

The schedule for development of the compliance program required the submission to EPA and the state of a final compliance program by March 31, 1980. The reissued permit contains a construction schedule for implementation of a compliance program satisfactory to EPA and the state to meet the Public Service Company's goal of an operating zero-discharge water management system.

Utah. - Industrial and municipal dischargers in Utah are required to obtain an NPDES permit from EPA and a construction permit from the Utah Water Pollution Committee. The discharger must submit appropriate information on the proposed installation, chemical concentrations, and possible

alternatives to discharge as required in the February 1977 Forum policy. The proposal is then evaluated for its impact on the lower main stem of the Colorado River and the practicability of achieving no discharge. The Bureau of Water Pollution Control cooperates with EPA in the NPDES program by drafting permits and certifying that the permits conform with state regulations including salinity requirements. The final authority and issuance of the NPDES permits in Utah rests with EPA. However, under agreement with the State of Utah, the state has been given the responsibility for issuance of the permits.

A total of 59 NPDES industrial permits has been issued in the Colorado River Basin in Utah. All four uranium mills and two powerplants are required to have no discharge of process water. One powerplant is allowed to continue its existing discharge because it is not practical to contain.

Twenty-three industrial permits have been issued during the period October 1979-September 1980. One deep mine has been required to submit additional salinity control cost information as required by the Forum policy. The other facilities were determined to contribute less than 1 ton per day or it was determined that total containment was not practical for those discharges from construction, coal mine drainage, fish hatchery, and one existing oil well.

Wyoming. - The Wyoming Department of Environmental Quality, Water Quality Division, has been granted authority by EPA for state administration of the NPDES permit program. The Forum policy is being followed in the issuance of NPDES permits which prescribes no-salt return wherever practicable.

The trona processing industry is the only major salt-producing industry in the Wyoming portion of the Colorado River Basin. This industry is completely containing all of its wastewaters without discharge. There is

a total of eight other industrial operations which discharge in the Wyoming portion of the Colorado River drainage. During 1979, these eight discharges contributed an average daily salt load of 12.3 tons to the Basin.

During the period October 1, 1979 to September 30, 1980, three industrial discharge permits were reissued. All reissued permits comply with the Forum policy.

Effluent Limitations - Municipal Discharges

Arizona. - There are 18 municipalities or quasi-public NPDES permittees in the watershed under discussion. Several small municipal dischargers have ceased discharging wastewater to the Colorado or its tributaries over the last few years. Fredonia is an example. A combined Indian reservation/ town of Parker collection and treatment system discharges about 2.8 tons of salt per day to the Colorado.

Most of the 18 permittees do not impact the main stem significantly, as they discharge to washes which are dry through most of the year. Nevertheless, the Forum guidelines are followed and all permits require that TDS of both source water and plant effluent be monitored.

California. - The permit issued to the city of Needles in 1975 is still in force. The requirements for incremental increases in salinity are more stringent than recommended by the Forum policy. No other municipal permits have been issued in the Colorado River drainage portion of California.

Nevada. - A program is presently being developed by the Clark County Sanitation District No. 1, Las Vegas, and North Las Vegas to coordinate, investigate, and encourage the implementation of management practices resulting in reduction of wastewater salinity. The principal emphasis of this program will be directed toward salinity control to meet the requirements of the NPDES permits issued to Clark County and the city of Las Vegas.

The first phase of the program, currently underway, will develop a public education program on salinity control and optimum use of water softeners. The second phase will be to develop an overall salt use program for adoption by Clark County and the cities. Other plans call for the implementation of a voluntary registration program for water softeners, and cessation of brine discharges to sewers fom commercial water softening activities. The program is scheduled for completion by July 1982.

The city of Henderson has been issued a ground water discharge permit. The city is acting independently of other municipal entities contributing effluent to Las Vegas Wash in meeting its permit requirements. Based on a Section 201 plan the city proposes to construct a 6.4-Mgal/d lagoon system which will collect sewage waste, starting with an aeration process and ending in an infiltration pond which will add water to the Las Vegas Wash as acceptable ground water and make surface water available for use in irrigation of golf courses and municipal green areas.

New Mexico. - Permits have been issued for 3 major and 2 minor sewage treatment plants, 2 water treatment plants, and 24 small domestic sewage systems. Forum policy will be followed in the issuance of new or reissued permits.

Utah. - Thirty-four permits have been issued in the Colorado River drainage. Of those, 29 are for wastewater treatment facilities while 5 are for water treatment facilities. Ten of the wastewater treatment facilities and all five of the water treatment facilities practice total containment. All new discharge permits will comply with the Forum policy regarding NPDES permits.

Wyoming. - Two municipal permits were issued during the period. As municipal permits are reissued, salinity monitoring requirements as detailed

in the Forum's policy have been made a compliance requirement of the permit. Currently, it appears that salinity increases from municipal uses are approximately equaling the 400-mg/L incremental increase considered to be reasonable as stated in the policy. One municipal permit was reissued during the period October 1, 1979 to September 30, 1980. All reissued permits comply with the Forum policy.

State Programs - Water Quality Management (208) Planning

The Basin states are individually developing water quality management plans to conform with the requirements of Section 208 of the Clean Water Act. These requirements include:

- Public involvement
- Problem assessment
- Identification of Best Management Practices (BMP)
- Establishment of control programs
- Designation of management agencies

Water quality management plans may address the following categories of polluting or potentially polluting activities and sources:

- Municipal wastewater treatment
- Industrial wastewater treatment
- Urban stormwater
- Agricultural activities
- Logging and related activities (silviculture)
- Mining and related activities
- Construction activities
- Salt water intrusion into surface waters
- Disposal of wastes by pumping into wells or subsurface cavities (well injection or deep well injection)
- Construction or operation of hydrologic modifications such as dams, levees, and flow diversion structures
- Residual waste disposal, such as solid waste landfills or disposal sites for municipal or industrial sewage treatment plant sludge

Arizona. - The Northern Arizona Council of Governments (COG) generated water quality management plans for the Colorado River and its tributaries lying within Apache, Coconino, Navajo, and Yavapai Counties, while the District IV Council planned for similar management in Mohave and Yuma

Counties. A state plan was written that incorporated recommendations made in the COG 208 plans. All three plans strongly supported Arizona's adoption of the Forum's water quality standards and plan of implementation. The two areawide plans were conditionally certified by the Governor in November 1978. All three plans were unconditionally certified by the Governor in June 1979. The areawide plans and state plan were conditionally approved by EPA in February and September 1979, respectively. The plans were approved by EPA May 1981. The Forum's standards and plan of implementation were adopted by the Water Quality Control Council on April 11, 1979.

An evaluation was conducted by Arizona Department of Health Services (ADHS) to see if a special Statewide policy regarding salinity control in Arizona could be developed. There are no significant point sources by the Clean Water Act definition in the state. Most of Arizona's salinity contributions to the Colorado River originate from nonpoint sources.

California. - The Regional Water Quality Control Board has been assigned as the planning agency for the Colorado River tributary drainage which is part of the nondesignated 208 planning area of the state. A specific 208 planning effort related to Colorado River salinity was initiated. The study was a cooperative effort between the Regional Water Quality Control Board, USGS, Palo Verde Irrigation District, and the Colorado River Board of California.

Results of the initial phase of the investigation indicated that a small localized area in the southern end of the Palo Verde Valley is the major salt contributor to the river. Complete evaluation of the ground water system in the southern portion of the Valley is necessary to determine the potential for salt reduction. Continued federal funding for this phase of the nondesignated 208 studies was not granted.

The Bureau, USGS, and the Palo Verde Irrigation District have initiated a test program on 320 acres in the southern portion of the Valley to evaluate the potential for accelerated flushing of saline ground waters during the ensuing years when surplus flows may be available in the river system.

The 208 salinity studies in the Reservation Division of the Yuma Project and the California portion of the Fort Mojave Indian Reservation have shown that neither of the areas are salt contributors.

Colorado. - Two Regional Councils of Government in the Colorado River Basin of Colorado were designated as 208 planning agencies by the Governor. These are the Colorado West Area Council of Governments, consisting of Moffat, Rio Blanco, Garfield, and Mesa Counties; and the Northwest Colorado Council of Governments, including Eagle, Grand, Jackson, Routt, Pitkin, and Summit Counties. The remainder of the Basin is included in the nondesignated 208 planning area in which the state has responsibility for preparing the plan. Salinity control programs were developed in the draft plans for waste treatment management in all areas of the Basin in Colorado.

The Colorado West Area region has a major salinity impact due to natural contributions and agricultural activity, principally in the Grand Valley. The 208 plan for this area has been certified by the Governor to EPA. Salinity control in the Grand Valley has been adequately assessed; however, further assessment work is needed outside of the Grand Valley.

The Northwest Colorado region is primarily at the high mountain headwaters of the Colorado River and is a minor factor in terms of salt loading to the river system. The plan directs its salinity control effort toward local control of nonpoint sources, i.e., municipal and urban runoff. Currently, the plan is under litigation.

The statewide plan which covers the remainder of the Basin was prepared by the state in cooperation with the San Juan Regional Commission and the District 10 Regional Planning Commission. The plans have been approved by the Water Quality Control Commission and certified by the Governor to EPA.

Critical salt yielding areas were assessed in both areas covered by the statewide plan by the Colorado Soil Conservation Board in cooperation with local soil conservation districts. Two areas were selected as candidates for cost-share assistance under the RCWP and were approved by the Governor. They are the Mancos Valley in the San Juan Basin and Tongue Creek, a tributary of the Gunnison River in Delta County. Those funds are being sought. As it is unlikely, however, that RCWP funds will be available for these areas in the near future, the state and affected farmers are pursuing special project funding assistance through the ASCS. The two areas identified in the 208 plans are in addition to McElmo Creek and the Lower Gunnison Salinity Control Units, both of which are being investigated through Title II of the Colorado River Salinity Control Act.

Nevada. - Pursuant to state law, in 1975 the Governor of Nevada assigned the Clark County Commissioners the responsibility to conduct 208 planning. Administration of the program was originally assigned to the Clark County Sanitation District No. 1 and was subsequently assigned to the Clark County Department of Comprehensive Planning. The study area encompasses all of Clark County. The 208 plan was conditionally approved by the state in June 1978 and by EPA in July 1979. A revised 208 plan was completed in February 1980. It has been approved by the State of Nevada; however, there has been no action by EPA to date.

Reevaluation of future treatment facilities was required under a "consent decree" issued by a local Federal District Court in March 1979 as

the result of a lawsuit brought by the cities of Las Vegas and North Las Vegas. The decree requires two types of studies which had been recommended in the initial Clark County 208 plan. The first is directed toward reviewing water quality standards in Las Vegas Wash and Lake Mead. The second is to identify wastewater treatment facilities that will be needed to meet those standards.

Included in the plan is a wastewater reuse and a disposal program. This consists of present reuse in Las Vegas Valley plus future contracted reuse by the Nevada Power Company for the proposed Harry Allen Energy System. A 201 study evaluating increased reclamation is recommended, particularly with respect to secondary wastewater to reduce costs associated with advanced wastewater treatment (AWT). Disposal options include release of secondary treated wastewater to Las Vegas Wash to maintain vegetation and reduce AWT costs. Disposal studies will be coordinated with the Bureau reevaluated program.

The 208 plan for the Lower Virgin River and the Muddy River has as its objective reducing saline agricultural return flows. The Bureau has contracted with the DRI for a study on the Lower Virgin River which will provide a basis to evaluate the feasibility of a project to control ground water saline flows. If feasible, this could involve an underground barrier.

The SCS is finalizing a report prepared on the need for and means of controlling saline agricultural ground water return flows from the Muddy River. It appears a project may be feasible which would involve replacing distribution systems with new nonconcrete lining or pipe and managing water applications. A sulfate condition exists in the soil which is destructive to concrete. Substantial federal, state, or county funding would be required.

New Mexico. - The Section 208 program in New Mexico is under the direction of the New Mexico Water Quality Control Commission. The Statewide Water Quality Management Plan, developed under Section 208 funding from the EPA, covers the entire state except for that portion of the Navajo Reservation lying within the state boundary. The Navajo Tribe is responsible for the Section 208 planning program on the Reservation. Much of the Colorado River Basin in New Mexico is within the Navajo Reservation.

A major portion of New Mexico's planning program continues to be focused on nonpoint sources. The three major nonpoint source program elements that may have applicability to the Colorado River Basin are irrigated agriculture, sediment, and silviculture.

The New Mexico Environmental Improvement Division has a contract with the Engineering Experiment Station of New Mexico State University to study the water quality impacts of irrigated agriculture on a privately owned farm in the Rio Grande Valley near Socorro, New Mexico. The field sampling was initiated in February 1977 and completed in December 1979. During this period, nutrient and salinity concentrations of irrigation water, runoff water, drainage water, and deep percolation water were measured. These data are still being analyzed.

The Statewide Water Quality Management Plan includes BMP's to be used on a voluntary basis to control or reduce sediment. Furthermore, implementation of these BMP's is to be emphasized in the top four priority areas in the state. The San Juan River Basin is ranked fourth. The New Mexico Soil and Conservation Division is continuing the Section 208 planning work on sediment by performing cost-effectiveness analyses of BMP's in the four priority areas and by development of information and education programs directed towards private landowners.

The goal of the silvicultural portion of the Statewide Water Quality Management Plan is to reduce or eliminate nonpoint source pollution from silvicultural activities.

The initial Statewide Water Quality Management Plan was approved by the New Mexico Water Quality Control Commission on October 23, 1978, and certified by the Governor on October 26, 1978. The EPA conditionally approved the plan on March 1, 1979. Additional elements of the plan were adopted by the Water Quality Control Commission on May 23 and 24, 1979, and certified by the Governor on May 29, 1979. On June 22, 1979, EPA conditionally approved the plan as a whole but did give full approval to two plan elements. On November 16, 1979, full approval was given by EPA to the environmental assessment plan element. An update to the plan, which included initial population projection series to the year 2000 for the state, counties, and the Albuquerque SMSA, was adopted by the Commission on October 9, 1979, and certified by the Governor on January 25, 1980. EPA conditionally approved the update on March 10, 1980. The latest update includes additional work on population projections and the designation of wastewater management agencies. That update was adopted by the Commission on October 19, 1980, and certified by the Governor on January 23, 1981. Conditional approval was given by EPA on April 6, 1981. In the Statewide Water Quality Management Plan, the importance of working cooperatively with the Forum is recognized.

Utah. - There are three regions in the Colorado River Basin that have been classified as designated areas with assigned planning agencies and one area consisting of Wayne County that is a portion of the nondesignated area for which the 208 plan will be developed by the Utah State Department of Health.

A detailed agricultural assessment is being performed for the 208 agencies described below. This assessment is being coordinated by the State Department of Agriculture with the 208 agencies, the SCS, and the Soil Conservation Districts participating. This output will prioritize agricultural related water quality problems and site-specific BMP's will be developed.

The status of the 208 plans for the areas in the Colorado River Basin is summarized below:

Uintah Basin Association of Governments (Duchesne and Upper Green River Drainages). - The Uintah Basin Water Quality Management Plan (208) was conditionally certified by the Governor on September 11, 1978, and conditionally approved by EPA on October 31, 1979. An onfarm program of the USDA which is designed to reduce salinity through improved irrigation systems and water management has just been initiated in a part of the Uinta Basin. The total program will involve implementing BMP's on 120,000 acres which is expected to significantly reduce salinity in agricultural return flows. Some elements of the RCWP, which were proposed for this area, have been incorporated into the current project.

Southwestern Utah - Five County Association of Governments (Virgin, Escalante, and Paria River drainages). - The Water Quality Management (208) Plan for this area was conditionally certified on December 11, 1979, and conditionally approved on May 2, 1980.

Southeastern Utah Association of Governments (Colorado River drainage). - The Water Quality Management (208) Plan for this area was conditionally certified on April 14, 1980, and conditionally approved on May 22, 1980.

The Six County Commissioners Organization (Dirty Devil River Basin). - The Water Quality Management (208) Plan for this area (Wayne County) was conditionally certified on May 19, 1980, and conditionally approved October 9, 1980.

Conditions were imposed on all of the above 208 plans by both the State of Utah and EPA. The nonpoint pollution control portions of all 208 plans were conditioned and a process prescribed to remove these conditions. The final approval of the agricultural assessment (statewide) depends upon the removal of these conditions imposed by the state and EPA. Agricultural pollution problems will be prioritized and BMP's will be prescribed on a site-specific basis. This control program will also include a timetable for implementation of each phase and the agencies responsible for implementation.

Wyoming. - The Water Quality Management planning program in Wyoming is under the direction of the Water Quality Division of the Department of Environmental Quality, The Clean Water Report for Southwestern Wyoming addresses water quality in Lincoln, Uinta, and Sweetwater Counties. This report was adopted at the local level, certified by the Governor, and conditionally approved by the EPA on October 9, 1980. The Governor's certification recognizes a salinity control program for the Green River Basin as a major water quality priority. The report recommends continuation of the Big Sandy River Unit Study, improved irrigation efficiencies and further study of a number of other management alternatives.

The Statewide Water Quality Management Plan was certified by the Governor and conditionally approved by the EPA on July 8, 1980. The statewide plan established an institutional framework under which planning and implementation activities can proceed in Wyoming. Implementation of much of the

program depends on the availability of funds and the acceptance of responsibilities by the designated management agencies. Management agencies with a role in the control of salinity in the Green River Basin include BLM, Bureau, DEQ, State Engineer, and the Wyoming Conservation Commission. Management agency agreements have been developed and are presently being implemented with the BLM, State Engineer, and the Wyoming Conservation Commission.

The Management agency agreement between the BLM and the DEQ provides for the coordination of planning and implementation of management practices on BLM administered public land and resources. The intent is to provide a basis for a continuing process to meet requirements of the BLM and the state.

The agreement between the Wyoming Conservation Commission and the DEQ provides for the continuing implementation of soil and water conservation practices by Wyoming farmers and ranchers. Under the agreement, impacts of agricultural activities will be identified and addressed through the voluntary development of conservation plans for individual farm units.

The agreement between the State Engineer and the DEQ provides for the evaluation of the impact of water depletion and development on water quality and salinity.

Education and Public Involvement

The Basinwide nature of salinity presents some difficult challenges in terms of effective public education and public involvement programs. However, implementation of salinity control programs requires a greater awareness of salinity - its sources, impacts, and alternative methods of control. The seven Basin states will continue to work with concerned agencies to increase public understanding of salinity and will coordinate this effort with the Forum. The Forum's Annual Progress Report will be a component of

this educational effort and will be distributed to interested individuals and organizations.

Since irrigation is the principal human-induced source of salinity, a major thrust of the public education/public involvement effort should focus on educating irrigators as to the sources, impacts, and methods of controlling salinity as it relates to irrigation practices. The goal of this effort is to encourage desirable changes in application of technology and management practices. The Basin states, with assistance from the Forum's Executive Director, when requested, will work with ongoing efforts (208 programs, SCS, and ES) to achieve this goal.

The Forum's meetings are open to the public and all comments on its activities are considered and acted on as appropriate. The Forum also provides for public involvement in the standards review process. The Forum, as part of the review process, holds public meetings to receive comments on the standards for salinity. As a result of such public input, appropriate changes are made.

As each of the Basin states proceeds with its adoption process, one or more statewide public hearings are held. There is widespread announcement of the Forum and state hearings and copies of the review are mailed to interested agencies and groups.

The Forum members participated with their 208 agencies in matters related to salinity and salinity control and will continue to do so as the need arises.

The Bureau publishes a quarterly newsletter entitled "Salinity Update" which provides current information on its activities related to salinity control. Salinity control activities of other federal agencies are also

covered in "Salinity Update." In addition, the Forum and the states utilize the newsletter as a means of keeping the public advised of their activities. The newsletter is mailed to over 1,500 readers.

Other State Salinity Control Implementation Activities

Arizona. - Arizona continues to support the basinwide approach to salinity control through the Colorado River Basin Salinity Control Forum. The State Water Quality Control Council adopted the original 1975 and the 1978 revision of the Colorado River salinity control standards including the plan of implementation as part of its water quality regulations. The State Water Quality Control Council adopted the "Policy for Use of Brackish and/or Saline Waters for Industrial Purposes" on July 8, 1981. This policy encourages and promotes the use of brackish and saline waters for industrial purposes where environmentally sound and economically feasible.

Arizona has adopted the policy developed by the Forum and approved by EPA regarding implementation of standards through the NPDES permit program. The state does not have permit issuing authority, but currently prepares the permits which are then issued by EPA. The state is seeking full authority for issuance and enforcement of NPDES permits.

California. - The state has in the past and continues to support the basinwide approach to salinity control. California adopted, as regulation, the Forum recommended numeric criteria and plan of implementation for salinity control as its water quality standards for salinity both in 1975 and 1978. Requirements for NPDES permits issued in the Colorado River drainage, by the state, are more stringent than those recommended by the Forum. California also places stringent requirements on salt discharges to ground waters which are in hydraulic continuity with the Colorado River. Finally,

the state fully supports the Forum policy regarding use of saline water for industrial purposes. In June 1975, a Water Quality policy on the use and disposal of inland waters for powerplant cooling was adopted. The policy established a priority for the use of saline water for powerplant cooling, California's only industrial use in the Colorado River drainage portion of the basin.

Colorado. - The Water Conservation Board added a staff person to work on salinity issues after additional funding was received from the Legislature. A comprehensive proposal was developed for 208 funds for salinity control activities in the state. A small portion of the proposal was funded so that one workyear will be funded.

Nevada. - In emphasizing salinity control in ongoing activities in the NPDES and Water Quality Management Programs, a new technical coordinating group has been formed by the Nevada Forum members. Through this group, the Bureau staff will have a line of communication to seven local political and industrial interests so final planning in Las Vegas Wash will incorporate salinity control as an objective. The group was formed in May 1981 and has scheduled formulation of a general multipurpose plan by the end of 1981.

New Mexico. - The State of New Mexico through the Forum Member, Advisory Council Members and the New Mexico Water Quality Control Commission support the Colorado River Basin Salinity Control Program and are taking all reasonable action to insure its implementation. State actions include: (1) support of federal legislation including appropriations to implement the program, (2) inclusion of salinity control measures in the 208 plans, (3) dissemination of information on salinity sources and control measures to the water users and the public in the Colorado River Basin area of the state, (4) consultation with industries on potential salinity reduction measures,

(5) implementation of Forum's Policy through existing legal and institutional mechanisms, e.g., NPDES, (6) the support of future funding for the Forum executive director whose major function is to assist in carrying out the Colorado River Salinity program, (7) allocation of state financial and manpower resources to several salinity research efforts, (8) providing matching funds to support the USGS water quality data collection program in the Colorado River Basin portion of the state which is necessary to monitor salinity conditions on the river, and (9) maintaining a continuous water quality planning program whereby new or additional salinity control measures can be addressed.

Utah. - In December 1980, the Utah Board of Water Resources passed a resolution which stated, in part:

> "Now therefore be it resolved that the Board of Water Resources will encourage and promote the use of such brackish and/or saline waters, except where it would not be environmentally sound or economically feasible or would significantly increase consumptive use of Colorado River System water in the State above that which would otherwise occur."

This resolution is in support of the Forum's Policy on the use of poor quality waters.

Wyoming. - The Governor has designated the State Planning Coordinator's Office as the lead agency for coordinating state activities in the Green River Basin. The DEQ is participating in this effort through the implementation of NPDES, nonpoint source programs and approved 208 plans. Other ongoing salinity control activities are in progress. The Forum's report is the State of Wyoming's strategy for addressing salinity in the Green River Basin.

The State Planning Coordinator's Office is encouraging applicants for industrial and energy water supplies from the Green River system to consider

using saline water out of the Big Sandy drainage either in lieu of or in concert with other waters.

## Other Non-Federal Measures to Control Salinity

### Minimizing Salinity Increases Caused by Powerplants

Thermal-electric power generation is the largest industrial use of water in the Colorado River Basin, and this use is expected to increase. As of December 1980, there were 10 large thermal-electric generating plants, with a total capacity of 12,762 MW, operating or under construction in the Basin. An additional 3000-MW capacity is expected to be added by 1995.

Since the passage of the Clean Water Act, all thermal-electric power generating plants in the West have been designed with evaporating cooling towers. With this system, water is continually flowing from the condenser to the cooling tower and back to the condenser. Water use (or loss) in the cooling cycle consists of the evaporation loss in the tower plus an additional requirement for "blowdown" to allow water to evaporate without forming excessive mineral deposits. It is this highly saline blowdown water which is the potential source of salinity to be controlled.

All of the powerplants planned and under construction, and all but three of the presently operating plants, will return no salt to the system. The Four Corners plant in New Mexico, which was designed and constructed prior to the no-salt return policy, has been upgraded to a "no-salt added" condition. The Huntington and Hunter plants in Utah have in operation, with conditional approval of the state, a system whereby the blowdown water is used for agriculture without appreciable return of salts to the stream system. Final approval will be given if the effectiveness of the system can be verified; otherwise, the plants will have to revert to lined evaporation ponds.

Use of Agricultural Drainage Water for Powerplant Cooling

The 1974 California legislature amended the Metropolitan District Act to permit such districts to enter into contracts for the sale of water for use in connection with the generation of electric power. The amendment states in part:

> "b. * * * Every such contract shall provide that agricultural waste water, brackish ground water, or other water not suitable for domestic, municipal, or agricultural purposes shall be utilized for powerplant cooling to the extent practicable and if not immediately available, such waste or brackish water, as it becomes available and to the extent practicable, shall replace the fresh water then being used for such purpose * * *."

Metropolitan Water District has agreed, in principle, to furnish up to a total of 100,000 acre-feet of Colorado River water each year to sites in the Mojave Desert area for powerplant cooling and related purposes. It is anticipated that through exchange provisions, agricultural drainage water would be used in the powerplant cooling cycle in lieu of freshwater supplies.

Industrial Uses of Saline Water

In September 1980, the Forum adopted a "Policy for Use of Brackish and/or Saline Water for Industrial Purposes" (Appendix B). This policy was aimed at encouraging the use of brackish and/or saline water wherever practical. If this water can be put to use, not only are those sources of salinity eliminated, but it delays use of high quality water which is presently reducing salinity by dilution. Although it is expected that all compact allocations will be used eventually, new salt-reducing technologies may be developed in the interim.

Use of Saline Water in Oil Shale Development

Oil shale facilities will use water in as many as six different steps in the process of producing crude oil from shale rock:

1. Dust control associated with mining and crushing of shale

2. Scrubbing by-product gasses

3. Upgrading (i.e., carrying out a chemical process known as hydrogenation, which will also necessitate evaporative cooling) of the pyrolysis oils and tars to produce a pumpable crude oil suitable as a refinery feedstock

4. Cooling, compaction, and disposal of spent shale

5. Revegetation of spent shale disposal areas

6. Miscellaneous plant uses (sanitary waste systems, etc.)

The possibility exists to use relatively high saline waters from sources such as salt springs and perhaps irrigation return flows in the first four of the six steps identified above. This would result in larger reductions in the salt load in the Colorado River system than if higher quality waters of lesser salinity concentrations were used. Such uses of higher salinity water would be subject to the water rights laws of the state in which the use occurred.

While the technology of using highly saline water in various industrial processes is promising, the particulars of such potential uses in the oil shale industry have yet to be thoroughly explored. In addition, the economic feasibility of such uses has yet to be proven. The Forum will continue to work with the appropriate federal agencies and the industry to seek answers to these questions as the oil shale industry moves into the design of its commercial facilities.

Use of Saline Water in Coal Slurry Pipelines

The transport of coal with water as a slurry in pipelines from western coal fields to areas with large energy demand for use in thermal electric or coal gasification plants is under consideration in a number of instances. Considerable opposition has developed to this type of use. In order to

minimize this opposition, the possibility of using saline or brackish water is being considered.

The Forum is supporting the use of brackish and/or saline water for industrial purposes in lieu of low salinity water. Reduced salt load in the Colorado River would result in the event that saline water were used in a slurry pipeline to export coal from the Basin. Federal legislation approving the use of coal slurry pipelines for transport of coal is under consideration by the Congress.

Non-Federal Efforts to Cope with Salinity of Colorado River Water Supply

Land Drainage

In order to prevent salt buildup on irrigated lands in the Colorado River Basin, it is necessary, in many areas, to provide extensive subsurface and surface drainage systems. This is most evident in the Lower Basin States of Arizona and California where in excess of $65 million have been expended to install drainage facilities. By providing adequate subsurface drainage facilities, dissolved salts are carried away and the salinity of the soil is maintained at a level that is acceptable for farming. Without these subsurface drainage pipes, farmers would not be able to apply sufficient water to leach the salts out of their lands. This practice is most predominant in Imperial Irrigation District and Coachella Valley Water District. Drainage water from these Districts flows into the Salton Sea and thus is not returned to the Colorado River. In order to alleviate the drainage situation, continuing programs are carried on for the lining of ditches and canals to minimize seepage loss and conserve the water for irrigation use.

In the Palo Verde Irrigation District, the possibility of applying temporary surplus flows in the Colorado River to accelerate leaching of salts from the southern part of the District is being considered. The process will

be tried on an area of about one-half section to determine feasibility and to make plans for expansion if it proves to be a viable process. The desired results would be to flush sufficient salts from lands so that in the future the area could be approximately in salt balance.

### Treatment and Blending

Where a supply of higher quality water is available it is blended with the more saline Colorado River water in order to reduce the salinity of the water delivered for use. This practice is followed by the Metropolitan Water District of Southern California (MWD). The MWD has two sources of water supply, the Colorado River and northern California water from the State Water Project system. The MWD blends lower salinity, higher cost northern California waters with higher salinity water from the Colorado River to achieve a blend of approximately 500-mg/LTDS. These blends are then delivered to its customers to the maximum extent possible within the limitations of its distribution system, with only a small portion of the MWD service area not able to receive blended supplies.

## Research and Analysis on Salinity Control

### Studies Underway

The Bureau is conducting studies on solar evaporation ponds. The purpose of these studies is to analyze specifications of construction, functional effectiveness, disposal, and effects of brine and residues to determine the most cost-effective designs. As an alternative to evaporation ponds, deep well injection is being investigated by the Bureau at Paradox Valley for the disposal of saline waters collected from shallow wells.

