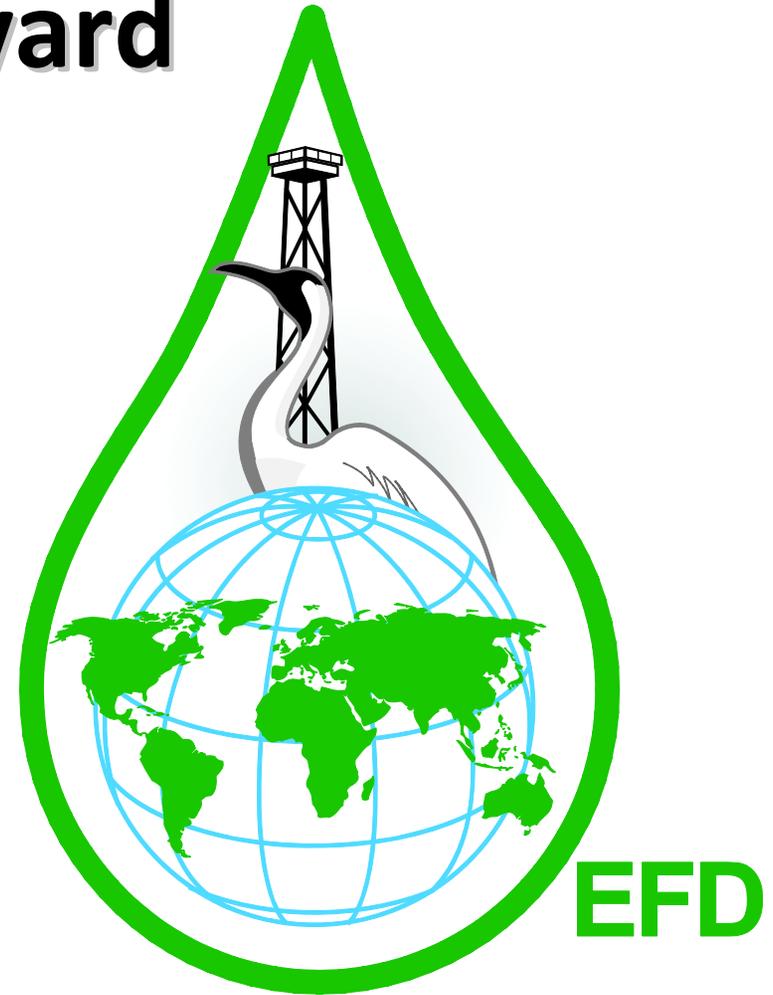
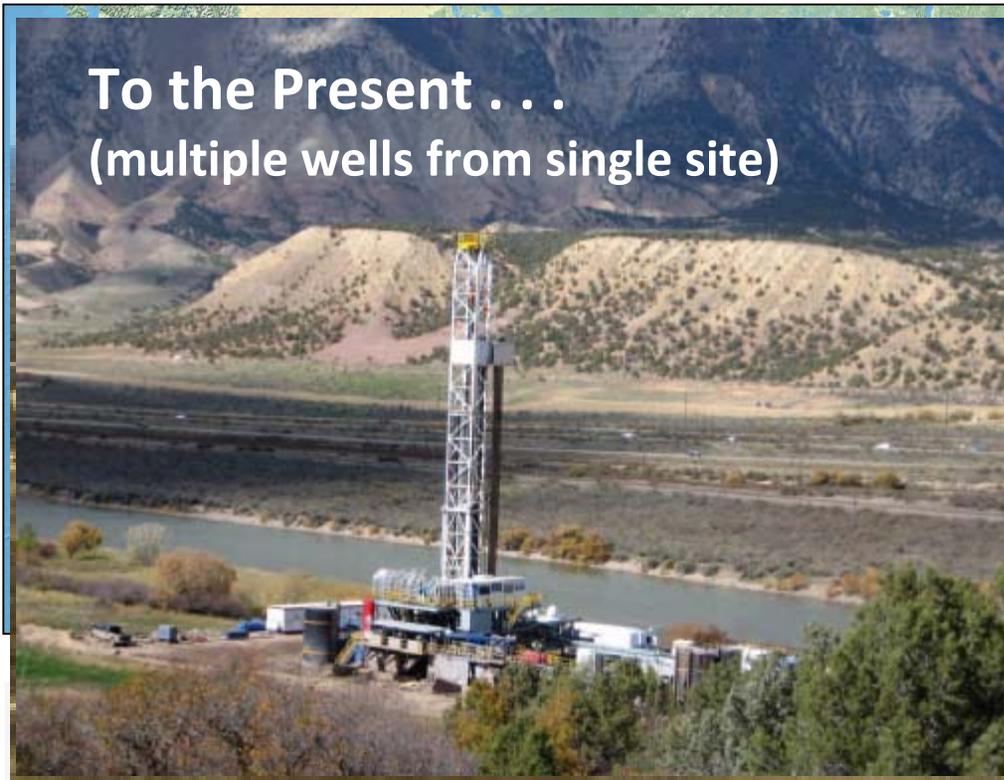
