

PROJECT STARR

STATE OF TEXAS ADVANCED OIL AND GAS RESOURCE RECOVERY PROGRESS REPORT

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Executive Summary

The State of Texas Advanced Resource Recovery program, Project STARR, has been successful in its major objective to increase royalty income to the Permanent School Fund through technological and research projects that promote the drilling and recompletion of profitable oil and gas wells on State Lands and Waters.

The Bureau of Economic Geology (Bureau) currently receives \$445,000 per year from the State to analyze State Lands properties and then advise and assist operators on how to increase production or discover new production. The State requires Project STARR to be revenue neutral—that is, Project STARR has to cause an amount of new royalty revenue to flow into the Permanent School Fund that equals or exceeds the amount that is appropriated to the program by the Legislature. This progress report summarizes Project STARR studies that have been done since the inception of the program and documents in detail the accomplishments of the program for the 2-year period (June 2002 to June 2004) since the last Project STARR report was submitted.

Over the last 2 years, Project STARR has helped generate \$21.3 million in royalties to the Permanent School Fund and \$6.3 million in severance tax to the State. Relative to royalty income, Project STARR is revenue positive by a factor of 23.9. This return is higher than that for the last biennium, which produced \$9.2 million, for a revenue-positive factor of 10.4. The increase in revenue is from a series of successful infill wells drilled in Corpus Christi Bay, higher lease royalties from these leases, and higher prices for oil and gas. If equivalent prices for oil and gas are used for the two reporting periods, the revenue positive factor of royalty is 16.5 for 2002 to 2004, as compared with 10.4 for 2000 to 2002.

On State Lands, proven oil reserves total 270 million barrels (MMbbl), which is only 8 percent of the 3.43 billion barrels (Bbbl) of oil that is projected to remain within these properties at reservoir abandonment (Holtz and Garrett, 1997). Of this 3.43 Bbbl, 1.6 Bbbl is mobile oil that can potentially be recovered if advanced geological, geophysical, and engineering technologies are applied to State Lands reservoirs. A similar picture emerges for natural gas in Texas State Lands fields. Cumulative gas production on State Lands is 10 trillion cubic feet (Tcf) (Holtz and Garrett, 1997). The amount of natural gas remaining in the largest State Lands gas reservoirs is estimated to be another 10 Tcf. The amount of natural gas projected to remain unrecovered at

reservoir abandonment using currently deployed technology will almost equal the amount of gas produced to date. With regard to in-place volumes of oil and gas, State Lands reservoirs are nowhere near depletion and many new deeper exploration targets exist. It is critical to apply new and advanced technologies to extract these remaining hydrocarbons, and Project STARR provides the expertise to help operators effectively deploy these technologies. With funding from the State of Texas and support from the General Land Office and the Railroad Commission of Texas, Project STARR is designed to help operators capture a portion of the large volume of this unrecovered oil and gas remaining in State Lands fields.

Project STARR data have been used to recommend more than 70 infill wells, 56 recompletions, and 14 step-out wells over the project's 9-year duration. Project STARR has also identified and worked on several prospects in previously undrilled deeper strata. To date, Project STARR has completed studies or is currently working on 22 fields on State Lands, and some of these studies have helped create royalty revenue to the Texas Permanent School Fund in the past 2 years since the last Project STARR report of \$21.3 million. It commonly takes several years between the delineation of prospects and the actual drilling of wells; therefore, many more millions of dollars to the Permanent School Fund may result from Project STARR's recent recommendations and successes. Over the life of Project STARR, ~\$56 million has been added to the Permanent School Fund from royalties on the increased production, an average of \$6.2 million per year.

Introduction

Revenue income to the Permanent School Fund is derived largely from oil and gas royalties from Texas State Lands (Fig. 1). However, oil and gas royalty income has declined even though a large hydrocarbon resource base remains on State Lands. In fact, State Lands fields and properties still contain more oil and gas than has been recovered over the decades-long history of State Lands production. Rather than being unattainable, a large volume of this remaining oil and gas is recoverable through improved scientific understanding and strategic, targeted deployment of advanced recovery technologies. Advanced technology has historically been the realm of major oil and gas companies, but many large companies in their pursuit of economies of scale have abandoned development of mature Texas oil and gas resources. The departure of these large

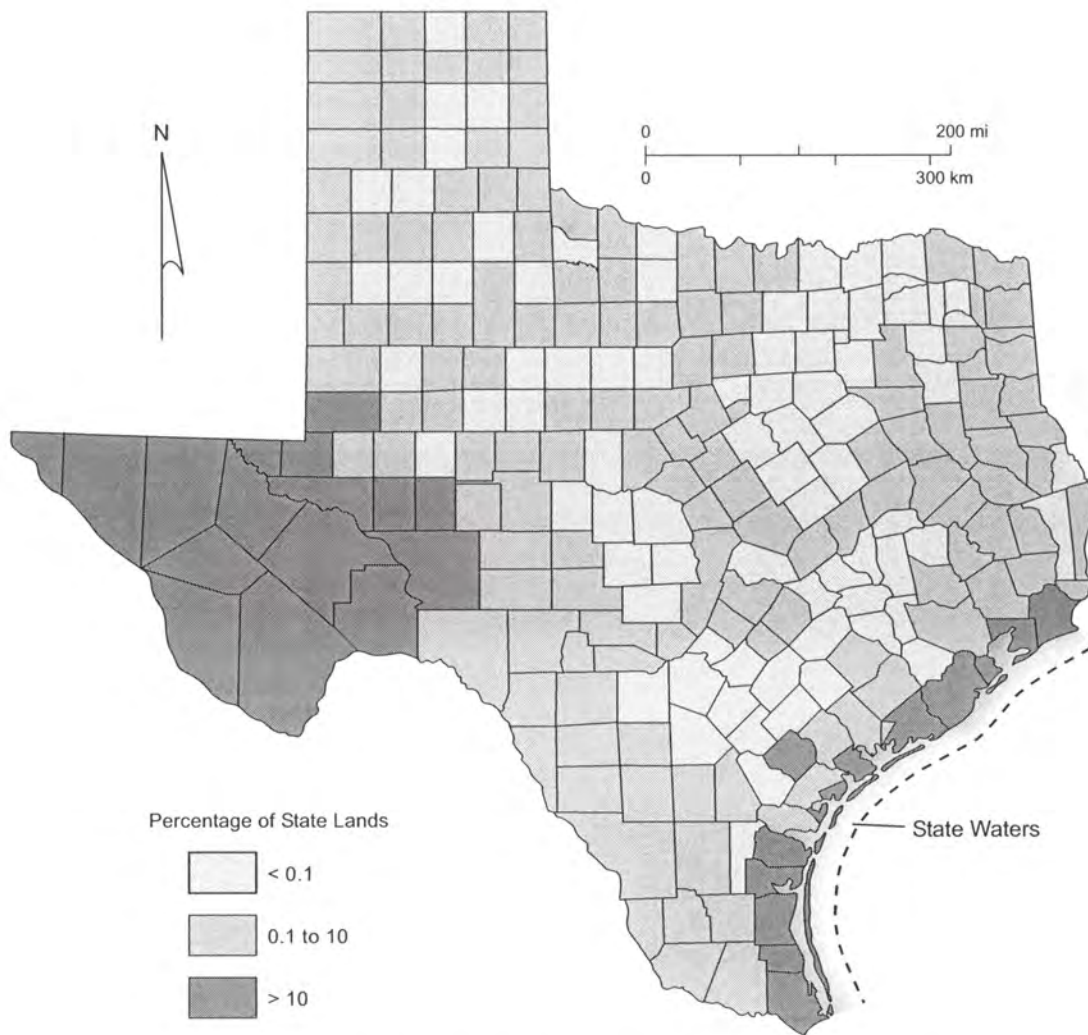


Figure 1. Location of Texas State Lands and State Waters. Onshore counties are shaded according to the percentage of area that is State Lands. The majority of onshore State Lands leases occur in the Permian Basin in West Texas and along the Gulf Coast. From Holtz and Garrett, 1997.

operators has created opportunities for the remaining smaller producers of State Lands fields. Independents, who have no advanced research and development capabilities, are requesting reservoir characterization assistance from the State of Texas Advanced Oil and Gas Resource Recovery Initiative (Project STARR) (see letters from clients in Appendix A). These independents recognize that without the advanced technology offered by Project STARR, they may miss producing substantial reserves on their State leases. The Bureau of Economic Geology, The University of Texas at Austin, with funding from the State of Texas and support from the General Land Office and the Railroad Commission of Texas, strives to provide this requested technical support. Opportunities for increased production have been identified and with the

support of allied operators these opportunities have been or are being drilled. Recent projects are described in the present report, and past projects are described in Appendix B.

To date, 22 fields have been chosen for assessment, and studies have been completed on 18 of the fields (Fig. 2 and Table 1). Twenty Texas operators have been, or are currently, involved in Project STARR (Table 1). Project STARR studies have been used to recommend more than 70 infill wells, 56 recompletions, and 14 step-out wells over the project's 9-year duration (Bureau of Economic Geology, 1996; Tyler et al., 1998; Hardage et al., 2000; Loucks et al., 2002b; present report). Working closely with clients, Project STARR has also identified several prospects in previously undrilled deeper strata. Of the targeted opportunities, at least 45 infill wells, 9 step-out wells, and 32 recompletions have been drilled on State Lands as a result of Project STARR interactions with operators. The identified deeper targets are currently active prospects. Several letters of acknowledgment are presented in Appendix A.

Highlights of the program history are listed below:

- Twenty-eight recompletions have been undertaken in Ozona and Keystone East fields (Appendix B) with incremental oil and gas reserve growth estimated at 8.8 billion cubic feet (Bcf) of gas and 2.44 million barrels (MMbbl) of oil (Tyler et al., 1998). The total royalty revenue generated from the reserves added in these two fields alone to the Permanent School Fund is estimated to exceed \$11 million (based on \$25/bbl oil and \$3.50/Mcf gas).
- In Umbrella Point field (see Appendix B), total royalty revenue generated from one infill well to the Permanent School Fund is approximately \$4 million based on its having produced 11.5 Bcf of gas and 90,000 barrels of condensate up to November 2001. Furthermore, during the 2002–2004 biennium, this previously shut-in well was brought back on production after being off production for a year.
- Fifteen infill wells drilled in the past 4 years in Corpus Christi Bay field have contributed \$29.7 million to the Permanent School Fund through royalty payments and ~\$8 million to the State in severance taxes.
- Two wells have been drilled in 2004 and successfully completed in the middle Frio Formation in the Red Fish Bay field by IBC. In August 2004, another well has hit its target sandstone reservoir and is being perforated. Reserves and production rates on these wells are at present confidential. IBC will continue an active drilling program over the next 12 months that is expected to have excellent results.

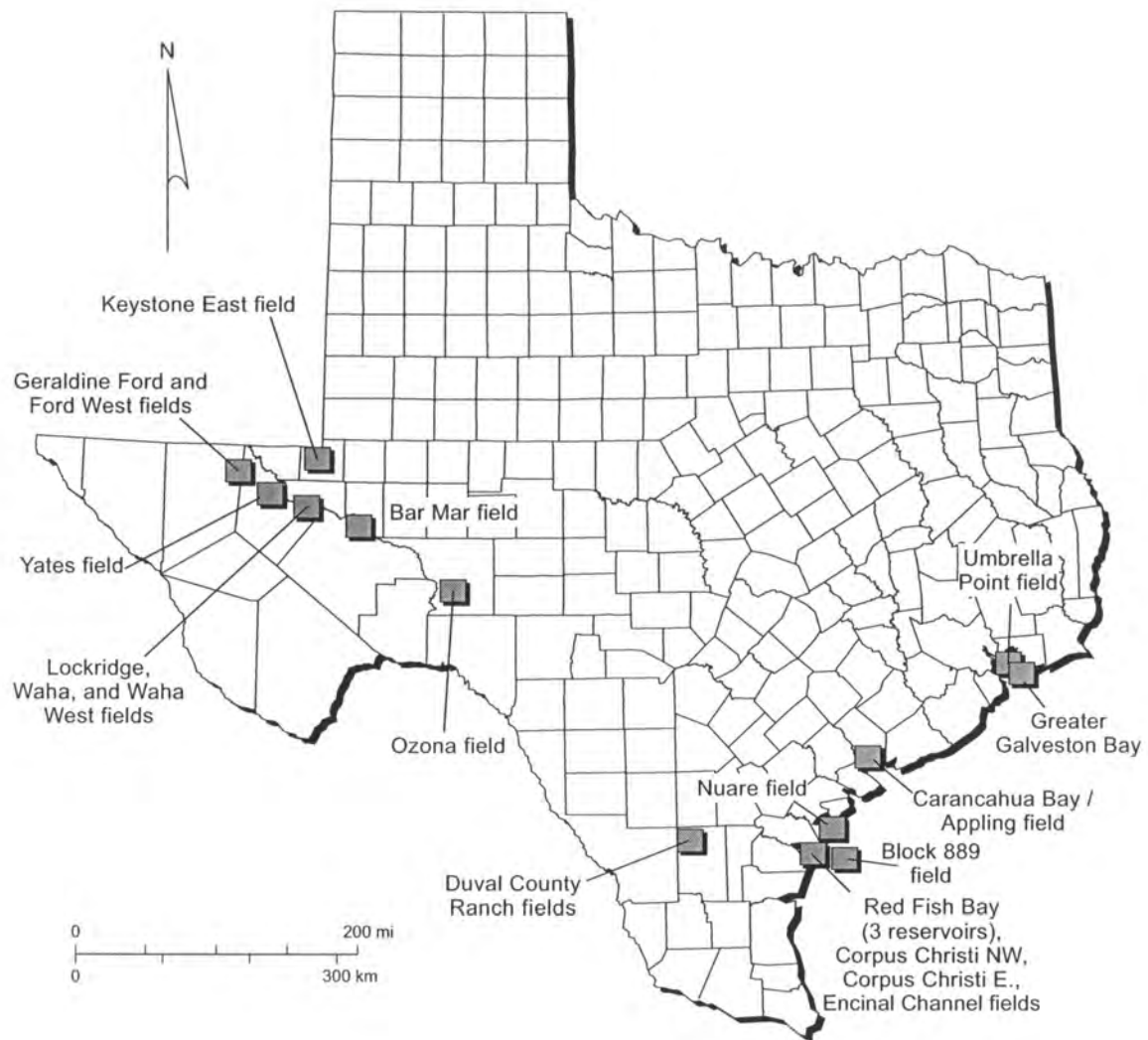


Figure 2. Map showing Project STARR field studies. Sixteen State Lands oil and gas fields have been or are being evaluated.

Table 1. Project STARR field studies.

