TEXAS GULF REGION

SPECIFIC PROBLEM ANALYSIS SUMMARY REPORT

1975 NATIONAL ASSESSMENT OF

WATER AND RELATED LAND RESOURCES

LP-13

Prepared by

Texas Department of Water Resources*

As Regional Sponsor
for the
U. S. Water Resources Council

August, 1977

*Effective September 1, 1977, Texas' three water resources agencies, the Texas Water Rights Commission, the Texas Water Development Board, and the Texas Water Quality Board, were consolidated to form the Texas Department of Water Resources. A number of publications prepared under the auspices of the predecessor agencies are being published by the TDWR. To effect as little delay as possible in production of these publications, references to these predecessor agencies will not be altered except on their covers and title pages.

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PREFACE

The Specific Problem Analysis phase of the U. S. Water Resources Council's 1975 Assessment of the Nation's severe water and related problems has included preparation of four technical documents by the Texas Water Development Board as regional sponsor for the Texas Gulf Region. The initial document, identified as Phase II Technical Memorandum No. 1 and completed in December, 1975, identifies and briefly describes the problems within the Texas Gulf Region. The second document, identified as Technical Memorandum on Phase II, Activity II and completed in June, 1977, provides State-Regional Futures and Problem Lists. The third document, identified as the Phase II, Activity III Technical Memorandum and completed in June, 1977, provides information concerning the probable adverse and/or beneficial effects of not solving the severe water and related problems from a State-Regional viewpoint.

This is the fourth and final specific problem analysis document submitted to the Water Resources Council summarizing the State-Regional Future for the Texas Gulf Region. The report contains the following summary information:

1. Introduction and Summary of Assessment Activities
2. Conclusions and Recommendations
3. Comparison of the State Regional Future (SRF) and the Modified Central Case (MCC)
4. Identification and Discussion of the Severe Water and Related Problems
5. Implications of Not Solving Severe Water and Related Problems, and
6. Regional Views of Present and Emerging National Issues.

The material contained in the final report has been modified and revised, as necessary, and thus supersedes information and data contained in previous Assessment reports. For the Texas portion of the Texas Gulf Region, information and data were derived from the May, 1977 planning document titled "Continuing Water Resources Planning and Development for Texas" prepared by the Texas Water Development Board.

INTRODUCTION

The 1975 Assessment of the Nation's Water and Related Land Resources was initiated by the U. S. Water Resources Council in February, 1974 to carry out one of its major program objectives required by the Water Resources Planning Act of 1965 which states the Council shall,

> "...maintain a continuing study and prepare an assessment biennially, or at such less frequent intervals as the Council may determine, of the adequacy of supplies of water necessary to meet the water requirements in each water resource region in the United States and the national interest therein."

The Council's first National Assessment, completed in 1968, was a first step in the development of a continuing assessment process. On a national and broad regional basis, it described the nature of available water and related land resources, projected requirements to the year 2020, and identified and discussed emerging problems.

The 1968 Assessment also contained recommendations for conducting future assessments. Briefly summarized, these recommendations directed that the next National Assessment be a continuation of assessing the water supply with refinements in geographic details, improvements in the water supply and water use data, including quantitative data on instream uses, and modified demographic, economic, and land use projections.

Objectives of the 1975 Assessment

The objectives of the 1975 Assessment are to identify, describe, and place in priority for resolution the Nation's severe existing and emerging water and related land resource problems from both the State-Regional and national viewpoints.

These problems are to be described as a function of a range of future conditions regarding water policies, population growth, economic growth, environmental quality, and implementation of improved water-use technologies. The 1975 Assessment considers the competition for water and short- and long-range conservation, development, use, and management planning needs for the Nation's limited water and related land resources.

The principal objectives include:

1. Identifying and placing into priority those existing and emerging water and related land resource problem issues which are determined to be severe.

2. Describing the urgency for resolving severe water and related land resource problem issues identified.

3. Documenting with equal emphasis significant opinions from two viewpoints [national and State-Regional] regarding: a) the severity of problem issues, b) the urgency and need to resolve problem issues, c) conclusions and recommendations concerning decisions required to resolve the problem, and d) future conditions assumptions upon which these viewpoints are based.

4. Providing supporting narrative and numerical information which describes why problem issues within selected problem areas are both severe and of a given urgency.

Overview of the 1975 Assessment Process

There are three major analysis steps in developing the 1975 Assessment: a) a nationwide analysis, b) an analysis of specific problems from the State-Regional viewpoint, and c) an analysis of problems of national significance.

Nationwide Analysis

The purpose of the nationwide analysis is to develop nationally-consistent estimates of current (1975) water supplies and both current and future (1985 and 2000) requirements for water for present and future-condition scenarios based upon the Federal viewpoint. The information developed by various Federal agencies for the nationwide analysis is termed the Modified Central Case (MCC).

Specific Problem Analysis

The purposes of the Specific Problem Analysis are to articulate the State-Regional viewpoint concerning water-related problems and to provide information in a nationally consistent format and level of detail for use in the analysis of problems of national significance. The information developed in the Specific Problem Analysis parallels from a regional viewpoint the information developed in the nationwide analysis and is termed the State-Regional Future (SRF). The Specific Problem Analysis is accomplished through the cooperative efforts of

State, regional, and Federal agencies under the overall direction of the Water Resources Council. Regional Assessment activities are coordinated and conducted by selected regional sponsors -- one for each of the 21 water resource regions defined by the Water Resources Council (Figure 1).

The Regional Sponsor for the Texas Gulf Region is the Texas Water Development Board. As a regional sponsor, the Board articulates for the Texas Gulf Region, in consultation with the Louisiana Department of Transportation and Development and the New Mexico Interstate Stream Commission, the State-Regional viewpoint concerning water-related problems and provides information in a nationally consistent format. The information is developed for the region as well as for subunits of the region. These subunits are termed Aggregated Subareas (ASA's) and approximate hydrologic drainage areas or river basins. As indicated on Plate I, there are five ASA's within the Texas Gulf Region. The Texas Gulf Region has been designated as Region 12 by the Water Resources Council, while ASA's were similarly identified as 1201, 1202, ..., 1205 (Plate I).

In order to assure that the Assessment contains information reflecting the State and Regional viewpoints, the Texas Water Development Board established an Assessment Coordinating Committee. This informal committee is an inter-agency organization, composed of representatives of the several State and Federal agencies working in the area of water and related land resources development and/or management. The Committee's principal function is to review draft Assessment materials and provide comments and suggestions. Members of the Texas Gulf Coordinating Committee are as follows:

Arthur Simkins	Texas Department of Water Resources - Study Director and Committee Chairman
C. E. Clayton	U. S. Department of Commerce
Alfred D'Arezzo	Texas Water Rights Commission
Gerald R. Dyson	Louisiana Department of Transportation and Development
Kern Ewing	General Land Office
Emmit Gloyna	Bureau of Reclamation - Austin, Texas
Robert J. Kemp	Texas Parks and Wildlife Department
G. E. Kretzschmar, Jr.	Texas State Soil and Water Conservation Board
E. R. Leggat	U. S. Geological Survey
Mark V. Lowry	Texas State Department of Health
George C. Marks	U. S. Department of Agriculture
Jesse Range	U. S. Army Corps of Engineers
F. Warren Norris	Environmental Protection Agency

FIGURE 1

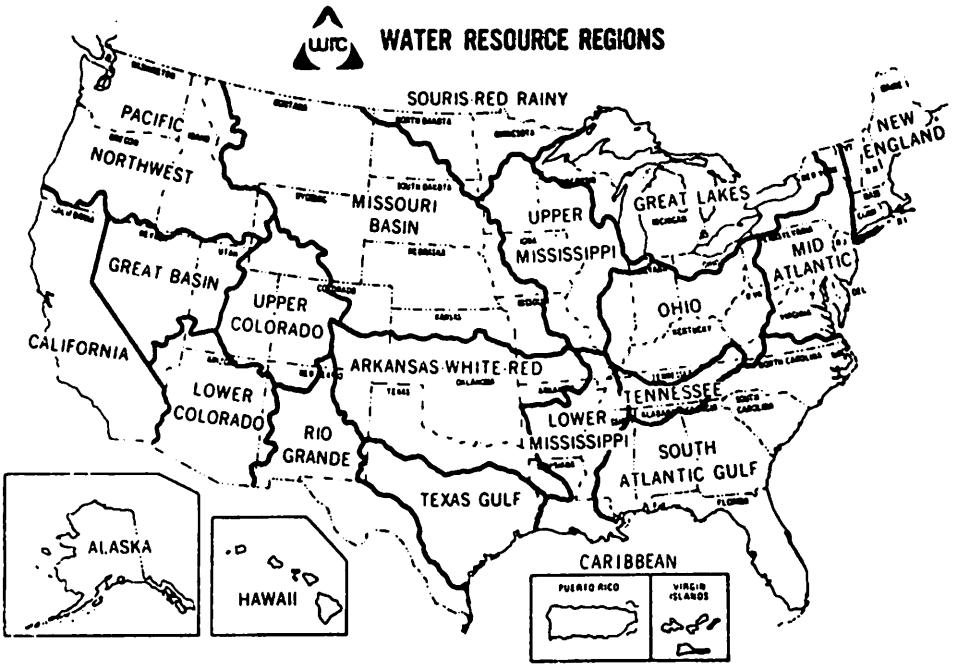
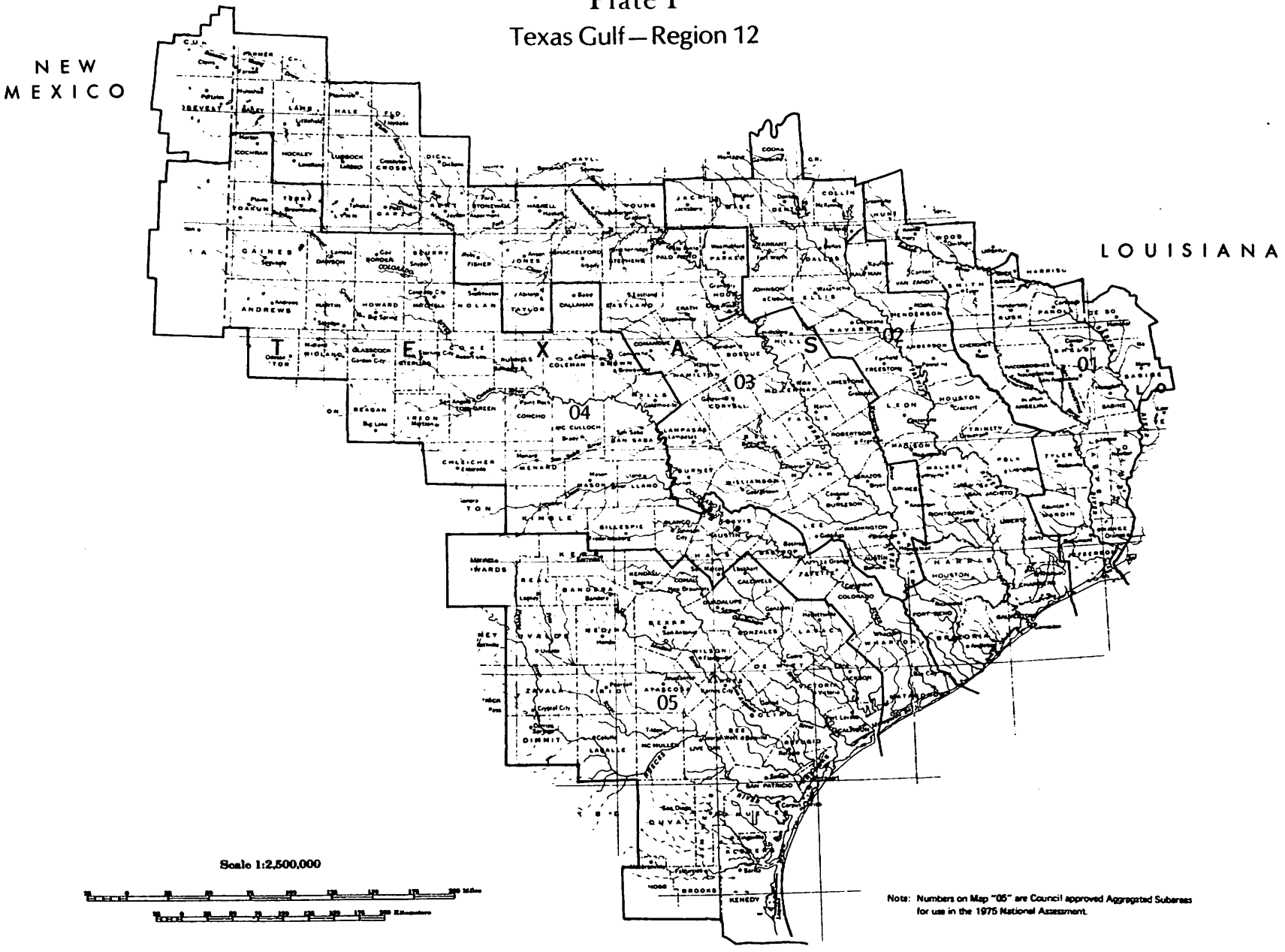

WRC
WATER RESOURCE REGIONS
SOURIS-RED RAINY
PACIFIC NORTHWEST
MISSOURI BASIN
UPPER MISSISSIPPI
GREAT LAKES
NEW ENGLAND
MID ATLANTIC
GREAT BASIN
UPPER COLORADO
OHIO
CALIFORNIA
ARKANSAS-WHITE-RED
TENNESSEE
LOWER COLORADO
RIO GRANDE
LOWER MISSISSIPPI
SOUTH ATLANTIC GULF
TEXAS GULF
ALASKA
HAWAII
CARIBBEAN
PUERTO RICO
VIRGIN ISLANDS

Plate I

Texas Gulf—Region 12



R. E. Patterson	Texas Department of Agriculture
Bob Richards	Texas Coastal and Marine Council
J. R. Runkles	Texas Water Resources Institute
Kenneth B. Schroeder	U. S. Burau of Reclamation - Albuquerque, New Mexico
Carl Slingerland	New Mexico Interstate Stream Commission
Captain Albert G. Stirling	U. S. Coast Guard
Otis M. Trimble	Department of Housing and Urban Development
A. W. Veselka	Federal Power Commission
Hugh C. Yantis	Texas Water Quality Board

The Specific Problem Analysis documents for the Texas Gulf Region are also reviewed by selected representatives of the public. Members of the Texas Gulf Assessment Coordinating Committee originally suggested public participants which they considered would have an interest in reviewing draft assessment products. Additional public participants have from time-to-time also been added. Those participants which responded to the initial request to review Assessment materials were thereafter requested to review later documents. Suggestions from all participants have significantly contributed to the development of each Assessment report. A list of all public participants is included in Appendix A of this document.

National Problems Analysis

The purpose of the national problem analysis is to use the results of both the nationwide analysis and the Specific Problem Analysis to develop a report containing both the State-Regional viewpoint and the national viewpoint. The report will identify and describe in detail: a) water-related problems, b) geographic areas containing problems of sufficient complexity to warrant the preparation of comprehensive plans or data collection programs, c) priorities for resolving the problems and preparing the "Level B" plans or data collection programs, and d) conclusions and recommendations concerning the Federal role in helping to resolve the high-priority problems.

These final Assessment products will be documented in: a) a national report prepared by the Water Resources Council, and b) regional reports for the 21 WRC regions, prepared by Regional sponsors.

Overview of the Texas Gulf Region

Description

The Texas Gulf Region extends from the Gulf of Mexico northwestward for some 650 miles into the Great Plains Province of

the United States. Most of the Region lies within the State of Texas, although two parishes in Louisiana and three counties in New Mexico are also included. Only a very small portion of the Region consists of Water surface.

The Region extends in a north-south direction some 500 miles from the Red River to the Lower Rio Grande Valley of Texas. The east-west extension is nearly 650 miles, from just west of the Texas-New Mexico border to east of the Sabine River.

Much of the Region consists of the drainage areas of the Sabine, Neches, Trinity, San Jacinto, Brazos, Colorado, Lavaca, Guadalupe, San Antonio, and Nueces Rivers. These rivers drain in a general northwest-southeast course to the Gulf of Mexico.

The natural vegetation of the Texas Gulf Region varies from short grasses in the semi-arid, northwestern section to dense forests in the eastern portion. Tall grasses and small groves of trees are predominant in the central portion of the Region.

Population

The Texas Gulf Region encompasses an area which in recent years has become the second fastest growing region in the Nation after Florida. Since 1950, the Region's population has increased by over 3.9 million, or 63.9 percent. The average annual increase from 1960 to 1975 was two percent.

Estimated 1975 population for the Region was 10.2 million, which was 4.8 percent of the National total. Metropolitan areas accounted for 79.4 percent of the total; the three major urban centers are Dallas/Fort Worth, Houston, and San Antonio. Although the metropolitan areas added over 600 thousand people from 1960 to 1970, the most rapid rate of increase (46 percent) occurred in cities of between 25 and 100 thousand population. Total rural population decreased in the 1950's, but since 1960 the total rural population of the Region has remained relatively stable at approximately 2 million. However, the percentage of rural-to-total population is decreasing at a rate of about 2.4 percent per year as the metropolitan areas increase their share of the Region population by about 1.5 percent annually.

Past increases in the Regional population have been primarily the result of natural increase (births minus deaths), but recently in-migration from outside the Region has become a major factor in growth, both in SMSA and non-SMSA areas. From 1960 to 1970, natural increase accounted for 90 percent of the population growth but in the years since 1970 in-migration accounted for 40 percent of the growth.

The Texas Gulf Region includes vast open lands, where population densities range between 8 and 18 persons per square mile, to urban, industrialized areas such as Dallas/Fort Worth and Houston where population densities of the central cities and immediate surrounding areas are between 320 and 380 persons per square mile. The rural coastal areas have higher population densities than other rural areas, ranging from 20 to 40 persons per square mile.

Rapid growth rates in the major urban areas have caused substantial increases in residential construction. The Houston area averaged over 20 thousand new housing units annually from 1970 to 1974, and the Dallas/Fort Worth Metroplex averaged over 28 thousand units per year during the period.

Over one-half of the entire population of the Region is contained in the area generally conforming to the Trinity River Basin (ASA 1202). The Houston and Dallas/Fort Worth SMSA's together contain 46 percent of total Texas Gulf population.

Economy

The historical economic base of the Region has been agriculture and oil and gas production. During the past twenty-five years, however, the Region's economy has diversified to an extent that trade, manufacturing, and services each contribute similar dollar amounts to the personal incomes of population.

A wide range of economic activity occurs within the Region and sources of earnings of the four million employed persons reflect the diversification of the area's economy. Total earnings in 1975 were $28.5 billion, or about $3.7 thousand per capita (measured in 1967 dollars). Agriculture accounted for four percent, manufacturing 22 percent, mining three percent, and other sources (transportation, communications, utilities, trade, services, finance, construction and government) 71 percent of the total earnings.

The Region contains major manufacturing establishments which contribute significant output to the Nation's economy. The largest concentration of petrochemical and petroleum refining capacity is located primarily along the Texas Gulf Coast. The Texas Gulf Region's petroleum processing industry ranks above all states in the Nation in value of output of petroleum-based products. The chemical industry in Texas is almost entirely situated in the Texas Gulf area, and Texas is the third leading chemical producing State in the Nation. These two industries contribute almost $1.4 billion annually in earnings to employees and produce over $4 billion (1972 dollars) in value added to raw materials each year. Other major manufacturing industries

are machinery, transportation, equipment, fabricated metals, and electrical apparatus. The major water-using manufacturing industries (paper, food, chemicals, petroleum refining, and metals) contribute about 37 percent of total Regional earnings.

The Houston area was the second ranking metropolitan area of the Nation in terms of growth in value added by manufacturing during the period 1967 to 1972, and was sixth in total new capital expenditures in 1972.

Personal income from agriculture in the Region constitutes approximately four percent of the entire Nation's total farm income. An estimated 50 percent of the total production is exported from the Region to the rest of the Nation and foreign countries. Growth of agriculture has been made possible by irrigation, especially in the Southern High Plains portion of the Region where over 60 percent of the cash receipts is derived from sales of irrigated crops. The Nation's leading rice-producing region, which requires total irrigation, is located along the Texas Gulf Coast.

As a major distribution center, the Dallas/Fort Worth metropolitan area ranks eighth among metropolitan areas in wholesale sales. This particular area also contains many durable goods manufacturing plants.

Earnings from the "other" category which consists of the service and marketing sectors are distributed among trade (18 percent), government (17 percent), services (15 percent), transportation and communications (8 percent), construction (7 percent), and financial sectors (5 percent) of total Regional earnings.

Natural Resources

The natural resources of the region are abundant and varied, and serve as a major stimulus to the regional economy. The presence of these natural resources allows the region to be a net exporter of goods and services. One of the most abundant natural resources is the land, of which 86.5 percent was used for agricultural purposes in 1975. The remainder of the land was used for urban, water, transportation, and other uses. Agricultural land, however, is expected to decline to 80.5 percent of the area by year 2000 due to urban growth and encroachment.

Mineral resources also account for a large share of the natural resource base. The leading mineral resources are petroleum and natural gas. The region accounts for a major percentage of the Texas resource reserve where in 1974 it was estimated that the liquid hydrocarbon reserves were 13.8 billion barrels and natural gas reserves were 78.5 trillion cubic feet. This made up 34 percent and 33 percent of the entire U. S. reserves of liquid hydrocarbons and natural gas, respectively.

Another important mineral resource currently being rapidly developed in Texas is lignite, a form of coal. Nearly all lignite reserves in Texas are located within the Texas Gulf region. It is estimated that the State of Texas reserves of near-surface lignite (reserves occurring at depths of less than 200 feet) amount to about 10.4 billion short tons, while deeper reserves approximate 100 billion short tons.

A third mineral resource important to both the Region and the Nation consists of extensive low-grade uranium deposits, part of which are currently being mined in Karnes and Live Oak Counties (ASA 1205). Several other non-metallic mineral resources occur in the region, the most important of which are cement, sulphur, sand and gravel, salt, and stone.

Production of metals is relatively insignificant in the region, as it comprises less than 1 percent of the total mineral production. Metals being produced include iron and magnesium.

Finally, the natural resources of the Texas Gulf coast areas are of major economic importance. The production of seafoods and other significant functions like waste assimilation are naturally renewed by the dynamic cycles of the estuarine ecosystems. During the six year period 1970-1976, the value of commercial fisheries landings was $98.5 million. Likewise, sport fishing also contributes economically and in 1975 was estimated to account for an economic impact in excess of $14 million annually just in the Corpus Christi bay system, the region's fourth largest estuary.

CONCLUSIONS AND RECOMMENDATIONS

This Chapter contains each State's (Texas, Louisiana, and New Mexico) conclusions and recommendations regarding the resolution of each of the severe water and related problems identified in each state. These problems were identified in previous assessment activities. A brief description of each problem is presented in Chapter Four - "Identification of Severe Water and Related Land Problems."

Water Quality Problems -- Beaumont-Port Arthur Metropolitan Area - Texas (Problem Identification Number 1)

Areawide water quality management problems within the Beaumont-Port Arthur-Orange metropolitan area are being examined under guidelines set forth in Section 208 of the Federal Water Pollution Control Act Amendments of 1972. The present study includes a current appraisal of both point and non-point source pollution problems of the area and the development of alternative strategies to manage areawide water-quality problems.

Currently, regional wastewater treatment facilities serving the metropolitan area are being expanded and improved, where needed, to bring point source contributions of pollution under control. Following the current round of plant construction activities, remaining water-quality studies will center on non-point sources of pollution. Solutions to the non-point source pollution problems may include measures for collection and treatment of urban runoff. Federal and state government should continue to support planning and implementation.

Construction of the U. S. Corps of Engineers authorized Salt-Water Barrier project near Beaumont, Texas would permanently eliminate the salt-water intrusion problem in the lower Neches River Basin. The project would provide a navigation gate by-pass channel, auxiliary dam, and appurtenances to permanently control salt-water intrusion in the Neches River and tributaries. The freshwater requirements associated with the navigational aspects of the authorized project would be approximately 10,000 acre-feet annually. These requirements can easily be met from existing and projected flows of the Neches River. Equitable cost-sharing criteria for construction and operation and maintenance of the project must be developed.

Water Supply Problems -- Upper Trinity River Basin - Texas (Problem Identification Number 2)

Projects which are recommended for highest priority consideration in planning to meet the present and projected water

needs of the Upper Trinity River Basin through the year 2000 include:

-- existing supplies for the City of Dallas stored in Lake Tawakoni

-- construction of additional pumping and conveyance facilities from Lake Tawakoni to Dallas in accordance with contractual permit provisions to deliver the city's full share of the yield of the reservoir.

-- utilization of approximately 114 thousand acre-feet annually currently stored in Lake Palestine in the Neches River Basin through construction of pumping and conveyance facilities for delivery to the City of Dallas

-- construction of the authorized Aubrey Reservoir Project

-- construction of the authorized Lakeview Reservoir Project

-- resumption of construction of the Cooper Lake and Channels Project located in the Sulphur River Basin, and construction of pumping and conveyance facilities to the Dallas area (specifically, to the City of Irving and the North Texas Municipal Water District)

-- construction of the permitted Richland Creek Reservoir in eastern Navarro County to supply water to Tarrant County WCID No. 1.

Implementation of these actions, together with continued utilization of local ground-water supplies, should provide sufficient dependable supplies to meet projected municipal and manufacturing requirements and existing electric generating power plant cooling water needs through the year 2000. However, increases in consumptive water use as a consequence of expanded steam-electric power plant base load capacity in the area could significantly reduce available supplies. Consequently, additional sources of supply (probably in the Sulphur River Basin and/or Sabine River Basin to the east) may need to be under construction before the year 2000 or soon thereafter.

Water Quality Problems -- Dallas-Fort Worth (Trinity River and Tributaries) - Texas (Problem Identification Number 3)

A water-quality management plan for the Trinity River Basin was developed pursuant to the requirements of Section 303(e) of the Federal Water Pollution Control Act Amendments of 1972 (p.L. 92-500). Areawide water quality management problems within the Dallas-Fort Worth metropolitan area are being

examined under guidelines set forth in Section 208 of the above-mentioned Act. The study includes a current appraisal of both point and non-point source pollution problems of the area and provides for the development of alternative strategies to manage areawide water-quality problems.

Currently, regional wastewater treatment facilities serving the metropolitan area are being expanded and improved where needed to bring point source pollutants under control. Following the current round of plant construction activities, remaining water-quality studies will center on non-point sources of pollution. Federal and State government should continue to support future planning and implementation.

Land Subsidence in the Houston-Galveston Area - Texas (Problem Identification Number 4)

The land-surface subsidence has generally resulted from the withdrawal of large quantities of ground water in the area.

During the period from 1906 to 1973, land-surface subsidence of one foot or more has occurred in an area of approximately 2,500 square miles. The maximum subsidence that has occurred during this period has been 8.5 feet.

In 1975, the Texas Legislature created the Harris-Galveston Coastal Subsidence District to aid in reducing land subsidence. The District issues permits for wells in Harris and Galveston Counties, and levies a tax on pumpage. By reducing the number of wells and the quantities of water pumped, further subsidence can be reduced. This is only a partial solution, however. In order to completely stop further subsidence, it will be necessary to accelerate construction of major conveyance, treatment, and distribution systems to provide additional supplies of surface water for this complex and highly important industrial and agricultural area of Texas. Completion of development of the lower Trinity River Basin by the year 2000 is essential. Additional development and conveyance of surface waters of the Neches and Sabine River Basins to the area will be necessary.

Water Quality Problems -- Houston Metropolitan Area - Texas (Problem Identification Number 5)

Areawide water quality management problems within the Houston-Galveston metropolitan area are being examined under guidelines set forth in Section 208 of P.L. 92-500. Current studies include an appraisal of both point and non-point source pollution problems and development of alternate strategies to solve areawide water-quality problems.

Regional wastewater treatment facilities serving the metropolitan area are being expanded and improved, where needed, to bring point source contributions of pollution under control. Following the current round of planned construction activities, emphasis on solving remaining water-quality problems will center on non-point pollution sources. Federal and State government should continue to support future planning and implementation.

Groundwater Quality Problems -- Haskell and Jones Counties - Texas (Problem Identification Number 6)

Ground-water in the Seymour aquifer, which is used extensively for irrigation, domestic, and livestock purposes and to a lesser extent for municipal supply, contains high concentrations of nitrate and fluoride. The nitrate concentrations appear to be principally the result of natural phenomena, with excessively high nitrate concentrations in local areas apparently related to land use measures and extended periods of high precipitation. In local areas of Haskell and Jones Counties, salinity, primarily sodium chlorides has also increased significantly in recent years. Localized salinity problems appear to be related to past oil and gas exploration and production and possibly intrusion of saline water from underlying aquifers.

Preliminary results of a statewide study indicates that many public water systems (community and non-community) in the area cannot meet nitrate and/or fluoride standards of EPA Interim Primary Drinking Water Standards (P.L. 93-523) and that considerable costs will be involved if these systems are required to meet such standards.

Continued degradation of ground-water quality could eventually preclude its general use for irrigation as well as for livestock watering and domestic purposes in Haskell and Jones Counties. The problem also occurs to a great extent in Knox, Baylor, and Wilbarger Counties which are located in the Arkansas-White-Red River Basins Region. Technical and financial assistance will be needed in the affected areas to address the problems.

Brazos Basin Salinity Problems above Possum Kingdom Reservoir - Texas (Problem Identification Number 7)

A reduction in the salinity of the Brazos River would allow for full utilization of Brazos River flows, which is impossible now because of the poor quality water. The U. S. Army Corps of Engineer's Brazos River Basin Natural Salt Control Project was authorized by Congress under P.L. 94-587 to improve the water quality in the Brazos River by locating and controlling the flow of natural chloride and sulfate

pollutants into the stream systems. This project is now in the advance engineering and design phase. The Corps has recommended a system of three impoundment reservoirs on the tributaries of the Salt Fork of the Brazos River as the most effective means of controlling the major sources of salt pollution.

Groundwater Availability and Quality Problems in the Carrizo Aquifer, Winter Garden Area - Texas (Problem Identification Number 8)

The Carrizo aquifer is the most utilized source of water in the Winter Garden Area and yields moderate to large (100 to more than 2,000 gallons per minute) quantities of water to wells. Use of the water is mainly for irrigation with minor use for municipal and industrial purposes in such towns as Carrizo Springs, Crystal City, Pearsall, Cotulla, Tilden, Jourdanton and Floresville. The aquifer receives an average of about 100,000 acre-feet of natural recharge annually in its outcrop area. From 1963 through 1969, it was estimated that the aquifer received about 9,500 acre-feet per year of water by subsurface leakage; mainly from the overlying sands of the Bigford Formation in Zavala, Dimmit, northwestern LaSalle and southwestern Frio Counties. From 1963 through 1969, the annual pumpage from the aquifer for irrigation, public supply, and industrial purposes averaged about 272,000 acre-feet and ranged from almost 200,000 acre-feet in 1968 to more than 425,000 acre-feet in 1967. Within the fresh to slightly saline portions of the aquifer, water quality is generally good; however, iron, sulfate, chloride, fluoride and nitrate problems are evident locally. Also, sodium hazard in relation to irrigation are evident generally in the area of the aquifer where total dissolved solids exceed 1,000 milligrams per liter.

Withdrawals of groundwater for irrigation have caused extreme "mining" of the aquifer's artesian storage; especially in Zavala and Dimmit Counties, where since 1946 water levels have declined locally to depths greater than 500 feet below the land surface. From 1946 to 1972,water-level declines of 430 feet have occurred in the area.

Past and future expected "mining" of artesian storage has and will cause leakage and encroachment of poorer quality water to the Carrizo aquifer. In local areas, especially in Dimmit County, saline water from the Bigford Formation is leaking through old well bores and contaminating the Carrizo aquifer. When these wells were drilled in the nineteen twenties and nineteen thirties the piezometric head of the Carrizo aquifer

was considerably above the head in the saline water sands of the Bigford. Because of pumpage, the head of the Carrizo has been significantly lowered below the head of the Bigford saline water sands. Since the old wells were poorly constructed initially and many have not been properly plugged and sealed, the saline water moves down their boreholes and mixes with the Carrizo water; thus, degrading its quality.

Also, pumpage has and will probably cause reversals in the hydraulic gradient of the aquifer; thus allowing for migration of the aquifer's "bad water line" and encroachment of poorer quality water to areas previously having good quality water.

In the eastern outcrop area of the aquifer in Frio, Atascosa, Bexar and Wilson Counties, shallow ground-water in the aquifer contains excessive, natural concentrations of iron. Also, the presence of natural organic matter such as pyrite and "impure" lignite has caused Carrizo water to have extremely low pH values, making it excessively corrosive. Throughout its entire extent in the Winter Garden area south and southwest of San Antonio, the aquifer contains water which is very hard. Locally, in Wilson County, some deep wells have encountered Carrizo water containing large amounts of hydrogen sulfide.

If ground-water pumpage is reduced to the aquifer's "safe" yield, surface water supplies must be developed to offset this reduction and to meet projected future needs. Detailed studies of various alternatives for solving the short and long-term water supply problems and needs of the Winter Garden Area must be undertaken.

Regional Ground and Surface Water Management Problems Associated with the Edwards (Balcones Fault Zone) Aquifer - Texas (Problem Identification Number 9)

Supplemental surface water supplies for the Edwards Aquifer region of the Guadalupe, San Antonio, and Nueces River Basins are needed to insure an adequate water supply for agricultural, municipal, and other uses. Studies by the Texas Water Development Board indicate the advisability of instituting an aquifer-wide management program for the Edwards Aquifer. Such a management program would necessitate the coordinated development and use of ground- and surface-water supplies in the area. This management program could provide a sustained flow from San Marcos Springs and also would reduce the possibility of drawing poor quality water into the freshwater bearing zone along the southern limit of the Edwards Aquifer. However, additonal study is needed in order to develop an equitable social, economic, and environmental solution to this problem.

Jackson County and Vicinity Groundwater Problems - Texas (Problem Identification Number 10)

In the area of Jackson County and vicinity the only source of fresh to slightly saline ground-water is the Gulf Coast aquifer which consists of alternating and discontinuous beds of water saturated sands and clays of Tertiary and Quaternary ages. The Gulf Coast aquifer in Jackson County and parts of adjacent counties has from 100 to more than 1,300 feet of net sand thickness containing fresh to slightly saline water. The depth to the base of slightly saline water in the aquifer is over 2,300 feet northeast of Ganado, Texas in Jackson and Wharton Counties and about 200 feet near Lolita, Texas in Jackson County. The aquifer's freshwater zone has as much as 1,200 feet of net sand thickness in the Ganado area. The depth to the base of freshwater in the Ganado area is more than 1,800 feet.

