

**FOSSIL ANTICLINE PROSPECT**  
**BIG HORN COUNTY, WYOMING**

**Executive Summary**



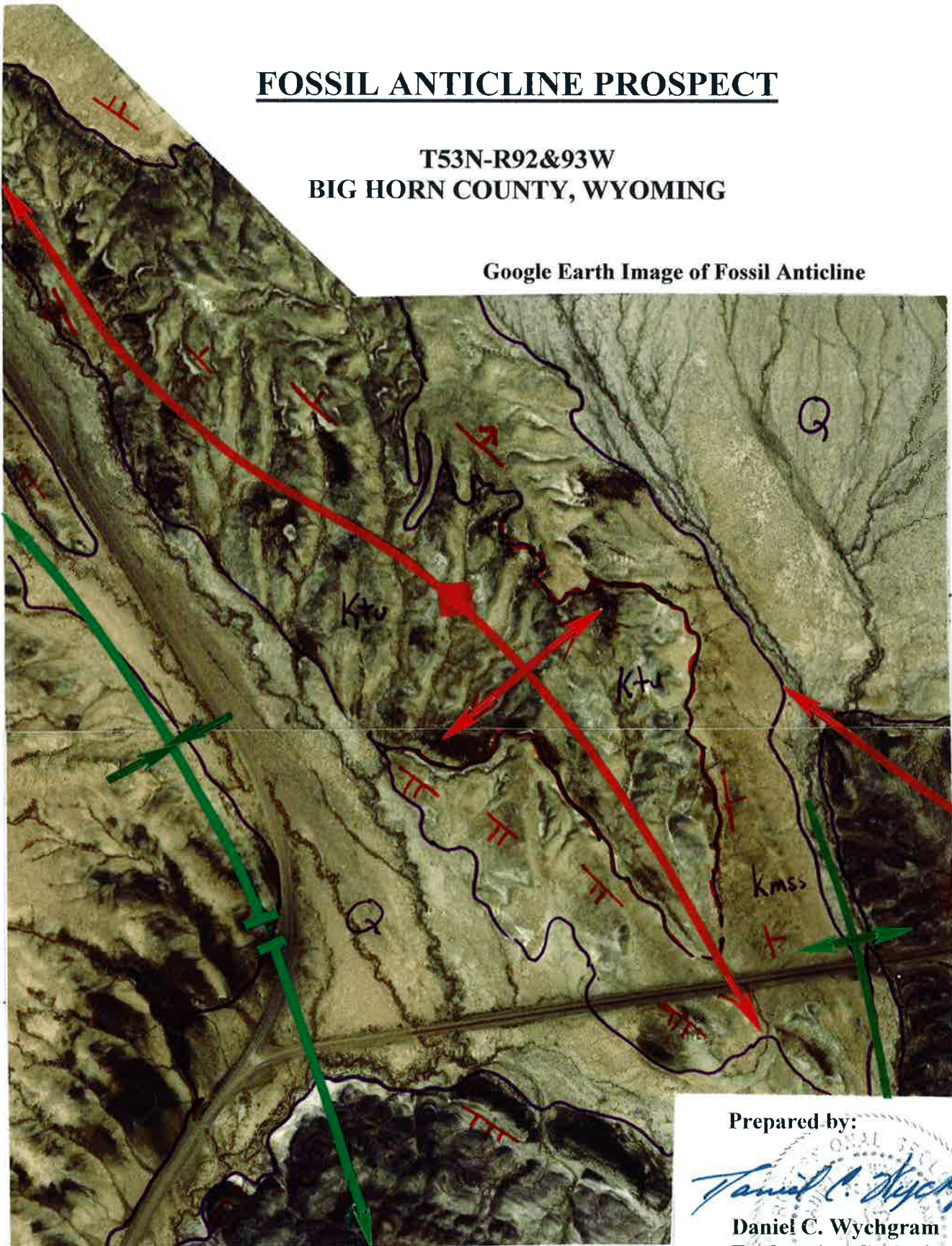
**Oblique Aerial View to East of Fossil Anticline Showing Drilling Location**



# FOSSIL ANTICLINE PROSPECT

T53N-R92&93W  
BIG HORN COUNTY, WYOMING

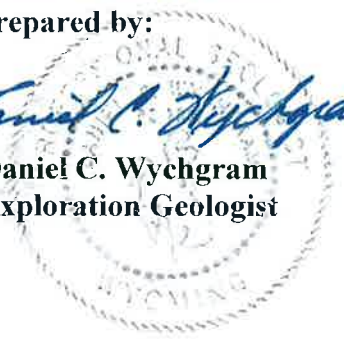
Google Earth Image of Fossil Anticline



Prepared by:

*Daniel C. Wychgram*

Daniel C. Wychgram  
Exploration Geologist

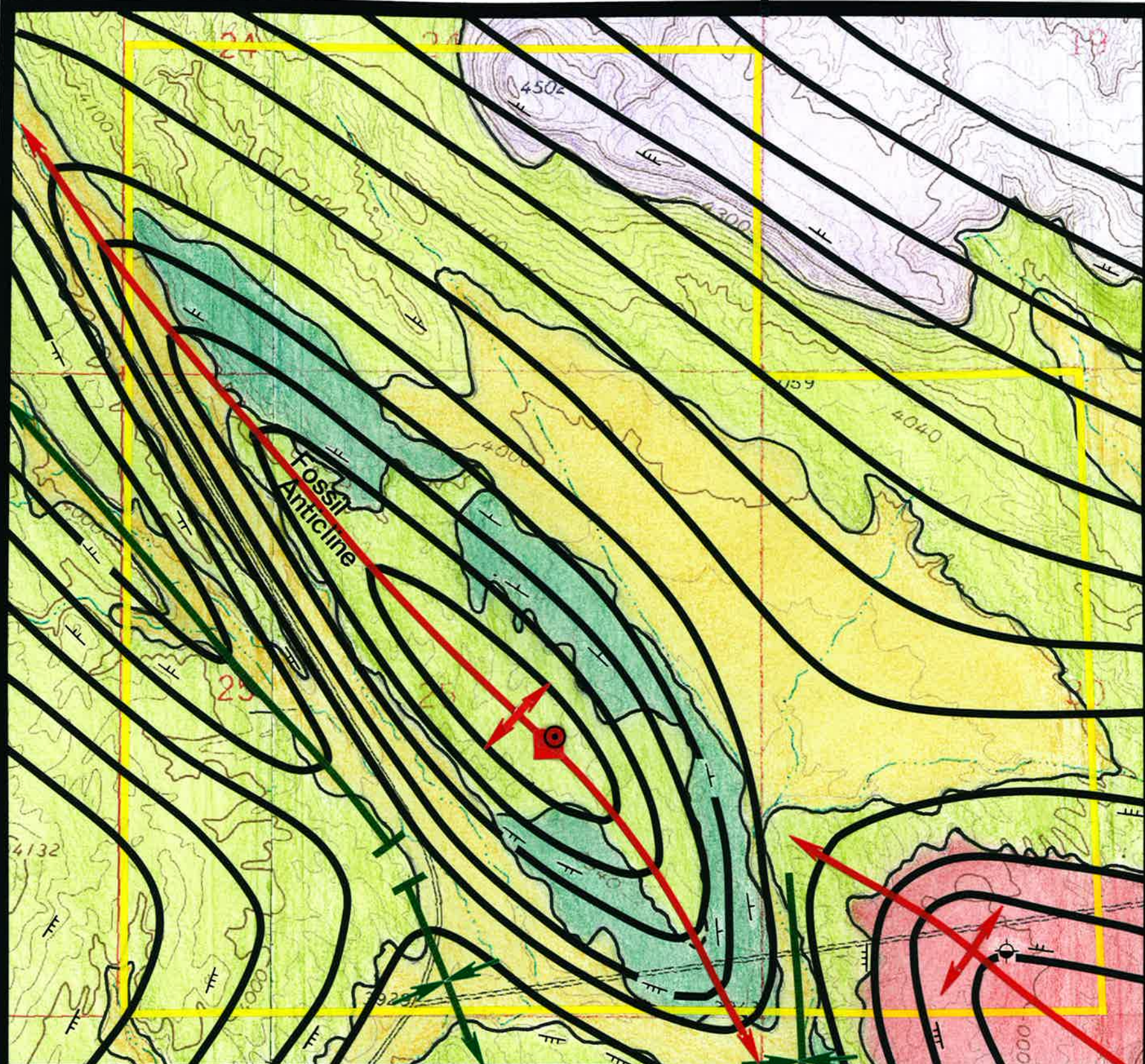




R93W





R92W

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# **FOSSIL ANTICLINE PROSPECT** BIG HORN COUNTY, WYOMING







## **MAP UNITS**

-  Quaternary Deposits
-  Frontier Formation
-  Mowry & Thermopolis Shale  
Muddy Sandstone Member  
shown in dark green
-  Cloverly Group