Studies are being continued by Utah State University for the determination of the quantity of salts that originate from public domain lands. BLM has expanded its salinity study on public domain lands to include

salinity from ground water discharge. The BLM has also continued to investigate the effects on salinity levels in surface runoff from livestock grazing and other activities that may disturb the soil.

Additional Studies Needed

During recent years, the salinity concentration in the Lower Basin has shown a slight decreasing trend. It is anticipated that this has resulted from changes in the flow characteristics of the river system following completion of Glen Canyon and other Colorado River Storage Project reservoirs and the filling and passage of water through the reservoirs. Such salinity reduction may also be due to inundation of saline sources from which salts are no longer picked up. There is a need to determine if this decreasing trend in salinity will continue or if salts are being concentrated in isolated parts of the reservoirs which later may be induced in the mainstream. In addition, the basic change in the flow characteristics of the river system and the impact of that change on the salt load need to be developed.

Additional information is needed about evaporation and the use of deep well injection as a means of disposal for saline water and brine.

Ion Constituent Analysis Research. - In an effort to further understand the complexities of the Colorado River Basin Salinity, the Bureau plans to let a contract to develop a salinity data base broken down by constituent ions. The historical data base would be correlated back to 1906, and then the effects of development would be removed. Through this detailed analysis and development, a better understanding would be developed of where and why changes in the salt-flow relationship are taking place.

# CHAPTER V. MEANS OF MAKING PLAN OPERATIONAL

The plan of implementation for salinity control will require additional legislative authorization for the construction of control units, clear delineation of the responsibility of the various participants, and the continuation of a monitoring program.

## Legislation Needed to Carry Out Programs

### Federal Programs

Bureau of Reclamation Water Quality Improvement Program. - Public Law 93-320 authorized construction of four salinity control projects and the completion of planning reports for 12 salinity control units of the Bureau's CRWQIP. Although planning and investigation on these latter units by the Bureau has been ongoing for several years, the U.S. Department of the Interior Solicitor in 1979 ruled that the Act did not authorize feasibility level studies of the units listed under Section 203(a)(1) of the Act. Legislation was subsequently introduced and enacted last year which provided the necessary authority for preparation of feasibility reports of 10 units. The legislation combined the Price and San Rafael Rivers into one unit, included the Meeker Dome Unit and the Lower Virgin River Unit, and excluded the Colorado River Indian Reservation and Palo Verde Irrigation District. These and other units of the CRWQIP will require specific construction authorization by the Congress.

Because of extensive delays in the planning program, it is now evident that many of these salinity control units will not be in operation by 1990 as previously anticipated. The estimated dates of initial operation are as follows:

| Salinity unit | Date of initial operation Bureau |
|---|---|
| Lower Gunnison Basin | 1988 |
| Uinta Basin | 1989 |
| LaVerkin Springs | Deferred |
| Glenwood-Dotsero Springs | 1994 |
| Lower Virgin River (formerly Littlefield Springs) | 1989 |
| Price-San Rafael Rivers | 1995 |
| Dirty Devil River | 1996 |
| McElmo Creek | 1993 |
| Big Sandy River | 1993 |
| Colorado River Indian Reservation | Deferred |
| Palo Verde Irrigation District | Deferred |
| Meeker Dome | 1993 |

These estimated dates of initial operation are based on the Bureau's latest schedule for completion of feasibility reports as discussed in Chapter V. If the time required for completing EIS's and obtaining authorization and appropriation of funds is extensive, further delay in the initial operation of the units will result.

Modifications to some units and combinations of units have occurred since the 1978 report. The Colorado River Indian Reservation Unit in Arizona has been deferred and a concluding report has been completed. Studies by contract consultants and the Bureau concluded there is little chance for cost-effective salinity reduction from water system improvements (lining of canals and laterals) for this unit. However, onfarm improvements may provide some salinity reduction. In March 1981 a Special Report was issued by the Bureau which demonstrates that water systems improvements in the southern portion of the Palo Verde Valley will provide cost-effective salinity reduction. Accordingly this unit is being removed from the deferred status and will be

included in new legislation. The Meeker Dome Unit, Colorado, with an estimated salinity reduction potential of 57,000 tons of salt per year, has been added to the program and has received specific feasibility study authorization. The Littlefield Springs Unit has been expanded and reformulated by the Bureau into a new unit, the Lower Virgin River Unit, with a substantial increase in estimated salt removal. Delays in the estimated completion dates of other units listed above since 1978 range up to several years. These estimates reflect delays in completion of feasibility reports on various units.

Based on past experience, it is apparent that renewed efforts to accelerate and simplify the process for completing feasibility reports are necessary to further define the control units. In addition, legislative authorizations and appropriations are necessary if the salinity control units are to be completed in a timely manner. Requests for authorization for each unit should be made promptly after completion of the planning reports, but the specific timing is difficult to determine at present. As in the case of Title II of Public Law 93-320, authorizing legislation will need to specify the financing, cost-sharing, and repayment arrangements for the projects.

In addition to legislative authorizations needed for the above-listed units, there is need for legislation to amend Title II to solve the problem of fish and wildlife mitigation on authorized and proposed units. This question arose with regard to Stage I of the Grand Valley Unit when legislation was introduced in 1979 providing for replacement of canals and laterals with pipe and for extensive fish and wildlife mitigation on the Grand Valley Unit. The legislation met opposition in the Congress over the question of providing for mitigation of artifically created wildlife habitat. The Bureau

was subsequently allowed to proceed with pipe laterals for Stage I. The question of fish and wildlife mitigation remains unresolved.

Department of Agriculture Program. - Participation by the USDA in the Colorado River Basin Salinity Control Program in accordance with Public Law 93-320 is being carried out under a cooperative agreement between the USDA and the Department of the Interior. In addition, specific agreements between participating agencies have been developed to cover investigations and programs by USDA agencies on individual projects. Primary emphasis has been on studies to identify areas contributing to salt loading, and investigations of onfarm measures to increase irrigation efficiencies and reduce salt loading from irrigated areas. Adequate authority exists for activities related to salinity control under the various programs of the USDA. Funding for ongoing salt source studies has generally been adequate and should be continued. Construction and implementation of onfarm programs for the Grand Valley and Unita Basin Units have been initiated. The USDA, however, has not indentified funds for the onfarm program in its normal budgetary process. The seven Basin states, through the Forum, have supported such funding with the result that in each of the past 3 years, the Congress has recommended that ASCS allot specific monies from the ACP program of the ASCS for onfarm salinity control activities. In addition, funds have been provided for technical assistance by the SCS and research by the ARS. Continued funding for the onfarm program is essential, and it would be most helpful if these funds were included as a specific line item in the overall USDA budget.

Bureau of Land Management and Forest Service Programs. - Lands under control of the BLM and the Forest Service contribute to the total salt load of the river. No specific action or legislation relating to controlling salinity from these lands is provided in the present plan. The BLM has been

studying the contribution of salinity to the river from public domain lands with emphasis on the Upper Colorado River Basin and two status reports have been issued. Studies are continuing and, as more information becomes available, the potential for salinity alleviation can be established and necessary legislation identified.

State Programs

Arizona continues to seek full authority for issuance and enforcement of NPDES permits. Under the current interim plan, the state prepares the permits which are then issued by EPA.

The need for specific legislation in other states' programs has not been identified.

## Financing Salinity Control Projects

There are many entities and levels of government concerned with the salinity of the Colorado River. However, only the federal government is involved in all the major Basin-wide aspects of the salinity problem, and a solution is only possible in a Basin-wide context. The Governments of the United States and Mexico have agreed that terms of Minute 242 constitute a permanent and definitive solution to the problem of the salinity of the water delivered to Mexico; however, without upstream salinity control, the problem may not remain resolved.

Federal lands, including Indian reservation lands, are the source of most of the naturally occurring salts in the river. Accordingly, it is believed that the federal government is the appropriate unit of government to finance the salinity control projects and to be allocated a major share of costs.

In enacting Public Law 93-320, Congress recognized the federal responsibility for the Colorado River as an interstate stream and adopted a cost-sharing

formula which provides that 75 percent of the costs of the four salinity control projects authorized by Title II of the Act shall be nonreimbursable. The remaining 25 percent of the Department of Interior costs are to be repaid from the Basin funds of the Upper and Lower Colorado River Basins. The Act directs the Secretary of Interior to consider the benefits to each of the Upper and Lower Basins from improved water quality, the causes of salinity, and the availability of revenues in each of the Basin funds in determining the allocation of costs. The maximum allocation to the Upper Basin Fund for any unit, however, is not to exceed 15 percent of the total costs allocated to the two Basin funds, with the remainder to be allocated to the Lower Basin Fund.

The cost-sharing arrangements for the other salinity control units authorized for study in the Act will be determined when these projects are authorized. However, the Colorado River Basin Salinity Control Advisory Council has recommended that the same 75 percent federal, 25 percent Basin-wide financing arrangement be applied to these other units presently under investigation, including the USDA onfarm program. The Advisory Council, composed of members appointed by the Governor of each of the seven Colorado River Basin states, was created under Title II of Public Law 93-320.

Costs that are not part of the salinity control projects mentioned in Title II of the Act will be incurred by the federal and state governments and by private and local governmental entities in implementing measures that will control the river's salinity. The financing on each particular action or measure will have to be individually determined.

## Responsibility for Accomplishing Salinity Control Measures

The plan of implementation recognizes that the Forum, the several federal agencies, and the Basin states each have specific responsibilities

for furthering the salinity control program. Table 6 presents in summary form the elements of the plan of implementation, including actions to be taken, the time schedule and the responsible entities.

The Forum will provide overall coordination and a continuing review of salinity changes and of program effectiveness. Every 3 years, or more often if necessary, the Forum, in light of existing depletions and salt concentrations, will consider and, where needed and feasible, recommend revisions in the schedule for installing salinity control measures and/or modifications of the numeric criteria. The review will include both federal and non-federal programs.

Appropriate federal agencies will complete planning reports and seek authorizations and funding for salinity control in accordance with Title II of Public Law 93-320. The Basin states will lend their support to requests for authorization and funding.

Identifying and Evaluating Progress in the Salinity Control Program

Progress in the salinity control program will be monitored and evaluated on a continuing basis. Changes in the plan of implementation will be considered with each 3-year review and more often as appropriate. Annually, the states, acting through the Forum, will prepare a report which will summarize pertinent results and progress of the salinity control program and the effect of other actions in the Basin having an influence on salinity. The report will be transmitted to the EPA, to state water resources and pollution control agencies, and be available to others interested in the salinity control program.

Baseline salinity values have been developed for 13 points on the main stem of the Colorado River and major tributaries other than the three main stem locations for which numeric criteria for salinity have been established.

Table 6. - Timing and responsibility for accomplishing implementation plan

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Paradox Valley Unit | Complete Definite Plan Report. | January 1979 | USBR |
| | Environmental Statement. | September 1978 | |
| | Provide the leadership and resources required to maintain local and Basin support for project implementation. | October 1975 through construction | USBR, State of Colorado, Forum. |
| | Install pumps and pipeline; construct reservoir. | 1984-1987 | USBR. |
| | Initial year of salt removal. | 1984 (deep well inj)<br>1987 (evap pond) | Congress and Federal Administration. |
| Grand Valley Unit | | | |
| Water Systems Improvement | Complete Definite Plan Report. | March 1980 | USBR. |
| | Negative Determination of EIS on Stage I. | July 1978 | |
| | EIS remainder of Unit. | July 1978 | |
| | Improve canals, laterals. | 1980-1990 | USBR, State of Colorado. |
| | Initial year of salt removal. | 1982 | |
| Onfarm Improvements | Initiate onfarm irrigation and related lateral improvements. | 1979 | USDA, State of Colorado local entities. |
| | Initial year of salt removal. | 1980 | Congress and Federal Administration. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Crystal Geyser Unit | Complete Definite Plan Report. | Completed June 1976 | USBR. |
| | Negative Determination of EIS. | June 1976 | USBR. |
| | This unit has been indefinitely deferred because of its poor cost effectiveness. | | |
| Las Vegas Wash Unit | Complete Definite Plan Report. | November 1978 | USBR. |
| | Environmental Statement. | Completed May 1977 | |
| | Construction of this unit has been indefinitely deferred, owing to changing conditions as outlined in Chapter V. The project is to be reevaluated and reformulated. | 1982 | |
| Lower Gunnison Basin Unit | | | |
| Water Systems Improvement | | | |
| Uncompahgre Project Portion | Complete Feasibility Report, Stage I. | December 1981 | USBR, State of Colorado. |
| Balance of Lower Gunnison Basin Area | Complete Feasibility Report, Stage II. | June 1987 | USBR, State of Colorado. |
| Onfarm Improvements | Initiate onfarm irrigation and related lateral improvements. | 1983 | USDA, State of Colorado, local entities. |
| | Initial year of salt removal. | 1984 | Congress and Federal Administration. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Uinta Basin Unit | | | |
| Water Systems Improvement | Complete Feasibility Report. | March 1983 | USBR, State of Utah. |
| | Initial year of salt removel. | 1989 | |
| Onfarm Improvements | Initiate onfarm and related lateral improvements. | 1980 | USDA, State of Utah, local entities. |
| | Initial year of salt removal. | 1981 | Congress and Federal Administration. |
| Meeker Dome Unit | Complete Feasibility Report. | January 1984 | USBR. |
| | Initial year of salt removal. | 1993 | Congress and Federal Administration. |
| LaVerkin Springs Unit | Status report. | December 1979 | USBR, State of Utah. |
| | Unit indefinitely postponed due to poor cost effectiveness. | | Congress and Federal Administration. |
| Lower Virgin River Unit (formerly Littlefield Springs Unit) | Complete Feasibility Report. | February 1982 | USBR, States of Arizona and Nevada. |
| Point Source Control | Initial year of salt removal. | 1989 | Congress and Federal Administration. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Onfarm Improvements | Initiate onfarm and related lateral improvements. | 1983 | USDA, states, local entities. |
| | Initial year of salt removal. | 1984 | Congress and Federal Administration |
| Glenwood-Dotsero Springs Unit | Complete Feasibility Report. | May 1984 | USBR, State of Colorado. |
| | Initial year of salt removal. | 1994 | Congress and Federal Administration. |
| Price-San Rafael Rivers Unit Diffuse Source Control | Complete Feasibility Report. | March 1986 | USBR, State of Utah. |
| | Initial year of salt removal. | 1995 | Congress and Federal Administration. |
| Onfarm Improvements | Initiate onfarm irrigation related lateral improvements. | 1984 | USDA, States, local entities, Congress, and Federal Administration. |
| | Initial year of salt removal. | 1985 | |
| Dirty Devil River Unit Diffuse Source Control | Complete Feasibility Report. | February 1987 | USBR, State of Utah. |
| | Initial year of salt removal. | 1996 | Congress and Federal Administration. |
| Onfarm Improvements | Initiate onfarm irrigation related lateral improvements. | Not scheduled | USDA, States, local entities, Congress, and Federal Administration. |
| | Initial year of salt removal. | Not scheduled | |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Onfarm Improvements | Initiate onfarm irrigation related lateral improvements. | Not scheduled | USDA, state, local entities, Congress, and Federal Administration. |
| | Initial year of salt removal. | Not scheduled | |
| McElmo Creek Unit Diffuse Source Control | Complete Feasibility Report. | September 1983 | USBR, State of Colorado. |
| | Initial year of salt removal. | 1993 | Congress and Federal Administration. |
| Onfarm Improvements | Initiate onfarm irrigation and related lateral improvements. | 1984 | USDA, States, local entities, Congress, and Federal Administration. |
| | Initial year of salt removal. | 1985 | |
| Big Sandy River Unit Point Source Control | Complete Feasibility Report. | May 1984 | USBR, State of Wyoming. |
| | Initial year of salt removal. | 1993 | Congress and Federal Administration. |
| Onfarm Programs | Initiate onfarm irrigation related lateral improvements. | Not scheduled | USDA, state, local entities, Congress, and Federal Administration. |
| | Initial year of salt removal. | Not scheduled | |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Industrial Water Use | Encourage and promote the use of saline or brackish water for industrial purposes except where it would be environmentally unsound, economically infeasible, or significantly increase consumptive use. | 1980 through 1995 | Affected state, USBR, and EPA. |
| Industrial Discharges | The objective for industrial discharges shall be a no-salt return policy wherever practicable. EPA has endorsed the policy statement of the Forum and each state that has permit issuing authority has adopted the policy, except Wyoming. All states are following the Forum policy regarding NPDES permits. | November 1975 | Each state or EPA. |
| Agricultural Discharges | Conduct educational program. | 1980 through 1995 | Affected state and EPA |
| Measures to Cope with Salinity | Expand land drainage system in Lower Basin. | Ongoing | Local agencies. |
| | Treating and blending Colorado River water. | Ongoing | Local agencies. |
| Research and Special Studies | Research on irrigation water application in relation to salinity output, Grand Valley, Colorado. | Ongoing | USDA (ARS), USBR, State of Colorado. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Research and Special Studies - Continued | Other research and demonstration projects in the Grand Valley area. | Ongoing | Colorado Department of Health and Natural Resources. |
| | Wellton-Mohawk irrigation management. | Completed | USBR, USDA (ARS), State of Arizona |
| | Studies of salt precipitation in reservoirs. | Ongoing | USBR. |
| | Studies of land processes contributing to salt production from diffuse sources. | Ongoing | BLM, Utah State University. |
| | Study of the natural interaction of water and soil in the Green River Basin. | Ongoing | USDA (ARS). |
| | Studies of other areas where production of salts from nonpoint sources is significant (the scope and makeup of this study will depend on results from the research already underway). | Ongoing | USBR, BLM, EPA, affected states. |
| | Studies in other areas of the extent to which increases in irrigation efficiency will be effective in reducing salt loading (the scope and makeup of this study will depend on results from the research already underway). | Not yet scheduled except New Mexico where applicable research has been completed. | EPA, affected states. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Research and Special Studies - Continued | Identify and evaluate state water resources management programs, policies, and regulations and assess them for the purpose of identifying where they can be redirected toward salinity control policy. | Ongoing | Each Basin state, EPA. |
| | Examination of municipal discharges as a source of salinity and of possible control measures. | Ongoing | Each Basin state. |
| | California. | Completed | Regional Water Quality Control Board. |
| | Clark Co., Nevada. | Completed | City of Las Vegas, Clark Co. |
| | Implementation of municipal discharge salinity control. | | |
| | Calfornia | Ongoing | Regional Water Quality Control Board. |
| | Clark Co., Nevada. | Ongoing | City of Las Vegas, Clark Co |
| | Studies of brine pond cost reduction. | Ongoing | USBR. |
| | Study of relationship between sediment production and salinity. | Ongoing | CSU. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Water Quality Management (208) | Develop Water Quality (208) Management Plans. | | Certification by the state and approval by EPA. |
| Arizona | | | |
| District IV COG | State certification. | June 1979 | District IV COG, state |
| | EPA approval. | May 1981 | EPA, local agencies. |
| | Develop nonpoint source controls. | Not scheduled | District IV COG, local agencies. |
| Northern Arizona COG | State certification. | June 1979 | Northern Arizona COG, |
| | EPA approval. | May 1981 | state, local agencies, |
| | Develop nonpoint source controls. | | EPA. |
| Statewide Plan | State certification. | June 1979 | State, local agencies, EPA. |
| | EPA approval. | May 1981 | State, local agencies. |
| | Develop nonpoint source control. | May 1981 | |
| California | | | |
| Statewide | State certification. | Aug. 1979 | Calif. Regional Water Qualit Control Board, state, local agencies. |
| | Test program - accelerated flushing of saline ground waters (temporarily suspended due to lack of surplus flows). | 1982 | USBR, USGS, Palo Verde Irrigation District, local farmers. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Water Quality Management (208) (continued) | | | |
| Colorado | | | |
| Northwest Colorado COG | Under litigation, being revised. | Ongoing | NW. Colorado COG, state, local agencies, EPA. |
| Colorado West COG | State certification.<br>EPA approval. | Dec. 1980<br>Feb. 1981 | Colorado West COG, state, local agencies, USBR, USDA, EPA. |
| | Improve irrigation delivery system (lining and control structures); improved onfarm irrigation practices (land leveling, drainage); improved grazing practices; salinity control measures. | Ongoing through 1995. | USBR, USDA, BLM, Colorado west COG, state, local agencies, local farmers and ranchers. |
| Statewide | State certification.<br>EPA approval.<br>Improve irrigation delivery system, onfarm improvements, erosion control. | 1980<br>1981 | USBR, USDA, state, local agencies, local farmers. |
| Nevada | | | |
| Clark County (includes entire drainage area of Colorado River in Nevada) | Conditional state certification.<br>Conditional EPA approval.<br>Revised 208 Plan completed.<br>State certification.<br>EPA approval. | June 1978<br>July 1979<br>Feb. 1980<br>May 1980<br>Oct. 1981 | Clark Co. Comm., state local agencies., EPA |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Water Quality Management (208) (continued) | | | |
| Nevada | | | |
| Clark County (continued) | Wastewater reuse and disposal with industrial use. | | |
| | Develop salinity source control strategy for wastewater. | | |
| Muddy River Water Quality Improvement Program (RCWP) | Application submitted.<br>Initiate construction. | Feb. 1981<br>Not funded | State, USDA (ASCS). |
| Statewide | State certification.<br>Conditional EPA approval.<br>Revised 208 plan (draft).<br>State certification.<br>EPA approval. | Nov. 1978<br>March 1979<br>June 1981<br>Sept. 1981<br>Oct. 1981 | Nevada Department of Natural Resources, state, EPA. |
| | Nevada diffuse source regulations adopted by State Environmental Comm. | Oct. 1980 | |
| New Mexico | | | |
| Statewide | State certification.<br>EPA approval. | Jan 1981<br>April 1981 | State, local agencies, EPA. |
| | Implement BMP's.<br>Develop information. and education programs.<br>Reduce nonpoint source. salinity from silviculture. | | State, NM Soil and Conservation District. |
| Indian Lands | | June 1979 | Navajo Tribal Council. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Water Quality Management (208) (continued) | | | |
| Utah | | | |
| Southwestern | Conditional state certification.<br>Conditional EPA approval. | April 1980<br>May 1980 | Southwestern Utah AOG, state, local agencies, EPA. |
| Uintah Basin | State certification.<br>EPA approval. | Dec 1978<br>Oct 1979 | Uintah Basin AOG, state, local agencies, EPA. |
| | Identify problem areas.<br>Establish monitoring programs.<br>Implement site specific BMP's.<br>Improve irrigation water management. | Ongoing | Uintah Basin AOG, State USDA, Soil Conservation District, local agencies. |
| Southeastern | State certification.<br>EPA approval. | Dec 1978<br>Oct 1979 | Southeast Utah AOG state, local agencies, EPA. |
| | Assessment of problem areas.<br>Coordinate between entities.<br>Review federal and state.<br>water projects. | Ongoing | Southeast Utah AOG, USDA, USBR, BLM, state, local agencies. |
| Six County Area | State certification.<br>EPA approval. | Dec 1979<br>May 1980 | Six County AGO, state, EPA. |
| | Sampling and monitoring activities, prioritize and schedule site-specific BMP's. | Ongoing | Six County AOG, state, USGS USDA, local agencies. |
| Ute Indian Tribe | In progress. | Ongoing | Ute Indian Tribe. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Water Quality Management (208) (continued) | | | |
| Wyoming | | | |
| Southwestern | State certification.<br>EPA approval. | March 1980<br>Oct 1980 | Southwestern Wyoming, Water Quality Association, state, EPA. |
| | Improvement of irrigation management practices, promote use of saline waters for industrial purposes, point source salinity control. | Further action pending completion of USBR and USDA studies | SW, WYO WQA, USDA, USBR, state, local agencies, local farmers. |
| Statewide | State certification.<br>EPA approval.<br>Improved irrigation management practices. Use of saline water for industrial purposes. | March 1980<br>July 1980 | WY. Dept. of Environmental Quality, State, local agencies, EPA. |
| Other Activities | Analyze the monitoring program to determine the adequacy of the selected stations for the establishment of baseline salinity values. | 1979 | Forum and Seven states. |
| | Develop baseline salinity values for the specified monitoring points. | 1979 | Forum. |

Table 6. - Timing and responsibility for accomplishing implementation plan - Continued

| Activity or source of salinity | Major Actions | Timing 2/ | Entities responsible for taking action 1/ |
|---|---|---|---|
| Other Activities - continued | Prepare annual report on salinity control program and effect of other activities having an influence on salinity. | Annually | Forum. |
| | Implement onfarm improvements in local agricultural areas under USDA Programs. Erosion control and improved irrigation mangement. | Ongoing | USDA, states, conservation districts, local farmers. |
| | Reconsider and, where necessary, revise schedule for installing salinity control measures and/or modify the numeric criteria. | 1981 or before, at least each 3 years thereafter | Seven states. |
| | Investigate measures for limiting salinity in addition to those now in the plan of implementation to be applied after about 1990. | 1981 and thereafter | Seven states. |

1/ States will review and comment on research and special studies, feasibility reports, EIS, and DPR.
2/ Some ongoing programs will continue indefinitely; others will have dates assigned for either completion or significant action after they have progressed further.

The determination of these baseline values, or ranges of values, is based on historic flow and quality data modified to the 1972 level of development. A more complete explanation of the computation of the baseline values and a list of locations is given in Chapter II.

## Standards Review Procedure

Prior to state action on the review of the numeric criteria and plan of implementation, public review and discussion will be sought through public meetings. The Forum will hold two regional meetings in the Basin to describe the Basinwide nature of the salinity problem and the control program and to solicit views from interested agencies, groups, and individuals.

In accordance with provisions of the Clean Water Act, each of the Basin states plans to review and revise as necessary salinity standards for the Colorado River within its boundaries, and transmit the results of that effort to the EPA in early 1982. It should be noted that there is no recommendation for change in the numeric criteria for salinity at the three lower main stem stations. Action by each state will be accomplished according to the required procedures of each state.

## CHAPTER VI. FUTURE POSSIBLE SALINITY CONTROL PROGRAMS

The plan of implementation presented in the 1975 report included all of the salinity control projects authorized or identified for further study by Title II of Public Law 93-320 as part of the CRWQIP of the Bureau. Status of these units is discussed in Chapter V of this report.

Since the analyses presented in this report only cover the period up to 1995, and development will continue beyond 1995, other means of limiting the salinity level must be sought. Only a few of the following described actions have been evaluated in any depth, and their effectiveness and feasibility are not conclusive at this time. The others have undergone only very preliminary investigation and their feasibility is not known. Because of the relatively short period before some of them may be required, it is important that a state-federal program to examine these and other possibilities be initiated as expeditiously as possible. Wherever possible, these investigations will need to be conducted concurrently with the detailed studies and construction program required to carry out the plan of implementation.

### Agricultural Return Flow and Other Saline Water Utilization

Increasing demands for energy in and near the Colorado River Basin has focused attention on the need for water to meet projected cooling requirements for energy conversion and power production. A potential source of water for these and other industrial purposes is the return flow from irrigated agriculture which occurs in substantial quantities in the Colorado River Basin. In recognition of this fact, the following policy (quoted in part) was adopted by the Forum on September 11, 1980:

> "* * * The Forum finds that the objective of maintaining 1972 salinity levels would be served by the exercise of all feasible measures including, wherever practicable, the use of brackish and/or saline waters for industrial purposes.

"The summary and on Page 32 of the Forum's 1978 Revision of the Water Quality Standards for Salinity states 'The plan also contemplates the use of saline water for industrial purposes whenever practicable, * * *.' In order to implement this concept, and thereby further extend the Forum's basic salinity policies, the Colorado River Basin states support the Water and Power Resources Service appraisal study of saline water collection, pretreatment and potential industrial use."

See Appendix for the full text of the policy.

Contingent on appropriation of funds, the schedule for completion of the Bureau's studies of saline water use is as follows:

| | |
|---|---|
| Initiate special study | April 1980 |
| Completion of special report | August 1981 |
| If study shows promise, completion of feasibility study | October 1983 |

The special study is underway and a preliminary draft of the report was distributed for comment in July 1981. The special study covered a broad spectrum of potential sources, uses, and disposal options for saline waters. Following a number of public participation meetings and input from the states, industry representatives, and technical reviewers, it was concluded that local industrial uses and coal slurry transport appear to be the most cost-effective options. Long distance collection and disposal options do not appear viable at this time.

A similar collection effort on a relatively small scale was earlier proposed in the Grand Valley area in Colorado.

Grand Valley Collection System, Colorado

A significant portion of the return flow from the 60,000 irrigated acres in the Grand Valley returns to the Colorado River as highly saline surface flow and ground water effluent. Installation of the USDA onfarm irrigation water use facilities began in 1979 and contracts for lining a portion of the main canal under Stage I of the Grand Valley Salinity Control Unit were completed in 1981. Following a 1-year monitoring program to verify the

results of Stage I, construction should be continued on the remainder of unit. The Grand Valley Salinity Control Unit is estimated to annually reduce irrigation return flows from about 250,000 acre-feet to 40 to 60,000 acre-feet. This remaining surface and ground water flow could be intercepted and transported by pipelines to a point of industrial use.

## Weather Modification

The largest winter orographic cloud seeding experiment in the United States, the Colorado River Basin Pilot Project, was conducted by the Bureau in the San Juan Mountains of southwest Colorado. Actual cloud seeding activities under this project were completed in April 1975 and an evaluation of the project results was prepared by Aerometric Research, Inc., of Goleta, California, in 1976.

The Bureau was directed by Congress in 1977 1/ to "prepare plans for the Colorado River Augmentation Program." Another cloud seeding program has been proposed for the San Juan Mountains which could lead to a Basinwide program for full operation by as early as 1989.

A report has been prepared by the Bureau entitled "Application of the Colorado River Simulation System in Evaluation of Weather Modification Activity." The report includes results of a study using the simulation model for water distribution and the Twelve Basin Investigation Microphysical and Convective Estimates for establishing the increment of increase in runoff from weather modification. If this incremental increase is correct and technical, institutional, and environmental problems can be resolved, the report shows significant benefits in increased flows and reduced salinity.