The aquifer is a prolific source of water and is estimated to contain about 95 million acre-feet of fresh ground water in Jackson County alone. However, most of this water is not available for development because it occurs at great depths and only a fraction can be drained by wells. It has been estimated that the "safe yield" of the Gulf Coast aquifer in Jackson County is about 28,400 acre-feet annually.

Recent water use inventories for Jackson County, however, indicate that withdrawals of ground-water from the aquifer were about 92,000 acre-feet in 1963 and about 127,000 acre-feet in 1974. These withdrawal rates indicate that the recent trend of annual ground-water use is significantly surpassing the "safe yield" of the aquifer, thus causing ground-water to be "mined" from the aquifer.

This "mining" of ground-water has caused, and if not controlled, will continue to cause: 1) a reduction in the base flows of the Lavaca and Navidad Rivers; 2) saline water encroachment, particularly along the Coast where saline ground water overlies and flanks the fresh to slightly saline water in the aquifer; and 3) a continual increase in land-surface subsidence and possibly fault activation which may result in inundation of land areas adjacent to the bays during high tides and hurricanes. Land-subsidence and related fault activation are irreversible problems should they occur.

The only solutions for these problems lie in reduced ground-water withdrawals through conjunctive use of the "safe" ground water yield of the aquifer with surface water supplies, particularly from the Palmetto Bend Reservoir project currently under construction by the Bureau of Reclamation.

Water Supply Problems in the Corpus Christi Metropolitan Area - Texas (Problem Identification Number 11)

The water demands in the Corpus Christi Metropolitan Area are rapidly approaching the annual dependable supply which Lake Corpus Christi will yield. The City of Corpus Christi and the Nueces River Authority are co-sponsors of the authorized Choke Canyon Reservoir on the Frio River. Contractual agreements with the U. S. Bureau of Reclamation have been signed by the local sponsors to initiate construction of Choke Canyon Reservoir. Choke Canyon Reservoir and Lake Corpus Christi are to be operated as a system in order to optimize the dependable annual firm yields. Completion of Choke Canyon Reservoir on schedule should provide for the projected municipal and manufacturing water requirements of the Corpus Christi Metropolitan Area through the year 2000.

Pollution, Recreation, Flooding, and Salt Water Intrusion Problems - Louisiana (Problem Identification Number 12)

Varying sources of pollution of Toledo Bend Reservoir water are known to exist and no critical problems are noted nor are they expected in the near future. The sources of pollution include subdivision and residential development, effluents of towns and industries, runoff from timber and agricultural operations in the nearby vicinity and other similar incidents. These activities are under the surveillance and permit supervision of the Sabine River Authority of Louisiana and/or the Louisiana Health and Human Resources Administration (The State Board of Health Office). Such activities will continue to be under surveillance and actions are intended to be taken to control these varying situations.

Access to recreational areas on Toledo Bend Reservoir and the Sabine River downstream is limited. However, regarding Toledo Bend Reservoir, a scenic highway is under construction extending from the Town of Logansport, Louisiana to Leesville, Louisiana, including a total of 95.6 miles. At this time, approximately 25 miles have been completed and two additional reaches comprising a total of 12 miles will be under construction by November, 1977. An overall completion date is not available at this time.

Flooding of areas along the lower Sabine River area are being reported with greater regularity than in the past. Very likely, the cause for increased flooding reports stems from additional areas being placed into productive development where these particular areas have low elevations and have very likely been subject to flooding historically and since not being in commercial use such inundations were not important

enough to consistently observe and report. It is noted that the U. S. Army Corps of Engineers, Fort Worth and Galveston Districts, are undertaking a study of the lower Sabine River. Although the study is multi-purpose, one of the features of the study will be to examine flooding problems and investigate preventive measures.

Saltwater intrusion in the lower Sabine River has always been a fact and has resulted in problems from time-to-time which have normally resulted from tides, river stages, and other natural phenomena. The topic of saltwater intrusion will be addressed in the Corps of Engineers' study mentioned in the preceding paragraph.

Flooding in DeSoto and Sabine Parishes, Louisiana during periods of extreme rainfall results in some damage, primarily to agricultural operations in the area. Most resultant damages occur in areas not considered feasible for structural remedies; therefore, non-structural measures appear to be the logical consideration for treatment. However, two areas are considered feasible for structural remedies, which are the Upper Bayou LaNana and Little San Miguel Watersheds.

Generally, surface and groundwater supplies in Southwest Louisiana, primarily Calcasieu Parish, are inadequate. The Sabine River is a logical source of freshwater supply and a project for diversion of Sabine River water to the vicinity of Lake Charles is now nearing completion. Waters delivered through this project will help to alleviate some of the existing problems. Such water supplies are intended to be utilized for industrial, agricultural, and possibly some domestic uses.

Shoreline erosion problems exist on the Louisiana shoreline of Toledo Bend Reservoir. These problems are under observation and surveillance of the Sabine River Authority of Louisiana and no serious impact on the economy of the general area is expected. There are no other implications known in relation to the economy and well-being of other areas of the State, region, or ASA.

Upper Colorado River Salinity Problems - Texas (Problem Identification Number 13)

Within the Upper Colorado River Basin of Texas a relatively small area in Scurry, Mitchell, Howard, and Coke Counties is affected by salinity problems. The entrance of salt water into the main stem of the Colorado occurs along a segment in Scurry and Mitchell Counties just below J. B. Thomas Reservoir. Oil field operations in this area prior to 1940 resulted in the construction of over 200 salt water evaporation pits from which salt water has seeped into the local alluvium. In additon, the migration of salt water from deeper formations into the shallow, freshwater producing

zones of the area has occurred from abandoned oil wells which were improperly plugged. Natural saline ground water also enters the river in the problem area, although indications are that concentrations in the river never exceeded 300 to 500 mg/l prior to early oil field operations. In 1975, however, dissolved solids concentrations of the main stem in the affected area averaged near 3,000 mg/l. Although improper waste disposal practices in oil and gas fields have been largely rectified, the residual effects of past practices continue to plague utilization of water resources in this portion of the basin, and the quality of low flows which carry much of the salt load will be slow to improve.

In Howard County, Beals Creek has its headwaters in the Natural Dam Salt Lake, a large natural saline lake in the western portion of the county. Although the quality of water in Natural Dam Salt Lake varies widely in response in precipitation, concentrations of dissolved solids have frequently exceeded 250,000 mg/l. Beals Creek also contributes to the salt load of the Colorado River where it enters the main stem a short distance above E. V. Spence Reservoir.

Solutions to these complex ground and surface water problems will be quite costly no matter how approached. Water quality is expected to improve slowly over the next several decades; however, a comprehensive study of the Upper Colorado saline water problem has not been undertaken.

Water Supply Problems in the Mid-Brazos River Basin - Texas (Problem Identification Number 14)

Because of extreme ground water level declines and the deterioration in the quality of ground water supplies, most of the projected municipal and manufacturing requirements throughout the Mid-Brazos River Basin must be met from surface-water sources. Existing surface water developments in the Leon River and Bosque River watersheds and on the mainstem of the Brazos should be able to meet much of the projected requirements in this area, although conveyance facilities and water treatment facilities would have to be constructed to make the water available to some locales. However, full utilization of surface water from the main stem of the Brazos for municipal and manufacturing purposes is contingent upon the successful completion of upstream natural salt-control measures (see conclusions and recommendations for Problem No. 7).

Problems Associated with the Freshwater Inflows to the Texas Bays and Estuaries (Problem Identification Number 15).

Estuarine research has established that freshwater inflows function primarily as: 1) a transport mechanism to bring vital nutrients and sediments to the estuarine systems, 2) a dynamic force in the periodic inundation and dewatering of deltaic marshes, and 3) a salinity gradient control. Problems associated with the freshwater inflows can be categorized into quantity, quality, and distributional aspects.

As water requirements for inland needs approach the developable supply of contributing river basins, the potential exists for substantial alteration of the freshwater inflow regimes. Diminished freshwater inflows can result in rising salinities along with reduced rates of flushing, nutrient and sediment transport, and waste dilution and assimilation. The effects of these system alterations can be potentially severe to shrimp, oysters, and other living resources which are dependent upon the nursery habitats of the bays and estuaries. In addition, a concomitant decline of commercial seafood industries, recreational fishing activities, and tourism can result in economic losses to the local communities, the State, and the Nation, although at this time it remains unclear as to the magnitude of these potential losses. With proper water resources development and management, it would be possible to reduce the effects of drought and substantially control seasonal freshwater inflow regimes for the benefit of the bays and estuaries. However, the legal and institutional framework within which such management could be performed remains unclear at present. Nevertheless, the objectives of comprehensive State-supported studies are to identify the freshwater inflow quantities, qualities, and distributions which must be provided to maintain estuarine environments at optimum sustainable levels of productivity in concert with established State and Federal legislation.

Recommendations relative to the problems associated with freshwater inflows to Texas bays and estuaries are as follows:

1. Increase public awareness, as well as the awareness of land and water resources planners and decision-makers, in order that full consideration can be given to freshwater inflow alterations and their potential economic and environmental consequences.

2. Renewal and continuation of State and Federal funding directed toward the support of broad-based scientific, engineering, and economic research to investigate the effects of freshwater inflow on bays and estuaries, and to accurately identify the required inflow regimes necessary for sustainable production from each of the major estuarine systems.

3. Development of methods, legislation, and institutional arrangements for allocating and providng, on a long-term basis, adequate freshwater inflows from the contributing river basins to maintain Texas coastal environments and their naturally renewing resources.

4. Development of equitable Federal cost-sharing and financial agreements with local and State entities for developing the supplies of water necessary for the bay and estuaries as well as for other needs.

Water Supply and Quality Problems in Small Cities and Rural Communities as a Consequence of Implementing the 1975 Safe Drinking Water Act - Texas (Problem Identification Number 16)

Improved arrangements for providing water and wastewater service to unincorporated rural areas is needed. State assistance, including financing and technical ehlp, is required to augment existing local efforts. State-supplied funding in the form of water-development loans to rural systems is one existing component of a comprehensive assistance approach. Additional technical assistance and personnel training are needed.

Flood Problems and Hurricanes - Texas (Problem Identification Number 17)

Based on the staggering human and physical losses of the resources in the region, and due to the fact that these losses continue to rise annually, flood problems and hurricanes must receive greater public recognition of their potential hazards and plans must be developed to reduce or eliminate losses from these natural occurrences.

One of the primary goals in the Region is to solve the problem of man's intensive use of the floodplain. Floodplains comprise a relatively large percentage of the total land area, and planning efforts must be increased to identify hazard areas and develop standards to allow for the most efficient use of the floodplains.

With the assistance of the National Flood Insurance Program, floodplain maps and data can be developed which will lead to greater public recognition of flood hazards. Floodplain management, however, should be implemented by local governments but with increased financial assistance from State and Federal governments. As more communities participate in the Program, the flood potential to existing and future construction can perhaps be reduced.

In areas where intensive development has occurred within the floodplain, structural flood protection measures are needed. Hurricane protection must also be provided to areas along the Gulf Coast.

Groundwater Depletion Problems in the Texas High Plains (Problem Identification Number 18)

The Texas Water Development Board has conducted extensive investigations to calculate the quantity of water in storage and to assess the capability of the Ogallala Aquifer to meet the future water needs of the High Plains region of Texas. These studies indicate that the Ogallala will not be able to support the present irrigation development in the Texas High Plains in the long-term.

Detailed investigations of the Ogallala are currently being conducted by the Texas Water Development Board, Federal agencies, universities, and local ground-water districts to find ways to increase recharge to the aquifer, and to increase efficient use and management of existing supplies. However, these measures are not adequate to meet the projected water requirements of the Region. In order to meet the projected water requirements of the Region and thereby sustain the economy of the area, it will be necessary to import water from outside the High Plains Region of Texas.

Water Supply Problems - Louisiana (Problem Identification Number 19)

Water supply needs exist generally in DeSoto, Sabine, and Calcasieu Parishes, Louisiana, immediately adjacent to the Sabine River and Toledo Bend Reservoir. Additionally, water supply problems are expected to prevail in Vernon, Beauregard, and Cameron Parishes with respect to the Sabine River Basin.

At the present time, withdrawals from Toledo Bend Reservoir are being made for water supplies to subdivisions, individual residential locations, recreation areas, and commercial operators. The Town of Logansport, DeSoto Parish, obtains its water supply from Toledo Bend Reservoir. Presently, a pipeline and pumping station system are under construction to deliver water to the Town of Many, Sabine Parish, from the Reservoir. The Town of Mansfield, DeSoto Parish, has approved a plan to obtain its city water supply from Toledo Bend Reservoir. Other communities and developments are now looking forward to ultimately relying on Toledo Bend Reservoir for their water supply. Projected water requirements for the Sabine River Basin, Louisiana, and all of the State of Louisiana are being determined in a statewide water resources study now in progress by the Department of Transportation and Development, Office of Public Works.

A water supply problem does exist in Calcasieu Parish. In order to provide for some of this need, construction is now nearing completion of the Sabine River Diversion Project which will provide supplemental water supplies from Sabine River to Calcasieu Parish and its Lake Charles vicinity. The Diversion Project does not provide the final answer and capacity to satisfy future requirements for industrial, agricultural, and domestic interests. That poses a future problem that cannot be satisfied by the Sabine River Diversion Project in the future. Supplemental water supplies to this area will be one of the objectives of the statewide water resources study.

It may be generally reported, however, that at the present time there are no extremely serious, critical water supply problems in the Sabine River Basin of Louisiana with the exception of those portions of Cameron and Calcasieu Parishes under the influence of saltwater intrusions from the Gulf of Mexico.

Water Supply and Related Problem - New Mexico (Problem Identification Number 20)

The most critical problem in New Mexico is diminishing ground-water supplies that furnish nearly all of the water used in the Texas Gulf Region in the State. Projections indicate that by the year 2000 about 117,800 acres of irrigated land in Curry and Roosevelt Counties will go out of production because of lowered ground-water levels and the water remaining in aquifer storage will be uneconomically recoverable for irrigation purposes. Shortly after 2000 a similar condition will occur in Lea County. Extensive and expansive works will be needed for municipal and industrial uses to utilize the remaining water in storage. As a result of the diminishing water supplies severe economic and social problems will occur throughout the area.

The on-going High Plains Study (P.L. 94-587) authorized the Department of Commerce in cooperation with the Federal, State and local entities to assess development alternatives and interbasin transfer and other augmentation measures to increase water supplies to the High Plains. This study is to be completed by July, 1980.

SOCIAL, ECONOMIC AND ENVIRONMENTAL GOALS AND THE STATE/REGIONAL FUTURE (SRF)- MODIFIED CENTRAL CASE (MCC) COMPARISON

This chapter contains two major parts. First, the general social, economic and environmental goals in the Texas Gulf Region are set forth. The Texas Gulf Region is composed of three states -- Texas, Louisiana, and New Mexico -- and therefore cannot be considered a separate political entity. Rather, the people in each state of the Texas Gulf Region elect local, state and national leaders to set forth the goals and laws of each state of the Nation. These goals are presented for each state's portion of the Texas Gulf Region.

The second part of this chapter contains a brief comparison at the regional level of the information developed by the states for the State Regional viewpoint as opposed to the information pertaining to the Federally derived Modified Central Case.

Social, Economic and Environmental Goals in the Texas Gulf Region

Texas

A clear statement of "State Policy for Conservation and Development of Texas Water Resources" is necessary to provide basic guidance for the information and implementation of a "Statewide Action Program." The absence of a clear statement of national policy in this regard makes it most difficult to develop effective national programs and it would be just as difficult to develop effective statewide programs without a clear statement of State policy. The Governor's Water Resources Conservation and Development Task Force recommendations submitted to the Governor on April 15, 1974, included the following:

"Recognizing that the total long-range projected water needs of the people of Texas exceed the State's total developable water resources, it should be the policy of the State of Texas:

"A. To develop and implement programs for full and timely development of Texas surface water resources to insure that these resources will be dependably available to meet the people's statewide water needs to the maximum practicable extent as they occur. Surface water resources can be made available on a dependable basis only by providing reservoirs to store water during

periods of high streamflow so water will be available during periods of low streamflow. Because it takes many years to finance, design, and build a reservoir, Texas must proceed with a continuing action program to develop its surface water resources in advance of the occurrence of anticipated needs."

"B. To establish and implement programs for movement of developed surface water resources to areas of water need, with adequate safeguards included to assure that the future water needs of source areas will be met. Actual movement of water can be deferred until the location and extent of the areas of need are clearly and unquestionably established, but development of the water resources must be initiated and accomplished well in advance if the water is to be available for movement to the areas of need when the needs occur."

"C. To assure efficient use of the State's available water resources. This will require multiple use of the available water resources, elimination of wasteful practices, effective control of water pollution and reuse of so-called 'waste' water to the extent feasible."

"D. To seek water from outside the State to supplement as necessary the water supplies that can be developed within Texas to meet fully its anticipated long-range water needs. In seeking sources of water from outside its boundaries, Texas must recognize the need to work out fair and equitable arrangements with the exporting area."

"E. To give balanced consideration to environmental, economic and social requirements in striving to meet the water needs of the people of Texas. Recognizing that long-range water supplies will undoubtedly be limited, choices between potential demands for water will have to be made which will best serve the overall interests of the people of Texas."

"F. To assure the most effective means of developing and conserving the groundwater resources of Texas. Development and use of the total water resources of the State in the best interest of the people of Texas requires management of ground and surface waters as integrated resources. The unique characteristics of aquifers in various parts of the State make it evident that criteria and objectives to achieve such management can be most effectively developed through local management entities."

"G. To seek appropriate Federal participation in water resource conservation and development in Texas while taking the necessary steps to effectively conserve and develop the State's water resources regardless of the

nature or extent of Federal participation."

"H. To utilize fully the capabilities of existing State water agencies and political subdivisions, modifying and supplementing these entities as appropriate to accomplish the most effective conservation and development of Texas water resources."

Louisiana

Water is one of Louisiana's most valuable resources. Management and development of Louisiana's water resources are basic to development of all other resources of the State. Human needs and economic development would be seriously impaired if water of acceptable quality were not available in adequate quantities to support the basic environment upon which Louisiana has historically depended. Therefore, it is essential that Louisiana's water resources be preserved and developed to maintain and supply the basic needs in the State.

1. Economic Development

It is the desire of the citizens, public officials, and civic leaders that Louisiana citizens experience a higher standard of living. For this to be achieved it will be necessary for the State to experience increased economic development. The following goals have been established as a means for achieving economic development in Louisiana.

A. The maximum potential growth in economic well-being must be achieved for all citizens.

B. The business and economic climate must be improved through improvement in the conduct of governmental affairs.

C. The full potential of our natural endowments and special resources must be developed.

D. Business leadership must be expanded and modern innovative enterprises must be stimulated.

E. Transportation facilities must be improved.

F. New and expanding industries must be attracted through enlightened industrial inducement programs.

G. The capacity of all people to contribute to and participate in prosperity must be elevated through improved educational and vocational programs.

H. People, agriculture and industry must be protected from the devastating effects of floods and hurricanes in Louisiana.

2. Human Needs and Resources

Economic prosperity cannot occur in Louisiana unless our human resources are properly and fully utilized. Conversely, every citizen cannot participate in improved economic conditions without the solution to problems of human needs. The following goals must be met.

A. It will be necessary to develop a set of conditions whereby those seeking employment can be employed to the fullest extent of their occupational potential.

B. Poverty in Louisiana must be eliminated in order that every citizen can maintain a sense of personal dignity.

3. Parks, Recreation, and Tourism

Parks, recreation, and tourism can be viewed as both elements of social or leisure time activities and as economic resources. Recreation and tourism programs must be developed in an orderly fashion in order that Louisiana citizens have ample recreational facilities and that tourism contribute to the economic prosperity to the fullest possible extent. The following goals should be accomplished.

A. Parks, recreation, and tourism must develop in an orderly fashion according to the dictates of a statewide plan.

B. The State of Louisiana should upgrade existing facilities as well as develop new ones so that people throughout the state can have access to outdoor recreation areas.

C. Historical and archeological landmarks throughout Louisiana should be preserved.

D. Louisianians should emphasize conservation and innovation in the development of its waterways for the enjoyment of its citizens and as tourist attractions.

4. Transportation

Louisiana can, with its natural transportation and resource advantages, become a major transportation center in the United States. Current transportation problems must be solved in order for Louisiana to take advantage of new transportation technology. The following

are major objectives of the State of Louisiana in regard to the development of transportation in this state.

A. Existing rail, air, water, and roadway facilities must be coordinated and integrated into a unified transportation system.

B. A statewide transportation plan must be developed integrating elements of the existing system with innovative and improved transportation elements.

C. The ports of Louisiana, the network of waterways, docks, and the passenger and recreational aspect of waterways must be revitalized.

New Mexico

The Texas Gulf Region (WRC No. 12) in New Mexico includes the counties of Curry, Roosevelt, and Lea. Curry and Roosevelt Counties are in ASA No. 1203, and Lea County is in ASA No. 1204. However, none of these counties lie entirely in the Texas Gulf Basin (hydrologic area). The northern part of Curry County drains to the Arkansas-White-Red River Basin and a small area along the western side drains to the Pecos River (Rio Grande Basin). About 15 percent of Roosevelt County (along the western edge) drains to the Pecos River. About 47 percent of Lea County, in the southern part, is in the Pecos River Basin. Except for Lea County, most of the water supplies and uses (including irrigation) are in the Texas Gulf Basin. Water used in the Pecos River Basin part of Lea County and exported from the Texas Gulf part of Lea County to Eddy County (Pecos River Basin) amounts to about 15 percent of the total use in Lea County.

So as to cover a wide range of alternative futures, New Mexico has used three sets of population projections in state planning studies. The projections are identified as BBR 1968, OBERS 1968, and BEA-BBR 1972 and are high, medium, and low levels of projections, respectively. Without advocating any one of the projections, they give an opportunity to look at a wide range of possibilities in future time frames. In the Texas Gulf Region area of New Mexico all three projections were used to estimate future requirements for water and related land resources. The state recommends OBERS 1968 projections (mid-range) be used in comparisons of the State-Regional Future and MCC data.

A basic assumption used in this and other studies is that water supply will be limited to the surface and groundwater supplies available to the state of New Mexico. Further, it is assumed that existing water laws, administrative procedures,

and interstate water compacts will be essentially unchanged during the period of study.

Surface water supplies play an insignificant role in providing any of the basin water requirements. Nearly all the water supply used in the Texas Gulf Region is pumped from groundwater and groundwater is being mined in all developed areas. Most of this supply is presently used for irrigation purposes. Another basic assumption is that in areas where water supplies are fully appropriated increased needs for municipal, industrial, mining, and certain other uses will be met by retirement of irrigated agriculture.

The three projections are used to identify increased urban, rural, and manufacturing needs. Increased needs for minerals, fish, wildlife, recreation, and certain other uses were estimated independently of population.

Because of the groundwater mining situation, groundwater supplies will not maintain the present level of irrigated agriculture. The economic impact of the loss of irrigation must be evaluated. As the water levels decline, pumping and operating costs of furnishing municipal supplies increase causing an adverse economic impact upon communities.

As growth and economic development occurs, careful planning will be required to conserve and protect environmental qualities of the basin. The qualities include clear air, open spaces, and areas of scenic beauty. There are water quality problems, especially in groundwater supplies in some of the rural areas.

Wind and water erosion are prevalent throughout the area. These conditions denude range and cropland, and in places extensive sand-dune areas have been formed. Continued conservation measures are required to assist in solving these problems and New Mexico supports such programs at the local, State, and Federal levels.

Flooding occurs throughout the basin. These problems are common to both large and small towns. Programs to assist in alleviating flood damage are needed and will require planning and funding at local, State, and Federal levels.

Comparison of the State Regional Future (SRF) and the Modified Central Case (MCC)

The State Regional Future and the Modified Central Case represents two different viewpoints or estimates concerning socio-economic characteristics (population, employment earnings, per capita income, etc.), volumetric requirements (withdrawals and consumptive fresh and saline water use for each sector of the economy), and water supplies.

The SRF estimates were developed by the Texas Water Development Board, the New Mexico Interstate Stream Commission and the Louisiana Department of Transportation and Development for their respective states. Detailed supporting materials are available from the regional sponsor - the Texas Water Development Board. The MCC estimates were developed by the following Federal agencies.

1. Socio-Economic Characteristics -- Department of Commerce and the Department of Agriculture
2. Domestic Water Use -- Environmental Protection Agency and Department of Agriculture
3. Manufacturing Water Use -- Bureau of Domestic Commerce
4. Mineral Water Use -- Bureau of Mines
5. Irrigation Water Use -- Department of Agriculture
6. Livestock Water Use -- Department of Agriculture
7. Electric Power Generation and Water Uses -- Federal Power Commission
8. Water Supply -- Geological Survey and Water Resources Council

The SRF and MCC estimates for the Texas Gulf Region are set forth in the following tables, 1 through 4. Similar information for each Aggregated Sub-Area (ASA) of the region is set forth in the Appendix. A cursory examination of the two viewpoints for each item will reveal many widely varying differences. Although a detailed explanation of the reasons for each differing estimate is not within the scope of this report, a general explanation offers some insight into the reasons for the discrepancies.

Generally, the reasons for differing estimates can be traced to: (1) different data sets from which the estimates are based, and (2) different assumption and methodologies for deriving the estimates for the future time periods. For example, the SRF gross water use (withdrawal) for manufacturing industries in 1975 was derived principally from actual reported water used by these industries in 1974. The MCC data were based upon a survey of large water-using industries for an earlier period. The information from this survey was then linked to the projections of economic activity for the appropriate industry. Consequently, if the projection of economic activity for a given industry for 1975 was not the same as what actually occurred, then the projected water use was also in error. Also, for the projected use in 1985 and 2000 the SRF estimates reflect different assumptions concerning water use in meeting the requirements set forth in Public Law 92-500.

A comparison of the base year 1975 water supply information

also illustrates the above-cited reasons for discrepancies. The differences in the present modified flow can be due to the selection of different USGS streamflow gages and periods of record to best reflect the ASA's flow. The disparity in the import and export values can be traced to the State's having recently reported data indicating the sources and quantity of water used, which the Federal agencies did not have available. The differences in the evaporation values can be due to selection of different evaporation rates and water surface areas of reservoirs.

The Texas Water Development Board, as the regional sponsor, recommends that only the SRF information be used in ater esource planning decisions since the information was developed from a superior historical data base and utilized the most up-to-date data and advanced projection techniques. However, it should be pointed out that the water supply estimates for both the SRF and MCC represent only the estimated streamflow at the exit point of an aggregated subarea. A valid and realistic appraisal of the available water supplies to meet the total demands cannot be made since the spatial distribution of the demand and supplies was not considered. For example, the current and future water requirements may occur in the upstream reaches of a river basin while most of the available water supply may occuring in the lower part of the region.

The method of water accounting prevents use of the detailed information available and thereby totally masks severe water supply problems. Consequently, the Regional Sponsor recommends that for the Texas portion of the Texas Gulf Region, the May, 1977 planning document titled "Continuing Water Resource Planning and Development for Texas" prepared by the Texas Water Development Board be used to accurately assess the water supply situation in Texas. In addition, materials prepared by the New Mexico Interstate Stream Commission and the Louisiana Department of Transportation and Development should be used for assessing similar problems in New Mexico and Louisiana, respectively.

Table 1
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
SOCIO-ECONOMIC CHARACTERISTICS

REGION: Texas Gulf - 1201, 1202, 1203, 1204, 1205	STATES: Texas, Louisiana, New Mexico							
CHARACTERISTIC	UNIT	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Population: Total	Number (000)	10,232,147	11,061,052	12,470,765	1.22	12,816,314	15,989,091	1.56
SMSA		8,121,369	8,663,298	10,172,524	1.25	10,264,252	13,437,800	1.65
Non-SMSA		2,110,778	2,397,754	2,298,241	1.09	2,552,062	2,551,291	1.21
Total Employment:	Number (000)	4,022,222	4,827,949	5,179,792	1.29	6,044,269	6,768,594	1.68
Earnings: Total	1967 $ (000)	28,574,222	44,596,521	48,074,252	1.68	77,099,110	92,329,879	3.23
Agriculture, Forestry, Fishing		1,096,876	1,103,376	1,153,846	1.05	1,224,934	1,435,990	1.31
Manufacturing		6,330,957	9,375,200	10,549,355	1.67	15,497,999	19,357,464	3.06
Food and kindred products		520,914	623,205	701,356	1.35	831,476	1,035,519	1.99
Paper and allied products		135,995	221,778	245,032	1.80	361,484	439,563	3.20
Chemical and allied products		793,344	1,287,108	1,502,559	1.89	2,520,646	3,250,368	4.10
Petroleum and coal products		578,849	749,046	812,321	1.40	1,071,784	1,271,681	2.20
Primary metals		287,307	372,516	437,840	1.52	523,720	680,685	2.37
Other		4,014,548	6,121,547	6,850,247	1.72	10,188,889	12,679,648	3.16
Mining		863,164	968,246	1,011,148	1.17	1,078,974	1,239,181	1.44
Other		20,283,225	33,149,699	35,359,903	1.74	59,297,203	70,297,244	3.47
Per Capita Income:	1967 $	3,666	5,080	5,086	1.39	7,689	7,689	2.10
Electric Energy Production:	GWH	131,688	273,606	312,997	2.38	820,470	639,346	4.86
Land Use: Total Land Area	Acres (000)	111,291						
Agricultural, Total		96,227	97,602	91,259	.95	95,541	89,563	.93
Feed Crops		9,689	14,194	12,760	1.32	12,719	13,041	1.35
Food Crops		3,190	1,549	1,796	.56	1,967	2,009	.63
Other Crops		4,565	3,625	3,690	.81	2,678	4,192	.92
Forests and Woodland Grazed		20,176	16,460	21,963	1.09	16,326	21,878	1.08
Pasture, Range and Other		58,607	61,774	51,050	.87	61,851	48,443	.83
Other, Total								
Urban								
Irrigated Farmland		5,297	3,868	5,920	1.12	2,740	8,129	1.53

Table 2

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawals)
(Million gallons per day-MGD)

REGION: 1201, 1202, 1203 Texas Gulf - 1204 & 1205	STATES: Texas, Louisiana, New Mexico				SOURCE: Fresh x Saline ___		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	1,427.06	1,378.30	2,555.68	1.79	1,620.50	3,379.27	2.37
Central Systems		1,320.00			1,564.60		
Non-Central Systems		57.80			55.90		
Manufacturing: Total	1,176.50	2,820.60	1,465.51	1.25	2,702.00	2,272.87	1.93
Food and kindred products	70.60	81.00	65.81	.93	79.00	69.53	.98
Paper and allied products	148.35	222.00	110.64	.75	241.00	154.83	1.04
Chemical and allied products	486.55	1,649.00	761.14	1.56	1,601.00	1,344.29	2.76
Petroleum and coal products	291.64	517.00	365.57	1.25	499.00	492.57	1.69
Primary metals	40.05	242.00	21.06	.53	162.00	12.46	.31
Other	139.31	109.60	141.29	1.01	120.00	199.19	1.43
Minerals: Total	194.08	1,196.10	233.86	1.20	1,311.00	283.80	1.46
Metals							
Non-Metals							
Fuels							
Irrigation: Total	7,205.1	8,671.50	8,017.2	1.11	6,677.70	9,255.5	1.28
Crops							
Other							
Livestock:	192.04	191.20	213.00	1.11	222.00	243.15	1.27
Steam Electric:	295.60	630.0	712.00	2.41	1,742.00	1,508.40	5.10
Public Lands:	18.80	13.5	13.80	.73	14.50	14.50	.77
Other Recreational Uses:	.50		.7			33.00	66.00
TOTALS	10,509.68	14,901.20	13,211.75	1.26	14,289.70	16,990.49	1.41

Table 2
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawal)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1201, 1202, 1203*, 1204*, 1205	STATES: Texas						SOURCE: Fresh / Saline X
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total							
Central Systems							
Non-Central Systems							
Manufacturing: Total							
Food and kindred products							
Paper and allied products							
Chemical and allied products							
Petroleum and coal products							
Primary metals							
Other							
Minerals: Total							
Metals							
Non-Metals							
Fuels							
Irrigation: Total							
Crops							
Other							
Livestock:							
Steam Electric:	4,410		5,300	1.20		13,600	3.08
Public Lands:							
Other Functional Uses:							
TOTALS	4,410		5,300	1.20		13,600	

* Zero saline water use in ASA 1203 and 1204.

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: 1201, 1202, 1203 Texas Gulf - 1204 & 1205	STATES: Texas, Louisiana, New Mexico				SOURCE: Fresh X Saline ___		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	794.48	467.00	1,485.32	1.87	540.60	1,936.34	2.44
Central Systems		431.30			506.90		
Non-Central Systems		35.70			33.70		
Manufacturing: Total	387.13	1,103.00	550.59	1.42	2,110.00	1,073.31	2.77
Food and kindred products	21.19	31.00	19.74	.93	56.00	20.85	.98
Paper and allied products	14.84	87.00	11.08	.75	193.00	15.48	1.04
Chemical and allied products	146.04	608.00	266.39	1.82	1,272.00	672.13	4.60
Petroleum and coal products	145.81	234.00	201.05	1.38	398.00	295.54	2.03
Primary metals	12.02	99.00	6.32	.53	129.00	3.72	.31
Other	47.23	44.00	46.01	.97	62.00	65.59	1.39
Minerals: Total	99.85	546.90	119.07	1.19	585.60	146.10	1.46
Metals							
Non-Metals							
Fuels							
Irrigation: Total	6,533.70	7,980.10	7,274.00	1.11	5,527.60	8,314.80	1.27
Crops							
Other							
Livestock:	192.04	191.20	213.00	1.11	222.00	243.15	1.27
Steam Electric:	148.60	221.00	357.20	2.40	858.00	752.20	5.06
Public Lands:		2.30			3.00		
Other Functional Uses:	5.30	0.00	5.70	1.08		24.40	4.60
T O T A L S	8,161.10	10,511.50	10,004.88	1.23	9,846.80	12,490.30	1.53

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1201, 1202, 1203*, 1204*, 1205	STATES: Texas						SOURCE: Fresh ___ Saline X
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total Central Systems Non-Central Systems							
Manufacturing: Total Food and kindred products Paper and allied products Chemical and allied products Petroleum and coal products Primary metals Other							
Minerals: Total Metals Non-Metals Fuels							
Irrigation: Total Crops Other							
Livestock:							
Steam Electric:	44.10		53	1.20		136	3.08
Public Lands:							
Other Functional Uses:							
TOTALS	44.10		53	1.20		136	3.08

* Zero saline water use in ASA 1203 and 1204.

