THE VALUE OF LICENSING GEOLOGISTS IN TEXAS

BACKGROUND INFORMATION FOR

SB405

**TEXAS SECTIONS
OF THE
ASSOCIATION OF ENGINEERING GEOLOGISTS
AND
AMERICAN INSTITUTE OF PROFESSIONAL GEOLOGISTS**

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March, 2001

THE VALUE OF LICENSING GEOLOGISTS IN TEXAS

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THE VALUE OF LICENSING GEOLOGISTS IN TEXAS

This report was compiled to provide information to the 77th Legislature regarding the need to license geoscientists.

There are several disciplines of geoscience, including:

- **Geology**
- **Geophysics**
- **Hydrogeology**
- **Engineering Geology**
- **Environmental Science, and**
- **Soil Science**

PROFESSIONAL LICENSURE OF GEOLOGISTS IN TEXAS IS NECESSARY TO PROTECT THE HEALTH, SAFETY AND WELFARE OF THE CITIZENS OF TEXAS.

Licensing geologists will establish minimum requirements of those who are engaged in the public practice of geology so that municipal, county and state agencies, and design professionals can rely on the geological work being performed.

This report is concerned with the impact of geologic conditions and processes on our critical resources and engineered structures and works, and the need to establish minimum requirements for persons that are engaged in the public practice of geology.

THE PUBLIC PRACTICE OF GEOLOGY

Geologists perform work that involves the application of geologic principles in the:

- identification, investigation, characterization and protection of critical natural resources;
- investigation of unstable geologic conditions that undermine the integrity of engineered structures, works and processes and can cause failure; and
- investigation of dynamic geologic processes that are destructive, invasive, and threaten the lives and homes of people in Texas.

Geological work includes:

- Identification and characterization of ground water aquifers with respect to: the amount of water that can be stored and pumped, location and aerial extent of recharge zones, discharge zones, and geologic features that promote or impede ground-water flow within the aquifers;
- Protection of the environment and critical natural resources from contamination;
- Investigation of geologic conditions that contribute to off site migration of buried municipal solid waste leachate, hazardous waste and radioactive waste from landfills, and hazardous and radioactive waste repositories;
- Investigation of geological conditions that contribute to landslides and other slope failures;
- Investigation and assessment of geologic conditions that cause coastal and stream erosion;
- Investigation of geologic conditions that contribute to sedimentation in streams and reservoirs;
- Investigation of the causes and aerial extent of subsidence; and
- Site-specific investigation of active faults in large coastal cities.

WHY LICENSE?

One third of the geologists in the State of Texas are engaged in the public practice of geology. At this time persons who have no geological education or training are free to engage in the public practice of geology.

The justification for licensing any profession is to protect the health, safety, and well-being of the public.

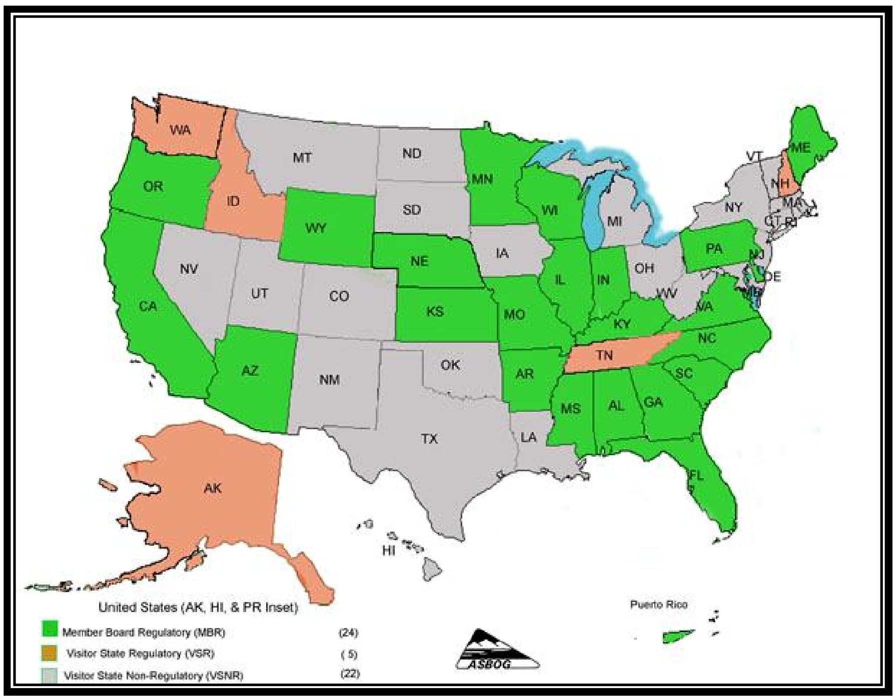
REASONS TO LICENCE GEOLOGISTS

- A license legally implies a responsibility for the quality of work.
- An individual possessing a professional license can be presumed to be fully qualified to offer geological services.
- The role of geologists has greatly increased during the last 20 years, and their interaction with the public on civil works and environmental projects has increased enormously.
- Licensure will identify geologists who have achieved minimum levels of education and relevant work experience required to protect the health safely and well being of the public.
- Licensure improves the overall quality and reliability of geological reports.
- Licensure of geologists distributes the risk associated with investigation of geologic conditions to those professionals most qualified by education and experience to take responsible charge of the investigation.
- Licensure better defines the roles of geologists who practice for the public. Consequently, the goals and objectives of the educational institutions that teach applied geology will be better defined, thus improving education and qualification of practitioners.

HOW MANY OTHER STATES LICENSE GEOLOGISTS?

The Association of State Boards of Geology (ASBOG) reports that currently, 29 states and territories regulate the public practice of geology. Regulation of geologists in additional states is being considered by their respective legislatures.

The figure below, provided by ASBOG, graphically presents the regulation and membership status of all 50 states and Puerto Rico.



29 States and territories currently regulate the public practice of geology. Of these, 24 have established registration by examination as well as experience (ASBOG)

HOW MANY GEOLOGISTS ARE THERE IN TEXAS?

Texas has the largest population of geologists of any single state or country in the world. The American Association of Petroleum Geologists, the largest international geological organization in the world, serving petroleum and environmental geologists alike, has an estimated total membership on the order of 30,000. Texas membership in this organization is approximately one-third of the total.

Texas geologists that belong to professional and technical organizations include:

- American Association of Professional Geologists (AAPG) ~ 10,000
- American Institute of Professional Geologists (AIPG) ~ 640
- Association of Engineering Geologists (AEG) ~ 120
- National Ground Water Association (NGWA-AGWSE) ~ 550
- Texas Association of Professional Geoscientists ~ 50
- Society of Independent Professional Earth Scientists ~ estimated 1,500
- Houston Geological Society ~ 4,000
- Dallas Geological Society ~ 800
- Austin Geological Society ~ 200

Geologists in Texas who do not belong to these organizations include academic instructors and researchers in universities and colleges in Texas, geologists who are employed by state agencies, and geologists who do not join organizations. Their numbers are estimated as follows:

- Instructors and researchers, and state agencies estimated 1,000 (conservative)
- Non-joiners estimated 500 (conservative)

In addition to geologists in Texas, there are geologists in Louisiana, Oklahoma and New Mexico who practice in Texas, and would be licensed. The number of out-of-state geologists are estimated to be on the order of 500 (conservative)

Total Members and Non-Members ~ 19,860
Accounting for dual memberships ~ 15,000 geologists in Texas

It is estimated that at least one-third of the estimated total geologists in Texas are engaged in the public practice of geology. Out of the estimated 15,000 geologists in Texas, an estimated 5,000 engage in the public practice of geology, and would be licensed.

HOW MUCH WILL LICENSING COST?

Licensing of geologists will not burden the taxpayer

A regulatory board for geologists and other geoscientists will be self-sustaining, and will NOT be a burden to taxpayers in the State of Texas. Expenses incurred by the board for Executive Director and staff salaries, and administrative costs will be incurred by the licensees.