<u>Fields</u>	<u>Operator</u>	<u>Period of Project STARR Interaction</u>
Keystone East field	Bass Enterprises, Hallwood Energy, Pioneer Natural Resources, Vista Resources	1995–1999
Geraldine Ford and Ford West fields: (primary funding by U.S. Department of Energy)	Conoco, Incorporated	1995–1997
Lockridge, Waha, and Waha West fields: (primary funding by U.S. Department of Energy and Gas Research Institute)	Shell Oil and Mobil Oil (now ExxonMobil)	1996–1998
Bar Mar field	Hanson Corporation	1997–1998
Ozona field	Union Pacific Resources (now Anadarko), Cross Timbers Oil Co.	1996–1998
Duval County Ranch fields	Killam Oil	1998–1999
Umbrella Point field	Panaco, Incorporated	1995–1999
Red Fish Bay field (shallow Frio)	Pi Energy	1996–1997
Corpus Christi East field	Sabco Oil and Gas, Royal Exploration	1998–2000
Corpus Christi NW field	Sabco Oil and Gas, Royal Exploration	1998–2000
Encinal Channel field	Sabco Oil and Gas, Royal Exploration	1999–2000
Mustang Island 889 field	Sabco Oil and Gas	2000–2001
Red Fish Bay field (Middle Frio)	IBC Petroleum, Cinco	2001–present
Red Fish Bay field (Deep Frio)	IBC Petroleum	2003–present
Mustang Island Offshore	Cabot Oil and Gas	2003
Northeast Red Fish Bay Project	Cabot Oil and Gas	2003
Yates field EOR	Kinder Morgan	2004–present
Galveston-Bay Shelf area study	Santos USA Corp	2004–present
Carancaha Bay Project	Brigham Exploration Company	2004–present

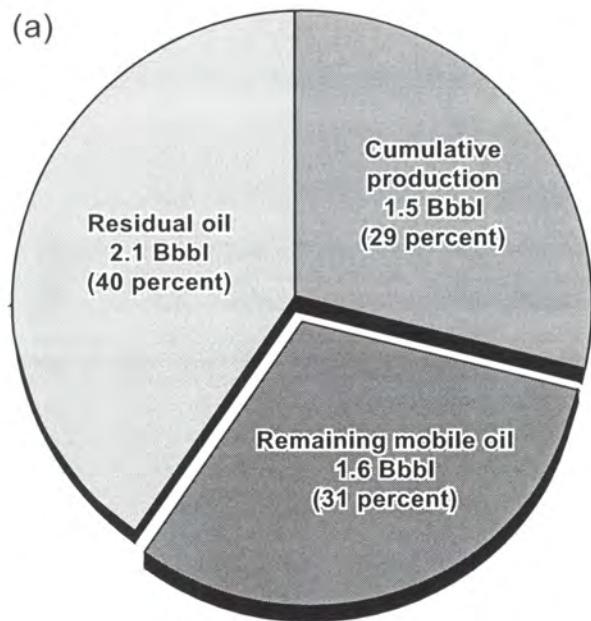
Historical Background on the Permanent School Fund

In 1839 the Republic of Texas began designating public lands to be used to benefit public schools, and the State of Texas now has more than 13 million acres set aside for revenue generation to assist public education (Fig. 1). In the 163 years since that forward-looking decision was made, billions in revenue for public schools have been generated by agricultural and mineral leasing of these lands, with most of the revenues being derived from royalties and rentals paid by oil and gas leases. In the 2003 fiscal year alone, annual oil and gas royalties to the Permanent School Fund were ~\$279 million.

A vast volume of oil and gas remains in State Lands fields (Holtz and Garrett, 1997). Remaining mobile oil on State Lands is estimated to be 1.6 billion barrels (Bbbl) (Fig. 3a), and remaining gas is 10 trillion cubic feet (Tcf) (Fig. 3b). At \$40/bbl oil at an average royalty of 15 percent, the potential estimated royalty to the Permanent School Fund on this oil is \$9.6 billion. Similarly for gas, at \$5/Mcf with an average royalty of 15 percent, the potential estimated royalty to the Permanent School Fund on this oil is \$7.5 billion. The combined potential estimated severance tax to the State is approximately \$5.7 billion. The hydrocarbons that remain are trapped in geologically complex reservoirs that require advanced technologies for successful, cost-effective recovery. The challenge for the State and for public education is that these oil and gas resources must be produced for their value to be realized. With support from the State of Texas, Project STARR and Texas operators are responding to this challenge.

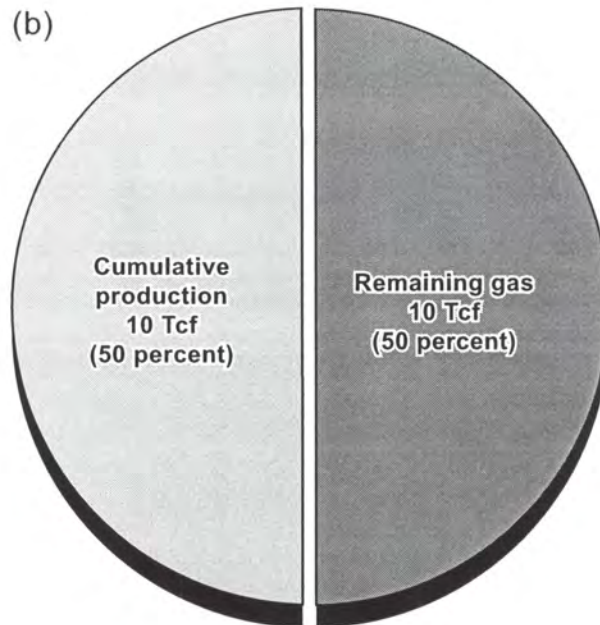
Project STARR Methodologies

The philosophy of Project STARR is to work with State Lands operators to deploy advanced recovery strategies and newly developed technologies on a field-by-field basis to ensure maximal recovery efficiency. We also work with operators to evaluate deeper prospective higher risk reservoirs such as the deep-shelf gas play. The deep-shelf gas play concentrates on offshore Tertiary sandstone reservoirs between the depths of 15,000 to 35,000 ft. The most volumetrically significant State Lands oil and gas resources are in the Gulf Coast and the Permian Basin (Fig. 4). Project STARR's approach is to concentrate on these two mature resource areas, where innovative and cost-effective strategies can best be deployed to stem the decline of production. Twenty-two State Lands fields (Fig. 2) have undergone, or are undergoing, characterization and extended development with the cooperation of State Lands operators. This maximization of oil and gas recovery from State Lands fields consists of three critical components: (1) reservoir characterization and advanced resource recovery technology deployment in key reservoirs, (2) identification of prospects in deeper untested sections, and (3) transfer of concepts and approaches about recovery optimization to State Lands fields and operators.



Original oil in place
5.2 billion barrels (Bbbl)

Remaining mobile oil value
 Total value : \$64 billion (\$40 per barrel)
 GLO royalty: \$9.6 billion (assuming 15%)
 Severance tax: \$2.5 billion (4.6% tax)



Original gas in place
20 trillion cubic feet (Tcf)

Remaining gas value
 Total value: \$50 billion (\$5 per mcf)
 GLO royalty: \$7.5 billion (assuming 15%)
 Severance tax: \$3.2 billion (7.5% tax)

Figure 3. Texas State Lands oil and gas volumetrics. (a) Despite a precipitous decline in revenues from State Lands oil production, only slightly more than one-quarter of the original oil in place has been produced. Remaining mobile oil is as large a recovery target as all the oil historically produced from State Lands fields. (b) These estimates of gas volume are conservative because they are based on relatively large gas fields. Cumulative production is only half of the original gas in place. From Holtz and Garrett, 1997.

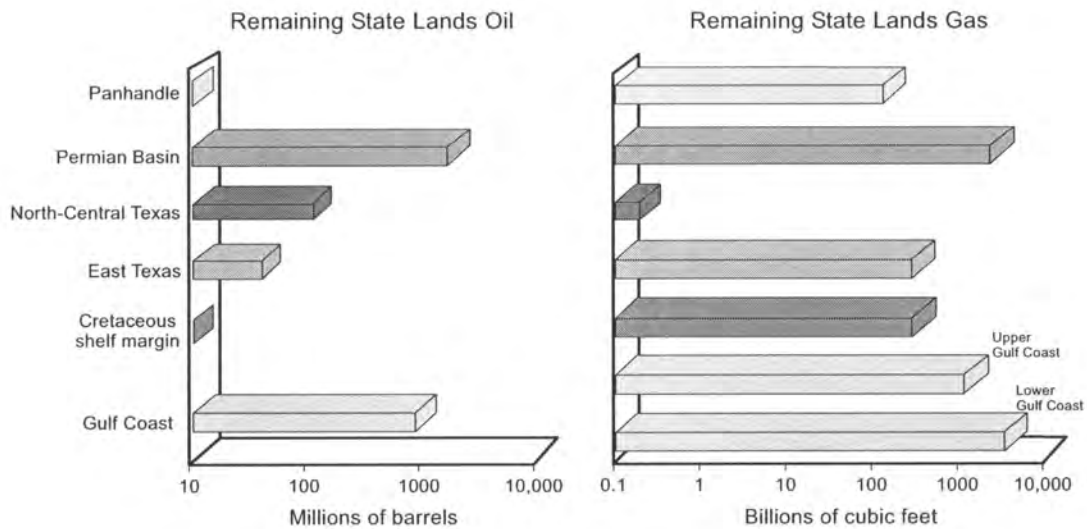


Figure 4. State Lands remaining oil and gas volumes. The Gulf Coast and Permian Basin regions have the most potential hydrocarbon reserves. From Holtz and Garrett, 1997.

Reservoir Characterization and Advanced Resource Recovery Technology Deployment

The advanced hydrocarbon recovery program applied by Project STARR is based on application of reservoir characterization techniques that delineate unrecovered oil and gas in selected State Lands reservoirs. Project STARR staff work with operators to deploy advanced reservoir exploitation plans that are based on a thorough understanding of the internal architecture of the reservoir and the effects that depositional systems have on oil and gas accumulation and distribution. Key to this effort is identification of oil and gas reservoirs that offer economic opportunities. Project STARR then has to recruit field operators who are ready to address and redesign, as appropriate, development efforts currently in place on properties that contain these reservoirs. Detailed geologic and engineering characterization projects have created quantitative descriptions of several State Lands reservoirs, identified untapped and bypassed compartments of remaining oil and gas, and defined deeper reservoir targets to drill.

The above Project STARR studies include reservoir characterization of the fields displayed in Figure 2 and listed in Table 1. The optimized recovery strategies recommended by Project STARR in these field studies include step-out wells, well deepening, recompletions, targeted infill drilling, injection profile modification, waterflood optimization, hydrofracing, and drilling untested deeper targets under producing fields.

Transfer of Project STARR Technology to Texas State Lands Operators

The success of the advanced recovery initiative, as measured in incremental barrels of oil in the tank and additional cubic feet of gas in the pipeline, is vitally important, but equally important is the transfer of successful approaches to improved oil recovery to operators of State Lands reservoirs. Because technology transfer can facilitate improved efficiencies in State Lands fields, Project STARR has developed a technology transfer approach that includes workshops, presentations, publications, and digital data sets (CD-ROM's).

In collaboration with the General Land Office and the Railroad Commission of Texas, Project STARR personnel from the Bureau of Economic Geology have provided assistance and advice to numerous operators on optimal development strategies, appropriate well-log suites, styles of reservoir heterogeneity and their effects on oil and gas recovery, and approaches to problem solution.

Through the transfer of technology developed by Project STARR to Texas operators, it is envisioned that many of the remaining State Lands oil and gas reserves will be explored and developed in future decades to sustain the Texas Permanent School Fund. As a result of this State funding, Project STARR has received several awards (Appendix C), and numerous publications, workshops, and lectures (Appendices D and E) have been provided to the public. Individual awards, publications, workshops, and presentations are listed in the appendices. Since the last Project STARR report, we have published 3 professional papers, presented 22 talks, and given several workshops.

The Project STARR team has a major paper in press titled "Understanding Growth-Faulted, Intraslope Subbasins by Applying Sequence Stratigraphic Principles: Application to the South Texas Oligocene Frio Formation" that will be published this November by the American Association of Petroleum Geologists. We are also presenting a workshop at the Gulf Coast Association of Geological Societies, in San Antonio in October of 2004, titled "Using Sequence Stratigraphic Wireline-Log Analysis to Develop Stratigraphic Architecture in Growth-Faulted Basins: Practical Application to the South Texas Offshore Frio Section."

Project STARR has been active in presenting seminars to industry. Over the last year, we have given private seminars on State Lands geology to Santos USA Corp., Cabot Oil and Gas, and Brigham Oil and Gas Exploration Company. A public seminar was presented in June 2004 for 20 energy companies in Houston, Texas.

Research Developed from Project STARR Program

Project STARR makes a major effort to produce research with the data available from our clients. Through our clients we get to review large seismic and wireline-log datasets that are not available to the public. With permission from the client and seismic vendor, we have received permission to publish some of our research results (see above section on Transfer of Project STARR Technology to Texas State Lands Operators).

We have made at least two major contributions to the understanding of exploration and development of sandstone reservoirs on State Lands along the Texas Gulf Coast (onshore and offshore):

1. *Understanding growth-faulted, intraslope subbasins by applying sequence stratigraphic principles* – We found through detailed analysis of Oligocene Frio Formation intraslope growth-faulted subbasins in the Corpus Christi, Texas, area that deposition during relative lowstands of sea level was the principal cause of growth faulting. Lowstand depocenters on the low-gradient upper continental slope comprising basin-floor-fan facies, slope-fan systems, and prograding lowstand delta systems exerted sufficient gravity stress to cause major sections of outer shelf and upper slope strata to fail and move into the Gulf of Mexico Basin. The faults sole out deep in the basin, and rotation of hanging-wall blocks mobilizes deep-water mud and forces the mud bodies basinward and upward to form mud (shale) ridges that constitute the basinward flank of intraslope subbasins above the footwall fault blocks. These subbasins have been prolific petroleum targets for decades and are now the focus of deep prospecting for gas. Lowstand sandstones are principal reservoirs, and synsedimentary tectonics produced anticlinal and fault traps and associated stratigraphic pinch-out traps on the flanks of the anticlinal structures. Understanding the origin of the faulted subbasins and their chronostratigraphic relationships and depositional processes provides a perspective that can improve deep gas exploration. We have presented these concepts at numerous professional meetings over the last several years, and as

mentioned above, a major paper is due for publication in November 2004 summarizing these concepts.

