

TEXAS WATER DEVELOPMENT BOARD

REPORT 89

LAWS AND PROGRAMS
pertaining to
WATER AND RELATED LAND RESOURCES

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Red River below Denison Dam

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LAWS AND PROGRAMS
pertaining to
WATER AND RELATED LAND RESOURCES

A. INTRODUCTION

The Texas Water Development Board participated with the Red River Coordinating Committee in preparing a comprehensive basin study of the lower Red River below the Denison Dam. The Committee report investigated the physical and economic potentialities and problems of the Red River basin having a nexus with water and related land resources. The report further catalogued the needs for development and made recommendations in attaining that goal.

The Texas Water Development Board prepared an appendix to the Committee report summarizing the State of Texas laws, policies, and programs pertaining to water and related land resources. Because of the interest expressed in the appendix, the Board has here revised the original appendix text for general distribution to the public.

Laws and Programs Pertaining to Water and Related Land Resources introduces one to the history of our State's water law and its present development; the different state agencies concerned with Texas water and their mutual cooperation; and, finally, the roles the many districts, local agencies, and interstate compacts perform in coordinating the State of Texas water laws and programs.

B. STATE LAW

1. Fundamental Precepts of State Water Law

Texas water policy has been influenced by the Civil Law of Spain, and Mexico, the Common Law of England through reception statutes, the enactments of the Republic of Texas, and later by those of the Texas State Legislature. Article XVI, Section 59 of the State Constitution embodies the principle that the State has the right and duty to develop and conserve its water resources. The Legislature has the power to pass all laws consistent with the general policy as stated by the constitutional provision.

Article 7467 Vernon's Annotated Texas Civil Statutes reserves to the State title to waters of (1) streambeds and their underflow, (2) lakes, (3) bays or arms of the Gulf of Mexico, and (4) the storm, flood, or rain waters of every river or natural stream, canyon, ravine, depression, or watershed within the State. Beds of navigable waters in Texas are also property of the State.

2. Water Rights

a. Water Right Doctrines Recognized in Texas

Two basic doctrines of surface water rights are recognized in Texas, the Appropriation doctrine and the Riparian doctrine. The corresponding water rights perfected under these are commonly referred to respectively as appropriative rights and riparian rights. The riparian right arises by operation of common law concepts as an incident to the ownership of land abutting a stream or watercourse, requiring no act other than the acquisition of title to the land (but see the discussion of Water Rights Adjudication Act of 1967, beginning on page 14). The appropriative right, on the other hand, is regulated by statute. It is not necessarily related to the land ownership and is today acquired by compliance with statutory requirements implemented by the rules and regulations of the Texas Water Rights Commission. Ownership and control over ground water is generally left exclusively to the owner of the surface estate. However, ground-water concepts are currently the subject of review. Modifications and exceptions to basic ground-water doctrine will be discussed later.

b. Surface-Water Law in Texas

Sources of water generally are categorized as surface or underground. Surface water may be classified either as diffused surface water, or as water within a defined watercourse. Diffused surface waters are those which occur in a natural state in places on the earth's surface other than in a watercourse, lake, or pond. A watercourse is defined as an identifiable natural stream having a definite natural channel originating from a

definite source of supply; waters in a watercourse may be subclassified as (a) ordinary or normal flow, (b) underflow, and (c) storm and flood water, as follows:

- (a) The ordinary or normal flow of a watercourse has been judicially defined as a flow below the line "which the stream reaches and maintains for a sufficient length of time to become characteristic when its waters are in their ordinary, normal and usual conditions, uninfluenced by recent rainfall or surface runoff." [*Mott v. Boyd*, 116 Tex. 82, 286 S. W. 458 (1926)].
- (b) The underflow consists of water in the sand, soil, and gravel immediately below the bed of an open stream, which supports the surface stream in its natural state or feeds it directly, together with the water in the lateral extensions of the subterranean water-bearing material on each side of the surface channel.
- (c) The storm and flood water is primarily the collected diffused surface water from recent precipitation.

The legal distinction between ordinary flow, underflow, and storm and flood flow is particularly significant in reconciling conflicting claims to the same water supply, which arise because of the dual recognition in Texas of both riparian and appropriation doctrines. The riparian right concept relates to and is concerned only with the ordinary flow and underflow of a stream. A riparian right does not attach to that portion of a stream comprised of storm and flood flow, and therefore generally will not attach to waters impounded by large reservoirs.

Diffused surface waters are considered to be private waters and are subject to capture and use by the owners of the surface estate. No State regulation of use is exercised with respect to diffused surface water until it reaches a watercourse.

(1) The Riparian Doctrine

Although not defined in Texas statutes, riparian rights are mentioned in legislative acts. Some of these statutory references appear contradictory.

In 1840 the Republic of Texas adopted the Common Law of England as the rule of decision insofar as it was not inconsistent with the Constitution and Acts

then in force. The judicial application and recognition of the riparian right concept in Texas began in 1856 with what is probably the first reported Texas court decision involving any phase of water law (See *Haas v. Choussard* 17 Tex. 588). In this case, the court quoted with approval the classic common law riparian doctrine, that except for his natural wants, a riparian user could not diminish the quantity of water in a stream that would otherwise flow past downstream riparian owners.

A subsequent series of court decisions created considerable contradiction and confusion. Initially, the courts held that irrigation was a natural use and that downstream riparian owners could not complain if upstream riparian owners consumed the entire water supply for irrigation. This was followed by contradictory decisions that irrigation was not a natural use of water, but was an artificial use. Still later, the courts held that if a particular stream were sufficiently large to permit irrigation without unreasonable impairment of the rights of downstream riparian owners, the use of water for irrigation would be lawful. In 1926 the entire subject of riparian and appropriative rights was considered by the Supreme Court of Texas in the case of *Mott v. Boyd*. The court concluded that since the Mexican decree of 1823, all of the several governments which had been sovereign in the State had recognized the right of the riparian owner to use water, not only for his domestic and household use, but for irrigation as well. The riparian right was held to attach to the ordinary or normal flow of a watercourse.

However, in 1962 the State Supreme Court, in the case of *Valmount Plantations et al v. The State of Texas*, held that Spanish and Mexican grants do not have appurtenant riparian irrigation rights in the absence of specific grants of irrigation water.

(2) The Appropriation Doctrine

(a) Historical Evolution of the Appropriation Doctrine

The Appropriation Doctrine evolved in the arid western states of the United States, from whence Texas water statutes were largely borrowed. Nevada, Colorado, and particularly Nebraska, contributed substantially to the text of early Texas water law. An understanding of the historical setting for early legal development is essential in relating water law concepts to present day planning problems.

With the exception of Texas and the comparatively small areas included in Spanish and Mexican land grants, the Western United States (from whence later Texas appropriation law was borrowed) was a part of a vast public domain administered and distributed by the United States government. In those vast areas, the federal government did not assert the same ownership of public water as it did of public land. Hence, the land was

disposed of without regard to available water. Rights to streams were not acquired by any orderly or systematic administrative procedure.

The failure of the federal and state governments to assert control over streams and dispose of them as a great public resource left water to be treated as though it belonged to no one, and could be appropriated in a manner similar to that of a gold claim. In the absence of public control, men took water from streams and used it; that is, they "appropriated" it—using the word "appropriate" in its ordinary sense: to take for one's own use. When water laws were enacted, this appropriation practice was legalized and the basis of such laws became known as the Doctrine of Appropriation. This concept is contrary on the one hand to the common law doctrine of riparian right (which strictly construed demands that water must not be taken from the stream unless it can be returned undiminished in volume), and on the other hand, to a public policy of permanent governmental control under a system whereby all water is disposed of by license, which had been adopted in some European countries, the British Colonies, and a few of the arid states.

Originally the Appropriation Doctrine was simply that anyone needing water had the right to take it. Changed conditions in the West, resulting from population growth and the consequent increase in demand for water, produced many limitations and modifications. Early definitions of appropriations contained in court decisions do not agree. The following is a synopsis of early concepts and doctrines which, in combination, form the basis of the Appropriation Doctrine:

(i) *Doctrine of Priority.*—Justice seemed to demand that when there was not water enough for all, those who first used water from a stream should have the superior right to continue that use, and the Doctrine of Priority resulted. The doctrine originated with the belief of the first settlers that their claims were superior to those of later comers, and they insisted that the owner of the last ditch or facility built should be the first to suffer when a stream failed to supply the needs of all. The first builders of water facilities could not anticipate how many were to follow. Unless protected by some such principle, the greater their success, the sooner they would be injured by the attempts of others to benefit by their experience. The general principle, that among appropriators the first in time is the first in right, is now a recognized rule in the water laws of the arid region and was so recognized by the end of the last century.

(ii) *Doctrine of Relation.*—Since many ditches were built about the same time, it became necessary to prescribe rules in determining when a right should attach. If the right should date from the time of actual use of the water, a premium would be placed upon poor

construction. It might happen that during the construction of a large canal, smaller canals or those more easily built might be begun and completed and appropriate all water, leaving the large canal a total loss to its builders. To avoid this, the Doctrine of Relation was adopted; that is, the right does not date from the time the water is used but relates back to the time of the beginning of the work.

(iii) *Modification as to Due Diligence.*—To prevent abuse, the doctrine of relation discussed above was modified by the provision that the work of construction must be carried on with "due diligence." Under the Doctrine of Relation, a water right is *initiated* when the work of construction begins, and dates from that time, but is not *perfected* until the water has been actually diverted and used. The question of "What is due diligence?" is a question of fact to be determined in each particular case, and when such diligence is not exercised, the right dates from the time of use.

(iv) *Beneficial Use—Limit as to Quantity.*—As scarcity of water led to the adoption of the Doctrine of Priority, the two led to the necessity of defining the quantity of water to which an appropriator should be entitled. While the early appropriators were entitled to protection in their use of water, the later comers had equal claim to protection from an enlargement of those uses. The first appropriator had the first right, but he did not have the right to take all the water he might want at any future time. His rights must, in justice to others, be defined as to quantity as well as to time. In theory, "beneficial use" has been made the measure of a right as to quantity. What constitutes "beneficial use," and the determination of the quantity of water so used, is left to the courts in most states.

(v) *Notice.*—With the adoption of the Doctrine of Priority, the need to provide notice of the extent of rights already acquired became apparent. Such notice was needed both for the protection of the rights already in existence, and as a warning to intending investors of the extent to which the stream waters had been preempted.

Initially, most western states, except Colorado and Texas, required the actual physical posting of a written notice at the intended point of diversion. While this procedure was undoubtedly an adaptation of the system of "posting" a gold or mineral claim with a physical monument containing a written description of the claim, there is little similarity between a stationary gold claim and the fluid movement of water on its way to the sea.

The diversion of water without any official record of the time or place of use produced much confusion and hardship when it became necessary to determine the priorities and amounts of appropriations. In early years,

the absence of official records meant that facts which governed rights in the stream had to be established by testimony. Often this determination was required many years after the irrigation appropriation had begun and continued for several generations. Eyewitnesses to the early development frequently were unavailable. The memory of those actually present was often faulty. Wide discrepancies regarding the dates of beginning the work, the size of the ditches, and the amounts of water used were the rule rather than the exception.

To achieve greater permanence, and to afford something approaching actual notice, most State statutes eventually required public registration of the claim in the office of the county clerk. Inadequate supervision coupled with poor understanding of the law by appropriators resulted in a "system" whereby all one need do to claim his own stream or river was present a proper fee to the registry official with a document setting forth his claim.

Many streams have appropriations many times the available yield. Sometimes cities claimed entire rivers without regard to earlier established concepts requiring "beneficial use." Disregard, carelessness, and misunderstanding of the law and its requirements evolved into habit, habit into community-accepted custom, and custom in some instances became generally but erroneously accepted as law. Throughout the arid western states, it is today common for holders of these early filings to flaunt them as superior vested rights—absolute and secure against the State—when there exists no relation between "beneficial use" and the appropriation claimed, and the requirement of "due diligence" has been completely disregarded.

(b) Development of Appropriative Rights in Texas

Prior to the 1870's, Texas water legislation was limited to a number of special laws granting franchises to particular canal companies and individuals for the construction of dams and canals to utilize specified quantities of water for beneficial purposes, and to an 1852 Act giving each County Commissioners Court administrative control over water distribution systems within the county.

The Private Corporations Act of 1871 permitted the organization of canal companies for the purpose of irrigation. Acts were passed in 1875 and 1876 which authorized the donation of public lands to canal companies for canal construction. These Acts were later construed to mean that the act of incorporating a canal company authorized the company to acquire a right to use water, but did not actually confer the perfected right.

The first effort to establish the doctrine of Prior Appropriation within the State was made in the Irrigation Act of 1889. This statute was rewritten and

reenacted in 1895. Both Acts declared that the unappropriated waters of every river or natural stream, within the arid areas of the State where irrigation was necessary for agricultural purposes, were the property of the public and subject to appropriation. A system of registration was established which required the filing of a sworn statement or "certified filing," describing the proposed appropriation of water. The statements were to be filed with a county clerk in the county where the point of diversion was to be located. As between appropriators, the first in time was to have a prior claim to a given water supply.

In 1913, the Texas Legislature completely rewrote laws relating to the use of water. The new act extended the classical system of prior appropriation to the entire State whereas the Acts of 1889 and 1895 had applied only to the arid portions of the State. A most important feature of the new act was the establishment of a Board of Water Engineers with original jurisdiction over all applications to appropriate water. That agency has functioned since 1913, having been renamed the Texas Water Commission in January 1962 and the Texas Water Rights Commission effective September 1, 1965.

(i) Certified Filings.—The 1913 Irrigation Act required everyone who had constructed or partially constructed a system for the diversion and use of water to file a sworn statement describing the system with the county clerk of the county where the point of diversion was located, if they had not previously done so in accordance with the Acts of 1889 and 1895. The Act also required anyone who had actually taken or diverted water for beneficial use prior to January 1, 1913, to file a certified copy of the previous statement recorded in the county clerk's office with the Texas Board of Water Engineers, together with a sworn statement describing the system and the amount and purpose for which water was diverted and used. An initial time limit of one year for compliance with the provision was later extended to 1916. The Act provided that those who filed with the Board "shall, as against the State, have the right to take and divert such water to the amount or volume thus being actually used and applied."

Together, the two statements filed with the Board came to be known as "Certified Filings" and are now so defined by statutes. Many of these filings declared an intent to irrigate several hundred thousand acres of land. Many of these large filings were never developed in accordance with the sworn statement describing the irrigation system, nor have the vast acreages been irrigated. Some of these undeveloped certified filings have been cancelled by subsequent action of the Texas Water Rights Commission. The extent to which other undeveloped certified filings should be recognized as vested rights to water use remains one of the several unresolved questions affecting optimum development of the water resources within the State. It is a matter of conjecture as to how many of these early rights could be

maintained in litigation today since many declared appropriations (1) never *attached* by virtue of the Doctrine of Due Diligence, or (2) were never *limited* as to quantity measured by "beneficial use," or (3) have been *abandoned*.

