

BUREAU OF RECLAMATION'S
HIGH PLAINS STATES GROUNDWATER RECHARGE DEMONSTRATION PROGRAM

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INTRODUCTION

The High Plains States Groundwater Demonstration Program Act of 1983 directs the secretary of the interior, acting through the Bureau of Reclamation, to engage in a special study of the potential for ground water recharge in the High Plains states (Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas and Wyoming) and other Reclamation Act states (Arizona, Colorado, Idaho, Montana, Nevada, North Dakota, Oregon, Utah and Washington).

The program is being carried out in two phases. Phase I consists of planning, development, and site selection, and Phase II includes design, construction, operation, and evaluation. The legislation established a two-year period for Phase I and a five-year period for Phase II. During Phase I, a detailed plan has been developed to construct demonstration projects. The cooperative non-federal/federal nature of the program has been a key element in the development of the plan. Maximum use has been made of the resources and assistance available from state and local entities. The key non-federal participants are the governors and their designated representatives from each of the 17 western states, as well as various officials from municipalities, irrigation districts and other local organizations.

In addition to non-federal cooperation, Reclamation has worked closely with sister agencies, the U.S. Geological Survey (USGS) and the Environmental Protection Agency (EPA), to formulate the program and evaluate the proposals. The Phase I report recommendations are the result of the active support and participation of the nonfederal interests, the USGS and the EPA.

Under the act, the plan is to contain not less than twelve demonstration sites in the High Plains states and not less than nine sites in the other Reclamation Act states. Demonstration project sites are located in areas having a declining water table, an available surface water supply, and a high probability of physical, chemical, and economic feasibility for recharge of the ground water reservoir.

The major themes of the program are as follows:

1. Operational/Demonstration Projects. The objective of this program is to move from research on ground water recharge to the pilot demonstration phase, and lay the groundwork for larger operational programs. Many technical and research studies have been undertaken; however, Congress, in passing the legislation intended that the emphasis be specifically on demonstration rather than new research. In that regard, maximum use was to be made of existing information, studies and projects.
2. Recharge Orientation. The emphasis of the program is on ground water recharge. Conjunctive use, conservation, and management of existing supplies are important tools in an overall resource management scheme; however, they are not intended to be the primary purpose of this program. Conditions of actual regional declining ground water levels on a long-term basis are considered to be at the heart of the program.
3. Local Supplies. The program expects local surface water supplies to be used in recharging nearby aquifers. Specifically excluded from legislation was the authorization of interbasin transfers of water. In fact, the law prohibits study of use of water originating in the drainage basin of the Great Lakes or from the state of Arkansas. The underlying theme of the Congress was "small and local." This constraint, while clear, limits the practical effect of demonstrating recharge of depleted aquifers on a regional basis. It is unfortunately true that, in the very areas where ground water overdraft and water level decline are most severe, a local surface supply is usually not available or is only available during high streamflows. Often the surface supply is fully appropriated. Nevertheless, demonstrating maximum effective use of all available local water supplies is a cornerstone of the program. Such efforts can make a significant contribution to the arrest of declining ground water situations.
4. Nonstructural. A widely held view that needs to be tested and confirmed is whether ground water recharge is a more economical and environmentally safe way to store water for future use than are massive new dams. These low capital intensive methods of meeting future water needs hold great promise for managing our limited water resources. However, they are not without problems, particularly the need to maintain and protect ground water quality. Addressing these problems is a major goal of the program.
5. Institutional and Legal. The program will examine the institutional and legal aspects of ground water recharge. Recent attempts by states to establish agreements

for managing ground water basins indicate the high level of awareness of the limitations of ground water to fully supplement surface supply. These issues will be explored in a special study during Phase II as part of the overall study.

6. Uniqueness. The authorizing legislation specifically states that the purpose of the plan is to determine whether various recharge technologies may be applied to diverse geologic and hydrologic conditions. During the technical evaluation of the proposals, Reclamation took note of those proposals which provide an opportunity to test technologies under new conditions.

The program officially began with the apportionment of funds by the Office of Management and Budget to the Bureau of Reclamation on December 2, 1985. The authorizing legislation requires a report on Phase I within 24 months of the appropriation of funds. Thus, the goal of Reclamation has been to transmit the Phase I report to Congress by December 1, 1987. The act authorized the appropriation of \$500,000 for Phase I and \$20 million for Phase II.

Early and active involvement of the 17 western states was the principal way the program was to be accomplished. Accordingly, each governor was asked to designate his representative to work with Reclamation. The state representatives reviewed the concepts included in the site nomination and selection process, and provided ideas and information which were incorporated into the evaluation process.

To ensure that individual state policies and program priorities were recognized in the development of this program, each governor reviewed, prioritized, and submitted their proposals to Reclamation. The governor's transmittal is a critical step in the planning phase as his prioritization of proposals helped ensure that each state's particular program direction was considered in the site selection.

