

Texas Tech University



**Environmental Issues Associated with Oil & Gas
Development in Texas**

Ronald J. Kendall, Ph.D.

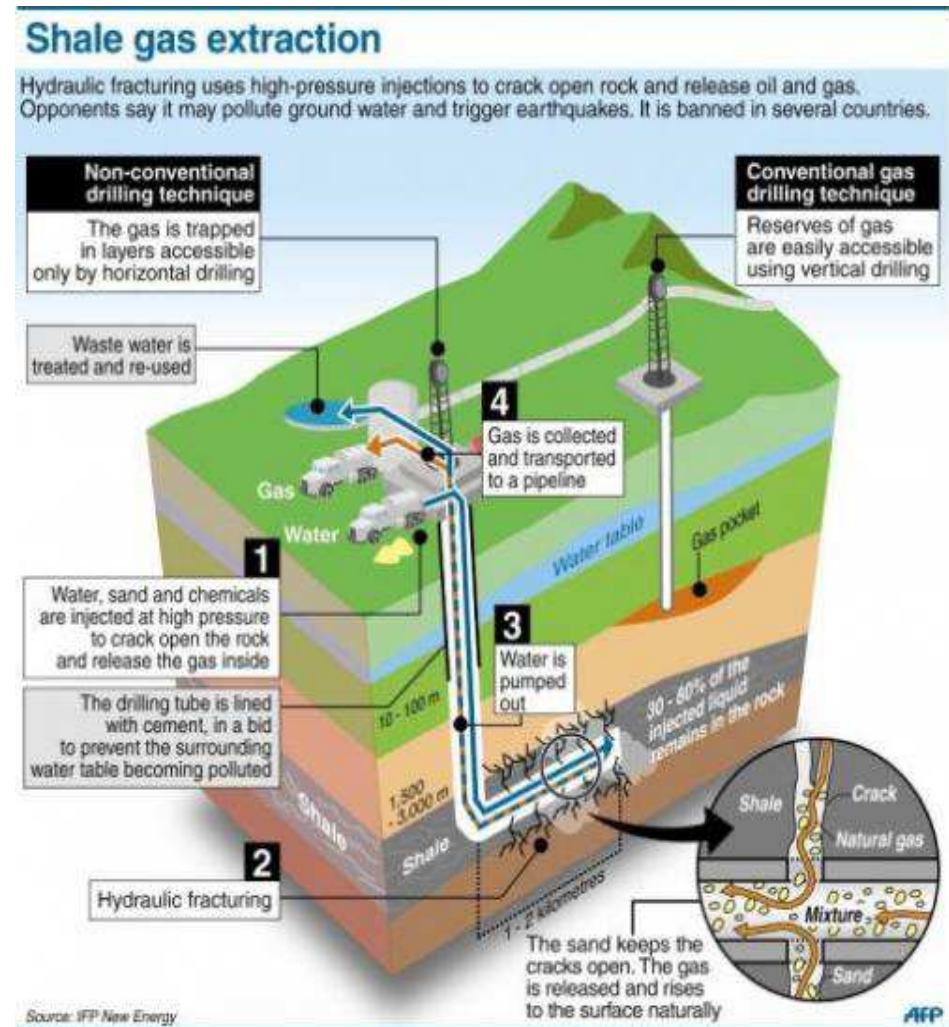
Professor of Environmental Toxicology

What is Fracking?



Fracking, or hydraulic fracturing, uses high-pressure injections of water, sand, and chemicals to crack open rock and release oil and gas. Fracking makes it possible to facilitate oil and gas extraction that was once unattainable with conventional technologies.

Horizontal drilling (along with traditional vertical drilling) allows for hydraulic fracturing in zones containing hydrocarbons. This creates new channels within the rock from which natural gas and oil is extracted at higher than traditional rates.