## **WELLS**

-  Cole, 1952, oil show in Phosphoria
-  Permitted drilling location for the  
Fossil No. 1-25 USA

## **MAP SYMBOLS**

-  Strike with dip of 1 to 3 degrees
-  Strike with dip of 3 to 10 degrees
-  Strike with dip of 10 to 25 degrees
-  Anticlinal axis showing  
apex and plunge
-  Synclinal axis showing  
spill point and plunge
-  Form-line contour based on  
strike, dip, key beds and  
outcrop pattern



Federal lease WYW172769

*Daniel C. Hychgram*



## **Introduction**

The Fossil Anticline is located a few miles northeast of Greybull, Wyoming. The structure demonstrates four-way closure and represents a classic trap for migrating hydrocarbons in the Bighorn Basin. Three primary potential oil zones exist in this closure: the Phosphoria Formation, the Tensleep Sandstone and the Madison Limestone. Each of these formations is a reliable and prolific producer in nearby anticlinal structures with established oilfields.

The Fossil Anticline is a well-exposed, doubly-plunging anticline. No records could be found to indicate that any drilling has been performed on this structure. This prospect is ready to drill with a federal oil and gas lease covering the entire area of potential production, a bentonite haul road providing excellent all-weather access, and state and federal drilling permits issued.

## **Geology**

This anticline was named the "Fossil Anticline" because of a fossil locality discovered while doing confirmation fieldwork. Three additional vertebrate fossils were discovered during a paleontological survey. The structure is easy to map in both the field and on aerial imagery due to the lack of vegetation and excellent exposures of the Thermopolis Shale. A white, resistant key marker bed can be seen on the front-piece image. This marker bed can be traced all the way around the inner structure except where it has been partially eroded off on the southwest limb. Further out on the structure, the Muddy Sandstone member of the Thermopolis Shale surrounds and outlines the closure and was selectively mapped on the flanks of the anticline. The map unit colored dark green on the geologic map is the Muddy Sandstone. The Fossil Anticline is a typical Laramide-age, northwest-southeast trending doubly-plunging anticline. Also typical is the northeast asymmetry expressed at the surface by steeper dip components on the southwest. Because of this asymmetry, the axial plane is inclined to the northeast. This geometry is an important consideration when targeting deeper oil reservoirs and requires locating test wells to the northeast of the surface anticlinal axis. An ideal location has been sited for the wildcat test well.

The nearest well of record that has been drilled in the area is the Cole well, shown on the geologic map, drilled in 1952. The well is located between the Fossil Anticline and Shell Creek Dome apexes and had only minor shows in the Phosphoria. Most of the information that is derived from the dry holes on the north end of the Shell Creek Dome can be used for planning the Fossil Anticline test well.

## **Wildcat Test Well**

The permitted drilling location has negligible soil or loose rock at the surface and little, if any, conductor pipe is required. The Thermopolis Shale is exposed at the surface. The surface casing should be anchored into the competent Cloverly Formation below the shale. This would place all of the Thermopolis Shale behind pipe along with associated problems of heaving shales and caving. The total depth of the well will be about 2,800 feet in order to test all three high-potential zones including and the upper two hundred feet of the Madison Limestone.

A formation thickness matrix was prepared from wells drilled to the southeast on the flanks of the Shell Creek Dome. A weighted average thickness for each interval was determined. Based on these thicknesses, and the assumption that the wildcat well would top the Cloverly Formation at approximately 200 feet drilling depth, the following depth projections are calculated for the Fossil #1-25 USA test well:

<u>Formation</u>	<u>Depth (ft)</u>	<u>Elevation (SL)</u>	<u>Comments</u>
Thermopolis Shale	Surface	+3,958	Place behind surface casing to prevent caving and heaving
Cloverly Fm.	200	+3758	Minor oil & gas potential
Morrison Fm.	420	+3538	Minor oil potential
Sundance Fm.	649	+3309	Minor oil potential
Gypsum Springs Fm.	1070	+2888	
Chugwater Group	1250	+2708	Curtis Sand potential
Dinwoody Fm.	1950	+2008	
Phosphoria Fm.	2000	+1958	Excellent oil potential
Tensleep Sandstone	2250	+ 1708	Excellent oil potential
Amsden Fm.	2435	+1523	
Madison Limestone	2605	+ 1353	Excellent oil potential
TD, estimate	2800	+ 1158	Evaluate upper 195 feet

### **Economics**

As with any wildcat well, economic expectations are speculative. No wells have been drilled on this structure. Consequently, all parameters beyond the 440 acres of area within closure are based on wells drilled on the flanks of the nearby Shell Creek Dome or the Torchlight Oil Field. The McKown well, drilled in 1964 only 1.5 miles to the southeast, cored a heavily oil-saturated (average 59.6%) core from the Phosphoria. The core analysis lab estimated that the API gravity of the oil was 18 degrees. If the oil is indeed 18-degree gravity, then it should be anticipated that heat would need to be added to the production via a heater-treater in order to separate out water and help in the winter shipping process.

