INL/EXT-05-00660

Estimating Well Costs For Enhanced Geothermal System Applications

K. K. Bloomfield
P. T. Laney

August 2005

The INL is a U.S. Department of Energy National Laboratory
operated by Battelle Energy Alliance

INL/EXT-05-00660

Estimating Well Costs for Enhanced Geothermal System Applications

K. K. Bloomfield
P. T. Laney

August 2005

Idaho National Laboratory
Renewable Energy and Power Technologies
Idaho Falls, Idaho 83415

Prepared for the
U.S. Department of Energy
Assistant Secretary for Energy Efficiency and Renewable Energy
Idaho Operations Office
Contract DE-AC07-05ID14517

ABSTRACT

The objective of this work reported is to investigate the costs of drilling and completing wells and to relate those costs to the economic viability of enhanced geothermal systems (EGS). This is part of a larger parametric study of major cost components in an EGS. The possibility of improving the economics of EGS can be determined by analyzing the major cost components of the system, which include well drilling and completion. Determining the sensitivity of EGS cost components will help to identify areas of research to reduce those costs. The results of this well cost analysis will help quantify well development cost for EGS.

ACKNOWLEDGEMENT

This work was supported by the U.S. Department of Energy, Assistant Secretary for Energy Efficiency and Renewable Energy under DOE Idaho Operations Office Contract DE-AC07-05ID14517. Such support does not constitute any endorsement by the U.S. Department of Energy of the views expressed in this publication.

CONTENTS

FIGURES

TABLES

Estimating Well Costs for Enhanced Geothermal System Applications

1. INTRODUCTION

Enhanced geothermal system (EGS) reservoir performance is controlled by the interplay of a complex set of parameters: reservoir, geologic, drilling, well completion, plant design, and operation. In order to identify, analyze, and mitigate the economic risks of any EGS prospect, one must first understand the relative importance of each of these parameters, how its relative importance changes under different constraints, and how they interactively affect EGS production. To date, no comprehensive parametric study on EGS is known to have been conducted within the industry. U.S. industry has not conducted a comprehensive study because it considers EGS an emerging technology. The parametric studies reported in the literature have only considered a limited set and range of parameters, thus potentially skewing their results.

To better understand EGS economics, the U.S. Department of Energy (DOE) has commissioned the Idaho National Laboratory to conduct a parametric study of EGS's major cost components and establish a baseline of information relating to EGS development costs. The drilling study reported in this document is part of that overall parametric study, undertaken to determine the relationship between available energy at depth (temperature gradient, flow rate and energy conversion efficiency), and energy costs with depth (drilling and pumping costs).

The amount of work that can be extracted from a geothermal fluid and the rate at which this work is converted to power increase as the fluid's temperature increases. The relationships between temperature and work (ideal or actual) illustrate the preference for higher fluid temperatures. Since drilling costs per foot generally increase with depth, and temperature gradients are at best linear with depth (if not slightly decreasing), it is apparent that at some depth the increase in temperature does not warrant increased drilling costs. Drilling cost results published to date are based on assumed relationships between drilling costs and depth that have no statistical basis and only illustrate the impact that drilling costs will have on the ability to access higher-temperature EGS resources. This indicates the need to know the precise relationship between drilling costs and depth. Once that relationship is established, a more realistic evaluation can be made one that incorporates these costs. Because pumping costs from increased lift and greater frictional loss with length of wellbore increase with depth, and parasitic load impacts power generation potential as well, all must be included in a study of comprehensive cost of EGS power versus depth.

Our first goal is to assemble reasonable drilling-costs-with-depth formulae for various regions of the United States and couple them with energy-recovery-with-depth as they relate to regional temperature gradients. Additional controls on the economic depth relationship will be the selling price of energy produced and the flow rate of each well. Obviously, higher gradient areas and areas with relatively low drilling costs have greater interest.

1.1 Regional Drilling Costs

To determine the areas from which to collect historical drilling costs, we used the nation-wide 4- and 6-km temperature gradient data developed by the Southern Methodist University Geothermal Laboratory and maps prepared by Idaho National Laboratory (Figures 1 and 2).

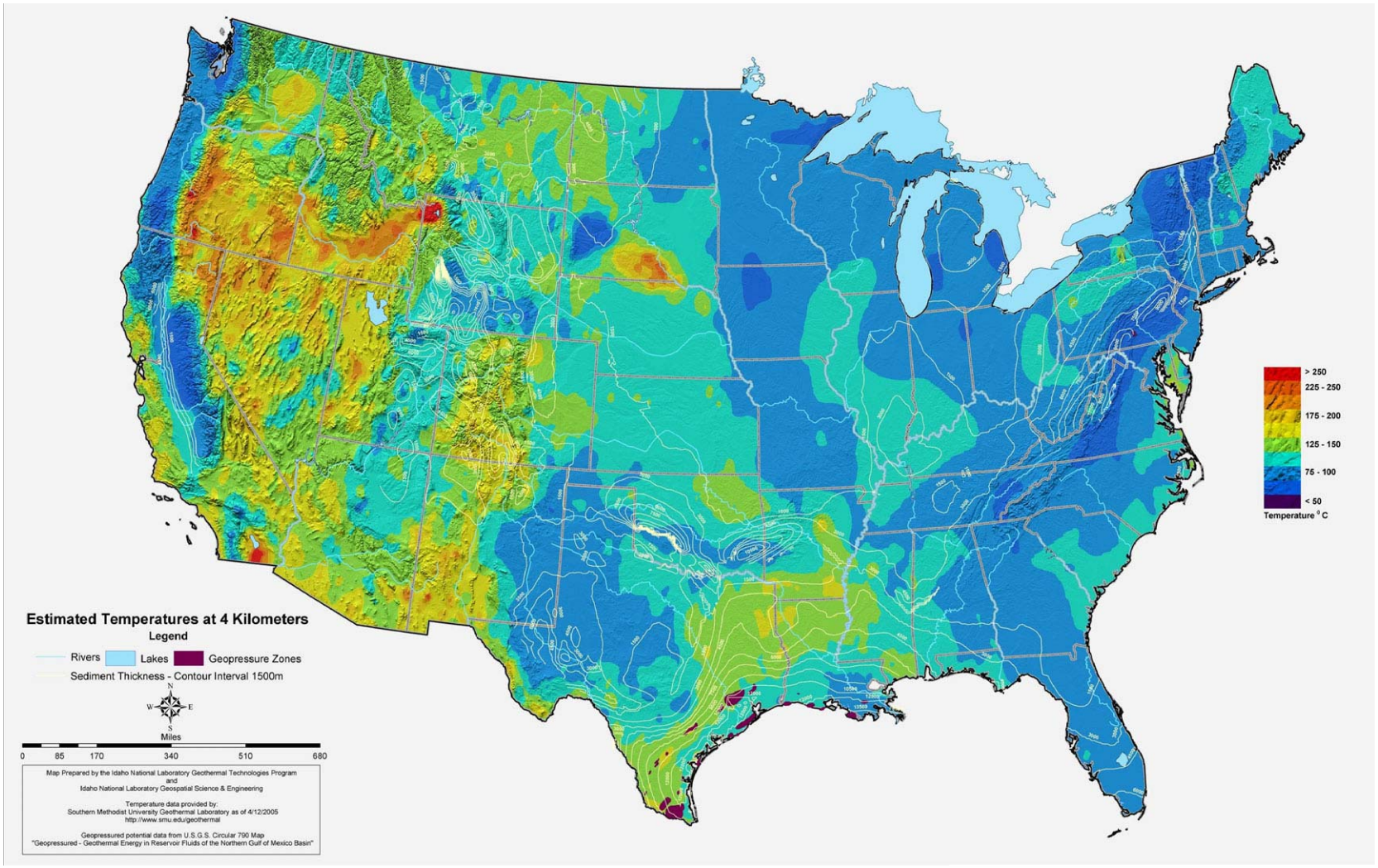


Figure 1. Estimated temperatures at 4 km [based on data from Blackwell and Richards (2004), Southern Methodist

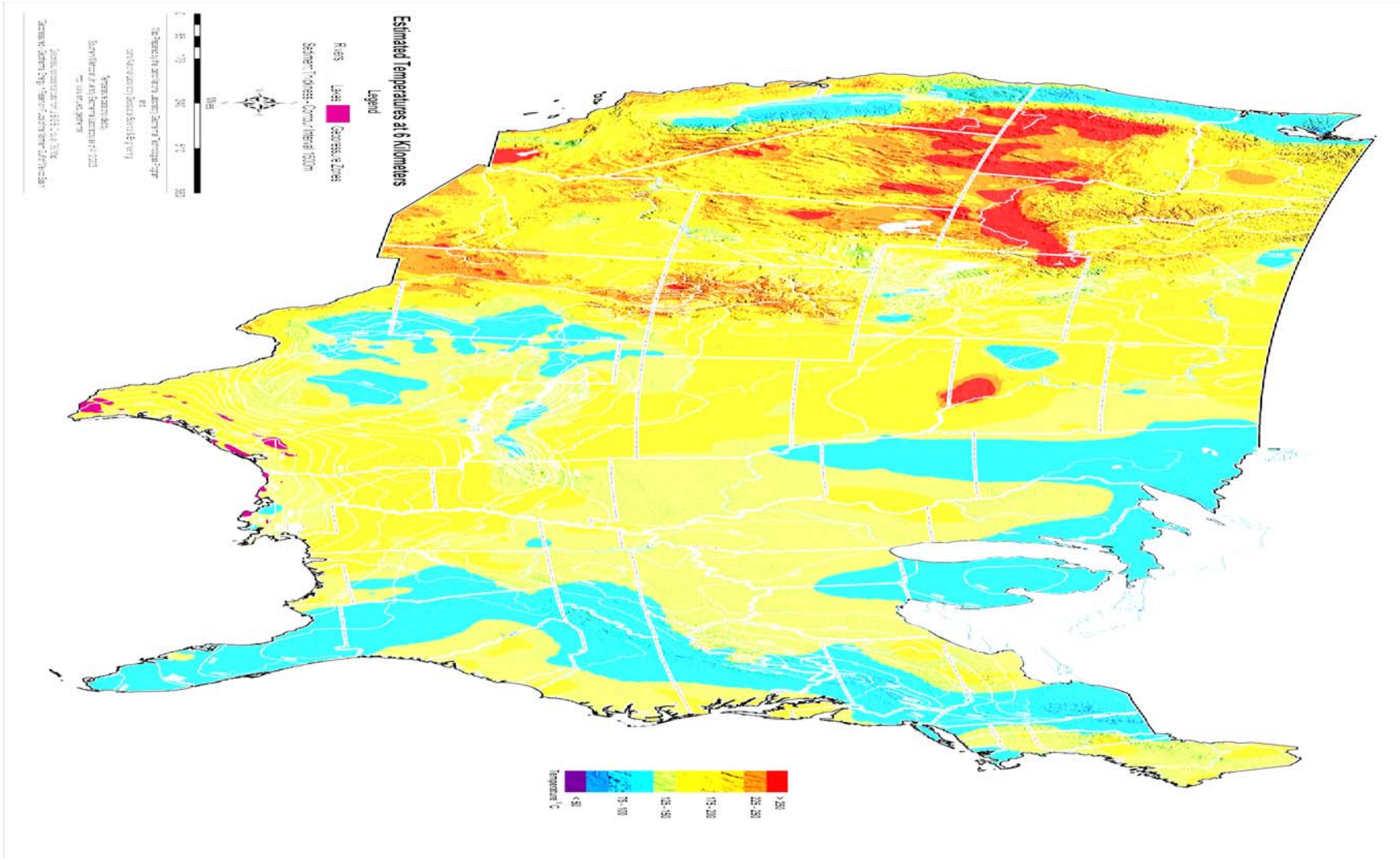


Figure 2. Estimated temperatures at 6 km [based on data from Blackwell and Richards (2004), Southern Methodist

Based on the information from these maps and temperature data, this study was limited to areas in the Western, Mid-continent, and Southern United States. These areas have the greatest potential for early success with EGS technology. Alaska and Hawaii were not included in this drilling study. And because several geothermal operators with proprietary concerns limited the availability of geothermal drilling data in many of these areas, we chose to concentrate on the vast drilling dataset from the oil and gas industry.

We have also incorporated, however, some specific geothermal drilling data from studies by Lovekin and Mansure. Table 1 summarizes depth and cost data representative of geothermal wells completed between 1997 and 2000 in Central America and the Azores (Lovekin et al. 2004). To escalate these prices to account for inflation, the costs of all wells have been escalated to equivalent U.S. dollars as of 1 July 2003, using the Producer Price Index. Figure 3 is a curve fit to the data in Table 1.

Table 1. Drilling costs from 1997 to 2000 for Central America and the Azores.

Depth Interval (ft)	Number of Wells	Total Footage	Total Cost ($K)	Average Depth (ft)	Average Cost/Well ($K)	Median Cost/Well ($K)
0–1,249	1	679	280	679	280	280
1,250–2,499	8	15,692	10,415	1,961	1,302	1,258
2,500–3,749	0	0	0	0	0	0
3,750–4,999	5	21,535	10,857	4,307	2,171	2,148
5,000–7,499	24	139,757	65,081	5,823	2,712	2,482
7,500–9,999	20	167,065	68,834	8,353	3,442	3,453
10,000–12,499	3	32,968	11,495	10,989	3,832	3,913
12,500–14,999	0	0	0	0	0	0
15,000–17,499	0	0	0	0	0	0
17,500–19,999	0	0	0	0	0	0
20,000+	0	0	0	0	0	0
Total	61	377,696	166,962	6,192	2,737	2,577

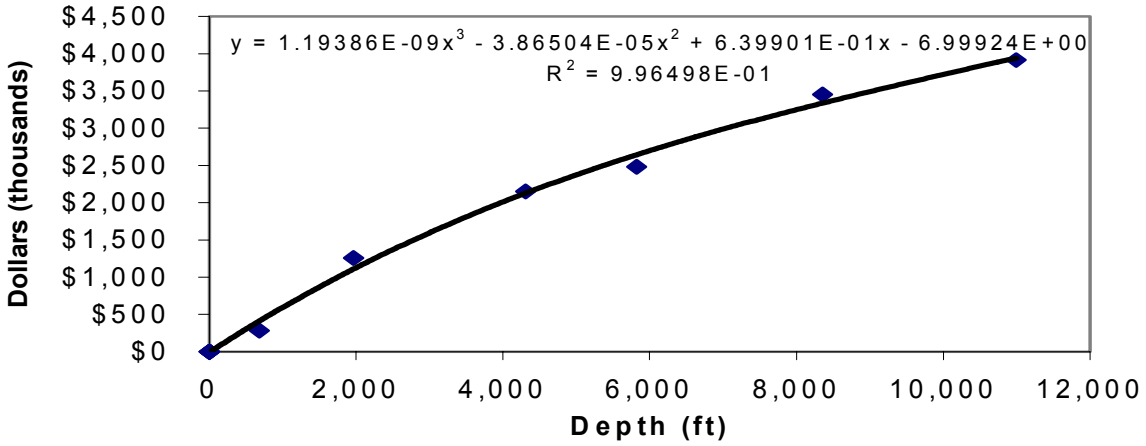


Figure 3. Average depth versus median cost from Table 1 for geothermal wells in Central America and the Azores from 1997-2000 (from Table 1 data).

Other data available from Sandia National Laboratory (Mansure et al. 2005) show geothermal drilling costs from the 1970s and activity from the mid 1980s through mid 1990s and inflated those cost to 2000. Table 2 presents the 1970 geothermal drilling costs. Table 3 presents the most recent mid 80s to mid 90s Sandia drilling data. Both sets of data combined represent less than 100 wells drilled.

Table 2. Geothermal drilling costs from the 1970s.(in year 2000 dollars)

Depth Interval (ft)	Number of Wells	Total Footage	Total Cost ($K)	Average Depth (ft)	Average Cost/Well ($K)	Median Cost/Well ($K)
0–1,249	0	0	0	0	0	0
1,250–2,499	4	7,460	1,908	1,865	477	369
2,500–3,749	6	18,086	7.615	3,014	1,269	1,254
3,750–4,999	9	42,732	10,677	4,748	1,186	792
5,000–7,499	25	151,033	48,985	6,041	1,959	1,800
7,500–9,999	11	94,996	27,385	8,636	2,490	2,415
10,000–12,499	4	40,994	15,676	10,249	3,669	3,538
12,500–14,999	0	0	0	0	0	0
15,000–17,499	0	0	0	0	0	0
17,500–19,999	0	0	0	0	0	0
20,000+	0	0	0	0	0	0
Total	59	355,301	111,246	6,022	1,886	1,792

Table 3. Geothermal drilling costs from the mid 1980s through mid 1990. (in year 2000 dollars)

Depth Interval (ft)	Number of Wells	Total Footage	Total Cost ($K)	Average Depth (ft)	Average Cost/Well ($K)	Median Cost/Well ($K)
0–1,249	0	0	0	0	0	0
1,250–2,499	0	0	0	0	0	0
2,500–3,749	0	0	0	0	0	0
3,750–4,999	0	0	0	0	0	0
5,000–7,499	3	19,863	4,014	6,621	1,338	1,472
7,500–9,999	17	150,297	33,684	8,841	1,981	1,892
10,000–12,499	5	52,174	8,828	10,435	1,766	1,875
12,500–14,999	0	0	0	0	0	0
15,000–17,499	0	0	0	0	0	0
17,500–19,999	0	0	0	0	0	0
20,000+	0	0	0	0	0	0
Total	25	222,334	46,526	8,893	1,861	1,792

The Oil and Gas drilling data presented in this paper represent more than 150,000 wells drilled in the Western, Midcontinent, and Southern United States. It includes parts of West and Central Texas (Texas Railroad Commmission Districts 2, 3, 4, 8, and 8A) to represent the higher-temperature anomalies in West Texas as well as the geopressured fairway in South Texas. Drilling data from parts of Arkansas and Northern Lousiana were also examined. More importantly, the areas surveyed and the cost data analyzed would be more representative of an EGS project in the future, since a goal of the Geothermal Technology

Program (GTP) is to increase the number of states with geothermal power by moving to areas not traditionally considered as prospective geothermal areas. The western states surveyed are California, Colorado, Montana, New Mexico, Texas District 8 and 8a, Utah, and Wyoming. Nevada drilling data were not available but drilling costs are assumed to be comparable with Utah's. Other states included in this report are Kansas, Oklahoma, and North Dakota, which allowed the study to increase the samples in the data sets for the median and deeper depths of 10,000 to 20,000 feet for comparison with states most likely to construct an EGS project. The majority of the data reported here are historical oil and gas drilling costs from *Oil & Gas Journal* and the most recent *2003 Joint Association Survey on Drilling Costs,* issued in March 2005. In addition, Appendix A presents some Authority for Expenditures (AFEs), which provide a more detailed picture of drilling costs for some wells in Texas, Oklahoma, and Montana drilled in the last six months or scheduled for drilling shortly. Because of the proprietary nature of the JAS survey data, we do not provided the detailed tables of data but rather data that has been analyzed and graphed. The data presented in the graphs includes the depth in feet and costs in thousands of dollars.

From the historical data, it is apparent that drilling activity (rig demand) drives drilling costs. The level of activity accounts for a large percentage of drilling cost changes. Hence, costs can be expected to rise as activity levels increase, particularly during short-term, cyclical activity spikes (OGJANN). Figure 4 illustrates the median costs of a 10,000-ft well from 1970 through 2001 and the cyclical pattern of those costs.

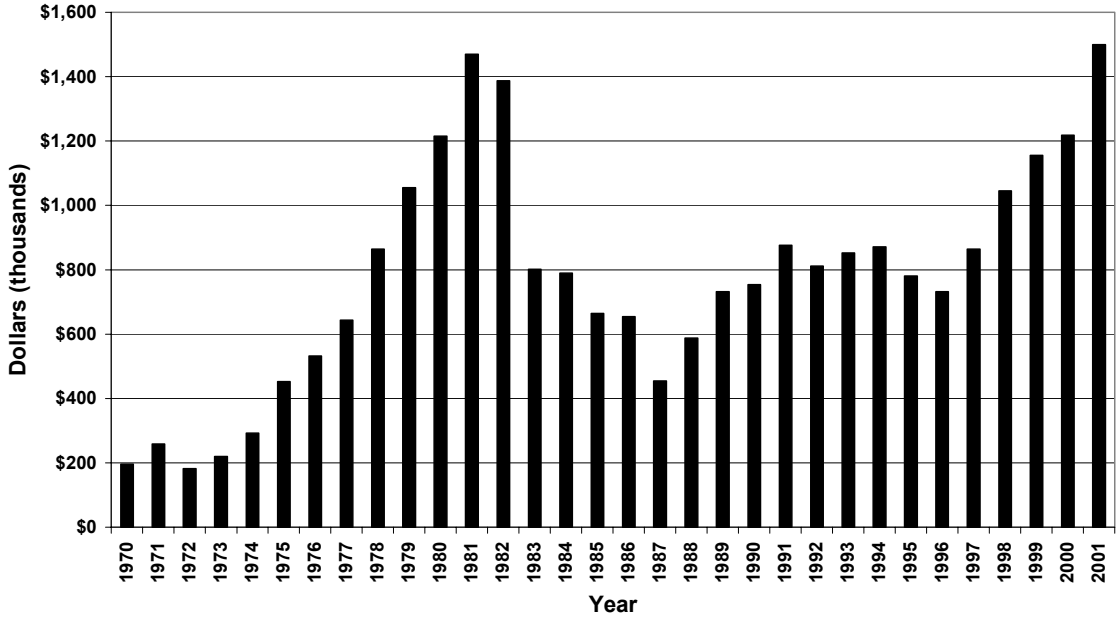


Figure 4. Cyclical example of the cost of drilling a 10,000-ft well. (these costs are not normalized to 2003 dollars)

Increases in oil/gas prices translate directly into higher drilling costs. Rising prices spur drilling of additional marginal wells. These drive up costs because they are more challenging projects. Higher prices also increase drilling costs because energy costs are a major component of total drilling costs, which include such material costs as casing, cement, and transportation to deliver materials to the drilling site.

U.S. onshore rig counts have been declining since 1981. Declining rig population creates a tighter rig market. Until day rates increase sufficiently to justify investment in construction, the market will continue to become tighter. Ultimately, this will lead to higher rates and drilling costs. A tight market is needed

over a sustained period to achieve day rates that justify new equipment. In a tight market, day rates are likely to increase until they reach levels that trigger new equipment investments.

Advances in drilling technologies have increased (and will continue to increase) efficiencies, resulting in lower overall costs. These gains mean rates will reflect the benefits/costs of advanced technology in most cases. However, new technologies could produce higher day rates for certain rigs, which provide offsetting benefits by requiring fewer drilling days.

The *2003 Joint Association Survey of Drilling* costs report the total cost of each well completed by the operator or contractor. This includes tangibles and intangibles. More specifically, the cost elements include labor, materials, supplies, water, fuel, and power. Direct overhead charges are also included for operations, such as site preparation, road building, mobilization, and demobilization and hauling costs. This report does not include wells that involved sidetracking operation. The drilling cost data also includes the cost of horizontal wells. The JAS survey does differentiate from the higher concentration of horizontal wells in Texas, Louisiana, and the Gulf of Mexico. These areas accounted for one fourth of the horizontal wells drilled. The average cost of per foot for a horizontal well was 17% higher than a well not drilled horizontally. Horizontal drilling averaged $254/ft verses $217/ft for a standard hole.

2. DISCUSSION

The objective of drilling is to reach the target depth or pay zone at the lowest cost, highest degree of safety, and minimal degree of damage to formation. To achieve this, two requirements must be satisfied. The first is proper design of the well program, which includes evaluating the formation, coring, and testing. The second is proper choice of a drilling rig, which includes the ability to reach the target depth rapidly and cheaply with the highest degree of safety. The well program is 40% of the well costs (Chilingarian and Vorabutr 1983). The remainder of the cost is proportional to the time for drilling, which includes rig day rate, rental tools, etc. A distribution of the well program cost follows:

1. Fixed costs, which includes location or site preparation and roads: 8–12%
2. Fixed costs, which includes moving, casing, cementing, service companies, evaluation of formation, coring, etc.: 23–27%
3. Completion, which includes perforating and site cleanup: 4–6%.

Proper planning of the well is key to optimizing operations and minimizing expenditures. In order to minimize the costs of drilling, it is imperative to gather as much information as possible about the area being drilled. This includes the gathering the costs from surrounding wells. Although gathering specific costs of drilling is beyond the scope of this project, a short summary is included to detail what information should be gathered before a drilling venture is undertaken.

The first step in planning a well is to gather all available data on past wells. It is important to be completely familiar with all sources of information, the availability of the sources, and the information normally associated with the sources.

Consider the geology expected to be encountered to reach the target depth. Knowing the geology will help determine casing depths, such as the depth of fresh water. Competent geology will determine surface casing requirements. Understand the production objective of the well, such as hole size, production casing requirements, and completion requirements. Know the geologic markers, along with the anticipated formation tops, to determine other well planning activities such as logging, formation testing, and cores.

The information to successfully complete the well program can be obtained from an adjacent well or “control wells.” Obtain such information as mud logs, electric logs, bit records as well as drilling rig inventory where available to determine the most cost-effective procedures in drilling a well.

3. PLOTS

The plots and curve fits for the different regions and states are presented as average depth verses median cost. The median cost was chosen because the average cost per well was not always a good representation of the central tendency of the depth interval. For example, a few very expensive wells can skew the average toward higher cost and away from the middle range of data. The result would be an average cost higher than the cost of a typical well. The median cost per well is unaffected by very high or low cost. By definition, the median of a set of data is the data point that divides the set in half so that an equal number of the data points are both larger and smaller than the median. Since these well costs were drilled in 2003, results are expressed in 2003 dollars.

The basic idea of curve fitting and statistics is simple: you want to utilize the data you collected to make general conclusions about the larger population from which the drilling cost were derived. That is, analyze this drilling depth and cost data and use the results to infer the cost with depth.

Appendix B presents a series of plots for each region and state studied. Data are presented with curve fits for the total range of depths for each state and then curve fitted in increments from 0 to 8,000 ft average depth and 8,000 to 20,0000 ft average depth. Three sets of curve fits for cost verses depth are presented in the appendix. The curve fits are polynomial, exponential, and power type.

3.1 Polynomial Curve Fitting

Polynomial regression fits data to the following equation: $y = A + Bx + Cx^2 + Dx^3 + Ex^4 .....$ where *y* is cost and *x* is depth. Any number of terms can be included. If you stop at the second (B) term, it is called a first-order polynomial equation, which is identical to the equation for a straight line. If you stop after the third (C) term, it is called a second-order, or quadratic, equation. If you stop after the fourth term, it is called a third-order, or cubic, equation.

Correlation quantifies how consistently the two variables vary together. When the two variables vary together, statisticians say that there is a lot of correlation. The direction and magnitude of correlation is quantified by the correlation coefficient, R. The polynomial curve fits displayed the best correlation for or regression for most of the oil and gas cost data. For specific details see curve fits in appendix B.

3.2 Exponential Curve Fitting

The exponential growth curve fit is also used to fit the cost versus depth data. The exponential growth fits data to the equation $y = Ae^{Bx}$. It is difficult to fit data to this equation with nonlinear regression because a tiny change in the initial values will drastically alter the sum of squares.

3.3 Power Series Curve Fitting

The power series curve fit defined by the equation $y = Ax^B$ is very versatile and has many uses. Fitting data to a power series is difficult for the same reason as exponential growth. The initial values of A and B are important, because small changes in those values can make a huge change in *y* or well cost.

4. CONCLUSIONS

A review of drilling costs with depth has been generated for regions and states of potential EGS sites. Publicly available geothermal drilling cost data are very limited. Geothermal drilling cost information for depths greater than 10,000 feet is so limited as to make it statistically unreliable for cost estimating purposes. Since EGS development might occur at depths greater than 10,000 feet, references to oil and gas drilling costs should be considered when determining an EGS project cost and the economics of power production from these depths and reservoir types.

5. REFERENCES

2003 Joint Association Survey on Drilling Costs, 2005, American Petroleum Institute.

Chilingarian G., and R. Vorabutr 1983, Drilling and Drilling Fluids, Appendix G, New York, Amsterdam: Elsevier, p.765–778.

Blackwell D., and M. C. Richards 2004, "The 2004 Geothermal Map of North America, Explanation of Resources and Applications," *Geothermal Resource Council Transactions*, Vol. 28, pp. 317–320.

Lovekin J., C. W. Klein, and S. K. Sanyal 2004, *New Geothermal Site Identification and Qualification*, California Energy Commission, P500-04-051, p. 29.

Mansure A., S. J. Bauer, B. J. Livesay, 2005, "Geothermal Well Cost Analyses 2005," *Geothermal Resource Council Transactions*, Vol. 29, in press.

Moore P. L., *Drilling Practices Manual*, Tulsa, Oklahoma: PennWell Books, 1974, pp. 3–72.

Oil and Gas Journal Annual, Haver Analytics, April 19, 2004, http://www.Haver.com.

Appendix A

Authority for Expenditures

Appendix A

Drilling Authority for Expenditure: Examples

In order to put the *2003 Joint Association Survey on Drilling Costs* information in perspective, we compare it to some current drilling cost information. This appendix presents eight Authority for Expenditures (AFEs) prepared by a drilling engineer for wells that have been or will be drilled in 2005. Because of the proprietary nature of these cost data, some of the descriptive information (i.e., lease/well name, operator, location, etc.) has been removed, but none of the information used to calculate the cost has been changed or removed.

The AFEs include both oil and gas wells, a directionally drilled well, and a multilateral completion. The wells are in Texas, Oklahoma, and Montana and range in depth from 900 to 13,200 feet (274 to 4,023 meters). Data in the AFEs include cost for items such as surveying, rig mobilization, drilling day work, bits, logging, casing, perforating, etc. Each AFE has three pages: a cover sheet, a drilling well cost estimate, and a completion cost estimate.

Location: Hill Co., MT; Well Type: Gas; Total Depth: 900 ft (274 m)

Date: 3/1/2005
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well:
Project ID:
Field Prospect:
Region: Havre
Location:
County/State: Hill County, MT

AFE Type: Capital Original ___ Supplement ___ Addendum X API Well Type 5
Operator: Inside PA_
Objective Formation: Eagle Auth. Total Depth (Feet): 900'
Project Description: Drill and Complete shallow gas well

Estimated Start Date:
Prepared By:
Estimated Completion Date:

GROSS WELL DATA

	Drilling		Completion		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	2				2
This AFE:	$86,797		$39,600	$53,592	$179,989
Prior AFE's:	$10,000				$10,000
Total Costs:	$96,797		$39,600	$53,592	$189,989

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	72.0000%	$62,493	$129,592
	3.0000%	$2,604	$5,400
	25.0000%	$21,699	$44,997
AFE TOTAL:	100.0000%	$86,797	$179,989

INTERNAL APPROVAL

Recommended: Approvals:

Engineering: ___ Date: ___ SVP Operations: ___ Date: ___

Geology: ___ Date: ___ SVP Asset Mgmt: ___ Date: ___

Land: ___ Date: ___ SVP BD&P ___ Date: ___

Drilling: ___ Date: ___ President: ___ Date: ___

PARTNER APPROVAL

Company Name: ___

Authorized By: ___ Date: ___

Title: ___

DRILLING WELL COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 3/1/2005

COUNTY/STATE: Hill County, MT | APPROVED BY: | DATE:

PROPOSED TOTAL DEPTH: 900' | AFE TYPE: Capital

PROPOSED TOTAL LATERAL: NA

		AFE NOMENCLATURE		DRYHOLE COST		SUSPENDED COST
		INTANGIBLE DRILLING COST DAYS: 2				
930	02	STAKING, SURVEY & PERMITS	02	$1,000	02	
930	04	ROAD & SITE PREPARATION	04	$2,300	04	
930	06	LEGAL & LANDMAN	06		06	
930	07	RIG MOBILIZATION / DEMOBILIZATION	07	$5,000	07	
930	08	DRILLING - TURNKEY	08		08	
930	10	DRILLING - FOOTAGE	10		10	
930	11	DRILLING - DAYWORK	11	$30,000	11	
930	12	WATER & WATER HAULING	12	$1,500	12	
930	13	FUEL & POWER	13	$3,500	13	
930	14	CASING TOOLS / SERVICES	14	$800	14	
930	15	BITS & REAMERS	15	$12,000	15	
930	18	CEMENT & CEMENTING SERVICES	18	$2,500	18	
930	20	MUD & CHEMICALS	20	$2,000	20	
930	25	DST / CORING / WIRELINE TESTS	25		25	
930	30	LOGGING - OPEN HOLE	30	$9,000	30	
930	34	GEOLOGICAL & ENGINEERING	34		34	
930	36	DIRECTIONAL SERVICES	36		36	
930	52	ENVIRONMENTAL COSTS	52	$1,000	52	
930	53	INSURANCE	53	$2,000	53	
930	70	TRANSPORTATION	70	$1,000	70	
930	75	CONTRACT LABOR & SERVICES	75	$1,000	75	
930	80	TOOL & EQUIPMENT RENTAL	80	$1,000	80	
930	88	PLUGGING	88		88	
930	90	DAMAGES	90	$2,200	90	
930	91	DRILLING SUPERVISION	91	$3,000	91	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$4,000	95	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD	96		96	
930	98	NON-OPERATED IDC	98		98	
935	10	DRILLING / WORKOVER OVERHEAD	10		10	
		TOTAL INTANGIBLE DRILLING COST		$84,800		
		TANGIBLE DRILLING COST				
950	01	CONDUCTOR CASING	01		01	
		ft. of in. #/ft. /ft.				
950	03	SURFACE CASING	03	$1,997	03	$1,997
		150 ft. of 7 in. 17.00 #/ft. $13.31 /ft.				
		ft. of in. #/ft. /ft.				
950	06	INTERMEDIATE CASING	06		06	
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
		TOTAL TANGIBLE DRILLING COST		$1,997		$1,997
		TOTAL DRILLING COST ESTIMATE		$86,797		$1,997

COMPLETION COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 3/1/2005

LOCATION: | APPROVED BY: | DATE:

COMPLETION FORMATION: Eagle | AFE TYPE:

		AFE NOMENCLATURE		ESTIMATED COST
		INTANGIBLE COMPLETION COSTS		
940	04	SITE PREPARATION & CLEAN UP	04	$4,500
940	10	COMPLETION UNIT	10	$4,000
940	11	DRILLING RIG	11	
940	12	WATER & WATER HAULING	12	$400
940	14	CASING TOOLS / SERVICES	14	$1,000
940	15	BITS & REAMERS	15	
940	18	CEMENT & CEMENTING SERVICES - PRIMARY	18	$4,700
940	20	DIRECTIONAL SERVICES	20	
940	30	LOGGING & PERFORATING	30	$7,500
940	44	ACIDIZING & FRACTURING	44	$10,000
940	46	PUMP TRUCK SERVICES	46	
940	47	SAND CONTROL	47	
940	48	SQUEEZE CEMENTING	48	
940	52	ENVIRONMENTAL COSTS	52	
940	53	INSURANCE	53	
940	70	TRANSPORTATION	70	$1,000
940	75	WIRELINE SERVICES	75	
940	80	TOOL & EQUIPMENT RENTAL	80	
940	85	CONTRACT LABOR & SERVICES	85	$1,000
940	92	COMPLETION SUPERVISION	92	$1,500
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$4,000
940	98	NON-OPERATED ICC	98	
		TOTAL INTANGIBLE COMPLETION COST		$39,600
		TANGIBLE COMPLETION COST		
955	02	CASING HEAD	02	$1,600
955	04	DIRT & DOZER WORK	04	
955	05	PRODUCTION CASING	05	
		1,200 ft. of 4-1/2 in. 9.50 #/ft. $6.66 /ft.		$7,992
		ft. of in. #/ft. /ft.		
		ft. of in. #/ft. /ft.		
955	06	LINER	06	
		ft. of in. #/ft. /ft.		
955	07	INTERMEDIATE CASING	07	
		ft. of in. #/ft. /ft.		
		ft. of in. #/ft. /ft.		
955	10	WELL SERVICE UNIT	10	
955	12	TUBING HEAD	12	$1,500
955	14	TUBING	14	
		1,000 ft. of 2-3/8 in. 4.70 #/ft. $3.00 /ft.		$3,000
		ft. of in. #/ft. /ft.		
955	16	RODS	16	
		ft. of in. /ft.		
		ft. of in. /ft.		
		ft. of in. /ft.		
		ft. of in. /ft.		
955	17	WELLHEAD EQUIPMENT	17	
955	18	SUBSURFACE EQUIPMENT		
955	20	PUMPING UNIT	20	
955	22	ENGINE	22	
955	24	MOTOR	24	
955	25	PUMPS	25	
955	26	ELECTRICAL EQUIPMENT	26	
955	30	STORAGE TANKS	30	
955	34	TREATING EQUIPMENT	34	
955	36	DEHYDRATION EQUIPMENT	36	
955	38	SEPARATION EQUIPMENT	38	$10,000
955	40	COMPRESSION	40	
955	50	FITTINGS, CONNECTIONS & VALVES	50	
955	55	LINE PIPE	55	$20,000
955	60	GAS MEASUREMENT EQUIPMENT	60	$2,500
955	65	GAS INJECTION EQUIPMENT	65	
955	70	TRUCKING	70	
955	85	ROUSTABOUT & GENERAL LABOR	85	$2,000
955	95	MISCELLANEOUS	95	$5,000
955	96	PROPERTY ACQUISITION	96	
955	98	NON-OPERATED EQUIPMENT COSTS	98	
		TOTAL TANGIBLE COMPLETION COST		$53,592
		TOTAL COMPLETION COST ESTIMATE		$93,192

Location: Crane Co., TX (Dist 8); Well Type: Gas; Total Depth: 3,400 ft (1,036 m)

Date: 3/15/2005
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well:
Project ID:
Field Prospect: Sand Hills (McElroy)
Region: Permian
Location:
County/State: Crane Texas

AFE Type: Capital
Original X Supplement ___ Addendum ___ API Well Type 6
Operator:
Inside PA_
Objective Formation: McElroy
Auth. Total Depth (Feet): 3400
Project Description: D&C McElroy gas producer then equip

Estimated Start Date: 6/26/2005
Prepared By:
Estimated Completion Date: 7/11/2005

GROSS WELL DATA

	Drilling		Completion		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	4		7		11
This AFE:	$129,800		$112,450	$68,950	$311,200
Prior AFE's:					
Total Costs:	$129,800		$112,450	$68,950	$311,200

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	100.0000%	$129,800	$311,200
AFE TOTAL:	100.0000%	$129,800	$311,200

INTERNAL APPROVAL

Recommended:
Approvals:

Engineering: Date:
SVP Operations: Date:

Geology: Date:
SVP Asset Mgmt: Date:

Land: Date:
SVP BD&P Date:

Drilling: Date:
President: Date:

PARTNER APPROVAL

Company Name:

Authorized By: Date:

Title:

DRILLING WELL COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 3/15/2005

COUNTY/STATE: Crane Texas | APPROVED BY: | DATE:

PROPOSED TOTAL DEPTH: 3400 | AFE TYPE: Capital

PROPOSED TOTAL LATERAL: NA

		AFE NOMENCLATURE			DRYHOLE COST	SUSPENDED COST
		INTANGIBLE DRILLING COST		DAYS:		
930	02	STAKING, SURVEY & PERMITS			$1,500	
930	04	ROAD & SITE PREPARATION: includes cliché University Lands			$21,500	
930	06	LEGAL & LANDMAN				
930	07	RIG MOBILIZATION / DEMOBILIZATION - in field			$6,000	
930	08	DRILLING - TURNKEY				
930	10	DRILLING - FOOTAGE	$/ft	3,400 ft		
930	11	DRILLING - DAYWORK	$8,500 day	4 days	$34,000	
930	12	WATER & WATER HAULING			$3,500	
930	13	FUEL & POWER			$2,500	
930	14	CASING TOOLS / SERVICES			$1,000	
930	15	BITS & REAMERS			$7,000	
930	18	CEMENT & CEMENTING SERVICES			$5,500	
930	20	MUD & CHEMICALS			$3,000	
930	25	DST / CORING / WIRELINE TESTS:				
930	30	LOGGING - OPEN HOLE: Platform Express			$6,300	
930	34	GEOLOGICAL & ENGINEERING				
930	36	DIRECTIONAL SERVICES				
930	52	ENVIRONMENTAL COSTS				
930	53	INSURANCE			$3,000	
930	70	TRANSPORTATION			$1,000	
930	75	CONTRACT LABOR & SERVICES			$2,000	
930	80	TOOL & EQUIPMENT RENTAL			$3,000	
930	88	PLUGGING				
930	90	DAMAGES: University Lands payment damages only			$6,000	
930	91	DRILLING SUPERVISION	$750 day	5 days	$3,750	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES			$5,000	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD				
930	98	NON-OPERATED IDC				
935	10	DRILLING / WORKOVER OVERHEAD				
		TOTAL INTANGIBLE DRILLING COST			$115,550	
		TANGIBLE DRILLING COST				
950	01	CONDUCTOR CASING			$4,500	
		40 ft. of 14 in. #/ft. /ft.				
950	03	SURFACE CASING			$9,750	$9,750
		650 ft. of 7.000 in. 20.00 #/ft. $15.00 /ft.				
		ft. of in. #/ft. /ft.				
950	06	INTERMEDIATE CASING				
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
		TOTAL TANGIBLE DRILLING COST			$14,250	$9,750
		TOTAL DRILLING COST ESTIMATE			$129,800	$9,750

COMPLETION COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 3/15/2005

LOCATION: | APPROVED BY: | DATE:

COMPLETION FORMATION: McElroy | AFE TYPE:

		AFE NOMENCLATURE				ESTIMATED COST
		INTANGIBLE COMPLETION COSTS				
940	04	SITE PREPARATION & CLEAN UP			04	$2,500
940	10	COMPLETION UNIT	2 days	2500 $/day	10	$5,000
940	11	DRILLING RIG	days	$/day	11	
940	12	WATER & WATER HAULING			12	$2,000
940	14	CASING TOOLS / SERVICES			14	$3,000
940	15	BITS & REAMERS			15	
940	18	CEMENT & CEMENTING SERVICES - PRIMARY			18	$10,500
940	20	DIRECTIONAL SERVICES			20	
940	30	LOGGING & PERFORATING			30	$3,750
940	44	ACIDIZING & FRACTURING	8000 acid	60000 frac	44	$68,000
940	46	PUMP TRUCK SERVICES			46	$2,000
940	47	SAND CONTROL			47	
940	48	SQUEEZE CEMENTING			48	
940	52	ENVIRONMENTAL COSTS			52	
940	53	INSURANCE			53	
940	70	TRANSPORTATION			70	$1,500
940	75	WIRELINE SERVICES			75	$1,500
940	80	TOOL & EQUIPMENT RENTAL			80	$3,500
940	85	CONTRACT LABOR & SERVICES			85	$2,000
940	92	COMPLETION SUPERVISION	6 days	700 $/day	92	$4,200
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES			95	$3,000
940	98	NON-OPERATED ICC			98	
		TOTAL INTANGIBLE COMPLETION COST				$112,450