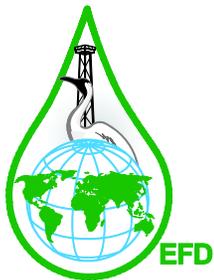
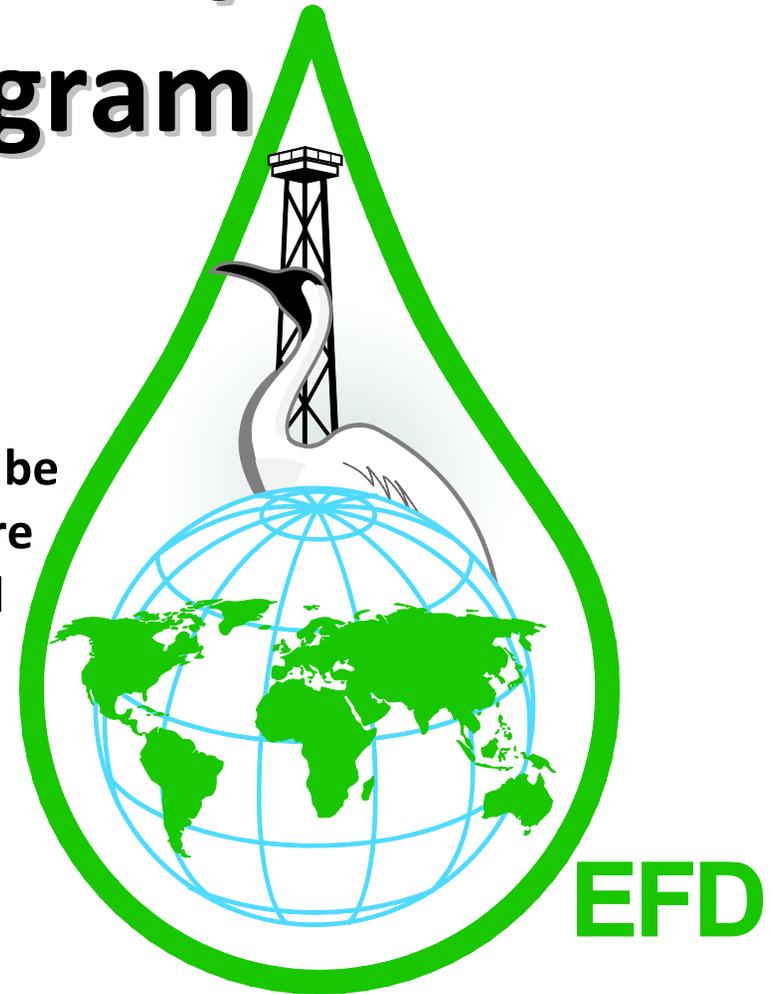


