NORTH DAKOTA OIL AND GAS IMPACT STUDY 2014-2019

PHASE II UPDATE

APRIL 8, 2014

NATIONAL PERSPECTIVE
REGIONAL EXPERTISE
TRUSTED ADVISOR

The items contained in this document pertain to Phase II of the North Dakota Oil and Gas Impact Study 2014-2019.

- Phase II Scope of Work
- April 8, 2014 Presentation
- Baseline Assumptions
- Variables

PHASE II SCOPE OF WORK

Phase 2 Validation of Baseline Condition and Identify Variables

Phase 2 will be a process of taking the information compiled in Phase 1 and identifying the specific data points and considerations that will be utilized for further analysis. This information will be documented as a set of basic assumptions. Prior to moving forward with analysis, these basic assumptions will be shared and validated by our industry contacts as well as our State and local government contacts.

Phase 2 will include:

- Validation of key data points and trends relevant to the studies purpose that will be further analyzed to produce the forecast
- Identification of variable and less-variable data that will be tracked differently
- Seek industry and governmental validation
  - Compile baseline conditions and communicate with industry and government for their review and validation—modify as required
- Summarize variables and any changes to baseline condition
  - Provide a 1-2 page report of findings and report out to North Dakota Legislative Management Committee

Project Review at a Glance

- Phase II Scope
  - Prepare Baseline Assumptions
  - Validate with State and Industry
  - Finalize Baseline Assumptions
  - Identify Variables to be Tracked
  - Summarize and Present

Baseline Assumption Validation

- Methodology
  - Review data from Phase I
  - Write draft assumptions
  - Distribute draft assumptions
  - Schedule follow-up meetings
  - Assess suggested changes
  - Finalize baseline assumptions
    - Modify as necessary in Phase III & IV

Global and Local Economic Trends

- Drilling and Drilling Rigs
- Drilling and Rig Efficiency
- Total Well Counts/Extent of Development
- Well Completion
- Oil and Gas Pricing
- Bakken Crude Differential
- Natural Gas
- Global Market

Global and Local Economic Trends

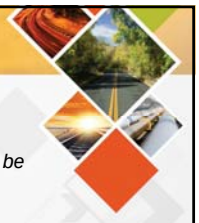
- Overarching Theme:

  The Batch Drilling and Completion process combined with North Dakota's cold winters will cause oil and gas development in the state to be cyclical from this point forward.

Infrastructure

- Surface Transportation
- Pipeline
- Rail
- Power
- Right of Way

Infrastructure



- Overarching themes:

  North Dakota's infrastructure should be built out to accommodate peak oil production of 1.2-1.5 MMBbd.

  Oil and gas is now recognized as a long-term industry in North Dakota. Greater collaboration will take place between oil and gas and other key industries in the state.

Environmental

- Water
- Spills
- Air Quality-Natural Gas
- Hydraulic Fracturing
- Endangered Species

Environmental

- Overarching themes:

  We will see heightened public awareness of environmental impacts and an increase in State environmental regulation.

Technology

- Drilling and Hydraulic Fracturing Advancements
- Monitoring and Automation Implementation
- Enhanced Oil Recovery

Technology

- Overarching themes:

  Operating costs are on the rise. Producers will look to technology and process improvements to keep production economic.

  Producers are seeing preliminary success using Methane for EOR.

Socio-Economic

- Labor
- Population
- Housing
- Quality of Life

Socio-Economic

- Overarching theme:
  Communities should anticipate cyclic population levels.

Phase III Overview

- Model and Forecast Trends, 2014-2019
- Track Variables
- Draw Correlations

Phase II Update

Questions?

BASELINE ASSUMPTIONS

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B. Assume any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method or process disclosed in the baseline assumptions.

The baseline assumptions have been validated and will be incorporated into the final North Dakota Oil and Gas Impact Study 2014-2019.

The baseline assumptions presented are subject to change before publication of the study.

BASELINE ASSUMPTIONS OVERVIEW

The following baseline assumptions were established from recent and relevant publications pertaining to study area and expert opinion of professionals within state agencies and the oil and gas industry.

Assumptions are influenced by variables such as: number of drilling rigs, producing wells in a specific region, technological advances in drilling and completion, development of oil, gas and water transportation infrastructure, environmental regulations, global markets and economics.

Baseline assumptions will feed into the forecast model, which will generate the most likely outcomes as to the future of oil and gas development in the study area for years 2014-2019.

