

# Bosque/Leon Rivers Perchlorate Study

*United States Army Corps of Engineers*



*Texas Natural Resource Conservation  
Commission*



*Brazos River Authority*



*The Institute of Environmental and  
Human Health at Texas Tech University*



*Montgomery Watson Harza*



**MWH**  
MONTGOMERY W.

*United States Environmental Protection  
Agency*



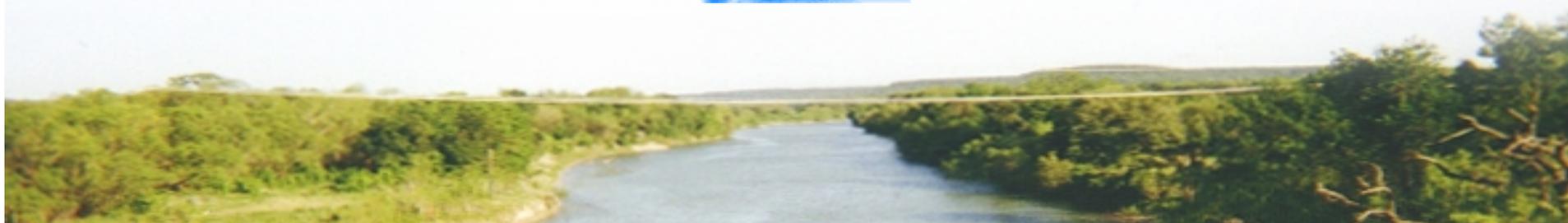
**Public Meetings**      **Waco - October 15, 2001**  
**Temple - October 16, 2001**



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# *Introduction & History*

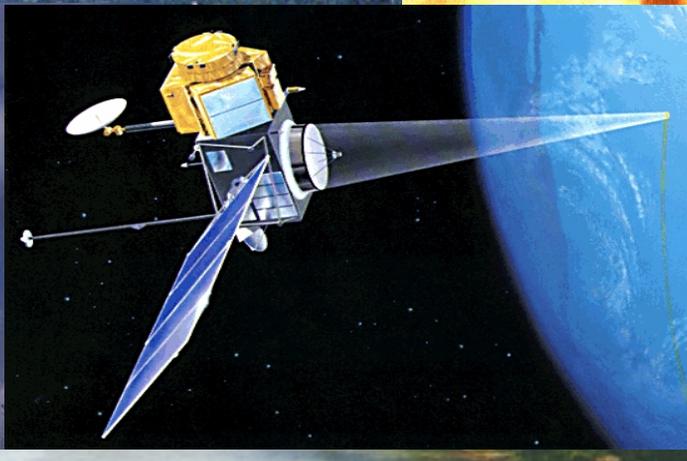
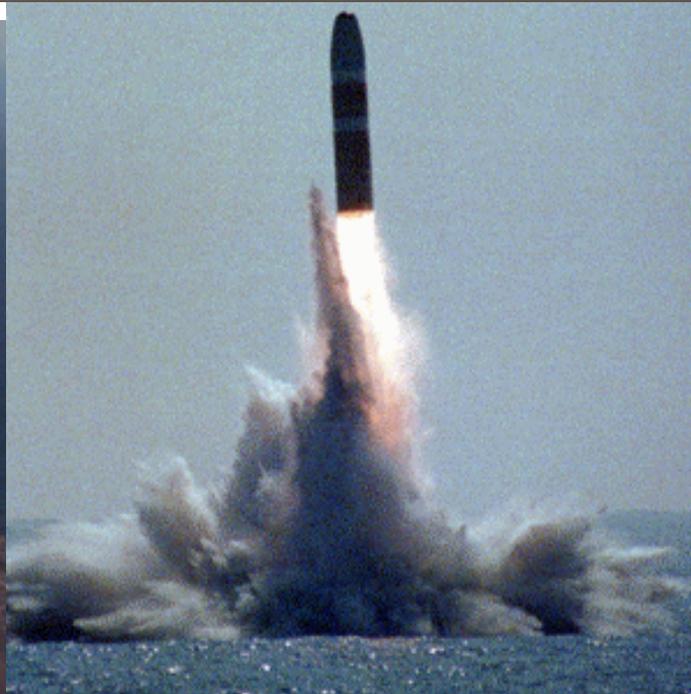
**Michael D. Meadows, P.E.**  
**Environmental Section Manager**  
**Project Development and Water**  
**Resources Division**  
**Brazos River Authority**





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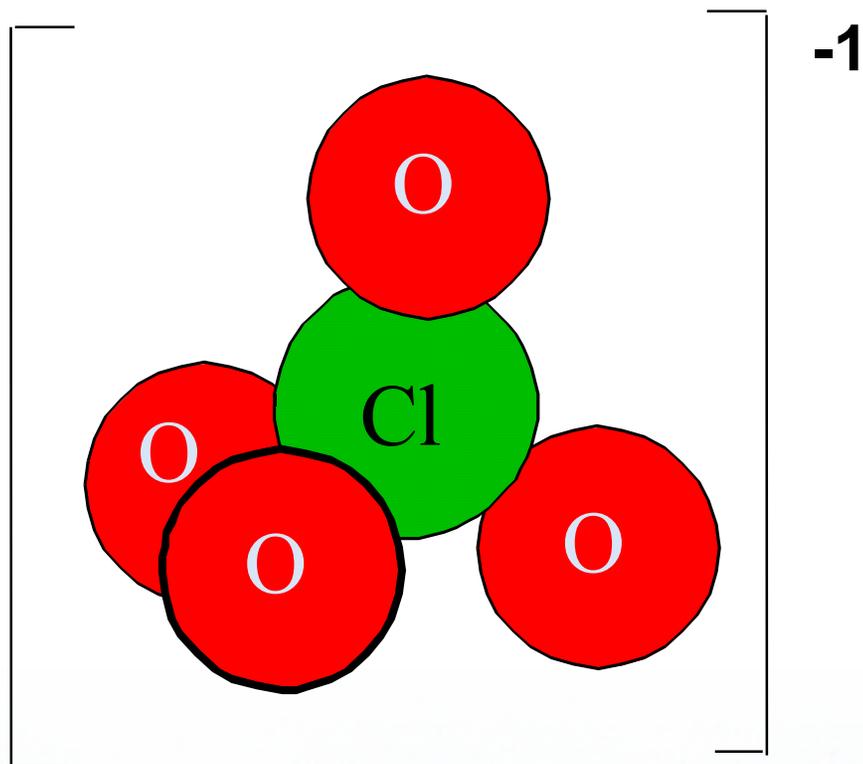
# *Ammonium Perchlorate - A national technical asset integral to strategic defense systems - ICBM, SLBM, NRO*

