

Spring 2018

BASIN BITS

The Official Publication of the Western Dakota Energy Association



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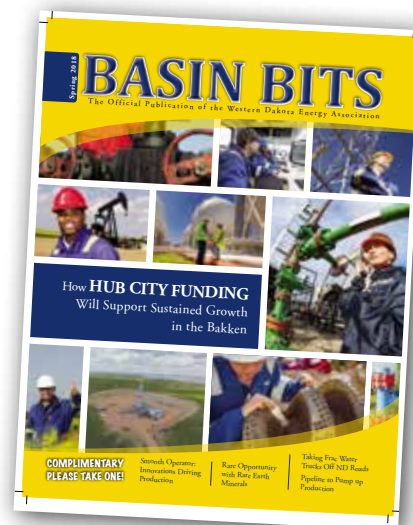
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On the cover: *The North Dakota Legislature's interim Energy Development and Transmission Committee is studying oil and gas tax revenue allocations to hub cities and hub city school districts. Ongoing funding to these communities will be **critical** to support continued growth in the state's oil industry.*





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From the Desk of the Western Dakota Energy Association's President



Shawn Kessel
President
Western Dakota Energy Association

Finding a larger role for the individual committees, expanding the LoadPass Permit System outside of western North Dakota, and continuing to advocate for a sufficient return of in-lieu-of funding to local political subdivisions in oil-producing counties to meet our needs are the top three priorities.

Advocating to Meet the Needs of Oil-Producing Counties

As the new board president of the Western Dakota Energy Association (WDEA), I would like to take the opportunity to introduce myself and provide a little background about who I am and where I have been.

I was born in Dickinson, ND. My parents, who were also both born in Dickinson, were part of the first graduating class at Trinity High School. If you were ever in Dickinson around that time and shopped at Lynch Grocery, I would like to say thank you—that was my grandparents' store. I graduated from high school in Carrington, ND and received my undergraduate degree from Moorhead State University. My Master's in Business Administration comes from the University of Mary. I have spent the vast majority of my years in North Dakota.

I have been involved with WDEA for more than seven years. As the city administrator in Dickinson since January 2009, I have been intimately involved in the community's preparation and response to oil impacts and the advocacy for local political subdivisions. Prior to Dickinson, I was the city administrator in Wahpeton for nine years. Between the two positions, I have spent a great deal of time in Bismarck developing relationships and advocating for causes.

During my tenure on the WDEA board, we were able to hire our new executive director, shepherd the name change vote to the membership, participate in creating the mission and vision for the organization, and develop multiple legislative strategies. I want to thank Daryl

Dukart, past-president, for his excellent leadership during his term. I would also like to thank the remaining board and committee members for volunteering their time and efforts to making western North Dakota the wonderful gem that it is.

Finding a larger role for the individual committees (school, county, and city), expanding the LoadPass Permit System outside of western North Dakota, and continuing to advocate for a sufficient return of in-lieu-of funding to local political subdivisions in oil-producing counties to meet our needs are the top three priorities for me (not necessarily in that order).

I want to commend WDEA Board Member Steve Holen for the work he is doing with the school committee in educating and advocating for changes to state law that would benefit schools. I would also like to thank WDEA Vice-President Gary Wilz for volunteering to lead a committee to establish a performance review process for the executive director.

Currently, WDEA is sponsoring a couple of different studies. One of them seeks to identify the gap between revenue and expenses experienced in cities and counties due to oil impacts. Another seeks to better understand how revenue generated from the gross production tax and oil and gas extraction tax are allocated and spent by the state. Having the knowledge these studies will reveal allows us to develop a better legislative strategy that will not only advocate but also educate thought leaders in North Dakota. Stay tuned—there is much to be done. 📊

ABOUT THE WESTERN DAKOTA ENERGY ASSOCIATION

The Western Dakota Energy Association (WDEA) is the trusted and unified voice for the betterment of the citizens of North Dakota and the membership of WDEA.

THANK YOU TO THE WDEA 2018 EXECUTIVE COMMITTEE FOR SERVING WESTERN NORTH DAKOTA!

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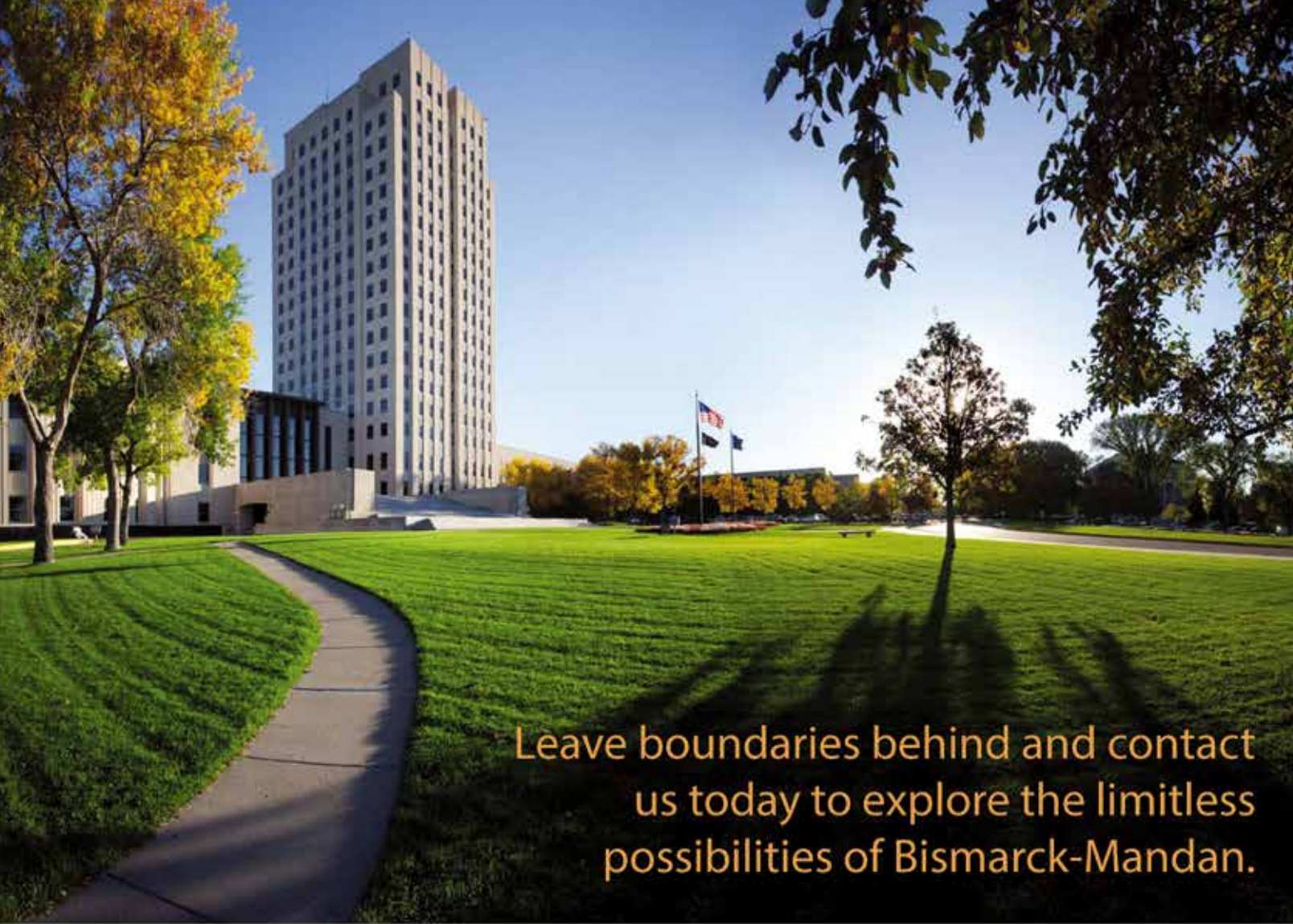
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Editor's note: As this issue of Basin Bits was going to press, Shawn Kessel announced he had accepted a new position and planned to resign as WDEA president effective June 1, 2018.



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From the Desk of the Western Dakota Energy Association's Executive Director



Geoff Simon
Executive Director
Western Dakota Energy Association

Producers in other shale plays are trying to attract the same workers we want to come to North Dakota. Our policymakers need to keep that in mind. Without oil industry workers, there is no oil industry.

Support the Communities that Support the Industry

Eye-popping!" That's a word I used when speaking to a North Dakota legislative committee studying the distribution of oil tax dollars to cities, counties, and schools in the oil-producing region. I used the term "eye-popping" to describe some of the statistics developed by AE2S Nexus, the financial analysis company we contracted to gather historic data and future cost projections for the four top oil-producing counties.

Dunn, McKenzie, Mountrail and Williams Counties collectively account for roughly 92 percent of North Dakota's total oil production. That's just one of the eye-popping numbers that demonstrate how the state's production has evolved in the low-price regime of the past couple years. It's no surprise that producers drill where they can make the most money, and since about the middle of 2015, most of the rigs operating in North Dakota have concentrated in the four-county region. The good news is that's likely to change soon. With oil prices climbing above the \$60 per barrel mark, we expect drilling activity will once again spread to other parts of western North Dakota.

But more about those eye-popping statistics. One of the most amazing numbers is \$987 million. That's the amount of money those top four counties have spent developing transportation infrastructure since 2010. Almost a billion dollars invested by county highway departments to build and maintain roads and bridges that support the oil industry! That doesn't include other dollars invested by the North Dakota Department of Transportation to build new and improved state highways to keep the industry moving.

The value of industry investment and associated infrastructure has also grown exponentially. The value of taxable property in McKenzie County has increased 1,062 percent since 2010. That's not a typo. The value of property subject to taxation, including residential housing, commercial buildings, and industrial property such as pipelines and gas processing plants, saw a more than tenfold increase in McKenzie County in the past seven years. The other major producing counties saw property values climb to four and five times their 2010 level.

