

THE FUTURE ROLE OF HYDROMETEOROLOGICAL PREDICTION IN WATER MANAGEMENT DECISION MAKING

Michael D. Hudlow

AUTHOR: Director, Office of Hydrology, National Weather Service, Silver Spring, Maryland 20910.

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INTRODUCTION

Water is the life blood of all society. Water is a precious resource which too often in the past has been taken for granted as being always available by simply turning a spigot or enjoying the many benefits it brings in the areas of recreation, hydropower, navigation, irrigation, and many other applications. Increasing and shifting populations, water pollution, and climate variability are placing ever increasing stresses on our water systems. In some parts of the world the problem of water shortages are already so acute that catastrophic environmental and economic impacts are occurring. Over two-thirds of the world's population consumes unsafe drinking water (International Conference on Water and Environment: Development issues for the 21st Century. 26-31 January 1992, Dublin Ireland.)

BACKGROUND

The United States has been blessed with abundant natural resources. The country's water resources have played major roles in development of all public and private sectors. However, the distribution of water in time and space across the United States varies considerably. This largely results from precipitation variability. Optimizing the available water has occurred largely through the installation of water resources structures. The pressing environmental and population trends now have reached a point that more integrated measures are required to address the most effective management of the United States water supplies. A significant component of a more integrated approach to water management involves improved hydrometeorological prediction capabilities. This presentation will focus on discussions of the role of hydrometeorological prediction in water management decision making. This will include illustrations of some of the latest scientific and technological advances and their relationship to providing increased levels of information required in a risk-based approach to making decisions. Examples of potential benefits of this approach will be shown.

Reaching solutions to the complex problems of effective water management in the future require multi-disciplinary approaches and cooperative efforts by many parties at the federal, state, and local levels. Participation by the scientific community as a whole and the private sector also are essential to many aspects of solving future water management problems. Examples of partnership roles will be discussed and the importance of multi-disciplinary efforts will be illustrated through appropriate coupling of the meteorological and hydrological disciplines.

CONCLUSIONS

In conclusion, application of the latest advances in hydrometeorological prediction technology will provide much improved information for making critical water management decisions. Advanced prediction capabilities combined with improved water facility operations will help immensely in meeting the Nation's future water demands. The social and policy implications are far reaching. Competing demands for water in all parts of the United States, including regional areas such as Georgia and the southeast United States, will increase. Adequately addressing these increasing requirements will require a smarter approach to the integration and interpretation of information and its application to the execution of water management decisions. Sound approaches will translate into large economic benefits and positive influences on society's overall environmental well being. These, in turn, will clearly have a major effect on our standard of living. Conversely, failure to act in prudent ways will bring increasingly negative impacts on our society.

PLENARY SESSION:

COMPREHENSIVE STUDY OF THE A.C.F. and A.C.T. RIVER BASINS

MODERATOR: David Word, Assistant Chief, Environmental Protection Division, Georgia Department of Natural Resources, Room 1058, 205 Butler Street, SE, Atlanta, Georgia 30303.

REFERENCE: *Proceedings of the 1993 Georgia Water Resources Conference*, held April 20 and 21, 1993, at The University of Georgia, Kathryn J. Hatcher, Editor, Institute of Natural Resources, The University of Georgia, Athens, Georgia.

Moderator: David Word, Georgia Department of Natural Resources, Environmental Protection Division

BRIEF CHRONOLOGY

Panelists:

Janet Starnes, Northwest Florida Water Management District, Route 1, Box 3100, Havana, Florida 32333.

Bob Grasser, Water Resources Coordinator, Planning and Economic Development Division, Alabama Department of Economic and Community Affairs, P.O. Box 250357, Montgomery, Alabama 36125-0347.

Nolton Johnson, Water Resources Management Branch, Georgia Department of Natural Resources, Environmental Protection Division, Suite 1266 E. Tower, 205 Butler Street, SE, Atlanta, Georgia 30303.