Table 4

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
WATER SUPPLIES
(Million gallons per day-MGD)

REGION: Texas Gulf	STATES: Louisiana, New Mexico, Texas		DURATION: ANNUAL X / MONTH ___		PROBABILITY: MEAN X / 80% ___ / 95% ___
	1975	MCC 1985	SRF 1985	MCC 2000	SRF 2000
Present Modified Flow:	26,367.6				
Imports From Other Regions: 1/	34.79	401.5	39.92	401.5	156.38
Exports To Other Regions: 2/	301.00	371.5	301.7	371.5	307.1
Groundwater Withdrawals:	7,171.73	4,693.3	4,960.81	3,305.64	3,398.29
Evaporation:	1,743.00	1,742.0	1,963.50	1,742.0	1,971.70
Depletions:	10,170.31	12,223.5	12,230.16	11,559.0	14,613.72
Natural Modified Flow:	29,366.18				
Future Modified Flow:		27,590.0	22,096.83	26,083.0	18,151.55

1/ SRF import value is only imports into the region; MCC is total of the imports of the ASA's.

2/ SRF export value is only exports out of the region, while MCC value is the total of the exports of the ASA's.

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
WATER SUPPLIES
(Million gallons per day-MGD)

REGION: Texas Gulf	STATES: Louisiana New Mexico, Texas		DURATION: ANNUAL X MONTH ____		PROBABILITY: MEAN ____ 80% ____ 95% X
	1975	MCC 1985	SRF 1985	MCC 2000	SRF 2000
Present Modified Flow:	6,220.0				
Imports From Other Regions: 1/	34.79	401.5	39.92	401.5	156,38
Exports To Other Regions: 2/	301.00	371.5	301.7	371.5	307.1
Groundwater Withdrawals:	7,171.73	4,693.3	4,960.81	3,305.64	3,398.29
Evaporation:	1,743.0	1,742.0	1,963.5	1,742.0	1,971,70
Depletions:	10,170.31	12,223.5	12,230.16	11,559.0	14,613,72
Natural Modified Flow:	9,218.58				
Future Modified Flow:		5,293.5	1,949.23	4,369.1	-1,995,86

1/ SRF import value is only imports into the region; MCC is total of the imports of the ASA's.
2/ SRF export value is only exports out of the region, while MCC value is the total of the exports of the ASA's.

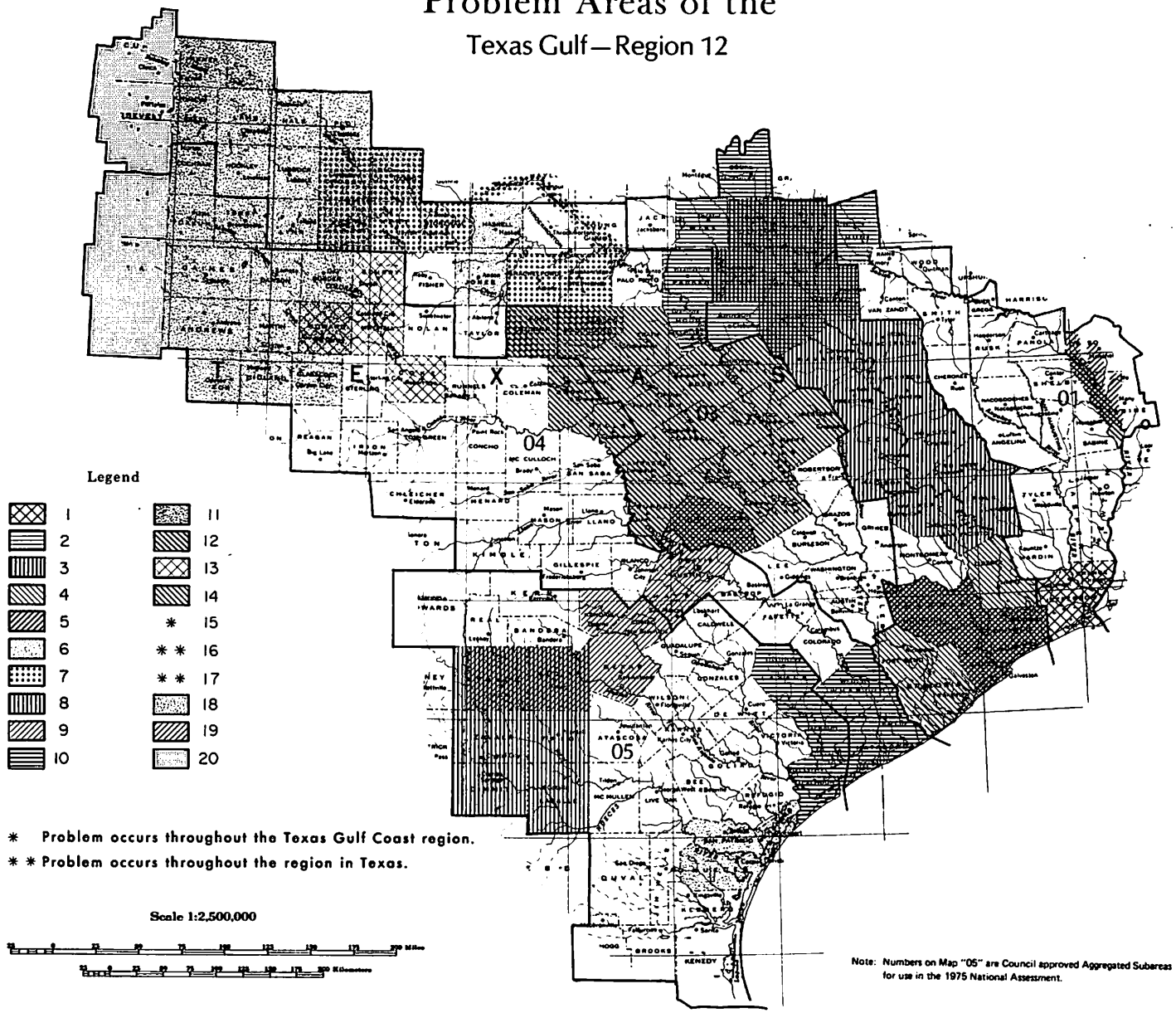
Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

IDENTIFICATION OF SEVERE WATER AND RELATED PROBLEMS

This Chapter includes brief statements which identifies each problem area and describes the issues which exist or are expected to develop by the year 2000 along with a regional map (Plate II) which identifies the location of the problem areas. These problems described herein were identified in earlier assessment activities (Activity I) according to the U. S. Water Resources Council's guidelines to focus on severe problems in critical need of resolution considering economic, social, and environmental effects for areas larger than a stream reach community or county. In accord with the guidelines pertaining to Activity III materials, these problems were also placed into two categories. Category I problems (equivalent to the Water Resources Council's definition of Category B) were those problems which are being adequately addressed by an on-going or recently completed study with subsequent problem resolution actions by either Federal or non-Federal entities that will be forthcoming in a timely fashion. The Category I problems are as follows:

Problem Identification Number	Problem Title	State
1	Water Quality Problems -- Beaumont-Port Arthur Metropolitan Area	Texas
2	Water Supply Problems -- Upper Trinity River Basin	Texas
3	Water Quality Problems -- Dallas Fort Worth (Trinity River and Tributaries)	Texas
4	Land Subsidence in the Houston-Metropolitan Area	Texas
5	Water Quality Problems - Houston Metropolitan Area	Texas
6	Groundwater Quality Problems Haskell and Jones Counties	Texas
7	Brazos Basin Salinity Problems above Possum Kingdom Reservoir	Texas
8	Groundwater Availability and Quality Problems in the Carrizo Aquifer, Winter Garden Area	Texas

Plate II
Problem Areas of the
Texas Gulf—Region 12



Problem Identification Number	Problem Title	State
9	Regional Ground and Surface Water Management Problems Associated with the Edwards (Balcones Fault Zone) Aquifer	Texas
10	Jackson County and Vicinity Groundwater Problems	Texas
11	Water Supply Problems in the Corpus Christi Metropolitan Area	Texas
12	Pollution, Recreation, Flooding and Salt Water Intrusion Problems	Louisiana

The second category of problems (Category II - which is the equivalent to the Water Resources Council's definition of Category A problems) includes those problems which are currently unresolved and are not being adequately addressed by an on-going or recently completed study, with no resolution actions forthcoming by either Federal or non-Federal entities in a timely fashion. The Category II problems are as follows:

Problem Identification Number	Problem Title	State
13	Upper Colorado River Salinity Problems	Texas
14	Water Supply Problems in the Mid-Brazos River Basin	Texas
15	Problems Associated with the Freshwater Inflows to the Texas Bays and Estuaries	Texas
16	Water Supply and Quality Problems in Small Cities and Rural Communities as a Consequence of Implementing the 1974 Safe Drinking Water Act	Texas
17	Flood Problems and Hurricanes	Texas
18	Groundwater Depletion Problems in Texas High Plains	Texas

Problem Identification Number	Problem Title	State
19	Water Supply, Flooding, and Erosion Problems	Louisiana
20	Water Supply and Related Problems in Curry, Roosevelt and Lea Counties	New Mexico

The principal distinction between Category I and Category II problems as set forth in the U. S. Water Resources Council guidelines pertaining to these activities involved the display of conclusions and recommendations regarding Category I problems for this report. Detailed information pertaining to the effects of not solving Category II problems were set forth in Activity Three. However, for both completeness and continuity, conclusions and recommendations are being set forth in the appropriate sections of this report regardless of the previously designated category. A description of each identified problem follows.

Water Quality Problems -- Beaumont-Port Arthur Metropolitan Area - Texas (Problem Identification Number 1)

Orange and Jefferson Counties are included in the Beaumont-Port Arthur Metropolitan Area. This area is highly industrialized, and contains large population centers. Several thousand acres of cropland also are irrigated in the area. Large diversions of freshwater from the Neches River and navigation improvements in the area have intensified water quality problems. Salt water migrates up the Neches River and has necessitated the construction of a salt water barrier upstream of Beaumont. In addition, urban runoff and return flows often constitute the majority of flow in the Neches River.

This area constitutes a large industrial complex known as the "Golden Triangle." It is a center for heavy industry and has been a major oil producing region since the turn of the century. This large industrial complex has contributed to the water quality problem by its large water demand and its effluent. Industrial water is supplied to industries in Jefferson County by the Lower Neches Valley Authority (LNVA) and the City of Beaumont which supplies many industries located in that city. The LNVA has a system of canals which serve much of Jefferson County.

During the rice-growing season, the LNVA supplies water to irrigate approximately 78.5 thousand acres of rice in Jefferson and portions of Liberty and Chambers Counties.

The LNVA and the City of Beaumont divert water from the Neches River and Pine Island Bayou north of Beaumont. Most of this water is distributed throughout Jefferson County and is ultimately discharged as wastewater into the streams and drainage canals of the Neches-Trinity Coastal Basin.

The Neches River and Sabine Rivers empty into Sabine Lake which was reportedly fresh prior to the first channel improvement in the area, and the dredging of Sabine Pass which occurred shortly before 1900. The navigation improvements coupled with diminished river flows caused by upstream diversion has allowed salt water currents to ascend far upstream of Beaumont. There is not sufficient flow in the Neches River to flush out the salt water since diversions often equal the river flow.

In order to protect the freshwater intakes on the Neches River and Pine Island Bayou from salt water contamination, temporary salt water barriers must be constructed. The LNVA constructs sheet piling barriers across the Neches River and Pine Island Bayou. The barriers are normally required during late summer and early fall due to increased diversion rates during the rice irrigation season. It has been necessary to install the barriers almost every year since 1948 and the barriers, which are removed when they are no longer needed, have remained in place for as long as six months.

With the salt water barriers in place, the Neches River essentially becomes a dead-end navigation and waste disposal channel. The flow below the barriers results from treated industrial and municipal effluent return flows; runoff from the associated drainage area; and, tidal action.

Urbanization also poses serious water quality degradation problems over and above the disposal of domestic and industrial wastes. The development of pervious open lands into impervious urban surfaces increases runoff rates and scour erosion and thereby introduces into the urban drainage contaminants that far exceed natural pollutants added to runoff by solution and erosion in rural areas. Urban "shock" pollution resulting from stormflow conditions can appreciably raise BOD and COD levels, and frequently introduces nitrogen, phosphorous, and bacteria into surface runoff.

Water Supply Problems -- Upper Trinity River Basin - Texas (Problem Identification Number 2)

The upper Trinity River Basin, including contiguous counties lying within the adjacent Brazos and Red River Basins, face serious water supply problems unless supplemental sources of supply are made available in the near future. Counties included in the area are Collin, Cooke, Dallas, Denton, Ellis, Hood, Hunt, Johnson, Kaufman, Parker, Tarrant, and Wise.

The region includes the Dallas-Fort Worth metroplex, a center of finance, insurance, transportation, manufacturing, petroleum interests, and agriculture, and numerous satellite cities and communities whose population and economic growth are rapidly expanding. The region's population, currently totalling about 3 million, is projected to grow to about 4.6 million by the year 2000.

Currently, municipal and manufacturing water use within the region amounts to approximately 592 thousand acre-feet per year (528 mgd), of which about 518 thousand acre-feet (452 mgd) is supplied by surface water sources.

Ground water aquifers, which currently provide about 74,000 acre-feet annually (66 mgd) to the area, primarily for municipal and industrial purposes, include the Trinity Group and the Woodbine Aquifers -- both of Cretaceous age. Wells completed in the deeper, thicker parts of the Trinity Aquifer yield up to 2,000 gpm, although wells completed in the thinner sections commonly produce less than 100 gpm. Although dissolved solids concentrations are generally low enough to be acceptable for municipal use, excessive fluoride concentrations constitute a problem in many parts of the aquifer. The most severe problem, however, results from declining pumping levels (pumping lifts exceed 1,000 feet in many wells) due to pumpage in excess of recharge in the Dallas-Fort Worth area and the natural low transmissibility of the aquifer. Many cities converted to surface water supplies; this trend is continuing.

Twenty-seven major reservoirs currently serve the region, three of which are used exclusively for steam-electric power plant cooling. Many of these projects are relatively small, however, and have correspondingly low yields. Additionally, a number of the larger reservoirs are federal projects constructed principally for flood control, and thus have relatively small conservation storage capacities. Two new federal projects, Lakeview and Aubrey Reservoirs, have been authorized for construction and when completed, these projects will provide additional water supply for the region. Lakeview Reservoir will also provide additional flood control storage.

On the basis of projected needs, however, supplies available from existing reservoirs in the area, existing diversion facilities from Lake Tawakoni in the adjacent Sabine River Basin, and completion of authorized Federal projects will allow the region to just barely keep pace with growing water needs. However, during a possible recurrence of critical-period drought conditions, the region would experience severe water shortages before the year 2000 unless supplemental sources and associated conveyance facilities are constructed to bring additional water supplies into the area. Construction of proposed raw water conveyance facilities from Lake Palestine, in the Neches River Basin, to the City of Dallas will provide additional supplies when completed.

The region includes the Dallas-Fort Worth metroplex, a center of finance, insurance, transportation, manufacturing, petroleum interests, and agriculture, and numerous satellite cities and communities whose population and economic growth are rapidly expanding. The region's population, currently totalling about 3 million, is projected to grow to about 5.5 million by the year 2000.

Currently, municipal and manufacturing water use within the region amounts to approximately 592 thousand acre-feet per year (528 mgd), of which about 518 thousand acre-feet (452 mgd) is supplied by surface water sources.

Ground water aquifers, which currently provide about 74,000 acre-feet annually (66 mgd) to the area, primarily for municipal and industrial purposes, include the Trinity Group and the Woodbine Aquifers -- both of Cretaceous age. Wells completed in the deeper, thicker parts of the Trinity Aquifer yield up to 2000 gpm, although wells completed in the thinner sections commonly produce less than 100 gpm. Although dissolved solids concentrations are generally low enough to be acceptable for municipal use, excessive fluoride concentrations constitute a problem in many parts of the aquifer. The most severe problem, however, results from declining pumping levels (pumping lifts exceed 1,000 feet in many wells) due to pumpage in excess of recharge in the Dallas-Fort Worth area and the natural low transmissibility of the aquifer. Many cities and industries which formerly used this aquifer have already converted to surface water supplies; this trend is continuing.

Twenty-seven major reservoirs currently serve the region, three of which are used exclusively for steam-electric power plant cooling. Many of these projects are relatively small, however, and have correspondingly low yields. Additonally, a number of the larger reservoirs are federal projects constructed principally for flood control, and thus have relatively small conservation storage capacities. Two new federal projects, Lakeview and Aubrey Reservoir, have been authorized for construction and when completed, these projects will provide additional flood control and water supply for the region.

On the basis of projected needs, however, supplies available from existing reservoirs in the area, existing diversion facilities from Lake Tawakoni in the adjacent Sabine River Basin, and completion of authorized Federal projects will allow the region to just barely keep pace with growing water needs. However, during a possible recurrence of critical-period drought conditions, the region would experience severe water shortages before the year 2000 unless supplemental sources and associated conveyance facilities are constructed to bring additional water supplies into the area.

Water Quality Problems -- Dallas-Fort Worth Area (Trinity River and Tributaries) - Texas (Problem Identication Number 3)

The Trinity River in the vicinity of the Dallas-Fort Worth metropolitan area suffers from pollution of its waters as indicated by both chemical and bacteriological analyses. Counties affected by this problem include Collin, Dallas, Denton, Ellis, Kaufman, and Tarrant. Because of low streamflows caused somewhat by the effect of upstream impoundments, and in effect, the diversion of stream flows through municipal water systems, municipal effluents from both Dallas and Fort Worth often comprise the bulk of streamflow in the Trinity downstream of the metropolitan area. Poor water quality conditions occur in the West Fork from Fort Worth to Dallas and in the East Fork from Lake Hubbard Dam to the confluence with the main stem of the Trinity River. Although the river tends to purify itself as it flows downstream, some quality problems are experienced all the way downstream to Lake Livingston.

The primary effects of effluent domination in the Trinity River are suppressed oxygen levels and high concentrating of BOD, ammonia, volatile suspended solids, phosphate, and fecal coliforms. Downstream of major treatment plant discharges, sludges that contain high concentrations of carbon, nitrogen and phosphorus accumulate on the river bottom. When the river rises rapidly these sludges are suspended in the water and add heavy shock loads of pollutants, often resulting in extensive fish kills. Urban runoff also contributes significantly to the inflow of pollutants. Because of these water quality problems, much of the main stem of the Trinity River as well as portions of the West Fork and East Fork are normally unsuitable for contact and non-contact recreation, domestic water supply and industrial use (without pretreatment). Game fish are generally unable to live and propagate in the Trinity River and tributaries below the metropolitan area because of the low dissolved oxygen levels which on occasion reach zero.

Downstream, the headwaters of Lake Livingston also have occasional low dissolved oxygen concentrations, high fecal coliform counts, and excessive aquatic growth. Algal blooms and excessive growth of water hyacinth and duckweed are evidence of water quality problems resulting from overnourishment of lake waters by incoming pollutants; however, the main pool of Lake Livingston and the other lakes of the basin only occasionally have water quality problems.

Land Subsidence in the Houston-Galveston Area - Texas (Problem Identification Number 4)

Land surface subsidence continues to be a destructive force in the Houston-Galveston area of Texas. Subsidence causes damages and property value losses as a result of permanent

inundation, and intensified temporary flooding. Overdrafting of the ground water aquifer which results in subsidence also leads to salt water encroachment and damage to some of the freshwater aquifers.

Subsidence in the bay shore areas has already resulted in permanently inundating lands previously above normal tide elevations and has subjected extensive additional lands to tidal inundations. Subsidence in the vicinity of freshwater streams has extended the area of their floodplains. Surface drainage has become less effective and in some areas drainage patterns have been reversed as a result of subsidence. Risks of severe floods in the future exists in this vicinity.

During the period from 1906 to 1973, land-surface subsidence of one foot or more has occurred in an area of approximately 2,500 square miles. The maximum subsidence that has occurred during this period has been 8.5 feet. The land-surface subsidence has generally resulted from the withdrawal of large quantities of ground water in the area. The water levels in these artesian aquifers have declined significantly, resulting in a decrease in hydraulic pressure in the system, dewatering and compaction of the clay beds which are interspersed with the water-bearing sands in the subsurface, and finally land-surface subsidence.

Pumping of ground water in the Houston-Galveston region has steadily increased. As a result of this increase, the rates of artesian pressure decline and subsidence have accelerated. Subsidence is expected to continue at a rate dependent on the decline in pressures resulting from future ground water pumpage. Surface water from the adjacent Trinity River Basin and the Brazos River in the Brazos River Basin is presently being diverted for use in southern Harris County. This switch from ground water to surface water supplies has already resulted in a slight recovery of artesian pressure and has thereby decreased the rate of subsidence. Additional surface water supplies must be developed and used to replace ground water sources in order to further reduce the effects of subsidence.

Water Quality Problems -- Houston Metropolitan Area - Texas (Problem Identification Number 5)

The Houston metropolitan area is composed primarily of Harris County, however, parts of the adjacent Chambers and Galveston Counties have water quality problems. Water quality problems of concern in this area are wastes from domestic and industrial sources, the periodic lack of dissolved oxygen in surface waters of the ship channel and bays, and salt water encroachment due to locally excessive ground-water pumpage.

The Houston metropolitan area is drained almost entirely by a

small and sluggish stream known as Buffalo Bayou, which has been channelized to form the Houston Ship Channel in its lower reaches. Its tributaries include small, intermittent bayous such as Brays Bayou, Hunting Bayou, Greens Bayou, and Sims Bayou. It is in this area that the Port of Houston, a deep water harbor, was established in 1914. This harbor usually ranks second or third annually in tonnage among the deep water ports of the Unites States. In addition to the Port of Houston, the Ports of Galveston and Texas City are situated adjacent to Galveston Bay. In 1971 the Galveston Bay area handled a cumulative tonnage of over 90 million short tons making it one of the world's most heavily used waterways. Most shipping involves either the transport of raw materials to industrial complexes located in Texas City and along the Houston Ship Channel, or the export of intermediate and final products from these industries to domestic and foreign destinations. Since the end of World War II, Houston and the Houston Ship Channel industrial complex as well as the Ports of Galveston and Texas City have undergone tremendous growth. The channel and bays have received wastes from domestic and industrial sources. These wastes, together with the sluggish flow characteristics of the waterway and tidal action, have overloaded the natural purification capacity of the estuary and have resulted in a pollution problem.

Along the entire length of the Ship Channel from Morgan's Point (Mile 0) to the Turning Basin (Mile 24) is a dredged-out portion of Buffalo Bayou. The channel's depth is approximately 40 feet, with a minimum bottom width of about 100 yards. During critical periods in the summer, there is often no dissolved oxygen from Mile 10 to Mile 24, a distance of 14 miles. During the winter months, the area deficient in oxygen is often reduced to an eight mile segment extending from Mile 16 to Mile 24.

Historically, the Houston-Galveston metropolitan area has obtained a large portion of its water supply from the Gulf Coast Aquifer. During the early days of Houston's development, the entire municipal supply came from this source and industries locating in the area developed their own wells to tap the abundant and good quality ground water supply. Pumpage from the Gulf Coast Aquifer during the period from 1890 through 1970 has caused a decline in the potentiometric surface (water level) in excess of 400 feet near the Houston Ship Channel and the upper end of Galveston Bay. This reversal of the regional hydraulic gradient has caused the interface between fresh and saline water to move toward this area. The present location of the saltwater interface is not well known; however, problems are now developing in the vicinity of Texas City and Galveston in Galveston County and near the coast in Chambers County.

Ground Water Quality Problems -- Haskell and Jones Counties - Texas (Problem Identification Number 6)

Relatively high concentrations of nitrogen -- locally, extremely large amounts -- are present in the ground water supplies of the Seymour aquifer of Haskell and Jones Counties, as well as in other counties of northcentral Texas. In addition to the nitrate problem, the salinity of this water supply (primarily sodium chloride) has also increased in recent years. The Seymour is the principal aquifer of the area and is used extensively for irrigation, domestic, and livestock purposes, and to a lesser extent as a municipal supply.

Extensive comprehensive investigations of the hydrology, ground water resources, and water quality problems in Runnels, Haskell, and Jones Counties strongly indicate the high nitrogen concentrations are principally the result of natural phenomena. The increasing nitrate content in local areas apparently is related to a combination of land use and land treatment measures as well as extended periods of above-average precipitation with corresponding rise of water levels in the aquifer. High nitrate content in ground water renders it unsafe for both human and when extremely high, livestock consumption. When the water is used for municipal purposes, the nitrate content must be reduced and this increases the water treatment costs.

Studies completed and presently underway indicate that localized salinity problems are related to rising water levels, past oil and gas exploration and production and salt water disposal methods, and/or possibly intrusion of saline water from underlying aquifers. High salinity content in ground water restricts its use locally for human consumption because of undesireable taste, and when it is used for municipal purposes, may increase costs of treatment.

Brazos Basin Salinity Problems Above Possum Kingdom Reservoir-Texas (Problem Identification Number 7)

At the present time, full utilization of the water resources of the main stem Brazos River is not possible because of the adverse effects of natural salt pollution from sources located within its principal upper basin tributaries. The quality of Brazos River main stem water is seriously degraded by emissions from major natural salt sources in the upper Brazos River Basin downstream from the High Plains Escarpment The major portion of this natural salt pollution consists of sodium chloride from salt springs and salt flats within the drainage area of the Salt Fork of the Brazos and, to a lesser extent, the Double Mountain Fork of the Brazos River in the upper basin, principally in the counties of Garza, Kent, and Stonewall.

Chloride concentrations constitute over one-half the total dissolved solids concentrations of the Brazos River flows downstream of the natural salt pollution sources. The sources of up to 70 percent of the chloride entering the river are readily identifiable in a relatively localized area of the Salt Fork of the Brazos River. Sulfate, the second most prolific contaminant in the waters of the Brazos, is also acquired from gypsum-bearing Permian age formations by runoff from large areas of the drainage areas of both the Salt and Double Mountain Forks of the Brazos River.

Numerous salt flats are located within the drainage system. The most prominent salt-producing flats are Dove Creek Salt Flat (Salt Croton Creek) of north-central Stonewall County, Hot Springs Salt Flat (Croton Creek) of eastern Kent County, and Short Croton Salt Flat (Short Croton Creek) also located in eastern Kent County. Salt flats, as the name implies, are relatively flat, except for small islands of Permian age rocks that extend above the level of the salt flat floor. Generally, these flats are encrusted with a thin layer of salt crystals which are dissolved and flushed into the associated streams by runoff.

There are few springs in the upper slopes of the salt-producing area, but those found are usually freshwater springs which flow only intermittently. Lower slopes have more springs and seeps with varying water quality, depending on whether the fresh or salt-fresh aquifer is above, below, or at about the level of the spring or seep. Springs occur in many of the stream bottoms and salt flats, discharging under artesian pressure into the overburden or from open joints in the shale or gypsum beds. Most of the springs of the salt flats discharge only salt water, but a few springs discharge a mixture of waters from both salt water and fresh water aquifers.

The location of the salt sources is such that pollution from them affects the main stem Brazos River throughout its entire length. This is by far the most serious water quality problem in the Brazos River Basin. Although the amount of water carrying dissolved minerals into the main stem of the river is fairly insignificant compared to the total amount of water the river empties into the Gulf of Mexico, it is enough to make the water in the river generally unsuitable for domestic use for a significant distance downstream. Higher quality tributary flows and tributary reservoir releases become polluted as they enter the main stem Brazos River.

Water presently flowing in the main stem of the Brazos River is undesirable for municipal supply and is not used for this purpose except in times of emergency. During critical years, however, cities such as Waco and Marlin have used Brazos River water as supplemental supplies. Presently, in the lower reach of the Brazos River, river water is used for

irrigation and industrial purposes. This is possible because of large inflows of good quality water from tributary sources within the region; however, during some periods river flow remains poor in quality even in the lower reaches of the Brazos River.

Ground Water Availability and Quality Problems in the Carrizo Aquifer, Winter Garden Area - Texas (Problem Identification Number 8)

The Carrizo Aquifer lies southwest of the San Marcos River and within the Guadalupe, San Antonio, Nueces and Rio Grande Basins. The aquifer extends over all or parts of Atascosa, Bexar, Caldwell, Dimmit, Frio, Gonzales, Guadalupe, Karnes, La Salle, Live Oak, McMullen, Maverick, Medina, Uvalde, Webb, Wilson, and Zavala Counties.

The Carrizo Aquifer is the most continuous, permeable, and most developed (heavily pumped) water-bearing unit in the area. Throughout most of the area, the Carrizo yields ground water which is acceptable for irrigation, public supply, and industrial purposes. The Carrizo Aquifer ranges in thickness from 150 to more than 1,000 feet, with maximum thickness in Atascosa County and minimum thickness in Dimmit County.

The average rate of recharge to the Carrizo Aquifer is about 100,000 acre-feet per year. Average annual pumpage for the period 1963-1969 was approximately 272,000 acre-feet. Thus, for this period about 172,000 acre-feet of water was pumped in excess of recharge, most of which came from storage. These large annual withdrawals of ground water from storage have caused declines in Carrizo water levels, which directly affect the cost of pumping water and are also related to water-quality changes within the aquifer, particularly in Dimmit, Zavala, and eastern Maverick Counties.

As a direct result of large water-level declines, well yields are reduced and in order to meet water demands, well pumps must be set deeper and larger motors installed. In some cases, new wells are needed to meet the demands for adequate ground-water supplies. These improvements cause operating costs to spiral upward as ground-water users attempt to meet demands, and in doing so cause additional water-level declines.

In local areas, especially in Dimmit County, saline water from the Bigford Formation is leaking through old well bores and contaminating the Carrizo Aquifer. When these wells were drilled in the nineteen twenties and nineteen thirties, water levels in the Carrizo Aquifer were considerably above the level of water in the saline water sands. Because of declines in hydrostatic head, the level of the Carrizo has been significantly lowered below the level of the saline water sands. Since the old wells were poorly constructed initially

and many have not been properly plugged and sealed, the saline water moves down their boreholes and mixes with the Carrizo water, thus degrading its quality.

Also, water-level declines in Dimmit and Zavala Counties have caused reversals in the hydraulic gradient of the aquifer; thus allowing for migration of the "bad water line" and encroachment of poorer quality water to areas previously having good quality water.

Regional Ground and Surface Water Management Problems Associated with the Edwards (Balcones Fault Zone) Aquifer - Texas (Problem Identification Number 9)

The San Antonio metropolitan area, centered in Bexar County, is the largest urban area in the Nation which depends solely on ground water for municipal and industrial needs. The source of the water is the Edwards (Balcones Fault Zone) Aquifer. San Antonio is the third largest city in the State and the area's population, currently totaling about 920 thousand, is projected to grow to about 1.3 million by the year 2000.

Studies show that the Edwards Aquifer is capable of meeting the foreseeable municipal, industrial, and agricultural needs of this area, but to the detriment of Comal and San Marcos Springs, adverse economic impacts on agriculture due to increased pumping lifts, and reduced freshwater inflows to San Antonio Bay. Another important aspect of this problem is the possibility that poor quality water at the southern limits of the Edwards Aquifer might be drawn into the freshwater section of the aquifer if water levels are lowered significantly below their lowest historic level.

The Edwards (Balcones Fault Zone) Aquifer extends from central Kinney County east and northeast through Uvalde, Medina, Bexar, Comal, and Hays Counties. It consists of the Edwards and associated limestones of Cretaceous age which are in hydraulic continuity. The Edwards Limestone yields large quantities of water due to its extensive honeycombed and cavernous nature. The portion of the Edwards Aquifer pertinent to this problem area is approximately 175 miles in length extending from Brackettville in Kinney County eastward to Kyle in Hays County and hydrologically connects three major river basins; the Nueces, the San Antonio, and the Guadalupe.

Average annual recharge to the Edwards (Balcones Fault Zone) Aquifer for the period 1934-1974 has been computed to be approximately 562,620 acre-feet per year which can be considered as the dependable annual yield without mining the aquifer. Annual discharge (pumpage and springflow) for the same period has averaged 561,900 acre-feet per year. Withdrawals from wells reached their maximum in 1971, when 407,000 acre-feet was pumped for municipal, industrial and

agricultural purposes. The primary effect of the withdrawals has been reduction in springflows during periods of drought. Comal Springs were dry, for the first time on record, for about five months, July to November, 1956. The lowest flow from San Marcos Springs also occurred at that time. Both springs support unique ecosystems, provide recreational opportunities for citizens of the entire State and provide a large portion of the base flow of the Guadalupe River. They significantly enhance the economy of the region.

Currently, Canyon Reservoir on the Guadalupe River is the only firm source of surface water available to the area. Two authorized Federal projects, Cloptin Crossing and Cibolo Reservoirs in the Guadalupe and San Antonio River Basins, respectively, offer potential sources of supplemental water to the area. Other potential reservoir projects, such as the Applewhite Reservoir project on the Medina River and the Cuero Reservoir project in the Guadalupe River Basin, are additional potential sources of surface water supply for the region.

Jackson County and Vicinity Ground Water Problems - Texas (Problem Identification Number 10)

In Jackson County and vicinity along the Texas Gulf Coast, the only source of fresh water is the Gulf Coast Aquifer, consisting of alternating and discontinuous beds of water-saturated sand and clay of Tertiary and Quaternary Age. Pumpage from wells in the area has exceeded natural recharge to the aquifer, so that mining of ground water is taking place. In addition to Jackson County, portions of Lavaca, Wharton, and Matagorda Counties are within the problem area.

Although the Gulf Coast Aquifer is a prolific source of water, extensive development of rice irrigation has caused ground water mining in the problem area. An estimated 95 million acre-feet of fresh ground water is in storage in Jackson County; however, most of this water is not available for development because it occurs at great depths and only a fraction of the water can be drained from the aquifer by wells. In 1974, agricultural wells in Jackson County pumped 123,146 acre-feet from the Gulf Coast Aquifer. This pumpage will have to be reduced to 25,000 acre-feet per year by the year 2000, if the long term yield of the aquifer (28,343 acre-feet per year) is not to be exceeded.

The Gulf Coast Aquifer in Jackson County and parts of adjacent counties contains from 100 to more than 1,300 feet of net sand thickness containing fresh to slightly saline water. The depths to the base of slightly saline water in the Aquifer is over 2,300 feet northeast of Ganado, Texas in Jackson and Wharton Counties and about 200 feet near Lolita, Texas in Jackson County. The Aquifer's freshwater zone has as much as 1,200 feet of net sand thickness in the Ganado Area. The

depth of the base of freshwater in the Ganado area is more than 1,800 feet.