Based on the numbers of licensed geologists, alone, and a fee of $100.00 per year per licensee, the projected revenue for operation of board expenses is estimated to be on the order of $500,000.

Many state boards of geology in other states operate with an Executive Director, and less than four additional staff members. In Wyoming, the board staff consists of the Executive Director and one staff member who works 30 hours per week. The number of license holders in Wyoming as of September 24, 2000 was 3,038 (mostly out-of-state).

It is estimated that in order for the **Texas Board of Professional Geoscientists** to operate smoothly, in addition to the Executive Director, three to four staff positions will be needed. Anticipated salaries are as follows:

- Executive Director ~ $100,000
- Four staff employees ~ $200,000

Approximately 5,000-square feet of office space will be needed. It is anticipated rent for office space will cost approximately $120,000 per year.

Office supplies and printing are estimated to cost $20,000 per year.

Office Furniture and equipment are estimated to cost on the order of $60,000 every three years, for a yearly cost of $20,000.

Communications are estimated to be on the order of $5,000 per year.

Travel expenses associated with board activities $35,000 per year.

Total annual cost for operation of the board is anticipated to be approximately $500,000.

The difference in revenue and operating expense is estimated to be $0.00.

Surplus funds should be evaluated after the first three years of operation, and adjustments can be made to license fees accordingly.

The cost of application processing and examinations will be paid by the applicants.

THE IMPACT OF GEOLOGIC CONDITIONS ON THE PUBLIC

Competent geological input is integral to protecting the public health, safety and well-being.

Geologists have unique expertise in the following areas of concern to the people of the State of Texas. In the past, many of these concerns were not considered problematic. However, with the unprecedented growth and development of the State, the judicious assessment of geologic processes and problems can no longer be overlooked.

Areas of concern in the State of Texas in which geologists are engaged in the public practice of geology are:

- **GROUND WATER RESOURCES**
  - **Groundwater Supply**
  - **Groundwater Contamination**
- **HAZARDOUS AND RADIOACTIVE WASTES**
- **STREAM EROSION**
- **COASTAL EROSION**
- **LANDSLIDES AND OTHER SLOPE FAILURES**
- **SUBSIDENCE**
- **ACTIVE FAULTS**

GROUNDWATER RESOURCES

Groundwater Supply

Geological knowledge is critical to understanding the storage and flow of water in the ground, and therefore the amount and quality of our ground-water supply.

Current and future statewide water-planning programs will require the expertise of geologists to provide reliable information on the locations of and conditions of the State's major and minor aquifers. Geologists also play a major role in understanding the naturally occurring factors including aquifer properties that affect both the quantity and quality of ground-water supply.

- Proper geological characterization of our aquifer systems is critical to ensure a sustained source of suitable quality drinking water.

- Overproduction of our groundwater resources will lead not only to a decline in the quality of life for all Texans, but also to economic problems in many areas of the state. Without adequate supplies of groundwater, many cities will lack the resources needed to maintain healthy economic growth.

- Protection of the fresh water aquifers in Texas depends upon an understanding of the geologic conditions under which the aquifers were formed and continue to be affected.

- Water lost from surface reservoirs through infiltration into the surrounding soils and non-aquifer bedrock removes a significant amount of fresh-water resource.

Just as the protection of our groundwater resources is critical to the future of Texas, the wise utilization of these resources is critical to ensure a future for Texas. Geologists are uniquely educated and trained to explore for, characterize and develop our groundwater resources. Among geologists, hydrogeologists are highly qualified to address these issues.

As the State of Texas explores ways to develop and manage groundwater resources, the role of the geologists and hydrogeologists becomes ever more critical. Planners and engineers who are responsible for designing, developing, and maintaining public water supply systems must be able to rely on qualified geologists and hydrogeologists to:

- develop accurate models of aquifers systems, requiring the use of complex mathematics such as partial differential equations;

- predict the effects of pumping on water levels in well fields: and

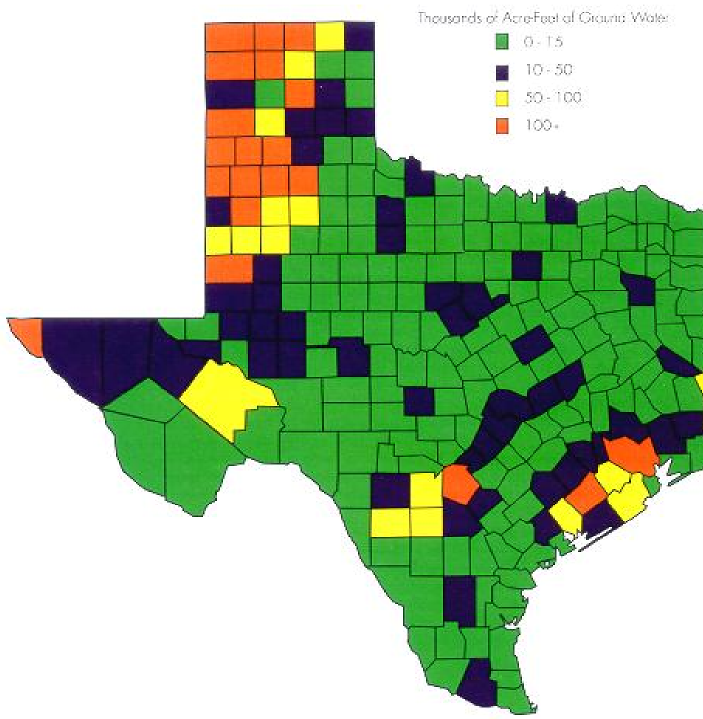
- estimate the volume of groundwater that can be recovered from well fields.

Groundwater Contamination

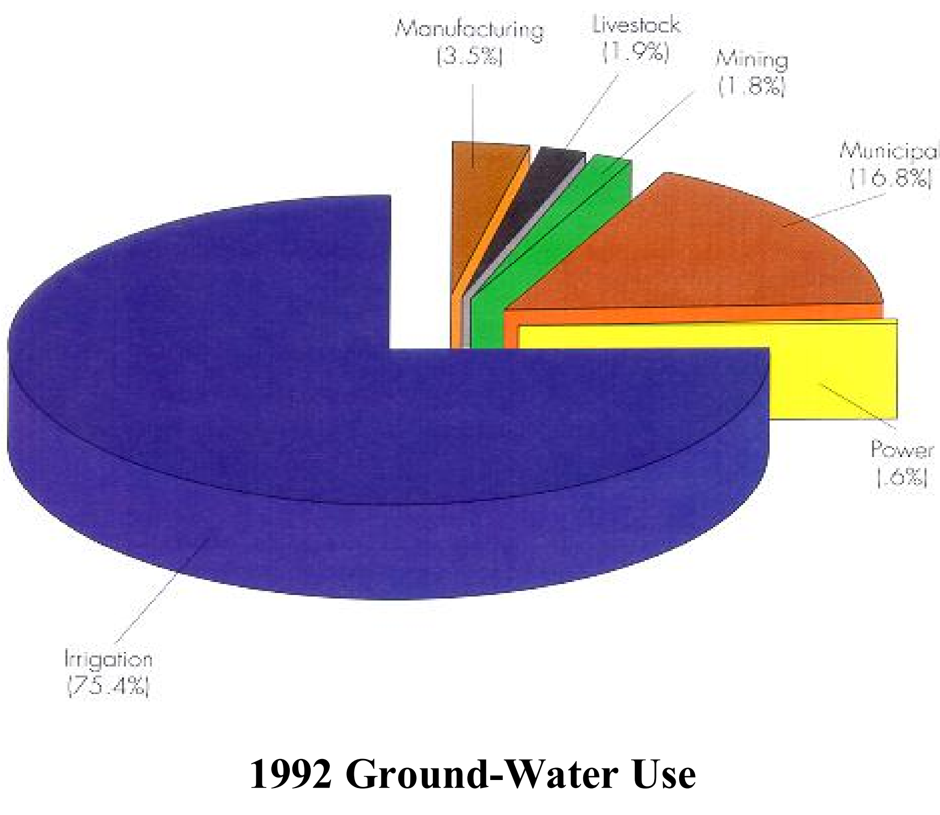
The groundwater resources of Texas are a critical resource for all Texans. Without a complete understanding of the geologic setting of these aquifers, we are at risk of contamination and the complete loss of this critical resource for survival. Geologists perform investigations that characterize and monitor ground-water contamination. Hydrogeologists, in particular, play important roles in the characterization of contaminated groundwater through their understanding of how contaminants are transported by groundwater flow systems. Flow models developed by hydrogeologists are used to predict the time required for contaminated groundwater to flow from one point to another, and to estimate the effects dispersion and rock-water interaction on the concentration of a contaminant. This information is needed by other professionals who design treatment and remediation systems.