### **Phosphoria Oil Potential**

The area of closure of Fossil Anticline, as indicated by the last closing form-line contour, is approximately 440 acres. This area was established by careful form-line analysis of the surface geology using relative dip amounts, strike components and outcrop pattern to create the included geologic and contour map. This contour map is qualitative as contrasted with a quantitative subsurface contour map which would be based on well-log-derived numbers from an adequate density of data points. However, the form-line analysis can be expected to mirror the subsurface structure when migrated to the northeast. Of the total 440 acres above the last closing contour (variable A in the formula below), all of it has to be considered prospective in the Phosphoria since there are no limiting dry holes. The data from the McKown well indicates that an oil-saturated core was recovered with an average oil saturation of 59.6% (variable So). Porosity of 28% ( $\Phi$ ) over a thickness of 12 feet (variable h below) has been calculated from state-of-the-art logs from a well drilled by the Wyoming Water Development Commission in 2008. This well is located less than 3 miles to the southeast. Using the structural and reservoir data above, the estimate of potential barrels of oil in place calculates as follows:

$$\text{BO (in place)} = VAh\Phi So \text{ where } V \text{ (volume constant)} = 7,758 \text{ bbls/ac. Ft}$$

$$\text{BO (in place)} = (7,758)(440 \text{ ac})(12 \text{ feet})(28\%)(59.6\%) = \underline{\underline{6,835,778 \text{ BO}}}$$

### **Tensleep Oil Potential**

To find representative reservoir parameters, the data available for the Tensleep Sandstone from the Torchlight Oil Field (10 miles to the south) is used. Here the pay thickness is 35 feet, the porosity averages 14% and no oil saturation percentage is available. Since at least 50% oil saturation is normally required for production, and since the Tensleep has produced nearly four million barrels of oil at the Torchlight Field, the 50% figure will be used.

$$\text{BO (in place)} = (7,758)(440 \text{ ac})(35 \text{ feet})(14\%)(50\%) = \underline{\underline{8,363,124 \text{ BO}}}$$

### **Madison Oil Potential**

Relying on the Madison reservoir parameters found at Torchlight Oil Field indicates a pay thickness of 70 feet, average porosity of 16% and no oil saturation percentage is provided. Using the minimum 50% value for oil saturation:

$$\text{BO (in place)} = (7,758)(440 \text{ ac})(70 \text{ feet})(16\%)(50\%) = \underline{\underline{19,115,712 \text{ BO}}}$$

### **References**

1. Anonymous, 1989, Torchlight, in Wyoming Geological Association Symposium on Wyoming Oil and Gas Fields, Bighorn and Wind River Basins, P. 509-510.
2. Dougan, Paul M., 2001, Equity Oil Company Annual Report 2001, P. 7.
3. Yapuncich, Sanderson & Brown Laboratory's report on a portion of McKown well's Phosphoria core.
4. Upper Phosphoria section of well log from Wyoming Water Development Commission's "BHRJPB Well #1".



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# CENTENNIAL ENERGY

Fossil No. 1-25 USA

NENWSE Sec. 25, T53N-R93W

Lease WYW172769

Big Horn County, WY

# References



Anonymous  
Anonymous  
Casper, Wyoming  
August, 1989

Map: Gene George  
Clark and George  
Oil and Gas Prop.

### DISCOVERY WELL

**Name:** Unknown  
**Location:** Approximate center 24-51N-93W  
**Date of Completion:** 1913  
**Initial Potential:** 30 BOPD Mowry - Lower Cretaceous  
**Total Depth:** 300± feet Mowry  
**Elevation:** 4200 Gr estimated  
**Casing:** Unknown  
**Perforations:** Open hole  
**Treatment:** None, natural  
**Pressures:** Unknown