2. *Site-specific sequence-stratigraphic section (S^5) benchmark charts as key to chronostratigraphic systems tract analysis in growth-faulted basins* – These charts are important tools for understanding the stratigraphic architecture that controls the accumulation and distribution of oil and gas reservoirs in Texas State Waters. The charts are based on composite wireline logs created by splicing unfaulted and relatively conformable log segments from the deepest wells in an area to provide a stratigraphic record that captures a complete succession of depositional and cyclic history. S^5 benchmark charts contain additional data that summarize available geologic information for a subbasin, site-specific area. Stratigraphic sequences and component systems tracts are basic information displayed on S^5 benchmark charts. This physical framework is calibrated with ages of sequences and bounding surfaces. Sequence-bounding unconformities and internal maximum-flooding surfaces delineated on S^5 benchmark charts, when correlated with other wireline logs and placed into the seismic time domain, produce a chronostratigraphic framework for an area. Comparison of S^5 benchmark charts among widely spaced or isolated sites provides a framework that temporally constrains systems tracts and regionally diachronous lithostratigraphic units. We have taught this approach to several companies, and we are teaching a short course in October 2004 on the construction of S^5 benchmark charts.

Recent and Current Projects

Corpus Christi Bay Project

A multifield study across Corpus Christi Bay was initiated in 1999. The initial part of the project was finished in August 2000 and presented to Sabco Oil and Gas Corporation (operator) and Royal Exploration Company, Inc. Work on the area continued through 2003. Collectively, these two companies are the largest State Lands leaseholders in Corpus Christi Bay, their major producing fields being Corpus Christi East and Encinal Channel (Fig. 5).

The operators provided an extensive database of 50 mi² of 3-D seismic data, logs from more than 60 wells, and production history information from a large number of wells across the bay to Project STARR. Analyses of these data have aided in the drilling of 15 step-out wells to date, of which 12 are shown on Figure 5. These wells have contributed approximately \$18.7 million to the Permanent School Fund through royalty payments and \$5.5 million to the state in severance taxes during the current reporting period. See Appendix A for a supporting letter by Sabco Oil and Gas Corporation.

In September 2003, Project STARR held a workshop for Sabco Oil and Gas and Royal Exploration Company to update both companies on research that resulted from the Corpus Christi Bay study and subsequent studies in the region. S⁵ benchmark charts, cross sections, and growth-fault-related sequence stratigraphic models were transferred to the companies to be used in future development and exploration. Recently, the operator communicated to Project STARR that they may continue their drilling program in Corpus Christi Bay in the near future.

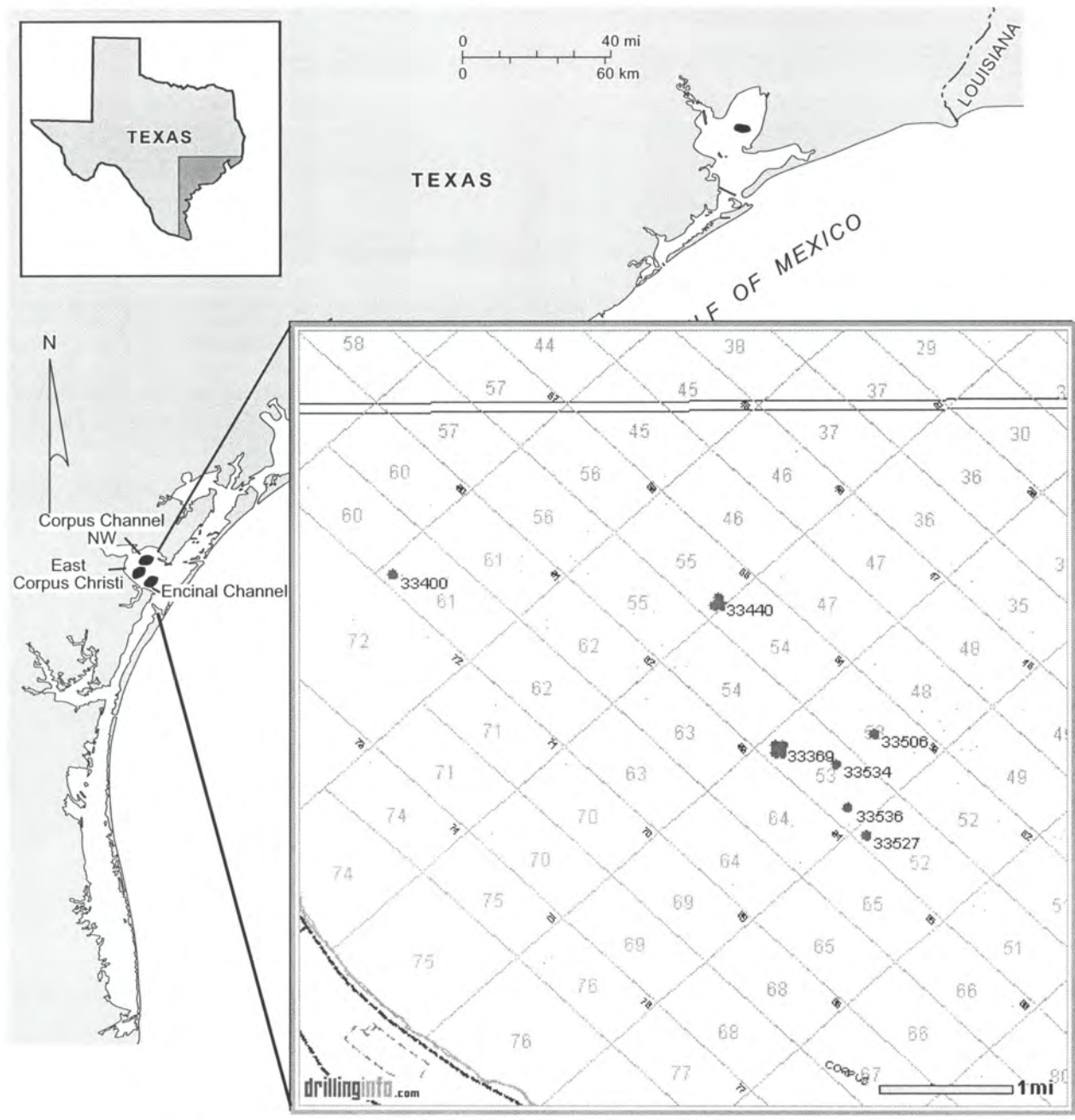


Figure 5. Location of gas wells drilling in Corpus Christi Bay by Sabco Oil and Gas and Royal Exploration.

Mustang Island Block 889 Project

A reservoir characterization study centered on Mustang Island Block 889 (Fig. 2) was completed for Sabco Oil and Gas Corporation in 2002 (Loucks et al., 2002b) (Fig. 6). Several infill and step-out drilling opportunities were generated, along with a lead on a deep-shelf gas prospect. According to the Texas Railroad Commission, Block 889 contains parts of three fields: (1) Mustang Island 889 with six wells, (2) Mustang Island 883 with two wells, and (3) Mustang Island 883-S with three wells. The geologic and engineering conclusions presented to the company are being used to evaluate the delineated additional drilling opportunity on Sabco's State Lands Block 889 and additional adjacent areas if they acquire new leases (see Appendix A for a supporting letter by Sabco Oil and Gas Corporation). The prime targets for additional wells are untapped fault compartments in the highly faulted middle Tertiary Frio section.

Reservoir engineering analysis was conducted on the Mustang Island Block 889 field area to tabulate reserves produced, identify compartmentalization, calculate reservoir efficiencies, and define individual well production history and performance. Through mass balance calculations, it is estimated that the maximum remaining recoverable gas in place is approximately 150 Bcf.

Most of the hydrocarbon production in the Mustang Island Block 889 area results from traps in the footwalls of synthetic faults between two major growth faults. Several opportunities were delineated for future production in State Block 889. Identification of prospects is being kept confidential at the company's request.

The general descriptions of the prospects are as follows:

- Prospect 1: An offset to a producing well to test a deeper section known to produce in nearby areas. Part of this prospect is structurally higher than the known equivalent production and is within a three-way closure against a fault. Probable recoverable reserves are 15 Bcf of gas and 392,000 barrels of condensate (Table 2).
- Prospect 2: Test of a newly recognized subcompartment of a long-time producing reservoir interval. Probable reserves are 7 Bcf of gas and 46,000 barrels of condensate (Table 2). (Table 2) with pressures of more than 4,000 psia in the previously produced interval. Significantly, an up-structure area of the compartment can be tested.

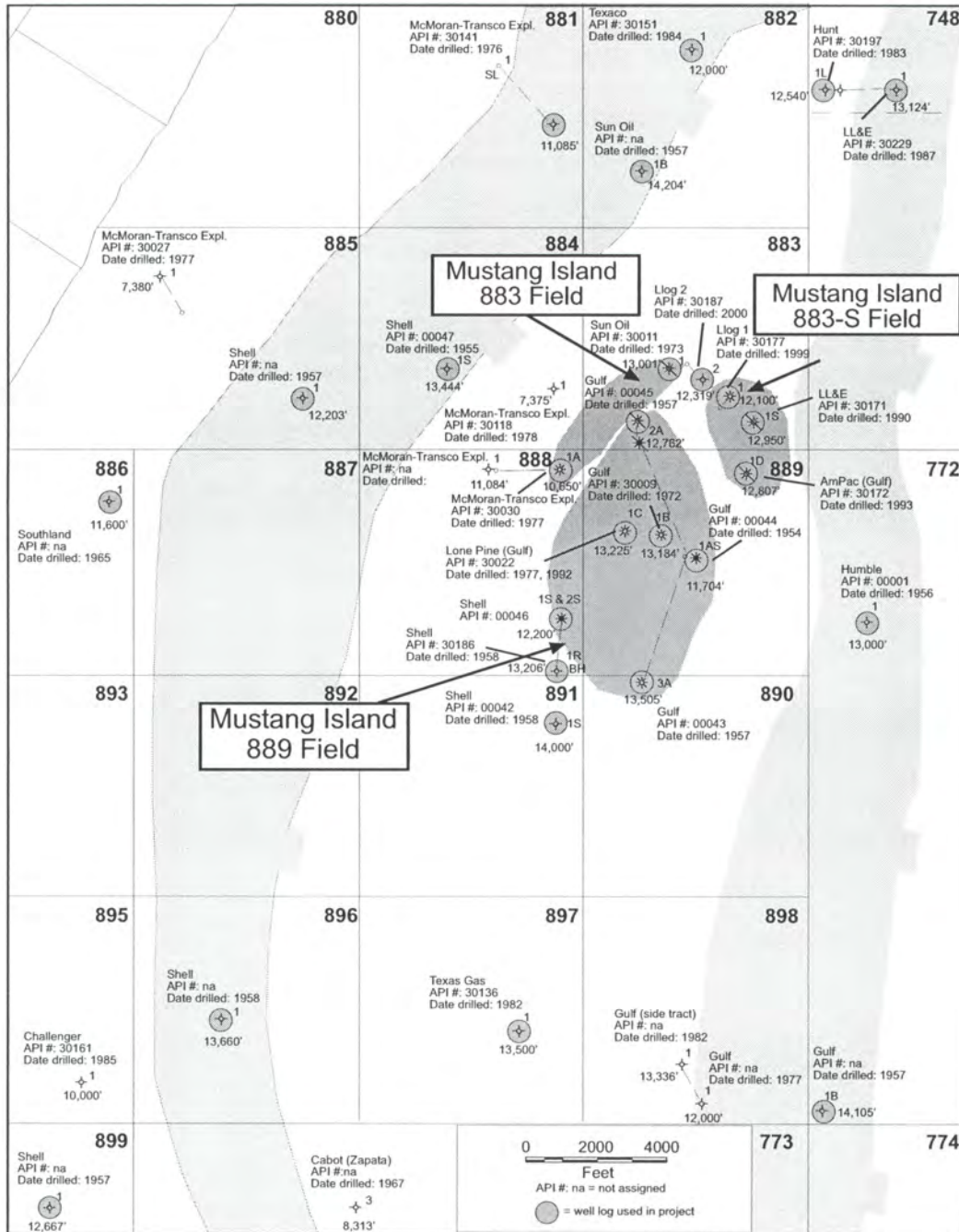


Figure 6. Location map of the Mustang Island Block 889 study area showing wells used in study and major growth faults.

- Prospect 3: Offset to an abandoned gas well. Well was abandoned at a high reservoir pressure. Analysis of the reservoir compartment indicates that the compartment still has remaining recoverable reserves of 17 Bcf and 441,000 barrels of condensate
- Prospect 4: An isolated, untested, structural closure between two faults. In the immediate area, equivalent intervals have produced 38 Bcf. Probable reserves are 3 Bcf of gas and 91,000 barrels of condensate (Table 2).
- Prospect 5: This prospect consists of a horst block at a shallower structural horizon with two-way dip closure between several large faults. The prospective interval displays closure at several horizons. None of the sandstones in this prospect have produced in this area, but similar sandstones in the Red Fish Bay area to the northwest have produced. Possible reserves are 8 Bcf of gas and 366,000 barrels of condensate (Table 2).
- Prospect 6: Additional deeper exploration targets are identified as stratigraphically trapped basin-floor fans that appear to exist along the lower section of a major growth fault. These deeper basin-floor fans may contain high-quality reservoir sands and form significant new reservoirs. Possible reserves are 18 Bcf of gas.

Table 2. Probable recoverable reserves from Mustang Island field project (using Ryder Scott Spreadsheet: www.ryderscott.com)

Prospect	Unrisked Recoverable Gas (billion standard cubic feet)	Unrisked Recoverable Condensate (barrels)
1	15	392,000
2	7	46,000
3	18	441,000
4	3	91,000
5	8	366,000
TOTAL	51	1,236,000

Total unrisks probable reserves (infill drilling) could reach 51 Bcf of gas and 1,236,000 barrels of condensate, and unrisks possible reserves (deeper exploration target) could reach 18.1 Bcf. A 25 percent success rate for infill drilling would contribute 12.8 Bcf of gas and 309,000 barrels of condensate in reserves worth approximately \$76.4 million in total revenues, and at an average royalty of 18.5 percent, the Permanent School Fund would receive \$14.1 million in royalties, and the State would receive \$0.8 million in severance taxes. If the deeper exploration play is successful it could contribute 18 Bcf in reserves worth \$90.5 million in total revenues, and at an average royalty of 18.5 percent, the Permanent School Fund would receive \$16.7 million in royalties over the life of the well, and the State would receive \$1.1 million in severance taxes.

Middle Frio Red Fish Bay Project

An area of approximately 115 square miles (6 miles east/west by 23 miles north/south) centered on the Red Fish Bay field (Figs. 2 and 7) was studied in detail for IBC Corporation (see Appendix A for a supporting letter by IBC Corporation). The prime targets for additional wells were untapped fault compartments in the highly faulted Oligocene middle Frio section. The main tasks of the BEG study were to (1) describe the structural and stratigraphic architecture of the area, (2) define the sequence stratigraphy of the penetrated sedimentary section, (3) delineate reservoir compartmentalization, and (4) identify potential drilling opportunities or bypassed pay. These tasks were accomplished through the integration of wireline-log, seismic, and engineering/production data. Fifty-three wireline logs were used for construction of cross sections, petrophysical analysis, and integration with seismic data.

