

Publications

TR- 95

Institutional Arrangements for Effective Groundwater Management to Halt Land Subsidence

W. L. Brah, L. L. Jones

- [Full Text](#)

In the Upper Galveston Bay region of the Texas coastal zone, water from naturally replenished underground aquifers provides much of the freshwater supply for municipal, industrial and agricultural needs. The availability of these easily accessible low cost freshwater supplies has contributed to the building of a strong and dynamic economic base. However use of these common water supplies in excess of natural replenishment has resulted in a gradual but accelerated and irreversible subsidence of the land surface throughout the region. The cause is long term and due to collective use of groundwater.

This natural phenomenon generally exhibits the range of characteristics expected when the carrying capacity of valuable common property resources is exceeded under dynamic socio-economic use pressures. These characteristics include competing and conflicting resource use, externalities (socioeconomic and environmental impacts) and

complex social, legal and political dilemmas.

Regional use of groundwater in excess of the "safe" production potential of the underground water bearing system has caused physical and economic losses in the coastal areas. Surface subsidence in excess of 8.5 feet has resulted in serious socio-economic and environmental impacts because of the loss of land elevations in already low shoreland areas. Bay waters have permanently inundated previously valuable commercial, industrial, recreational, municipal and private property. Subsidence has increased the susceptibility of much of the region to destruction through tidal surges generated by tropical storms and hurricanes. Conceivably, the somewhat inchoate interests of approximately 350,000 persons and large numbers of state and private enterprises located in susceptible coastal areas are affected.

The natural phenomenon of subsidence, and its technical solution decreased groundwater use and/or use of alternative surface water supplies, pose difficult institutional questions and equity issues both to public and private sectors that as yet remain unanswered and unresolved.

Traditionally, groundwater has been treated as a free good or at least a relatively cheap one. Since owners of private property overlying the water bearing system are afforded legal proprietary interest in the water in Texas, the regional groundwater resources have been developed and used primarily on an individual, uncoordinated basis with little or no concern for the relationship between extraction and natural replenishment, or regard for any collateral effects of groundwater use. Social costs are unregistered under such an arrangement and only private costs are considered by users. Institutions governing the use and allocation of groundwater resources were primitive or nonexistent. Therefore, effective action to arrest the ever increasing overdraft was absent. With increased water use, however, subsidence related costs have become apparent.

For many years the majority of groundwater users ignored the subsidence problem since it was thought to affect and indeed was only felt by a minority of local land owners

and waters users bordering on coastal bays and other water courses. Even though the implication (for example, hurricane threat) of subsidence to the region was recognized, an internal cost differential between groundwater and surface water sources hindered voluntary conversion to the higher cost surface water by the collectivity of groundwater users. Aggregate social costs generated by overuse of groundwater exceeded the aggregate price differential, but these social costs were largely unregistered. They were felt only by a minority of community interests in a manner disproportionate to their use of the groundwater. Logically, therefore, intensive use of inexpensive groundwater continued.

Although industrial, municipal, agricultural and private interests were interrelated through the common use of the aquifer, a basis for collective action was difficult because of conflicting interests. In the early 1970's a movement began to form some collective organization to soften the conflict and aid individuals to allocate the regional water resources in such a manner as to abate and control surface subsidence; to enable individuals to compete peacefully for scarce resources in a manner that would lead to a satisfactory allocation of currently available or potential supplies of water resources. Water users were thus confronted with the problem of rearranging decision-making capabilities.

The execution of a solution was generally beyond individual water user's scope of action due to physical, legal and economic factors.

Existing collective organizations and institutions were also viewed as inadequate for this purpose. Water related institutions were vertically and horizontally fragmented, each dealing with some aspect of groundwater use and development but political entities with adequate scope to deal with the problem were either unwilling or unable to engage in regional water management. Indeed, these political organizations and other institutions may have actually contributed to the subsidence problem. They were not only ill equipped to respond, but also were primarily designed for water use, and may have provided incentives to their constituents to continue using groundwater and to generally

disregard the overall community interest.

Hence, the greater problem in the short run was not one of a shortage of water, but one of creating institutional arrangements to interrelate users of common water supplies and to obtain conjunctive use of surface water with groundwater so that effective management and subsidence control could result.

The issues to be addressed were not how shall a resource be allocated among users competing for the inexpensive supply, and the more complex question of how users shall allocate their use of groundwater as against the more expensive surface water. It is an economic dilemma of how best to use existing water supplies and how and when to expand existing water supplies as the demand for water increases. If aggregate demand for water were not met, pressure would be brought to bear upon "scarce" groundwater resources, exacerbating the subsidence of the land. A management institution was needed to devise an acceptable decision system to reorder incentives for groundwater use into disincentives and to reorder disincentives for surface water into incentives. In short, legal, physical and economic relationships between the community of interests embedded in existing institutional arrangements needed to be redefined and restructured. This implied a progressive departure from the traditional way of allocating groundwater resources.

Much time, energy and resources was spent by the local community in deciding upon an optimal institutional strategy and devising self-governing organizational arrangements to express their interests and solve their problems. However, the community was hampered in its efforts by obstructions imposed by existing institutional arrangements and by a change resistant political climate of the State Legislature whose authorization for local proposals for an institutional solution was needed. The political mechanism attained by the community through concerted effort was a special purpose subsidence control district which could respond to the threatening problem only in a limited fashion. The emphasis was on subsidence control through well spacing, regulation and permits, rather than on a more comprehensive approach of integrated and coordinated

conjunctive water resource management. Such a district is able only to force important management issues and problems onto other political entities, and must leave many equity issues and needs unresolved and unanswered.

It is the purpose of this report to evaluate alternative political structures for comprehensive management of the subsidence area's complex water problems. Alternative arrangements of legal, economic and political institutions with the capacity and ability to conjunctively manage regional ground and surface water resources to abate and control subsidence are developed and examined. These alternative institutional arrangements are based on both practical and theoretical management methods advanced in the literature on water resource management for solving commonality problems in the use of groundwater resources.

Texas Water Resources Institute

1500 Research Parkway A110
2260 TAMU
College Station, TX 77843-2260

TWRI and the [Texas A&M Institute of Renewable Natural Resources](#) are working together to foster and communicate research and educational outreach programs focused on water and natural resources science and management issues in Texas and beyond.

Phone: 979.845.1851
Fax: 979.845.0662
Email: twri@tamu.edu



[Compact with Texans](#) | [Privacy and Security](#) | [Accessibility Policy](#) | [State Link Policy](#) | [Statewide Search](#)
[Plug-ins](#) | [Veterans Benefits](#) | [Military Families](#) | [Texas Homeland Security](#) | [Open Records/Public Information](#)
[Equal Opportunity Statement](#) | [Risk, Fraud & Misconduct Hotline](#)

© 2013 All rights reserved. Problem with this page? Contact: twri-webmaster@tamu.edu

| [SSO](#) |

[CANOPY](#)