Courtesy of The Rural Blog

Fracking Sites



Permian Basin



Oil Production in the Permian Basin:

2010 – 270 million barrels

2011 – 295 million barrels

2012 – 312 million barrels

2013 – 889,808 barrels per day as reported by the Texas Railroad Commission

Source: Texas Railroad Commission

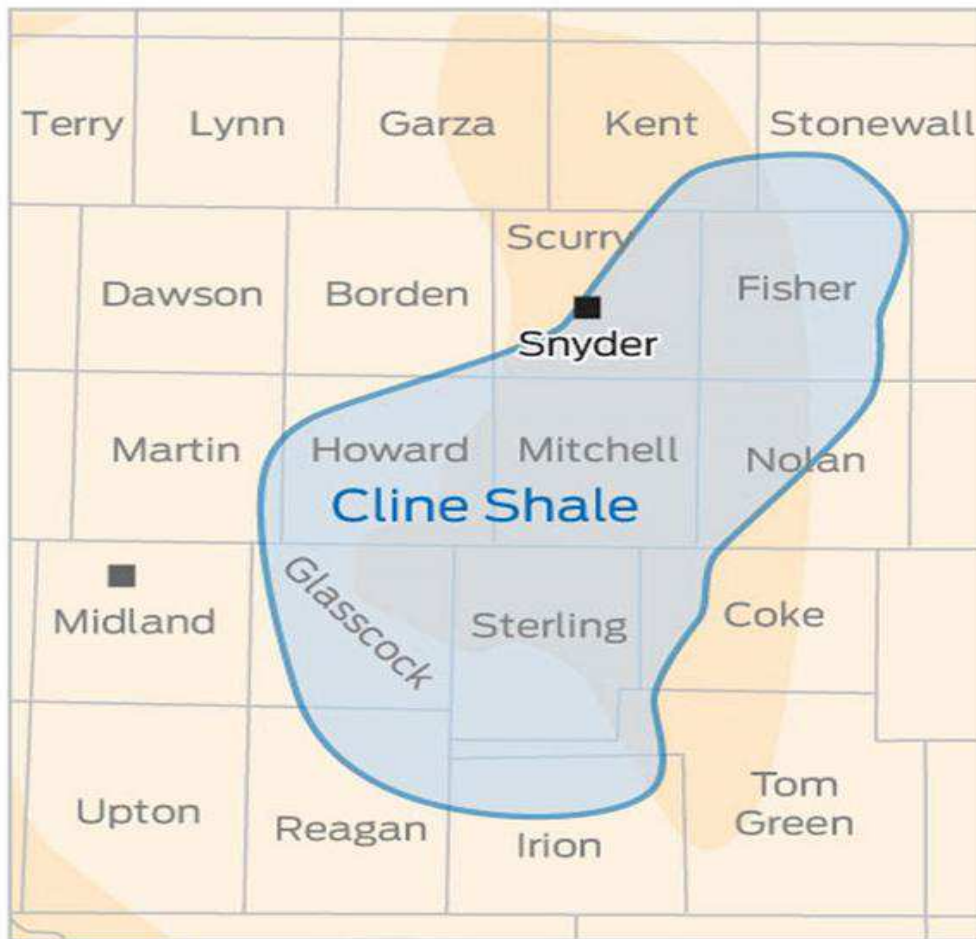
Projected Total for 2013:
324,779,920



What is the Cline Shale?



Cline shale



Source: Keith Schaefer, Oil and Gas Investments Bulletin (4/19/12)

The Cline Shale (also known as the Lower Wolfcamp) lies over a very large area on the eastern shelf of the Permian Basin.

It produces a light crude oil. The shale layer is 200-550 ft. thick. It runs north to south and is approximately 140 x 70 miles in size.

Counties included in the shale are Borden, Coke, Fisher, Glasscock, Howard, Mitchell, Nolan, Scurry, Sterling, and Tom Green.