The Red Fish Bay area provides an array of development opportunities. Traditionally, most of wells have been drilled into fault-trapped reservoirs of the highstand and transgressive facies of the upper Frio Formation. The middle Frio reservoir study targets sandstones of deeper lowstand prograding deltaic wedges. The area of seismic coverage defined several more untested fault compartment opportunities in addition to potential stratigraphic traps.

A number of leads and prospects were developed with IBC. Identification of prospects is being kept confidential at the company's request. Two of the leads were drilled in 2004 and

successfully completed in the middle Frio Formation. In August 2004, another well has encountered its target and is being perforated. Reserves and production rates on these wells are at present confidential. IBC will continue an active drilling program over the next 12 months that is expected to have excellent results.

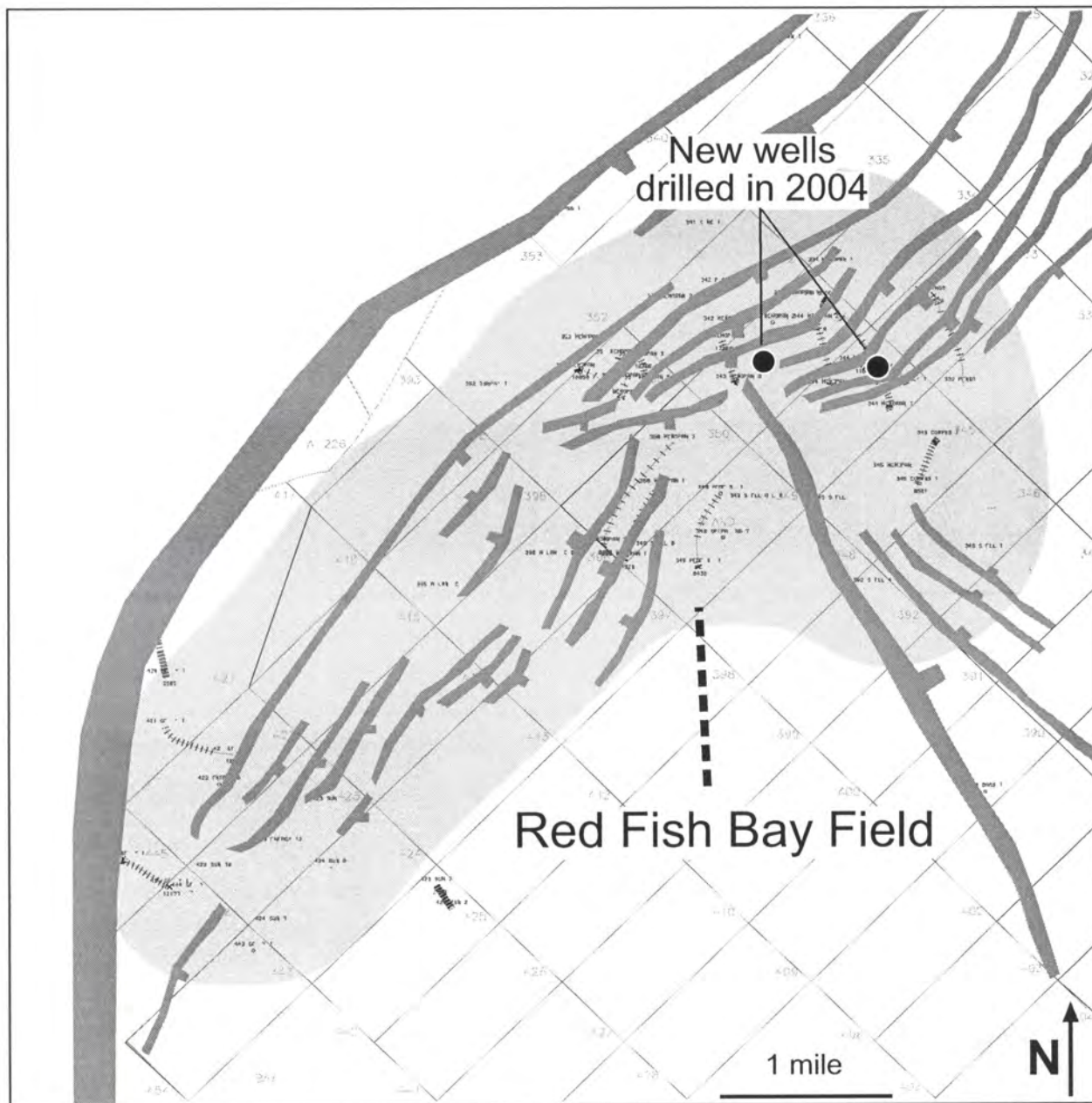


Figure 7. Red Fish Bay field showing location of two new wells drilled by IBC in 2004.

Deep Frio Red Fish Bay Project

Project STARR conducted a sequence stratigraphic, structural and seismic study in the lower (deep) Frio Formation of the Red Fish Bay area (Fig. 2) (see Appendix A for a supporting letter by IBC Corporation). The goal of this study was to evaluate the exploration potential of the deep-shelf gas play slope and basin-floor-fan depositional systems below the productive prograding wedge complex. Deepwater deposits are prolific reservoirs worldwide. However, such plays are only recently becoming exploration targets in State Waters of the Corpus Christi Bay area. Log and seismic data were correlated and analyzed throughout the Red Fish Bay area. Root-mean square (RMS) amplitude analysis reveals the presence of slope-fan deposits. These slope-fan channel sands are productive in a few wells, but they did not produce more than 3 Bcf over a 9-year production period. Our cooperative investigation with IBC has identified a large deep structure that could be productive in either slope or basin-floor-fan facies. As noted above, the basin-floor-fan prospect in the Block 889 area was estimated to be approximately 18 Bcf in size. If similar sized reservoirs are discovered in the deep Frio sediment wedge, tens of millions of dollars would be added to the Permanent School Fund and to the State. The location and description of this structure are confidential. A report to IBC summarizing the conclusions developed by Project STARR is in preparation.

Northeast Red Fish Bay Project

Project STARR assisted Cabot Oil and Gas Company by evaluating the geology of prospects that were being developed in the northeast Red Fish Bay area (Fig. 2) (see Appendix A for a supporting letter by Cabot Oil and Gas). Project STARR provided Cabot Oil and Gas Company with an S⁵ benchmark chart that compiled the prospective sandstone reservoirs into a sequence stratigraphic framework. The first well drilled in 2003, State Tract 277 #2, encountered productive sandstone in the lower section of the Frio prograding wedge. As of April 2004, the well had produced 583 MMcf and 4,600 barrels of condensate, with estimated royalty revenues of more than \$600,000 and a severance tax of \$180,000. During the same time period, the second well, the State Tract 277 #3, had produced 605 MMcf and 9,418 barrels of condensate, with an estimated royalty revenue for the Permanent School Fund of more than \$700,000 and a severance tax of more than \$200,000.

Mustang Island Offshore Regional Project

An analysis of the Oligocene stratigraphic interval of the offshore Mustang Island area was completed for Cabot Oil and Gas Company by the Project STARR team in late 2003 (see Appendix A for supporting letter by Cabot Oil and Gas). The main goals of the investigation were to develop a sequence stratigraphic framework of the area, identify depositional environments, establish the relationship of sedimentation and gravity tectonics, and delineate gross sand trends. The analysis was based on seven 2-D seismic lines and 21 digitized wireline logs. The study built upon conclusions from a previous research project by Project STARR in an area around State lease Block 889. The major product from this study was the analysis of the stratigraphic section based on sequence stratigraphic principles. An S⁵ benchmark chart and associated cross sections were prepared for Cabot Oil and Gas Company showing the complete stratigraphic section with major sandstone intervals that may be prospective for deep gas. Cabot Oil and Gas Company will use these data to aid in interpreting their proprietary 3-D seismic volume. Project STARR will continue to interact as consultants in this endeavor to develop prospects. As prospects are drilled, Project STARR will help evaluate the results and incorporate the earned royalties and severance taxes into our revenue-neutrality calculations.

Yates Field, Pecos County, West Texas Project

Kinder Morgan is a pipeline company that specializes in CO₂ enhanced recovery projects. They acquired Marathon Oil Company's giant Yates field (Fig. 2) in 2002. A large part of the field is on State Lands. Kinder Morgan is currently converting the recovery process in the field from a nitrogen flood to a CO₂ flood for enhanced oil recovery. The field is currently producing 18,000 barrels of oil per day. However, without a continuous aggressive enhanced oil recovery program, the field would become uneconomical in less than 10 years. Their plans are to keep production at today's rates or higher for many decades. Kinder Morgan estimates that its CO₂-pressure-maintenance-injection program for the Yates field will result in approximately 10-40 million barrels of additional recoverable oil over the next 20 years. Even at the low end of this estimate, a successful enhanced oil recovery project would earn the Permanent School Fund \$1.25 million per year in royalty. The Project STARR team has been working with Kinder Morgan since April 2004 to accomplish this goal (see Appendix A for supporting letter by Kinder Morgan).

Project STARR is assisting Kinder Morgan in their geologic interpretation, reservoir characterization efforts, and data transfer. The San Andres reservoirs in the field have been worked intensively by Marathon Oil Company's Yates field team for many years. A reservoir characterization volume generated in Stratamodel™ by Marathon geologists and engineers was transferred by the Project STARR team to the Roxar reservoir characterization software package accessible to Kinder Morgan. This was a major step in providing Kinder Morgan with up-to-date reservoir concepts in the field. A log database residing in Geolog-software files was transferred to a more readable format usable in different geologic interpretation software packages that will be used to develop a CO₂ flood for enhanced oil recovery. The Project STARR team also organized a 2-day workshop for Kinder Morgan led by a former Marathon geologist (current BEG geologist) to review the geology and engineering work performed by Marathon over the life of the field.

Continued interaction by Project STARR will be to assist Kinder Morgan on selected geological problems. We are in the process of assisting Kinder Morgan in transferring their large Yates field core database (24,000 ft of core) to the BEG's Midland core storage facility for better accessibility to the geologist working on the Yates enhanced recovery program.

Galveston-Bay Shelf Area Project

Project STARR began a collaborative effort with Santos USA Corp. in mid-June 2004. Santos USA has acquired a total of approximately 19,300 acres of 5-year primary term leases in Texas State Waters offshore Galveston and Jefferson Counties (Fig. 2). The leasehold has four areas of interest in the Vicksburg interval and two shallower areas of interest in the Frio interval that have been mapped from 3-D seismic. The first well in Santos USA's planned State Waters exploration program is the Cougar B prospect, which is a large salt-induced structure having a target objective in Oligocene upper Vicksburg deepwater sands. It is located in the High Island area in 25 to 30 ft of water. Santos USA assigns a 90 percent-chance reserve potential of 167 Bcf equivalent. At \$5/Mcf gas, these reserves would be valued at approximately \$835 million with an estimated royalty to the Permanent School Fund of approximately \$154 million (assuming an average royalty factor of 18.5 percent, the mean royalty factor for leases in the area) and severance tax to the State of \$51 million. Project STARR is working on the stratigraphic architecture of the leased area to understand sandstone depositional environments, distribution of

potential reservoirs (reservoir-quality sandstones), and age of the sandstones. A series of S⁵ benchmark charts of the greater Galveston Bay growth-faulted subbasins are being constructed. These data will be integrated with seismic data covering areas of interest.

Carancahua Bay Project

Brigham Exploration Company and Project STARR are collaborating on a study in the Carancahua Bay area (Fig. 2) to evaluate the middle and lower Frio stratigraphic interval for new step-out wells and deeper prospects. The study began in July 2004. Project STARR will use seismic and wireline logs to develop the sequence stratigraphic and structural framework. Major products will be our S⁵ benchmark charts and cross sections.

Project STARR's Return on State Investment

Production data from the Texas Railroad Commission show that Project STARR-related wells have provided \$21,264,930 in royalty revenue for the Permanent School Fund during the past 2 years (Table 3). The revenue numbers for Table 3 are calculated using actual royalties by lease and actual value of gas and condensate during month produced. We calculated the average monthly prices using data from the Web site of the Energy Information Administration (EIA) of the U.S. Department of Energy (<http://www.eia.doe.gov/>). From that Web site, we downloaded two spreadsheets. One contained average monthly U.S. wellhead prices for natural gas. The other contained Cushing, Oklahoma, daily prices for West Texas Intermediate crude oil. The production values per lease came from the Railroad Commission's "ACTI Texas Oil and Gas Production" database (<http://driller.rrc.state.tx.us/Apps/WebObjects/acti>). Approximately \$6.3 million (Table 3) in severance taxes associated with these wells has been collected by the State.

Relative to royalty income, Project STARR is revenue positive by a factor of 23.9. This return is higher than that for the last biennium, which produced \$9.2 million for a revenue-positive factor of 10.4. The increase in revenue is from a series of successful infill wells drilled in Corpus Christi Bay, higher lease royalties from these leases, and higher prices for oil and gas. If equivalent values (2000 to 2002 values) for oil and gas are used for the two reporting periods, the revenue-positive factor of royalty is 16.5 for 2002 to 2004 versus 10.4 for 2000 to 2002.

Table 3. Summary of royalty revenue to the Permanent School Fund and severance tax to the State. Credit is in accordance with metrics approved by the State of Texas Comptroller's office.

Field Name	RRCID for each Well per Project	Royalty Rate	Condensate Wellhead Value	Condensate Royalty Value (5/2002 to 4/2004)	Condensate Severance Tax	Gas Wellhead Value	Gas Royalty Value (9/2001 to 8/2003)	Gas Severance Tax		
Encinal	180008#	16.67%	\$1,289,424	\$214,904	\$49,428	\$6,333,607	\$1,055,603	\$395,850		
	185577	22.50%	\$415,859	\$93,568	\$14,825	\$8,144,768	\$1,832,573	\$473,415		
	187453	16.67%	\$1,296,786	\$216,131	\$49,710	\$13,247,489	\$2,207,919	\$827,968		
	187460	16.67%	\$132,783	\$22,130	\$5,090	\$915,700	\$152,617	\$57,231		
	187846	25.00%	\$3,014,467	\$753,617	\$103,999	\$14,971,500	\$3,742,875	\$842,147		
	196653	16.67%	\$178,045	\$29,674	\$6,825	\$1,887,030	\$314,506	\$117,939		
	196661	16.67%	\$139,612	\$23,269	\$5,352	\$2,521,743	\$420,291	\$157,609		
	195078	16.67%	\$2,318,327	\$386,389	\$88,869	\$11,802,015	\$1,967,007	\$737,626		
	195038	25.00%	\$1,207,370	\$301,843	\$41,654	\$6,161,561	\$1,540,390	\$346,588		
	194843	16.67%	\$600,831	\$100,139	\$23,032	\$6,656,844	\$1,109,476	\$416,053		
	195589	18.91%	\$983,149	\$185,913	\$36,673	\$10,814,030	\$2,044,933	\$657,682		
					\$2,327,578	\$425,457	\$16,388,191	\$5,030,108		CC Bay Total: \$24,171,334
	Nuare	199216	20.00%	\$156,425	\$31,285	\$5,756	\$3,008,557	\$601,711	\$180,513	
Stedman Island	202192	20.00%	\$329,698	\$65,940	\$12,133	\$3,288,843	\$657,769	\$197,331		
				\$97,225	\$17,889		\$1,259,480	\$377,844	Nuare/Stedman Island Total: \$1,752,438	
Umbrella Point	169064	12.50%	\$46,966	\$5,871	\$1,890	\$4,963,999	\$620,500	\$325,762	Umbrella Pt. Total: \$954,024	
Red Fish Bay	186038	20.00%	\$5,733	\$1,147	\$211	3,979	\$796	\$239		
	186060	20.00%	\$95,295	\$19,059	\$3,507	209,852	\$41,970	\$12,591		
	186047	20.00%		\$0	\$0	422	\$84	\$25		
		20.00%	\$441,202	\$88,240	\$16,236	2,073,944	\$414,789	\$124,437		
			\$108,446	\$19,954		\$457,639	\$137,292		Red Fish Bay Total: \$723,331	
									Royalties Total \$21,264,930	
									Severance Taxes Total \$6,336,197	
									Grand Total \$27,601,127	

Well was shut in for at least a year, or a new zone was perforated.