Keith Graham, U. S. Army Corps of Engineers, Mobile District, P.O. Box 2288, Mobile, Alabama 36628.

Discussion Topics:

- (1) Water Demands and Resources in the ACT/ACF Basin.
- (2) Basinwide Alternatives Under Consideration for the ACF/ACT Comprehensive Study.
- (3) Summary of Scopes-of-Work for the Comprehensive Study of the Apalachicola-Chattahoochee-Flint (ACF) and the Alabama-Coosa-Tallapoosa (ACT) River Basins.
- (4) Strategy for Coordinating Mechanisms for the ACT /ACF River Basins.

Note: The following text was condensed by Kathryn J. Hatcher from material provided by Keith Graham of the Mobile District Corps of Engineers. This source material is listed at the end of this paper under Literature Cited.

Overview

This brief chronology highlights some of the significant events that led to the controversy over water resources in the Apalachicola-Chattahoochee-Flint (ACF) and the Alabama-Coosa-Tallapoosa (ACT) river basins, among the States of Alabama, Georgia and Florida and the U. S. Army Corps of Engineers (Corps).

The severe droughts experienced in this region during 1981, 1986 and 1988, significantly focused public attention and concern about water shortages and lake drawdowns experienced in the two basins. This acute level of public awareness made water conflicts a hot political topic in the 1990 election campaigns of candidates for state Governors and representatives of the U. S. Congress. The media published numerous articles on the controversy, the players, the ongoing events and the perceived consequences.

The conflict reached a pivotal point in June 1990, when the State of Alabama filed suit against the Corps challenging the environmental documentation for proposed water supply reallocations in Georgia and seeking to enjoin all proposed contracts for reservoir storage. Shortly thereafter, the Corps began negotiations with the three states seeking to resolve the conflicts and settle the litigation.

A comprehensive water resource study (directed by Congress, and approved in the FY 1991 Civil Works Appropriations Act) served as the keystone for the negotiation strategy by offering the opportunity to better understand the various needs of the states as well as the capabilities and limitations of the water resources in the ACF and ACT basins.

The negotiation process was intense and required considerable coordination, communication and building of trust and relationships. Changes in State leadership in Georgia and Florida in 1991, coupled with shifts in negotiating styles, likely influenced the process. As a result of this arduous and time-consuming negotiation process, the Governors of the States of Alabama, Georgia and Florida and Assistant Secretary of the Army (Civil Works) signed a Memorandum of Agreement (MOA) on

partners through the Comprehensive Study to address and resolve water resource issues in the basins. This unprecedented approach could well serve as a model for water resource conflict resolution in other parts of the nation.

MEMORANDUM OF AGREEMENT (3 Jan 1992)

The MOA has the following provisions:

- 1) The Corps will withdraw the Post Authorization Change (PAC) report for the reallocation of storage in Lake Lanier for water supply.
- 2) Any existing water withdrawals may continue and may be increased to meet reasonable demands. Written notice must be provided to the other parties if existing withdrawals are increased by 10 mgd or more or if new withdrawals are initiated with consume 1 mgd or more.
- 3) During the Comprehensive Study, the Corps will operate the Federal reservoirs to maximize the water resources benefits to the basins as a whole.
- 4) The parties agree to support the Comprehensive Study and to contribute monetary and non-monetary support to the study.
- 5) The parties will agree to a system to facilitate the resolution of future disputes regarding the Comprehensive Study or the water resources of the ACF and ACT Basins.
- 6) The State of Alabama and the Corps shall file a motion with the U.S. District Court to assign the lawsuit to an inactive docket.

Also, an earlier Letter of Agreement signed (29 April 1991) by Alabama, Georgia and the Assistant Secretary of the Army for Civil Works, contained the following provisions:

- 1) Georgia will withdraw its Section 404 permit request for the proposed West Georgia Regional Reservoir.
- 2) Permanent reallocations at Carters Reservoir (2 mgd) and at Allatoona Reservoir (11.5 mgd) were agreed upon.
- 3) Georgia will participate in the Comprehensive Study.
- 4) Discussions will continue among the parties concerning water resources issues in the ACF Basin.
- 5) The Corps will cease further processing of previous reservoir reallocation reports.
- 6) The Comprehensive Study will be conducted from a basinwide perspective.