Global and Local Economic Trends

- Drilling and Drilling Rigs
- Drilling and Rig Efficiency
- Total Well Counts/Extent of Development
- Well Completion
- Oil and Gas Pricing
- Bakken Crude Differential
- Natural Gas
- Global Market

Infrastructure

- Surface Transportation
- Pipeline
- Rail
- Power
- Right-of-Way

Environmental

- Water Resources
- Spills
- Oilfield Waste
- Air Quality-Natural Gas
- Hydraulic Fracturing
- Endangered Species

Technology

- Drilling and Hydraulic Fracturing Advancements
- Monitoring and Automation Implementation
- CO_2 Enhanced Oil Recovery in Conventional Oil Fields

Socio-economic

- Labor
- Population
- Housing
- Community Attributes

Global and Local Economic Trends

Drilling and Drilling Rigs

Description: Exploration and production efforts within the North Dakota Williston Basin study area are not geographically uniform. Drilling has trended toward fewer rig moves and increased utilization of walking drill rigs and multiple well pads. In 2012, the number of infill wells drilled exceeded the number of first wells in an exploration area drilled. Since 2012, infill drilling has more than doubled compared to first well drilling counts. Batch drilling and completions are becoming more commonplace, optimizing production. Workover rigs are needed to extend production.

Assumption: The number of wells per pad will vary from a single well in lower production areas to an average of six wells per pad and more than 12 at optimum locations. The rig count will stay the same or decrease slightly as drilling becomes more efficient. Infrastructure will be developed to accommodate 1.2-1.5 million barrels per day (MMBd). Leases in highly productive areas are secured and most companies will not exhaust drilling of their assets in the next five years. Batch drilling and well completions in combination with North Dakota weather patterns are creating inconsistent production streams and new infrastructure needs.

Drilling and Rig Efficiency

Description: Technology and process improvements are rapidly reducing drilling, well completion time and overall costs. From 2012-2014 the cost to drill and "frack" a long horizontal well was reduced from about $12 million to $8 million. In that timeframe, drilling had decreased 10 days, requiring 26 days or less to drill a new well. Oil drilling rigs in North Dakota drilled an average of more than 13 wells per rig in 2013. During the exploration phase, winter weather limitations, load limits, clearance restrictions, vehicle capacity limitations and rig-up and demobilization times significantly impacted rig efficiency. During the infill phase of development, rig efficiency is primarily affected by the pad drilling processes and technological advancements in drilling and completion.

Assumption: Technological advancements in unconventional oil and gas drilling will continue to reduce well drilling and development costs. Increased infill drilling will utilize current infrastructure and decrease surface impacts. The number of wells drilled per rig will likely increase approximately five percent each year during the study period.

Total Well Counts/Extent of Development

Description: The recoverable oil and gas in the Bakken and Three Forks Formations make it the largest continuous oil accumulation in the US and accounts for more than half of all domestic-assessed tight oil resources. The second largest continuous oil accumulation in the US is the combined resources of the Eagle Ford Shale and Austin Chalk in Texas and Louisiana. Conservative government estimates state 40,000 wells would be required to fully develop the Bakken and Three Forks Formations and could take 20 years or more to complete drilling activities.

Assumption: The Three Forks Formation has several "benches" or layers economical for development. Overall physical size and resource potential of individual benches is being refined, implying near-term difficulty in

predicting well counts for that formation. Total well counts in the North Dakota Williston Basin are projected to reach 40,000 to 120,000, based on the price of crude remaining between $70 to $100 (USD 2013) per barrel at the wellhead. Production companies will focus on increased drilling densities, exploring other benches and experimenting with drilling and completion methodologies that will result in higher production rates, increased timeline to fully develop assets and improved economics to develop a spacing unit.

Well Completion

Description: Logistical challenges, technical challenges and oil pricing have led to a delay in well completion for some wells within the study area. The completion services industry operating in North Dakota is experimenting with a variety of perforation methods, variable numbers of hydraulic fracturing stages, and a variety of proppant types and quantities in the effort to maximize the profitability of individual wells. Completion costs can vary widely depending on the methodologies and material quantities used, as well as by the impact of severe weather conditions. Producers are addressing some of the cost variables by reducing completion activities during weather conditions (winter) that result in slowed and more costly completion efforts.