An additional problem which has occurred in some portions of Texas underlain by the Gulf Coast Aquifer, but has not yet been a major factor in Jackson County, is land surface subsidence. Sands of the Gulf Coast Aquifer may become compacted as the pore pressure in the freshwater zone is reduced through pumpage.

Water Supply Problems in the Corpus Christi Metropolitan Area - Texas (Problem Identification Number 11)

The City of Corpus Christi and the surrounding Coastal Bend area obtains its water supply exclusively from surface water sources in the Nueces River Basin. Annual rainfall amounts in the basin vary from 20 inches per year at the headwaters to about 30 inches per year at Corpus Christi. Surface impoundment is necessary since the natural flow of the Nueces River varies from no flow during extremely dry periods to as much as 140,000 cubic feet per second during extreme floods.

Water requirements for the City of Corpus Christi and the surrounding towns and industries have been increasing at a steady rate. Currently, in addition to the water which is used for domestic and industrial purposes in Corpus Christi, the City also delivers treated water to Reynolds Metals Company and San Patricio Municipal Water District. The San Patricio Water District in turn supplies the DuPont Chemical Company, Big 3 Industries, and the towns of Odem, Taft, Gregory, Portland, Ingleside, Port Aransas, Rockport, and Aransas Pass. Three raw water pumping stations are located near the treatment plants and water from these stations supply Celanese Corporation at Bishop, Suntide Refinery near Corpus Christi, and San Patricio Municipal Water District. The Alice Water Authority also purchases water from the City at Lake Corpus Christi for municipal use.

Present inadequacies of supplies to meet future demands are a result of inadequate storage capacity (surface impoundments) within the basin, since the basin yield could be significantly increased through additional impoundment. Currently, water demands of the City of Corpus Christi are rapidly approaching the annual dependable supply of Lake Corpus Christi, the only major impoundment in the city's systems. Ground water withdrawals currently exceed estimated safe yield from local aquifers (primarily the Gulf Coast Aquifer). As a result of such overdrafts, long-term withdrawals will need to be reduced to avoid additional problems that are inherent with such ground water mining.

Pollution, Recreation, Flooding, and Salt Water Intrusion Problems in Louisiana - (Problem Identification No. 12)

This problem area involves the Sabine River Basin portions of DeSoto and Sabine Parishes adjacent to Toledo Bend Reservoir and secondly, of Vernon, Beauregard, Calcasieu, and Cameron Parishes below Toledo Bend Reservoir. Problems include surface water pollution, limited access to recreational facilities, flooding, and the potential of saltwater intrusion in the coastal zone.

Pollution in Toledo Bend Reservoir stems from subdivision and residential development nearby, some effluent from towns and industries on tributary streams, and some forestry and agricultural operations. These problems of pollution are under the surveillance and observation of the Sabine River Authority of Louisiana and the Louisiana Health and Human Resources Administration (the State Board of Health Office) and are not expected to reach any critical or serious proportions.

Limited access to recreation areas is identified as a problem since the result is a lack of economic activity. If adequate access to the recreation areas were provided, the number of visitors and users of Toledo Bend Reservoir and its fringe area for boating, camping, picnicking, swimming, skiing, and other water-related activities would be increased significantly. This problem will be relieved somewhat by the ultimate completion of the Toledo Bend Forest Scenic Highway extending from Logansport to Leesville, Louisiana, a length of 95.6 miles.

Some flooding is experienced along Louisiana tributary streams to the Sabine River. Generally, structural flood control measures to control this flooding are not feasible except in the Upper Bayou LaNana and Little San Miguel watersheds. In remaining areas, non-structural measures appear to be the logical alternative method of controlling flood damages.

In the coastal area of Louisiana adjacent to Sabine River some flooding does occur due to tidal fluctuations resulting in stages exceeding the elevations of land areas. Flood damages are reported more frequently now than in the past, which is attributed to development and productive use of lands with extremely low elevations. Additionally, this same general area is subject to saltwater intrusion from the Gulf of Mexico dependent upon rainfall, tidal conditions and river stages.

Upper Colorado River Salinity Problems - Texas (Problem Identification Number 13)

Within the Upper Colorado River Basin of Texas, four counties are principally affected by saline water quality problems. These counties are Scurry, Mitchell, Howard, and Coke.

Although surface water in most of the Colorado River Basin is relatively low in dissolved solids, inflow of saline water in the upper Colorado River Basin below Lake J. B. Thomas seriously degrades the quality of the main stem for about 100 miles downstream. The salt load contributed to the main stem within a 696 square mile drainage area is of both natural and man-made origin.

Entrance of salt water into the main stem of the Colorado occurs along a segment in Scurry and Mitchell Counties just below J. B. Thomas Reservoir. Early oilfield operations in this area resulted in the construction of over 200 salt water evaporation pits from which salt water easily seeped into the local alluvium. In addition to salt water originating from this source, early oil wells were often improperly plugged and abandoned, thus leaving the possibility of the entrance of saline water from deeper formations into fresh-water aquifers. Naturally occurring saline water in the Santa Rosa Aquifer discharges into the river below J. B. Thomas Dam and in the headwaters of E. V. Spence Reservoir. Runoff from above the salt producing area is very low in dissolved solids as evidenced by the average dissolved solids concentrations of 250 mg/l in Lake J. B. Thomas, whereas below this area on the main stem of the Colorado dissolved solids concentrations averaged near 3,000 mg/l in 1975.

Beals Creek, a comparatively large tributary which has its headwaters in a large natural depression known as Natural Dam Salt Lake, also contributes to the salt load of the Colorado River as it enters the main stem just above E. V. Spence Reservoir. Although the quality of water in the natural saline lake varies widely in response to precipitation, concentrations of dissolved solids have frequently exceeded 250,000 mg/l.

In the salt contributing area below Lake J. B. Thomas, much of the dissolved-solids load is contributed by the base flow of the river and by runoff from local rainstorms occurring within the intervening drainage age. These high dissolved solids concentrations in local runoff generally occur following periods during which the main stem has little or no flow, and result largely from solution of salt deposited by evaporation of the saline base flow contributed by the Santa Rosa Aquifer.

Former waste disposal practices in oil and gas fields which have contributed to the Colorado River salinity problem have been largely rectified. The residual effects of past practices, however, continue to plague development of water resources in this part of the basin, and the chemical quality of low flows of the river which carry much of the salt load will be slow to improve. Also, the water stored in E. V. Spence Reservoir will continue to be marginal for most municipal and industrial uses without dilution.

Water Supply Problems in the Mid-Brazos River Basin - Texas (Problem Identification Number 14)

The problem area comprises 18 counties in the central portion of the Brazos Basin of Texas. The primary source of groundwater in the area are the Hensel and Hosston members of the Travis Peak Formation. In the Waco area most wells completed in these aquifers during the early 1900's (1900-1930) flowed small to moderate amounts of water at the land surface. Since 1900, more than 400 feet of water level decline has occurred because pumpage has exceeded the recharge to the area.

The Hensel Formation has as much as 70 feet of net sand thickness containing fresh to slightly saline water at depths from about 900 to 2,500 feet. The Hosston Formation has a maximum net sand thickness containing fresh to slightly saline water of more than 340 feet and is encountered at depths from about 1,000 to 3,600 feet. Total dissolved solids of the waters from these aquifers in the Waco area range from 500 to 900 milligrams per liter.

Because of the reduction in the aquifer's artesian pressure and mining of aquifer storage, numerous cities, such as Waco, Temple and Hillsboro, have been forced to convert their supply to surface water sources. However, due to natural salt pollution in the upper and middle Brazos Basin, the main stem Brazos River at Waco is generally unsuitable for municipal use unless blended with higher quality water. Thus, the mid-Brazos groundwater depletion problem is complicated by the Brazos Basin salinity problems above Possum Kingdom Reservoir.

Problems Associated with Freshwater Flows to the Texas Bays and Estuaries - Texas (Problem Identification Number 15)

Texas has the distinction of possessing the most diverse coastal region in the Nation and one of the most productive series of estuarine ecosystems in the world. These estuarine areas are subject to the full spectrum of naturally dynamic physical, chemical, and biological processes. One fundamental

aspect of the processes is the timing, magnitude, and quality of freshwater inflows from the 15 major Texas river basins that contribute to the 7 major Texas estuarine systems. Extensive research has shown that freshwater inflow functions primarily as: (1) a transport mechanism to bring vital nutrients and sediments to the estuarine systems, (2) a dynamic force in the periodic inundation and dewatering of the coastal wetlands, and (3) a salinity gradient control.

However, bays and estuaries may be altered in the future as water requirements approach the firm yields of contributing river basins and thereby change the freshwater inflow regimes of the estuarine systems. Avoiding the resulting environmental stress and reduced estuarine productivity requires the establishment of water management criteria for these estuaries based upon the best available scientific and engineering analyses.

In 1975, the 64th Legislature enacted legislation directing State agencies to perform comprehensive studies of the effects of freshwater inflows upon Texas bays and estuarines and, further, to develop methods of providing and maintaining their ecological environments and living resources. Detailed evaluations of the interrelationships between freshwater inflows and estuarine environments are now being executed under this legislation to assess the environmental impacts of water resources development in Texas. Reconnaissance level investigations begun in 1967 have been expanded to broad-based scientific, engineering, and economic research probing the nature of the Texas coastal region. In addition to the collection of baseline data, computerized mathematical models to simulate the environmental systems have been developed for the purpose of assessing the effects of water resources development and management policies on Texas bays and estuaries.

With properly planned water resources development and management, it would be possible to reduce the effects of drought and substantially control seasonal freshwater inflow regimes for the benefit of Texas estuarine systems, although at present the legal and institutional framework within which such management could be performed remains unclear. Nevertheless, the objectives of the comprehensive studies are to identify the freshwater inflow quantities and the vital quality constituents which must be provided at appropriate times and geographic locations to maintain Texas estuarine environments at sustainable levels of productivity in compliance with established State and federal legislation.

Water Supply and Quality Problems in Small Cities and Rural Communities as a Consequence of Implementing the 1974 Safe Drinking Water Act - Texas (Problem Identification Number 16)

Since the passage of the Safe Drinking Water Act of 1974 (P.L. 93-523) and subsequence issuance of regulations by the Environmental Protection Agency related to the Interim

Primary Drinking Water Standards, it has been estimated that approximately 600 public water systems in Texas are in violation of the drinking water standards. The majority of these violations result from an inability to meet maximum standards set for fluoride contamination, although other violations have resulted from inability to meet the maximum standards for nitrate. The problem area extends throughout the entire State of Texas although certain areas of West Texas and the Trans-Pecos -- where ground water quality tends to be degraded by fluoride and nitrate -- are the most seriously affected.

It is estimated that 6 percent of the population of Texas (about 734,000 persons) reside in areas where current water supply systems cannot meet the Safe Drinking Water Standards. These water supply systems are generally of small size and serve rural customers in low density residential areas. The additional cost of meeting the Safe Drinking Water Standards will create financial problems on the public and private water systems involved. Rising costs of electricity, labor, and other necessary ingredients for operation are already vastly increasing plant operating costs. It is estimated that out of the 600 systems that will be unable to meet the standards it will be economically infeasible for 504 of these systems to invest the necessary funds to bring their systems up to standards. The population affected in this case is estimated to about 500,000 persons residing in the service area of the 504 systems.

Flood Problems and Hurricanes - Texas (Problem Identification Number 17)

Flooding occurs almost every year on one or more of the major streams of the State. Texas history records many damaging floods which have occurred throughout the State. Many of these floods have resulted in the loss of human life and have caused serious economic losses to urban areas, to agriculture, to transportation, and to utilities industries.

Because of the wide variation in the climate and physiography of Texas, the magnitude and character of floods differ widely, both within and between the major river basins of the State. In the eastern part of Texas, where rainfall is abundant, streams flow through broad, flat valleys bordered by timber and dense growths of vegetation. Stream channels commonly have gentle slopes and small capacities, following meandering courses from their headwaters to the Gulf. Runoff is comparatively slow and stream velocities are generally low. During periods of intense rainfall, the large volumes of water accumulate in the valleys of the basins and are released slowly to the streams. These conditions generally produce

broad, flat-crested floods which move slowly in the lower regions of the basins and cause prolonged periods of inundation of the land.

In the central and western parts of the State, ground and tree cover is sparse. Stream slopes vary from steep to moderately steep, becoming flatter in the coastal plains. During periods of intense rainfall, runoff is more rapid than in the eastern part of the State, with high peak flows, high stream velocities, and shorter periods of land inundation.

Hurricanes, with their associated problems of high winds, heavy rainfall, tornados, and tidal surges, directly affect areas along the Gulf of Mexico. As the dying storm centers move inland, heavy rain, tornados, and flooding can affect areas several hundred miles inland from the Coast.

The most serious statewide flooding in recent years occurred in 1957. In a period beginning in April and continuing through June, every major river and principal tributary in the State reached flood stage. Flood conditions existed for as long as 80 days on many of the major rivers during this period.

Ground Water Depletion Problems in the Texas High Plains - Texas (Problem Identification Number 18)

The Ogallala Formation of Pliocene age occurs at or near the surface over much of a 42-county High Plains area of northwest Texas. The formation consists of alternating beds of silt, clay, sand, gravel, and caliche.

The saturated zone of the aquifer ranges in thickness from a few feet to more than 500 feet. In the irrigation area north and west of Lubbock, the saturated interval ranges between 100 and 300 feet. South of Lubbock, the saturated zone is between 25 and 150 feet thick. The thickest saturated section is north of Amarillo and is over 500 feet.

The Ogallala Aquifer in Texas is one of the most intensely developed aquifers in the United States. Pumpage for irrigation ranges from about 5 to 10 million acre-feet annually, depending on the amount of precipitation occurring during the irrigation season, and supports more than 65 percent of irrigated acreage in Texas. This pumpage is considerably greater than the exceedingly small average annual natural recharge to the aquifer. As a result, the saturated thickness of the aquifer is declining in the Texas High Plains.

The Ogallala will not support the present irrigation development in the Texas High Plains in the long-term. Declining

water levels and increasing pumping costs due to the reduction in saturated thickness will result in substantial reduction in supplies of water for irrigation in the High Plains during the next 20 to 30 years. The decline and ultimate exhaustion of this aquifer will result in reduced agricultural production, lowered supplies of food and natural fibers for consumer markets, higher retail prices for these commodities, and lowered employment and incomes for this region of Texas.

Detailed investigations of the Ogallala Formation are being conducted by the State, Federal agencies, universities, and local ground-water districts to determine the quantity of water in storage, to find ways to increase recharge to the aquifer, to increase efficient use and management of existing supplies, and to increase water conservation. The economy-wide, large negative impacts of exhaustion of this aquifer as a water supply for this major irrigation area of Texas is one of the most serious water-supply problems of Texas during the remainder of the 20th century.

Water Supply, Flooding and Erosion Problems - Louisiana (Problem Identification Number 19)

This problem area includes all Louisiana Parishes of the Sabine River Basin. The problems are not considered to be serious and efforts are being made to resolve these problems. Water withdrawals from Toledo Bend Reservoir are being made or else are pending for the Towns of Logansport, Mansfield, and Many, Louisiana. Others are in the process of considering the Sabine River water as a supply source. Projected water requirements for the Sabine River Basin in Louisiana and other areas of the State are now under study by an overall analysis of Statewide water resources.

In Calcasieu Parish, the Sabine River Diversion Project will provide supplemental water supplies from Sabine River to Calcasieu Parish and its Lake Charles vicinity. Present and future requirements will not be completely met by this diversion and supplemental water supply. This problem will be addressed as one of the objectives of the Louisiana Statewide water resources study.

Generally, there are no extremely serious water supply problems in the Sabine River Basin of Louisiana, with the exception of those portions of Cameron and Calcasieu Parishes which are influenced by saltwater intrusions from the Gulf of Mexico.

Some flooding is experienced along Louisiana tributary streams to Sabine River. Generally, structural flood control measures to control this flooding is not feasible except in two instances, which are Upper Bayou LaNana and Little San Miguel Watersheds.

In remaining areas, non-structural measures appear to be the logical alternative method of controlling flood damages.

Shoreline erosion problems exist on the Louisiana shoreline of Toledo Bend Reservoir. These problems are under observation and surveillance of the Sabine River Authority of Louisiana and no serious impact on the economy of the general area is expected. There are no other implications known in relation to the economy and well-being of other areas of the State, region, or ASA.

Water Supply and Related Problems in Curry, Roosevelt, and Lea Counties - New Mexico (Problem Identification Number 20)

In the western Texas Gulf Region, the New Mexico counties of Curry, Roosevelt and Lea are principally affected by water supply, water quality and flooding problems as well as having limited recreational facilities.

Essentially all of the water in the New Mexico portion of the Texas Gulf Region is furnished from ground water supplies, which occur primarily in the sands and gravels of the Ogallala Formation. Large-scale pumpage of ground water for irrigation, industrial, municipal, domestic, livestock, and power production has resulted in aquifer mining and water level decline. Without additional water supplies, the resulting drop in water levels and the small quantities of water remaining in aquifer storage will be uneconomically recoverable for irrigation purposes. Potable ground water is generally available throughout the area; however, in a few locations the water is very hard and high in sulfates or chlorides.

THE IMPLICATIONS OF NOT SOLVING SEVERE WATER AND RELATED LAND RESOURCES PROBLEMS

This Chapter presents a general discussion of the implications relative to the State/Regional Future and the Texas Gulf Region of not solving the region's severe water and water-related problems between now and the year 2000. Table 5 gives an indication of the number of people and the percentage of the population in the Texas Gulf Region who are and will continue to be directly affected if these problems are not solved. However, it should be recognized that in several instances the implications are more for reaching than just the immediate problem area and some have national significance.

Water Quality Problems -- Beaumont-Port Arthur Metropolitan Area - Texas (Problem Identification Number 1)

Water quality problems in the Beaumont-Port Arthur metropolitan area accentuated by intensive industrial activities and urbanization will continue to be detrimental to the aquatic life in the lower Neches River Basin, the lower Sabine River Basin and Sabine Lake. Contact and non-contact recreational activities will continue to be hampered and in general, the quality of life within this metropolitan area for all of its citizens will be less than desirable as long as the water pollution problems are not abated.

Salt water intrusion in the lower Neches River will continue to threaten freshwater supplies for the City of Beaumont and the Lower Neches Valley Authority and its customers almost every year during the low-flow season. Efforts to halt the salt-water intrusion with temporary salt-water barriers have been successful, but have created a dead-end to navigation for as long as six months. Consequently, full utilization of the flow of Neches River can never be realized until a permanent solution to this problem is developed.

Water Supply Problems -- Upper Trinity River Basin - Texas (Problem Identification Number 2)

The SRF projected municipal and industrial water requirements for the upper Trinity River Basin are anticipated to exceed existing supplies within five to ten years, with a shortage of 511.6 thousand acre-feet by the year 2000. Failure to alleviate these shortages will result in competition for available supplies among all users and economic growth will be severely restricted in the area. The role of the Dallas-Fort Worth metroplex as a national commercial and manufacturing center will be drastically diminished. Unemployment will rise

Table 5. Population and Areas Affected by Water and Related Problems in the Texas Gulf Region

Problem Identification Number	Problem and Area	State	Population	% of Region	Population	% of Region	Population	% of Region
1	Water Quality Problems -- Beaumont Port Arthur Metropolitan Area	Texas	325,151	3.2	355,650	2.9	405,800	2.5
2	Water Supply Problems -- Upper Trinity River Basin	Texas	2,679,632	26.2	3,434,450	27.5	4,620,500	28.9
3	Water Quality Problems -- Dallas-Ft. Worth (Trinity River & Tributaries)	Texas	2,[illegible]3,145	26.2	3,413,400	27.4	4,578,000	28.6
4	Land Subsidence -- Houston-Galveston Area	Texas	2,315,567	22.6	2,972,950	23.8	4,068,800	25.4
5	Water Quality Problems -- Houston Metropolitan Area	Texas	2,099,219	20.5	2,690,900	21.6	3,678,400	23.0
6	Groundwater Quality Problems -- Haskell and Jones Counties	Texas	9,014	0.09	8,002	0.06	6,825	0.04
7	Brazos River Basin Salinity Problems -- Above Possum Kingdom Reservoir	Texas	74,963	0.7	72,150	0.6	65,700	0.4
8	Groundwater Availability and Quality Problems in the Carrizo Aquifer -- Winter Garden Area	Texas	76,549	0.8	83,700	0.7	94,200	0.6
9	Regional Ground and Surface Water Management Problems -- Edwards (Balcones Fault Zone) Aquifer	Texas	1,019,208	10.0	1,342,300	10.8	1,714,900	10.7
10	Groundwater Problems -- Jackson County and Vicinity	Texas	114,449	1.1	118,900	1.0	127,000	0.8
11	Water Supply Problems -- Corpus Christi Metropolitan Area	Texas	312,071	3.0	365,700	2.9	444,900	2.8
12	Pollution, Recreation, Flooding, and Salt Water Intrusion Problems	Louisiana	40,988	0.4	40,425	0.3	40,191	0.2
13	Salinity Problems -- Upper Colorado River Basin	Texas	66,663	0.7	68,800	0.6	70,900	0.5
14	Water Supply Problems -- Mid-Brazos River Basin	Texas	592,638	5.8	730,850	5.9	843,000	5.3
15	Problems Associated with the Freshwater Inflows to the Texas Bays & Estuaries	Texas						
16	Water Supply and Quality Problems in Small Cities and Rural Communities as a consequence of Implementing the 1974 Safe Drinking Water Act	Texas						
17	Flood Problems and Hurricanes	Texas						
18	Groundwater Depletion Problems -- Texas High Plains	Texas	607,055	5.9	669,300	5.4	762,500	4.8
19	Water Supply, Flooding, and Erosion Problems	Louisiana	40,988	0.4	40,425	0.3	40,191	0.2
20	Water Supply and Related Problems in Curry, Roosevelt, and Lea Counties	New Mexico	121,000	1.2	157,500	1.3	200,300	1.3

and the local economy will degenerate as commercial institutions and industrial facilities relocate to more favorable areas.

Water Quality Problems -- Dallas-Fort Worth Metropolitan Area - Texas (Problem Identification Number 3)

Water quality in the Trinity River and its tributaries in the Dallas-Fort Worth metropolitan area will continue to be detrimental to aquatic life and, in general, the quality of life of the populace in the immediate problem area. Much of the main stem of the Trinity River as well as portions of the West Fork and East Fork will remain unsuitable for contact and non-contact recreation. Although water quality improves somewhat downstream, the effects of water quality problems in the Dallas-Fort Worth metropolitan area reach all the way down the main stem of the Trinity River to the headwaters of Lake Livingston.

Downstream water users will also continue to be adversely affected. Treatment costs of water for municipal and manufacturing purposes will increase as the level of contaminants increase and consequently full utilization of the Trinity River for all uses may not be possible.

Land Subsidence in the Houston Metropolitan Area - Texas (Problem Identification Number 4)

Land surface subsidence in the Houston-Galveston Area, resulting in large part from sustained ground water pumpage, has become a serious problem. During the period from 1906 through 1973, the amount of land surface subsidence was one foot or more in an area of approximately 2,500 square miles. The center of subsidence is at Pasadena, where as much as 7.5 feet (2.3 meters) occurred between 1943 and 1973. Estimates of subsidence are based on the amount of water level decline, the thickness of clay, and the compressibility of the clay. Certain land areas are now inundated and low lying areas have become more frequently submerged due to normal tides. An increased number of industrial and residential areas have become vulnerable to heavy loss in the event of a hurricane. Subsidence will continue at a rate dependent on the decline in pressure resulting from ground water pumpage.

Water Quality Problems -- Houston Metropolitan Area - Texas (Problem Identification Number 5)

In recent years, considerable progress has been made in cleaning up the Houston Ship Channel area, but problems still remain. The tremendous municipal and industrial growth projected for the Houston metropolitan area will continue to adversely affect aquatic life in Buffalo Bayou, and its

tributaries and portions of Galveston Bay. In general, the quality of life of the citizens in the area will continue to be less than desirable if adequate water quality management is not attained. The inferior quality of water in the Ship Channel area will continue to preclude its use for certain industrial process and cooling waters without expensive pretreatment.

Ground Water Quality Problems -- Haskell and Jones Counties Texas (Problem Identification Number 6)

In the Haskell and Jones counties area, major ground water problems consist of relatively high concentrations of nitrogen and sodium chloride.

In the event there is a continued buildup of nitrogen in the ground water in the Haskell and Jones County area, there will be a discontinuance of its use for domestic purposes and eventually, if the condition remains unchecked, it will become unfit for livestock use as well. Several municipalities are presently using the ground water as a public supply. In time, if the concentrations of nitrogen exceed 45 milligrams per liter the communities using the water will be required to install expensive treatment facilities, discontinue its use, or seek an alternate surface-water source.

Continued degradation of ground water quality by the addition of sodium chloride to the Seymour aquifer could eventually preclude the aquifer's use for irrigation as well as for domestic purposes and for livestock. Municipalities will be forced to desalinate the ground water at considerable expense, secure their own surface-water source, or join a regional water supply system.

Brazos River Basin Salinity Problems above Possum Kingdom Reservoir - Texas (Problem Identification Number 7)

If the salinity problems in the Brazos River Basin above Possum Kingdom Reservoir are not solved a continuation of the current situation may be expected in which a large portion of the river's natural flow is unsuitable for agricultural, industrial, and municipal use in the problem area. Municipalities located in the middle of the Brazos Basin are now using ground water which is becoming increasingly of short supply. The same municipalities are unable, however, to use the Brazos River water because of its high salinity for municipal purposes except in times of emergency.

The location of the salt pollution sources are such that they they adversely affect the main stem Brazos River throughout its entire length. Presently, in the lower reach of the

Brazos River, water is used for irrigation and low-grade industrial purposes. This is possible because of large inflows of good quality water from downstream tributary sources within the region; however, during some periods, river flow remains poor in quality, resulting in damage to water distribution systems and increasing the soil salinity of irrigated cropland.

A failure to implement salinity alleviation measures in the upper Brazos will continue to hinder full utilization throughout the entire length of the main stem Brazos River.

Ground Water Availability and Quality Problems in the Carrizo Aquifer - Texas (Problem Identification Number 8)

In the Carrizo Aquifer, large artesian water-level declines have taken place in Dimmit and Zavala Counties where large amounts of ground water have been used for irrigation. Declines of 240 feet have been noted in this area for the period 1929-1930 to 1970. South of Pearsall, Texas, water levels have declined approximately 180 feet for the period 1929-1930 to 1970.

Digital computer model studies of the Carrizo Aquifer using projected withdrawals for the period 1970 through 2020 indicates that water levels in Dimmit and Zavala Counties, particularly near Batesville, Crystal City, and Carrizo Springs, will continue to decline rapidly; elsewhere, water levels will slowly decline throughout the area. Maximum water-level declines ranging from 100 to 180 feet are projected for the area and are based on the assumption that pumpage will remain unregulated and occurs at predicted rates.

Continued "mining" of artesian storage will cause leakage and encroachment of poorer quality water into the Carrizo Aquifer. In local areas, especially in Dimmit County, saline water from overlying sands is leaking through old well bores and contaminating the Carrizo Aquifer due to the difference in hydrostatic head. Future neglect of these leaky wells combined with increased development of the aquifer may result in widespread contamination through interformation leakage on a regional scale.

Also, ground water mining will cause pumping costs to increase and regional reversals in the hydraulic gradient of the aquifer, thus allowing for migration of the aquifer's "bad water line" and encroachment of poorer quality water to areas previously having good quality water.

Regional Ground and Surface Water Management Problems Associated with the Edwards (Balcones Fault Zone) Aquifer - Texas (Problem Identification Number 9)

The Edwards (Balcones Fault Zone) Aquifer is capable of meeting the foreseeable municipal, industrial, and agricultural water needs of the San Antonio Region, but to the detriment of Comal and San Marcos Springs, adverse economic impacts on agriculture due to increased pumping levels, and reduced freshwater inflows to San Antonio Bay.

Total annual projected pumpage from the Edwards Aquifer to meet municipal, industrial, agricultural, and other demands is expected to be 636,100 acre-feet by the year 2000 and 906,400 acre-feet by the year 2020 if supplemental surface water supplies are not developed. The next time a major drought of the extent of the 1950-1957 drought occurs, Comal Springs may be expected to go dry again and to remain dry for a longer period of time. Eventually, the springs may go dry even if a major drought does not occur, because average withdrawals from wells are approaching and most certainly will surpass the average recharge (562,620 acre-feet per year) to the aquifer, which in time will leave little or nothing to spill through the springs. San Marcos Springs will be affected in a similar manner although to a lesser extent because of its lower elevation and closer proximity to the recharge zone.

Both San Marcos and Comal Springs support unique ecosystems, provide recreational opportunities for citizens of the entire State, and significantly enhance the economy of the region. These important aspects of the springs will be lost to the citizens of the State should they go dry. Another part of this problem is the possibility that poor quality water at the southern limits of the Edwards Aquifer might be drawn into the freshwater section of the aquifer if water levels are lowered significantly below their lowest historical level by increased pumpage.

Jackson County and Vicinity Ground Water Problems - Texas (Problem Identification Number 10)

In Jackson County and the vicinity, the principal ground water problem is the "mining" of ground water storage from the Gulf Coast Aquifer which through 1969 had caused declines of water levels of from 55 to 110 feet in northern Jackson and 100 feet in central Matagorda Counties, respectively.

Continued "mining" of ground water storage at its present rate will cause a reduction in the base flows of the Lavaca an Navidad Rivers which in turn will reduce the quantity and quality of freshwater inflows into the bay causing an

adverse affect on the associated estuarine system.

With time, declining water levels will result in lower well yields with the resulting increase in water demands requiring additional expenditures to lower the pumps, to purchase larger pump motors, to pump from greater depth, or to add new wells.

Excessive future ground water pumpage with the lowering of water levels also causes land-surface subsidence and activates surface faulting. As a result of land subsidence, property values are lowered, man-made structures are damaged, and low-lying areas may be inundated during high tides and hurricanes.

Through the year 1974, on the order of 0.2 to 1 foot of subsidence has already occurred in the area and this condition will continue to worsen.

When freshwater aquifers associated with saline-water which overlies, underlies, or occurs downdip are heavily pumped, saline water moves toward pumping wells resulting in the deterioration of water quality and loss of storage for potential recharge in the future. This condition is now a major problem in the Matagorda-Old Gulf area of Matagorda County and it will continue with time.

Water Supply Problems in Corpus Christi Metropolitan Area - Texas (Problem Identification Number 11)

Based upon the existing water supplies and the SRF projected water requirements, the Corpus Christi Area will begin experiencing water supply shortages by the year 1980. The principal water use in the area is for industrial purposes mainly in the petrochemical manufacturing facilities located around Corpus Christi Bay. Shortages in water supply would lead to reduced product output or closure of these plants, thereby decreasing domestic petroleum refining capacity and adding to the nation-wide enery shortage problems.

The City of Corpus Christi also delivers treated water to a number of surrounding towns and to the San Patricio Water District which in turn serves a number of customers with municipal and industrial water. Shortages in water supply will preclude any expansion of service to meet the growing needs of Corpus Christi's service area which has no other alternative supply sources available.

Pollution, Recreation, and Salt Water Intrusion Problems - Louisiana (Problem Identification Number 12)

This problem area involves the Sabine River Basin portions of

DeSoto and Sabine Parishes adjacent to Toledo Bend Reservoir and secondly, of Vernon, Beauregard, Calcasieu, and Cameron Parishes below Toledo Bend Reservoir. Problems include surface water pollution, limited access to recreational facilities, flooding, and the potential of saltwater intrusion in the coastal zone.

Pollution in Toledo Bend Reservoir stems from subdivision and residential development nearby, some effluent from towns and industries on tributary streams, and some forestry and agricultural operations. These problems of pollution are under the surveillance and observation of the Sabine River Authority of Louisiana and the Louisiana Health and Human Resources Administration (the State Board of Health Office) and are not expected to reach any critical or serious proportions.

Limited access to recreation areas is identified as a problem since the result is a lack of economic activity. If adequate access to the recreation areas were provided, the number of visitors and users of Toledo Bend Reservoir and its fringe area for boating, camping, picnicking, swimming, skiing, and other water-related activities would be increased significantly. This problem will be relieved somewhat by the ultimate completion of the Toledo Bend Forest Scenic Highway extending from Logansport to Leesville, Louisiana, a length of 95.6 miles.

Some flooding is experienced along Louisiana tributary streams of the Sabine River. Generally, structural flood control measures to control this flooding are not feasible except in two instances, which are Upper Bayou LaNana and Little San Miguel Watersheds. In remaining areas, non-structural measures appear to be the logical alternative method of controlling flood damages.

In the coastal area of Louisiana adjacent to Sabine River some flooding does occur due to tidal fluctuations resulting in stages exceeding the elevations of land areas. Flood damages are reported more frequently now than in the past, which is attributed to development and productive use of lands with extremely low elevations. Additionally, this same general area is subject to saltwater intrusion from the Gulf of Mexico dependent upon rainfall, tidal conditions, and river stages.

Upper Colorado Salinity Problems - Texas (Problem Identification Number 13)

The high salinity which occurs in the reach of the Colorado River between Lake J. B. Thomas and E. V. Spence Reservoir presents a serious problem to all water-using sectors in

the area. Dissolved solids levels in much of the reach are too high for many agricultural and industrial uses, and use of the 55,300 acre-feet of yield from E. V. Spence Reservoir for domestic supply will be restricted if the Safe Drinking Water Act (P.L. 93-523), which requires total dissolved solids in municipal water supplies to be below 500 mg/l, is enforced. Thus, large quantities of water will not be available for use if application of salinity control methods such as the diversion projects near Big Spring and Colorado City and the Santa Rosa Aquifer pumping project are not intensified.

Water Supply Problems in the Mid-Brazos River Basin - Texas (Problem Identification Number 14)

The continued mining of water from the Travis Peak Formation in the middle region of the Brazos River Basin will result in the further decline of ground water levels. This decline will result in increased water costs as pumping lifts increase and a decrease in the yields of existing wells. Degradation of water quality may also occur as brackish or saline water migrates through the Travis Peaks Formation to replace the freshwater depleted through continued ground water mining.

Problems Associated with the Freshwater Inflows to the Texas Bays and Estuaries - Texas (Problem Identification Number 15)

If actions are not taken to resolve the problem of maintaining adequate freshwater inflow regimes to Texas bays and estuaries, several economic and environmental consequences are likely to result. Without adequate freshwater inflows, it can be anticipated that environmental stresses and imbalances could increase. Eventually, these effects could lead to a reduction in economic sectors such as tourism and commercial and recreational fishing that are dependent upon the coastal environment.

