

NORTH DAKOTA GEOLOGICAL SURVEY

E. A. Noble, State Geologist

NORTH DAKOTA CRUDE OIL INVENTORY AS OF JANUARY 1, 1973

by

Clarence B. Folsom, Jr. P.E.

Miscellaneous Series #51

Grand Forks, North Dakota, 1973

# NORTH DAKOTA CRUDE OIL INVENTORY AS OF 1 January, 1973

by

Clarence B. Folsom, Jr. P.E. <sup>1</sup>

## ABSTRACT

North Dakota's reserves of crude oil, recoverable with present technical knowledge, available equipment and current operating practices, were 664,647,204 barrels on 1 January 1973. This figure is a decrease from the 667,679,383 barrels reported for 1 January 1972.

315,200,000 barrels, or 47% of these reserves, will be recovered by energy supplementation.

Reports of 92 well completions were received by the Geological Survey in 1972. Of these 25 were completed as producing wells. About 51.8% of the production in the month of December, 1972 came from unit operations and 36.7% of the producing wells are considered to be marginal, or stripper wells.

Five new pools were opened during the year. With permits issued for 50 wildcat prospects the success ratio was 1 in 10.

The methods used, the data sources, and the assumptions made in previous reports in this series have been followed so that the results may be compared and valid conclusions drawn therefrom.

## Results of the Study

On 1 January 1973 North Dakota's reserves of crude oil were 664,647,204 Stock Tank Barrels. This oil is considered to be technically recoverable with present equipment and techniques. Because of economic factors ultimate recovery may be less, but it is expected that improved techniques will offset this and may even add to the total.

Cumulative production to 1 January 1973 was 394,764,192 barrels. Production for the year of 1972 was 20,624,185 barrels, an average of 43.3 barrels per well per producing day. The total production for 1972 was about 5% below that for 1971. In addition to crude oil 2,034,511 barrels of hydrocarbon liquids and 43,403 long tons of sulfur were produced.

Energy supplementation was under way in 25 of the 134 producing pools\* and 51.8% of the reserves will be recovered from these pools. No new projects were initiated in 1972.

\*The North Dakota Industrial Commission recognizes 27 projects in 136 pools.

---

<sup>1</sup>Chief Petroleum Engineer, North Dakota Geological Survey

During 1972 there were 124 producing wells abandoned and only 25 new producers completed. Operators completed 67 dry holes. Five new pools were discovered as the result of the 50 wildcats drilled.

There were 1946 wells capable of producing oil at the end of the year. Of these 749 were classified as marginal on the basis of their production in December.<sup>2</sup> This represented an increase of 28, or 3.8% during 1972. One hundred and six wells became marginal and 78 marginal wells were plugged, or converted to service wells.

The North Dakota Geological Survey issued 103 permits and received 92 completion reports. There were 50 active locations at the end of the year.

The results of the study have been tabulated in several ways and the tables appear at the end of the report.

### Explanation of Methods used in this Study

Throughout this inventory the standard volumetric method of estimating reserves has been used, according to the following formula:

$$R=7758 A h p (1-s)r/B \text{ where}$$

R Recoverable reserves by presently known techniques

A Proven acreage

h Net average productive thickness in feet

p Percent porosity

s Percent water saturation

r Recovery factor-percent

B Reservoir volume factor - Barrels per barrel

The recovery factor, used here, does not take into account the economics of production. Since the study is intended to serve the same purpose as the annual inventories conducted by private business concerns, the economic situation was considered to be beyond the scope of the work.

For the purpose of this inventory a 40-acre tract was considered proven acreage if it contained a producing well, or if it offset a producing well. Credit given to offsetting 40-acre tracts was reduced if they contained dry holes or were offset in turn by dry holes.

The net average productive thickness was determined by Sidney B. Anderson, Chief Subsurface Geologist for the North Dakota Geological Survey, from mechanical logs on file in his office. Drill stem tests, core analyses, and other information were considered. Additional development, particularly in relatively new pools, tended to reduce the average thicknesses used in earlier estimates.

Porosities and saturations were taken from core analyses, where available, or from log calculations. When such data was not available, values were assigned by analogy to other nearby pools producing from the same geologic intervals under similar conditions.