Coming to your back yard



Environmentally Friendly Drilling Systems Program

Identifying, developing and demonstrating cost effective, low-impact technologies that can be used in environmentally sensitive areas that are currently off-limits or highly restrictive should these areas be opened up for development.



All Areas are Environmentally Sensitive



EFD Program - History

- Formed Team in 2005
- Texas A&M took lead to obtain U.S. Department of Energy Funding
 - DE-FC26-05NT42685
- Formed Joint Industry Partnership
- Identified Technologies
- Demonstrated low impact technologies to minimize environmental tradeoffs



What has been Accomplished (so far)

- **Reports**

- Technology Assessment report on current practices
- Waste Management system at the rig site
- Rig Efficiency
- Membrane Filtration of Drilling Wastes
- Alternative power for rigs
- Public Acceptance and Technology Assimilation
- Systems Approach and Quantitative Decision

15 Publications

35 Presentations

3 Workshops

- **Clearing house for EFD technologies**

- **“Disappearing Roads” competition for students across the U.S.**

- **Scorecard to measure tradeoffs**



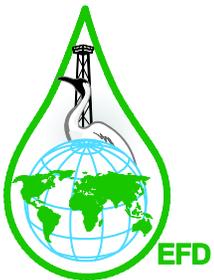
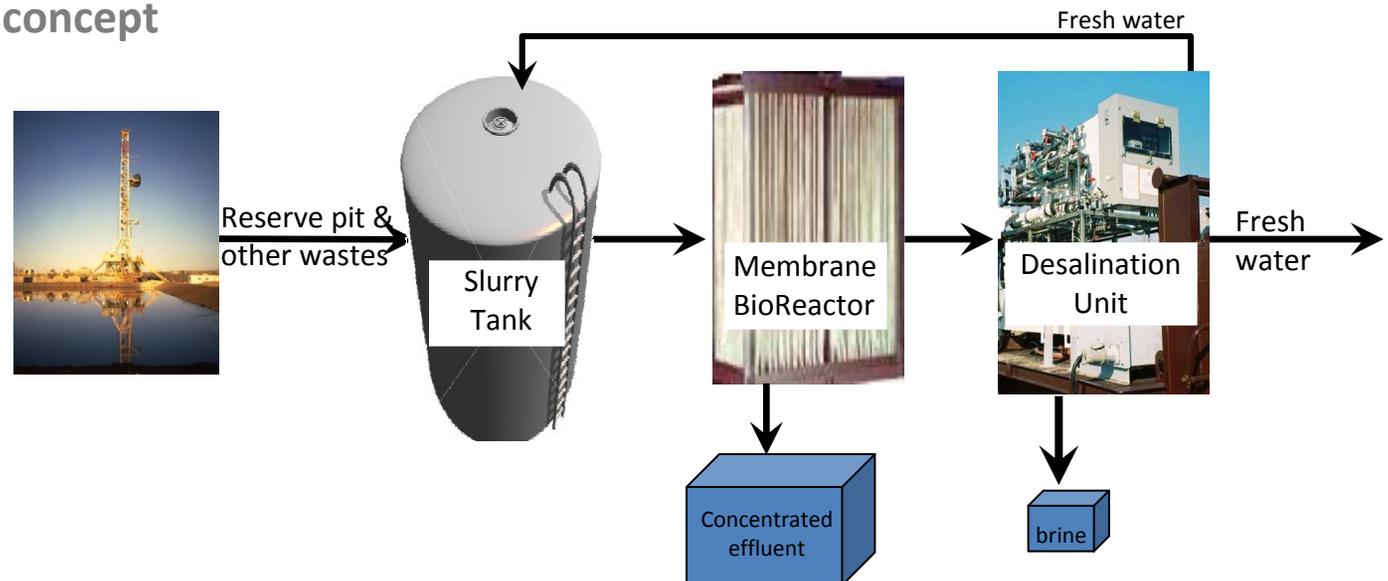
What has been Accomplished (continued)

- **Initiated Related Projects**

- Small Producer Low Impact Oil Field Access Road Project in Desert Ecosystems
- Concept Study Exploration and Production in Environmentally Sensitive Arctic Areas

- **Technology Prototypes & Commercial Development**

- Membrane Treatment of Well Site Fluids
- Modular Power from the Grid for Light Weight Drilling Systems
- Recycled Drill Cuttings/Tank bottoms
- “Laydown Road” concept