		TANGIBLE COMPLETION COST										
955	02	CASING HEAD									02	$900
955	04	DIRT & DOZER WORK							04		04	
955	05	PRODUCTION CASING									05	
		3,400	ft. of	4-1/2	in.	11.60	#/ft.	$8.40 /ft.				$28,560
			ft. of		in.		#/ft.	/ft.				
			ft. of		in.		#/ft.	/ft.				
955	06	LINER									06	
			ft. of		in.		#/ft.	/ft.				
955	07	INTERMEDIATE CASING									07	
			ft. of		in.		#/ft.	/ft.				
			ft. of		in.		#/ft.	/ft.				
955	10	WELL SERVICE UNIT							10		10	
955	12	TUBING HEAD							12		12	$1,850
955	14	TUBING							14		14	
		3,400	ft. of	2-3/8	in.	4.70	#/ft.	$4.00 /ft.				$13,600
			ft. of		in.		#/ft.	/ft.				
955	16	RODS							16		16	
			ft. of		in.		/ft.					
			ft. of		in.		/ft.					
			ft. of		in.		/ft.					
			ft. of		in.		/ft.					
955	17	WELLHEAD EQUIPMENT							17		17	$2,500
955	18	SUBSURFACE EQUIPMENT									18	
955	20	PUMPING UNIT							20		20	
955	22	ENGINE							22		22	
955	24	MOTOR							24		24	
955	25	PUMPS							25		25	
955	26	ELECTRICAL EQUIPMENT							26		26	
955	30	STORAGE TANKS							30		30	
955	34	TREATING EQUIPMENT							34		34	
955	36	DEHYDRATION EQUIPMENT							36		36	
955	38	SEPARATION EQUIPMENT							38		38	$5,500
955	40	COMPRESSION							40		40	
955	50	FITTINGS, CONNECTIONS & VALVES							50		50	$3,800
955	55	LINE PIPE							55		55	$2,000
955	60	GAS MEASUREMENT EQUIPMENT							60		60	$2,200
955	65	GAS INJECTION EQUIPMENT							65		65	
955	70	TRUCKING							70		70	$2,000
955	85	ROUSTABOUT & GENERAL LABOR							85		85	$2,500
955	95	MISCELLANEOUS							95		95	$3,540
955	96	PROPERTY ACQUISITION							96		96	
955	98	NON-OPERATED EQUIPMENT COSTS							98		98	
		TOTAL TANGIBLE COMPLETION COST										$68,950
		TOTAL COMPLETION COST ESTIMATE										$181,400

Location: Andrews Co., TX (Dist. 8); Well Type: Oil; Total Depth: 4,750 ft (1,448 m)

Date:
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well: **Project ID:**
Field Prospect: Fuhrman (San Andres) Region: Permian
Location: County/State: Andrew Texas

AFE Type: Capital Original ___ Supplement X Addendum ___ API Well Type 6
Operator: Inside PA_
Objective Formation: San Andres Auth. Total Depth (Feet): 4750
Project Description: D&C San Andres producer then equip

Estimated Start Date: 2/14/2005 Prepared By:
Estimated Completion Date: 3/9/2005

GROSS WELL DATA

	Drilling		Completion		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	7		11		18
This AFE:	$140,250		$121,500	$208,630	$470,380
Prior AFE's:	$17,200				
Total Costs:	$157,450		$121,500	$208,630	$487,580

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	100.0000%	$140,250	$470,380
AFE TOTAL:	100.0000%	$140,250	$470,380

INTERNAL APPROVAL

Recommended: Approvals:

Engineering: Date: SVP Operations: Date:
Geology: Date: SVP Asset Mgmt: Date:
Land: Date: SVP BD&P Date:
Drilling: Date: President: Date:

PARTNER APPROVAL

Company Name:
Authorized By: Date:
Title:

DRILLING WELL COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE:

COUNTY/STATE: | APPROVED BY: | DATE:

PROPOSED TOTAL DEPTH: 4750 | AFE TYPE: Capital

PROPOSED TOTAL LATERAL: NA

		AFE NOMENCLATURE				DRYHOLE COST		SUSPENDED COST
		INTANGIBLE DRILLING COST		DAYS:				
930	02	STAKING, SURVEY & PERMITS			02		02	
930	04	ROAD & SITE PREPARATION			04	$5,300	04	
930	06	LEGAL & LANDMAN			06		06	
930	07	RIG MOBILIZATION / DEMOBILIZATION			07	$8,500	07	
930	08	DRILLING - TURNKEY			08		08	
930	10	DRILLING - FOOTAGE	$/ft	4,650 ft	10		10	
930	11	DRILLING - DAYWORK	$8,500 day	7 days	11	$59,500	11	
930	12	WATER & WATER HAULING			12	$4,000	12	
930	13	FUEL & POWER			13	$5,000	13	
930	14	CASING TOOLS / SERVICES			14	$1,500	14	
930	15	BITS & REAMERS			15	$12,000	15	
930	18	CEMENT & CEMENTING SERVICES			18	$5,000	18	
930	20	MUD & CHEMICALS			20	$4,000	20	
930	25	DST / CORING / WIRELINE TESTS			25		25	
930	30	LOGGING - OPEN HOLE			30		30	
930	34	GEOLOGICAL & ENGINEERING			34		34	
930	36	DIRECTIONAL SERVICES			36		36	
930	52	ENVIRONMENTAL COSTS			52		52	
930	53	INSURANCE			53	$5,000	53	
930	70	TRANSPORTATION			70	$1,500	70	
930	75	CONTRACT LABOR & SERVICES			75	$2,500	75	
930	80	TOOL & EQUIPMENT RENTAL			80	$3,500	80	
930	88	PLUGGING			88		88	
930	90	DAMAGES			90	$2,500	90	
930	91	DRILLING SUPERVISION	$775 day	10 days	91	$7,750	91	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES			95	$2,500	95	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD			96		96	
930	98	NON-OPERATED IDC			98		98	
935	10	DRILLING / WORKOVER OVERHEAD			10		10	
		TOTAL INTANGIBLE DRILLING COST				$130,050		
		TANGIBLE DRILLING COST						
950	01	CONDUCTOR CASING			01	$4,000	01	
		ft. of	in.	#/ft.	/ft.			
950	03	SURFACE CASING			03	$6,200	03	
		400 ft. of	8-5/8 in.	24.00 #/ft.	$15.50 /ft.			
		ft. of	in.	#/ft.	/ft.			
950	06	INTERMEDIATE CASING			06		06	
		ft. of	in.	#/ft.	/ft.			
		ft. of	in.	#/ft.	/ft.			
		TOTAL TANGIBLE DRILLING COST				$10,200		
		TOTAL DRILLING COST ESTIMATE				$140,250		

COMPLETION COST ESTIMATE

LEASE / WELL: _____ PREPARED BY: _____ DATE: _____

LOCATION: _____ APPROVED BY: _____ DATE: _____

COMPLETION FORMATION: San Andres AFE TYPE: _____

		AFE NOMENCLATURE								ESTIMATED COST
		INTANGIBLE COMPLETION COSTS								
940	04	SITE PREPARATION & CLEAN UP							04	$2,500
940	10	COMPLETION UNIT	10	days		2150	$/day		10	$21,500
940	11	DRILLING RIG		days			$/day		11	
940	12	WATER & WATER HAULING							12	$2,500
940	14	CASING TOOLS / SERVICES							14	$2,000
940	15	BITS & REAMERS							15	
940	18	CEMENT & CEMENTING SERVICES - PRIMARY							18	$17,000
940	20	DIRECTIONAL SERVICES							20	
940	30	LOGGING & PERFORATING							30	$4,000
940	44	ACIDIZING & FRACTURING	4200	acid		57,800	frac		44	$62,000
940	46	PUMP TRUCK SERVICES							46	$1,500
940	47	SAND CONTROL							47	
940	48	SQUEEZE CEMENTING							48	
940	52	ENVIRONMENTAL COSTS							52	
940	53	INSURANCE							53	
940	70	TRANSPORTATION							70	$1,500
940	75	WIRELINE SERVICES							75	
940	80	TOOL & EQUIPMENT RENTAL							80	$3,000
940	85	CONTRACT LABOR & SERVICES							85	$2,000
940	92	COMPLETION SUPERVISION		days			$/day		92	
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES							95	$2,000
940	98	NON-OPERATED ICC							98	
		TOTAL INTANGIBLE COMPLETION COST								$121,500
		TANGIBLE COMPLETION COST								
955	02	CASING HEAD							02	$800
955	04	DIRT & DOZER WORK						04	04	
955	05	PRODUCTION CASING							05	
		4,700 ft. of 5-1/2 in. 15.50 #/ft. $10.60 /ft.								$49,820
		ft. of in. #/ft. /ft.								
		ft. of in. #/ft. /ft.								
955	06	LINER							06	
		ft. of in. #/ft. /ft.								
955	07	INTERMEDIATE CASING							07	
		ft. of in. #/ft. /ft.								
		ft. of in. #/ft. /ft.								
955	10	WELL SERVICE UNIT						10	10	
955	12	TUBING HEAD						12	12	$500
955	14	TUBING						14	14	
		4,650 ft. of 2-7/8 in. 6.50 #/ft. $4.25 /ft.								$19,763
		ft. of in. #/ft. /ft.								
955	16	RODS						16	16	
		1,600 ft. of 1 in. $2.80 /ft.								$4,480
		2,900 ft. of 7/8 in. $2.20 /ft.								$6,380
		20 ft. of 1-3/4 in. $3.25 /ft.								$65
		ft. of in. /ft.								
955	17	WELLHEAD EQUIPMENT						17	17	$5,500
955	18	SUBSURFACE EQUIPMENT							18	
955	20	PUMPING UNIT						20	20	$85,000
955	22	ENGINE						22	22	
955	24	MOTOR						24	24	$3,500
955	25	PUMPS						25	25	$4,500
955	26	ELECTRICAL EQUIPMENT						26	26	$11,000
955	30	STORAGE TANKS						30	30	
955	34	TREATING EQUIPMENT						34	34	
955	36	DEHYDRATION EQUIPMENT						36	36	
955	38	SEPARATION EQUIPMENT						38	38	
955	40	COMPRESSION						40	40	
955	50	FITTINGS, CONNECTIONS & VALVES						50	50	$4,500
955	55	LINE PIPE						55	55	$3,500
955	60	GAS MEASUREMENT EQUIPMENT						60	60	
955	65	GAS INJECTION EQUIPMENT						65	65	
955	70	TRUCKING						70	70	$1,500
955	85	ROUSTABOUT & GENERAL LABOR						85	85	$4,500
955	95	MISCELLANEOUS						95	95	$3,322
955	96	PROPERTY ACQUISITION						96	96	
955	98	NON-OPERATED EQUIPMENT COSTS						98	98	
		TOTAL TANGIBLE COMPLETION COST								$208,630
		TOTAL COMPLETION COST ESTIMATE								$330,130

Location: McClain Co., OK; Well Type: Oil & Gas; Total Depth: 8,850 ft (2,697 m)

Date: 2/11/2005
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well: **Project ID:**
Field / Prospect: (Golden Trend Area) Region: MidCon
Location: County/State: McClain County, Oklahoma

AFE Type: Capital Drlg Original ___ Supplement X Addendum ___ API Well Type 6 - Dev
Operator: Inside PA? (Y/N) ___
Objective Formation: Hart/Deese Auth. Total Depth (Feet): 8,850'
Project Description: Drill, complete and equip a producing oil & gas well

Estimated Start Date: Prepared By:
Estimated Completion Date:

GROSS WELL DATA

	Drilling		Completion		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	0				0
This AFE:	$695,000		$437,200	$319,800	$1,452,000
Prior AFE's:	$48,000		$0	$0	$48,000
Total Costs:	$743,000		$437,200	$319,800	$1,500,000

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	93.000000%	$0	$1,350,360
Others	7.000000%	$48,650	$101,640
AFE TOTAL:	100.0000%	$48,650	$1,452,000

INTERNAL RECOMMENDATION & APPROVAL

Recommended:
Reservoir: Date:
Operations: Date:
Geology: Date:
Land: Date:
Drilling: Date:

Approvals:
Eng / Prod'n Mgr: Date:
SVP Operations: Date:
SVP Asset Mgmt: Date:
President: Date:
CEO: Date:

PARTNER APPROVAL

Company Name:

Authorized By: Date:

Title:

DRILLING WELL COST ESTIMATE

LEASE / WELL:		PREPARED BY:	DATE: 2/11/2005
COUNTY/STATE:	McClain County, Oklahoma	APPROVED BY:	DATE:
PROPOSED TOTAL DEPTH:	8,850'	AFE TYPE:	Capital Drlg
PROPOSED TOTAL LATERAL:	NA		

		AFE NOMENCLATURE		DRYHOLE COST		SUSPENDED COST
		INTANGIBLE DRILLING COST	DAYS:			
930	02	STAKING, SURVEY & PERMITS	02		02	
930	04	ROAD & SITE PREPARATION	04	$5,000	04	
930	06	LEGAL & LANDMAN	06		06	
930	07	RIG MOBILIZATION / DEMOBILIZATION	07	$75,000	07	
930	08	DRILLING - TURNKEY	08		08	
930	10	DRILLING - FOOTAGE	10		10	
930	11	DRILLING - DAYWORK	22 days at $11,000/day	11	$242,000	11
930	12	WATER & WATER HAULING	12	$10,000	12	
930	13	FUEL & POWER	13	$40,000	13	
930	14	CASING TOOLS / SERVICES	14	$10,500	14	
930	15	BITS & REAMERS	15	$48,000	15	
930	18	CEMENT & CEMENTING SERVICES	18	$30,000	18	
930	20	MUD & CHEMICALS	20	$48,000	20	
930	25	DST / CORING / WIRELINE TESTS	25		25	
930	30	LOGGING - OPEN HOLE	30	$19,000	30	
930	34	GEOLOGICAL & ENGINEERING	34		34	
930	36	DIRECTIONAL SERVICES	36		36	
930	52	ENVIRONMENTAL COSTS	52	$10,000	52	
930	53	INSURANCE	53		53	
930	70	TRANSPORTATION	70	$1,500	70	
930	75	CONTRACT LABOR & SERVICES	75	$20,000	75	
930	80	TOOL & EQUIPMENT RENTAL	80	$28,000	80	
930	88	PLUGGING	88		88	
930	90	DAMAGES	90	$5,000	90	
930	91	DRILLING SUPERVISION	91	$28,500	91	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$35,150	95	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD	96		96	
930	98	NON-OPERATED IDC	98		98	
935	10	DRILLING / WORKOVER OVERHEAD	10		10	
		TOTAL INTANGIBLE DRILLING COST		$655,650		
		TANGIBLE DRILLING COST				
950	01	CONDUCTOR CASING	01	$4,000	01	
		100 ft. of 20 in. #/ft. $40.00 /ft.				
950	03	SURFACE CASING	03	$14,850	03	
		450 ft. of 13-3/8 in. 48.00 #/ft. $33.00 /ft.				
		ft. of in. #/ft. /ft.				
950	06	INTERMEDIATE CASING	06	$20,500	06	
		1,000 ft. of 8-5/8 in. 24.00 #/ft. $20.50 /ft.				
		ft. of in. #/ft. /ft.				
		TOTAL TANGIBLE DRILLING COST		$39,350		
		TOTAL DRILLING COST ESTIMATE		$695,000		

COMPLETION COST ESTIMATE

LEASE / WELL: _____ PREPARED BY: _____ DATE: 2/11/2005

LOCATION: _____ APPROVED BY: _____ DATE: _____

COMPLETION FORMATION: Hart/Deese AFE TYPE: 6 - Dev

		AFE NOMENCLATURE			ESTIMATED COST
		INTANGIBLE COMPLETION COSTS			
940	04	SITE PREPARATION & CLEAN UP		04	$6,000
940	10	COMPLETION UNIT	9 days at $4,000/day	10	$36,000
940	11	DRILLING RIG	2 days at $11,000/day	11	$22,000
940	12	WATER & WATER HAULING		12	$8,000
940	14	CASING TOOLS / SERVICES		14	$8,000
940	15	BITS & REAMERS		15	$1,500
940	18	CEMENT & CEMENTING SERVICES - PRIMARY		18	$25,000
940	20	DIRECTIONAL SERVICES		20	
940	30	LOGGING & PERFORATING		30	$25,000
940	44	ACIDIZING & FRACTURING	1 stimulation at $200,000/job	44	$200,000
940	46	PUMP TRUCK SERVICES		46	$3,500
940	47	SAND CONTROL		47	
940	48	SQUEEZE CEMENTING		48	
940	52	ENVIRONMENTAL COSTS		52	$1,000
940	53	INSURANCE		53	$1,000
940	70	TRANSPORTATION		70	$5,000
940	75	WIRELINE SERVICES		75	$9,000
940	80	TOOL & EQUIPMENT RENTAL		80	$20,000
940	85	CONTRACT LABOR & SERVICES		85	$20,000
940	92	COMPLETION SUPERVISION		92	$20,000
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES		95	$26,200
940	98	NON-OPERATED ICC		98	
		TOTAL INTANGIBLE COMPLETION COST			$437,200

		TANGIBLE COMPLETION COST									
955	02	CASING HEAD							02		02 $1,200
955	04	DIRT & DOZER WORK							04		04
955	05	PRODUCTION CASING							05		05 $123,900
		8,850	ft. of	5-1/2	in.	17.00	#/ft.	$14.00 /ft.			
			ft. of		in.		#/ft.	/ft.			
			ft. of		in.		#/ft.	/ft.			
955	06	LINER							06		06
			ft. of		in.		#/ft.	/ft.			
955	07	INTERMEDIATE CASING							07		07
			ft. of		in.		#/ft.	/ft.			
			ft. of		in.		#/ft.	/ft.			
955	10	WELL SERVICE UNIT							10		10
955	12	TUBING HEAD							12		12 $3,500
955	14	TUBING							14		14 $35,200
		8,800	ft. of	2-7/8"	in.	4.70	#/ft.	$4.00 /ft.			
			ft. of		in.		#/ft.	/ft.			
955	16	RODS							16		16 $20,000
			ft. of		in.		/ft.				
			ft. of		in.		/ft.				
			ft. of		in.		/ft.				
			ft. of		in.		/ft.				
955	17	WELLHEAD EQUIPMENT							17		17 $8,000
955	18	SUBSURFACE EQUIPMENT							18		18 $5,000
955	20	PUMPING UNIT							20		20 $70,000
955	22	ENGINE							22		22 $15,000
955	24	MOTOR							24		24 $10,000
955	25	PUMPS							25		25
955	26	ELECTRICAL EQUIPMENT							26		26 $2,000
955	30	STORAGE TANKS							30		30 $8,000
955	34	TREATING EQUIPMENT							34		34
955	36	DEHYDRATION EQUIPMENT							36		36
955	38	SEPARATION EQUIPMENT							38		38 $5,000
955	40	COMPRESSION							40		40
955	50	FITTINGS, CONNECTIONS & VALVES							50		50 $2,500
955	55	LINE PIPE							55		55 $4,500
955	60	GAS MEASUREMENT EQUIPMENT							60		60 $1,000
955	65	GAS INJECTION EQUIPMENT							65		65
955	70	TRUCKING							70		70
955	85	ROUSTABOUT & GENERAL LABOR							85		85
955	95	MISCELLANEOUS							95		95 $5,000
955	96	PROPERTY ACQUISITION							96		96
955	98	NON-OPERATED EQUIPMENT COSTS							98		98
		TOTAL TANGIBLE COMPLETION COST									$319,800
		TOTAL COMPLETION COST ESTIMATE									$757,000

Location: Latimer Co., OK; Well Type: Gas–Directional Drill; Total Depth: 10,500 ft (3,200 m)

Date: 3/24/2005
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well:
Project ID:
Field / Prospect: Hartshorne South
Region: MidCon
Location:
County/State: Latimer County, Oklahoma

AFE Type: Capital Drlg
Original ___ Supplement X Addendum ___
API Well Type: 5 - Ext
Operator:
Inside PA? (Y/N) ___
Objective Formation: Atoka
Auth. Total Depth (Feet): 10,500'
Project Description: Drill, complete and equip directional producing gas well

Estimated Start Date:
Prepared By:
Estimated Completion Date:

GROSS WELL DATA

	Drilling		Completion		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	0				0
This AFE:	$1,596,000		$547,600	$325,400	$2,469,000
Prior AFE's:	$64,500		$0	$0	$64,500
Total Costs:	$1,660,500		$547,600	$325,400	$2,533,500

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	18.164000%	$289,897	$448,469
Others	81.836000%	$1,306,103	$2,020,531
AFE TOTAL:	100.0000%	$1,596,000	$2,469,000

INTERNAL APPROVAL

Recommended:
Engineering: Date:
Geology: Date:
Land: Date:
Drilling: Date:

Approvals:
Engineering Mgr: Date:
SVP Operations: Date:
SVP Asset Mgmt: Date:
President: Date:

PARTNER APPROVAL

Company Name:
Authorized By: Date:
Title:

DRILLING WELL COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 3/24/2005

COUNTY/STATE: Latimer County, Oklahoma | APPROVED BY: | DATE:

PROPOSED TOTAL DEPTH: 10,500' | AFE TYPE: Capital Drlg

PROPOSED TOTAL LATERAL: NA

		AFE NOMENCLATURE		DRYHOLE COST		SUSPENDED COST
		INTANGIBLE DRILLING COST DAYS:				
930	02	STAKING, SURVEY & PERMITS	02	$1,500	02	
930	04	ROAD & SITE PREPARATION	04	$40,000	04	
930	06	LEGAL & LANDMAN	06	$4,000	06	
930	07	RIG MOBILIZATION / DEMOBILIZATION	07	$70,000	07	
930	08	DRILLING - TURNKEY	08		08	
930	10	DRILLING - FOOTAGE	10		10	
930	11	DRILLING - DAYWORK	11	$600,000	11	
930	12	WATER & WATER HAULING	12	$3,000	12	
930	13	FUEL & POWER	13	$60,000	13	
930	14	CASING TOOLS / SERVICES	14	$3,000	14	
930	15	BITS & REAMERS	15	$80,000	15	
930	18	CEMENT & CEMENTING SERVICES	18	$25,000	18	
930	20	MUD & CHEMICALS	20	$115,000	20	
930	25	DST / CORING / WIRELINE TESTS	25		25	
930	30	LOGGING - OPEN HOLE	30	$25,000	30	
930	34	GEOLOGICAL & ENGINEERING	34	$9,000	34	
930	36	DIRECTIONAL SERVICES	36	$225,000	36	
930	52	ENVIRONMENTAL COSTS	52		52	
930	53	INSURANCE	53	$10,000	53	
930	70	TRANSPORTATION	70	$10,000	70	
930	75	CONTRACT LABOR & SERVICES	75	$25,000	75	
930	80	TOOL & EQUIPMENT RENTAL	80	$24,000	80	
930	88	PLUGGING	88		88	
930	90	DAMAGES	90	$10,000	90	
930	91	DRILLING SUPERVISION	91	$75,000	91	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$65,000	95	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD	96		96	
930	98	NON-OPERATED IDC	98		98	
935	10	DRILLING / WORKOVER OVERHEAD	10		10	
		TOTAL INTANGIBLE DRILLING COST		$1,479,500		
		TANGIBLE DRILLING COST				
950	01	CONDUCTOR CASING	01	$4,000	01	
		100 ft. of 16" in. 54.00 #/ft. $40.00 /ft.				
950	03	SURFACE CASING	03	$112,500	03	
		4,500 ft. of 9-5/8" in. 36.00 #/ft. $25.00 /ft.				
		ft. of in. #/ft. /ft.				
950	06	INTERMEDIATE CASING	06		06	
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
		TOTAL TANGIBLE DRILLING COST		$116,500		
		TOTAL DRILLING COST ESTIMATE		$1,596,000		

COMPLETION COST ESTIMATE

LEASE / WELL: _____ PREPARED BY: _____ DATE: 3/24/2005

LOCATION: _____ APPROVED BY: _____ DATE: _____

COMPLETION FORMATION: Atoka AFE TYPE: 5 - Ext

		AFE NOMENCLATURE			ESTIMATED COST
		INTANGIBLE COMPLETION COSTS			
940	04	SITE PREPARATION & CLEAN UP		04	$3,000
940	10	COMPLETION UNIT	12 days at $4,000/day	10	$48,000
940	11	DRILLING RIG		11	
940	12	WATER & WATER HAULING		12	$10,000
940	14	CASING TOOLS / SERVICES		14	$8,000
940	15	BITS & REAMERS		15	$3,000
940	18	CEMENT & CEMENTING SERVICES - PRIMARY		18	$18,000
940	20	DIRECTIONAL SERVICES		20	
940	30	LOGGING & PERFORATING		30	$26,000
940	44	ACIDIZING & FRACTURING		44	$300,000
940	46	PUMP TRUCK SERVICES		46	$5,000
940	47	SAND CONTROL		47	
940	48	SQUEEZE CEMENTING		48	
940	52	ENVIRONMENTAL COSTS		52	
940	53	INSURANCE		53	$1,000
940	70	TRANSPORTATION		70	$4,000
940	75	WIRELINE SERVICES		75	$10,000
940	80	TOOL & EQUIPMENT RENTAL		80	$42,000
940	85	CONTRACT LABOR & SERVICES		85	$10,000
940	92	COMPLETION SUPERVISION		92	$24,000
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES		95	$35,600
940	98	NON-OPERATED ICC		98	
		TOTAL INTANGIBLE COMPLETION COST			$547,600

		TANGIBLE COMPLETION COST											
955	02	CASING HEAD									02	$1,200	
955	04	DIRT & DOZER WORK								04	04		
955	05	PRODUCTION CASING								05	05	$224,000	
		14,000	ft. of	5-1/2"	in.	17.00	#/ft.	$16.00	/ft.				
			ft. of		in.		#/ft.		/ft.				
			ft. of		in.		#/ft.		/ft.				
955	06	LINER								06	06		
			ft. of		in.		#/ft.		/ft.				
955	07	INTERMEDIATE CASING								07	07		
			ft. of		in.		#/ft.		/ft.				
			ft. of		in.		#/ft.		/ft.				
955	10	WELL SERVICE UNIT								10	10		
955	12	TUBING HEAD								12	12	$5,000	
955	14	TUBING								14	14	$45,000	
		10,000	ft. of	2-3/8"	in.	4.70	#/ft.	$4.50	/ft.				
			ft. of		in.		#/ft.		/ft.				
955	16	RODS								16	16		
			ft. of		in.		/ft.						
			ft. of		in.		/ft.						
			ft. of		in.		/ft.						
			ft. of		in.		/ft.						
955	17	WELLHEAD EQUIPMENT								17	17	$15,000	
955	18	SUBSURFACE EQUIPMENT								18	18	$10,000	
955	20	PUMPING UNIT								20	20		
955	22	ENGINE								22	22		
955	24	MOTOR								24	24		
955	25	PUMPS								25	25		
955	26	ELECTRICAL EQUIPMENT								26	26		
955	30	STORAGE TANKS								30	30	$2,000	
955	34	TREATING EQUIPMENT								34	34		
955	36	DEHYDRATION EQUIPMENT								36	36		
955	38	SEPARATION EQUIPMENT								38	38	$4,000	
955	40	COMPRESSION								40	40		
955	50	FITTINGS, CONNECTIONS & VALVES								50	50	$2,000	
955	55	LINE PIPE								55	55	$15,000	
955	60	GAS MEASUREMENT EQUIPMENT								60	60	$1,000	
955	65	GAS INJECTION EQUIPMENT								65	65		
955	70	TRUCKING								70	70		
955	85	ROUSTABOUT & GENERAL LABOR								85	85		
955	95	MISCELLANEOUS								95	95	$1,200	
955	96	PROPERTY ACQUISITION								96	96		
955	98	NON-OPERATED EQUIPMENT COSTS								98	98		
		TOTAL TANGIBLE COMPLETION COST										$325,400	
		TOTAL COMPLETION COST ESTIMATE										$873,000	

Location: Smith Co., TX (Dist. 6); Well Type: Gas; Total Depth: 11,950 ft (3,642 m)

Date: 6/29/2005
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well: **Project ID:**
Field Prospect: (Cotton Valley Taylor Sand) Region: ARK-LA-TX
Location: County/State: Smith, Texas
AFE Type: Drill & Complete Original ___ Supplement X Addendum ___ API Well Type 6
Operator: Inside PA_
Objective Formation: Cotton Valley Taylor Sand Auth. Total Depth (Feet): 11,950
Project Description: Drill, Complete & Equip a Taylor Cotton Valley Vertical Development Producing Gas Well

Estimated Start Date: 6/1/2005 Prepared By:
Estimated Completion Date: 7/16/2005

GROSS WELL DATA

	Drilling		Completion/Facility		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	20				20
This AFE:	$690,112		$444,735	$305,153	$1,440,000
Prior AFE's:	$60,000				$60,000
Total Costs:	$750,112	$0	$444,735	$305,153	$1,500,000

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	100.000000%	**$750,112**	**$1,500,000**
AFE TOTAL:	100.0000%	$750,112	$1,500,000

INTERNAL APPROVAL

Recommended: Approvals:

Engineering: Date: SVP Operations: Date:
Geology: Date: SVP Asset Mgmt: Date:
Land: Date: SVP BD&P Date:
Drilling: Date: President: Date:

PARTNER APPROVAL

Company Name:
Authorized By: Date:
Title:

DRILLING WELL COST ESTIMATE

LEASE / WELL:		PREPARED BY:	DATE: 6/29/2005
COUNTY/STATE:	Smith, Texas	APPROVED BY:	DATE:
PROPOSED TOTAL DEPTH:	11,950	AFE TYPE:	Drill & Complete
PROPOSED TOTAL LATERAL:	NA		

		AFE NOMENCLATURE		DRYHOLE COST		SUSPENDED COST
		INTANGIBLE DRILLING COST DAYS: 20				
930	02	STAKING, SURVEY & PERMITS	02		02	
930	04	ROAD & SITE PREPARATION	04		04	
930	06	LEGAL & LANDMAN	06		06	
930	07	RIG MOBILIZATION / DEMOBILIZATION	07	$60,000	07	
930	08	DRILLING - TURNKEY	08		08	
930	10	DRILLING - FOOTAGE	10		10	
930	11	DRILLING - DAYWORK	11	$260,000	11	
930	12	WATER & WATER HAULING	12	$6,000	12	
930	13	FUEL & POWER	13	$20,000	13	
930	14	CASING TOOLS / SERVICES	14	$4,000	14	
930	15	BITS & REAMERS	15	$65,000	15	
930	18	CEMENT & CEMENTING SERVICES	18	$27,000	18	
930	20	MUD & CHEMICALS	20	$18,000	20	
930	25	DST / CORING / WIRELINE TESTS	25		25	
930	30	LOGGING - OPEN HOLE	30	$20,000	30	
930	34	GEOLOGICAL & ENGINEERING	34	$9,000	34	
930	36	DIRECTIONAL SERVICES	36		36	
930	52	ENVIRONMENTAL COSTS	52		52	
930	53	INSURANCE	53	$12,000	53	
930	70	TRANSPORTATION	70	$5,000	70	
930	75	CONTRACT LABOR & SERVICES	75	$20,000	75	
930	80	TOOL & EQUIPMENT RENTAL	80	$25,000	80	
930	88	PLUGGING	88		88	
930	90	DAMAGES	90		90	
930	91	DRILLING SUPERVISION	91	$22,000	91	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$31,662	95	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD	96		96	
930	98	NON-OPERATED IDC	98		98	
935	10	DRILLING / WORKOVER OVERHEAD	10		10	
		TOTAL INTANGIBLE DRILLING COST		$604,662		
		TANGIBLE DRILLING COST				
950	01	CONDUCTOR CASING	01	$5,500	01	
		40 ft. of 16 in. #/ft. /ft.				
950	03	SURFACE CASING	03	$79,950	03	
		2,500 ft. of 8-5/8 in. 24.00 #/ft. $15.50 /ft.				
		2,000 ft. of 8-5/8 in. 32.00 #/ft. $20.60 /ft.				
950	06	INTERMEDIATE CASING	06		06	
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
		TOTAL TANGIBLE DRILLING COST		$85,450		
		TOTAL DRILLING COST ESTIMATE		$690,112		

COMPLETION COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 6/29/2005

LOCATION: | APPROVED BY: | DATE:

COMPLETION FORMATION: Cotton Valley Taylor Sand | AFE TYPE: 6

		AFE NOMENCLATURE		ESTIMATED COST
		INTANGIBLE COMPLETION COSTS		
940	04	SITE PREPARATION & CLEAN UP	04	$2,000
940	10	COMPLETION UNIT	10	$15,000
940	11	DRILLING RIG	11	
940	12	WATER & WATER HAULING	12	$20,000
940	14	CASING TOOLS / SERVICES	14	
940	15	BITS & REAMERS	15	
940	18	CEMENT & CEMENTING SERVICES - PRIMARY	18	$27,000
940	20	DIRECTIONAL SERVICES	20	
940	30	LOGGING & PERFORATING	30	$12,500
940	44	ACIDIZING & FRACTURING	44	$300,000
940	46	PUMP TRUCK SERVICES	46	
940	47	SAND CONTROL	47	
940	48	SQUEEZE CEMENTING	48	
940	52	ENVIRONMENTAL COSTS	52	
940	53	INSURANCE	53	
940	70	TRANSPORTATION	70	$10,000
940	75	WIRELINE SERVICES	75	
940	80	TOOL & EQUIPMENT RENTAL	80	$9,000
940	85	CONTRACT LABOR & SERVICES	85	$25,000
940	92	COMPLETION SUPERVISION	92	$2,000
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$22,235
940	98	NON-OPERATED ICC	98	
		TOTAL INTANGIBLE COMPLETION COST		$444,735

		TANGIBLE COMPLETION COST		PRODUCTION COST		FACILITY COST
955	02	CASING HEAD	02		02	
955	04	DIRT & DOZER WORK	04		04	
955	05	PRODUCTION CASING	05		05	
		11,950 ft. of 5-1/2 in. 17.00 #/ft. $14.50 /ft.		$173,275		
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
955	06	LINER	06		06	
		ft. of in. #/ft. /ft.				
955	07	INTERMEDIATE CASING	07		07	
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
955	10	WELL SERVICE UNIT	10		10	
955	12	TUBING HEAD	12		12	
955	14	TUBING	14		14	
		11,850 ft. of 2-3/8 in. 4.70 #/ft. $4.15 /ft.		$49,178		
		ft. of in. #/ft. /ft.				
955	16	RODS	16		16	
		ft. of in. /ft.				
		ft. of in. /ft.				
		ft. of in. /ft.				
		ft. of in. /ft.				
955	17	WELLHEAD EQUIPMENT	17	$18,000	17	
955	18	SUBSURFACE EQUIPMENT		$4,500	18	
955	20	PUMPING UNIT	20		20	
955	22	ENGINE	22		22	
955	24	MOTOR	24		24	
955	25	PUMPS	25		25	
955	26	ELECTRICAL EQUIPMENT	26		26	$1,000
955	30	STORAGE TANKS	30		30	$6,700
955	34	TREATING EQUIPMENT	34		34	
955	36	DEHYDRATION EQUIPMENT	36		36	
955	38	SEPARATION EQUIPMENT	38		38	$5,000
955	40	COMPRESSION	40		40	
955	50	FITTINGS, CONNECTIONS & VALVES	50		50	$6,000
955	55	LINE PIPE	55		55	$24,000
955	60	GAS MEASUREMENT EQUIPMENT	60		60	$4,000
955	65	GAS INJECTION EQUIPMENT	65		65	
955	70	TRUCKING	70		70	$2,000
955	85	ROUSTABOUT & GENERAL LABOR	85		85	$6,500
955	95	MISCELLANEOUS	95		95	$5,000
955	96	PROPERTY ACQUISITION	96		96	
955	98	NON-OPERATED EQUIPMENT COSTS	98		98	
		TOTAL TANGIBLE COMPLETION COST		$244,953		$60,200

TOTAL COMPLETION COST ESTIMATE	$749,888

Location: Roger Mills Co., OK; Well Type: Gas; Total Depth: 12,705 ft (3,872 m)

Date: 3/21/2005
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well:
Project ID:
Field Prospect: Strong City
Region: MidCon
Location:
County/State: Roger Mills County, Oklahoma

AFE Type: Capital Drlg Original X Supplement ___ Addendum ___ API Well Type 6
Operator:
Objective Formation: Red Fork
Auth. Total Depth (Feet): 12,705'
Project Description: Drill, complete and equip a vertical producing gas well

Estimated Start Date:
Prepared By:
Estimated Completion Date:

GROSS WELL DATA

	Drilling		Completion		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	0				0
This AFE:	$1,028,688		$357,400	$137,600	$1,523,688
Prior AFE's:			$0	$0	$0
Total Costs:	$1,028,688		$357,400	$137,600	$1,523,688

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	3.123800%	$0	$47,597
Others	96.876200%	$996,554	$1,476,091
AFE TOTAL:	100.0000%	$996,554	$1,523,688

INTERNAL APPROVAL

Recommended:
Engineering: ___ Date: ___
Geology: ___ Date: ___
Land: ___ Date: ___
Drilling: ___ Date: ___

Approvals:
Engineering Mgr: ___ Date: ___
SVP Operations: ___ Date: ___
SVP Asset Mgmt ___ Date: ___
President: ___ Date: ___

PARTNER APPROVAL

Company Name:
Authorized By: ___ Date: ___
Title:

DRILLING WELL COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 3/21/2005

COUNTY/STATE: Roger Mills County, Oklahoma | APPROVED BY: | DATE:

PROPOSED TOTAL DEPTH: 12,705' | AFE TYPE: Capital Drlg

PROPOSED TOTAL LATERAL: NA

		AFE NOMENCLATURE		DRYHOLE COST		SUSPENDED COST
		INTANGIBLE DRILLING COST DAYS:				
930	02	STAKING, SURVEY & PERMITS	02		02	
930	04	ROAD & SITE PREPARATION	04		04	
930	06	LEGAL & LANDMAN	06		06	
930	07	RIG MOBILIZATION / DEMOBILIZATION	07		07	
930	08	DRILLING - TURNKEY	08		08	
930	10	DRILLING - FOOTAGE	10		10	
930	11	DRILLING - DAYWORK	11		11	
930	12	WATER & WATER HAULING	12		12	
930	13	FUEL & POWER	13		13	
930	14	CASING TOOLS / SERVICES	14		14	
930	15	BITS & REAMERS	15		15	
930	18	CEMENT & CEMENTING SERVICES	18		18	
930	20	MUD & CHEMICALS	20		20	
930	25	DST / CORING / WIRELINE TESTS	25		25	
930	30	LOGGING - OPEN HOLE	30		30	
930	34	GEOLOGICAL & ENGINEERING	34		34	
930	36	DIRECTIONAL SERVICES	36		36	
930	52	ENVIRONMENTAL COSTS	52		52	
930	53	INSURANCE	53		53	
930	70	TRANSPORTATION	70		70	
930	75	CONTRACT LABOR & SERVICES	75		75	
930	80	TOOL & EQUIPMENT RENTAL	80		80	
930	88	PLUGGING	88		88	
930	90	DAMAGES	90		90	
930	91	DRILLING SUPERVISION	91		91	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$785,100	95	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD	96		96	
930	98	NON-OPERATED IDC	98		98	
935	10	DRILLING / WORKOVER OVERHEAD	10		10	
		TOTAL INTANGIBLE DRILLING COST		$785,100		
		TANGIBLE DRILLING COST				
950	01	CONDUCTOR CASING	01	$243,588	01	
		ft. of in. #/ft. /ft.				
950	03	SURFACE CASING	03		03	
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
950	06	INTERMEDIATE CASING	06		06	
		ft. of in. #/ft. /ft.				
		ft. of in. #/ft. /ft.				
		TOTAL TANGIBLE DRILLING COST		$243,588		
		TOTAL DRILLING COST ESTIMATE		$1,028,688		

COMPLETION COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 3/21/2005

LOCATION: | APPROVED BY: | DATE:

COMPLETION FORMATION: Red Fork | AFE TYPE: 6

		AFE NOMENCLATURE		ESTIMATED COST
		INTANGIBLE COMPLETION COSTS		
940	04	SITE PREPARATION & CLEAN UP	04	
940	10	COMPLETION UNIT	10	
940	11	DRILLING RIG	11	
940	12	WATER & WATER HAULING	12	
940	14	CASING TOOLS / SERVICES	14	
940	15	BITS & REAMERS	15	
940	18	CEMENT & CEMENTING SERVICES - PRIMARY	18	
940	20	DIRECTIONAL SERVICES	20	
940	30	LOGGING & PERFORATING	30	
940	44	ACIDIZING & FRACTURING	44	
940	46	PUMP TRUCK SERVICES	46	
940	47	SAND CONTROL	47	
940	48	SQUEEZE CEMENTING	48	
940	52	ENVIRONMENTAL COSTS	52	
940	53	INSURANCE	53	
940	70	TRANSPORTATION	70	
940	75	WIRELINE SERVICES	75	
940	80	TOOL & EQUIPMENT RENTAL	80	
940	85	CONTRACT LABOR & SERVICES	85	
940	92	COMPLETION SUPERVISION	92	
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	
940	98	NON-OPERATED ICC	98	$357,400
		TOTAL INTANGIBLE COMPLETION COST		$357,400

