

2023 HOUSE ENERGY AND NATURAL RESOURCES

HB 1272

2023 HOUSE STANDING COMMITTEE MINUTES

Energy and Natural Resources Committee Coteau AB Room, State Capitol

HB 1272
1/27/2023

Relating to the jurisdiction of the industrial commission and reviewing the enhanced oil recovery potential status of a well
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9:11 AM

Chairman Porter opened the hearing. Members present: Chairman Porter, Vice Chairman D. Anderson, Representatives Bosch, Conmy, Dockter, Hagert, Heinert, Ista, Marschall, Novak, Olson, Roers Jones, and Ruby. Absent: Representative Kasper.

Discussion Topics:

- Enhanced oil recovery
- CO₂
- New well bore status

Rep Jeremy Olson, District 26, presented HB 1272, Testimony 16977
Preston Page, ND Petroleum Counsel, Testimony 17380
Ron Ness, President of ND Petroleum Council, Testimony 17377
Jeff Herman, Regional Manager, Petro Hunt LLC, Testimony 17379

Additional written testimony:

Kyle Gardner, Corbra Oil & Gas Corporation, Testimony 17378
John Harju, VP, Strategic Partnerships UND Energy & Environmental Research Center,
Testimony 17313

9:42 AM Chairman Porter closed the hearing.

Kathleen Davis, Committee Clerk

2023 HOUSE STANDING COMMITTEE MINUTES

Energy and Natural Resources Committee Coteau AB Room, State Capitol

HB 1272
1/27/2023

Relating to the jurisdiction of the industrial commission and reviewing the enhanced oil recovery potential status of a well

10:15 AM

Chairman Porter opened the hearing. Members present: Chairman Porter, Vice Chairman D. Anderson, Representatives Bosch, Conmy, Dockter, Hagert, Heinert, Ista, Marschall, Novak, Olson, Roers Jones, and Ruby. Absent: Representative Kasper.

Discussion Topics:

- Committee Action

Rep Ruby moved a Do Pass on HB 1272, seconded by Rep Dockter.

Representatives	Vote
Representative Todd Porter	Y
Representative Dick Anderson	Y
Representative Glenn Bosch	Y
Representative Liz Conmy	Y
Representative Jason Dockter	Y
Representative Jared Hagert	Y
Representative Pat D. Heinert	Y
Representative Zachary Ista	Y
Representative Jim Kasper	AB
Representative Andrew Marschall	Y
Representative Anna S. Novak	Y
Representative Jeremy Olson	Y
Representative Shannon Roers Jones	Y
Representative Matthew Ruby	Y

Yes 13 No 0 Absent 1 Motion carried. Rep. Olson is carrier.

10:16 AM Chairman Porter closed the hearing.

Kathleen Davis, Committee Clerk

REPORT OF STANDING COMMITTEE

HB 1272: Energy and Natural Resources Committee (Rep. Porter, Chairman)
recommends **DO PASS** (13 YEAS, 0 NAYS, 1 ABSENT AND NOT VOTING). HB
1272 was placed on the Eleventh order on the calendar.

2023 SENATE ENERGY AND NATURAL RESOURCES

HB 1272

2023 SENATE STANDING COMMITTEE MINUTES

Energy and Natural Resources Committee Peace Garden Room, State Capitol

HB 1272
3/9/2023

A bill relating to the jurisdiction of the industrial commission and reviewing the enhanced oil recovery potential status of a well.
--

9:30 AM Chairman Magrum opened the meeting.

Senators, Kessel, Boehm and Magrum are present. Senators Patten, Beard and Kannianen are absent. Senator Beard joined the meeting at 10:24 AM.

Discussion Topics:

- Williston Basin
- Infrastructure
- Recovery technologies
- Carbon storage
- Madison formation
- Legacy wells
- CO2 injection

9:32 AM Representative J. Olson introduced the bill and provided written testimony #22088.

9:36 AM Ron Ness, President, North Dakota Petroleum Council, testified in favor of the bill and provided written testimony #23283.

9:38 AM Kyle Gardner, Vice President of Engineering, Cobra Oil and Gas Corporation, testified in favor of the bill and provided written testimony #23285.

9:46 AM Chairman Magrum called a recess.

10:01 Chairman Magrum continued the public hearing. Senator Kannianen has joined the meeting.

10:11 AM Bruce Hicks, Assistant Director, Oil and Gas Division, Department of Mineral Resources, North Dakota Industrial Commission, testified neutral on the bill and provided written testimony #23138.

10:26 AM Chairman Magrum closed the public hearing.

10:26 AM Chairman Magrum closed the meeting.

Rick Schuchard, Committee Clerk

2023 SENATE STANDING COMMITTEE MINUTES

Energy and Natural Resources Committee Peace Garden Room, State Capitol

HB 1272
3/17/2023

Relating to the jurisdiction of the industrial commission and reviewing the enhanced oil recovery potential status of a well.

9:17 AM Chairman Patten opened the meeting.

Chairman Patten and Senators Kessel, Beard and Boehm are present. Senators Magrum and Kannianen are absent.

Discussion Topics:

- Committee action

9:18 AM The committee has discussion on the bill.

9:19 AM Senator Kessel moved to Do Pass the bill. Motion seconded by Senator Beard.

9:20 Roll call vote was taken.

Senators	Vote
Senator Dale Patten	Y
Senator Jeffery J. Magrum	AB
Senator Todd Beard	Y
Senator Keith Boehm	Y
Senator Jordan L. Kannianen	AB
Senator Greg Kessel	Y

Motion passes 4-0-2.

Senator Kessel will carry the bill.

This bill does not affect workforce development.

9:21 AM Chairman Patten closed the meeting.

Rick Schuchard, Committee Clerk

REPORT OF STANDING COMMITTEE

HB 1272: Energy and Natural Resources Committee (Sen. Patten, Chairman)
recommends **DO PASS** (4 YEAS, 0 NAYS, 2 ABSENT AND NOT VOTING). HB
1272 was placed on the Fourteenth order on the calendar. This bill does not affect
workforce development.

TESTIMONY

HB 1272



North Dakota House of Representatives

STATE CAPITOL
600 EAST BOULEVARD
BISMARCK, ND 58505-0360



Representative Jeremy Olson

District 26
P.O. Box 692
Arnegard, ND 58835-0692

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COMMITTEES:

Finance and Taxation
Energy and Natural Resources

25 January 2023

Mr. Chairman, I am Jeremy Olson, State Representative, District 26, representing most of McKenzie and Dunn Counties, which is the heart of the Bakken and America's fastest growing city, and now the 2nd largest oil producing county in America. A county in Texas recently surpassed us. As a young man, I left North Dakota and served our country as an Army Officer and frankly never imagined I would have an opportunity to move back home and could never had dreamed of someday representing the people in my district in the legislature. One thing made that possible – the incredible growth of the Bakken shale development! My same story can be repeated time after time across western North Dakota, we are now building schools instead of closing schools, opening businesses instead of closing them; and finding more daycare is a real issue in my district. This is good news.

As the prime sponsor of HB 1272, I am interested in doing everything we can to ensure my daughters and their children have that same opportunity to make North Dakota their lifelong home. This bill is forward thinking and likely a bit ahead of the technology and opportunity's we have heard so much about relating to CO₂ and Enhanced Oil Recovery over the past few weeks in this committee. The oil industry has peaks and valleys. As policymakers, we need to embrace policies that help create a positive business climate that helps stabilize small businesses through the valleys and helps them thrive and grow when the time is right. We know there are billions of barrels of oil left in the Bakken and the Williston Basin. HB 1272 authorizes the Industrial Commission to establish a new well status that will ensure well bores and infrastructure remain viable and ready once the technology, policy, and economics align for enhanced oil recovery through CO₂ and other recovery technologies yet to be discovered.

There may be some who testify against this bill with concerns, fear, or an anti-development mindset. I urge you to not be swayed by this fear, but instead think big and to the future, and empower our state's oil and gas regulators and elected officials to maximize the vision and direction we provide through legislative policy. Another great example of forward thinking is the policy direction set by previous legislative bodies setting the stage for carbon storage and sequestration. That began in 2004 with research and continued in 2009, when the legislature passed legislation that set the stage for carbon utilization and storage. Just think how far ahead of the world North Dakota is now in this space.

In closing, consider for a moment, how many of us in this room would not be here if it weren't for a collection of the great minds of the world, risk-takers and entrepreneurs that cracked the code of the Bakken just 15-18 years ago. I'm going to leave the details of HB 1272 to the presenters following me but think of our children and their children and where they will live and work if we don't take the initiative to set the right policies to recover even more of our state's valuable resources. I urge your vote of support on HB 1272 and the future of oil and gas development in our state. Thank you, I would be happy to answer any questions.

Jeremy L Olson
ND State Representative, District 26

**House Bill 1272**

Testimony of John Harju, Vice President for Strategic Partnerships

University of North Dakota Energy & Environmental Research Center

House Energy and Natural Resources Committee

January 27, 2023

My name is John Harju, and I am the Vice President for Strategic Partnerships at the University of North Dakota's (UND's) Energy & Environmental Research Center (EERC). Thank you for the invitation to provide testimony concerning House Bill 1272.

North Dakota has significant potential to extend the life of both legacy and unconventional (Bakken) oil production to continue a healthy economy for generations to come. North Dakota has been strategic in anticipating technological advancements that strengthen our energy industry, providing stability and growth for our workforce and communities. Creating a regulatory framework to preserve production infrastructure can strategically position North Dakota for enhanced oil recovery that is now in sight as CO₂ projects are being realized.

The size of the prize is substantial, in relation to over 3.6 billion barrels of oil that have already been produced from the Bakken Formation. The EERC has identified over 1 billion barrels of oil that could be produced from over 200 conventional oil fields in North Dakota, using approximately 358 million tons of CO₂. In addition to legacy production, technology advancements that could produce incremental oil from the Bakken may realize even greater impacts. However, to realize these outcomes, a new regulatory

classification is needed to preserve oil and gas production wells while developers are waiting on miscible fluids and attendant infrastructure (e.g., CO₂). Presently, any well that does not produce for 1 year enters an abandonment status, ultimately awaiting permanent plugging and abandonment. House Bill 1272 would help limit how much future investment is required for future development by allowing for secure preservation of wells that are destined for enhanced oil recovery. Over 40,000 wells have been drilled in North Dakota, but less than half are presently active.