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1/ Public Works for Water and Power Development and Energy Research Appropriation Bill, Senate, 95th Congress, 1st Session, Report No. 95-301, June 25, 1977, page 65.

Increased flow due to weather modification will result in an increased salt load just as any year of high flow brings down more salt than a low flow year. Salinity concentrations will vary with the type, location, and time of development of beneficial use made by the states of the increased yield.

## Irrigation Efficiency

Return flow from agriculture has been identified as the major source of salinity in the Colorado River that may be controlled. It appears if drainage of irrigation water through soils that contain residual salts can be minimized, the amount of salt carried to the Colorado River by this means can be reduced. To help meet the general objective of maintaining salinity at or below 1972 levels while permitting development to continue, research must be continued to improve irrigation efficiency.

Recent cooperative work by the SCS, Bureau, and farmers in the Wellton-Mohawk Irrigation and Drainage District near Yuma, Arizona, and the Colorado River Indian Reservation, Arizona, show positive results in reducing water diversions. Use of lasers to achieve dead level irrigation and onfarm and related irrigation system improvements have been used singly and in combination. A similar program is being initiated in Imperial Valley in cooperation with the Imperial Irrigation District.

Laser leveling is effective where the original slope of the land is not excessive and relatively high heads of water are available for irrigation. Rapid application of water onto dead level fields results in a very uniform application not yet found possible by other means. The SCS has been involved with the farmers in onfarm improvements under provisions of Public Law 93-320. The principal improvement in reducing water consumption has been installation of water measurement structures. These have permitted better control of the

application of the irrigation water. Other improvements have been aimed at increasing hydraulic head by resloping and lining laterals.

The Irrigation Management Services (IMS) described in Title II of Public Law 93-320 has not been well received by local farmers because of a lack of water control structures and measuring devices. As this equipment is installed by the farmers, USBR, and USDA, in a joint effort, will provide technical assistance to implement the program.

## Rangeland Management Practices

BLM has investigated the effects of livestock grazing on salinity levels in surface runoff. It has been suggested that providing a systematic rest for vegetation and soils during critical periods can be an important means of controlling salinity in runoff. The BLM is also evaluating methods for controlling highly saline ground water discharges from public domain lands.

## CHAPTER VII. PROVISION FOR REVIEWING AND REVISING STANDARDS

Both the numeric criteria and plan of implementation will be continuously reviewed in the light of changed conditions or new information. Revisions to the plan of implementation and upward or downward changes to the numeric criteria will be considered at 3-year intervals.

The Forum in its statement of "Principles and Assumptions for Development of Colorado River Salinity Standards and Implementation Plan," approved by the Forum on September 20, 1974, included Principle 7 as follows:

> "7. The plan of implementation shall be reviewed and modified as appropriate from time to time, but at least once each 3 years. At the same time, the [numeric] standards, as required by Section 303(c)(1) of PL 92-500 shall be reviewed for the purpose of modifying and adopting standards consistent with the plan so that the Basin States may continue to develop their compact-apportioned waters while providing the best practicable water quality in the Colorado River Basin."

The Forum took this position because the Colorado River Basin is a large and complex area with many problems. A wide range of research, technical studies, and actions are underway and much knowledge is yet to be gained. Usable procedures for dealing with much of the salinity of irrigation return flows are only in the initial stages of development. Construction on the authorized units in the Bureau salinity control program is underway. There are as yet no firm procedures for the financing or cost sharing of salinity control works other than for the four authorized units of the Bureau program.

The permanent Work Group continues to keep current with salinity control efforts and suggests revisions. The Work Group operates under a schedule which enables the states to take action on any potential revision by the required revision date.

APPENDIX A

TOTAL DISSOLVED SOLIDS VS. FLOW


| | Pages |
|---|---|
| Figure 1 (a) and (b) - Colorado River near Cameo | A- 1 and A- 2 |
| Figure 2 (a) and (b) - Gunnison River near Grand Junction | A- 3 and A- 4 |
| Figure 3 (a) and (b) - Colorado River near Cisco | A- 5 and A- 6 |
| Figure 4 (a) and (b) - San Juan River near Archuleta | A- 7 and A- 8 |
| Figure 5 (a) and (b) - San Juan River near Bluff | A- 9 and A-10 |
| Figure 6 (a) and (b) - Colorado River at Lees Ferry | A-11 and A-12 |
| Figure 7 (a) and (b) - Green River near Green River, Wyo. | A-13 and A-14 |
| Figure 8 (a) and (b) - Duchesne River near Randlett | A-15 and A-16 |
| Figure 9 (a) and (b) - Green River at Green River, Utah | A-17 and A-18 |
| Figure 10 (a) and (b) - San Rafael River near Green River | A-19 and A-20 |
| Figure 11 (a) and (b) - Dolores River at Cisco | A-21 and A-22 |
| Figure 12 (a) and (b) - White River near Watson | A-23 and A-24 |
| Figure 13 (a) and (b) - Virgin River at Littlefield | A-25 and A-26 |

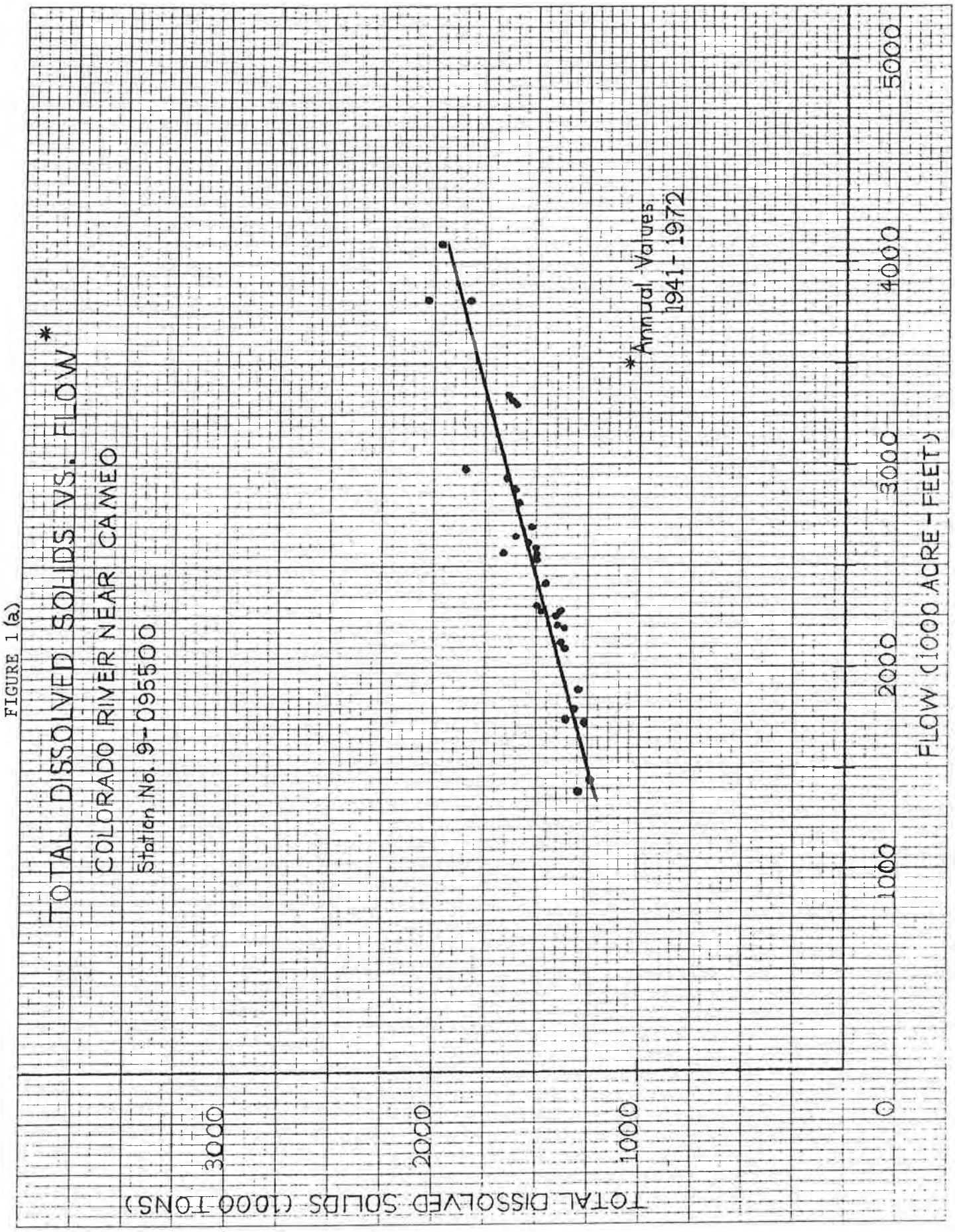

TOTAL DISSOLVED SOLIDS VS. FLOW *
COLORADO RIVER NEAR CAMEO
Station No. 9-095500
* Annual Values
1941-1972
TOTAL DISSOLVED SOLIDS (1000 TONS)
FLOW (1000 ACRE-FEET)
0
1000
2000
3000
4000
5000

FIGURE 1 (a)

FIGURE 1(b)

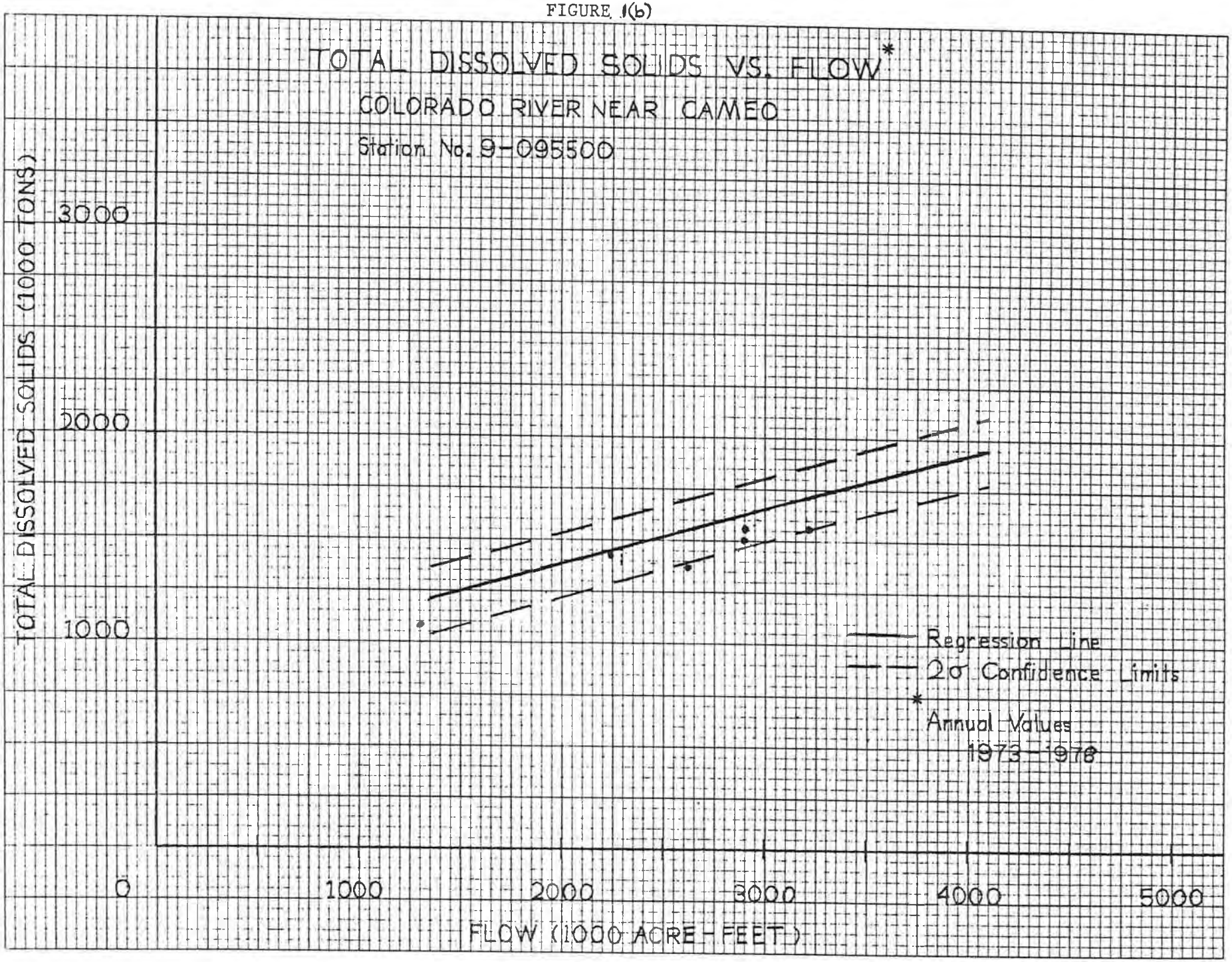

TOTAL DISSOLVED SOLIDS VS. FLOW*
COLORADO RIVER NEAR CAMEO
Station No. 9-095500
TOTAL DISSOLVED SOLIDS (1000 TONS)
3000
2000
1000
0
1000
2000
3000
4000
5000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
* Annual Values
1973 - 1978

FIGURE 2 (a)

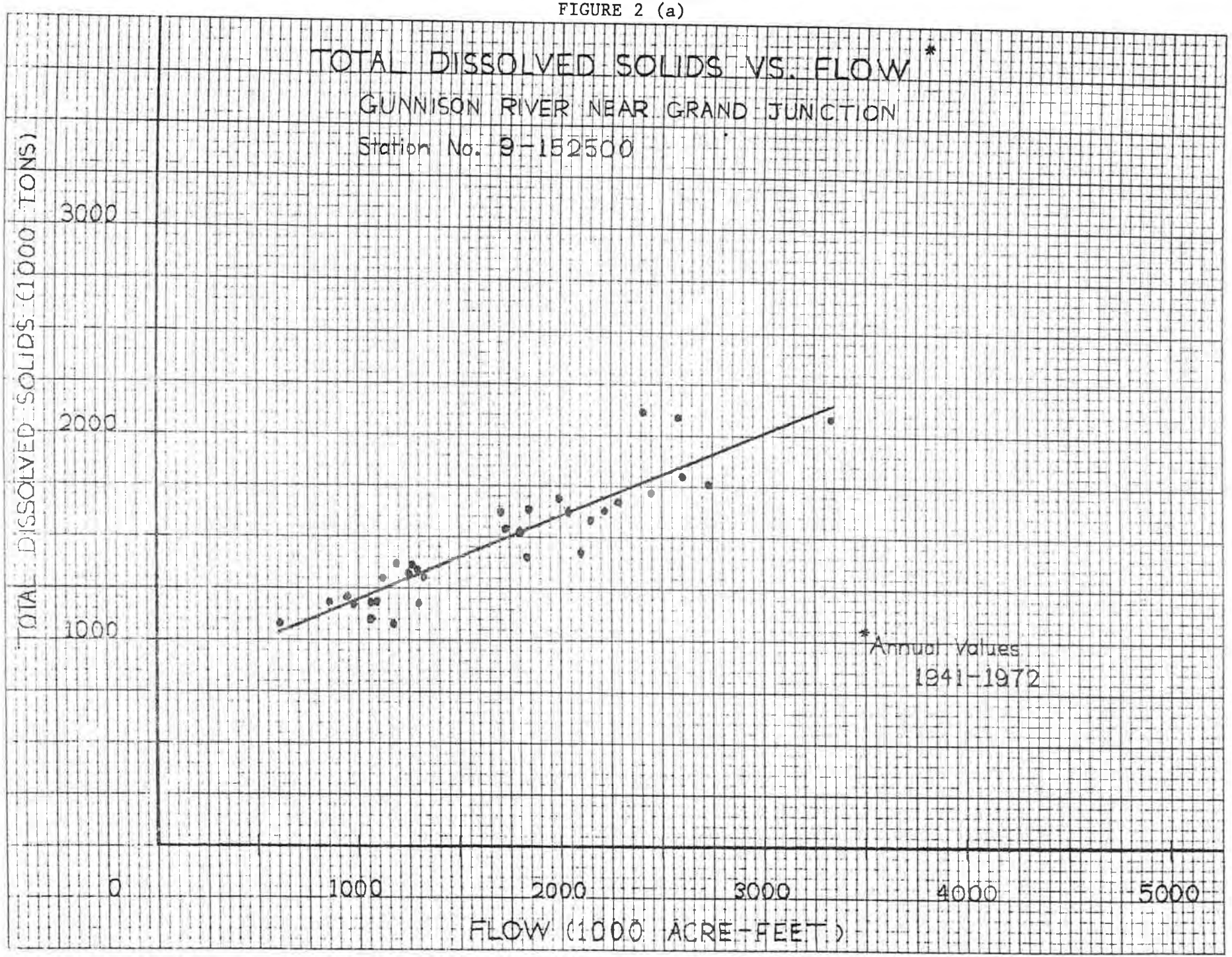

TOTAL DISSOLVED SOLIDS VS. FLOW *
GUNNISON RIVER NEAR GRAND JUNCTION
Station No. 9-152500
TOTAL DISSOLVED SOLIDS (1000 TONS)
3000
2000
1000
0
1000
2000
3000
4000
5000
FLOW (1000 ACRE-FEET)
*Annual Values
1941-1972

FIGURE 2 (b)

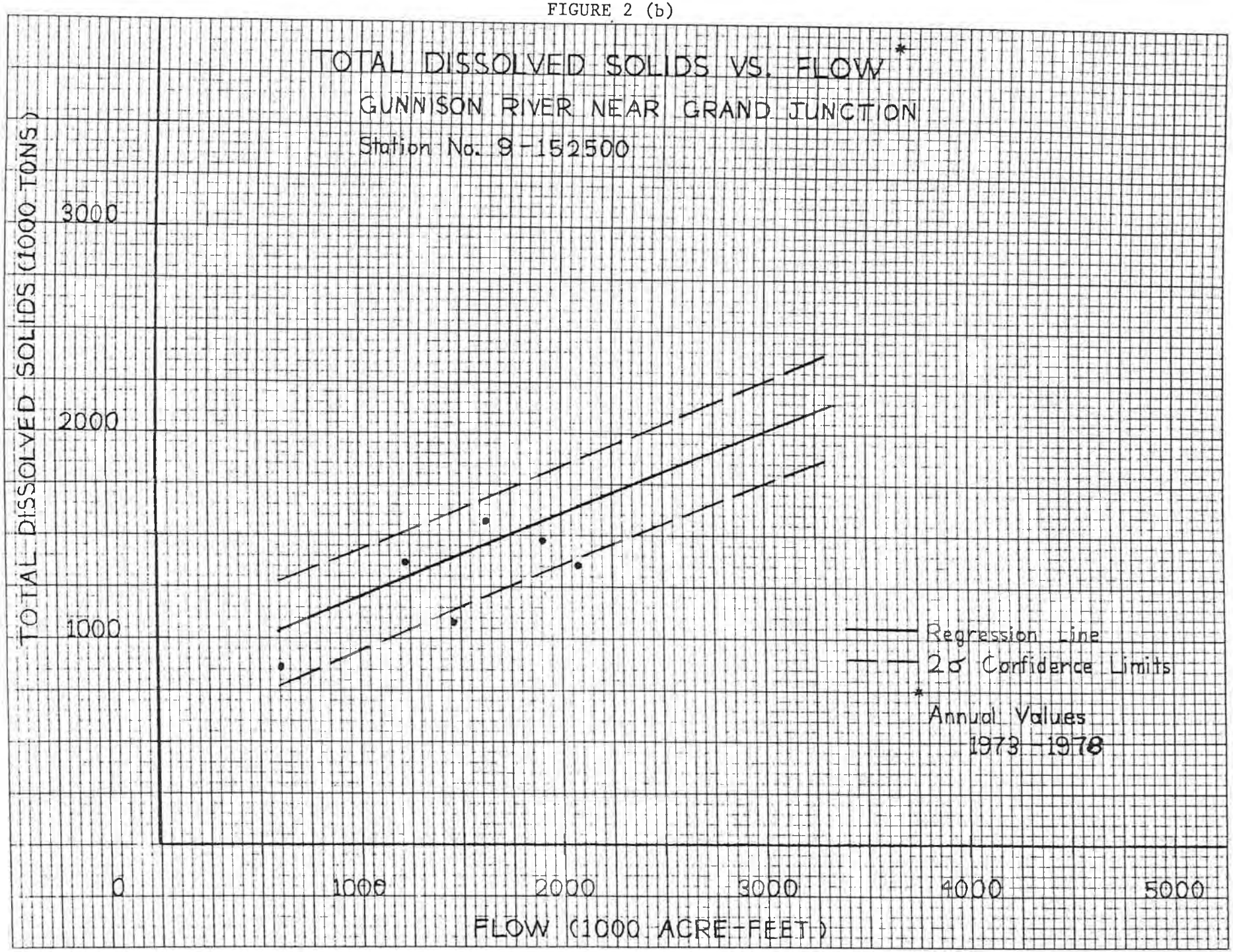

TOTAL DISSOLVED SOLIDS VS. FLOW *
GUNNISON RIVER NEAR GRAND JUNCTION
Station No. 9-152500
TOTAL DISSOLVED SOLIDS (1000 TONS)
3000
2000
1000
0
1000
2000
3000
4000
5000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
* Annual Values
1973 - 1978

FIGURE 3 (a)

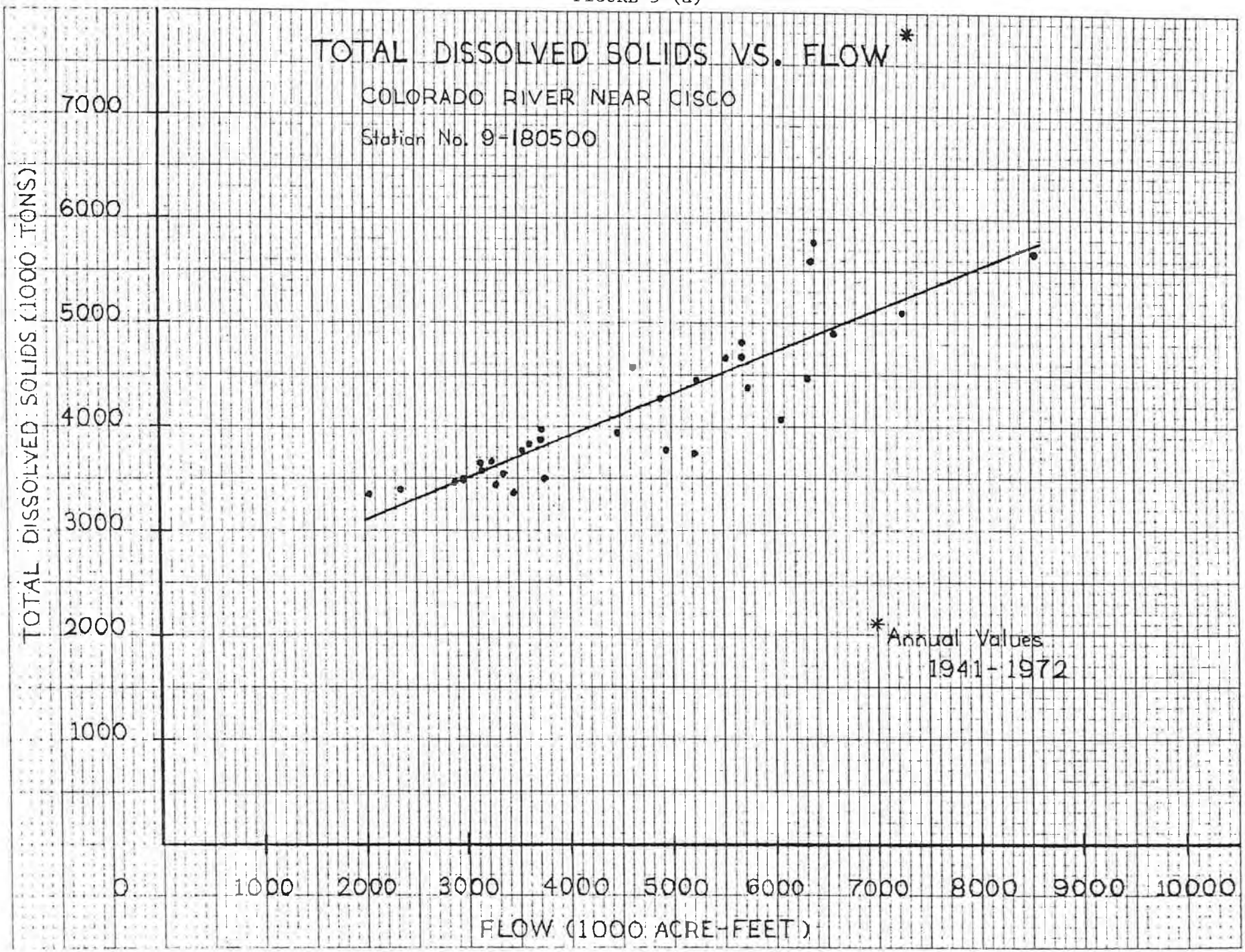

TOTAL DISSOLVED SOLIDS VS. FLOW*
COLORADO RIVER NEAR CISCO
Station No. 9-180500
TOTAL DISSOLVED SOLIDS (1000 TONS)
7000
6000
5000
4000
3000
2000
1000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
FLOW (1000 ACRE-FEET)
*Annual Values
1941 - 1972

FIGURE 3 (b)

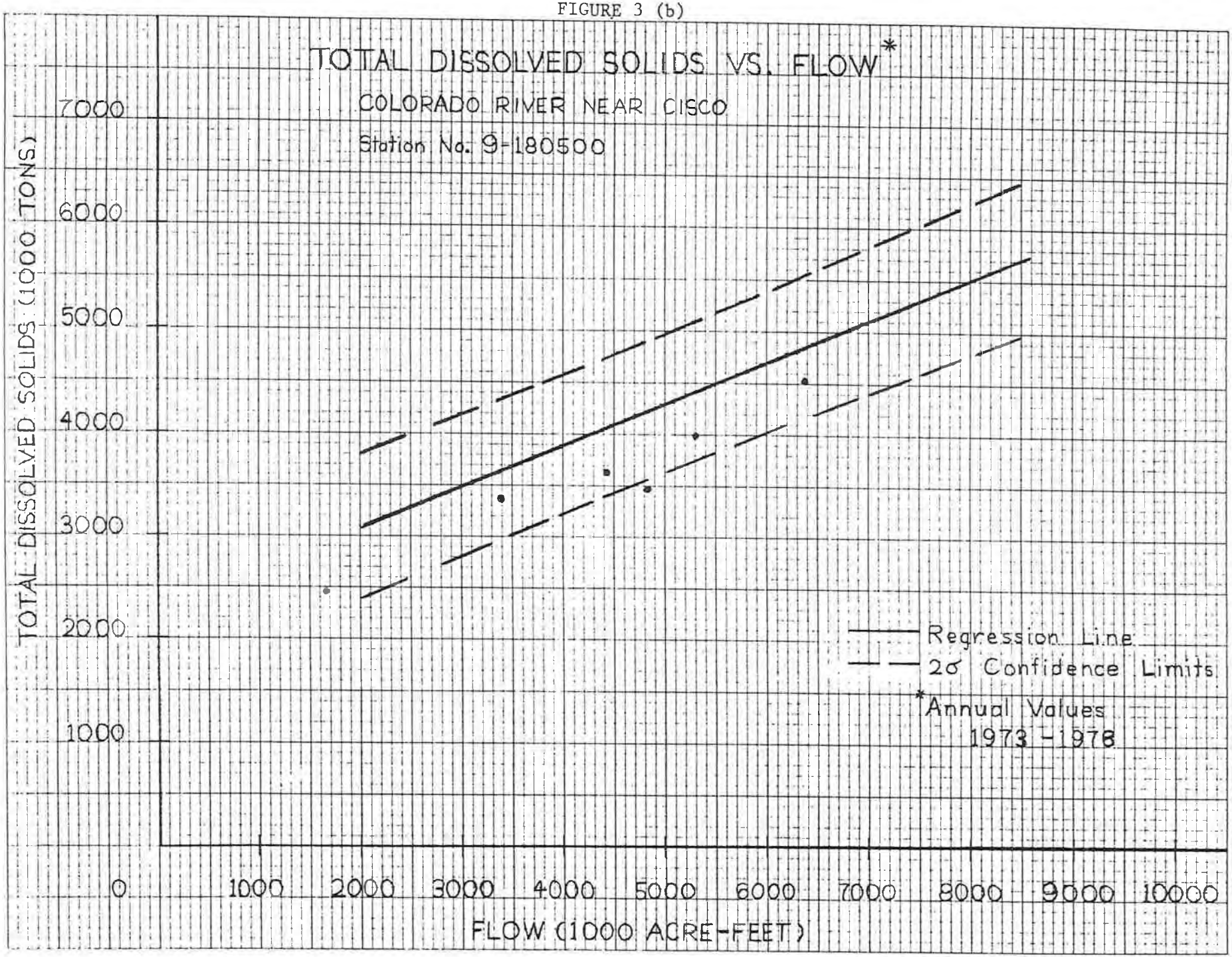

TOTAL DISSOLVED SOLIDS VS. FLOW*
COLORADO RIVER NEAR CISCO
Station No. 9-180500
TOTAL DISSOLVED SOLIDS (1000 TONS)
7000
6000
5000
4000
3000
2000
1000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
10000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973 - 1978

FIGURE 4 (a)