(ii) *Appropriation Permits.*—The Irrigation Act of 1913 was revised and reenacted in 1917. A principal feature of the Act of 1917 authorized the Texas Board of Water Engineers to adjudicate water rights. This provision of the Act was held unconstitutional in 1921. The Act of 1917, without the adjudicative provision, was reported in the 1925 revision of the Texas Civil Statutes and, with numerous amendments, remains the statutory basis for appropriative right concepts in the State today.

Present-day statutes retain the cornerstone of the prior appropriation doctrine in that "as between appropriators, the first in time is the first in right." To this cornerstone, the statutes add the following concept of actual beneficial use as a limit to the measure and extent of a perfected water right: "Rights to the use of water acquired under the provisions of this chapter shall be limited and restricted to so much thereof as may be necessarily required when beneficially used for the purposes stated in this chapter, irrespective of the capacity of the ditch or other works, and all the water not so applied shall not be considered as appropriated." Beneficial use is defined as "the use of such a quantity of water, when reasonable intelligence and reasonable diligence are exercised in its application for a lawful purpose, as is economically necessary for that purpose." (Article 7476, V.A.C.S.)

In 1931, a proviso was added that all appropriations of water for any purpose other than domestic and municipal purposes "shall be granted subject to the right of any city, town, or municipality . . . to make further appropriations of said water thereafter without the necessity of condemnation or paying therefor, for domestic and municipal purposes . . ." The Rio Grande waters are specifically excluded.

In Texas today, anyone who desires to appropriate water must make an application in writing to the Texas Water Rights Commission. The Commission, as a regulatory agency with broad discretionary powers, is charged with the administration of rights to the water resources of the State. The Commission consists of three members appointed by the Governor for six-year terms, with the consent of the Senate. The Chairman is designated by the Governor.

The Rules and Regulations and Modes of Procedure of the Texas Water Rights Commission prescribe the procedures for applying for a water permit. The Commission will consider an application for approval if the application is in proper form, complies with statutory provisions, contemplates an authorized use of

water, does not impair existing water rights or vested riparian rights, and is not detrimental to the public welfare.

After approval of an application, the Commission issues a permit giving the applicant the right to take and use water only to the extent stated. Permits may be "regular," "seasonal," "temporary," or "contract" in nature. A "regular" permit is permanent in nature and does not limit the appropriator to the taking of water during a particular season or between certain dates. A "seasonal" permit is also permanent in nature, but the taking of water is limited to certain months or days during the year. A "temporary" permit is granted for a period of time not exceeding three months and does not vest in the holder any permanent right to the use of water. A "contract" permit is granted for a stated duration and governs the use of water to be obtained from the storage facilities owned by another person or entity. A "contract" permit requires a written consent agreement or contract with the owner of the facility.

The Water Rights Commission may also grant permits for the impoundment and storage of water with the use of the impounded water to be determined at a later date by the Commission.

Once the right to the use of water has been perfected by (1) issuance of a permit from the Texas Water Rights Commission and (2) subsequent beneficial use of the water by the permittee, the water authorized to be appropriated under the terms of the particular permit is not subject to further appropriation by the Commission until the permit is cancelled. Formal cancellation of unused permits and certified filings is possible either by administrative action initiated by the Commission or by judicial proceedings to adjudicate water rights between claimants. Cancellation by administrative action has, in the past, been difficult in the typical situation because of inadequacies in cancellation statutes. However, the recently enacted Water Adjudication Act of 1967 is expected to facilitate the administrative process. Adjudication by the courts frequently does not provide the flexibility of action, the geographic coverage, or the inclusion of all parties desirable from the State's view.

Article 7500a allows a landowner to construct a small reservoir on his own property to impound not more than 200 acre-feet of water for domestic and livestock purposes only, without securing a permit. A simplified, short-form application for a permit to appropriate water for other than domestic and livestock purposes is available to the owner of a small reservoir of this size. Permits granted by the Texas Water Rights Commission pursuant to this statute may be for a period of years.

After considering the practical difficulties encountered by pioneer water appropriators in perfecting their claim, and analyzing the concepts they evolved as necessary aids to determine water rights—which concepts

Texas Legislatures have codified as appropriation statutes—it is apparent that certain elements are inevitably present in every perfected water right under the nonriparian concept of appropriation, i.e., under the Appropriation Doctrine.

These elements are: (1) A definite point in *time* at which the claimed right can be said to have *attached*, in other words, a time of attachment. The doctrines of Priority and Relation, the latter as modified by the requirements of due diligence, relate to the time of attachment. (2) A definite *limitation as to quantity*. The “declared” appropriation must be considered with and governed by the “actual” appropriation, as measured by actual beneficial use. (3) Adequate *notice* to subsequent appropriators in accordance with prescribed customary procedure.

The absence of any one or more of these elements must cause an asserted claim or right to fail. The Doctrine of Abandonment results in forfeiture or loss, as would estoppel (*Mott v. Boyd*, discussed earlier) and prescription. The procedure by which an agency of the State issues a permit to appropriate public waters is a mere extension of the concepts underlying and embodied within earlier appropriative processes, and the later certified filings. Time of attachment, limitation—both declared and actual (that is, the appropriative limit *declared* within the permit document, and *actual* appropriation as measured or limited by actual “beneficial use”)—, and *notice* are current requirements for the perfection of a water right by means of a statutory permit.

(3) The Water Rights Adjudication Act of 1967

This recent statute modifies claims of right to public water under the riparian doctrine or water impounded under Article 7500a for other than domestic or livestock purposes. It is incumbent upon the user to file a statement, including the nature of right claimed and volume of water used, with the Texas Water Rights Commission before September, 1969. Failure to file such a sworn statement will result in an extinguishment of such right, and bar any claim thereon. The act further provides for adjudication of rights in any stream, upon the Water Rights Commission's own motion, or upon petition by ten or more claimants of rights, or upon petition by the Water Development Board.

c. Ground-Water Law in Texas

As a prelude to discussion of the ground-water law of Texas, it is desirable to understand the term “ground water” as defined by statute and case law. A more accurate term would probably be “percolating waters.”

(1) Percolating Water Theory

“Percolating waters” are defined as those waters below the surface of the ground not flowing through the earth in known and defined channels, but are waters percolating, oozing, or filtering through the earth. Percolating waters are distinguished from (1) “subterranean streams flowing in well defined beds and having ascertainable channels” and (2) “the ordinary underflow of every river and natural stream of the State.”

The state of the law with respect to ownership of subterranean streams flowing in well defined channels is not well settled in Texas. However, “stream underflow” (the water that flows beneath, and alongside of a surface stream channel) is the property of the State (Article 7467). Both stream underflow and subterranean streams have been expressly excluded from the definition of underground water in Article 7880-3c, which recognizes the ownership and rights of Texas landowners to underground water (Section D).

There exists a legal presumption in Texas that all sources of ground water are percolating waters as opposed to subterranean streams. The courts in the past have been reluctant to accept testimony of engineers and hydrologists as conclusively rebutting this presumption. Consequently, the surface landowner is presumed to own underground water until it is conclusively rebutted by a showing that the source of such supply is a subterranean stream or stream underflow, a burden of proof that may be very difficult to meet.

(2) Résumé of Important Cases

The following is a résumé of the limited case law in the ground-water field, showing the chronological development of ground-water law in Texas.

Action v. Blundell 12 M&W 324 (Exch. Chamber 1843): In this early English case, the plaintiff had for years enjoyed the use of a water well situated on his own property in connection with his cotton mill. The defendant excavated two coal pits within three-quarters of a mile from plaintiff's well, rendering the plaintiff's supply inadequate for milling purposes. The Court held that ground water is not governed by the law relating to rivers and streams, and said (p. 354):

“... but that it rather falls within the principal which gives to the owner of soil all that lies beneath his surface; that the land immediately below is his property, whether it is solid rock, or porous ground, or venous earth, or part soil, part water; that the person who owns the surface may dig therein, and apply all that is there found to his own purposes at his free will and pleasure; and that if, in the exercise of

such right, he intercepts or drains off the water collected from underground springs in his neighbor's well, this inconvenience to his neighbor falls within the description of *damnum absque injuria*, which cannot become the ground of an action."

Houston & T.C.R.R. v. East, 98 Tex. 146, 81 S. W. 279 (Tex. Sup. Ct., 1904): Plaintiff in this case had for years used a well on his own land for household purposes. Defendant Railroad Company owned the fee simple title to adjacent land on which the defendant dug a well and, with a steam pump, withdrew 25,000 gallons a day to supply its locomotives and machine shops. Plaintiff's well became dry, for which he sought damages.

The Court recognized *Action v. Blundell* as the controlling rule and discussed opinions of American courts applying the "English rule." The controlling American opinion influencing the Court was the 1861 Ohio case of *Frazier v. Brown*, 12 Ohio Street 294, which announced the impossibility of administering any set of legal rules governing ground water because no one (in 1861) could say with any degree of accuracy from where ground water came or flowed, where it was going, or how it was to get there. Too, the Court had observed that correlative rights to underground water would unduly interfere with railroad and highway construction, public works, existing health standards, and economically productive mining operations. The Court concluded that in the absence of malice or wanton conduct on the part of the defendant, the law recognizes no correlative rights with respect to underground waters. The defendant was making a reasonable and legitimate use of the water which he took from under his land.

Texas Co. v. Burkett, 117 Tex. 16, 296 S. W. 273 (Tex. Sup. Ct., 1927): This case involved the legal question of whether or not the plaintiff had the right to convey all right, title, and interest to underground waters beneath his tract. On page 278 of the opinion, the Court states:

"In other words, insofar as this record discloses, they [the waters] were neither surface water nor subsurface streams with defined channels, nor riparian water in any form, and therefore, were the exclusive property of Burkett, who had all the rights incident to them that one might have as to any other species of property."

Therefore, the Court concluded, his water could be used either on or away from the land surface.

Pecos County W. C. & I. D. Dist. No. 1 v. Williams, 271 S. W. 2nd 503 (Tex. Civ. App., 1954; error refused n.r.e.): Plaintiffs had for many years used the spring

flow of Comanche Springs for irrigation. Immediately prior to this lawsuit, the defendants drilled numerous water wells south and west of the springs, drying up the springs as a consequence. Plaintiffs alleged that the wells were drilled into a well defined subterranean channel which supplied the springs and that under such facts, the law with respect to percolating water would not apply. The Court, after commenting on the lack of evidence to support this allegation, stated at page 507:

"So it seems well decided that the mere fact that the wells of one man dried up springs or the wells of another, neither proves nor indicates a well defined channel of underground water."

The presumption that all underground waters are percolating water prevailed, and the Court concluded that plaintiffs were not entitled to enjoin the pumping of defendants wells.

City of Corpus Christi v. Pleasanton, 154 Tex. 289, 276 S. W. 2nd 798, (1955): The Supreme Court held, in the tradition of the *East* case, that since the Lower Nueces River Water Supply District was the owner of the land on which it had drilled four large artesian wells, which wells were designed to flow, and did flow, into the Nueces River at a rate of 10 million gallons a day, and since the ultimate use of the water was for "a beneficial use" (municipal purposes), in spite of a 63 to 74 percent evaporation loss during an 118-mile trip downstream to the place of ultimate use, the flowing of said wells was not subject to injunction under existing law. The Court stated that the owner of the land could produce all it could capture for use on or off the land so long as the ultimate use was beneficial. This was a 9-3 decision with strong dissents registered by Justice Griffin and Justice Will Wilson, later Attorney General of Texas. Justice Wilson said, in effect, that it was ridiculous to follow 19th Century knowledge of hydrologic and geologic limitations when modern technology could sufficiently answer every question and lay aside every doubt of inquiring jurists.

Marvin Shurbet et ux v. The Commissioner of Internal Revenue, 242 F. Supp. 736, affirmed 347 F. 2nd 103, (1961): Mr. Shurbet, acting on his own behalf and that of the High Plains Underground Water Conservation District No. 1, brought suit in the Federal court for refund of income taxes based upon a claim that water supplies from the Ogallala Formation, for which the landowner paid a stated consideration at the time of land purchase, were being permanently depleted. After the Federal Circuit Court of Appeals recognized the validity of the claim, the Internal Revenue Service agreed to follow the opinion. The consequence of this case to other areas of Texas water law may be far-reaching. It constitutes specific recognition on the part of the courts and a governmental agency—significantly the Internal Revenue Service—of the unique

nature of ground water and its consequent dollar value to the surface owner. Although limited only to the High Plains Ogallala Formation where the underground water supply is known to be permanently disappearing, the extension of the recognition principle should be much easier with this precedent.

From the *East* case through *Pleasanton*, the Texas Courts have followed unequivocally the "English" or "common law" rule that the landowner has a right to take for use or sale all the water he can capture from beneath his land. The court in *East* deliberately chose not to adopt the "American rule" which is based on "reasonable use" and correlative rights. Consequently, neither an injured neighbor nor the State can effectively exercise any degree of conservation and control over water-use practices involving ground water. This is in contrast with the extensive and direct involvement of the State in conserving and controlling surface-water supplies. The situation is paradoxical when one realizes the interrelationship of ground- and surface-water development for future State needs and the necessity of adequate ground-water supplies to meet future municipal and domestic requirements in certain areas.

While an individual may have little to say about a neighbor's use of a common ground-water supply, landowners overlying defined ground-water reservoirs may adopt voluntary well regulation through mutual association in underground water conservation districts; Article 7880-3c provides the framework for these districts, and to date eight have been formed. Through this voluntary association, effective well spacing, proration, and conservation can be achieved. The locally formed conservation district is likely to continue as the best avenue toward underground water conservation until such time as correlative rights to percolating waters are recognized.

Impairment of a landowner's right in the percolating waters under his land, when this impairment is the result of a trespass on the land, is of course actionable. To date there are only three legal actions available to a landowner in Texas for outside interference with his percolating water rights. The first is the common law right recognized in jurisdictions which apply the English rule. This right arises when there is malice or wanton conduct with results in a taking for the sole purpose of injuring a neighbor. The second action recognized in Texas arises when artesian flow results in no beneficial use, and as such, is defined as "waste." In the *Pleasanton* case, the Court found that the loss during transportation of 63 to 74 percent of the water initially captured did not amount to "waste" since the ultimate use was "beneficial." Article 7602 of the Civil Statutes and Article 846 of the Penal Code defines "waste" in relation to artesian wells, and provides, among other exceptions, that waste will not exist if the water is "used for the purposes and in the manner in which it may be lawfully used on the premises of the owner of such

well." The third action arises as a result of contamination of the quality of water in a landowner's well. Cases thin the third category have arisen mostly in areas where it can be conclusively shown that oil and gas operations have allowed brines, oil, and other substances to escape into the percolating fresh water bearing strata. *Continental Oil Company v. Berry*, 52 S. W. 2nd 953 (Tex. Civ. App., 1932; error refused).