Presently, almost 800 Bakken wells have a short- or long-term abandonment status, with about half of these wells permanently plugged. With respect to conventional assets, over 200 Madison wells have abandonment status which still could be preserved. In contrast, over 3500 Madison wells have already been plugged. Creating a regulatory framework for a well status that allows developers to securely preserve a well for future enhanced recovery would provide strategic positioning of North Dakota's assets and encourage investment in our already-discovered mineral resources.



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House Bill 1272
Testimony of Ron Ness
House Energy and Natural Resources Committee
January 27, 2023

Chairman Porter and members of the Committee, my name is Ron Ness, president of the North Dakota Petroleum Council (“NDPC”). The North Dakota Petroleum Council represents more than 600 companies involved in all aspects of the oil and gas industry, including oil and gas production, refining, pipeline, transportation, mineral leasing, consulting, legal work, and oilfield service activities in North Dakota. I appear before you today in support of House Bill 1272.

There is much discussion about the future of the Bakken and North Dakota’s ability to sustain more than one million barrels of oil per day for the next decade and beyond. The carbon dioxide discussion is front page news. What is less known is the incredible size and world-class resource status of the Bakken shale formation in our state. Estimates of recoverable oil in the Bakken range from thirteen to twenty-four billion barrels of oil. As of today, we have produced about four billion barrels of oil from the Bakken. The future of the Bakken is dependent upon success of new technologies, and the most likely technology to be used will include the utilization of spacing units and unitized fields with the use of natural gas and/or carbon dioxide injection in some wells to push oil to adjacent wells to maximize production. This technique is vastly different than what is being done in the Bakken today where each well is a producing well and operates as a single business unit. House Bill 1272 is a look into the future and is an attempt to ensure that oil producers can identify which wells in their fields have the potential for enhanced oil recovery or “EOR.” Creating a new well status, as would be authorized by House Bill 1272, will allow Bakken producers to go to the North Dakota Industrial Commission and request that wells be put on “EOR” well status when the production from a certain well declines to uneconomic levels in order to preserve that wellbore for future EOR projects. Currently, when the production of a well drops below expectations of other wells in the field, these wells are moved to

temporarily abandoned, or “TA,” well status, essentially placing them on a company’s liability side of the balance sheet. Operators then begin to look at plugging these TA wells despite the fact that great potential may still exist with the advancement of new technology or enhanced oil recovery once the entire spacing unit or field production declines. From a North Dakota standpoint, it is important that Bakken wells capable of future development be retained on the asset side of the balance sheet by the producer. Researchers indicate it will take up to ten years before we likely have the technology to advance carbon dioxide utilization throughout the Bakken. Each of these Bakken wells is like a \$7 to \$10 million business, and we do not want that business to close its doors when business is slow. In the Bakken, we have a world-class resource that, once a well bore is plugged and abandoned, it is highly unlikely a new well will be drilled to replace it. Most of the Bakken spacing units now have between four and twelve producing wells on a pad. Some of these wells develop mechanical problems as they age, and those are the wells that should be analyzed for future potential, plugged and abandoned if future potential is very low, and not moved to EOR status. The Department of Mineral Resources has a process for that to happen. Unfortunately, we are seeing plugging and abandonment happen to many wells in the Bakken once production declines. Large operators with assets across the globe have many opportunities to invest. As we have seen in the past, smaller local and regional operators typically follow these larger operators and utilize technologies and efficiencies to produce incremental barrels of oil at lower volumes for decades. These wells, like small businesses, create jobs, pay taxes, stimulate the local economy, and become critical to community success. The goal of House Bill 1272 is to keep the wells in play. This can happen with a simple change in the way the Department of Mineral Resources regulates the industry. If this was a main street business, we would do this in a heartbeat to keep a business open. The time to act is now before these well bores begin to disappear. The more productive Bakken wells will continue to produce massive amounts of oil and new wells will be drilled and completed. Developing a plan for the lower-producing wells with good wellbore integrity now, is thinking long term for the State of North Dakota. NDPC urges your support and a **Do Pass Recommendation** for HB 1272. I would be happy to answer any questions.



**Legacy Well Innovations &
Opportunities**

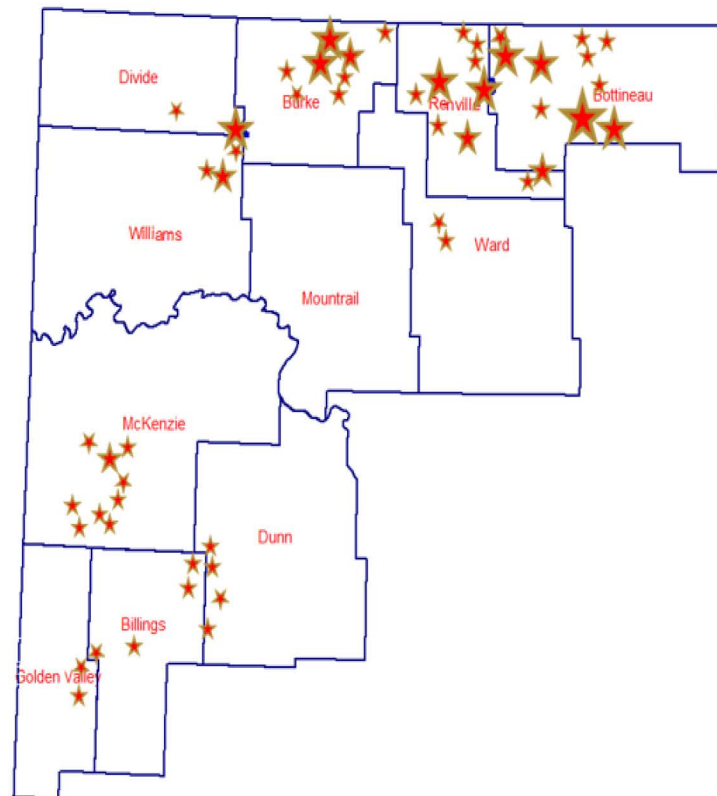
House Bill 1272

**Testimonial Presentation of
Kyle Gardner**

**House Energy and Natural Resources
Committee**

January 27, 2023

Cobra Oil & Gas Corporation





Williston Basin Fun Facts

- According to NDGS production/well count data, all ND productive formations that have produced more than 1MM BO, average 221,411 BO/well.
- Bakken/Three Forks Cumulative Production/Total Well Count yields an average 233,910 BO/well.
- Bakken/Three Forks made 1,078,594 BOPD in September-2022.
- Bakken /Three Forks currently produce 96% daily production in ND.
- The Madison Formation links every Bakken well to a historically prolific conventional reservoir.

SO WHAT IS NEXT?

Madison Formation Fun Facts

- Conventional carbonate reservoir.
- Contains reservoir quality rock throughout the basin.
- Can source its own hydrocarbon.
- Has been identified as a Residual Oil Zone (ROZ) formation via academic research and empirical production data.

What is a Residual Oil Zone (ROZ)?

- A section within the stratigraphic column of a formation that exists below the “oil-water contact” of a reservoir which contains “immobile oil.”
- These sections of reservoirs have been naturally water flooded by 3 different criteria.
- In result, remnants of oil are stranded within sections of rock that the oil once migrated through.

Methods to Exploit the ROZ

- CO₂ Injection into the ROZ allows the CO₂ to become miscible within the oil droplets which in result lowers the oil interfacial surface tension, reduces viscosity and helps vacate the oil from the rock.
- Depressurizing the ROZ lowers the reservoir pressure within a radius around the wellbore to the bubble point pressure which allows the oil droplets to swell from gas expansion within the oil and helps vacate the oil from the rock.



RENVILLE COUNTY

FORMATION : MISSION CANYON
 DRLG. FLUID: SALT GEL NO OIL
 LOCATION :
 STATE : NORTH DAKOTA

DATE :
 FILE NO. :
 ANALYSTS :
 ELEVATION:

CONVENTIONAL CORE ANALYSIS

SAMP. NO.	DEPTH	PERM. TO HORZ.	AIR (MD) VERTICAL	POR. FLO.	FLUID SATS. OIL	WATER	GR. DNS.	DESCRIPTION
1	4572-73	0.92		13.5	12.9	30.0		LM FN XLN VUGGY CALC INF.
2	4573-74	64		18.5	15.2	23.2		LM FN XLN VUGGY CALC INF.
3	4574-75	7.2		12.0	17.6	35.2	CVF	LM FN XLN VUGGY CALC INF.
4	4575-76	104		18.5	16.6	35.2	CVF	LM FN XLN SCAT VUGS CALC INF.
5	4576-77	0.15		6.5	3.2	60.9		LM FN XLN SCAT VUGS CHKY
6	4577-78	42		12.8	10.9	34.2		LM FN XLN VUGS CALC XTAL
7	4578-79	1.1		7.4	7.1	31.0		LM FN XLN VUGS CALC XTAL
8	4579-80	0.39		20.7	23.7	23.7		LM OOL SCAT VUGS CALC INF.
9	4580-81	13		10.1	11.9	31.8		LM FN XLN VUGS CALC INF.
10	4581-82	3.8		10.2	8.8	29.2		LM FN XLN VUGS CALC INF.
11	4582-83	19		11.3	18.5	36.9	CVF	LM FN XLN VUGS CALC INF.
12	4583-84	33		11.9	14.8	28.0	CVF	LM FN XLN VUGS CALC INF.
13	4584-85	7.6		10.0	14.0	32.0	CVF	LM FN XLN SCAT VUGS CALC INF.
14	4585-86	36		11.1	14.3	28.6	CVF	LM FN XLN CALC INF.
15	4586-87	14		11.9	9.9	38.0		LM FN XLN VUGS CALC INF.
16	4587-88	13		23.4	14.8	33.6		LM FN XLN VUGS CALC INF.
17	4588-89	51		12.6	26.3	21.7		LM FN XLN VUGS CALC INF.
18	4589-90	7.8		18.1	23.4	23.4		LM FN XLN VUGS CALC INF.
19	4590-91	178		12.5	14.1	39.1		LM FN XLN VUGS CALC INF.
20	4591-92	13		14.4	18.5	27.8	CVF	LM FN XLN VUGS CALC INF.
21	4592-93	0.12		9.0	17.7	28.8	CVF	LM FN XLN VUGS CALC INF.
22	4593-94	0.16		7.7	12.1	40.3	CVF	LM FN XLN VUGS CALC INF.
23	4594-95	0.66		8.8	8.0	48.2		LM FN XLN VUGS CALC INF.
24	4595-96	66		3.0	3.6	50.3		LM FN XLN VUGS
25	4596-97	3.5		10.5	13.3	39.8		LM FN XLN CALC INF.