Water Supply and Quality Problems in Small Cities and Rural Communities as a Consequence of Implementing the 1974 Safe Drinking Water Act - Texas (Problem Identification Number 16)

Since the passage of the Safe Drinking Water Act of 1974 (P.L. 93-253) and subsequent issuance of regulations by the

Environmental Protection Agency related to the Interim Primary Drinking Water Standards, it has been estimated that approximately 600 public water systems serving 734,000 Texans (6 percent of the population of Texas) are in violation of the drinking water standards.

The limited quantity and poor quality of water in these affected areas result in negative impacts on the metropolitan centers in the region. If these problems are not solved, quality of life of the citizens of the region will decline, regional development and economic well-being of the citizens will not continue, and protection and enhancement of the natural water and related land resources within the affected areas will not take place.

Flood Problems and Hurricanes - Texas (Problem Identification Number 17)

The implications of not solving flooding and hurricane problems in the Gulf Coastal Region are staggering. Financial losses due to flooding and hurricanes severely hamper the State's economy and cause undue hardships on the local political entities and individuals affected by flooding. Loss of life has been great in the past and predictions of high death tolls from future hurricanes occurring in coastal areas where subsidence has occurred have been made. Transportation, industry, utilities and jobs are all severely affected by flood problems.

If the Region desires to continue growth and expansion of its industries, it must quickly develop a regional concept of floodplain management, incorporating both structural and non-structural measures.

On a national level, it is imperative that flood problems of the Region be solved. Outlays of federal tax dollars in the form of disaster relief loans and grants have continually spiralled upward. Estimates of national annual flood losses range up to $1 billion.

The Gulf Coast Region has in the past received federal assistance for numerous disasters due to flooding and hurricanes. The Region's industry and agriculture constitutes a substantial percentage of the Nation's total economy. Effects of a devastating disaster in the Region will certainly be felt in other parts of the Nation.

Ground Water Depletion Problems in the Texas High Plains - Texas (Problem Identification Number 18)

In the Southern High Plains area of the Texas Gulf Region ground water pumpage from the Ogallala Aquifer has caused

water-level declines in excess of 100 feet and has resulted in pumping lifts of 300 feet or greater in some areas. Approximately eight million acre-feet of ground water was pumped during the year 1974 which far exceeds the aquifer's natural recharge. Projected pumpage requirements are shown on Figure II which indicates even greater future water-level declines.

At projected rates of use as shown in Figure II, the present ground water supplies in the Southern High Plains area are expected to be nearing depletion in some localities by the year 2000.

Continuing water-level declines in the Ogallala Aquifer of the High Plains of Texas will cause a reduction in well yields, require greater expenditures to lower pumps or replace motors, and/or the drilling of more wells to meet increased water demands. Eventually, if supplemental water is not found, the area will return to dryland farming with its associated lower crop yields. This decline in agricultural production will reduce employment, lower incomes, result in higher prices for agricultural products to the consumers, and will have a profound impact on the economy of the State and possibly the Nation since the irrigated agriculture of this area produces a major part of the food and fiber of both the State and Nation.

Water Supply, Flooding, and Erosion Problems - Louisiana (Problem Identification Number 19)

This problem area includes all Louisiana Parishes of the Sabine River Basin. These problems are not considered to be serious and efforts are being made to resolve these problems. Water withdrawals from Toledo Bend Reservoir are being made or else are pending for the Cities of Logansport, Mansfield, and Many, Louisiana. Others are in the process of considering the Sabine River water as a supply source. Projected water requirements for the Sabine River Basin in Louisiana and other areas of the State are now under study by an overall analysis of Statewide water resources.

In Calcasieu Parish, the Sabine River Diversion Project will provide supplemental water supplies from Sabine River to Calcasieu Parish and its Lake Charles vicinity. Present and future requirements will not be completely met by this diversion and supplemental water supply. This problem will be addressed as one of the objectives of the Louisiana statewide water resources study.

Generally, there are no extremely serious water supply problems in the Sabine River Basin of Louisiana, with the

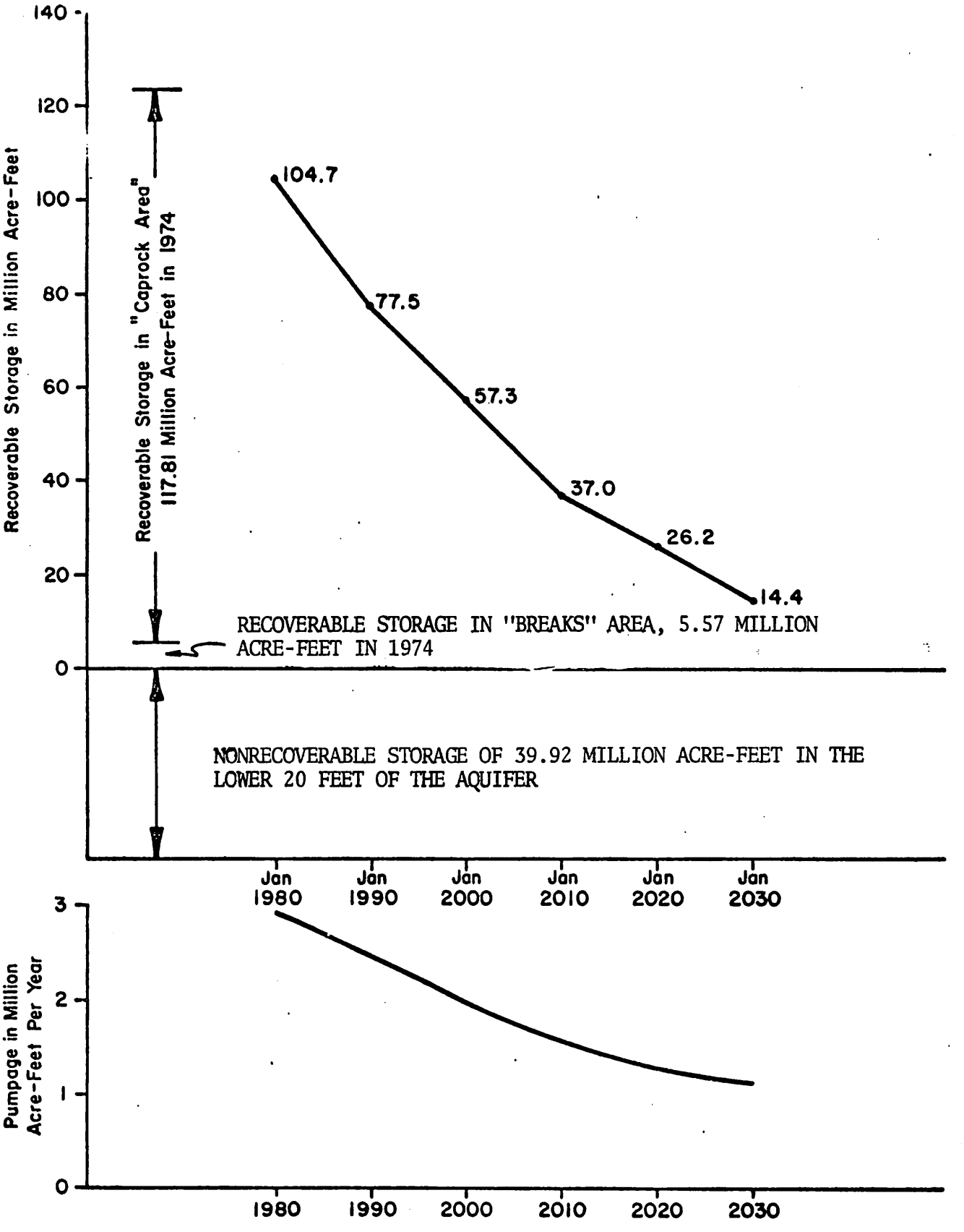


Figure II

Projected Pumpage and Storage Depletion in the Ogallala Aquifer, Southern High Plains

exception of those portions of Cameron and Calcasieu Parishes which are influenced by saltwater intrusions from the Gulf of Mexico.

Some flooding is experienced along Louisiana tributary streams to the Sabine River. Generally, structural flood control measures to control this flooding are not feasible except in two instances, which are Upper Bayou LaNana and Little San Miguel Watersheds. In remaining areas, non-structural measures appear to be the logical alternative method of controlling flood damages.

Shoreline erosion problems exist on the Louisiana shoreline of Toledo Bend Reservoir. These problems are under observation and surveillance of the Sabine River Authority of Louisiana and no serious impact on the economy of the general area is expected. There are no other implications known in relation to the economy and well-being of other areas of the State, region, or ASA.

Water Supply and Related Problems in Curry, Roosevelt, and Lea Counties - New Mexico (Problem Identification No. 20)

In the western Texas Gulf Region, the New Mexico counties of Curry, Roosevelt and Lea are principally affected by water supply, water quality and flooding problems as well as having limited surface water recreational facilities.

Essentially all the water in the New Mexico portion of the Texas Gulf Region is furnished from ground water sources. Large-scale pumpage of ground water for irrigation, industrial, municipal, domestic, livestock, and power production has resulted in aquifer mining and water level declines. Diminishing ground water supplies will result in a loss to food and fiber production. By the year 2000, approximately 225,000 acres of irrigated land in Curry County and 75,000 acres in Roosevelt County are projected to drop out of production. In Lea County, ground water in storage is probably sufficient to last through 2000; however, after this time a reduction in the irrigated lands is projected to occur. Limited water availability will also have social, environmental, and economic impacts on the area.

Where quality and quantity of ground water supplies are marginal, expensive treatment and construction will be required to improve the quality of water for domestic and industrial uses.

Surface water runoff from precipitation results in flood damages in eleven communities. Agricultural lands have problems with sheet erosion and headcutting, which destroys range and cropland affecting crop production and livestock grazing capabilities.

Recreational facilities are limited because of the lack of surface streams. There are only a few freshwater lakes and these are generally privately-owned. According to the Bureau of Outdoor Recreation study of this area, deficits in surface water supplies preclude any development of facilities to meet their projections of recreational demands. The U. S. Fish and Wildlife Service has projected water requirements for the Grulla Wildlife Refuge which cannot be met from surface water sources, and would require the retirement of most if not all of the irrigated acreage in Roosevelt County.

REGIONAL VIEWS OF PRESENT AND EMERGING NATIONAL ISSUES

This Chapter includes a series of statements concerning present and emerging national issues relating to water resources in the Texas Gulf Region. Attention is focused in the role of the Federal and State Government in planning and management of water and related land resources. These issues include: economic development and growth, water resources, management, energy development, flood control, navigation, coastal zone management, water use conflects, recreation, and cost-sharing policies.

Economic Growth and Development

Comparison of the OBERS and State projections of population and economic activity in the Texas Gulf Region presents a number of questions relating to the role of the Federal and State Governments in planning and management of the Nation's water and related land resources:

1. What should be the State role in the projection of population and economic activity on which projections of future water demands are based?

2. Can a satisfactory procedure be developed for reconciling discrepancies between State and National growth expectations on which the scale of water resource development and management programs must be determined?

3. Should the commitment of Federal funds for regional water projects be linked to the use of OBERS or other Federal agency projections, particularly in cases where a State or regional agency, using accepted statistical procedures and a detailed data base, has produced its own set of projections in a rigorous and sophisticated manner? Also, in some cases the regional projections may be derived using more current data and may already be in use by the State for not only water but other resource planning.

The OBERS 1980 population projection for the State of Texas, used in the 1975 National Water Assessment, is lower than the July 1, 1975 current population estimate for Texas by the U. S. Bureau of the Census. The discrepancy between the OBERS and State (Texas Water Development Board) projections of employment, income, and earnings results almost exclusively from the differences in the population projections, and the different population forecasts are a principal cause

of the variance in predicted water demands. From a Regional point of view, the Federal projections must improve considerably (and be updated on a regular basis), and the role of the States in projecting economic development and growth must be greatly expanded.

Another emerging issue is the importance assigned to Regional income gains in Federal analyses of proposed water resource projects. Although the Principles and Standards of the U. S. Water Resources Council establishes a regional income account and a social well-being account, almost all of the analyses involves various trade-offs between only national income gains and adverse environmental impacts. From a regional viewpoint, too little emphasis is given to regional economic development and growth, but also significant net national benefits are frequently relegated to the "lesser importance" of regional income gains. The Principles and Standards sets up the mechanism to account for regional income gains from water projects, but if present practice continues, a precedent will be set for relegating regional economic growth to a very secondary and dormant role in water resource planning and development.

Water Resources Management

The future management of the region's water resources will include not only existing practices but also potentially new practices oriented toward conservation and increased efficiency of water use in most sectors. Management of the region's available supplies will include continued development of new water storage and conveyance projects, augmentation of existing water supplies through modified and improved project operation, conservation of water through improved water use efficiency, and the control of brush and phreatophyte growth.

Water Development

The construction of large surface water impoundments has proven to be an economically justified and engineeringly sound approach to providing dependable water supplies where alternative sources were either unavailable or unreliable. The development of reservoir projects has drawn opposition in some areas due to the alteration of the lands within the reservoir areas from a terrestrial to an aquatic environment. While environmental alterations do occur as a result of reservoir construction, it is generally possible to mitigate the effects of these alterations and thus allow the development of needed water projects within acceptable limits of environmental change.

Augmentation of Existing Water Supplies

The quantity and quality of water supplies which might be developed from both surface and ground water sources can vary according to the operating criteria for the project or water-supply system. In many cases, it is possible to increase the water supply yield for a given set of capital investments through coordinated or "systems" operation of surface-water projects and the conjunctive use of surface and ground water supplies. Both of these approaches can increase the efficiency of the total water supply system; however, implementation of such management practices is often constrained by existing institutional and legal structures.

Water Conservation

The meaning of the term water conservation is expanding from the concept of the careful management of soil and water resources to that of reducing consumption of natural resources such as energy and water. The need to conserve or reduce water consumption in the Texas Gulf Region is due to both the lack of available water supplies and the rapidly-increasing costs and increasing difficulties associated with new water resource development. Thus, new water supply development and water conservation must be considered jointly in planning future water resources development and management. Water conservation practices could lead to significant water savings in the municipal, industrial, and agricultural sectors.

Phreatophyte and Brush Growth and Control

Several species of plants which have little or no economic value transpire large volumes of water. Woody plants whose roots penetrate the saturated zones of ground-water aquifers and alluvial stream-channel deposits are termed phreatophytes, and include saltcedar, cottonwood, and willow. The most serious effect of this presently essentially uncontrolled invasion of saltcedar in certain areas of the region is depletion of streamflow and non-beneficial consumption of water from irrigation conveyance and distribution systems.

The eradication of brush and replacement with beneficial vegetation could result in substantial net savings of water in the form of additional natural recharge to ground-water aquifers and increased streamflow.

The largely uncontrolled spread of phreatophytes and non-beneficial brush species dictate the urgent need for programs to control infestation by phreatophytes and other brush species as a means of conserving water supplies.

Energy Development

The very large water requirements associated with all forms of energy development and energy production are already burdening available water supplies in some areas. This burden will intensify as energy demands increase and the energy-producing sector of the economy must compete with other major water-using sectors for limited water supplies. Consumptive water requirements for petroleum and natural gas production now exceed 160,000 acre-feet per year and will increase as enhanced recovery methods are more extensively employed in the future. Total water withdrawals by petroleum refineries is currently over 300,000 acre-feet per year and consumption exceeds 100,000 acre-feet per year. Steam-electric power plants now consume about 200,000 acre-feet of freshwater each year; this consumptive use will increase to over one million acre-feet annually by the year 2000. Much of this additional water demand will result from increases in electric power generation capacity; however, a significant portion of the increase will be the result of environmental regulations which, as presently formulated, will require stackgas scrubbers for sulphur dioxide control at lignite and many coal-fired power plants and closed-cycle cooling such as wet cooling towers and/or single-purpose cooling ponds at other power generating plants. Scrubbers can increase water consumption by as much as 20 percent per unit of electricity produced, and closed-cycle cooling systems consume as much as 60 percent more water than once-through cooling systems. Because of the lower thermodynamic efficiencies of nuclear-fueled power generating plants can consume up to 50 percent more water per unit of electricity produced than fossil-fueled plants. The emerging coal and lignite processing industries, as well as uranium mining and milling, will also require ever increasing amounts of water.

Water quality may also be affected by energy development. Problems associated with petroleum, gas, coal, lignite and uranium production and processing can be adequately controlled with current technology. By contrast, as water is evaporated in the cooling of power generating plants, the dissolved solids in the residual water increases. Since currently proposed environmental regulations require the increased use of more water consumptive closed-cycle cooling systems, these regulations can in reality cause increased deterioration of water quality from a dissolved solids standpoint, while attempting to lessen the potentially harmful effects of thermal discharges.

Flood Control

Non-structural measures for the solution of flooding problems are receiving ever-increasing emphasis at the National level, although urgent needs for structural flood control projects

currently exist and will continue to exist in the Texas Gulf Region. Federal funds for construction of structural flood control projects are increasingly diminishing due to emerging environmental concerns and current policies of the Executive Branch of the Federal Government.

The Federal government, through the National Flood Insurance Program, is attempting to reduce the Nation's flood damages through flood plain management. Federal agencies have been directed to give equal consideration to non-structural alternatives when planning flood control projects.

Many political entities within the Texas Gulf Region have raised serious objections to the Federal approach toward reducing flood damages. Many feel that the National Flood Insurance Program constitutes a federal land use program and that floodplain management standards are too restrictive in that much valuable land is placed within the floodplain, thereby stopping growth and development.

It is obvious that there must be a balance between structural and non-structural measures in order to effectively reduce flood problems. Structural measures such as hurricane protection facilities, dams, and levees constitute the only viable alternative in many areas. Floodplain management and sound planning must be accomplished in all areas of the region. Adequate federal funds should be made available to finance flood control projects. Also, a need exists to accurately determine the extent that local entities can finance such measures and to find new ways to finance flood protection measures. Structural measures such as hurricane protection, dams, and levees must be developed to protect vital areas. Floodplain management and sound planning must be accomplished in all areas of the Region. If federal funds are not available for local projects (structural and non-structural), adverse, social, economic, and environmental effects will occur.

Navigation

In the Texas Gulf Region, extensive transportation revolves around major port facilities which serve ocean-going vessels of commerce and connecting intracoastal and riverine waterways which have been developed for bulk movement of materials by barge. Texas ports are grouped by the U. S. Corps of Engineers into thirteen principal harbor areas used for foreign and domestic import and export. The facilities at each of these major ports connect with coastwide barge shipments as well as with rail and truck transportation. The major existing coastwide canal is the Gulf Intracoastal Waterway, which extends from Florida to the Rio Grande and parallels the Texas Gulf Coast for some 423 miles. This

dredged channel makes possible lost-cost transportation of well over 60 million tons of commodities annually. The Waterway connects with other navigable waterways serving manufacturing plants which, in turn, translate into a vital force in the economic structure of Texas.

Some of the benefits attributable to activities dependent upon navigation in the Texas Gulf Region are jobs and income, taxes, energy savings, and minimum product prices. If future benefits accruing from water transportation are to be a certainty, the deep-water ports and connecting waterways must be maintained and enlarged as needed. Mass transportation of raw and finished products provides advantageous cost savings. Future industrial growth along the waterways will be needed to serve the growing population. It is prudent to plan for the necessary enlargement of these arteries well in advance of need to prevent congestion and overloading by increasing freight traffic. Resolution of increasing problems centered around the disposal of dredged earth resulting from maintenance operations or from new construction need to be accomplished in ways least disturbing to the environment.

Coastal Zone Management

With the enactment of recent Federal legislation, especially the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500), the Coastal Zone Management Act of 1972 (P.L. 92-583), and the Federal Fishery Conservation and Management Act of 1976 (P.L. 94-265), man's activities and overall management of resources in coastal areas in the future will require more specific planning and most likely will be subjected to increased federal regulation.

The State of Texas has long been concerned with coastal issues such as storm protection, waterway development, recreation, fisheries management, water resource supplies, and beach protection. In 1969, Texas began a four-year study of its coastal resources. As a result of this study, legislation was enacted which will govern certain aspects of management of the coastal public lands and various other coastal topics. The study also led to the recommendation that the State seek funds under the Federal Coastal Zone Management Act of 1972 to develop a management process to coordinate the many and varied activities and policies. At this time, the State is entering its fourth year of federal funding for this Program.

The importance of the coast, both for today and the foreseeable future, is evident in the fact that approximately one-third of Texas' population and economic activity is located within this one-tenth on the State's total land area. The Gulf Coast has grown very rapidly and most

indicators point to continued and accelerated growth. Development pressures will be greatest in urban areas with port facilities; however, increasing demands for recreational areas, port and waterway development, industrial sites, mineral production, freshwater supplies, recreational housing and environmental amenities will be felt throughout the coast.

The economic sectors depending directly upon the coastal waters are waterborne transportation, manufacturing industries that depend upon water borne transportation, commercial fishing, and most of the recreation and tourism in the coastal region. These sectors compete with each other for the use of coastal resources. Other economic sectors also make competing demands, particularly for freshwater supplies and space. The water demands from these economic sectors (i.e., municipal, industrial, and agricultural) divert and , in certain cases, consume substantial quantities of the freshwater inflows available to the coastal zone; however, through proper water resources planning and development it will be possible to protect the coastal environments by limiting many of the objectionable effects and managing the quantity and quality of freshwater inflows to the Texas coastal systems for the long-term public benefit.

Instream Flow Needs

The emerging issue of instream flow needs (IFN) for inland riverine environments is an extension of the currently recognized problem of providing riverine inflows to the Texas coastal environments. The IFN of any river basin, or basin segment, includes fundamental streamflow requirements of the endogenous aquatic system for support of the area's natural fish and wildlife. In addition, IFN may also include demands placed on the river system for recreational activities and maintaining scenic beauty.

Assessment of IFN involves complex scientific and engineering determinations of the expected changes associated with future basin development. Assessment can be further complicated by the appurtenant nature of water resources; that is, relating the quantification of IFN to the legal basis for such flows if prior water allocation and perfection of water rights has not specifically addressed this beneficial use.

As municipal, industrial, agricultural, and other freshwater demands increase within Texas river basins, the potential exists for substantial alteration of the hydrological regime, degradation of the natural aquatic environments, and decline of social benefits derived from a healthy, functioning ecosystem. With adequate water resources development and management, it is possible to sustain, and in many cases enhance, the natural environments of downstream river seg-

ments through controlled reservoir releases. This is particularly important where the natural hydrological regime is characterized by extreme low flow of intermittent streamflow conditions. The issue of instream flow needs must be approached with a full understanding of the legal, institutional, and financial aspects and must be addressed on the basin of local conditions and local needs.

Water Recreation

Water is an important recreational resource, not only because of the number and popularity of activities which take place directly on or in the water, but also for the activities which are indirectly related to water. According to the Texas Out-Door Recreation Plan (1975), approximately 43 percent of the total recreation participation that occurred in Texas in 1968/1970 was related to some type of water resource. In the urban areas where suitable recreation waters are infrequent, 24 percent of the participation was water related. However, in the rural areas over 70 percent of the recreation participation was related to or occurred within close proximity to water resources.

Texas has substantial recreational water resources which include: (1) over 1.1 million surface acres of major lakes and reservoirs, (2) approximately 80,000 miles of rivers, streams, and bayous (none designated as wild or scenic rivers), (3) approximately 2.1 million surface acres of saltwater bays, and (4) an estimated 2,264 miles of Gulf Coast and bay shoreline. Of these water resource categories, a great deal of the recreation participation takes place on Texas' large lakes and reservoirs. In 1968/1970, over 31 percent of the water recreation took place on lakes and reservoirs above 250 surface acres in size.

Given the importance of water to recreation, planning for the development of additional water resources in Texas should consider the demands for water-oriented recreation opportunities.

Regardless of the primary purpose for developing a reservoir or lake, recreationists consistently seek access to these resources and the opportunities they provide. Currently, the recreational waters in Texas can support most of the boating, skiing, and fishing demands on a statewide basis. However, the existing water supplies must be increased to meet future demands. The requirement for additional surface acres of recreation water from freshwater lakes and reservoirs is expected to increase 8.9 percent over the present supply by year 2000. To meet this need would require the addition of about 103,000 surface acres within those areas of the State where additional water

development is needed and feasible.

Examination of the geographical distribution of recreational water resources indicates two major actions need to be taken if the 12.5 million Texas residents (1976 population) and 22 million annual visitors are to recreate as they prefer: (1) almost all of the larger urban areas, which together contain 79 percent of the Texas population, should be provided with additional surface water acres where possible; and (2) accessibility to reservoirs, rivers, streams, and along the Texas Coast would need to be increased.

Another major problem is concerned with the Federal Water Project Recreation Act (P.L. 89-72), wherein all federal water projects authorized by Congress after 1965 require State or local 50 percent cost-sharing and full-time management of associated recreational areas. This aspect of the law is of great concern to Federal agencies, the State, and other entities due to the ever-increasing inability of State and local agencies to assume cost and management responsibilities for areas at existing federal projects and for areas of new federal water projects currently being planned. A lack of action on the part of federal, state, and local governments to adjust to this problem will almost certainly reduce recreational opportunities provided by federal water projects in the future.

Thus, the most significant problems associated with providing adequate water recreation are feasibility of geographic development near major population centers, limited access to the water, economic constraints on recreational facilities, and the fact that recreational water considerations are inextricably tied to, and largely based upon, factors other than recreation.

APPENDIX A

Public Participation and Review

PUBLIC PARTICIPATION AND REVIEW

This appendix contains a list of the names and addresses of all public participants from which comments were solicited on Assessment Activities I, II, and IV draft documents. Public comments were not solicited on draft Activity III materials in accordance with Water Resources Council assessment guidelines. The list also identifies those public participants that responded to the regional sponsor's request to review each of the assessment draft documents.

In addition to the above list, this appendix contains copies of written materials concerning the review of the draft Activity IV report from public participants and from members of the Texas Gulf Assessment Coordinating Committee. In reviewing this correspondence it should be noted that some of the comments and suggestions may not be in accordance with the materials contained in this report. Where appropriate, the Regional Sponsor has endeavored to incorporate the reviews, comments or suggestions into the final document.

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS

PUBLIC PARTICIPANTS	Activity I Draft		Activity II Draft		Activity IV Draft	
	Sent	Responded	Sent	Responded	Sent	Responded
Mrs. Betty Anderson, President League of Women Voters of Texas 1212 Guadalupe Austin, Texas 78701	x	x	x	-	x	x
Mr. Tom Anderson Project Coordinator El Llanco Estacado RC&D Box 886 Tucumcari, New Mexico 88401	-	-	x	-	x	-
Mr. Ernest Angelo, Jr. Mayor P. O. Box 1152 Midland, Texas 79701	x	-	-	-	-	-
Mr. R. A. Apffel Mayor P. O. Box 779 Galveston, Texas 77550	x	-	-	-	-	-
Mr. Charles E. Ball, Executive Vice President Cattle Feeders Association, Texas 2915 South Georgia Amarillo, Texas 79109	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft		Activity II Draft		Activity IV Draft	
	Sent	Responded	Sent	Responded	Sent	Responded
Mr. Roy Bass Mayor P. O. Box 2000 Lubbock, Texas 79457	x	x	x	x	x	-
Mr. Richard G. Bean Executive Director Capital Area Planning Council 105 West Riverside Drive #246 Austin, Texas 78704	x	x	x	-	x	-
Mr. Bob R. Beard Mayor P. O. Box 137 Mesquite, Texas 75149	x	-	-	-	-	-
Mr. Bill Bowles Mayor P. O. Box 11 Grand Prairie, Texas 75050	x	-	-	-	-	-
Mr. Harry Bozman City of Amarillo Director of Utilities P. O. Box 1971 Amarillo, Texas 79186	-	-	-	-	x	-
Mr. David Brune Manager Trinity River Authority Box 5768 Arlington, Texas 76011	x	-	-	-	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft		Activity II Draft		Activity IV Draft	
	Sent	Responded	Sent	Responded	Sent	Responded
J. W. Buchanan Manager, North Plains Water Conservation District No. 2 Box 935 Dumas, Texas 79029	-	-	-	-	x	-
Mr. Bob Burr Executive Director Golden Crescent Council of Governments P. O. Box 2928 Victoria, Texas 77901	x	-	-	-	-	-
E. P. Cape, Director Public Works, City of Houston P. O. Box 1562 Houston, Texas 77001	-	-	-	-	x	-
Mr. Charles A. Cass Executive Director Central Texas Council of Governments P. O. Box 729 Belton, Texas 76513	x	-	-	-	-	-
Mr. Carroll Chaloupka, President Texas Farm Bureau P. O. Box 489 Waco, Texas 76703	x	x	x	-	x	x

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Jerry W. Chapman Executive Director Texoma Regional Planning Commission 1000 Arnold Boulevard Denison, Texas 75020	x	x	x	-	x	x
Ms. Lila Cockerell Mayor P. O. Box 9066 San Antonio, Texas 78285	x	-	-	-	-	-
Mr. Glenn J. Cook Executive Director Brazos Valley Development Council P. O. Drawer 4128 Bryan, Texas 77801	x	-	-	-	-	-
Mr. John Cooper Southwest Research Institute P. O. Box 2604 Corpus Christi, Texas 78411	x	x	x	-	x	-
Mr. Ernest W. Crawford Executive Director Permian Basin Regional Planning Commission P. O. Box 6391 Midland, Texas 79701	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. W. R. Farquhar, Jr. General Manager Lavaca-Navidad River Authority Box 429 Edna, Texas 77957	-	-	-	-	x	-
Mr. George W. Finger President Canadian River Municipal Water Authority P. O. Box 99 Sanford, Texas 79078	x	-	-	-	-	-
Mr. John L. Franson Southwest Regional Representative National Audubon Society 2507 Rogge Lane Austin, Texas 78723	x	-	-	-	-	-
Mr. Jeffrey M. Friedman Mayor P. O. Box 1088 Austin, Texas 78767	x	-	-	-	-	-
Mr. Edward G. Fritz Texas Committee on Natural Resources 4144 Cochran Chapel Road Dallas, Texas 75209	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Bobbie T. Gallagher Executive Director West Central Texas Council of Governments P. O. Box 3195 Abilene, Texas 79604	x	x	x	-	x	-
Mr. Pitser Garrison President Neches River Conservation District P. O. Box 387 Lufkin, Texas 75901	x	-	-	-	-	-
Mr. Dan A. Gattis Executive Secretary Farmers State Association of Young 201 East 11th Street Austin, Texas 78701	x	-	-	-	-	-
Mr. Ted Getterman Mayor P. O. Box 1370 Waco, Texas 76703	x	x	-	-	-	-
Mr. Gilbert Gomez Steering Committee Chairman Sureste RC&D Hagerman, New Mexico 88232	-	-	x	x	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mr. Ladd Gordon, Director New Mexico State Game & Fish Department Villagra Building Santa Fe, New Mexico 87503	x	-	-	-	-	-
Mr. Sam Graft, Director New Mexico State Park & Recreation Commission 141 E. De Vargas Santa Fe, New Mexico 87501	x	-	x	-	x	-
Mr. L. W. Gray, President Manufacturers Association, Texas P. O. Box 52428 Houston, Texas 77052	x	-	-	-	-	-
Mr. L. A. Greene, Jr. Attorney at Law Suite 519 Medical Towers Building Houston, Texas 77025	x	-	-	-	-	-
Mr. Evett Grindstaff Chairman Upper Colorado River Authority Box 7 Robert Lee, Texas	x	-	-	-	-	-