THE COMPREHENSIVE STUDY

Since the public workshops of July and August 1991, the four partners of the Comprehensive Study have been working towards defining the scopes of work, establishing a budget, and beginning the work effort through contract and within their own staff capabilities.

The goal of the study is to develop relevant technical information, strategies and plans and to recommend a formal coordination mechanism for the long term, basin

wide management and use of the water resources to meet the environmental, public health, and economic needs of the two basins.

This goal is being accomplished through four main objectives, listed below.

Water Demand Objective. conduct a comprehensive assessment of the demands for water resources in both basins. This assessment shall include historic (period of record), present, and future demands for the years 1995, 2000, 2010, 2020, and 2050, when appropriate. Demands shall include both instream and out-of-stream uses such as agriculture, environmental quality (including water quality, riverine, estuarine and terrestrial wildlife and habitat, wetlands and special natural resources such as the fresh-water needs of Apalachicola Bay), industrial, navigation, power generation, recreation, waste assimilation and water supply. Water resources include surface water, including reservoirs, and ground water.

Water Resources Availability Objective. Conduct a comprehensive assessment of the historic and present availability of surface and ground water resources in both basins. This will include the influence of climate (drought and flood) and pertinent physiographic factors such as topography and geology.

Comprehensive Management Strategy Objective. Develop implementable strategies for the planning period for the basins to guide water management decisions for a full range of hydrologic conditions, including flood and drought. Implementable strategies will consider methods to influence water availability, interbasin transfers, water conservation measures and other water management practices. Water management decisions are to consider the impacts of existing water resource commitments, the institutional framework, and a cumulative assessment of actions with the basins, being aware of the local, regional and national perspectives.

Coordination Mechanism Objective. Recommend a permanent coordination mechanism for the implementation of comprehensive management strategies.

STUDY MANAGEMENT

The four equal partners of the Comprehensive Study, Alabama, Georgia, Florida and the U.S. Army Corps of Engineers, have established a management structure with representatives from each party who are responsible for the overall management of the study process including reviewing and overseeing technical work, developing study costs and schedules, reviewing the results of the study and developing recommendations for the implementation of the study's findings.

This coordinated management structure includes the elements shown in Figure 1.

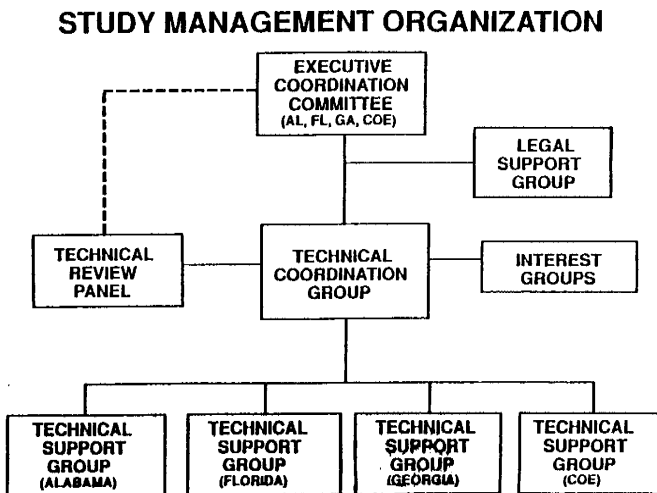


Figure 1. Study Management Organization.

SCOPES OF WORK

The study partners, Alabama, Florida, Georgia and the U.S. Army Corps of Engineers, through the Technical Coordination Group (TCG) began working on the detailed scopes of work for the study elements contained in the Plan of Study for the Comprehensive Study.