Impressive stuff to be sure, but the big question is: What does the future look like in the Bakken, and how will the state and its policymakers respond? Honestly, no one

expects those eye-popping numbers to continue, but there's no doubt oil and natural gas production in North Dakota will continue to grow. Or is there cause for doubt? As you will learn from reading the cover story of this issue (on page 16), nowadays, the Bakken has competition, so it's essential that we keep feeding the golden goose to keep the industry humming. North Dakota must remain attractive, not only to investors in terms of tax and regulatory policies, but to industry workers as well.

The bottom line is the industry needs people, and to attract that workforce, we need attractive communities. At the outset of the boom, the focus was on basic infrastructure. The industry needed roads, utilities, and some rudimentary housing for workers. But today, the situation has changed. More workers are moving their families to North Dakota, and there are more who want to do the same soon. They need single-family housing, good schools, health care, recreation, shopping, and entertainment options. And communities in the oil-producing region need money to help make those amenities possible.

Producers in other shale plays are trying to attract the same workers we want to come to North Dakota. Our policymakers need to keep that in mind. Without oil industry workers, there is no oil industry. We need vibrant, attractive communities to entice people to live and work here. The State of North Dakota must continue to provide the financial support needed by oil-impacted communities to deliver the services that support both the industry **and** its workers. Keep feeding that golden goose!

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From the Desk of the North Dakota Petroleum Council



Ron Ness
President
North Dakota Petroleum Council

This new infrastructure is a \$2.5 billion investment that will help accommodate increasing natural gas production, but other challenges exist that will require a collaborative approach.

NDPC Reconvenes Task Force to Increase Natural Gas Capture

The North Dakota Petroleum Council (NDPC) reconvened a task force to explore means of pursuing higher natural gas capture and spurring additional infrastructure development. The Natural Gas Capture and Infrastructure Development Task Force met in March to establish goals and will begin collecting and analyzing data to find common challenges that can be addressed through industry-wide coordinated efforts.

The NDPC's task force model has been successful in the past and helped the industry continually meet or exceed its gas capture goals. The multi-year industry downturn and changes over the past two years, however, have created new challenges that need to be addressed.

Among the largest challenges has been the industry downturn. Although natural gas production has increased over the past two years, the depressed market inhibited investment in gas processing and

transmission assets. The industry has announced more than 800 million cubic feet per day of new or expanded processing and transport capacity. This new infrastructure is a \$2.5 billion investment that will help accommodate increasing natural gas production, but other challenges exist that will require a collaborative approach.

The task force has established six subcommittees that are closely examining key challenges, including gathering and processing infrastructure, tribal issues, transmission pipeline infrastructure, gas capture plans, remote capture technology, and stranded gas.

The task force, which consists of more than 80 people representing 39 companies working and operating in the Bakken, recently met in Denver.

The committee will continue to meet monthly and developed recommendations on how to increase capture in April.

In just four years since this task force was first formed and came out with its initial findings and recommendations, so much has changed. It became clear we needed to revisit this issue in a rapidly changing environment and pursue new innovations and new ideas to ensure we're continuing to meet our goals and capture more natural gas for the benefit of mineral owners, value-added markets, and the state as a whole.

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Bakken Now: Your Guide to the 2018 Williston Basin Petroleum Conference

May 22-24, 2018 | Bismarck, ND | Bismarck Event Center

MONDAY, MAY 21, 2018

7:00 a.m. – 7:00 p.m. Exhibitor Set-Up – Exhibit Hall and Outdoor Exhibits

TUESDAY, MAY 22, 2018

7:00 a.m. Exhibitor Set-Up – Exhibit Hall and Outdoor Exhibits

10:00 a.m. Conference Registration Opens – Lobby

Oak, Maple, Birch, Cottonwood & Linden Rooms

9:00 a.m. – 12:00 p.m. Bakken / Three Forks / Madison / Spearfish Core Workshop (Pre-registration is required, \$125 per person)
Hosts: Tim Nesheim, Jeff Bader, Travis Stollendorf, North Dakota Geological Survey

11:30 a.m. Expo Opens – Visit the Expo and Outdoor Exhibits

12:00 p.m. – 1:00 p.m. Lunch – Proudly sponsored by LIUNA North Dakota at their outdoor booth

Exhibit Hall D

1:00 p.m. – 2:45 p.m. Growing the Energy Workforce and Advancing Our Western North Dakota Communities
Session Chair: Rob Lindberg, Bakken Backers

1:00 p.m. Workforce Education – Brent Sanford, North Dakota Lieutenant Governor

1:20 p.m. Workforce Statistics – Cindy Sanford, Job Service North Dakota / Williston

1:40 p.m. Community Infrastructure / Growth – Geoff Simon, Western Dakota Energy Association

2:00 p.m. Growing Creedence Energy – Kevin Black, Creedence Energy Services

2:15 p.m. Millennials Matter: How to Attract, Retain, & Intrigue Today's Workforce – Danita Bye, Sales Growth Specialists

2:45 p.m. – 3:00 p.m. Networking: Visit the Expo & Outdoor Exhibits

3:00 p.m. – 4:30 p.m. Natural Gas Capture & Infrastructure Development
Session Chair: Phil Archer, NDPC Natural Gas Capture Task Force, Whiting Oil & Gas
Gas Capture Regulations – Bruce Hicks, North Dakota Oil & Gas Division
Production Growth & Capture Data – Justin Kringstad, North Dakota Pipeline Authority
Expanding Gas Processing Capacity – Christy Williamson, ONEOK Rockies Midstream
Tackling Gas Capture in the Core of the Bakken – Diaco Aviki, Crestwood Midstream Partners
Advances in Remote Capture – Brian Cebull, GTUIT

Meeting Rooms 103, 104 & 105

1:00 p.m. – 4:30 p.m. Williston Basin Breakthrough Technologies
Session Chairs: Michael Kukuk, Oasis Petroleum & Curtis Ryland, Marathon Oil

1:00 p.m. Intriguing New Pipeline Monitoring Technologies – Brian Kalk, Energy & Environmental Research Center

1:20 p.m. UAS: Oil & Gas Inspection & Detection – Brad Tomer, Avitas Systems, a GE Venture

1:40 p.m. Enhancing the Bakken with Beyond Visual Line of Sight UAS – Jim Cieplak, Harris Corporation

2:00 p.m. The Davis Refinery: Industry Proven Technology, Comprehensively Applied to Meet Lower Emissions – Lance Medlin, Meridian Energy

2:20 p.m. Break: Visit the Expo and Outdoor Exhibits

2:40 p.m. Leveraging Digital Technology to Optimize Equipment Operation and Maintenance – David Dunlevy, Caterpillar Oil & Gas

3:00 p.m. Well-Site Automation – Travis Wardlaw, EOG Resources

3:20 p.m. Moving Past the Thief Hatch / Alternative Central Tank Battery Designs – Ryan Lunsford, Whiting Petroleum Corporation

3:40 p.m. Dust Control for New OSHA Regulations – John Jackson, Unimin Energy

4:00 p.m. Energy Transmission Siting in North Dakota: An Overview of Procedures for Route Adjustments Before or During Construction of Transmission Pipelines – Lawrence Bender, Fredrikson & Byron, P.A., on behalf of Dakota Access Pipeline

Meeting Rooms 101 & 102

1:00 p.m. – 2:45 p.m. Cyber Security: Is Your Infrastructure Safe?
Session Chairs: Tony Straquandine, Alliance Pipeline & Kari Cutting, North Dakota Petroleum Council

1:00 p.m. Cybersecurity: Today's Invisible Battlespace – Jerad Saylor, USAF Space Command

1:20 p.m. Protecting U.S. Infrastructure: FERC's Cybersecurity Program – Joe McClelland, Federal Energy Regulatory Commission

2:00 p.m. Is Your Home/Business Data Safe? – John Nagel, CyberNet Security, LLC

2:20 p.m. The Future of Cyber Security: A Panel Discussion

Networking: Ice Breaker Social in Exhibit Hall

5:00 p.m. – 8:00 p.m. Networking: Ice Breaker Social
BBQ Proudly Sponsored by Halliburton and Hosted Bar from 6:00 p.m. – 7:30 p.m.

Wednesday, May 23, 2018

CNBC is Exclusively Broadcasting Live from the Williston Basin Petroleum Conference

7:00 a.m. Conference Registration Opens – Lobby

7:00 a.m. Hot Breakfast Buffet – Exhibit Hall A-D

Morning Session – Exhibit Hall D

8:00 a.m. Welcome – Ron Ness, North Dakota Petroleum Council
National Anthem – Medora Burning Hills Singers

8:15 a.m. Remarks: North Dakota Governor Doug Burgum

8:30 a.m. Address from Miss America Cara Mund

8:40 a.m. Global Market Impact of the American Energy Renaissance – Harold Hamm, Continental Resources & Dr. Edward Lewis Morse, Citigroup Inc., Research Division

9:10 a.m. Address from U.S. Secretary of the Interior Ryan Zinke (Invited)