Although the landowner's right to capture and his right to enjoin waste by his neighbor are recognized, the character of title which vests in the surface landowner once ground water is captured and reduced to possession is not clear. The Supreme Court, in *Pleasanton*, stated on page 802 that:

" . . . and owner of land could use all of the percolating water he could capture from wells on his land for whatever beneficial purposes he needed it, on or off of the land, and could likewise sell it to others for use off of the land and outside of the basin where produced, *just as he could sell any other species of property.*" (Emphasis added.)

Although it appears that this right of capture is accompanied by an absolute right of use, the courts do place limitation on the use to which the owner can put ground water. "Waste" is a limitation on the owner of a flowing artesian well and, as was stated in the *Pleasanton* case, the court will look to the ultimate use of the water and if found to be wasteful, equitable remedy may be available.

3. Access to Lakes and Streams

Article 7581, V.A.C.S., authorizes employees of the Water Rights Commission to enter private property and any waterway when such entry is necessary to discharge of the Commission's duties.

Although there is no statutory authority granting general public access to lakes and river, all public lakes within the State do accommodate recreational needs of citizens. However, a person may not enter upon private lands as a means of access to a waterway, although State law recognizes—with few exceptions—the right of the public to travel up or down the streambed of a "navigable stream" in those instances where access can be lawfully accomplished, for example, where a public stream intersects or is bridged by a public highway. A "navigable stream" is defined as one averaging 30 feet in width from cutbank to cutbank.

4. Transbasin Diversion

Articles 7589 and 7590, V.A.C.S., set forth the limitation and procedures for diversion of water from one basin to another. Transbasin diversion is prohibited when it results in prejudicing any person or property in the watershed of origin. These statutes have been relied upon very little in the past, but are expected to have increasing influence in the future. Superimposed on these statutes is Article 8280-9 establishing the Texas Water Development Board, and in particular, §3 (b) therein, limiting the Board's planning powers as to interbasin transfer of water to that volume of water in excess of the amount needed to supply the reasonably foreseeable water requirements of the river basin of origin for the next 50 years.

5. Eminent Domain

At present, there are inadequate statutory provisions authorizing land acquisition by a State agency for reservoir purposes. To date, most water development projects have been constructed in conjunction with a local political entity possessed with condemnation powers.

C. STATE ADMINISTRATIVE AGENCIES AND PROGRAMS

Government has come to play an important role in the protection and development of water resources. This role has evolved from one which was primarily regulatory in nature to one which is promotional in character. The governmental institutions of our nation, state, and localities have become positive participants in active programs aimed not only at overseeing private development and guarding against waste, but at developing our natural resources for the public at large. As results of this changing role of government, the administrative organization and the intergovernmental relations are relatively complex. Many local, state, and federal agencies are concerned with different specific water programs.

An inventory of these governmental agencies is here presented in order to show the role of each in the development and administration of water resources, as well as some of the legal bases for intergovernmental relations.

1. Historical Development and Statutory Evolution of State Water Agencies in Texas

The history of water legislation in Texas dates back to 1889 when the Texas Legislature borrowed statutory concepts and procedures from Nebraska, Colorado, Wyoming, and other arid western states in an attempt to provide for the orderly distribution and

peaceful development of water resources. The primary contenders in 1889 were cattle versus irrigation interests.

Although later attempts at effective legislation were to be made in 1898, it was not until 1913 with the passage of an Act creating the Board of Water Engineers that any real semblance of orderly development of water rights became possible. This Board, created in 1913, was the first State agency concerned with water development and water rights.

The State of Texas was exposed to severe floods in 1913 and 1914, and the citizenry of Texas began to demand a constructive conservation program. There was open agitation for an amendment to the constitution which would recognize the State's duty to prevent floods, or at least to take steps necessary for the conservation of the State's natural resources. In order to avoid any question as to the State's legal right to regulate the conservation of natural resources, a Conservation Amendment was adopted in 1917, which stated that the conservation and development of all the natural resources of the State were public rights and duties and the Legislature was authorized to pass all laws appropriate for this purpose.

As cities and industries developed within the State, municipal and hydroelectric interests appeared in competition with those of cattlemen and irrigators. Competition over the available and oftentimes uncertain water supply led to the passage of the Wagstaff Act in 1931, which declared beneficial use preferences, as a guide for the Board of Water Engineers in the granting of future water permits. The Act declared in effect that for a given supply of water, domestic and municipal needs must be met first, followed, in their respective order, by industrial needs, irrigation, mining, hydroelectric, navigation, and recreation and pleasure.

In 1957, another constitutional amendment was adopted creating a second Board concerned with water matters, the Texas Water Development Board. The Board consisted of six members appointed by the Governor with only two full-time paid employees. The Board was directed to initiate and administer a program of loan assistance to local political subdivisions, for the purpose of encouraging the development of the State's water resources.

In 1961, the Legislature created yet a third Board, the State Water Pollution Control Board consisting of six members (three members appointed by the Governor and the remaining three members comprised of the agency heads from the State Health Department, the Parks and Wildlife Department, and the Water Development Board). Effective September 1, 1967, the Water Pollution Control Board was superseded by the Texas Water Quality Board, which is to be composed of the same members. The purpose of the Water Quality Board is substantially the same as that of the Water Pollution Control Board: to effectuate the declared policy of the

State to maintain the quality of its waters consistent with the public health and public enjoyment thereof, the protection of wildlife, the operation of existing industries, and the economic development of the State.

In 1962, the Legislature changed the name of the Board of Water Engineers to the "Texas Water Commission" to more accurately reflect the functions and responsibilities of the agency. Thus, in 1962, there existed in Texas three agencies concerned with water administration:

- (1) The Texas Water Commission (which was formerly the Board of Water Engineers);
- (2) The Water Pollution Control Board—concerned with matters of pollution;
- (3) The Texas Water Development Board—concerned only with the financial aspects of developing reservoirs and related facilities, by a program of lending State funds to local political subdivisions.

However, by this time, there had been added to the responsibility of the Water Development Board the additional function of acquiring storage facilities by outright purchase in the name of the State of Texas, as opposed to merely loaning State funds to political subdivisions.

Three years later, in 1965, after a comprehensive two-year study initiated by the privately financed Texas Research League, the 59th Legislature realigned the functions and responsibilities of the Water Commission and the Water Development Board. Beginning September 1, 1965, all planning and development functions which had, by previous statutes, been vested in the Water Commission, were transferred to the Water Development Board. While the Water Development Board had only two full-time employees in 1957, beginning September 1965, Board Staff and personnel consisted of 185 authorized positions. Currently (August 1968), the Board employs 227 persons. Personnel data, records, equipment, and office space formerly occupied by the Texas Water Commission were transferred to the Texas Water Development Board.

The Water Commission retained the primary function of administering water rights, including the issuance of permits, and the name of the agency was appropriately changed to the Texas Water Rights Commission.

Today in Texas, there are three major agencies concerned exclusively with water development, regulation, and control:

- (1) The Texas Water Rights Commission

- (2) The Texas Water Development Board

- (3) The Texas Water Quality Board

As discussed elsewhere, numerous other State agencies have water-oriented interests in addition to other functions.

2. Present State Agencies in Texas Water-Resources Programs

Eight State agencies, in addition to river authorities discussed on page 61, are actively engaged in various phases of the State's water-resources programs. In addition, the programs of many other State agencies bear upon the handling of water problems, including several educational institutions which undertake studies and conduct conferences, and the Attorney General's office, which examines the legality of bonds of all local and State agencies and renders advisory opinions on them. The activities undertaken are diversified and far-reaching, and often overlap federal agencies operating in the State. The authority to supervise and coordinate the various local units of government charged with developing and conserving the waters of the State is divided among several agencies, as is the power to plan and coordinate the State's programs. The need for effective administrative planning and coordination will undoubtedly increase as the State continues to grow.

a. Texas Water Rights Commission

In 1913, 24 years after the legislature first enacted the statute providing that waters in the arid section of the State might be appropriated under the doctrine of "first in time is first in right," the predecessor to the Texas Water Rights Commission (the Board of Water Engineers) was established to approve the appropriation, storing, and diversion of the State's waters.

(1) Administrative Organization

The Texas Water Rights Commission is composed of three members, all appointed by the Governor with the consent of the Senate for six-year, overlapping terms, with one term expiring every two years. An Executive Director is the chief administrative officer of the agency and is directly responsible to the Commission.

(2) Functions

The primary objective of the Texas Water Rights Commission, as stated by statute, is "to conserve this natural resource in the greatest practicable measure for the public welfare." In carrying out this mandate the Commission performs a number of functions, including

the administration of water rights, the collection of data, the supervision of certain water districts, and other regulatory activities.

(a) Water Rights Administration

The original purpose of the Water Rights Commission was the approval of appropriation, storing, or diversion of the State's waters. Such approval was necessitated by the State's waters. Such approval was legal doctrine of prior appropriations, under which nonriparian users could obtain a right to use a certain quantity of water by obtaining a permit from the designated State agency. Under the original acts, these permits to appropriate water were obtained merely by filing with the county court clerk, but in 1913, the agency was established and was given control over the allocation of the State's waters.

All waters in the State are not, however, subject to appropriation. The vested riparian rights were not affected by this act, and the Board (now Texas Water Rights Commission) had no control over the rights of a riparian user of water. Neither were the rights of landowners to underground water brought within the purview of this act. The Board was authorized to control the allocation of water defined in the statute as:

" . . . the waters of the ordinary flow and underflow and tides of every river or natural stream, of all lakes, bays or arms of the Gulf of Mexico, and the storm, flood or rain waters of every river or natural stream, canyon, ravine, depression or watershed within the State of Texas."

The purposes for which water may be appropriated were established by the Legislature in 1913. These are: irrigation, mining, milling, manufacturing, development of power, city water works, and livestock raising. In 1931, a preference list was devised by the Legislature to guide the Commission in its appropriation of the State's waters. This preference list provided the following order for all streams in the State of Texas with the exception of the Rio Grande: (1) domestic and municipal uses, including water for sustaining both human and domestic animal life; (2) water to be used in processes designed to convert materials of a lower order of value into forms having greater utility and commercial value, and to include water necessary for the development of electric power by means other than hydroelectric; (3) irrigation; (4) mining and recovery of minerals; (5) hydroelectric power; (6) navigation; and (7) recreation and pleasure.

The Legislature has charged that: ". . . it shall be the duty of the [Texas Water Rights Commission] . . . to conserve this natural resource in the

greatest practicable measure for the public welfare; and recognizing the Statutory precedent established for granting the privilege to take and utilize the waters of the State, preference be given not only in the order of preferential uses declared, but that preference also be given those applications the purposes for which contemplate and will effectuate the maximum utilization of waters and are designated and calculated to prevent the escape of public waters without contribution to a beneficial public service."

The important words are "it shall be the duty" and "but that preference also be given those applications the purposes for which contemplate and will effectuate the maximum utilization of waters and are designated and calculated to prevent the escape of waters without contribution to a beneficial public service." The Commission has interpreted these words to mean that as between applicants with the same priority rights, the concept of "a beneficial public service" would come into consideration. Where an applicant is above another on the preference list, the words "it shall be the duty" require the Commission to appropriate the water solely on the basis of availability.

Another aspect of administration of water rights is the adjudication of claims. With a dual system of water rights, riparian and appropriative, it is often necessary to adjudicate conflicting rights, and the 60th Legislature enacted the Water Rights Adjudication Act, mentioned earlier, to facilitate administrative adjudication by the Commission.

(b) Other Water Management and Regulation

The Commission has been assigned a number of additional tasks in the management and regulation of the State's water resources. In addition to issuing permits to use the State's waters, two major roles of the agency are to supervise some types of local water districts and to provide assistance in the nature of technical advice and guidance to these local units.

The Commission has a statutory obligation to receive petitions for the creation of multicounty water improvement districts, water control and improvement districts, and underground water conservation districts, or such districts which include sanitation facilities in one or more counties. This statutory obligation also extends to holding hearings on the applications, approval or disapproval of the petitions, appointment of temporary directors under certain conditions, and furnishing necessary technical data and topographic maps to the petitioners. For underground water conservation districts, the Commission must also designate the boundaries of

the underground water reservoir or subdivision thereof before such a district may be created. The Commission also has the responsibility of reviewing the feasibility of projects planned by water control and improvement districts intending to issue bonds to cover the costs of planning or construction of necessary facilities, or both.

It should be emphasized, however, that the Commission does not have jurisdiction over the creation of drainage districts, levee improvement districts, fresh water supply districts, water control and preservation districts, or navigation districts; nor does it have jurisdiction over water control and improvement districts created entirely within one county. Neither does the Commission have regulatory power over proposed plans of bond issues of all types of water districts; it has power only over water control and improvement districts. The Commission, furthermore, does not have a watermaster to determine allotted amounts of water that are diverted, and unless a complaint is made, it does not supervise actual diversions.

The Commission may, upon granting a permit for the use of water, fix the time at which actual construction shall begin. Further, the Commission may enjoin construction which is in violation of the statutes or of its own duly promulgated rules and regulations. It may also condemn any existing structure which becomes a public menace or is dangerous to life and property.

Frequently, the Commission is also given the responsibility of nominating and appointing officials of river authorities and other special act districts. The Commission also has the responsibility of submitting a list of prospective directors from among whom the Governor may make nominations for certain river authorities. In some instances the statutes provide, as for the Sulphur River Conservation and Reclamation District, that the Commission and the State Reclamation Engineer shall appoint directors, subject to the Governor's approval.

The Commission, in its regulatory role, acts in some instances as a price-fixing agency. As between private irrigation corporations and riparian water users, it may fix a reasonable price to be paid for the use of water when the corporation and the water user cannot agree. The Commission is authorized to fix the price river authorities may charge for hydroelectric power sold to municipalities or to rural cooperatives.

The Commission also performs duties or conducts investigations pertaining to water resources and water uses which the Governor may direct. Further, where water shortages have existed, the Commission has been requested to divide the meagre river flows between appropriators and to ensure riparian municipalities of a water supply.

The Commission has some functions to perform in the control of water pollution and waste. The statutes authorized it to abate the waste of water from uncapped artesian wells, and to prevent the excessive or wasteful use of water by persons contiguous to any canal or irrigation system. It may declare any water improvement or irrigation work which permits an unreasonable loss of surface water in its operation a public nuisance, and abate it as such.

b. Texas General Land Office

(1) Administrative Organization

The General Land Office of the State of Texas is a constitutional office which provides for a Land Commissioner to be elected every two years by the people of the State. He is responsible for the supervision and administration of the public lands of the State of Texas.

(2) Functions

Originally the Land Office was established to dispose of public lands and to handle the mechanics, titles, and issue patents out of the State. Today the Land Office, under the supervision of the Land Commissioner, supervises some 4½ million acres of submerged lands, 800,000 acres of uplands, most of which is in far West Texas, and handles the oil and gas leasing of some 22½ million mineral acres. The Land Commissioner also supervises and administers the Veterans Land Program, which buys land for veteran purchasers and permits them to pay for the land over a period of 40 years by making small down payments and making semiannual payments to the State.