CVF CLOSED VERTICAL FRACTURE

These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representation as to the accuracy of the data.

Type II ROZ

- Standard conventional approach “Pop the Top”
- Cobra Oil & Gas ROZ approach (full yellow section)
- Rock data, petrophysical data, mudlog data, & production data support a Type II ROZ.



Type II ROZ

[REDACTED]

FORMATION : MISSION CANYON
 ORLG. FLUID: SALT GEL NO OIL
 STATE : NORTH DAKOTA

DATE : [REDACTED]
 FILE NO. : [REDACTED]
 ANALYSTS : [REDACTED]
 ELEVATION: [REDACTED]

RENVILLE COUNTY

CONVENTIONAL CORE ANALYSIS

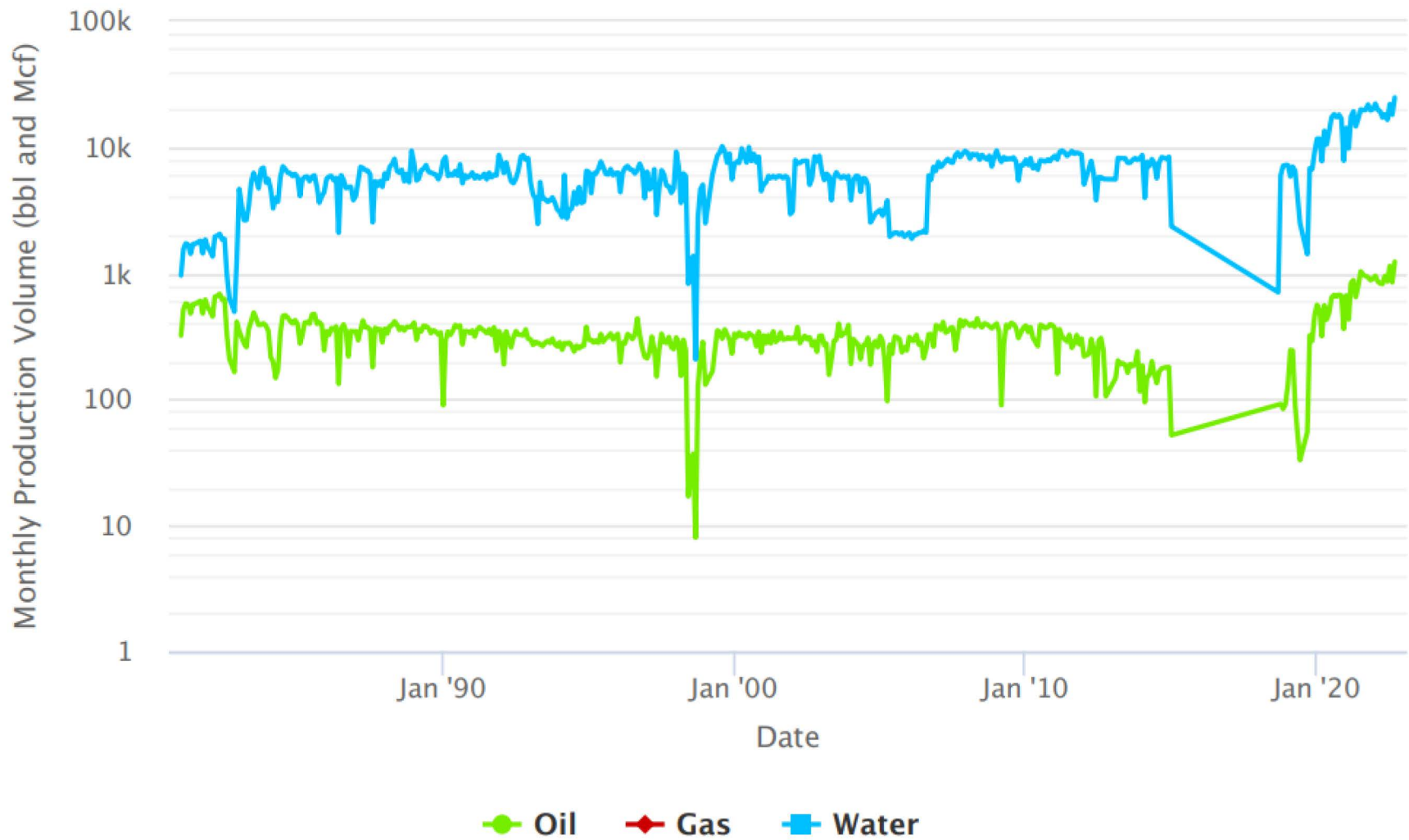
SAMP. NO.	DEPTH	PERM. TO HORZ.	AIR (MD) VERTICAL	POR. FLD.	FLUID SATS. OIL	WATER	GR. DNS.	DESCRIPTION
26	4597-98	20		14.3	8.0	29.5		LM FN XLN CALC INF.
27	4598-99	38		14.6	9.3	42.6		LM FN XLN CALC INF.
28	4599 -0	2.6		13.3	11.6	26.0	CVF	LM FN XLN VUGS CALC INF.
29	4600 -1	200		15.2	11.2	31.0	CVF	LM FN XLN SCAT VUGS CALC INF.
30	4601 -2	11		11.5	15.2	28.8	CVF	LM FN XLN SCAT VUGS CALC INF.
31	4602 -3	157		21.7	14.0	29.7	CVF	LM FN XLN OOL CALC INF.
32	4603 -4	250		18.3	17.2	27.4	CVF	LM FN XLN VUGS CALC INF.
33	4604 -5	31		17.9	12.8	28.8	CVF	LM FN XLN OOL CALC INF.
34	4605 -6	314		15.8	14.9	27.5	CVF	LM FN XLN OOL CALC INF.
35	4606 -7	61		18.1	15.5	35.2	CVF	LM FN XLN CALC INF.
36	4607 -8	93		15.2	17.4	32.4		LM FN XLN CALC INF.
	4608-4612							NO ANALYSIS LS
37	4612-13	24		10.6	13.1	26.1	CVF	LM FN XLN CALC INF.
38	4613-14	6.5		7.0	3.0	62.7	CVF	LM V/FN XLN CALC INF.
39	4614-15	113		9.1	2.3	51.9	CVF	LM V/FN XLN CALC INF.
40	4615-16	41		8.9	1.1	43.2	CVF	LM V/FN XLN CALC INF.
	4616-4623							NO ANALYSIS LS
41	4623-24	0.03		6.7	7.7	33.8	CVF	LM V/FN XLN CALC INF.
42	4624-25	2.8		10.9	16.3	29.0	CVF	LM V/FN XLN SUC CALC INF.

CVF CLOSED VERTICAL FRACTURE

- Standard conventional approach “Pop the Top”
- Cobra Oil & Gas ROZ approach (full yellow section)
- Rock data, petrophysical data, mudlog data, & production data support a Type II ROZ.

These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representation as to the reliability, accuracy, or modification of any data, or any other information used in connection with which such report is made or called upon.

Monthly Production





Type II ROZ Results (Mission Canyon – Renville County, ND)

- After completing the full section of the productive Mission Canyon bed, oil cut increased with increased takeaway from increased reservoir deliverability.
- Cobra Oil & Gas deems this a method of reservoir depressurization. CO₂ injection would yield better results with managing less total water.
- Like the San Andres ROZ plays of the Permian Basin, Cobra Oil & Gas believes the Mission Canyon ROZ potential could cover large areas of the Williston Basin.

Needs for Bakken EOR & Madison ROZ Potential

- Available & affordable CO₂.
- Available wells with mechanical integrity.
 - Wells of mechanical integrity within areas of Bakken EOR or Madison ROZ potential should be viewed as resources at a State level, not liabilities.
- Fluid handling systems.



References

1. Melzer, S., (2006) "Stranded Oil in the Residual Zone." U.S. Department of Energy Report, February.
2. Melzer, S., Trentham, R., (2016) "San Andres Formation Residual Oil Zones and Their Relationships to the Horizontal Carbonate Play On the Northern Shelf." Society of Independent Professional Earth Scientists, April.
3. Burton-Kelly, M., Dotzenrod, N., Feole, I., Peck, W., He, J., Butler, S., Kurz, M., Kurz, B., Smith, S., Gorecki, C., Energy & Environmental Research Center, (2018) "Identification of Residual Oil Zones in the Williston and Powder River Basins" U.S. Department of Energy, March.



Thank You!

I will gladly answer any questions for further discussion.

House Bill 1272
January 27, 2023

Chairman Porter and members of the Committee, my name is Jeff Herman. I am the Regional Manager for Petro-Hunt, L.L.C out of the company's Bismarck office. The Hunt companies have been involved in North Dakota oil and gas exploration and production since the late 1940s and currently operate 701 active wells in the state, 654 of which are horizontal Bakken/Three Forks wells. We employ 150 full-time North Dakota employees in our oil field operations and the gas processing plant that we operate by Killdeer, as well as an additional 50 parties working on a contract basis. I appear before you today in support of House Bill 1272.