Exploration and Production in Environmentally Sensitive Arctic Areas

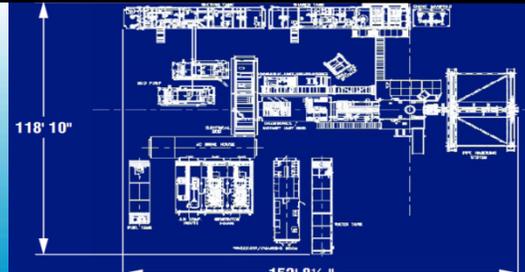
Reduce environmental concerns for ecologically sensitive areas currently open for development.



Durabase (mat) Road Construction



Small Modular Rig



Prototype Inland Platform being Installed

Plans for Next Phase

University/National Laboratories Alliance

- Texas A&M University – Systems Engineering Design Methodology: Low Impact Well Design Optimization
- University of Colorado – Best Practices Database
- University of Arkansas – Dissemination and Decisions Support
- University of Wyoming – Western Mountain States Studies
- Utah State University/Sam Houston State University – Societal Studies
- West Virginia University – Eastern Mountain States Studies
- Los Alamos National Laboratory/Argonne National Laboratory – Technical Support

***Press Release
Feb. 16, 2009***



Texas researchers form alliance to promote 'environment-friendly drilling'



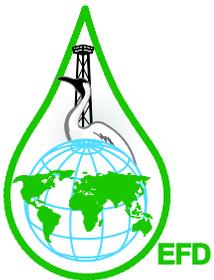
"Our program takes a systematic approach to develop and integrate new, low-impact technologies that reduce the footprint of drilling and production activities. The US has an abundant supply of clean, natural gas. The issue is to obtain access in environmentally sensitive areas with cost-effective technologies. The Alliance brings together high-level scientific organizations to work together on key issues to increase our domestic energy supply and create jobs to decrease our dependence on foreign energy supplies," said Haut.

<http://www.instantnews.net/texas-researchers-form-alliance-to-promote-environment-friendly-drilling.aspx>

Plans for Next Phase

Engineering Designs for Low Impact Drilling and Fracturing

- **Prototype Small Footprint Drilling Rig**
 - Demonstrate the viability of the technology as a lower-cost, lower-environmental impact technology that can benefit domestic exploration and production.
- **Application for Semi-Arid Ecosystem**
 - Hold workshop to develop the environmental cost/benefit methodology.
 - Hold workshops to show how Systems Engineering Design Methodology and the EFD Scorecard can be used to identify low impact systems.
- **Disappearing Roads**
- **NOx Air Emissions Studies**
- **Reduced Fracturing Footprints**