The partners recognized both the importance and complexity of the "scoping phase." The scopes are key to the entire study process and crucial for a successful study effort. Attention was focused on how these scopes of work were to be developed and structured so that interdependent relationships among the study elements could be identified and redundancy minimized.

The objectives of the various scopes, who has lead responsibility, and its current status are as follows:

Municipal and Industrial Water Demand (Georgia). The objectives of the municipal and industrial water demand scope are to collect existing and projected demands within the two basins through the planning period. Water use rates for municipal (gallons per capita per day) and industrial (gallons per employee per day) will be calculated from the historical data. Trends in water use rates will be determined and used in estimating future

water use.

The inventory phase will be conducted February to September 1993 through an existing contract with Gulf Engineers, Inc., out of Baton Rouge, Louisiana. The last phase of work will be conducted September 1993 to September 1994.

Apalachicola River and Bay (Florida). The objective of this scope is to gain knowledge of the bay and riverine system in order to characterize the freshwater and nutrient requirements for maintaining historic productivity and diversity in the system. The ecological relationships that exist in the Apalachicola River and Bay and the linkages and correlations between riverine and estuarine productivity will be examined. Physical attributes of the estuary and the relationships between the physical processes and biological productivity will be documented.

The Northwest Florida Water Management District will conduct this study.

Population and Employment (Corps). The objective is to produce forecasts of key economic and demographic variables to be employed in evaluating future demand for water throughout the ACF-ACT Study area. The forecasts will be produced for several geographic area delineations with the study area for the planning horizons 1995, 2000, 2010, 2020, and 2050. These forecasts will be used to calculate estimates of demand for water in the analyses of several demand elements such as municipal and industrial, recreational, agricultural and navigational demand. These forecasts will also be used in the Basinwide Management Elements of the Study to evaluate various economic scenarios in relation to changes in water supply and demand.

This work will be conducted October 1993 to August 1994 through professional services contract.

Basinwide Management Scope (Alabama). The objective is to develop a range of water management strategies to guide future water management decisions in the ACT and ACF basins. The study will be accomplished by analyzing the existing and projected water resource demands from the eight demand studies and comparing demands with the current availability of ground and surface water. Problems will be identified by geological location and expected time of occurrence through the period from 1995 to 2050. The study will then formulate alternative solutions and analyze the cumulative impacts of a reasonable number of the management strategies which can be used in a coordinated manner to address the water needs of the basins.

Recreation Demand Scope (Georgia). The focus of recreation studies in the basins will be to determine current and future recreation demand and use of reservoir, river and stream resources and the extent to which recrea-

recreation studies in the basins will be to determine current and future recreation demand and use of reservoir, river and stream resources and the extent to which recreation use and the value of recreation is affected for each incremental unit of water allocated to competing and future uses.

(1) Existing data for each water related recreation facility will be collected and consolidated. These data will include information on historic monthly and peak day visitation, and the types of facilities available, including capacity limits.

(2) Where possible, types of water dependent recreation uses will be categorized, including fishing, boating, skiing, swimming, etc. Existing data from Federal, state and private sources will be used extensively.

(3) Recreation values will be determined for each recreation facility.

(4) Recreation demand will be forecast, based on predicted changes in population and expected capacity constraints, for each area for the planning periods.

(5) The relationship of water levels and flows to recreation visitation will be determined.

It is expected that an initial regression analysis relating visitation to lake levels will be initiated March 1993, utilizing an existing contract with Gulf Engineers, Inc., and completed in December 1994.

Environmental Study Element (Florida). The purpose of this scope of work is to determine the environmental needs of the two basins as they relate to both water quality and quantity. After public review, the scope of work for the environmental study element was revised and then presented to the TCG in July 1992. It was recommended that the U.S. Fish and Wildlife Service (USFWS) assume the coordination of a multi-agency work group to implement this effort and that U.S. Army Corps of Engineers Waterways Experiment Station send a proposal to implement this scope.

In January 1993, a work order was executed for the National Wetland Inventory Map digitization for the main river segments.