Petro-Hunt, LLC builds its oil and gas production base in ND through various ways, including drilling new wells on leasehold we have purchased and buying producing properties from companies that have decided to leave the state or companies that decide to shed some of their properties for one reason or another. To date, we have purchased the production of Chevron/Gulf, Texaco, and SM Oil and Gas when they left the state. When we purchased the interests of SM Oil and Gas in Divide County in 2018, the asset included thirteen Bakken wells with two-mile laterals that had been drilled but not completed (also referred to as as "DUC" wells). We have completed two of those wells to date and plan to complete an additional six of the thirteen wells. We do not plan to complete the remaining five wells as we feel they are too close to other completed wells in the spacing unit. As such, the reservoir is being adequately drained by those existing wells and the approximate \$8 million cost to complete them would be economic waste. However, since these five wells have perfectly good well bores that cost approximately \$3 million each to drill, we do not feel it would be prudent to plug and abandon them at this time. We feel they have potential future use as either enhanced oil recovery (EOR) operation wells or possible replacement wells for one of the offset wells should it go down and be beyond repair for some reason.

Petro-Hunt is a participating partner with the Energy & Environmental Resource Center (EERC) in its ongoing research on the potential of EOR for the ND Bakken. As such, we also hope that as our Bakken/Three Forks wells get to the end of their economic life that we can maintain those with good well bores for potential EOR use in the future. I urge a Do Pass on House Bill 1272. I would be happy to answer any questions.

House Bill 1272
Testimony of Preston Page
House Energy and Natural Resources Committee
January 27, 2023

Chairman Porter and members of the Committee, my name is Preston Page, president of Dakota Energy, LLC. Dakota Energy is a small oil and gas company focused on the Williston Basin. I appear before you in support of House Bill 1272.

There have been over 18,000 wells spud in North Dakota since 2000, most targeting the Bakken reservoir. As the Bakken play matures, it will require investment in new technology to maintain and grow oil production.

The map being presented shows the wells targeting the Bakken Formation with outlines of what our company defines as Tier 1, 2, and 3.

On the lower left corner of the map is the summary oil production chart of the Bakken wells in North Dakota. Overall, oil production has maintained above 1 million barrels of oil per day, or “bopd.” The chart identifies oil production by date and highlights the steep declines in shale resources and its dependence on new development.

Enhanced Oil Recovery (EOR) holds the potential to assist in stabilizing the declining oil production of the Bakken. Numerous operators and research institutes are studying the potential of EOR. Part of the issue these operators are encountering is that they do not have wellbores with solid mechanical integrity to test new EOR practices. The wells they operate are economic and generate cash flow. Operators are reluctant to take economic, producing wells offline to try EOR practices. The EOR well status created by House Bill 1272 is designed to give time for operators of Bakken wells to study and implement developed and upcoming EOR practices.

Of wells spud since 2010 targeting the Bakken, 108 have been plugged and abandoned, limiting any potential to test new EOR practices.

Dakota Energy urges your support and a DO PASS recommendation to HB 1272. With that, I would be happy to answer any questions.



North Dakota House of Representatives

STATE CAPITOL
600 EAST BOULEVARD
BISMARCK, ND 58505-0360



Representative Jeremy Olson

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COMMITTEES:

Finance and Taxation
Energy and Natural Resources

9 February 2023

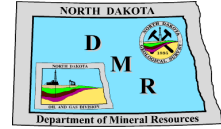
Mr. Chairman, I am Jeremy Olson, State Representative, District 26, representing most of McKenzie and Dunn Counties, which is the heart of the Bakken and America's fastest growing city, and now the 2nd largest oil producing county in America. A county in Texas recently surpassed us. As a young man, I left North Dakota and served our country as an Army Officer and frankly never imagined I would have an opportunity to move back home and could never had dreamed of someday representing the people in my district in the legislature. One thing made that possible – the incredible growth of the Bakken shale development! My same story can be repeated time after time across western North Dakota, we are now building schools instead of closing schools, opening businesses instead of closing them; and finding more daycare is a real issue in my district. This is good news.

As the prime sponsor of HB 1272, I am interested in doing everything we can to ensure my daughters and their children have that same opportunity to make North Dakota their lifelong home. This bill is forward thinking and likely a bit ahead of the technology and opportunity's we have heard so much about relating to CO₂ and Enhanced Oil Recovery over the past few weeks in this committee. The oil industry has peaks and valleys. As policymakers, we need to embrace policies that help create a positive business climate that helps stabilize small businesses through the valleys and helps them thrive and grow when the time is right. We know there are billions of barrels of oil left in the Bakken and the Williston Basin. HB 1272 authorizes the Industrial Commission to establish a new well status that will ensure well bores and infrastructure remain viable and ready once the technology, policy, and economics align for enhanced oil recovery through CO₂ and other recovery technologies yet to be discovered.

There may be some who testify against this bill with concerns, fear, or an anti-development mindset. I urge you to not be swayed by this fear, but instead think big and to the future, and empower our state's oil and gas regulators and elected officials to maximize the vision and direction we provide through legislative policy. Another great example of forward thinking is the policy direction set by previous legislative bodies setting the stage for carbon storage and sequestration. That began in 2004 with research and continued in 2009, when the legislature passed legislation that set the stage for carbon utilization and storage. Just think how far ahead of the world North Dakota is now in this space.

In closing, consider for a moment, how many of us in this room would not be here if it weren't for a collection of the great minds of the world, risk-takers and entrepreneurs that cracked the code of the Bakken just 15-18 years ago. I'm going to leave the details of HB 1272 to the presenters following me but think of our children and their children and where they will live and work if we don't take the initiative to set the right policies to recover even more of our state's valuable resources. I urge your vote of support on HB 1272 and the future of oil and gas development in our state. Thank you, I would be happy to answer any questions.

Jeremy L Olson
ND State Representative, District 26



House Bill 1272

Date of Testimony: 3-09-2023

Good morning Chairman Patten and members of the Senate Energy and Natural Resources Committee. I offer the following for informational purposes only:

Abandoned Wells						
Formation	AB Wells	Plug Cost		Reclaim Cost		Plug + Reclaim Cost
		Per Well	Total	Per Well	Total	
Bakken	356	\$140,000	\$49,840,000	\$177,000	\$63,012,000	\$112,852,000
Non-Bakken	297	\$145,833	\$43,312,401	\$127,250	\$37,793,250	\$81,105,651
Total	653		\$93,152,401		\$100,805,250	\$193,957,651

Temporarily Abandoned Wells						
Formation	TA Wells	Plug Cost		Reclaim Cost		Plug + Reclaim Cost
		Per Well	Total	Per Well	Total	
Bakken	108	\$140,000	\$15,120,000	\$177,000	\$19,116,000	\$34,236,000
Non-Bakken	209	\$145,833	\$30,479,097	\$127,250	\$26,595,250	\$57,074,347
Total	317		\$45,599,097		\$45,711,250	\$91,310,347

Bakken Total	\$147,088,000
Non-Bak Total	\$138,179,998
Grand Total	\$285,267,998

Sincerely,
 Bruce E. Hicks
 Assistant Director
 NDIC-DMR-OGD

Bruce E. Hicks
 ASSISTANT DIRECTOR
 OIL AND GAS DIVISION

Lynn D. Helms
 DIRECTOR
 DEPT. OF MINERAL RESOURCES

Edward C. Murphy
 STATE GEOLOGIST
 GEOLOGICAL SURVEY

43-02-03-55. Abandonment of wells, treating plants, underground gathering pipelines, or saltwater handling facilities - Suspension of drilling.

1. The removal of production equipment or the failure to produce oil or gas for one year constitutes abandonment of the well. The removal of production equipment or the failure to produce water from a source well for one year constitutes abandonment of the well. The removal of injection equipment or the failure to use an injection well for one year constitutes abandonment of the well. The failure to plug a stratigraphic test hole within one year of reaching total depth constitutes abandonment of the well. The removal of treating plant equipment or the failure to use a treating plant for one year constitutes abandonment of the treating plant. The removal of saltwater handling facility equipment or the failure to use a saltwater handling facility for one year constitutes abandonment of the saltwater handling facility. An abandoned well must be plugged and its site must be reclaimed, an abandoned treating plant must be removed and its site must be reclaimed, and an abandoned saltwater handling facility must be removed and its site must be reclaimed, pursuant to sections 43-02-03-34 and 43-02-03-34.1. A well not producing oil or natural gas in paying quantities for one year may be placed in abandoned-well status pursuant to subsection 1 of North Dakota Century Code section 38-08-04. If an injection well is inactive for extended periods of time, the commission may, after notice and hearing, require the injection well to be plugged and abandoned. If an underground gathering pipeline is inactive for seven years, the commission may, after notice and hearing, require the pipeline to be properly abandoned pursuant to sections 43-02-03-29 and 43-02-03-29.1.
2. The director may waive for one year the requirement to plug and reclaim an abandoned well by giving the well temporarily abandoned status for good cause. This status may only be given to wells that are to be used for purposes related to the production of oil and gas within the next seven years. **If a well is given temporarily abandoned status, the well's perforations must be isolated, the integrity of its casing must be proven, and its casing must be sealed at the surface, all in a manner approved by the director.** The director may extend a well's temporarily abandoned status and each extension may be approved for up to one year. A fee of one hundred dollars shall be submitted for each application to extend the temporary abandonment status of any well. A surface owner may request a review of a well temporarily abandoned for at least seven years pursuant to subsection 1 of North Dakota Century Code section 38-08-04.
3. In addition to the waiver in subsection 2, the director may also waive the duty to plug and reclaim an abandoned well for any other good cause found by the director. If the director exercises this discretion, the director shall set a date or circumstance upon which the waiver expires.
4. The director may approve suspension of the drilling of a well. If suspension is approved, a plug must be placed at the top of the casing to prevent any foreign matter from getting into the well. When drilling has been suspended for thirty days, the well, unless otherwise authorized by the director, must be plugged and its site reclaimed pursuant to sections 43-02-03-34 and 43-02-03-34.1.

History: Amended effective April 30, 1981; January 1, 1983; May 1, 1990; May 1, 1992; August 1, 1999; January 1, 2008; April 1, 2010; April 1, 2012; April 1, 2014; October 1, 2016; April 1, 2018; April 1, 2020; April 1, 2022.