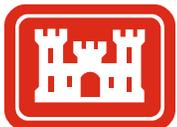




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# *Perchlorate – $ClO_4^-$*





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## *Defining Perchlorate*

- Inorganic salt used in solid rocket fuel as an oxidizer component in the solid propellant for rockets, missiles, and fireworks;
- Due to its shelf-life, it must be washed out of the missile and rocket inventory and be replaced with a fresh supply; and
- Large supplies of perchlorate have been disposed of at ammunition facilities.





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# *High-Pressure Water Washout of Solid Propellant*





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# *Perchlorate*

- Perchlorate dissolves easily like table salt;
- Once perchlorate dissolves, it results in a stable anion that can persist for decades in the environment; and
- Perchlorate moves easily through groundwater and surface water.







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# *States with Perchlorate Manufacturers or Users*





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# *Uses of Perchlorate*

- 90% solid rocket fuel oxidizer
- Explosives
- Fireworks and pyrotechnics
- Reported in nitrate fertilizer from Chile





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# *Perchlorate Toxicology*

- Thyroid disruption (mimics iodide)
- Human drug tests in 1950's
- EPA Provisional Reference Dose 1992/1995  
Range of 4 to 18 ppb in drinking water
- Children's health
  - Neonatal data not conclusive (epidemiology)
- High uncertainties





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## *Ecological Risks*

- Direct effects on fish and animals at high concentrations
- Unknown developmental effects
- Concern for arid region wetlands
- Agriculture uses – Colorado River & groundwater
  - Lettuce near Yuma
  - Imperial Valley/Coachella Valley
  - Citrus in Riverside





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# *Treatment Technology*

- Granulated activated charcoal (GAC) of limited use
- Effective treatments include:
  - Anoxic bioremediation
  - Ion exchange
  - Reverse osmosis





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# *Perchlorate Web Sites*

- USEPA – Interagency Perchlorate Steering Committee
  - [www.epa.gov/ogwdw/ccl/perchlor/perchlor.html](http://www.epa.gov/ogwdw/ccl/perchlor/perchlor.html)
- California Department of Health Services
  - [www.dhs.cahwnet.gov](http://www.dhs.cahwnet.gov) (search, or:)
  - [www.dhs.cahwnet.gov/ps/ddwem/chemicals/perchl/perchlindinx.htm](http://www.dhs.cahwnet.gov/ps/ddwem/chemicals/perchl/perchlindinx.htm)





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# *Chronology of Perchlorate Testing in the Bosque River Watershed*