9:45 a.m. – 10:30 a.m.	Networking: Visit the Expo & Outdoor Exhibits
10:30 a.m.	Senator John Hoeven and Senator Heidi Heitkamp Videos
10:40 a.m.	Introductions: Kathleen Neset, Neset Consulting Leading the Way in Shale: Future Challenges and Opportunities for the Bakken – Greg Hill, Hess Corporation
11:00 a.m.	Liberty's Stomping Horse Bakken EOR Project – Mark Pearson, Liberty Resources
11:30 a.m.	Marketing Bakken Oil to the World – Brady Cook, Koch Industries, Inc.
12:00 p.m.	Lunch provided throughout the Expo – Proudly sponsored by Bakken Now Plus Sponsors: Continental Resources, Oasis Petroleum & XTO Energy
Afternoon Session – Exhibit Hall D	
1:15 p.m. – 2:45 p.m.	The New Energy Economic Reality Session Chairs: Preston Page, Page Petroleum & Kathleen Neset, Neset Consulting Outlook for U.S. Monetary Policy & The Implications for Energy Sector – Neel Kashkari, Federal Reserve Bank of Minneapolis Conversation 1: Global Oil Market Perspective / The Williston Basin's Contribution Conversation 2: Shift in Public Market Mindset as to the Energy Sector – Bob Morris, Citi Research; Doug Leggate, Bank of America; & John Gerdes, KLR Group
2:45 p.m.	Networking: Visit the Expo & Outdoor Exhibits
3:00 p.m. – 4:30 p.m.	Regulation: New Day, Better Way! Session Chairs: Zac Weis, Marathon Oil & Alan Olson, Montana Petroleum Association Douglas Benevento, EPA Region 8; Dave Glatt North Dakota Department of Health; Wayne Stenehjem, North Dakota Attorney General; & Tim Fox, Montana Attorney General
4:30 p.m.	Networking: Visit the Expo & Outdoor Exhibits
Meeting Rooms 103, 104 & 105	
1:15 p.m. – 4:00 p.m.	Williston Basin Optimization Session Chairs: Doug Goehring, North Dakota Agriculture Commissioner & John Harju, Energy & Environmental Research Center
1:15 p.m.	U.S.-Canada Collaborations on EOR and CO ₂ -EOR – Dan Maclean, Petroleum Technology Research Centre
1:45 p.m.	Expanding the Margins of the Williston Basin: The Impact of Refined Stimulation Design – Kyle Trainor, NP Energy Services, LLC
2:15 p.m.	Strategic Completion Design and Operation in Addressing Parent-Child Well Impact – Ashley Thoma, Statoil & Lionel Ribeiro, Statoil
2:45 p.m.	Networking: Visit the Expo & Outdoor Exhibits
3:00 p.m.	Fiber Optics in Completions: Real Time Stage Optimization – Price Stark, Pinnacle
3:30 p.m.	Completion Drivers to Optimize Dollars per Barrel of Oil Equivalent – Leen Weijers, Liberty Oil Field Services
4:00 p.m.	Networking: Visit the Expo & Outdoor Exhibits
Meeting Rooms 101 & 102	
1:15 p.m. – 4:30 p.m.	Williston Basin's Multi-Zone Geology Session Chairs: Ed Murphy, ND Geological Survey; Melinda Yurkowski, Petroleum Geology; & Saskatchewan Geological Survey, Saskatchewan Ministry of the Economy
1:15 p.m.	Untapped Unconventional Potential: Heat Flow and Source Bed Thermal Maturity – Burke Brunson, UND Geology Graduate Student
1:40 p.m.	Spearfish / Madison Formations – Travis Stollendorf, North Dakota Geological Survey
2:05 p.m.	Tyler Formation – Jeff Brehm, Tall Cotton Petroleum
2:30 p.m.	Madison Targets in Saskatchewan & North Dakota – Arden Marsh, Saskatchewan Geological Survey & Tim Nesheim, North Dakota Geological Survey
2:55 p.m.	Networking: Visit the Expo & Outdoor Exhibits
3:20 p.m.	Birdbear-Duperow (Devonian) – Jeff Bader, North Dakota Geological Survey
3:45 p.m.	Stonewall and Lower Interlake Formations (Silurian) – Tim Nesheim, North Dakota Geological Survey
4:10 p.m.	Helium Resources and Potential of the Phanerozoic Western Canada Sedimentary Basin, Southern Saskatchewan – Melinda Yurkowski, Petroleum Geology, Saskatchewan Geological Survey, Saskatchewan Ministry of the Economy
Networking: Ice Breaker Social in Exhibit Hall	
5:00 p.m. – 7:00 p.m.	Social – Proudly Sponsored by LIUNA North Dakota
Social Gathering at Ramkota Hotel, Dakota Ballroom	
7:00 p.m. – 10:00 p.m.	Social Gathering – Sponsored by the ND Oil PAC (Minimum Donation \$20 at Door)
THURSDAY, MAY 24, 2018	
7:30 a.m.	Conference Registration Opens – Lobby
7:30 a.m.	Hot Breakfast Buffet – Exhibit Hall A-D & Rooms 104-105 Hallway
Morning Session – Exhibit Hall D	
8:00 a.m.	Welcome – Blu Hulsey, Continental Resources
8:05 a.m.	Congressman Kevin Cramer Video
8:10 a.m.	World Supply / Demand – Linda Capuano, U.S. Energy Information Administration
8:30 a.m.	Bakken Now! Production Growth & Infrastructure Needs – Lynn Helms, Department of Mineral Resources
8:50 a.m.	The Best Play Gets Better – Jack Stark, Continental Resources
9:10 a.m.	High-Tech Oil Shale – Lee Tillman, Marathon Oil
9:30 a.m. – 10:40 a.m.	Networking: Visit the Expo & Outdoor Exhibits
10:45 a.m.	Bakken CEOs – What's Next for the Williston Basin Moderator: Ron Ness, North Dakota Petroleum Council Panelists: Don Hrap, ConocoPhillips & Thomas Nusz, Oasis Petroleum Why the Bakken? – Brad Holly, Whiting Petroleum Corporation
11:30 a.m.	Politics & America 2018 – J.C. Watts, J.C. Watts Companies
<i>*Agenda may change. The latest version is available on the WBPC website, www.wbpccnd.org.</i>	



Affordable, Competitive, & Attractive Communities:





Bakken Competes with Other Shale Plays for Workforce

By Heather Syverson, AE2S Nexus

During the height of the Bakken oil boom, western North Dakota experienced an unprecedented influx of people from all over the country looking for a piece of the action. In response, the affected cities and counties scrambled to expand water, sewer, transportation, and housing infrastructure. State lawmakers took notice and funded major projects such as expansion of the Williston Regional Water Treatment Plant to ensure essential infrastructure had adequate capacity to serve growing populations.

When oil prices dropped a few years ago, there was almost a sense of relief because the cities and counties finally had a chance to catch their breath, complete major infrastructure projects, and start planning for the future. But with prices on the rise, the Bakken is getting busy again.

“While the industry slowdown of the past few years allowed many of these communities to catch up, they’re facing yet another crunch with the increase in activity,” says Ron Ness, president of the North Dakota Petroleum Council. “Growing these communities should be a top priority for the use of oil tax revenues.”

When the boom was taking off 10 years ago, the nation was in a recession, so finding workers wasn’t a problem. But with growing competition from other shale plays, Ness says the Bakken faces a new challenge: attracting employees to North Dakota.

“There’s a critical need for infrastructure to allow these communities to grow and to provide quality-of-life attributes that are necessary to attract and retain a permanent, millennial workforce,” he says.

TWO STUDIES COMPLETED

Last year, the Western Dakota Energy Association (WDEA) partnered with oil-impacted cities and counties to fund two studies conducted by AE2S Nexus aimed at identifying unmet needs in Bakken communities. The *Six City Study: Affordability, Needs & Funding Gaps* and the *4-County Oil Impacts Analysis* revealed several quality-of-life issues that need to be addressed in order for the Bakken to successfully compete for workforce with the Permian, Niobrara, Woodford, and Eagle Ford oil plays. Not surprisingly, communities that are affordable, competitive, and attractive are the most likely to attract and retain residents.

“Workers are finding comparable jobs with comparable pay in other shale plays with a lower cost-of-living that may have more moderate climates, larger cities, or other amenities,” says Shawn Gaddie, AE2S Nexus division manager. “In order to compete with national oil and gas plays, North Dakota communities must continue to improve tangible and measurable quality-of-life aspects for their workforce. And they must do so with an eye toward affordability, which is a challenge that every community faces.”

COST OF LIVING COMPARISONS

Six cities were included in the original economic study—Dickinson, Killdeer, Stanley, Tioga, Watford City, and Williston—and Minot was brought into the loop in 2017. The study found that when it comes to the cost of living, places like Minot, Dickinson, Williston, and Watford City are more expensive than cities in other oil-producing regions in Colorado, Texas, Wyoming, and Oklahoma.

“Although the price of oil often dictates employer activity in oil plays, the quality of life and cost of living dictate what employees do,” says Gaddie. “This applies not only to people who are considering moving here but also to the people currently living and working in western North Dakota. When the cost of living gets too high, communities run the risk of losing the people they have.”

In a comparison of median housing costs in oil play communities in North Dakota, AE2S Nexus found the average home in Watford City is highest at \$300,000, and the owner pays average annual property taxes of \$2,489. Fort Collins and Greeley, Colorado, and Midland, Texas had the next highest



Data courtesy of Bestplaces.net. Index value of 100 is representative of national average.



Based on publicly available listing and recent sale price on www.zillow.com.*

median home prices. Dickinson, Williston, and Minot had higher median home prices than oil play cities in Wyoming and Texas.

Property taxes compound the higher housing costs, with average tax bills for homes in North Dakota cities coming in higher than those in Colorado and Wyoming. Although they were higher, North Dakota property tax rates are actually in line with the rest of the country. And two Texas communities that were considered, Midland and Odessa, have much higher average property taxes than North Dakota communities, ranging from \$4,500 to \$5,300 per year.

AFFORDABILITY AND SAFETY

The hub cities, as well as the towns that surround them, saw populations balloon, stretching city services, infrastructure, and available housing. The cost of living soared due to the scarcity of housing and higher taxes to cover mounting city and county infrastructure and personnel expenses.

However, things have improved in recent years. Developers rushed to build apartment

buildings and homes to house the new residents. Apartments are now plentiful and affordable, and there are more single-family homes on the market or under construction. In Minot alone, 2,380 new homes were built between 2007 and 2017.

Leaders of hub cities are well aware of their residents’ cost-of-living concerns and are working to find solutions.

“The City of Dickinson has been recognized nationally on several occasions for our outstanding quality of life. But this recognition doesn’t mean the city isn’t actively trying to solve problems, take advantage of opportunities, and make things better for current and future residents,” says City Administrator Shawn Kessel. “Our cost of living has come down in recent years as it relates to housing but remains high compared to other communities experiencing a significant economic impact from oil activities.”