PUBLIC PARTICIPANTS	Activity I Draft		Activity II Draft		Activity IV Draft	
	Sent	Responded	Sent	Responded	Sent	Responded
Mr. Jack Halbert Mayor P.O. Box 2039 Tyler, Texas 75701	x	x	-	-	-	-
Mr. W. Ralph Hardy 4529 Cloudview Road Fort Worth, Texas 76109	-	-	-	-	x	-
Mr. James W. Harrison Executive Director Southwestern New Mexico Council of Governments P.O. Box 1211 Silver City, New Mexico 88061	-	-	x	-	x	-
Mr. John Ray Harrison Mayor P.O. Box 672 Pasadena, Texas 77501	x	x	x	-	x	-
Mr. R. L. B. Harrison Steering Committee Chairman Llano Estacado RC&D Star Route, Box 97 Portales, New Mexico 88130	x	-	-	-	-	-
Mr. Edward Harte Publisher, Corpus Christi Caller P.O. Box 9136 Corpur Christi, Texas 78408	x	-	-	-	-	-
Mr. Scott L. Hartgrove Chairman Lower Concho River Water and Soil Conservation District Paint Rock, Texas 76866	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Jack Halbert Mayor P. O. Box 2039 Tyler, Texas 75701	x	x	-	-	-	-
Mr. W. Ralph Hardy 4529 Cloudview Roard Fort Worth, Texas 76109	-	-	-	-	x	-
Mr. James W. Harrison Executive Director Southwestern New Mexico Council of Governments P. O. 1211 Silver City, New Mexico 88061	-	-	x	-	x	-
Mr. R. L. B. Harrison Steering Committee Chairman Llano Estacado RC&D Star Route, Box 97 Portales, New Mexico 88130	x	-	-	-	-	-
Mr. Edward Harte Publisher, Corpus Christi Caller P. O. Box 9136 Corpus Christi, Texas 78408	x	-	-	-	-	-
Mr. Scott L. Hartgrove Chairman Lower Concho River Water and Soil Conservation District Paint Rock, Texas 76866	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Royal Hatch Executive Director Houston-Galveston Area Council P. O. Box 22777 Houston, Texas 77027	x	x	x	-	x	-
Mr. John A. Hayes General Manager Red Bluff Water Power Control District 111 West 2nd Street Pecos, Texas 79772	x	-	-	-	-	-
Mr. Don Heathington Steering Committee Chairman South Eastern RC&D 1204 Clayton Avenue Artesia, New Mexico 88210	x	-	-	-	-	-
Mr. Dan Hemphill Mayor P. O. Box 4398 Odessa, Texas 79761	x	-	-	-	-	-
Mr. Charles Herring General Manager Lower Colorado River Authority P. O. Box 220 Austin, Texas 78767	x	-	-	-	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mrs. J. W. Hersey 1 Longbow Houston, Texas 77024	x	-	-	-	-	-
Mr. John Hickerson El Paso Water Utilities Public Service Board City of El Paso Box 511 El Paso, Texas 79999	-	-	-	-	x	-
Mr. Ben Hickey, General Manager Tarrant WCID #1 P. O. Box 4508 Fort Worth, Texas 76106	x	x	x	x	x	-
Mr. Fred Hofheinz Mayor 900 Brazos Houston, Texas 77002	x	-	-	-	-	-
Mr. William S. Huey, Director Department of Game and Fish Villagra Building Santa Fe, New Mexico 87503	-	-	x	-	x	-
Mr. Fred Lee Hughes Mayor P. O. Box 60 Abilene, Texas 79604	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mr. O. H. Ivie General Manager Colorado River Municipal Water District P. O. Box 869 Big Spring, Texas 79720	x	-	-	-	x	-
Mr. Victor Jaeggli General Manager West Central Texas MWD P. O. Box 2362 Abilene, Texas 79604	x	-	-	-	x	-
Dr. Oscar G. Janes President Sulphur River Conservation & Reclamation District 151 S. E. 1st Street Cooper, Texas 75432	x	-	-	-	-	-
Mr. Neal Johnson Agribusiness Council of Texas Executive Secretary 8140 Burnet Road Austin, Texas 78758	x	-	-	-	-	-
Mr. Don Kelley Executive Director South East Texas Regional Planning Commission P. O. Drawer 1387 3800 Highway 365 Nederland, Texas 77627	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Jason M. Luby Mayor P. O. Box 9277 Corpus Christi, Texas 78408	x	x	-	-	-	-
Mr. R. Dan Matkin Mayor 835 W. Irving Blvd. Irving, Texas 75060	x	x	x	-	x	-
Mr. Robert G. Mauermann Executive Secretary Texas Shrimp Association P. O. Box 1666 Brownsville, Texas 78520	x	-	-	-	-	-
Mr. Truett Mayes Executive Director South Plains Association of Governments 1611 Avenue M Lubbock, Texas 79401	x	-	-	-	-	-
Mr. Robert L. McClellah Mayor P. O. Box 1751 San Angelo, Texas 76901	x	-	-	-	-	-
Mr. G. W. McNeir Executive Secretary Texas Bay & Gulf Fisherman's Association P. O. Box 281 Galveston, Texas 77550	x	x	x	-	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mr. John Mehos Liberty Fish and Oyster Company P. O. Box 267 Galveston, Texas 77550	x	-	-	-	-	-
Mr. W. D. Miller President San Patricio MWD P. O. Drawer S Ingleside, Texas 78362	x	-	-	-	-	-
Mr. Robert M. Moore Moore & Laurence 609 Fannin Street Suite 1517 Houston, Texas 77002	x	-	-	-	-	-
Mr. Robert M. Nall Mayor of Tyler P. O. Box 2039 Tyler, Texas 75701	-	-	x	x	x	-
Mr. Jay Naman President Farmers Union, Texas 800 Lake Air Drive Waco, Texas 76710	x	-	-	-	-	-
Mr. J. D. Nixon General Manager Lower Neches Valley Authority P.O. Box 3007 Beaumont, Texas 77704	x	x	x	x	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mr. Raymond D. Noah Mayor P. O. Box 309 Richardson, Texas 75080	x	-	-	-	-	-
Mr. Al Notzon Executive Director Alamo Area Council of Governments 118 Broadway Three Americas Building, #400 San Antonio, Texas 78205	x	x	x	x	x	x
Dr. Phillip Oetking 3456 Ocean Drive Corpus Christi, Texas 78411	x	-	-	-	-	-
Dr. Graciela Olivarez Director State Planning Office Room 403 Executive-Legislative Building Santa Fe, New Mexico 87503	x	x	x	-	x	-
Mr. Clif Overcash Mayor 1000 Throckmorton Fort Worth, Texas 76102	x	-	-	-	-	-
Mr. Pat Pace Pace Fish Company, Incorporated 55 West Fronton Road Brownsville, Texas 78520	x	x	x	x	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Nike Pappas Executive Director South Eastern New Mexico Economic Development District P. O. Box 6639, RIAC Roswell, New Mexico 88201	x	-	-	-	-	-
W. D. Parish, Manager Hidalgo & Cameron Counties Water Control & Improvement District No. 9 Box 237 Mercedes, Texas 78570	-	-	-	-	x	-
Mr. Fred Parkey, General Manager Red River Authority 305 Hamilton Building Wichita Falls, Texas 76301	x	-	-	-	x	-
Mr. Fred Pfeiffer, General Manager San Antonio River Authority Box 9284 San Antonio, Texas 78204	x	x	x	-	x	-
Mr. Clyde Phate Chairman Central Colorado River Authority P. O. Box 964 Coleman, Texas 76934	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mr. William J. Pitstick Executive Director North Central Texas Council of Governments P. O. Drawer COG Arlington, Texas 76011	x	x	x	-	x	x
Mr. Don Raines Mayor P. O. Box 189 Garland, Texas 75040	x	-	-	-	-	-
Mr. Troy Ramsey Executive Director Eastern Plains Planning Council Curry County Courthouse Clovis, New Mexico 88101	x	-	-	-	-	-
Mr. Cecil Reid Executive Director Sportmen's Clubs of Texas 311 Vaughn Building Austin, Texas 78701	x	-	-	-	-	-
Mr. I. M. Rice, Director Dallas Water Utilities 500 South Ervay, Room 201A Dallas, Texas 75279	x	x	x	x	x	x

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mr. James E. Ridge Executive Director Concho Valley Council of Governments 7 West Twohig Building, #505 San Angelo, Texas 76901	x	-	-	-	-	-
Mr. Carl W. Riehn Executive Director & General Manager North Texas Municipal Water District. Drawer C Wylie, Texas 75098	x	-	-	-	x	-
Mr. Ken Ritter Mayor P. O. Box 3827 Beaumont, Texas 77704	x	x	x	-	x	-
Mr. J. L. Robinson, Director Fort Worth Water Department City of Fort Worth P. O. Box 870 Fort Worth, Texas 76101	-	-	-	-	x	-
Mr. Felix W. Ryals Panhandle Underground Water Conservation District Box 637 White Deer, Texas 79097	-	-	-	-	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Bernis W. Sadler Mayor P. O. Box 1089 Port Arthur, Texas 77640	x	x	x	-	x	-
Mr. Richard Shannon Attorney First Federal Savings Building Austin, Texas	x	-	-	-	-	-
Mr. John W. Simmons General Manager Sabine River Authority P. O. Box 579 Orange, Texas	x	x	x	x	x	-
Mr. Gordon H. Smith, P.E. Assistant Director Department of Public Works P. O. Box 1562 Houston, Texas 77001	x	-	-	-	-	-
Mr. M. A. Smith Mayor P. O. Box 1370 Waco, Texas 76703	-	-	x	-	x	-
Mr. John Specht General Manager Guadalupe-Blanco River Authority P. O. Box 271 Seguin, Texas 78155	x	x	x	-	x	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. A. K. Steinheimer Executive Director Heart of Texas Council of Governments 216 North Fifth Street Waco, Texas 76705	x	-	-	-	-	-
Ms. Sharron Stewart 102 Carnation Lake Jackson , Texas 77566	x	-	-	-	-	-
Dr. Hans Suter 1002 Chamberlain Corpus Christi, Texas 78404	x	-	-	-	-	-
Mr. Homer Tanner Manager North East Texas MWD P. O. Box 680 Daingerfield, Texas 75638	x	-	-	-	x	-
Mr. Glyn Taylor, Manager Evergreen Underground Water Conservation District Box 82 Pleasanton, Texas 78064	x	-	-	-	-	-
Mr. Richard P. Thomas Executive Director Middle Rio Grande Development Council P. O. Box 1461 Del Rio, Texas 78840	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. Lee Tillman, Executive Director Eastern Plains Planning Council Curry County Courthouse Clovis, New Mexico 88101	-	-	x	-	x	-
Mr. Tom J. Vandergriff Mayor P. O. Box 231 Arlington, Texas 76010	x	-	-	-	-	-
Mr. Robert P. Van Dyke General Manager City Water Board P. O. Box 2449 San Antonio, Texas 78206	-	-	-	-	x	-
Mr. Sam E. von Rosenberg Executive Director Dairy Association of Texas Incorporated P. O. Box 30287 San Antonio, Texas 78216	x	-	-	-	-	-
Mr. Bill J. Waddle General Manager Water Conservation Association Texas 202 San Jacinto Building Austin, Texas 78701	x	-	-	-	-	-

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICPANTS	Activity I Draft Sent	Responded	Activity II Draft Sent	Responded	Activity IV Draft Sent	Responded
Mr. R. J. Walker Manager Bexar Metropolitan Water District Drawer B San Antonio, Texas 78285	x	-	-	-	-	-
Mr. Robert R. Weaver Executive Director Coastal Bend Council of Governments International Airport Corpus Christi, Texas 78410	x	-	-	-	-	-
Colonel MacDonald D. Weinert Manager Edwards Underground Water District 2603 Tower Life Building San Antonio, Texas 78205	x	x	x	-	x	-
Colonel Walter J. Wells General Manager Brazos River Authority P. O. Drawer 7555 Waco, Texas 76710	x	x	x	-	x	-
Mr. John W. White Executive Director Nueces River Authority Box 349 Uvalde, Texas 78801	x	x	x	x	x	x

1975 NATIONAL WATER ASSESSMENT, PUBLIC PARTICIPANTS - continued

PUBLIC PARTICIPANTS	Activity I Draft Sent	Activity I Draft Responded	Activity II Draft Sent	Activity II Draft Responded	Activity IV Draft Sent	Activity IV Draft Responded
Mr. J. A. Willhelm, Manager Galveston Company Water Authority P. O. Box 1651 Texas City, Texas 77590	x	-	-	-	-	-
Mr. Wes Wise Mayor Main & Harwood Streets Dallas, Texas 75201	x	-	-	-	-	-
Mr. J. T. Woodson President Farm Bureau, Texas P. O. Box 489 Waco, Texas 76703	x	-	-	-	-	-
Mr. Whitlock Zander Executive Secretary Upper Guadalupe River Authority P. O. Box 1278 Kerrville, Texas 78028	x	-	-	-	-	-

COMMENTS AND SUGGESTIONS RECEIVED FROM PUBLIC PARTICIPANTS ON THE DRAFT "SPECIFIC PROBLEM ANALYSIS SUMMARY REPORT," (ACTIVITY IV)

I. Letter from the regional sponsor requesting comments.

II. Review comments received by the regional sponsor.

A. Alamo Area Council of Governments

B. Dallas Water Utilities

C. League of Women Voters

D. North Central Texas Council of Governments

E. Nueces River Authority

F. Texas Farm Bureau

G. Texoma Regional Planning Commission

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

TEXAS WATER DEVELOPMENT BOARD
A. L. Black, Chairman
Robert B. Gilmore, Vice Chairman
Milton T. Potts
John H. Garrett
George W. McCleskey
Glen E. Roney

Charles E. Nemir
Executive Director, Acting

TEXAS WATER COMMISSION
Joe D. Carter, Chairman
Dorsey B. Hardeman
Joe R. Carroll

A copy of the final draft document to the U. S. Water Resources Council concerning the 1975 National Water Assessment is enclosed for your review and comment. The enclosed report, "The Specific Problem Analysis Summary Report" is the fourth and final report pertaining to the Specific Problem Analysis phase of the Assessment. This report contains a summary of assessment activities; conclusions and recommendations regarding resolution of problems; a comparison of water requirements and supplies developed by the States with those developed by Federal agencies; a discussion of severe water problems; the broad implications of not solving the problems, and; Regional views of National issues.

It it not necessary that each reviewer give "The Specific Problem Analysis Summary Report" a detailed review since the report contains independent sections which pertain to specific problems and areas of the Texas Gulf Region. Each reviewer could concentrate attention upon the specific area(s) and problem(s) relevant to that reviewer's area. However, please feel free to comment on any or all aspects of the report. If you wish to provide comments concerning the draft document, please provide them by September 30, 1977 so that we can meet our deadline to the U. S. Water Resources Council.

Your comments enable us to provide the U. S. Water Resources Council with assessment documents which more accurately reflect the views within the Texas Gulf Region.

P.O. Box 13087 Capitol Station • Austin, Texas 78711 • Area Code 512/475-3187

If you have any questions concerning the enclosed material please call Dr. Herbert W. Grubb at Area Code 512/475-3821 or Arthur Simkins at Area Code 512/475-3787.

Sincerely,

Charles E. Nemir

Enclosure

aacog alamo area council of governments

October 6, 1977

Mr. Charles E. Nemir
Executive Director, Acting
Texas Department of Water
Resources
P. O. Box 13087, Capitol Station
Austin, Texas 78711

RE: Final Draft of the 1975 National Water Assessment -
"The Specific Program Analysis Summary Report"

Dear Mr. ~~Nemir~~ Chuck:

The Alamo Area Council of Governments (AACOG) would like to thank you for the opportunity to review the final draft of the above referenced report. Our staff review finds the document to be acceptable on all portions of the report dealing with the AACOG region. We have no specific comments to make nor do we have any objections to the narrative.

Again, the opportunity to review the document is appreciated. If we can be of any further assistance, now or in the future, let me know.

Regionally yours,

Al J. Notzon, III
Executive Director

AJN/DET/ip

three americas building san antonio, texas 78205 phone (512) 225-5201

dallas water utilities
500 S. Ervay • Dallas, Texas 75277 • (214) 748-9711

September 23, 1977

Mr. Charles E. Nemir
Executive Director, Acting
Texas Department of Water Resources
1700 N. Congress Avenue
Austin, Texas 78711

Dear Mr. Nemir:

In response to your letter of September 15, 1977, requesting comments on the 1975 National Water Assessment reports, "The Specific Problem Analysis Summary Report" and the "Texas Gulf Regional Report", we have confined our remarks to two specific issues: (1) Re-use as it relates to the Objectives of the 1975 Assessment and (2) Water Supply Problems in the Upper Trinity River Basin of Texas (Problem Identification Number 2).

Re-Use: The section on the Objectives of the 1975 Assessment dealing with the identification of water resource problems failed to address the subject of re-use or re-cycling - a very important aspect of water supply and water quality that will confront the state in future years. We believe that recycling of water, together with the inherent technical and legal problems, should be addressed in this assessment. Recycling includes:

(1) The return by a municipality of its treated sewage effluent to a water supply reservoir where it is diluted with fresh water and re-used in the municipal system.

(2) The situation where City A sells raw water to City B on the condition that City B return its treated effluent to City A's watershed and not divert it to another watershed.

(3) The situation where a city wants to sell its effluent for industrial or irrigation purposes.

In other words, the term "recycling" should be construed to include all types of water re-use.

There are two principal forces at work which are bringing about a tremendous interest in the re-use of water. These are: (1) Escalating costs of water, and (2) environmental restrictions imposed on reservoir construction by water quality control authorities. Reservoirs now cost up to 10 times the cost of similar reservoirs just 10 years ago. Furthermore, transmission distances and costs are increasing. The demand for "Mitigation Land" can increase land costs for reservoirs beyond the point of economic feasibility.

The second force which provides incentive for re-use is the state and federal system of environmental controls. As the United States Environmental Protection Agency and the Texas Department of Water Resources move toward more stringent regulations as to wastewater discharge, in many cases, treated effluents will become too valuable to throw away. Moreover, in many situations involving industrial use, closed systems and recycling are, or soon will be, mandatory under EPA standards.

As re-use comes more to the forefront, certain questions will have to be addressed:

(1) What is the legal position of a city, or an industry, which sets about to effect the re-use of the waste water which it had previously abandoned to the stream as return flows, and what are the legal consequences when it deprives downstream users of the flows on which they previously depended?

(2) How does re-use affect riparian rights?

(3) For those cities who use ground water as their principal service of supply, do they have full freedom to re-use sewage effluent and to change the place and purpose of use as long as it does not discharge the effluent into a stream?

Water Supply Problems - Upper Trinity River Basin - Texas (Problem Identification Number 2): While we generally agree with the overall conclusions drawn in this section concerning the problems and their recommended remedies, there appear to be several minor errors in fact which should be corrected. These are:

(1) The additional pumping and conveyance facilities from Lake Tawakoni to Dallas will be used to supply an additional 58,000 acre-feet of water annually, not an additional 184,500 acre-feet annually as now stated.

(2) The report incorrectly states that the Aubrey Reservoir project will provide additional flood control. During the planning stages, the Corps of Engineers determined that the degree of flood protection currently provided by Lake Lewisville is adequate and need not be increased. Accordingly, the Aubrey Lake project has been planned to provide, in combination with the existing Lake Lewisville, the same degree of flood protection as currently exists. The flood control storage in Lake Lewisville will be reduced to an amount adequate to regulate the flood runoff originating on the drainage area between Lake Lewisville and the Aubrey Lake site. Flood control storage sufficient to control the drainage area above Aubrey Lake will be provided in that project. No net change in the current flood control capacity on the Elm Fork watershed will result from these actions.

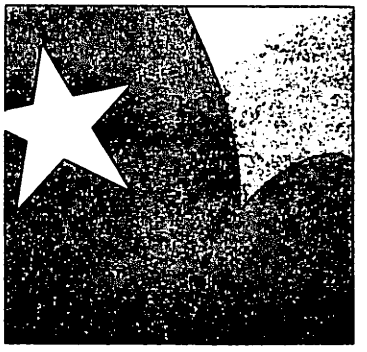
(3) No mention is made of the proposed raw water transmission line from Lake Palestine to Dallas which is scheduled for construction prior to the year 2000. For completeness, this should be included.

The opportunity to review and comment on these reports is appreciated. If you have any questions or require additional information, please let me know.

Sincerely,

I. M. Rice
Director

IMR:RBM:mjm



League of Women Voters of Texas • Betty Anderson, President
1212 Guadalupe Suite 109 • Austin, Texas 78701 • Tel. 512/472-1100

October 10, 1977

Mr. Charles E. Nemir
Texas Department of Water Resources
P.O. Box 13087
Austin, Texas 78711

Dear Mr. Nemir:

Thank you for the opportunity to review the Specific Problem Analysis Report: Texas Gulf Region, prepared by the Texas Water Development Board for the U.S. Water Resources Council.

Our comments on the report are enclosed.

Sincerely,

Betty Anderson

Betty Anderson, President

Catherine Perrine

Catherine Perrine, Water Director

cc - U.S. Water Resources Council
Dr. Herbert W. Grubb

LEAGUE OF WOMEN VOTERS OF TEXAS October, 1977

Comments on SPECIFIC PROBLEM ANALYSIS SUMMARY REPORT: TEXAS GULF REGION
Prepared by the Texas Water Development Board for the U.S. Water Resources Council

SOCIAL, ECONOMIC AND ENVIRONMENTAL GOALS:

We agree that clear statements of goals and policies for water resources development are necessary at both the State and Federal levels. As we have previously recommended, formulation of goals and policies--with the widest possible citizen participation--should be the first step in revising the 1968 Texas Water Plan.

Two of the goals included in the policy statement of the Governor's Water Task Force are, we believe, especially pertinent to the problems analyzed in this Report:

E. To give balanced consideration to environmental, economic and social requirements in striving to meet the water needs of the people of Texas. Recognizing that long-range water supplies will undoubtedly be limited, choices between potential demands for water will have to be made which will serve the overall interests of the people of Texas.

F. To assure the most effective means of developing and conserving the ground water resources of Texas. Development and use of the total water resources of the State in the best interest of the people of Texas requires management of ground and surface waters as integrated resources. . . .

SOCIO-ECONOMIC CHARACTERISTICS:

We note with interest the considerable differences between the MCC (national) and SRF (regional) projections of future population growth. These differences indicate the complexity and uncertainty of anticipating future population patterns and point to the need for flexibility in water resources planning. Long-range planning should anticipate a range of conditions so that implementation can meet actual needs in a timely way, without unnecessary costs for projects which may prove to be premature or unnecessary.

We also note the very wide discrepancies between the MCC and SRF projections for acres of irrigated farmland. The MCC projection shows a decrease from the 1975 estimate of 5,297 acres to 2,740 acres in the year 2000, while the SRF projection shows an increase to 8,129 acres.

We are interested in learning what information was used by the Texas Department of Water Resources in making the SRF projections. At the 1976 Water for Texas Conference, Dr. Earl Heady, who directs the MCC modeling program at Iowa State University, gave a rather general explanation of the factors considered in their analyses. These analyses indicate that supply of major agricultural products will be in excess of domestic and foreign demands through the year 2000, and that "to develop more irrigation would aggravate the supply and price situation."

VOLUMETRIC REQUIREMENTS:

We are disturbed by SRF projections showing even greater increases in consumptive water uses than in population:

Year 2000:	Population	156% of 1975 population
Year 2000:	Consumptive Water Use	
	Domestic	244% of 1975 use
	Manufacturing	277% of 1975 use
	Steam Electric	506% of 1975 use

Has sufficient consideration been given to opportunities for conservation in these major water uses?

WATER SUPPLIES:

The tabulations on this basic subject are, as stated on page 33, neither valid nor realistic for a Region that relies chiefly on ground water and impoundments, rather than river flow, for its water supply. We agree with the recommendations that Texas Water Development Board data be used for water supply estimates, and that separate analyses be made of upstream and downstream segments of the larger river basins.

In addition to the information included in the Continuing Water Resources Planning and Development draft, tabulations of present (1974 or 1975) basin water supplies and reservoir yields should be included.

SPECIFIC PROBLEMS:

Water Quality Problems - Beaumont-Port Arthur, Dallas-Fort Worth, and Houston Metropolitan Areas (Numbers 1, 3, and 5)

We agree that the areawide water quality management plans being developed through the "208" program are the proper mechanism for addressing these problems. We urge that recommendations be added for continued State and Federal support of "208" planning, and for implementation of the plans when these are completed.

Control of pollution from non-point sources will be difficult to achieve, as there are few proven techniques available. Further improvement in point-source effluents will also require innovative, and often expensive, processes.

Though considerable progress is being made in reducing point-source pollution, the State Water Quality Inventory indicates that six river segments in these three Metropolitan Areas will not attain the 1983 water quality goal, even assuming continued Federal assistance for municipal wastewater treatment and continued industrial cooperation.

We suggest that these problems be classified in Category II: problems for which solutions are not yet forthcoming.

Water Supply Problems - Upper Trinity River Basin (Number 2)

Cities in the Upper Trinity Area have planned far ahead to meet their water needs. They now have a firm supply of 1,030,000 acre-feet per year--far in excess of present municipal and manufacturing requirements of 592,000 acre-feet.

Lakeview Reservoir is now under construction, design has been completed for the Aubrey and Cooper projects, and the Richland Reservoir is currently being designed. With completion of these reservoirs, the cities' firm supply will be 1,440,300 acre-feet per year--161,900 acre-feet in excess of the projected demand for the year 2000 of 1,278,400 acre-feet. [2]

This demand estimate is based on a projected population of 4,564,600--a higher population figure than the North Central Texas Council of Government's current projection of 4,048,970. And the demand estimate assumes a 57% increase in per capita municipal use over the 1974-2000 period. In view of the rising percentages of apartment residents (who have no yards to water), escalating water prices, and the potential for conservation in domestic water use, the projected per capita increase seems unlikely. Water supply for this area does not appear to us to be a serious problem for the year 2000.

We are, however, concerned that depletion of the area's aquifers continues. Large users to whom surface water is readily available choose, because of lower costs, to pump ground water. Though the amount of ground water which underlies the area is small in comparison to the Basin's total needs, it is of importance to residents of small towns and rural areas, for whom conversion to surface water will create hardships. And, in the long-term future, even small amounts of available water may be important.

Land Subsidence in the Houston-Galveston Area (Number 4)

We agree that there is an urgent need to complete conveyance, treatment, and distribution facilities which will enable the City of Houston and other major water users to shift to surface water supplies.

However, we see no need for further reservoir construction to serve the Houston-Galveston area. Current surface water supplies are more than adequate to permit reduction of ground water use to safe levels and meet projected water needs, with a surplus of 380,000 acre-feet per year in the Lower Trinity in the year 2000.[3]

Ground Water Availability and Quality Problems in the Carrizo Aquifer, Winter Garden Area (Number 8)

Ground water management in this area is obviously needed; however, the Report does not identify a source of surface water for potential conjunctive use. This appears to us to be a Category II problem.

Ground Water Quality Problems - Haskell and Jones Counties (Number 6)

No proposed solution for these problems is included in the "Conclusions and Recommendations."

Regional Ground and Surface Water Management Problems Associated with the Edwards Aquifer (Number 9)

We strongly support the concept of aquifer-wide management recommended for this area. The related issue of protecting water quality should be addresssed in the management plan. Financial, legal, and institutional arrangements to implement proposed solutions may be the most difficult issues.

We suggest that the Texas Department of Water Resources take the lead in the resolution of the problems of this unique resource. Because the problems affect so many governmental entities encompassing various combinations of land ownership and water use, a regional approach to planning and management will be needed.

The cities, river authorities, irrigation farmers, and environmentalists look at the aquifer from different perspectives. The Department can provide factual information about the region's water resources and problems from an impartial perspective. And the Department can provide a forum for public consideration of alternative possibilities for solving areawide problems.

We would classify the Edwards Aquifer problems in Category II, as no plan for resolving them has been proposed or agreed on.

Problems Associated with the Freshwater Inflows to Texas Bays and Estuaries (Number 15)

We are alarmed by the Future Modified Flows projected for the year 2000 (pp. 60-71). Especially shocking are the "95% Probability" tables showing that under drouth conditions every major river west of the Neches will have a negative flow--that is, be dry--as it approaches the Gulf. A negative flow is projected for the Colorado in the year 2000 even under "mean" conditions--that is, it will be dry more than half the time.

Past drouths have been damaging to the estuaries. It appears that future ones could be fatal!

The principal factors contributing to the problem seem to be: more water use, more reliance on surface water as ground water supplies are depleted, and more evaporation from more reservoirs. (In the Brazos and Colorado basins, present evaporation is double present consumptive water use--excluding irrigation. Amazing!)

Obviously, these same factors will cause diminished flows upstream. We suggest that this problem be broadened to include "problems associated with instream flows" or that a separate problem on this topic be added.

Flood Problems and Hurricanes (Number 17)

We applaud the emphasis given in the "Conclusions and Recommendations" to prevention of flood problems through appropriate use of flood hazard areas. We should like to see additional recommendations for increased information to the public concerning flood hazards, and for more State and Federal assistance to local governments in developing flood plain management programs. As you know, both the State and Federal agencies charged with this responsibility have minimum staffs assigned to flood plain management.

Groundwater Depletion Problems in the Texas High Plains (Number 18)

We believe that the "Conclusions and Recommendations" should include State and Federal incentives that could be offered to encourage more efficient use of the groundwater and to reduce irrigated acreage when crop surpluses exist.

FOOTNOTES:

1. Earl O. Heady, "U.S. Supply Situation for Food and Fiber and the Role of Irrigated Agriculture," Proceedings of the TAMU Water for Texas Conference, March 25-25, 1976, page 23.

2. Phase I Draft, Continuing Water Resources Planning and Development for Texas, pages IV-271 to IV-275.

3. Ibid., Pages IV-295 to IV-299.

North Central Texas Council of Governments

P. O. Drawer COG Arlington, Texas 76011

October 28, 1977

Charles E. Nemir
Acting Executive Director
Texas Department of Water Resources
1700 N. Congress Ave.
Austin, Texas 78711

RE: 7-10-04011, Received September 16,1977
1975 National Assessment of Water and Related Land Resources - Specific Problem Analysis Summary Report

Dear Mr. Nemir:

Your 1975 National Assessment of Water and Related Land Resources - Specific Problem Analysis Summary Report has been reviewed by the North Central Texas Council of Governments. This review included consideration of potentially affected local governments for possible project notification. No potentially affected local governments were identified under NCTCOG's Local Significance Criteria.

In addition, the project was reviewed for appropriate areawide concerns. This review process included consideration by appropriate NCTCOG planning staff, by the Government Applications Review Committee on October 5, 1977, and by the NCTCOG Executive Board on October 28, 1977. On the basis of the review process, the Board adopted the following areawide position.

> The NCTCOG Review Process has disclosed no conflict with the review criteria of areawide comprehensive planning as outlined in OMB Circular A-95 (revised). It is noted that the Plan adequately addresses the recommendations contained in the North Central Texas Regional Water Supply Study adopted by NCTCOG.

We sincerely thank you and your staff for your kind cooperation in this matter, and if we can be of further service or assistance, please feel free to call upon us.

Sincerely,

William J. Pitstick
Executive Director

WJP:sw

cc: Adlene Harrison, Regional Administrator, Environmental Protection Agency, Dallas
Eve Leslie, 208 Project Officer, Environmental Protection Agency, Dallas
Gary Cobb, Acting Director, Water Resources Council, Washington, D. C.

360 Place 1201 N. Watson Rd.(Hwy. 360) Dallas/Fort Worth (817) 640-3300

NUECES RIVER AUTHORITY

300 East Main Street
P. O. Box 349 Phone 512 278-6810
Uvalde, Texas, 78801

September 19, 1977

JOHN W. WHITE
EXECUTIVE DIRECTOR
UVALDE, TEXAS

Mr. Charles E. Nemir
Executive Director
Texas Department of Water Resources
P. O. Box 13087 Capitol Station
Austin, Texas 78711

Dear Mr. Nemir:

This is in response to your letter of September 15, 1977 addressed to Mr. John Graves, past president of the Nueces River Authority and your September 15 letter to me in regard to "the final draft document to the U. S. Water Resources Council concerning the 1975 National Water Assessment. The Texas Water Development Board is to be complimented for the excellence of their "Specific Problem Analysis Summary Report 1975 National Assessment of Water and Related Land Resources.

The comments of the Nueces River Authority are restricted to the following Problem Identification Numbers.

Problem Number 8 - Groundwater availability and Quality Problems in the Carrizo Aquifer, Winter Garden Area.

Problem Number 9 - Regional Ground and Surface Water Management Problems Associated with the Edward's (Balcones Fault Zone) Aquifer.

Problem Number 11 - Water Supply Problems in the Corpus Christi Metropolitan Area.

With regard to Problem Identification Number 8, Conclusions and Recommendations page 16, it is stated that, "The only solution for the ground-water depletion problems of the Carrizo Aquifer lies in reduced ground-water withdrawals through conjunctive use of the aquifers 'safe' yield and import of surface water from areas with surplus water supplies."

The Nueces River Authority does not agree with the conclusion that the only solution lies in the import of surface water from other areas. Several studies, including the Nueces River Authority Master Plan developed in 1958, and the Report of the U. S. Study Commission of 1962 recommended that reservoirs up stream from Crystal City and at Cotulla on the Nueces River be developed as a supply of surface water for ~~the~~ Winter garden area.

On page IV-712 of Volume 2, TWQB continuing Water Resources Planning and Development For Texas of May, 1977 it is stated that "The potential Cotulla Reservoir project in La Salle County might assist in meeting some of these demands and in redistributing additional developable supplies within the basin."

In the discussion of Problem Number 11 on page 86 the Problem Analysis Summary Report states that "Present inadequacies of supplies to meet future demands is a result of inadequate storage capacity (surface impoundments) within the basin, since the basin yield could be significantly increased through additional impoundments."

It is therefore recommended that the conclusion to Problem Number 8 on page 16 be revised to indicate that the solution to the Carrizo Aquifer problem lies in the development of surface water resources in the Nueces basin and in the vicinity of Zavala and Dimmit Counties to be followed with importation of surface water from other areas as the need requires.

With regard to Problem Identification Number 9, the Nueces River Authority does not concur in limiting pumpage from the Edwards Aquifer to not in excess of 425,000 acre feet annually. In our response on September 6, 1977 to TWDB Continuing Water Resources Planning and Development for Texas dated May, 1977, we discussed this subject in considerable detail. A copy of this letter is enclosed herewith. We are still of the opinion that the question of pumpage limitation requires considerable more investigation. It is recommended therefore that a specific number of acre feet not be suggested at this time. Suffice it to say that the matter is under study. As we stated in our September 6 letter we object also to the implication that sustaining flow of San Marcos Springs overrides all other important uses of Edwards Aquifer Water. Your proposed Management program would limit pumping for irrigation so that the recreation and tourist trade in the San Marcos area can continued to flourish. We believe far more study regarding the social and economic impact of such a decision is required before it is adopted as a Management Plan or policy.

We have no comment with regard to Problem Identication Number 11 other than to agree with your conclusion that the Choke Canyon Reservoir operated in conjunction with Lake Corpus Christi will take care of the water requirements of Corpus Christi and the Coastal Bend area of Texas through the year 2000.

Sincerely,

John W. White
Executive Director

JWW/jk

TEXAS Farm BUREAU

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STATE OFFICE: P. O. BOX 489 ▪ Waco, Texas, 76703 ▪ 817 772-3030

September 29, 1977

Mr. Charles E. Nimir, Acting Executive Director
Texas Department of Water Resources
1700 North Congress Avenue
Austin, Texas 78701

Dear Mr. Nemir:

The Texas Farm Bureau does not have the facilities to review the technical data contained in the Texas Gulf Region Specific Problem Analysis Summary Report 1975 National Assessment of Water Related Land Resources. However, we have reviewed the document and find that there are conclusions that cannot be supported by the Texas Farm Bureau under present policy guidelines.

The most serious problem we face in the area of water development is keeping the programs within the State of Texas. It is unrealistic to believe that any broad national water management program would be successful.

In conclusion, we in the Texas Farm Bureau will watch these issues as they develop in the State Legislature, national Congress and administrative areas of the state and nation. I am attaching a statement presented to the Water Resource Council in Dallas, Texas on August 1, 1977, outlining the state's basic position with regard to water.

It is kind of you to present this information to us for review and we hope that these suggestions and policy statements will have some weight in developing programs that are workable.

Sincerely,

Carrol G. Chaloupka

Carrol G. Chaloupka
President

ck
Attch.

TEXAS FARM BUREAU

STATEMENT TO WATER RESOURCE COUNCIL

DALLAS, TEXAS

August 1, 1977

My name is William C. Wedemeyer, Research and Education Director of the Texas Farm Bureau. My job assignment also includes staff coordination of natural resources. Our organization is composed of 195,571 Texas families, organized in 210 independent, cooperating county Farm Bureaus. The Texas Farm Bureau also is a member of the American Farm Bureau Federation. All of these organizations work together by means of a "Cooperative Agreement."

The Texas Farm Bureau supports the American Farm Bureau Federation's position with regard to national water policy. Mr. Allan Grant, President of the American Farm Bureau Federation will present our views with regard to national policy on August 4 in Washington, D. C. The Texas Farm Bureau supports these policies as explained by President Grant.

