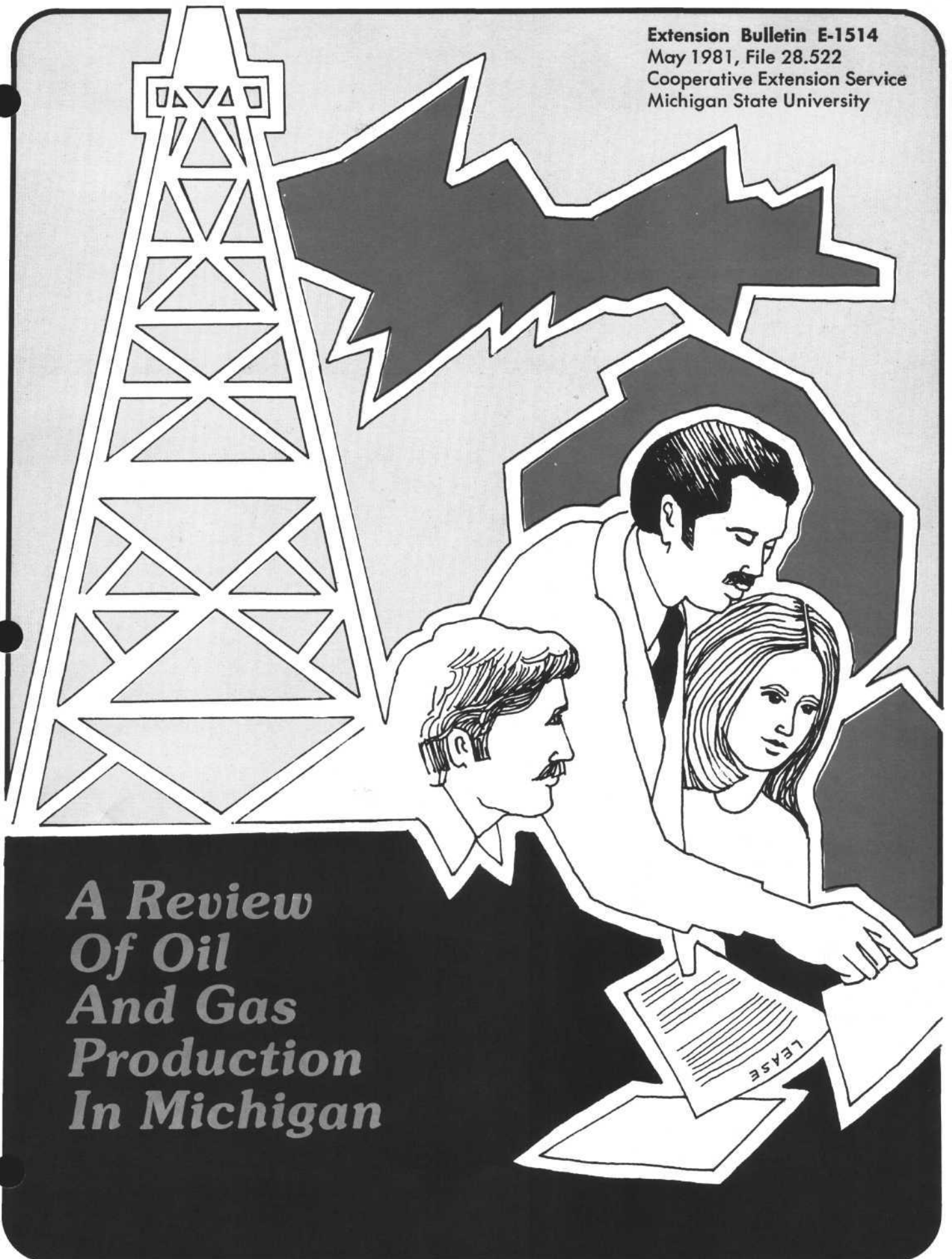


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*A Review  
Of Oil  
And Gas  
Production  
In Michigan*

## OIL AND GAS IN MICHIGAN

Oil was first discovered in the 1890's in the Port Huron area, though earnest exploration began in 1925 with the Saginaw Field producing from about 1800 feet. Recent discoveries in Michigan range in depths from 1000 feet in Cass County to 7200 feet in Kalkaska and Crawford counties.

Estimated total cumulative crude oil and condensate production through 1980 was approximately 837,687,000 barrels and natural gas production was 1,713,479,000,000 cubic feet.