		TANGIBLE COMPLETION COST								
955	02	CASING HEAD						02	02	
955	04	DIRT & DOZER WORK						04	04	
955	05	PRODUCTION CASING						05	05	
		6,950	ft. of	4-1/2"	in.	#/ft.	$5.18 /ft.			
			ft. of		in.	#/ft.	/ft.			
			ft. of		in.	#/ft.	/ft.			
955	06	LINER						06	06	
			ft. of		in.	#/ft.	/ft.			
955	07	INTERMEDIATE CASING						07	07	
			ft. of		in.	#/ft.	/ft.			
			ft. of		in.	#/ft.	/ft.			
955	10	WELL SERVICE UNIT						10	10	
955	12	TUBING HEAD						12	12	
955	14	TUBING						14	14	
		6,750	ft. of	2-3/8"	in.	4.70 #/ft.	$1.93 /ft.			
			ft. of		in.	#/ft.	/ft.			
955	16	RODS						16	16	
			ft. of		in.	/ft.				
			ft. of		in.	/ft.				
			ft. of		in.	/ft.				
			ft. of		in.	/ft.				
955	17	WELLHEAD EQUIPMENT						17	17	
955	18	SUBSURFACE EQUIPMENT						18	18	
955	20	PUMPING UNIT						20	20	
955	22	ENGINE						22	22	
955	24	MOTOR						24	24	
955	25	PUMPS						25	25	
955	26	ELECTRICAL EQUIPMENT						26	26	
955	30	STORAGE TANKS						30	30	
955	34	TREATING EQUIPMENT						34	34	
955	36	DEHYDRATION EQUIPMENT						36	36	
955	38	SEPARATION EQUIPMENT						38	38	
955	40	COMPRESSION						40	40	
955	50	FITTINGS, CONNECTIONS & VALVES						50	50	
955	55	LINE PIPE						55	55	
955	60	GAS MEASUREMENT EQUIPMENT						60	60	
955	65	GAS INJECTION EQUIPMENT						65	65	
955	70	TRUCKING						70	70	
955	85	ROUSTABOUT & GENERAL LABOR						85	85	
955	95	MISCELLANEOUS						95	95	
955	96	PROPERTY ACQUISITION						96	96	
955	98	NON-OPERATED EQUIPMENT COSTS						98	98	$137,600
		TOTAL TANGIBLE COMPLETION COST								$137,600
		TOTAL COMPLETION COST ESTIMATE								$495,000

Location: Dawson Co., MT; Well Type: Gas–Dual Lateral Completion;
Depth: TVD –9,150 ft, KOP –8,600 ft, Total Depth –13,200 ft (4,023 m)

Date: 6/29/2005
AFE number:

AUTHORITY FOR EXPENDITURE

Foreman Area:

Lease / Well:						**Project ID:**	
Field Prospect:	North Pine					Region:	CCA
Location:				County/State:	Dawson County, Montana		
AFE Type:	Capital	Original		Supplement	X	Addendum		API Well Type	6
Operator:				Inside PA:	N				
Objective Formation:	Red River U2 & U4					Auth. Total Measured Depth (Ft):			13,200
Project Description:	Drill, Complete, & Equip a Dual Lat GRH producing well					Auth. Total Lateral (Ft):			3800' X 2

Estimated Start Date:	01/06/05
Estimated Completion Date:	03/10/05

Prepared By:

GROSS WELL DATA

	Drilling		Completion		
	Dry Hole	Suspended	Intangible	Tangible	Total
Days:	30		5		35
This AFE:	$1,190,000		$57,000	$197,800	$1,444,800
Prior AFE's:	$50,000				
Total Costs:	$1,240,000		$57,000	$197,800	$1,494,800

JOINT INTEREST OWNERS

	Working Interest Percent	Dry Hole $	Completed $
	100.0000%	$1,190,000	$1,444,800
AFE TOTAL:	100.0000%	$1,190,000	$1,444,800

INTERNAL APPROVAL

Recommended:

Engineering: _____ Date: _____

Geology: _____ Date: _____

Land: _____ Date: _____

Drilling: _____ Date: _____

Approvals:

SVP Operations: _____ Date: _____

SVP Asset Mgmt: _____ Date: _____

SVP BD&P _____ Date: _____

President: _____ Date: _____

PARTNER APPROVAL

Company Name: _____

Authorized By: _____ Date: _____

Title: _____

DRILLING WELL COST ESTIMATE

LEASE / WELL:		PREPARED BY:	DATE: 6/29/2005
COUNTY/STATE:	Dawson County, Montana	APPROVED BY:	DATE:
PROPOSED TOTAL DEPTH:	13,200	AFE TYPE:	Capital
PROPOSED TOTAL LATERAL:	3800' X 2		

		AFE NOMENCLATURE		DRYHOLE COST		SUSPENDED COST
		INTANGIBLE DRILLING COST DAYS: 30				
930	02	STAKING, SURVEY & PERMITS	02	$4,500	02	
930	04	ROAD & SITE PREPARATION	04	$30,000	04	
930	06	LEGAL & LANDMAN	06		06	
930	07	RIG MOBILIZATION / DEMOBILIZATION	07	$48,000	07	
930	08	DRILLING - TURNKEY	08		08	
930	10	DRILLING - FOOTAGE	10		10	
930	11	DRILLING - DAYWORK	11	$383,000	11	
930	12	WATER & WATER HAULING	12	$12,000	12	
930	13	FUEL & POWER	13	$30,000	13	
930	14	CASING TOOLS / SERVICES	14	$17,000	14	
930	15	BITS & REAMERS	15	$41,600	15	
930	18	CEMENT & CEMENTING SERVICES	18	$60,000	18	
930	20	MUD & CHEMICALS	20	$28,000	20	
930	25	DST / CORING / WIRELINE TESTS	25		25	
930	30	LOGGING - OPEN HOLE	30		30	
930	34	GEOLOGICAL & ENGINEERING	34	$23,000	34	
930	36	DIRECTIONAL SERVICES	36	$120,000	36	
930	52	ENVIRONMENTAL COSTS	52		52	
930	53	INSURANCE	53	$10,000	53	
930	70	TRANSPORTATION	70	$30,000	70	
930	75	CONTRACT LABOR & SERVICES	75	$25,000	75	
930	80	TOOL & EQUIPMENT RENTAL	80	$55,000	80	
930	88	PLUGGING	88		88	
930	90	DAMAGES	90		90	
930	91	DRILLING SUPERVISION	91	$30,000	91	
930	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$15,000	95	
930	96	NON-OPERATED ADMINISTRATIVE OVERHEAD	96		96	
930	98	NON-OPERATED IDC	98		98	
935	10	DRILLING / WORKOVER OVERHEAD	10		10	
		TOTAL INTANGIBLE DRILLING COST		$962,100		
		TANGIBLE DRILLING COST				
950	01	CONDUCTOR CASING	01	$4,500	01	
		ft. of in. #/ft. /ft.				
950	03	SURFACE CASING	03	$38,300	03	$38,250
		1,700 ft. of 9-5/8 in. 32.30 #/ft. $22.50 /ft.				
		ft. of in. #/ft. /ft.				
950	06	INTERMEDIATE CASING	06	$185,100	06	$81,600
		5,100 ft. of 7 in. 23.00 #/ft. $16.00 /ft.				
		3,300 ft. of 7 in. 26.00 #/ft. $24.00 /ft.				
		900 ft. of 7 in. 29.00 #/ft. $27.00 /ft.				
		TOTAL TANGIBLE DRILLING COST		$227,900		$119,850
		TOTAL DRILLING COST ESTIMATE		$1,190,000		$119,850

COMPLETION COST ESTIMATE

LEASE / WELL: | PREPARED BY: | DATE: 6/29/2005
LOCATION: | APPROVED BY: | DATE:
COMPLETION FORMATION: Red River U2 & U4 | AFE TYPE: Capital

		AFE NOMENCLATURE		ESTIMATED COST
		INTANGIBLE COMPLETION COSTS		
940	04	SITE PREPARATION & CLEAN UP	04	$2,000
940	10	COMPLETION UNIT 5 Days	10	$15,000
940	11	DRILLING RIG	11	
940	12	WATER & WATER HAULING	12	$1,000
940	14	CASING TOOLS / SERVICES	14	
940	15	BITS & REAMERS	15	
940	18	CEMENT & CEMENTING SERVICES - PRIMARY	18	
940	20	DIRECTIONAL SERVICES	20	
940	30	LOGGING & PERFORATING	30	
940	44	ACIDIZING & FRACTURING	44	$20,000
940	46	PUMP TRUCK SERVICES	46	
940	47	SAND CONTROL	47	
940	48	SQUEEZE CEMENTING	48	
940	52	ENVIRONMENTAL COSTS	52	
940	53	INSURANCE	53	
940	70	TRANSPORTATION	70	$4,000
940	75	WIRELINE SERVICES	75	
940	80	TOOL & EQUIPMENT RENTAL	80	$1,000
940	85	CONTRACT LABOR & SERVICES	85	$5,000
940	92	COMPLETION SUPERVISION	92	$3,000
940	95	MISCELLANEOUS SERVICES & CONTINGENCIES	95	$6,000
940	98	NON-OPERATED ICC	98	
		TOTAL INTANGIBLE COMPLETION COST		$57,000
		TANGIBLE COMPLETION COST		
955	02	CASING HEAD	02	$3,500
955	04	DIRT & DOZER WORK	04	$6,000
955	05	PRODUCTION CASING	05	
		ft. of in. #/ft. /ft.		
		ft. of in. #/ft. /ft.		
		ft. of in. #/ft. /ft.		
955	06	LINER	06	
		ft. of in. #/ft. /ft.		
955	07	INTERMEDIATE CASING	07	
		ft. of in. #/ft. /ft.		
		ft. of in. #/ft. /ft.		
955	10	WELL SERVICE UNIT	10	
955	12	TUBING HEAD	12	$500
955	14	TUBING	14	$30,800
		8,700 ft. of 2-7/8 in. 6.50 #/ft. $3.53 /ft.		
		ft. of in. #/ft. /ft.		
955	16	RODS	16	$20,000
		ft. of in. /ft.		
		ft. of in. /ft.		
		ft. of in. /ft.		
		ft. of in. /ft.		
955	17	WELLHEAD EQUIPMENT	17	$2,000
955	18	SUBSURFACE EQUIPMENT	18	$3,000
955	20	PUMPING UNIT	20	$85,000
955	22	ENGINE	22	
955	24	MOTOR	24	$8,000
955	25	PUMPS	25	$3,000
955	26	ELECTRICAL EQUIPMENT	26	$12,000
955	30	STORAGE TANKS	30	
955	34	TREATING EQUIPMENT	34	
955	36	DEHYDRATION EQUIPMENT	36	
955	38	SEPARATION EQUIPMENT	38	
955	40	COMPRESSION	40	
955	50	FITTINGS, CONNECTIONS & VALVES	50	$2,000
955	55	LINE PIPE	55	$7,000
955	60	GAS MEASUREMENT EQUIPMENT	60	
955	65	GAS INJECTION EQUIPMENT	65	
955	70	TRUCKING	70	
955	85	ROUSTABOUT & GENERAL LABOR	85	$5,000
955	95	MISCELLANEOUS	95	$10,000
955	96	PROPERTY ACQUISITION	96	
955	98	NON-OPERATED EQUIPMENT COSTS	98	
		TOTAL TANGIBLE COMPLETION COST		$197,800
		TOTAL COMPLETION COST ESTIMATE		$254,800

Appendix B

Drilling Cost versus Depth Curves

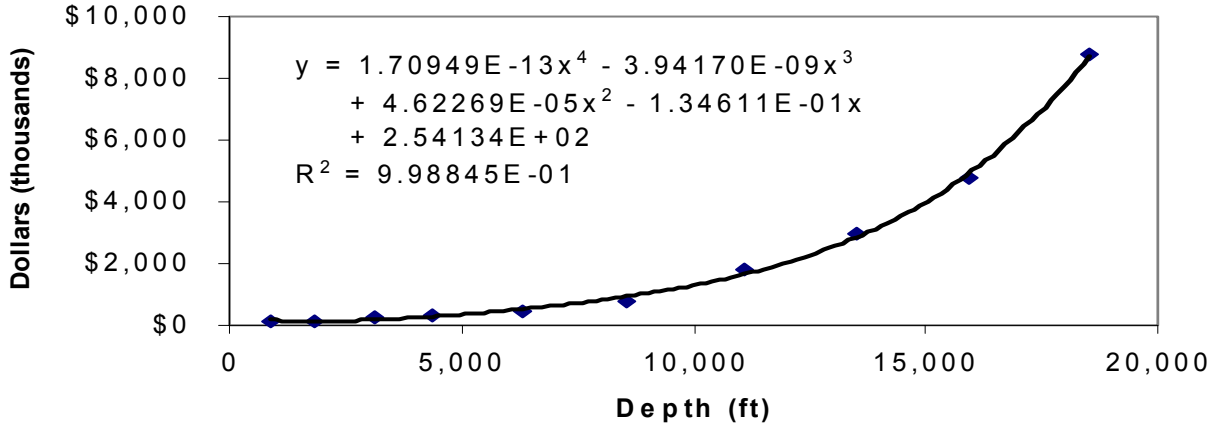
Total range of depth (feet)

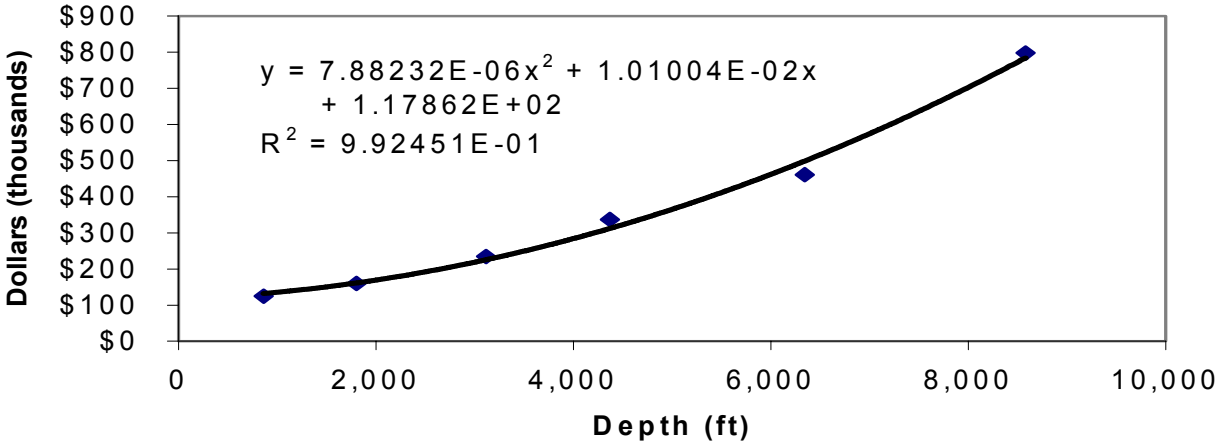
0 – 8000 (feet)

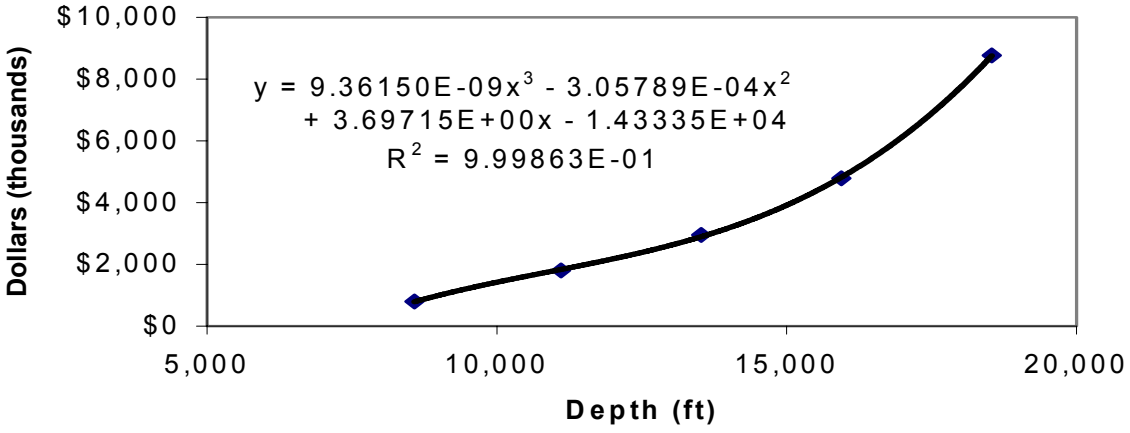
8000 – 20000 (feet)

Polynomial Curve Fitting Plots

Polynomial Curve Fit for All Wells Surveyed

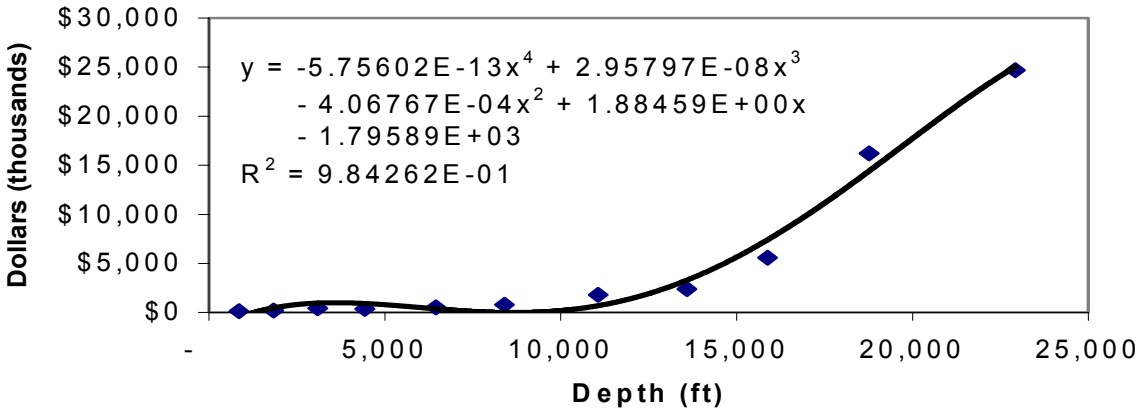


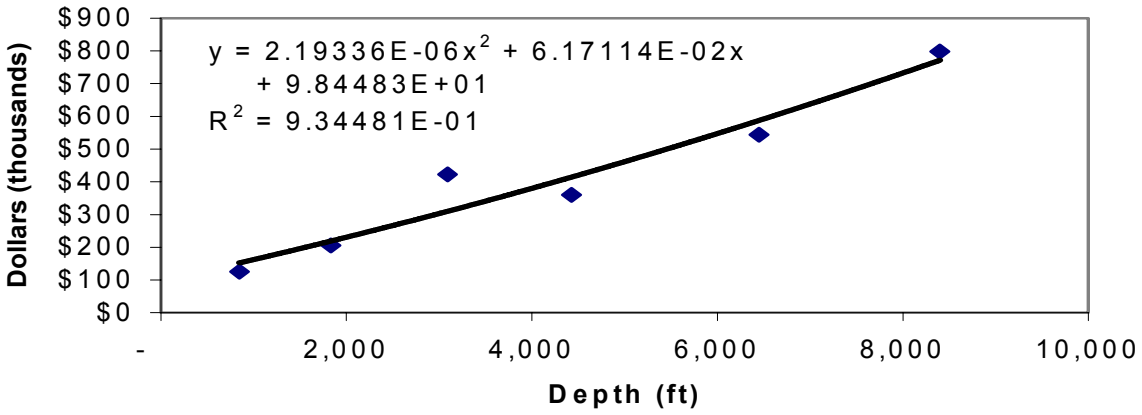


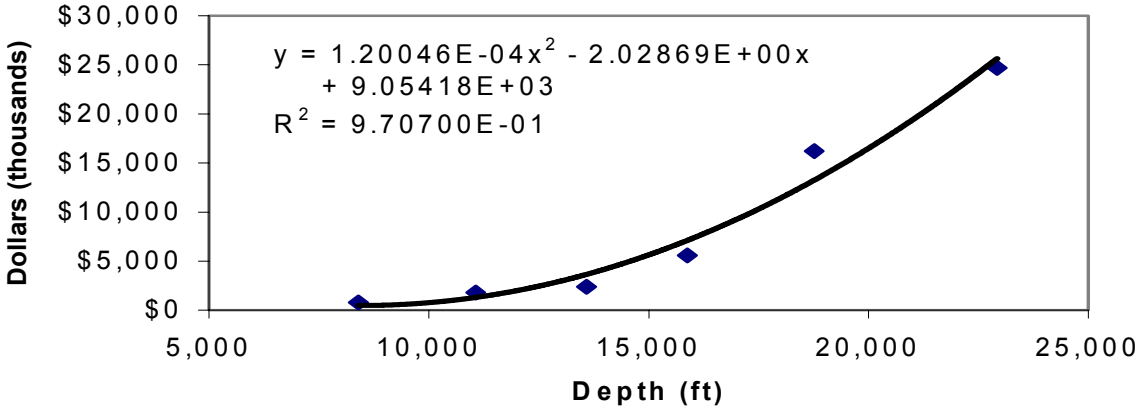


Western United States

Total Western States Wells Surveyed

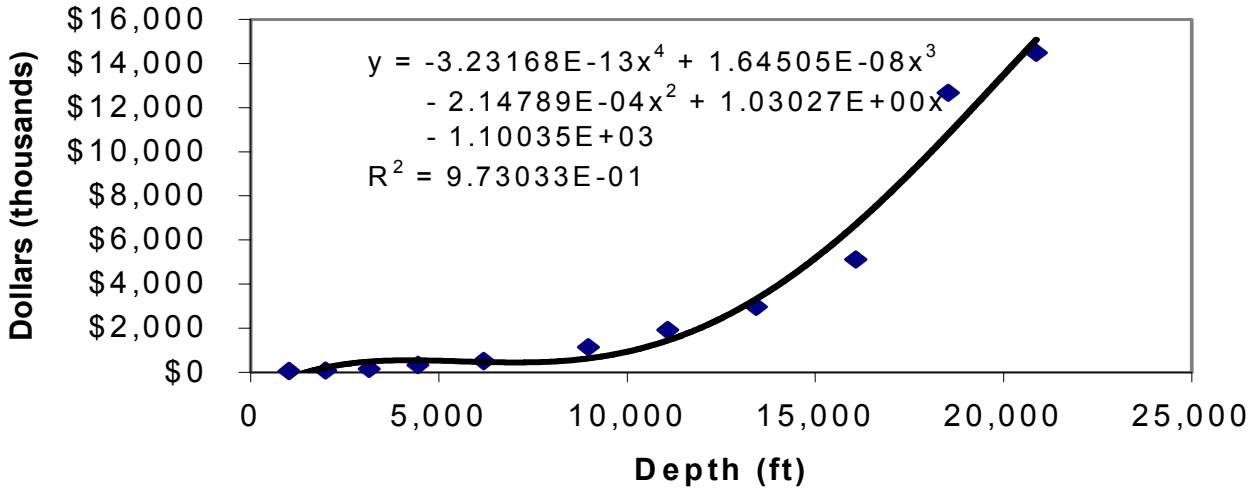


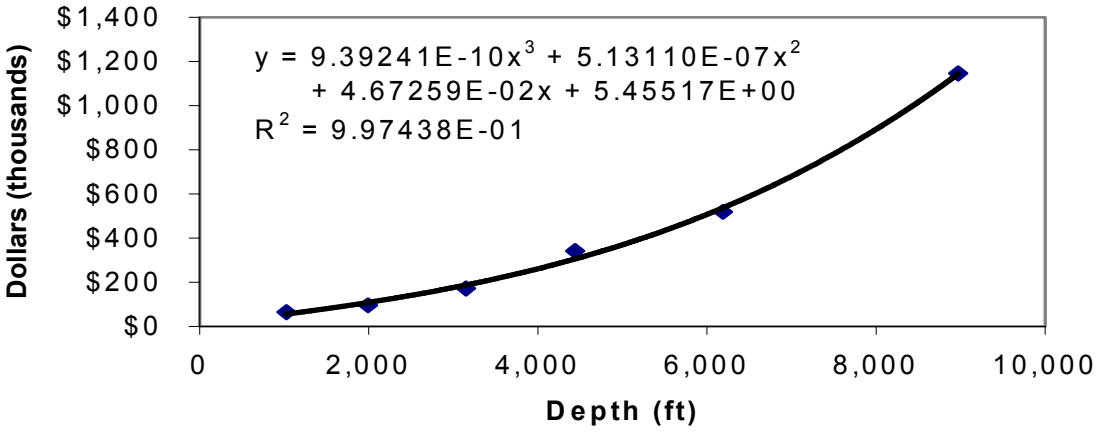


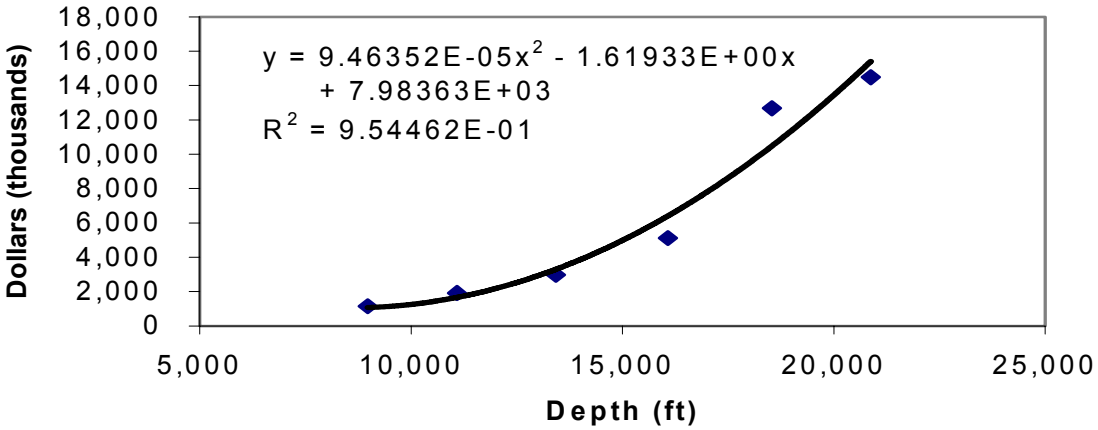


Southeastern United States

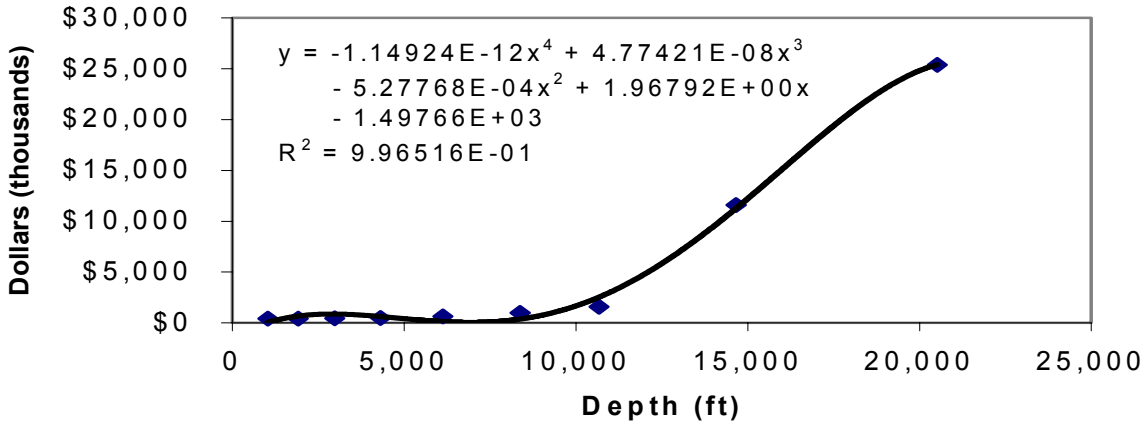
Texas Districts 2, 3, and 4

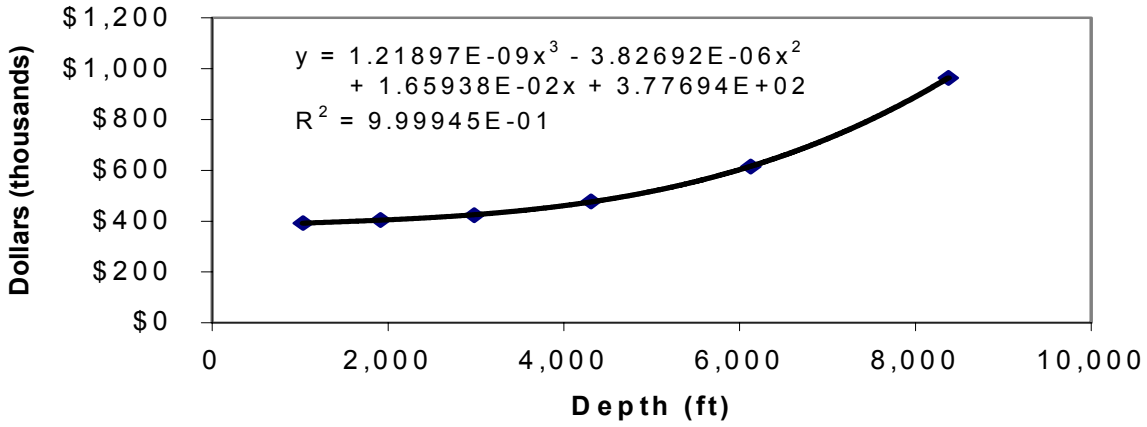


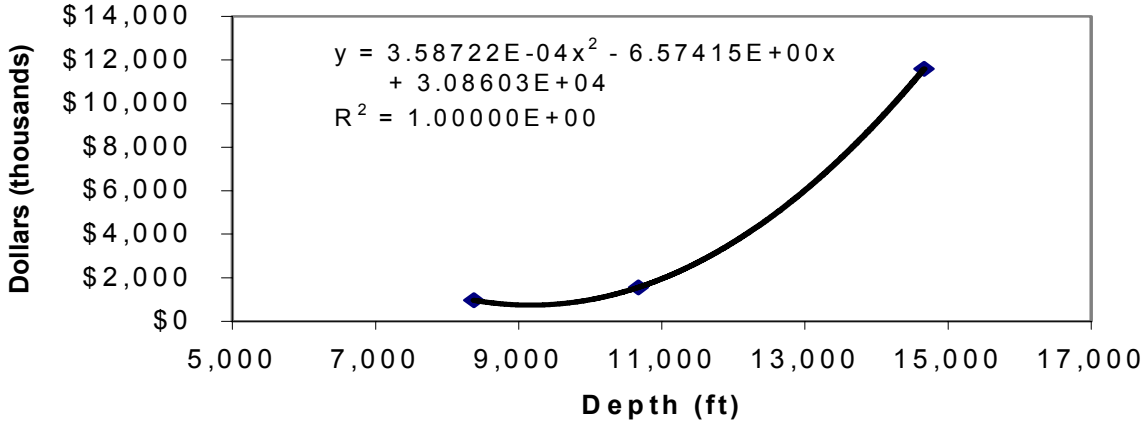




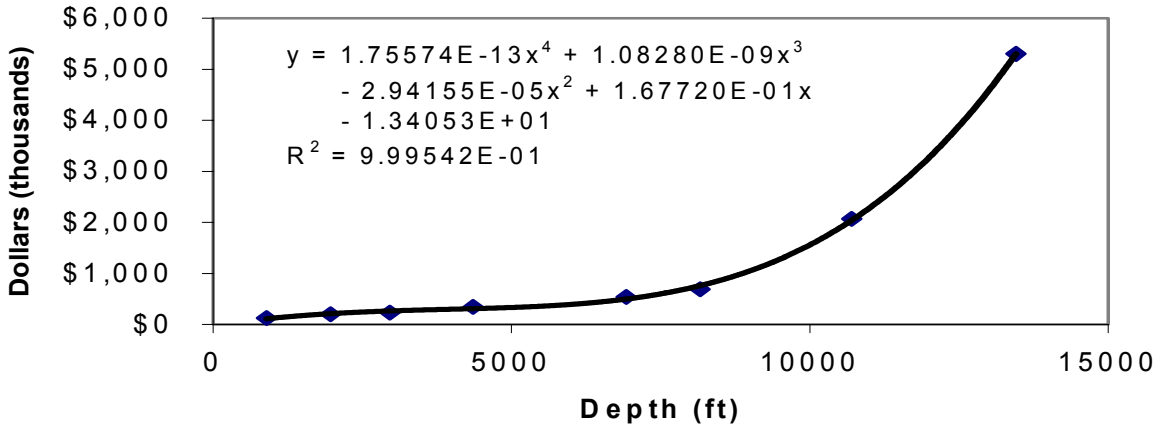
California Onshore

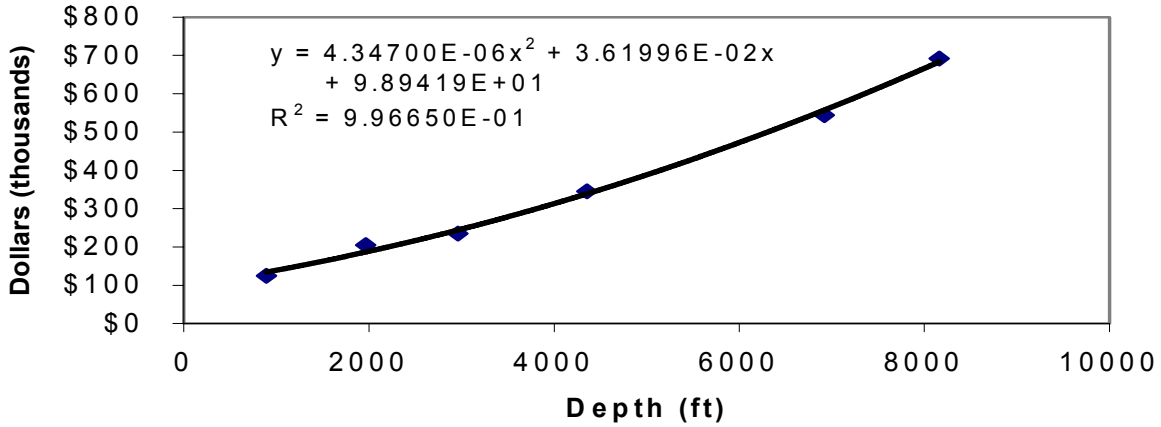


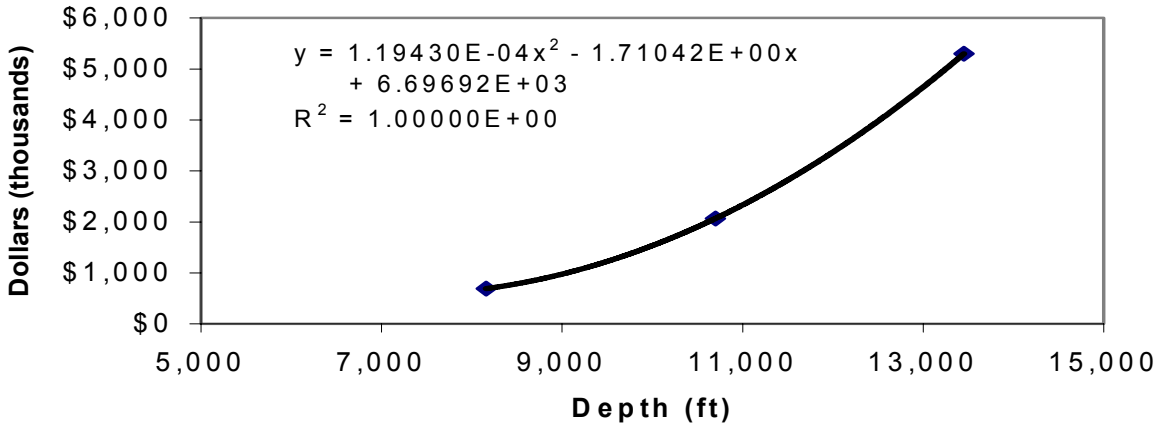




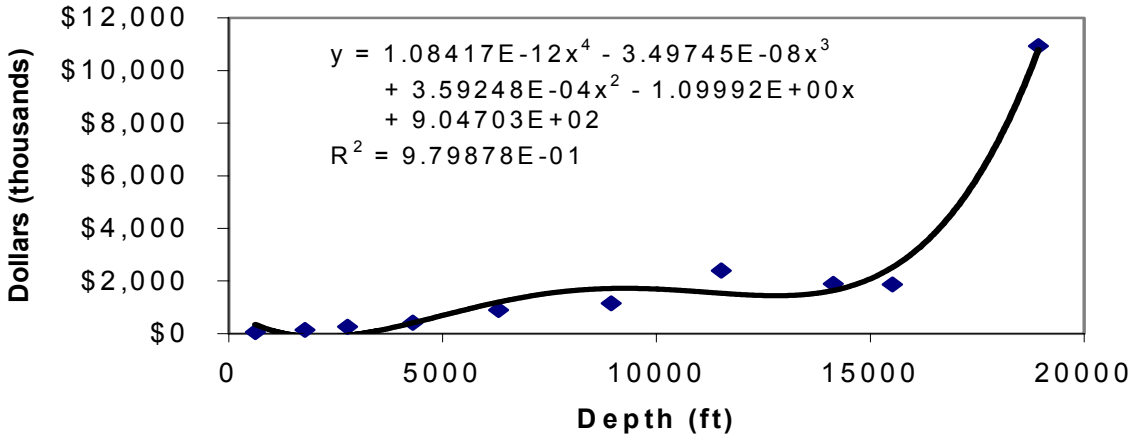
Colorado

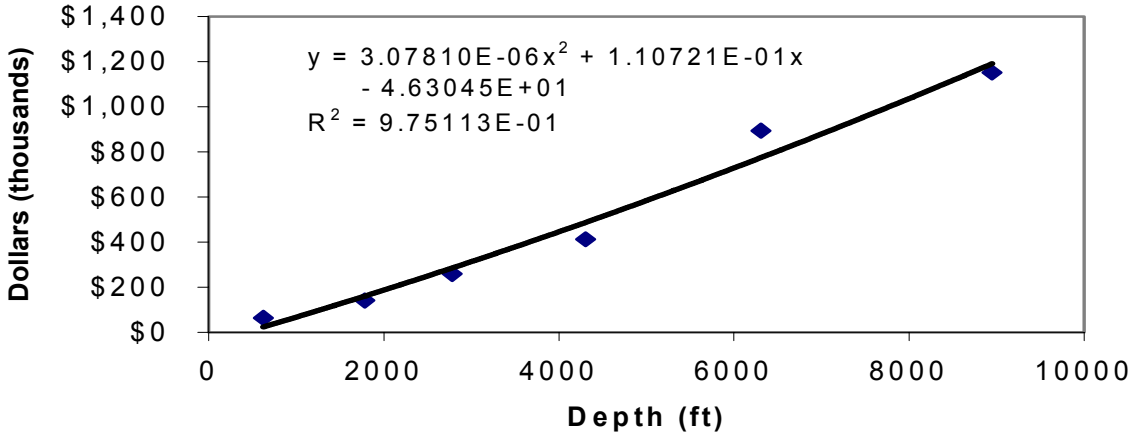

$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.75574E-13x^4 + 1.08280E-09x^3
- 2.94155E-05x^2 + 1.67720E-01x
- 1.34053E+01
R^2 = 9.99542E-01
0
5000
10000
15000
Depth (ft)

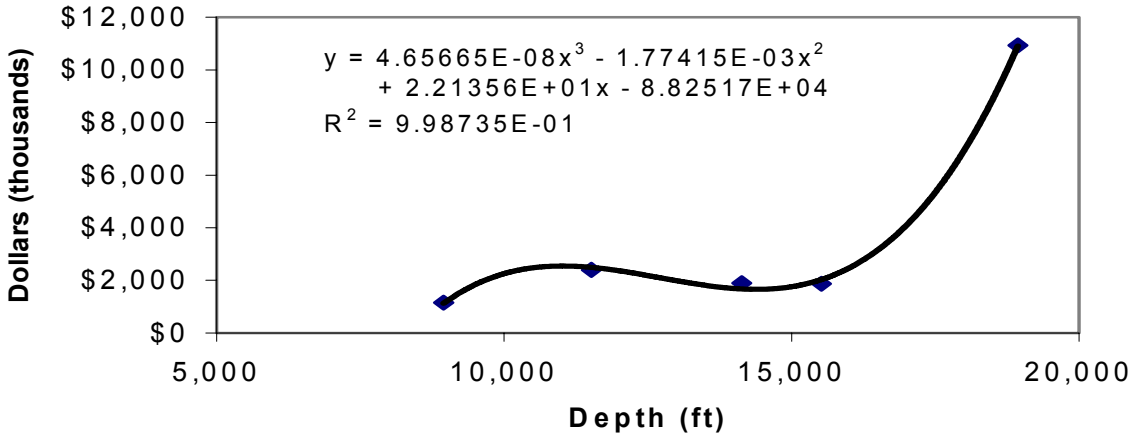

$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 4.34700E-06x^2 + 3.61996E-02x
+ 9.89419E+01
R^2 = 9.96650E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.19430E-04x^2 - 1.71042E+00x
+ 6.69692E+03
R^2 = 1.00000E+00
5,000
7,000
9,000
11,000
13,000
15,000
Depth (ft)

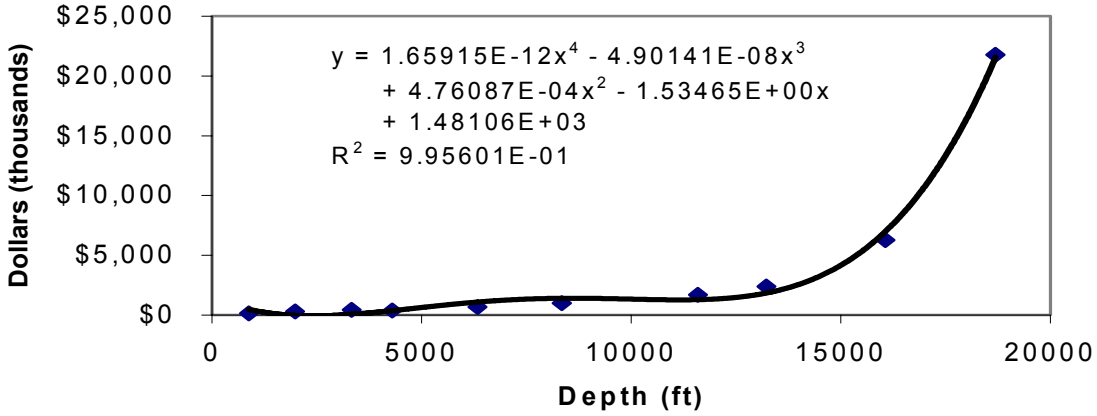
Montana

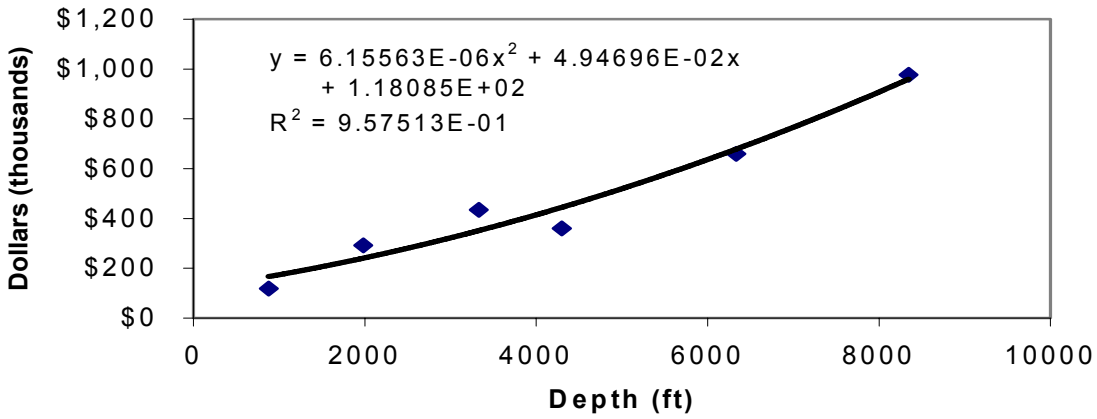

$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Dollars (thousands)
y = 1.08417E-12x4 - 3.49745E-08x3
+ 3.59248E-04x2 - 1.09992E+00x
+ 9.04703E+02
R2 = 9.79878E-01
0
5000
10000
15000
20000
Depth (ft)