Kessel says finding the right mix of housing options for residents isn’t easy because demographics of the community are changing rapidly.

"We have become a very young community, with an average age of 33, and compared to most other cities in the region, we're becoming much more ethnically diverse," he says. "These trends are welcomed but responding to them takes time. We have an excellent base of infrastructure now, with capacity in some areas but not all. Much more work needs to be done to continue to be considered a city with an excellent quality of life."


Safety is an important quality-of-life consideration. Over the past decade, construction projects widened roads and replaced pavement worn out by heavy truck traffic. Statistics gathered in the 4-County Study found that Dunn, McKenzie, Mountrail, and Williams Counties collectively invested \$987 million in new and improved roads since 2010. The transportation investments helped heavy-truck traffic move more efficiently, and improved safety for the oil and agricultural industries, as well as the general public. Three of the four counties also built or expanded courthouses and correctional facilities, which also enhanced public safety.

New or expanded medical facilities such as the new Trinity Hospital that will be built in Minot provide more space for patients. New and expanded emergency response facilities also enhanced safety in places like Williston, where new fire stations helped reduce response times for EMTs and firefighters so effectively that the city's residents now enjoy some of the lowest insurance rates in the nation. Williston's ISO rating, which is used by insurance companies to determine the risk or likelihood of fire damage in a community, recently dropped to Class 2, a level achieved by only a small percentage of U.S. cities. Watford City also recently added a ladder truck to its fleet to prepare for possible fires in the city's 70-plus multi-story buildings.

Despite these improvements, there is still work to be done when it comes to staffing rural fire departments and ambulance services. Karolin Jappe, McKenzie County emergency manager, testified before the interim Energy Development and Transmission (EDT) Committee on March 8, 2018. Jappe, who serves as a volunteer firefighter and EMS provider for the Alexander Volunteer Fire Department, told the committee that funding for staff and equipment is an ongoing need.

"The county has been put in a position of having to help fund equipment needs, buildings, or special projects with the volunteer organizations," said Jappe. "This takes funding away from other departments and services needed in the county."

The chairman of the EDT Committee, Senate Majority Leader Rich Wardner,



A community's debt, and its taxes, special assessments, and utility rates all need to be carefully considered to maintain affordability for residents, while ensuring the city remains able to adequately fund its infrastructure and services...

R-Dickinson, says quality and quantity of workforce are critical to the development and operation of the Bakken oil fields.

"Many non-oil residents will say, 'We want to fund needs not wants' in the oil counties," says Wardner. "Well, let me tell you: the needs are there, and they're created by the activity of the oil and gas industry."

ATTRACTIVE AMENITIES

Affordability and safety are key factors in attracting and retaining families, but other needs are also important. Ensuring that communities have good schools, attractive public parks, recreational opportunities, retail shopping, restaurants, and access to health care facilities is also very important to residents.

Cindy Sanford, manager of Job Service in Williston, says more workers are coming to North Dakota with plans to stay, as opposed to the transient nature of the workforce during the boom a few years ago.

"There are a lot of career jobs here, so we're seeing fewer people who just come in to make a little money and then move on," says Sanford.

Over the past decade, the state and hub cities have invested in new schools in Williston, Minot, Dickinson, and Watford City to accommodate growing enrollment numbers. Williston's newest school is scheduled to open in the fall of 2018.

Year-round recreation is also important, especially in the Bakken, where frigid winters can be viewed as a drawback to people who are considering a move to the Upper Midwest. The Williston Area Recreation Center and the Rough Rider Center in Watford City are shining examples of how a community's investment in recreational facilities pays dividends in residents' happiness.

Minot City Manager Tom Barry highlighted his city's recreation options when he

testified before the interim EDT Committee in March.

"Minot is home to Roosevelt Park Zoo, Maysa Arena, the North Dakota State Fair, the Scandinavian Heritage Park, multiple passive and active recreational facilities, golf courses, parks, and pathways," said Barry. "These facilities draw people to live, work, and play."

New or improved airports make it easier than ever for residents and business travelers to fly directly to and from the Bakken. Minot has a new airport terminal, and there are plans to improve Dickinson's main runway and to lengthen and realign the runway in Watford City. And Williston's new XWA airport is expected to open in 2019.

"XWA presents us with an opportunity to really advance our economic position in western North Dakota," says Shawn Wenko, executive director of Williston Economic Development.

"Transportation is a key component toward healthy growth and development. The addition of XWA will give the City of Williston the ability to handle additional flights and destinations."

For businesses operating in the Bakken, convention facilities and hotels are also an important consideration. The number of hotels and conference facilities in the hub cities and surrounding communities has steadily increased over the past 10 years, making it easier than ever to conduct business in the Bakken. Quality of life is something businesses that are investing in the Bakken are looking at more than ever before.

"It's all about creating a quality of life in a community that people want to relocate and live in," says Wenko. "In my dealings with businesses today, it's the quality of life aspect they are most interested in."

STAYING COMPETITIVE

Maintaining affordability and adding attractive amenities will help Bakken communities stay competitive. But they can't do it alone. The responsibility to keep the Bakken competitive with other oil plays rests with both state and local entities.

In North Dakota, the oil industry pays a five percent gross production tax (GPT) in lieu of property taxes to address industry impacts to cities and counties. The hub cities and other Bakken communities depend on revenue provided through the GPT distribution formula to support necessary infrastructure and expansions. But adequate GPT funding did not arrive immediately, so cities were forced to incur substantial debt to pay for infrastructure projects that were necessary due to the explosive population increases. And those cost impacts are expected to continue. The Hub City Study indicates that even a moderate oil price recovery will continue to place significant demands on the ability of cities to build and maintain infrastructure and deliver essential governmental services.

"The hub cities were forced into debt to accommodate the needs of the oil and gas industry," says Wardner. "They had to build water treatment plants and wastewater treatment

facilities, they had to build out main line sewer and water lines, increase city hall staff to meet the needs of the citizens, and add law enforcement officers—all of which were needed in direct relation to the increase in oil and gas production in western North Dakota."

Previous state and local investments have positioned each city for further growth. However, the rebound in oil prices and associated increase in local tax revenue are not projected to meet the hub cities' and oil-producing counties' anticipated needs. Therefore, they will remain heavily dependent on major revenue sources such as GPT to offset projected capital infrastructure and associated debt service demands.

"Without the funding the GPT provides, hub cities and other oil and gas impacted communities would need to reevaluate how critical infrastructure is built and funded," says Linda Svihovec, AE2S Nexus city/county services coordinator. "The resulting cost burden would negatively impact the overall affordability within North Dakota communities and impede the ability to compete for the workforce that's necessary to meet industry needs."

Hub cities also use property, utility, and sales tax revenue, as well as special assessments, to fund infrastructure projects and provide parks and other community facilities. While these taxes and fees are not generally included

in cost-of-living indices, they are an important aspect of overall affordability and one of the few items within the ability of state and local authorities to control.


A community's debt, and its taxes, special assessments, and utility rates all need to be carefully considered to maintain affordability for residents, while ensuring the city remains able to adequately fund its infrastructure and services, according to Gaddie.

"Cities can maintain affordability for residents, but they also need ongoing support from the state," says Gaddie. "Unique funding and financing strategies will be required to fill the projected funding gaps. Addressing these shortfalls will require a collaborative effort at the state and local level."

WE'VE ONLY JUST BEGUN

North Dakota's oil and gas industry has already invested \$127 billion in the state, but industry regulators say that is just the tip of the iceberg. Lynn Helms, director of the state's Department of Mineral Resources, predicts that over the life of the Bakken play, the total investment will approach \$600 to \$700 billion. Helms estimates producers have already invested \$100 billion into wells drilled and completed, another \$11 billion in wells drilled but not yet completed, and about \$15 billion in gas processing facilities and crude oil and natural gas pipelines.

"Funding the needs of the oil patch communities should be the number-one priority on the list of expenditures of GPT revenue," says WDEA Executive Director Geoff Simon, "The bottom line is, the oil industry is still investing in North Dakota, so we need to continue to invest in quality-of-life improvements for the people who live and work in our hub cities and oil-producing counties."

The interim EDT Committee will deliver a report to the full legislature this fall, reporting the results of its study of hub city funding and the GPT distribution formula. WDEA has played an active role in the committee's work. WDEA presentations and testimony shared with the committee can be read on the website at www.ndenergy.org/News/GPT-Study. 

The competition the Bakken faces for attracting and keeping its workforce is a hot topic among the hub cities and oil industry. It will be the focus of one of the featured panels at the 2018 Williston Basin Petroleum Conference. The panel will include a discussion of community growth, workforce, and attracting and retaining a permanent workforce, particularly Millennials and Generation Z. The conference runs May 22-24, 2018 in Bismarck.



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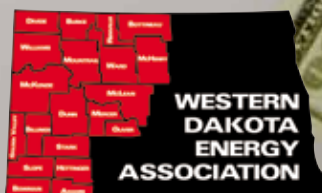
The Western Dakota Energy Association will be awarding scholarships to students in North Dakota focusing on energy-related degrees.

The scholarships are awarded based on grade point average and letters of recommendation to students attending North Dakota colleges, universities, or vocational schools who plan to work in the oil and gas industry in western North Dakota.

Students are welcome to apply for one of the scholarships, which will be awarded in September 2018.

Applications must be submitted by August 31, 2018.

For more information, go to www.ndenergy.org.