In 1978 the oil and gas exploration and production industry became the largest mineral resources industry in Michigan in terms of dollar value of raw material product. In the first six months of 1980 oil and gas had a gross wellhead value of \$525,740,359. There are approximately 260 companies and individuals producing oil and gas in Michigan.

The forecast for 1990 of crude oil and condensate production is 23,971,000 barrels as compared to an estimated 33,900,000 barrels in 1980. The 1990 forecast of natural gas production is 86,577,000,000 cubic feet as compared to an estimated 159,000,000,000 cubic feet in 1980. Discovery of a major new source could significantly alter these projections.

### A REVIEW

#### GROWTH

In the last ten years oil production has tripled and gas production has quadrupled. In 1980 crude oil and condensate (natural gas liquids) production was approximately 33,900,000 barrels and natural gas production was 159,000,000 MCF (thousand cubic feet) as compared to 1970 production figures of 11,693,488 barrels and 39,252,013 MCF. Natural gas figures throughout this report include both dry natural gas produced from gas wells and casinghead gas produced from oil wells.

#### NATIONAL RANK OF PRODUCTION

Based upon Independent Petroleum Association of America (IPAA) statistics as of January 1, 1980, Michigan ranks 11 of 33 oil-producing states. The Interstate Oil Compact Commission reports that Michigan ranks 10 of 32 gas-producing states as of the same date.

#### EMPLOYMENT

A Michigan Oil and Gas Association membership survey in May 1980 indicates that 10,000 men and women are employed in the exploration, production, and associated service industries. The IPAA estimates in its 1979 report that the related manufacturing and transportation aspects of the petroleum industry, exclusive of wholesale and retail activities, employ 11,400 people.

#### RESERVES

Michigan oil reserves more than quadrupled between 1969 and 1979. Oil reserves, as reported by the American Petroleum Institute, totaled 51,517,000 barrels in 1969. Geological Survey Division estimates to December 31, 1979 include 195,775,000 barrels of primary oil and 46,537,000 barrels of oil recoverable by secondary techniques. For the same period of time gas reserves increased from 750,964,000 MCF to 1,797,923,000 MCF as reported by the American Gas Association (AGA).

#### NORTHERN SALINA-NIAGARAN TREND

The large increases in production over the past 10 years are attributable to the discovery and development of the northern Salina-Niagaran reef belt that stretches northeasterly from Mason County to Presque Isle County. From a negligible contribution in 1970, the northern Salina-Niagaran trend yielded an estimated 73% of the State's crude oil and condensate and 85% of the State's natural gas in 1980. The development of the Salina-Niagaran reef reservoirs is largely the result of the successful application of computers and geophysical theory to accurately identify occurrence of potential reservoir structures.

## STRIPPER PRODUCTION

As of January 1, 1980 Michigan had 3,277 stripper oil wells compared to 3,555 in 1970. A stripper oil well is a well from which crude oil produced does not exceed 10 barrels per day. Eighty percent of the State's oil wells produced 10 or less barrels of oil per day in 1980.

## SECONDARY RECOVERY AND PRESSURE MAINTENANCE PRODUCTION

In 1979 a total of 32 secondary recovery and pressure maintenance projects accounted for approximately 10% of the total production. These projects produced 3,430,704 barrels of oil that would not otherwise be recovered through primary methods of depletion of oil fields. This recovery of oil is achieved through the injection of produced brine, fresh water, and/or produced or purchased gas.

## GAS STORAGE

Michigan, with its 48 subsurface gas storage projects, ranks third in the nation according to the AGA. Illinois ranks first in the United States with a cyclic gas storage capacity of 849,053,000 MCF; Pennsylvania second with 686,712,000 MCF; and, Michigan third with 648,145,000 MCF. In the ten-year period ending in 1980, gas storage capacity in the State increased by 28%. A valuable resource for future years will be the depleted reef reservoirs in the northern Salina-Niagaran trend. It is expected that a number of these reservoirs will be converted to gas storage.

## DRILLING ACTIVITY

856 drilling permits were issued in 1980, exceeding the several preceding years by 200 or more. Approximately 90% of these permits were used to explore for either oil or gas and the balance for gas storage or brine disposal wells. Preliminary estimates for 1980 indicate that 30% of the drilled wells discovered oil, 8% discovered gas, and 62% were dry. As of January 1981, 23 drilling contractors with 37 rotary rigs and 8 cable tool rigs were in service.