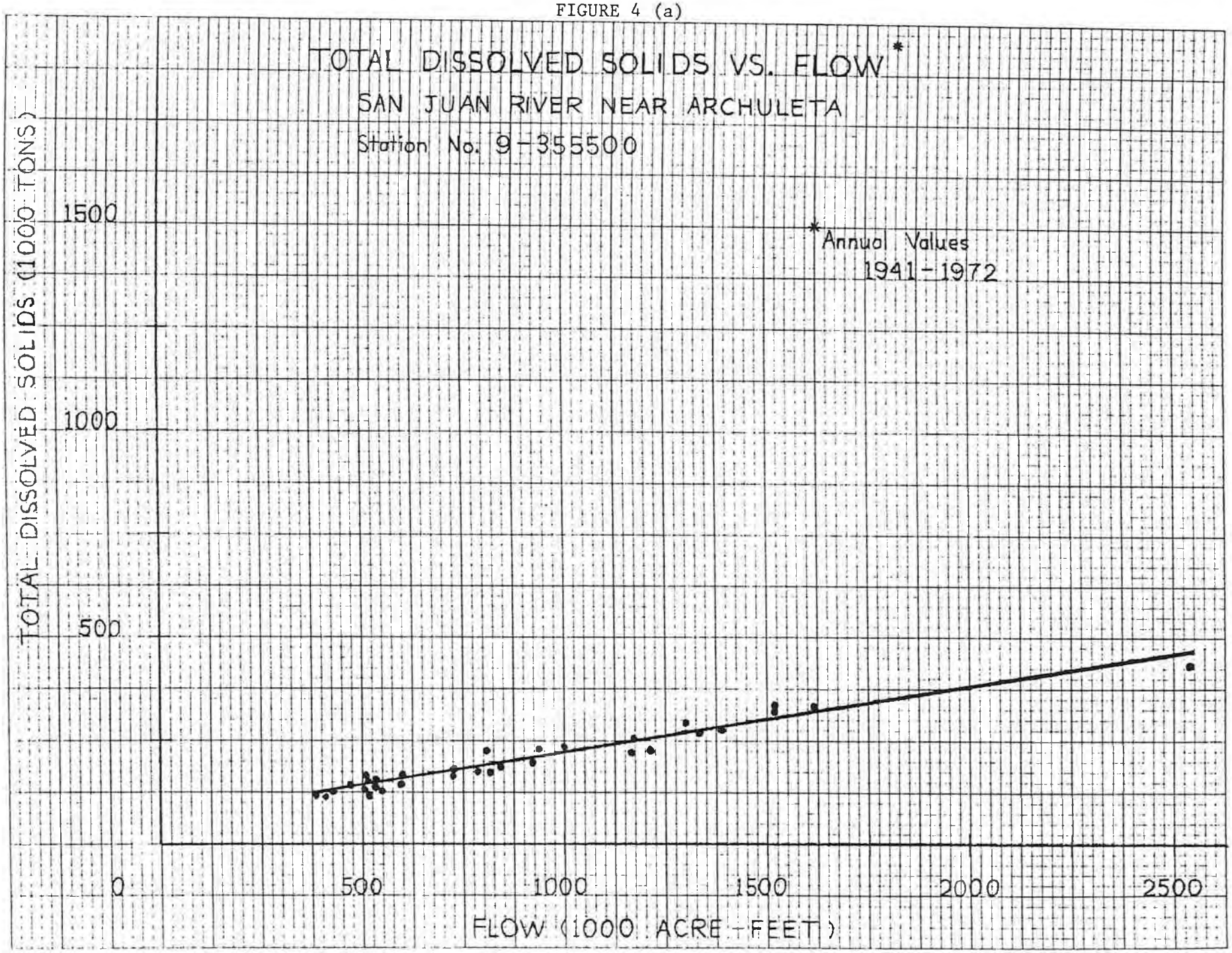

TOTAL DISSOLVED SOLIDS VS. FLOW*
SAN JUAN RIVER NEAR ARCHULETA
Station No. 9-355500
*Annual Values
1941-1972
TOTAL DISSOLVED SOLIDS (1000 TONS)
1500
1000
500
0
500
1000
1500
2000
2500
FLOW (1000 ACRE-FEET)

FIGURE 4 (b)

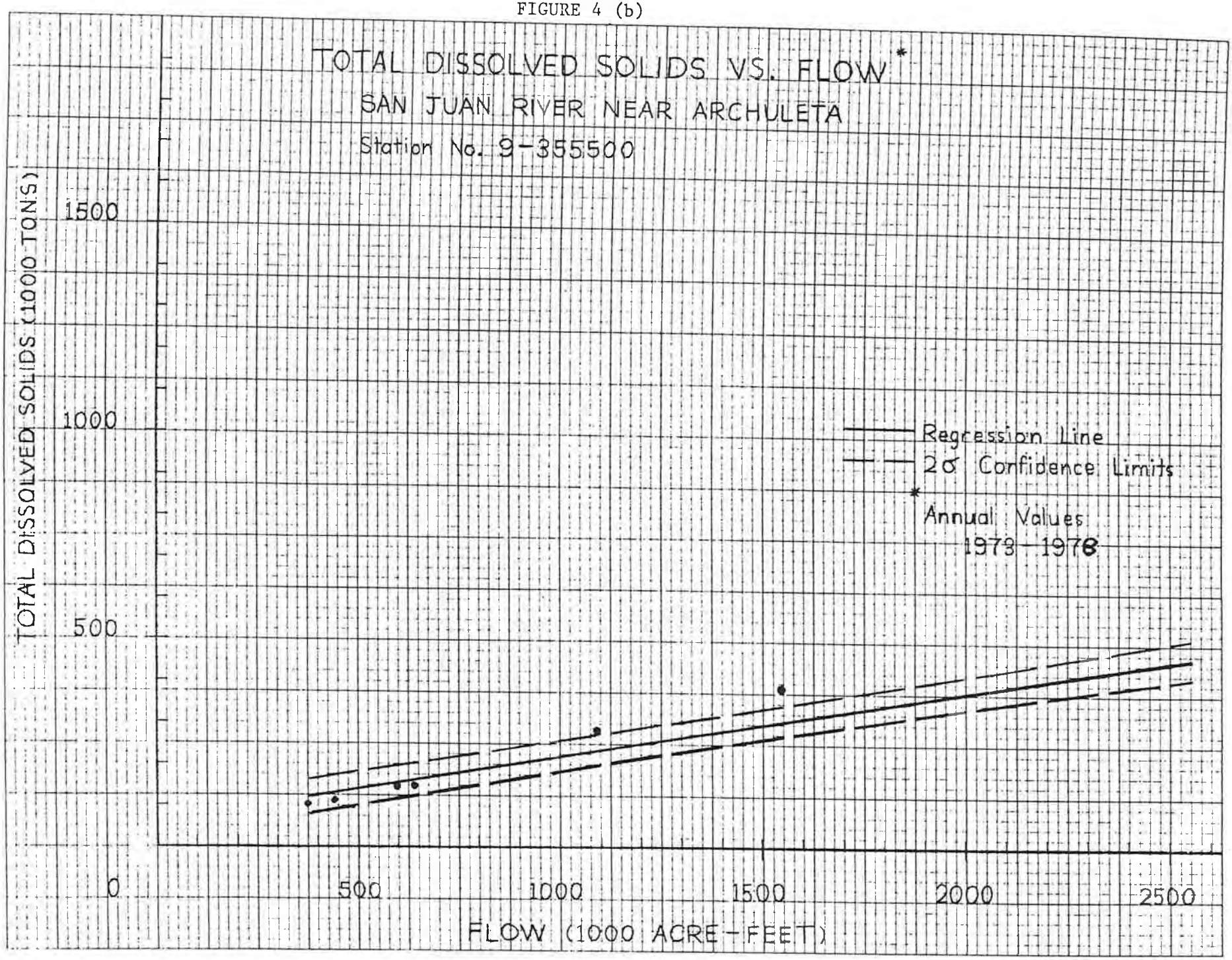

TOTAL DISSOLVED SOLIDS VS. FLOW*
SAN JUAN RIVER NEAR ARCHULETA
Station No. 9-355500
TOTAL DISSOLVED SOLIDS (1000 TONS)
1500
1000
500
0
500
1000
1500
2000
2500
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
* Annual Values
1973-1978

FIGURE 5 (a)

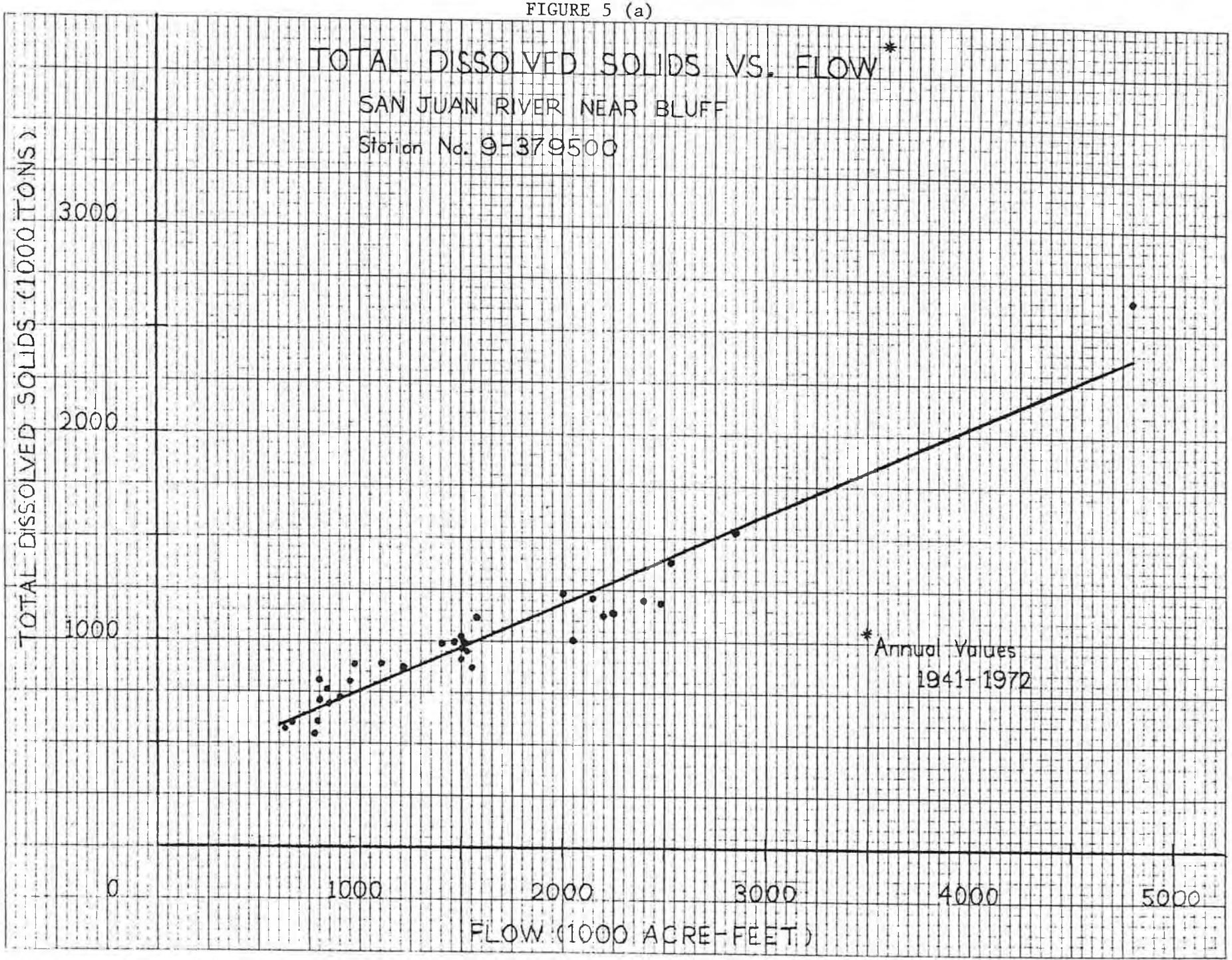

TOTAL DISSOLVED SOLIDS VS. FLOW*
SAN JUAN RIVER NEAR BLUFF
Station No. 9-379500
TOTAL DISSOLVED SOLIDS (1000 TONS)
3000
2000
1000
0
1000
2000
3000
4000
5000
FLOW (1000 ACRE-FEET)
*Annual Values
1941-1972

FIGURE 5 (b)

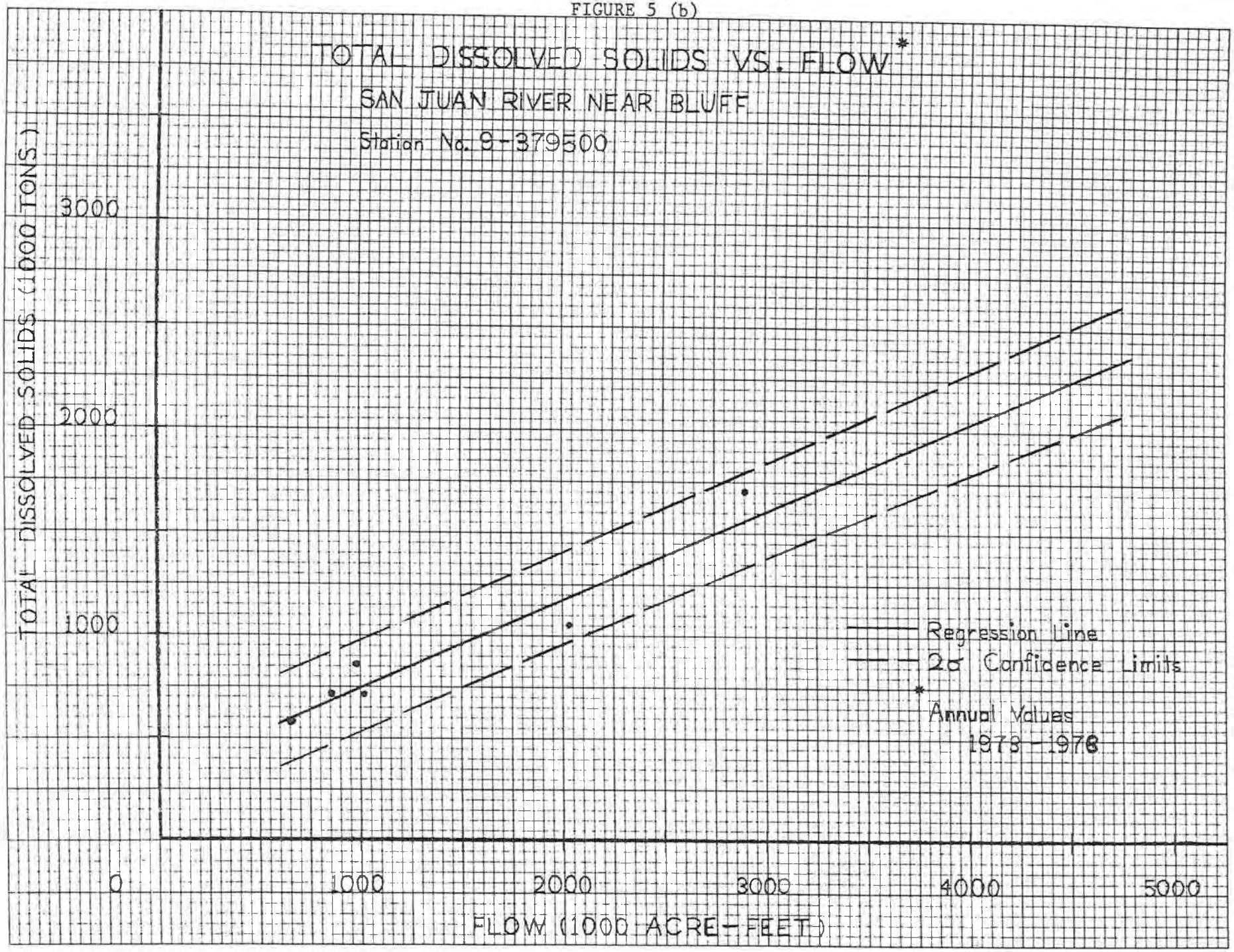

TOTAL DISSOLVED SOLIDS VS. FLOW*
SAN JUAN RIVER NEAR BLUFF
Station No. 9-379500
TOTAL DISSOLVED SOLIDS (1000 TONS)
3000
2000
1000
0
1000
2000
3000
4000
5000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
* Annual Values
1973 - 1976

FIGURE 6 (a)

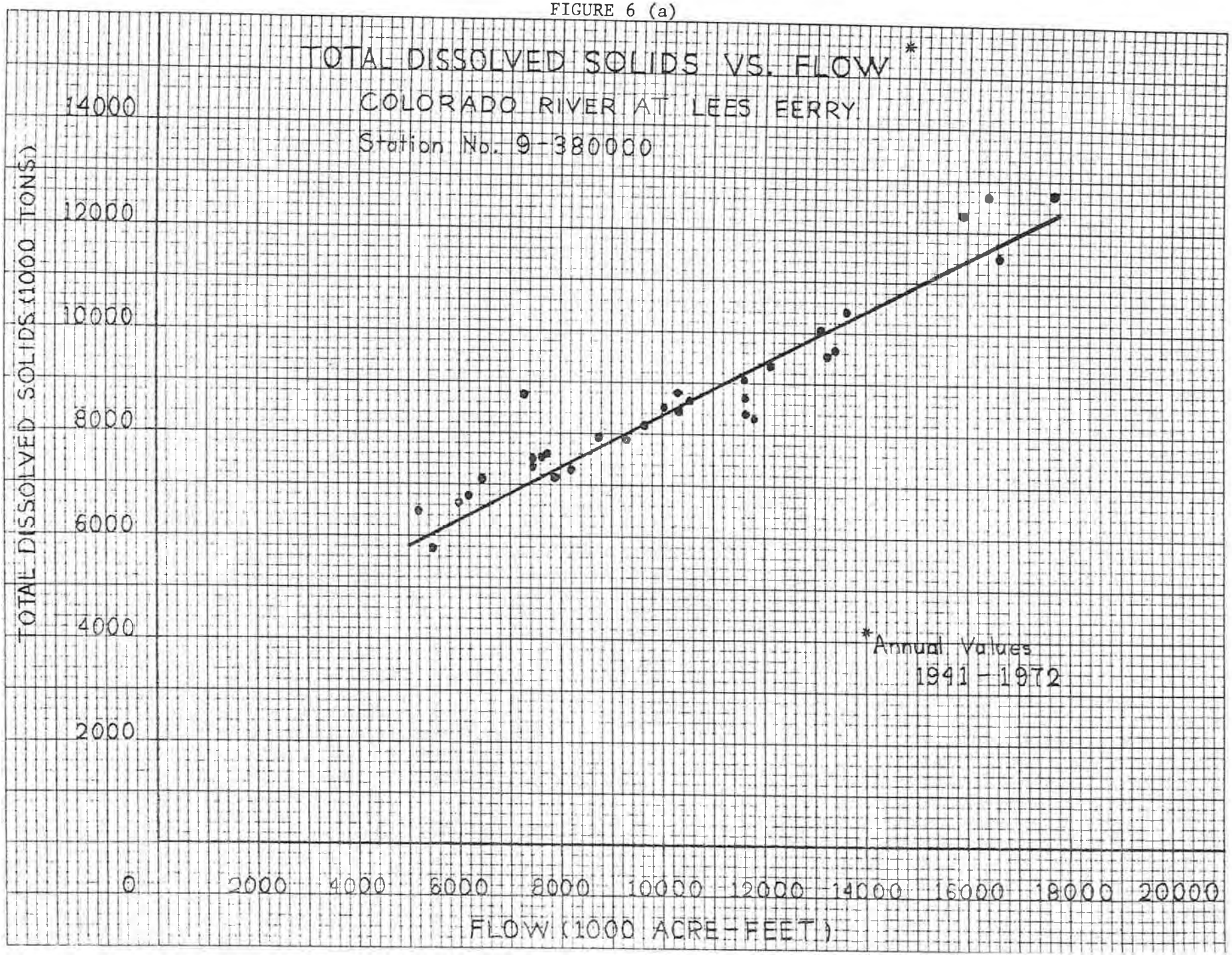

TOTAL DISSOLVED SOLIDS VS. FLOW *
COLORADO RIVER AT LEES FERRY
Station No. 9-380000
TOTAL DISSOLVED SOLIDS (1000 TONS)
14000
12000
10000
8000
6000
4000
2000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
FLOW (1000 ACRE-FEET)
*Annual Values
1941 - 1972

FIGURE 6 (b)

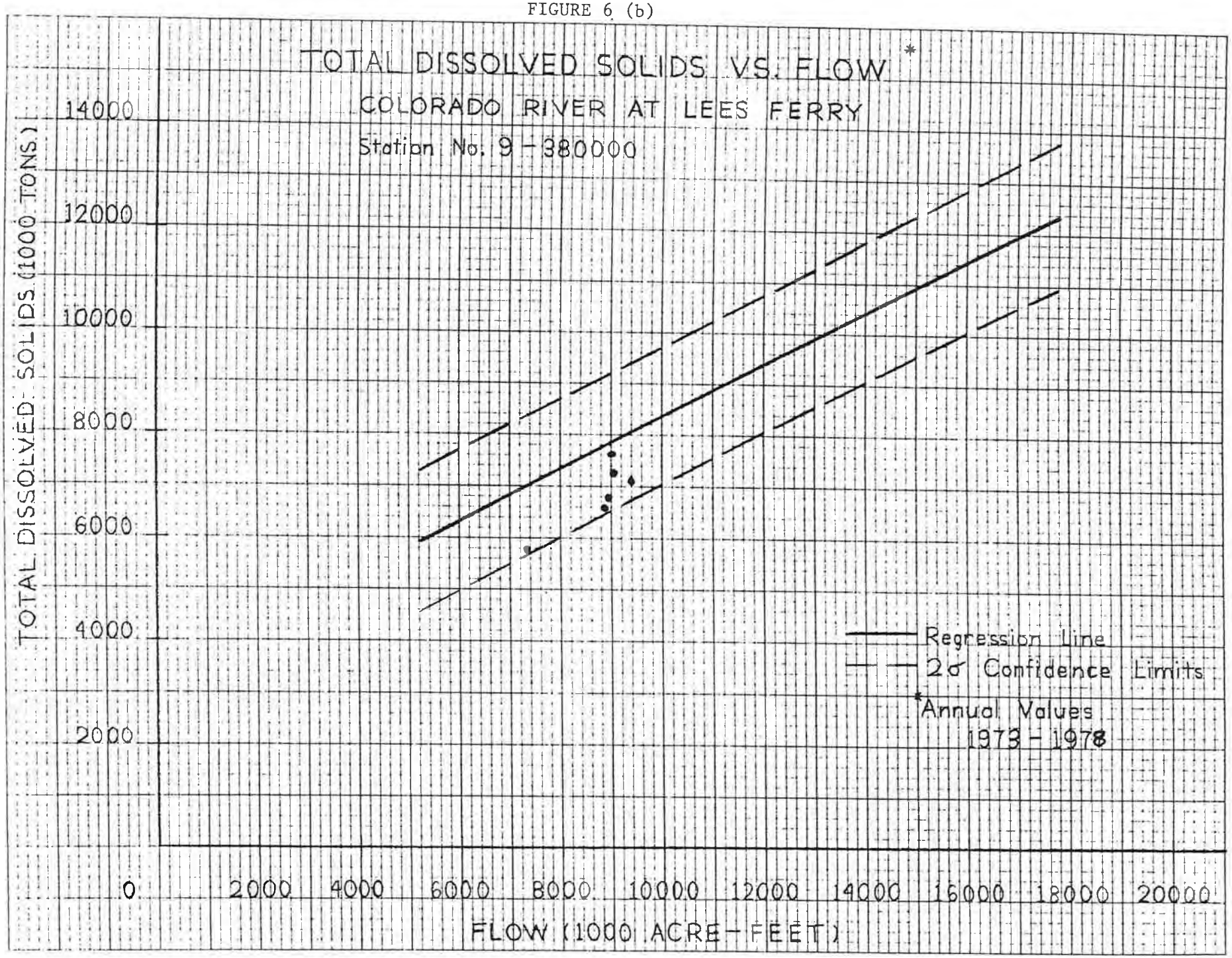

TOTAL DISSOLVED SOLIDS VS. FLOW *
COLORADO RIVER AT LEES FERRY
Station No. 9-380000
TOTAL DISSOLVED SOLIDS (1000 TONS)
14000
12000
10000
8000
6000
4000
2000
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
20000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973 - 1978

FIGURE 7 (a)

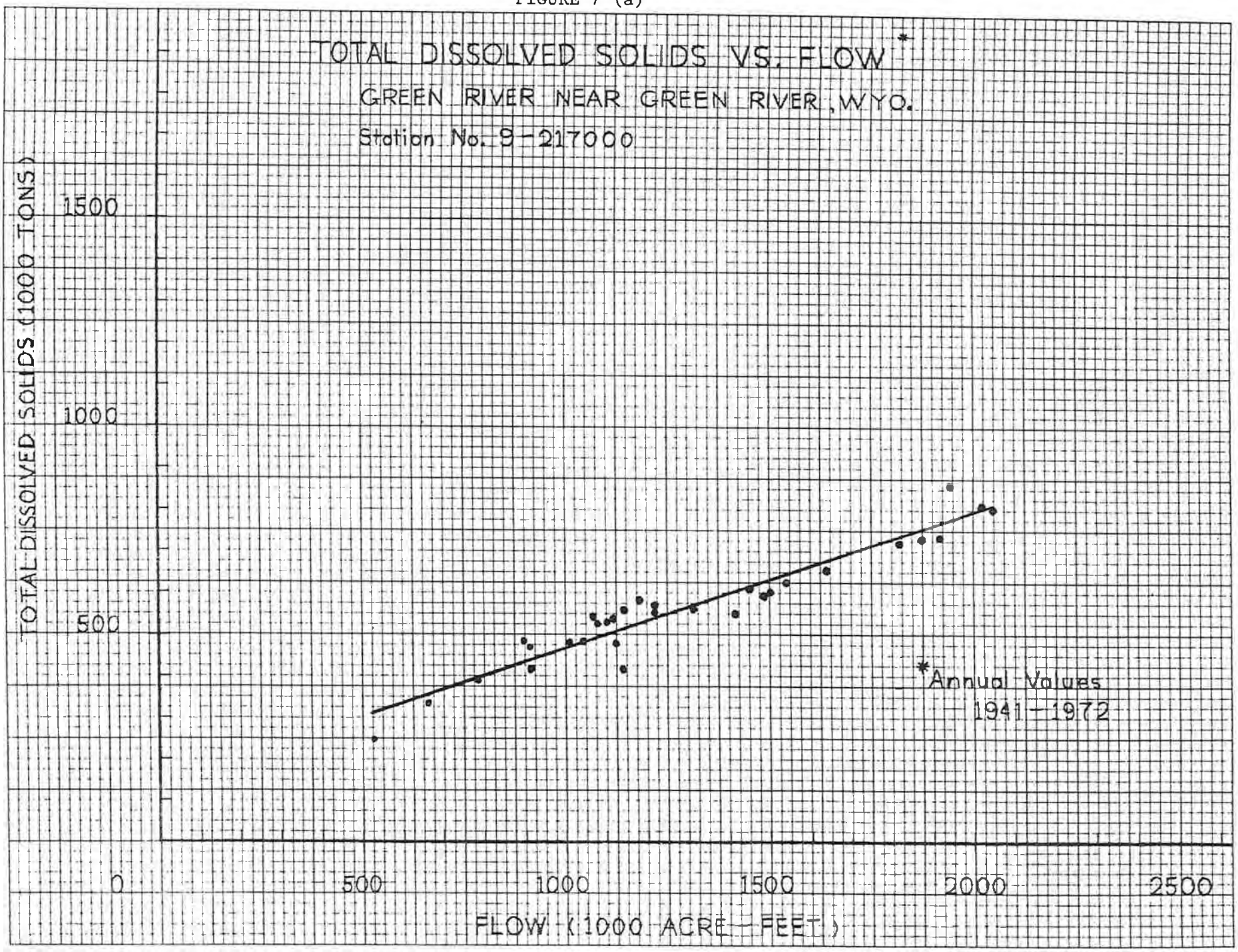

TOTAL DISSOLVED SOLIDS VS. FLOW*
GREEN RIVER NEAR GREEN RIVER, WYO.
Station No. 9-217000
TOTAL DISSOLVED SOLIDS (1000 TONS)
1500
1000
500
0
500
1000
1500
2000
2500
FLOW (1000 ACRE-FEET)
*Annual Values
1941-1972

FIGURE 7 (b)

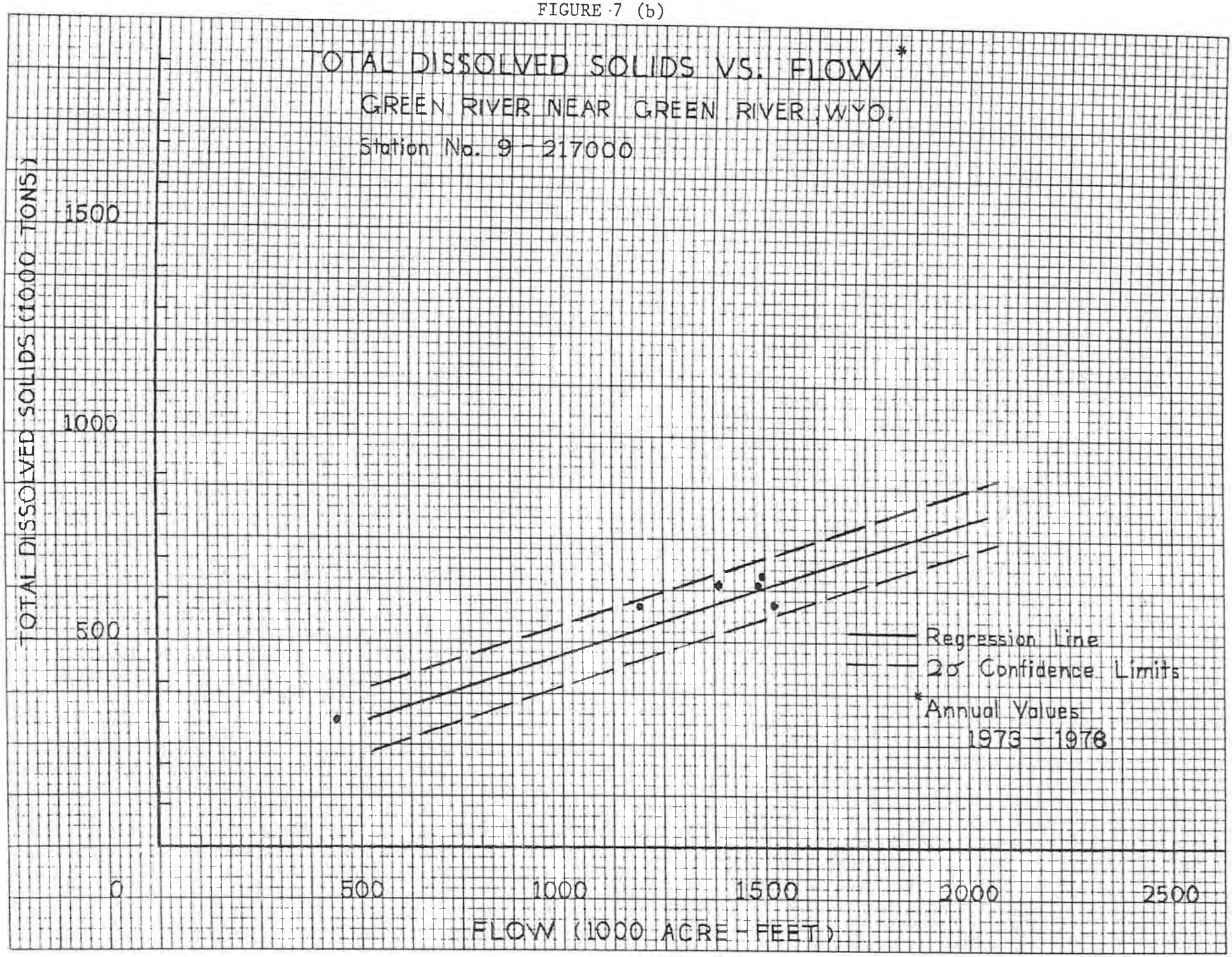

TOTAL DISSOLVED SOLIDS VS. FLOW*
GREEN RIVER NEAR GREEN RIVER, WYO.
Station No. 9-217000
TOTAL DISSOLVED SOLIDS (1000 TONS)
1500
1000
500
0
500
1000
1500
2000
2500
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973 - 1978