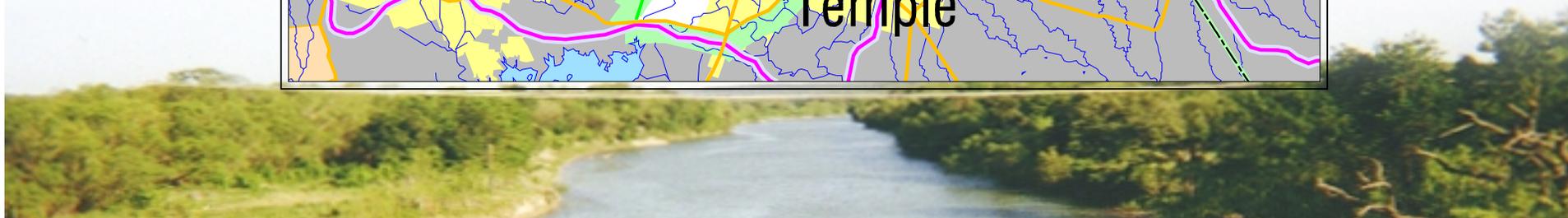
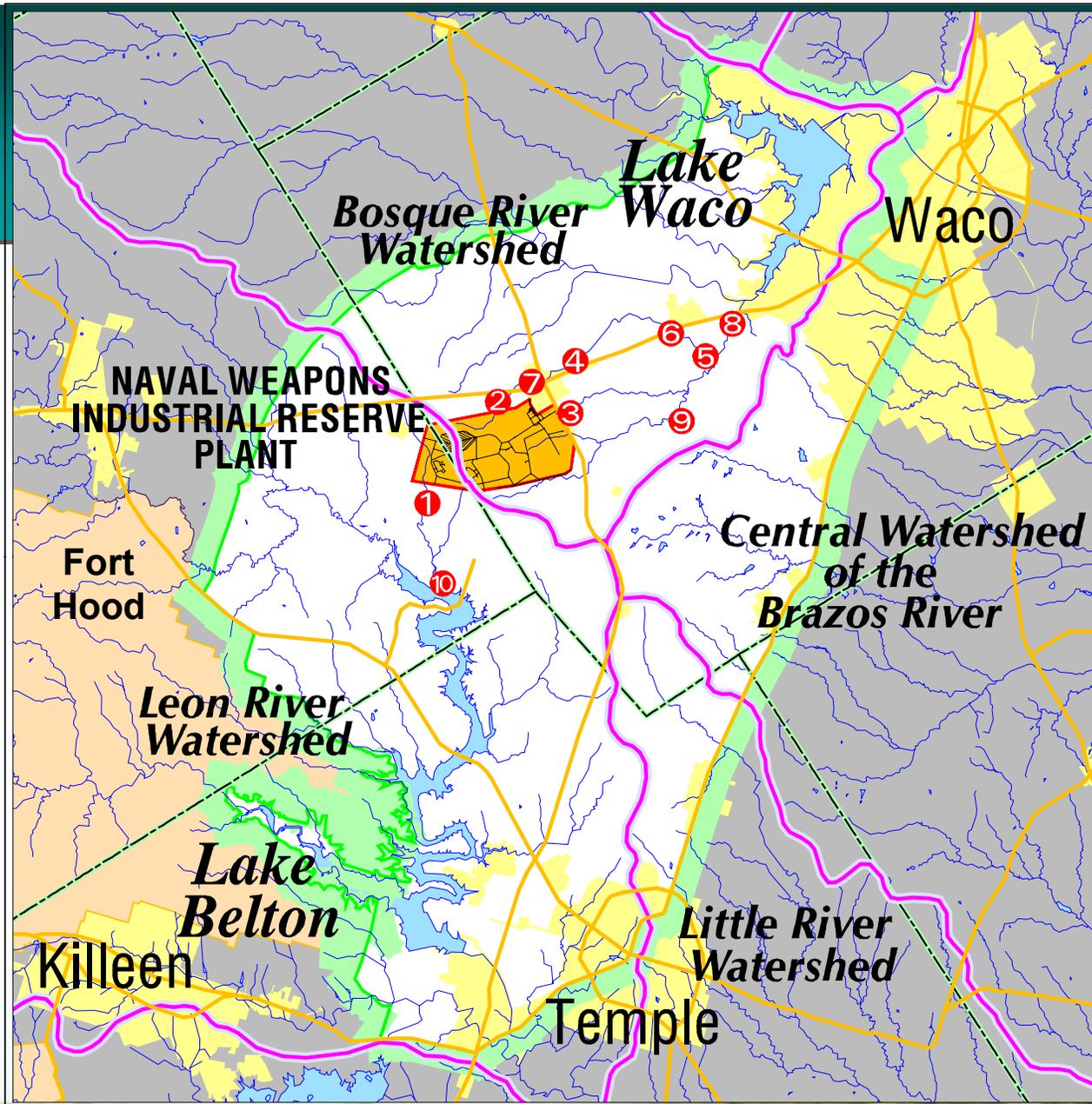
- Water quality monitoring in the South Bosque River watershed indicated unexplained high levels of nitrates;
- City of Waco learned that a facility manufacturing solid fuel rockets in California had released perchlorate into the groundwater which ultimately contaminated the drinking water, irrigation, and recreation water supplies.

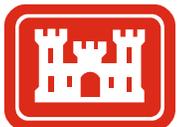




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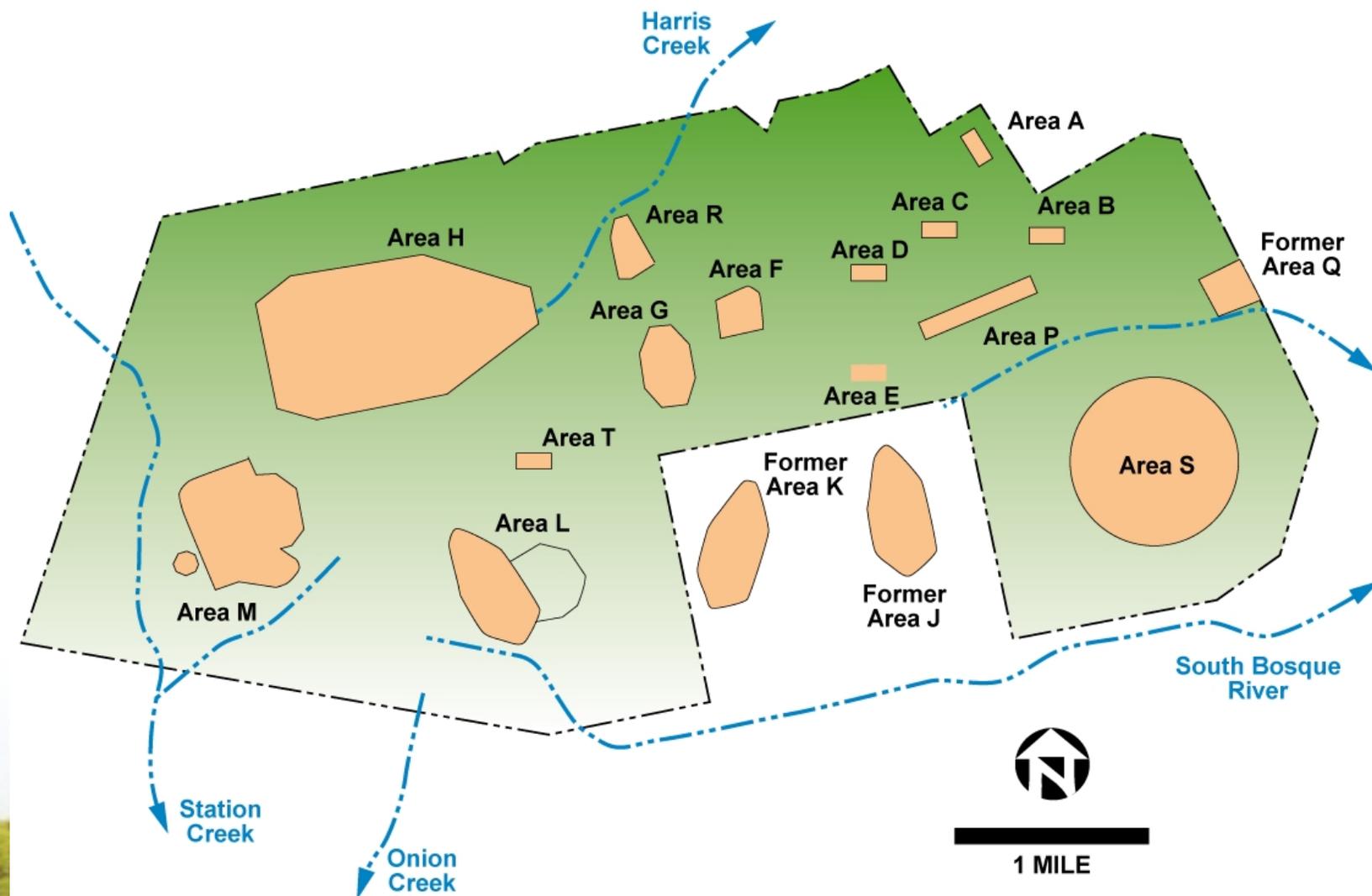
# Area Map