## DRILLING COSTS

In 1978 oil wells cost an average of \$53.74/foot (average depth 4,847 feet); gas wells \$56.09/foot (average depth 5,297 feet); and dry holes \$43.29/foot (average depth 4,745 feet). The drilling figures include the costs of completing and equipping a well for production. These costs increased proportionately with the rate of inflation in the 1970's.

## CRUDE OIL AND NATURAL GAS CONSUMPTION

According to the latest available figures, Michigan produces an estimated 14.3% of its crude oil needs and refines approximately 80% of its produced crude (76,800 barrels per day) in six refineries located in the Lower Peninsula. The refineries process an additional 54,200 barrels of out-of-state crude on a daily basis. Approximately 18.2% of Michigan's natural gas needs are supplied by Michigan production. Natural gas consumption in 1979 was approximately 44% residential, 21% commercial, and 35% industrial. All natural gas produced in Michigan is consumed in Michigan.

## LEASED LAND

Exclusive of Great Lakes bottom land, Michigan's land area spans 36,500,000 acres, with the State owning approximately 3,800,000 acres in fee and 2,100,000 acres with only mineral rights. In December, 1980 the oil and gas industry held leases to 1,583,596 acres of State land and an estimated 11,000,000 acres of private and Federal lands.

## TAX REVENUES

During the period 1970-79 an almost sixteenfold increase in severance taxes from \$900,692 to \$14,148,813 resulted from increased production and wellhead values. A marked increase to nearly \$47,000,000 in 1980 resulted from revision of severance tax rates. Table 1 illustrates severance revenues and privilege fee assessment. The latter is for administration of the oil and gas regulatory act.

## ROYALTY REVENUES

Under the general heading of royalties, revenues to the State are derived from four sources. These are: production royalty based on a constant percentage owner's share; bonus payments for the privilege of leasing lands for oil and gas exploration and development; yearly lease rental payments; and, application assignment fees for land transactions. Revenue totals in these areas were \$32,246,000 in 1979-80 as contrasted with \$1,359,996 in 1970. Table 2 is a listing of the separate values.

## 1990 FORECAST

### CRUDE OIL AND CONDENSATE PRODUCTION

In the absence of a major new find, crude oil and condensate production is expected to be 23,971,000 barrels in 1990; this is approximately two thirds that of 1980. If no new oil reserves were to be discovered in the 1980's, oil production could be expected to be only 14,447,000 barrels per year.

### NATURAL GAS PRODUCTION

In the absence of a major new find, natural gas production is expected to be 86,577,000 MCF in 1990. This is approximately one half that of 1980. If no new gas reserves were to be discovered in the 1980's, gas production could be expected to be 67,064,000 MCF in 1990.

### CRUDE OIL AND CONDENSATE RESERVES

If no new major fields are discovered in the 1980's, crude oil and condensate reserves are expected to be 167,000,000 barrels in 1990. This compares to 245,000,000 barrels in 1980. Important additions to crude oil and condensate reserves are anticipated to occur from:

1. further development of the northern Salina-Niagaran trend in Mason, Manistee, Benzie, Wexford, Grand Traverse, Kalkaska, Antrim, Crawford, and Otsego counties.

It is believed that as of January 1, 1980, approximately 60% of the probable reserves in these counties

had been discovered. In the 1980's approximately 75% of the remaining probable Salina-Niagaran reserves are expected to be explored.

2. development of the northern Salina-Niagaran trend in Montmorency, Cheboygan, and Presque Isle counties.

In 1980 there were 25 shut-in wells (some for as long as six years) in these counties awaiting the construction of a gas sales pipeline. Further exploration and development are expected in these counties when the pipelines are constructed.

3. development of northern Salina-Niagaran trend reefs in Oceana, Muskegon, Ottawa, Allegan, and Barry counties.

Reefs are predicted to exist in this area, but the productive capability and their numbers are unknown.

4. discovery of reserves in deep formations in the central Lower Peninsula.

An aggressive drilling campaign is currently being conducted in an effort to discover reserves in deep formations in this part of the State. Concurrent with this activity are anticipated geophysical programs to acquire 1,100 miles of seismic data in 1981 with expected client use to include major, large independent, and some Michigan based companies. In the past, most of the efforts to drill for the discovery of oil and gas have taken place at depths of less than 8,000 feet. At the beginning of 1981, 10 wells were in various drilling stages with target depths greater than 10,000 feet. Though no new discoveries have been reported as of January 1981, the interest is great and speculation is unrestrained.