(a) Pollution Control Activities

In supervising the minerals of the State, the Land Office writes lease forms, and sets up rules and policies which give this department sufficient control over pollution in connection with oil and gas development off the Texas coast. The General Land Office cooperates with the Parks and Wildlife Department, the Railroad Commission, and other regulatory agencies of the State in attempting to regulate and prevent pollution.

c. Texas Water Development Board

(1) Administrative Organization

The Texas Water Development Board is administered by a Board of six members, appointed by the Governor with the consent of the Senate for overlapping terms of six years. Each member must have had at least

ten years of successful business or professional experience. One member must be appointed from each of the fields of engineering, law, farming, and public or private finance; and two members may be appointed "at large" without reference to occupation.

(2) Functions

(a) *Loan and Purchase Functions*

The Board was created as an agency of the State of Texas by an amendment to the Constitution in 1957 for the purpose of making loans to local governmental agencies sponsoring the construction of projects for the conservation and development of water resources of the State. In 1962 and 1966 the Constitution was amended to broaden the Board's power by authorizing it to purchase conservation storage facilities in reservoirs to be constructed on Texas streams and for any system or works necessary for the filtration, treatment, or transportation of water by federal or local governmental agencies to the end that the remaining reservoir sites in Texas may be developed to their optimum potential. Both the loan and purchase programs were designed to be ultimately self-liquidating, although the latter is not expected to acquire that status for some years.

The loan program involves the purchase by the Board of bonds issued by a local governmental agency sponsor (city, water district, or authority) of a water project at a rate of interest which is one-half of the one percent greater than the cumulated effective rate on the Board's own bonds. The loan program was conceived by the Legislature in 1957 as a 25-year program, and provision was made in the act that no loans can be made after December 31, 1982. The self-liquidating quality of the loan program arises from the requirement that all funds coming into the Board's hands from interest on local securities which it has purchased and from the collection of matured principal shall, to the extent required, be used to pay debt service on the Board's own bonds and to maintain the reserve fund therefor.

Under the purchase program the Board acquires what amounts to an undivided interest in storage reservoirs and systems or works necessary for the filtration, treatment, or transportation of water after a finding that (1) there is a future need for each of such water supply projects and that (2) there is no local sponsor or sponsors financially capable of developing such facilities or systems. It is contemplated that the Board interests in these storage facilities and associated systems will be salable in the future. Funds from such sales, which are fixed by law at a price not less than the Board's capital investment plus interest computed at a rate equal to the cumulative effective rate on the Board's bonds at the time of the sale plus one-half of one percent, shall, to the extent required, be used to pay

debt service on the Board's bonds and to maintain the reserve fund therefore.

In the acquisition of such storage facilities and associated systems the Board may make a cash payment for an interest in them. When the sponsor for a dam or reservoir is an agency of the federal government, the Board may enter into a long-term contract for the payment of its share.

(b) *Collection of Data*

In fulfilling its tasks in the management and allocation of the State's waters the Board must undertake various hydrographic studies. Data obtained from such studies help in many projects, such as the planning and design of adequate municipal water supplies, the determination of waters available for irrigation, and the planning of industrial expansion. This hydrographic information is also needed for flood control, development of power potential, soil conservation, protection against stream pollution, designing of highways and other structures, protection of fish and wildlife, and the improvement of navigation. For these reasons, the collection of information about water resources is one of the principal functions of the Board.

Much of the work of data collection is undertaken in cooperation with the U.S. Geological Survey. In general, the cooperative undertakings are handled by personnel of the U.S. Geological Survey, supported by federal funds which are matched by state and local funds. The Board also cooperates with the U.S. Department of Agriculture, the Texas A&M University, and others in studying the duty of water. This consists of studies to determine the optimum irrigation water requirements for typical crops grown under various climatic and soil conditions, the determination of methods of application of water best suited to different crops grown in Texas under given site conditions, and the development of irrigation practices which will increase irrigation efficiency.

Other data collection conducted by the Board includes the following activities: stream measurements of daily, monthly, and annual discharges of the various rivers and streams (in cooperation with the U.S. Geological Survey, the U.S. Army Corps of Engineers, various Texas water districts, and other agencies); ground-water investigations, made to collect information as to location, size, and yield behavior of underground reservoirs and to determine the fluctuations of the water table or changes in artesian pressures; and studies of the quality of water, made to determine the salinity of the waters and the possible sources of pollution, as well as the extent of salt water.

(c) Reclamation Engineer Functions

The Board inherited from the former State Reclamation Department powers to assist and supervise levee improvement and drainage districts. It includes the power of supervision over the creation of districts, passing on the feasibility of plans prior to the issuance of bonds, and the power to inspect the construction of levees and other works of improvement.

The statutes provide that the State Reclamation Engineer shall have the power to make and approve agreements or contracts for cooperating with any branch of the federal, state, county, or city governments. He is to confer with any branch of the various levels of government to the end of obtaining authority, advice, or assistance in connection with his official work.

The Reclamation Engineer (now Texas Water Development Board) is further charged with the duty of conducting and making surveys, maps, reports, and publications, as may be required in the process of planning such improvements as levees, dikes, canals, dams, drains, waterways, reservoirs, or any improvements incidental to them.

(d) Control of Waste and Pollution

Although the Board has no regulatory power over the pollution of surface or ground water, it works in conjunction with the Railroad Commission in preventing the contamination of fresh water bearing strata by highly mineralized water from oil operations, and with the Water Quality Board in problems of ground-water contamination. The Board also has made a number of studies of the danger of the encroachment of salt water from beneath the Gulf into the fresh-water sands along the Texas coastal region. In its studies of the quality of water, the Board analyzes the water to determine its suitability for irrigation, general farm and ranch supplies, and municipal and domestic supplies. In such studies, the various types of pollution are, of course, among the main factors studied. The Executive Director of the Board is a member of the Texas Water Quality Board.

(e) Comprehensive Planning and Coordination

The Texas Water Development Board recently undertook the task of compiling a comprehensive statewide plan for the development and distribution of available waters. The plan will serve as a flexible guide to the future development of water resources in the State.

d. Texas State Soil and Water Conservation Board

The Texas State Soil and Water Conservation Board was created to perform the state-level administrative functions necessary to operate the Soil and Water

Conservation District program. Because of the physical unity between soil and water, many of the conservation activities undertaken by the State's Soil and Water Conservation Board vitally affect the water resources of the State.

(1) Administrative Organization

The Board is composed of five members, elected for a five-year term by the supervisors of the subdivisions of the State that they represent. The Board employs an executive director to supervise the agency's activities.

The Board's main task is to coordinate the programs and activities of the 184 Soil and Water Conservation Districts throughout the State.

(2) Functions

The Board's activities are primarily directed along three lines: (1) perform state-level administrative functions incident to the organization and operation of Soil and Water Conservation Districts; (2) coordinate the programs of the Soil and Water Conservation Districts; and (3) administer state responsibilities in the upstream watershed protection and flood prevention program.

(a) Upstream Watershed Program

The Texas Soil and Water Conservation Board has been designated by the Governor as the state agency to receive and approve or disapprove applications of political subdivisions for federal assistance in planning and carrying out watershed protection and flood prevention projects as contemplated under Public Law 566, Acts of the 83rd Congress, as amended by Public Law 1018, Acts of the 84th Congress.

This program seeks to conserve soil and water by beginning the conservation program upstream, where the water falls. Small detention dams coupled with proper land use and conservation measures are installed for this purpose. Under the authorization of these acts, watershed protection and flood prevention work may be carried out on any watershed under 250,000 acres in extent if the project is economically justifiable. The federal government, through the U.S. Soil Conservation Service, pays the entire cost of improvements applicable to flood prevention. Participating local governments bear the cost attributable to the storage of water for use, share the cost of agricultural water management, furnish all land rights and easements, and operate and maintain the projects. It is this type of application which the State's Soil and Water Conservation Board has been designated by the Governor to receive.

e. Texas State Department of Health

(1) Administrative Organization

The State Board of Health consists of nine members, appointed by the Governor and confirmed by the Senate for overlapping terms of six years. Six of these members must be licensed physicians, who must have had at least five years of medical practice; one member is required to be a similarly qualified dentist, and one a pharmacist, while the ninth member must be a graduate civil engineer with a minimum of five years experience and a specialist in sanitary engineering.

The State Commissioner of Health, formerly called the State Health Officer, is appointed by the State Board of Health and serves as the executive head of the Department of Health. He is subject to the general supervision of the board members, and may be removed by them.

The Commissioner of Health is charged with the supervision and coordination of the departmental activities. Under his direction, operating divisions of the department perform varied functions. The divisions most directly concerned with matters pertaining to water are the divisions of Sanitary Engineering and Waste Water Technology and Surveillance.

(2) Functions

The activities of these two divisions are multiple and varied, and have evolved as a result of the need for assistance by communities in improving environmental conditions in urban and rural areas.

The Texas State Department of Health is the official governmental agency created to prevent and control disease and to promote good health. Minimizing health hazards associated with water is, for this reason, of major concern to the department.

(a) Protection of Local Water Supply and Supervision of Municipal Sewage Disposal

The protection of the purity of the public water supply is one of the major tasks of the Department of Health. Its Division of Sanitary Engineering is charged with the making of studies and investigations, the collection of evidence in connection with the enforcement of laws pertaining to the provision of safe water for the public, the pollution of streams affecting water supplies, and various other items of general sanitation.

The State Department of Health must approve the plans for all water supply or sewage disposal systems. In undertaking this responsibility, the Department makes available to the local units of government and to many

State agencies consulting services on public health engineering.

The Division of Sanitary Engineering also undertakes an educational program to train operators of municipal water and sewage plants. A vocational in-service training program has been worked out with other institutions and with professional organizations to undertake such training. Certificates of competence are issued by the Department to individuals in charge of the production, treatment, and distribution of public water supplies and to those in charge of the operation of sewage treatment plants.

(b) Collaboration with the Federal Government

The Department collaborates with the Federal Health Service in the certification of water supplies used in interstate traffic, the certification of oysters produced in Texas, and other similar programs to control the spread of contagious diseases.

f. Texas Parks and Wildlife Department

(1) Administrative Organization

The Parks and Wildlife Department is governed by a three member commission, appointed by the Governor with the consent of the Senate for overlapping terms of six years.

The Commission appoints an executive director of the Department and delegates to him such executive duties as are deemed appropriate. The executive director is subject to the general supervision of the Commission, and may be removed by them.

(2) Functions

The Parks and Wildlife Commission was established for, among others, the purpose of protecting, perpetuating, and improving the recreational and wildlife resources of Texas. In fulfilling this responsibility, the Commission is charged with the enforcement of the pollution laws insofar as they relate to the protection of fish and other edible animals. The Commission is also concerned with the acquisition, development, maintenance, and operation of parks. It develops and maintains recreational facilities on lands adjoining several lakes and streams of the State and enforces all water safety programs within the State.

(a) Resource Development Planning

The Department is responsible for developing recreational potentials of the State. In this function the

Department cooperates with the various state and federal water agencies, as well as with other agencies. The Department has requested assignment of recreational areas on reservoirs now being constructed, or to be constructed, by the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation.

(b) Pollution Abatement Activities

In undertaking their responsibilities for enforcement, game management officers regularly patrol the entire State. In the course of these routine patrols, the officers often find evidence of pollution. Technicians of other divisions engaged in making surveys of streams, lakes, and bays report any evidence of pollution.

In abating pollution activities, the agency cooperates with a number of other State agencies, including the Department of Health, the Railroad Commission, the Water Rights Commission, the Water Development Board, and the Attorney General's office, as well as with a number of federal agencies. The executive director of the Parks and Wildlife Department is a member of the Water Quality Board.

g. Railroad Commission of Texas

(1) Administrative Organization

The Railroad Commission, established in 1891, has three commissioners who are elected and who hold office for six years. The commissioners serve on a full-time basis, and collectively constitute an administrative directorate for the work performed through five operating divisions.

(2) Functions

The Railroad Commission, the State's principal regulatory agency for public utilities, has jurisdiction over the oil and gas industry. A related responsibility of the Commission is the prevention of pollution of surface and ground waters from crude petroleum oil, salt water, or other mineralized waters which may escape from oil and gas wells.

The Oil and Gas Division is charged with supervising the enforcement of laws and Commission rules that govern the conservation and prevention of physical waste in the production of oil and gas. The Division has the responsibility for inspecting each well for equipment, safety, protection against water intrusion, and similar matters.

(a) Regulation of Disposal of Oil-Field Wastes

The salt water (brine) brought to the surface in oil and gas drilling and recovery operations is highly concentrated, and requires a large amount of fresh water to dilute it. Since water in such quantities is not available in Texas streams, the problem is one of completely disposing of the brine and preventing its reaching fresh-water sources—both surface streams and ground-water strata. The most satisfactory means of disposing of oil-field brine yet discovered is its injection into deep porous underground strata separate from fresh-water strata, with a layer of impervious material between.

Since 1955, the Railroad Commission has had legislative authorization to make and enforce regulations to protect the surface and underground waters from the escape of oil-field waste and brine. The Commission has made such regulations and rules, and has worked with the oil and gas industry in an effort to solve the problems. The Act of 1955 also provided that the Commission may require a bond to ensure that all wells drilled will be plugged in accordance with rules and regulations when the wells are abandoned.

The Chariman of the Railroad Commission is a member of the Texas Water Quality Board.

h. Texas Water Quality Board

(1) Administrative Organization

This seven member board is composed of the State Commissioner of Health, the Executive Director of the State Parks and Wildlife Department, the Executive Director of the Texas Water Development Board, the Chariman of the Railroad Commission of Texas, and three members appointed by the Governor for six-year terms.

(2) Functions

The Legislature created the Texas Water Quality Board to provide better protection of the waters of the State from pollution.

The Board is authorized to establish water quality criteria for all streams and to issue permits for the discharge of waste into or adjacent to the waters of the State. The Board is instructed to consult, advise, and cooperate with other agencies, affected groups, and industries in its program of prevention, abatement, and control of pollution, and conduct studies and collect and disseminate information relating to water pollution and its control and prevention. The Board will prepare a comprehensive plan for the control of water quality and

administer the federal-state grant-in-aid program for the construction of local waste-treatment facilities, pursuant to the Federal Water Pollution Control Act. Construction plans for a proposed sewage treatment facility are required to be filed with the Board prior to construction.