Areas of concern are described below:

- Contaminated water draining from improperly designed and installed household septic tanks frequently reaches local shallow groundwater supplies or enters the surface water system.
- Improperly sited and abandoned sanitary landfills represent a significant risk to public health through contamination of the groundwater by solid waste leachate.
- Leaking underground storage tanks have destroyed shallow aquifers that once provided drinking water to entire communities.
- Monitoring well seals that are not appropriate for the local geologic conditions have contributed to contamination of groundwater resources throughout Texas.
- Identification and characterization of the recharge zones, ground-water flow and contaminant transport routes.

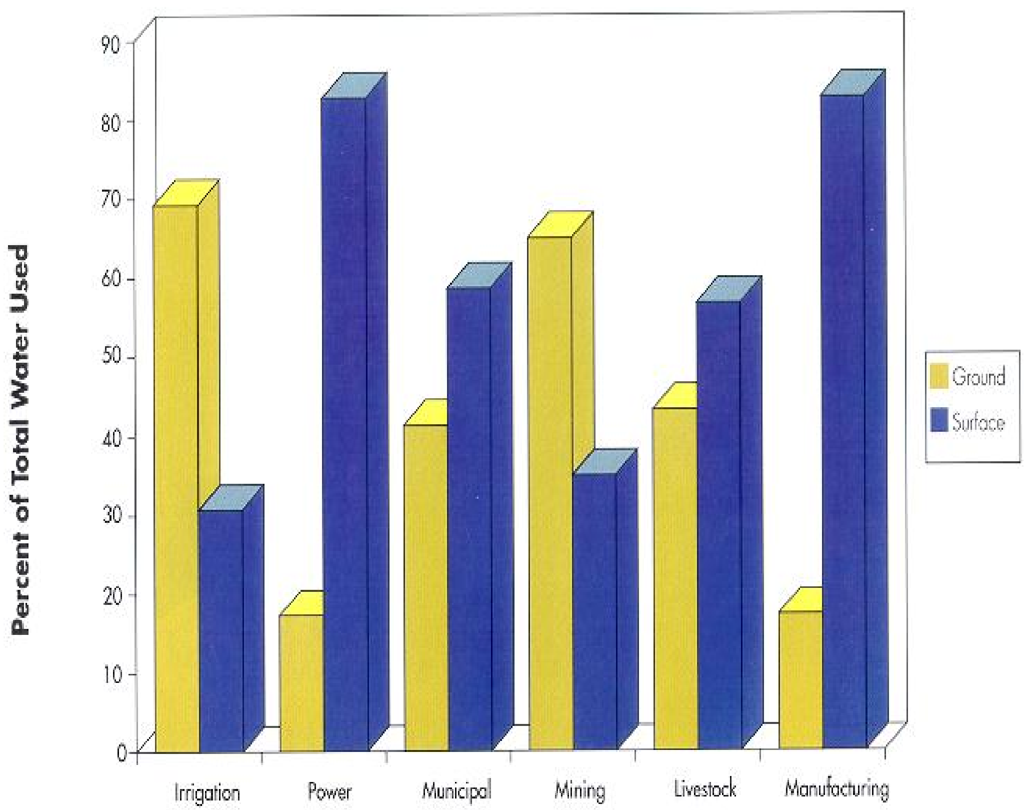


1992 GROUND-WATER PUMPAGE



1992 Ground-Water Use

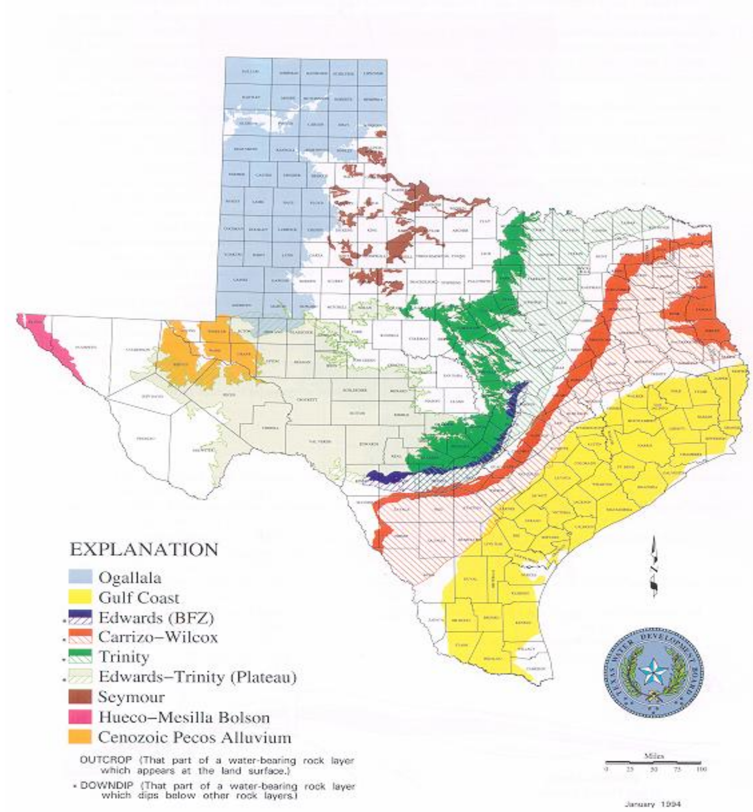
From Texas Water Development Board Report 345