Cline Shale



Positive aspects:

Recoverable Oil

Current estimates are 30 billion barrels, though this could rise significantly as more wells are dug.

Jobs Creation

50,000 jobs that could last up to 20 years

Total Economic Impact

Could generate \$30 billion annually once full exploration begins.

Source: Rigzone

Negative aspects:

Environmental impacts

Damage to road system

Air & water issues



Todd Wiseman/KUT

Industry Issues



State and Federal Regulations



Railroad Commission of Texas



The Railroad Commission of Texas establishes standards and enforces regulations for oil and gas exploration and production in Texas and has jurisdiction over all “oil and gas wells in Texas; persons owning or operating pipelines in Texas and persons owning or engaging in drilling or operating oil and gas wells in Texas as sanctioned by the Texas Natural Resource Code 81.051 (2011)”.

From a substantive perspective, the Texas Commission on Environmental Quality’s jurisdiction over oil and gas production activities is generally limited to regulation of air quality and surface water. The Railroad Commission regulates virtually all other aspects of oil and gas operations, including those that affect water quality.

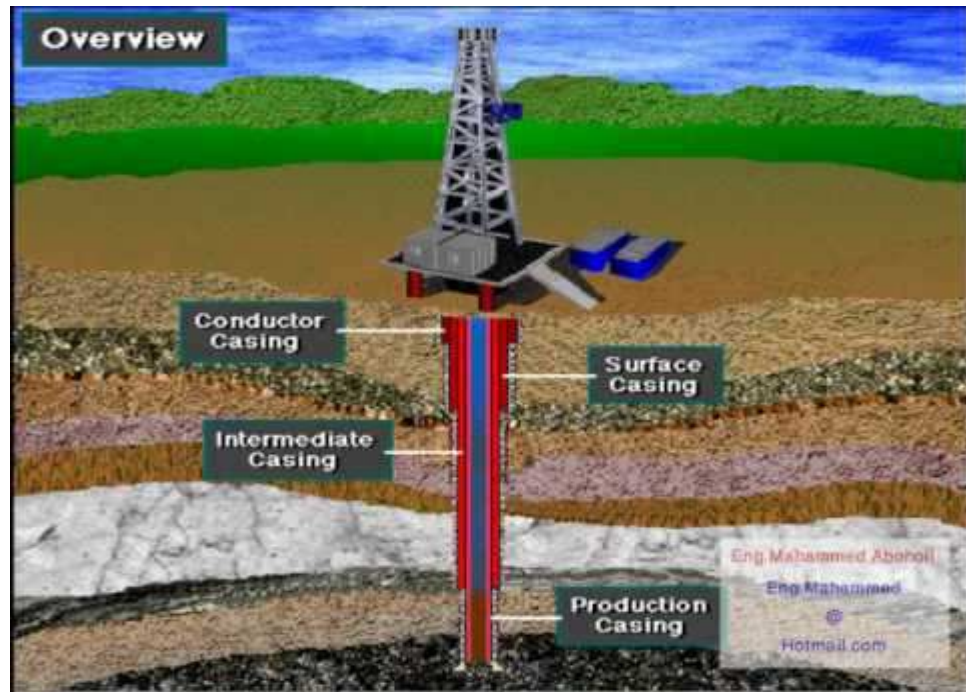


New Rules



New rules were imposed by the Railroad Commission in 2012 and 2013 to clarify requirements for drilling, casing, cementing, and fracking of oil and gas wells currently found in 16 Texas Administrative Code 3.13. Generally, the rules are intended to protect the State's groundwater from potential pollution due to injection and enhanced recovery by fracking and are meant to more clearly outline well construction requirements and update the requirements for drilling, casing, cementing, and fracking.

Casing



State and Federal Regulations



The Clean Air Act is the law that defines EPA's responsibilities for protecting and improving the nation's air quality and the stratospheric ozone layer.

