

CHAPTER 1 – INTRODUCTION, SCOPE, AND OBJECTIVES

The Water-Related Problem

The potential for the occurrence of drought and the associated adverse consequences for the economy, political system, and social institutions, is always an issue in dry places, like the southwestern United States (Young 1995). Numerous natural hazards, including earthquakes, floods, and drought, impose economic damages (Howe and Cochrane 1992). Adverse impacts of droughts are felt by both instream and offstream users of water, including reduced agricultural output, falling hydropower production, reduced water quality, damages to recreation users, groundwater overdraft, and damages to endangered species.

In the Rio Grande Basin, (Figure 1-1) each drought since the late nineteenth century has given rise to analysis of water problems, to questions regarding the adequacy of the water and institutional resources to meet the existing needs for water, and to actions intended to achieve a better balance between supply and demand for water in the future (Thomas 1963). For example the severe drought during 1951-57 was largely responsible for increased development of groundwater pumping and use of groundwater storage.

The quality of the water throughout the Rio Grande Basin is generally poorer in years of drought than in years of more abundant water supply. Because there is typically a progressive increase in total salt concentration of the river water from the upper to the lower end of the basin, the problem of quality is more critical to the downstream users than to those near the headwaters. In much of Texas, the major problem during drought conditions is elevated salinity in the river, thus making river water less suitable and/or more expensive for irrigation and municipal uses. Apportionment of water is also more important and also more difficult during drought when water supplies are lower than normal. Apportionment is a central objective of international treaties, interstate compacts, state water laws, and court decisions pertaining to water (Thomas 1963).