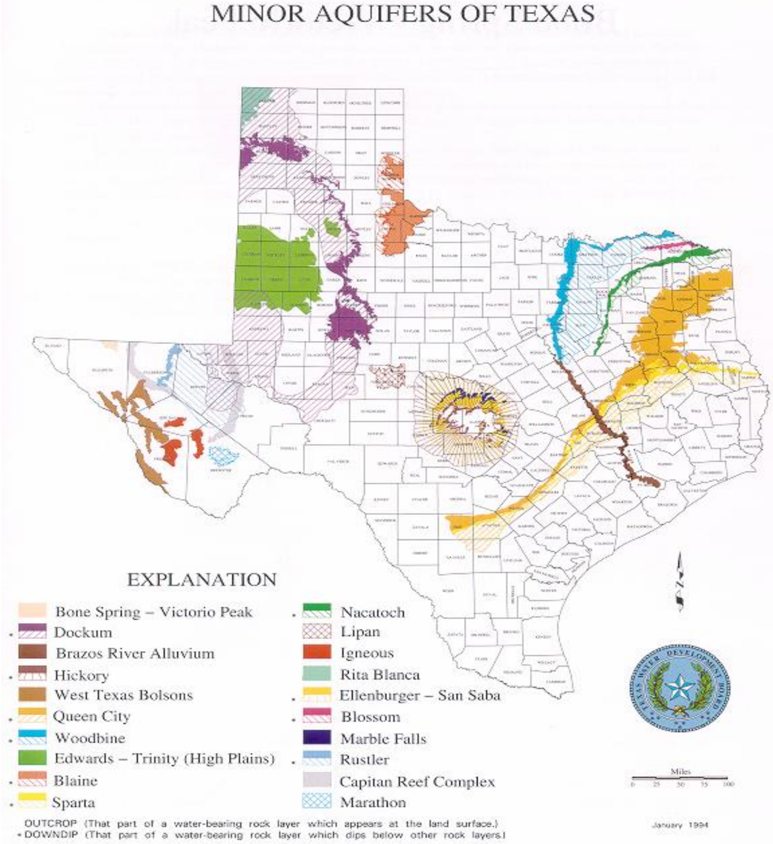
1992 Water Use by Type

From Texas Water Development Board Report 345

MAJOR AQUIFERS OF TEXAS



MINOR AQUIFERS OF TEXAS



From Texas Water Development Board Report 345

Era	Period	Aquifer
Cenozoic	Quaternary	Cenozoic Pecos Alluvium Brazos River Alluvium West Texas Bolsons Seymour Lipan
	Tertiary	Gulf Coast Carrizo-Wilcox Hueco-Mesilla Bolson Ogallala Sparta Igneous Queen City
Mesozoic	Cretaceous	Woodbine Edwards-Trinity (Plateau) Edwards-Trinity (High Plains) Edwards (BFZ) Trinity Nacatoch Blossom Rita Blanca
	Jurassic	Rita Blanca
	Triassic	Dockum
Paleozoic	Permian	Blaine Bone Spring-Victorio Peak Capitan Reef Complex Rustler Lipan
	Pennsylvanian	Marble Falls Marathon
	Mississippian	Marathon
	Devonian	Marathon
	Silurian	Marathon
	Ordovician	Ellenburger-San Saba Marathon
	Cambrian	Ellenburger-San Saba Hickory
Precambrian		

Major and Minor Aquifers in Texas and the Geologic Formations That Host Them

From Texas Water Development Board Report 345

HAZARDOUS AND RADIOACTIVE WASTES

Geological input is critical to any substance put on or in the ground.

Industrial hazardous waste has been disposed of in several ways in the past, both legally and illegally. Included in these wastes are pesticides, industrial and military solvents, dry cleaning fluids, waste oil, plutonium and trans-uranic waste and their daughter products, spent nuclear fuel rods, and low-level medial radioactive waste. Because the decay rate for hazardous wastes is sometimes very slow, and half life of radioactive wastes are sometimes very long, long-term containment is a challenge. Even if the waste is containerized and buried properly in repositories, the containers may break down and leak prior to complete decay of the wastes. Geologic conditions that will promote off-site migration of these contaminants are generally investigated by geologists and hydrogeologists prior to, and during construction of the repositories.

- The E.P.A. estimates that 90 percent of hazardous waste from about 750,000 sources in the U.S. is disposed of improperly. Region 6, which includes Texas, has over 1240 hazardous waste generators and 11 Superfund sites.
- Failure to understand the geologic and hydrologic setting in which these wastes have been buried, dumped, has resulted in problems.
- Hazardous wastes can leach into the groundwater and surface water.
- Hazardous wastes can cause human, animal and plant poisoning.
- Hazardous wastes can contaminate soils making it unsuitable for agriculture or habitation.
- Hazardous wastes depreciate land values, and when improperly disposed create problems that may endure centuries.

STREAM EROSION

Geological input is important in predicting loss of soil resources, related water pollution and loss of reservoirs.

Assessment of stream erosion hazards involves prediction of the potential magnitude and timing of erosion and prediction of where the eroded material will be deposited and how fast. Studies have shown that many of the simpler models used in the past to predict erosion are inadequate. Proper assessment of erosion requires detailed knowledge of the properties of the soils and rock and their propensity to change seasonally.

- The bulk of water used in Texas comes from approximately 190 large reservoirs. To meet the projected water needs, the State of Texas will spend approximately 2 billion dollars to develop new surface water storage capacity in the late 1990ôs and early 2000ôs and another 5 billion dollars by 2040. Historically, U.S. reservoirs lose an average of 0.2 percent of their volume per year through sedimentation in reservoirs. At this rate, Texas will lose storage capacity equivalent to 19 reservoirs over the next 50 years.

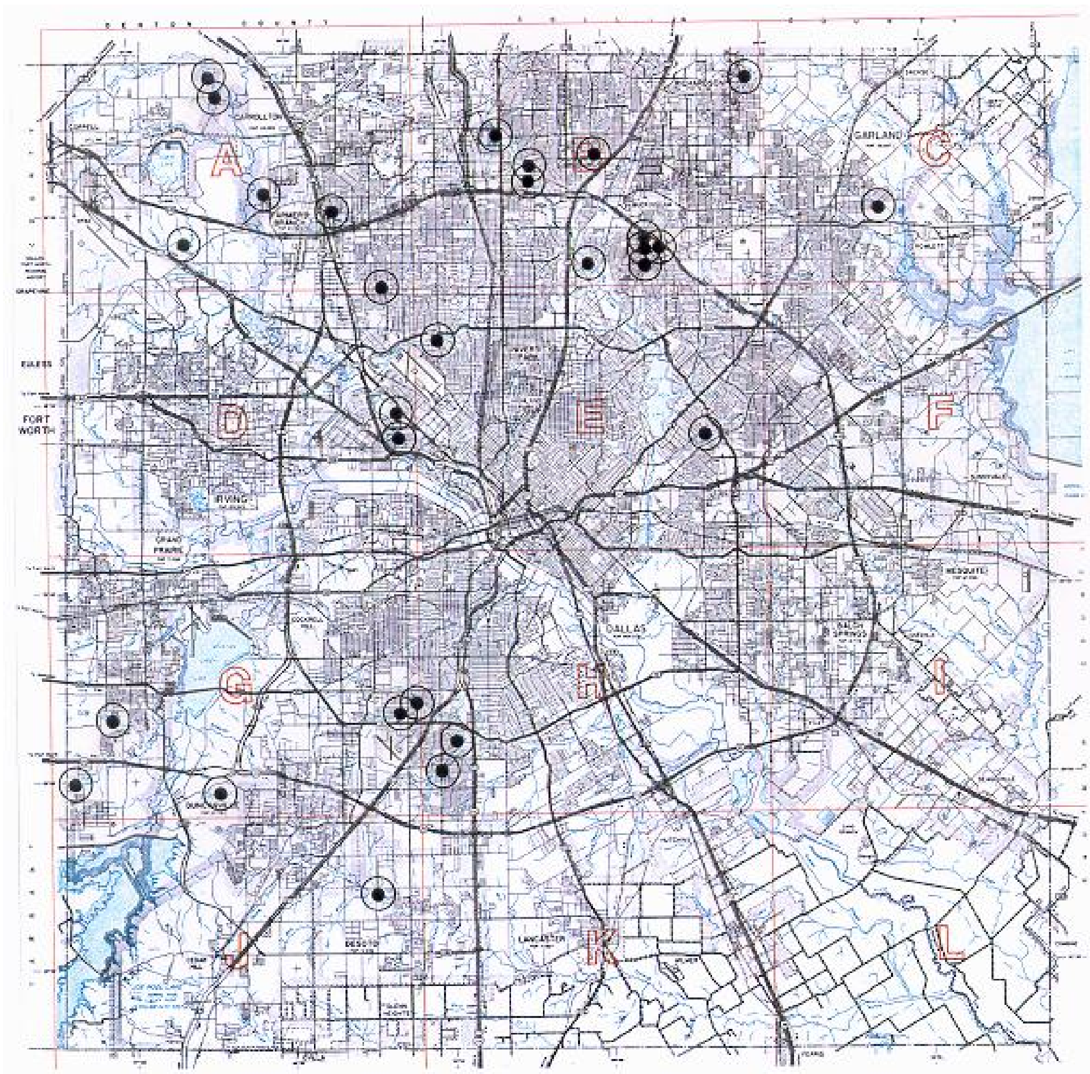
- The actual rate of volume loss is a function of land use, conservation practices, and knowledge of soil and rock erodibility and changes in erodibility over seasons.