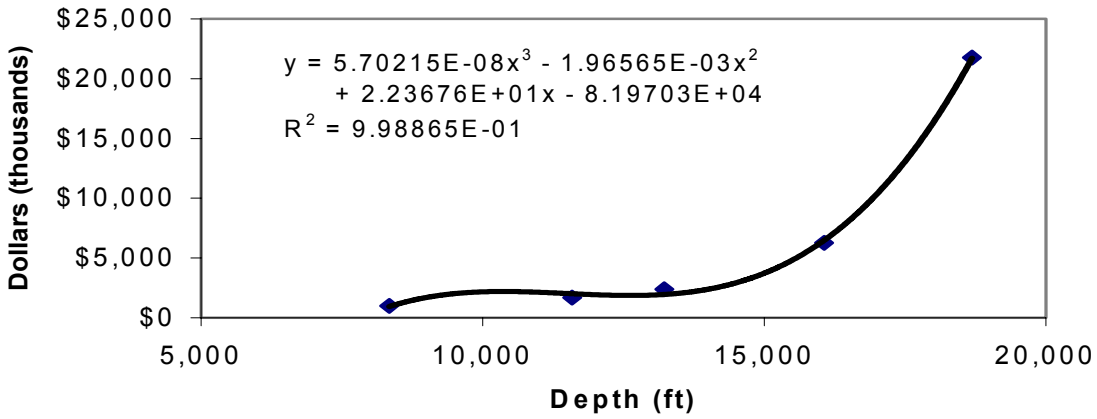

$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 3.07810E-06x2 + 1.10721E-01x
- 4.63045E+01
R2 = 9.75113E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Dollars (thousands)
y = 4.65665E-08x3 - 1.77415E-03x2
+ 2.21356E+01x - 8.82517E+04
R2 = 9.98735E-01
5,000
10,000
15,000
20,000
Depth (ft)

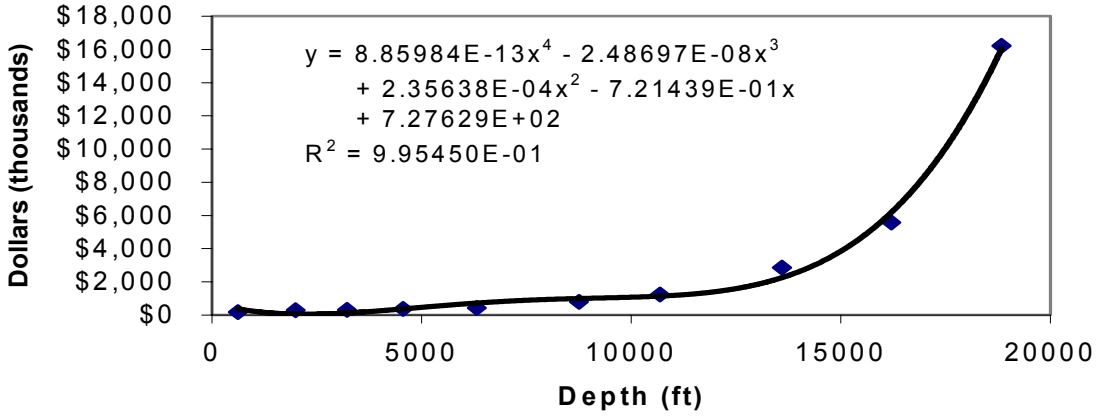
New Mexico

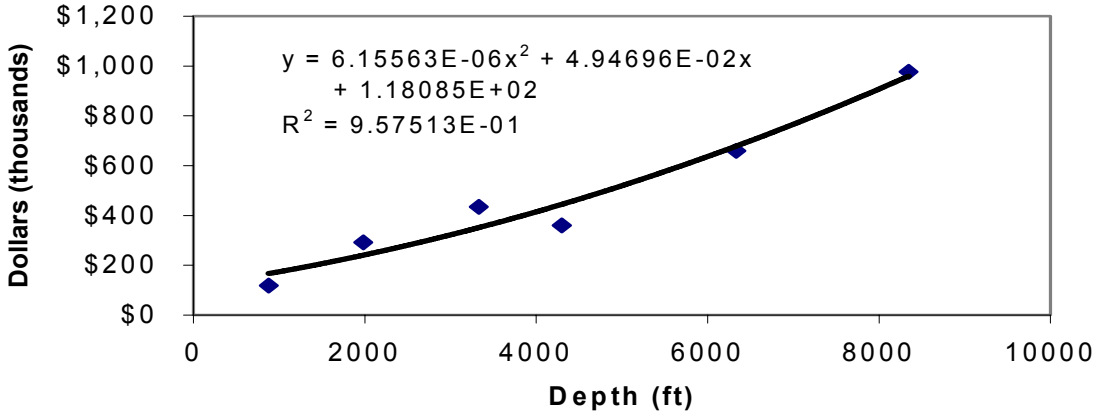

$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = 1.65915E-12x^4 - 4.90141E-08x^3
+ 4.76087E-04x^2 - 1.53465E+00x
+ 1.48106E+03
R^2 = 9.95601E-01
0
5000
10000
15000
20000
Depth (ft)

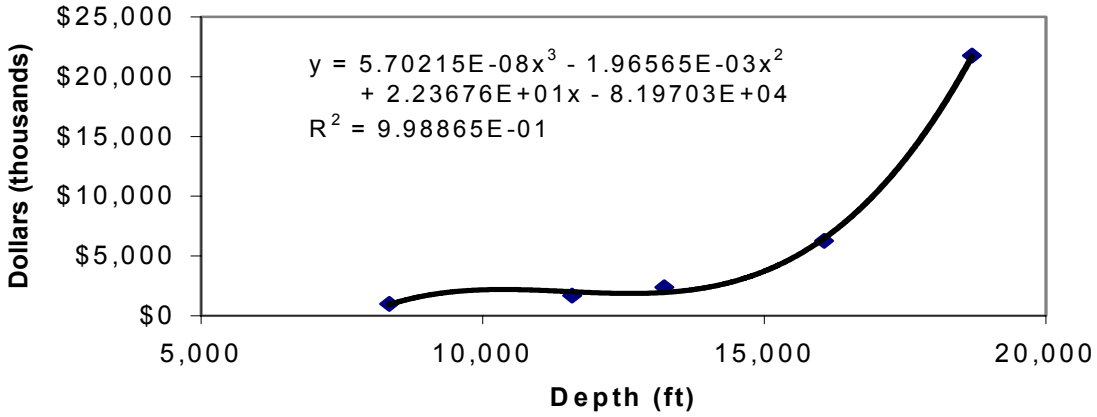

$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 6.15563E-06x^2 + 4.94696E-02x
+ 1.18085E+02
R^2 = 9.57513E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = 5.70215E-08x^3 - 1.96565E-03x^2
+ 2.23676E+01x - 8.19703E+04
R^2 = 9.98865E-01
5,000
10,000
15,000
20,000
Depth (ft)

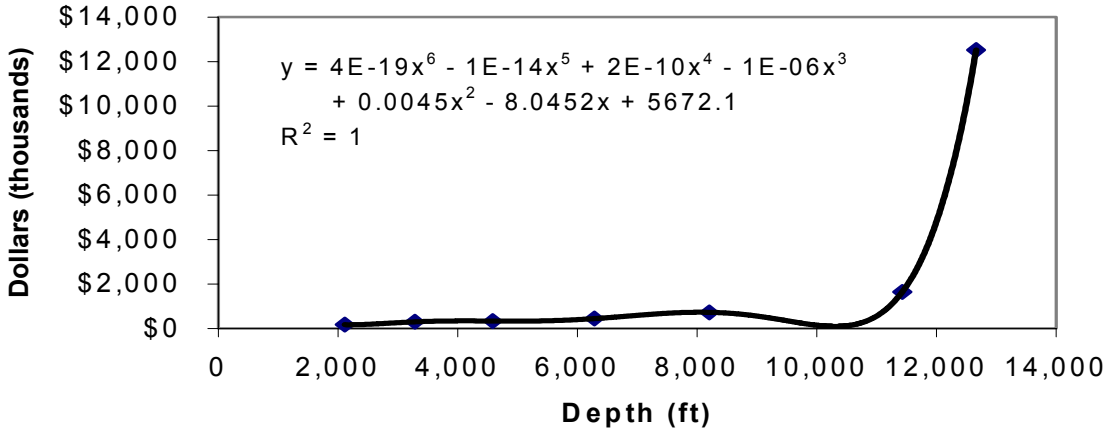
Texas District 8

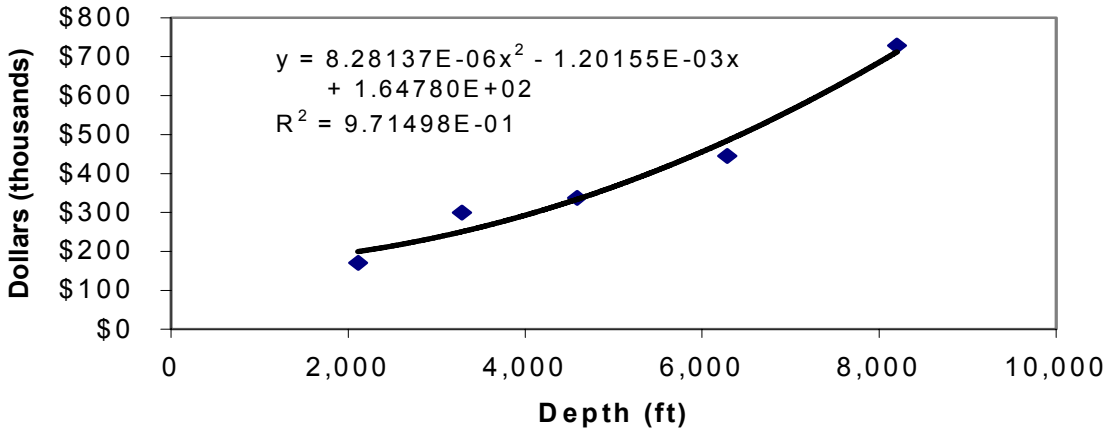


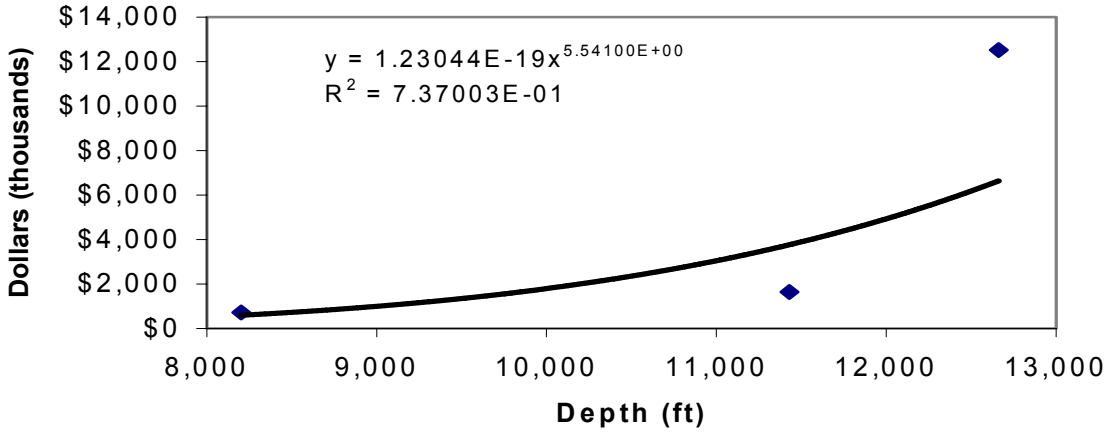




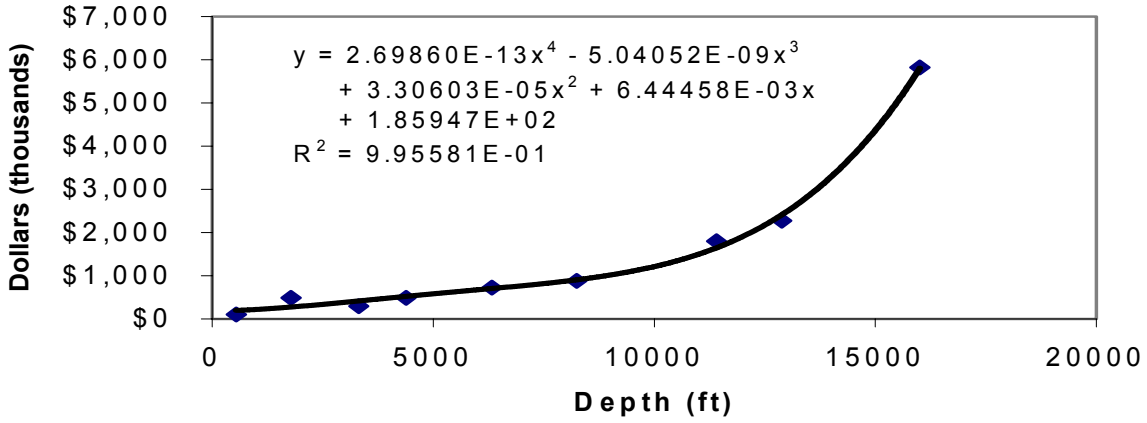
Texas District 8A

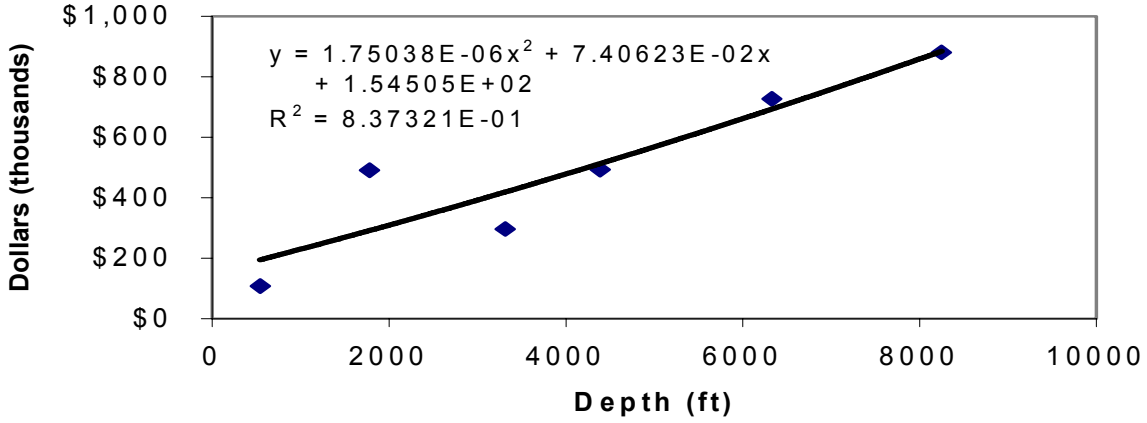


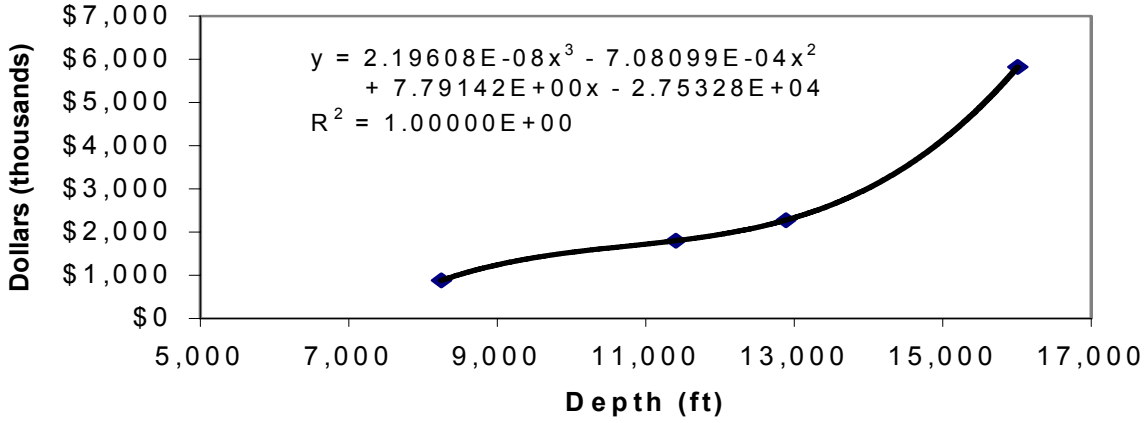




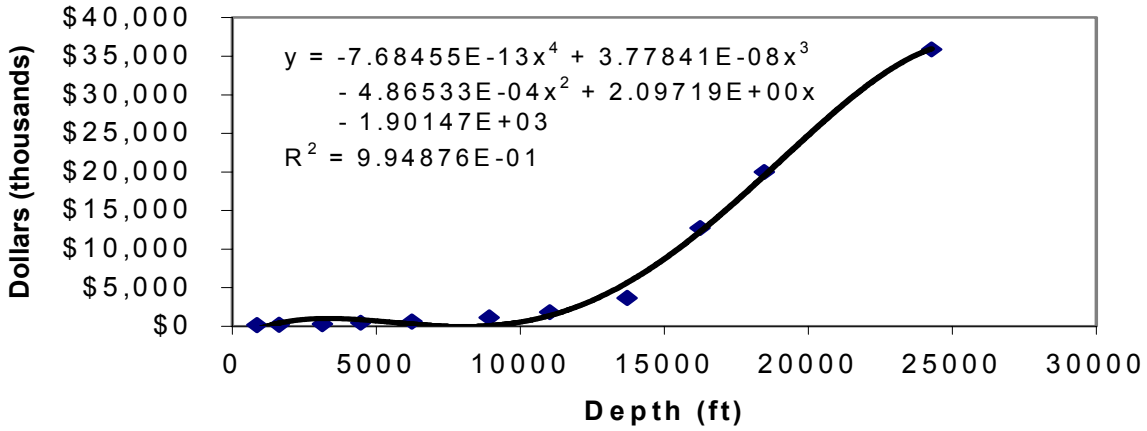
Utah

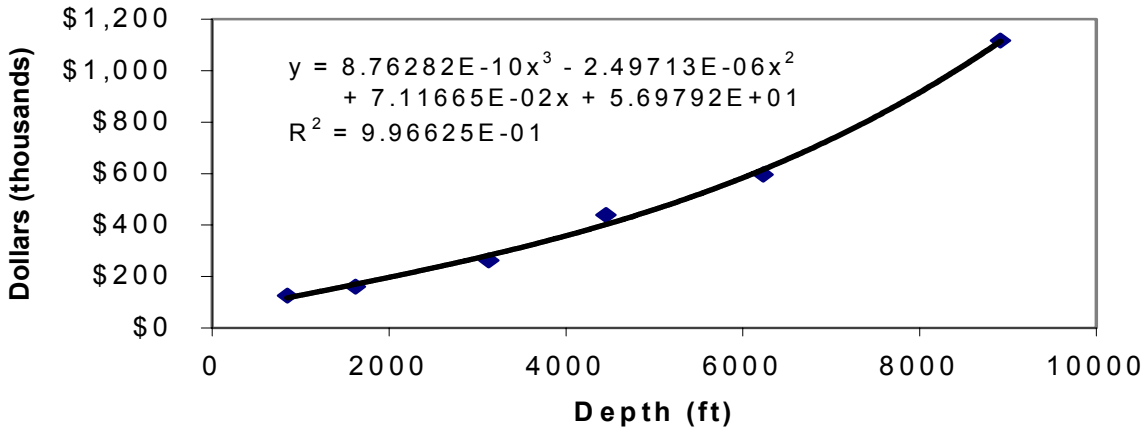

$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 2.69860E-13x^4 - 5.04052E-09x^3
+ 3.30603E-05x^2 + 6.44458E-03x
+ 1.85947E+02
R^2 = 9.95581E-01
0
5000
10000
15000
20000
Depth (ft)

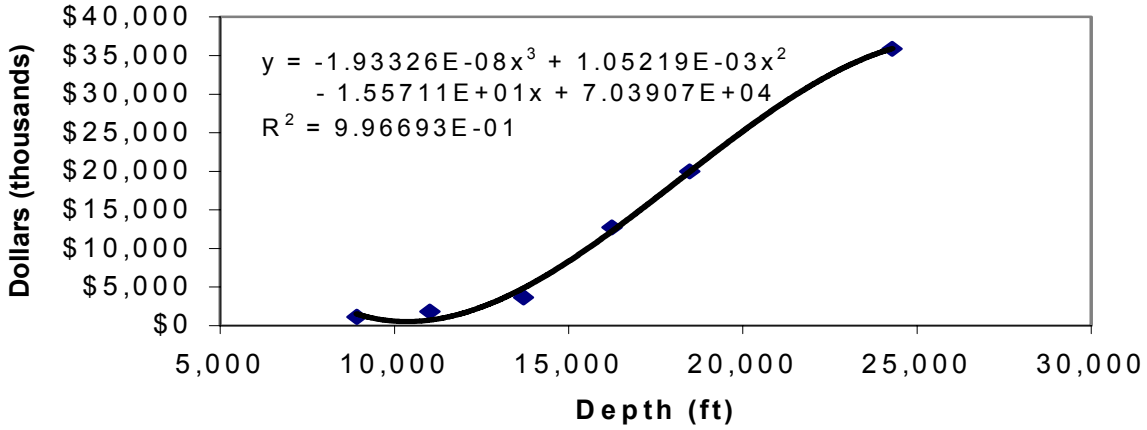

$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 1.75038E-06x^2 + 7.40623E-02x
+ 1.54505E+02
R^2 = 8.37321E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 2.19608E-08x^3 - 7.08099E-04x^2
+ 7.79142E+00x - 2.75328E+04
R^2 = 1.00000E+00
5,000
7,000
9,000
11,000
13,000
15,000
17,000
Depth (ft)

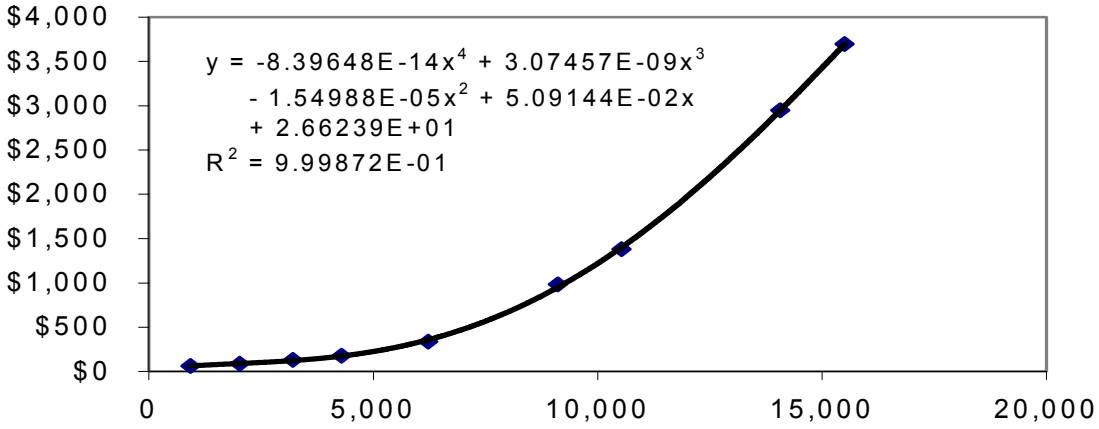
Wyoming

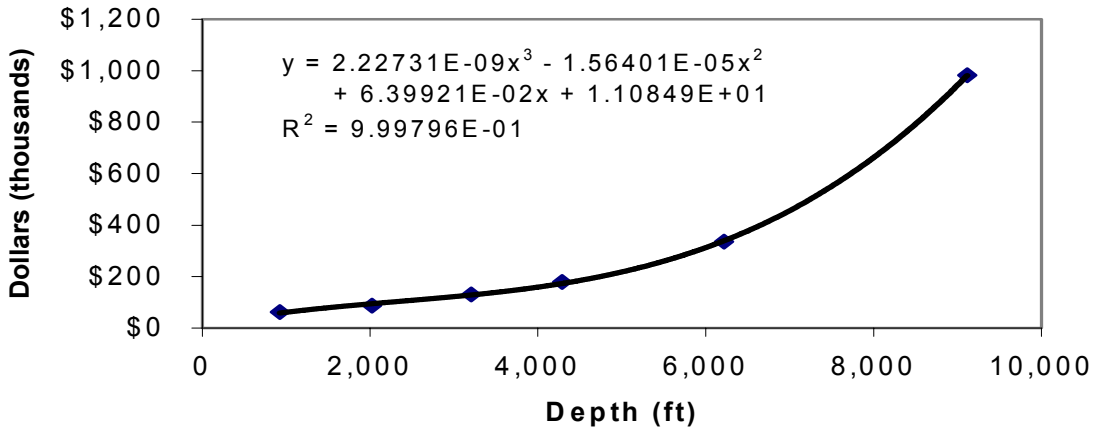

$40,000
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = -7.68455E-13x^4 + 3.77841E-08x^3
- 4.86533E-04x^2 + 2.09719E+00x
- 1.90147E+03
R^2 = 9.94876E-01
0
5000
10000
15000
20000
25000
30000
Depth (ft)

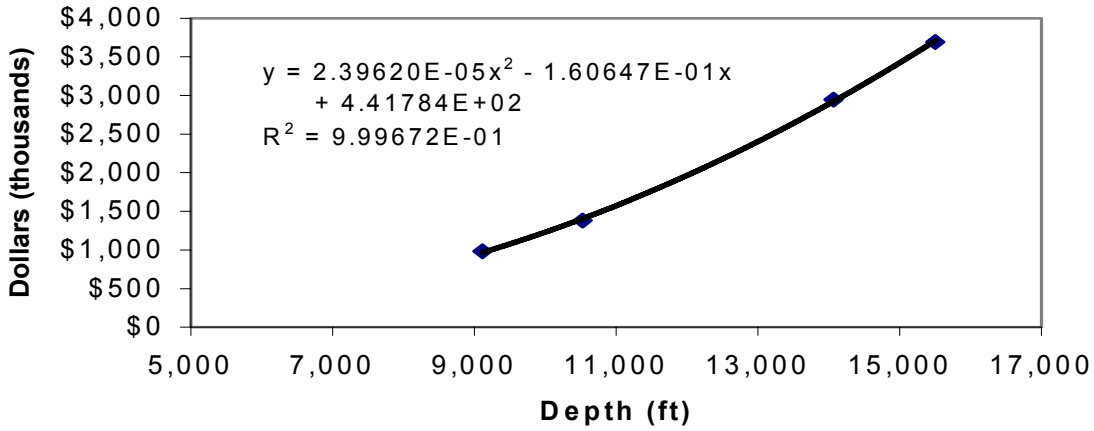

$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 8.76282E-10x^3 - 2.49713E-06x^2
+ 7.11665E-02x + 5.69792E+01
R^2 = 9.96625E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$40,000
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = -1.93326E-08x^3 + 1.05219E-03x^2
- 1.55711E+01x + 7.03907E+04
R^2 = 9.96693E-01
5,000
10,000
15,000
20,000
25,000
30,000
Depth (ft)

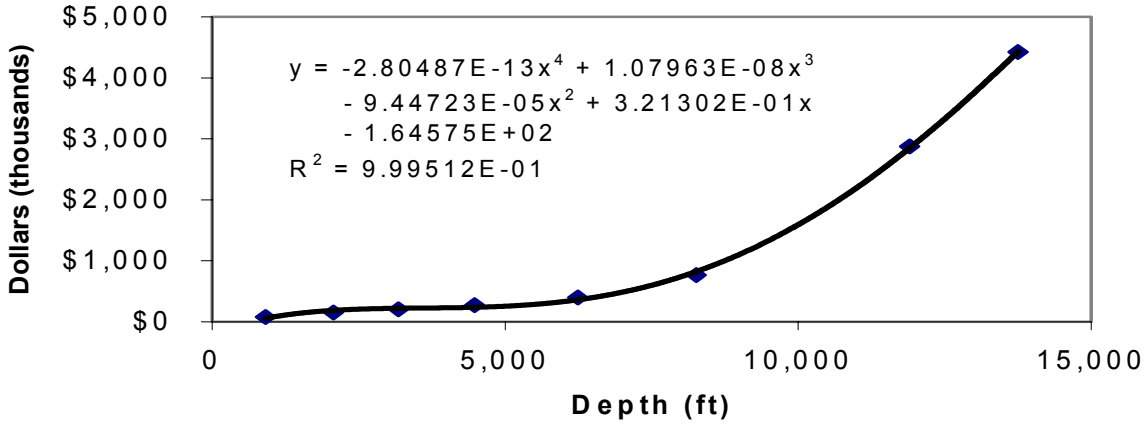
North Louisiana

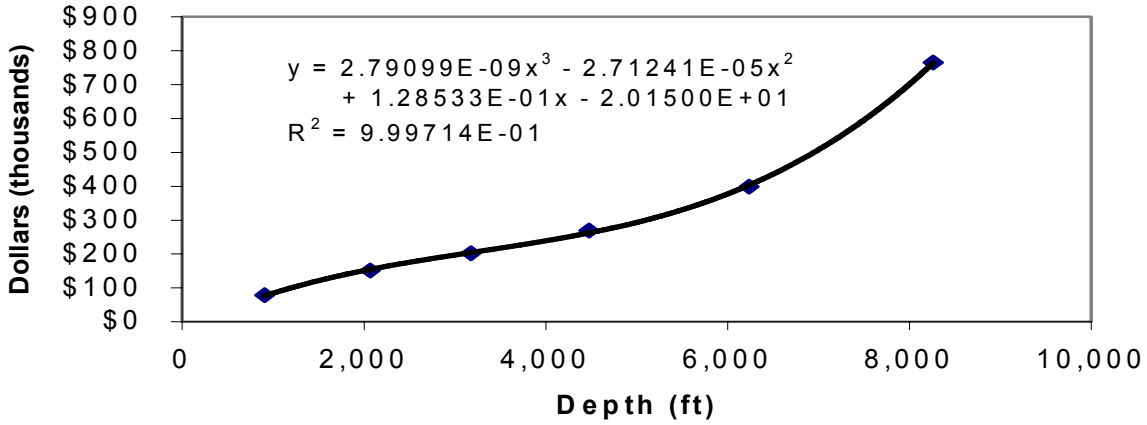


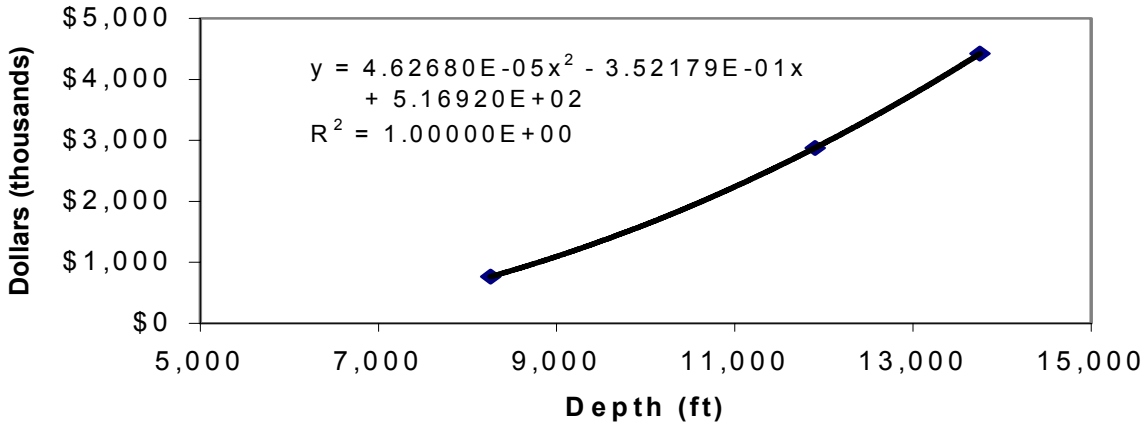




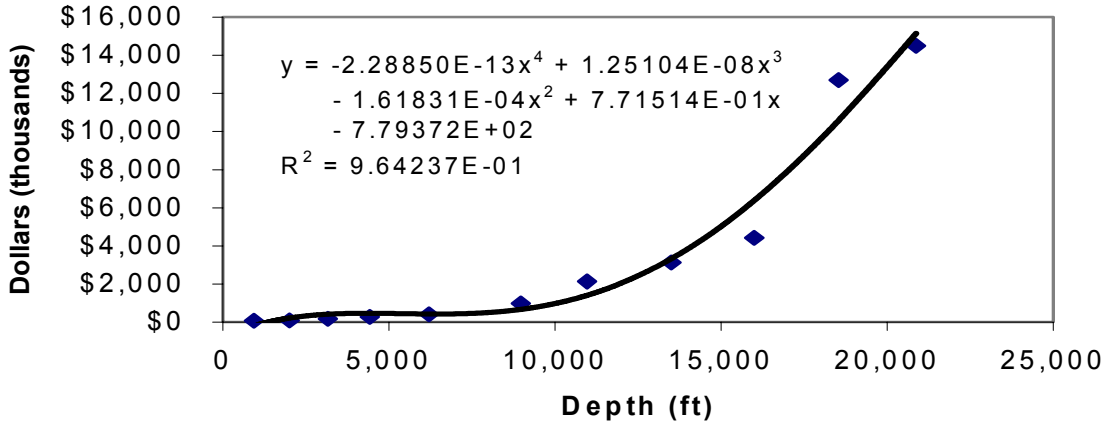
Arkansas

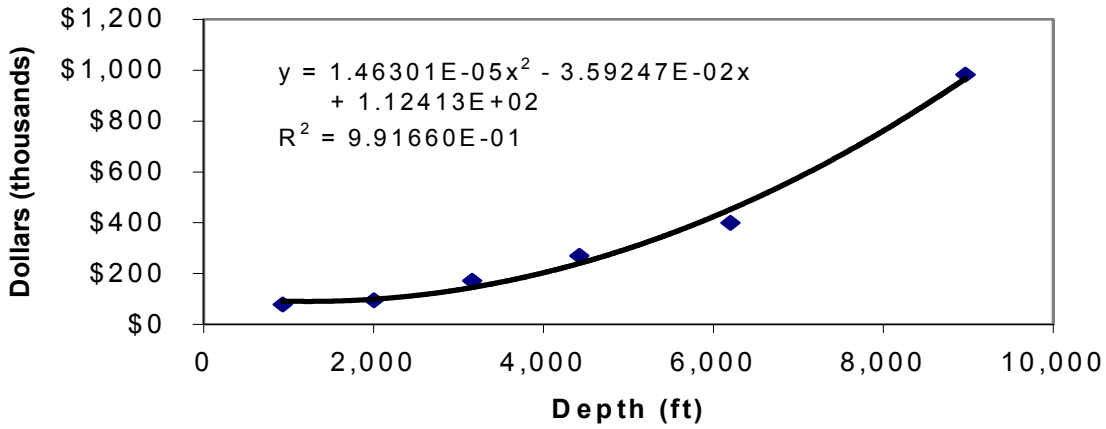

$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = -2.80487E-13x^4 + 1.07963E-08x^3
- 9.44723E-05x^2 + 3.21302E-01x
- 1.64575E+02
R^2 = 9.99512E-01
0
5,000
10,000
15,000
Depth (ft)

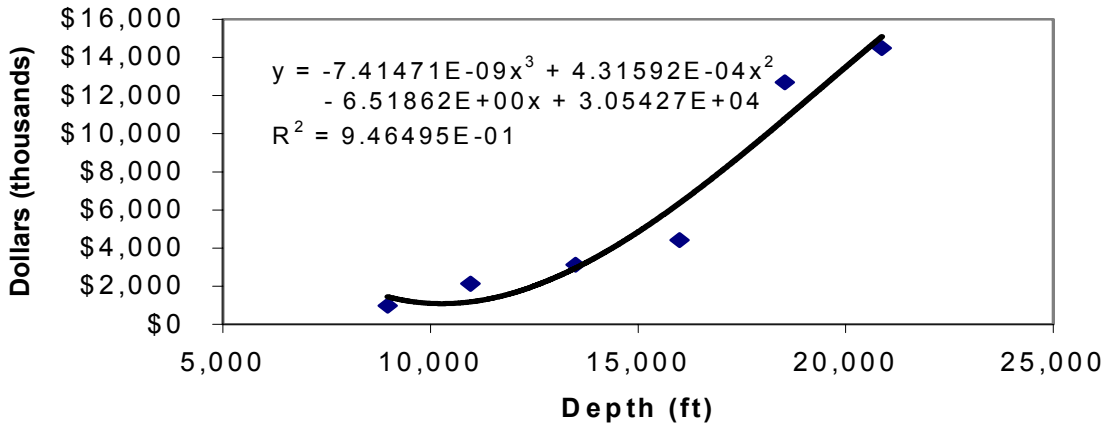

$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 2.79099E-09x^3 - 2.71241E-05x^2
+ 1.28533E-01x - 2.01500E+01
R^2 = 9.99714E-01
0
2,000
4,000
6,000
8,000
10,000
Depth (ft)


$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 4.62680E-05x^2 - 3.52179E-01x
+ 5.16920E+02
R^2 = 1.00000E+00
5,000
7,000
9,000
11,000
13,000
15,000
Depth (ft)

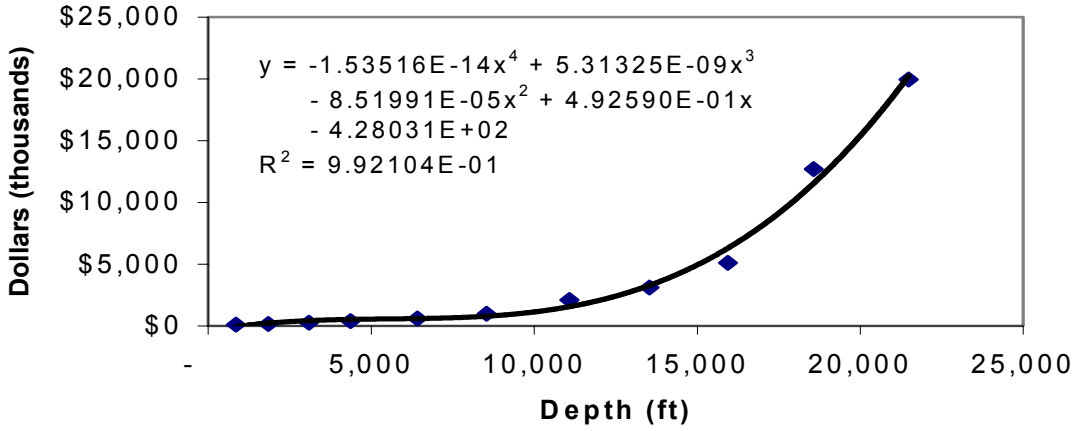
Total Wells Surveyed Southeast United States

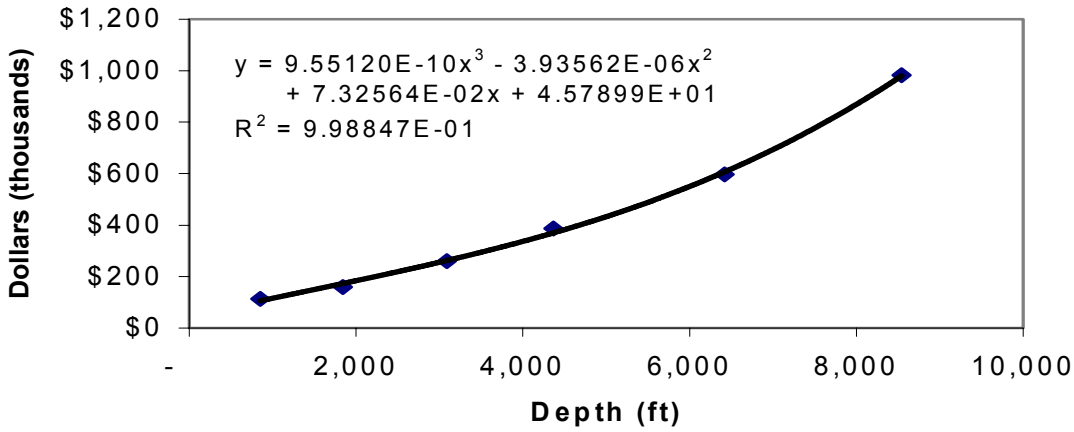


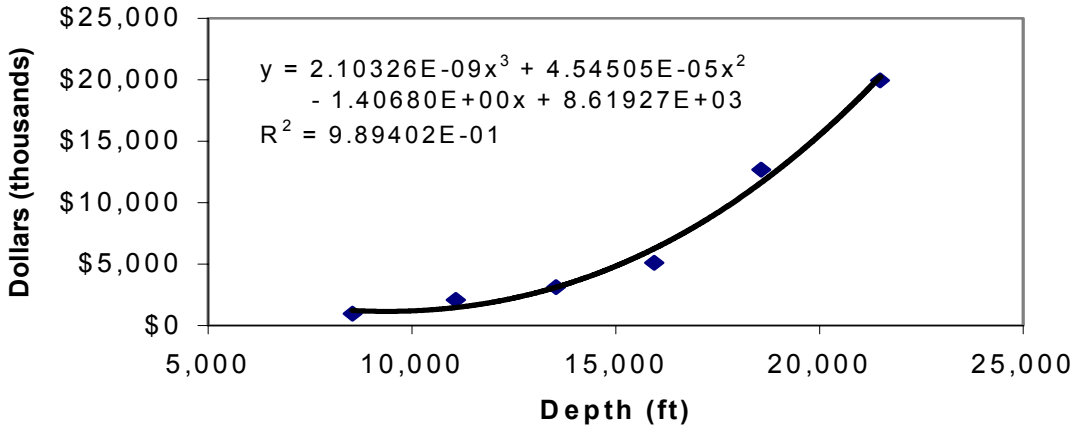




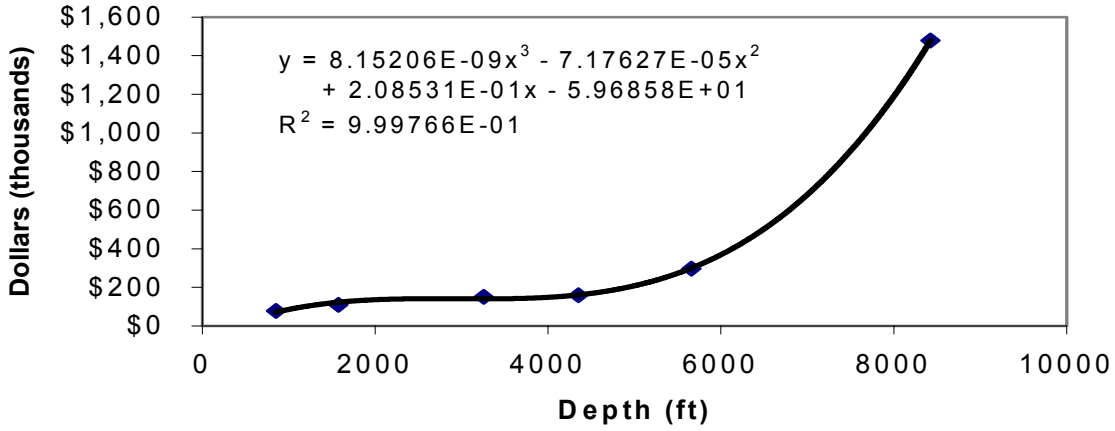
Total Wells Surveyed Western and Southeast United States