Our statement today will be limited to an explanation of the Texas Farm Bureau's policy with regard to a national water policy. Texas Farm Bureau members have spent considerable time in discussing water policy at all levels and we are proud to share these policy decisions with the Water Resource Council. Our first consideration is the system of government supported by the Texas Farm Bureau. Our delegates' statement regarding this matter reads, in part, as follows: "...Our philosophy is founded on the belief in a supreme being which is the highest ideal of mankind. We believe in self-government and in limitations upon government power, but most especially, the moral obligations to preserve and protect freedom. We therefore, recommend that the basic philosophy of local, state and national Farm Bureaus be the guide in consideration of policy. We

admonish the voting delegates at the precinct, county, state and national levels to be cognizant of the recommendations of their parent organization and let these views be known without fear of reprisal." Our voting delegates have always interpreted the word "freedom" to mean the right to own and control property. If government removes from the individual the right to control property, that government has in effect, removed the right to own the property.

Our state organization has always been extremely interested in preserving and extending states' rights. The policy statement on this subject reads as follows: "We favor increased emphasis on the assumption of responsibility by states and local units of government for exercising their appropriate functions. Responsibility for performance of government functions should be assigned to that unit of government closest to the people, which can administer such functions effectively.

"Therefore, we urge the Texas Farm Bureau and the American Farm Bureau to exert all possible powers and influence to assert and maintain states' and local rights."

Attached is a copy of the organization's policy statements with regard to water. You are encouraged to review these carefully as they represent a great deal of sound thinking in the area of public water policy.

Our first and most important message to you is that the membership of the Texas Farm Bureau does not believe it to be a proper function for any government agency to develop public water policy. The activities of the various branches of the Executive branch of government must be limited to the administration of laws properly enacted by the United States Congress. If the Executive branch of government is permitted to participate in policy development, one of the

primary provisions of the national Constitution which separates the three branches of government; Legislative, Executive and Judicial, will have been effectively eliminated.

Texas Farm Bureau's specific policy relating to water policy provides that the State of Texas must be responsible for the development and control of its water resources. This means that what assistance the Federal government gives to the state must be in the form of grants. It is also a function of the Congress of the United States to authorize these grants without the direction of a national water policy. In other words, the basic responsibility for the development and control of Texas water resources must remain with the State of Texas. We in the Texas Farm Bureau trust you will use your influence and position to assist us in convincing Congress of these fundamental facts concerning water policy.

TEXAS FARM BUREAU WATER POLICY 1977

"We believe that any water plan for Texas must be equitable to all sections of the state, and that each water use area must have its full legal water requirements, present and future, provided for from its traditional supply before any water is diverted to a water deficient area. The plan must take into consideration future needs for water for agricultural uses, and must protect established rights of prior beneficial users of water as well as the riparian rights of landowners.

* * * *

"Future water planning and development should take into account broad geographic areas and needs, including equitable valuation of intangible benefits in benefit-cost analysis. Farm Bureau should be aware of such studies and represent the interests of farmers and ranchers in these fields.

"We strongly favor that water stored for irrigation, flood prevention, pollution control or any purposes, should be stored in adequate small upstream dams in preference to large downstream reservoirs where this is economically feasible and where fewer acres of fertile land will be flooded.

* * * *

"We recommend flood plan authorities use more realistic determination of flood areas.

* * * *

"We recommend reapportionment of the division of flood control money to allow more for maintenance of existing drainage structures and less for new construction, according to the needs of individual counties.

* * * *

"We recommend that farmers and ranchers from different areas of the state be represented on the Texas Water Development Board and the Rivers Authority Board.

* * * *

""We support the concept of importing water into Texas for domestic, municipal, agricultural, commercial and industrial purposes. We commend "Water Incorporated" for the educational work they are doing. We should be alert to see that agriculture receives its rightful priority of water use.

* * * *

"We favor supporting the effort of the Texas Land Owners Rights Association in their opposition to the Flood Disaster Protection Act of 1973.

* * * *

"It is urgent that we do everything possible to immediately stop oil producers in the State of Texas from using fresh water, either underground or surface, for secondary recovery of oil by water flooding.

* * * *

"The State of Texas must not relinquish its basic responsibility for the development and control of its water resources to the federal government.

* * * *

"We believe that adoption of the water rights Adjudication Act by the Texas Legislature is a step forward toward clarifying and establishing water rights in Texas. We will work to see that this law is administered fairly and equitably to users of water for agricultural purposes. We support the present statute allowing construction and use of stock tanks and ponds up to 200 acre feet capacity, and will oppose any attempt to curtail application of the law. There should be no restrictions on the use of these impoundments, and permits should not be required for their construction.

* * * *

"We oppose any legislation or action that would deprive or take away the rights of landowners to the use of water from streams adjacent to or on the property they own, regardless of the use of such rights in the past.

* * * *

"We oppose the increasing involvement and mounting authority by the Army Corps of Engineers or other government agencies.

* * * *

"The law forces water well drillers to disclose information often affecting the value of the property, if made public. Such information should normally be considered the property of the owner paying for it. Water well drillers should not be required to divulge such information, to the state or anyone else, without the consent of the person paying for the well.

* * * *

"We recommend that non-profit community water supply corporations be given the same consideration as municipalities under Article VIII, Section 1 of the Constitution of the State of Texas.

* * * *

"Underground water belongs by law to surface owners of the land. We will oppose any attempt to repeal, restrict or modify this law.

* * * *

"We oppose legislation or regulation by Federal or State Government to control the withdrawal of underground water for irrigation purposes.

* * * *

"We recommend that control and management of underground water be retained at the local level, and that efforts to place underground water under state control be opposed.

* * * *

"We commend the Texas Water Quality Board on progress toward control of water pollution in Texas. We urge the Board to continue and increase its efforts to:

1. Strictly enforce laws designed to prevent pollution of underground and surface waters.
2. Supervise exploratory underground drilling to protect known water supplies from pollution which might result from drilling at other depths.
3. Strictly enforce the law providing for plugging abandoned oil and gas wells.
4. Develop adequate regulations to control industrial pollution of water.

* * * *

"Texas Farm Bureau should continuously observe the actions of the Water Quality Board. Findings on those issues affecting agriculture should be reported to Farm Bureau members and to the general public. We should seek legislation, if necessary, to prevent abuse of the broad powers of the Water Quality Board.

* * * *

"We urge the Texas Water Quality Board to adopt the recommendations submitted to it by the Texas Farm Bureau Water Quality Study Committee.

* * * *

"Agriculture should be represented on the Texas Water Quality Board by a bonafied farmer or rancher.

* * * *

"We are for the Texas Railroad Commission requiring Oil Companies to plug abandoned wells properly in order to eliminate them as possible polluters of ground or surface water. We are against the Texas Railroad Commission holding the landowner responsible for plugging wells if the operator cannot be located.

* * * *

"We recommend stronger regulations or stricter enforcement of present law regarding the use of explosives which disturb or harm surrounding water wells and other property.

* * * *

"It is now the law that landowners must live within an irrigation or drainage district before they are eligible to vote in district elections. We recommend that the law be changed to read that landowners may live within the county or adjoining county.

"We support legislation that will provide for irrigation districts to be established for the purpose of irrigation and drainage only.

* * * *

"We should work to amend the law that established the Harris-Galveston subsidence district so as to exempt agriculture irrigation water from its jurisdiction.

* * * *

"State legislation should be enacted that will provide the research needed to develop a feasible system of filtering and drilling of recharge water wells in playa lakes or the High Plains."

(STATE & NATIONAL POLICIES OF THE TEXAS FARM BUREAU 1977, p. 23-26)

TEXOMA Regional Planning Commission

Council of Governments Cooke, Grayson & Fannin Counties

1000 Arnold Blvd. Denison, Texas 75020 *Telephone (214) 786-2955*

October 4, 1977

Mr. Charles E. Nemir
Executive Director
Texas Department of Water Resources
1700 North Congress Avenue
Austin, Texas 78701

Subject: Specific Problem Analysis Summary Report
1975 National Assessment of Water and
Related Land Resources

Dear Mr. Nemir:

This letter is in response to your letter dated September 30, 1977, concerning comments on the above-referenced report. Pages 11 and 12 of the referenced report recommend the Lake Aubrey Reservoir Project for the highest priority consideration in planning to meet the present and projected water needs of the Upper Trinity River Basin through the year 2000. We are enclosing a copy of the Texoma Regional Planning Commission resolution no. 496, expressing the Commission's concerns over the proposed Lake Aubrey project. These concerns have not been properly addressed and resolved by the Aubrey project and should therefore serve to reduce your priority recommendation of the project.

Sincerely,

Jerry W. Chapman

Jerry W. Chapman
Executive Director

JWC/cdm

Enclosure

RECEIVED
OCT 12 1977
DEPT. OF
WATER RESOURCES

RESOLUTION NO. 496

A RESOLUTION BY THE TEXOMA REGIONAL PLANNING COMMISSION RELATING TO THE FINAL SUPPLEMENT TO FINAL ENVIRONMENTAL STATEMENT AUBREY LAKE.

WHEREAS, the Corps of Engineers has forwarded the Final Supplement to the Final Environmental Statement Aubrey Lake to the Texoma Regional Planning Commission for review and comment; and

WHEREAS, the Supplement was reviewed and discussed by the Texoma Regional Planning Commission at a Full Commission meeting on November 20, 1975; and

WHEREAS, the Supplement reflects a requirement for upgrading sewer facilities within five miles of the proposed lake; and

WHEREAS, the primary purpose of the proposed lake is to provide water supply to the local sponsors of Lake Aubrey; now therefore

BE IT RESOLVED BY THE TEXOMA REGIONAL PLANNING COMMISSION:

Section I

THAT, it is hereby requested that the Corps of Engineers through contractual agreement with the local sponsors of Lake Aubrey, require the local sponsors to be responsible for restitution to the local communities incurring added liabilities and burdens as a result of the proposed lake as outlined in the following.

Section II

THAT, the local sponsors pay for all non-federal cost of upgrading community sewer facilities as required in the lake water shed.

AND IT IS SO ORDERED.

On motion of Mayor Glenn Loch, seconded by Mayor Jerdy Gary, the foregoing Resolution was passed and approved on this the 20th day of November, 1975, by the following vote:

AYE: Unanimously
NAY:

At Full Commission Meeting of the Texoma Regional Planning Commission, November 20, 1975.

President
Texoma Regional Planning Commission

Secretary-Treasurer

COMMENTS AND SUGGESTIONS RECEIVED FROM MEMBERS OF THE TEXAS GULF COORDINATING COMMITTEE CONCERNING THE DRAFT "SPECIFIC PROBLEM ANALYSIS SUMMARY REPORT" (ACTIVITY IV)

I. Letter from committee chairman requesting comments

II. Review comments received

A. Department of the Army

B. Federal Power Commission

C. Louisiana Department of Transportation and Development

D. Texas Parks and Wildlife Department

E. United States Department of Commerce

TEXAS DEPARTMENT OF WATER RESOURCES
1700 N. Congress Avenue
Austin, Texas

TEXAS WATER DEVELOPMENT BOARD
A. L. Black, Chairman
Robert B. Gilmore, Vice Chairman
Milton T. Potts
John H. Garrett
George W. McCleskey
Glen E. Roney

Charles E. Nemir
Executive Director, Acting

TEXAS WATER COMMISSION
Joe D. Carter, Chairman
Dorsey B. Hardeman
Joe R. Carroll

A copy of the final draft document to the U. S. Water Resources Council concerning the 1975 National Water Assessment is enclosed for your review and comment. "The Specific Problem Analysis Summary Report" is the fourth and final report pertaining to the Specific Problem Analysis phase of the Assessment. This report contains a summary of assessment activities; conclusions and recommendations regarding resolution of problems; a comparison of water requirements and supplies developed by the States with those developed by Federal agencies; a discussion of severe water problems; the broad implications of not solving the problems, and; regional views of National issues.

If you wish to provide comments concerning the draft document, please provide them by September 30, 1977 so that we can meet our deadline to the U. S. Water Resources Council.

Your comments enable us to provide the U. S. Water Resources Council with assessment documents which more accurately reflect the views within the Texas Gulf Region.

If you have any questions concerning the enclosed material please call.

Sincerely,

Arthur Simkins

Enclosure

P.O. Box 13087 Capitol Station • Austin, Texas 78711 • Area Code 512/475-3187

DEPARTMENT OF THE ARMY
SOUTHWESTERN DIVISION, CORPS OF ENGINEERS
MAIN TOWER BUILDING, 1200 MAIN STREET
DALLAS, TEXAS 75202

SWDPL-P

OCTOBER 1977

Mr. Arthur Simkins
Regional Study Director
Texas Water Development Board
PO Box 13087
Capitol Station
Austin, Texas 78711

Dear Mr. Simkins:

The draft document entitled "Specific Problem Analysis Summary Report" concerning the 1975 National Water Assessment has been reviewed by this office. The report reflects the Corps of Engineers views on water and related land resource problems and issues in the Texas Gulf Region.

Section V of the draft report contains implications of not solving severe water and related problems. We note that Category I problems, or those which are being adequately addressed by ongoing studies, are included in discussions in this section along with discussions of unresolved problems. We recommend that you give consideration to limiting this section of the report to discussions of unresolved problems, or those referred to as Category II, in order that proper emphasis be given to needed actions relative to those unresolved problems. We appreciate the opportunity to review this draft report.

Sincerely yours,

Barry G. Rought

BARRY G. ROUGHT, P.E.
Chief, Planning Division

FEDERAL POWER COMMISSION
REGIONAL OFFICE
819 Taylor Street, Room 9A05
Fort Worth, Texas 76102

September 30, 1977

In reply refer to:
PWR-FW

Mr. Arthur Simkins
Texas Water Development Board
P. O. Box 13087, Capitol Station
Austin, Texas 78711

Dear Mr. Simkins:

Receipt is acknowledged of your letter dated September 14, 1977 which transmitted one copy of the final draft report, "Specific Problem Analysis Summary Report" for the Texas Gulf Region for inclusion in the 1975 National Water Assessment. The report has been reviewed with particular emphasis on those sections related to electrical power, and on discussions relative to Toledo Bend Dam and Reservoir which operates under FPC License No. 2305.

Discussions of the possibility of providing a re-regulating dam below Toledo Bend at the Bon Weir site and on continuing problems of shoreline erosion at Toledo Bend are adequate for purposes of the final draft report. This office has previously investigated the hydroelectric power potential at the Bon Weir site, and considering the favorable economic climate which prevails today, hydroelectric power may prove feasible at Bon Weir. Consideration must be given in such a study to power losses at Toledo Bend due to tailwater encroachment by Bon Weir Reservoir. Shoreline erosion due to wave action at Toledo Bend Reservoir is a significant problem, and is the subject of continuing observation and investigation by the Sabine River Authorities of Texas and Louisiana. To our knowledge, no remedial plan of action has been initiated.

We note discussions in the draft report, beginning on page 31, relative to the differences between the MCC and SRF projections and agree in general with the explanations for the wide variances. As a matter of record, however, the MCC estimates submitted by FPC for "Electric Power and Water Uses" were based on the best information and judgement available from the electric power industry and other entities as to future load growth, type and location of generation, and type of cooling. In this regard, we have recently received copies of revised MCC estimates of electric power generation and cooling water use which will appear in the Final 1975 National Assessment Report. Although these data differ only slightly from that shown in your draft report, a tabulation of this revised material for WRC Region 12 is attached for use in your final report should you so desire.

Also errors were noted on Table 1, page 37, regarding SRF electric energy production for ASA 1203. It appears that values for fresh water withdrawals in MGD were inadvertently substituted for electric energy production in GWH on this table for SRF 1975, SRF 1985 and SRF 2000. Correction of this table necessitates correction of Table 1, page 34, which totals electric energy production for all of Region 12.

The opportunity to review and comment on this report is appreciated.

Sincerely yours,

Lenard B. Young
Regional Engineer

Attachment

MCC STEAM-ELECTRIC POWER GENERATION AND
COOLING WATER REQUIREMENTS
WRC REGION 12

(Revised as of June 1977)

ASA	Electric Power Generation (GWH)	Fresh Water for Power Withdrawals (MGD)	Fresh Water for Power Consumption (MGD)
		1975	
1201	16,335	13	8
1202	61,994	63	38
1203	17,484	39	23
1204	14,432	532	17
1205	13,749	77	13
Region	123,994	724	99
		1985	
1201	38,322	52	33
1202	90,660	111	69
1203	86,298	168	107
1204	33,699	553	37
1205	25,700	116	24
Region	274,679	1,000	270
		2000	
1201	188,105	500	331
1202	139,950	838	190
1203	189,472	309	201
1204	213,569	492	245
1205	93,420	123	27
Region	824,516	2,262	994

State of Louisiana
Department of Transportation and Development

EDWIN EDWARDS
GOVERNOR

GEORGE A. FISCHER
SECRETARY

Office of Public Works
P. O. Box 44155 Capitol Station Baton Rouge, Louisiana 70804

October 6, 1977

Mr. Arthur Simkins, Coordinator
National Water Assessment
Texas Gulf Region
Texas Department of Water Resources
P. O. Box 13087, Capitol Station
Austin, Texas 78711

Dear Mr. Simkins:

I wish to acknowledge our telephone conversation of September 29, 1977, and the extension of time which you granted for Louisiana to submit its comments on the specific problem and analysis summary report for the Texas Gulf Region. Those comments are attached where we are submitting a re-draft of Problem Identification No. 12 which begins on Page 18 and later on Page 87; and also for Problem Identification No. 19 which begins on Page 23 and later on Page 92. Please substitute these re-drafts in place of the information contained in the summary report.

By copy of this letter, I am providing the Sabine River Authority of Texas a copy of the re-drafted portions for their review. We have already undertaken verbal discussions of these re-drafted portions with these gentlemen from Texas, the counterpart of the Sabine River Authority of Louisiana.

If you wish to contact me regarding this submittal, you may telephone me at (504) 389-5928. Thank you for your generous reception and assistance provided.

Sincerely yours,

Gerald R Dyson

GERALD R. DYSON
Program Administrator

GRD/cjh

Enclosure

cc: Mr. Sam Collins

Texas Gulf Region

Specific Problem Analysis Summary Report

1975 National Assessment of

Water and Related Land Resources

Re-draft of: Pollution, Recreation, Flooding, and Saltwater Intrusion Problems--Louisiana (Problem Identification No. 12), Pages 18-19

Varying sources of pollution of Toledo Bend Reservoir water is known to exist and no critical problems are noted nor are they expected in the near future. The sources of pollution include subdivision and residential development, effluents of towns and industries, runoff from timber and agricultural operations in the nearby vicinity and other similar incidents. These activities are under the surveillance and permit supervision of the Sabine River Authority of Louisiana and/or the Louisiana Health and Human Resources Administration (The State Board of Health Office). Such activities will continue to be under surveillance and actions are intended to be taken to control these varying situations.

Access to recreational areas on Toledo Bend Reservoir and the Sabine River downstream is limited. However, regarding Toledo Bend Reservoir, a scenic highway is under construction extending from the Town of Logansport, Louisiana, to Leesville, Louisiana, including a total of 95.6 miles. At this time, approximately 25 miles have been completed and two additional reaches comprising a total of 12 miles will be under construction by November, 1977. An overall completion date is not available at this time.

Flooding of areas along the lower Sabine River area are being reported with greater regularity than in the past. Very likely, the cause for increased flooding reports stems from additional areas being placed into productive development where these particular areas have low elevations and have very likely been subject to flooding historically and since not being in commercial use such inundations were not important enough to consistently observe and report. It is noted that the U. S. Army Corps of Engineers, Ft. Worth and Galveston Districts, are undertaking a study of the lower Sabine River. Although the study is multi-purpose, one of the features of the study will be to examine flooding problems and investigate preventive measures.

Saltwater intrusion in the lower Sabine River has always been a fact and has resulted in problems from time to time which have normally resulted from tides, river stages, and other natural phenomena. The topic of saltwater intrusion will be addressed in the Corps of Engineers' study mentioned in the preceding paragraph.

Flooding in DeSoto and Sabine Parishes, Louisiana during periods of extreme rainfall results in some damage, primarily to agricultural operations in the area. Most resultant damages occur in areas not considered feasible for structural remedies; therefore, non-structural measures appear to be the logical consideration for treatment. However, two areas are considered feasible for structural remedies, which are the Upper Bayou LaNana and Little San Miguel Watersheds.

Generally, surface and groundwater supplies in Southwest Louisiana, primarily Calcasieu Parish, are inadequate. The Sabine River is a logical source of freshwater supply and a project for diversion of Sabine River water to the vicinity of Lake Charles is now nearing completion. Waters delivered through this project will help to alleviate some of the existing problems. Such water supplies are intended to be utilized for industrial, agricultural, and possibly some domestic uses.

Shoreline erosion problems exist on the Louisiana shoreline of Toledo Bend Reservoir. These problems are under observation and surveillance of the Sabine River Authority of Louisiana and no serious impact on the economy of the general area is expected. There are no other implications known in relation to the economy and well-being of other areas of the State, region, or ASA.

WATER SUPPLY PROBLEMS -- LOUISIANA (PROBLEM IDENTIFICATION NO. 19) -- Pages 23, 24 and 25

Water supply needs exist generally in DeSoto, Sabine, and Calcasieu Parishes, Louisiana, immediately adjacent to the Sabine River and Toledo Bend Reservoir. Additionally, water supply problems are expected to prevail in Vernon, Beauregard, and Cameron Parishes with respect to the Sabine River Basin.

At the present time, withdrawals from Toledo Bend Reservoir are being made for water supplies to subdivisions, individual residential locations, recreation areas, and commercial operators. The Town of Logansport, DeSoto Parish, obtains its water supply from Toledo Bend Reservoir. Presently, a pipeline and pumping station system are under construction to deliver water to the Town of Many, Sabine Parish, from the Reservoir. The Town of Mansfield, DeSoto Parish, has approved a plan to obtain its city water supply from Toledo Bend Reservoir. Other communities and developments are now looking forward to ultimately relying on Toledo Bend Reservoir for their water supply. Projected water requirements for the Sabine River Basin, Louisiana, and all of the State of Louisiana are being determined in a State-wide water resources study now in progress by the Department of Transportation and Development, Office of Public Works.

A water supply problem does exist in Calcasieu Parish. In order to provide for some of this need, construction is now nearing completion of the Sabine River Diversion Project which will provide supplemental water supplies from Sabine River to Calcasieu Parish and its Lake Charles vicinity. The Diversion Project does not provide the final answer and capacity to satisfy future requirements for industrial, agricultural, and domestic interests. That poses a future problem that cannot be satisfied by the Sabine River Diversion Project in the future. Supplemental water supplies to this area will be one of the objectives of the State-wide water resources study.

It may be generally reported, however, that at the present time there are no extremely serious, critical water supply problems in the Sabine River Basin of Louisiana with the exception of those portions of Cameron and Calcasieu Parishes under the influence of saltwater intrusions from the Gulf of Mexico.

Pollution, Recreation, Flooding, and Saltwater Intrusion Problems in Louisiana (Problem Identification No. 12), Page 87

This problem area involves the Sabine River Basin portions of DeSoto and Sabine Parishes adjacent to Toledo Bend Reservoir and secondly, of Vernon, Beauregard, Calcasieu, and Cameron Parishes below Toledo Bend Reservoir. Problems include surface water pollution, limited access to recreational facilities, flooding, and the potential of saltwater intrusion in the coastal zone.

Pollution in Toledo Bend Reservoir stems from subdivision and residential development nearby, some affluent from towns and industries on tributory streams, and some forestry and agricultural operations. These problems of pollution are under the surveillance and observation of the Sabine River Authority of Louisiana and the Louisiana Health and Human Resources Administration (the State Board of Health Office) and are not expected to reach any critical or serious proportions.

Limited access to recreation areas is identified as a problem since the resultant is a lack of economic activity. If adequate access to the recreation areas were provided, the number of visitors and users of Toledo Bend Reservoir and its fringe area for boating, camping, picnicking, swimming, skiing, and other water-related activities would be increased significantly. This problem will be relieved somewhat by the ultimate completion of the Toledo Bend Forest Scenic Highway extending from Logansport to Leesville, Louisiana, a length of 95.6 miles.

Some flooding is experienced along Louisiana tributary streams to Sabine River. Generally, structural flood control measures to control this flooding is not feasible except in two instances, which are Upper Bayou LaNana and Little San Miguel Watersheds. In remaining areas, non-structural measures appear to be the logical alternative method of controlling flood damages.

In the coastal area of Louisiana adjacent to Sabine River some flooding does occur due to tidal fluctuations resulting in stages exceeding the elevations of land areas. Flood damages are reported more frequently now than in the past, which is attributed to development and productive use of lands with extremely low elevations. Additionally, this same general area is subject to saltwater intrusion from the Gulf of Mexico dependent upon rainfall, tidal conditions, and river stages.

Water Supplies, Flooding, and Erosion Problems -- Louisiana (Problem Identification No. 19), Pages 92 & 93

This problem area includes all Louisiana Parishes of the Sabine River Basin. The problems are not considered to be serious and efforts are being made to resolve these problems. Water withdrawals from Toledo Bend Reservoir are being made or else are pending for the Towns of Logansport, Mansfield, and Many, Louisiana. Others are in the process of considering the Sabine River water as a supply source. Projected water requirements for the Sabine River Basin in Louisiana and other areas of the State are now under study by an overall analysis of State-wide water resources.

In Calcasieu Parish, the Sabine River Diversion Project will provide supplemental water supplies from Sabine River to Calcasieu Parish and its Lake Charles vicinity. Present and future requirements will not be completely met by this diversion and supplemental water supply. This problem will be addressed as one of the objectives of the Louisiana State-wide water resources study.

Generally, there are no extremely serious water supply problems in the Sabine River Basin of Louisiana, with the exception of those portions of Cameron and Calcasieu Parishes which are influenced by saltwater intrusions from the Gulf of Mexico.

Some flooding is experienced along Louisiana tributary streams to Sabine River. Generally, structural flood control measures to control this flooding is not feasible except in two instances, which are Upper Bayou LaNana and Little San Miguel Watersheds. In remaining areas, non-structural measures appear to be the logical alternative method of controlling flood damages.

Shoreline erosion problems exist on the Louisiana shoreline of Toledo Bend Reservoir. These problems are under observation and surveillance of the Sabine River Authority of Louisiana and no serious impact on the economy of the general area is expected. There are no other implications known in relation to the economy and well-being of other areas of the State, region, or ASA.

Recommendation number 4, page 22, addresses the possibility of "developing the supplies of water necessary for the bay and estuaries." Although this is an option, the alternative of protecting those supplies from appropriation would be preferable and much less expensive.

The reference to "effluent use of the floodplains", in the third paragraph on page 22, is apparently in error. Perhaps the reference should be to "efficient use".

The Department, in its comments on the recent draft water planning document of the Texas Water Development Board, discussed the subject of water import needs of the Texas High Plains. These comments are also applicable to the discussion of this subject on page 23 of the draft problem assessment.

The report's attempt to provide an analysis of specific problems from the State-Regional viewpoint fails to adequately address water and land related resource problems by failing to assess potential land and river resource impacts from reservoir development. Some examples of problems not addressed (and which are recommended for inclusion) are as follows:

1. Current and future river recreation which would be lost (and not replaced by flat-water recreation) to future reservoir impoundments.

2. Problems related to the Federal Water Projects Recreation Act that include, but are not limited to, the following:

    a. Assurance of development and management of park and recreation facilities at federal water projects when cost-sharing agreements with State and local governments do not materialize.

    b. Increased access to underutilized public lands for recreation at existing reservoirs not covered under the current version of the Act.

    c. Non-existing funds for operation and maintenance at Federal water projects.

The problems cited above represent a public entitlement having a social, economic and environmental value. The report should address these problems with appropriate recommendations for lessening or mitigating their impact.

On pages 26 through 28 of the report, under the subheading "Social, Economic and Environmental Goals in the Texas Gulf Region" for the State of Texas, no reference is made to any social or environmental goals. It merely lists predetermined water development policies. "Policy E" only mentions social and environmental goals be considered in striving to meet water needs. In contrast, pages 28 through 30 give examples of

genuine social, economic and environmental goals for the State of Louisiana in providing for: (1) economic development; (2) human needs and resources; (3) parks, recreation and tourism; and (4) transportation. Such goals should be determined and stated for Texas. Regarding outdoor recreation, it is noted that in December of 1976 the Department provided the Texas Water Development Board copies of the Texas Outdoor Recreation Plan and Texas Waterways and Trailways for consideration in developing this and other related reports. We recommend again that the Texas Department of Water Resources consider these documents when developing the final "Specific Problem Analysis Summary Report".

An indication of the societal and economic benefits of a quality environment may be obtained from the results of the 1975 National Hunting and Fishing Survey (U. S. Department of the Interior). According to the Survey, 2.8 million Texans spent $9.8 million for inland fishing and 2.1 million Texans spent $5.2 million for coastal fishing. These data do not include expenditures for other forms of recreation which are dependent upon proper water resource management.

The section entitled "Flood Control", on pages 110 and 111, primarily consists of arguments against nonstructural prevention of flood damages, and states that "If Federal funds are not available for local [structural] projects, adverse social, economic and environmental effects will occur." It is recommended that the reference to adverse environmental effects be deleted from the sentence, since such structural projects most often do result in environmental damages.

We appreciate the opportunity to review and comment on this document.

Sincerely,

HENRY B. BURKETT
Executive Director

HBB:BDK:lmw

UNITED STATES DEPARTMENT OF COMMERCE
Maritime Administration
Central Region Office
No. 2 Canal Street
New Orleans, La. 70130

September 23, 1977

Mr. Arthur Simkins
Texas Department of Water Resources
P. O. Box 13087
Capitol Station
Austin, TX 78711

Dear Mr. Simkins:

We have reviewed the Texas Water Development Board's report enclosed with your letter of September 14, 1977. We find the areas of concern are well defined and are unable to offer any further comments at this time.