Under the Texas Water Quality Act of 1967, specific functions in support of the activities and programs of the Board are assigned to the Texas State Department of Health, the Railroad Commission of Texas, the Texas Parks and Wildlife Department, and the Texas Water Development Board. A local government, as defined in the Act, is empowered to implement and enforce Board policies and directives within its jurisdiction. There are other governmental agencies acting under other statutes which have specific pollution control responsibilities for certain activities under their jurisdiction. Section 11 (i) (3) of the Act directs the Board to "establish policies and procedures for the purpose of securing close cooperation in the work of the agencies of the state with respect to water quality control functions carried on by such agencies." Implicit in this duty is the responsibility of the Board to be informed on all aspects of water quality and the control and abatement of pollution; to assist in resolving questions as to the respective authority and duties of governmental agencies vested with water quality control functions; and to strive for coordination of effort among such agencies, to the end that the public can be authoritatively advised on water quality matters, duplication of activities can be minimized, and the State policy for water quality control can be effectuated. Policies and procedures for cooperation in the water quality control effort are established only after notice to and opportunity for affected agencies to make recommendations to the Board.

3. Coordination of State Agencies in Water Resources Development (The Planning Agencies Council for Texas—PACT)

Principally because the reorganization of water-related agencies is of such recent vintage, there are gray areas of shared responsibility and interlocking authority. The Planning Agencies Council for Texas (PACT) was established within the Governor's office by legislative resolution to coordinate plans of the various State agencies. Members of PACT include:

Air Control Board
Coordinating Board, Texas College
and University System
Texas Education Agency
Texas Employment Commission

Texas State Department of Health
Texas Industrial Commission
Texas Department of Mental Health
and Mental Retardation
Texas Parks and Wildlife Department
Railroad Commission of Texas
Soil and Water Conservation Board
Texas Water Development Board
Water Quality Board
Water Rights Commission
Department of Public Welfare
Texas Highway Department

4. Cooperative Efforts by State and Federal Agencies

The activities of the federal government in the varied facets of water planning and development in Texas are conducted as they are in other states, through a diverse hierarchy of federal agencies and bureaus. Responsibility for major water-supply projects in Texas is divided between the U.S. Army Corps of Engineers and the U.S. Bureau of Reclamation generally along the 100th meridian which splits the State into equal parts. Use of the full federal capability—financial, technical, and construction—has been implicit in Texas planning, provided of course that conflicting aims and views of the various entities can be resolved. In the Planning Agencies Council for Texas (PACT), Texas will provide federal agencies with a focal point for dealing with the State on matters which cross State agencies' lines of responsibilities, and a forum through which one voice can speak for the State government on specific problems.

D. WATERSHED DISTRICTS AND PROGRAMS (CONSERVATION AND RECLAMATION DISTRICTS, AND RIVER AUTHORITIES)

Texas differs somewhat from her sister states in water resource development in that many of her rivers are purely intrastate streams. Eight of the major Texas rivers run from their sources in West Texas to the Gulf. This has made possible the creation within the State of a basinwide type of district, which is called either a conservation and reclamation district or a river authority. As originally conceived, these "conservation districts" were an attempt to create a governmental unit

which would have an overall basinwide perspective, as well as the authority fully to develop and conserve the water and soil resources of the basin.

This recognition of the natural unity between land and water resources and the need for a governmental agency capable of planning and coordinating such programs in the entire watershed arose concomitantly with the development of the idea of regionalism. The literature in this field, as well as the creation of the Tennessee Valley Authority by the federal government, indicates that in the late 1920's regionalism was thought to be the solution of many governmental problems. This feeling extended into the early 1930's, and Texas' experimentation with this new concept was initiated in part because of the conditions attendant upon the depression. The economic conditions of unemployment, delinquent taxes, and the financial distress of many water districts, plus the disastrous floods of this period, stimulated the growth of a basinwide district as a means of acquiring possible federal grants and loans.

In 1929, the State created its first conservation and reclamation district, the Brazos River Conservation and Reclamation District, since renamed the Brazos River Authority. This was a pioneering move, for here was the first authority ever set up to administer the waters of a major river.

1. Powers

River authorities are created as governmental agencies, bodies politic and corporate, and vested with all the authority as such under the Constitution and the laws of the State. They have the power of such water districts as are authorized in the provisions of the Conservation Amendment in the Constitution. They may formulate plans for the control, storing, and preservation of storm and flood waters of the river and its tributaries, and they have the power to provide and maintain improvements for the common benefit of the district. They are, furthermore, usually given specifically broad powers to do a number of things.

2. Finances

Most of these river authorities are not given the power to tax. To obtain funds necessary for carrying out its planning activities, the authority is to rely upon the counties it encompasses to contribute funds.

The river authorities are also empowered to receive loans and grants from the federal government. In fact, some of the acts specifically state that the conservation district will ask federal aid.

River authorities may issue bonds secured by the revenue to be derived from the sale of water or electrical power. The revenues from such sales are used to pay the

operating expenses and to amortize bond issues for these purposes. Often there is no limit placed upon such issues of revenue bonds, but in other instances a maximum is placed upon the amount of revenue bonds which may be issued without a special act of the legislature.

Because of larger jurisdiction, most river authorities are in a better position to finance, construct, and operate dams and reservoirs on the mainstem of a river or on a large tributary than is a city or a local water district. Certainly, if the proposed dam is to be constructed across a major Texas stream, the project can best be financed by a river authority. Furthermore, the authority may cooperate with local interests which may contract to purchase water and power from such projects.

3. Functional and Legal Status

The Texas river authority is, to a degree, a middle unit of government—lying between the State and local levels. It resembles in many aspects, and is treated in some ways in the statutes creating it, as a State agency. The Texas Supreme Court has upheld this classification. Indicative of this status, too, is the fact that the directors are elected for a six-year term, whereas local officials can be elected for only a two- or four-year term. Often these directors are appointed by the same method as many other State officials—by the Governor, with the consent of the Senate. The books and accounts of the river authorities are audited, as are other State agencies' books and accounts, by the State Auditor.

On the other hand, the authority resembles a local unit of government. Its jurisdiction is often over a small area; it is subject to the supervision of the Texas Water Rights Commission, and in some instances to the Texas Water Development Board, which has been delegated the duties that the State Reclamation Engineer formerly held.

E. LOCAL ADMINISTRATIVE AGENCIES AND PROGRAMS

Several units of local government in Texas are authorized to engage in various water programs. Counties, cities, and the various kinds of water districts are all authorized by statute to undertake certain projects.

1. Counties

Texas counties perform a dual governmental role. They carry out a number of direct service functions for their people, and they also serve as agents in carrying out the State law. In both roles counties are responsible for various phases of water programs.

a. Water Resources Functions

Early in the State's development, counties were relied upon to undertake certain water-related functions. They were authorized to clear and improve streams for navigation and to make drainage and flood control improvements on petition of specified numbers of property owners. These programs, however, were limited, as constitutional limitations permitted only a special assessment tax to finance these improvements. The county remained the only unit of local government authorized to perform these services until 1904, when the Constitution was amended to permit the establishment of special districts. Since that time, these new units have assumed most of the duties of making such improvements.

b. Taxing Authority

Since the withdrawal of the State from the ad valorem tax field in 1951, counties have been authorized to increase their taxes and to spend the additional funds for flood control purposes. Those counties having taxable values of \$290 million or more on the tax rolls may spend up to \$15,000 a year for the purpose of making a preliminary engineering survey relating to drainage, reclamation, and conservation, as well as levee improvement or flood control. And all counties may expend road funds for the purpose of constructing ditches for drainage along the roads.

Those counties which have been relieved of the payment of State taxes because of "great public calamity" are given special broad powers to construct and maintain pools, lakes, reservoirs, dams, canals, and waterways for flood control, drainage, and irrigation purposes. They may issue bonds not to exceed one-fourth of the assessed valuation of thy real property within the county to undertake these projects. Most of these counties are in the coastal region.

c. Cooperative Programs with Federal Government

Texas counties have authority to cooperate with the federal government in navigation projects. They may issue bonds up to one-fourth of the assessed value of the real estate in each county to purchase land and rights-of-way for such projects, and they have the power of eminent domain to aid in carrying out this authority. They may convey these lands without cost to the United States, if necessary, to aid in navigation projects undertaken by the federal government. Coastal counties are specially authorized to provide the right-of-way and easements necessary for the intracoastal canal.

Similar cooperation in flood control programs is authorized. Counties may agree to indemnify the United States on account of damages or claims arising out of or

connected with the construction of such flood works and may transfer without monetary consideration the county land and rights in land needed for such flood control works.

d. Contracting Authority

Texas counties have the authority to contract with any city or town, and may acquire water systems and water supply reservoirs for the purpose of supplying water. Those counties authorized to acquire a water supply from subterranean waters may sell, contract to sell, and deliver any or all of such water to any public or municipal corporation.

e. Administrative Agency of State Government

In addition to the authority to participate directly in water programs, counties act as administrative agencies of the state government. They are responsible for enforcing the state laws, including fish and game laws, and water laws pertaining to water districts.

f. Creation and Supervision of Local Water Districts

Under the general water law statutes, the commissioners court of a county is empowered to create all types of water districts which are located entirely within the county. Some types of districts (for example, levee, drainage, water control and preservation, and navigation) which include land in several counties are also organized by a single county board or commissioners court. The county commissioners court appoints the governing board of levee, drainage, and navigation districts, and the boards of water control and preservation districts situated in only one county. If there are not enough residents to constitute a governing body for a fresh water supply district, the commissioners court may appoint a three-man governing board.

Ostensibly, counties also have a certain amount of supervisory authority over general law districts. The county auditor, in a county having an auditor, has general oversight of all the books and records of all the county officers, as well as those of the district or state, who are authorized to receive or collect money. Districts are required to file with the county auditor a copy of the requisition for all purchases of supplies and materials and, in some instances, the county auditor is required to prescribe the accounting system for the districts in the county. There are, however, many exceptions to these general rules. Population-bracket bills often exclude specific counties from these provisions, and most of the district-enabling legislation provides specifically that the district directors shall employ a competent, private auditor to audit the district's accounts. It is provided,

however, that any commissioners court shall have the authority to employ a disinterested, competent, and expert public accountant to audit all or any part of the books, records, or accounts of any district officer when, in its judgment, an imperative public necessity exists.

Thus far Texas counties have not been too active in undertaking responsibilities in the area of water resource administration and development. Some of this inactivity may stem from limitations upon the taxing power, while part may arise from the fact that other units of government (special districts), better suited to perform these functions, have preempted most of this field.

2. Cities

a. Construction and Administration of Local Water Supply and Waste Disposal

Unlike counties, cities exist primarily to regulate and administer the local or internal affairs of their incorporated territories. For this reason, they have a vital concern in maintaining an adequate municipal water supply. Texas cities may construct municipal water supply systems and issue the bonds required to construct them if such construction and bonding are approved in popular elections. They also have authority to contract with private water companies or with water districts to supply municipal water.

Municipal water-supply systems are used not only to provide water for urban domestic use, but also for such city services as fire protection, street sprinkling, swimming pools, and parks. In addition, many industries and commercial establishments draw on the municipal water supply.

Another service cities are required to undertake is that of waste disposal. Texas cities are authorized to construct sewer systems and sewage disposal plants. Most of these plants must be financed with bond issues, which are subject to the voters' approval and to the statutory and constitutional limitations regarding indebtedness. If the city council desires, it may levy sewage service charges to help meet the expense of this service. Another source of revenue for construction of municipal sewage treatment plants is the federal aid available to some cities under the Federal Water Pollution Control Act.

b. Construction and Administration of Flood Control Measures

Flood protection measures are also undertaken by cities, as many cities are located on or near streams subject to overflow. Home rule cities have the power to

straighten, widen, or in other ways improve, any river or stream within the city and to levy a special assessment on the property owners specially benefited. They may also establish improvement districts to undertake these functions, and these districts may issue bonds for making such improvements. All Texas cities may cooperate with the federal government in undertaking flood control measures. They may acquire lands, easements, and rights-of-way and may deed these without monetary consideration to the United States to aid in the flood control program authorized by Congress. Furthermore, cities may borrow or accept grants from the federal government to undertake such improvements.

c. Construction and Administration of Navigation Improvements

Texas cities located on navigable streams may acquire land for the purpose of establishing and maintaining wharves, docks, railway terminals, or any other aid to navigation. They may also deed this property to the federal government for the improvement of navigation. Any city situated within the territorial limits of a navigation district and having a deep water port may purchase, construct, own, and maintain dikes, spillways, seawalls, and breakwaters to protect the city. Further, they may elevate and reclaim submerged or low lands along the waterfront, dredge channels, and build and operate drydocks, piers, wharves, and boat basins. To finance these improvements to their harbors, coastal cities may issue bonds.

d. Construction and Administration of Hydroelectric Plants and Power

Texas cities may generate, purchase, and distribute hydroelectric power. They may own and operate municipal electrical plants and may contract with other generating agencies for electrical energy. Numerous Texas cities now purchase part or all of their electricity from agencies generating hydroelectric power, such as the Lower Colorado River Authority and the Brazos River Transmission Electrical Co-Operative.

3. Water Districts

a. Functions and Types of Water Districts

Since the 1904 constitutional amendment permitting the creation of special districts, water districts have become the most important unit of local government undertaking water programs in the State. The local water districts, together with the federal agencies, are the action agencies which construct, operate, and maintain most waterworks and water projects.

Water districts in Texas undertake all of the major types of water programs, including flood control, drainage, navigation, sewage disposal, power supply, groundwater control, mosquito control, soil conservation, and recreation, as well as irrigation, domestic, commercial, and industrial water supply. These tasks of supplying and controlling water often involve the construction of levees, dams, lakes, and power facilities, or the channelling, clearing, and maintenance of streams and rivers. Water districts in Texas do all of these things, and more.

Water districts may be created under general or special laws, and both classifications are commonly found in Texas. The Legislature often creates districts by special legislation, even though the general laws grant broad powers to districts.

There are thirteen types of general law water or water-related districts. A list of the type of districts which may be created under the general law is shown in Table 1.

Table 1.--Types of General Law Water Districts in Texas

Water Control and Improvement	Municipal Water
Water Improvement	Irrigation
Water Control and Preservation	Levee Improvement
Water Power Control	Drainage
Water Supply	Navigation
Fresh Water Supply	Conservation and
Underground Water Conservation	Reclamation

As can be seen, the mission of the district is generally indicated by the prefix to the title, "Irrigation Districts," "Water Control and Improvement Districts," "Drainage Districts," etc. The statutes describing and authorizing water districts fill two volumes of the State code, running from Article 7466 to Article 8280 and covering more than 2,500 pages. The length and complexity of these laws are due, in part, to the fact that, since the passage of the first conservation amendment in 1904, new water district legislation has simply been tacked on to the old.