- The annual cost of removal of sediment from small drainage ways and water supplies in Texas approaches 13 million dollars. This cost does not include cost estimates of lost soil as a resource, which are estimated to be three to twenty dollars a ton. About two thirds of stream erosion and sedimentation could be reduced by proper assessment of this process.

- Gully stream bank erosion in Texas is estimated to produce 98.5 million tons of sediment. Such erosion results in land loss, degradation of aquatic habitats, water quality, and can reduce downstream reservoir yields over time.

- Increased stream bank erosion in urban areas, the result of pavement, storm sewers, and changes in land use in the watershed could approach 5-10 million dollars a year or more.

- Costs associated with stream channel erosion and related structural improvements to protect the slopes in urban watersheds could approach $1.70 per linear foot of channel.



Locations of Selected Stream Erosion Studies at Cut Banks, Dallas County
From ñIs It Time To Get The Cities Involved?ò (Reed, R.F., 1994)

Erosion and steepening of cut bank within Austin Chalk Formation in Dallas area. Note the corner of the apartment foundation has been undermined by the erosion.

Conditions of erosion control gabion baskets after 1991 flood, Dallas area. Note undermining of home foundations.

Additional view of damage to home from erosion during 1991 flood, Dallas area.

Exposure of pier foundation under home as a result of stream erosion in Dallas area.

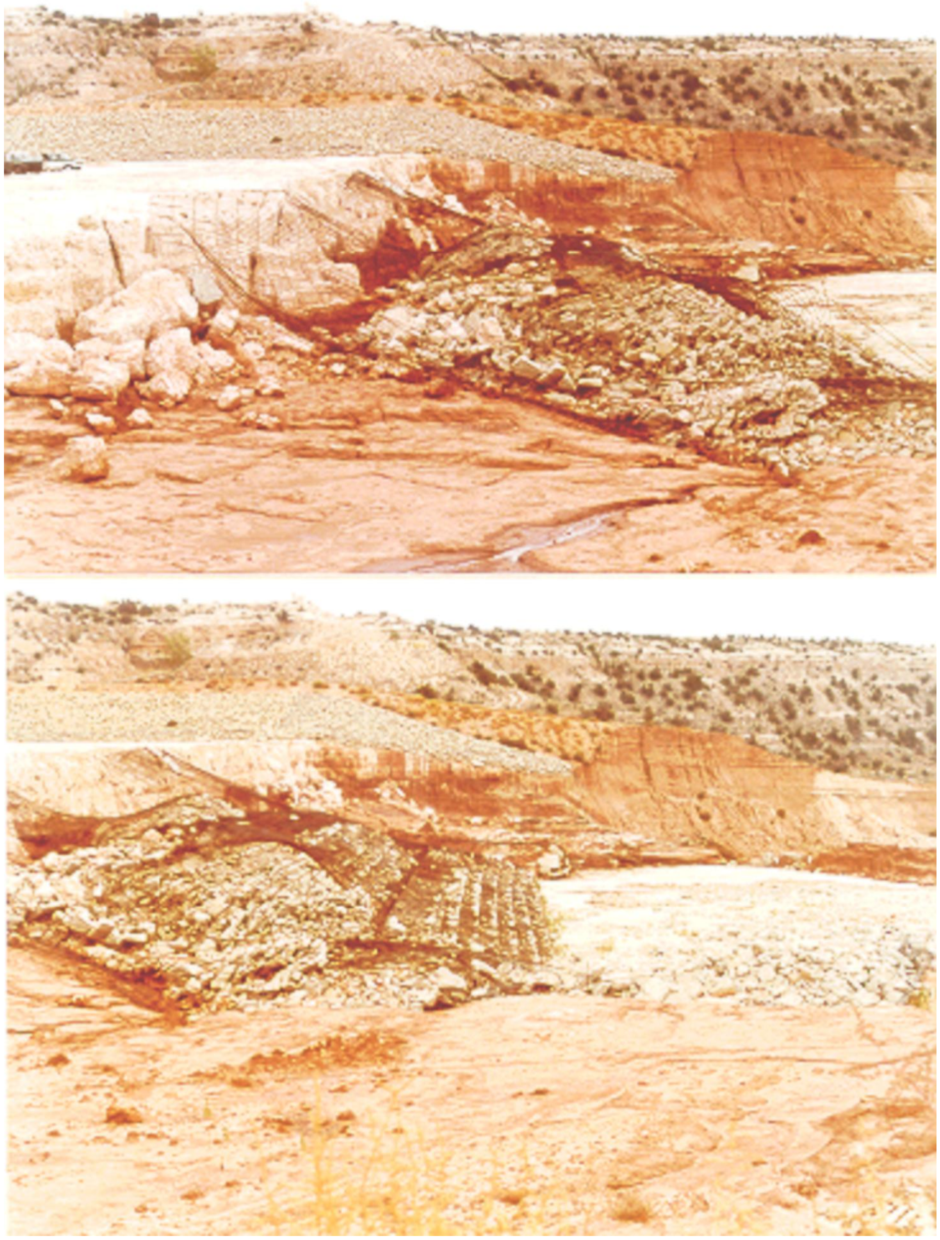
Head scarp of slope failure initiated by stream erosion at the base of the slope along creek.

Failed retaining wall behind home resulting from stream erosion at the base of the wall.

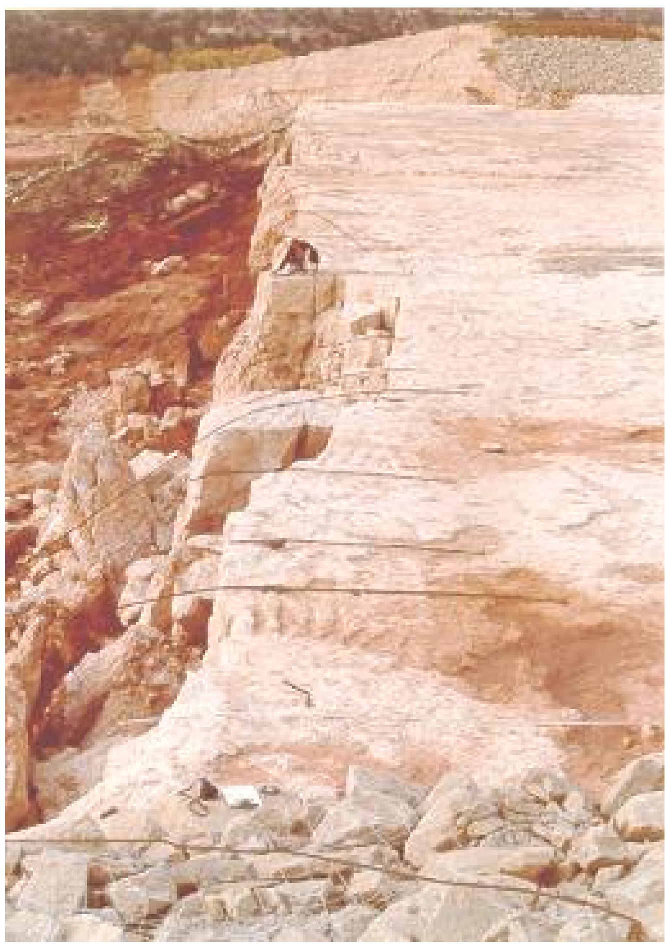
Lake Tanglewood Dam emergency spillway on June 30, 1966, prior to construction of erosion control improvements.

Lake Tanglewood Dam emergency spillway on August 1, 1977 after construction of erosion control improvements.