United States Code, Title 42, Chapter 85

The Clean Water Act establishes the basic structure for regulating discharges of pollutants into the waters of the United States and regulating quality standards for surface waters.

United States Code, Title 33, Chapter 26

The Endangered Species Act provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend.

United States Code, Title 16, Chapter 35

Natural Resources



Natural resources issues that may guide oil and gas development in West Texas:

1. Water issues, including surface and ground water
2. Air emissions
3. Well site development and minimization of impact
4. Endangered species



Water



Fracking can use millions of gallons of water.

Water can become polluted with gases and/or chemicals.

Toxic wastewater needs disposal or recycling.

Puts stress on water supplies, both surface and ground, from the large amounts of water being withdrawn.

Goals

Reduce water usage - appropriately maintaining wells, using other fluids, such as propane gel or mixing carbon dioxide or nitrogen with water to make foam.

Treat and recycle frack water.



Groundwater



Solutions

Groundwater – water found underground in the cracks and spaces in soil, sand, and rock. Must be protected. Appropriate casing and well operations can achieve this goal. Texas Railroad Commission monitors wells and works to protect groundwater resources.

Contaminated groundwater affects property values, taints community image, affects economic development, and quality of life and is very costly and difficult to clean-up.

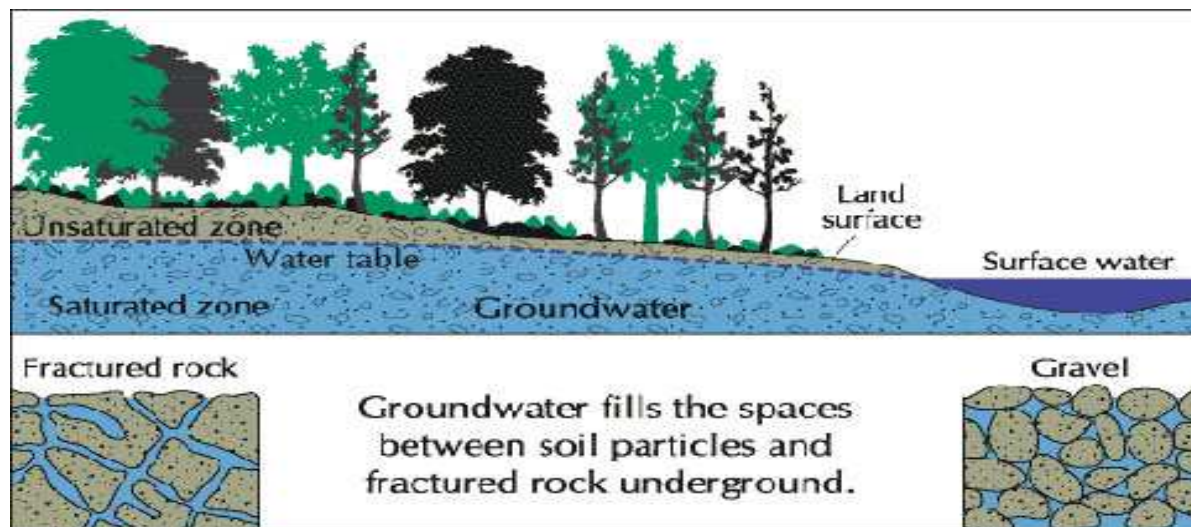


Image compliments of US Geological Survey, adapted by The Groundwater Foundation.