Assumption: Fluctuations in weather and oil prices affect the backlog of wells awaiting completion in the study area. Well completions will be managed separately from drilling in order to meet individual producers' business capital needs. Batch completions combined with harsh winters will drive cyclic development.

Oil and Gas Pricing

Description: The price for Bakken crude at the wellhead closely follows West Texas Intermediate (WTI) and maintains 75 to 80 percent of WTI futures. The price differential between WTI and Brent remains much narrower than it has been since 2012 and will average $10. Crude price at the wellhead remains at an average price of $75 (2013 USD) per barrel, which given decreasing well costs, is sufficient to attract investment capital in more productive areas of the Bakken. Breakeven points for individual wells will vary by company and by area, with breakeven points generally estimated to be in the $30-$40 per barrel range in core areas of the play within Dunn, McKenzie, Mountrail, and Williams counties.

Assumption: Oil price will always cycle higher and lower based on supply and demand and the US's historical petroleum products consumption habits. Growing oil demand will be balanced by energy efficiency and increased supply from the Canadian Oil Sands and shale plays. The price of oil will not have a significant effect on drilling in North Dakota as long as it stays between $70 and $100 (2013 USD) per barrel at the wellhead. Oil and gas production is the only way to recover the costs of drilling and capital investments will continue to be made as long as the economics support a return on capital. If the rate of return on investment capital decreases in the Bakken, operators will pursue other oil shale plays. If the cash flow is less than the investment cost due to commodity price, too large of a differential, or declining production, capital will shift to different plays.

Bakken Crude Differential

Description: Bakken crude at the wellhead has a historical differential of 20 to 25 percent discount compared to West Texas Intermediate (WTI) prices for a barrel of oil. The differential between Bakken Crude and WTI is generally due to the additional costs incurred to deliver oil to market (refineries) which are heavily concentrated along the Gulf, east and west coasts of the US. It is also affected by the limited amount of US refining capacity configured to refine light, sweet crude. The majority of shale oil production is light and sweet, which while easier to refine than heavier grades of crude, must now compete for limited refining capacity. Most US refineries are now configured to handle less costly heavier, sour crude from domestic sources and/or imported from Canada, the Middle East, Mexico and Venezuela—leaving refineries with less capacity and financial incentive to refine higher priced domestic-sourced light, sweet crude. Heavier crude is refined into many more products, purchased at lower costs and can be expanded into additional barrels of product as carbon chains are shortened. As a result, heavier crude is more desirable for some refiners.

Assumption: Lack of infrastructure, refinery capacity and export regulations will prevent an equilibrium between Bakken crude and WTI during the study period. The Bakken to WTI differential will average a spread of $5-$10. Refining capacity for light, sweet crudes in the Gulf coast will be filled by production from the Permian Basin and Eagle Ford shale plays, which will drive Bakken crude exports east and west.

Natural Gas

Description: Natural gas pricing is largely determined by composition. Each source of natural gas has varying quantities of methane, the most abundant product today, and natural gas liquids, which has historically demanded a higher premium. Bakken-derived gas is currently more valuable than natural gas from conventional dry-gas plays due to the higher ratio of natural gas liquids such as ethane, propane, butane, isobutane and pentanes. Natural gas can help drive the vitality of the Bakken.

Assumption: Natural gas consumption will continue to increase substantially as transportation methods and electrical generation more readily utilize natural gas and as exports of liquid natural gas increase. The US will likely see natural gas (methane) prices rise as demand increases from business, residential and international sources. Liquefied Natural Gas (LNG) technologies will become economic in the Bakken and companies will use this technology to develop more options that allow greater utilization of liquid-rich natural gas. Methane utilization for enhanced oil recovery will increase.

Global Market

Description: Global consumption of liquid fuels has risen at an annual rate of approximately 1.6 MMbd over the last five years, which means a bigger than “Bakken-size” new play, or increased production of that level must be discovered worldwide each year over the last five years in order to satisfy demand. Liquid fuels demand in the US and the west as a whole has been relatively stable (even slightly diminished) over the last seven years. Liquid fuels demand growth has come principally from China and other emerging economies (mostly Asian) over the last seven years and is expected to be the driving force behind increased consumption in the immediate future. The rate of

increase in global consumption of liquid fuels is anticipated to taper to an annual increase of about one MMbd over the course of the study. Current global liquid fuels consumption equals approximately 91 MMbd. US liquid fuels consumption at the beginning of 2014 equaled approximately 18.5 MMbd. US refining capacity is less than consumption at approximately 17.75 MMbd. Increased production of light, sweet crude in the US has already significantly reduced the US's importation of foreign-sourced light, sweet crude. Production increases to meet global consumption increases have and are projected to come almost entirely from North America.