FIGURE 8 (a)

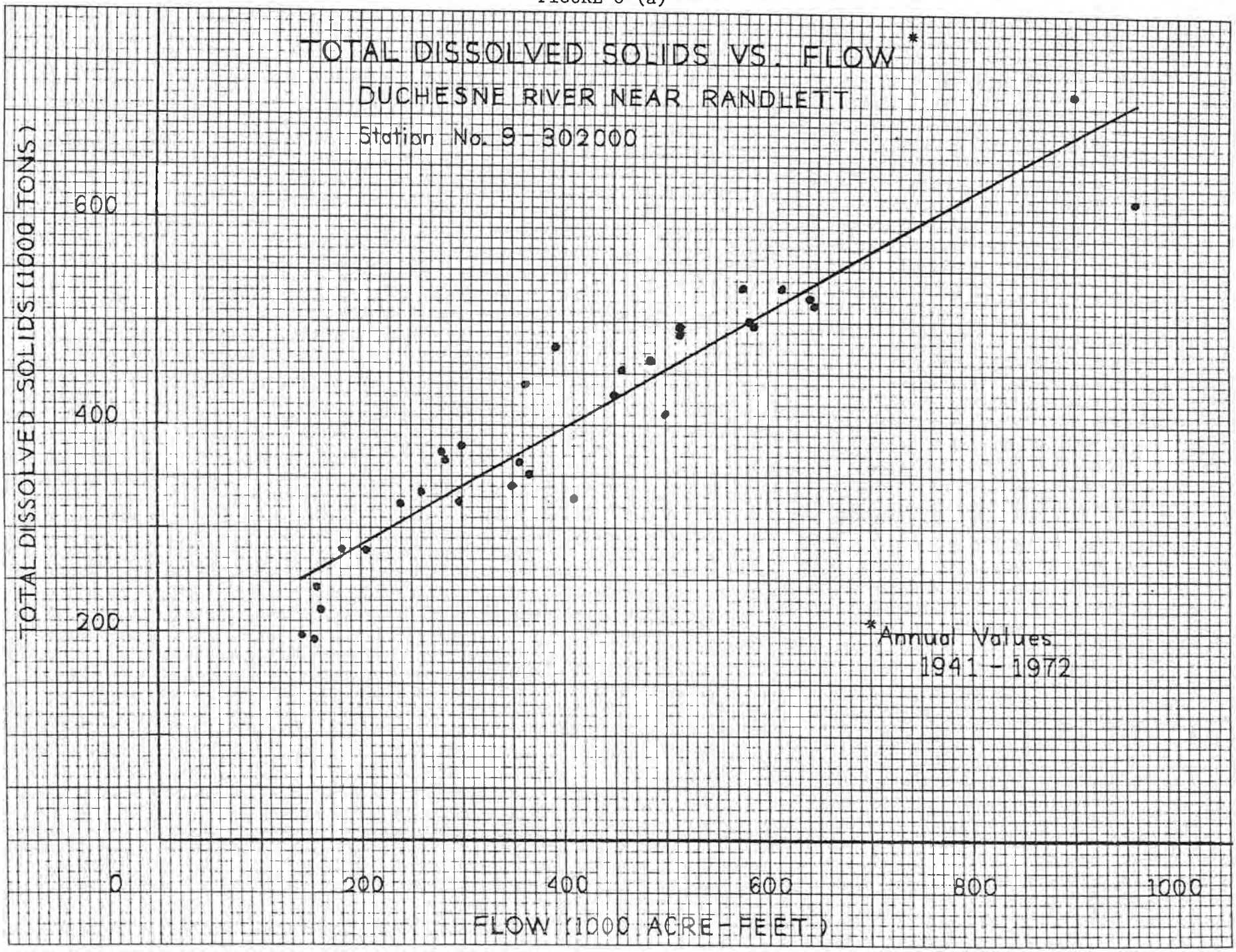

TOTAL DISSOLVED SOLIDS VS. FLOW*
DUCHESNE RIVER NEAR RANDLETT
Station No. 9-302000
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
*Annual Values
1941 - 1972

FIGURE 8 (b)

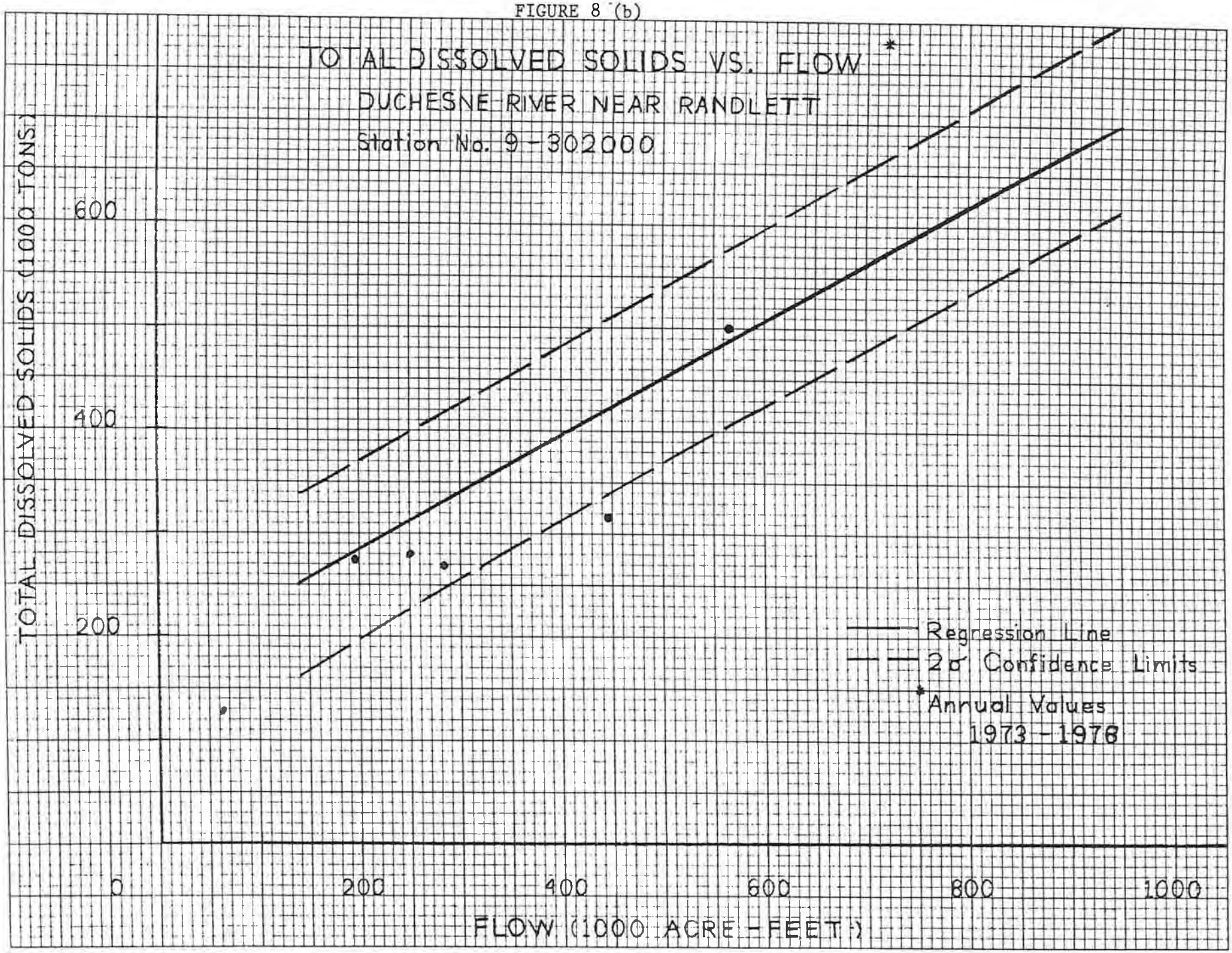

TOTAL DISSOLVED SOLIDS VS. FLOW
DUCHESNE RIVER NEAR RANDLETT
Station No. 9-302000
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973 - 1976

FIGURE 9 (a)

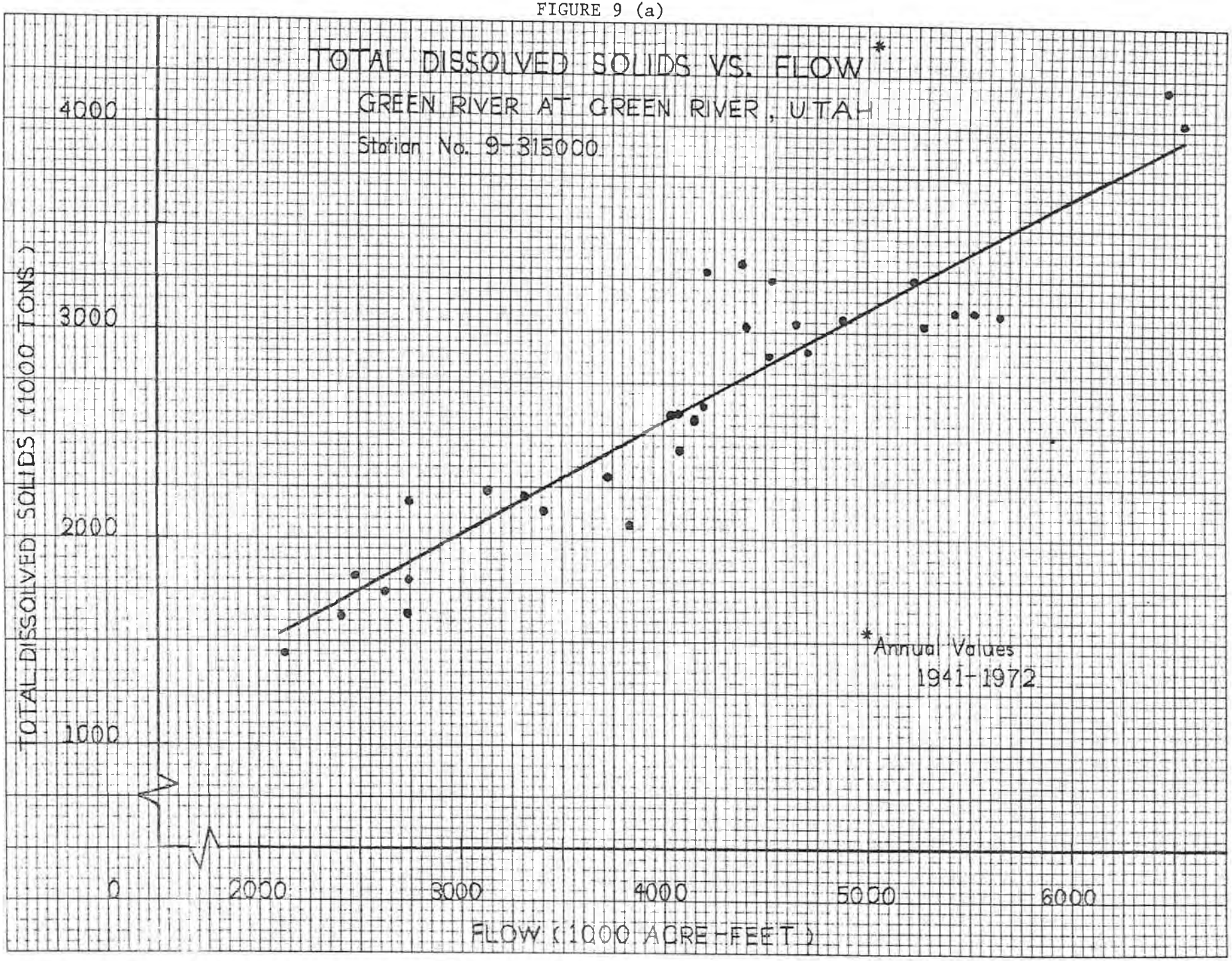

TOTAL DISSOLVED SOLIDS VS. FLOW*
GREEN RIVER AT GREEN RIVER, UTAH
Station No. 9-315000
TOTAL DISSOLVED SOLIDS (1000 TONS)
4000
3000
2000
1000
0
2000
3000
4000
5000
6000
FLOW (1000 ACRE-FEET)
*Annual Values
1941-1972

FIGURE 9 (b)

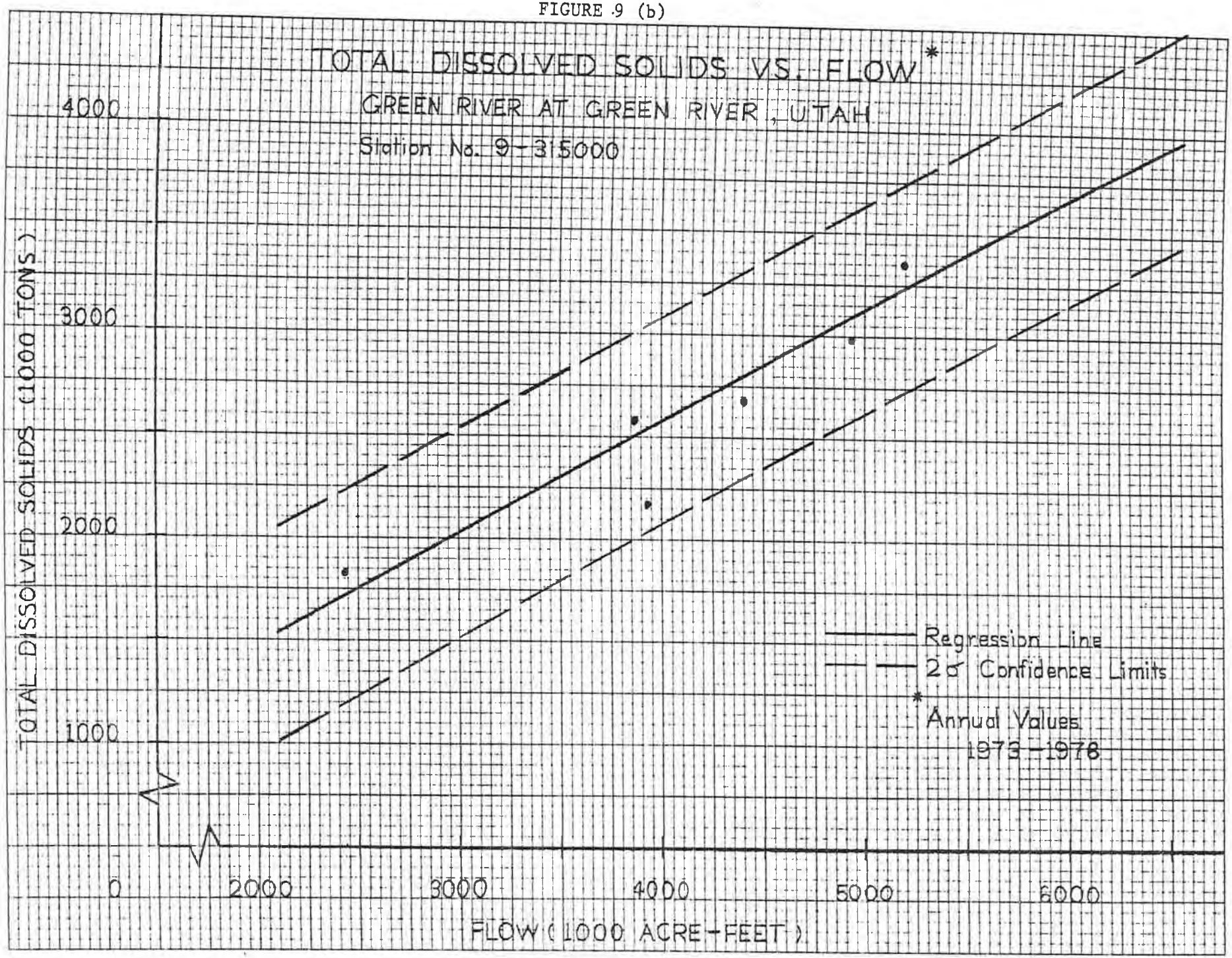

TOTAL DISSOLVED SOLIDS VS. FLOW*
GREEN RIVER AT GREEN RIVER, UTAH
Station No. 9-315000
TOTAL DISSOLVED SOLIDS (1000 TONS)
4000
3000
2000
1000
0
2000
3000
4000
5000
6000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973-1978

FIGURE 10 (a)

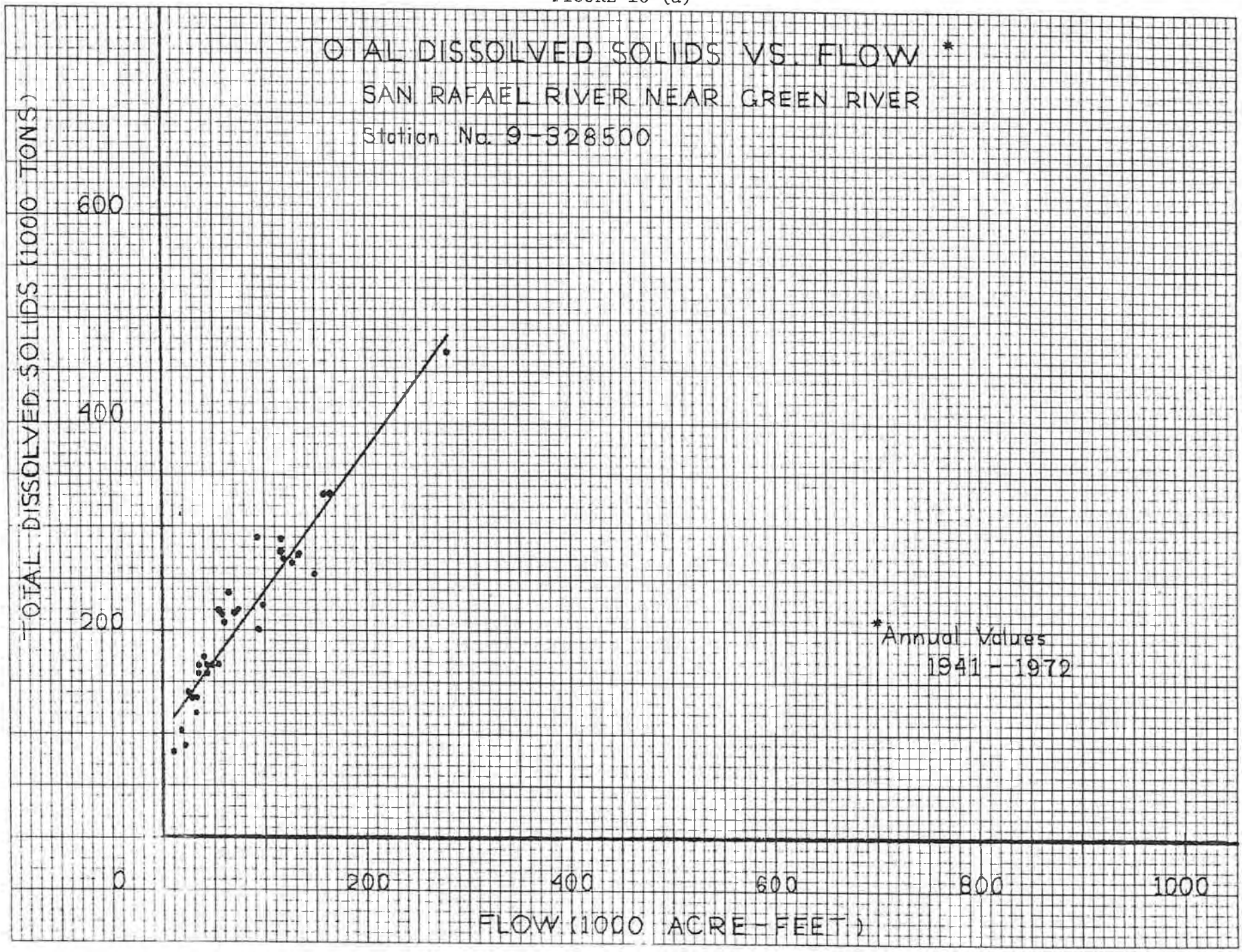

TOTAL DISSOLVED SOLIDS VS. FLOW *
SAN RAFAEL RIVER NEAR GREEN RIVER
Station No. 9-328500
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
*Annual Values
1941 - 1972

FIGURE 10 (b)

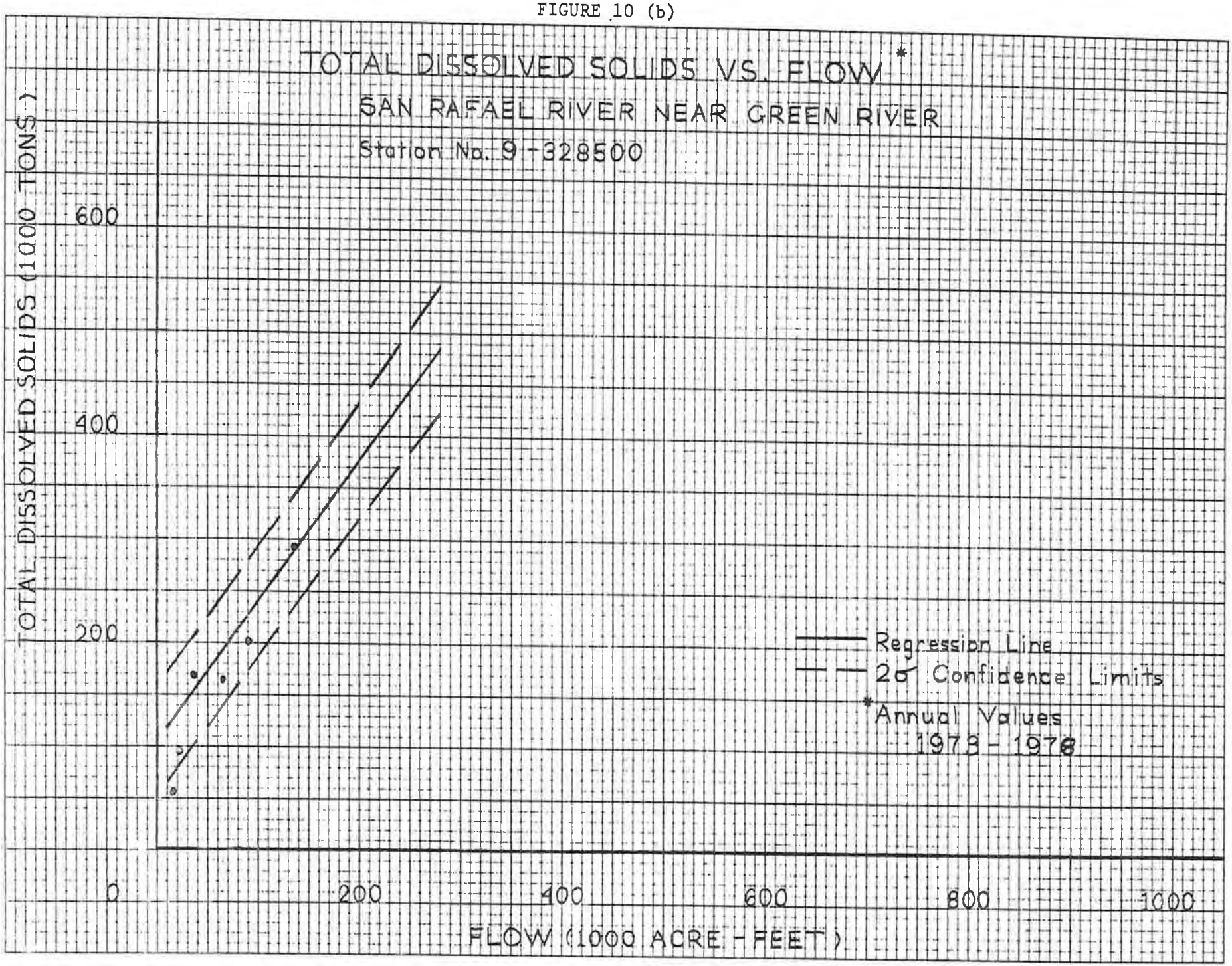

TOTAL DISSOLVED SOLIDS VS. FLOW *
SAN RAFAEL RIVER NEAR GREEN RIVER
Station No. 9-328500
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973 - 1978

FIGURE 11 (a)

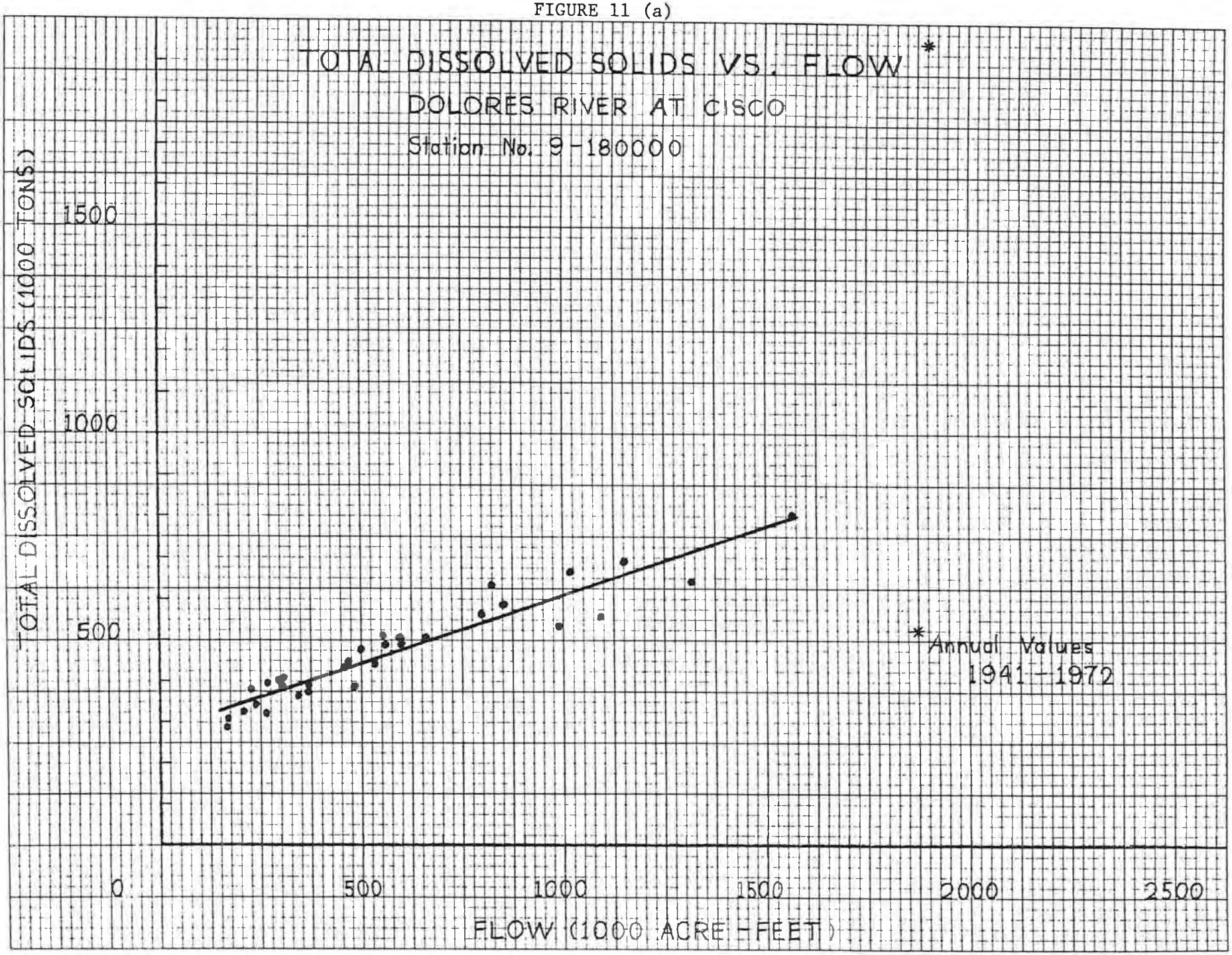

TOTAL DISSOLVED SOLIDS VS. FLOW *
DOLORES RIVER AT CISCO
Station No. 9-180000
TOTAL DISSOLVED SOLIDS (1000 TONS)
1500
1000
500
0
500
1000
1500
2000
2500
FLOW (1000 ACRE-FEET)
*Annual Values
1941-1972

FIGURE 11 (b)