Fracking Fluids Disclosure

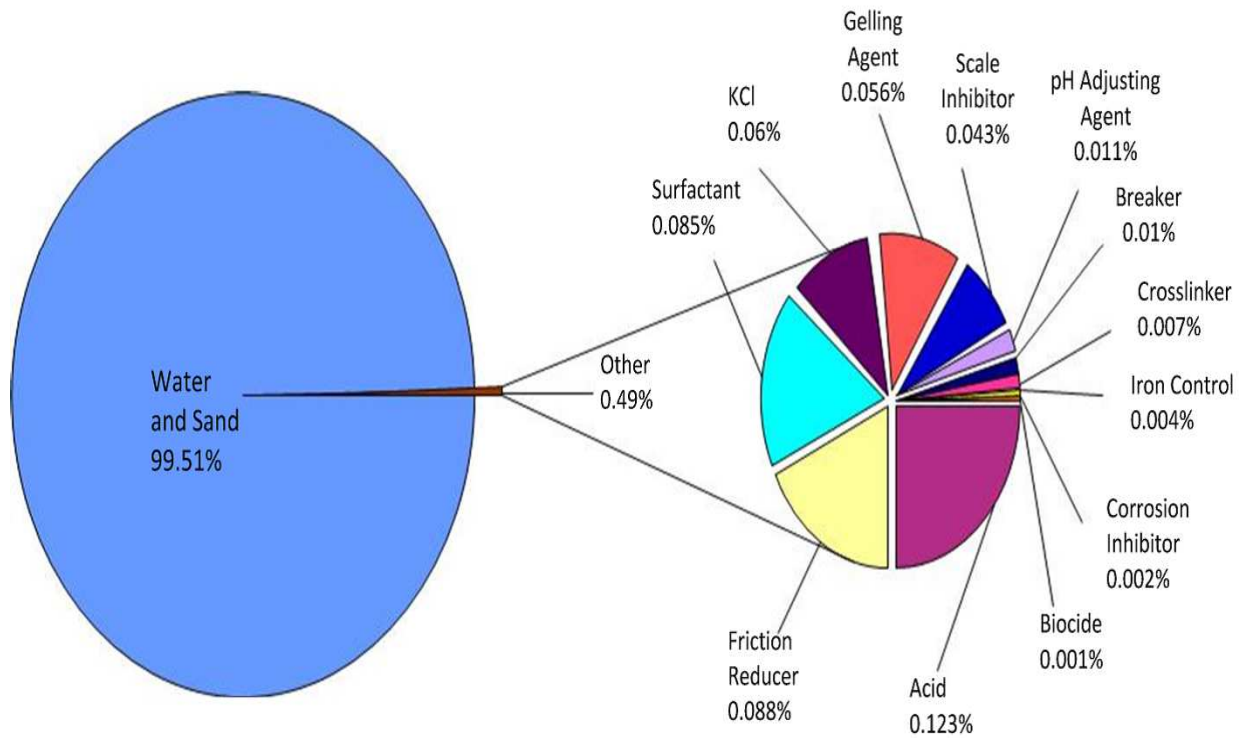


In 2011, the Texas legislature passed a law requiring operators, by law, to disclose the chemicals used in their fracking fluids so long as doing so would not reveal trade secrets. Under the law, well operators are required to “complete the form posted on the hydraulic fracturing chemical industry internet website of the Groundwater Protection Council with respect to the well in which fracking fluids are used”. The reference website, FracFocus, has been operating since April 11, 2011.

Fracking Fluids



Fracking fluid includes water and sand. Other options are being developed and deployed.



Source: U.S. Department of Energy, 2009

Fracking Fluids - Additives



Additive Type	Main Compound(s)	Purpose	Common Use of Main Compound
Diluted Acid (15%)	Hydrochloric or muriatic acid	Helps dissolve mineral and initiate cracks in rock	Swimming pool chemical and cleaner
Biocide	Glutaraldehyde	Eliminates bacteria in the water that produces corrosive byproducts	Disinfectant, sterilize medical and dental equipment
Breaker	Ammonium persulfate	Allows a delayed break down of the gel polymer chains	Bleaching agent in detergent and hair cosmetics
Corrosion inhibitor	N.n-dimethyl formamide	Prevents corrosion of the pipe	Used in pharmaceuticals, acrylic fibers, and plastics
Crosslinker	Borate salts	Maintains fluid viscosity as temperature increases	Laundry detergents, hand soaps, cosmetics
Friction Reducer	Polyacrylamide Mineral oil	Minimized friction between the fluid and the pipe	Water treatment, soil conditioner Make-up remover, laxatives, candy
Gel	Guar gum or hydroxyethyl cellulose	Thickens the water in order to suspend the sand	Cosmetics, toothpaste, sauces, baked goods, ice cream
Iron control	Citric acid	Prevents precipitation of metal oxides	Food additive, flavoring in food and beverages; lemon juice ~7% citric acid
KCI	Potassium chloride	Creates a brine carrier fluid	Low sodium table salt substitute
Oxygen scavenger	Ammonium bisulfite	Removes oxygen from the water to protect the pipe from corrosion	Cosmetics, food and beverage processing, water treatment