Since the 1970s, US laws state the export of domestically-produced crude oil is illegal without a license from the US Department of Commerce. In the intervening years, very few licenses have been granted and only for small amounts of allowable export. There are no restrictions on the export of refined petroleum products derived from crude oil refined in US refineries – including either domestically or internationally sourced crude oil. Although the US has exported refined petroleum products (and small amounts of crude oil) for several decades, the recent development of oil production from unconventional resources, such as the Bakken Formation, has jump-started the petroleum export business and with it the US economy. Beginning approximately in 2006, the export of refined petroleum products (and small amounts of crude) from the US has grown steadily from approximately one MMbd to over 4.4 MMbd in 2013.

Assumption: Global demand for crude oil will continue to increase at an annual rate of at least one MMbd over the study period. Production increases required to meet global consumption increases during 2014-2019 will come primarily from North America. US light, sweet crude will displace comparable imports in US refineries. US sourced light, sweet crude may be approved for export during the course of the study period; however, Bakken Crude may experience significant pricing pressure/discounting prior to that approval.

Infrastructure

Surface Transportation

Description: Due to the variety of roads and traffic flow, the State, counties and local government are looking for ways to improve durability, extend useful life and control maintenance costs. Traffic flows and vehicle type impacts road durability.

Assumption: Trucking demand per barrel of oil will continue to decrease as more gathering systems come on line. Overall trucking demand, however, is expected to remain high as increased gathering pipeline connections will be partially offset by increased production. Trucking requirements will continue to be influenced by support for continued drilling, wellfield operations, regional population growth and secondary development.

Pipeline

Description: Four types of pipelines are experiencing growth: gas gathering – Instrumental and required; oil gathering – optional, easy to reach wells are already connected, trucks can gather oil that pipelines have not reached, reduce spills, improve efficiency and reduce truck traffic; produced water gathering for treatment or disposal – optional, pipelines used to reduce spills, improve efficiency and reduce truck traffic; and fresh water

distribution for hydraulic fracturing – provide improved efficiency, accommodate centralized treatment and reduce truck traffic. Transmission pipelines are used to export oil from local tank farms to national markets. Current transmission pipeline capacity is good, at 580,000 barrels per day. The export pipelines compete heavily with rail as producers maintain market flexibility utilizing both export systems. Easement acquisition for new pipeline corridors is the largest concern. New gathering systems reaching wells is essential in order to minimize flaring and address air quality concerns, minimize spill potential and reduce truck traffic.

Assumption: Gathering pipeline infrastructure will continue to be built out over the next five years at current rates. Exporting oil out-of-state will continue to be accomplished utilizing both rail and pipeline to maintain market flexibility. The amount of oil moved through pipelines is driven by the pricing differential between WTI and Brent. Southbound pipelines will be underutilized and difficult to fill to capacity.

Rail

Description: In 2013, rail transported 72 percent of Bakken Crude to market and has the capacity to transport 965,000 barrels per day. Currently rail shipping costs $7 more per barrel than to transport the oil by pipeline, however, producers utilize both rail and pipeline to capture higher market share based on Bakken Crude fluctuating pricing differentials. North Dakota's largest economy, agriculture, has been negatively impacted due to increased shipping of oil, record crop production and harsh winter weather. Recent high-profile train wrecks carrying oil have prompted the attention of lawmakers and federal regulators.

Assumption: Rail will continue to export the majority of crude during the study period. Producers prefer to have flexibility in shipping options and will continue to utilize both rail and pipeline to maintain market flexibility. Midstream pipeline companies exporting oil out-of-state will continue to compete heavily with Class I rail for contracts. Crude by rail shipping will not impact North Dakota's agricultural industry long-term unless agriculture production remains at 2013 levels and extreme winter weather impacts overall shipping. Stricter regulations implemented during the study period requiring new crude shipping cars and improvements to rail infrastructure will increase shipping costs.