In addition to general law districts, there are over 400 special water districts which were created directly by the Legislature. These bear various names, but the official names given them are notoriously unreliable as indicators of the activities performed by the districts. A large number of these are similar in form, and perform the same functions as districts organized under the enabling acts. Some are basinwide in scope, and are vested with broad powers to accomplish multiple-purpose development of the waters of the entire watershed. (See "Watershed Districts and Programs," page 47.) Others perform one or two specific tasks, much as multicity districts—a type of district which has become very popular in Texas since World War II—which provides water supply or sewer facilities for the member

cities. There are, in addition to these types, several other special act water districts.

b. Creation of Water Districts

The method provided for the creation of the general law districts is found in the enabling legislation. Most of these enabling statutes for surface water districts provide four steps in the procedure for establishing a district. They are: (1) a petition for the establishment of a district by a certain number of taxpaying residents, (2) a hearing before the county commissioners court or other authorizing agency, (3) approval of the action by a popular election, and (4) the appointment or election of the directors of the district.

Surface water districts (other than municipally created districts) within one county may be established by the county board. The agency authorized to create bicounty districts, however, varies from one statute to another. For instance, levee improvement districts, if located in two or more counties, may be created by the county board selected by the district to have authority over it, while for a similar navigation district, the county in which most of the land is situated receives the petition. The Texas Water Rights Commission receives the petition for the establishment of bicounty water improvement districts and water control and improvement districts.

The procedure for establishing an underground water district is somewhat more complex. The Ground-Water Conservation Districts Act (Art. 7880-3c) provides for the conservation and preservation of underground water reservoirs or subdivisions thereof. The organization of such district involves two distinct procedures: (1) the designation of an underground reservoir or subdivision thereof, and (2) the creation proceeding. The Texas Water Rights Commission must first, either at its own instance or upon a landowner's petition, designate an underground water reservoir or subdivision thereof. After such a designation by the Commission, a groundwater district, coterminous with its boundaries, may be formed according to the procedure laid down in the Water Control and Improvement District statute.

As has been noted, not all types of water districts found in the State may be created under existing statutes. For example, neither a local government nor the Texas Water Rights Commission is authorized to organize river authorities, valley improvement districts, or water recreation districts. These and others, with names such as watershed districts and authorities, flood and irrigation districts, navigation and port districts, sanitation authorities, water and soil conservation districts, water and sewer improvement districts and authorities, municipal and industrial authorities, and so on, may be created only by the Legislature.

c. Number of Districts

The total number of water districts in Texas is very difficult to determine. One reason for this is that various types of general law districts may be created by a number of different agencies: counties, cities, and the Texas Water Rights Commission. Further, there are the special law districts. Some of these require an election of confirmation in the localities involved, and in some instances the proposition fails to receive an affirmative vote. Unfortunately, special act districts voted down in confirmation elections are retained in the statutes and are likely to be included in any census of districts.

Until the Legislature enacted a statute requiring a copy of the order or act creating a district to be filed with the Texas Water Rights Commission (1955), there was no way of knowing the total number of water districts without a county-by-county and city-by-city census. Even with this requirement, it is difficult to ascertain the total figure, because many districts are either dormant or have been abolished or annexed by municipalities. Furthermore, there has not been complete compliance with this registration requirement.

d. Powers

Special districts in Texas have been granted sweeping powers by the Legislature in matters relating to water. For example, the most common type of water district, the Water Control and Improvement District, may provide water for irrigation as well as for domestic, commercial, and industrial uses. It also may improve rivers for navigation, and undertake drainage programs, as well as build dams, reservoirs, and lakes; and it may operate sanitary sewer systems, collect refuse, and so on. Such a district may even be formed to determine the feasibility of forming a district. Other types of districts, especially those authorized by earlier legislation, have more limited authority.

The powers and functions of an underground water district include: (1) making and enforcing regulations for the conservation and recharging of underground reservoirs; (2) making and enforcing rules against waste; (3) issuing permits for the drilling of wells within the reservoir; (4) requiring reports on the drilling, equipping, and completion of wells; (5) acquiring lands for the purpose of recharging operations; (6) making surveys and plans and carrying on research relative to ground water; and (7) enforcing by injunction or other appropriate process the duly adopted regulations of the district.

The wide variety of water districts created by special acts and their lack of uniformity make it difficult to generalize about their powers. Many of the districts created by the Legislature are similar in form and perform the same functions as districts created under the general statutes. If one excludes the river authorities,

districts dealing primarily with soil erosion, and several other types such as sanitation and water recreation districts, then most of the districts are very similar to, and function in the same way as, water control and improvement districts.

Water districts are units of government, and have the usual corporate powers—the power of eminent domain, the power to levy taxes and special assessments, and the power to issue bonds, subject to limitations appearing in the enabling laws. In fulfilling their missions, districts are authorized to make necessary surveys, examinations, investigations, and plans; to purchase or construct, and maintain, water works and facilities; and to cooperate and contract with federal agencies, individuals, private corporations, other districts, river authorities, and other municipalities.

e. Administrative Organization

Water districts are governed by boards of directors of various sizes and kinds. Those formed under the general laws are governed by boards composed of from three to five directors each. In levee improvement, drainage, and water control and preservation districts, the directors are appointed by the county board. But in water improvement, water control and improvement, fresh water, and underground water districts, the directors are elected by the real property owners who are qualified voters of the district. Some districts may be divided for electoral purposes into divisions or precincts. For example, the directors of a water improvement district may divide the district into equal sections and provide that the directors shall be elected from these sections. And the "precinct method" of electing directors is required for underground water districts.

The qualifications required for directors are simple. They must be owners of real property in the district, over 21 years of age, residents of the state and district, and eligible to vote. They are not required to have particular professional qualifications.

Board directors for districts created under special acts are also selected in various and unique ways. In fact, one of the reasons often given for creating a district by a special act of the Legislature is to provide representation on the Board for constituent elements, such as in multiple-city districts. The most prevalent methods of selecting these directors are by appointment by the Governor, another state official, or members of the constituent units. The size of the governing bodies ranges from 3 to 21 members.

f. Control and Supervision of Districts

There is little control or supervision of water districts by either state agencies or the public. In fact, the general criticism that the public is unable to exert

adequate control over special districts applies with equal validity in Texas. The rapid multiplication of disparate, often overlapping, water districts of all kinds and sizes makes it impossible for even the most conscientious citizen to understand their problems and activities, much less watch and regulate them.

Equally true is the criticism that there is a lack of control, supervision, and coordination by the State. The criticism stems from the fact that the only legal restrictions usually pertain solely to financial powers and the engineering soundness of proposed projects. This, in turn, results in uncoordinated, splintered efforts among these governmental entities, which can sometimes lead to an irrational competition for public monies without intelligent weighing of the relative merits of competing demands.

The entire program of supervision of water districts by state agencies consists of the following: water improvement and water control and improvement districts which issue bonds must submit their proposed engineering plans to the Texas Water Rights Commission for an investigation as to the engineering feasibility of the proposed project. The bond issue to finance such a project must next be examined as to its legality by the Attorney General. Bond issues proposed by all general law and most special act water districts must be submitted to the Attorney General. The only factors considered by these agencies are the technical engineering and legal aspects, and after the plans and bonds are approved, there is no supervision of the actual construction to ensure that it is in accordance with the approved plan. Nor is there any supervision of the sale of the bonds. Levee districts are required to submit their plans for the approval of the Texas Water Development Board. This, too, is an examination only as to the engineering soundness of the district's plans. Water rights of all districts diverting water from rivers and streams are subject to the same control by the Texas Water Rights Commission as the Commission exercises over all others.

There are also few statutory limits and controls upon the financial powers of most districts. The majority of districts operating under enabling acts enacted since the 1917 Conservation Amendment are free from state-imposed limitations. The only requirement in most cases is that the bonded indebtedness be incurred only after approval by a majority of the property tax-paying voters of the district voting at any single election. No tax or debt limitations were placed upon most districts organized under these statutes.

This results in a contrasting situation wherein the State, the counties, and home rule and general law cities are subject to constitutional or statutory debt and tax restrictions, while water districts, generally, are not. This, of course, is one explanation for the rapid growth of water districts.

4. Soil and Water Conservation Districts

Soil conservation intimately affects the conservation of water resources. The rate of runoff, the amount of silt from erosion, and the infiltration of water to recharge ground-water reservoirs can be influenced by soil conservation, and are crucial to a water conservation and development program. This is well stated in the Texas statute called the State Soil Conservation Act, which states:

"That the consequences of such soil erosion in the form of soilblowing and soilwashing are the silting and sedimentation of stream channels, reservoirs, dams, ditches, and harbors; the loss of fertile soil material in dust storms; the piling up of soil on lower slopes, and its deposit over alluvial plains; the reduction in productivity or outright ruin of rich bottom lands by overwash of poor subsoil material, sand, and gravel swept out of the hills; deterioration of soil and its fertility, deterioration of crops grown thereon, . . . a blowing and washing of soil into streams which silts over spawning beds, and destroys water plants, diminishing the food supply of fish; a diminishing of underground water reserve, which causes water shortages, intensifies periods of drought, and causes crop failures; an increase in the speed and volume of rainfall runoff, causing severe and increasing floods, which bring suffering, disease, and death; . . . and losses in navigation, hydroelectric power, municipal water supply, irrigation development, farming, and grazing."

In 1939, the Texas Legislature passed this soil conservation law, which authorized the establishment of districts for the purpose of conserving the soil resources of the State. Impetus for the state law came from the national Soil Conservation Act of 1935, under which technical assistance was made available to farmers, provided they were organized into districts, in applying soil conservation measures.

By February 1968, there had been organized in Texas 184 soil and water conservation districts; these covered more than 98 percent of the land in the State. Each district is governed by an elected five-member board of supervisors and is an independent subdivision of the State. Among other things, the districts are authorized to: (1) carry out preventive and control measures within the district; (2) conduct surveys and investigations of flood damage, soil erosion, and control measures needed; (3) conduct demonstration projects; (4) furnish agricultural and engineering machinery and

equipment, fertilizer, seeds, and such other material or equipment, as will assist farmers and ranchers in carrying on erosion control, flood prevention, and water management operations; and (5) cooperate or enter into agreements with any agency, governmental or otherwise, or any occupier of lands within the district in the carrying on of erosion control and prevention operations within the district.

Soil and water conservation districts in Texas have no taxing or bonding powers. Financing of the soil and water conservation practices undertaken within the district is met, for the most part, by the individual farmers and ranchers. They may be assisted in the planning and construction stages by technicians from the U.S. Soil Conservation Service, and they sometimes receive materials from the federal agency. Furthermore, financial assistance is available to the individual farmers under other programs of the U.S. Department of Agriculture.

The soil and water conservation districts exist to aid the planning of activities within the district and to channel requests for technical assistance to the U.S. Soil Conservation Service. The State Soil and Water Conservation Board (discussed on page 38a) functions largely as a clearinghouse of information for the 184 districts, and coordinates their programs through advice and consultation.

F. INTERSTATE COMPACT COMMISSIONS

The interstate character of several of the rivers in Texas has necessitated compacts with other states to allocate these waters and to plan for the development of the river basins. Texas is now a party to four interstate compacts: the Rio Grande Compact between Texas, Colorado, and New Mexico*; the Canadian River Compact between Texas, Oklahoma, and New Mexico; the Pecos River Compact between Texas and New Mexico; and the Sabine River Compact between Texas and Louisiana.

1. Administrative Organization

The administration of these compact commissions is entrusted to multimember boards. The Rio Grande, Pecos, and Canadian Commissions consist of one representative from each participating state and, since national interests are involved, a representative of the federal government as well. In each case, the federal representative is designated chairman. The Sabine River Compact Administration is composed of two members from each of the participating states and one from the

* Waters of the Rio Grande are allocated also by international treaty and administered by the International Boundary and Water Commission—United States and Mexico.

federal government, the latter serving as chairman. All commissions require that any salary and all expenses for each representative be borne by the government he represents.

2. Functions

The principal purpose of these commissions is to determine whether or not the states are meeting their obligations under the terms of the compact for the delivery of water into the river. Several of these compacts provide not only for the preservation and equitable apportionment of the waters of the river but also for the development of the water resources in the basin. The primary concern, however, of all four water compacts now in operation is that of apportionment. None of them has moved very far in the direction of water resource development.

G. GOVERNMENTAL TRENDS IN WATER RESOURCES DEVELOPMENT

Until 1964, local units of government operating with the federal government bore the brunt of the State's responsibility to develop and conserve Texas' water resources, as declared in Article XVI, Section 59, of the State Constitution. They undertook and financed the programs to build dams and reservoirs, to improve the harbors, to operate and maintain these facilities, and to do the numerous other things required in these programs.

As the population and industrialization of the State have grown, the increased water problems have made necessary the creation of new water agencies and the adjustment of the size of local units to better fulfill their functions. Much of the responsibility for water development shifted from the county to water districts, and then from single-purpose water districts to multiple-purpose river authorities. Parallel to this development has been the trend in cities toward water districts, and toward multicity districts to undertake projects which a city alone could not develop.

These changes were accomplished in a patchwork manner. Newly created units were often given tasks, responsibilities, and authority already possessed by older units. As a result, numerous local agencies have overlapping authority and responsibility, and in many instances there has been little coordination between them.

At the beginning of the present accelerated planning program in Texas, there were more than 600 river authorities, water districts, and other local or regional political entities with direct responsibility for some aspect of water development. As in the case of state and federal agencies, the need for effective administrative

planning and coordination increased as the population of the State increased and the demands for water continued to grow.

Beginning in 1964, under the direction of Governor Connally, the State of Texas as whole became the focal point for the development and management of water resources in Texas. Whereas responsibility for water management began with cities, followed by water districts, and multicity districts and river authorities, the recent trend in water management in Texas has been greater centralization of responsibility in statewide agencies. This trend has not been dictated by a new theory of water management but has been necessitated by the increasing complexity and size of water problems and the increasing difficulty of local units of government to deal effectively with them.

H. PROGRAMS ADMINISTERED BY TEXAS WATER DEVELOPMENT BOARD

1. Development of a Texas Water Plan

a. Statutory Language Applicable to Texas Water Plan

Article 8280-9 Section 3 (b), Vernon's Annotated Texas Civil Statutes:

"(b) . . . The Texas Water Development Board is specifically charged with the following duty: the preparation, development, and formulation of a comprehensive State Water Plan for this state, including as a definition and designation of river basins and watersheds as separate units for purposes of water development and inter-watershed transfers"

(Plan to serve public interest of entire State)

" . . . The Board shall be governed in its preparation of said plan by a regard for the public interest of the entire state, and shall direct its efforts to plan for the orderly development and management of water resources in order that sufficient water will be available at reasonable cost to further the economic development of the entire state"

(Bays, estuaries, and navigation)

" . . . Consideration shall also be given in the plan to the effect of upstream development upon the bays, estuaries,

and arms of the Gulf of Mexico and to the effect upon navigation."

(Amendments to Plan)

"The Board shall also make such modifications and amendments to said State Water Plan as experience and changed conditions make advisable, and the Texas Water Commission or its successors shall, when requested by the Board, hold a public hearing in the same manner and for the same purposes as specified herein on the original State Water Plan. Any modifications and amendments so adopted by the Board shall become a part of the said Plan."