Additives Continued



Additive Type	Main Compound(s)	Purpose	Common Use of Main Compound
pH Adjusting Agent	Sodium or potassium carbonate	Maintains the effectiveness of other components, such as crosslinkers	Washing sodas, detergents, soap, water softener, glass and ceramics
Proppant	Silica, quartz sand	Allows the fractures to remain open so gas can escape	Drinking water filtration, play sand, concrete, brick mortar
Scale inhibitor	Ethylene glycol	Prevents scale deposits in the pipe	Automotive antifreeze, household cleaners, de-icing agent
Surfactant	Isopropanol	Used to increase the viscosity of the fracture fluid	Glass cleaner, antiperspirant, hair color

Specific compounds used will vary depending on company preference, water quality, etc. Compounds shown above are representative of the major compounds used in hydraulic fracturing of gas shales.

Source: www.fracfocus.org

Air



Drilling operations can release airborne contaminants.

“Fugitive emissions” (unintentional gas leaks) are possible at every stage of gas operations. Emissions release methane and other volatile organic compounds (VOC).

“Flaring” emits air pollutants.

Goals

Capture gas to use as energy

Reduce VOC emissions

Reduce toxic air pollutants



Flaring

Air



Contaminants that are released from natural gas production:

- **BTEX Compounds** – Benzene, Toluene, Ethylbenzene, Xylene; all volatile organic compounds; benzene is a known carcinogen and, along with toluene, can affect the central nervous system and reproductive system; ethylbenzene and xylene can cause respiratory and neurological effects.
- **Carbon Monoxide** – poisonous if inhaled; inhibits the blood's ability to carry oxygen; can cause dizziness, unconsciousness, and death.
- **Hydrogen Sulfide** – lethal if inhaled at high concentrations; rotten egg odor.
- **Nitrogen Oxides** – has a role in forming smog; can cause respiratory problems, heart conditions, and lung damage.
- **Sulfur Dioxide** – has a role in forming particulate pollution (the suspension of dust and soil in the air); can cause respiratory illness, heart conditions, damage lungs, and premature death.
- **Methane** – can cause oxygen deprivation and can act as an asphyxiant at high concentrations; flammable and explosive.

Source: Catskill Mountain Keeper

Air Issues



All of the new production from unconventional plays is increasing the need for tank batteries to hold the surplus production and reduce volatile organic compounds (VOCs) emitted. In 2011, VOC release was greatly tightened related to the requirements for “oil and gas handling and production facilities” located in Texas.



1973 Endangered Species Act



Section 3 – Definitions

“Endangered” refers to a species that is in imminent danger of extinction throughout all or a significant portion of its range.

“Threatened” refers to a species that is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.



USFWS Information, Planning and Conservation (IPaC) System

Endangered Species Act



Section 4 – Listing

- Individual petition or Fish and Wildlife Service initiative
- Mandates listing of “endangered” or “threatened” species

List factors

- Present or threatened damage to or destruction of habitat or curtailment of range
- Overutilization for commercial, recreational, scientific, or educational purposes
- Disease or predation
- Inadequacy of existing protective measures
- Other natural or manmade factors

Listing criteria

- Decisions made “solely on the basis of the best scientific and commercial data available”
- Prohibited from considering economic factors such as economic impacts that may result from listing a species

Listing Process

- 90 day review of listing petitions to determine whether listing may be warranted
- 12 month review of species that may warrant listing

Endangered Species Act



Zero Tolerance Law Section 9

Prohibits “take” any endangered fish or wildlife species by any “person”

Applies to both public and private actors and actions.