The evaluation process included USGS evaluation of the hydrologic and geologic aspects of proposals including the monitoring plan; EPA review of the plans for monitoring and evaluation of general water quality impacts from artificial recharge; and Reclamation evaluation of engineering, economic, environmental and legal aspects of proposals, and public acceptability.

TECHNICAL EVALUATION OF PROJECT PROPOSALS

Reclamation received 41 proposals involving a wide range of types of recharge project proposals. Some proposals involve using existing recharge projects and increasing the facilities for recharge and/or monitoring. Other proposals plan to use existing conveyance facilities to transport surface water to potential recharge sites; still others propose to use existing pits or ponds to store recharge water supplies and existing or abandoned wells to inject recharge water supplies into the aquifers.

The majority of the proposals however, call for the construction of new facilities. These facilities include channel diversion structures, retention dikes and gates, flushable gravel filters, sediment ponds, dual-purpose (injection and extraction) wells, monitoring systems, spreading mechanisms, percolation ponds, underground barriers, and shallow dry wells. Several ways to obtain the necessary water supplies are proposed. Some proposals are based upon accumulation of snow; some use excess spring runoff; and some use treated effluent. Exchanges of water to obtain a recharge supply also are being considered. Some proposals take advantage of fluctuations in seasonal water supply or demand to obtain water for recharge demonstration purposes. In addition to the objective of increasing aquifer supplies, some proposals would evaluate the reduction or stabilization of land subsidence through injection of water into underlying aquifers. Other proposals would reduce salt-water intrusion into aquifers using injection wells.

Figure 1 shows the location of all 41 proposals. The proposals have been reviewed and evaluated by the three federal agencies, using the procedures and criteria process developed jointly by Reclamation, the USGS, and the EPA. Each proposal was subjected to an initial screening derived from the requirements specified in the act, including a declining water table, an available surface water supply, and a high probability of physical, chemical and economic feasibility for recharge of the ground water reservoir. The specific screening criteria developed were as follows:

Screening Criteria:

- Declining Water Table
- An Available Surface Water Supply
- A Minimum of 20% Non-Federal Cost Sharing
- Lack of Serious Environmental Problems
- Public Acceptability of Proposal
- Received a Priority from the Governor



Figure 1. High Plains States Groundwater Demonstration Program
Location of Proposed Recharge Demonstration Sites

As a practical matter, all proposals received were given a full technical evaluation, since on initial screening all appeared to pass the screening tests. All proposals underwent additional evaluation during which a detailed analysis was made of the following eleven factors.

Geohydrologic Feasibility	Cost Sharing
Engineering Feasibility	Federal Cost versus Total Cost
Cost Estimate	Legal and Institutional Issues
Legal Access	Environmental Issues
Monitoring	Uniqueness
Rehabilitation Plan	

The total evaluation process proved to be iterative in that, in some cases, during the detailed evaluations, additional information was developed indicating serious environmental problems, lack of priority established by the governor, or absence of a declining water table.

RECOMMENDED PLAN

After each project had been technically scored and evaluated, an overall plan was developed. In selecting projects to be included in the final recommended plan, four overall objectives were considered.

- Technical Merit
- Environmental Clearance Requirements
- Requirements of the Act (Public Law 98-434)
- Cost Ceiling Constraints

The process for selecting projects for Phase II considered both quantitative and qualitative or judgmental factors. The four overall objectives had to be balanced and traded off where all four objectives could not be achieved simultaneously. Often constraints imposed by one objective had a very limiting effect on the proposals that would be otherwise selected based on other objectives.

Technical Merit. Technical merit was measured objectively by the overall technical score achieved by each proposal based on Reclamation regional evaluations. Proposals were selected on the basis of technical score, unless constrained by other considerations that could not be included in the eleven technical evaluation factors.

These other considerations included:

-Responsiveness to the intent of the act to recharge aquifers. Even though all proposals passed the screening criteria requiring the existence of a declining water table, some proposals were in areas where the declining water table was very localized, or even seasonal. These proposals dealt with conjunctive use where water was being used more efficiently, allowing for seasonal storage. These proposals, while very meritorious from the standpoint of conserving and managing water more efficiently, are not located in long-term regional declining water table situations.

-Balance in types or recharge projects. Another technical consideration was the goal of promoting the opportunity to develop unique recharge situations and obtaining a balance in the types of recharge technology being tested. Examples of recharge technologies included in the proposals were deep-well injection, in-channel methods, spreading basins and land treatment.

-Uniqueness. Testing diverse and varied recharge technologies was a purpose specified in the act. In making the final selections, a judgment was made on whether to place certain proposals in the recommended plan to achieve a balance in technologies in the program that could not be measured by simply taking the highest score.

Environmental Clearance Requirements. Only proposals for which all environmental compliance requirements are or can reasonably be expected to be achieved are included in the recommended plan. This includes completing requirements of appropriate compliance under the National Environmental Policy Act (NEPA), Fish and Wildlife Coordination Act, Endangered Species Act, Clean Water Act, Safe Drinking Water Act, and National Historic Preservation Act.