General Authority: NDCC 38-08-04

Law Implemented: NDCC 38-08-04



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House Bill 1272

Testimony of Ron Ness

Senate Energy and Natural Resources Committee

March 9, 2023

Chairman Patten and members of the Committee, my name is Ron Ness, president of the North Dakota Petroleum Council (“NDPC”). The North Dakota Petroleum Council represents more than 600 companies involved in all aspects of the oil and gas industry, including oil and gas production, refining, pipeline, transportation, mineral leasing, consulting, legal work, and oilfield service activities in North Dakota. I appear before you today in support of House Bill 1272.

Estimates of recoverable oil in the Bakken range from thirteen to twenty-four billion barrels of oil. As of today, we have produced about four billion barrels of oil from the Bakken. The future of the Bakken is dependent upon success of new technologies, and the most likely technology to be used will include the utilization of spacing units and unitized fields with the use of natural gas and/or carbon dioxide injection in some wells to push oil to adjacent wells to maximize production. This technique is vastly different than what is being done in the Bakken today where each well is a producing well and operates as a single business unit. House Bill 1272 is a look into the future and is an attempt to ensure that oil producers can identify which wells in their fields have the potential for enhanced oil recovery or “EOR.” Creating a new well status, as would be authorized by House Bill 1272, will allow Bakken producers to go to the North Dakota Industrial Commission and request that wells be put on “EOR Potential” well status when the production from a certain well declines to uneconomic levels in order to preserve that wellbore for future EOR projects. Currently, when the production of a well drops below expectations of other wells in the field, these wells are moved to temporarily abandoned, or “TA,” well status, essentially placing them on a company’s liability side of the balance sheet. Operators then begin to look at plugging these TA wells despite the fact that great potential may still exist with the advancement of new technology or enhanced oil recovery once the entire spacing unit or field production

declines. From a North Dakota standpoint, it is important that Bakken wells capable of future development be retained on the asset side of the balance sheet by the producer. Researchers indicate it will take up to ten years before we likely have the technology to advance carbon dioxide utilization throughout the Bakken. Each of these Bakken wells is like a \$7 to \$10 million business, and we do not want that business to close its doors when business is slow. In the Bakken, we have a world-class resource that, once a well bore is plugged and abandoned, it is highly unlikely a new well will be drilled to replace it. Most of the Bakken spacing units now have between four and twelve producing wells on a pad. Some of these wells develop mechanical problems as they age, and those are the wells that should be analyzed for future potential, plugged and abandoned if future potential is very low, and not moved to EOR status. The Department of Mineral Resources has a process for that to happen. Unfortunately, we are seeing plugging and abandonment happen to many wells in the Bakken once production declines. Large operators with assets across the globe have many opportunities to invest. As we have seen in the past, smaller local and regional operators typically follow these larger operators and utilize technologies and efficiencies to produce incremental barrels of oil at lower volumes for decades. These wells, like small businesses, create jobs, pay taxes, stimulate the local economy, and become critical to community success. The goal of House Bill 1272 is to keep the wells in play. This can happen with a simple change in the way the Department of Mineral Resources regulates the industry. If this was a main street business, we would do this in a heartbeat to keep a business open. The time to act is now before these well bores begin to disappear. The more productive Bakken wells will continue to produce massive amounts of oil and new wells will be drilled and completed. Developing a plan for the lower-producing wells with good wellbore integrity now, is thinking long term for the State of North Dakota. NDPC urges your support and a **Do Pass Recommendation** for HB 1272. I would be happy to answer any questions.



Legacy Well Innovations & Opportunities

House Bill 1272

**Testimonial Presentation of
Kyle Gardner**

**Senate Energy and Natural
Resources Committee**

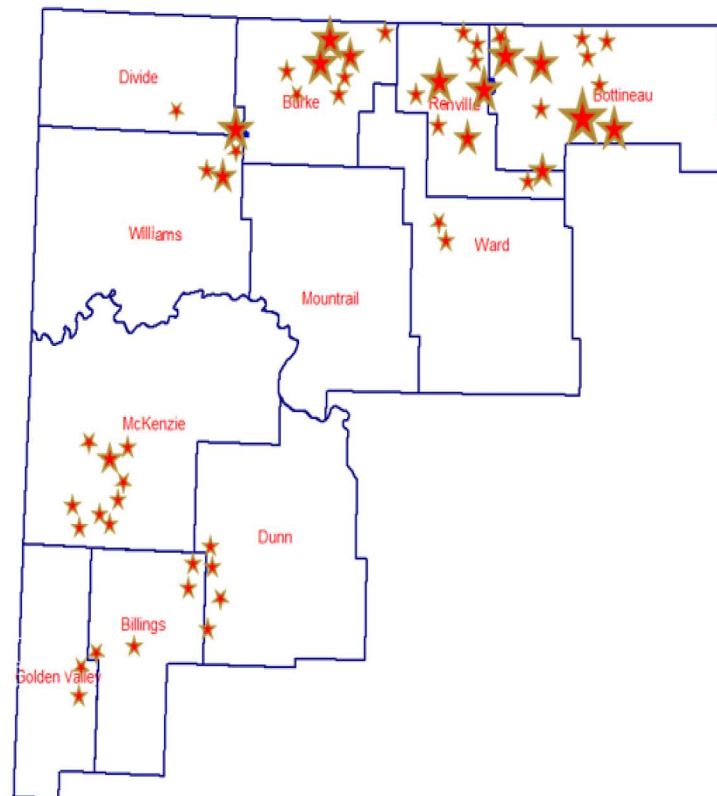
March 9, 2023

OPERATIONS

Cobra operates producing properties in Alabama, Arkansas, Louisiana, New Mexico, North Dakota, Michigan, Mississippi, Oklahoma, Texas, Utah and Wyoming .