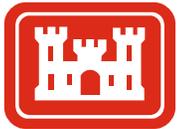




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# General Site Map - NWIRP McGregor





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# *The Bosque/Leon River Watershed Stakeholders Alliance*

- **City of Belton**
- **City of Bruceville-Eddy**
- **City of Copperas Cove**
- **City of Gatesville**
- **City of Harker Heights**
- **City of Hewitt**
- **City of Killeen**
- **City of Lorena**
- **City of Moody**
- **City of Morgan's Point**
- **City of Nolanville**
- **City of Robinson**
- **City of Temple**
- **City of Troy**
- **City of Waco**
- **City of Woodway**
- **Bell County WCID #1**
- **Bell County WCID #3**
- **Bluebonnett Water Supply Corporation**
- **Bell County and McLennon County Health Districts**
- **Central Texas American Water Works Association**

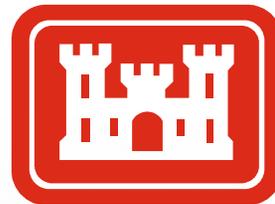


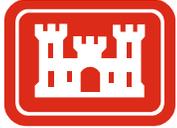


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# *Project Overview*

**Brian J. Condike**  
**Project Manager**  
**US Army Corps of Engineers**  
**Fort Worth District**





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# *Project Team Members*

- **U.S. Army Corps of Engineers** – project management and technical support
- **Texas Natural Resource Conservation Commission (TNRCC)** - advisory to study team, liaison with Interagency Perchlorate Steering Committee
- **Brazos River Authority (BRA)** – technical services and stakeholder coordination
- **The Institute of Environmental and Human Health (TIEHH) at Texas Tech University** – toxicological and ecological studies
- **Montgomery Watson Harza** – watershed hydrological studies, fate and transport, modeling
- **U.S. Environmental Protection Agency** – advisory to study team, regulatory liason
- **Stakeholder Consortium** – advisory to study team, community interface





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# *Project Overview*

- **Authority and Funding**
- **Goal**
- **Objectives**
- **Study Area**





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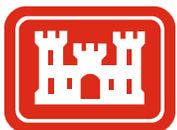
## *Authority and Funding*

Congress appropriated \$4,000,000 in FY 2001

*"...for the Corps of Engineers, in coordination with other Federal agencies and the Brazos River Authority, ...to assess the impact of perchlorate associated with the former NWIRP (Naval Weapons Industrial Reserve Plant) at McGregor, Texas."*

- Public Law 106-377





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## *Project Goal*

**Evaluate potential human and environmental exposure to perchlorate in the lakes Waco and Belton study area.**



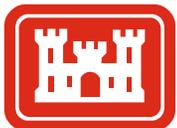


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# *Objectives*

- Develop effective community relations plan.
- Compile existing study area information.
- Identify and fill the key data gaps.
- Define the Conceptual Study Model (CSM).
- Evaluate fate and transport pathways.
- Evaluate potential environmental exposure to perchlorate in the study area.
- Evaluate potential human exposure to perchlorate in the study area.
- Present recommendations for watershed protection.





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# *Regulatory Perspective*

**Michael Honeycutt, Ph.D.**

**Senior Toxicologist**

**Texas Natural Resource Conservation  
Commission**

**Phone: 512-239-1793**

**Email: [mhoneycu@tnrcc.state.tx.us](mailto:mhoneycu@tnrcc.state.tx.us)**





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# *Regulatory Perspective*

- Water contamination issues due to solubility
- Toxicology studies completed
- Ecotoxicology studies underway





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## *Regulatory Perspective*

- Drinking water – No MCL, TNRCC Interim Action Level = 4 ppb
- Groundwater – 4 ppb Residential, 7 ppb Commercial/Industrial
- Surface water – 4 ppb