### GENERAL FIELD DATA

**Regional Setting:** East Flank, Bighorn Basin  
**Other Formations with Shows:** None reported  
**Exploration Method Leading to Discovery:** Surface mapping  
**Trap Type:** Structural, anticline  
**Surface Formations:** Frontier - Upper Cretaceous  
**Oldest Formation Penetrated:** Precambrian  
**Well:** Pan American Pet., 10 Orchard Unit, NWSESE 24-51N-93W  
**Spacing Order:** None, unit excluded from Rule 302  
**Logging Practice:** Past; EL, MICL, GRN, Recent; LATL, SNP, SONL  
**Completion Practice:** Pre 1948; open hole, Recent; set casing through pay, selectively perforate, acidize  
**Productive Area:** 840 acres Madison  
**Number of Producing Wells:** 19  
**Number of Abandoned producers:** 147+ (145+ Mowry, 1 Phosphoria, 1 Tensleep)  
**Number of Dry Holes:** 31+  
**Number of Shut-in Wells:** 38 (6 Mowry, 6 Phosphoria, 6 Tensleep, 20 Madison)  
**Number of Disposal Wells:** 2 Tensleep  
**Number Pressure Maintenance Injection Wells:** 8  
**Market for Production:** Marathon Pipeline  
**Major Operators:** Amoco Production Co.

### RESERVOIR DATA

**Formation:** Mowry "Kimball" and "Oeth Louie" - Cretaceous  
**Lithology:** Sandstone  
**Discovery Date:** 1913  
**Porosity:** Unknown  
**Permeability:** Unknown  
**Average Pay Thickness:** 30 feet - "Kimball"; 25 feet - "Oeth Louie"  
**Oil Column:** 300± feet  
**Oil/Water Contact:** +3550± feet  
**Gas Oil Ratio:** Unknown  
**Initial Pressure:** Unknown

## TORCHLIGHT

T51N R92-93W  
Big Horn County, Wyoming  
Mowry "Kimball" and "Oeth Louie", Phosphoria, Tensleep, Madison, Bighorn

**Present Pressure:** Depleted  
**Drive Mechanism:** Solution gas  
**Rw and/or Salinity:** 0.58 @ 68° F.  
**Bottom hole Temperature:** Unknown  
**Character of oil or gas:** Gravity - 46.3° API; Sweet; Paraffin base; Color - dark green  
**Continuity of Reservoir:** Over entire structure with variable porosity and permeability  
**Cumulative Production:** 203,745 + BO, 1/1/89  
**Primary Recovery:** 199,244 BO  
**Secondary:** 4461 + BO  
**Estimated Ultimate Recovery:** 203,745 BO

### DISCUSSION

The total number of wells drilled between 1913 and 1932 is not certain and primary production ceased in 1932. A limited waterflood has been conducted with unknown results.

### RESERVOIR DATA

**Formation:** Phosphoria - Permian  
**Lithology:** Dolomite, anhydritic, cherty  
**Discovery Date:** October 31, 1947  
**Location:** Stanolind, 1 Unit, SWSSE 24-51N-93W  
**Initial Potential:** F 1500 MCF/GPD on DST  
**Perforations:** 2830 - 2860 DST; Tensleep discovery, did not produce from the Phosphoria  
**Treatment:** None  
**Porosity:** 12% average; 5.4% average, Core, Range 2.5 - 10.5% (NWSE 14 and NESE 25-51N-93W, 29 samples, nonproductive)  
**Permeability:** 1.4 md average, Core, Range 0-15 md; highly variable due to fracturing  
**Average Pay Thickness:** 30 feet  
**Oil/Gas Column:** Gas - 150 feet; Oil - 200 feet  
**Gas/Oil/Water Contact:** Gas/Oil + 1140 feet; Oil/Water + 940 feet  
**Gas Oil Ratio:** Variable, 0 to 219,000:1; only gas at the present time  
**Initial Pressure:** 1450 psi SIP DST  
**Present Pressure:** Unknown  
**Drive Mechanism:** Solution gas, limited water  
**Rw and/or Salinity:** 0.22 @ 68° F. DST  
**Bottom hole Temperature:** 100° F. Log (SESW 24-51N-93W)  
**Character of oil or gas:** Oil: Gravity - 31.3° API; Pour point - <5° F.; Sulfur - 1.99%; Viscosity - 42 sec @ 100° F.; Specific gravity - 0.869; Nitrogen - 0.08%; Color - greenish black; Gas: BTU - 1144; Methane - 80.1%; Ethane - 10.86%; Propane - 2.12%; Butane - 1.24%; Pentanes + - .81%; N2 - 3.21%; He - 0.01%; H<sub>2</sub>S - 1.66%

**Continuity of Reservoir:** Covers entire structure, variable porosity and permeability  
**Cumulative Production:** 3,394,226 MCFG, 1/1/89, oil included with Tensleep production  
**Primary Recovery STBO or MCF/AC FT:** Unknown