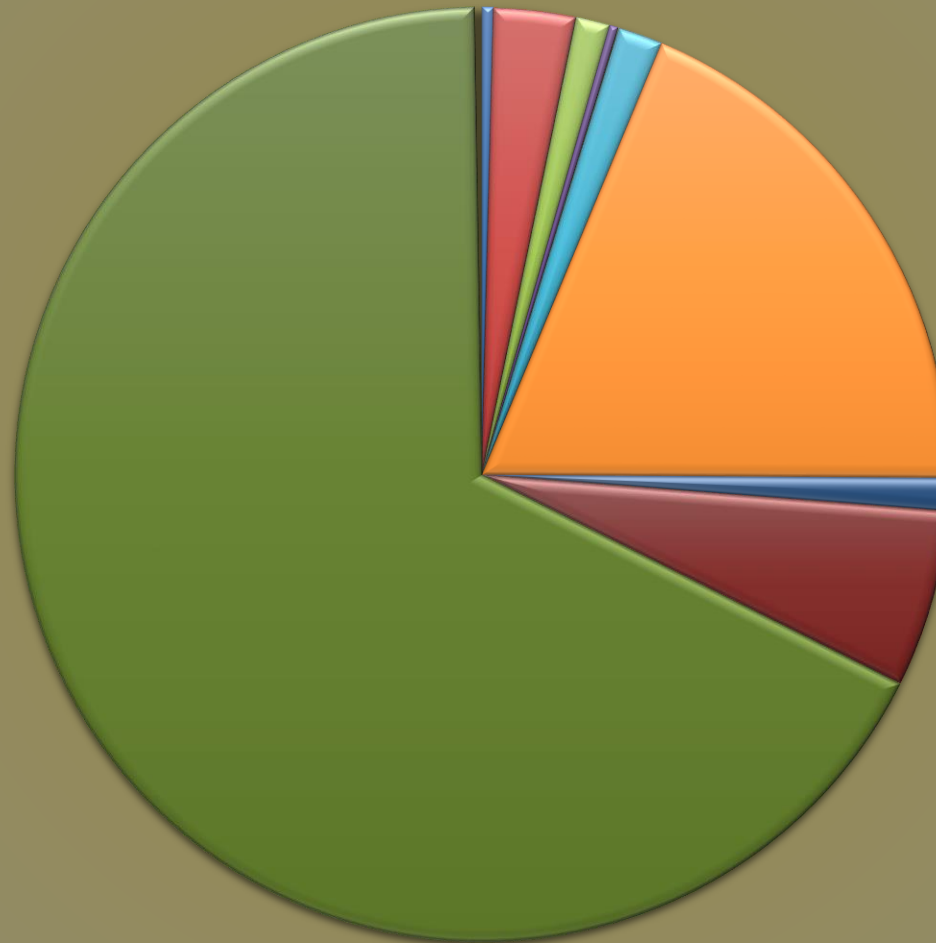
Cobra Oil & Gas Corporation





North Dakota Cumulative Oil Production By Formation

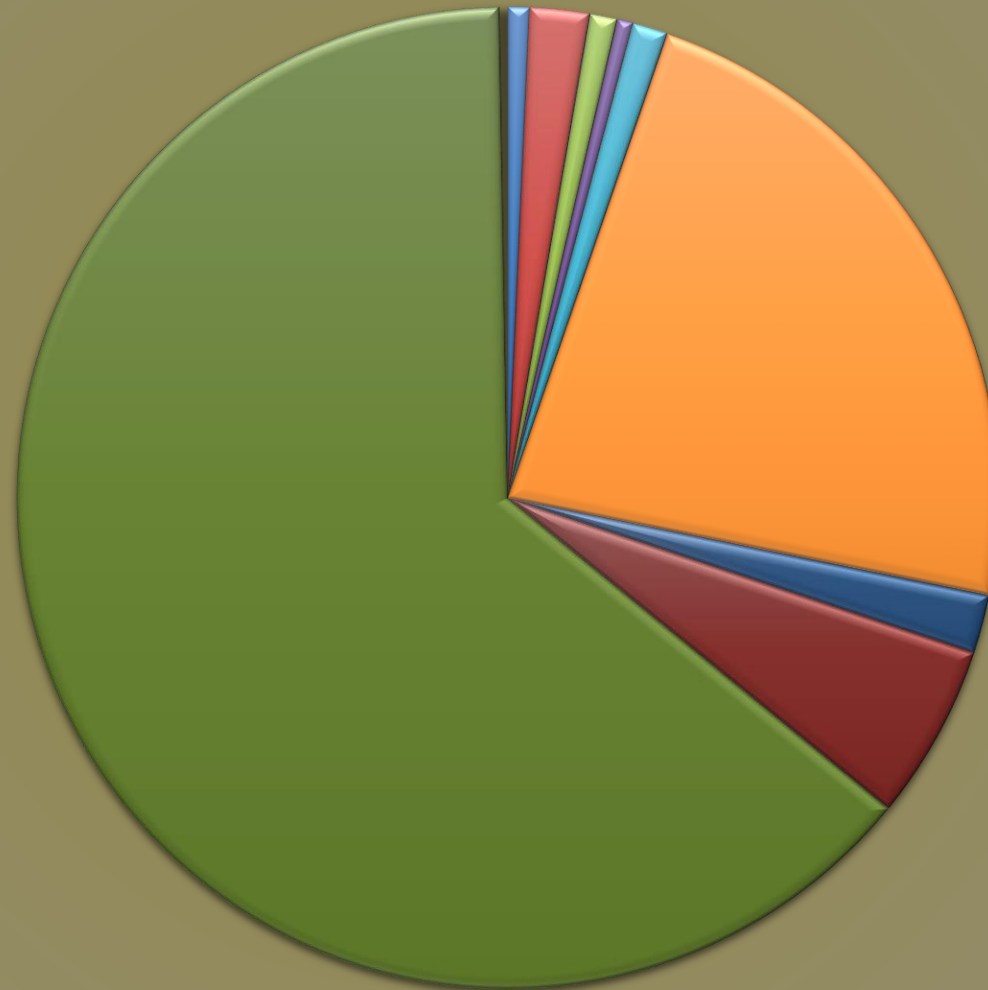
5,567,590,678
Barrels of Oil



- BIRDBEAR
- DEVONIAN-DUPEROW
- SILURIAN
- STONEWALL
- TYLER/HEATH
- MADISON GROUP
- SPEARFISH/MADISON
- RED RIVER GROUP
- BAKKEN/THREE FORKS
- DAWSON BAY
- WINNIPEGOSIS

North Dakota Total Well Count By Formation

25,146
Total Wells



■ BIRDBEAR

■ DEVONIAN-DUPEROW ■ SILURIAN

■ STONEWALL

■ TYLER/HEATH

■ MADISON GROUP

■ SPEARFISH/MADISON

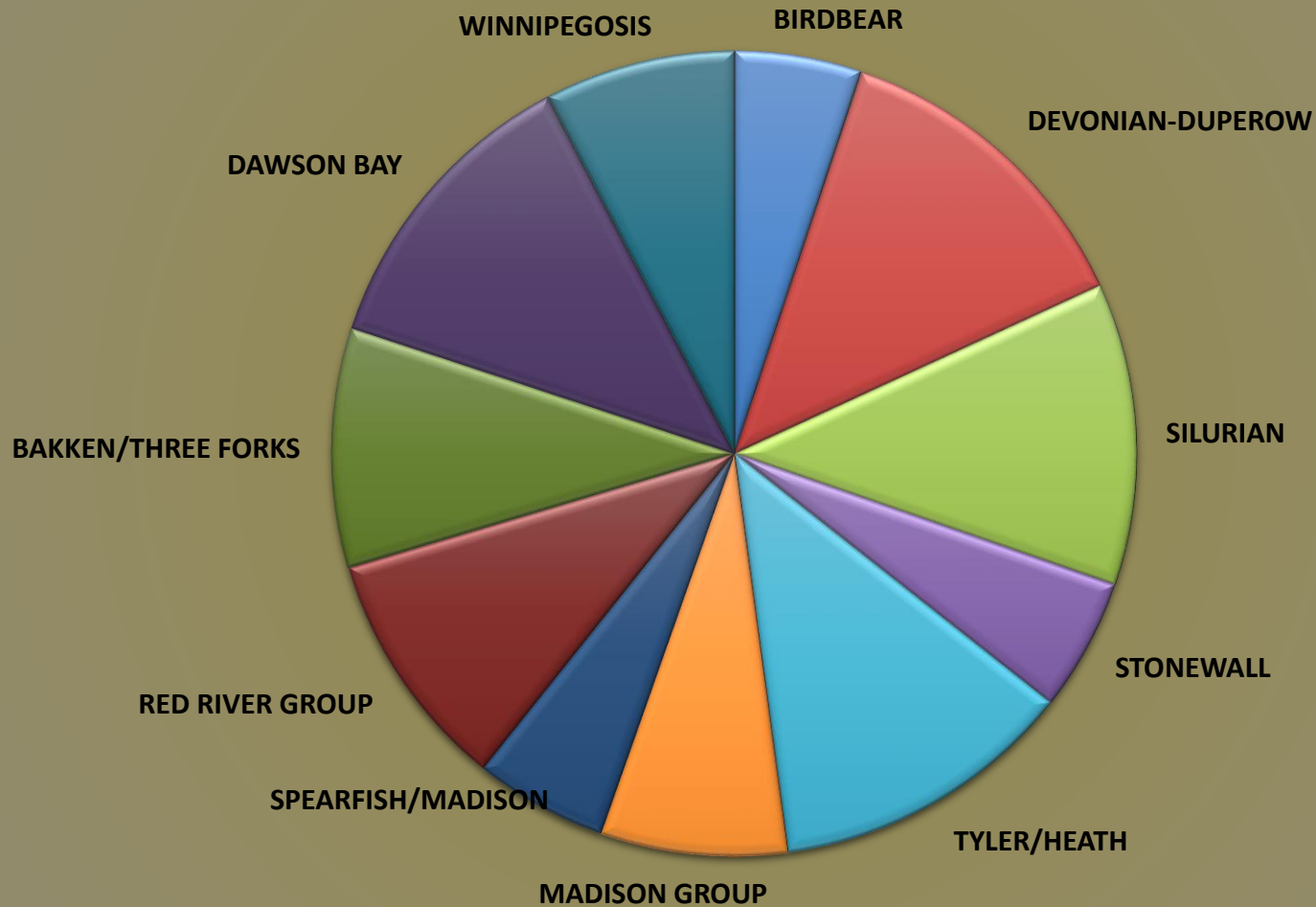
■ RED RIVER GROUP

■ BAKKEN/THREE FORKS

■ DAWSON BAY

■ WINNIPEGOSIS

North Dakota Cumulative BO/Well By Formation



-  BIRDBEAR
-  DEVONIAN-DUPEROW
-  SILURIAN
-  STONEWALL
-  TYLER/HEATH
-  MADISON GROUP
-  SPEARFISH/MADISON
-  RED RIVER GROUP
-  BAKKEN/THREE FORKS
-  DAWSON BAY
-  WINNIPEGOSIS



Williston Basin Fun Facts

- According to NDGS production/well count data, all ND productive formations that have produced more than 1MM BO, average 221,411 BO/well.
- Bakken/Three Forks Cumulative Production/Total Well Count yields an average 233,910 BO/well.
- Bakken/Three Forks made 1,078,594 BOPD in September-2022.
- Bakken /Three Forks currently produce 96% daily production in ND.
- The Madison Formation links every Bakken well to a historically prolific conventional reservoir.

SO WHAT IS NEXT?



Madison Formation Fun Facts

- Conventional carbonate reservoir.
- Contains reservoir quality rock throughout the basin.
- Can source its own hydrocarbon.
- Has been identified as a Residual Oil Zone (ROZ) formation via academic research and empirical production data.

What is a Residual Oil Zone (ROZ)?

- A section within the stratigraphic column of a formation that exists below the “oil-water contact” of a reservoir which contains “immobile oil.”
- These sections of reservoirs have been naturally water flooded by 3 different criteria.
- In result, remnants of oil are stranded within sections of rock that the oil once migrated through.