(Federal assistance)

"The Board may take all necessary action to qualify for federal assistance in financing the development and improvement of the Plan."

b. Introduction

The Texas Water Development Board has as a statutory duty the development of a comprehensive water plan for Texas. The objectives of the Board's planning program are to: (1) define the present and future needs for water in the State, and (2) select the plan for meeting those needs that will best afford the opportunity for development and use of the State's total water resources.

The planning program at present is conducted in terms of three specific programs:

- (1) Plan formulation and report preparation,
- (2) Cost allocation and economic analyses, and
- (3) A research program to develop techniques for systems simulation.

While all three areas of planning are being carried on contemporaneously, the concentrated effort at present is on the first two.

c. Plan Formulation and Report Preparation

The scope of the planning program encompasses all water resources available to Texas, including surface and ground waters, fresh and saline, including waters from both intrastate and interstate streams, and

including the coastal bays and estuaries. It also includes consideration of possible importation from out-of-State sources for needs which cannot be supplied from the intra- and interstate sources presently available to Texas.

All water requirements of the State are considered: municipal demands, industrial requirements, irrigation needs, water quality management, recreation requirements, fish and wildlife needs, navigation needs, and water requirements for mining, including secondary oil recovery. The needs for flood control and hurricane protection are accorded full consideration. Watershed management to maintain the quality, as well as the quantity, of the available water resources, necessary drainage of irrigated lands, preservation of reservoir sites, and flood plain zoning are among planning considerations.

Special consideration is being given to the problems of maintaining the quality of ground water resources of Texas, proper disposal of the ever-increasing volumes of wastes, and quality control related to deterioration from natural mineral deposits.

The complex legal, financial, and institutional arrangements for implementation of the Plan's proposals are under study, and a long-range program for the Water Development Board in implementation of the Plan is being developed.

Scheduling of the planning program is based on the urgency of pending water problems to be resolved within the framework of a responsible statewide water plan. This master plan report, scheduled for release in 1968, will set forth the initial phases of proposed plans for protection, development, conservation, redistribution, and administration of water resources necessary to meet the maximum demands for water for all purposes in all parts of the State to the year 2020.

The master plan framework will include proposals for implementation and will indicate project priorities based on evaluation of the State's greatest projected needs.

d. Cost Allocation and Economic Analysis

In formulating a water development plan, there is not generally a fixed need for water which can be satisfied by one facility of a particular size. Therefore, a range of developments were studied to (1) compare alternative facilities and (2) establish the bases for selection of elements (or combination of elements) for the Plan which will serve the economic needs for water of the people of the State and maintain certain constraints of priorities of use to maximize benefits over costs.

In general, the cost figures considered in the Plan are an approximation of costs established under federal procedures to repay the estimated construction and operating costs of facilities. Their significance is that they provide a basis for comparison and selection between alternative developments.

Because of the tremendous costs involved and the direct federal interest in the purposes of water resource development, the federal government will be involved to a great extent in the construction of facilities within the framework of the Texas Water Plan. Therefore, it is necessary that the Plan be formulated generally in accordance with the principles of Senate Document 97, 87th Congress, 2nd Session, which sets forth the economic planning criteria for all federal water resource development projects. The maximization of benefits over costs, which is in the interest of the people of Texas, is emphasized in this document.

e. A Research Program to Develop Techniques for Systems Simulation

The Texas Water Development Board has reached a stage in its planning activities at which it can assess the complexities of data analysis and of operational management in the development of water resources. A new approach to this problem in Texas will be the use of dynamic operational models to simulate the intricate and changing land and water resource system.

To this end, the Board has begun a research program to apply the most advanced and sophisticated techniques available for systems simulation and analysis. Numerous disciplines, including hydrology, geology, engineering, economics, law, and social impact, will ultimately be involved in the development of techniques for using electronic computers to simulate the water plan in operation.

2. Technical Programs and Functions

a. Statutory Language Applicable to the Technical Programs and Functions

Article 8280-9 Section 21 (a), (b), (c), (d), (f), (g), (h), (i), (j), (l), and (m), Vernon's Annotated Texas Civil Statutes:

* (Water-related investigations)

The Texas Water Development Board is charged with: "(a) making investigations and studies, and collecting data and information on the occurrence, quantity, quality and availability of the surface and ground waters within the State, including particularly the technical duties and functions set forth in Articles 7472(d), 7524, 7537(a), 7527(b), 7621(c), and 7621(d), Vernon's Annotated Texas Civil Statutes."

(Data collection contracts)

"(b) After consultation with and approval by the Board, negotiating and executing agreements with other state agencies, political subdivisions and municipal corporations of the state, federal agencies, and private persons and corporations for cooperative or joint studies and investigations of the occurrence, quantity and quality of the surface and ground waters of the state, the topographical mapping of the state, and the collection, processing and analysis of other basic data relating to the development of the water resources of the state, and the administration and performance of such agreements;"

* Art. 7472(d)	Concerning surveys to disclose measure and potential availability of water resources.
Art. 7524	Concerning certain flow measurements and related calculations.
Art. 7527	Concerning maintenance of proper records.
Art. 7528	Concerning determination of water quantities throughout the State.
Art. 7537(a)	Concerning survey of underground water supply.
Art. 7537(b)	Concerning Red River natural pollution study.
Art. 7621(b)	Concerning injection wells for industrial and municipal waste.
Art. 7621(c)	is now repealed. Former Article 7621c related to the protection of underground water and required the registration of well drillers. (See Article 7621e, The Texas Water Well Drillers Act)

Also, see Art. 8280-12 Sec. 1-19, The Weather Modification Act of 1967.

(Basic data collection and analysis)

"(c) Collecting, receiving, analyzing and processing basic data concerning the water resources of the state; provided all data collected by the Board shall be the property of the State of Texas;"

(Topographic-geologic mapping)

"(d) Carrying on the program for topographic and geologic mapping of the state;"

(Publication of data)

"(f) Evaluating, preparing for publication, publishing and reproducing engineering, hydrologic and geologic data, information and reports relating to the water resources of the state;"

(Investigation of regional needs)

"(g) Determining the silt load of streams and making investigations and studies of the duty of water and surveys to determine the water needs of the distinct regional divisions of the watershed areas of the state;"

(Appearance in the public interest)

"(h) Aiding, advising and assisting the Board in regard to other engineering, hydrologic and geologic matters. It is specifically provided that the designated employees of the Board shall appear and present evidence at public hearings held by the Texas Water Commission or its successor or any other agency, state, local or federal, for any purpose involving matters affecting the public interest"

(Examination of engineering matters before Texas Water Rights Commission)

" . . . The Board shall receive and examine all engineering plans and proposals involved in matters coming before the Texas Water Commission or its successors and may appear before the Commission in any hearing concerning such plans or proposals;"

(Miscellaneous technical functions)

“(i) Performing other technical engineering, hydrologic functions in the administration of the water resources of the state.”

(Administration of Centralized Data Bank)

“(j) The Executive Director, under the direction and with the approval of the Board shall cause to be created a centralized data bank incorporating all hydrological data collected by the several agencies of the State of Texas.”

(Reclamation engineering functions)

“(l) All those powers and duties relating to reclamation engineering formally vested by law in the State Board of Water Engineers and its successor, the Texas Water Commission under the provisions of Chapters 5 and 6, Title 128, Revised Civil Statutes of Texas, 1925, as amended, are transferred and vested in the Texas Water Development Board. And all such powers and duties shall hereafter be executed and performed by the Texas Water Development Board or its authorized agents and employees. . . .”

(Approval of reclamation plans required)

“(m) From and after the taking effect of this Act it shall be unlawful for any persons, corporation or levee improvement district, without first obtaining the approval of plans for the same by the Texas Water Development Board, to construct, attempt to construct, cause to be constructed, maintain or cause to be maintained, any levee or other such improvement on, along or near any stream of this state which is subject to floods, freshets, or overflows”

b. Introduction

The technical programs and activities of the Texas Water Development Board generally are categorized as follows:

- (1) Surface- and ground-water availability,
- (2) Data collection, data inventory, and related studies,

(3) Water-related services, and

(4) Planning, special studies, and research.

c. Surface- and Ground-Water Availability

(1) Surface Water

The Texas Water Development Board is continuously involved in determining the water supply that can be developed to meet the State's future needs. The determination of surface water availability has been accomplished by employing or modifying recognized techniques of water resource engineering in combination with extensive use of the latest electronic data computing equipment. The end result has been directed toward analysis of river basin water supplies for meeting basin requirements to the year 2020 in the most efficient and economic manner. In effect, the ultimate development of a river basin has been studied so that the incremental (1960-2020) development of reservoirs can be analyzed together with the effect on an approach toward basin optimization to meet future requirements. Data necessary for these massive studies were extracted from various river basin master plans, the 1980 planning report of the Texas Board of Water Engineers, proposed federal projects, the report of the U.S. Study Commission-Texas, various project reports prepared by cities and industries, and active applications and presentations to the Texas Water Rights Commission.

Urbanization, development of new water projects, and changing channel conditions have the effect of changing the regimen of a stream. Runoff characteristics and basin hydrologic conditions change with time; therefore, the Board is continually updating its river basin hydrologic studies. The Board's updating operations include defining upstream contributing drainage areas and sedimentation rates in existing and proposed reservoirs, adjusting for additional upstream development, adjusting river runoff for changing future conditions, and refining estimates of evaporation rates for existing and future reservoirs.

Surface water availability studies are made to accomplish the following:

- (1) Determine the yield-capacity relationship of a reservoir site, by means of reverse computer operation of the reservoir.
- (2) Determine the safe annual yield of the reservoir for variable demands and allocated storage, and determine spills for downstream operation, by means of forward reservoir operation.

- (3) Determine deposition and location of sediment inflow into a reservoir and the effects of reduced capacity on future yields.
- (4) Compute basin water resources, considering sequences of development and location of requirements.
- (5) Determine total basin water resource under present and future conditions, using irrigation, municipal, and industrial water requirements and using return flows and their quality as it affects reuse.
- (6) Provide flood routing computations for dam and reservoir design.

(2) Water Quality Conditions

The Texas Water Development Board, in cooperation with federal, state, and local agencies, has encouraged and conducted intensive studies on water quality conditions in some of the major Texas streams. Sources of natural pollution—the saline flow of springs and seeps into the Pecos, Brazos, and Red Rivers, and to a lesser degree the Colorado River—have been the subject of intensive study.

Federally supported projects to alleviate this natural pollution, together with information available from the Texas Water Quality Board regarding the quantity and quality of municipal, industrial, and other waste discharges, are incorporated in the basin operation studies made by the Board.

(3) Ground Water Field Investigations

Ground water field investigations are made to determine the occurrence, availability, dependability, quality, and quantity of ground water, particularly with reference to the sources of water suitable for public supply, industrial, and irrigation use.

The Texas Water Development Board also makes investigations incidental to the preparation of recommendations for delineation of underground water reservoirs in response to local petition.

In beginning a regional approach to studying ground water conditions in the State, the Board is conducting two major field investigation programs, one in West Texas and one in East Texas. The West Texas Investigation Program currently consists of the north-central Texas studies, with headquarters in Abilene, and an Edwards Plateau study, with headquarters in San Angelo. The Edwards Plateau study includes a field

investigation incidental to the preparation of recommendations for delineation of boundaries of the underground water reservoir.

The East Texas Investigation Program currently consists of continuing regional studies in the southern part of the Trinity Sands aquifer, with headquarters in Waco, and the southwestern part of the Carrizo-Wilcox aquifer, with headquarters in San Antonio.

After the initial phases of these field investigations are completed, the Board will maintain district offices to continue studies on these important sources of the State's water supply.

d. Data Collection, Data Inventory, and Related Studies

(1) Texas Water Development Board and U.S. Geological Survey Cooperative Programs

Since 1915, the Texas Water Development Board and U.S. Geological Survey have cooperated in data-collection programs. The Board acts in an administrative capacity by outlining programs for maintaining an inventory of the State's water resources which are essential to planning and development. Technical services required to gather data and publish records are largely furnished by the Geological Survey. Funding is shared equally by the state and federal agencies; in some instances, local entities may account for all or part of the State contribution.

Present programs with the Geological Survey include (a) surface water, (b) quality of water, and (c) ground water investigations, and an extensive topographic mapping program. These and sub-topical activities are discussed in this section, with the exception of topographic mapping, which will be discussed in a section on water-related services (page 96). During fiscal year 1968, State cash participation in the cooperative programs amounted to \$666,619. Additional State participation in the cooperative programs is provided in the form of technical assistance and coordination by State personnel.

(a) Surface Water Programs— U.S. Geological Survey

Stream Gaging and Reservoir Content Stations.—The objective of the stream gaging program is to determine the discharge rates and volumes of streamflow at selected stations. The gaging records fall into two main categories. These are (1) hydrologic investigative measurements used to determine the quantity of water reaching a specific point in the stream, and (2) measurements used in operational management as a means of

fulfilling legal water rights, or administratively in meeting water accounting requirements.

In order to have continuous records of contents of major Texas reservoirs, a system of reservoir content gaging stations is maintained. Additional information is obtained on seepage losses and evaporation losses from reservoirs by a system of reservoir inflow and outflow gages.

Bay and Estuary Studies.—These studies, to extend over at least three years, began immediately following the large flood flows that were discharged to the bays by streams in flood stage as a result of Hurricane Beulah.

The objective of these studies is to ascertain the following:

- (1) Occurrence, source, and distribution of nutrients,
- (2) Current patterns, directions, and rates of water movement,
- (3) The physical, organic, and inorganic water quality and its areal distribution, and
- (4) The occurrence, quality, and dispersion of natural and man-made pollutants discharged to the bays and contiguous streams.

Small Watershed Investigations.—The objective of the small watershed investigations is to obtain basic data on rainfall and inflows to and outflows from small flood-detention structures. The U.S. Soil Conservation Service also participates in these investigations.

Drainage Area Measurements.—The objectives of the drainage area measurements are to define more accurately the drainage areas within the major river basins and coastal areas as adequate topographic maps become available.

Urban Hydrology.—Urban hydrology studies are made to provide comparisons of runoff characteristics between urban and rural watersheds in the same locale, and to determine the effects of urbanization on small watersheds. Some cities are cooperators in these studies.

Streamflow Temperature, Base Flow, and Water Delivery Studies.—The objective of the streamflow temperature studies is to measure changes in temperature caused by municipal and industrial return flows, particularly where a thermal load from steam electric plants and other manufacturing sources is involved. The significance of temperature variance is that it may destroy or alter the ecology of a stream.

The objective of base flow studies is to determine that portion of stream discharge which is derived from or lost to ground-water formations and reservoir releases or other sources other than the net rainfall which created the surface runoff. Base flow data show the minimum available water supply from a stream at any point.

The objective of water delivery studies is to measure and account for the differences in the releases from storage and the recoveries at point of delivery.