---

<sup>2</sup>A well is classified as marginal if it produces less than ten barrels of oil per day. The average is computed on the basis of the actual number of days produced during December, 1972, or last month produced.

The formation volume factors were obtained from reservoir fluid analyses, when available, or by analogy.

The final result of the calculation was rounded off to the nearest thousand barrels, if the total was over 1 million, or to the nearest 500 barrels. The cumulative production to 1 January 1973 was then deducted to arrive at the final figure. Since the production is known to the exact barrel, this results in the final figure being shown to the single barrel.

The reserves found in the Heath Formation (Tyler equivalent) are credited to the Pennsylvanian, reflecting the present thinking of the subsurface section of the Survey.

A word of caution should be given concerning the figures in the column headed "Producing Acres." The figures shown are the total of all producing spacing units in the pool. Thus, where there are several pools in the field, the same acreage may be included in one or all of the pools. The area classified as productive will be less than that shown, but no effort was made to account for this in the tabulation. Perhaps this can be included in future reports.

Totals for "Fields" and "Pools" are given in Table II only since marketing districts are defined in such a way that no "Field" or "Pool" crosses a marketing district boundary, although they can, and do, cross county lines.

### Stripper Well Survey

Table IVa provides data on the stripper wells in North Dakota. Table IVb shows comparable data for 1 January 1972. These wells account for about 2000 barrels per day of production. They also represent about 19.5% of the producing acreage in North Dakota.

In attempting to analyze the information in Tables IVa and IVb it should be kept in mind that the average production for December, 1972, is figured on the basis of actual producing days while the average for the year is based on 366 days.

### Highlights of 1972

The discovery of the Red Wing Creek-Madison Pool, in McKenzie County, set off a flurry of leasing activity in the last part of the year. The well, drilled by True Oil Company, was a tight-hole and set off speculation as to its success when the operator began building a tank battery while the well was still drilling. Four off-set wells were staked around the discovery and two more within two miles of it. One of the latter was completed as a dry hole.

Previously another operator had drilled two dry holes about two miles apart to the northeast and southwest of the True well. It was the data from these wells that lead A. Kirth Erickson to postulate a thrust fault which he called the 'Redwing Creek Fault'.<sup>1</sup>

---

<sup>1</sup>A. Kirth Erickson, "Surficial Lineaments and Their Structural Implications in the Williston Basin", unpublished Thesis, Dept. of Geology, University of North Dakota, 1970.

Three new pools were discovered in existing fields. In the Stoneview Field, Burke County, deeper drilling found oil in the Red River Formation (Ordovician) and Winnipegosis (Devonian) and to the north of existing 'Heath Sand' production in the Rocky Ridge Field, Billings County, a well was completed in the Madison (Mississippian).

The other discovery was in the State Line Field in southern Bowman County. The well, located just  $1\frac{1}{2}$  miles from the South Dakota border, found oil in the Red River Formation.

But, while these discoveries were getting close attention the abandonment of 78 marginal wells was taking place. This was the largest number of marginal wells plugged in one year in North Dakota.

Crude oil production continued to decline at a rate of about 5% per year. No additional energy supplementation projects were begun although one was authorized for a combination Heath and Madison flood in the Fryburg Field, Billings County.

1972 was the year that the Energy Crisis became a reality although many people still think it is a hoax conjured up by the oil industry to justify price increases. It might be difficult to sell this idea to the citizens of the 61 localities, in 20 states, that were effected by the heating oil scarcity. In actuality it was a problem of distribution rather than a shortage of product but it was only the tip of the iceberg. A real shortage could occur next winter.

1972 was also the year that power distributors changed their advertising approach from the 'hard sell' to the 'turn out the lights' theme. It was interesting to note that the people of North Dakota took a light-hearted view of the situation. The common attitude was that, "North Dakota's power comes from Lignite and we have plenty of that so why worry?"

### How Will It Be In '73?

The prospect of a shortage of petroleum products continues to be the dark cloud on the horizon. Possible shortages of diesel fuel and gasoline face the farmers and tourists in the coming spring and summer. The situation will be most severe in the west coast and in the larger metropolitan centers. North Dakota may feel only slight discomfort although the supply of fuel for field work may disrupt the plans of farmers in some areas.