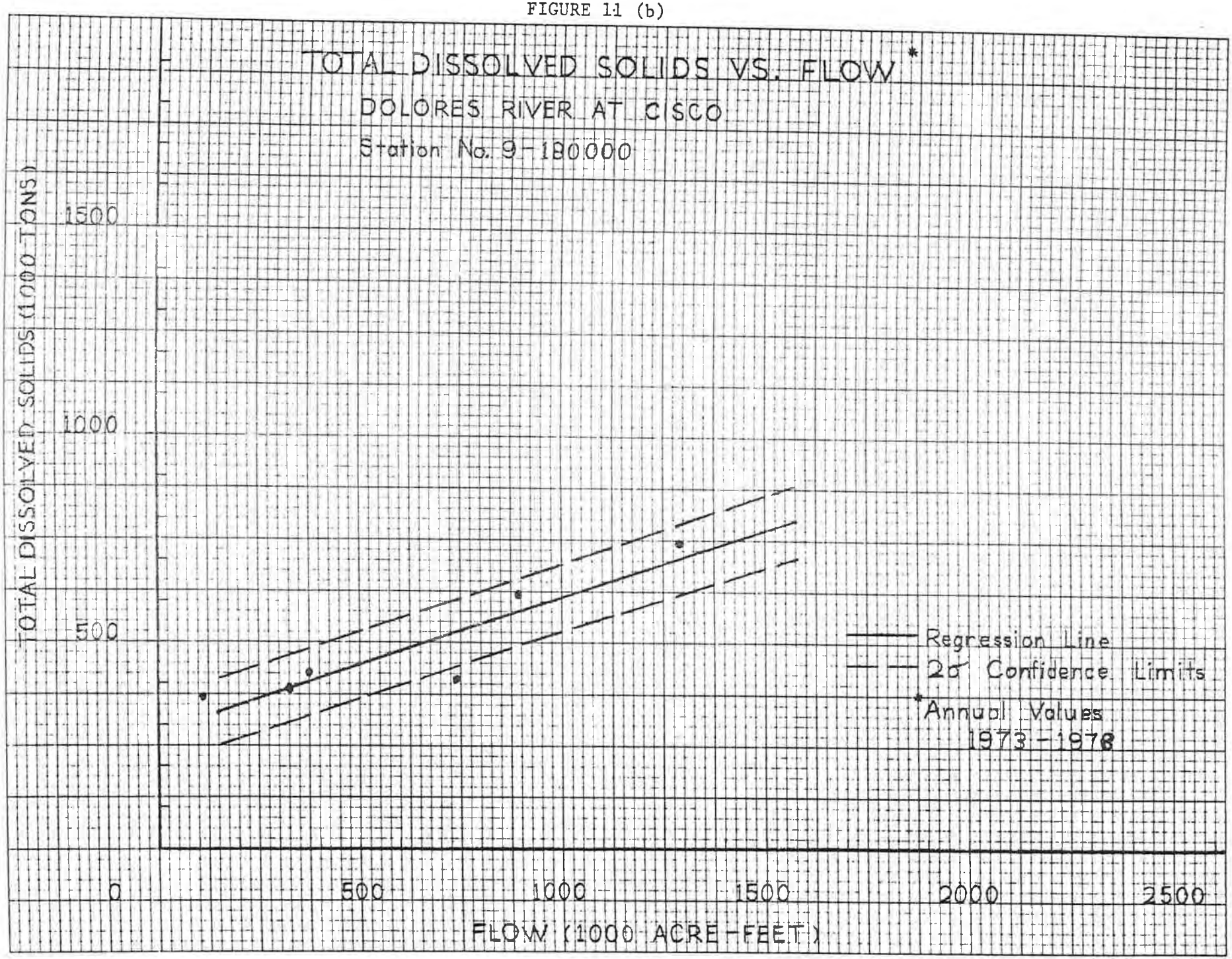

TOTAL DISSOLVED SOLIDS VS. FLOW *
DOLORES RIVER AT CISCO
Station No. 9-180000
TOTAL DISSOLVED SOLIDS (1000 TONS)
1500
1000
500
0
500
1000
1500
2000
2500
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973-1978

FIGURE 12 (a)

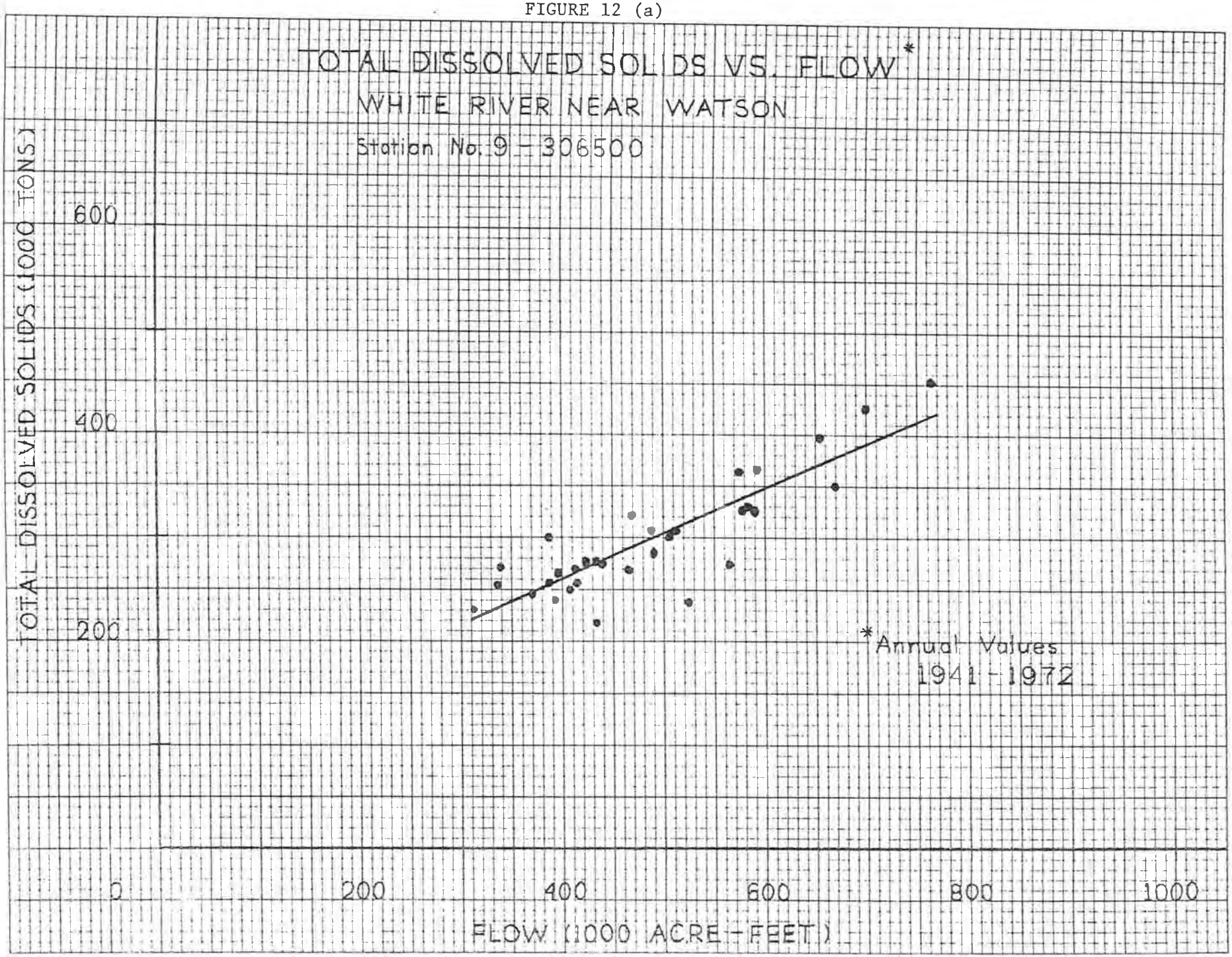

TOTAL DISSOLVED SOLIDS VS. FLOW*
WHITE RIVER NEAR WATSON
Station No. 9 - 306500
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
*Annual Values
1941 - 1972

FIGURE 12 (b)

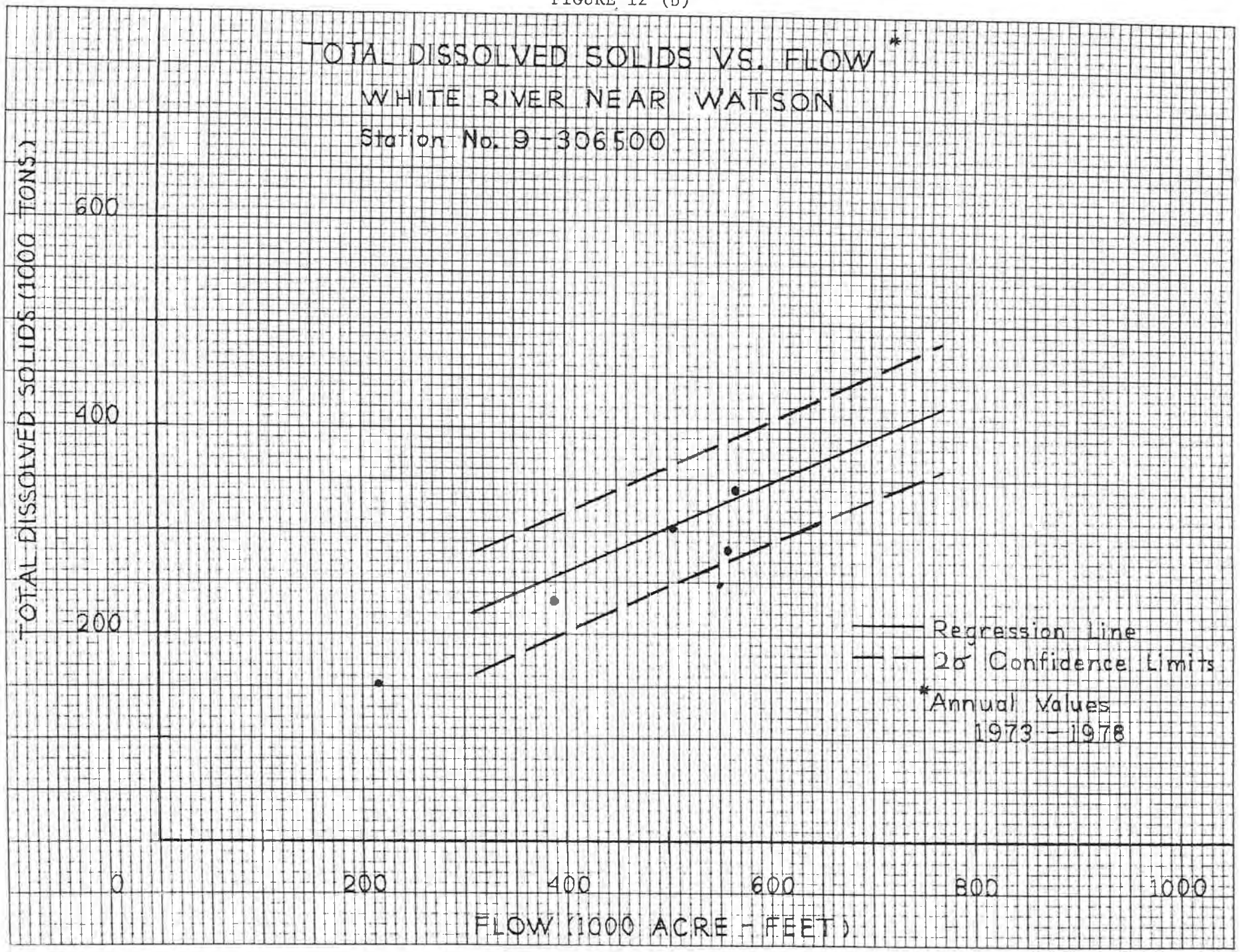

TOTAL DISSOLVED SOLIDS VS. FLOW *
WHITE RIVER NEAR WATSON
Station No. 9-306500
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
*Annual Values
1973 - 1978

FIGURE 13 (a)

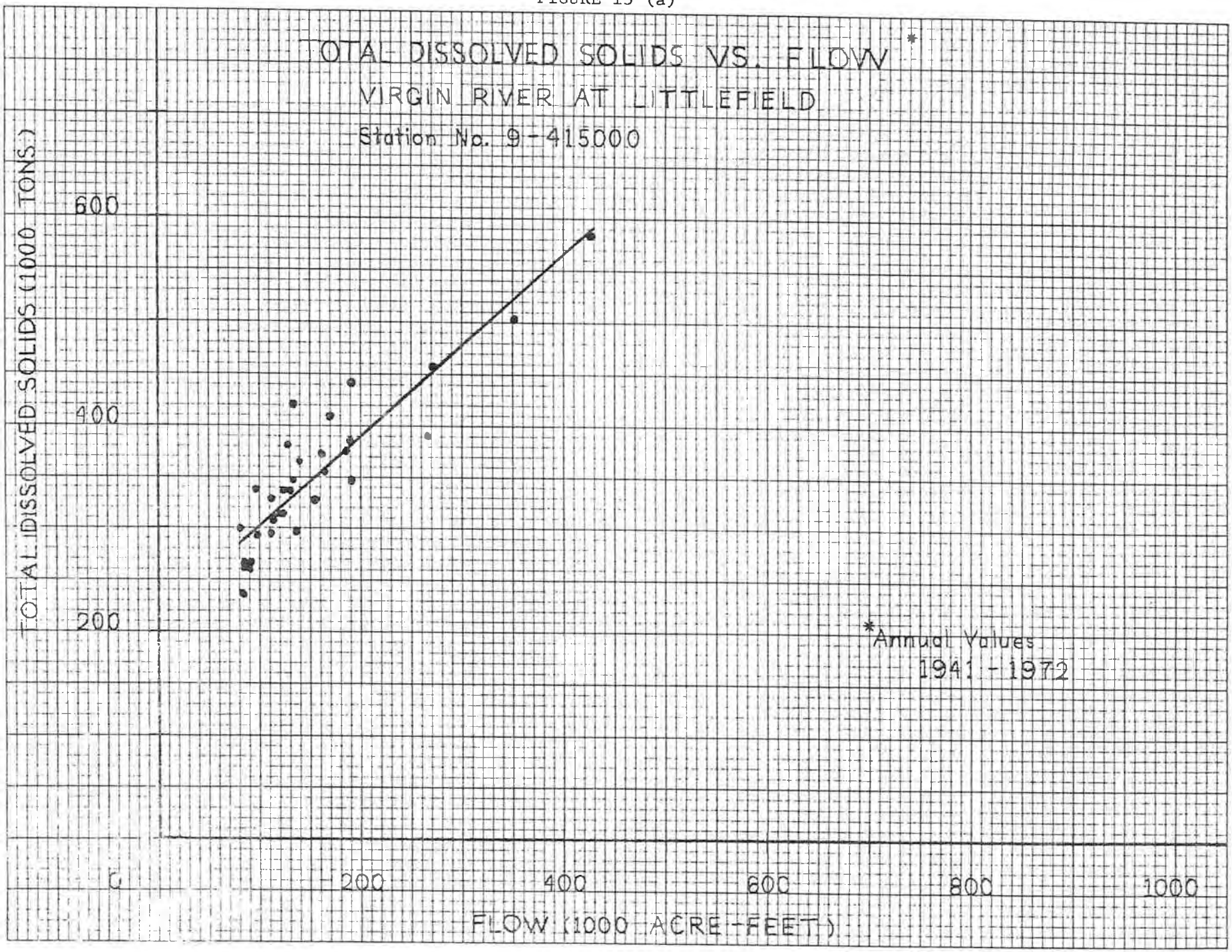
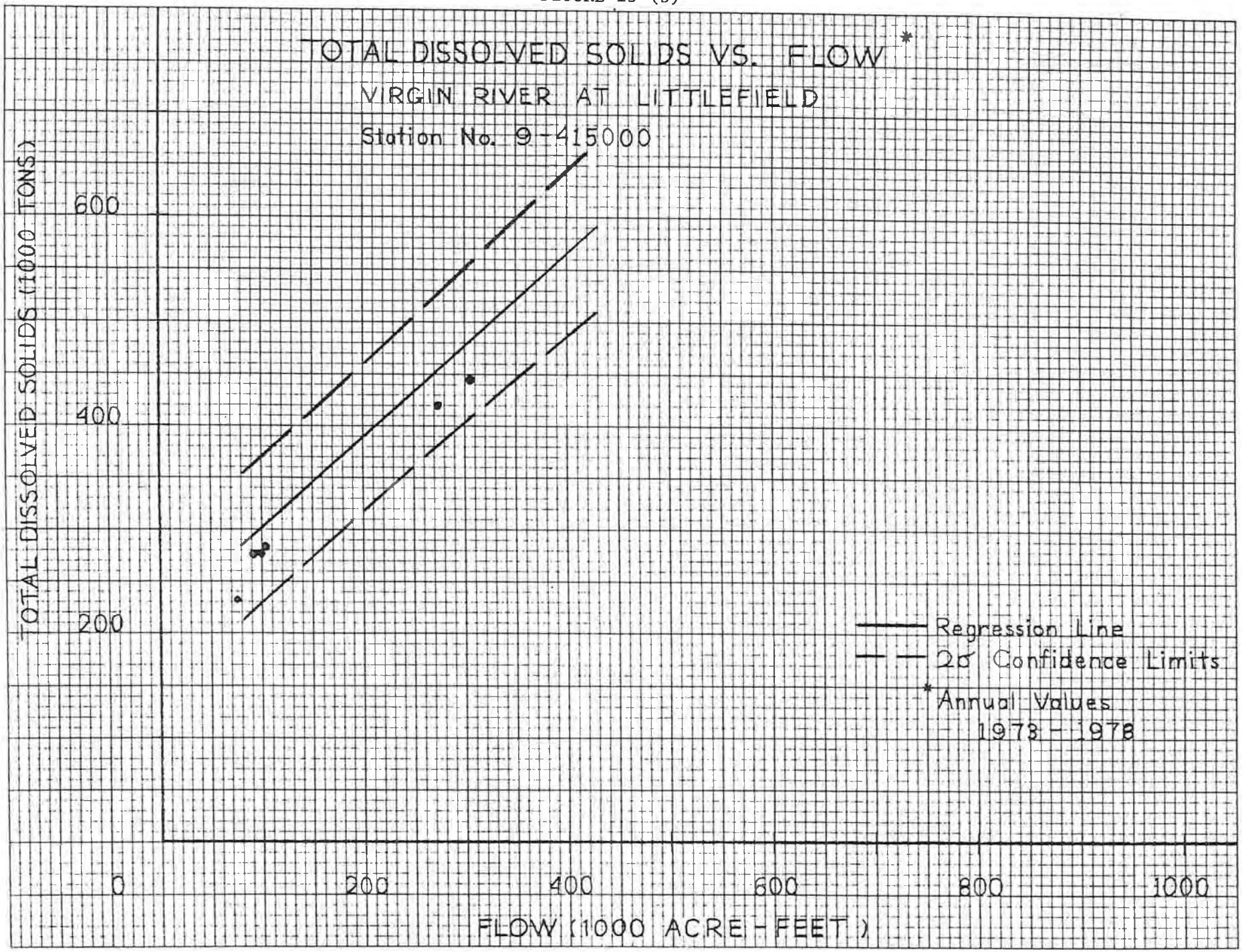

TOTAL DISSOLVED SOLIDS VS. FLOW *
VIRGIN RIVER AT LITTLEFIELD
Station No. 9-415000
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
*Annual Values
1941 - 1972

FIGURE 13 (b)


TOTAL DISSOLVED SOLIDS VS. FLOW *
VIRGIN RIVER AT LITTLEFIELD
Station No. 9-415000
TOTAL DISSOLVED SOLIDS (1000 TONS)
600
400
200
0
200
400
600
800
1000
FLOW (1000 ACRE-FEET)
Regression Line
2σ Confidence Limits
* Annual Values
1973 - 1978

APPENDIX B

# Policy for Use of Brackish and/or Saline Waters for Industrial Purposes

by

The Colorado River Basin Salinity Control Forum

September 11, 1980

# Policy for Use of Brackish and/or Saline Waters for Industrial Purposes

by

The Colorado River Basin Salinity Control Forum
September 11, 1980

The States of the Colorado River Basin, the federal Executive Department, and the Congress have all adopted as a policy that the salinity in the lower mainstem of the Colorado River shall be maintained at or below the flow-weighted average values found during 1972 while the Basin states continue to develop their compact-apportioned waters. In order to achieve this policy, all steps which are practical and within the framework of the administration of states' water rights must be taken to reduce the salt load of the river. One such step was the adoption in 1975 by the Forum of a policy regarding effluent limitations for industrial discharges with the objective of no-salt return wherever practicable. Another step was the Forum's adoption in 1977 of the "Policy for Implementation of Colorado River Salinity Standards through NPDES Permit Program." These policies are part of the basinwide plan of implementation for salinity control which has been adopted by the seven Basin states.

The Forum finds that the objective of maintaining 1972 salinity levels would be served by the exercise of all feasible measures including, wherever practicable, the use of brackish and/or saline waters for industrial purposes.

The summary and on page 32 of the Forum's 1978 Revision of the Water Quality Standards for Salinity states "The plan also contemplates the use of saline water for industrial purposes whenever

practicable, . . ." In order to implement this concept, and thereby further extend the Forum's basic salinity policies, the Colorado River Basin states support the Water and Power Resources Service appraisal study of saline water collection, pretreatment and potential industrial use.

The Colorado River Basin contains large energy resources, which are in the early stages of development. The WPRS study should investigate the technical and financial feasibility of serving a significant portion of the water requirements of the energy industry and any other industries by the use of Basin brackish and/or saline waters. The Forum recommends that:

1) The Colorado River Basin states, working with federal agencies, identify, locate and quantify such brackish and/or saline water sources.

2) Information on the availability of these waters be made available to all potential users.

3) Each state encourage and promote the use of such brackish and/or saline waters, except where it would not be environmentally sound or economically feasible or would significantly increase consumptive use of Colorado River System water in that State above that which would otherwise occur.

4) The U.S. Water and Power Resources Service with the assistance of the States encourage and promote the use of brackish return flows from federal irrigation projects in lieu of fresh water sources except where it would not be environmentally sound or economically feasible or would significantly increase consumptive use of Colorado River System water.

5) The U.S. Water and Power Resources Service consider a federal contribution to the cost of industrial use of brackish and/or saline water where cost effective as a joint private-government salinity control measure. Such activities shall not delay the implementation of the salinity control projects identified in Title II of P.L. 93-320.

# APPENDIX C

## New Legislation

Excerpt from
Public Law 96-375
October 3, 1980

## SECRETARY OF THE INTERIOR--INVESTIGATION OF WATER RESOURCE DEVELOPMENTS

(Sec. 12. Salinity control proposals, study.)

New Legislation

PUBLIC LAW 96-375 [H.R. 5278]; October 3, 1980

# SECRETARY OF THE INTERIOR—INVESTIGATION OF WATER RESOURCE DEVELOPMENTS

An Act to authorize the Secretary of the Interior to engage in feasibility investigations of certain water resource developments, and for other purposes.

*Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,* That the Secretary of the Interior is hereby authorized to engage in feasibility studies of the following proposals:

Water resource developments, feasibility investigations.

* * *

Salinity control proposals, study.

SEC. 12. The Secretary of the Interior is hereby authorized to engage in feasibility studies of the following salinity control proposals:

(1) Lower Gunnison Basin unit, located in Delta, Montrose, and Ouray Counties, Colorado.

(2) Glenwood-Dotsero Springs unit, located in Garfield and Eagle Counties, Colorado.

(3) Meeker Dome unit, located in Rio Blanco County, Colorado.

(4) McElmo Creek unit, located in Montezuma County, Colorado.

(5) Uinta Basin unit, located in Duchesne and Uintah Counties, Utah.

(6) Dirty Devil River unit, located in Sanpete, Sevier, Emery, and Wayne Counties, Utah.

(7) Price-San Rafael Rivers unit, located in Carbon, Emery, and Sanpete Counties, Utah.

(8) La Verkin Springs unit, located in Washington County, Utah.

(9) Lower Virgin River unit, located in Clark County, Nevada, and Mohave County, Arizona.

(10) Big Sandy River unit, located in Sweetwater County, Wyoming.

SEC. 13. Nothing in this Act shall be interpreted to preclude or delay issuance of a license by the Federal Energy Regulatory Commission.

Approved October 3, 1980.

LEGISLATIVE HISTORY:

HOUSE REPORT No. 96-710 (Comm. on Interior and Insular Affairs)
SENATE REPORT No. 96-890 accompanying H.R. 5278, and No. 96-938 accompanying S. 3017 (Comm. on Energy and Natural Resources).
CONGRESSIONAL RECORD, Vol. 126 (1980):
Feb. 5, considered and passed House.
Sept. 17, considered and passed Senate, amended, in lieu of S. 3017.
Sept. 24, House concurred in Senate amendment.

94 STAT. 1508

# APPENDIX D


| | Page |
|---|---|
| Table D-1 - SUMMARY ESTIMATED TOTAL USE COLORADO RIVER BASIN | D-1 |
| Table D-2 - ESTIMATED INCREASES OVER BASE COLORADO RIVER BASIN | D-2 |

# APPENDIX D

## TABLE D- 1

### SUMMARY ESTIMATED TOTAL USE
### COLORADO RIVER BASIN

(Thousands of Acre Feet Per Year)

| By State | YEAR 1979 Base Condition | YEAR 1985 Low | YEAR 1985 Moderate | YEAR 1985 High | YEAR 1990 Low | YEAR 1990 Moderate | YEAR 1990 High | YEAR 1995 Low | YEAR 1995 Moderate | YEAR 1995 High |
|---|---|---|---|---|---|---|---|---|---|---|
| UPPER COLORADO RIVER BASIN (Depletions) | | | | | | | | | | |
| State | | | | | | | | | | |
| Arizona | 35 | 33 | 38 | 42 | 37 | 42 | 46 | 40 | 40 | 50 |
| Colorado | 1,785 | 1,872 | 1,882 | 1,932 | 2,019 | 2,033 | 2,367 | 2,126 | 2,264 | 2,448 |
| New Mexico | 394 | 372 | 384 | 512 | 500 | 533 | 671 | 518 | 559 | 670 |
| Utah | 769 | 825 | 834 | 834 | 951 | 981 | 1,067 | 1,939 | 1,091 | 1,147 |
| Wyoming | 379 | 396 | 396 | 417 | 428 | 428 | 489 | 452 | 452 | 552 |
| Subtotal Depletions Upper Colorado River Basin[1/] | 3,362 | 3,498 | 3,534 | 3,737 | 3,935 | 4,017 | 4,640 | 4,175 | 4,412 | 4,867 |
| LOWER COLORADO RIVER BASIN (Diversions less returns) | | | | | | | | | | |
| State | | | | | | | | | | |
| Arizona | 1,071[2/] | 1,543 | 1,666 | 1,959 | 2,800 | 2,800 | 2,800 | 2,800 | 2,800 | 2,800 |
| California | 4,925 | 4,698 | 4,698 | 4,698 | 4,400 | 4,400 | 4,400 | 4,400 | 4,400 | 4,400 |
| Nevada | 87 | 134 | 145 | 156 | 158 | 189 | 218 | 198 | 239 | 300 |
| Subtotal Mainstream Diversions Less Returns-Lower Colorado River Basin | 6,083 | 6,375 | 6,509 | 6,813 | 7,358 | 7,389 | 7,418 | 7,398 | 7,439 | 7,500 |
| TOTAL USE - Colorado River Basin | 9,445 | 9,873 | 10,043 | 10,550 | 11,293 | 11,406 | 12,058 | 11,573 | 11,851 | 12,367 |
| Upper Basin CRSP Reservoir Evaporation | 617 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 | 520 |
| Lower Basin Reservoir Evaporation | 1,130 | 1,050 | 1,050 | 1,050 | 1,050 | 1,050 | 1,050 | 1,050 | 1,050 | 1,050 |
| Deliveries to Mexico Scheduled | 1,700 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 | 1,500 |
| In Accordance with Minute 242 | 178 | | | | | | | | | |
| TOTAL USES AND LOSSES[3/] | 13,070 | 12,943 | 13,113 | 13,620 | 14,363 | 14,476 | 15,128 | 14,643 | 14,921 | 15,437 |

1/ Does not include estimated 520 AF/YR reservoir evaporation from Lakes Powell, Flaming Gorge, Fontenelle, Blue Mesa, Morrow Point and Crystal.

2/ 1979 values for Arizona are diversions less returns including estimated unmeasured return flows.

3/ Does not include net instream losses below Hoover Dam and tributary inflow between Lee Ferry and Hoover Dam estimated to average 200,000 af/yr and 750,000 af/yr., respectively.