**Secondary:** Unknown  
**Estimated Ultimate Recovery:** 5+ BCFG; oil undetermined  
**Decline Curve:** Appendix

#### RESERVOIR DATA

**Formation:** Tensleep - Pennsylvanian  
**Lithology:** Sandstone  
**Discovery Date:** October 31, 1947  
**Location:** Stanolind, 1 Unit, SWSENE 24-51N-93W  
**Initial Potential:** F 1632 BOPD  
**Perforations:** 3038 - 3140 open hole  
**Treatment:** None, natural  
**Porosity:** 14% average Log  
**Permeability:** Not reported  
**Average Pay Thickness:** 35 feet  
**Oil Column:** 200 feet  
**Oil/Water Contact:** +940 feet  
**Gas Oil Ratio:** Variable, 0 to 8113:1  
**Initial Pressure:** 1600 psi Rock pressure  
**Present Pressure:** Unknown  
**Drive Mechanism:** Water  
**Rw and/or Salinity:** 3.3 @ 68° F. produced water  
**Bottom hole Temperature:** 100° F. Log (SENWSE 24-51N-93W)  
**Character of oil or gas:** Gravity - 35° API; Pour point - <5° F.; Viscosity - 39 sec @ 100° F.; Sulfur - 1.83%; Specific gravity - 0.850; Nitrogen - 0.055  
**Continuity of Reservoir:** Continuous and widespread  
**Cumulative Production:** 3,753,272 BO, 11,989,698 BW, 1/1/89, includes Phosphoria  
**Primary Recovery STBO or MCF/AC FT:** Unknown  
**Secondary:** Unknown, water injection began in 1987  
**Estimated Ultimate Recovery:** 3,800,000 BO  
**Decline Curve:** Appendix

#### RESERVOIR DATA

**Formation:** Madison - Mississippian  
**Lithology:** Dolomite and limestone  
**Discovery Date:** April 11, 1948  
**Location:** Stanolind, 2 Orchard Unit, SWNESE 24-51N-93W  
**Initial Potential:** P 450 BOPD  
**Perforations:** 3363 - 3635 open hole  
**Treatment:** Acidized w/3000 gal  
**Porosity:** 16% average, Core, Range 5-27.5% (limited data)  
**Permeability:** 25 md average, Core, Range 0.2 - 269 md; lower zone is irregularly cavernous  
**Average Pay Thickness:** 70 feet  
**Oil Column:** 380 feet

**Oil/Water Contact:** +425 feet  
**Gas Oil Ratio:** Unknown, very low gas  
**Initial Pressure:** 1500 psi DST  
**Present Pressure:** Unknown  
**Drive Mechanism:** Water  
**Rw and/or Salinity:** 9.5 @ 100° F. produced  
**Bottom hole Temperature:** 110° F. Log (SENWSE 24-51N-93W)  
**Character of oil or gas:** Gravity - 20.5° API; Pour point - <5° F.; Viscosity - 400 sec @ 100° F.; Sulfur - 2.72%; Specific gravity - 0.931; Nitrogen 0.22; Color - brownish-black  
**Continuity of Reservoir:** Widespread, highly variable porosity and permeability  
**Cumulative Production:** 12,212,973 BO, 581,137 MCFG, 295,932,277 BW, 1/1/89, includes 6 wells commingled w/Tensleep; 38 wells  
**Primary Recovery STBO or MCF/AC FT:** Unknown  
**Secondary:** Unknown, gas injection started in 1964  
**Estimated Ultimate Recovery:** 14,000,000 BO  
**Decline Curve:** Appendix