Line 'em on Up:



Flexible Water Lines Take Thousands of Frac Water Trucks Off ND Roads

By Paul Adair

Leonardo da Vinci once said that water is the driving force of all nature and, while he was not referring to oil and natural gas production in North Dakota, water has truly become the story of the Bakken in 2018. As fracking technologies and efficiencies improve, western North Dakota is seeing a tremendous increase in demand for water. Most fracs today average anywhere between 250,000 to 300,000 barrels (42 gallons per barrel) per frac per well, much higher than the 20,000 to 30,000 barrels required per frac per well in years past. Even greater, the multi-well locations are now using well over one million barrels of water when fracturing. For one site alone, these one million barrels of water used during the frac process would equate to 42 million gallons of water, which would require 840 large haul trucks to bring in loads of fresh water plus 5,880 smaller truckloads to remove the produced water, all adding up to a gross weight of 336 tons. Extrapolate that across the approximately 100 newly drilled wells each month in western

North Dakota and that could take 672,000 trucks off of the state's county roads for just those 100 new wells.

But a simple polyurethane or PVC-based flexible water line—or lay-flat hose—may be the solution to best deliver large volumes of water required to frac an oil well.

NOT NEW, BUT NEW TO THE INDUSTRY

Lay-flat hose is not a new technology—fire hoses are a type of lay-flat hose that have been used by fire departments across North Dakota for years. The mining industry has also made use of flat-line hose in the transport of water over otherwise impassable terrain, like over the sheer walls of open pits. Really, it is only the application of this technology to a water transfer service for the oil industry in the Bakken that is relatively new.

But, the versatility and quality of lay-flat hoses has seen its popularity increase over the last four years to where virtually all water sourcing companies in the Bakken are making some use of them today.

Lay-flat hose is prized in the Bakken today for its ability to traverse the rugged landscape directly from the water source to the frac site. The lay-flat hose remains flexible even under high-pressure and, as such, can be directed over obstacles that would hinder traditional pipe solutions and require additional set up. In doing so, lay-flat hose is able to provide Bakken operators a reliable and constant flow of water to frac sites, where high water volumes are needed.

EFFICIENT AND RESILIENT

In addition, using lay-flat hose has helped fracs become more efficient and productive overall. The average frac time when using lay-flat hose to transport one million barrels of water is only two to four weeks compared to when traditional water transfer methods, such as trucks, are used.

“Think of it in the context of the water needs in your own yard,” says Jeff Kostecky, vice-president of Water Transfer at Belfield-based MBI Energy Services. MBI is a leading provider of temporary above-ground water pipeline transfer options in North Dakota.



“We all understand the benefit of hooking up a water hose to the spigot (your water source) in order to water your lawn or garden, rather than filling and carrying buckets of water one at a time to do the exact same job.”

Lay-flat hose is deployed to the site in large spools that carry 660 feet (one-eighth of a mile) of 10-inch hose, each of which can contain approximately 63 barrels of water. High-volume pumps are then used to move the water from the source to frac locations at a rate of up to 90 barrels per minute. These flexible water lines are also extremely resilient and, once flattened, are perfect for transport and out-of-the-way storage until the next time they are required.

There are only minor challenges to overcome when using these flexible water lines in North Dakota, primarily related to the climate.

The long, cold winter months in the Peace Garden State can create problems. But, so far, the flexible water lines have helped surprisingly well. There can also be issues finding high volumes of water for sourcing in the vicinity of the fracturing location. Because lay-flat hose used in this way is still fairly new to the Bakken, it can sometimes be challenging for water transfer companies to find workers in the area who are experienced with the product and with managing the lines in rough terrain.

MOVING MILLIONS OF BARRELS OF WATER

Ultimately, lay-flat hose is a viable, cost-effective method of transferring water to the frac site that helps take water trucks off of North Dakota roads and reduces the impact of industry traffic on municipal roadways. It is an effective and efficient option for operators in parts of the Bakken where it is the best, and often only, choice.

“MBI has transferred millions of barrels of water using lay-flat hose,” says Kostecky. “Our longest transfer to date is a distance of 28 miles, and we can lay out approximately three or four miles of hose in a day. The potential for use of these flexible water lines in the Bakken is endless due to the current availability and flexibility of lay-flat hose.”



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When Disaster Strikes: Putting Protection Plans in Place

The Minot Water Treatment Plant floodwall project was completed in 2017. As a regional water treatment facility, the project was funded through FEMA Hazard Mitigation Grant Program dollars, the City of Minot, and the State of North Dakota. Photo Credit: Souris River Joint Board.



By Jason Spiess

In June 2011, the Mouse River rushed through the town of Minot at record levels, causing catastrophic damage to the town and its culture. Minot City Alderman Shaun Sipma recalls how that event impacted his personal and professional life.

"I was a television news anchor at that time and my home was one of the ones destroyed in the flood," says Sipma. "So, this is a process I have followed from not only the build-up of the flood but with every step of the process after."

During the flood, water velocity levels under Minot's Broadway Bridge were recorded at 27,400 cubic feet per second—that's five times the rate existing channels and levees were designed for. In the end, over 4,000 structures were damaged, destroyed, or lost.

Not to mention that water levels were too high for passenger and emergency vehicles to cross most bridges.

A CITY DIVIDED

"If you look at Minot, we are a city that is built on South Hill, in the Valley, and North Hill. And in 2011, we were a city divided because the river cuts right through the heart of the city," says Sipma. "That also separated our emergency services."

The record-breaking flow overwhelmed most of the flood-fighting efforts along the Mouse River, causing extensive damages to homes, businesses, public facilities, infrastructure, farms, and ranches. Residential, commercial, and public structures sustained damages over \$690 million, while the destruction to infrastructure totaled hundreds of millions, just to the city of Minot alone.

Now, take those cold, hard numbers and multiply it by all the locally-grown emotion and shattered culture from a

The Phase MI-1 4th Avenue project, which will include approximately 2,500 feet of floodwalls and earthen levees, a closure structure, and a large pump station.



The MI-2A Perkett Ditch project was completed in 2017 to address interior drainage issues that would arise with the construction of the flood risk reduction project. This created a ponding system to capture storm water and also provided a new community amenity in the area.



natural disaster and then multiply that by everything an unexpected oil boom brings.

"Couple everything together with the fact there was essentially no housing available. There was nothing on the market that you could buy or rent anywhere, so it was kind of a double-edged sword," says Dan Jonasson, Public Works Director in Minot.

A double-edged sword amplified, or accelerated, by \$100 per barrel of oil. Metaphors aside, the sheer fact you had a natural disaster layered into a natural resource opportunity may be as close to a literal "perfect storm" as you can get for a city.

"So, we were not only trying to recover from the flood, but we were also trying to build infrastructure to meet the demands of displaced residents and the impact from the oil," says Jonasson.

He continued citing examples across the board. From the rapid expansion, to flood-ridden remodeling, to ag and energy start-up companies, the Minot area was being stretched, pulled, and ripped apart at the seams.

"Over the course of three years, we saw Minot add about 8,000 people," says Jonasson.

Minot added these near-10,000 residents over three years, while the flood subtracted 4,000 structures in three weeks. This proved to be a serious problem that the citizens, the industry, and the government had to solve.

PUTTING A PLAN INTO ACTION

After a series of public meetings, a plan was selected and is now moving forward. The project, called the Mouse River Enhanced Flood Protection Project (MREFPP), was initiated by the Souris River Joint Board.

Although selected, the project was not a unanimous decision in the eyes of the public, especially those who were going to be impacted by its path.

"The one that was chosen was done after a series of public meetings that were filled with high emotions because it became clear that a number of homes were going to be bought out," says Sipma, adding that just the decision process in the project can be a very expensive and time-consuming event due to the emotional and extraordinary circumstances. Meetings involving sentimentality and land ownership can easily become a whole new ancillary project, but eventually these issues were resolved.

THE PRICE OF SAFETY


"The key reason is about the why. It is about safety, security, and the economics as well," says Sipma. "This is a basin-wide project that will not only impact the city of Minot, but also Velva, Burlington, Sawyer, and many of the subdivisions."

The economics of the project is a different story and emotion. So is who is going to pay for it. Right now, the cost of the MREFPP is estimated at around \$1 billion over four phases.

There is a heightened level of concern because it appears no help will be coming from the federal government. The project is set-up on a 65:35 percent split cost, with 65 coming from the state, and 35 from the city of Minot. The primary source for local funding is from a portion of the Minot city sales tax allocated to flood protection.

"The hard part about all of this is and the significant difference between the Grand Forks flood and Minot flood control projects are federal dollars. Right now, in terms of the actual flood control project, we don't have any federal dollars," says Sipma.

Jonasson, who is also a member of the Souris River Joint Board, agrees with Sipma regarding the accountability of the financing, but sees a possible silver lining with the state.

"The biggest challenge in this project is funding," says Jonasson. "Every day, we are looking for new avenues of funding—where we might find a dollar here and a dollar there to get this project built. At the rate it is going, it will take 20 to 30 years to complete, and that is just not acceptable." 

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Growing Pains:

Challenges for Emergency Service Providers in the Oil Patch

By Andrea Danelak

Dunn County emergency manager Denise Brew remembers the first time she realized volunteers faced some new challenges due to increased oil exploration in the area.

"We responded to a normal call and had shorts and sandals on. On the way home, we had an accident at an oil rig and had to climb on top of the drilling rig. When we got back, we re-wrote the protocol for attire," she recalls. "That was sort of the introduction to, 'You need to change your ways.'"

Due to dramatic population growth, emergency service providers and volunteers in North Dakota have seen their fair share of change—and associated challenges—over the past few years, with call volumes continuing to skyrocket.

"Specifically, for Dunn County, it was an incredible impact," says Brew, who has been Dunn County emergency manager since 2007, volunteers with Killdeer Area Ambulance Service and Halliday Ambulance, and is squad leader of the Manning Quick Response Unit. "It went from a slow rural EMS response to, 'Holy cow, we have the oil boom' and call after call after call."

Ann Hafner, Killdeer Area Ambulance Service manager, echoes that statement. A decade ago, her team responded to 75 service calls annually. In 2017, that number jumped to 571. What used to be strictly a volunteer ambulance service now employs paid staff to help keep up with demand, and Hafner anticipates this will be their busiest year.