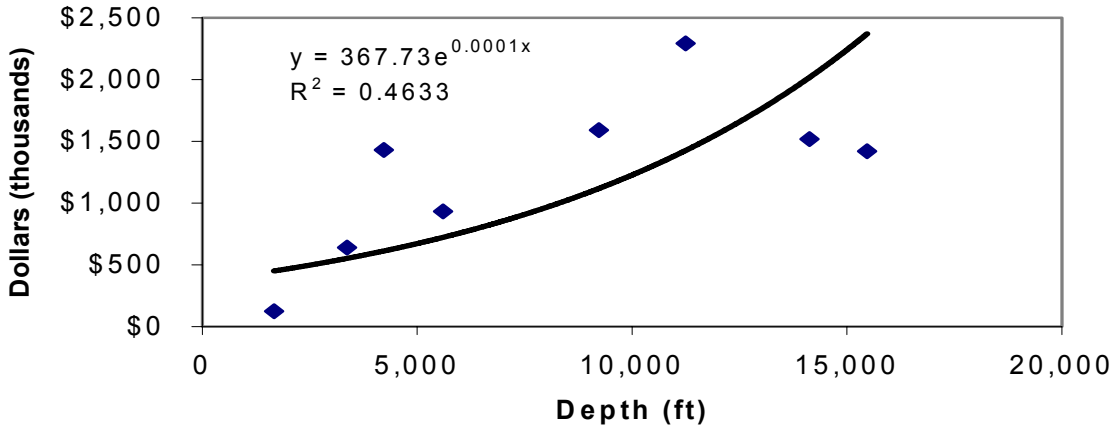




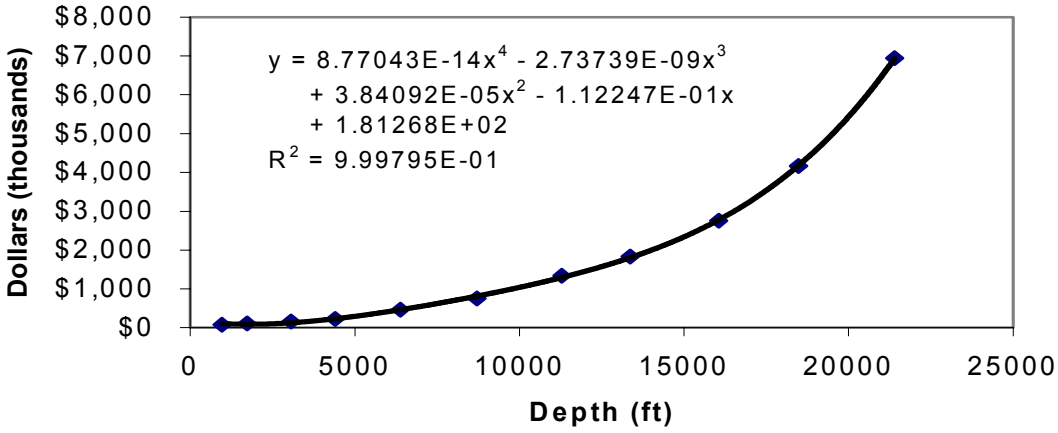
Kansas

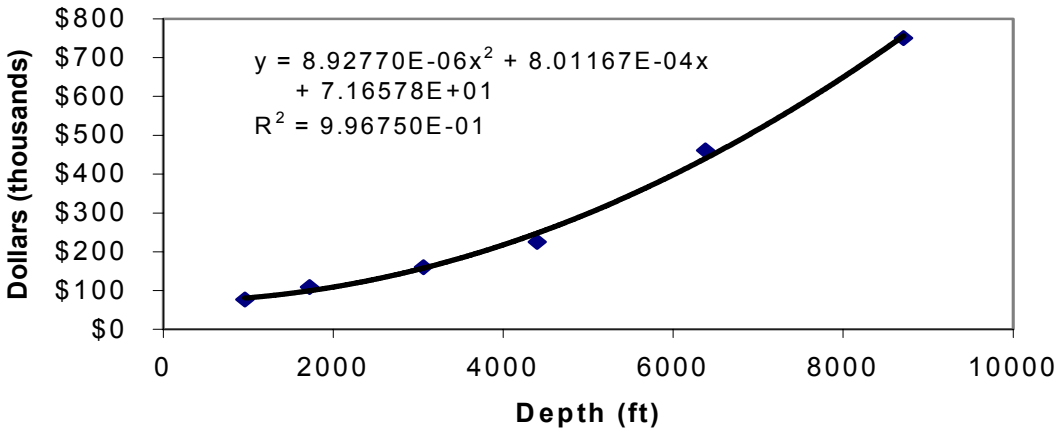


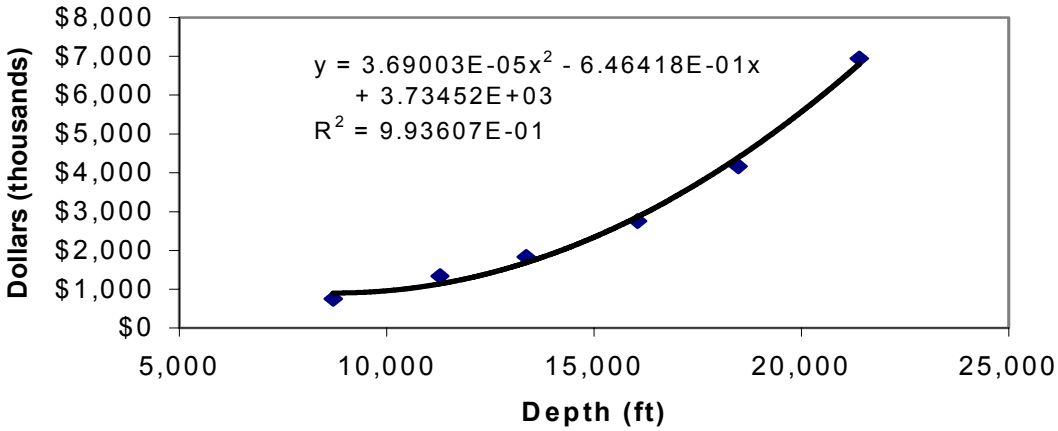
North Dakota



Oklahoma

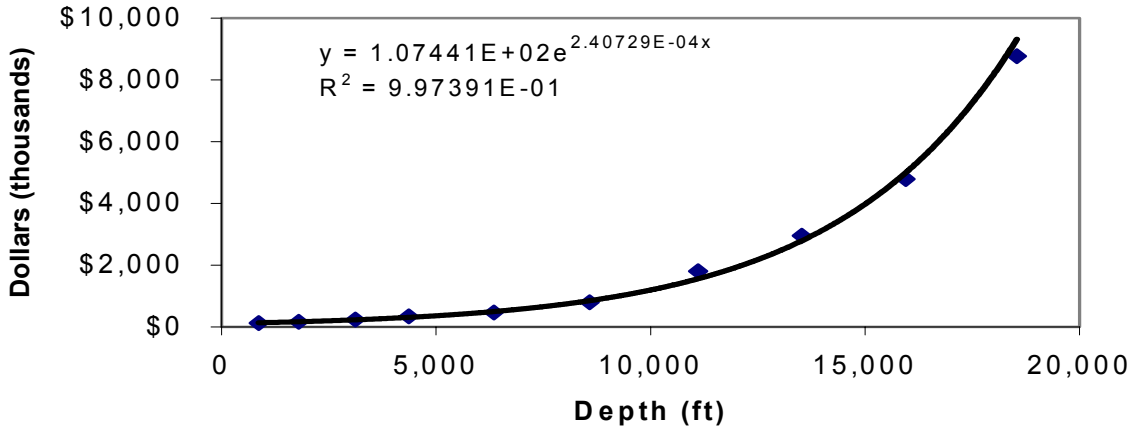

$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 8.77043E-14x^4 - 2.73739E-09x^3
+ 3.84092E-05x^2 - 1.12247E-01x
+ 1.81268E+02
R^2 = 9.99795E-01
0
5000
10000
15000
20000
25000
Depth (ft)

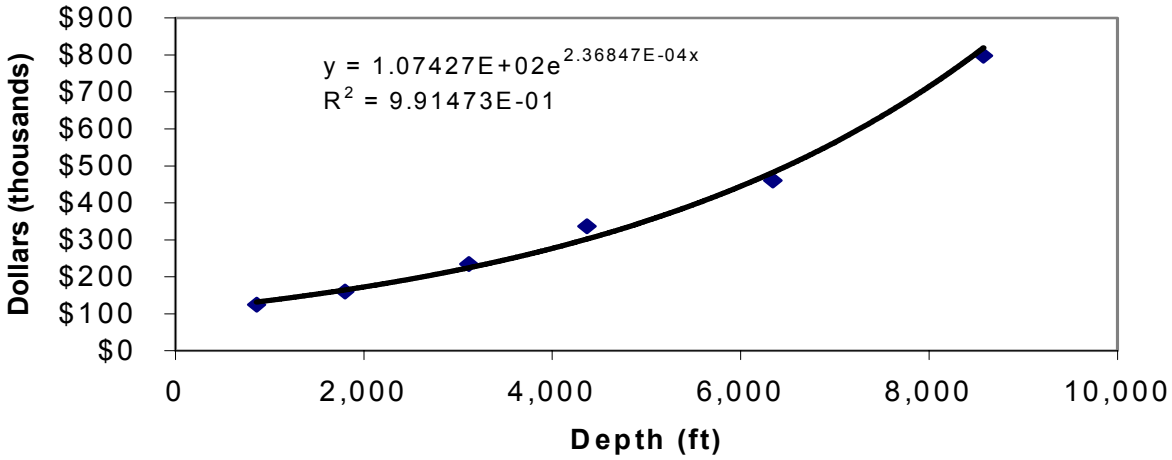

$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 8.92770E-06x^2 + 8.01167E-04x
+ 7.16578E+01
R^2 = 9.96750E-01
0
2000
4000
6000
8000
10000
Depth (ft)

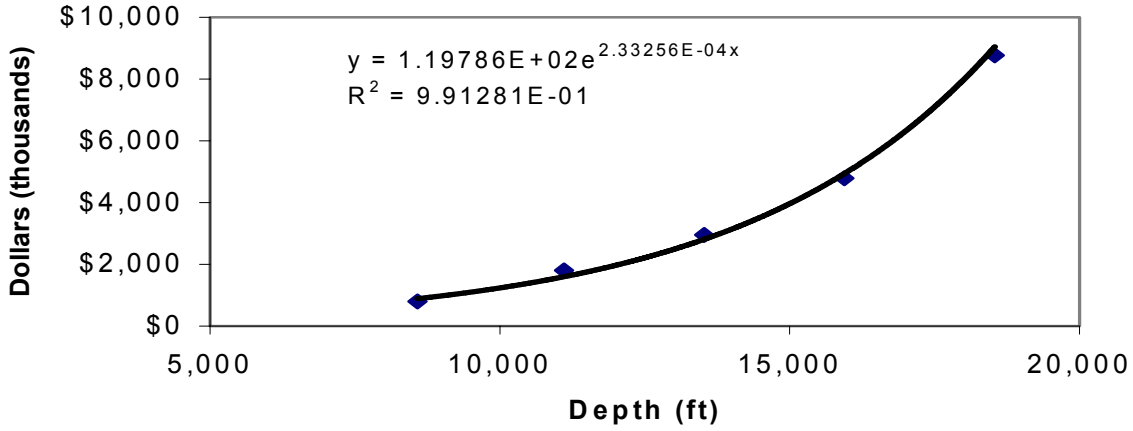

$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 3.69003E-05x^2 - 6.46418E-01x
+ 3.73452E+03
R^2 = 9.93607E-01
5,000
10,000
15,000
20,000
25,000
Depth (ft)

Exponential Curve Fitting Plots

Exponential Curve Fit For All Wells Surveyed

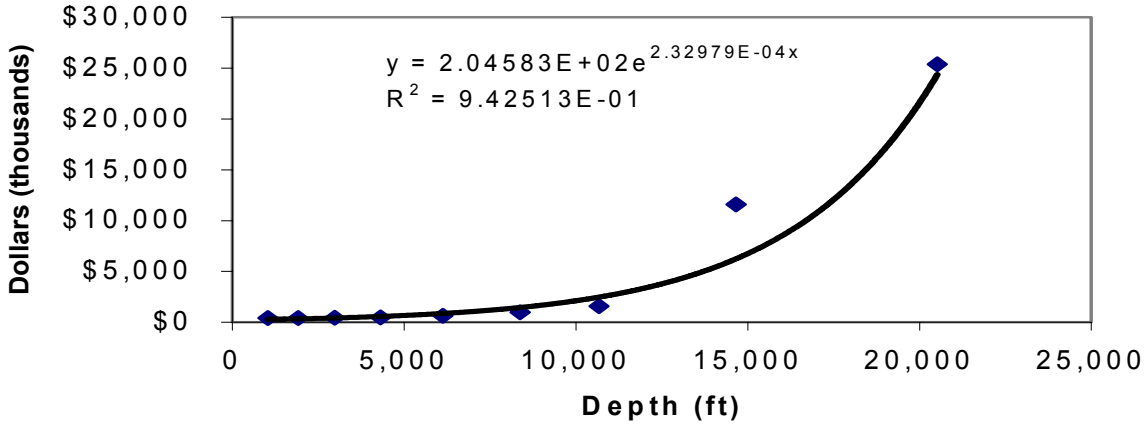


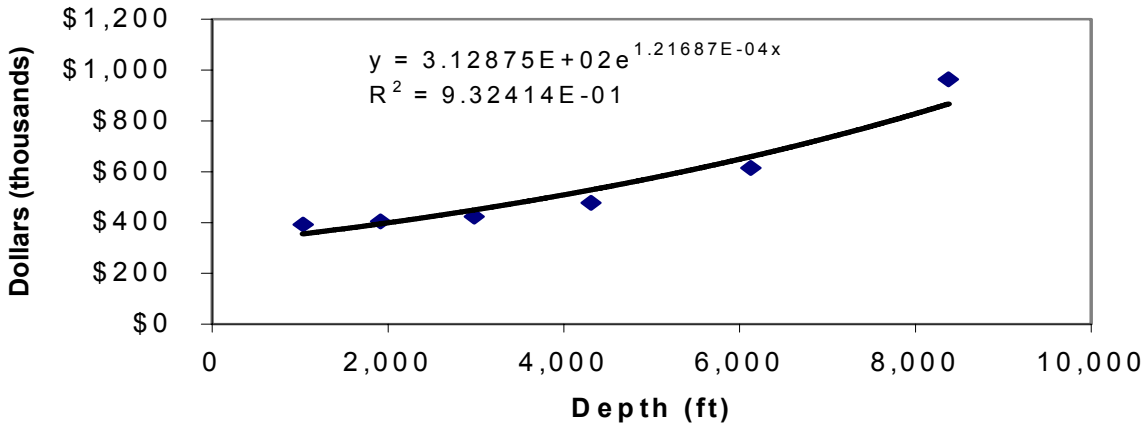


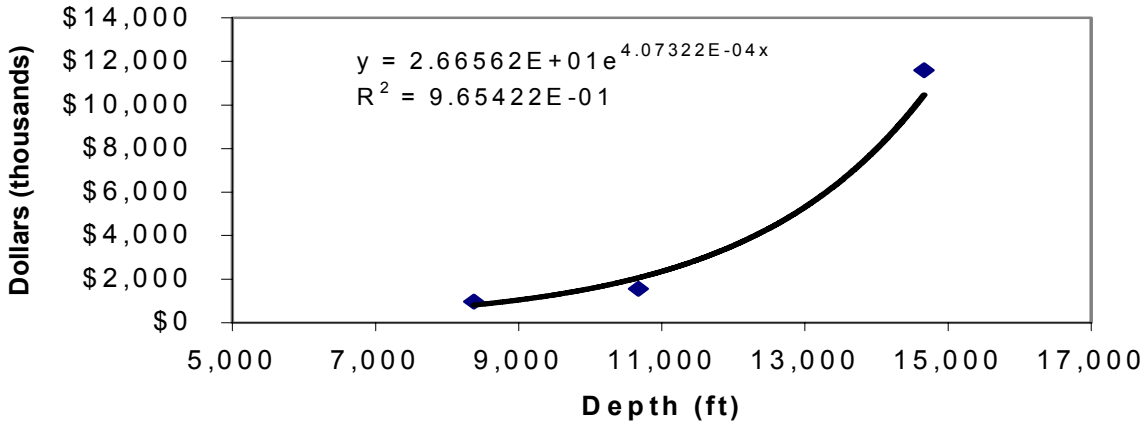


Western States

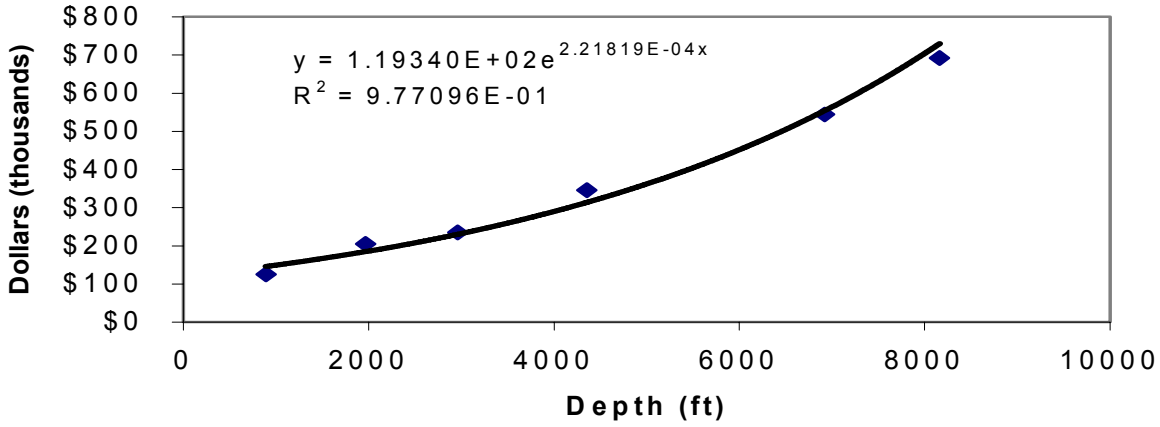
California onshore

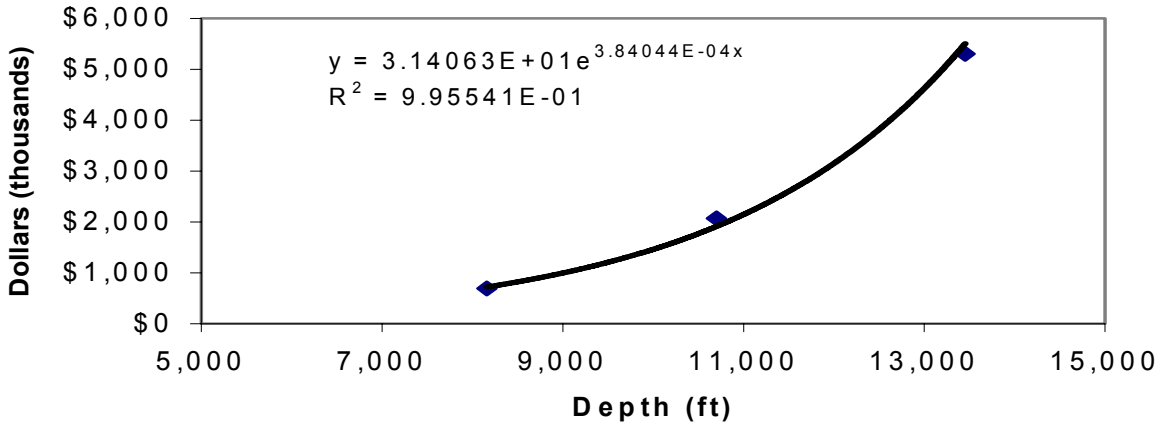


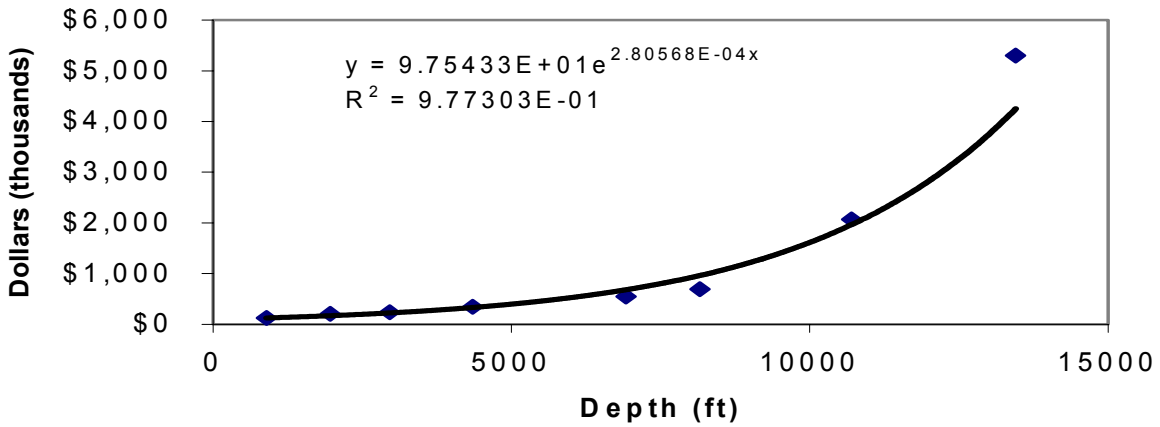




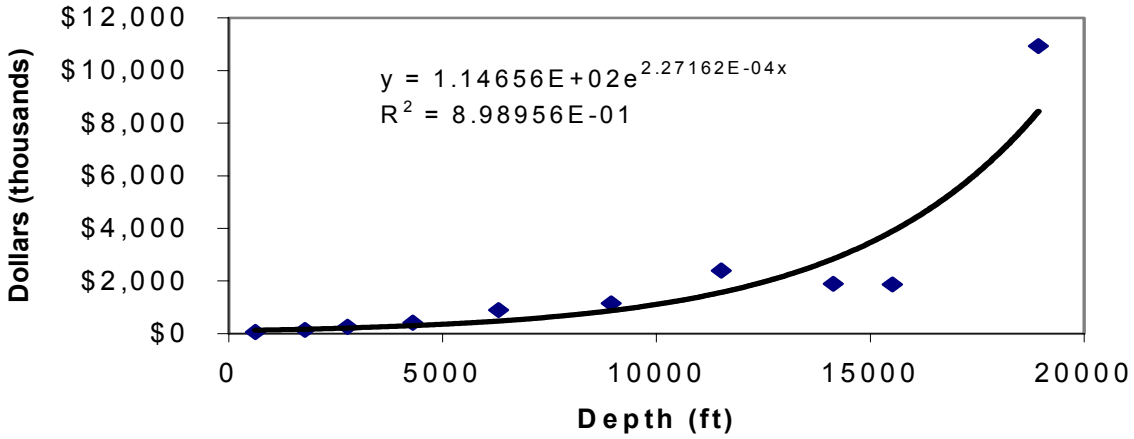
Colorado

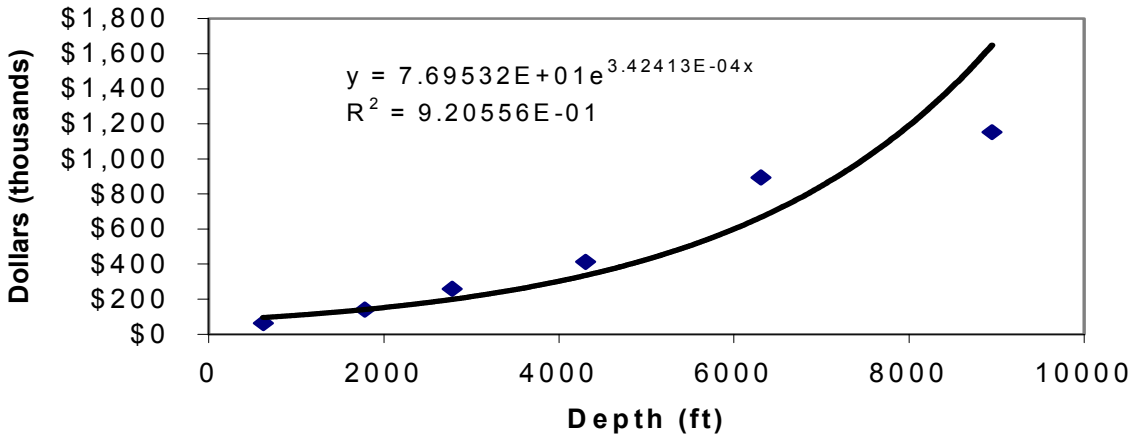

$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 1.19340E+02e2.21819E-04x
R2 = 9.77096E-01
0
2000
4000
6000
8000
10000
Depth (ft)

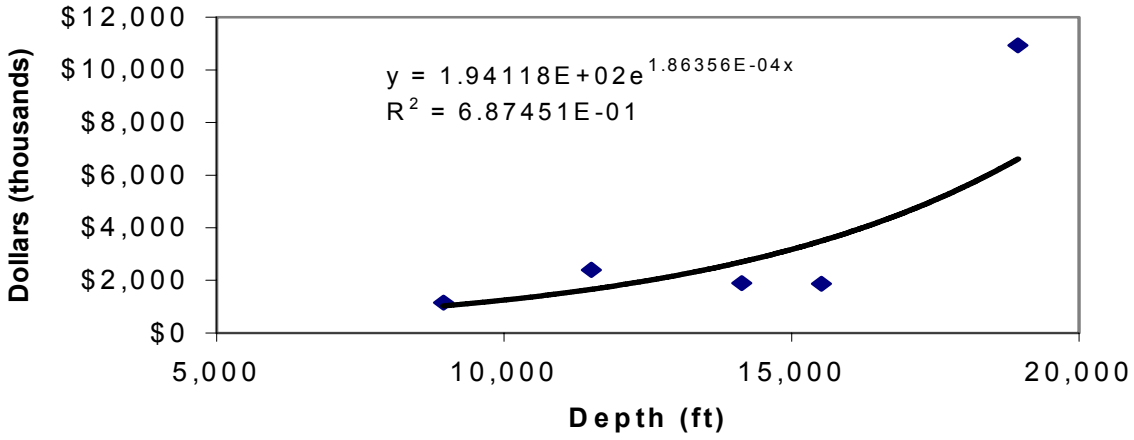

$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 3.14063E+01e3.84044E-04x
R2 = 9.95541E-01
5,000
7,000
9,000
11,000
13,000
15,000
Depth (ft)


$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 9.75433E+01e2.80568E-04x
R2 = 9.77303E-01
0
5000
10000
15000
Depth (ft)

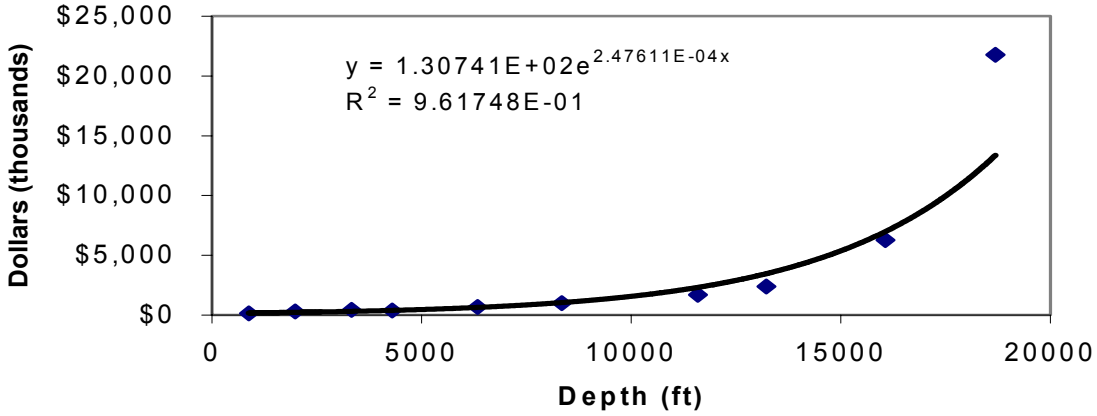
Montana

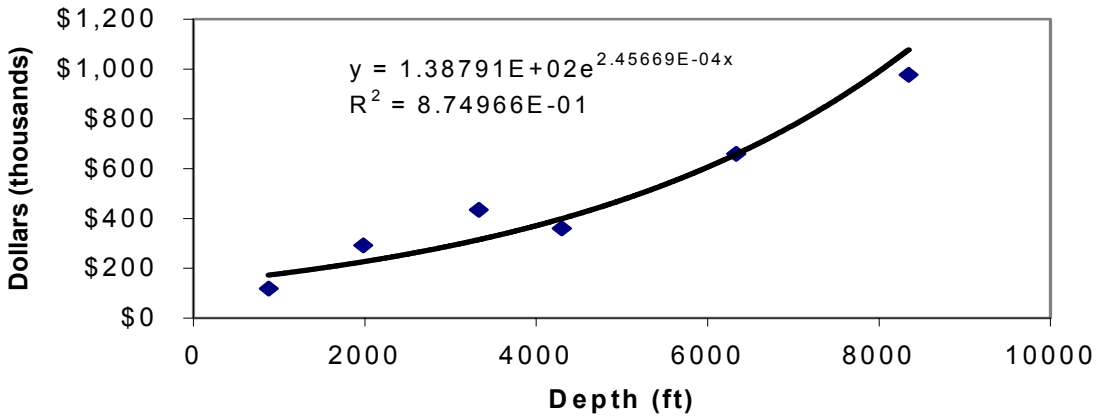

$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Dollars (thousands)
y = 1.14656E+02e2.27162E-04x
R2 = 8.98956E-01
0
5000
10000
15000
20000
Depth (ft)

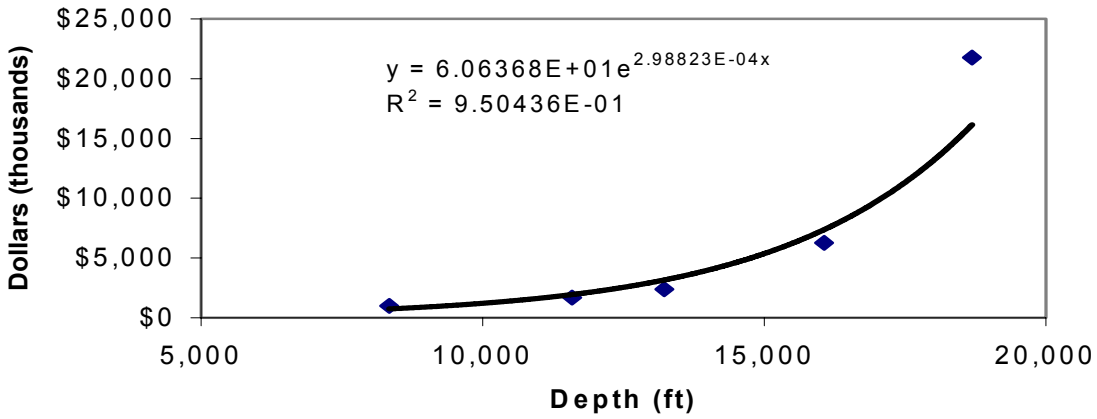

$1,800
$1,600
$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 7.69532E+01e3.42413E-04x
R2 = 9.20556E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Dollars (thousands)
y = 1.94118E+02e1.86356E-04x
R2 = 6.87451E-01
5,000
10,000
15,000
20,000
Depth (ft)

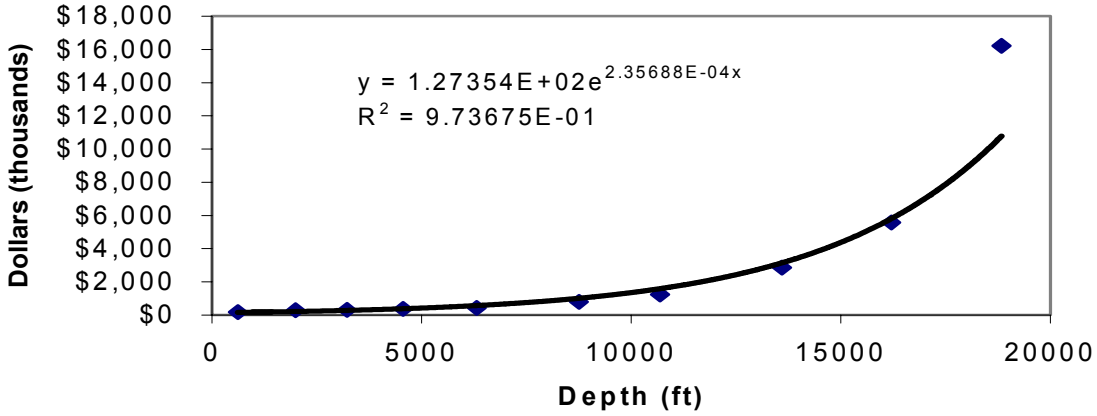
New Mexico

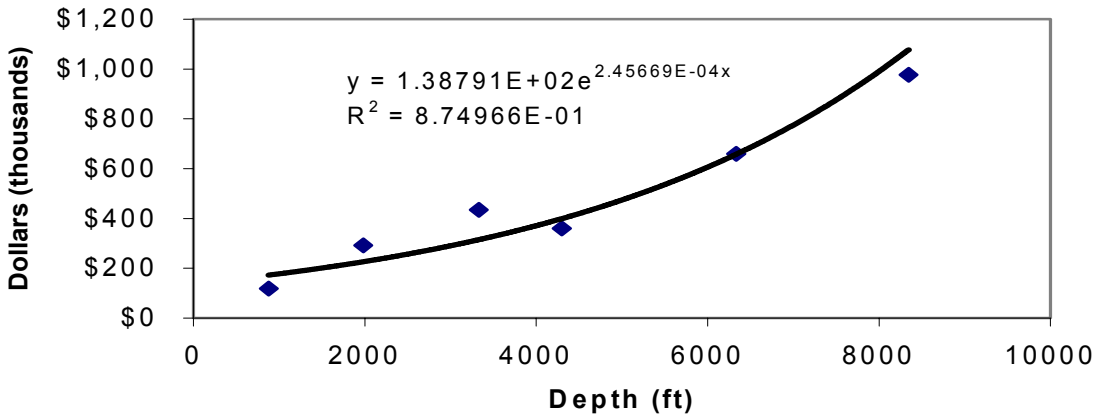

$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = 1.30741E+02e2.47611E-04x
R2 = 9.61748E-01
0
5000
10000
15000
20000
Depth (ft)

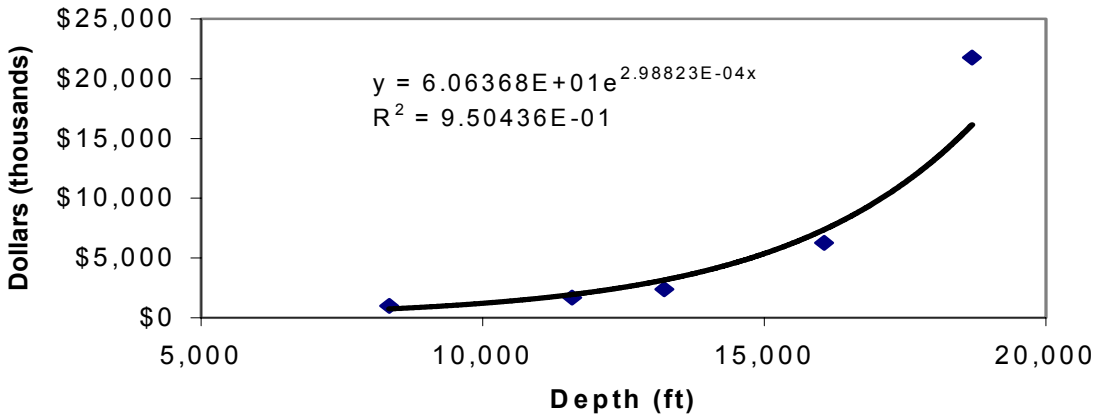

$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 1.38791E+02e2.45669E-04x
R2 = 8.74966E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = 6.06368E+01e2.98823E-04x
R2 = 9.50436E-01
5,000
10,000
15,000
20,000
Depth (ft)