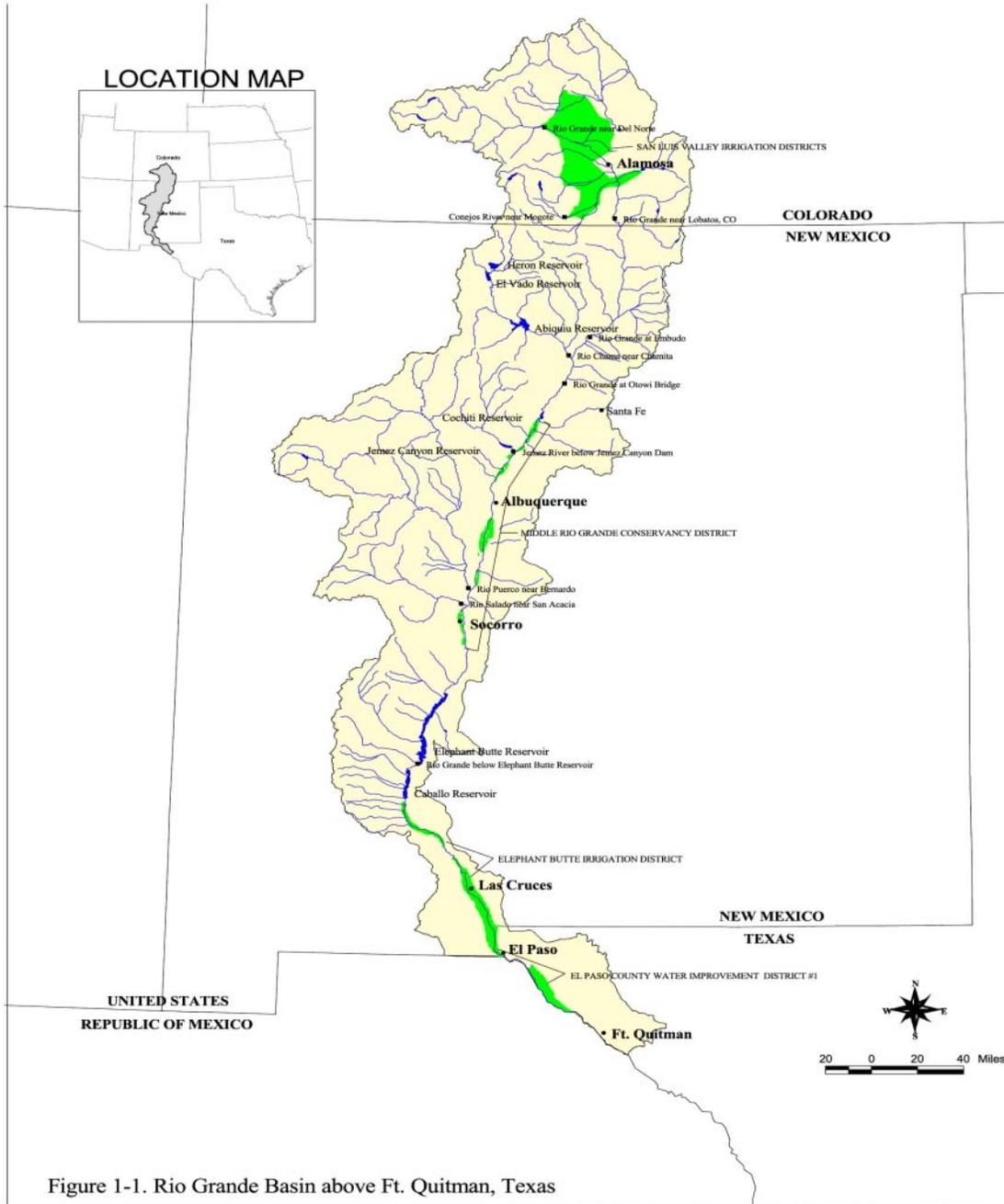
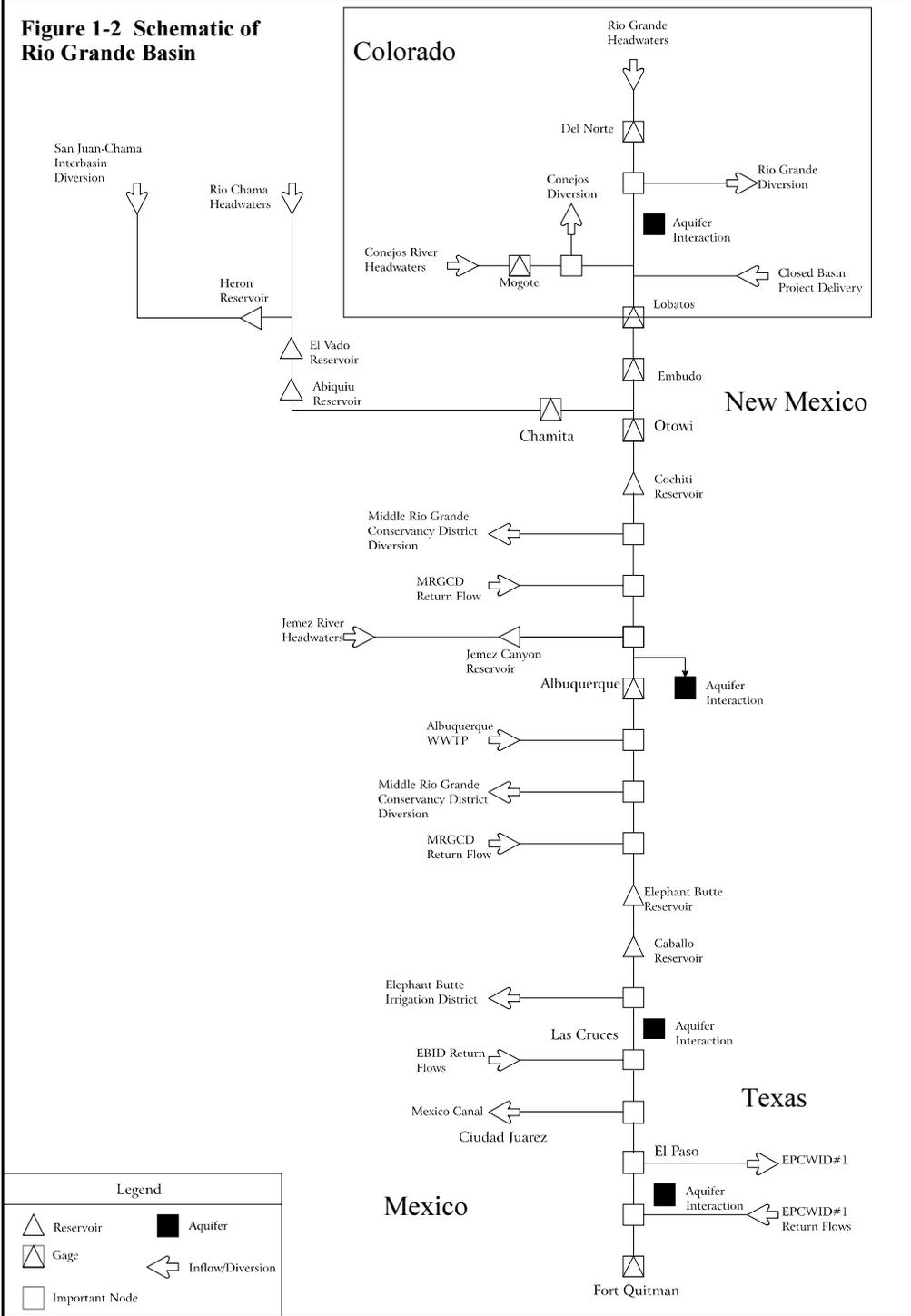