"There used to be so few requests that you could work at the grocery store and

take one or two calls a month," says Hafner, who is a nationally registered paramedic and has been with Killdeer Area Ambulance Service since 2012. "But in February of this year, we did 45 calls. This has totally changed how we do everything, from the type of truck we drive, to our training, to how we get paid."

In 2014, the Killdeer Area Ambulance Service even moved into a new building to account for the growth. "Now, we have payments on the building, electricity, water, insurance, upkeep—expenses we didn't have five years ago," says Hafner, who is also on the roster of the Dickinson Area Ambulance Service, First Medic Ambulance Service, and Mercer County Ambulance Service.

Staffing issues remain at the forefront of the challenges. Recruitment has been an



ongoing concern for some areas, and a nationwide shortage of paramedics isn't helping.

"We just can't attract any of the new graduates," says Hafner. "Because they can go anywhere and there are so few of them, we have to pay a lot. Our budget has increased 10 times from what it was 10 years ago."

West Dunn fire chief Ryan Hauck counts himself fortunate to have a core group of volunteers, but they feel "slightly burned out" with the increased activity.

"Finding the time is always a challenge for the volunteers. They can't always leave their job or family," he says. "I just want to make sure everyone goes home safe, no matter what the call."

INDUSTRY-RELATED INCIDENT TRAINING

Counties have been compelled to bring in providers from other areas of the country to take calls, which poses its own challenges when they aren't familiar with the oilfields or the Bakken. "There are a lot of people who don't live here, which is wonderful; it's a support. But they have to go through another round of training," says Brew.

Indeed, the oilfields have introduced different types of incidents than what providers typically see. As a result, the need for training and equipment to respond to industry-specific traumas, like exposure to gases or chemical injuries, is significant.

"You can't train enough," says Brew. "We need more enhanced training in response to situations like gases. We need more knowledge of what we're heading into and how to be careful. We need the support to provide that training. We need to make sure providers have every tool and everything they need to respond."

Oil companies have played a role in assisting with training and planning, which has been useful in helping providers find the locations of incidents and ensuring they are equipped with the appropriate gear.

"With a plan, we have an idea of what the building looks like or the terminology involved. We understand where to go," says Hauck, who was elected chief of the West Dunn Fire Protection District in 2016. Hauck previously acted as assistant fire chief and continues to volunteer for the Killdeer Area Ambulance Service and the Dunn Center Quick Response Unit.

At least a third of his team's annual calls are related to the oilfield, says Hauck.

STRAIN ON ROADS, BUDGETS

Another challenge stemming from the population surge is that increased traffic created a strain on local roads, leading to more traffic accidents in the area.



The Killdeer Area Ambulance at the scene of an oil site emergency. Photo by Ann Hafner.

The Killdeer Area Ambulance answers an emergency call and joins forces with a helicopter in a field in North Dakota. Photo by Ryan Hauck.



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“With the growth of employment, the roadways weren’t prepared, and we saw a lot of auto extrication due to accidents occurring,” says Hauck, noting there have already been some changes to highway infrastructure to account for the increased traffic.

Poor road conditions have also meant additional wear-and-tear on emergency vehicles, which was already a challenge for Hafner’s team due to lengthy drives to the hospital.

“From the front door of our ambulance bay to the emergency room, on good roads and with good weather, it takes 45 minutes. There aren’t a lot of ambulance services in the state that have to go that far,” she says. “Our ambulances take a lot of abuse, so we have to replace tires a lot, and I’ve ordered two windshields in two weeks (due to rock chips).”

Efforts to build public awareness of the challenges facing providers are ongoing. Both Hafner and Brew have been involved with Oil Impacted Emergency Medical Services, a group formed in 2011 to discuss the impact of oil and gas production on the industry.

“We’re trying to get the word out to increase everyone’s knowledge that even though they put grant money into the infrastructure, we’re still impacted,” says Hafner. “We need to buy gas; we need to buy equipment. We’re now at the point that we need to be able to survive.”

“We’re trying to be a voice to share with the rest of the state that the Bakken oilfield is happening here in western North Dakota,” adds Brew, “but that someday, it will affect everyone in the state.”

Rare Opportunity

with Rare Earth Minerals

in North Dakota

By Paul Adair

Rare earth elements, or rare earths, have found widespread use because of their powerful magnetism, optical properties, luminescence, and the strength they can provide the products that are manufactured from them, including many of the electronic and energy-efficient items found in the typical American home or business.

A recent report by the U.S. Geological Survey (USGS) has revealed a high level of national dependence on foreign competitors to meet the growing demand for certain minerals, identifying 23 out of 88 minerals that are considered to be priorities for U.S. national defense and the economy because they are vital components in products ranging from batteries to military equipment. The United States was 100 percent net import reliant on 20 mineral commodities in 2016, including manganese, niobium, tantalum, and others. To put that reliance into perspective, just six decades ago, the U.S. was 100 percent import reliant for the supply of only eight nonfuel mineral commodities.

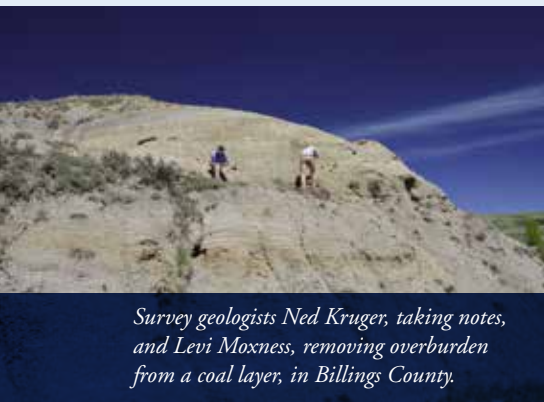
This is why the December results of a comprehensive two-year study of rare earths in lignite coal in western North Dakota by the state's Department of Mineral Resources – North Dakota Geological Survey (NDGS) is so exciting. NDGS published its 104-page

The samples the geologists are taking in the photo at the top of page 30 are from the closer of the two buttes in this image. Looking to the northwest, the prominent butte in the background is Bullion Butte.

Survey geologists Levi Moxness (foreground) and Ned Kruger sample coal for rare earth analysis in Slope County. The coals in some of these areas contain uranium, so the geologists are wearing dust masks as a precaution.



Survey geologists Ned Kruger and Levi Moxness sampling a thin coal along the east edge of a butte in Slope County. A stratigraphically higher thin coal has been uncovered for sampling in the foreground.



Survey geologists Ned Kruger, taking notes, and Levi Moxness, removing overburden from a coal layer, in Billings County.



Survey geologists Ned Kruger and Levi Moxness sampling a thick lignite bed in Slope County.

report, *Rare Earth Element Concentrations in Fort Union and Hell Creek Strata in Western North Dakota*, revealing that North Dakota's coals, or lignites, contain some of the highest concentrations of rare earths in the nation. This resource could potentially bring an end to America's reliance on foreign sources of these valuable minerals.

"We started collecting coal and organic-rich rock samples in the fall of 2015 and

collected samples throughout 2016 and into the late fall of 2017," says Survey Geologist Ned Kruger, who oversees the coal exploration and subsurface mineral programs at the NDGS and conducts investigations of the state's mineral resources.

"So far, we have collected 573 rock samples, with the vast majority being lignite samples, from 84 sites in western North Dakota. We have had 446 of those samples analyzed for their rare earth

element content, and of the first 352 samples analyzed, 19 exceeded 300 ppm, the threshold that the US Department of Energy has established, with the highest value being 603 ppm."

RARE EARTHS LEVELS IN TOP 20 ACROSS U.S.

These numbers put the North Dakota samples in the top 20 of coal samples nationwide in terms of concentrations of rare earths, with the 603-ppm sample being the fifth highest concentration ever recorded, at twice the U.S. Department of Energy's potential economic threshold. What is also promising is that the high concentrations of rare earths were scattered across the state, from northern Billings County to Bowman County, with the highest concentrations originating from Slope County.

"We are still very early in the process, but these results are very encouraging," says Ed Murphy, who has been the state geologist over the last 14 years. "Survey geologists will now focus attention on the lignite deposits that contained high concentrations of rare earth elements to determine how large the areas are where these concentrations remain high."

While rare earths can be found in rocks throughout North Dakota, uncovering them in high concentrations above 300 ppm is generally difficult, which is how they earned the name "rare" earth elements in the first place. NDGS' first study spread out throughout the Badlands of North Dakota where there was easy access to the coal seams and, on average, the sample sites were spaced five miles apart. NDGS' second study focused more on an area of Slope County where the highest concentrations were discovered, with sample sites only spaced 500 feet apart.

"We've made progress but are still focused on creating an exploration model that could be used to predict where rare earth elements are most likely to be found at higher concentrations," says Kruger. "With just 446 analyses over an area of 1,875 square miles, we still have a lot of work to do."

And while the hunt for rare earth elements is just beginning, the idea that North Dakota lignite could be a viable source of rare earth elements is encouraging. There is hope that the discovery of an economical method of extracting these rare earths from North Dakota coal could greatly benefit the existing lignite industry and potentially create an entirely new industry for the state.

"It is possible that coal mines and processing plants could be established in western North Dakota," says Kruger. "Or perhaps existing coal mines could add processing equipment to remove rare earth elements from the coals they are already mining, or it could potentially be a combination of both."

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Smooth Operator

Innovations Driving Production

By Paul Adair

Operators in North Dakota are continuously on the hunt for new and innovative methods to improve their bottom line, get the most out of the Bakken, and reduce costs while they're at it. Whether it's promoting efficiency, upgrading systems, or adopting better technologies to bring wells into production, companies are embracing change and finding production in places like never before.

For the most part, development in the Bakken is now being driven by improvements to fracture stimulation. Increased proppant volumes are demonstrating improvements in most U.S. unconventional plays and, while this is also true for the Bakken, the limited height of the Middle Bakken / Three Forks intervals makes wellbore conformance more critical. This means containing the height growth of the induced fractures and creating more complex fracture networks near the wellbore with an even distribution of stimulation along the full lateral length. Achieving this requires more perforation clusters, more frac stages, different techniques to divert frac fluids, and other techniques.