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# *Ecological Evaluation*

**Dr. Todd Anderson**

**The Institute of Environmental  
and Human Health**

**Texas Tech University**



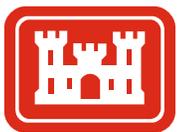


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# *Ecological Assessment*

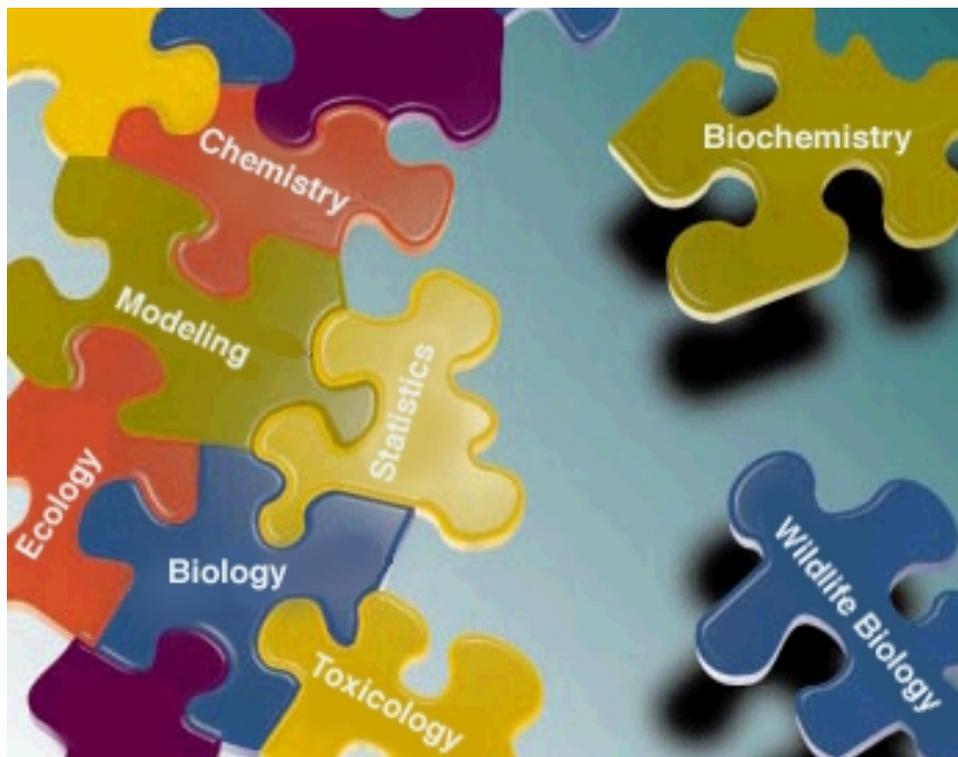
## **Assessing potential environmental impacts of perchlorate contamination in the Lake Waco and Lake Belton Watersheds**





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***Risk = Exposure + Effect***



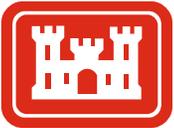


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# *Two Main Questions*

- Who/what is being exposed?
- Where do the exposures occur?
- Study Components
  - Water Quality Analyses
  - Dietary Analyses
  - Tissue Residue Analyses

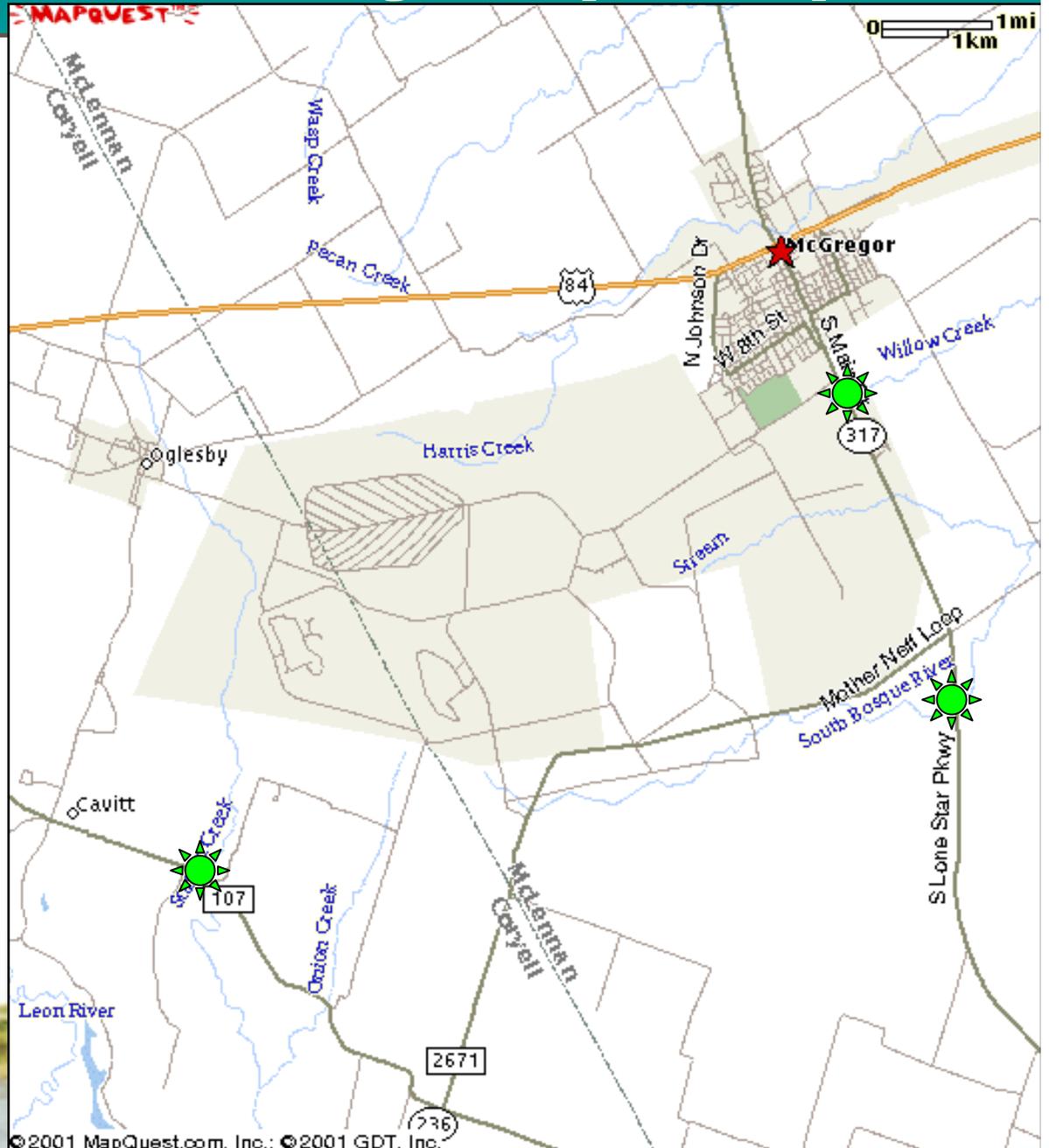




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# Results of Water Quality Analyses