#### RESERVOIR DATA

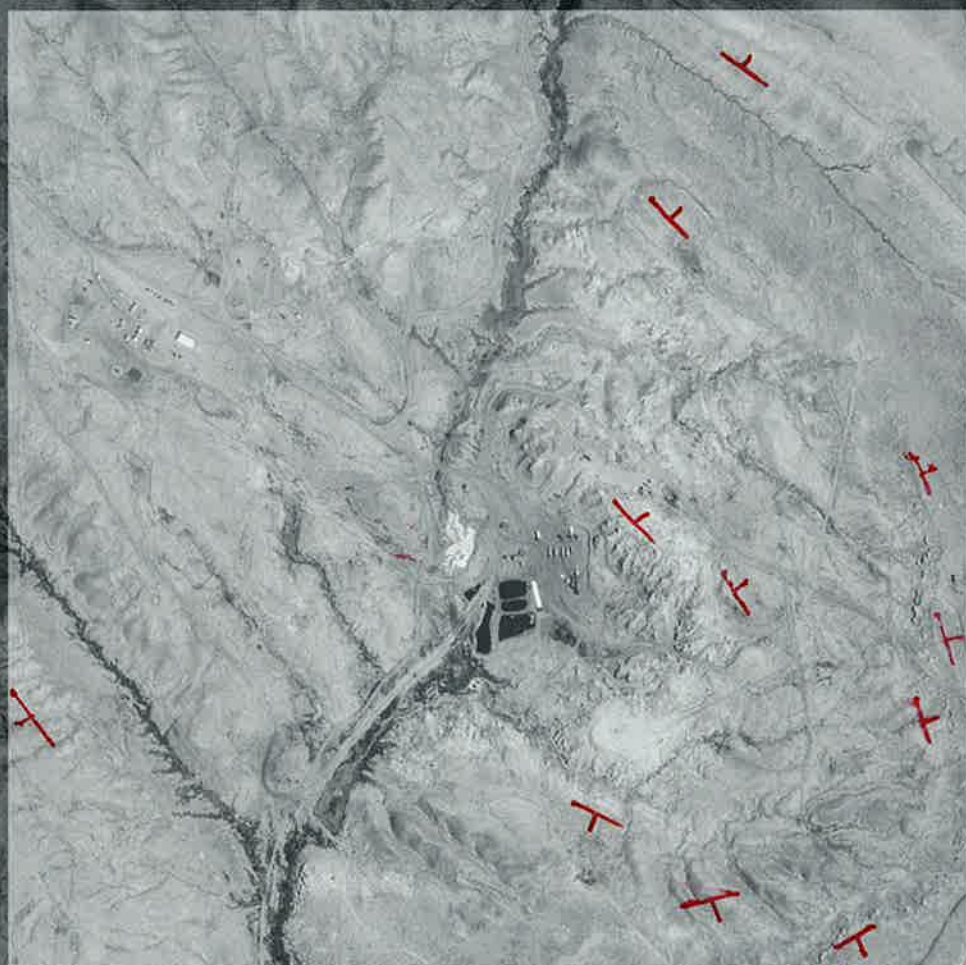
**Formation:** Bighorn - Ordovician  
**Lithology:** Dolomite  
**Discovery Date:** March 12, 1962  
**Location:** Pan American Pet., 10 Orchard Unit NWNESE 24-51N-93W  
**Initial Potential:** P 51 BO, 371 BWPD  
**Perforations:** 4119 - 4133  
**Treatment:** None  
**Porosity:** 14% average Log  
**Permeability:** Unknown  
**Average Pay Thickness:** 16 feet  
**Oil Column:** 40± feet  
**Oil/Water Contact:** Unknown  
**Gas Oil Ratio:** 0  
**Initial Pressure:** 1904 psi DST  
**Present Pressure:** Depleted  
**Drive Mechanism:** Water  
**Rw and/or Salinity:** 2.2 @ 68° F.  
**Bottom hole Temperature:** 116° F. DST @ 4130 feet (NESE 24-51N-93W)  
**Character of oil or gas:** Gravity - 24° API  
**Continuity of Reservoir:** Unknown, 1 well  
**Cumulative Production:** 5519 BO, 1/1/89  
**Primary Recovery:** 5519 BO  
**Secondary:** None  
**Estimated Ultimate Recovery:** 5519 BO

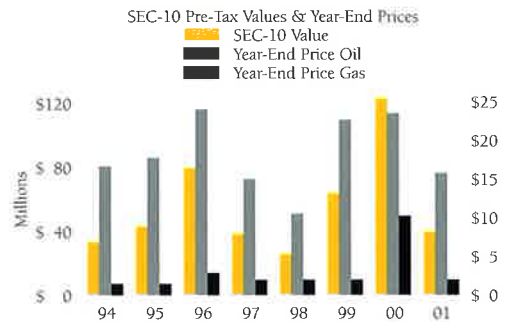
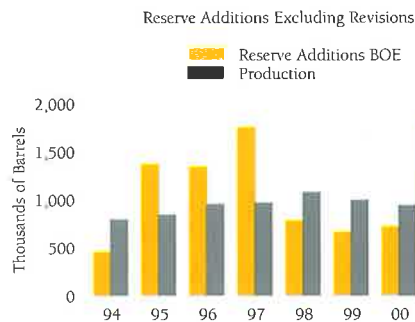
#### REFERENCES

Biggs, Paul and R.H. Espach, 1960, Torchlight Field: Petroleum and Gas Fields of Wyoming, Bureau of Mines Bulletin 582, p. 270-273.  
 Wyoming Geological Association, 1957, Torchlight Field: Symposium, Wyoming Oil and Gas Fields. Wyoming Oil and Gas Commission, 1988, Production data; well files.