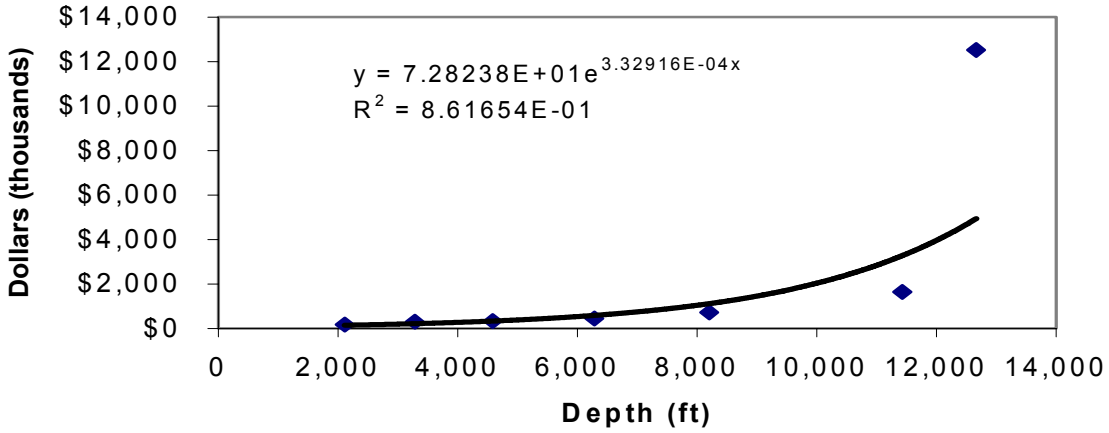
Texas District 8

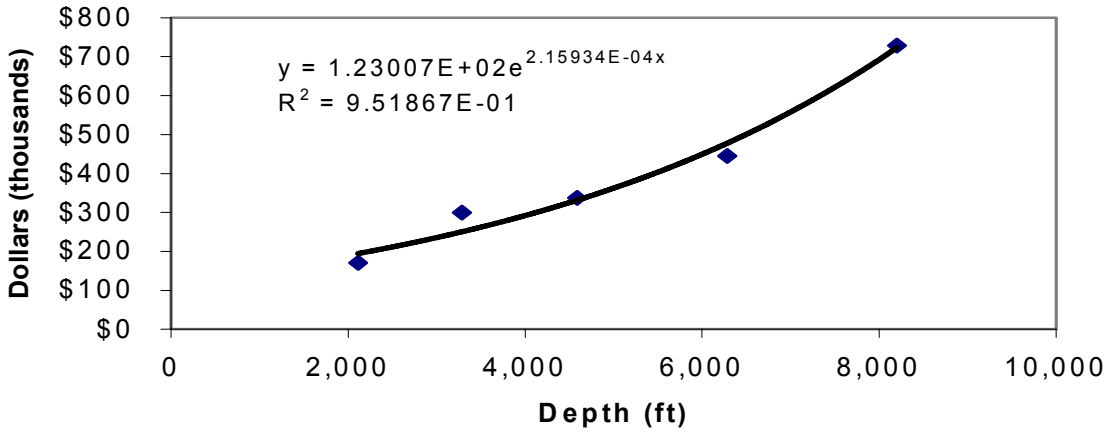


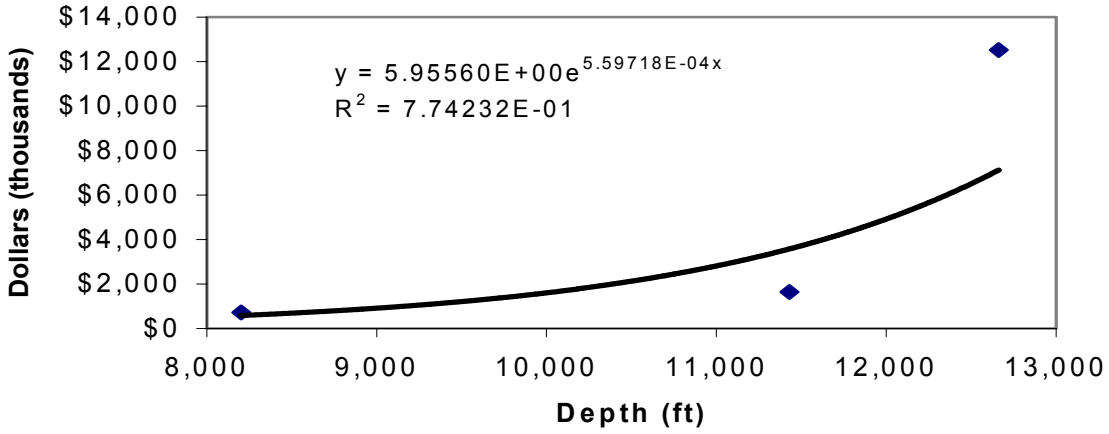




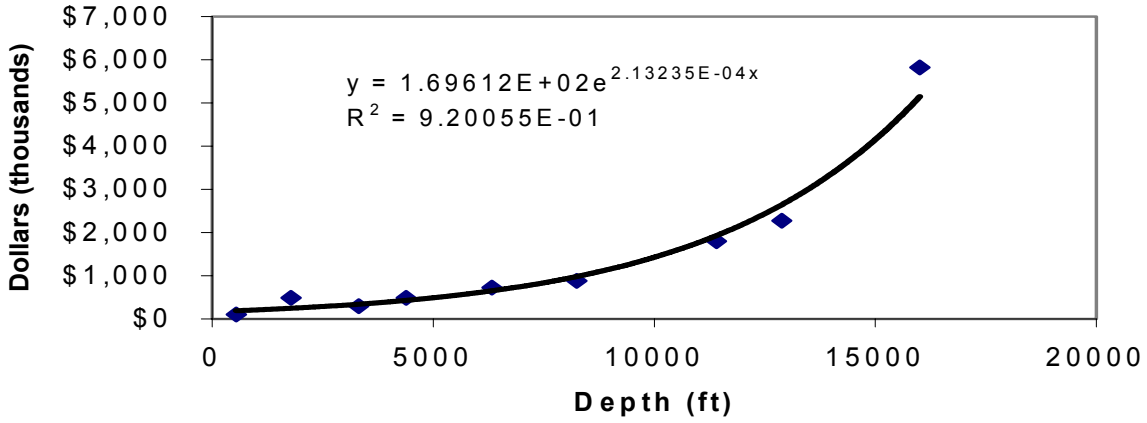
Texas District 8A

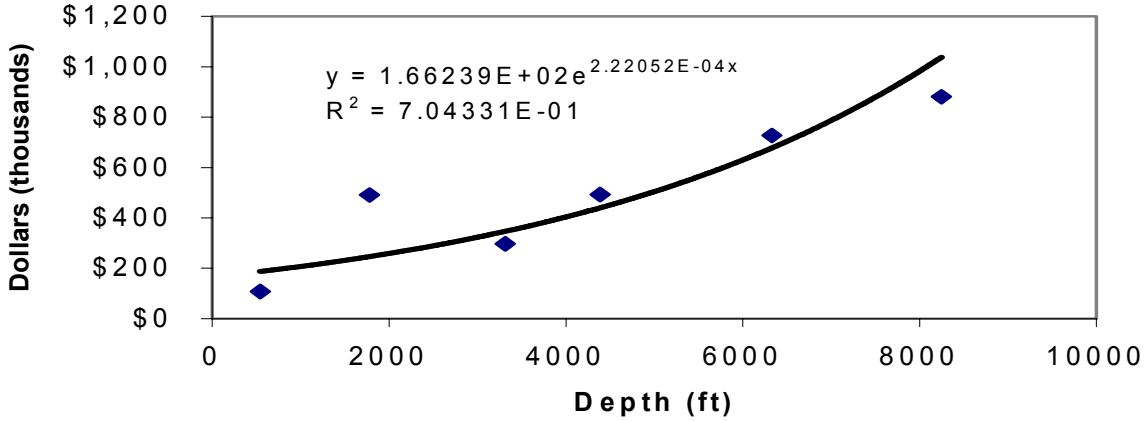


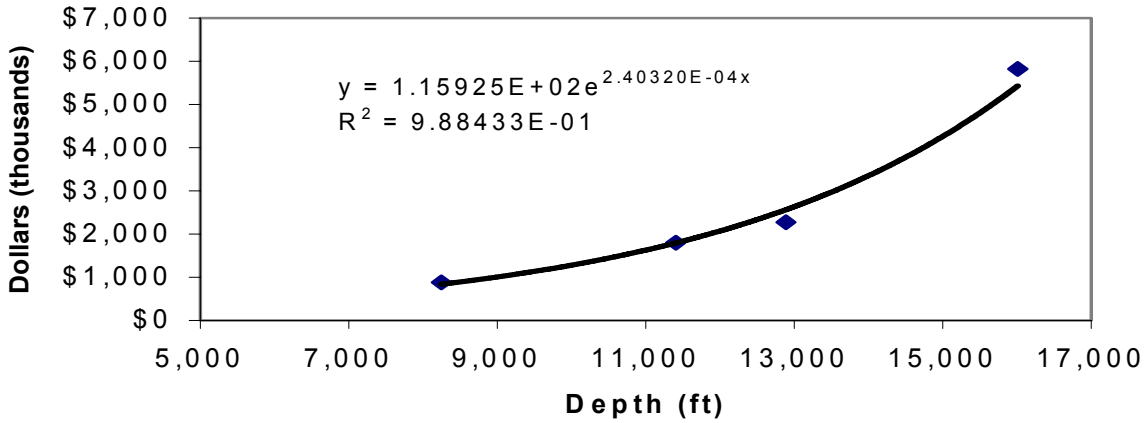




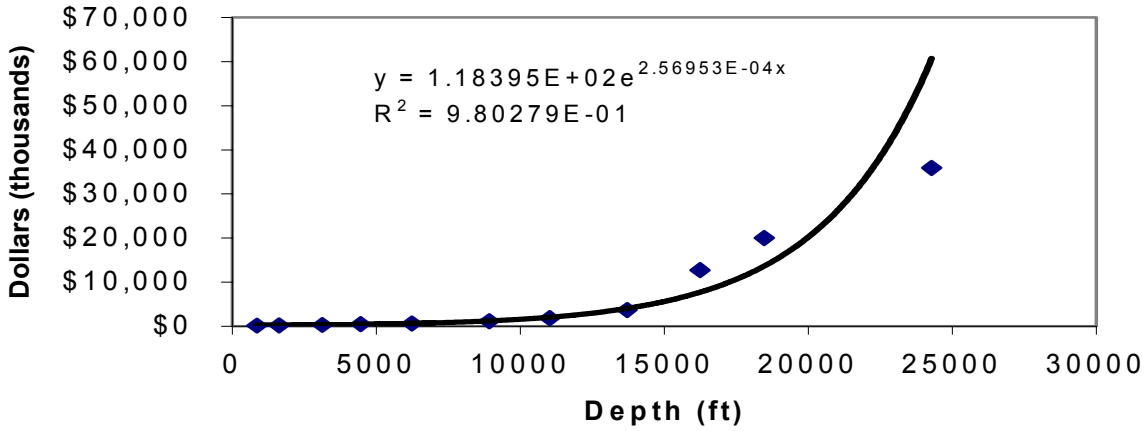
Utah

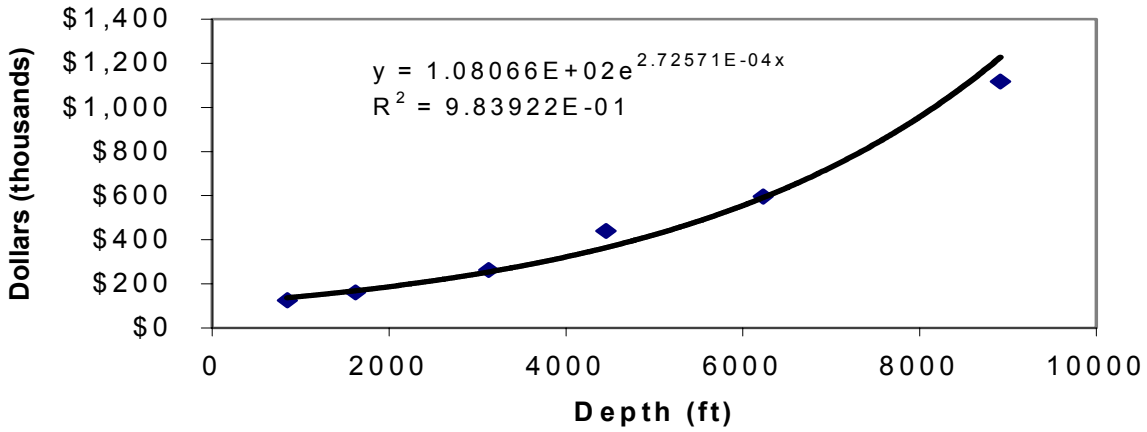

$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.69612E+02e2.13235E-04x
R2 = 9.20055E-01
0
5000
10000
15000
20000
Depth (ft)

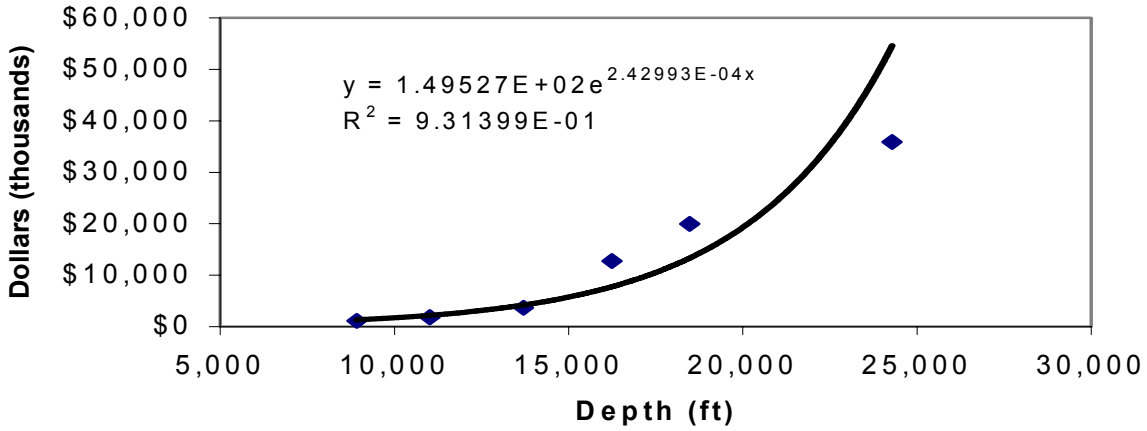

$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 1.66239E+02e2.22052E-04x
R2 = 7.04331E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.15925E+02e2.40320E-04x
R2 = 9.88433E-01
5,000
7,000
9,000
11,000
13,000
15,000
17,000
Depth (ft)

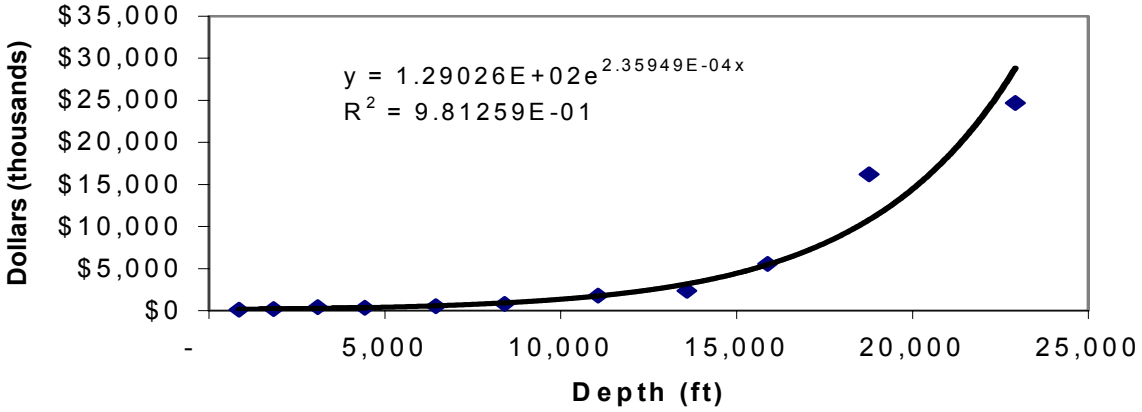
Wyoming

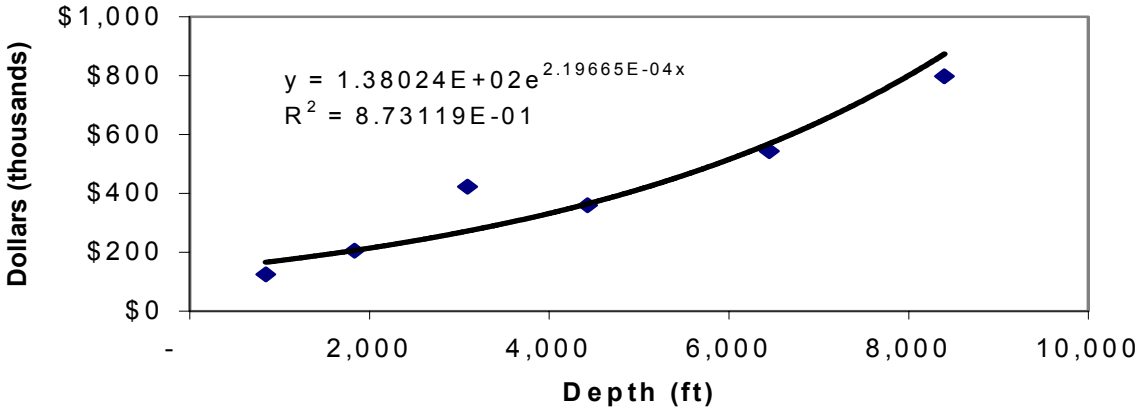

$70,000
$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
Dollars (thousands)
y = 1.18395E+02e2.56953E-04x
R2 = 9.80279E-01
0
5000
10000
15000
20000
25000
30000
Depth (ft)

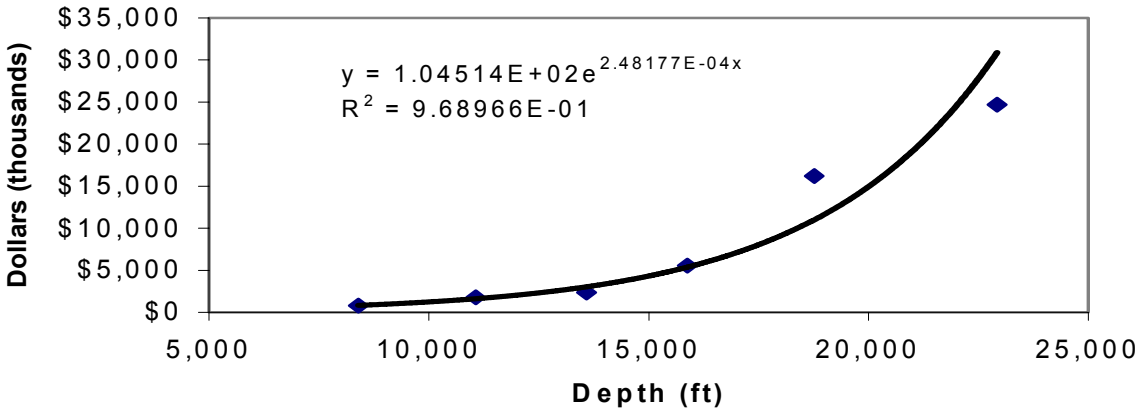

$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 1.08066E+02e2.72571E-04x
R2 = 9.83922E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
Dollars (thousands)
y = 1.49527E+02e2.42993E-04x
R2 = 9.31399E-01
5,000
10,000
15,000
20,000
25,000
30,000
Depth (ft)

Western U.S. States total wells surveyed

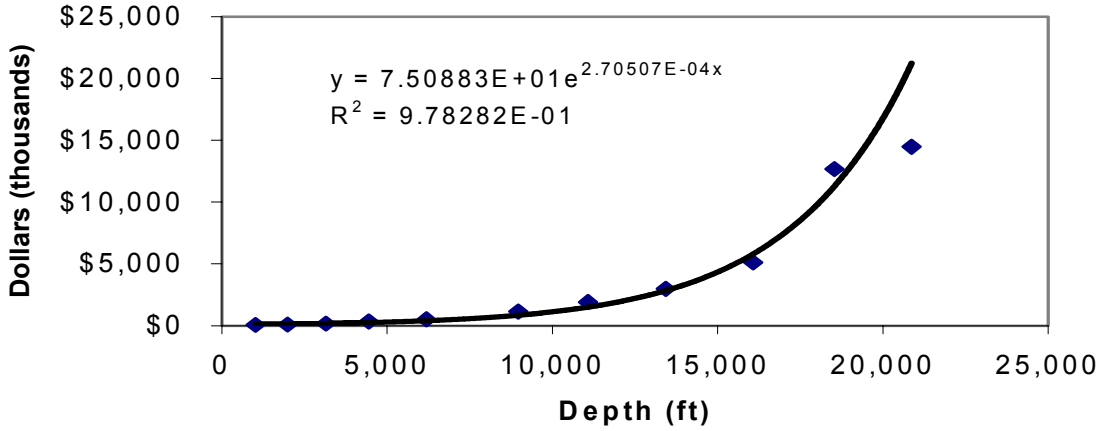


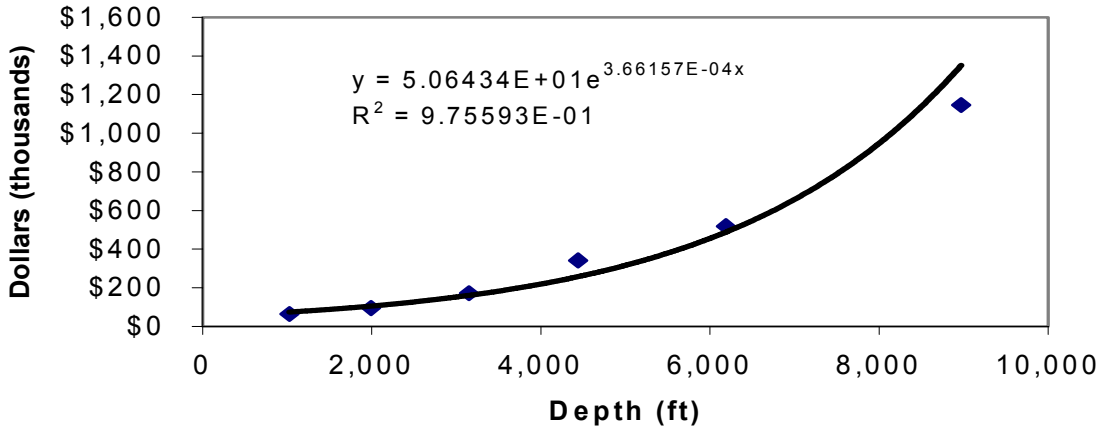


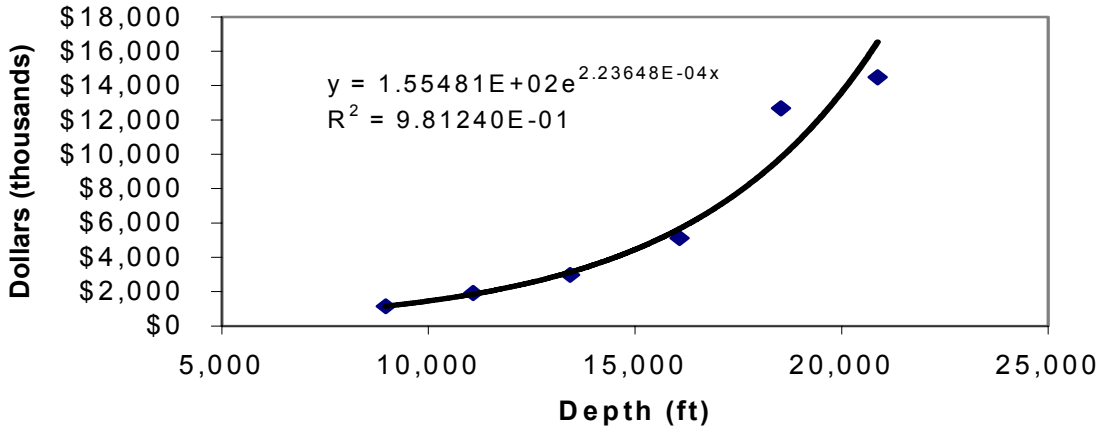


Southeast United States

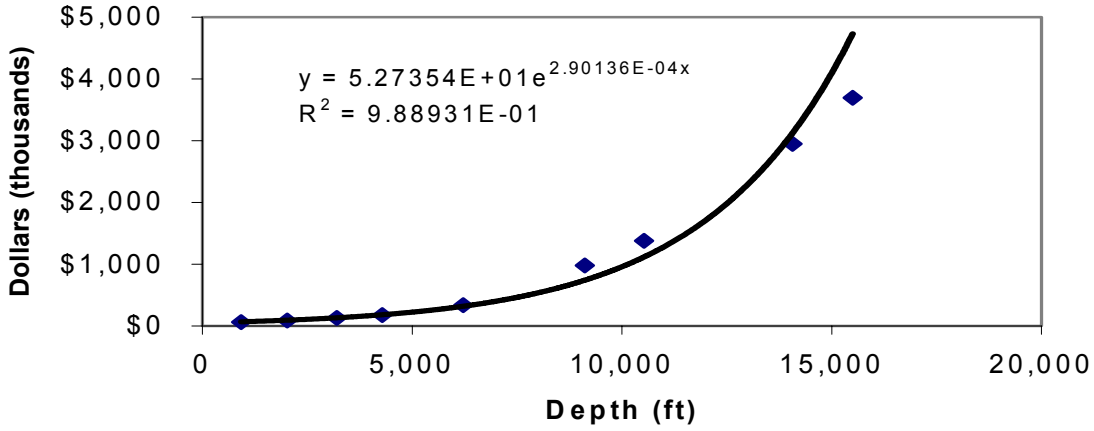
Texas Districts 2, 3 and 4

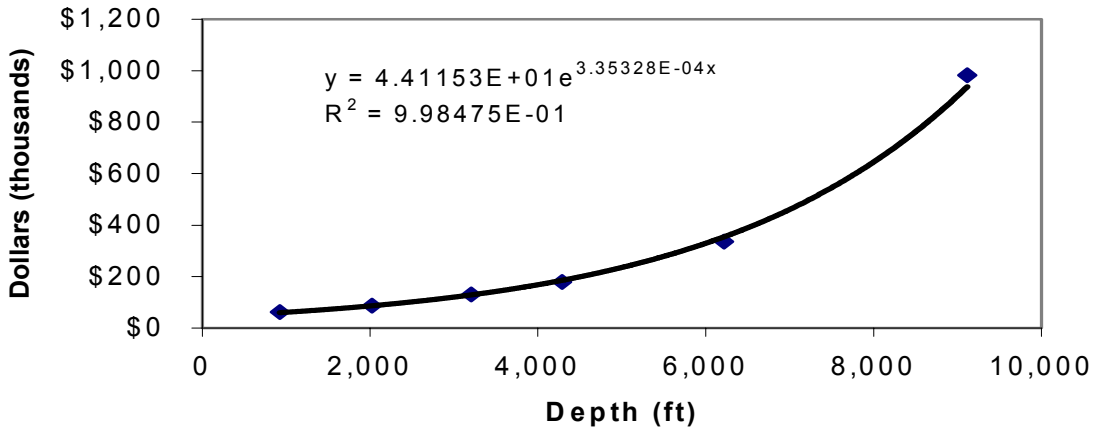


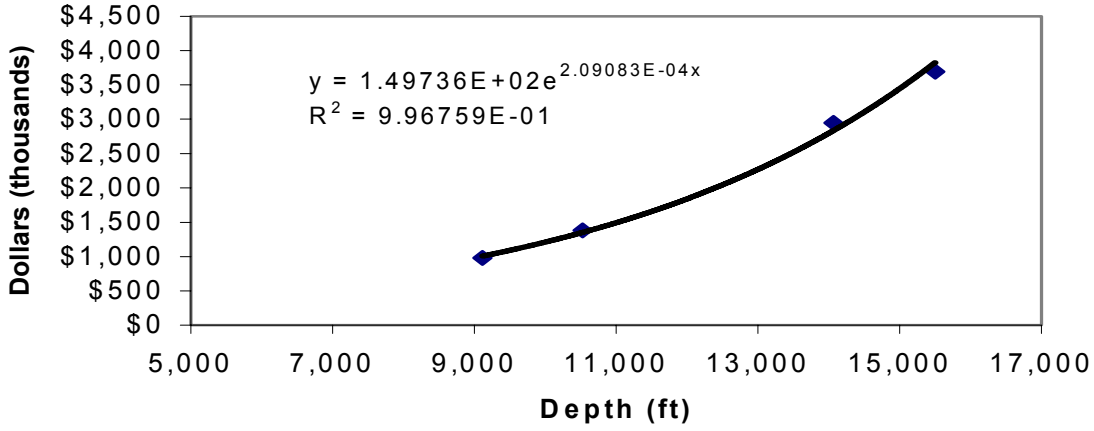




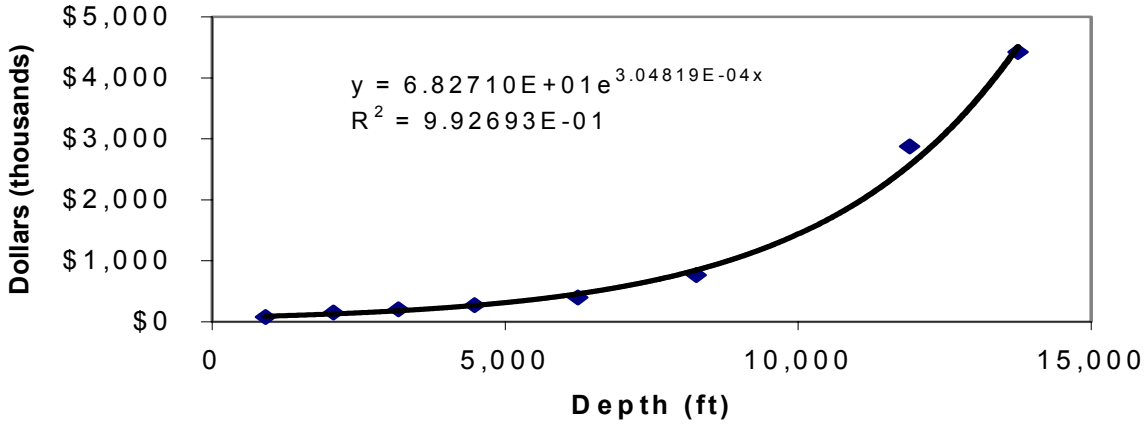
North Louisiana

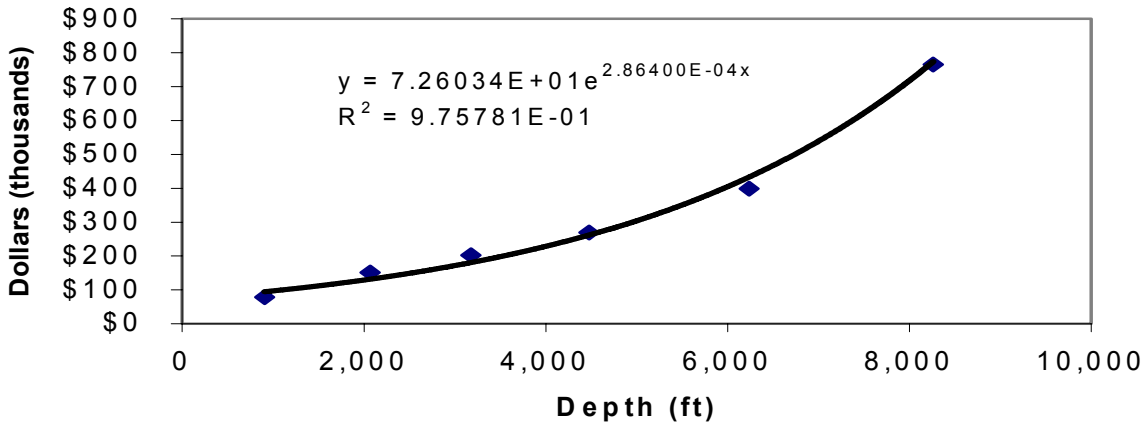


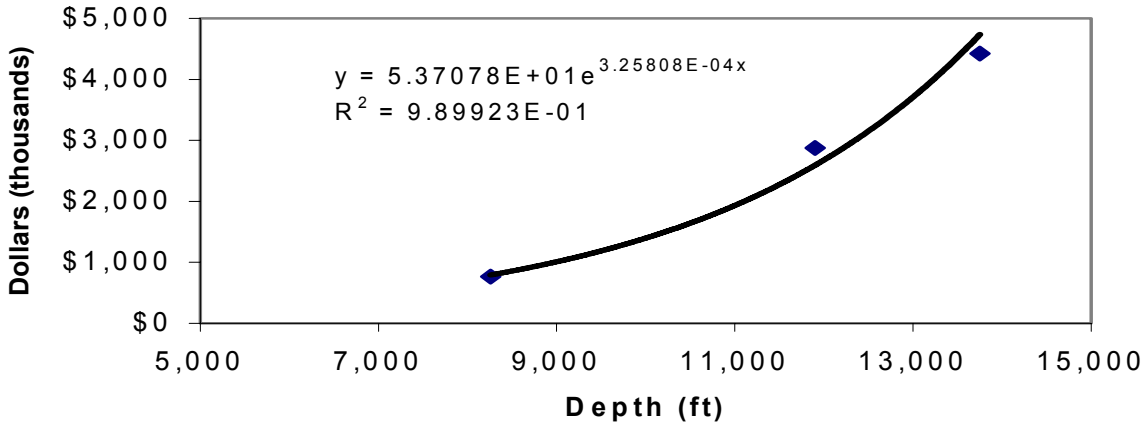




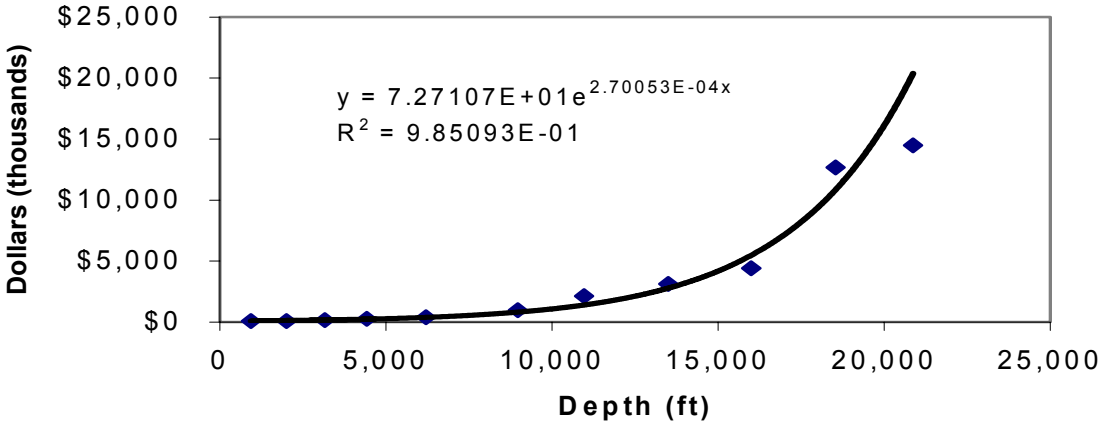
Arkansas

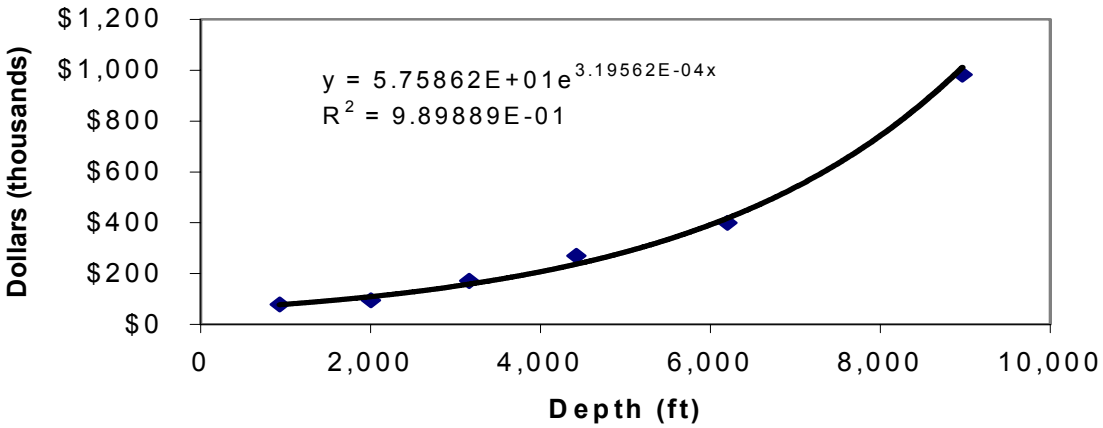

$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 6.82710E+01e3.04819E-04x
R2 = 9.92693E-01
0
5,000
10,000
15,000
Depth (ft)

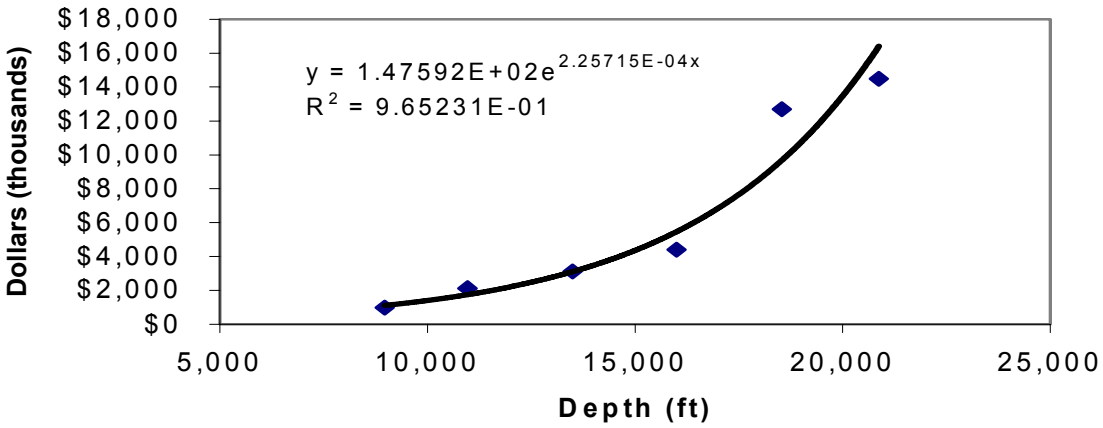

$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 7.26034E+01e2.86400E-04x
R2 = 9.75781E-01
0
2,000
4,000
6,000
8,000
10,000
Depth (ft)


$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 5.37078E+01e3.25808E-04x
R2 = 9.89923E-01
5,000
7,000
9,000
11,000
13,000
15,000
Depth (ft)

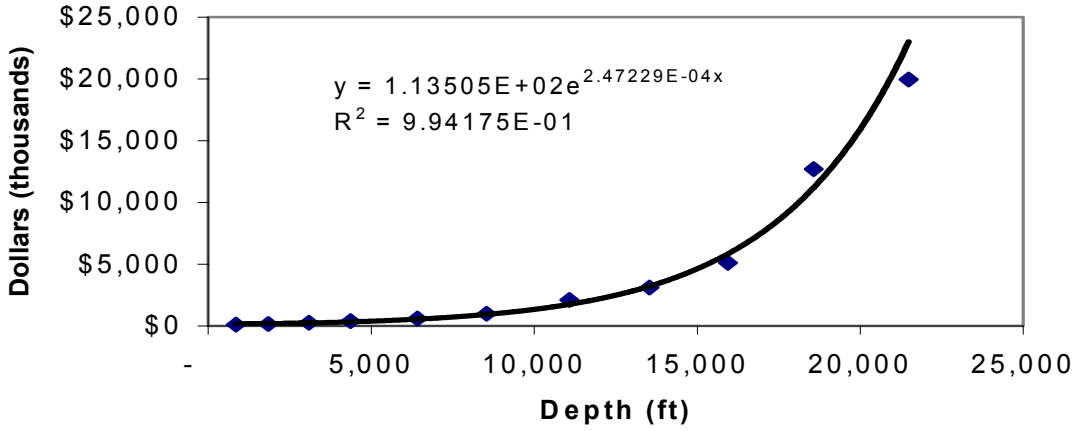
Total Wells Surveyed Southeast United States

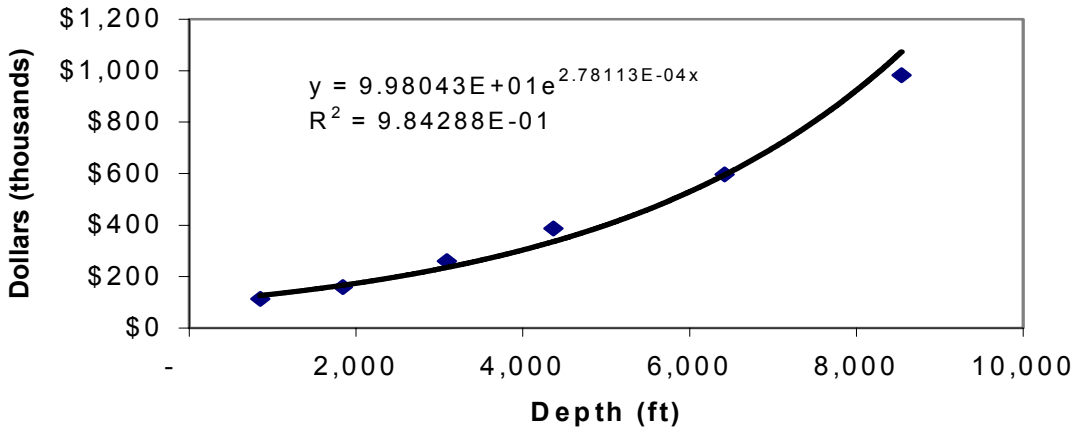


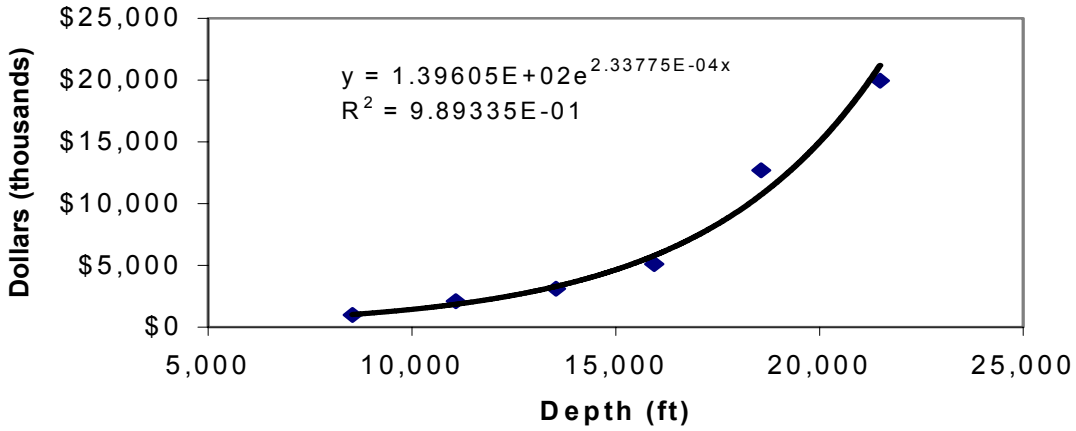




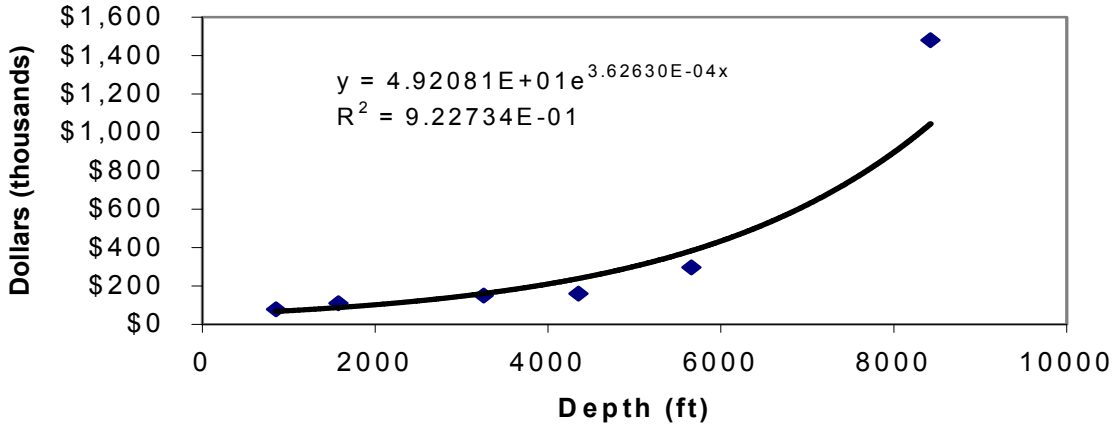
Total Wells Surveyed Western and Southeast United States