*(b) Quality of Surface Water—
U.S. Geological Survey*

This program is designed to determine the quality of surface water at particular points in Texas streams. Quality of water sampling is conducted both on a daily and partial record basis. The quality program includes a determination of chemical constituents and, at certain locations, determinations of organic material, or the presence of pesticides and herbicides.

*(c) Ground Water Programs—
U.S. Geological Survey*

The Texas Water Development Board and the U.S. Geological Survey participate in two categories of ground water investigations: detailed studies and continuing studies.

Detailed Studies.—These are made for selected geographic units (generally counties) to provide refined quantitative data on the quantity and quality of the ground-water resource. Included in the scope of these investigations is a determination of the location and extent of fresh water-bearing formations, chemical quality of ground water, quantity of ground water being withdrawn and the effects these withdrawals have had on water levels and water quality, hydraulic characteristics of important water-bearing formations, and an estimate of the quantity of ground water available for development from each of the important aquifers. These detailed studies also include analysis of special ground water problems such as encroachment of inferior quality water into fresh water-bearing formations, subsidence of the land surface caused by ground water withdrawals, discharge of saline ground water into surface streams, and the relationship of ground water recharge and discharge to streamflow, where such problems are significant.

Continuing Studies.—In four areas of the State, continuing studies of a detailed nature have been conducted for many years by the Board in cooperation with local interests and the U.S. Geological Survey. These areas include the San Antonio area, the Houston area, the El Paso area, and Galveston County. The need for ground water information in each of these areas is

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specific. Continuing studies have therefore been planned to meet special objectives and to relieve the problems of the individual areas.

Although the scope of the continuing studies varies with the needs and problems of each area, the principal objectives of the studies are to formulate and execute a continuous basic data collection and interpretation program, including: measurement of water levels, observation of changes in water quality, inventory of ground water withdrawals, encroachment of salt water, and studies of land subsidence problems.

(2) Texas Water Development Board Programs

Evaporation Program.—The evaporation program is conducted to obtain pan evaporation data on a daily basis from stations throughout the State. Pan evaporation rates are correlated and adjusted to approximate evaporation losses from free water surfaces. The Texas Water Development Board currently operates and maintains a network of 47 evaporation stations in Texas in cooperation with various State and federal agencies, cities, companies, districts, individuals, colleges, and river authorities.

Sediment Program.—The objective of this program is to determine the suspended sediment load of Texas streams. The Texas Water Development Board operates 50 sediment sampling stations in Texas. Near-surface samples are obtained daily. During fiscal year 1968, the agency acquired depth integrating sampling equipment, which will permit authentication or correction of correlation factors presently used in computing suspended transport.

Ground Water Use Inventory.—This program is designed to obtain data on ground water use. Between January and June of each year approximately 2,500 municipalities and industries are canvassed to determine the amount of ground water consumed by each user during the previous year.

Water-Use Summary Inventory.—The objective of this program is to gather detailed statistical data on ground-water and surface-water use from the larger municipalities and industries in Texas. The Texas Water Development Board will use these data to correlate actual water uses with those projected in the Texas Water Plan. These data are collected between January and June each year by mail and by visits to the water users.

Return Flow Inventory.—The objective of this inventory is to determine that portion of the total water being used in comparison to that portion being returned to a stream or other point of disposal. Questionnaires are sent to the larger cities and to those industries which have a permit for disposal of waste to a stream.

Waterflood Inventory.—The objective of this program is to determine the source, amount, and quality of water used in secondary-recovery operations of the petroleum industry. The Railroad Commission of Texas canvasses the petroleum industry once every two years to obtain data on the efficiency of these operations in the production of oil and gas. At the completion of the canvass, the Texas Water Development Board extracts data on water use from the records of the Railroad Commission. In January 1968, the Railroad Commission began a canvass of the industry to obtain data on secondary recovery operations for 1966 and 1967.

Irrigation Inventory.—The objective of this program is to obtain (at approximately five-year intervals) data on the source and amount of water used for irrigation, the acreage under irrigation, and the crops being irrigated. The information is tabulated by county soil conservation districts, by zones of major river basins, and (on a county basis) by type-of-farming areas. The next inventory is to be for crop year 1969. Planning of the project was begun in early 1968. The project will be conducted in cooperation with the Texas Soil and Water Conservation Board and the Soil Conservation Service of the U.S. Department of Agriculture.

Industrial Water-Use Inventory.—The objective of this inventory is to gather data from the larger water-using industries pertaining to volume of water used, source, quality, treatment, amount recirculated, manner of use, and amount and method of disposal of effluent. The last comprehensive industrial water-use inventory was for calendar year 1964. Another comprehensive industrial water-use inventory is planned for the five-year interval ending in 1969.

Observation Well Program.—The objective of this program is to determine the effects of discharge and recharge upon the various aquifers by measuring a network of observation wells throughout the State. Water levels are measured annually in over 2,900 wells at a time of year when the water levels show greatest recovery from the effects of seasonal pumping. Additional water-level data are collected by other groups and assembled in the records on file with the Board. In areas undergoing rapid changes, automatic water-level recording devices are used to obtain continuous records for certain wells, and bi-monthly measurements are made in other selected or "special" wells. At the end of fiscal year 1968, 38 automatic water-level recorders were in operation and 75 special observation wells were being measured bi-monthly.

Well Numbering Programs.—The objective of this program is to assign permanent numbers to wells used in Texas Water Development Board or U.S. Geological Survey reports, in addition to wells used in the observation well program. The wells are located on maps and numbered according to a grid system.

Drillers' Log Program.—In this program the well logs, reports pertaining to the encounter of water, and plugging reports received from water well drillers are acknowledged, located on maps, and assigned a temporary number.

Phreatophyte and Brush Control.—The objective of this program is to demonstrate the effects of phreatophytes and phreatophyte control projects on the hydrology of certain areas. The benefits from these projects are measured in terms of salvage of ground and surface waters from non-beneficial consumptive use.

County Climate Characteristics.—The objective of this program is to describe climatic characteristics of each of the 254 counties of Texas.

Rainless Days.—The objective of this program is to provide tables of probabilities of dry periods for use in planning for irrigation, crop planting and harvesting dates, and reservoir operation. This is a joint effort of the Texas Water Development Board, U.S. Weather Bureau, Texas Water Rights Commission, and Texas A&M University.

Excess Rainfall and Droughts.—The objective of this program is to gather data on rainfall frequency and drought periods for use in designing and operating water storage and conveyance facilities.

e. Water-Related Services

(1) Surface Casing Program

The primary function of the Surface Casing Program is to make recommendations to the oil and gas industry and to the Railroad Commission of Texas as to the depth to which protection of usable quality ground water and surface drainageways should extend in the industry's drilling and production operations.

The Board has no rules and regulations requiring an operator to contact the agency for these recommendations, but participates in the program through rules of the Railroad Commission under authority given that agency by statutes bearing specifically on the drilling and production activities of the oil and gas industry.

Statewide Rule 13 (a) of the Railroad Commission requires that an operator obtain a letter from the Texas Water Development Board recommending the depth to which "fresh-water strata" should be protected when drilling a new lease or in an area not covered by field rules stipulating surface casing depth.

Rule 8 of the Railroad Commission requires that all "fresh-water strata" be protected in drilling or production activities.

Rule 8 also requires that a letter be obtained from the Board giving the recommended protection depth before an operator begins seismic test drilling, stratigraphic or core tests, or other exploratory tests that will penetrate the base of "fresh-water strata."

(2) Water Quality Program

The primary functions of the Water Quality Program are as follows:

(a) Evaluation of applications to the Board for permits to dispose of municipal and industrial wastes (as defined in Article 7621b as amended by House Bill 949 of the 59th Legislature) by subsurface injection. Evaluations are made to determine whether such injection operations will offer a predictable hazard to water resources of the State, and are authorized under Article 7621b, Vernon's Annotated Texas Civil Statutes.

(b) Evaluation of applications for permits from the Railroad Commission of Texas to dispose of wastes produced with oil and gas by subsurface injection, in order to determine that such injection operations will not offer a predictable hazard to water resources of the State as authorized under Article 7621b, Vernon's Annotated Texas Civil Statutes.

(c) Investigations of and research relating to existing or potential problems of pollution or contamination of the ground water resources of the State, and preparation of reports giving results of investigations or research, and recommendations, as directed under Article 7621d, Vernon's Annotated Texas Civil Statutes. Included are investigations conducted relative to permit applications made to the Texas Water Quality Board.

(3) Topographic Mapping Program

Currently (August 1968), the Texas Water Development Board participates in the topographic mapping program on an equal-matching-dollar basis with the federal government at a level of \$400,000 in State funds per year.

Additionally, the Texas Mapping Advisory Committee makes recommendations which contribute to determining the areas to be mapped under the all-federally financed mapping program. Participants in the Texas Mapping Advisory Committee are the State Soil and Water Conservation Board, Texas Industrial Commission, Texas Water Rights Commission, General Land Office, Texas Highway Department, Texas Society of Professional Engineers, Bureau of Economic Geology (The University of Texas at Austin), Texas Surveyors' Association, South Texas Chamber of Commerce, West Texas Chamber of Commerce, East Texas Chamber of Commerce, North Plains Ground Water Conservation

District No. 2, High Plains Underground Water Conservation District No. 1, and Texas Water Development Board.

These maps are essential aids to many endeavors completely beyond the water resource development field.

(4) Plan, Design, Review, and Inspection of Texas Water Development Board Funded Projects and Projects Before the Texas Water Rights Commission

The Texas Water Development Board reviews the plans and specifications for all projects to be financed out of its Development Fund.

The engineering feasibility of any project proposed for financing through the fund is investigated, including checking the estimated cost of the engineering design, checking construction, and confirming estimates of the quantity and quality of water to be developed as a result of construction of the project.

In this review, it is determined whether there is a need or projected future need for the water to be developed by the project, and whether the project will make optimum development of the site.

(5) Materials Testing Program

The materials testing program, which is conducted in the Board's laboratory, has two main objectives: (1) to evaluate construction of water-related facilities, and (2) to provide data for engineering design of water-related facilities.

Currently, emphasis in the materials testing laboratory is placed on compaction control of fill material, identification of borrow materials to determine suitability for use as construction materials, suitability of rip rap material, and testing of concrete. The major role of the laboratory is in providing support service to the technical divisions of the Board.

(6) Administration of the Weather Modification Act

The Board, as agent of the State on weather modification matters, provides administrative support such as record keeping, issuance of licenses and permits, and investigations on all matters relating to weather modification and cloud seeding.

(7) Administration of the Water Well Drillers Act

The Board, under the Water Well Drillers Act, provides administrative support to the Water Well

Drillers Board by issuing licenses, holding examinations, and conducting investigations.

(8) Reclamation Engineer Functions

The Board became responsible for the duties and functions of the State Reclamation Engineer in 1965. Generally, the Board's participation involves supervision over projects of conservation districts, reclamation districts, and levee improvement districts. The Board is also the repository of all the prior accumulation of reclamation records transferred from the General Land Office. Articles 7960 through 8030, Vernon's Annotated Texas Civil Statutes, set out the duties, powers, and authority of the State Reclamation Engineer.

(9) Centralized Data Bank

The objective of the Centralized Data Bank program is to provide a comprehensive data storage and retrieval system that will incorporate hydrologic, economic, and engineering data of the several agencies that participate in water-resource-oriented studies.

f. Planning, Special Studies, and Research

(1) Agricultural Programs—Irrigation and Drainage

The broad objectives of the agricultural programs are as follows:

(a) To develop diversion requirements for individual irrigation areas.

(b) To carry out programs dealing with problems in agriculture water requirements, water development, water use, and water conservation in the State.

(c) To determine capabilities of different soils and soil types for sustained irrigation.

(d) To investigate overall effect of proposed irrigation on the State's economy and water resources.

(e) To conduct a by-crop analysis of consumption of irrigation water.

To accomplish these broad objectives, the Board maintains cooperative and liaison relationships with many state, federal, and local agencies having interests in this field similar to those of the Board.

(2) Desalting

The Texas Water Development Board has conducted studies under contract with the U.S. Department

of the Interior, Office of Saline Water, to determine the preliminary economic feasibility of using saline water resources in developing additional municipal and industrial water supplies by saline water conversion, and to determine the potential contribution of saline water conversion to future water supply in the State. The statewide study considered all cities with a population over 1,000. A regional study was made of the Lower Rio Grande Valley, which considered a regional supply system serving several cities from one desalt plant. A third study considered the type and characteristics of desalting plants most suitable to the treatment of saline waters in West Texas and evaluated the possibilities of regional desalting systems in seven areas.

(3) Playa Lake Modification

The Board has participated with other state, federal, and local agencies in studying methods of modifying the playa lakes in the High Plains of Texas for use as a source of supplemental water supply and for possible storage facilities for water imported to this region. In addition, a study has been made for the Board in which data were collected and maps prepared on the location of playa lakes and other depressions, and their drainage areas in 23 counties in the Southern High Plains. These mapping studies will continue, as well as the cooperative efforts with other agencies.

(4) Meteorology

The Board is conducting meteorology research projects in cooperation with The University of Texas, Texas A&M University, the Medina Electric Cooperative, Inc., the Texas Water Rights Commission, the Texas Agricultural Experiment Station, and the U.S. Environmental Science Services Administration. These projects are directed toward weather modification for purposes of water conservation, increasing the supply of available water, and ameliorating or eliminating the effects of severe weather.

(5) Economics

Regional Analysis.—In addition to the economic analysis of the potential impact of the Water Plan on the State, the Texas Water Development Board is constructing econometric and statistical models, and benefit-cost analysis, by way of a regional breakdown of the State.

Agriculture-Business Analysis.—An analysis of Texas "agribusiness" is being drafted by the Board. This report, in four sections, analyzes the agricultural sector of the Texas economy by land resource areas; examines in detail "agribusiness" activities linked to agricultural production; estimates primary, secondary, and tertiary benefits to Texas agriculture and irrigation; and predicts future agricultural benefits that could be attained with water resource development.

Summary reports of benefits from irrigation are being prepared for the High Plains, Trans-Pecos, North Central Texas, Winter Garden, Lower Rio Grande Valley, Coastal Bend areas, and Webb and Maverick counties. These reports project to 2020 the irrigation benefits to farmers, to processors of farm commodities, to suppliers of farm inputs, and to local retailers. The impact of new irrigation on the area economy is quantified.

Employment-Population Projections.—The Board is projecting Texas employment by county and by industry sector. These employment forecasts are based on: population projections of the Board; labor force participation rates by age, sex, and color, projected to 1980 by the Bureau of the Census (and projected by the Board to 2020); birth, death, and migration rates derived by the Board from census data; and county population by age, sex, and color projected to 1990 by the Bureau of Business Research of The University of Texas (and projected by the Board to 2020). It is hoped that the employment forecasts by county and by industry sector can later be used to project industrial water requirements by standard industrial classification group and by county.