Coordinating Mechanism/Institution Framework (Alabama). The objective of this study element is to analyze the existing institutional framework (legal parameters) and potential coordinating mechanism (organizational characteristics) to develop a basis for revising the legal framework, as necessary, and recommending a coordinating mechanism(s) for the future management of the water resources in the ACT/ACF basins.

The institutional framework will be studied by analyzing existing legislation and regulations of the three states and the federal government which impact water resource management in the two basins. Other arrangements of the institutional framework will be studied in conjunction with the coordinating mechanisms which exist in other states.

Alternatives for changing the institutional framework will be based on the alternatives developed in the Basinwide Management Program and an assessment of the probability of making changes to implement the identified alternatives.

The coordination mechanisms will be analyzed by studying effective intergovernmental relationships that exist in other river basins. Organizational characteristics, authority and implementation procedures will be adapted from the other organizations to fit the needs of the ACT/ACT basin.

Navigation Water Demand Scope (Corps). The objectives of the navigation water demand scope are to describe and quantify existing demand for navigation use of water in the basins and to forecast the future demands for water use in the basins. This scope will also provide information necessary to determine the effects of varying flow conditions on the navigability of the channels in the basins. Data collected will include the historic use of the navigation channels, the historic channel availability, the types of barges used, the typical configuration of barges in a single tow, the amounts of various commodities that are contained in full barge loads, and historic dredging and disposal area use data. Analyses of the transportation costs involved in using the waterways or using alternative modes of transportation will be made. An analysis of the dredging and disposal area use data will be made to determine the availability. A forecast of the future commodity movements that can be expected will be made. The relationship between savings in transportation and channel availability will be established so that the impacts of changes in system management decision can be estimated.

The inventory phase of the scope will be conducted March to December 1993, through an existing contract with Gulf Engineers, Inc. Subsequent phases will be conducted in December 1993 to October 1994.

Groundwater Supply Scope (Georgia). The objectives of the groundwater supply study are to determine the existing and potential future availability and quality of the groundwater resources within the basins. The study element is designed to estimate how much water can be withdrawn before adverse effects will be experienced by surface water resources. Additionally, the study element will address the potential limits on growth and/or groundwater use from existing aquifers before other sources of water from either surface water sources or other aquifers will need to be developed.

This work is expected to be performed by the U.S. Geological Survey (USGS), and is scheduled for March 1993 to April 1995.

Agricultural Demand (Alabama). The objective of this study element is to describe and quantify the existing and projected agricultural demand on water resources within

the ACT/ACF river basins through the year 2050.

Individual components of agricultural water use including irrigation, aquaculture, turf farms and nurseries will be analyzed and projected. Consideration will also be given to alternative growth scenarios within the agricultural sector.

The Study will be conducted by the Soil Conservation Service (SCS) offices in Alabama and Georgia and coordinated with the Florida SCS, beginning March 1993.

Water Quality Scope (Georgia). The objectives of the water quality scope are to describe and quantify the existing and projected waste assimilation demand on water resources by stream segment within the basins. The tasks are: (1) compile and analyze available relevant water quality data; (2) utilize existing models for analyzing waste assimilation capacities and current water quality conditions; (3) evaluate and assess a strategy for the basins' nonpoint sources for potential impacts on water quality; (4) determine the basins' waste assimilation demand and address the wasteload allocations for the years through 2050; and (5) evaluate the impacts alternative water resources plans will have on the basins' water quality.

The data analyses will identify critical areas of water quality concern, areas where additional data collection are needed to characterize the basins' water quality and stream segments where additional data are needed to complete the water quality modeling work.

The models will be used to measure and evaluate the effects of various point source loads and alternative water resource plans on the basins' overall water quality and to assure maintenance of water quality standards.

It is expected that this work will be performed through a professional services contract and/or by other Federal agencies. This study element is scheduled to be initiated in March 1993 and completed in July 1995.