Under normal circumstances it would be expected that the situation would result in increased exploratory activity but much will depend on the policies followed by the federal government. Proposed changes in tax laws and the oil import program could easily discourage domestic exploration.

In North Dakota a market will exist for at least 11,000 barrels per day of additional oil production. With the prospect of a well-head price increase in the offing an increase in exploratory drilling would be a normal reaction. Whether or not it materializes will depend on the economic and political climate that prevails.

An estimate, based on the volume of sedimentary rocks untested, and the productivity of those sediments in other areas of the Williston Basin, indicates that as much as 750 million barrels of oil might possibly be found in North Dakota in the future. To date only one out of three townships in the state have had wells drilled that would adequately test all potentially productive formations.

However, new exploratory drilling faces a roadblock in the form of opposition from 'environmentalists'. This will be particularly true in the case of federal lands, both on and off-shore. In the southwestern part of North Dakota, where the Federal Government controls large areas the drillers are, already, experiencing delays in obtaining approval for well locations. It appears that these delays may be as long as six months to a year.

But, all things considered, 1973 would seem to offer the prospect of an active year for the oil industry in North Dakota.

#### ACKNOWLEDGMENTS

All of the information and data used in making this inventory was obtained from the files and records of the North Dakota State Industrial Commission, at the office of the North Dakota Geological Survey in Grand Forks.

In addition to Mr. Anderson, recognition is herewith given to the help and assistance of Mr. F. E. Wilborn, Jr., Assistant Petroleum Engineer for the Survey and Mr. Ray Simons, the Survey's Statistician.

TABLE I

Crude Oil Inventory in North Dakota

	Primary Reserves Sto Bbls.	Secondary Reserves Sto Bbls.	Total Recoverable Sto Bbls.	Production Remaining to 1-1-73 Sto Bbls.	% Recoverable of STO	Fields Disc. Total to 1-1-73	Pools Disc. to 1-1-73	Fields Aband.	Pools Aband.	Producing Acres	
District I	362674550	283147000	645821550	253869214	391952336	58.9	31	53	2	10	163785
District IIa	69388200	8297000	77685200	31509026	46176174	6.9	22	22	4	4	66103
District IIb	109960500	235000	110195500	49858191	603373097	9.0	35	36	3	4	65710
District IIIc	45346500	10938000	56284500	24612039	31672461	4.7	18	19	2	2	35365
District IIIa	31247000	1655000	32902000	2910301	29991699	4.5	3	4	1	1	3721
District IIIb	125594500	10928000	136522500	31303421	105219079	15.8	17	23	3	5	42098
<b>Totals</b>	<b>744211250</b>	<b>315200000</b>	<b>1059411250</b>	<b>394062192</b>	<b>665349058</b>	<b>100.0</b>	<b>126*</b>	<b>157*</b>	<b>15</b>	<b>26</b>	<b>302282</b>
Less Gasoline Plants & Misc.				701854	701854						
				<b>394764046</b>	<b>664647204</b>						

\*The North Dakota Industrial Commission has defined 128 Fields and 159 Pools.

TABLE II

## Crude Oil Inventory in North Dakota

	Primary Reserves Bbls. STO	Secondary Reserves Bbls. STO	Total Recoverable Bbls. STO	Production Remaining to 1-1-73 Bbls. STO	% Recoverable of STO	Fields Disc. Total to 1-1-73	Fields Disc. to 1-1-73	Pools Aband. 1-1-73 to 1-1-73	Producing Aband. Acres
Billings	56315500	4750000	61065500	20025142	41040358	6.1			24489
Bottineau	91656500	10938000	102594500	39412617	63181883	9.5			59965
Bowman	51863500	6178000	58041500	9285453	48756047	7.3			12339
Burke	80218200	26106750	106324950	42249410	64075540	9.6			68815
Divide	15483000	9052500	24540500	4654635	19885815	2.9			9578
Dunn	390000	390000	390000	360944	29056				360
Golden Valley	530500	530500	530500	250727	279773	0.4			1360
McHenry	5850000	5850000	5850000	387310	5462690	0.8			1000
McKenzie	152094000	71773000	223867000	92126355	131740145	19.8			65406
Mountrail	28329000	43944000	72273000	26127566	46145434	6.9			15060
Renville	38469000	235000	38704000	23441047	15262953	2.3			22690
Slope	440400	440400	440400	626628	3777372	0.5			1080
Stark	19041500	19041500	19041500	9235404	9806096	1.5			14120
Ward	3579000	3579000	3579000	2154924	1424076	0.2			4240
Williams	195982550	132222750	338205300	123723480	214481820	32.2			81230
Totals	744211250	315200000	1059411250	394062192	665349053				382282
Less Gasoline Plants & Mics.				701854	701854				
				394764046	664647204				