"Liberty Resources uses geologic information to better design the frac stage lengths to stimulate 'similar rock' and optimize the number of stages," says Gordon Pospisil, vice-president of business development at Liberty Resources. "This, combined with cemented liners and 'extreme limited entry' perforating has proven to consistently deliver higher rates and Estimated Ultimate Recovery (EUR). But frac technology is ever-evolving and Liberty, like most operators, is continually seeking out innovations to improve on designs."

DEDICATION TO INNOVATION

This dedication to innovation is paying dividends, as the average stimulated well in 2016 is reported to produce six times that of the same well in 2005. The significant increase in production is entirely attributable to changes in technology over the last decade, which have increased operations from single stages to 50 or more stages on average in two-mile laterals. Proppant loadings have also gone up at the same time, from less than 200 pounds per foot of lateral, to averaging 1,000 pounds per foot in 2015. This, combined with slick water, higher water volumes pumped at higher rates, cemented liners, and other techniques, have greatly expanded the

Clockwise from top left: A centralized production facility with three-phase separation of oil, water, and gas; a water and oil storage tank battery; real-time reservoir surveillance of oil, water, and gas production volumes at the well level prior to separation; and a cement-stabilized pad.



The average stimulated well in 2016 is reported to produce six times that of the same well in 2005. The significant increase in production is entirely attributable to changes in technology over the last decade...

productive area of the Bakken from the concentrated core areas to encompass the basin and vertically into the Three Forks intervals below the Middle Bakken.

Drilling in the Bakken has become far more efficient thanks to cutting-edge technologies,

including managed pressure drilling, rotary steerable tools, oil-based muds, and additives for better lubricity. These types of innovations have allowed the drilling of “three-mile” wells, with lateral completed intervals that stretch up to three miles, or three sections.

“This increases the producing interval of the well as a percentage of the total well length to make the well produce more per foot of costs,” says Pospisil, who has over 30 years’ experience in the oil industry in the Rockies, Alaska, Texas, and Alberta with Liberty Resources, Atlantic Richfield, BP, and Touche Ross & Co (now Deloitte LLP).

“The Bakken was the first basin to move to routine, two-mile laterals for better efficiencies, flexibility around surface features, and the reduction of the number of pads required. The three-mile laterals (and, in some cases, even longer) will help make additional areas of the Bakken that were once previously passed over or considered inaccessible economical.”

INTRODUCING GAME-CHANGING TECHNOLOGIES

On the production side of things, many new technologies are being introduced. Innovations such as multi-phase metering, continuous fluid rates, and pressure and temperature monitoring have all improved production rates and reduced lease operating costs. Operators today have real-time data and event monitoring to identify when a well goes offline or has reduced rates to allow for improved response times. Along with multi-well pads and centralized processing facilities, these technologies reduce surface impacts and reduce costs (Lease Operating Costs) per barrel produced.

Operators are also beginning to rely on improved artificial lift, using jet pumps to dramatically increase initial production rates when compared to pump jacks, which require two-mile rods to actuate a down-hole pump.

Looking ahead, Pospisil says Gas Enhanced Oil Recovery (EOR) is sure to become a game-changing technology for the Bakken. The process involves using the abundant supply of rich gas (produced gas with ethane and propane components along with the methane) to stimulate additional Bakken oil recovery.

“Liberty Resources is among a number of operators with Gas EOR pilots being designed,” says Pospisil. “We are working with the EERC to design a pilot to increase recovery from a fully developed Drill Spacing Unit (DSU) in Williams County. Historical EURs suggest a recovery of only about seven percent of the original oil in place, but recent studies suggest that recoveries could increase by 30 to 70 percent through rich gas injection. If this is true, it will dramatically increase rates and improve economics across the Bakken, improving the bottom line for innovative companies.”

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Vision West Awarded \$500K Bush Foundation Prize

By Andrea Danelak

Deb Nelson attributes the success of Vision West ND to several factors, but one in particular stands out.

"We started out as a grassroots effort, and we continue to work as a grassroots effort," says Nelson, the administrator of Vision West ND, a consortium that works to promote sustainability throughout western North Dakota.

The largest collaborative in the state's history, the consortium's membership includes representatives from western North Dakota counties, economic development regions, universities, and state organizations.

"We aren't a group of just commissioners or businesspeople—we are a large group of people who represent economic development, energy, and cities and counties. It's such a wide array of people who are involved and, when coming together, it brings such a big scope," says Nelson. "We've been able to educate each other in a way that we wouldn't have been able to otherwise."

Some areas of focus have been issues surrounding child care, housing, and quality of life. Nelson is especially proud of the consortium's GoLocal! ND project, which is designed to help communities learn what it means to promote localism. Having started with pilot communities, it is now ready to expand into the region.

"That's one of our proudest moments," says Nelson.

HELPING COMMUNITIES THRIVE

In late 2017, the group's efforts were recognized when Vision West ND received a 2017 Bush Prize for Community Innovation from the Bush Foundation. The prize, which, according to the Bush Foundation, is awarded to organizations with track records of making great ideas happen, marks the largest grant ever awarded to the consortium.

"This prize gives us a boost in our ability to provide education and additional resources," says Nelson. "It also gives us the ability to lead some projects for communities we couldn't have done otherwise."

One of those projects is a child care case study handbook, which provides a model for successful child care facilities for communities struggling with child care issues. Other

The Vision West ND team proudly shows off their 2017 Bush Prize for Community Innovation from the Bush Foundation. From left to right: Donna Scott, Bush Foundation Consultant; Maggie Arzendorf-Schubbe, and Deb Nelson.



initiatives will focus on mental and behavioral health awareness, and the consortium also hopes to work on some planning initiatives with the Three Affiliated Tribes (the Mandan, Hidatsa, and Arikara Nation).

"We are also looking into a workshop on unmanned aircraft systems, so we can provide information to government agencies on how they can be used for agronomy and further used in the energy industry," says Nelson. "People are asking for it and have shown a real interest."

In addition to specific projects benefiting the region, the Bush Foundation prize will help local communities with economic diversification to ensure long-term sustainability.

"We put [a portion of the prize] into our foundation right off the top, so small communities will be able to apply for community grants," she says. "We think we've set Vision West up fairly well to help these communities into the future."

HERE FOR THE LONG-TERM

Nelson looks forward to seeing Vision West ND continue to grow and achieve its goals. As the consortium operates on memberships, grants, and donations, the Bush Foundation prize will help keep it viable



The 2017 Bush Prize for Community Innovation, which is awarded to organizations with track records of making great ideas happen, marks the largest grant ever awarded to the consortium.

over the coming years, as well as offer it more credibility.

"Before, people were wondering what we were all about and whether we'd be around for the long-term," says Nelson. "When (an organization such as) the Bush Foundation recognizes the work that we have done in the past, it allows people to say, 'Oh, they have done good work.'"

"We have a real confidence this is going to help us broaden our aspects and help our communities even more than what we've done in the past," she says. "I think this prize will extend our ability to continue our work for a long, long time—and that's what we're really excited about."



Pipeline to Pump Up Production

By Paul Adair

In early January, Tulsa-based ONEOK Inc., one of the largest energy mid-stream service providers in the U.S. that connects prolific supply basins with key market centers, announced its plans to invest almost \$1.4 billion in the construction of a new pipeline and related infrastructure within the Bakken to transport natural gas liquids (NGLs) from the Rocky Mountain region to the company's existing Mid-Continent NGL facilities. The company owns and operates one of the nation's premier NGL systems and is an industry leader in the gathering, processing, storage, and transportation of natural gas.

The approximately 900-mile Elk Creek Pipeline will have the capacity to transport up to 240,000 barrels per day (bpd) of unfractionated NGLs from close to the company's Riverview terminal in eastern Montana all the way to Bushton, KS. The planned route of the new pipeline will run parallel to ONEOK's existing Bakken NGL Pipeline and the majority of the Overland Pass Pipeline, of which ONEOK owns 50 percent. In addition, the Elk Creek Pipeline will also have the capability

to be expanded to 400,000 bpd with additional pump facilities.

"The existing Bakken NGL and Overland Pass Pipelines are operating at full capacity," said Terry K. Spencer, ONEOK's president and CEO, in January. "Additional NGL takeaway capacity is critical to meeting the needs of producers who are increasing production and are required to meet natural gas capture targets in the Williston Basin."

Once complete, the Elk Creek Pipeline will strengthen ONEOK's position in the high-production areas of the Bakken, Powder River, and Denver-Julesburg regions, while also providing additional reliability and redundancy on the company's NGL system.

BUILT TO THE HIGHEST OF STANDARDS

Pipelines are the safest and most efficient method of transporting energy resources, and ONEOK already safely operates an extensive network of natural gas liquids infrastructure, from the Canadian border to the Texas Gulf Coast. ONEOK's zero-incident culture of safety will apply to the design, construction, and operation of the project.

"The Elk Creek Pipeline will meet or exceed government and industry standards, be monitored daily during construction, and will be tested prior to being placed in service," says Stephanie Higgins, a spokesperson for ONEOK. "Once operational, the project will be monitored around-the-clock using sensors and communications technology and will undergo regular inspections to check for operational integrity."

While some pipeline projects may grab headlines for all the wrong reasons, the public response toward ONEOK's plans for the Elk Creek Pipeline project has been very positive. This is due, in large part, to the sizeable amount of advance work the company put into its outreach efforts within the region to engage with affected stakeholders.

"Listening to stakeholders and obtaining input on the route is an important part of the project's development," says Higgins. "We have committed to proactive and meaningful dialogue with landowners, community leaders, and other stakeholders in order to provide accurate and timely responses to their questions or concerns."