- Willow Creek
- South Bosque
- Station Creek





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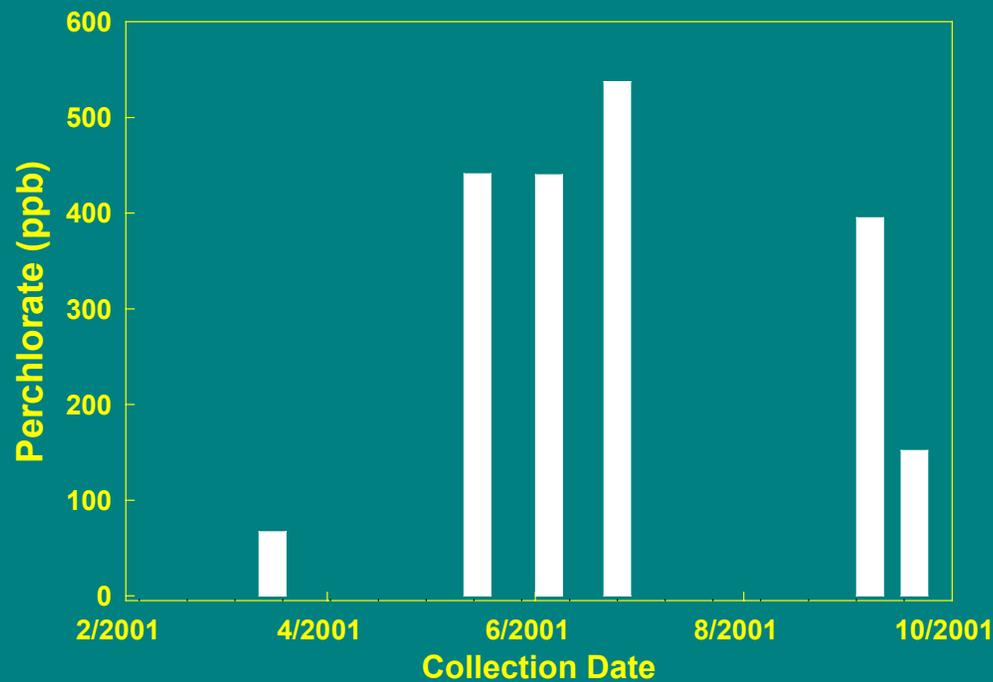
# *Willow Creek at Hwy 317*





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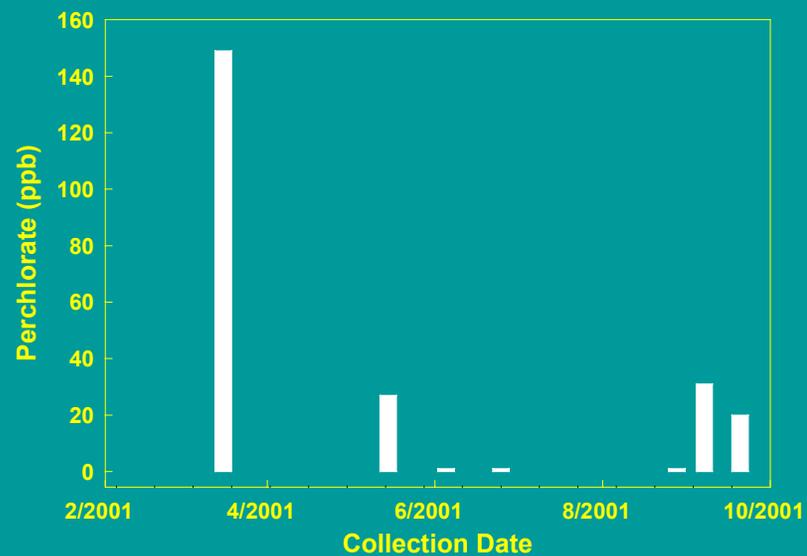
# *South Bosque at Hwy 317*





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# *Station Creek at Hwy 107*





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# *Results of Tissue Residue Analyses*

- Fish collected  
May, 2001
- Fish collected  
August, 2001





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# *Watershed Survey*

**David B. Ebersold, R.G., C.E.G.**  
**Principal Hydrogeologist**  
**Montgomery Watson Harza**



**MWH**

**MONTGOMERY WATSON HARZA**





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# *Project Benefit*

Objective, comprehensive evaluation of  
potential impacts on human and  
environmental health



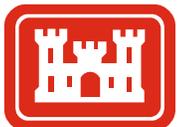


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# *Watershed Evaluation Goals*