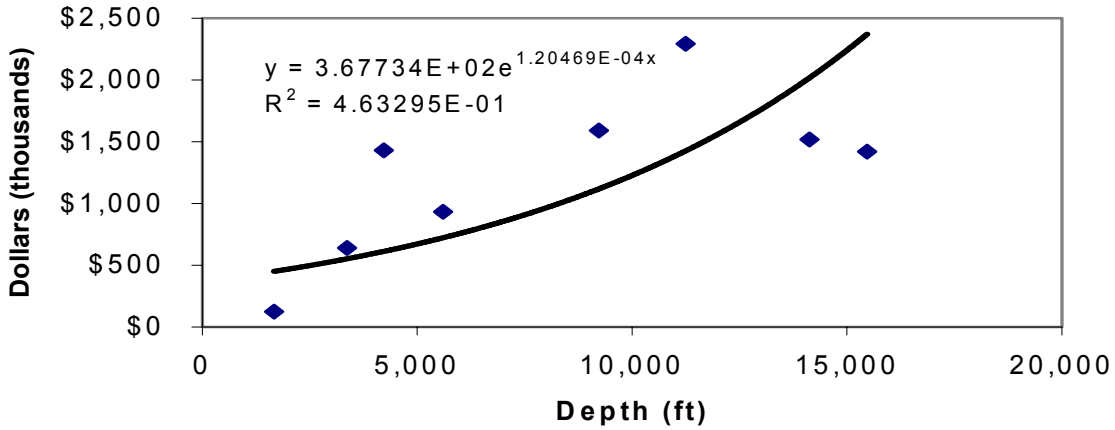




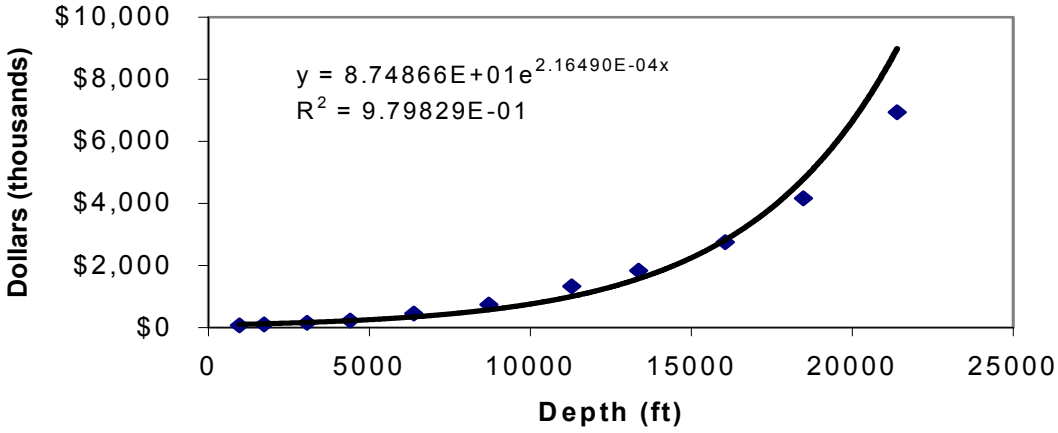
Kansas

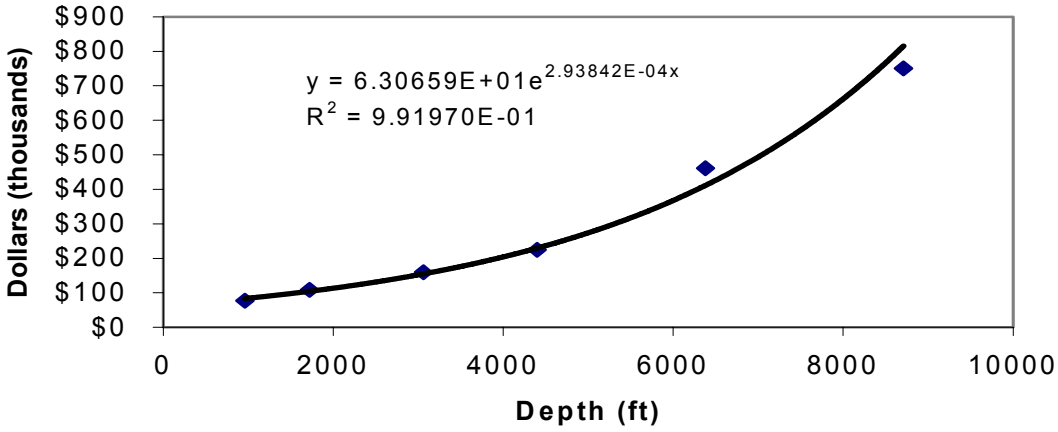


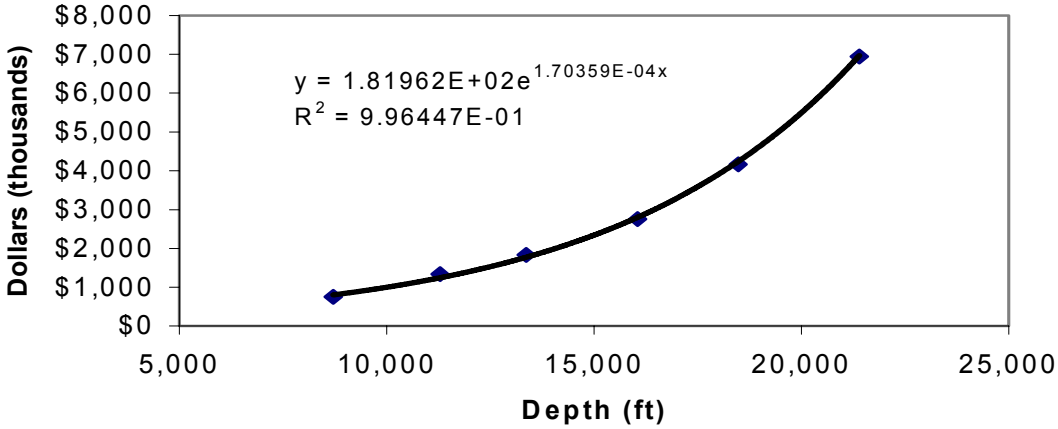
North Dakota



Oklahoma

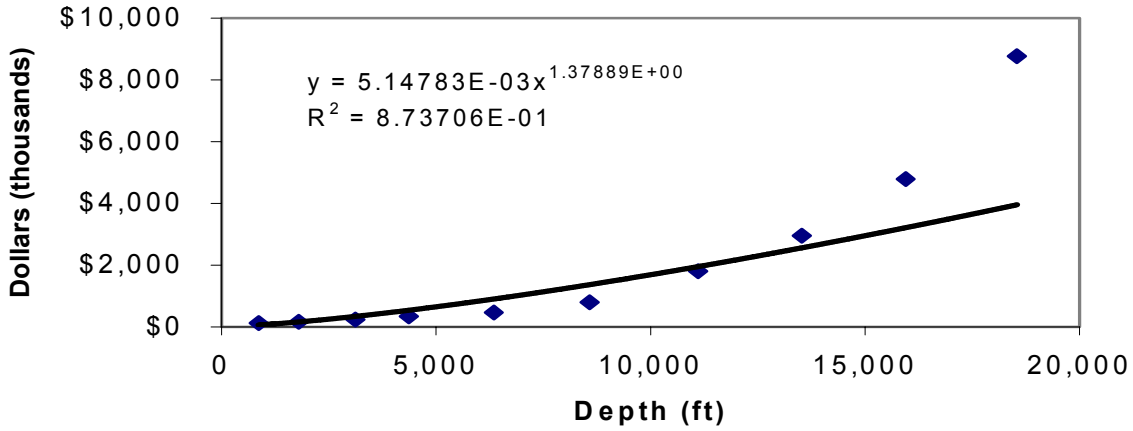

$10,000
$8,000
$6,000
$4,000
$2,000
$0
Dollars (thousands)
y = 8.74866E+01e2.16490E-04x
R2 = 9.79829E-01
0
5000
10000
15000
20000
25000
Depth (ft)

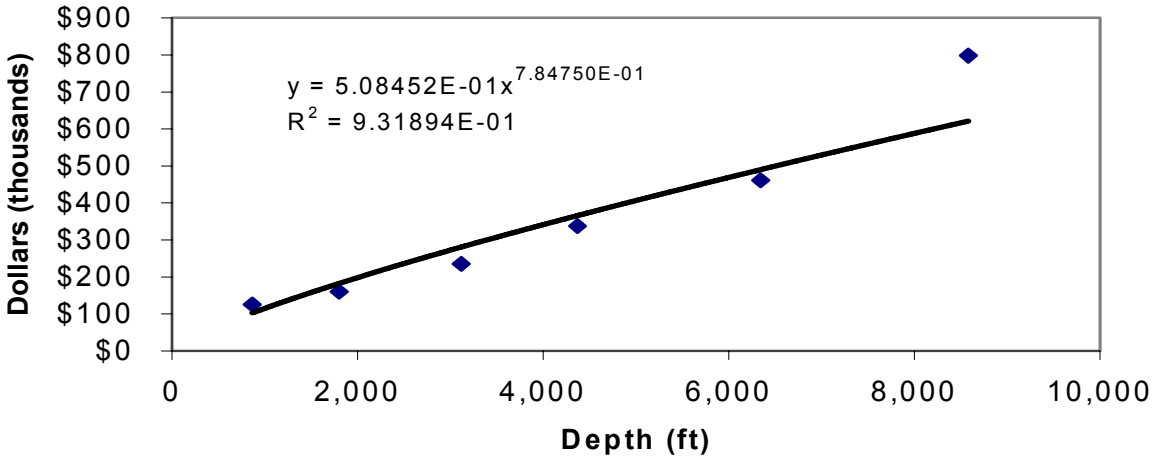

$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 6.30659E+01e2.93842E-04x
R2 = 9.91970E-01
0
2000
4000
6000
8000
10000
Depth (ft)

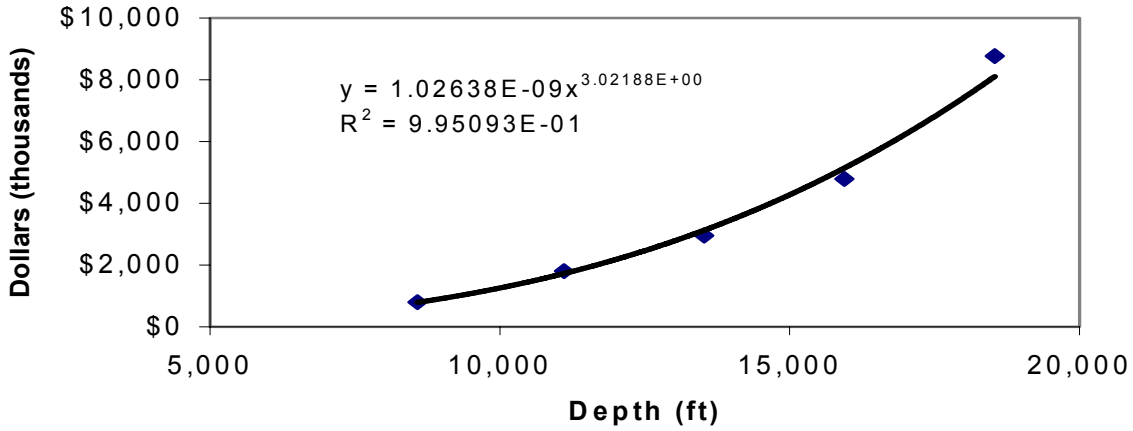

$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.81962E+02e1.70359E-04x
R2 = 9.96447E-01
5,000
10,000
15,000
20,000
25,000
Depth (ft)

Power Series Curve Fitting Plots

Power Series Curve Fit for All Wells Surveyed

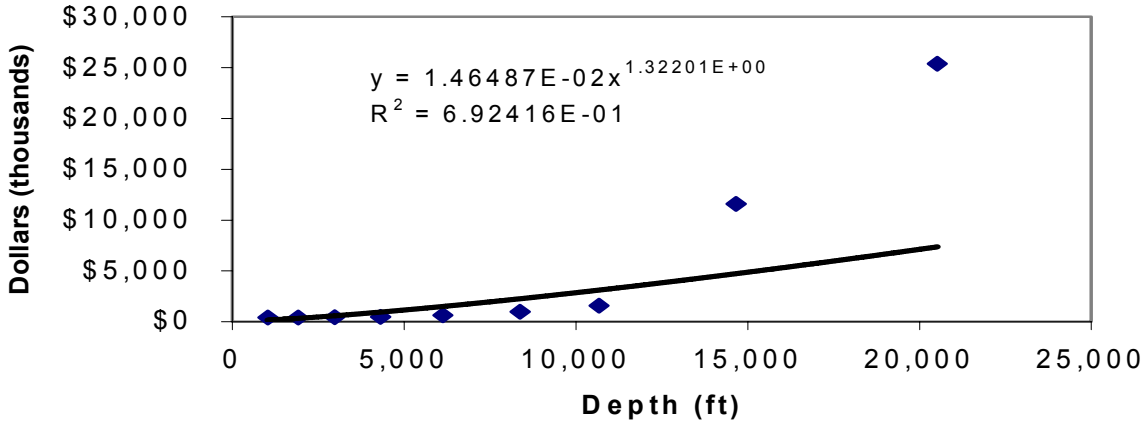


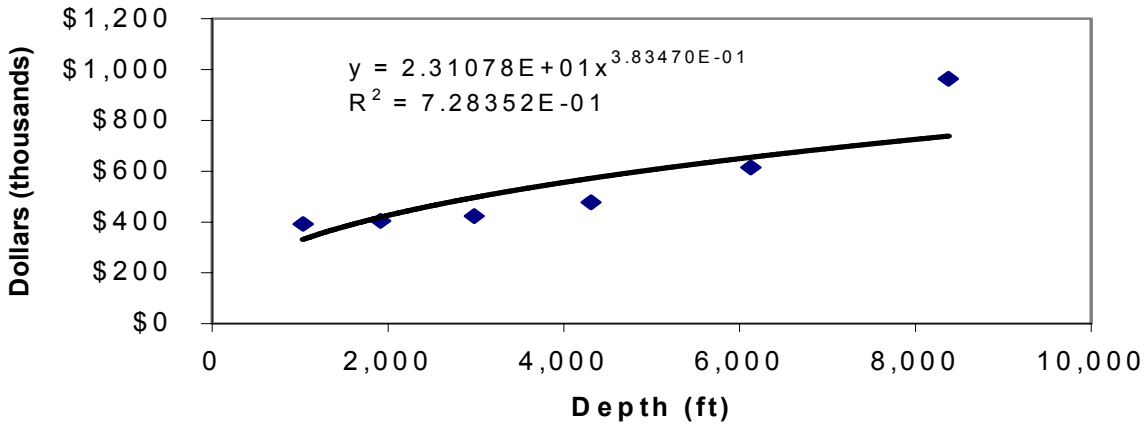


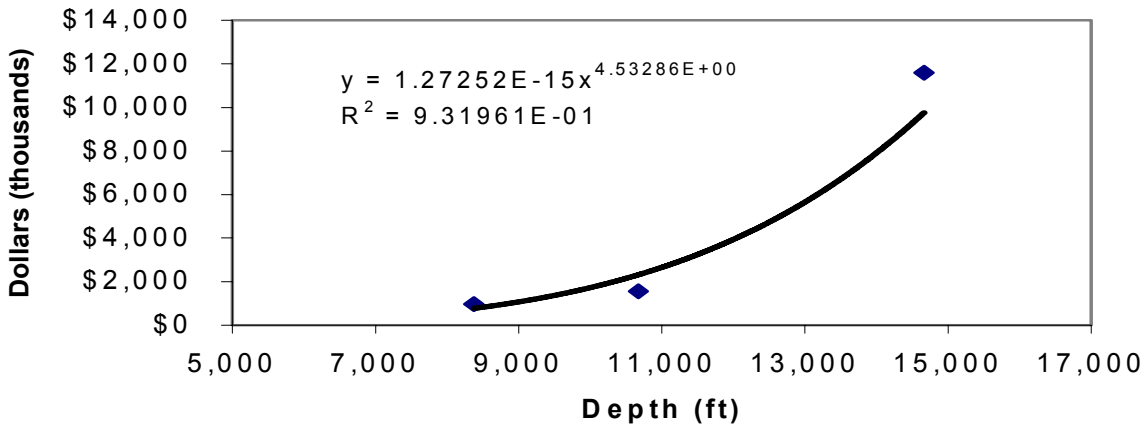


Western States

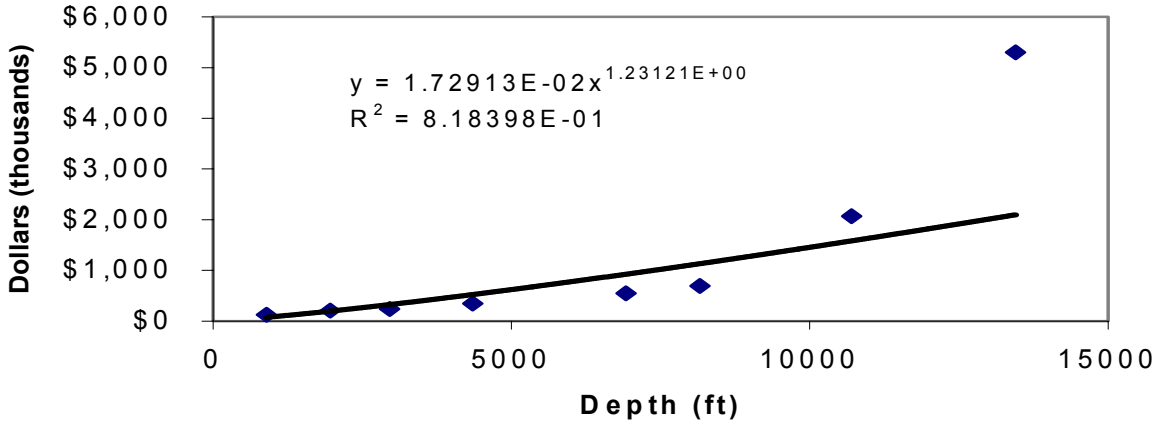
California onshore

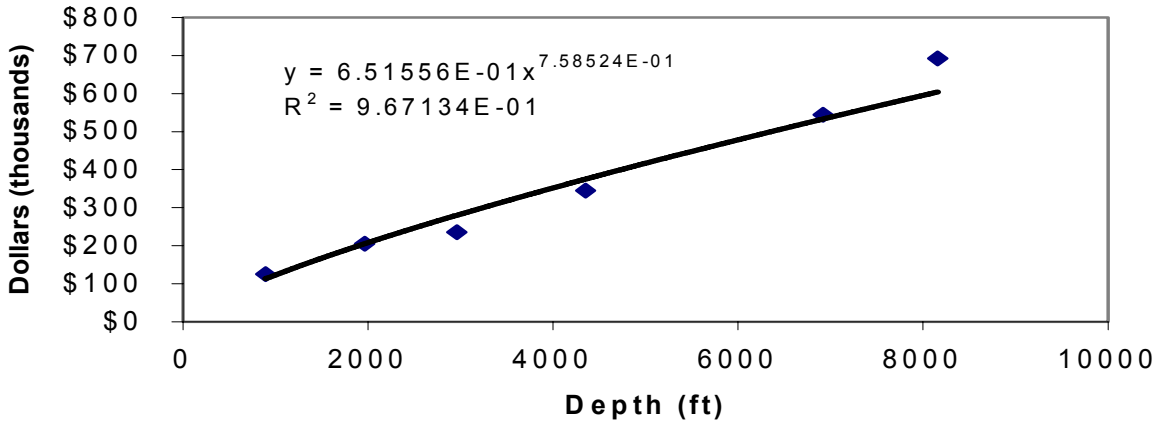


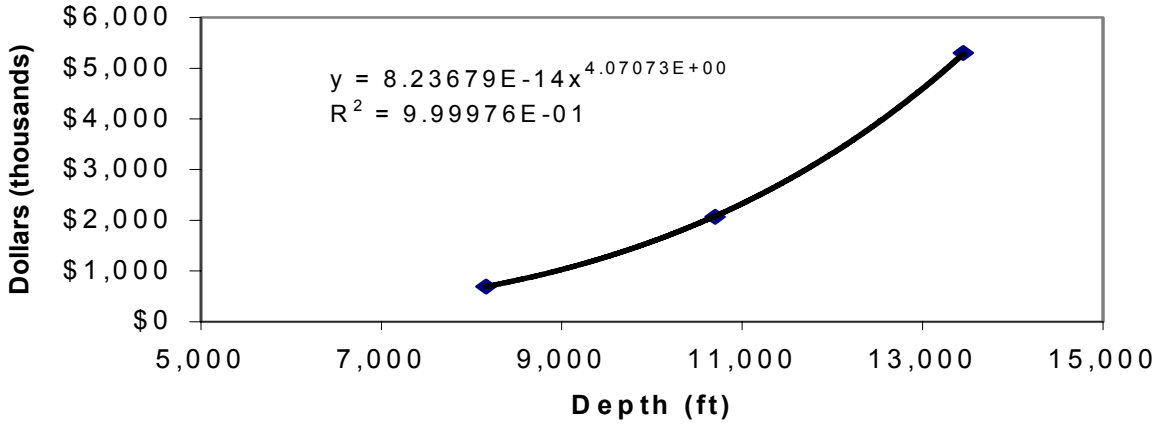




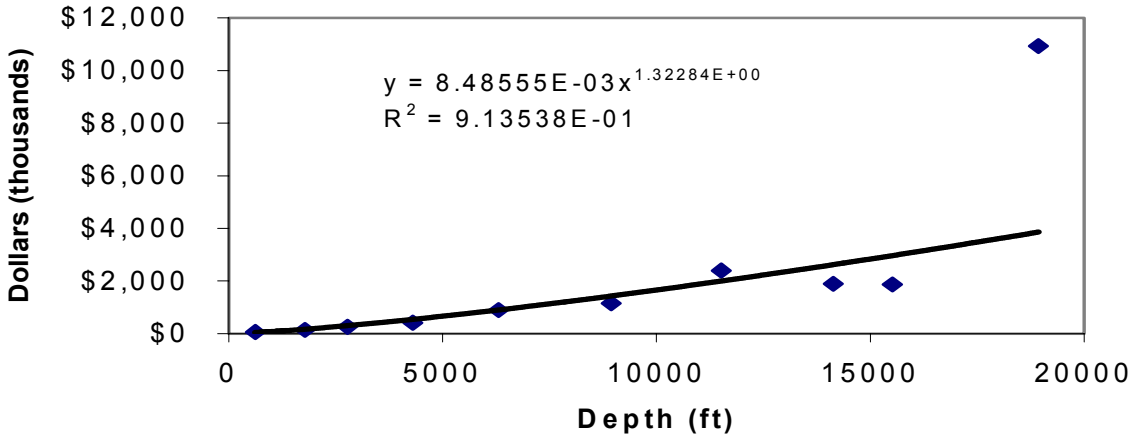
Colorado

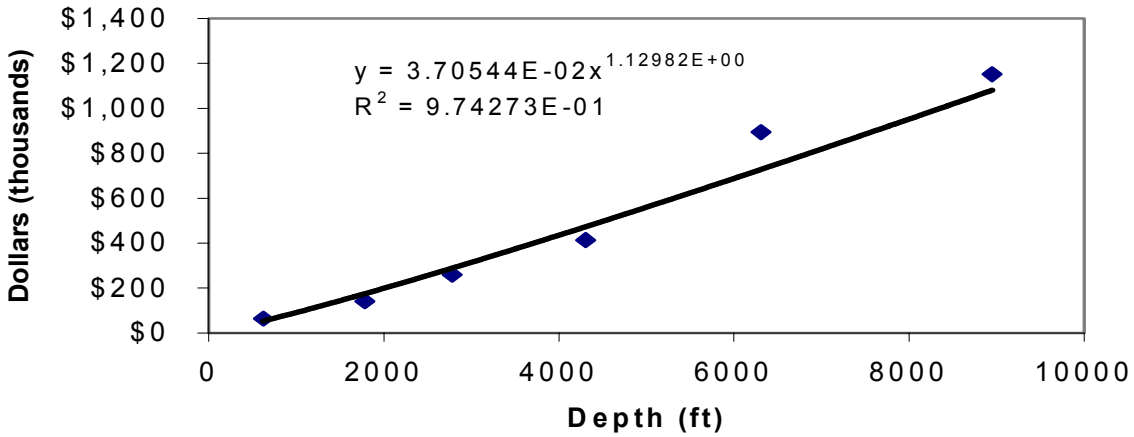

$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.72913E-02x^1.23121E+00
R^2 = 8.18398E-01
0
5000
10000
15000
Depth (ft)

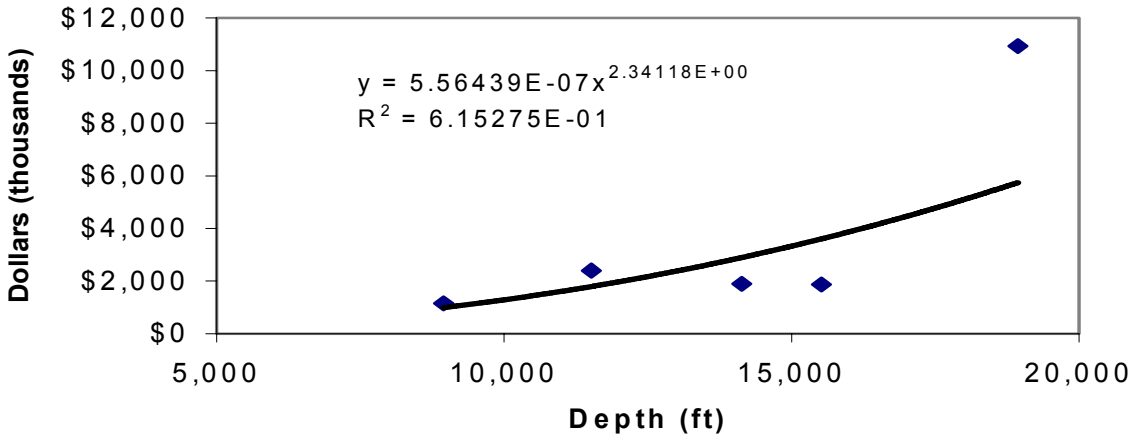

$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 6.51556E-01x^7.58524E-01
R^2 = 9.67134E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 8.23679E-14x^4.07073E+00
R^2 = 9.99976E-01
5,000
7,000
9,000
11,000
13,000
15,000
Depth (ft)

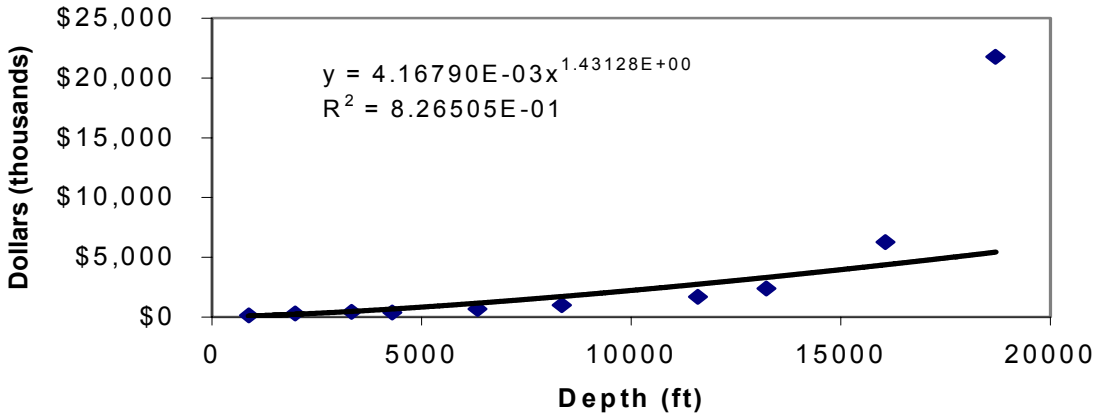
Montana

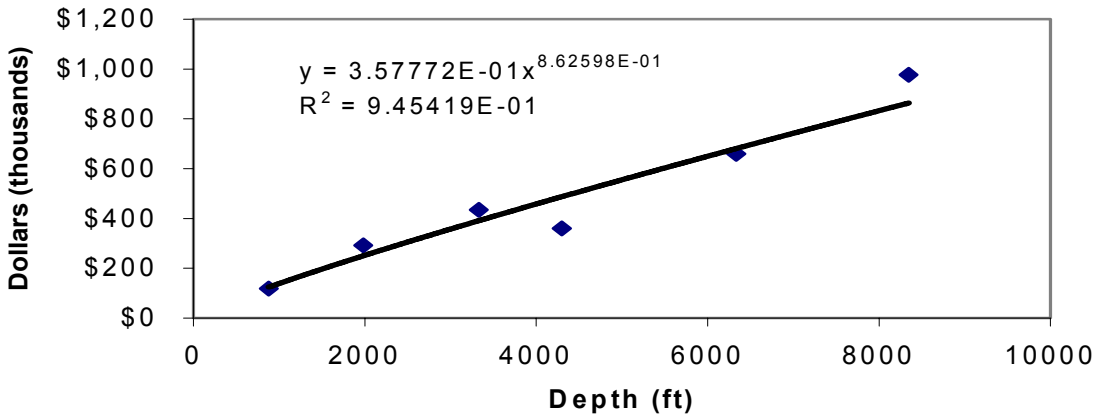

$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Dollars (thousands)
y = 8.48555E-03x^1.32284E+00
R^2 = 9.13538E-01
0
5000
10000
15000
20000
Depth (ft)

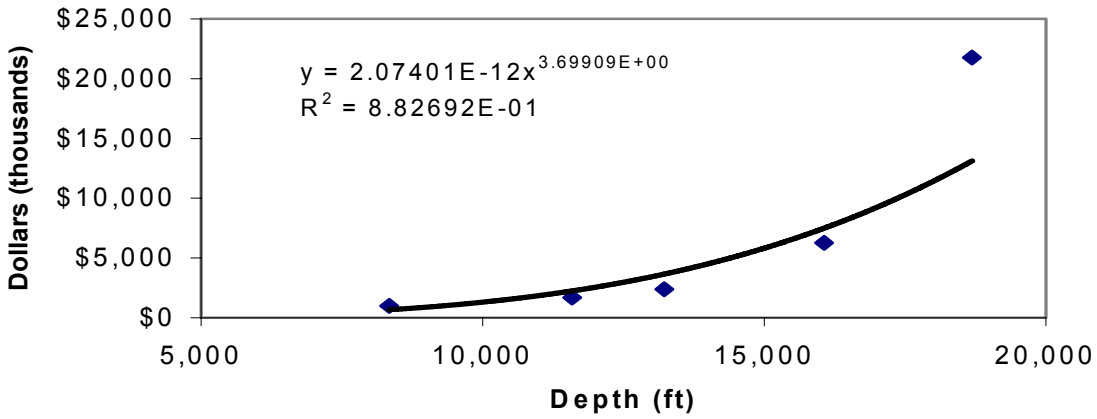

$1,400
$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 3.70544E-02x^1.12982E+00
R^2 = 9.74273E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$12,000
$10,000
$8,000
$6,000
$4,000
$2,000
$0
Dollars (thousands)
y = 5.56439E-07x^2.34118E+00
R^2 = 6.15275E-01
5,000
10,000
15,000
20,000
Depth (ft)

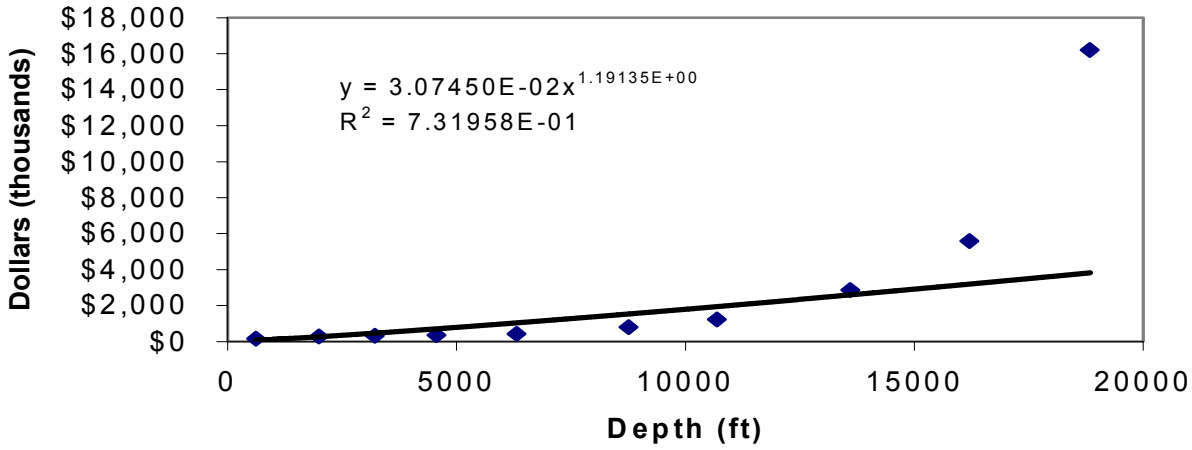
New Mexico

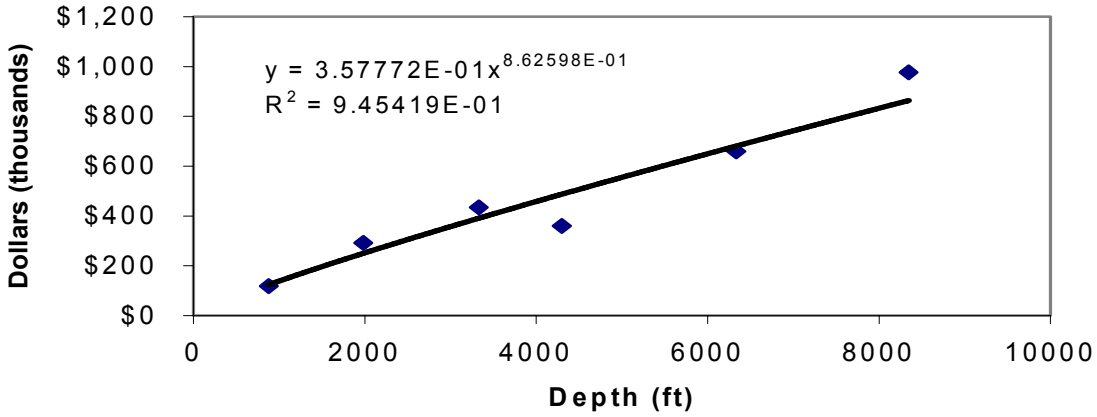

$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = 4.16790E-03x^1.43128E+00
R^2 = 8.26505E-01
0
5000
10000
15000
20000
Depth (ft)

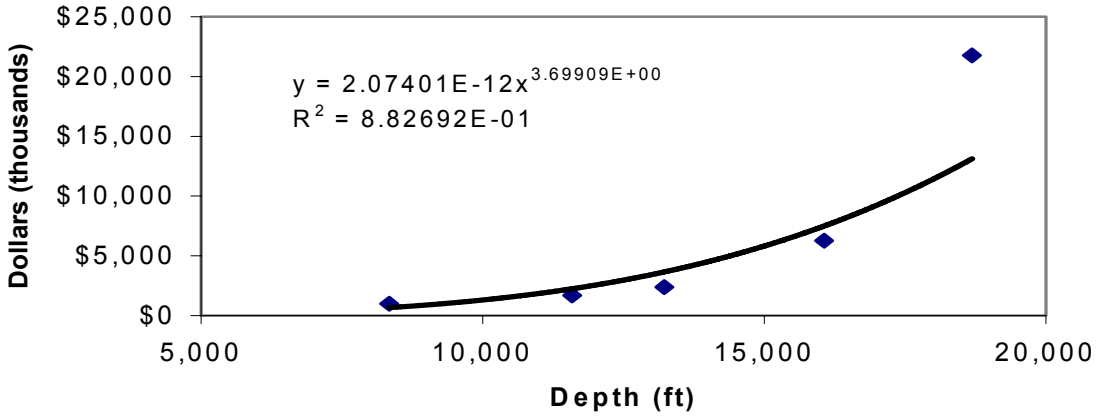

$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 3.57772E-01x^8.62598E-01
R^2 = 9.45419E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = 2.07401E-12x^3.69909E+00
R^2 = 8.82692E-01
5,000
10,000
15,000
20,000
Depth (ft)

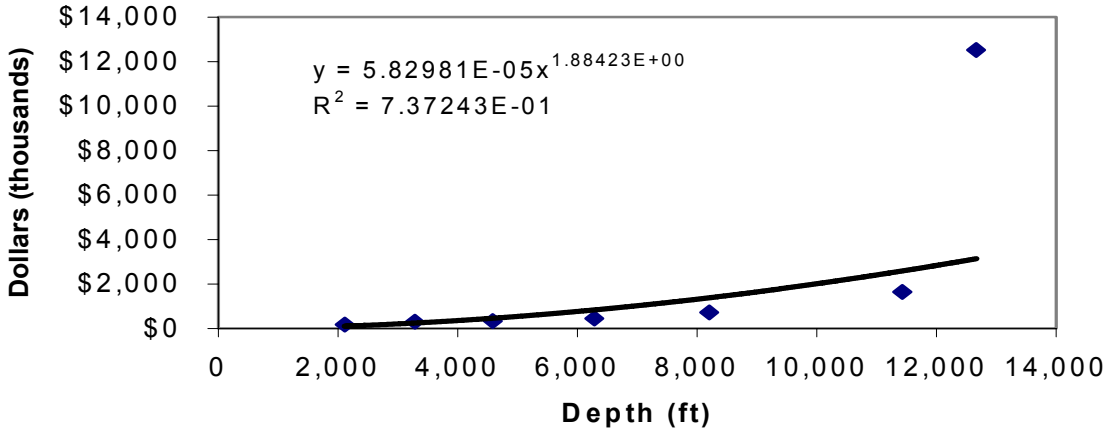
Texas District 8

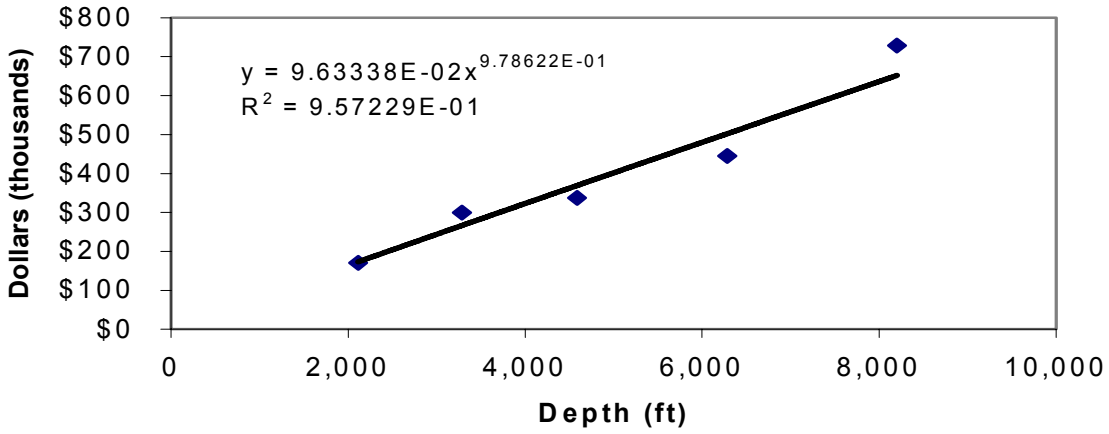


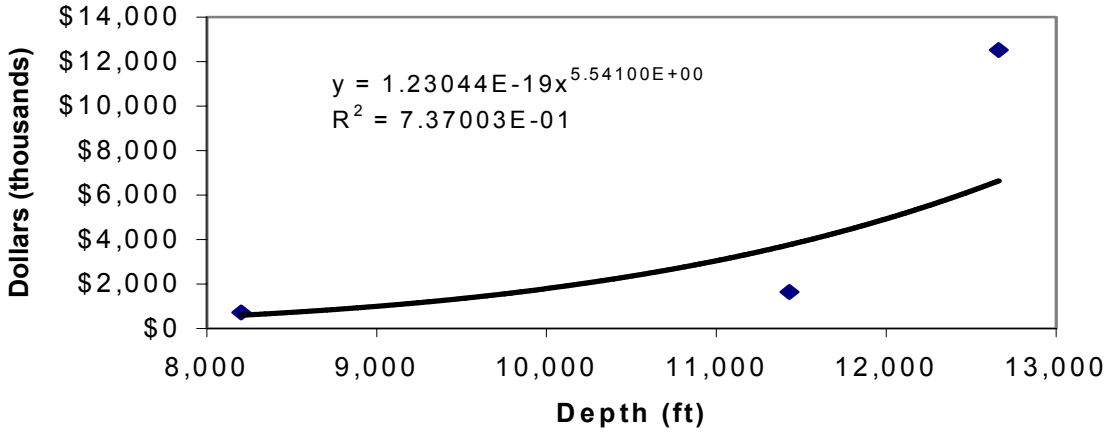




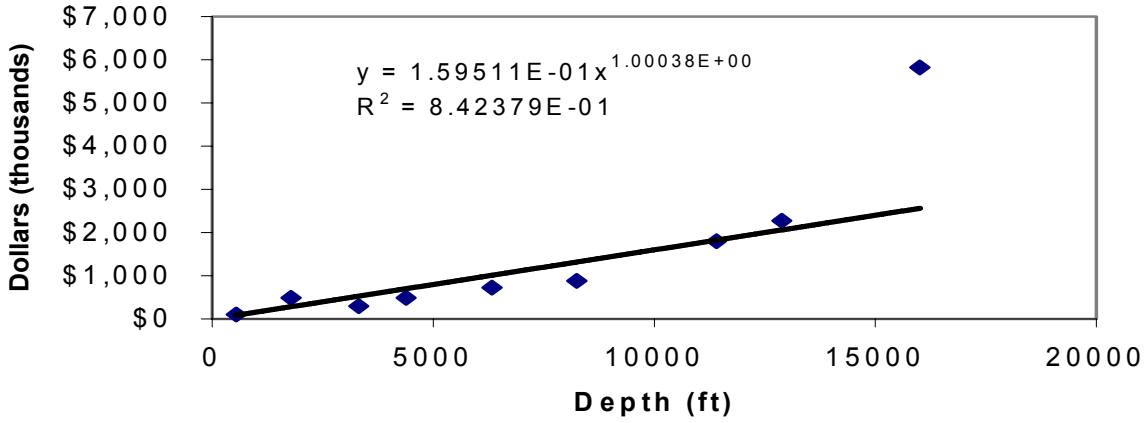
Texas District 8A

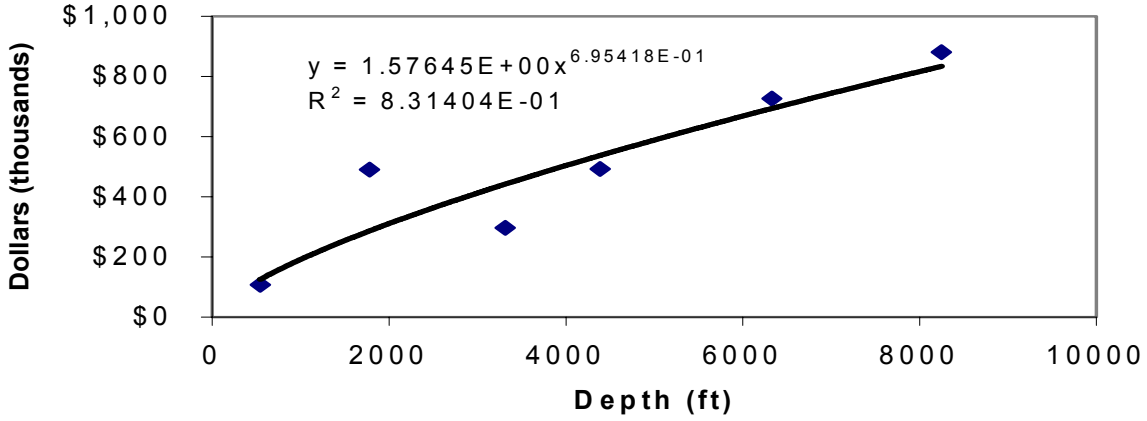


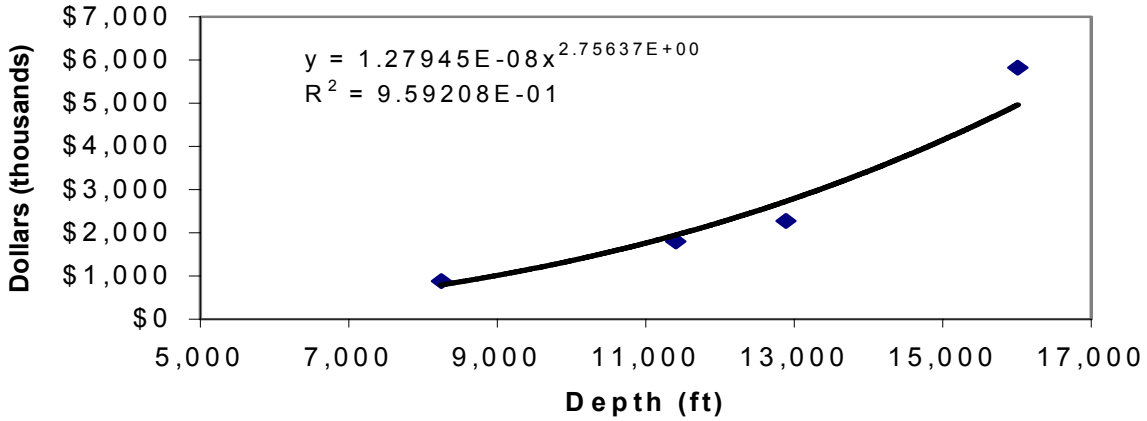




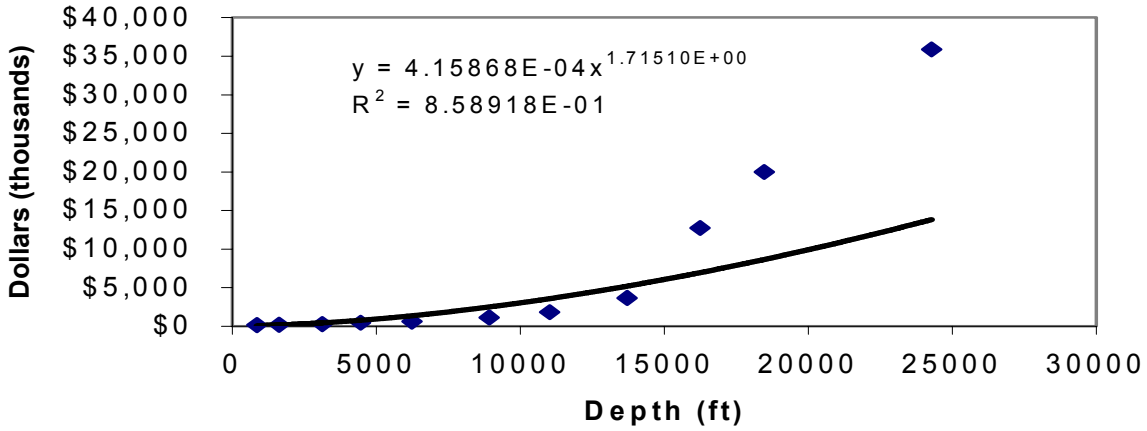
Utah

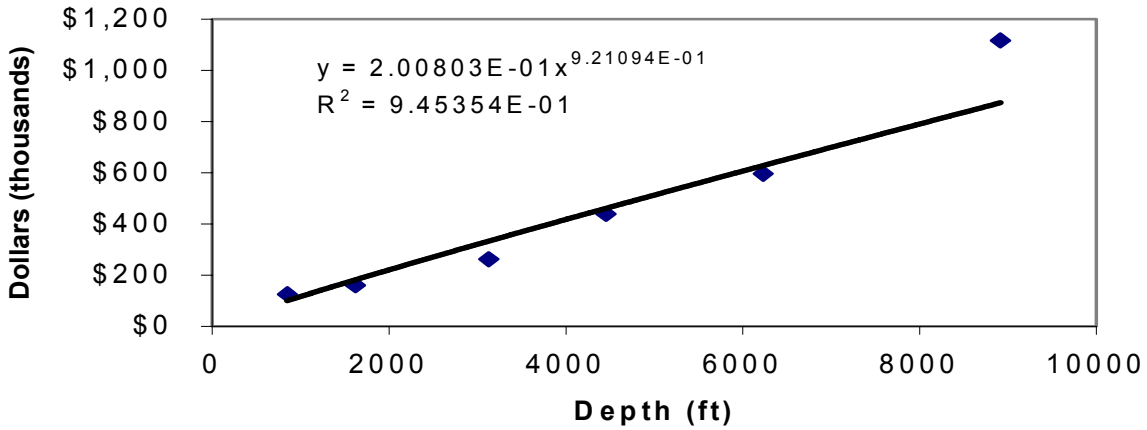

$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.59511E-01x^1.00038E+00
R^2 = 8.42379E-01
0
5000
10000
15000
20000
Depth (ft)