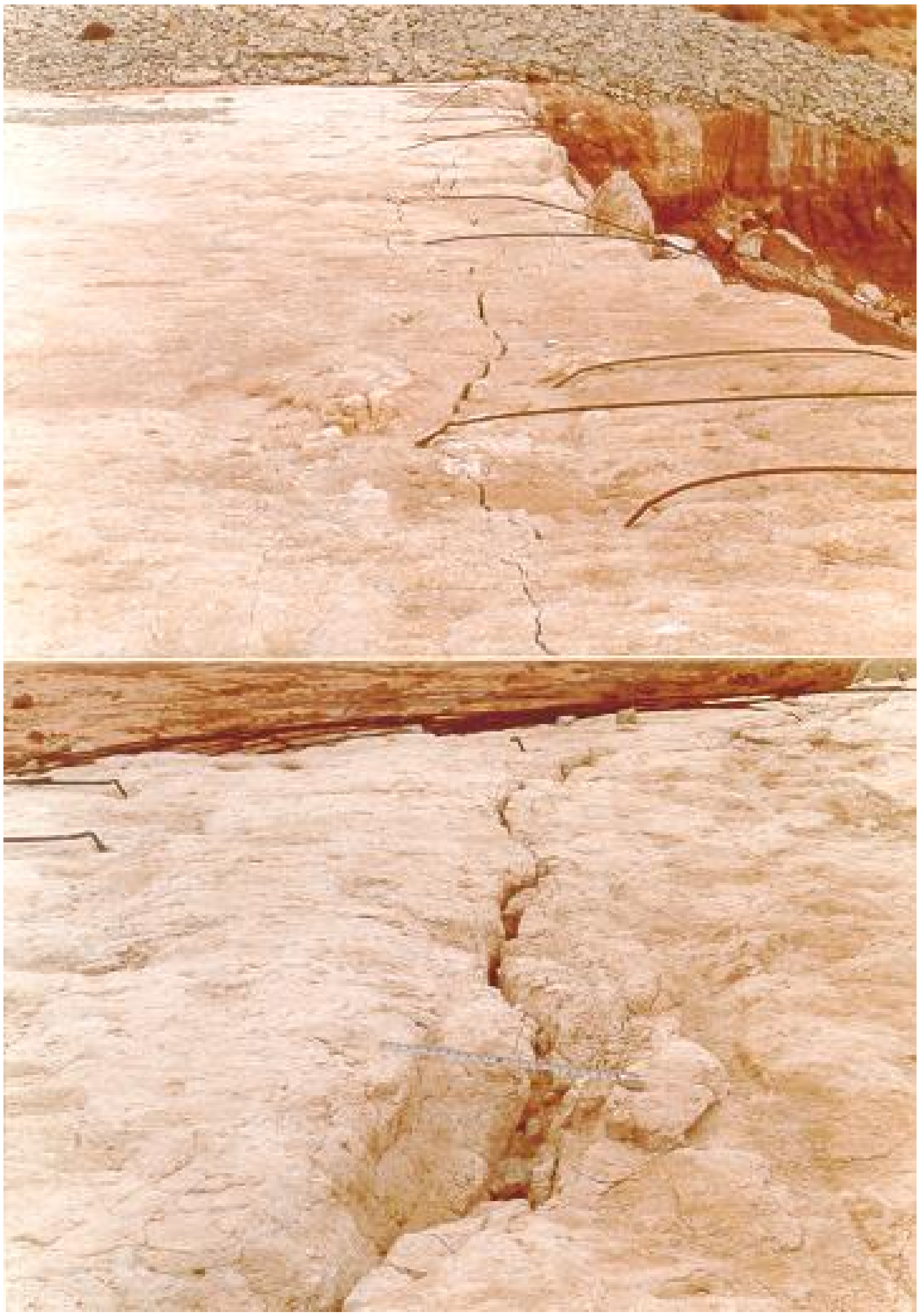
Lake Tanglewood Dam emergency spillway following May 27, 28, 1978 rainstorm that resulted in flow over spillway. Note failure of the erosion control improvements and significant downstream erosion.



Lake Tanglewood Dam and emergency spillway showing destroyed gabion baskets erosion control improvements.



Lake Tanglewood Dam emergency spillway. Note: Blocks of rock pulled from face of spillway along pre-existing vertical fractures.



Lake Tanglewood Dam and emergency spillway showing vertical fractures within the rock along the face of spillway.

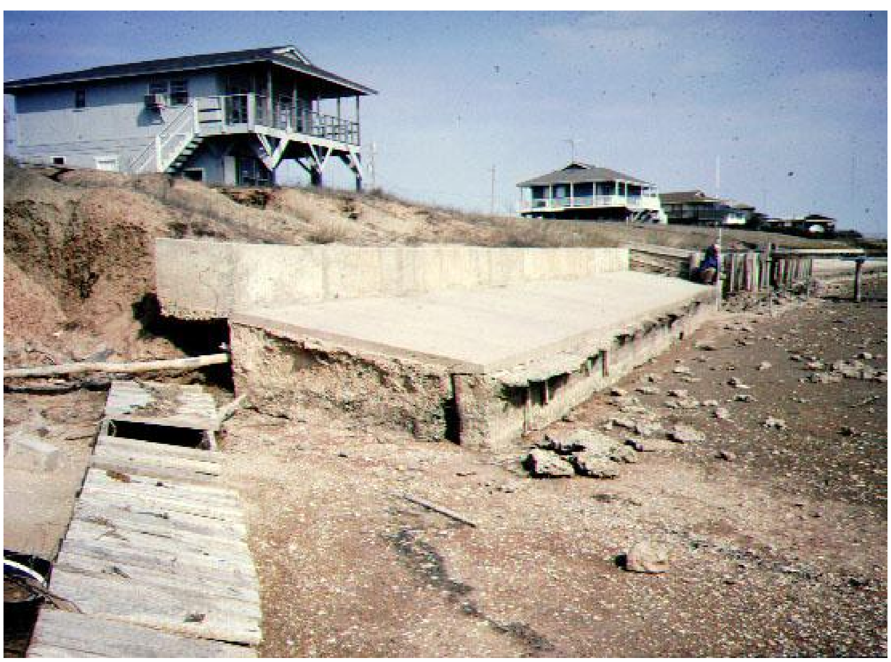
COASTAL EROSION

Coastal erosion is a complex geological problem.

Coastal losses and hazards can be reduced and managed through the application of regional scale geologic evaluations of the actual short-term and, more importantly, long-term natural processes.

- Shoreline erosion in Texas represents a significant financial burden on all Texans because the cost of coastal protection and lost tax revenue is in the millions of dollars per year.
- A significant contribution to the cause of shoreline erosion has been the construction of the many inland water supply reservoirs. Just as their filling with sediment will result in the loss of the reservoir, this trapped sediment is critically needed to renourish the coastal sediment transport system. With the decline in river sediment delivery to the coast there is a corresponding increase in shoreline erosion.
- Construction of protective structures along the shoreline that are not designed with an understanding of the active geologic and soils processes are a financial loss to the individual homeowner: they pay for the structure and lose their home anyway.
- The combination of both long-term and hurricane erosion of our coastal dunes results in an increase in the risks related to hurricane scour and flooding.

Inadequate assessment of sediment balance led to loss of this costal home. Note exposed Septic Tank.



Damage to property due to coastal erosion of clay-rich sediment in Texas back bays can be as bad as damage to structures exposed on the open coast.

LANDSLIDES AND SLOPE FAILURES

Geologic conditions contribute to the occurrence of landslides and other slope failures. Identification and remediation of landslide and other slope failure hazards requires knowledge of the geologic conditions.

Damage caused by landslides and other slope failures can be reduced by alternatives such as avoidance, removal, or permanent stabilization of slide masses. This is accomplished through detailed geologic assessment of the site and submission of this assessment to the developer and engineers.

- Based on findings and on conversations with geotechnical engineers, geologists, and Texas Department of Highways and Public Transportation, it is estimated that the cost of repair due to slope failures ranges from 0.5 to 2 million dollars a year. This figure does not include failures associated with stream banks, which would significantly increase this estimate. Geological input to engineers is critical to proper assessment of slope stability.

- It is projected that slope failures will be more common in the future as development continues to move onto the less stable slopes. In a study of urbanization of the slopes in Waco, Texas, slope failures increased from one every mile to one every 324 feet following unregulated urban growth on the slopes.