In addition, as is true with other ONEOK pipeline projects, Elk Creek will be

Continued on page 36



AE2S Nexus:

Focus on Clients First

By Mark Halsall

AE2S Nexus is a registered municipal advisory firm headquartered in Grand Forks, ND. Since 2010, its expert team of financial professionals has been helping municipal clients navigate the complexities of state and federal funding programs, project financing, utility financial health, and asset management.

For the last few years, AE2S Nexus has been assisting the Western Dakota Energy Association (WDEA) with financial research and analysis to support funding from state-collected oil and gas tax revenues that are distributed to WDEA members.

“We look at the future needs of communities and the counties in western North Dakota,” says Shawn Gaddie, AE2S Nexus division manager. “Specifically, we’ve been helping them develop messaging materials to interim legislative committees and to the state legislature itself related to what those needs are going to be around future infrastructure spending and future operational costs.”

As a long-time associate member of the WDEA, AE2S Nexus has been helped, in turn, by its ties with the association.

“The WDEA does a great job in representing its membership and a lot of its members are clients of ours individually, and so it’s just another way to connect and stay close to the vest on what’s going on in western North Dakota,” says Gaddie. “WDEA Executive Director Geoff Simon and his team do a great job of staying involved and providing support to those communities, and we definitely benefit from that engagement.”

In addition to its Grand Forks location, AE2S Nexus has offices in Fargo, Bismarck, Dickinson, Minot, and Watford City. “We work with local political subdivisions all over the state,” Gaddie says.

The company, he adds, continues to expand its client base throughout the Upper Midwest and now has numerous offices in South Dakota, Minnesota, and Montana. A new office was also recently opened in Utah.

AE2S Nexus was formed as an off-shoot of AE2S, which stands for Advanced Engineering and Environmental Services, and it is one of several subsidiary companies. From two founding shareholders in 1991, AE2S has grown into a prosperous firm of 300-plus employees comprised of civil, environmental, structural and civil engineers, technicians, surveyors, financial analysts, computer programmers, and administrative personnel.

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AE2S Nexus headquarters in Grand Forks, ND.

Continued from page 34

a welcome contributor to the regional economy throughout the life-cycle of the project.

"We fully expect that the Elk Creek Pipeline will generate thousands of jobs throughout the execution of the project," says Higgins. "Once this project is completed, the communities along the proposed route will benefit from tax revenues that go to support things such as public services and schools."

EMPOWERING AND INVESTING IN COMMUNITIES

ONEOK strongly believes in empowering the communities in which it operates, where its employees live and work. Currently, ONEOK employs more than 2,400 people company-wide and nearly 500 in those regions are directly impacted by the Elk Creek pipeline project. In the years since 2012, the company has invested heavily in the region, with almost \$1.8 million in corporate and foundation contributions being put to work in Montana, Wyoming, Colorado, and Kansas, where the existing Bakken NGL and Overland Pass pipelines operate.

The Elk Creek Pipeline is currently in the right-of-way acquisition phase and ONEOK will soon commence with its civil, environmental, and engineering surveys. The pipeline is scheduled to be in service by the end of 2019.

The Elk Creek project is but one part of ONEOK's long-term pipeline and infrastructure planning. Only weeks after announcing the \$1.4 billion for Elk Creek, the company announced that another \$2.3 billion by 2020 would be invested on other NGL projects, including a Midcontinent-to-Gulf Coast NGL pipeline, a fractionation facility in Mont Belvieu, TX, and a natural gas processing plant in North Dakota.

Continued from page 35

"I think in the way we have diversified ourselves beyond an engineering company, we are very well-positioned into the future to operate in a space like public-private partnerships, because we have many of the arms that are required to deliver in that type of arrangement," says Gaddie.

In January, AE2S became a fully employee-owned company.

"The timing was right," says Gaddie, adding that the new ownership model not only accrues tax benefits but also helps everyone on staff to really understand and appreciate how their contributions help the company thrive.

Gaddie, who in addition to his AE2S Nexus duties also sits on the board of directors of the parent company, notes that the key to success for all AE2S firms is exceptional customer care.

"Client service is the number-one value in our company, which means making sure we are not offering square peg, round hole solutions to what the customers' needs are," says Gaddie. "There are a lot of companies similar to us out there that seem to always offer the same solution, regardless of the problem itself."

"We want to make sure that we're always addressing our clients' needs and that we're addressing them promptly and on a timeframe that they've set, with custom answers," says Gaddie. "Clients first is how I would characterize our culture and our business model."



*AE2S Nexus Division
Manager Shawn Gaddie.*

FOR MORE INFORMATION

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THE BAKKEN TOP 20

The following are the top 20 oil and gas producers in North Dakota as of April 2018. The list, which shows the cumulative amount of oil and gas that the companies have produced in North Dakota in 2018, was provided by the North Dakota Department of Mineral Resources in April 2018.

As of mid-April 2018, there are 60 active rigs drilling in the North Dakota oil patch, according to the North Dakota Oil & Gas Division of the North Dakota Department of Mineral Resources. This number is up from 56 in January, 57 in February, and 59 in March. The all-time high reached 218 on May 29, 2012.

As the West Texas Intermediate (WTI) oil price flows between \$45 and \$60 per barrel, operators have shifted from running the minimum number of rigs, with incremental increases and decreases. If the WTI price dips below \$45 per barrel for longer than 30 days, the rig count is expected to drop. The statewide rig count is down 72 percent from the high.

The number of producing wells in North Dakota, as of February 2018 is 14,327 (preliminary; the all-time high was 14,338 in December 2017). Of those wells, 12,540 (87 percent) are now unconventional Bakken – Three Forks wells and 1,787 (13 percent) produce from legacy conventional pools. Over 99 percent of drilling now targets the Bakken and Three Forks formations.

1. **Continental Resources, Inc.**
Oil production (2018): 3,961,155 bbls
Gas production (2018): 7,332,624 mcf
Tel: (405) 234-9000
Toll-Free: (800) 256-8955
Killdeer: (701) 764-6582
Rhome: (701) 279-6688
Tioga: (701) 664-3001
Web: www.contres.com
2. **Whiting Oil & Gas Corp.**
Oil production (2018): 3,074,910 bbls
Gas production (2018): 7,505,728 mcf
Tel: (303) 837-1661
Web: www.whiting.com
3. **Hess Bakken Investments II, LLC**
Oil production (2018): 2,986,909 bbls
Gas production (2018): 5,831,557 mcf
Tel: (713) 496-4000
Web: www.hess.com
4. **Statoil Oil & Gas, LP**
Oil production (2018): 2,955,637 bbls
Gas production (2018): 2,243,556 mcf
Tel: (512) 427-3300
Web: www.statoil.com
5. **Burlington Resources Oil & Gas Co., LP**
Oil production (2018): 2,463,368 bbls
Gas production (2018): 3,465,769 mcf
Tel: (432) 688-6800
Web: www.br-inc.com
6. **Marathon Oil Co.**
Oil production (2018): 2,445,169 bbls
Gas production (2018): 3,257,121 mcf
Tel: (713) 629-6600
Web: www.marathonoil.com
7. **XTO Energy Inc.**
Oil production (2018): 2,349,718 bbls
Gas production (2018): 5,555,661 mcf
Tel: (817) 870-2800
Toll-Free: (800) 299-2800
Web: www.xtoenergy.com
8. **QEP Energy Co.**
Oil production (2018): 2,227,195 bbls
Gas production (2018): 4,859,717 mcf
Tel: (303) 672-6900
Web: www.qepres.com
9. **Bruin E&P Partners, LC**
Oil production (2018): 2,011,558 bbls
Gas production (2018): 2,593,077 mcf
Tel: (713) 456-3000
Web: www.bruinep.com
10. **Oasis Petroleum North America, LLC**
Oil production (2018): 2,009,027 bbls
Gas production (2018): 5,072,567 mcf
Tel: (281) 404-9500
Web: www.oasispetroleum.com
11. **Slawson Exploration Co., Inc.**
Oil production (2018): 1,532,760 bbls
Gas production (2018): 1,572,075 mcf
Tel: (316) 263-3201
Fax: (316) 268-0702
Web: www.slawsoncompanies.com/exploration.html
12. **EOG Resources, Inc.**
Oil production (2018): 1,436,637 bbls
Gas production (2018): 2,737,190 mcf
Tel: (713) 651-7000
Toll Free: (877) 363-3647 (EOGR)
Web: www.eogresources.com
13. **Enerplus Resources USA Corp.**
Oil production (2018): 1,326,710 bbls
Gas production (2018): 1,840,891 mcf
Tel: (701) 675-2135
Web: www.enerplus.com
14. **WPX Energy Williston, LLC**
Oil production (2018): 1,228,649 bbls
Gas production (2018): 1,480,549 mcf
Tel: (701) 837-2900
Web: www.wpxenergy.com
15. **Newfield Production Co.**
Oil production (2018): 943,996 bbls
Gas production (2018): 2,028,197 mcf
Tel: (281) 210-5100
Web: www.newfld.com
16. **Petro Hunt, LLC**
Oil production (2018): 736,818 bbls
Gas production (2018): 1,214,410 mcf
Tel: (214) 880-8400
Charlson: (701) 675-2467
Web: www.petrohunt.com
17. **Zavanna, LLC**
Oil production (2018): 660,745 bbls
Gas production (2018): 1,326,748 mcf
Tel: (303) 595-8004
Web: zavanna.com
18. **Abraxas Petroleum Corporation**
Oil production (2018): 410,397 bbls
Gas production (2018): 609,606 mcf
Tel: (210) 490-4788
Web: www.abraxaspetroleum.com
19. **Lime Rock Resources**
Oil production (2018): 406,031 bbls
Gas production (2018): 336,299 mcf
Tel: (713) 292-9500
Web: www.limerockresources.com
20. **Crescent Point Energy**
Oil production (2018): 402,787 bbls
Gas production (2018): 418,768 mcf
Tel: (888) 693-0020
Web: www.crescentpointenergy.com

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