Section 11

Provides for civil or criminal penalties for endangered species act violations:

Civil penalties up to \$25,000 per violation

Criminal penalties up to \$50,000 and/or one year in prison per violation

West Texas Candidates as Endangered or Threatened Species



Tringa Photography



West Texas Candidates as Endangered or Threatened Species



Lesser Prairie Chicken

(*Tympanachus pallidicinctus*)

Found in Colorado, New Mexico, Oklahoma, Texas, and Kansas

Loss of habitat, degradation from livestock grazing, agriculture, oil and gas extraction, wind energy production, herbicides, unnatural fire, and fire suppression, as well as habitat fragmentation from fences and powerlines, play a role in population decline

Currently a candidate for ESA listing and could be listed in 2014



Lesser Prairie Chicken
Tringa Photography

West Texas Candidates as Endangered or Threatened Species



Dunes Sagebrush Lizard (*Sceloporus arenicolus*)

Found in New Mexico and Texas

Population decline blamed on habitat destruction, livestock grazing, herbicides, and dune systems being interrupted by the oil industry

Proposal for listing was withdrawn by the USFWS in 2012



West Texas Candidates as Endangered or Threatened Species



Minnows: Sharpnose Shiner (*Notropis oxyrhynchus*)

Smalleye Shiner (*Notropis buccula*)

Found in arid prairie streams originating from the Brazos River in Texas

Range reduction, alterations of the natural stream flow regime, river fragmentation, water quality degradation, have lost at least 50% of their historical range



Sharpnose Shiner



Smalleye Shiner

Searching for a Balance



Section 7 – Consultation

All federal agencies, in consultation with the Secretary of the Interior and/or Commerce, must insure that actions they authorize, fund, or carry out are “not likely to jeopardize the continued existence” of any listed species or adversely modify or destroy critical habitat

Federal nexus may include any activity involved in federal contracts, permits, licenses, authorizations, leases, or funding.

- Drilling activities on federal lands
- Drilling on federal offshore leases
- Pipelines across the wetlands that require permits from the Army Corps of Engineers
- Activities affecting waters of the United States

Achieving a Balance



Section 10 – Habitat Conservation Plan (HCP)

1. Planning document ensuring that the possibility that a listed species may be taken will be minimized or mitigated by preserving the habitat upon which the species depends,
2. Can apply to both listed and non-listed species, including those that are candidates or have been proposed for listing,
3. May include assurances that additional commitments will not be imposed if circumstances change.



Minimize Footprint



Water Management

Ozone used as a disinfectant to clean water – “Advanced Oxidation”. No chemicals are used and recycling of the water is possible.

A new liquid petroleum gas gel instead of water can be used as the primary fracking fluid.

‘Smart Sponge’ is a de-oiling technology to remove oil and other contaminants from the frack water at production sites.

Air Management

Keep more gas in the pipeline

Collect leaking gas (use as energy)

Environmental Management

Develop habitat conservation plans and good management practices

Develop systems to prevent and contain discharges and minimize impacts of water withdrawals

Utilize West Texas low-grade cotton for oil clean-up



Sustainability



“The capacity to endure”

“Fill the needs of today without compromising the future”



Economic viability
Environmental stewardship
Social responsibility



Contact Information



Ronald J. Kendall, Ph.D.

Professor, Department of Environmental Toxicology

Texas Tech University

Box 41163

Lubbock, TX 79409-1163

ron.kendall@ttu.edu

806.885.0238