Slide into open excavation and destruction of a section of Elm Street in Dallas. Slide resulted from insufficient fracture investigation in Austin Chalk prior to excavation.

Slide into open excavation on Maple Avenue on November 11, 1984. Note that head scarp has undermined Maple Avenue.

Slide into open excavation on Maple, November 11, 1984. Failure of soldier piles due to inadequate anchoring of piles resulting from lack of investigation of geologic conditions along that section.

Landslide in high walls of new landfill cell in north Texas resulting from pre-existing geologic conditions.

View of the failed western wall of the landfill due to landslide.

Geologists standing on slide block of failed western wall looking across block separation at landfill scarp.

Geologist performing fracture orientation measurement along landslide scarp on failed western wall of landfill.

Geologist on edge of failed landslide block.

Geologist on failed landslide block along western high wall of landfill.

Home damaged by landslide in Dallas area. Note crack in house siding and broken retaining wall.

Separated scarp of landslide extending under home in Dallas area.

Separated scarp of landslide extending under home in Dallas area showing breaks in wall.

Side of house pulled away at foundation level resulting from movement of landslide.

Broken foundation along landslide scarp.

Pool deck down dropped and pulled away from house during landslide.

Gap between pool and home resulting from landslide.

Landslide in north Dallas area showing failure scarp near homes.

Failed attempted control of landslide using shotcrete next to homes. Note the shotcrete failed as slide continued to move.

Landslide along creek in Carrollton area showing proximity to home and exposed pipes.
The landslide resulted from stream erosion at the toe of the slope.

Landslide at home in Carrollton area showing progressive failure of head scarp undermining driveway.

Damage to retaining wall adjacent to home in Benbrook , undermined by a landslide.

View of broken retaining wall along failure scarp of landslide, Benbrook.

Landslide failure scarp to left of backhoe. Note nearby homes, Grapevine.

Failed slope at golf course in Plano.

Failed slope at golf course in Plano.

SUBSIDENCE

Subsidence has resulted from the lack of consideration of geological processes associated with fluid withdrawal from the ground.

Subsidence has been an ongoing issue in the coastal areas of Texas, particularly in the Houston area, where subsidence of large areas has resulted in flooding of residential subdivisions, and sometimes in abandonment of the subdivision.

- Excessive pumping of underground fluids has led to ground subsidence and many undesirable surface changes, such as flooding, increased land erosion, poor drainage, reversal of drainage directions, as well as damage structures built across subsidence faults.

- Subsidence can reactivate growth faults along the Texas coast that result in land and property losses.

- Damage caused by subsidence over caves and abandoned underground mine openings can range from minor drainage problems to complete disastrous collapse of the ground below a structure.

View showing fault traces in pavement associated with subsidence in Houston. Note depressed area to the right.

Residence in Brownwood Subdivision ï Baytown. Subsidence of this subdivision area resulted in flooding, and submergence of this home and others in the area. This subdivision was abandoned as a result of the subsidence and subsequent flooding.

ACTIVE FAULTS

Prediction and evaluation of active faulting is a geological problem.

Both seismic (earthquake generating) and aseismic (non-earthquake generating) active faults have been identified, mapped and studied by geologists in Texas. ñActiveò means that displacement across the fault plane is ongoing.

Seismic Faults produce earthquakes as rocks moving relative to each other grind and lock, and slip again. Sudden slippage results in shock waves that move through the rocks to the ground surface, producing earthquakes.

Aseismic faults generally occur in sediments that fail easily, and slip freely across the fault planes. While these faults do not produce earthquakes, they still involve displacement across the fault plane. Where structures have been built across fault planes of active faults, damage to the structures has occurred.

- West Texas has experienced a number of earthquake events that have caused damage to structures.
- The potential for significant damage to structures in Texas from earthquakes in Oklahoma and in northern Mexico is a real threat to the safety of the citizens of Texas.
- Microseismic faults have produced small earthquakes in east Texas resulting in localized damage to farm houses and rural communities. These types of earthquakes typically have resulted from withdrawal of fluids in oil fields, and subsequent reactivation of existing faults.
- Displacement along aseismic faults in the Houston area has resulted in damage to many structures. Although geologists in the Houston area have recognized the existence of these faults for many years, scarce fault investigations have been performed by geologists prior to construction of structures in these areas. In the last 10 years, as these faults were recognized to be problematic, performance of fault investigations has increased dramatically to allow developers to avoid building structures within fault zones.

Baytown Texas ï Wooster Fault damaging home at 329 Abbot. Not economically feasible to relevel home. Downthrown fault block is to the left.

View of structure built on Long Point Fault at the intersection of Long Point and Lynnview in Houston

Fault extending under home at 1307 Moorhead in Houston. Note the downthrown block is to the left. The home is settling to the left with fault movement.

Home foundation built on Long Point Fault at 9131 Olathe in Houston. Note the foundation is broken and has fallen down to the left with movement of the fault. The home had to be demolished.

Building constructed on Long Point Fault on the south side of Long Point Road between Peck and Willendahl. Note the ñdown to the rightò drop in the driveway. In this picture the fault is downthrown to the right. The building has settled with the fault.

Requirements for Geological Services in Texas State and Local Statutes

Compiled by John Mikels, C.P.G

Texas Section of the American Institute of Professional Geologists (AIPG)

Geological services or the services of a qualified or professional **geologist** are specifically called for in a number of local and state Texas statutes, rules, and technical guidelines. Examples of these are summarized below:

1. TNRCC technical guidance on Pressure Cementing of Public Water Supply Wells: Affects TNRCC Rule 30TAC290.41(c)(3)(C). Exceptions to certain public supply well casing cementing rules will not be granted until a **Hydrogeologist** has made a detailed evaluation of the geologic framework of the well site, in support of such an exception request. (NOTE: hydrogeology is the branch of geology which deals with water within the earth - groundwater - and is the major area of practice for many of the environmental and groundwater resources geologists in Texas).

2. Hays County Subdivision and Development Regulations - Water Availability Study: Article III, Section 3.12 of these Hays County regulations require that, as part of the platting process for certain subdivisions that will be dependent on groundwater, a Water Availability Study be conducted. This study is to identify the quality and quantity of groundwater available for the tract and its long term sustainability. The study is predominantly **geologic and hydrogeologic** in scope. The rules require the study be ñ...performed by a State of Texas Registered Professional Engineer or **Hydrogeologist**...ò.

3. TNRCC Rule 30TAC230 - Groundwater Availability Certification for Platting: Statewide rules for non-PGMA counties (only 15 PGMA counties in State) which require groundwater availability certification as part of their platting process. Scope of required work is substantially **geologic or hydrogeologic** in nature (characterizations of stratigraphy, lithology & geologic structure; lithologic and geophysical logging of wells; performance and analyses of pumping tests to determine aquifer characteristics; calculation of temporal and spatial effects of pumping). Current rule language states that the certification must be made by, and only by, a Texas Licensed Professional Engineer. This language precludes from performing these types of groundwater investigations those professionals who have traditionally been the dominant practitioners in this area - namely the **geologists and hydrogeologists**. Enactment of a Geoscience Practice Act, and consequent TNRCC rule revisions, would allow the many otherwise qualified professionals to make these certifications.

4. Texas Water Code, Chapter 35 - Groundwater Studies: One of the steps in the preparation of a Priority Groundwater Management Area establishment report is an appraisal of the areas **hydrogeology**. This report is prepared by TWDB staff, unless contracted out to a consultant.

5. Blanco County Subdivision Ordinance - Water Availability Regulations: Similar in scope and purpose to the Hays County regulations cited above (Example No. 2). Study is substantially **geologic and hydrogeologic** in nature. Ordinance requires Water Availability study be performed and certified by a ñqualified expertò, which is defined in the Ordinance as ñ...an engineer registered to practice in the State of Texas.ò. Enactment of a Geoscience Practice Act in Texas will allow this Ordinance to be amended to include **geologists and hydrogeologists**, who are the dominant practitioners in the area of groundwater resource identification and evaluation in Texas.