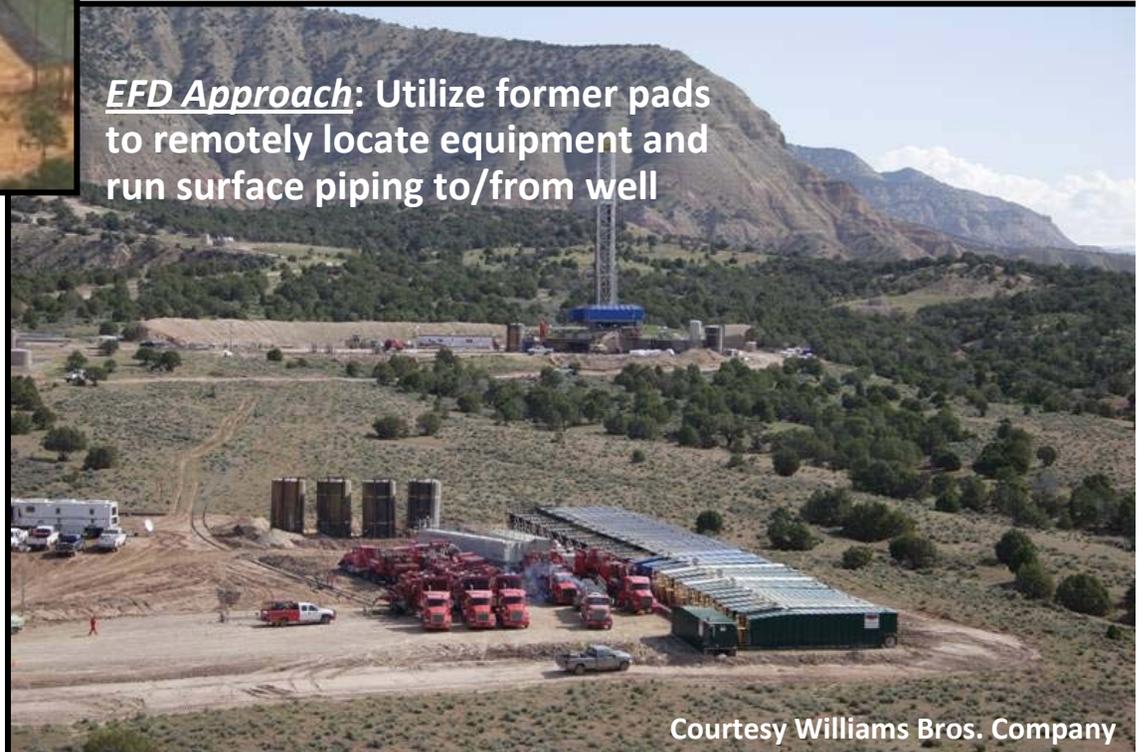


Remote Hydraulic Fracturing – Another Best Practice



- Reservoir must be fracture stimulated
- Could reuse produced water

EFD Approach: Utilize former pads to remotely locate equipment and run surface piping to/from well



Approx. 170,000 gallons of water and 150,000 pounds of sand are used for each frac job stage. (Can be as many as 8 frac stages per well)



Courtesy Williams Bros. Company

Plans for Next Phase

Engineering Designs for Low Impact Drilling and Fracturing

Measuring Effectiveness of EFD

- Develop plan to implement a multimedia effort to familiarize the public with drilling and production and to address concerns.
- Factsheets and other outreach educational materials pertaining to environmentally friendly energy exploration and production practices will be developed, printed and disseminated.
- Review potential social impacts.
- Develop and optimize scorecards for various ecosystems.



EFD Facts		
Project:		
Location:		
Ecosystem:		
	Max	Score
AIR	10	0
WATER	15	0
SITE	15	0
WASTE MANAGEMENT	20	0
BIODIVERSITY	20	0
SOCIETAL	20	0
	100	0

★ ★ ★ ★ ★

Tradeoff Scorecard Development

Academia

- Texas A&M University College Station
- Texas A&M University Kingsville
- University of New Hampshire
- UT Medical Center
- Mississippi State University
- Sam Houston State
- University of South Alabama
- John Hopkins University
- University of Arizona
- University of Texas
- University of Houston

Environmental Organizations

- NRDC
- Environmental Defense
- The Nature Conservancy
- Conservation International
- Mercer Arboretum
- Bureau of Applied Anthropology/Arizona
- Clinton Climate Initiative
- Rocky Mountain Clean Air
- McFaddin Ranch

Industry

- API
- Ballard Exploration
- BP
- Shell
- Chevron
- StatoilHydro
- ConocoPhillips
- Devon
- King Exploration
- Halliburton
- Huisman
- National Oil Well – Varco
- MI Swaco
- TerraPlatform
- T. Baker Smith
- Weatherford
- Derrick Equipment
- Composite Mats
- Ecology and Environmental Inc.
- PTTC
- IADC

State/Federal Agencies

- US Department of Energy
- Bureau of Land Management
- US Park Service
- Texas Railroad Commission
- Texas General Land Office
- Texas Dept. of Agriculture
- Texas Dept. of Transportation
- US Minerals Management Services
- Texas Parks & Wildlife
- Texas Water Board
- Texas Commission on Env. Quality
- US Environmental Protection Agency
- US Fish and Wildlife
- Argonne National Laboratory
- Big Thicket Preserve
- Idaho National Laboratory