TABLE III

## Crude Oil Inventory in North Dakota

	Primary Reserves Bbls. STO	Secondary Reserves Bbls. STO	Total Recoverable Bbls. STO	Production Remaining to 1-1-73 Bbls. STO	% of Total Recoverable to 1-1-73	Fields Disc. Total to 1-1-73	Pools Disc. to 1-1-73	Fields Aband. Pools Aband.	Producing Acres
Devonian	53140000	36670000	89810000	41174098	45.7	7.3	22	3	31291
Mississippian	498206250	256502000	754708250	308391584	40.9	67.1	102	11	264239
Pennsylvanian	53699500	4750000	58499500	20787363	35.5	5.6	7	1	24309
Ordovician	95130000	6178000	101358000	16048486	15.8	12.8	16	4	23989
Silurian	15725000	1100000	16825000	9057056	53.8	1.1	4	1	10171
Triassic	28260500	10000000	38260500	19390970	50.7	2.8	6	1	20905

Totals	744211250	315200000	1059411250	394062197	37.2			26	*
--------	-----------	-----------	------------	-----------	------	--	--	----	---

Less Gasoline Plants & Misc.				701854					
------------------------------	--	--	--	--------	--	--	--	--	--

				394764046					
--	--	--	--	-----------	--	--	--	--	--

\*This does not represent the actual producing area since in several fields, two or more zones are productive, resulting in a duplication of acreage.

TABLE IVa

## North Dakota Stripper Wells

	Number of Wells	1972 Prod. Bbls.	Acres	Abandoned During 1972	Remaining Primary Reserves 1-1-73	Secondary Reserves 1-1-73	Ave. Daily Production Dec. 1972	Ave. Daily Production Per Well 1972
Billings	19	34122	5360	1	23000	1230000	3.1	4.9
Bottineau	101	166681	7321	6	5133000	357000	4.0	4.5
Bowman	3	1193	240	0	1638000	247000	0	1.0
Burke	147	180250	19006	2	12022000	2086000	2.7	3.3
Divide	7	17349	1200	0	1516000	2095000	3.6	6.7
Dunn	0							
Golden Valley	0							
McHenry	1	1078	30	0	136000		1.5	5.1
McKenzie	131	93824	11022	17	6325000	14763000	0.6	1.9
Mountrail	73	79315	5771	6		19425000	1.1	2.9
Renville	40	76902	3200	1	2335000	30000	4.0	5.2
Slope	0							
Stark	8	9767	1760	1	1101000		1.8	3.3
Ward	2	0	320	1	172000		0	0
Williams	217	136583	13562	43	23203000	45920000	1.0	1.7
<b>Totals</b>	<b>749</b>	<b>798134</b>	<b>74642</b>	<b>73</b>	<b>53604000</b>	<b>86653000</b>	<b>1.92</b>	<b>2.91</b>