TABLE D-2

ESTIMATED INCREASES OVER BASE
COLORADO RIVER BASIN
(Thousands of Acre-Feet Per Year)

| Category of Uses (by State) | YEAR 1979 | YEAR 1985 | | | YEAR 1990 | | | YEAR 1995 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Low | Moderate | High | Low | Moderate | High | Low | Moderate | High |
| UPPER COLORADO RIVER BASIN (Depletions) | | | | | | | | | | |
| Out-of-Basin Exports | | | | | | | | | | |
| Colorado | 540 | 76 | 81 | 116 | 111 | 121 | 211 | 146 | 176 | 236 |
| New Mexico | 164 | -98 | -94 | -54 | -76 | -70 | -33 | -74 | -66 | -33 |
| Utah | 149 | 22 | 22 | 22 | 105 | 105 | 105 | 120 | 120 | 135 |
| Wyoming | 8 | 2 | 2 | 2 | 5 | 5 | 7 | 8 | 8 | 12 |
| Subtotal | 861 | 2 | 11 | 86 | 145 | 161 | 290 | 200 | 238 | 350 |
| In-Basin Agricultural Use | | | | | | | | | | |
| Arizona | 8 | -2 | 0 | 1 | -1 | 1 | 1 | 0 | 1 | 1 |
| Colorado | 1,175 | -6 | -6 | 4 | 64 | 64 | 196 | 59 | 140 | 218 |
| New Mexico* | 185* | 52 | 59 | 131 | 157 | 179 | 208 | 165 | 188 | 198 |
| Utah | 569 | 11 | 12 | 12 | 35 | 65 | 95 | 65 | 97 | 120 |
| Wyoming | 279 | 2 | 2 | 7 | 11 | 11 | 27 | 22 | 22 | 48 |
| Subtotal | 2,216 | 57 | 67 | 155 | 266 | 320 | 527 | 311 | 448 | 585 |
| In-Basin Coal Development (Including electrical power generation) | | | | | | | | | | |
| Arizona | 25 | 0 | 3 | 6 | 3 | 6 | 10 | 5 | 10 | 14 |
| Colorado | 12 | 10 | 10 | 15 | 15 | 15 | 20 | 20 | 20 | 33 |
| New Mexico | 29 | 23 | 23 | 34 | 23 | 23 | 83 | 29 | 29 | 83 |
| Utah | 22 | 21 | 29 | 29 | 39 | 39 | 52 | 39 | 59 | 77 |
| Wyoming | 41 | 0 | 0 | 7 | 7 | 7 | 22 | 15 | 15 | 45 |
| Subtotal | 129 | 54 | 65 | 91 | 87 | 90 | 187 | 108 | 133 | 252 |
| In-Basin Oil Shale | | | | | | | | | | |
| Arizona | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Colorado | 0 | 5 | 10 | 10 | 18 | 24 | 48 | 24 | 36 | 66 |
| New Mexico | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Utah | 0 | 0 | 0 | 0 | 1 | 1 | 44 | 44 | 44 | 44 |
| Wyoming | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 7 |
| Subtotal | 0 | 5 | 10 | 10 | 19 | 25 | 96 | 68 | 80 | 117 |

* Includes 24,000 acre-feet/year Navajo reservoir evaporation

TABLE D-2 (cont'd)

| Category of Uses (by State) | YEAR 1979 | YEAR 1985 Low | YEAR 1985 Moderate | YEAR 1985 High | YEAR 1990 Low | YEAR 1990 Moderate | YEAR 1990 High | YEAR 1995 Low | YEAR 1995 Moderate | YEAR 1995 High |
|---|---|---|---|---|---|---|---|---|---|---|
| Other In-Basin Uses (Fish & Wildlife & Other M&I Uses) | | | | | | | | | | |
| Arizona | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Colorado* | 58 | 2 | 2 | 2 | 26 | 24 | 107* | 92* | 107* | 110* |
| New Mexico | 16 | 1 | 2 | 7 | 2 | 7 | 19 | 4 | 14 | 28 |
| Utah | 29 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| Wyoming | 51 | 13 | 13 | 22 | 26 | 26 | 50 | 28 | 28 | 61 |
| Subtotal | 156 | 18 | 19 | 33 | 56 | 59 | 178 | 126 | 151 | 201 |
| Total by States | | | | | | | | | | |
| Arizona | 35 | -2 | 3 | 7 | 2 | 7 | 11 | 5 | 11 | 15 |
| Colorado | 1,785 | 87 | 97 | 147 | 234 | 248 | 582 | 341 | 479 | 663 |
| New Mexico | 394 | -22 | -10 | 118 | 106 | 139 | 277 | 124 | 165 | 276 |
| Utah | 769 | 56 | 65 | 65 | 182 | 212 | 298 | 270 | 322 | 378 |
| Wyoming | 379 | 17 | 17 | 38 | 49 | 49 | 110 | 73 | 73 | 173 |
| Total Upper Colorado River Basin | 3,362 | 136 | 172 | 375 | 573 | 655 | 1,278 | 813 | 1,050 | 1,505 |
| LOWER COLORADO RIVER BASIN (Diversions less returns) | | | | | | | | | | |
| Out-of-Basin Exports | | | | | | | | | | |
| Arizona | 0 | 400 | 500 | 700 | 1,575 | 1,531 | 1,514 | 1,536 | 1,514 | 1,502 |
| California | 4,354 | -226 | -226 | -226 | -515 | -515 | -515 | -515 | -515 | -515 |
| Nevada | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subtotal | 4,354 | 174 | 274 | 474 | 1,060 | 1,016 | 999 | 1,021 | 999 | 987 |
| In-Basin Agricultural Use | | | | | | | | | | |
| Arizona | 1,011 | 56 | 74 | 151 | 119 | 160 | 162 | 139 | 161 | 164 |
| California | 566 | -1 | -1 | -1 | -15 | -15 | -15 | -15 | -15 | -15 |
| Nevada | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Subtotal | 1,577 | 55 | 73 | 150 | 104 | 145 | 147 | 124 | 146 | 149 |

* Includes 64,000 acre-feet/year of reservoir evaporation connected with hydro-electric generation

TABLE D-2 (cont'd)

| Category of Uses (by State) | YEAR 1979 | YEAR 1985 | | | YEAR 1990 | | | YEAR 1995 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Low | Moderate | High | Low | Moderate | High | Low | Moderate | High |
| In-Basin Electrical Generation | | | | | | | | | | |
| Arizona | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| California | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Nevada | 12 | 7 | 7 | 7 | 11 | 11 | 11 | 11 | 11 | 11 |
| Subtotal | 12 | 7 | 7 | 7 | 11 | 11 | 11 | 11 | 11 | 11 |
| Other In-Basin Uses (Fish & Wildlife Plus Other M&I Uses) | | | | | | | | | | |
| Arizona | 60 | 16 | 21 | 37 | 35 | 38 | 53 | 54 | 54 | 63 |
| California | 5 | 0 | 0 | 0 | 5 | 5 | 5 | 5 | 5 | 5 |
| Nevada | 75 | 40 | 51 | 62 | 60 | 91 | 120 | 100 | 141 | 202 |
| Subtotal | 140 | 56 | 72 | 99 | 100 | 134 | 178 | 159 | 200 | 270 |
| Total by State | | | | | | | | | | |
| Arizona | 1,071 | 472 | 595 | 888 | 1,729 | 1,729 | 1,729 | 1,729 | 1,729 | 1,729 |
| California | 4,925 | -227 | -227 | -227 | -525 | -525 | -525 | -525 | -525 | -525 |
| Nevada | 87 | 47 | 58 | 69 | 71 | 102 | 131 | 111 | 152 | 213 |
| Total Lower Colorado River Basin | 6,083 | 292 | 426 | 730 | 1,275 | 1,306 | 1,335 | 1,315 | 1,356 | 1,417 |

# SUPPLEMENT TO

# 1981 REVIEW

**SUPPLEMENTAL REPORT ON THE 1981 REVIEW**

**WATER QUALITY STANDARDS FOR SALINITY**

**COLORADO RIVER SYSTEM**

**October 27, 1981**

October 27, 1981

Supplemental Report

on the

1981 Review

# WATER QUALITY STANDARDS FOR SALINITY

# COLORADO RIVER SYSTEM

Prepared by

Colorado River Basin Salinity Control Forum

MEMBERS OF THE COLORADO RIVER BASIN
SALINITY CONTROL FORUM

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George L. Christopulos

EXECUTIVE DIRECTOR
Jack A. Barnett

CONTENTS


| | Page |
|---|---|
| TRANSMITTAL LETTERS | 1 |
| INTRODUCTION | 5 |
| STATEMENTS AND FORUM RESPONSES | 7 |
| EPA | 7 |
| Metropolitan Water District of Southern California | 8 |
| International Boundary and Water Commission | 10 |
| Colorado River Water Conservation District | 12 |
| Environmental Defense Fund | 20 |
| Virgil E. Duncan | 30 |
| MISCELLANEOUS STATEMENTS | 31 |
| Imperial Irrigation District | 32 |
| San Diego County Water Authority | 33 |
| Palo Verde Irrigation District | 34 |
| Coachella Valley Water District | 35 |
| Colorado River Board of California | 36 |
| Las Vegas Valley Water District | 37 |
| Bureau of Reclamation | 38 |
| Gray, Cary, Ames & Frye | 41 |
| ADDITIONAL STATEMENTS | 43 |
| Las Vegas Wash Development Committee | 44 |
| League of Women Voters of Las Vegas Valley | 45 |
| State of California, Department of Water Resources | 47 |
| California Farm Bureau Federation | 48 |
| Department of Water and Power the City of Los Angeles | 50 |
| MODIFICATIONS | 51 |

# TRANSMITTAL LETTERS

The Federal Water Pollution Control Act requires that at least once every three years the states of the Colorado River Basin review water quality standards relating to the salinity of the waters of the Colorado River. The states collectively initiate this review under the auspices of the Colorado River Basin Salinity Control Forum and prepare a proposed report and a supplemental report.

Upon the Forum's adoption of these two reports, they are transmitted to the individual states for their own independent action. The following is a copy of the transmittal letter to the State of Arizona. Following Arizona's transmittal letter is a listing of the recipients in each of the states of an identical letter.

Colorado River Basin
Salinity Control Forum
220 South 200 East
Suite 320
Salt Lake City Utah 84111
(801) 533-0133

December 14, 1981

Honorable Bruce Babbitt
Governor of Arizona
Statehouse
Phoenix, Arizona 85007

Dear Governor Babbitt:

Enclosed is a copy of the report "1981 Review - Water Quality Standards for Salinity, Colorado River System", approved on July 8, 1981, by the seven state Colorado River Basin Salinity Control Forum.

Subsequent to the July approval, two regional public meetings were held to provide an opportunity for those who so desired to present comments or suggestions on the proposed report. The meetings were held on September 29, 1981 in Las Vegas, Nevada and October 1, 1981 in Grand Junction, Colorado. A supplement, including modifications to the report based on comments and suggestions received, is also enclosed. The attached supplement was approved by the Forum on October 27, 1981. The report and the supplement constitute the 1981 review of the Colorado River salinity standards.

Section 303(c)(1) of the Federal Water Pollution Control Act (commonly referred to as the Clean Water Act) requires that:

> *The Governor of a State or the State water pollution control agency of such State shall from time to time (but at least once each three year period beginning with the date of enactment of the Federal Water Pollution Control Act Amendments of 1972) hold public hearings for the purpose of reviewing applicable water quality standards and, as appropriate, modifying and adopting standards. Results of such review shall be made available to the Administrator.*

The enclosed report and its supplement reflect some changes in the plan of implementation adopted by the Forum. Therefore, the Forum urges

that each state water control agency adopt the 1981 Review as appropriate, thus preserving the basin-wide approach to salinity control developed by the basin states over the last decade. The Forum urges that your State take prompt action in adopting this review.

Sincerely,

George Christopulos

George Christopulos
Chairman

JAB/mkh

Enclosure

cc: Arizona Forum Members

Identical transmittal letter sent to each of the following:

Honorable Bruce Babbitt
Governor of Arizona
Statehouse
Phoenix, Arizona 85007

Honorable Edmund G. Brown, Jr.
Governor of California
State Capitol
Sacramento, California 95814

Honorable Richard D. Lamm
Governor of Colorado
State Capitol
Denver, Colorado 80203

Honorable Robert List
Governor of Nevada
State Capitol
Carson City, Nevada 89701

Honorable Bruce King
Governor of New Mexico
State Capitol
Santa Fe, New Mexico 87501

Honorable Scott M. Matheson
Governor of Utah
State Capitol
Salt Lake City, Utah 84114

Honorable Ed Herschler
Governor of Wyoming
State Capitol
Cheyenne, Wyoming 82001

# INTRODUCTION

This supplement to the subject report contains statements and comments received by the Forum and also the Forum's responses to these comments. Statements and comments were received at public meetings held in Las Vegas, Nevada, on September 29, 1981, and Grand Junction, Colorado, on October 1, 1981. Comments were also officially received by mail up to and including October 1, 1981. The supplement also includes the correction of typographical errors. Each comment or statement received is presented followed by the Forum's response. Additional statements or comments received after October 1, 1981, are printed herein without Forum response.

The states of the Colorado River Basin, acting through the Colorado River Basin Salinity Control Forum, prepared these revisions pursuant to Section 303 of the Clean Water Act.

## EPA STATEMENT, FORUM PUBLIC MEETING, GRAND JUNCTION, OCT 1, 1981

EPA commends the Colorado River Basin Salinity Control Forum for its review of the Colorado River Basin Salinity Standards. This effort, by the Forum, reflects the balancing of diverse interests and the accommodation essential to achieving resolution of the complex interstate and international Colorado River Salinity Control problems. These accords are necessary conditions for making the basinwide approach succeed.

There is one issue we urge the Forum to resolve. During the previous (1978) revision process, concern was raised by some states and EPA over the manner and timeliness in which each state adopted the standards and plan of implementation.

On February 27, 1981, EPA wrote to the Forum indicating that EPA's concept of the basinwide approach was based on the understanding that the three lower mainstem numeric criteria were adequate only if appropriately and formally connected to the basinwide plan of implementation. In that letter, EPA suggested that, "...the basinwide plan of implementation, its relationship to the numeric criteria, the basin states' salinity control activities, and the manner in which the plan of implementation is adopted, be discussed by the basin states and EPA during the current triennial review process."

While there has been some discussion of the concerns, we are not aware that the options have been fully explored or the issues resolved. To prevent a reoccurance of the apparent misunderstandings that arose over adoption of the previous revision, we urge further discussion and early resolution of the concerns raised in EPA's letter of February 27, 1981.

EPA recognizes that the basin states may have differing procedural and legal requirements for addressing these concerns. However, we believe that it is very important for the Forum to understand and concur with the manner and schedule of individual state adoption of the standards and plan of implementation. Your attention to this matter is greatly appreciated.

Thank you

*RESPONSE*

*The manner of and schedule for action by the individual states on the 1981 review of the water quality standards for salinity and the plan of implementation were discussed at length by the Forum in March 1981. The Forum will address these matters at future meetings as needed in order to work towards a process which is timely and consistent with applicable state laws and regulations.*

## COMMENTS OF THE METROPOLITAN WATER DISTRICT OF SOUTHERN CALIFORNIA ON THE 1981 REVIEW OF WATER QUALITY STANDARDS FOR SALINITY--COLORADO RIVER SYSTEM*

The Metropolitan Water District of Southern California wishes to again commend the Colorado River Basin Salinity Control Forum on its continued efforts regarding salinity control. The Forum is also to be commended for its efforts in maintaining federal and interstate cooperation and support of the program, and for its overall coordination and on-going monitoring of salinity changes and program effectiveness. We have reviewed the proposed report on the 1981 review of the Colorado River salinity standards and implementation plan and have the following comments:

We were pleased to learn from the report that the U.S. Department of Agriculture has increased its funding for their on-farm salinity control activities, and for related technical assistance and research. And we note that revisions to the salt-routing studies show a decrease in the salt-loading estimate over that made for the 1978 review.

The report points out that changes were made in the study procedures used for estimating the amount of salt entering the river system. It is important that the salinity studies be as accurate as possible. Based on the results of these studies, large amounts of money will be spent for salinity control projects.

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* Statement presented to the Colorado River Basin Salinity Control Forum at the public meeting held in Las Vegas, Nevada, on September 29, 1981.

The report reveals a disturbing aspect of the overall salinity control program. It is the ever-increasing slippage in project completion dates. This is a matter of concern to Metropolitan as it is to all other Colorado River water users because of the adverse impacts of the river's salinity. The latest estimate of completion dates shows that all projects have slipped--some as much as eight years over the estimate made in 1978. Several are not scheduled to be in operation until the mid-1990s. The completion dates for the feasibility studies for these projects have also slipped--some as much as two years. Funding is one of the main constraints causing these delays. Unless Federal and State funding priorities are more favorably rearranged, the salinity control program goals may not be met, and may jeopardize the related national goals of our treaty with Mexico.

The Metropolitan Water District appreciates this opportunity to comment on the Forum's 1981 review report. We endorse the report and its recommendations for the salinity standards and the plan of implementation, and we urge their adoption by each of the concerned states.

RESPONSE

*The District expressed concern over the ever increasing slippage in the salinity program. In 1979, the Bureau revised the overall schedule for the salinity control program. Since that time, the Bureau has essentially maintained that schedule.*

OFFICE OF THE COMMISSIONER
UNITED STATES SECTION

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO
IBWC BUILDING
4110 RIO BRAVO
EL PASO, TEXAS 79902

SEP 28 1981

Mr. Jack A. Barnett
Executive Director
Colorado River Basin Salinity Control Forum
220 South 200 East, Suite 320
Salt Lake City, Utah 84111

Dear Jack:

Thank you for your letter of August 20, 1981 which enclosed for our review a copy of the Colorado River Basin Salinity Control Forum's "Proposed Report on the 1981 Review of Water Quality Standards for Salinity of the Colorado River System," and advises us of the two scheduled public meetings to receive comments.

As Principal Engineer Baumli discussed with Mr. Weber, we are concerned with those portions of the proposed report beginning on Page 18 relating to projected salinity concentrations, in particular Tables 3, 4, and 5 which show projected salinity concentrations, assuming an average virgin flow of 13.0 million acre-feet (MAF), which exceed the established numerical salinity criteria, in some cases, by substantial amounts. To use such low average flows seems overly conservative and would arouse unnecessary concerns on the part of Mexico.

We understand also that the values are projections only and importantly do not reflect salinity control measures such as the on-farm programs which would further reduce salinity concentrations. We suggest, therefore, that discussion and publication of detailed projections for an average of 13 MAF be deferred at least until the effects of all salinity control measures have been quantified. We would have no objection to the general relationships shown in Figures 3, 4, and 5, but we suggest that an appropriate note be made that the projections do not include other control measures. Your careful consideration of these comments will be appreciated.

I do want to add on the positive side that the proposed report contains an excellent summary of the Forum's commendable work and of the federal and state efforts to control the Colorado River salinity. We will be looking forward to receiving a copy of the final report.

We would also appreciate, if at all possible in the future, your early consultation with this agency during the preparation of future draft reports.

Sincerely,

J. F. Friedkin
Commissioner

RESPONSE

The Forum desires to present a wide range of possible flow conditions. The Forum concurs with the Commission, however, that the probability of a 15-year period with an average virgin flow of 13.0 maf/yr is low. In addition, a number of salinity control measures which are in the early stages of formulation have not been included in this review owing to a lack of quantification of salt removal. Such measures will be included in future reviews.

October 1, 1981

STATEMENT BEFORE THE COLORADO RIVER BASIN SALINITY CONTROL FORUM BY THE COLORADO RIVER WATER CONSERVATION DISTRICT.

Grand Junction, Colorado

Gentlemen:

I represent the Colorado River Water Conservation District (River District). The River District was created by the Colorado General Assembly in 1937 to safeguard, conserve, and put to beneficial consumptive use water apportioned to the State of Colorado by the Colorado River Compact of 1922 and subsequently by the Upper Colorado River Basin Compact of 1948. The River District covers 29,000 square miles west of the Continental Divide and north of the San Juan mountains within the State of Colorado.

I would like to take this opportunity to make four comments concerning the proposed review of water quality standards and related matters:

FIRST. The River District is alarmed that we see no

evidence on the part of the Forum to deal with loss of water to the upper basin states for the benefit of lower basin users. For example, under the current plans, the evaporative losses from a project that diverted saline spring waters from a stream would be considered a consumptive use in the state where the springs were located even though the principal beneficiaries would be the states of the lower basin. Since many of the salinity control projects are located within the River District, our water users could be unduely harmed unless a method is developed to allocate water lost by the salinity control program to both the upper and lower basin states.

SECOND. The River District supports and encourages innovative programs to put to use brackish or saline water diverted away from streams for the purpose of salinity control. However, we ask that you take steps to determine the impacts and mitigate the affects these programs have on the water rights of local users. For example, the River District envisions a project that could collect saline spring water along the Colorado River and deliver it to the oil shale industry for their use. If a call was placed on the river by downstream users with senior water rights, Colorado law would require putting the saline water back into the stream unless some type of mitigation, probably storage, is included as a part of the salinity program to protect the rights of these users. In other words, the salinity control programs must be designed and implemented to protect water rights guaranteed to water users by state laws.

THIRD. Programs that reduce the agricultural consumption of water on the Western Slope of Colorado may have a deliterious affect on other Western Slope users. The senior water rights of irrigators in the Grand Valley presently controls the mainstem of the Colorado during periods when the River must be administered. A significant reduction in the Grand Valley irrigator's water needs will result in a net increase in diversions to the East Slope making salinity control even more difficult and expensive.

FOURTH. The River District has been informed by the Department of Interior that the salinity control program does not fully allow for upper basin states to develop the water allocated to them under the 1922 and 1948 compacts. In a letter to the Federal Energy Regulatory Commission dated August 25, 1981, commenting on data being collected for a proposed reservoir in Western Colorado, the Regional Solicitor for the Rocky Mountain Region stated:

> "Increasing salinity concentrations result from two basic and separable processes: (1) salt loading, by adding new tonnages of salt to the existing load of the stream; and (2) salt concentrating, by reducing the volume of water whereby the salt load is diluted in a smaller volume of

flow. The latter process is a result of the use of Compact-related water use, and the salinity impacts of that use are expected to be offset by the Colorado River Water Quality Improvement Program. That program does not include any provision for offsetting salt loading from any new project. We suggest that the sponsors describe any measures that they rpopose to minimize new salt loading that could result from project implementation and that these measures be described in the EIS. Otherwise, this will have to be considered as an unmitigated impact."

If this were indeed true, the results would be devastating to all upper basin states. To make use of the compact water allocated to Colorado, Colorado must build additional storage projects.

The River District asks that the Forum take positive steps to affirm that the proposed salinity control programs must offset the increases in salinity due to the development of compact allocated water in the upper basin states including salt loading as the result of new storage projects. A copy of the letter I quoted from is attached to my statement.

The River District would like to thank the Forum for this opportunity to make comments and pledges its cooperation in developing and implementing programs to maintain Colorado River water quality.

Richard E. Kuhn
Assistant to Secretary-Engineer

United States Department of the Interior
OFFICE OF THE SOLICITOR
DENVER REGION
P.O. BOX 25007
DENVER FEDERAL CENTER
DENVER, COLORADO 80225

AUG 28 1981

COLORADO RIVER WATER
CONSERVATION DISTRICT

August 25, 1981

Mr. William W. Lindsay
Director, Office of Electric
Power Regulation
Federal Energy Regulatory Commission
825 N. Capitol Street, N.E.
Washington, D.C. 20426

Re: Juniper-Cross Mountain Project No. 2757,
Colorado

Dear Mr. Lindsay:

We appreciate the opportunity to review the Applicants' response to your supplemental data request. As a cooperating agency for the EIS, we are pleased to provide the enclosed information and analyses on those areas which are within the Department of the Interior's jurisdiction by law and/or special expertise. We believe that this will assist your agency in completing the EIS for this project.

For your information, we have also enclosed the United States' Motion for Reconsideration of the Opinion and Order in Colorado River Water Conservation District v. Andrus, C.A. No. 78-A-1191. The Opinion and Order were sent to you by the Applicants on August 12, 1981.

Sincerely,

Margot Zallen

Margot Zallen
For the Regional Solicitor
Rocky Mountain Region

Enclosures

cc: Roland C. Fischer, Secretary-Engineer
Colorado River Water Conservation District
P.O. Box 1120
Glenwood Springs, Colorado 81601

Q & A 15: In order for the EIS to more definitely evaluate consequences, we suggest that the discussion of this issue be expanded to include more facts, such as estimates of peak stages, flood velocities, or damage to life and property including to the town of Maybell. For example, the canyons of the Dinosaur National Monument could act both as dams and as accelerators to the flood waves, pooling them in the areas upstream until they rise enough to develop enough head to force their way through the canyons. The staff of Dinosaur National Monument estimates a rapid rise in the canyons of the Monument up to 45 feet, with velocities in the 30 feet per second range. Some 300 people could be in those canyons on a given day with little warning time. The staff estimates that the flood wave could be down to the canyon section from Cross Mountain in about 30 minutes, with grave danger to those camped at Deer Lodge Park as well as those in the canyon.

In calculating the potential 24-hour steady discharge of 1.3 million acre-feet, our estimate is that in 24 hours, this would be a steady discharge of 670,000 cfs. Judging by the ages of certain trees on the river shores, the Monument staff estimates that there has been no discharge above the 25,000 to 30,000 cfs level in the last several hundred years. We accordingly do not understand the answer's estimate of 800,000 acre-feet as the maximum probable flood which would equal a 24-hour steady discharge of 400,000 cfs.

Q & A 22: Increasing salinity concentrations result from two basic and separable processes: (1) salt loading, by adding new tonnages of salt to the existing load of the stream; and (2) salt concentrating, by reducing the volume of water whereby the salt load is diluted in a smaller volume of flow. The latter process is a result of the use of Compact-related water use, and the salinity impacts of that use are expected to be offset by the Colorado River Water Quality Improvement Program. That program does not include any provision for offsetting salt loading from any new project. We suggest that the sponsors describe any measures that they propose to minimize new salt loading that could result from project implementation and that these measures be described in the EIS. Otherwise, this will have to be considered as an unmitigated impact.

The applicant may not be aware that the Department of the Interior has documented occurrences of gypsum dissolution

RESPONSE

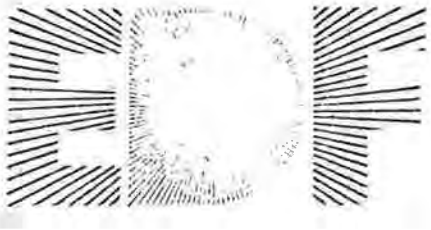
Point One: The question of water consumption associated with salinity control is a matter which the Forum has under consideration.

The federal government has, in the case of the salinity control units authorized for construction, obtained water rights for salinity control under the affected states appropriation system.

Point Two: All salinity control projects will be implemented in accordance with the applicable state water laws.

Point Three: The allocation and use of water within each state is not a matter for Forum consideration.

Point Four: The Forum appreciates its attention having been brought to the Regional Solicitor's letter of August 25, 1981. His letter inaccurately states that the Colorado River Water Quality Improvement Program does not take into account salt loading from new projects. This is not true. To the contrary, the objective of the program is to maintain the adopted numeric criteria while the Basin states continue to develop their compact-apportioned waters. Thus, the salinity program is being planned and carried out with the explicit recognition that new projects will be developed in the future and those projects may involve some salt loading. However, the Forum expects project sponsors: (1) to quantify the anticipated extent of new salt loading that will result from project implementation, and (2) to the extent practicable, formulate the project in a fashion that will minimize new salt loading.



Comments
on
Proposed Report on the 1981 Review

Water Quality Standards for Salinity

(Prepared by the Colorado River
Basin Salinity Control Forum)

Environmental Defense Fund
Denver, Colorado

October 1, 1981

Comments prepared by:

Daniel F. Luecke, Ph.D.

Comments presented at public meeting convened by the Salinity Control Forum, Grand Junction, CO, October 1, 1981.

## Comments on Salinity Control Forum Proposed Report

### Introduction

The Colorado River Basin Salinity Control Forum (hereinafter Forum) deserves to be commended for the breadth of its (proposed) report on salinity standards for the Colorado River. The report introduces the reader to the many facets of the problem of salinity control in the river basin and explains, quite adequately, how various parts of the problem are related.

But more important than the breadth of the report is its candor in admitting that the salinity control program can work only under the most optimistic of assumptions. The admission is most clearly illustrated by the situations depicted in Tables 4 and 5 of the report (pages 21 and 22). These tables present the projected concentrates of total dissolved solids (TDS) in milligrams per liter (mg/l) at each control point (Hoover, Parker and Imperial Dams) for the years 1990 and 1995 for various combinations of average annual flow, river basin development (or flow depletion), and progress of the salinity control program (as measured by number of projects). Ignoring the columns without salinity control projects, the remaining combinations of flow, development, and program progress form a set of outcomes at each dam site which spans most, if not all, future possibilities. Assuming that each combination is equally likely, the probability of a violation of the standard can be estimated.[1/] A simple calculation shows that

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1/ The probabilities are computed by assuming that each combination of flow, depletion, and project development form

[Footnote continued next page.]

in 1990 the probability of a violation at at least one control point is 0.72 (or 72 percent) and in 1995 it increases to 0.83 (or 83 percent). The probabilities of a violation at more than one point are 0.50 (50 percent for 1990) and 0.67 (67 percent) for 1995.

The figures in these tables form a remarkable admission on the part of the Forum--an admission that the salinity control program is so ineffective that violations of the standard are likely to be so commonplace as to occur over 70 percent of the time. Such a frank statement about the program's status and likely progress over the next several years is to be applauded. On the other hand, the dismal prospects for controlling salinity in the Colorado River concern those of us with an interest in the river's water quality.

Specific Concerns With the Report

More specific concerns with the report relate to: (1) the provision for ignoring violations of the standards; (2) the absence of costs and damage estimates for salinity; (3) the peculiar specification of a baseline; and (4) the failure to lay out in

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1/ Continued

independent events with equally likely probabilities of occurring. In fact, it's obvious that the events are neither independent nor equally likely. For example, any event in 1990 with 14 salinity control projects is negligibly small. Ignoring this would underestimate the probability of a violation. Conversely the conditional probability of any combination with only three projects in 1995 given 14 projects in 1990 is zero. But disregarding these factors in order to keep the calculations very simple, estimating the probability of a violation involves counting violations and summing the probabilities of their occurrence. Modifying the assumptions of independence and equal likelihood would change the probabilities some but not so much that the point on program ineffectiveness would be invalid.

a coherent fashion the full range of options for salinity control. I recognize that the standards contain built-in provisions for their own violation, but it is important, nonetheless, to flag the open-ended interpretation the report gives to violations which result from development proceeding at a pace control measures cannot match. It states that "[s]hould water development projects be completed before control measures are brought on-line, temporary increases above the criteria could result and these increases will be deemed in conformance with the standard."[2/] Unfortunately, no attention is given to defining "temporary" or specifying the magnitude of the "increases." Is one year temporary or is five years considered a reasonable and allowable lag? Is an acceptable increase 10 percent above the standard or is any increase to be ignored no matter what its magnitude may be? By failing to give any indication of how it intends to interpret the conditions which give license to violations, the Forum's report demonstrates a cavalier attitude toward the standards and responsibility of its members for meeting them.

My second concern is with the absence of any cost or damage data. In not presenting costs of control projects or salinity damage estimates, the report fails to provide a basis for comparing control options. More importantly, it does not reveal the fact that almost all of the salinity control projects which are part and parcel of the water quality standards have costs which greatly exceed benefits, if benefits are measured as

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2/ Proposed Report on the 1981 Review, p. v.

damage reduced.[3/] Moreover, without cost estimates (however crude they may be), there is no opportunity to see that some of the more attractive options--particularly those nonstructural options concerned with decreasing the agricultural salt load--may deserve more attention than they receive in the report.