The rate of decline in oil and gas production on Texas State Lands is symptomatic of the hydrocarbon production decline in the entire state and nation over the past few decades. In 1997, a report by the Railroad Commission of Texas titled "Texas Natural Resources Study: A Status Report of the Hydrocarbon Industries of Texas" (Matthews et al., 1997) projected that rates of hydrocarbon production will decline dramatically to low levels within the next decade.

Advanced reservoir characterization and technology can help reduce this rate of decline and aid in recovering more hydrocarbons from mature fields before abandonment. Current projections indicate that Project STARR is helping operators generate significant revenue for the Permanent School Fund. Within the last 2 years Project STARR results were used to drill 11 new wells in Corpus Christi Bay, 3 wells in Red Fish Bay, and 2 in the Nuare field. In Corpus Christi Bay

alone, where Project STARR has worked with operators, 18.2 Bcf of gas has been produced over the last 4 years from new wells.

Royalty revenue to the Permanent School Fund for the next biennium (2004 to 2006) from incremental oil and gas production could equal or exceed Project STARR's present excellent economic results. This estimate is based upon several infill wells that may be drilled in Block 889, 12 more infill and stepout wells in the Red Fish Bay middle Frio section, exploration wells in the Greater Galveston Bay area to deep gas targets, infill wells in the Carancahua Bay area, and enhanced oil recovery activities in the West Texas Yates field. Several planned regional studies may also initiate drilling of new exploration targets. The amount of revenue will depend on when the wells are drilled within the 2-year period and whether the wells produce as projected. The rates of actual and forecasted returns on Project STARR are excellent and fully satisfy Project STARR's revenue-neutral requirement for continued funding.

With sustained oil and gas development funding from the State of Texas, Project STARR has an ultimate goal of capturing an incremental 5 percent of the remaining mobile oil and gas resource on State Lands and Waters that probably would not be captured without the application of advanced technology. This estimate is based on our belief that we can apply advanced technology to identify new reservoirs and apply better reservoir characterization principles than can be done by many of the smaller companies without research and technology resources. The mobile oil resource on State Lands is 1.6 Bbbl. Achieving the goal of 5 percent incremental oil would yield 80 million barrels and provide a return to the Permanent School Fund of \$400 million, assuming an average present price of \$40/bbl and a 12.5 percent royalty. Similarly, a capture of 5 percent of the 10 Tcf of remaining gas would yield 500 Bcf and generate \$375 million for the Permanent School Fund, assuming an average present price of \$5.00/Mcf and an average 15 percent royalty. By achieving these levels of incremental recovery, the Project STARR initiative could help generate \$775 million in royalties to the Permanent School Fund over the long term.

The wellhead value of the additional oil and gas reserves would be \$3.2 billion and \$2.5 billion, respectively, for a total of \$5.7 billion. Calculations based on the Texas Railroad Commission's "General Model of Oil and Gas Impact on the Texas Economy" derived from the Comptroller's Input-Output model of the Texas economy can be further utilized to estimate the overall effect of the additional oil and gas reserves in terms of economic value, taxes, and jobs

created. The economic value of the oil and gas reserves as they cycle through the Texas economy is calculated as \$16.6 billion (wellhead value multiplied by 2.91). Total taxes of \$679 million are derived from severance (4.5 percent oil and 7.5 percent gas of wellhead value), ad valorem (3.95 percent of wellhead value), franchise (0.18 percent of economic value), and sales (2 percent of economic value) taxes. The number of additional jobs created equals 108,870, assuming 19.1 jobs are created per million dollars of wellhead value.

Sustained funding for Project STARR will permit reservoir characterization analysis of several major oil and gas fields on State Lands per year and act as a catalyst that will focus advanced exploration and development technologies back on State Lands and Waters and increase revenue flow to the Permanent School Fund.

Project STARR Revenue Neutrality Metrics

Project STARR must demonstrate revenue neutrality to the State of Texas Comptroller's Office each biennium in order to be considered for funded in the next biennium. Both royalties to the Permanent School Fund and State severance tax can be accounted to the revenue neutrality calculations based on the metrics presented in Table 4. This metric table was developed in conjunction with the State of Texas Comptroller's Office in 2004. Six different types of projects are noted in Table 4.

Table 4. Project STARR revenue neutrality metrics.

Type of STARR Recommendation	Expiration period following recommendation (Initial/incremental production must begin before recommendation expires)	Time period for credit following initial production	Royalty Credit (Royalties to PSF)	Severance Tax Credit
1. Drilling new infill or stepout well in established field	4 years	2 years	100%	100%
2. Drilling new infill or stepout well in established field with multiple reservoir intervals	4 years	2 years following completion of each additional reservoir interval	100%	100%
3. Recompletion - missed pay well in established filed	4 years	2 years	100%	100%
4. Enhanced oil recovery (EOR) field project	4 years	2 years following initial response/production	100% of incremental production	100% of incremental production
5. Exploration well	4 years	2 years	100%	100%
5.a. Subsequent development wells following discovery of new field	2 years following initial production from exploration well	2 years	100%	100%
5.b. Copycat wells following discovery of new field	4 years following initial production from exploration well	2 years	25%	25%
6. Wells drilled based on influence of regional trend studies	4 years	2 years	25%	25%

Recommendations

Project STARR has been very successful by focusing on field-scale studies that are limited in their geographic extent. This concentrated focus on small, reservoir-sized areas leads to immediate royalty revenue flow into the Permanent School Fund because specific areas and specific reservoir depths can be identified where State Lands operators can take recommended actions to increase production. To expand upon our present program, we will request \$1,009,000 per year from the State. This is an annual budget increase of \$565,000 and will be used to add new technical staff in engineering, geology, petrophysics, and geophysics and to account for

inflation since inception of the project in 1995. This funding level allows Project STARR to keep intact its present reservoir characterization team and to add new team members whose expertise will enhance the project as well as to increase the number of oil and gas fields analyzed. It will also allow for regional exploration trends to be studied.

The regional-scale projects could identify new play trends across State Lands. These large-scale studies would be an ideal complement to the current, small-area Project STARR studies and provide a multiyear focus and a long-term technology implementation that would better sustain the Permanent School Fund. The Bureau of Economic Geology recommends that funding for Project STARR be increased to the levels noted above, to allow the program to conduct regional-scale studies. These regional-scale studies may have a longer term payout than do reservoir-scale projects, but they should create a long-term, larger magnitude increase of revenue flow for the Permanent School Fund and State and sustain that revenue generation for a greater period of time than do reservoir-scale studies.

The Bureau of Economic Geology is in the process of proposing a 2-year industry consortium study titled "Stratigraphic Architecture and Sandstone Reservoir Quality in Deep-Shelf Gas Plays of Texas State Waters" that is directed toward reducing reservoir risk on new, very deep exploration targets on Texas submerged lands. The proposed strategy for this initiative involves the systematic application of state-of-the-science technology and methods to evaluate tracts of Texas submerged lands that have potential for successful prospecting by the private sector. This study should complement Project STARR efforts, stimulating the very deep shelf gas play by reducing reservoir risk.

Overall, Project STARR has been very successful interacting with State Lands operators to drill more wells. Our success rate with the operators has been excellent, as indicated by the revenue generated. We strongly believe that the requested increase in funding support for Project STARR will be more than offset by an increase in royalties to the Permanent School Fund and severance tax to the State of Texas.

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Appendix A

2003–2004 Letters of Cooperation

Sabco

Oil and Gas Corporation

Dr. Robert Loucks
The Bureau of Economic Geology
University Station
PO Box X
Austin, TX 78713-8924

July 30, 2004

Dear Bob:

I hope all is going well at the BEG! We at Sabco Oil & Gas(Sabco) wish to express our gratitude for your interaction and help regarding our various drilling projects situated in Texas State Waters. A review of specific projects is given below:

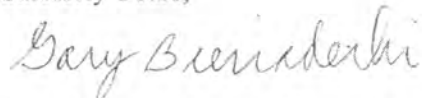
Encinal Channel, Nueces County – We will be drilling three wells, two of which will be new fault block tests, beginning August 11, 2004. Current production from the Field, which is entirely on Texas State leases, is approximately 40,000 MCFD and 900 barrels of condensate per day. The technical review with the BEG last September was helpful in understanding the sedimentary and structural geology of the Encinal Channel area within the regional framework model developed by the BEG.

Mustang Island Block 889, Nueces County – Two wells are planned for drilling this year beginning in October. Both of these wells will be Marg Tex sand tests designed to test the entire massive low stand sand section. We are using the sequence stratigraphy principles and type log developed by the BEG as the basis for our sand/reservoir prediction model. Understanding the stratigraphy in this geologically complex sub-basin was the key element necessary to develop our drilling prospects. Sabco thanks the BEG for their fine work and many contributions to the understanding of the 889 area.

San Antonio Bay, Matagorda County – Two wells will be drilled this year beginning in August of this year. Paleo data provided to Sabco from the BEG was helpful in determining electric log correlations in the study area and regional Frio depositional models developed by the BEG were supportive of our exploration effort.

Once again, Sabco Oil & Gas thanks the BEG for their support and contributions to our oil and gas exploration efforts. We look forward to more successful collaborations in the near future!

Sincerely Yours,



Gary Biesiadecki, Senior Geologist, Sabco Oil & Gas



IBC PETROLEUM, INC.

10010 San Pedro, Suite 360, San Antonio, Texas 78216
Telephone (210) 342-2225 Facsimile (210) 342-7408
michaelj@ibcsat.com

June 17, 2004

Dr. Robert G. Loucks
University Station
P. O. Box X\
Austin, Texas 78713-8924

Re: STARR Team Support

Dear Dr. Loucks:

On behalf of IBC Petroleum, I would like to thank you and the STARR team for your ongoing support of our project in Redfish Bay Field, Corpus Christi Bay, Nueces County, Texas.

We appreciate your insightful knowledge of the regional geology and your detailed grasp of the local conditions. Your help in understanding the geology of deeper, unexplored prospects in the field has been invaluable, and your studies of the area using our seismic data have prompted us to consider future drilling. We are currently completing a second well that we drilled with encouragement from the STARR team.

Sincerely,

IBC PETROLEUM, INC.

Michael J. Pawelek
Vice President

 **Cabot Oil & Gas Corporation**
Gulf Coast Region
1200 Enclave Parkway, Suite 300
Houston Texas 77077-4544

September 8, 2004

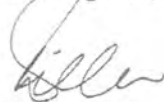
Robert (Bob) G. Loucks, Ph.D.
Bureau of Economic Geology
Box X, University Station
Austin, TX 78713-8924

Bob:

I take this opportunity to thank you and your staff at the Bureau of Economic Geology (BEG) for the applied technical support you have provided us over the past year. I am grateful for your willingness to freely transfer technology developed in the academic realm that is applicable to our business of finding hydrocarbon reserves in the Texas Gulf Coast and specifically in the Red Fish Bay and Mustang Island areas.

The log correlations, cross sections, and regional overview you provided us have definitely advanced our understanding of the area and given us the confidence to continue our drilling activities. As we expand our efforts in the Frio Trend we look for your continued support and assistance.

Kind regards,



Paul M. Miller.
Geologist



June 17, 2004

Dr. Robert G. Loucks
Senior Research Scientist
Bureau of Economic Geology
Jackson School of Geosciences
The University of Texas at Austin
Econ Geol, Bur-3rd Floor
1 University Station Stop E0630
Austin, Texas 78712

Dear Dr. Loucks,

This letter is to acknowledge the time that you and your colleagues on the STARR project spent with me last autumn reviewing your research while I was still working for BNP, an active operator of Texas state waters leases. I was very impressed by the high quality of personnel and skills they could apply to my exploration problems. I appreciate the insight that our discussions provided me and BNP and wish we could have cooperated in a Padre Island project together.

As you know, my current employer, Endeavour Corporation, does not currently operate on Texas state lands leases. However, should Endeavour Corp. acquire such leases, I hope that we would be able to collaborate in the future.

Sincerely,

A handwritten signature in cursive script that reads "Michael Neese".

Michael Neese

KINDER MORGAN
CO₂ COMPANY, L.P.
500 North Loraine, Suite 900 Midland, Texas 79701

Dr. Robert Loucks
Bureau of Economic Geology
The University of Texas at Austin
J.J. Pickle Research Center
10100 Burnet Road, Building 130
Austin, Texas 78758

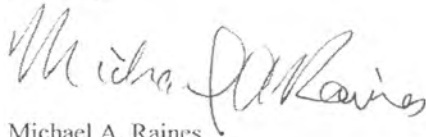
September 2, 2004

Dear Dr. Loucks,

I would like to take a moment to say "Thank You" on behalf of Kinder Morgan CO₂ Company's Midland Production office for your efforts and the efforts of the other STARR team members. We appreciate your help in getting us started as we take over operations of the Yates Field Unit (YFU) in Pecos County. Due to your efforts, we have much more efficiently gained access to digital log data and to the geologic models built by the previous operator. You have helped us understand the model in use now, where it came from, and how it all fits together. The work done on the YFU Project will provide great benefits to us as we move this field into a more intense phase of tertiary recovery through the use of CO₂.

Because the State of Texas owns Royalty Interest at some level in literally half of our tracts (see image below), I believe that the value of this project to the State will also become apparent soon, and shall surely be seen as a tremendous investment of State funds. We look forward to continuing to work with the STARR team over the next year as I pass the geologic duties on to our new geologist, Fred Behnken. I'm sure Fred will find the interaction with your team just as helpful as I have to date.