TABLE IV<sup>b</sup>

## North Dakota Stripper Wells

	Number of Wells	1971 Prod. Bbls.	Acres	Abandoned During 1971	Remaining Primary Reserves 1-1-72	Secondary Reserves 1-1-72	Ave. Daily Production Dec. 1971	Ave. Daily Production Per Well 1971
Billings	17	44713	4320	1	5240275	3017000	6.27	7.2
Bottineau	105	181852	7904	5	5133968	952300	6.9	4.74
Bowman	6	56855	480	0	2445604	497000	5.69	25.96
Burke	133	166960	16976	0	10982570	6805000	5.91	3.43
Divide	6	13482	960	0	1388728	1099000	3.61	6.15
Dunn	0	-	-	0	-	-	-	-
Golden Valley	0	-	-	0	-	-	-	-
McHenry	1	1826	80	0	136800	-	3.58	5.0
McKenzie	130	114008	12226	3	9688117	14807000	5.13	2.4
Mountrail	69	84216	5455	1	413545	18264000	6.77	3.34
Renville	33	73736	2640	0	2039035	30000	7.17	6.12
Slope	0	-	-	0	-	-	-	-
Stark	5	11994	1120	0	540276	-	6.64	6.57
Ward	2	179	320	0	172204	-	-	-
Williams	214	186631	17875	3	18325000	43614000	7.26	2.38
<b>Totals</b>	<b>721</b>	<b>936454</b>	<b>67356</b>	<b>13</b>	<b>56506122</b>	<b>89085300</b>	<b>6.56</b>	<b>3.55</b>

## APPENDIX A

### MARKETING DISTRICT I

Geographical description: Township 148 North to 161 North, Ranges 94 West to 97 West, inclusive.

Fields: Gros Ventre, Viking, North Tioga, Tioga, McGregor, West Tioga, East Tioga, White Earth, Beaver Lodge, Capa, Hofflund, Delta, Charlson, Blue Buttes, Antelope, Croff, Bear Den, Lost Bridge, Pershing, Camel Butte, Fancy Buttes, Dimmick Lake, Clear Creek, Keene, Sand Creek, Northwest McGregor, Stoneview, Wildrose, Hawkeye, Hamlet, and North Fork.

### MARKETING DISTRICT II

#### Subdistrict A

Geographical description: Township 164 North, Range 88 West to 103 West, inclusive, Township 163 North, Ranges 88 West to 103 West, inclusive, Township 162 North, Ranges 88 West to 103 West, inclusive, Township 161 North, Ranges 88 West to 93 West, and 98 West to 103 West, inclusive and Township 160 North, Ranges 88 West to 93 West, and 98 West to 103 West, inclusive.

Fields: Baukol-Noonan, East Goose Lake, Noonan, Short Creek, Columbus, Coteau, Portal, Rival, Black Slough, Foothills, Northeast Foothills, Rennie Lake, Lignite, Flaxton, Stony Run, Woburn, Bowbells, Perella, Flat Lake East, Writing Rock, and Dimond, and Entry.

#### Subdistrict B

Geographical description: All of the state not included in other districts or subdistricts.

Fields: Dickinson, Haas, North Haas, Kuroki, Wayne, Wiley, Elmore, Sherwood, Eden Valley, Pratt, Glenburn, Lake Darling, Lansford, Lone Tree, Mackobee Coulee, Mohall, North Maxbass, South Antler Creek, Southwest Haas, Tolley, Chola, South Lone Tree, Southwest Aurelia, Mouse River Park, Zenith, Loraine, North Grano, Seven Mile Coulee, Blaine, Antler, Buffalo Creek, Colquhoun, and West Dickinson.

#### Subdistrict C

Geographical description: Townships 160 North to 164 North, Ranges 77 West to 80 West, inclusive.

Fields: North Souris, Scandia, Northeast Landa, Roth, Starbuck, South Starbuck, North Westhope, Westhope, South Westhope, Newburg, East Newburg, West Roth, Boundary Creek, Russell, Eidsvold, Landa, Scotia, and Southwest Starbuck.

## MARKETING DISTRICT III

### Subdistrict A

Geographical description: Townships 158 North to 160 North, Ranges 98 West to 107 West, inclusive.

Fields: Grenora, Alexander, and Round Prairie.

### Subdistrict B

Geographical description: Townships 129 North to 158 North, Ranges 98 West to 107 West, inclusive.

Fields: Little Missouri, Cedar Creek, Coyote Creek, Horse Creek, Medicine Pole Hills, Rocky Ridge, Fryburg, Medora, Rough Rider, Square Butte, Rider, Poker Jim, Red Wing Creek, State Line, Blacktail, Elkhorn Ranch, and Eleven Bar.