Sincerely,

G. T. BORNKESSEL
Port Development Officer

APPENDIX B

Comparison of SRF and MCC for ASA's 1201-1205

Table 1
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
SOCIO-ECONOMIC CHARACTERISTICS

REGION: Texas Gulf - 1201	STATES: Texas, Louisiana							
CHARACTERISTIC	UNIT	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Population: Total	Number (000)	944,268	1,067,951	1,066,274	1.13	1,188,900	1,261,691	1.34
SMSA		541,747	580,100	611,798	1.13	618,700	725,000	1.34
Non-SMSA		402,521	487,851	454,476	1.13	570,200	536,691	1.33
Total Employment:	Number (000)	353,451	423,037	425,905	1.20	495,949	516,182	1.46
Earnings: Total	1967 $ (000)	2,365,639	3,546,094	3,709,883	1.57	6,118,906	6,798,798	2.87
Agriculture, Forestry, Fishing		28,099	19,379	23,609	.84	20,995	27,540	.98
Manufacturing		877,942	1,291,020	1,376,156	1.57	2,105,062	2,391,076	2.72
Food and kindred products		36,282	48,339	49,106	1.35	69,272	73,962	2.04
Paper and allied products		40,477	64,925	69,135	1.71	108,505	120,175	2.97
Chemical and allied products		162,472	215,018	287,332	1.77	414,138	575,408	3.54
Petroleum and coal products		238,550	303,736	313,719	1.32	429,738	464,009	1.95
Primary metals		50,560	78,418	78,062	1.54	115,580	122,272	2.42
Other		349,601	580,584	578,802	1.66	967,829	1,035,250	2.96
Mining		41,638	38,912	41,051	.99	36,834	40,340	.97
Other		1,417,960	2,196,783	2,269,067	1.60	3,956,015	4,339,842	3.06
Per Capita Income:	1967 $	3,324	4,469	4,651	1.40	6,961	7,240	2.18
Electric Energy Production:	GWH	15,299	37,990	49,727	3.25	187,680	91,539	5.98
Land Use: Total Land Area	Acres (000)	10,879						1.00
Agricultural, Total		9,510	7,083	8,979	.94	7,127	8,828	.93
Feed Crops		243	67	339	1.40	72	347	1.43
Food Crops		156	120	67	.43	110	75	.48
Other Crops		58	55	48	.83	38	54	.93
Forests and Woodland Grazed		5,784	4,219	5,561	.96	4,194	5,540	.96
Pasture, Range and Other		3,269	2,622	2,964	.91	2,713	2,812	.86
Other, Total		48	0	0	0	0	0	0
Urban		29	0	0	0	0	0	0
Irrigated Farmland		78	97	103	1.32	95	151	1.94

Table 1
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
SOCIO-ECONOMIC CHARACTERISTICS

REGION: Texas Gulf - 1202	STATES: Texas							
CHARACTERISTIC	UNIT	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Population: Total	Number (000)	5,160,047	6,014,375	6,574,661	1.27	7,305,518	8,968,600	1.74
SMSA		4,918,746	5,750,475	6,303,962	1.28	7,017,218	8,666,200	1.76
Non-SMSA		241,301	263,900	270,699	1.12	288,300	302,400	1.25
Total Employment:	Number (000)	2,189,478	2,720,325	2,936,918	1.34	3,416,232	4,039,479	1.85
Earnings: Total	1967 $ (000)	16,808,208	27,098,303	29,177,892	1.74	48,478,167	57,891,102	3.44
Agriculture, Forestry, Fishing		138,356	124,033	140,751	1.02	140,894	170,894	1.24
Manufacturing		4,255,373	6,343,939	7,046,635	1.66	10,502,791	13,036,135	3.06
Food and kindred products		305,136	380,265	419,926	1.38	519,977	640,494	2.10
Paper and allied products		87,451	142,562	158,483	1.81	227,468	284,379	3.25
Chemical and allied products		502,479	871,829	971,998	1.93	1,736,639	2,176,227	4.33
Petroleum and coal products		286,621	378,244	420,620	1.47	546,257	683,059	2.38
Primary metals		141,924	170,328	196,976	1.39	228,736	293,101	2.07
Other		2,931,762	4,400,711	4,878,632	1.66	7,243,714	8,958,875	3.06
Mining		457,218	561,553	570,927	1.25	647,511	726,076	1.59
Other		11,957,261	20,068,778	21,419,579	1.79	37,186,971	43,957,997	3.68
Per Capita Income:	1967 $	4,009	5,548	5,538	1.38	8,238	8,198	2.04
Electric Energy Production:	GWH	63,933	90,660	121,408	1.90	139,950	237,014	3.71
Land Use: Total Land Area	Acres (000)	16,764						
Agricultural, Total		13,441	14,367	13,885	1.03	13,606	13,681	1.02
Feed Crops		1,200	1,978	1,629	1.36	1,341	1,665	1.39
Food Crops		550	343	328	.60	319	367	.67
Other Crops		336	380	272	.81	391	309	.92
Forests and Woodland Grazed		5,202	3,493	5,920	1.14	3,403	5,897	1.13
Pasture, Range and Other		6,153	8,173	5,736	.93	8,152	5,443	.88
Other, Total								
Urban								
Irrigated Farmland		230		310	1.35	429	486	2.11

Table 1
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
SOCIO-ECONOMIC CHARACTERISTICS

REGION: Texas Gulf - 1203	STATES: Texas, New Mexico							
CHARACTERISTIC	UNIT	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Population: Total	Number (000)	1,337,541	1,294,003	1,547,122	1.16	1,327,262	1,810,700	1.35
SMSA		775,016	579,000	946,529	1.22	546,900	1,154,800	1.49
Non-SMSA		562,525	715,003	600,593	1.07	780,362	655,900	1.17
Total Employment:	Number (000)	479,080	541,269	578,861	1.21	578,417	691,719	1.44
Earnings: Total	1967 $ (000)	2,949,283	4,275,725	4,702,381	1.59	6,713,774	8,442,682	2.86
Agriculture, Forestry, Fishing		460,062	468,141	486,253	1.06	527,260	614,427	1.34
Manufacturing		400,529	541,522	702,767	1.75	870,756	1,277,836	3.19
Food and kindred products		58,619	62,193	74,718	1.27	74,396	100,026	1.71
Paper and allied products		4,516	8,060	10,179	2.25	14,492	20,505	4.54
Chemical and allied products		11,257	11,103	22,884	2.03	20,253	49,729	4.42
Petroleum and coal products		1,787	2,288	2,799	1.57	3,167	4,414	2.47
Primary metals		23,773	29,271	36,373	1.53	43,706	63,434	2.67
Other		300,577	428,607	555,814	1.85	714,742	1,039,728	3.46
Mining		39,893	38,016	47,965	1.20	41,597	63,041	1.58
Other		2,048,799	3,228,046	3,465,396	1.69	5,274,161	6,487,378	3.17
Per Capita Income:	1967 $	3,364	4,584	4,620	1.37	7,047	7,123	2.12
Electric Energy Production:	GWH	20,409	82,216	59,640	2.92	189,390	150,269	7.36
Land Use: Total Land Area	Acres (000)	29,658						
Agricultural, Total		24,622	27,040	22,840	.93	25,177	22,712	.92
Feed Crops		3,961	6,926	5,023	1.27	5,538	5,133	1.30
Food Crops		1,486	576	807	.54	617	903	.61
Other Crops		2,450	1,750	1,983	.81	1,239	2,253	.92
Forests and Woodland Grazed		3,031	2,991	3,460	1.14	2,986	3,446	1.14
Pasture, Range and Other		13,694	14,797	11,567	.84	14,797	10,977	.80
Other, Total								
Urban								
Irrigated Farmland		3,262	2,256	3,328	1.02	1,083	3,800	1.16

Table 1
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
SOCIO-ECONOMIC CHARACTERISTICS

REGION: Texas Gulf - 1204	STATES: Texas, New Mexico							
CHARACTERISTIC	UNIT	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Population: Total	Number (000)	1,041,748	1,080,307	1,224,417	1.18	1,158,970	1,505,100	1.44
SMSA		608,559	631,707	761,571	1.25	728,970	1,020,300	1.68
Non-SMSA		433,189	448,600	462,846	1.07	429,100	484,800	1.12
Total Employment:	Number (000)	410,638	457,961	502,296	1.22	508,206	624,440	1.52
Earnings: Total	1967 $ (000)	2,653,437	3,855,996	4,179,760	1.58	6,228,878	7,632,628	2.88
Agriculture, Forestry, Fishing		278,713	313,567	298,136	1.07	369,641	375,795	1.35
Manufacturing		278,135	480,831	525,615	1.89	859,868	1,046,632	3.76
Food and kindred products		29,985	35,470	40,304	1.34	46,790	59,928	2.00
Paper and allied products		81	196	101	1.25	306	340	4.20
Chemical and allied products		42,360	81,473	86,075	2.03	162,657	185,430	4.38
Petroleum and coal products		18,444	22,159	24,552	1.33	29,912	37,202	2.02
Primary metals		8,405	7,390	12,271	1.46	10,312	20,126	2.39
Other		178,860	334,143	362,332	2.03	609,891	743,606	4.16
Mining		226,793	236,325	246,199	1.09	258,499	292,225	1.29
Other		1,869,796	2,825,273	3,109,810	1.66	4,740,870	5,917,976	3.17
Per Capita Income:	1967 $	3,468	4,677	4,707	1.36	7,124	7,109	2.05
Electric Energy Production:	GWH	16,493	33,290	43,075	2.61	213,160	82,615	5.01
Land Use: Total Land Area	Acres (000)	29,730						
Agricultural, Total		26,537	27,624	23,542	.89	27,986	23,011	.87
Feed Crops		2,019	3,361	2,681	1.33	4,059	2,740	1.36
Food Crops		628	356	372	.59	385	416	.66
Other Crops		1,445	982	1,163	.80	619	1,321	.91
Forests and Woodland Grazed		3,617	3,386	4,126	1.14	3,380	4,110	1.14
Pasture, Range and Other		18,828	19,539	15,200	.81	19,543	14,424	.77
Other, Total								
Urban								
Irrigated Farmland		1,277	800	1,394	1.09	693	2,244	1.76

Table 1
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Summary Report
SOCIO-ECONOMIC CHARACTERISTICS

REGION: Texas Gulf - 1205	STATES: Texas							
CHARACTERISTIC	UNIT	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Population: Total	Number (000)	1,748,543	1,604,416	2,058,291	1.18	1,836,564	2,443,000	1.40
SMSA		1,277,301	1,122,016	1,548,664	1.21	1,352,464	1,871,500	1.47
Non-SMSA		471,242	482,400	509,627	1.08	484,100	571,500	1.21
Total Employment:	Number (000)	589,575	685,357	735,812	1.25	769,269	896,774	1.52
Earnings: Total	1967 $ (000)	3,797,655	5,820,403	6,304,336	1.66	9,559,385	11,564,669	3.05
Agriculture, Forestry, Fishing		191,646	178,256	205,097	1.07	166,144	247,334	1.29
Manufacturing		518,978	717,888	898,182	1.73	1,159,522	1,605,785	3.09
Food and kindred products		90,892	96,938	117,302	1.29	121,041	161,109	1.77
Paper and allied products		3,470	6,035	7,134	2.06	10,713	14,164	4.08
Chemical and allied products		74,776	107,685	134,270	1.80	186,959	263,574	3.52
Petroleum and coal products		33,447	42,619	50,651	1.51	62,710	82,997	2.48
Primary metals		62,645	87,109	114,158	1.82	125,386	181,752	2.90
Other		253,748	377,502	474,667	1.87	652,713	902,189	3.56
Mining		97,622	93,440	105,006	1.08	94,533	117,499	1.20
Other		2,989,409	4,830,819	5,096,051	1.70	8,139,186	9,594,051	3.21
Per Capita Income:	1967 $	3,190	4,401	4,441	1.39	6,798	6,832	2.14
Electric Energy Production:	GWH	15,554	29,450	39,147	2.52	90,290	77,909	5.01
Land Use: Total Land Area	Acres (000)	24,260						
Agricultural, Total		22,117	21,488	22,013	1.00	21,645	21,331	.96
Feed Crops		2,266	1,862	3,088	1.36	1,709	3,156	1.39
Food Crops		370	154	222	.60	536	248	.67
Other Crops		276	458	224	.81	391	255	.92
Forests and Woodland Grazed		2,542	2,371	2,896	1.14	2,363	2,885	1.13
Pasture, Range and Other		16,663	16,643	15,583	.94	16,646	14,787	.89
Other, Total								
Urban								
Irrigated Farmland		450	485	785	1.74	443	1,448	3.22

Table 2
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawals)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1201	STATES: Texas, Louisiana				SOURCE: Fresh X Saline		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	107.70	117.0	189.36	1.76	141.8	235.04	2.18
Central Systems		106.2			131.3		
Non-Central Systems		10.8			10.5		
Manufacturing: Total	288.02	625.0	298.71	1.04	540.0	401.36	1.39
Food and kindred products	5.29	5.0	4.91	.93	4.0	5.21	.98
Paper and allied products	94.67	101.0	70.16	.74	86.0	100.23	1.06
Chemical and allied products	63.74	199.0	89.37	1.40	203.0	140.63	2.21
Petroleum and coal products	110.44	295.0	119.55	1.08	225.0	135.82	1.23
Primary metals	1.30	16.0	1.48	1.14	12.0	1.61	1.24
Other	12.58	9.0	13.24	1.05	10.0	17.86	1.42
Minerals: Total	8.89	112.8	10.69	1.20	108.6	10.29	1.16
Metals	.01	0.0	.00	.00	0.0	.00	.00
Non-Metals	6.50	15.6	8.61	1.32	19.5	8.44	1.30
Fuels	2.38	97.2	2.08	.87	89.1	1.85	.78
Irrigation: Total	172.90	289.0	246.60	1.43	230.1	356.9	1.34
Crops							
Other							
Livestock:	18.26	19.5	20.60	1.13	23.1	23.93	1.31
Steam Electric:	17.8	44.0	72.6	4.08	455.0	152.4	8.56
Public Lands:	.7	.7	1.0	1.4	1.3	1.3	1.9
Other Functional Uses:							
TOTALS	614.27	1,208.0	839.56	1.37	1,499.9	1,181.22	1.92

Table 2

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawals)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1202	STATES: Texas				SOURCE: Fresh X / Saline		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	696.09	690.3	1,326.19	1.91	856.4	1,852.65	2.66
Central Systems		674.5			839.6		
Non-Central Systems		15.8			16.8		
Manufacturing: Total	723.11	1,830.0	962.19	1.33	1,809.0	1,582.99	2.19
Food and kindred products	41.36	62.0	39.70	.96	62.0	44.06	1.07
Paper and allied products	53.35	121.0	40.17	.75	155.0	54.17	1.02
Chemical and allied products	348.74	1,290.0	559.26	1.60	1,212.0	1,021.01	2.93
Petroleum and coal products	163.73	186.0	223.51	1.37	234.0	326.40	1.99
Primary metals	15.86	91.0	5.18	.33	63.0	3.60	.23
Other	100.07	80.0	94.37	.94	83.0	133.75	.34
Minerals: Total	35.56	314.7	43.93	1.24	370.8	54.65	1.54
Metals	.00	33.6	.00	1.33	33.6	.00	1.00
Non-Metals	13.12	108.3	18.39	1.40	138.9	25.45	1.94
Fuels	22.44	172.8	25.54	1.14	198.3	29.20	1.30
Irrigation: Total	507.9	979.3	788.3	1.55	965.9	1,208.8	2.38
Crops							
Other							
Livestock:	33.43	38.2	36.62	1.10	44.9	41.19	1.23
Steam Electric:	96.8	82.0	149.5	1.54	566.0	351.8	3.63
Public Lands:	6.5	1.2	1.2	.18	1.6	1.6	.25
Other Functional Uses:							
TOTALS	2,099.39	3,935.7	3,307.93	1.58	4,613.6	5,093.68	2.43

Table 2

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (Withdrawals)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1203	STATES: Texas, New Mexico				SOURCE: Fresh X Saline		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	203.39	174.9	335.14	1.65	186.0	407.44	2.99
Central Systems		161.3			174.2		
Non-Central Systems		13.6			11.8		
Manufacturing: Total	28.32	81.0	29.89	1.05	58.0	36.70	1.28
Food and kindred products	7.67	0.0	6.84	.89	0.0	6.36	.83
Paper and allied products	.06	0.0	.07	1.17	0.0	.10	1.67
Chemical and allied products	3.36	0.0	5.52	1.52	0.0	9.19	2.53
Petroleum and coal products	.77	0.0	1.08	1.40	0.0	1.35	1.75
Primary metals	6.69	73.0	3.59	.54	48.0	1.77	.26
Other	9.77	8.0	12.79	1.31	10.0	17.93	1.84
Minerals: Total	27.12	112.2	39.28	1.45	125.1	52.87	1.95
Metals		0.0			0.0		
Non-Metals		26.1			35.7		
Fuels		86.1			89.4		
Irrigation: Total	4,234.70	4,655.5	3,923.10	.93	2,430.4	3,473.60	.82
Crops							
Other							
Livestock:	61.87	55.7	68.43	1.11	65.5	77.71	1.26
Steam Electric:	92.0	142.0	246.0	2.67	258.0	534.6	5.81
Public Lands:	2.6	2.6	2.6	1.0	2.6	2.6	1.0
Other Functional Uses:	0.2	0.0	0.3	1.5	0.0	32.4	162.0
T O T A L S	4,650.20	5,223.9	4,644.74	1.0	3,125.6	4,617.92	.99

Table 2

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawals)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1204	STATES: Texas, New Mexico				SOURCE: Fresh X Saline		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	176.52	159.8	275.48	1.56	176.4	355.47	2.01
Central Systems		150.2			167.8		
Non-Central Systems		9.6			8.6		
Manufacturing: Total	23.05	36.6	32.97	1.43	69.0	50.07	2.17
Food and kindred products	2.72	0.0	2.42	.89	0.0	2.45	.90
Paper and allied products	.21	0.0	.16	.79	0.0	.20	.95
Chemical and allied products	10.31	28.0	17.58	1.71	59.0	29.64	2.87
Petroleum and coal products	4.22	4.0	5.93	1.41	4.0	7.91	1.87
Primary metals	.92	0.0	.89	.97	0.0	.84	.91
Other	4.67	4.6	5.99	1.28	6.0	9.03	1.93
Minerals: Total	114.33	458.7	130.61	1.14	504.0	155.59	1.36
Metals							
Non-Metals							
Fuels							
Irrigation: Total	1,619.9	2,618.9	1,963.8	.97	2,106.4	2,478.4	.90
Crops							
Other							
Livestock:	37.60	35.1	41.68	1.11	37.9	47.81	1.27
Steam Electric:	42.20	248.0	124.70	2.95	379.0	245.60	5.82
Public Lands:	5.5	5.5	5.5	1.0	5.5	5.5	1.0
Other Functional Uses:	0.3	0.0	0.4	0.0	0.0	0.6	0.0
T O T A L S	2,019.40	3,562.6	2,574.64	1.27	3,278.2	3,339.04	1.65

Table 2

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawals)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1205	STATES: Texas				SOURCE: Fresh x Saline ___		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	243.36	236.3	429.51	1.77	259.9	528.67	2.17
Central Systems		227.8		•	251.7		
Non-Central Systems		8.5			8.2		
Manufacturing: Total	114.00	248.0	141.75	1.24	226.0	201.75	1.77
Food and kindred products	13.56	14.0	11.94	.88	13.0	11.45	.84
Paper and allied products	.06	0.0	.08	1.33	0.0	.13	2.09
Chemical and allied products	60.40	132.0	89.41	1.48	127.0	143.82	2.38
Petroleum and coal products	12.48	32.0	15.50	1.24	36.0	21.09	1.69
Primary metals	15.28	62.0	9.92	.65	39.0	4.64	.30
Other	12.22	8.0	14.90	1.22	11.0	20.62	1.69
Minerals: Total	8.18	197.7	9.35	1.14	202.5	10.40	1.27
Metals	.10	5.4	.07	.71	8.1	.05	.55
Non-Metals	3.92	36.3	5.09	1.30	38.7	6.00	1.53
Fuels	4.16	156.0	4.19	1.01	155.7	4.35	1.04
Irrigation: Total	669.7	128.8	1,095.9	1.64	944.9	1,737.8	2.59
Crops							
Other							
Livestock:	40.88	42.7	45.67	1.12	50.6	52.51	1.28
Steam Electric:	46.8	114.0	119.2	2.55	84.0	224.0	4.79
Public Lands:	3.5	3.5	3.5	1.0	3.5	3.5	1.0
Other Recreational Use:							
T O T A L S	1,126.43	971.00	1,844.88	1.64	1,772.4	2,758.63	2.45

Table 2
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawal)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1201	STATES: Texas						SOURCE: Fresh ___ Saline X
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total Central Systems Non-Central Systems							
Manufacturing: Total Food and kindred products Paper and allied products Chemical and allied products Petroleum and coal products Primary metals Other							
Minerals: Total Metals Non-Metals Fuels							
Irrigation: Total Crops Other							
Livestock:							
Steam Electric:	720		900	1.25		2,300	3.19
Public Lands:							
Other Functional Uses:							
TOTALS	720		900	1.25		2,300	3.19

Table 2
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawal)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1202	STATES: Texas						SOURCE: Fresh ___ Saline X
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total Central Systems Non-Central Systems							
Manufacturing: Total Food and kindred products Paper and allied products Chemical and allied products Petroleum and coal products Primary metals Other							
Minerals: Total Metals Non-Metals Fuels							
Irrigation: Total Crops Other							
Livestock:							
Steam Electric:	3,000		3,500	1.17		9,500	3.17
Public Lands:							
Other Functional Uses:							
TOTALS	3,000		3,500	1.17		9,500	3.17

Table 2
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (withdrawal)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1205	STATES: Texas				SOURCE: Fresh ___ Saline X		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total							
Central Systems							
Non-Central Systems							
Manufacturing: Total							
Food and kindred products							
Paper and allied products							
Chemical and allied products							
Petroleum and coal products							
Primary metals							
Other							
Minerals: Total							
Metals							
Non-Metals							
Fuels							
Irrigation: Total							
Crops							
Other							
Livestock:							
Steam Electric:	690		900	1.30		1,800	2.61
Public Lands:							
Other Functional Uses:							
TOTALS	690		900	1.30		1,800	2.61

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1201	STATES: Texas, Louisiana				SOURCE: Fresh X Saline		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	64.2	37.8	107.25	1.67	44.8	128.44	2.00
Central Systems		31.2			38.5		
Non-Central Systems		6.6			6.3		
Manufacturing: Total	89.50	215.0	108.44	1.21	428.0	168.79	1.89
Food and kindred products	1.59	3.0	1.47	.92	3.0	1.56	.98
Paper and allied products	9.47	36.0	7.02	.74	69.0	10.02	1.06
Chemical and allied products	19.12	79.0	31.28	1.64	161.0	70.31	3.68
Petroleum and coal products	55.22	90.0	65.75	1.19	180.0	81.49	1.48
Primary metals	.39	4.0	.44	1.13	10.0	.48	1.23
Other	3.71	3.0	2.48	.67	5.0	4.93	1.33
Minerals: Total	2.16	55.8	2.26	1.05	51.9	2.20	1.02
Metals	.00	0.0	.00	.00	0.0	.00	.00
Non-Metals	.85	2.1	1.12	1.32	2.7	1.18	1.39
Fuels	1.31	53.7	1.14	.87	49.2	1.02	.78
Irrigation: Total	122.20	231.2	177.80	1.45	189.3	261.10	2.14
Crops							
Other							
Livestock:	18.26	19.5	20.60	1.13	23.1	23.93	1.31
Steam Electric:	8.9	28.0	36.3	4.08	296.0	72.2	8.11
Public Lands:		1.0			1.3		
Other Functional Uses:	5.0		5.4	1.08		5.8	1.16
T O T A L S	310.22	588.3	458.05	1.48	1,034.4	662.46	2.14

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1202	STATES: Texas					SOURCE: Fresh X Saline	
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	369.18	210.0	719.33	1.95	259.5	1,004.16	2.72
Central Systems		200.3			249.4		
Non-Central Systems		9.7			10.1		
Manufacturing: Total	242.47	711.0	367.92	1.52	1,409.0	768.80	3.17
Food and kindred products	12.41	19.0	11.91	.96	44.0	13.22	1.07
Paper and allied products	5.33	51.0	4.02	.75	124.0	5.42	1.02
Chemical and allied products	104.62	447.0	195.74	1.87	964.0	510.50	4.88
Petroleum and coal products	81.86	119.0	122.93	1.50	186.0	195.84	2.39
Primary metals	4.76	45.0	1.55	.33	50.0	1.07	.22
Other	33.49	30.0	31.77	.95	41.0	42.75	1.28
Minerals: Total	14.12	114.6	16.55	1.17	132.9	19.53	1.38
Metals	.00	4.8	.00	.00	4.8	.00	.00
Non-Metals	1.73	14.4	2.45	.42	18.6	3.41	1.97
Fuels	12.39	95.4	14.10	1.14	109.5	16.12	1.30
Irrigation: Total	356.9	792.8	576.6	1.62	800.0	906.6	2.54
Crops							
Other							
Livestock:	33.43	38.2	36.62	1.10	44.9	41.19	1.23
Steam Electric:	48.4	50.0	74.7	1.54	157.0	175.9	3.63
Public Lands:		1.2			1.6		
Other Functional Uses:							
TOTALS	1,064.49	1,917.8	1,791.72	1.68	2,804.9	2,916.18	2.74

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1203	STATES: Texas, New Mexico				SOURCE: Fresh x Saline		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	126.20	71.8	254.40	2.02	75.6	306.88	2.43
Central Systems		63.5			68.5		
Non-Central Systems		8.3			7.1		
Manufacturing: Total	9.71	32.0	10.84	1.12	43.0	15.61	1.61
Food and kindred products	2.30	0.0	2.05	.89	0.0	1.91	.83
Paper and allied products	.01	0.0	.01	1.00	0.0	.01	1.00
Chemical and allied products	1.09	0.0	1.93	1.77	0.0	4.59	4.21
Petroleum and coal products	.38	0.0	.59	1.55	0.0	.81	2.13
Primary metals	2.01	28.0	1.08	.54	38.0	.53	.26
Other	3.92	4.0	5.18	1.32	5.0	7.76	1.98
Minerals: Total	12.91	51.3	20.20	1.56	54.3	26.99	2.09
Metals		0.0			0.0		
Non-Metals		3.6			4.8		
Fuels		47.7			49.5		
Irrigation: Total	4,015.50	3,953.5	3,756.10	.94	2,082.1	3,369.30	.84
Crops							
Other							
Livestock:	61.87	55.7	68.43	1.11	65.5	77.71	1.26
Steam Electric:	46.0	90.0	123.0	2.67	170.0	267.3	5.81
Public Lands:	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Functional Uses:	0.1	0.0	0.1	1.0	0.0	18.3	183.0
TOTALS	4,272.29	4,254.3	4,233.07	.99	2,490.5	4,082.09	.96

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1204	STATES: Texas, New Mexico				SOURCE: Fresh x Saline ___		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	111.81	62.8	193.77	1.73	68.1	243.92	2.18
Central Systems		57.0			62.9		
Non-Central Systems		5.8			5.2		
Manufacturing: Total	8.12	25.0	12.59	1.55	53.0	23.70	2.92
Food and kindred products	.82	0.0	.73	.89	0.0	.73	.89
Paper and allied products	.02	0.0	.02	1.00	0.0	.02	1.00
Chemical and allied products	3.09	19.0	6.15	1.99	46.0	14.82	4.80
Petroleum and coal products	2.11	3.0	3.26	1.55	3.0	4.75	2.25
Primary metals	.28	0.0	.27	.96	0.0	.25	.89
Other	1.80	3.0	2.16	1.20	4.0	3.13	1.74
Minerals: Total	67.84	233.4	77.07	1.15	254.4	94.19	1.39
Metals		0.0			0.0		
Non-Metals		6.3			7.5		
Fuels		227.1			246.9		
Irrigation: Total	1,387.50	2,013.3	1,740.00	1.25	1,625.0	2,196.40	1.28
Crops							
Other							
Livestock:	37.60	35.1	41.68	1.11	37.9	47.81	1.27
Steam Electric:	21.90	34.0	63.60	2.90	219.0	124.80	5.70
Public Lands:	0.0	0.1	0.0	0.0	0.1	0.0	0.0
Other Functional Uses:	0.2	0.0	0.2	1.00	0.0	0.3	1.50
T O T A L S	1,634.97	2,403.70	2,128.91	1.30	2,257.5	2,731.12	1.67

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf	STATES: Texas - 1205				SOURCE: Fresh X Saline ___		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total	123.09	84.6	210.57	1.71	92.6	252.94	2.05
Central Systems		79.3			87.6		
Non-Central Systems		5.3			5.0		
Manufacturing: Total	37.33	120.0	50.80	1.36	177.0	96.41	2.58
Food and kindred products	4.07	9.0	3.58	.88	9.0	3.43	.84
Paper and allied products	.01	0.0	.01	1.00	0.0	.01	1.00
Chemical and allied products	18.12	63.0	31.29	1.73	101.0	71.91	3.97
Petroleum and coal products	6.24	22.0	8.52	1.37	29.0	12.65	2.03
Primary metals	4.58	22.0	2.98	.65	31.0	1.39	.30
Other	4.31	4.0	4.42	1.03	7.0	7.02	1.63
Minerals: Total	2.82	91.8	2.99	1.06	92.1	3.19	1.13
Metals	.02	.9	.01	.50	1.2	.00	.00
Non-Metals	.51	4.8	.67	1.31	5.1	.79	1.55
Fuels	2.29	86.1	2.31	1.01	85.8	2.40	1.05
Irrigation: Total	651.6	989.3	1,023.5	1.57	831.2	1,581.4	2.43
Crops							
Other							
Livestock:	40.88	42.7	45.67	1.12	50.6	52.51	1.28
Steam Electric:	23.4	19.0	59.6	2.55	16.0	112.0	4.79
Public Lands:		0.0			0.0		
Other Functional Uses:							
TOTALS	879.12	1,347.4	1,393.13	1.58	1,259.5	2,098.45	2.39

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1201	STATES: Texas						SOURCE: Fresh ___ Saline __X
FUNCTIONAL USE	SRF 1975 -	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total							
Central Systems							
Non-Central Systems							
Manufacturing: Total							
Food and kindred products							
Paper and allied products							
Chemical and allied products							
Petroleum and coal products							
Primary metals							
Other							
Minerals: Total							
Metals							
Non-Metals							
Fuels							
Irrigation: Total							
Crops							
Other							
Livestock:							
Steam Electric:	7.2		9	1.25		23	3.19
Public Lands:							
Other Functional Uses:							
TOTALS	7.2		9	1.25		23	3.19

Table 3
1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1202	STATES: Texas						SOURCE: Fresh ___ Saline X
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total Central Systems Non-Central Systems							
Manufacturing: Total Food and kindred products Paper and allied products Chemical and allied products Petroleum and coal products Primary metals Other							
Minerals: Total Metals Non-Metals Fuels							
Irrigation: Total Crops Other							
Livestock:							
Steam Electric:	30		35	1.17		95	3.17
Public Lands:							
Other Functional Uses:							
TOTALS	30		35	1.17		95	3.17

Table 3

1975 NATIONAL ASSESSMENT
Specific Problem Analysis Final Report
VOLUMETRIC REQUIREMENTS (consumptive use)
(Million gallons per day-MGD)

REGION: Texas Gulf - 1205	STATES: Texas				SOURCE: Fresh ___ Saline X		
FUNCTIONAL USE	SRF 1975	MCC 1985	SRF 1985	SRF RATIO 1985/75	MCC 2000	SRF 2000	SRF RATIO 2000/75
Domestic: Commercial and Institutional, Total							
Central Systems							
Non-Central Systems							
Manufacturing: Total							
Food and kindred products							
Paper and allied products							
Chemical and allied products							
Petroleum and coal products							
Primary metals							
Other							
Minerals: Total							
Metals							
Non-Metals							
Fuels							
Irrigation: Total							
Crops							
Other							
Livestock:							
Steam Electric:	6.9		9	1.30		18	2.61
Public Lands:							
Other Functional Uses:							
TOTALS	6.9		9	1.30		18	2.61

Table 4
1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1201		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [X] 80% [ ] 95% [ ]	
STATES: Texas-Louisiana						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	10,303	9,953				
Imports	0.0	0.0	0.0	0.0	0.0	0.0
Exports	320.98	0.0	390.92	0.0	557.30	0.0
Groundwater Withdrawals	171.63	158.4	125.18	158.4	99.5	158.4
Evaporation	0.0	35.2	0.0	35.2	0.0	35.2
Depletions Upstream ASA's Intra ASA	631.2	523.2	848.97	604.3	1,219.76	1,040.2
Natural Modified Flow	10,762.6	10,317.8				
Future Modified Flow			10,038.78	9,871.9	9,642.31	9,435.9

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4
1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: 12	ASA No.: 01		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [ ] 80% [ ] 95% [X]	
STATES: Texas-Louisiana						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	3,133	3,037				
Imports	0.0	0.0	0.0	0.0	0.0	0.0
Exports	320.98	0.0	390.92	0.0	557.30	0.0
Groundwater Withdrawals	171.63	158.4	125.18	158.4	99.5	158.4
Evaporation	0.0	35.2	0.0	35.2	0.0	35.2
Depletions Upstream ASA's Intra ASA	631.2	523.2	848.97	604.3	1,219.76	1,040.3
Natural Modified Flow	3,592.57	3,402.7				
Future Modified Flow			2,868.78	2,992.3	2,472.31	2,591.3

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow = Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4
1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1202		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [X] 80% [ ] 95% [ ]	
STATES: Texas						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	6,235.6	7,497.8				
Imports	442.36	186.8	709.60	401.5	1,253.94	401.5
Exports	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater Withdrawals	756.19	593.9	587.56	593.9	458.55	593.9
Evaporation	395.4	313.1	495.7	313.1	499.9	313.1
Depletions Upstream ASA's Intra ASA	1,016.93	1,786.3	1,577.82	2,101.7	2,162.14	3,105.7
Natural Modified Flow	6,496.34	8,244.2				
Future Modified Flow			5,506.08	7,246.0	4,334.2	6,242.0

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4

1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1202		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [ ] 80% [ ] 95% [X]	
STATES: Texas						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	1,228.2	1,422				
Imports	442.96	186.8	709.60	401.5	1,253.94	401.5
Exports	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater Withdrawals	765.19	593.9	587.56	593.9	458.55	593.9
Evaporation	395.4	313.1	495.7	313.1	499.9	313.1
Depletions Upstream ASA's Intra ASA	1,016.93	1,786.3	1,577.82	2101.7	2,162.14	3105.7
Natural Modified Flow	1,488.94	2,168.4				
Future Modified Flow			498.68	871.7	-214.65	331

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4
1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1203		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [X] 80% [ ] 95% [ ]	
STATES: Texas and New Mexico						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	4,609	4,718.4				
Imports	32.55	0.0	37.47	0.0	45.00	0.0
Exports	412.99	371.5	578.63	371.5	907.37	371.5
Groundwater Withdrawals	4,095.21	3,656.6	2,535.47	2,403.6	1,414.94	730.6
Evaporation	568.8	788.0	593.1	788.0	594.5	788.0
Depletions Upstream ASA's Intra ASA	5,221.53	6,223.2	5,367.33	5,041.2	5.520.66	3,277.1
Natural Modified Flow	5,735.32	7,025.0				
Future Modified Flow			2,903.46	3,816.58	1,629.6	4,738.5

Depletions = Cosumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4
1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1203		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [ ] 80% [ ] 95% [X]	
STATES: Texas and New Mexico						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	840	775.6				
Imports	32.55	0.0	37.47	0.0	45.00	0.0
Exports	412.99	371.5	578.63	371.5	907.37	371.5
Groundwater Withdrawals	4,095.21	3,656.6	2,535.47	2,403.6	1,414.94	730.6
Evaporation	568.8	788.0	593.1	788.0	594.5	788.0
Depletions Upstream ASA's Intra ASA	5,221.53	6,223.2	5,367.33	5,041.2	5,520.66	3,277.1
Natural Modified Flow	1,966.32	3,082.4				
Future Modified Flow			-865.54	-444.8	-2,139.4	535.3

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4

1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1204		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [X] 80% [ ] 95% [ ]	
STATES: Texas-New Mexico						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	1,537	1,809.8				
Imports	3.31	0.0	3.79	0.0	10.28	0.0
Exports	12.73	0.0	27.65	0.0	53.57	0.0
Groundwater Withdrawals	1,331.92	954.4	983.98	686.4	717.61	287.4
Evaporation	554.8	482.9	558.1	482.9	558.1	482.9
Depletions Upstream ASA's Intra ASA	2,189.19	2,988,4	2,710.87	2,880.8	3,332.51	2,732.2
Natural Modified Flow	2,394.29	3,843.8				
Future Modified Flow			667.4	1,893	-220.61	1,643.0

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4
1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1204		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [ ] 80% [ ] 95% [X]	
STATES: Texas-New Mexico						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	308.2	323.2				
Imports	3.31	0.0	3.79	0.0	10.28	0.0
Exports	12.73	0.0	27.65	0.0	53.57	0.0
Groundwater Withdrawals	1,331.92	954.4	983.98	686.4	717.61	287.4
Evaporation	554.8	482.9	558.1	482.9	558.1	482.9
Depletions Upstream ASA's Intra ASA	2,189.19	2,988,4	2,710.87	2,880.8	3,332.51	2,732.2
Natural Modified Flow	1,165.49	2,357				
Future Modified Flow			-561.4	467.6	-1,449.41	327.4

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4
1975 NATIONAL ASSESSMENT
SRF-MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1205		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [X] 80% [ ] 95% [ ]	
STATES: Texas						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	3,683.0	3,942.8				
Imports	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater Withdrawals	816.78	851.0	728.62	851.0	707.69	851.0
Evaporation	284.0	123.0	234.0	123.0	234.0	123.0
Depletions Upstream ASA's Intra ASA	1,113.12	1,321.7	1,709.73	1,451.0	2,417.0	1,381.0
Natural Modified Flow	3,979.34	4,413.5				
Future Modified Flow			2,998.23	3,813.5	2,269.38	3,883.5

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.

Table 4
1975 NATIONAL ASSESSMENT
SRF--MCC Comparison
WATER SUPPLIES
(Million gallons per day)

REGION: Texas Gulf	ASA No.: 1205		DURATION: ANNUAL: [X]		PROBABILITY: MEAN [ ] 80% [ ] 95% [X]	
STATES: Texas						
	1975 SRF	1975 MCC	1985 SRF	1985 MCC	2000 SRF	2000 MCC
Present Modified Flow	710.6	646.4				
Imports	0.0	0.0	0.0	0.0	0.0	0.0
Exports	0.0	0.0	0.0	0.0	0.0	0.0
Groundwater Withdrawals	816.78	851.0	728.62	851.0	707.69	851.0
Evaporation	234.0	123.0	234.0	123.0	319.2	123.0
Depletions Upstream ASA's Intra ASA	1,113.12	1,321.7	1,709.73	1,451.0	2,417.65	1,381.0
Natural Modified Flow	1,006.94	1,117.0				
Future Modified Flow			25.83	517.1	-703.02	587.1

Depletions = Consumptive Use + Evaporation - Imports + Exports.
Natural Modified Flow = Present Modified Flow + Depletions - Groundwater Withdrawals.
Future Modified Flow = Natural Modified Flow - Depletions + Groundwater Withdrawals.