Sincerely,



Michael A. Raines
Earth Sciences
Midland Office

Cc: Fred Behnken

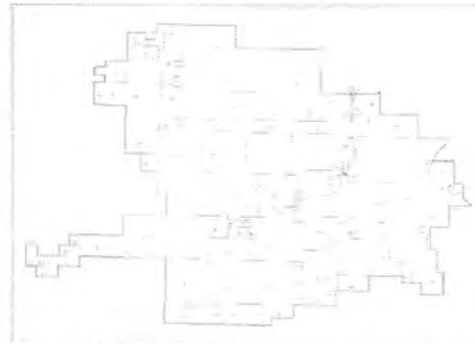


Figure 1: Yellow tracts contain State owned Royalty Interest.

Appendix B

Previous Project STARR Studies

Appendix B presents a summary of fields where Project STARR has completed studies in the past. These fields are still producing, but the revenue collected from these fields was not used to calculate revenue neutrality for the present biennium.

Ozona Field Project

Ozona gas field in Crockett County has produced 1 Tcf of gas from more than 2,000 wells and includes approximately 24 mi² of State Lands. Project STARR did a geologic characterization of Ozona Canyon sandstone gas reservoirs on 18 mi² of State Lands in the field and on another 8 mi² of State Lands just outside the present field boundaries (Fig. B1). This work assessed and ranked the production potential of most of the State Lands locations available for development. Union Pacific Resources Company (UPR) of Fort Worth (now Anadarko Oil and Gas) completed 16 wells on Project STARR-recommended State Lands locations.

Advanced reservoir characterization will be a continuing effective tool for increasing oil and gas production on State Land leases in the Ozona field. Most Ozona sandstone reservoirs form narrow belts or ribbons resulting from their deposition in channels on ancient sea floors. Well locations can be selected by targeting the thickest parts of these sandstone trends, as has been demonstrated by wells based on Project STARR recommendations. Production results show that geologically targeted locations in Ozona field are above-average producers (Fig. B2). As a result of the Project STARR initiative, projected recovery from the 16 project wells is estimated to be 8 Bcf of gas and 560 Mbbl of oil and natural-gas liquids (Tyler et al., 1998). Royalty revenue to the Texas Permanent School Fund from June 1998 through April 2000 has been more than \$0.2 million (assuming a price of \$2/Mcf for gas), and royalty revenue to the Texas Permanent School Fund from June 2000 through April 2002 has been more than \$0.2 million (assuming a price of \$3.50/Mcf for gas based on Energy Information Administration average monthly U.S. natural gas wellhead price), for a total of \$0.4 million.

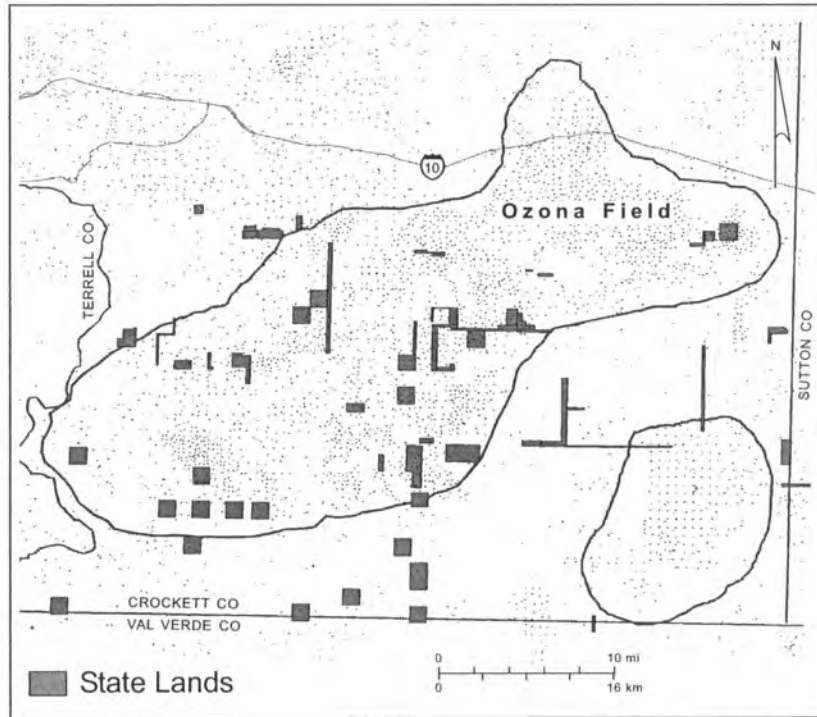


Figure B1. Location of Ozona gas field and State Lands, Crockett County, Texas.

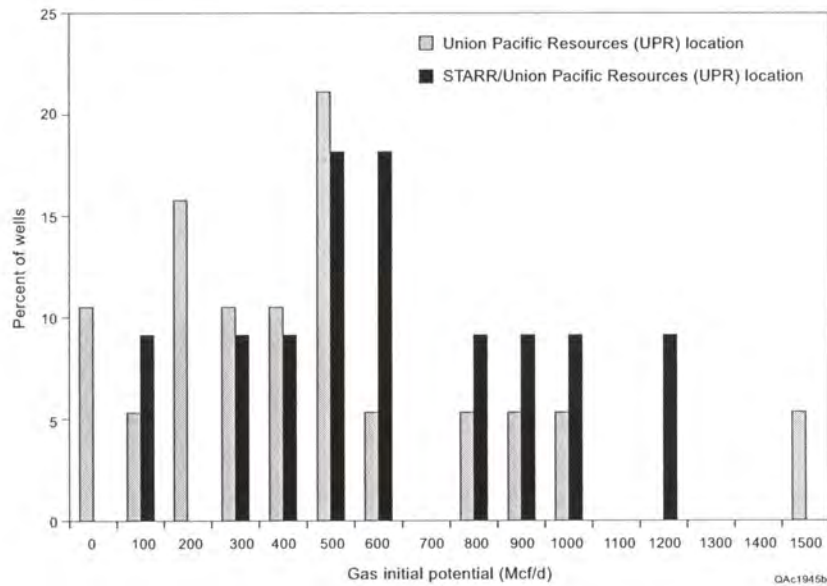


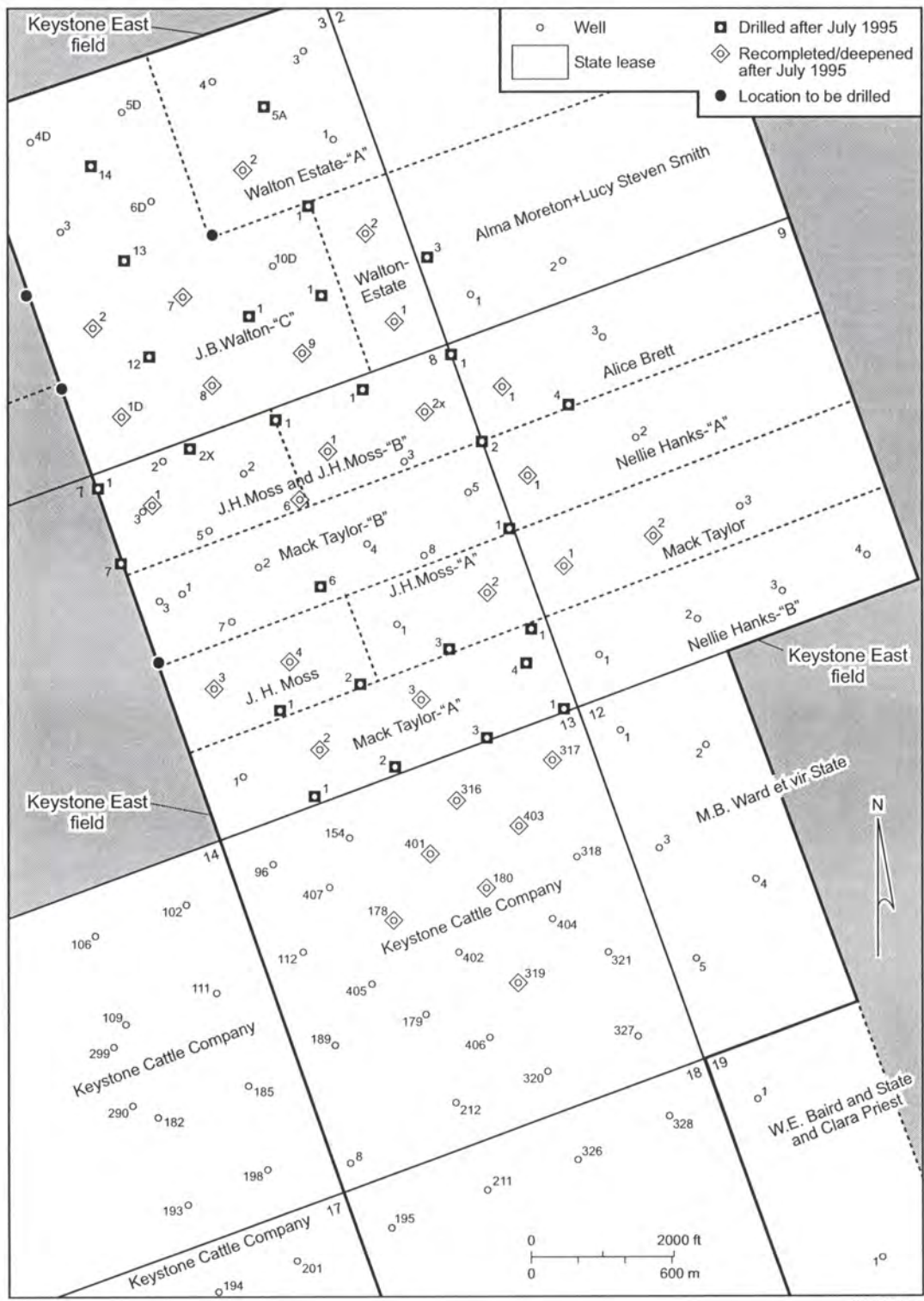
Figure B2. Histogram showing distribution of potential productivity of Ozona gas wells. Initial potential tests (IP's) are a general measure of ultimate recovery. Project STARR-recommended locations on State Lands have an average IP of 607 Mcf/d of gas versus an average of 366 Mcf/d of gas for a randomly selected group of recent Union Pacific Resources (now Anadarko) Ozona completions.

Keystone East Field Project

Keystone East field is in Winkler County on the northwest side of the Central Basin Platform (Fig. 2). Project STARR estimates the original oil in place in this field to be approximately 106 MMbbl. Cumulative production is about 19 MMbbl, or only 18 percent of the original oil in place. Recoverable future reserves are estimated to be 19 MMbbl for the total field. Project STARR work added almost 2 MMbbl of the 19 MMbbl of reserves (Tyler et al., 1998).

Project STARR provided technical support to four Texas State Lands operators in Keystone East field: Bass Enterprises, Hallwood Energy, Pioneer Natural Resources, and Vista Resources. Five wells were drilled in 1997, bringing the total new Project STARR-supported wells to 22, along with 28 recompletions (Fig. B3). This development activity has resulted in a production-rate increase of 140 percent, corresponding to a production rate of 774 bbl/d (Fig. B4). The incremental production resulting from Project STARR technology support includes 480,698 bbl of oil and 835 Mcf of gas. At average wellhead prices of \$16/bbl for oil and \$2/Mcf for gas, the State's one-eighth royalty resulted in \$1,170,146 of incremental revenue through December 1997, which was reported in a previous Project STARR report (Tyler et al., 1998). No revenue from Keystone East field is included in this current Project STARR report.

Project STARR work has focused on modeling, implementation of a secondary recovery program, and evaluation of perforation locations and pay connectivity. It is projected that secondary recovery can increase the State Lands reserve base by two-thirds in this field, which would result in a projected royalty revenue to the Texas Permanent School Fund of \$3.9 million over the lifetime of the project (Tyler et al., 1998).



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Figure B3. Location of Keystone East field in Winkler County, Texas. Project STARR development recommendations have resulted in 22 new wells and 28 recompletions.

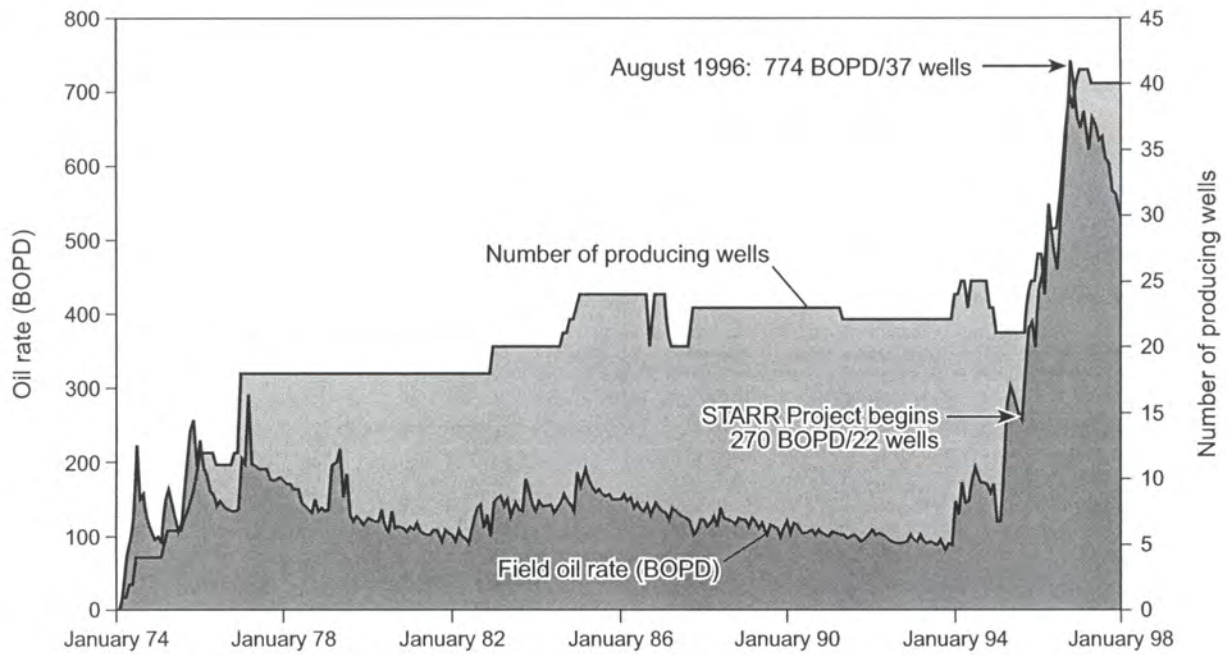


Figure B4. Production history of Keystone East field illustrating a 190 percent peak production increase since the beginning of Project STARR.