5. discovery of oil and gas in established producing formations in unexplored areas of the State.

6. establishment of new secondary recovery and pressure maintenance projects, especially in the northern Salina-Niagaran trend.

7. application of evolving tertiary or other enhanced recovery technology to currently known reservoirs.

#### NATURAL GAS RESERVES

If there are no new major finds, natural gas reserves are expected to be 933 million MCF in 1990; this compares to 1,833 million MCF in 1980. Traditionally, drilling for new reserves is concentrated upon potential oil bearing targets. Deep central basin exploration could significantly alter the gas reserves estimates. A modest development can be expected in the future in the production of gas from the Antrim Shale formation.

#### DRILLING ACTIVITY

An estimated 1,000 to 1,400 wells will be drilled in 1990. This forecast is based upon the incentives provided by higher crude oil and natural gas prices and expected continued demand for hydrocarbon products. Costs of drilling are expected to increase comparably to the rate of inflation. Although increasing amounts of dollars are invested for exploration activities, the amount of oil and gas reserves being found per foot of well drilled is becoming less each year. Worldwide statistics show that when the first 100 million feet of wells were drilled, an average of 240 barrels of oil per foot was discovered. In 1980 an average of only 30 barrels of oil was found per foot of well drilled. In the future the rate of discovered reserves per drilled foot is expected to decrease.

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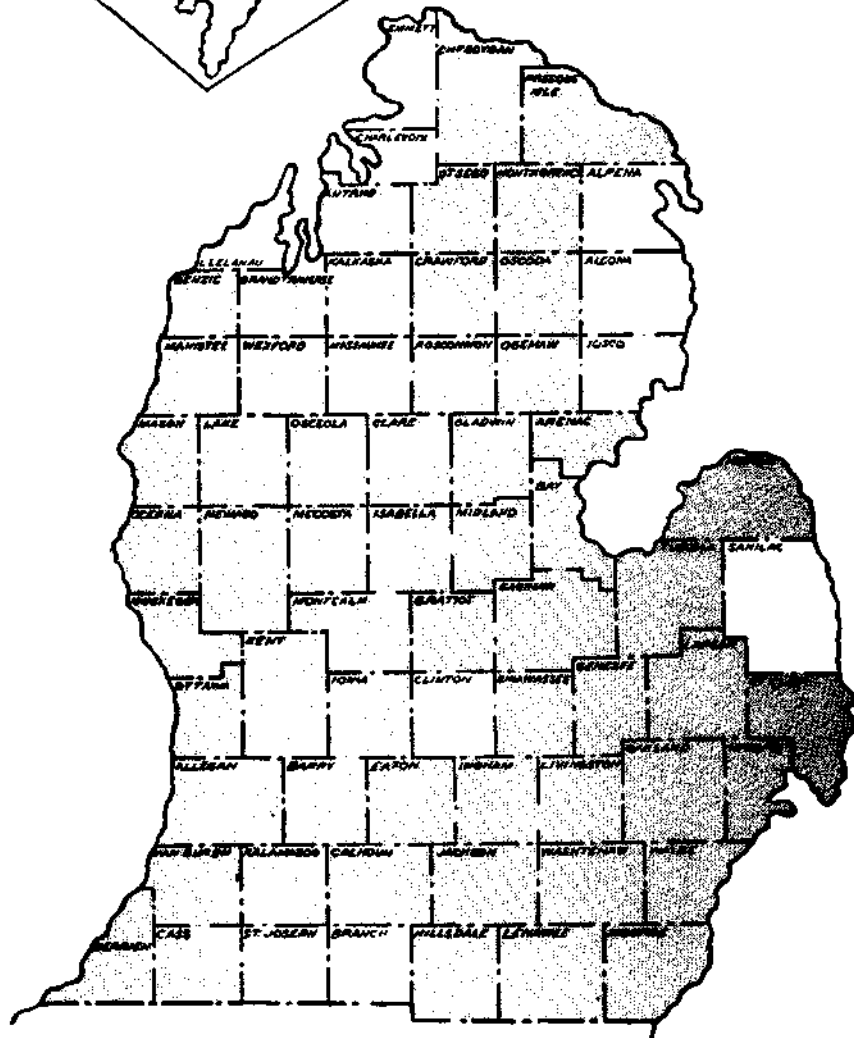
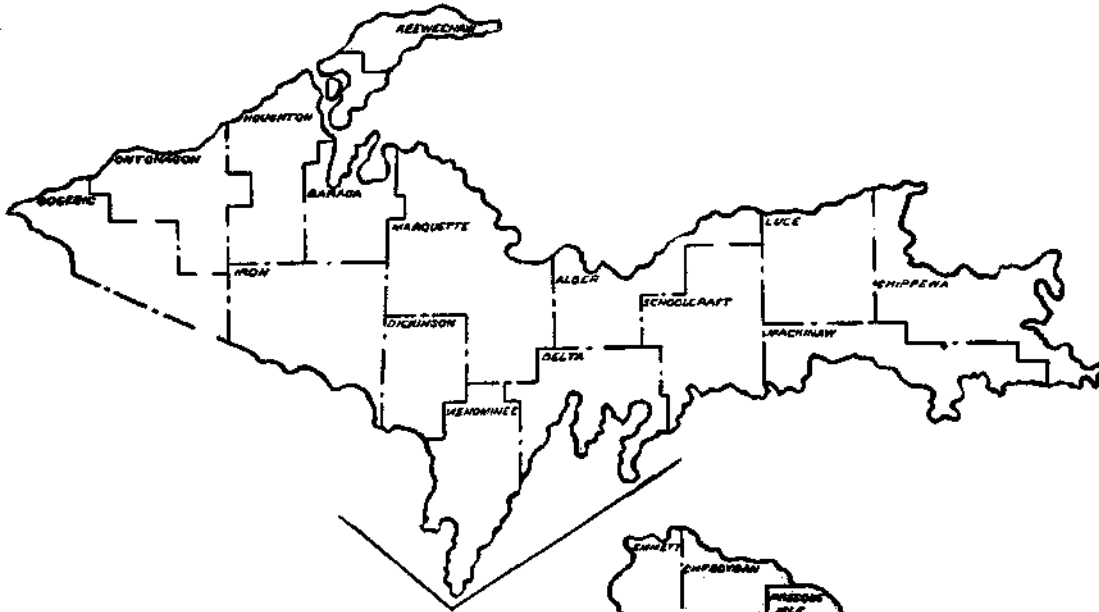
Table 1 : OIL AND GAS TAX REVENUES