6. Cow Creek Groundwater Conservation District (Kendall County) - Water Availability Report: Similar in scope and purpose to the Hays and Blanco Counties regulations cited above (Examples Nos. 2 and 5). Study is substantially **geologic and hydrogeologic** in nature. Ordinance requires Water Availability report be prepared by ñ...a State of Texas Registered Professional Engineer or a **Certified Hydrogeologist**...ò. The State of Texas currently has no certifying or licensing program for **geologists/hydrogeologists**. Currently 29 other states have some form of licensing or registration program for **geologists**. The only national ñcertifyingò programs are those of the AIPG (Certified Professional Geologist) and the NGWAôs Association of Groundwater Scientists and Engineers (Certified Groundwater Professional).

7. Barton Springs/Edwards Aquifer Conservation District (Hays and Travis Counties): The District generally requires that a **Hydrogeologic** Study be performed to support permit applications and major permit amendments for permitted wells in the Districtôs jurisdiction . The scope and purpose of these studies are predominantly **geologic** and **hydrogeologic** in nature. The technical guidelines for conducting these studies state that they must include **geologic and hydrostratigraphic** descriptions of the well site and surrounding area, prepared by a ñqualified **geologist**ò. ñQualified **geologist**ò is not defined in the Districtôs rules or guidelines.

8. TNRCCôs Edwards Aquifer Rules (30TAC213) - Geologic Assessments: For certain types of development on the Edwards Aquifer Recharge, Transition, and Contributing Zones, the TNRCC requires that a Water Pollution Abatement Plan (WPAP) be submitted to the agency. The WPAP details the steps that will be taken during and post development to protect the aquifer from the effects of development. One of the components of Recharge Zone WPAPs is a **Geologic** Assessment (GA). The scope and purpose of the GA is entirely **geologic** in nature and includes: mapping of the surface geology, description of the stratigraphy beneath the site, identification of **geologic** structures, and identification and description of aquifer recharge features (caves, sinkholes, fracture zones, etc.). The GA must be prepared by a **Geologist**, which the TNRCC defines as {30TAC213.3(14)}:

> ñA person who has a received a baccalaureate or post-graduate degree in the natural science of **geology** from an accredited university and has training and experience in groundwater hydrology and related fields, or has demonstrated such qualifications by registration or licensing by a state, professional certification, or has completed accredited university programs that enable that individual to make sound professional judgements regarding the identification of sensitive features located in the recharge or transition zone.ò

9. Texas Railroad Commission Rules on the Surface Mining Permit Applications (16TAC12.126, 127, 128, and 137): Information on environmental resources to be submitted with a permit application must include: ñ...a description of the **geology**, hydrology,...ò; ñ...information on...**geology** related to hydrology...ò; ñ...areal and structural **geology** of the permit area and adjacent areas and other **geologic** parameters which influence the required reclamation...ò; ñ...the lithology and thickness of the aquifers...ò. Rule §12.137(b) states that ñMaps, plans, and cross sections included in a permit application which are required by this section shall be prepared by or under the direction of and certified by a qualified registered professional engineer or **professional geologist**...ò.

10. Texas Railroad Commission Rules on the Underground Mining Permit Applications (16TAC12.172, 173, 174, and 183): Contains very similar language regarding the submittal of **geologic** information with a permit application as cited above in Item 10 for Surface Mining Permit Applications. Rule §12.183(b) states that ñMaps, plans, and cross sections included in a permit application which are required by this section shall be prepared by or under the direction of and certified by a qualified registered professional engineer or **professional geologist**...ò.

11. TNRCC Rules on Location Standards for Hazardous Waste Storage, Processing, or Disposal (30TAC335.204): In determining the suitability of sites for the management of hazardous wastes (treatment facilities, impoundments, landfills, etc.), the **geologic and hydrogeologic** characteristics of the proposed site must be carefully and fully determined. This rule and the supporting technical guidance call for a variety of tasks that are predominantly **geologic** in nature. For example, ñ...active **geologic** processes...ò in the vicinity of the site must be well characterized {§335.204(a)(7), (b)(8), (c)(7), (d)(7), (e)(9)}. In addition, regarding the location of a site with respect to **geologic** faults, ñThe presence, and if a fault is found to be present, the width and location of the actual or inferred surface expression of a fault, including both the identified zone of deformation and the combined uncertainties in locating a fault trace, must be determined by a **qualified geologist** or geotechnical engineer.ò {§335.204(a)(9), (b)(12), (c)(11), (d)(11), (e)(13)}

12. TNRCC Rules for Public Water Systems (30TAC290.38 - 47): The extent of treatment or proposed changes in the extent of treatment of public water supply obtained from groundwater (wells, springs) is to be determined based on several factors, including ñ...**geological** data...ò {§290.41(c)(3)(F)(ii); §290.42(b)(3) & (c)(2)}.

13. <u>TNRCC Rules on Locations for Municipal Solid Waste Landfills (30TAC330)</u>: ñApplications submitted for the operation of sites located within areas that may be subject to differential subsidence or active **geological** faulting shall include detailed fault studies. ..... Such studies shall be conducted under the direct supervision of a professional engineer experienced in geotechnical engineering or a **geologist** qualified to evaluate such conditions.ò {§330.303(b)}.

14. <u>TNRCC Municipal Solid Waste Landfill Site Soil and Liner Evaluation Report (TNRCC Form 0674)</u>: The instructions on completing this form state that the form is to be completed by ñ...a qualified independent third-party professional engineer experienced in geotechnical engineering and soils testing or a graduate **geologist** whose education and/or experience is in engineering **geology** and geotechnical soils testing.ò The Professional of Record (POR; engineer or geologist) who prepares the report must also sign off on the report.

15. <u>TNRCC Risk Reduction Rules (30TAC350)</u>: The rules govern a program for identifying and quantifying the extent of hazardous contamination in environmental media (soils, bedrock, groundwater) and determining the need for and scope of remedial action. Much of this program depends on the accurate characterization of the **geologic and hydrogeologic** framework beneath and in the vicinity of the impacted site (§350.51). Such characterization is critical to the remedial action decision-making process. The rules do not define the qualifications of professionals who can conduct the required **geologic and hydrogeologic** characterizations.

16. <u>Texas Water Code, Chapter 27 - Injection Well Act</u>: This Act governs the siting, permitting, design, construction, and operation of wells in Texas used for the subsurface disposal (injection) of a variety of hazardous and non-hazardous liquid wastes. It also governs wells used for extraction of certain minerals (sulfur, uranium, etc.). The purpose of this Chapter is to ensure protection of human health, the environment (particularly groundwater resources), and oil and gas resources. Depending on the type and use of an injection well, it is under the jurisdiction of either the TNRCC or the Texas Railroad Commission, and these agencies have developed their specific rules, including **geologic and hydrogeologic** characterizations, in compliance with TWC Chapter 27. A key element in the safe siting and design of injection wells is a thorough understanding of the surrounding **geologic and hydrogeologic** framework. This task is specifically called for in §27.051(f), §27.053, and §27.056(1).

17. <u>Texas Water Code, Chapter 28 - Water Wells and Drilled or Mined Shafts</u>: Certain activities governed by the Water Code, under rules promulgated by either the TNRCC or the Railroad Commission, require the performance of specific **geologic** tasks (eg: §28.033, §28.034, §28.037).

18. <u>TNRCC Corrective Action Project Manager Registration Rule (30TAC334.457)</u>: Professionals who are responsible for remediation of environmental impact resulting from leakage or spills from Underground or Aboveground Storage Tanks (UST, AST) are required to be registered by the TNRCC. Qualifications for registration include education, experience, and successful passage of an examination. Qualification criteria include a demonstration of experience in and knowledge of the **geologic and hydrogeologic** skills necessary to safely and effectively manage corrective action at impacted UST/AST sites.

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Stream Erosion

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