Power Resources Water Demand Scope (Corps). The objectives are to describe and quantify the existing conditions under which electric power facilities (hydropower and thermal production) operate and to estimate the electric load and resource use in the future. The scope will also determine the potential effects of alternative flow conditions on power generation and propose alternative operating conditions for power generation consistent with other water resource management objectives in the two basins.

A permanent task force will be established to assist in establishing the baseline conditions from which impacts will be measured, propose alternative management strategies to be tested and perform other tasks assigned by the Technical Coordinating Group.

The efforts for describing the conditions under which power is produced is scheduled to begin in July 1993 and be completed by December 1993.

In the development of the scope, a task force was also

convened. The task force has met on four occasions to develop the scope of work. Each meeting was hosted by the Oglethorpe Power Company. Membership on the task force includes one member representing each study partner and a representative from the Southeastern Power Administration. Work to be accomplished under the currently proposed scope includes maps and a description of the complex interconnections between the various power producers in the southeast.

The value of the energy produced by power facilities in the basins and the impacts from management decisions will be measured by an economic dispatch model with input data from public sources and concerned utilities. The methodology for determining the value and subsequent impacts on dependable capacity as a result of management decisions is yet to be determined.

Since a very close relationship exists between the power resources scope and the surface water modelling scope, extensive coordination between the two scopes will be maintained throughout the study.

Database (Alabama). The database is the "empty file cabinet" which will become the repository for all study information. This work element is a necessary support function for the study. Through agreement with the states and the Corps, Alabama will contract for this work as a part of Alabama's contribution to the study.

Contractor selection is currently in progress and work is expected to begin in March 1993.

Surface Water Supply Scope (Corps). The objectives are to provide a comprehensive analysis of water resources through data gathering, modeling and/or other techniques, and to examine the needs for optimization and management studies.

The data gathering effort has produced a data base with most of the flow information expected to be needed during the analysis phase. Additional structuring of the data base may be necessary to accommodate modeling needs. Also there will be a need for additional hardware to improve accessibility of this data for other study elements.

For the analysis of water resources the use of HEC-5 modeling techniques have been approved. This study will involve development of simulation modeling to determine what are the existing water resources in the basins, and what are the natural conditions without influences of regulation and diversions. Once existing and natural conditions have been established, modeling techniques will be used to evaluate alternatives (variations in uses or regulation). An analysis of information produced from these alternatives will provide the basis for preparation of decision documents that will give details of cumulative impacts for various decisions. These impacts will be measured against "baseline" conditions which are existing conditions operated with expected future uses of water

resources. Both intermittent and final reports will be prepared with results displayed in arrays for interpolation of data.

Coordination with study partners, either directly or through the Technical Review Panel, will be extensive throughout the study process. It has been suggested that each study partner appoint a technical point of contact to represent them in this coordination.

There remains support among the study partners for optimization and management type studies under this scope of work. Optimization might be accomplished through "prescriptive" modeling and analysis, with values assigned to desired results. Management might involve an analysis of methods and techniques to properly monitor and operate regulation structures or diversions. Such management may include use of high technology devices.

STUDY BUDGET

The total budget for this Comprehensive Study has risen since the public meetings in July and August 1991, when it was estimated that the study effort would cost \$3 to \$5 million. After hearing the public's input at the public meetings outlining the study's goals and at the workshops on developing the Scope of Work, it was realized that more detail would be required to provide the information to meet the needs and expectations of the various publics in the two basins.

Based on public input, the budget for the study effort is now set at \$13,500,000. The budget total is a combination of Federal funding (\$11,250,000) and state funding (\$2,250,000).

LITERATURE CITED

- Mobile District, U. S. Army Corps of Engineers, January 16, 1992. "Chronology of Significant Actions/Events, Water Resources Conflicts, Alabama, Georgia and Florida," unpublished document, 7 pages.
- U.S. Army Corps of Engineers, Mobile District, "Comprehensive Water Resources Study Newsletter," Spring 1993.