Year ending June 30th	Severance Tax Dollars	Privilege Fee Dollars	Total Dollars
1967-1968	952,525	16,650	969,175
1968-1969	1,019,518	15,374	1,034,892
1969-1970	943,587	14,953	958,540
1970-1971	900,692	14,395	915,087
1971-1972	914,148	14,880	929,028
1972-1973	1,075,843	16,143	1,091,986
1973-1974	2,286,217	812,404	3,098,621
1974-1975	4,502,153	1,602,049	6,104,202
1975-1976	7,612,566	1,814,881	9,427,447
1976-1977	9,090,725	752,649	9,843,374
1977-1978	10,714,591	320,555	11,035,146
10/78-9/79	14,148,813	1,304,513	15,453,326
10/79-9/80	*46,993,883	*1,988,304	*48,982,187

Table 2 : OIL AND GAS ROYALTY REVENUES

Calendar Year	Production Royalty Dollars	Yearly Fee Rental Dollars	Lease Bonus Dollars	Application Asgmt. Fees Dollars	Total Income Dollars
1967	250,785	199,399	49,192	1,126	500,502
1968	324,934	451,117	1,223,971	2,849	2,002,871
1969	404,709	819,550	894,133	872	2,119,264
1970	429,796	929,596	- 132	736	1,359,996
1971	749,815	858,360	1,361	426	1,609,962
1972	944,441	831,057	10,165,151	2,854	11,943,503
1973	1,960,854	1,261,208	3,133	1,658	3,226,853
1974	5,476,864	1,280,128	7,131,732	2,248	13,890,972
1975	9,635,776	1,297,692	514,248	4,663	11,452,379
1976	13,293,254	1,328,660	524,973	631	15,147,508
1977	13,327,908	1,190,620	357,006	3,069	14,878,603
1978	18,244,530	1,131,238	14,483	1,733	19,391,984
1979	24,269,564	1,100,307	1,414,667	1,047	26,785,585
1980	*30,900,000	*1,340,000	*3,700	*1,989	*32,245,689

\* Preliminary



Counties with oil and/or gas production (shaded).



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