EFD Facts

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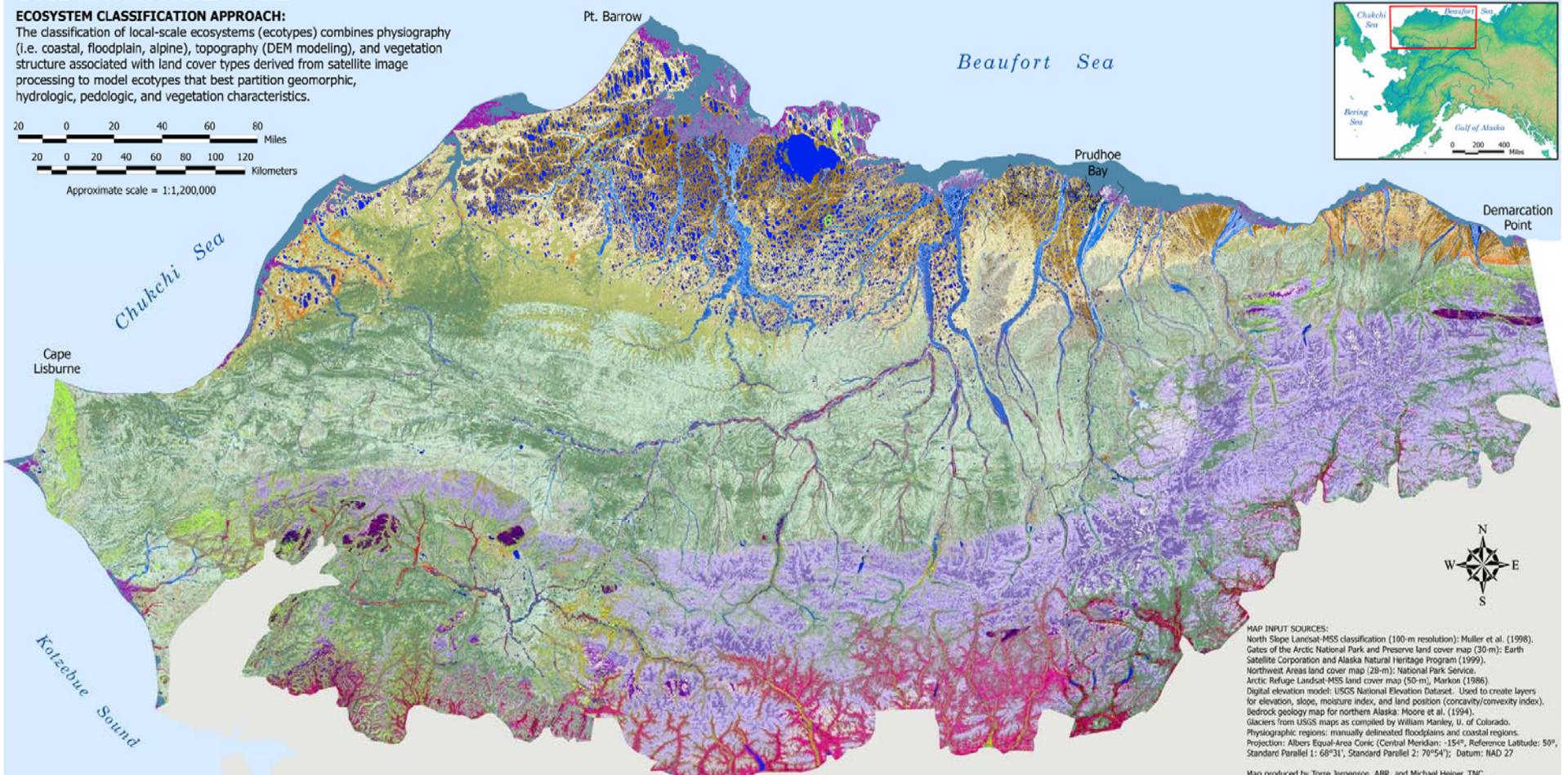


Ecosystem and Biodiversity Measurement and Assessment

Develop tools for adaptive ecosystem management to assist integrated management of land, water and living resources that promotes conservation and sustainable use

ECOSYSTEM CLASSIFICATION APPROACH:

The classification of local-scale ecosystems (ecotypes) combines physiography (i.e. coastal, floodplain, alpine), topography (DEM modeling), and vegetation structure associated with land cover types derived from satellite image processing to model ecotypes that best partition geomorphic, hydrologic, pedologic, and vegetation characteristics.