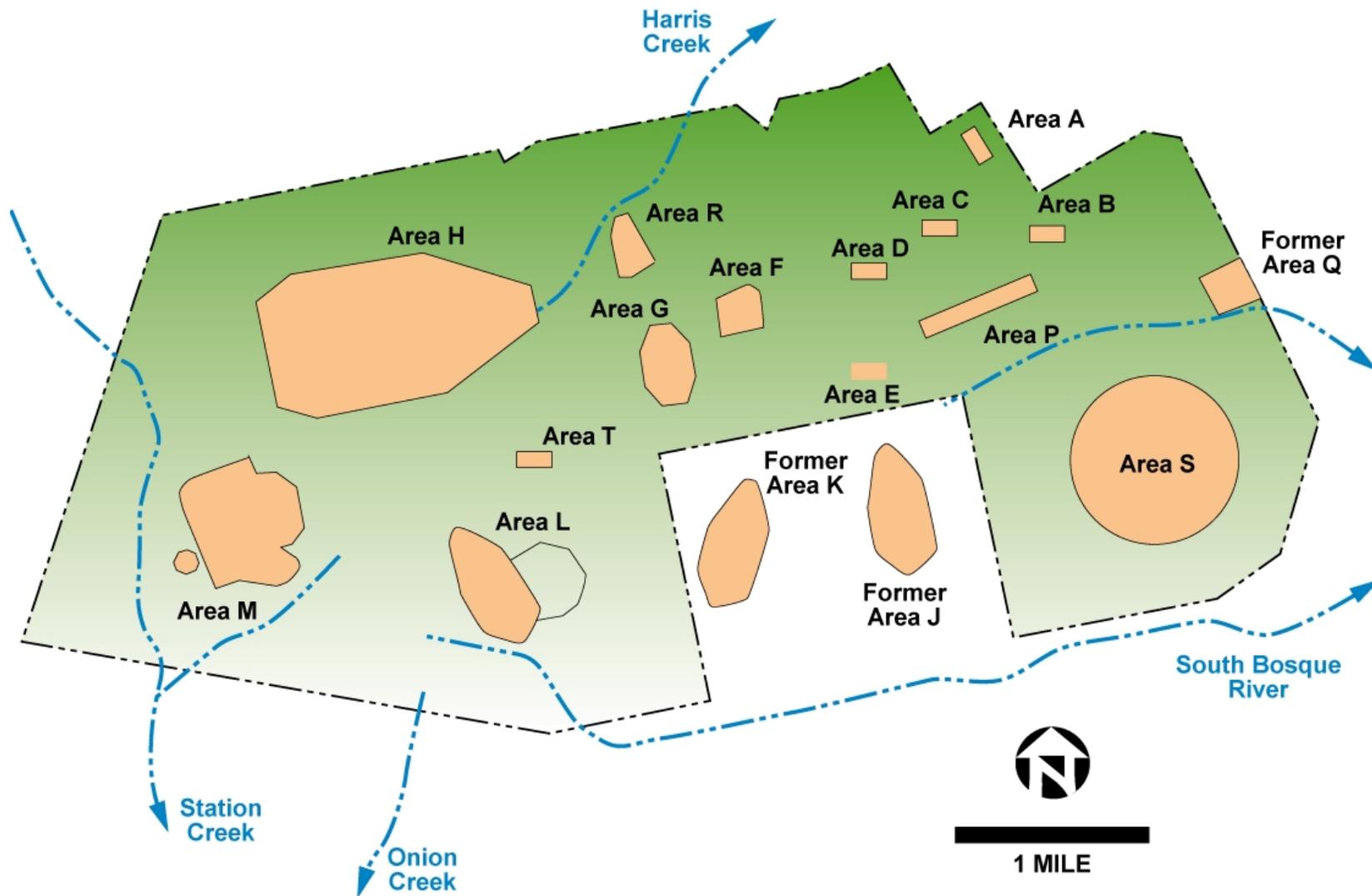
- How do waters mix in the rivers?
- Uniform mixing?
- Is dilution safe?
- Is perchlorate accumulating in the lakes?
- How does perchlorate already off site travel in the groundwater system?
- Where does off site perchlorate go?
- Does off site perchlorate pose a risk to human and environmental health?





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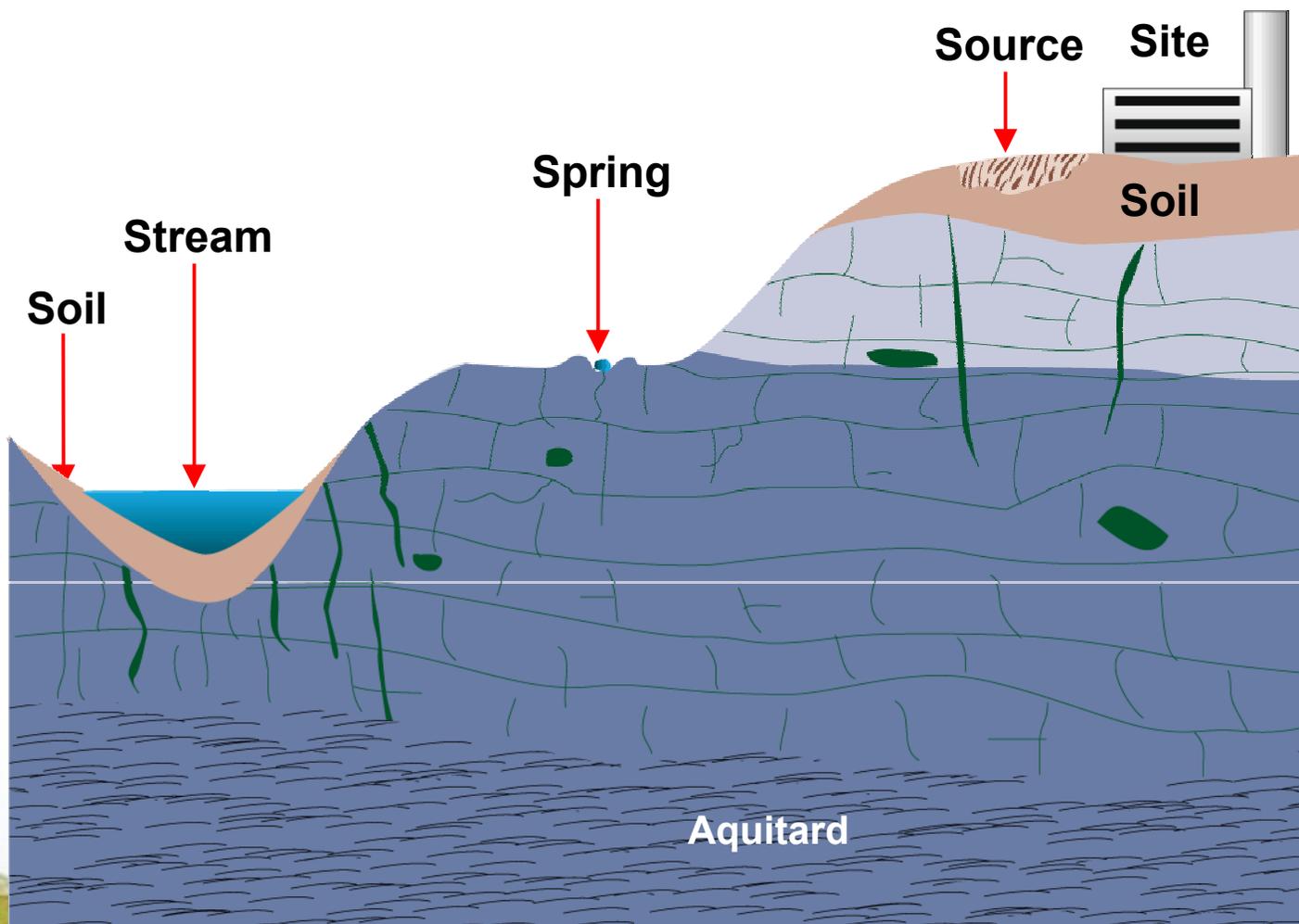
# General Site Map - NWIRP McGregor