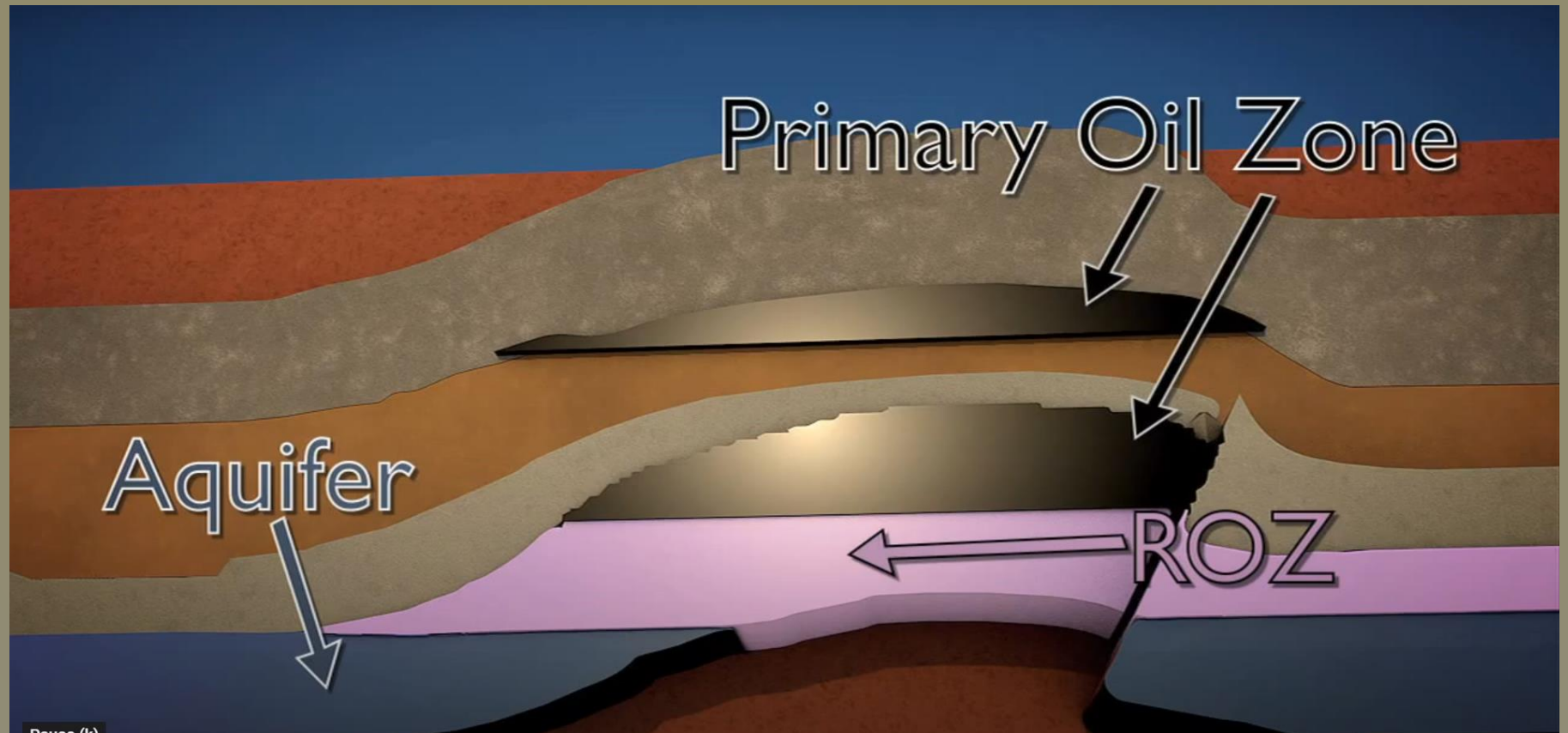
Types of ROZ

- **Type I** – Occurs when an existing hydrocarbon accumulation in a trap is subjected to a regional tilt (tectonically induced). Forcing oil to re-establish a new equilibrium.
- **TYPE II** – Occurs when a trap's seal is breached & allows for some or all of the hydrocarbon accumulation to vertically migrate from the trap, up the stratigraphic section.
- **TYPE III** – Similar to Type I but the static hydrocarbon accumulation undergoes a tilt due to ground water flows within the reservoirs.

Methods to Exploit the ROZ

- CO₂ Injection into the ROZ allows the CO₂ to become miscible within the oil droplets which in result lowers the oil interfacial surface tension, reduces viscosity and helps vacate the oil from the rock.
- Depressurizing the ROZ lowers the reservoir pressure within a radius around the wellbore to the bubble point pressure which allows the oil droplets to swell from gas expansion within the oil and helps vacate the oil from the rock.

Type II ROZ





RENVILLE COUNTY

FORMATION : MISSION CANYON
 DRLG. FLUID: SALT GEL NO OIL
 LOCATION :
 STATE : NORTH DAKOTA

DATE :
 FILE NO. :
 ANALYSTS :
 ELEVATION:

CONVENTIONAL CORE ANALYSIS

SAMP. NO.	DEPTH	PERM. TO HORZ.	AIR (MD) VERTICAL	POR. FLO.	FLUID SATS. OIL	WATER	GR. DNS.	DESCRIPTION
1	4572-73	0.92		13.5	12.9	30.0		LM FN XLN VUGGY CALC INF.
2	4573-74	64		18.5	15.2	23.2		LM FN XLN VUGGY CALC INF.
3	4574-75	7.2		12.0	17.6	35.2	CVF	LM FN XLN VUGGY CALC INF.
4	4575-76	104		18.5	16.6	35.2	CVF	LM FN XLN SCAT VUGS CALC INF.
5	4576-77	0.15		6.5	3.2	60.9		LM FN XLN SCAT VUGS CHKY
6	4577-78	42		12.8	10.9	34.2		LM FN XLN VUGS CALC XTAL
7	4578-79	1.1		7.4	7.1	31.0		LM FN XLN VUGS CALC XTAL
8	4579-80	0.39		20.7	23.7	23.7		LM OOL SCAT VUGS CALC INF.
9	4580-81	13		10.1	11.9	31.8		LM FN XLN VUGS CALC INF.
10	4581-82	3.8		10.2	8.8	29.2		LM FN XLN VUGS CALC INF.
11	4582-83	19		11.3	18.5	36.9	CVF	LM FN XLN VUGS CALC INF.
12	4583-84	33		11.9	14.8	28.0	CVF	LM FN XLN VUGS CALC INF.
13	4584-85	7.6		10.0	14.0	32.0	CVF	LM FN XLN SCAT VUGS CALC INF.
14	4585-86	36		11.1	14.3	28.6	CVF	LM FN XLN CALC INF.
15	4586-87	14		11.9	9.9	38.0		LM FN XLN VUGS CALC INF.
16	4587-88	13		23.4	14.8	33.6		LM FN XLN VUGS CALC INF.
17	4588-89	51		12.6	26.3	21.7		LM FN XLN VUGS CALC INF.
18	4589-90	7.8		18.1	23.4	23.4		LM FN XLN VUGS CALC INF.
19	4590-91	178		12.5	14.1	39.1		LM FN XLN VUGS CALC INF.
20	4591-92	13		14.4	18.5	27.8	CVF	LM FN XLN VUGS CALC INF.
21	4592-93	0.12		9.0	17.7	28.8	CVF	LM FN XLN VUGS CALC INF.
22	4593-94	0.16		7.7	12.1	40.3	CVF	LM FN XLN VUGS CALC INF.
23	4594-95	0.66		8.8	8.0	48.2		LM FN XLN VUGS CALC INF.
24	4595-96	66		3.0	3.6	50.3		LM FN XLN VUGS
25	4596-97	3.5		10.5	13.3	39.8		LM FN XLN CALC INF.

CVF CLOSED VERTICAL FRACTURE

These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representation as to the accuracy of the data.

Type II ROZ

- Standard conventional approach “Pop the Top”
- Cobra Oil & Gas ROZ approach (full yellow section)
- Rock data, petrophysical data, mudlog data, & production data support a Type II ROZ.



Type II ROZ

[REDACTED]

FORMATION : MISSION CANYON
 ORLG. FLUID: SALT GEL NO OIL
 STATE : NORTH DAKOTA

DATE : [REDACTED]
 FILE NO. : [REDACTED]
 ANALYSTS : [REDACTED]
 ELEVATION: [REDACTED]

RENVILLE COUNTY

CONVENTIONAL CORE ANALYSIS

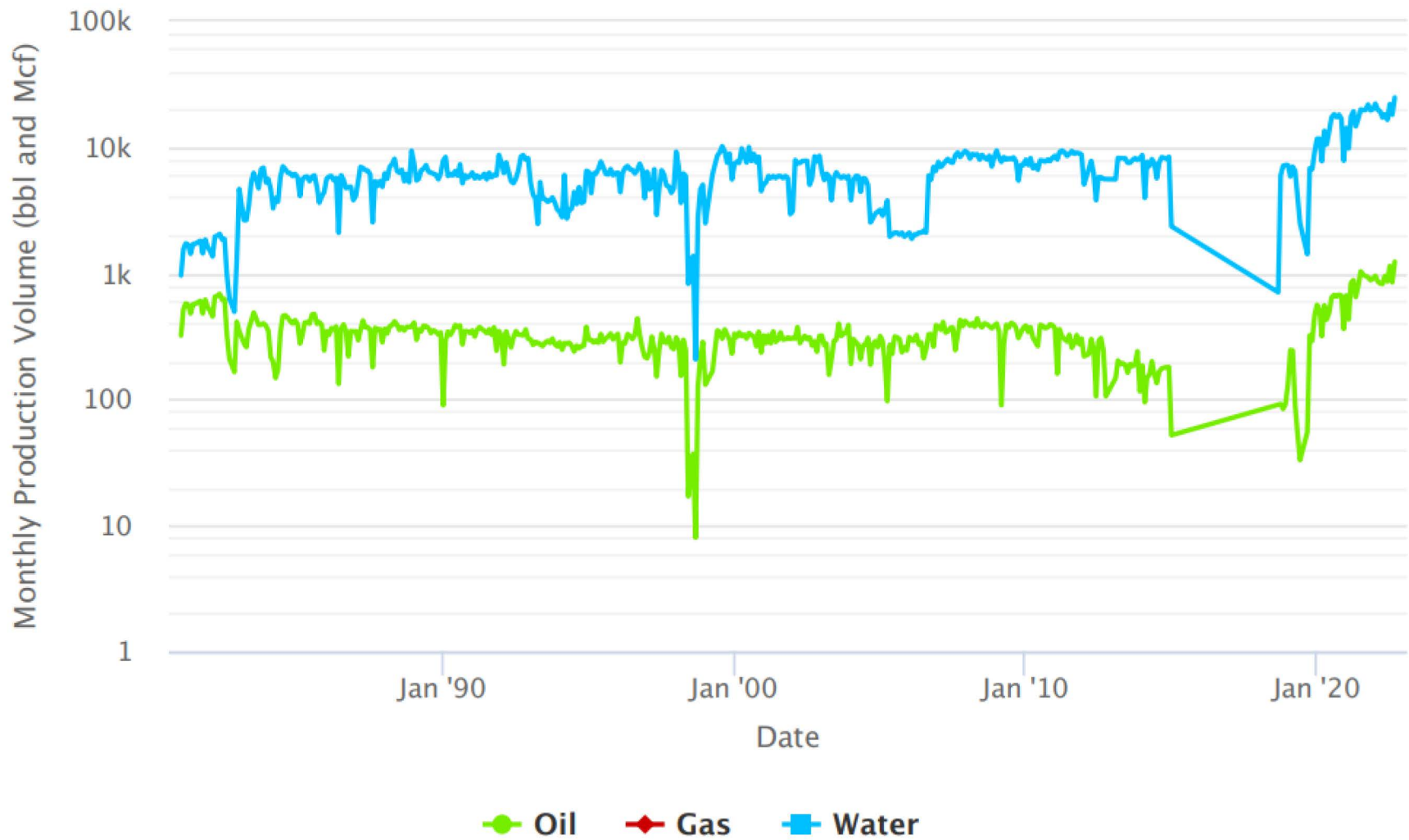
SAMP. NO.	DEPTH	PERM. TO HORZ.	AIR (MD) VERTICAL	POR. FLD.	FLUID SATS. OIL	WATER	GR. DNS.	DESCRIPTION
26	4597-98	20		14.3	8.0	29.5		LM FN XLN CALC INF.
27	4598-99	38		14.6	9.3	42.6		LM FN XLN CALC INF.
28	4599 -0	2.6		13.3	11.6	26.0	CVF	LM FN XLN VUGS CALC INF.
29	4600 -1	200		15.2	11.2	31.0	CVF	LM FN XLN SCAT VUGS CALC INF.
30	4601 -2	11		11.5	15.2	28.8	CVF	LM FN XLN SCAT VUGS CALC INF.
31	4602 -3	157		21.7	14.0	29.7	CVF	LM FN XLN OOL CALC INF.
32	4603 -4	250		18.3	17.2	27.4	CVF	LM FN XLN VUGS CALC INF.
33	4604 -5	31		17.9	12.8	28.8	CVF	LM FN XLN OOL CALC INF.
34	4605 -6	314		15.8	14.9	27.5	CVF	LM FN XLN OOL CALC INF.
35	4606 -7	61		18.1	15.5	35.2	CVF	LM FN XLN CALC INF.
36	4607 -8	93		15.2	17.4	32.4		LM FN XLN CALC INF.
	4608-4612							NO ANALYSIS LS
37	4612-13	24		10.6	13.1	26.1	CVF	LM FN XLN CALC INF.
38	4613-14	6.5		7.0	3.0	62.7	CVF	LM V/FN XLN CALC INF.
39	4614-15	113		9.1	2.3	51.9	CVF	LM V/FN XLN CALC INF.
40	4615-16	41		8.9	1.1	43.2	CVF	LM V/FN XLN CALC INF.
	4616-4623							NO ANALYSIS LS
41	4623-24	0.03		6.7	7.7	33.8	CVF	LM V/FN XLN CALC INF.
42	4624-25	2.8		10.9	16.3	29.0	CVF	LM V/FN XLN SUC CALC INF.