2020 Vision

Network of Self-Sustaining Regional Centers

- Remote sensing
- Modeling
- Risk management assistance



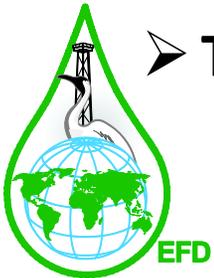
Plans for Next Phase

- **Conceptual Design for Semi-Arid Ecosystem**
- **Low-Impact Logistical Support**
- **Small Footprint Drilling Rig**
- **NOx Air Emissions Studies**
- **Reduced Fracturing Footprints**
- **Measuring the Effectiveness**



➤ **The Human Dimension: Societal Acceptance**

➤ **The EFD Scorecard**



Outreach & Technology Transfer

- **Following the direction of industry sponsors and stakeholders**

- Industry advisors lined to key program elements

- **Open Communication**

- Environmental forums

- Conferences

- Workshops

- Bringing parties together

- Special studies

<i>This Week's Schedule</i>		
May 12	Anchorage	IOGCC
May 13	Washington DC	Energy Day
May 14	Trinidad	SPE Workshop
May 14	Dallas, TX	Drilling Fluids School

- **Addressing public perception**

- Example: Energy Day (5/13/09) at Capitol Visitor's Center



What to Remember

www.efdsystems.com

Environmentally Friendly Drilling Systems Program

- Joint industry, academia, government, non-profit program
- Focused on current and emerging technologies
- Demonstrates technologies and measures tradeoffs

Measuring Environmental Tradeoffs

- Key component of the Program
 - *What gets measured, gets done.*
 - *What gets identified, gets dealt with.*

Prototype Environmental Tradeoffs Scorecard

- Different Scorecards for Different Ecosystems
- Six Attributes: *Air, Water, Waste Management, Site, Biodiversity, Societal*



EFD Participants

Environmental Organizations

The Nature Conservancy

Natural Resources Defense Council

Environmental Defense
Clinton Climate Initiative
Conservation International
Fort Worth Nature Center
Rocky Mountain Clean Air
World Ocean Council

Academia

Texas A&M University - College Station

Texas A&M University - Kingsville
Mississippi State University

Sam Houston State University

Utah State University

John Hopkins University
University of South Alabama
University of Arizona
University of Texas

University of Arkansas

University of Colorado

University of Houston

West Virginia University

Made in-kind commitment

Made cash commitment

Partnering w/HARC for next phase

State/Federal Agencies

US Department of Energy
Bureau of Land Management
US Park Service
Texas Railroad Commission
Texas General Land Office
Texas Department of Agriculture
Texas Department of Transportation
US Minerals Management Services
Texas Parks & Wildlife
Texas Water Board
Texas Commission on Environmental Quality
US Fish and Wildlife
Wyoming Oil & Gas Conservation Commission
New York State Dept. of Env. Conservation

Government Laboratories

Argonne National Laboratory

Idaho National Laboratory

Los Alamos National Laboratory

Other

Houston Advanced Research Center

Jicarilla Apache Nation
McFaddin Ranch

Industry

API
Apache
Ballard Exploration
BP
Chesapeake Energy
Chevron
ConocoPhillips
Derrick Equipment
Devon
EnCana
EnerCrest
Gulf Coast Green Energy
H&P
KatchKan
King Exploration
Halliburton
Huisman
M-I SWACO
MGM Energy Corp
NABORS DRILLING
NATIONAL OIL WELL - VARCO
Newpark Resources
Shell
StatoilHydro
TerraPlatforms
T. Baker Smith
Total
Weatherford
PTTC
IADC

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