Turning to the third point I welcome the Forum's presentation of the concept of a salinity baseline against which to measure (or track) the effects of basin development, land use change, and the effectiveness of control efforts. But I can only wonder at the choice of a simple two variable linear regression relating flow to total dissolved solids (TDS) as the model for the baseline. I am further puzzled when the report states that a two standard deviation band about the regression line will constitute the baseline range. This broad band is defended as necessary given the great variability of the relationship and the importance of so many other factors in influencing the effect of flow on salt load. But the explanation is entirely unacceptable and, as a consequence, the simple two variable relationship is unusable. If other explanatory variables (e.g., land use, soil type, average slope, presence of natural sources, etc.) might aid in refining the relationship they should be included. Without them, or without some effort devoted to refining the regression expression, the baseline will be of very little value in monitoring the river basin and explaining the effects of change and development on water

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3/ See, for example, Bureau of Reclamation, "Summary of Activities of the Water and Power Resources Service" Presented to Colorado River Salinity Control Advisory Council, Santa Fe, New Mexico, September 1980, and Howe, C., "Colorado River: Lower Basin Benefits and Costs from Upper Basin Salinity Reduction Programs (Draft)," for DRI, Denver, Colorado, January 1981.

quality as measured by salinity.

The final point of the four concerns the report's failure to lay out all of the options for controlling salinity in a form which would allow a fruitful comparative analysis. Presenting the various Bureau of Reclamation, Soil Conservation Service, and other projects and programs in a common format would facilitate comparisons. Instead the report discourages the kind of analysis which makes it difficult to identify a set of economically sound and environmentally effective options. In particular, it is impossible to relate projects and programs which concentrate on controlling the largest man-made source of salt--irrigated agriculture--with other alternatives. This is a significant defect in the report given the fact that a number of recent reports on agricultural options present results which suggest that they are by far the most cost-effective.[4/]

One Observation on Future Possibilities

One other comment on the report relates to future salinity control programs. Listed among various options is weather modification. Suggesting weather modification as a means of dealing with a water resource or water quality problem is often the last gasp of a dying program. In a way it's an admission of the state of desperation faced by a program doomed to fail. Given the forecasts

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4/ See Big Sandy River Colorado River Basin Salinity Control Study, prepared by U.S. Dept. of Agriculture Soil Conservation Service, Casper, Wyoming, U.S.D.A. Report (Nov. 1980); and Draft Supplement to the Colorado River Water Quality Improvement Program Final Environmental Statement for Lower Gunnison Basin Unit, Montrose and Delta Counties, Colorado and Uintah Basin Unit, Duchesne, Wasatch and Uintah Counties, Utah, prepared by U.S. Dept. of Agriculture Soil Conservation Service (May 1981).

presented in Tables 4 and 5 (the tables mentioned above), perhaps it is.

The use of weather modification as an effective resource management tool remains a rather remote possibility. In a recent report of the Statistical Task Force to the Weather Modification Advisory Board it was concluded that in those programs it reviewed results were equivocal at best and in some cases negative outcomes were statistically significant.5/ (In particular the Colorado River Basin pilot project and Climax II were criticized.) Given the state of weather modification efforts the Forum cannot expect much help from this quarter in its efforts to control Colorado River salinity.

Concluding Comment

Given the shortcomings I see in the report and the shortcomings the Forum admits in the salinity control program, I would make only one more remark. In order to control salinity in the Colorado system more attention must be given to the largest man-made source--irrigated agriculture. Nonstructural agricultural options are attractive because they appear to be less expensive, more effective, and perhaps less environmentally disruptive. The capital intensive program to which the Bureau of Reclamation is committed will not allow the basin states (that make up the Forum) to meet even the rather lax standards with which they are faced.

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5/ The Management of Weather Resources (Volume II): The Role of Statistics in Weather Resources Management, Report of the Statistical Task Force to the Weather Modification Advisory Board, Washington, D.C. (1978).

RESPONSE

The probability estimates of flow, depletion and projected development and salinity levels exceeding the numeric criteria at the three measuring stations in EDF's comments are grossly oversimplified. A number of salinity control measures which are in the early stages of formulation have not been included in this review owing to a lack of quantification of salt removal. Such measures will be included in future reviews.

The Forum has not ignored future violations of the salinity standards. Temporary increases above the criteria levels at the three stations in the lower main stem are part of the water quality standards and are not violations of the standards. The provisions for temporary increases above the criteria levels were included as part of the EPA Regulations - 40 CFR, Part 120, December 18, 1974, which served as the basis under which the Forum prepared the initial salinity standards in 1975. The Forum does not consider that it is necessary at this time to define "temporary increases" which will be deemed in compliance with the standards because the Forum does not anticipate that the criteria will be exceeded in the next 3-year review period.

It is the policy of the Forum that salinity is to be maintained while the Basin states continue to develop their compact-apportioned waters. The forum does not have a "cavalier" attitude toward water quality standards for salinity or towards the responsibility of the states for implementing those standards. Working through the Forum, the Basin states have adopted a policy of no-salt return from industrial discharges. In addition, the states are addressing non-point sources of salinity through the 208 planning process and are implementing actions identified by the Forum in the plan of implementation.

It is also the position of the Forum that water development and salinity control projects have co-equal status. Two of the authorized salinity control projects are under construction by the federal government, and planning on other units is proceeding. The Basin states are implementing those actions within their jurisdiction to control river salinity. Based on current levels of salinity, projected water development, and salinity control efforts, the Forum does not anticipate that the criteria will be exceeded in the near future. The Forum has

considered the provisions for temporary increases above the criteria levels in the past and will give further considerations to the questions concerning this provision.

The general policy for water quality control is based on cost-effectiveness, not benefit/cost analyses. The Forum is following the general policy that the numeric criteria will be maintained in the most cost-effective manner. The analyses presented in the 1981 Review includes all of the salinity control measures necessary to maintain the numeric criteria including the non-structural options and onfarm programs for which quantitative information is available. The Forum has recognized the very cost-effective nature of agricultural programs. The Basin states have worked diligently with agricultural officials to gain thier support for the onfarm programs. The Executive Director of the Forum has been working with its legislative representative in preparing draft legislation for early introduction into Congress which, among other things, directs the Secretary of Agriculture to establish cooperative onfarm water management programs for salinity control. It is hoped that the EDF will actively support this legislation.

The Forum is cognizant of the fact that salinity concentration at a given point is influenced by many factors other than the magnitude of stream flow. At the present time, however, stream flow is the only parameter directly affecting salinity concentration for which an appreciable quantity of historical data is available. From all that can be determined, it is also by far the most important variable in the equation. As funding and man-power permits, investigation into the effects of additional independent variables will be conducted. Until such time as new relationships can be established and verified, there is little choice but to continue to use the present quantity/quality baseline values.

The plan of implementation was developed to maintain the numeric criteria. The studies show that in order to maintain the criteria under the projected levels of development and a range of virgin water supplies, that all twelve salinity control units for which the Forum has quantitative information will be required. As studies progress, the twelve units presently identified may not prove to be the most cost-effective units and other control measures may be substituted. Detailed analyses

of the impacts of the individual units have and are being made by the various entities responsible for planning efforts on those units. When studies are completed and reports on the individual units and their impacts and costs become available, the forum will include that information in its future analyses. However, the Forum does not intend to duplicate the studies made by others.

The Forum, in its discussion of weather modification, points out that salinity concentrations resulting from increased flows will vary depending on the type, location, and time of development of beneficial use of any increased water yield. The Forum's discussion of weather modification does not imply that it offers any more than a possible measure to aid in the maintenance of the criteria.

The Forum wishes to stress that its efforts are being directed toward non-structural measures through its recently adopted policy calling for the use of saline waters for industrial purposes as well as its efforts to place greater emphasis on agricultural salinity control programs.

Virgil E. Duncan

Private Citizen, Los Angeles, California

Comments were also received from Mr. Duncan who requested that the Forum take into consideration, during the next review period, the following concerns:

1) The present 75/25 arrangement for repayment does not appear to be viable for the future and suggests the Forum consider other repayment alternatives.

2) Repayment of all salinity control costs be based on an appropriate distribution between those who contribute to the salt load and those who benefit from its control.

3) Increase water prices to more accurately reflect cost of providing water service thus promoting conservation, primarily among agricultural users, which would aid in reducing salinity.

4) Incremental borrowing costs using current interest rates be included in determining the true cost of salinity control.

5) The provisions allowing for "temporary" increases above the criteria levels be defined in terms of time and salinity levels.

RESPONSE

*The above comments were made verbally. Mr. Duncan also indicated that he would like the Forum to address these five areas of concern over the next three year period. The Forum does intend to address these issues before the 1984 report is completed.*

## MISCELLANEOUS STATEMENTS

A number of agencies submitted statements supporting the report and made no recommendations for changes. The agencies are: Imperial Irrigation District, San Diego County Water Authority, Palo Verde Irrigation District, Coachella Valley Water District, Colorado River Board of California, Las Vegas Valley Water District, the Bureau of Reclamation, and Gray, Cary, Ames & Frye, Attorneys at Law.

TELEPHONE 714-355-1112

IMPERIAL IRRIGATION DISTRICT

OPERATING HEADQUARTERS • IMPERIAL, CALIFORNIA 92251

September 21, 1981

Executive Director
Colorado River Basin Salinity
Control Forum
c/o Colorado River Board
107 South Broadway, Room 8103
Los Angeles, CA 90012

Gentlemen:

Imperial Irrigation District, being one of the major beneficiaries of salinity control and being subject to damages due to adverse effects of salinity, is in full support of the Colorado River Basin Salinity Control Forum in its efforts to control salinity in the Lower Colorado River region.

The projects which are designed to maintain the numeric salinity criteria in the Lower Colorado River should be carried out expediently to fulfill these objectives, as provided under the Clean Water Act of 1977 (PL 92-500 as amended by PL 95-217), since they were authorized for implementation by Title II provisions of PL 92-320.

To summarize, we have examined the "Proposed Report on the 1981 Review - Water Quality Standards for Salinity Colorado River System" and agree with its content. This District is eager to see the various facets of these criteria maintained.

Very truly yours,

D. A. TWOGOOD
General Manager

# San Diego County Water Authority

2750 Fourth Avenue, San Diego, California 92103 (714) 297-3218

(A Public Agency Organized June 9, 1944)

Ralph E. Graham, Chairman
Roy W. Lessard, Vice Chairman
Nat L. Eggert, Secretary
Linden R. Burzell, General Manager and Chief Engineer
Paul D. Engstrand, General Counsel


September 21, 1981

Mr. Myron B. Holburt
California Member
Colorado River Basin
Salinity Control Forum
107 South Broadway, Room 8103
Los Angeles, CA 90012

Dear Myron:

The San Diego County Water Authority agrees with the recommendations of the Forum as described in the 1981 Review.

Particularly we see no reason to recommend changes in the numeric salinity criteria for the "Below Hoover Dam," "Below Parker Dam," and "Imperial Dam" stations.

Also we agree that the plan of implementation described should be carried out, specifically construction of the Paradox Valley and Grand Valley Units listed in Section 202, Title II, as well as proceeding with the Meeker Dome Unit and 10 of the units listed in Section 203(a)(1), Public Law 93-320.

Please have this letter introduced in the hearing scheduled for Tuesday, September 29, 1981 in Las Vegas.

Very truly yours,

L. R. Burzell
General Manager and Chief Engineer

LRB:jmr

cc: John Cranston

120,500 ACRES LOCATED ALONG COLORADO RIVER

# PALO VERDE IRRIGATION DISTRICT

Office Address
180 West 14th Avenue
Blythe, California

Mailing Address
P.O. Box 1199
Blythe, California 92226

Telephone (714) 922-3144

September 23, 1981

Jack A. Barnett, Executive Director
Colorado River Basin Salinity Control Forum
220 South 200 East, Suite 320
Salt Lake City Utah 84111

Dear Mr. Barnett:

The Palo Verde Irrigation District concurs with the 1981 Review and recommended revisions of the Water Quality Standards For Salinity - Colorado River System, dated July 9, 1981, as prepared by the Colorado River Basin Salinity Control Forum.

Yours very truly,

Virgil L. Jones
Manager

VLJ/elc

ESTABLISHED IN 1918 AS A PUBLIC AGENCY

# COACHELLA VALLEY WATER DISTRICT

POST OFFICE BOX 1058 • COACHELLA, CALIFORNIA 92236 • TELEPHONE (714) 398-2651

DIRECTORS
RAYMOND R. RUMMONDS, PRESIDENT
TELLIS CODEKAS, VICE PRESIDENT
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OFFICERS
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BERNARDINE SUTTON, SECRETARY
VICTOR B. HARDY, AUDITOR
REDWINE AND SHERRILL, ATTORNEYS

September 21, 1981

File: 0022.13

State of California
Colorado River Board
107 South Broadway, Room 8103
Los Angeles, California 90012

Subject: 1981 Review Water Quality Standards For Salinity - Colorado River System

Gentlemen:

The Coachella Valley Water District concurs with the Seven State Colorado River Salinity Control Forum's findings, particularly the numeric salinity criteria and plan of implementation for salinity control for the Colorado River System, i.e. Salinity in mg/L below Hoover Dam 723, below Park Dam 747 and Imperial Dam 879.

The seven principal components of implementation are endorsed by this District.

Yours very truly,

Keith H. Ainsworth

for Lowell O. Weeks
General Manager-Chief Engineer

KHA:rs

STATE OF CALIFORNIA—THE RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

COLORADO RIVER BOARD OF CALIFORNIA
107 SOUTH BROADWAY, ROOM 8103
LOS ANGELES, CALIFORNIA 90012
(213) 620-4480

September 25, 1981

Mr. Jack Barnett, Executive Director
Colorado River Basin Salinity
Control Forum
Chancellor Building, Suite 320
Salt Lake City, Utah 84111

Dear Mr. Barnett:

The Colorado River Board of California has been deeply involved in seeking solutions to the basin's salinity problems for many years. In 1970 it published its report on the need for controlling Colorado River Salinity which outlined present and future problems and recommended policies to solve those problems. California users of Colorado River water already suffer high economic losses from the high salinity concentration of the water and will be subject to additional millions of dollars of detriments each year if the projected rise in salinity is not checked.

The Board supports the basin-wide approach to salinity control which will maintain salinity in the lower mainstream while the basin states continue to develop their compact apportioned waters. The Board also strongly supports the coequal development of water and salinity control measures.

The Board's staff has actively worked with the other members of the Forum in developing the 1981 review. The Board fully supports the Forum's efforts in salinity control and the 1981 Review of the Colorado River Basin Salinity Standards.

Sincerely,

M. B. Holburt

Myron B. Holburt
Chief Engineer

Comments on
Proposed Report on the 1981 Review
of
Water Quality Standards for Salinity
Colorado River System
by
Las Vegas Valley Water District
Las Vegas, Nevada
September 29, 1981

We have reviewed the proposed report dated July 9, 1981 and support its findings.

We are further pleased as to the progress of the current work on the Las Vegas Wash Unit. We believe the current joint federal-state-local comprehensive planning program which addresses and integrates the environmental, wastewater management and salinity reduction in Las Vegas Wash flows is proceeding well. We are looking forward to reviewing the Bureau of Reclamation's recommended plan and report on or before the end of 1981.

We appreciate the opportunity to review the proposed report of the Colorado River Basin Salinity Control Forum.

STATEMENT ON BEHALF OF ROBERT N. BROADBENT, COMMISSIONER, BUREAU OF RECLAMATION, FOR PRESENTATION BEFORE THE PUBLIC MEETINGS RELATING TO PROPOSED 1981 REVIEW - WATER QUALITY STANDARDS FOR SALINITY FOR THE COLORADO RIVER SYSTEM - LAS VEGAS, NEVADA, SEPTEMBER 29, 1981, AND GRAND JUNCTION, COLORADO, OCTOBER 1, 1981

Colorado River salinity standards are of special importance to the Department of the Interior and the Bureau of Reclamation. We are charged with planning and constructing the principal physical components of the plan of implementation to maintain the adopted standards for the Colorado River System. Thus, the standards have a direct bearing on the Bureau's particular share of responsibilities associated with development and management of the water resources of the Colorado River Basin.

The Bureau of Reclamation endorsed the salinity standards proposed by the Colorado River Basin Salinity Control Forum adopted by the Basin States, and approved by the Environmental Protection Agency in 1975. We have been continuously kept informed of the progress of the Forum during the current review of the water quality standards. We appreciate having had the opportunity to work with the Forum in this endeavor.

We believe the Forum's approach of considering the total basin as a single operating entity is the most logical and workable method to meet the overall objective of maintaining salinity levels in the lower main stem at or below 1972 levels, while water resource development continues throughout the Basin. Our own independent analyses support the Forum's conclusion that salinity levels at the three numeric criteria stations will not exceed the 1975 criteria (i.e., 1972 salinity levels) or the proposed 1981 criteria during the

next 3 years. In the long term, the Forum salinity projections appear reasonable for the assumptions used. During our analyses, we also observed a significant deviation in the runoff-salt load-relationship for the past several years. Preliminary findings indicate a statistically significant reduction in salt load entering Lake Powell. We are undertaking a detailed examination of the hydrologic data in an attempt to ascertain the underlying reasons for this reduction and the implications as to salinity control. Similarly, we are undertaking an effort to model the thermal and chemical processes taking place in Lakes Powell and Mead to provide a better basis for estimating future changes in the salinity of those reservoirs.

Reclamation activities associated with the plan of implementation for meeting Colorado River salinity standards include the construction of two authorized projects, feasibility studies leading to authorization and construction of 11 additional salinity control units, advance planning on the authorized Las Vegas Wash Unit, and steps to encourage industrial use of saline and/or brackish waters. We are making significant progress on construction of the Grand Valley and Paradox Valley salinity control units. The well field for the Paradox Valley Unit is operating successfully and is now being fine tuned; designs, specifications, and permit applications are being prepared for brine disposal using deep well injection. In Grand Valley, construction of Stage I is proceeding more rapidly than earlier anticipated, with lining of the Highline Canal completed last spring and the contract for the pipe laterals just recently having been awarded. Planning for Stage II is continuing with the intent of beginning additional construction as soon as Stage I monitoring results can be incorporated into the plans.

Feasibility investigations under the Colorado River Water Quality Improvement Program were initially progressing more slowly than was desirable because of the newness of the technology and the limited staff that was available. However, in recent years, those problems have been overcome and the studies are continuing essentially on schedule. We have recently prepared Special Reports or Status Reports on four agricultural source units which indicate that formulated plans for these units appear to have viability for successful implementation. We have also let contracts for feasibility studies on four point and diffuse source units to identify the salt loading mechanisms and develop alternatives for control. In addition, we have just released a Special Report on the Saline Water Use and Disposal Opportunities Concepts, our first step toward adopting the Forum's policy for industrial use of saline water. That report suggests that beneficial use of saline and brackish water may replace desalting and evaporation as a more cost effective and environmentally acceptable salinity control strategy.

In summary, we believe the Proposed 1981 Review - Water Quality Standards for Salinity, Colorado River System, which confirms the numeric criteria and updates the plan of implementation for salinity control, is an excellent review of the established standards. We concur in the adequacy of numeric criteria for the next 3 years and in the plan of implementation. We look forward to continued close cooperation with the Forum, the Basin States, and the Federal agencies in implementing the control program.

GRAY, CARY, AMES & FRYE
ATTORNEYS AT LAW
525 B STREET, SUITE 2100
SAN DIEGO, CALIFORNIA 92101
TELEPHONE (714) 236-1661
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GORDON GRAY (1877-1967)
W. P. CARY (1882-1943)
WALTER AMES (1893-1980)
FRANK A. FRYE (1904-1970)

OTHER OFFICES
IN
LA JOLLA
EL CENTRO

September 24, 1981

Mr. Myron B. Holburt
California Member
Colorado River Basin
Salinity Control Forum
107 South Broadway, Room 8103
Los Angeles, California 90012

Dear Myron:

I have examined the proposed report of the Colorado River Basin Salinity Control Forum on water quality standards for salinity of the Colorado River System.

I agree with the recommendations of the forum as set forth in this report and agree that the kind of implimentation should be carried out.

I also see no reason to recommend changes in the numeric salinity criteria for the stations "Below Hoover Dam", "Below Parker Dam", and "Imperial Dam".

Very sincerely yours,

John M. Cranston
Member Colorado River Board
of California, Director
Metropolitan Water District
of Southern California,
and Director of San Diego
County Water Authority

JMC/md

## ADDITIONAL STATEMENTS

Additional statements were received by the Forum after the October 1, 1981 deadline for submission of comments. Copies of the statements have been included in the supplement, however, since they were received after the deadline, the Forum did not have sufficient time to respond. For the most part, the comments were supportive or the statements did not require Forum response.

# LAS VEGAS WASH DEVELOPMENT COMMITTEE

5800 EAST FLAMINGO ROAD

LAS VEGAS, NEVADA 89122

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# ADVISORY TO THE BOARD OF COUNTY COMMISSIONERS CLARK COUNTY

October 3, 1981

Mr. Jack A. Barnett, Executive Director
Colorado River Basin Salinity Control Forum
220 S 200 E.
Suite 320
Salt Lake City, Utah 84111

Dear Mr. Barnett:

As Chairman of the Las Vegas Wash Development Committee (WDC) I took advantage of a by chance opportunity to peruse for just a short time the 1981 Review for Water Quality Standards for Salinity, Colorado River System, July 1981.

The WDC has been advisory to the Clark County Board of Commissioners since 1974 on the Las Vegas Wash and its environs. It is a unique wildlife habitat in our desert, or any other desert community.

The Wash is briefly mentioned in the Review, but I would like to emphasize the interest the community is taking in the area. Lands have been purchased recently which create the nucleus for a Desert Wetlands Park with potentially the outstanding feature of a large marsh area which has attracted over 250 species of birds and many forms of animals and plants. Enclosed, please find a recently published brochure on this subject. A slide program and photo collection is also available.

The non-structural trend to your examination of agricultural contributions on the river please members of the WDC.

The WDC would appreciate receiving the next Forum Review as well as the opportunity to know as much as possible about the Bureau of Reclamation's studies and planning processes in Las Vegas Wash area.

Sincerely,

Glade Koch

Glade Koch (Mrs.)

3578 Freedom
Las Vegas, Nevada 89102

Oct 4, 1981

Mr. Jack A. Barnett, Executive Director
Colorado River Basin Salinity Control Forum
Suite 320
220 South 200 East
Salt Lake City, Utah 84111

The League of Women Voters of Las Vegas Valley was pleased to receive a copy of 1981 Review, Water Quality Standards for Salinity, Colorado River System. We regret that circumstances prevented our submitting comments by October 1 and hope that this will still be in time to be of some value.

On the whole, the League was pleased with the report as written. We were particularly pleased to see what appears to be a greater emphasis on non-structural approaches and improvements in agricultural practices to facilitate salinity reduction. Specific items we feel deserve League comment are:

1. Page 73. Plans for a Wetlands Park in Las Vegas Wash should be recognized. The park has been approved by Clark County Board of Commissioners and in 1980, land acquisition for park purposes was begun. The Park Master Plan will soon be completed. Preservation and restoration of marsh areas in the park area is an integral part of park goals. Salinity control projects must be co-ordinated with park development as well as with sewage treatment plans.

2. Page 81. While a new technical

co-ordinating group has been formed by Nevada Falcon members, it must be recognized that no final multi-purpose plan can be formulated until issues of beneficial uses for Vegas Wash and Vegas Bay, criteria, water quality standards, and sewage treatment facility needs have been resolved. Due to difficulties in reaching agreements in the Water Quality Studies Board, the work under the Consent Decree is more than a year behind schedule and new court cases have been filed. It is unrealistic to assume that a final multi-purpose plan can be developed by the end of 1981 through the technical committee.

Daisy J Talvitie
Environmental Committee
League of Women Voters
of Las Vegas Valley

STATE OF CALIFORNIA — RESOURCES AGENCY

EDMUND G. BROWN JR., Governor

DEPARTMENT OF WATER RESOURCES
P.O. BOX 388
SACRAMENTO
95802
(916) 445-9248

OCT 5 1981

Colorado River Basin
Salinity Control Forum
220 South 200 East, Suite 320
Salt Lake City, UT 84111

This is in response to your letter of August 28, 1981, requesting our comments on the "Proposed Report on the 1981 Review - Water Quality Standards for Salinity Colorado River System", prepared by the Colorado River Basin Salinity Control Forum.

We have reviewed the subject report and find it comprehensive and sufficient. The Department strongly supports the Forum's salinity control effort. We compliment the Forum on the preparation of the report.

Thank you for the opportunity to review this document.

Sincerely,

Ronald B. Robie
Director

# CALIFORNIA FARM BUREAU FEDERATION

PUBLIC AFFAIRS DIVISION
JAMES C. ELLER, Manager
11TH & L BUILDING
SACRAMENTO, CALIF., 95814
TELEPHONE: 916 - 446-4647

October 6, 1981

Mr. Jack Barnett, Executive Director
Colorado River Basin
Salinity Control Forum
220 South 200 East
Suite 320
Salt Lake City, Utah 84111

Dear Mr. Barnett:

The California Farm Bureau Federation submits this statement for the consideration of the Forum regarding the Proposed Report on the 1981 Review - Water Quality Standards for Salinity - Colorado River System.

Progress toward salinity reduction can be made in the most effective and efficient manner only after possession of a great deal of technical information. We wish to express gratitude that the investigations are continuing in this effort to reduce salinity in the river. We are most anxious that decisions to reduce salt content in the Colorado be limited to those which are economically justified. The Yuma desalting plant does not appear to qualify in that respect and is therefor a source of concern to us. It will be of increasing concern as long as Mexicali continues to use the Salton Sea as a cesspool.

Your report indicates that there are seventeen irrigation areas considered as "salt source units", and that in 7 of these units, comprising 600,000 acres of irrigated farmland, on-farm salinity control measures may be cost effective. We would urge that definitive data be developed on the most promising of these, and that efforts be made to direct the cost-sharing funds administered by ASCS toward this purpose. Your report indicates this is the solution currently being conducted in Grand Valley and pursued in other units.

The report indicates 582,000 acre-feet of water, containing two-and-a-half million tons of salt (approximately 4.3 tons per acre-foot) exists in such a pattern that it might be available for use in energy development. It is our impression that most of this water exists in states which have not yet developed uses for all the Colorado River water to which they are entitled, and that

these same states are likely to require considerable additional water in order to develop their energy resources. We are, of course, pleased at such prospects, since a significant part of California's agricultural production is dependent on the quality of the river downstream. The report admits to the existence of legal, institutional, environmental and cost-sharing problems. As to cost-sharing, if energy conversion activities are allowed to include in their product cost base, the burden of access to only water of a high salt content, it appears most of the purchasers of the product energy would likely be the same residents of the southwest which would also benefit from the higher quality water resultant in the Colorado River. Although far from a precise relationship, at least a "user-fee" principle would approximate. Our policy supports the user fee principle.

Sincerely,

William I. DuBois
Director
Natural Resources

WID/fb

Department of Water and Power the City of Los Angeles

TOM BRADLEY
Mayor

Commission
JOHN J. GUARRERA, *President*
SARA C. STIVELMAN, *Vice President*
RICARDO R. GUTIERREZ
JACK W. LEENEY
HERBERT C. WARD
JUDITH K. DAVISON, *Secretary*

JAMES L. MULLOY, *General Manager and Chief Engineer*
PAUL H. LANE, *Chief Engineer of Water Works and Assistant Manager*
NORMAN E. NICHOLS, *Chief Electrical Engineer and Assistant Manager*
NORMAN J. POWERS, *Chief Financial Officer*

October 7, 1981

Mr. Jack Barnett
Executive Director
Colorado River Basin Salinity
Control Forum
220 South 200 East, Suite 320
Salt Lake City, Utah 84111

Dear Mr. Barnett:

Proposed Report on the 1981 Review -
Water Quality Standards for Salinity
Colorado River System

This is in response to an August 28, 1981 invitation by the California members of the Colorado River Basin Salinity Control Forum to make comments and suggestions on the above titled report. We are in general agreement with all points covered in the report and support the report's recommendations.

Of particular importance are the recommendations to expedite construction of two salinity control units, the Paradox Valley and Grand Valley Units, authorized by Section 202, Title II, of Public Law 93-320, the Colorado River Basin Salinity Control Act. In addition, we support the authorization and construction of the Meeker Dome Unit and ten additional units listed in Section 203(a)(1) of the same Act if these projects prove to be feasible from the ongoing studies. We believe these salinity control units will be essential in minimizing the salinity of the Colorado River and making a better quality water available for delivery to the City of Los Angeles and other users of Metropolitan Water District's water supply in the future.

We appreciate the opportunity to review and comment upon the report. If we can be of further assistance to you, please let us know.

Sincerely,

PAUL H. LANE
Chief Engineer of Water Works
and Assistant Manager

cc: Myron B. Holburt

## MODIFICATIONS

On the basis of statements made at regional public meetings held in Las Vegas, Nevada, on September 28, 1981, and Grand Junction, Colorado, on October 1, 1981, and on written comments dated October 1, 1981, or before; and to correct other minor errors, the following changes to the "1981 Review - Water Quality Standards for Salinity, Colorado River System" were approved by the Salinity Control Forum on October 27, 1981.

Pages 19, 20, and 21; Tables 3, 4, and 5. The right column heading "with all 14 salinity control projects" on all three tables, change "14" to "12".

Page 66, last sentence. The first paragraph should be corrected to read: "However, under agreement with the State of Utah, the state has been given the responsibility for drafting of the minor permits."

Page 66, end of third paragraph. Add "a portion of the water from the oil well is used for agricultural purposes".

Table 6, Page 107. Under Southwestern, the word "Conditional" should be struck on both lines so as to read "State Certification" and "EPA approval". The date for State Certification should be changed from April 1980 to December 1979. Under Uintah Basin, the date for State Certification should be changed from December 1978 to September 1978. Under Southeastern, the date for State Certification should be changed from December 1978 to April 1980, and for EPA approval, the date should be changed from October 1979 to May 1980. Six County Area should be changed to Wayne County and the date for State Certification should be changed from December 1979 to April 1980, and the date for EPA approval should be changed from May 1980 to October 1980.