CVF CLOSED VERTICAL FRACTURE

- Standard conventional approach “Pop the Top”
- Cobra Oil & Gas ROZ approach (full yellow section)
- Rock data, petrophysical data, mudlog data, & production data support a Type II ROZ.

These analyses, opinions or interpretations are based on observations and materials supplied by the client to whom, and for whose exclusive and confidential use, this report is made. The interpretations or opinions expressed represent the best judgment of Core Laboratories, Inc. (all errors and omissions excepted); but Core Laboratories, Inc. and its officers and employees, assume no responsibility and make no warranty or representation as to the reliability, accuracy, or modification of any data, or any other information used in connection with which such report is made or called upon.

Monthly Production





Type II ROZ Results (Mission Canyon – Renville County, ND)

- After completing the full section of the productive Mission Canyon bed, oil cut increased with increased takeaway from increased reservoir deliverability.
- Cobra Oil & Gas deems this a method of reservoir depressurization.
- Like the San Andres ROZ plays of the Permian Basin, Cobra Oil & Gas believes the Mission Canyon ROZ potential could cover large areas of the Williston Basin.

TerraTek Core Services, Inc.™

University Research Park - 360 Wakara Way - Salt Lake City, Utah 84108 - (801) 584-2400 - TWX 910-925-5204

Page 2



Type II/III ROZ

- Standard conventional approach “Pop the Top”
- Unconventional approach to Type II/III ROZ example.
- Rock data, petrophysical data & mudlog data support a Type III ROZ over a wide range of the Williston Basin.

Sample Number	Depth (feet)	Permeability	Porosity (%)	Saturation		Grain Density (gm/cc)	Lithology
		Horz (md)		Oil (%)	H2O (%)		
19	9186.0-87.0	7.0	14.0	24.2	26.0	2.79	Dol,mx1,sl/lm
20	9187.0-88.0	21	17.5	38.8	21.3	2.81	Dol,mx1,sl/lm
21	9188.0-89.0	9.6	14.8	36.3	22.4	2.82	Dol,mx1,sl/lm
22	9189.0-90.0	3.2	11.9	37.6	25.6	2.78	Dol,mx1,sl
23	9190.0-91.0	0.04	4.3	10.8	18.4	2.78	Dol,mx1,sl
24	9191.0-92.0	24	15.6	63.9	21.3	2.83	Dol,mx1
25	9192.0-93.0	11	14.4	30.2	17.0	2.84	Dol,mx1
26	9193.0-94.0	0.14	6.5	5.7	32.1	2.79	Ls,mx1,dol
27	9194.0-95.0	0.40	4.5	21.6	39.6	2.81	Ls,mx1,dol
28	9195.0-96.0	13	13.0	48.4	30.5	2.81	Dol,mx1
29	9196.0-97.0	33	18.6	41.8	24.1	2.83	Dol,mx1
30	9197.0-98.0	20	16.5	53.2	14.3	2.82	Dol,mx1
31	9198.0-99.0	5.1	13.2	35.8	19.4	2.81	Dol,mx1,sl/lm
32	9199.0-00.0	2.7	11.6	48.3	24.6	2.79	Dol,mx1,sl/lm
33	9200.0-01.0	4.8	13.0	18.0	9.0	2.76	Dol,mx1,sl/lm
	9201.0 - 9201.5						Not Suitable for Analysis
	9201.5 - 9202.0						Not Recovered
34	9202.0-03.0	2.9	13.8	45.2	39.1	2.85	Dol,f-mx1
35	9203.0-04.0	0.51	10.4	17.9	56.1	2.85	Dol,f-mx1
36	9204.0-05.0	7.5	16.3	34.6	32.6	2.84	Dol,f-mx1
37	9205.0-06.0	7.5	18.5	39.2	43.1	2.84	Dol,f-mx1
38	9206.0-07.0	0.22	16.1	5.2	71.1	2.85	Dol,f-mx1



TerraTek Core Services, Inc.™

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Page 3



Sample Number	Depth (feet)	Permeability	Porosity	Saturation		Grain Density (gm/cc)	Lithology
		Horz (md)	(%)	Oil (%)	H2O (%)		
39	9207.0-08.0	18	15.5	9.4	56.3	2.83	Dol, f-axl
40	9208.0-09.0	0.58	12.9	25.3	40.8	2.84	Dol, f-axl
41	9209.0-10.0	0.44	10.0	19.0	47.1	2.83	Dol, f-axl
42	9210.0-11.0	1.4	13.3	40.6	28.5	2.82	Dol, f-axl
43	9211.0-12.0	0.14	8.4	11.5	56.2	2.82	Dol, fxl, sl/lms
44	9212.0-13.0	0.01	4.0	9.2	45.9	2.79	Dol, fxl, sl/lms
45	9213.0-14.0	0.04	8.5	9.9	46.2	2.84	Dol, vf-fxl
46	9214.0-15.0	0.22	11.6	8.3	53.9	2.83	Dol, vf-fxl
47	9215.0-16.0	0.05	8.7	11.7	59.6	2.83	Dol, vf-fxl
48	9216.0-17.0	0.03	7.4	12.2	52.2	2.83	Dol, vf-fxl
49	9217.0-18.0	0.02	6.8	6.2	40.1	2.83	Dol, vf-fxl
50	9218.0-19.0	0.03	9.2	18.0	51.0	2.82	Dol, vf-fxl
51	9219.0-20.0	0.01	9.0	10.2	56.2	2.83	Dol, vf-fxl

Type II/III ROZ

- Standard conventional approach “Pop the Top”
- Unconventional approach to Type II/III ROZ example.
- Rock data, petrophysical data & mudlog data support a Type III ROZ over a wide range of the Williston Basin.



Type II/III ROZ Metrics (Mission Canyon Fryburg Bed – Renville County, ND)

- In a 1 mile radius from the referenced well \approx 2,600,000 BO & 30,000,000 BW have been produced from 5 wells completed from the interval highlighted in “pink.”
- The entire pore space capacity for 1 square mile of reservoir rock with the average quantities and height of the referenced core in the presentation is \approx 20,000,000 Bbls, if the rock were completely filled with water.
- It is only possible to recover more total liquid than the calculated storage capacity of this rock section by having an increased:
 - I. Average porosity
 - II. Vertical height
 - III. Drainage radius



Type II/III ROZ Outlook (Mission Canyon Fryburg Bed – Renville County, ND)

- Assuming adequate fluid handling and disposal/injection capacity, in order to produce the stranded oil in this ROZ, the entire interval should be completed and depressurized or injected with CO₂.
- Most of the Mission Canyon Fields are not defined by “dry holes” beyond the limits of productive reservoirs, but by the economic limit of commercial production at that point in time.
- Within the State of North Dakota, Mission Canyon Formation ROZ reserves could be comparable to the estimates of Bakken EOR reserves.

Brownfield ROZ vs. Greenfield ROZ

- **Brownfield ROZ** – exists when a section of the ROZ contains the overlying “Oil-Water Contact” and commercially produced by conventional means.
 - CO₂ can be injected into the Brownfield ROZ for EOR purposes.
- **Greenfield ROZ** – No overlying primary production exists. This section has been naturally waterflooded & commercial production from a conventional application is not feasible. The only portion of the ROZ present is below the “Oil-Water Contact.”
 - CO₂ can be sequestered into the Greenfield ROZ, which would yield barrels of oil from offset producers, unable to be recovered by other means.

Needs for Bakken EOR & Madison ROZ Potential

- Available & affordable CO₂.
- Available wells with mechanical integrity.
 - Wells of mechanical integrity within areas of Bakken EOR or Madison ROZ potential should be viewed as resources at a State level, not liabilities.
- Fluid handling systems.



References

1. Melzer, S., (2006) "Stranded Oil in the Residual Zone." U.S. Department of Energy Report, February.
2. Melzer, S., Trentham, R., (2016) "San Andres Formation Residual Oil Zones and Their Relationships to the Horizontal Carbonate Play On the Northern Shelf." Society of Independent Professional Earth Scientists, April.
3. Burton-Kelly, M., Dotzenrod, N., Feole, I., Peck, W., He, J., Butler, S., Kurz, M., Kurz, B., Smith, S., Gorecki, C., Energy & Environmental Research Center, (2018) "Identification of Residual Oil Zones in the Williston and Powder River Basins" U.S. Department of Energy, March.



Thank You!

I will gladly answer any questions for further discussion.