Figure 1-1. Rio Grande Basin above Ft. Quitman, Texas



As of the year 2001, the physical and institutional systems serving the Rio Grande Basin (Figure 1-2) have a considerable capacity for coping with severe drought. Still, there has been no comprehensive analysis to date of information needed for drought planning for the basin. Moreover, increasing population and growing demands placed on land and related water, including demands for endangered species habitat, are increasing potential drought severity and magnifying probable economic losses incurred during a series of dry years.

This research aimed to identify economic and hydrologic impacts of policy measures for addressing severe and sustained drought in the Rio Grande Basin.

Objectives

The overriding objective was to evaluate various institutional adjustments for coping with severe drought in the Rio Grande Basin of Colorado, New Mexico, and Texas. Detailed objectives are as follows:

- (Hydrology) Formulate credible drought scenarios by assessing the probability of a prolonged and severe drought and develop drought scenarios for the major water resource systems of the study area.
- (Hydrology-Institutions) Develop a mass balance hydrologic model that accounts for sources and uses of water in the Rio Grande Basin under present water laws, policies, and management institutions. This model was the basis for evaluation of the hydrologic and economic impacts of droughts of various severities and durations.
- (Hydrology-Economics) Identify economic damages associated with selected drought scenarios by identifying the magnitude, location, and distribution of drought damages under present laws, policies, and management institutions.
- (Institutions-Economics) Incorporate institutional responses in the model for mitigating economic damages of drought by identifying available legal and institutional flexibility to limit drought damages.

- (Hydrologic-Economic-Legal Policy Analysis) Operate the model to assess hydrologic and economic impacts of alternative drought mitigation policies.

Scope

The original plan of the study was limited to the geographic area of the Rio Grande Basin from the Colorado headwaters to the Gulf of Mexico. Subsequently, the scope was reduced to include only the basin above El Paso, Texas. The economic analysis is limited to impacts of drought on the direct economic effects on agricultural, municipal, hydroelectric, and recreation uses. The hydrologic scope was limited to the mainstem of the Rio Grande and associated groundwater aquifers connected to the mainstem. The time step of the hydrology model is annual.

Approach

A highly experienced and nationally recognized interdisciplinary team was assembled to define the existing engineering-institutional-economic system, to structure credible drought scenarios in light of occurrences during the period for which recorded data exist, to assess their hydrological and economic impacts, and to evaluate selected drought mitigation strategies for reducing economic damages when such droughts occur. Because of recent memories of water users and managers in the basin, the severe drought of the 1950s was examined closely to see what adjustments would be needed today to adapt to a drought of that severity, in comparison to a future period of normal water supply.

As part of the information transfer plan, we also established an advisory council. One objective in establishing an advisory council was to preserve productive interaction between the study and individuals in the private sector and government charged with water management responsibilities in the basin. Another objective was to maintain contact with the broad range of public opinion on water resources development and management in the study area. This continuing contact was particularly important in assessing political impacts of various proposed institutional adjustments for coping with drought.