Umbrella Point Field Project

Project STARR worked with Panaco, Inc., of Houston, Texas, to improve oil and gas production from Umbrella Point field in Galveston Bay, Chambers County (Fig. 2). Previously, the operator of these State Lands leases was Goldking Oil and Gas. Umbrella Point field produces oil and gas from Gulf Coast Frio barrier island/strandplain sandstones. Cumulative production from the middle Frio at Umbrella Point field through mid-1997 was 17 MMbbl of oil and 103 Bcf of gas from 36 wells developed in 15 zones at depths from 8,000 to 10,000 ft. In late 1997, when Project STARR began work at Umbrella Point, daily production was 189 bbl of oil and 2.8 MMcf of gas from 11 completions in 10 wells.

Remaining hydrocarbons in place are estimated to be 32 MMbbl of mobile oil and 173 Bcf of gas. Project STARR recommended four infill wells and four recompletions (Fig. B5). Twenty-three prospect locations were also recommended to Panaco on the basis of their prospect criteria and Bureau mapping and 3-D seismic interpretation. Using Project STARR's interpretation of 3-D seismic data, Panaco completed an Umbrella Point gas well in the lower Frio Formation in January 1998. On initial test, the well flowed 11.5 MMcf/d of gas with 220 bbl/d of liquids. Gas production from this well has increased total field production significantly (Fig. B6). This well is a significant contribution to the Permanent School Fund, having produced 11.5 Bcf of gas and 80,000 barrels of condensate from June 1998 through November 2001. Royalty revenue to the Permanent School Fund to date from this well totals approximately \$4.1 million.

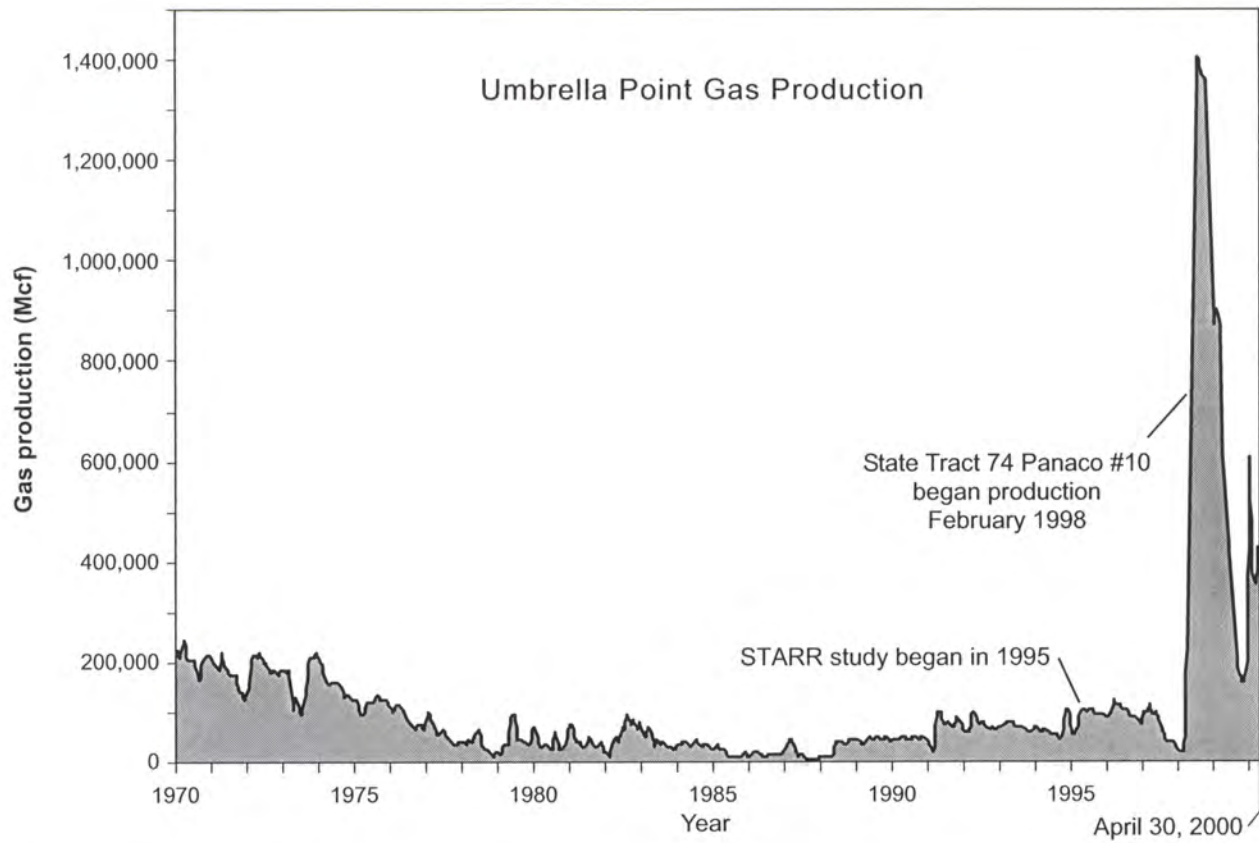


Figure B6. Umbrella Point field monthly gas production from January 1970 through April 2000.

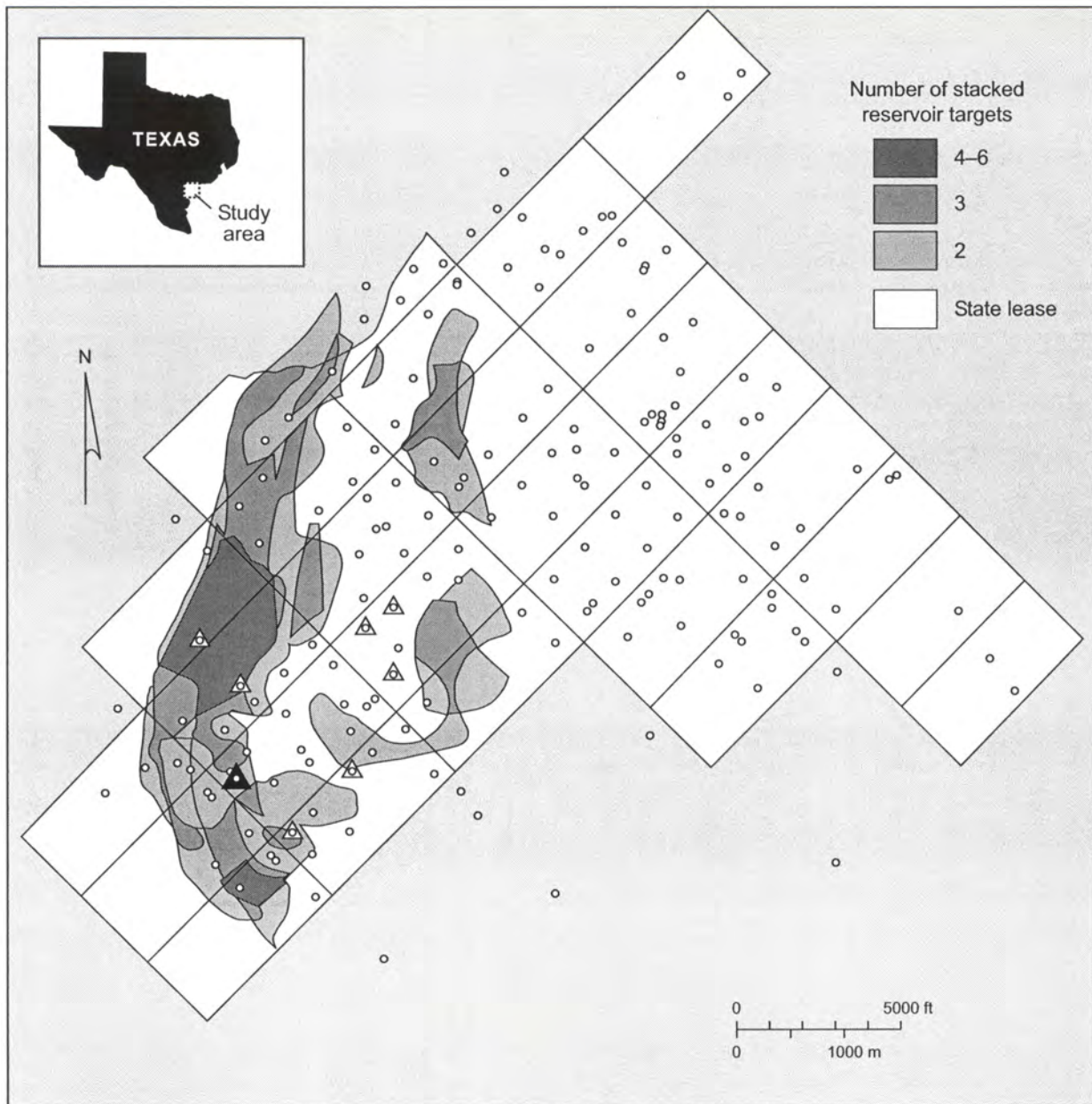
Red Fish Bay Field (Shallow Frio) Project

Red Fish Bay field, Nueces County, lies in the downdip Frio Barrier Island/Strandplain-to-Shoreface/Shelf play 5 mi southeast of Aransas Pass in Corpus Christi and Red Fish Bays (Fig. 2). Since field discovery in 1950, more than 19 MMbbl of hydrocarbon liquid and 103 Bcf of gas have been produced from 50 sandstone reservoirs in the middle to upper Frio Formation.

Nineteen upper Frio Formation reservoirs, at depths of 7,300 to 8,500 ft, account for approximately 80 percent of the field's total hydrocarbon production. Operators who considered upper Frio reservoirs to be depleted largely abandoned these reservoirs in the early 1970's. Subsurface mapping by Project STARR staff has shown that extensive areas containing thick sandstone reservoirs within the oil and gas columns remain untapped.

Project STARR identified 21 prospective oil and gas recompletion opportunities in Red Fish Bay field. There are substantial underdeveloped reservoir regions that have few wells or plugged and abandoned wells that were completed in other reservoirs. Exploitation of these areas will require drilling of infill wells. Because of the multiple stacked reservoirs in Red Fish Bay field, many infill-drilling targets overlap, and regions having as many as four to six stacked reservoirs have been delineated (Fig. B7).

Preliminary estimates of remaining hydrocarbon potential indicate that 60 MMbbl of mobile oil and 13 Bcf of gas remain in the reservoirs. Recommended recompletion and infill-drilling strategies should yield an additional estimated 7 MMbbl of oil and 5 Bcf of gas from Red Fish Bay field. In late 1997, Pi Energy performed a Project STARR-recommended recompletion that tested 200 bbl/d and was then choked back to 80 bbl/d. This recompletion represents a significant increase over the 30-bbl/d total field production that existed when the study began and increased the known reserves for the field (Tyler et al., 1998). Projected royalty revenue to the Texas Permanent School Fund from this well is \$167,000. IBC now owns the field.



- △ STARR recompletion opportunity
- ▲ STARR-recommended recompletion
- Well

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Figure B7. Proposed Project STARR infill-drilling opportunities for oil reservoirs in Red Fish Bay field, Nueces County, Texas. Optimal drilling sites contain as many as four to six stacked prospective targets.

Lundell and Forty-Nine Fields, Duval County Ranch Project

Project STARR worked with Killam Oil Co., Ltd., to seek exploration and infill-drilling opportunities in the Duval County Ranch area, Duval County, South Texas (Fig. 2). About 5,000 acres of State Lands were included in the study area, with an additional 6,000 acres available for development on the periphery of the fields. Killam Oil leased several blocks of State Lands within the area.

The study area is located between Lundell and Forty-Nine oil and gas fields on the productive Jackson-Yegua trend. Total cumulative production from the two mature fields has reached 12 MMbbl of oil and 27 Bcf of gas. The targeted reservoirs for the extended recovery program are relatively shallow—between 1,500 and 2,400 ft. Detailed geological reservoir characterization has identified the distribution, thickness, quality, compartmentalization, and trapping mechanisms of the reservoirs. Exploration and improved recovery opportunities were identified on the basis of the geological analysis.

To date, reservoir characterization has demonstrated the presence of untapped and/or bypassed oil and gas reservoirs in an area of approximately 2,000 acres. One infill-drilling location on State Lands was recommended to the operator (Fig. B8). Access to a larger database from the operator has improved geological reservoir characterization of the fields and the chances of finding additional reserves. The potential production of the new well could be comparable to that of Forty-Nine field, where drilled recommendations increased oil several tens of barrels per day.