Requirements of the Act (Public Law 98-434). The act requires a minimum of twelve projects to be selected in the eight High Plains states and a minimum of nine in the remaining Reclamation Act states. Although not specifically stated, the inference is that the recharge demonstration projects are to be apportioned in a geographically diverse manner among the states.

The act also requires Reclamation to contract with the states to conduct a study to identify and evaluate alternative means by which the costs of ground water recharge projects could be allocated among the beneficiaries of the projects within the respective states and identify and evaluate the economic feasibility of and the legal authority for utilizing ground water recharge in water resources development projects. This program will be carried out in Phase II.

Cost Ceiling Constraints. The act authorizes \$20,000,000 at October 1983 prices for Phase II demonstration projects. Adjusted for inflation, this would permit expenditures of \$21,125,000 at September 1986 price levels, the date when the proposals were submitted.

In formulating the recommended plan, the authorization ceiling of \$21,125,000 (September 1986 prices) was considered a constraint. However, this authorized cost ceiling was not considered a target. Rather, the overriding objective was to meet the goal of selecting a minimum of 21 demonstration projects which were the most technically sound, environmentally safe, and which would contribute the most to new and innovative ground water recharge technology.

The range in costs for the 41 proposals received varied from \$80,000 to \$3,263,000 (federal project costs). Thus, even though some proposals were very highly rated, the cost of their inclusion could preclude a number of other desirable projects. It was not feasible to quantitatively trade off the specific technical merits of one large proposal versus a number of smaller proposals. Therefore, judgment was used in making the selections by considering the objectives of attaining a balance between recharge techniques, and institutional, geographic, hydrogeologic, and climatic settings.

In the final selection process, only those projects that could be fully certified as environmentally sound at the time of the final Phase I report were selected. This meant that some projects that might significantly contribute to ground water recharge information had to be dropped from consideration. In some cases, those projects have a high probability of eventually meeting environmental compliance requirements. However, due to the complexity of the environmental issues and the time required for environmental compliance, they are precluded from consideration for selection. If recommended projects drop out due to lack of sponsor support or for unforeseen technical or institutional problems, sponsors of the other proposed projects will be contacted about their interest in being reconsidered.

The recommended plan, displayed in Table 1, includes 21 projects in 15 states: 12 projects in the High Plains states and nine projects in the other western states. The location of the recommended projects are shown in Figure 2. Federal costs would be \$18,520,400 including costs for the economic study and program coordination. This is below the authorized program cost ceiling (indexed) of \$21,125,000. The difference between proposed program costs and authorized ceiling provides for contingencies to allow for future cost escalation or other changes in program costs.

Two states do not have projects in the recommended plan. North Dakota did not submit any proposals. Wyoming, a High Plains state, submitted one proposal; however, the proposal was rated technically deficient on environmental, hydrological, legal, and institutional factors.

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Table 1
Recommended Plan

Proposal	Priority		Environ. Category	USGS Rating	% Cost Share	Total Project Cost \$1000
	State	Regional				
<u>High Plains States</u>						
Colorado						
Plains-Arikaree	1	3 of 11	4	1.0	20.0	196
Frenchman	2	7 of 11	4	.1	57.0	186
Denver Basin Aquifer	4	2 of 11	4	1.0	53.1	2283
Kansas						
Smoky Hill	1	1 of 11	2	1.0	20.0	890
Equus Beds	1	3 of 7	3	1.0	33.0	3583
Big Bend	2	2 of 7	4	1.0	20.0	133
Nebraska						
York	1	4 of 11	2	.95	20.0	1169
Adams County	2	6 of 11	3	.6	20.0	645
New Mexico						
Alamogordo	1	4 of 7	4	.8	20.0	582
Oklahoma						
Blaine Gypsum	1	6 of 7	3	.4	20.0	896
South Dakota						
Huron	1	9 of 11	3	.4	20.0	1132
Texas						
Hueco Bolson	2	1 of 7	4	1.0	30.4	412
<u>Other Western States</u>						
Arizona						
Rillito Creek	1	2 of 6	3	.5	46.4	2726
California						
Arcade	1	2 of 7	4	.9	20.0	399
Stockton	2	5 of 7	3	.8	20.0	1055
Idaho						
Southwest Irrig. Dist.	1	6 of 7	3	.9	20.0	3028
Montana						
Turner-Hogeland	1	5 of 11	4	.3	20.0	795
Nevada						
Washoe County	1	1 of 6	2	.9	20.0	945
Oregon						
Hermiston	2	3 of 7	4	.75	20.0	952
Utah						
SE Salt Lake County	2	1 of 3	4	.9	56.3	3336
Washington						
Highline Well Field	1	1 of 7	4	.7	20.0	812



**Figure 2. High Plains States Groundwater Demonstration Program
Location of Recommended Phase II Recharge Demonstration Sites**