# EQUITY OIL COMPANY ANNUAL REPORT 2001





The second source of improved oil production performance is a result of 2001 fourth quarter drilling in the Torchlight field which was a direct result of the 3-D survey of the field the Company conducted in early 2001. One of the purposes of the survey was to attempt to locate a drilling location in the field that would replicate the type of reserves and production rate associated with the Torchlight #37 well which was drilled in 1968. That well produced a total of 858,000 barrels in the first 16 months of its productive life at rates as high as 4,400 barrels per day. The Torchlight #59, which was drilled in December 2001 and completed in January 2002, may have encountered a zone with properties similar to the Torchlight #37 since it tested at an initial rate of 300 barrels per day flowing 100% oil with a flowing tubing pressure of 350 psig. It is presently producing at a rate of 200 barrels per day due to the limitations of the surface equipment in the field. Assuming that the present flowing characteristics are sustained, additional equipment will be installed early in the third quarter of 2002 so that the full productive potential of the well can be determined. A second extension well, the #1-19 MCP Federal, was also drilled in December 2001 and has recently been completed as a more typical Torchlight well producing 50 barrels of oil and 1,050 barrels of water per day. Since both the Torchlight #59 and the #1-19 MCP Federal were completed subsequent to year-end 2001, no reserves associated with the wells were recorded in 2001.

The major thrust of our exploration activity in 2001 was the continuation of the development of our Beaver Creek prospect. This prospect is the result of the prolific Nisku discovery, the #24-15 Beaver Creek well drilled in 1998. Through year-end 2001 that well has produced a total of 1 million barrels of oil and 594 MMCF of gas at rates as high as 2,200 barrels of oil per day. During 2000 and 2001, Equity conducted a total of 35 square miles in two 3-D geophysical surveys in the Beaver Creek area to attempt to identify additional Nisku drilling targets. The surveys have identified multiple prospective drilling locations, the first of which is planned to be drilled beginning in March of 2002. Drilling in the Beaver Creek prospect area has been hampered by a protracted period of negotiations with the United States Forest Service to obtain the required drilling and surface occupancy permits. It is hoped that the initial test, the BTA #1-B Equity Redtail, will validate the effectiveness of the 3-D work that we have done in the area.



# YAPUNCICH, SANDERSON & BROWN LABORATORIES BILLINGS, MONTANA

13 N. 22ND ST.

## CORE ANALYSIS REPORT

Lab. No. 6624

Field SHELL CREEK DOME (WC) County BIG HORN State WYOMING  
 Well No. 1 GOVERNMENT Location 31-53N-92W  
 Formation PHOSPHORIA Depth 1620-30'  
 Operator SHRAKE, MCKOWAN & KUNKEL Date 12-11-64

### Laboratory Data

Sample No.	Depth Feet	Porosity Percent	Permeability Millidarcys	SATURATION, % PORE SPACE		Matrix Density	Remarks
				Retorted Oil	Water		
1	1620-21	12.5	5.1	64.8	35.2	2.70	
2	1621-22	11.6	0.8	50.0	41.4	2.80	
3	1622-23	13.5	1.4	64.4	35.6	2.79	
4	1623-24	14.3	3.7	65.7	34.3	2.78	
5	1624-25	12.7	1.0	65.4	33.9	2.76	<div>           U.S. GEOLOGICAL SURVEY            RECEIVED            DEC 29 1964            THERMOPOLIS WYOMING         </div>
6	1625-26	10.8	8.6	54.2	44.4	2.74	
7	1626-27	12.2	10	63.9	14.8	2.75	
8	1627-28	9.0	1.1	55.6	16.7	2.76	
9	1628-29	13.3	12	77.4	22.6	2.75	
10	1629-30	10.3	13	35.0	41.7	2.80	

### SUMMARY

### PROBABLE PRODUCTION

1620-30 12.0 5.7 59.6 32.1 2.76 NONE

REMARKS: 3½" ROTARY CORE. BROWN FLUORESCENCE. SLOW ACID REACTION.  
 SAMPLED BY OPERATOR. GRAVITY OF RETORTED OIL 30° API.  
 INDICATING ABOUT 18° API FOR THE ORIGINAL CRUDE.