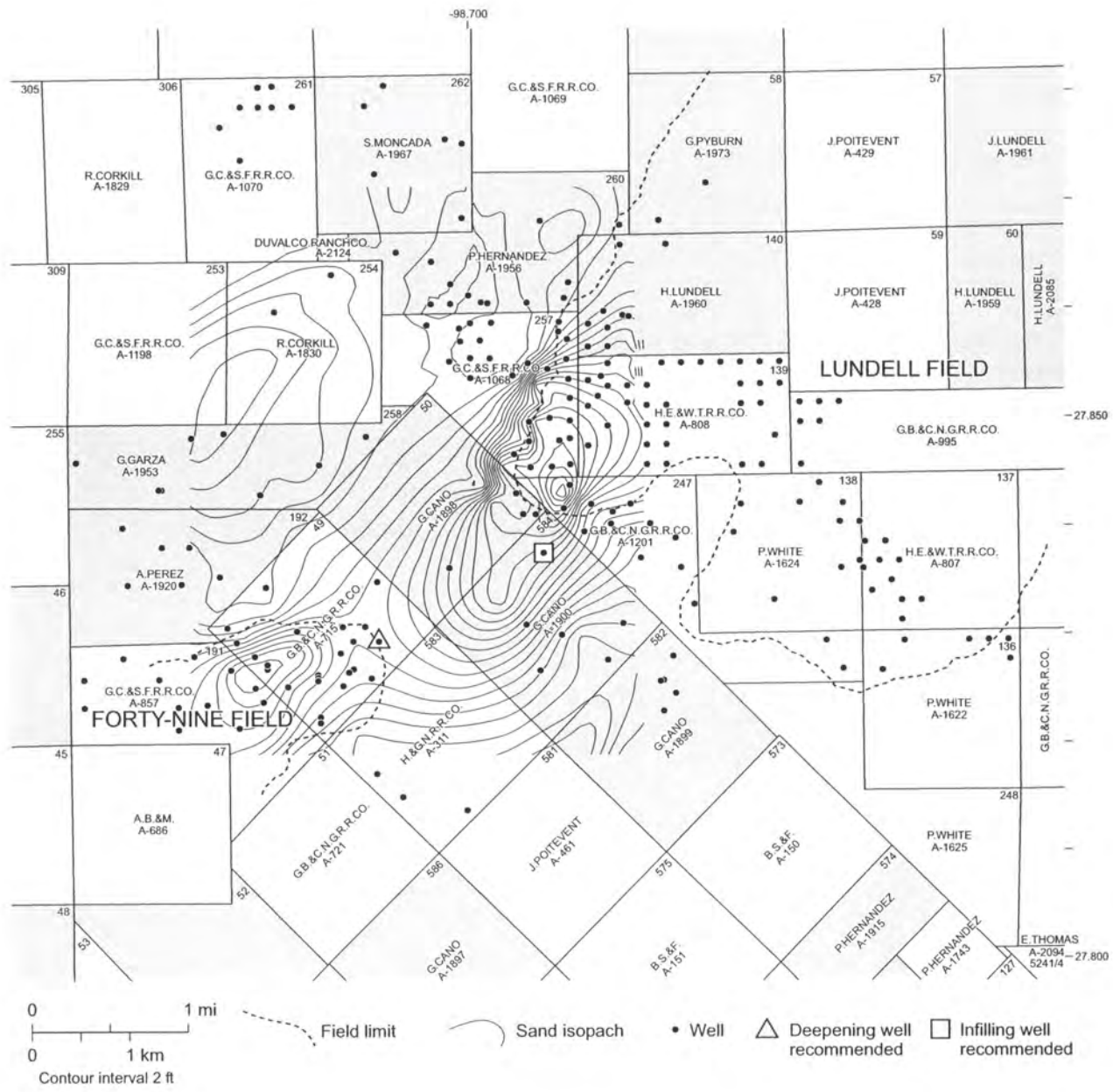
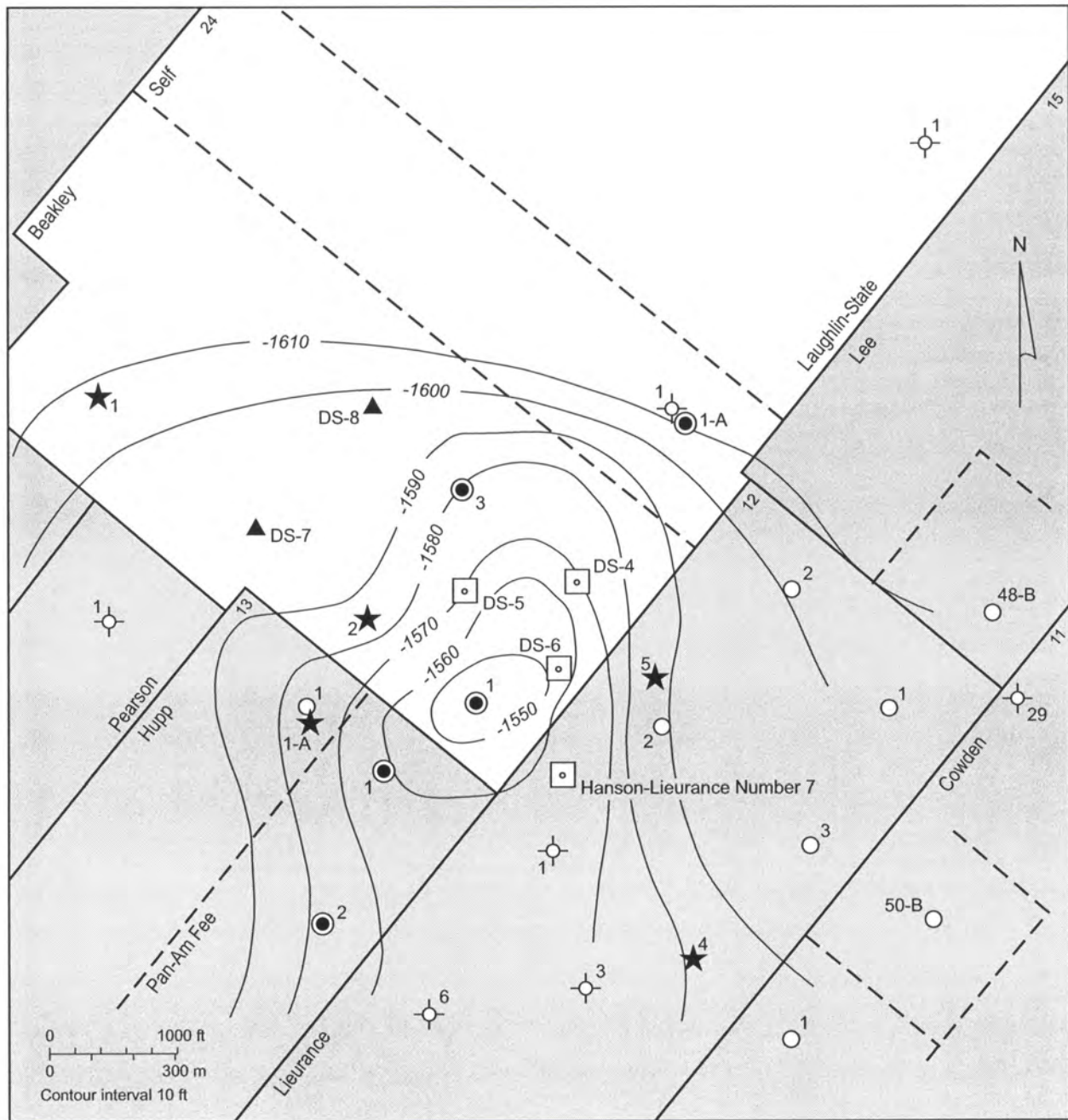


Figure B8. Location of Lundell and Forty-Nine fields, Duval County Ranch area, Duval County, South Texas. Project STARR investigation focused on the underexplored area between the two fields. Shown also is a sand-isopach map with location of Project STARR-recommended well actions resulting from preliminary geological reservoir characterization in this study.

Bar Mar Field Project

Bar Mar field is located in the southern Central Basin Platform (Fig. 2) in Crane County and is part of the West Texas Leonardian Restricted-Platform Carbonate play. Project STARR demonstrated to operators of this field that reserve additions occur in Leonardian Restricted-Platform Carbonate play reservoirs when advanced resource optimization strategies are implemented.

Project STARR provided advanced technical and engineering support to Hanson Corporation for field development and recommended a development plan for Bar Mar leases that included three infill wells, two step-out wells, and two recompletions on State Lands leases (Fig. B9). Infill wells and recompletions were targeted to increase primary recovery efficiency and to position wells for a secondary recovery project. These Project STARR recommendations generated \$67,000 of royalty revenue for the Permanent School Fund from June 1998 through March 2002.



- | | | | |
|---|-------------------|---|---------------------------|
| ▲ | Step-out location | ● | Lower Clear Fork producer |
| □ | Infill location | ⊗ | Plugged and abandoned |
| ○ | Well | □ | State lease |
| ★ | Recompletion | | |

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Figure B9. Location map of Bar Mar field, Crane County, Texas. Project STARR development plan includes three infill wells, two step-out wells, and two recompletions.



Appendix C

Project STARR Awards

Project STARR has been honored to receive several excellence in geoscience awards. These honors include Best Paper Awards at the Gulf Coast Association of Geological Societies (GCAGS) annual convention and at the West Texas Geological Society (WTGS) Fall Symposium. A Best Paper Award for “Petrophysics of the Ramsey Sandstone, Ford Geraldine Unit, Reeves and Culberson Counties, Texas” was presented to author George Asquith at the 1997 WTGS Fall Symposium, Midland, Texas; a Best Poster Award for “Project STARR—State of Texas Advanced Oil and Gas Resource and Recovery Program” was given to Roger Tyler at the 1997 GCAGS Convention, New Orleans, Louisiana; and a Best Paper Award for “Resources Optimization through Characterization of Downdip Frio Shoreface/Shelf Sandstone Reservoirs: Red Fish Bay Field, South Texas” was presented to Roger Barnaby at the 1994 GCAGS Convention, Austin, Texas.

Appendix D

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Appendix E

Project STARR Workshops and Presentations

“Project STARR—The State of Texas Advanced Resource Recovery Program”: presented by Robert Loucks at the Texas Alliance of Energy Producers Annual Convention, Wichita Falls, Texas, April 2002.

“Project STARR—The State of Texas Advanced Resource Recovery Program”: presented by Robert Loucks at the Desk and Derrick Club Annual Convention, Austin, Texas, April 2002.

“Reservoir characterization and advanced resource recovery technology on Texas State Lands”: poster session presented at the Gulf Coast Association of Geological Societies Annual Convention, Corpus Christi, Texas, October 1998.

“STARR—The State of Texas Advanced Resource Recovery Program”: presented by Roger Tyler at the Society of Independent Professional Earth Scientists (SIPES) Convention, July 23, 1998, Durango, Colorado.

“State of Texas Advanced Resource Recovery Project (STARR)”: presented by Roger Tyler at the Railroad Commission of Texas, Regional Technology Transfer Conference, Midland, Texas, May 13, 1998.

“Integrated Strategies for Carbonate Reservoir Reserve Growth: An Example from the Ellenburger Group, Permian Basin, West Texas”: presented by R. P. Major, G. B. Asquith, B. A. Cain, B. A. Hardage, D. E. Lancaster, and H. Zeng: sponsored by the West Texas Geological Society, Midland, Texas, April 23, 1998, and Houston Geological Society, Houston, Texas, June 25, 1998.

“Reservoir Characterization of Keystone East Holt field; Modeling restricted platform carbonate”: presented by Mark Holtz at the Bureau of Economic Geology Seminar, April 22, 1998.

“Slope and Basin-Floor Depositional Systems, Ozona Sandstone, Val Verde Basin, Southwest Texas”: presented by Scott Hamlin at the Bureau of Economic Geology Seminar, April 15, 1998.

“State of Texas Advanced Resource Recovery Project (STARR)”: presented by Roger Tyler at the Railroad Commission of Texas, Regional Technology Transfer Conference, Houston, Texas, April 8, 1998.

“Reservoir Characterization of Keystone East Holt field”: presented by Mark Holtz at the Southwest Section of the American Association of Petroleum Geologists, March 31, 1998, Wichita Falls, Texas.

“Reservoir characterization of a deep-water channel-levee and lobe system, Bell Canyon Formation, Ford Geraldine Unit, West Texas (Delaware Basin)”: core display presented by S. P. Dutton on February 26, 1998, at the Permian Basin Section SEPM core workshop on DOE-Sponsored Studies of Permian Producing Fields, Midland, Texas.

“Incorporation of core data into reservoir characterization of a deep-water channel-levee and lobe deposit, Ford Geraldine Unit, Delaware Basin”: core display presented by S. P. Dutton at the Sixth Archie Conference on

Improving Reservoir Productivity Using Static and Dynamic Delineation Methods, February 10, 1998, Kerrville, Texas.

“Petrophysics of the Ramsey Sandstone, Ford Geraldine Unit, Reeves and Culberson Counties, Texas”: presented by G. B. Asquith at the Permian Basin Well Log Society, January 15, 1998, Midland, Texas.

The “Reservoir Characterization Ford Geraldine Unit: Permian Bell Canyon Formation, West Texas” workshop was held on November 21, 1997, in Carlsbad, New Mexico. The workshop was followed by a two-day field trip titled “Facies Architecture of Submarine Channel-Levee and Lobe Sandstones: Permian Bell Canyon Formation, Delaware Mountains, West Texas.” The U.S. Department of Energy, the State of Texas Advanced Resource Recovery Project, and the Petroleum Technology Transfer Council jointly sponsored the workshop and field trip.

“Reservoir characterization of a deep-water channel-levee and lobe system, Bell Canyon Formation, Ford Geraldine Unit, West Texas (Delaware Basin)”: presented by S. P. Dutton to Texas Tech University, Geoscience Colloquium, November 14, 1997, Lubbock, Texas.

“State of Texas Advanced Oil and Gas Recovery Program—Project STARR”: presented by Roger Tyler at the Society of Independent Professional Earth Scientists, November 13, 1997, Austin, Texas.

“Petrophysics of the Ramsey Sandstone, Ford Geraldine Unit, Reeves and Culberson Counties, Texas”: presented by G. B. Asquith on November 12, 1997, at the Amarillo chapter of the Society of Professional Well Log Analysts, December 2, 1997, at The University of Texas at El Paso, and December 3, 1997, at New Mexico State University at Las Cruces.

“Reservoir characterization of channel-levee and lobe deposits Bell Canyon Formation, Geraldine Ford field, West Texas (Delaware Basin)”: presented by S. P. Dutton at the Bureau of Economic Geology Seminar, November 12, 1997.

“Reservoir characterization of Keystone East field, STARR Project”: presented by Mark Holtz at the West Texas Geological Society Fall Symposium, October 31, 1997, Midland, Texas.

“Methodology of 3-D computer modeling in restricted platform carbonate reservoirs, example from Keystone East Holt field”: presented by Mark Holtz at the West Texas Society of Petroleum Engineers meeting, October 2, 1997, Midland, Texas.

“Reservoir Characterization of Permian Deep-Water Sandstones, Bell Canyon Formation, Geraldine Ford Area, West Texas (Delaware Basin)” was held in Midland in March 1997. This workshop was co-hosted by the West Texas Geological Society. It was attended by approximately 90 people, who received a set of workshop notes.

“Identifying Reserve Growth Potential through Integrated Geologic and Engineering Reservoir Characterization” was held at the 1996 Annual Convention of the Gulf Coast Association of Geological Societies (GCAGS) on October 2–4, 1996, in San Antonio, Texas. The short course provided an examination of subsurface reservoir analogs to the State Lands Gulf Coast and West Texas oil and gas reservoirs.

“Canyon Sandstones—a Geologically Complex Natural Gas Play in Slope and Basin Facies, Val Verde Basin, Southwest Texas”: presented by Scott Hamlin to the South Texas Geological Society, San Antonio, Texas, March 1996.

“Origins of growth-faulted subbasins in South Texas and associated hydrocarbon reservoirs”: presented by STARR Group to Cabot Oil Co. Houston, TX., 2003.

“Origins of growth-faulted subbasins in South Texas and sequence stratigraphic analysis of the associated sediment fill”: presented by Bob Loucks at the University of Oklahoma’s Shell Oil Company Invited Colloquium series, Norman, OK, 2003.

“Identifying fault compartmentalization in the middle Frio sandstones, Redfish Bay, South Texas”: by Randy Remington to the Bureau of Economic Geology Research Seminars, 2002.

“Sequence stratigraphy of growth-faulted subbasin in the Frio Formation along south Texas Gulf Coast”: presented by Frank Brown to the Bureau of Economic Geology Research Seminars, 2003.

“STARR Program”: presented by Ramon Treviño and Ursula Hammes to the General Land Office 2003 Summer Lease Sale, 2003.

“Reservoir Characterization of the Red Fish Bay Field in the Corpus Christi Area, Oligocene Frio Formation”: presented by Ursula Hammes to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.

“Overview of the Block 889 Area, Offshore Mustang Island, Texas”: presented by Ramon Treviño to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.

“Origins of growth-faulted subbasins in South Texas and sequence stratigraphic analysis of the associated sediment fill”: presented by Bob Loucks to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.

“STARR Program”: presented by Bob Loucks to the STARR/PTTC forum at the Bureau of Economic Geology Houston Research Center, 2004.