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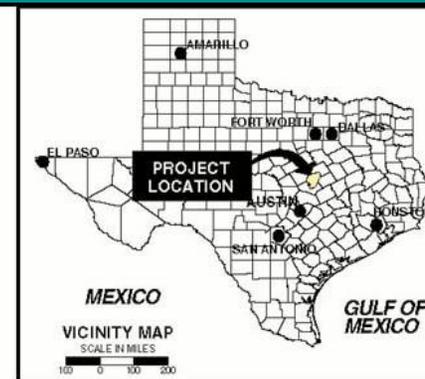
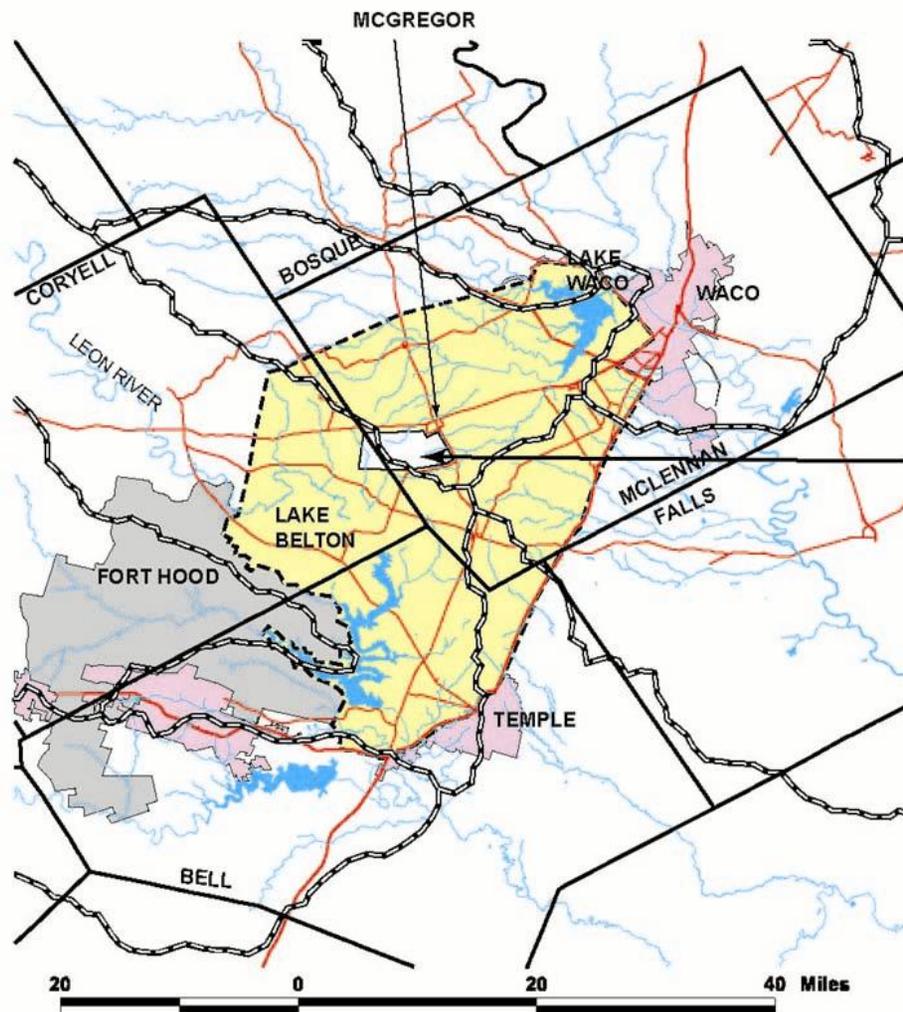
# *Conceptual On-Site Transport Model*



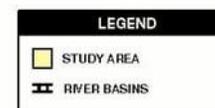


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# Study Area



NAVAL WEAPONS  
INDUSTRIAL RESERVE  
PLANT



BRAZOS RIVER BASIN, TEXAS  
**BOSQUE & LEON RIVER BASINS**

1 JANUARY 2001

U.S. ARMY ENGINEER DISTRICT, FORT WORTH, TEXAS  
SOUTH-WESTERN DIVISION



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# *Watershed Study Tasks*

- Collect and Review Existing Data Throughout Watershed
- Identify Data Gaps
- Field Investigation Program
- Develop Geographic Information System
- Develop Watershed Conceptual Model
- Modeling of Perchlorate Fate and Transport
- <Ecological and Toxicological Assessment >
- Project Reporting





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## *Project Progress*

- Developed project web site for public access  
[www.swf.usace.army.mil/links/ppmd/perchlorate/index.html](http://www.swf.usace.army.mil/links/ppmd/perchlorate/index.html)
- Conducted interviews with community leaders
- Collected and reviewed over 300 reports, studies, maps and other documents
- Developed data repository and electronic database
- Initiated conceptual model development
- Initiated GIS development





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## *Upcoming Milestones*

- Conceptual watershed model complete end of 2001
- Initial evaluation of fate and transport complete early 2002
- Geographic Information System complete 2002





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# *Conclusion*

# Questions?