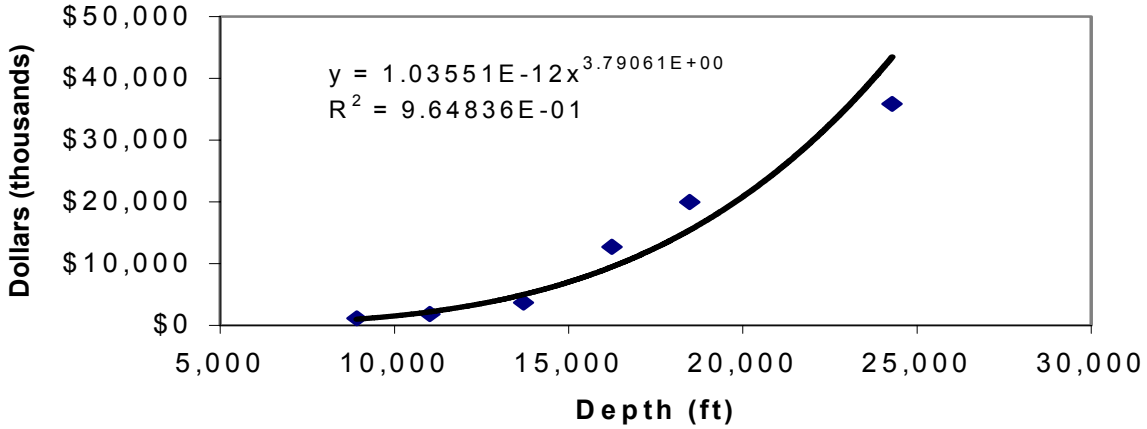

$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 1.57645E+00x^6.95418E-01
R^2 = 8.31404E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.27945E-08x^2.75637E+00
R^2 = 9.59208E-01
5,000
7,000
9,000
11,000
13,000
15,000
17,000
Depth (ft)

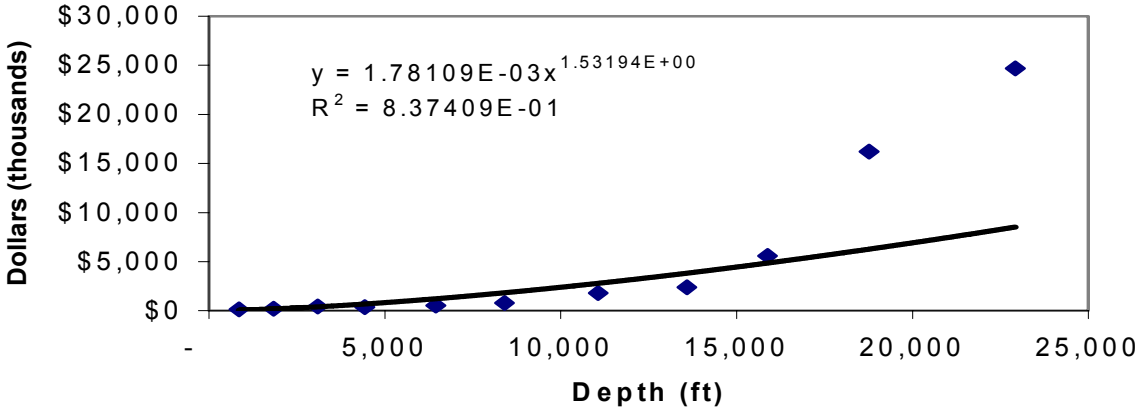
Wyoming

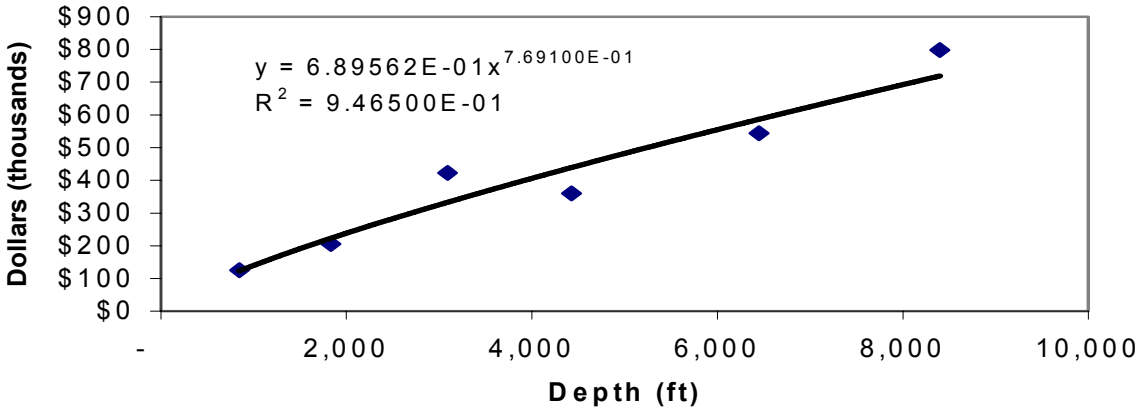

$40,000
$35,000
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
Dollars (thousands)
y = 4.15868E-04x^1.71510E+00
R^2 = 8.58918E-01
0
5000
10000
15000
20000
25000
30000
Depth (ft)

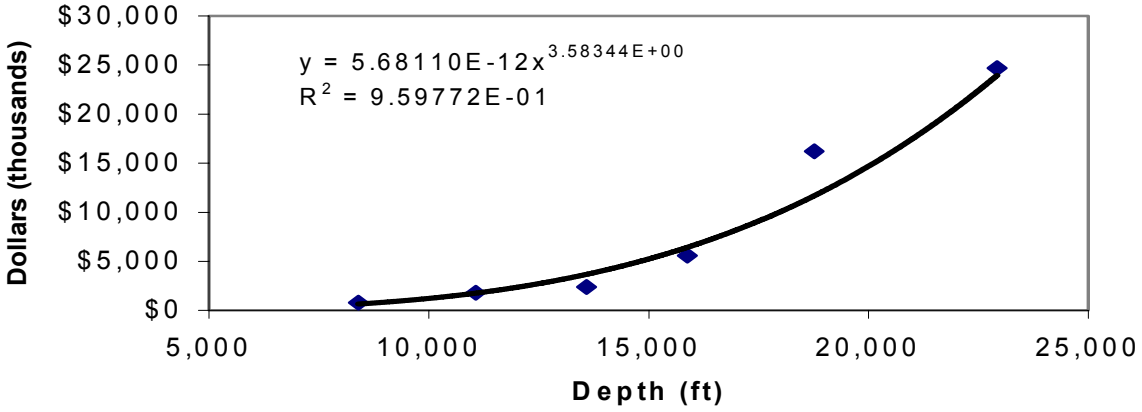

$1,200
$1,000
$800
$600
$400
$200
$0
Dollars (thousands)
y = 2.00803E-01x^9.21094E-01
R^2 = 9.45354E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$50,000
$40,000
$30,000
$20,000
$10,000
$0
Dollars (thousands)
y = 1.03551E-12x^3.79061E+00
R^2 = 9.64836E-01
5,000
10,000
15,000
20,000
25,000
30,000
Depth (ft)

Western U.S States total wells surveyed

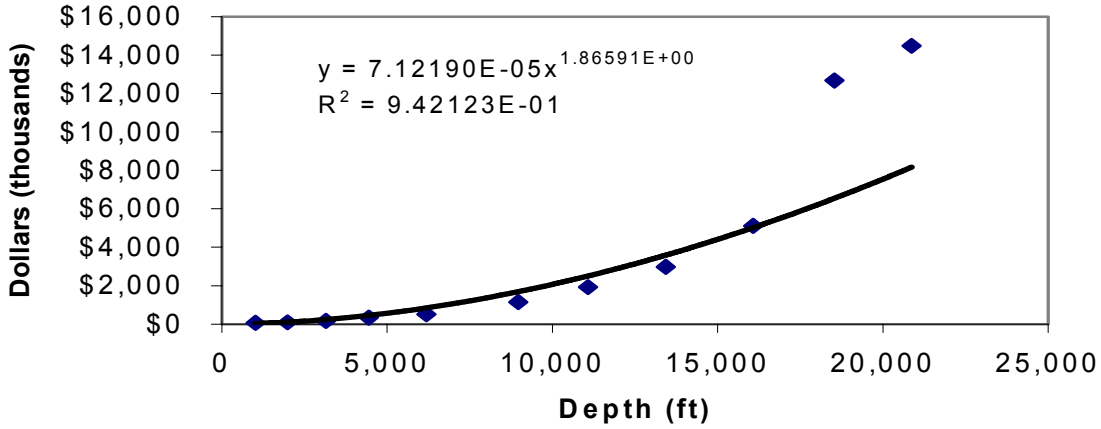


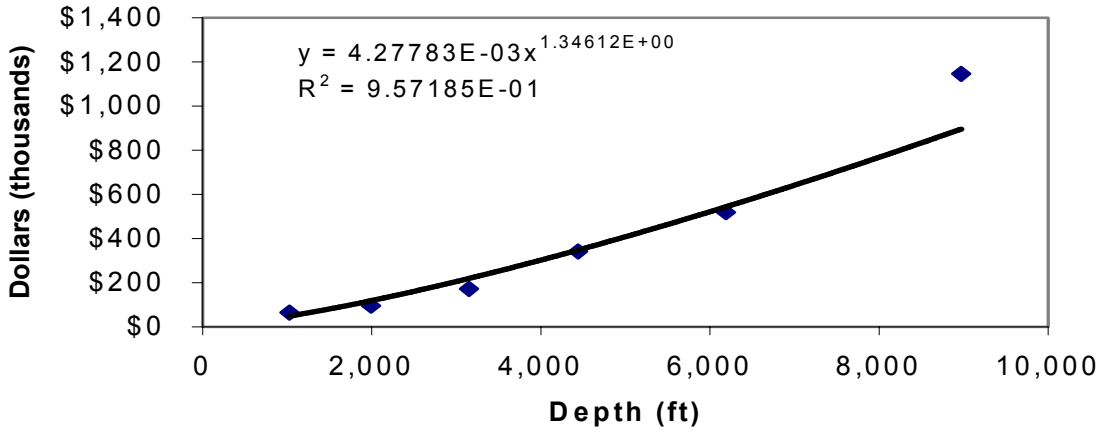


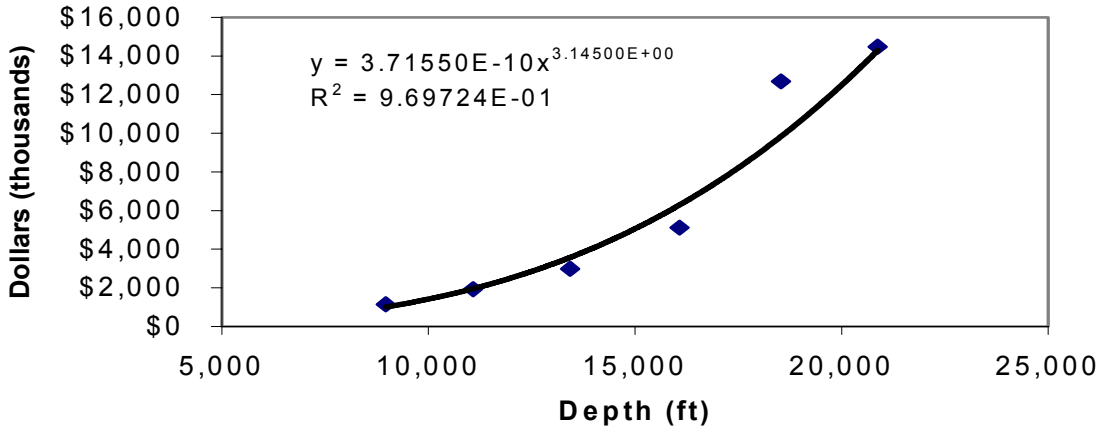


Southeast United States

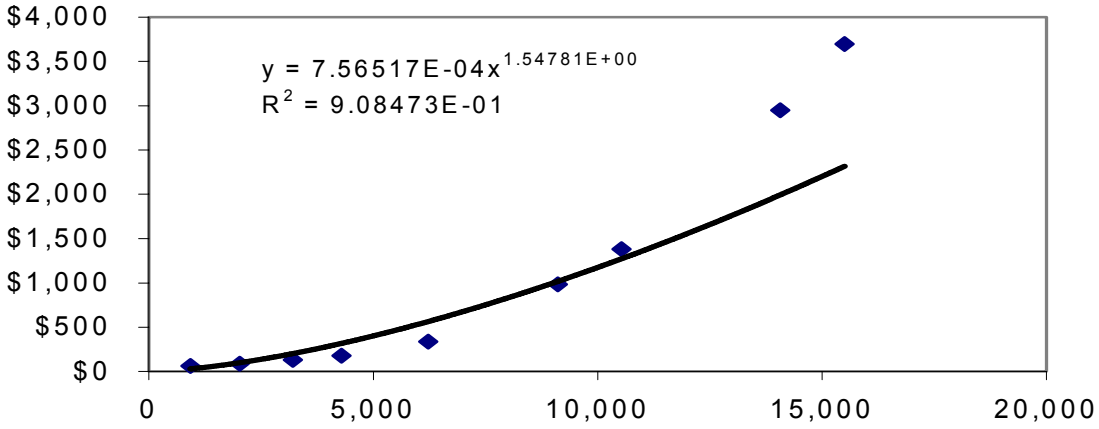
Texas Districts 2, 3 and 4

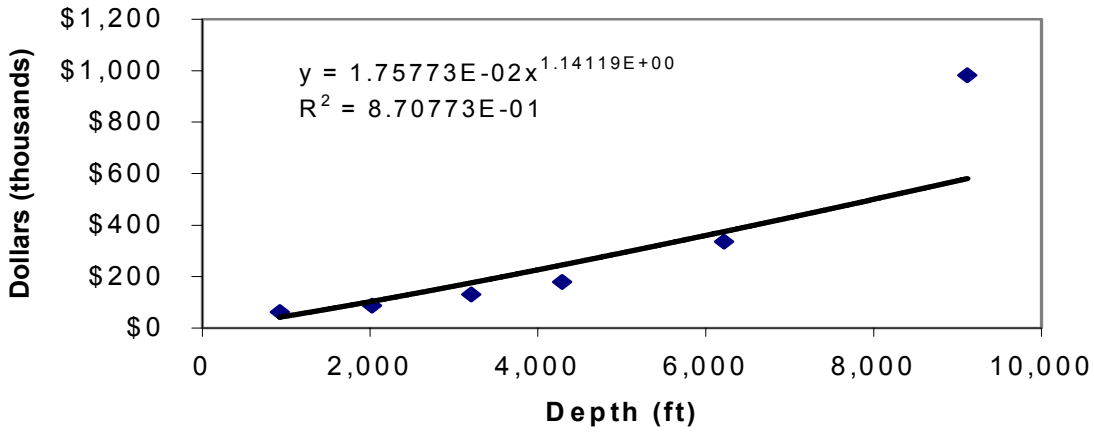


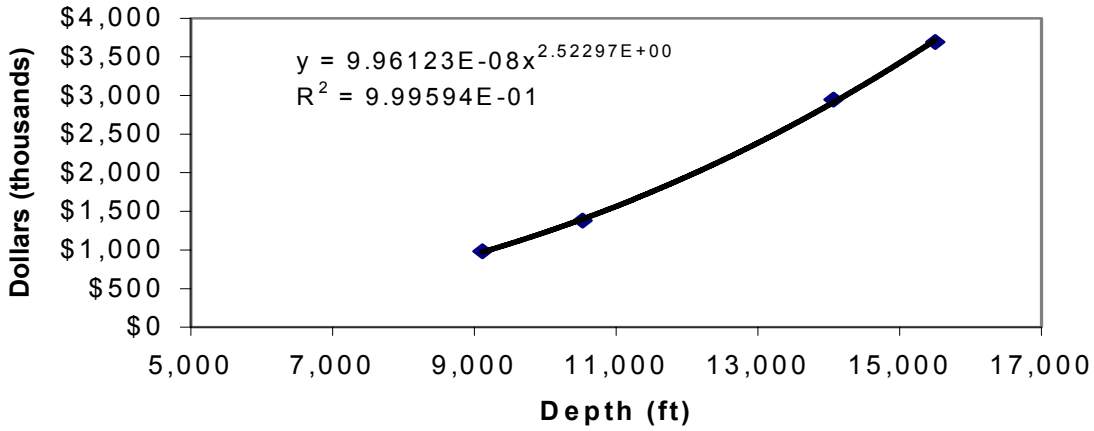




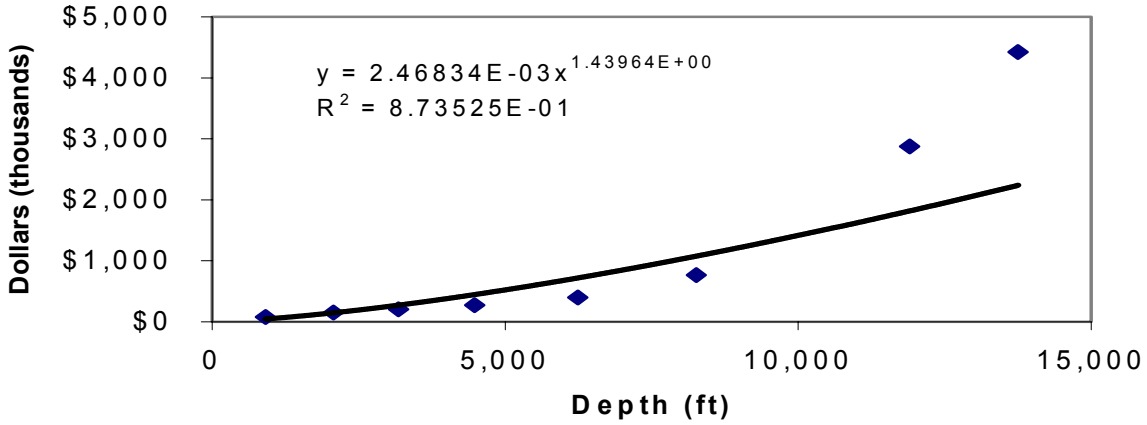
North Louisiana

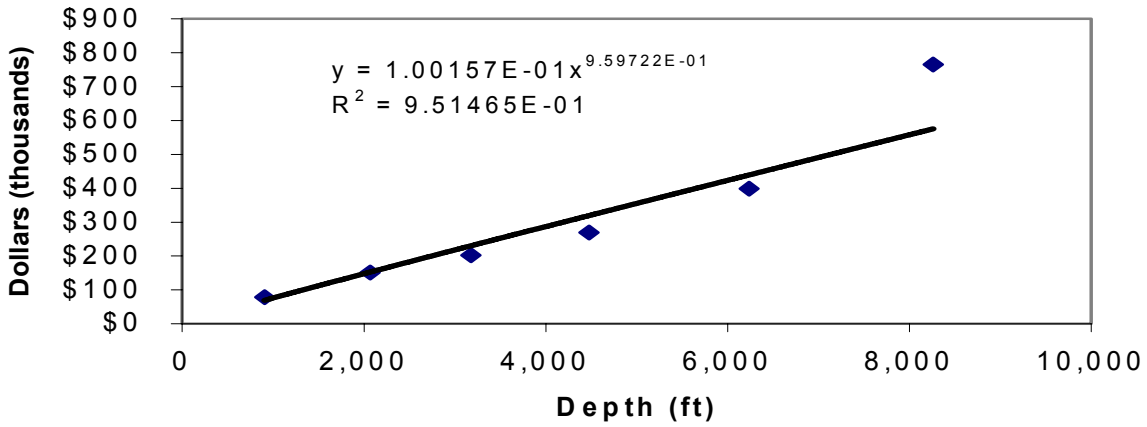


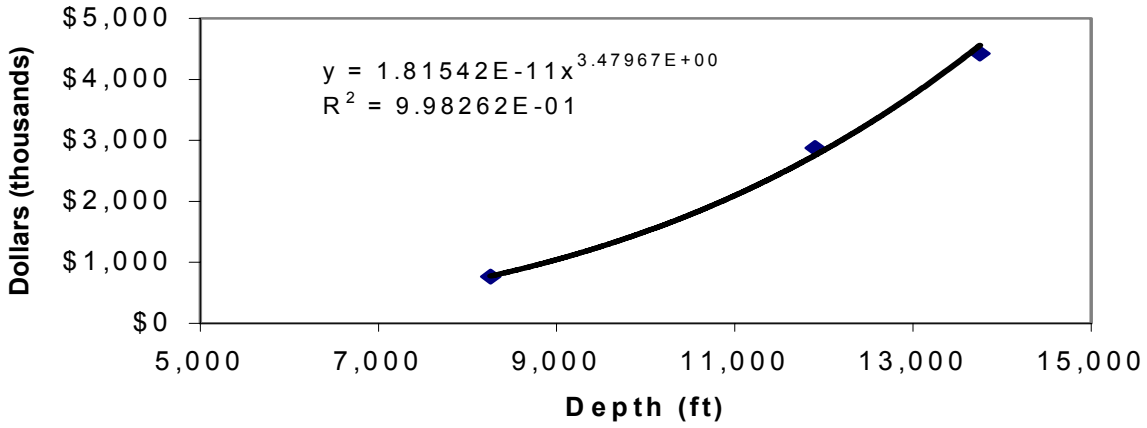




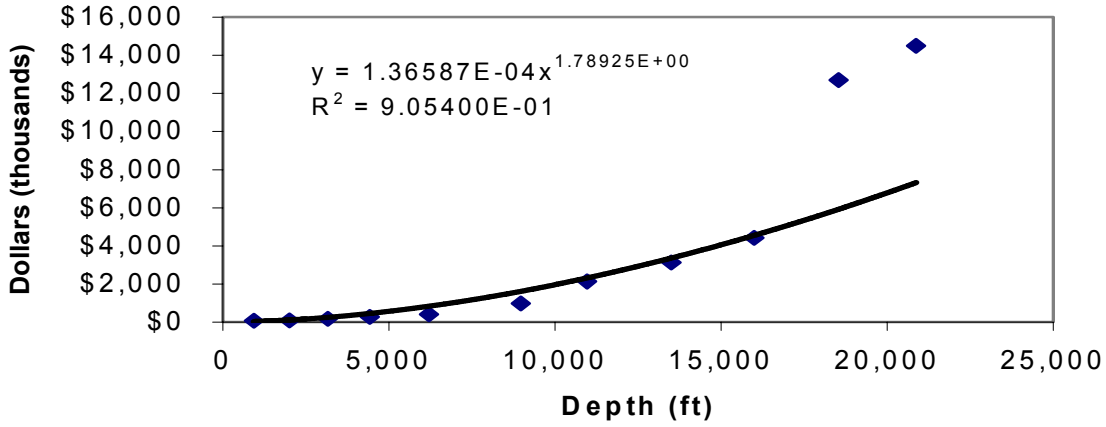
Arkansas

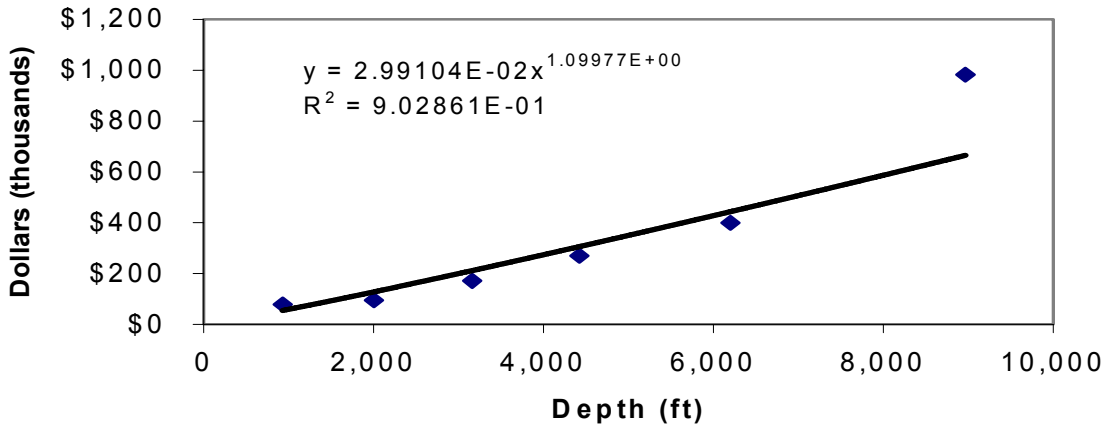

$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 2.46834E-03x^1.43964E+00
R^2 = 8.73525E-01
0
5,000
10,000
15,000
Depth (ft)

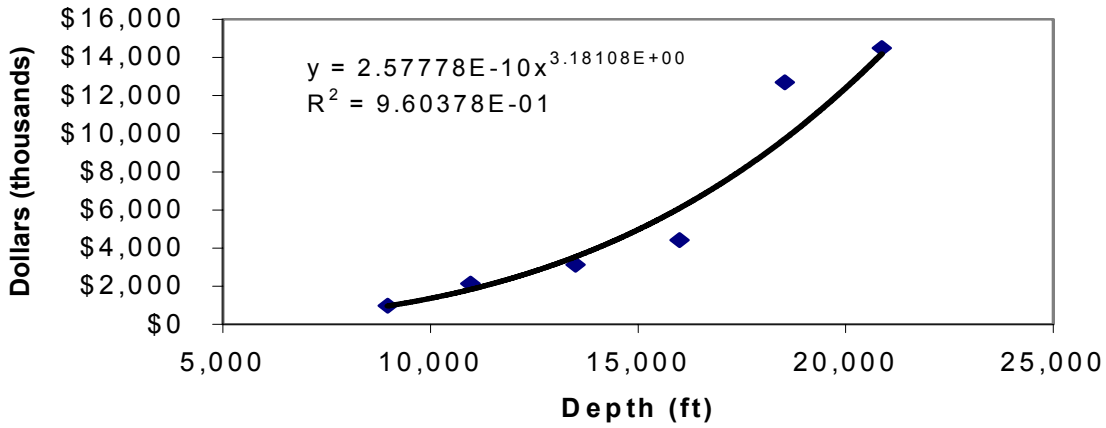

$900
$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 1.00157E-01x^9.59722E-01
R^2 = 9.51465E-01
0
2,000
4,000
6,000
8,000
10,000
Depth (ft)


$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.81542E-11x^3.47967E+00
R^2 = 9.98262E-01
5,000
7,000
9,000
11,000
13,000
15,000
Depth (ft)

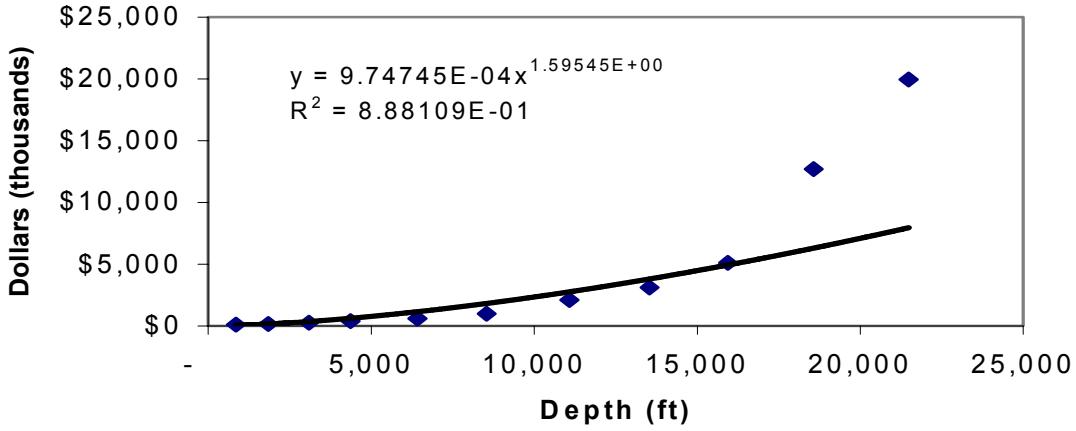
Total wells surveyed Southeast U. S.

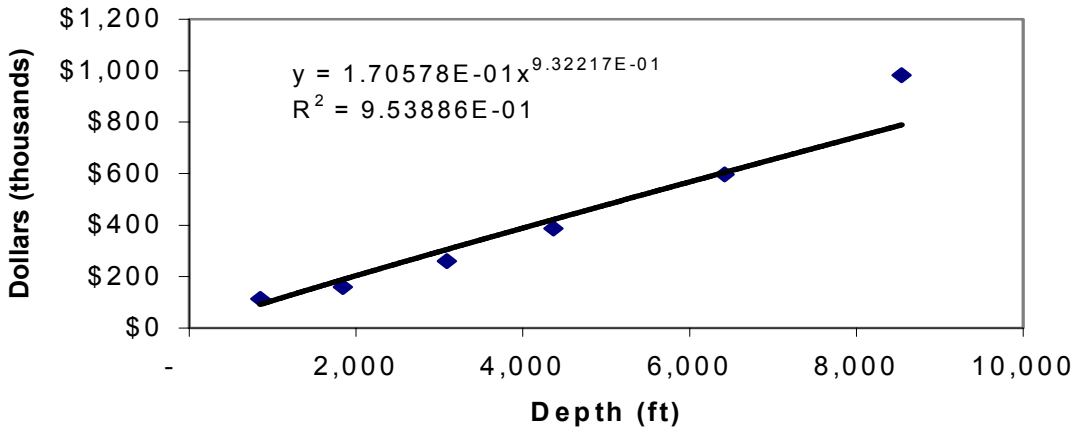


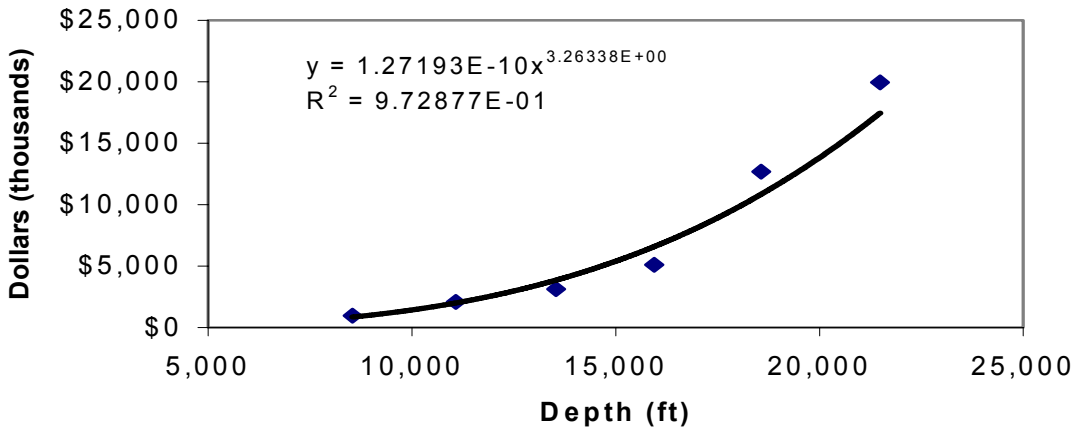




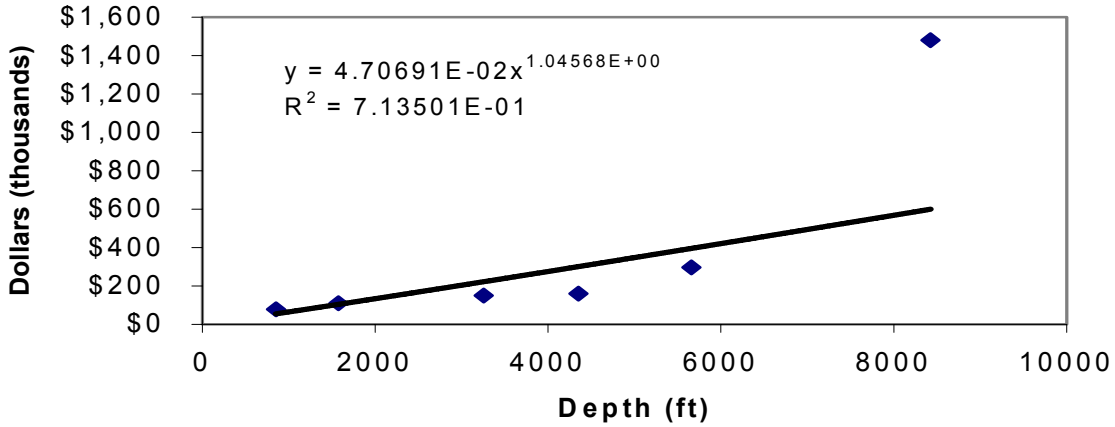
Total wells surveyed Western and Southeast U.S.



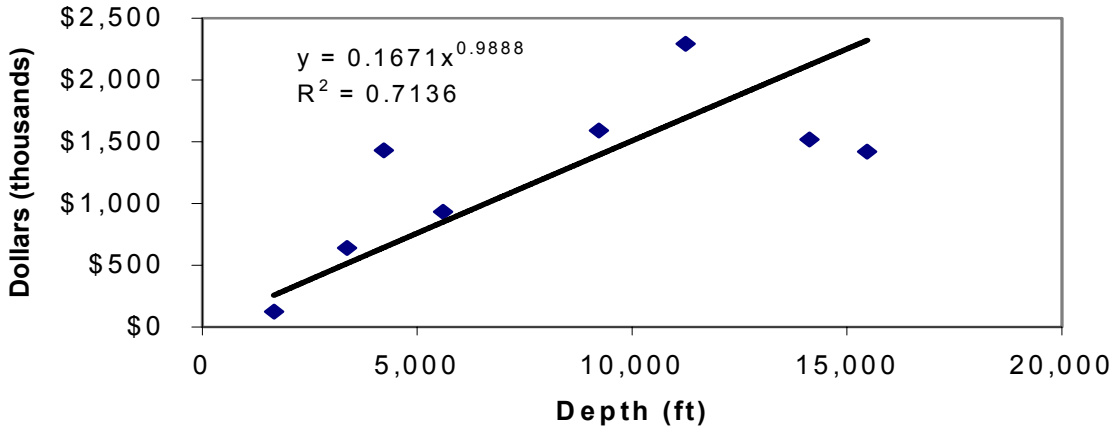




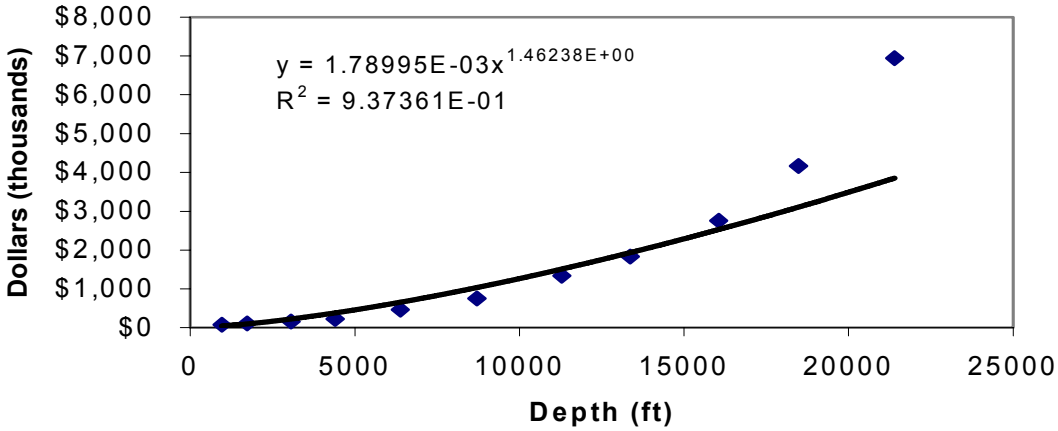
Kansas

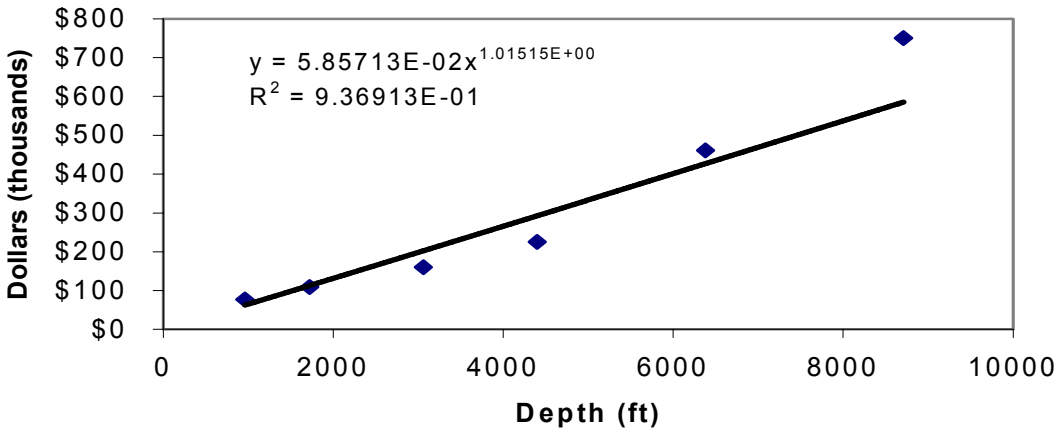


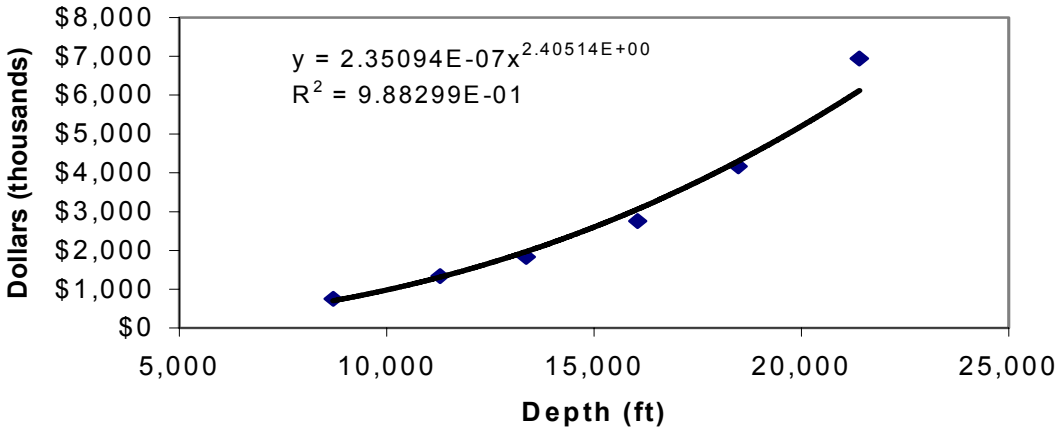
North Dakota



Oklahoma


$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 1.78995E-03x^1.46238E+00
R^2 = 9.37361E-01
0
5000
10000
15000
20000
25000
Depth (ft)


$800
$700
$600
$500
$400
$300
$200
$100
$0
Dollars (thousands)
y = 5.85713E-02x^1.01515E+00
R^2 = 9.36913E-01
0
2000
4000
6000
8000
10000
Depth (ft)


$8,000
$7,000
$6,000
$5,000
$4,000
$3,000
$2,000
$1,000
$0
Dollars (thousands)
y = 2.35094E-07x^2.40514E+00
R^2 = 9.88299E-01
5,000
10,000
15,000
20,000
25,000
Depth (ft)