Power

Description: The most recent electrical demand forecast, completed at the end of 2012, showed an approximate 200% increase in regional electrical demand between 2012 and 2032. The increase was due to oilfield development. The most significant portion of growth was predicted to occur between 2012 and 2017. Regional electric cooperatives continue working to build the grid out to the loads. Many producers utilize temporary power sources, such as diesel and flare gas for fuel, until the grid reaches out to their sites. Lack of power supply on the Fort Berthold Reservation present significant concerns, as approximately one-third of the State's oil production comes from the reservation.

Assumption: During the study period 90 percent of electrical infrastructure will be built out and tied to the grid. Electrical demand will be supported by additional base load natural gas generation, natural gas distributed generation and completion of the Basin Electric Antelope Valley Station to the Neset 345kV transmission line. Electrical service will not restrict the growth of new facilities, however, right-of-way issues may slow development.

Power supply has the potential to become an acute problem. Distributed generation for power supply will provide a solution on the Fort Berthold Reservation.

Right-of-Way

Description: In the study area, the costs of right-of-way have become significant as land owners are fatigued from the pace and longevity of the Bakken oil play.

Assumption: All future infrastructure will be impacted by the costs of right-of-way. The pace and cost of right-of-way acquisition will slow infrastructure installation and will result in additional costs and inefficiencies.

Environmental

Water Resources

Description: Significant quantities of water are required for the well completion process. The water can come from fresh water sources or treatment and re-use of produced water. Currently fresh water options such as Lake Sakakawea are the most economic for producers.

Assumption: There is an adequate water supply for producers without affecting other North Dakota industries. Technology advances will increase water re-use for production when economic. The State will increase regulations on fresh water and production water. Operational costs of obtaining, handling, treating and disposing of water will increase.

Spills

Description: Spill prevention and mitigating impacts to the environment in addition to complying with state reporting requirements will continue throughout the study period. Saltwater spills are much more problematic than oil spills.

Assumption: As production increases the risk of spills increases. More spills will occur, some spills potentially more serious than others. North Dakota currently has 18,000 miles of pipeline, and by completion of the study North Dakota could have an additional 13,000 – 15,000 miles of pipeline (gas, oil, produced water and fresh water). Stricter regulations and fines will be implemented for saltwater and oil spills.

Oilfield waste

Description: Hazardous substances are contained in some oil and gas industry waste that is created during development. Proper handling and disposal of oilfield waste is a topic of concern in the study area. Recent violations related to improper disposal of NORM (Naturally Occurring Radioactive Materials) waste have heightened the awareness of the issues and drawn attention toward the need to more actively manage how waste is dealt with in North Dakota. The North Dakota Department of Health commissioned a study to look at the amount of NORM waste being generated from development activities, while also evaluating the state's waste disposal regulations.

Assumption: The North Dakota Department of Health will review and adjust if necessary the safe threshold for NORM waste disposal (as measured in picocuries per gram). Stricter regulations on illegal dumping will be enforced.

Air Quality-Natural Gas

Description: Natural gas is flared for one of two reasons; either a well is not tied-in to a gas gathering system, or wells are tied-in but do not have the line/processing capacity to take product away from location. On average approximately 30% of all natural gas is being flared in the Bakken. Oil and gas companies are currently responding to rules to capture gas at the wellhead immediately after well completion instead of releasing gas into the atmosphere or flaring.

Assumption: Oil and gas companies will focus on reducing flaring to limits as outlined by the North Dakota Industrial Commission Flaring Goals in 2014. Infill wells per pad may be limited to prevent exceeding natural gas emission limitations until infrastructure is in place to capture excess gas. Air emission triggers will be tripped, requiring emission reductions. The EPA will have new regulatory actions specific to methane emissions in place by the end of the study period.

Hydraulic fracturing

Description: The EPA will continue to provide oversight, guidance and, where appropriate, rulemaking to protect potential impacts on drinking water and ground water due to hydraulic fracturing. The State has not waited for EPA to establish rules but rather has taken the lead to address the concerns regarding water contamination and hydraulic fracturing.

Assumption: The State of North Dakota will continue to enforce rules pertaining to hydraulic fracturing. The EPA will not stop hydraulic fracturing, however, new regulation requirements will continue to increase the costs for hydraulic fracturing.

Endangered Species

Description: Endangered and threatened species listed within the 19 oil and gas producing counties include the following: the black-footed ferret, interior least tern, gray wolf, pallid sturgeon, whooping crane and the piping plover. Currently, four additional species are proposed for listing within the study area, while the gray wolf is proposed for de-listing. The northern long-eared bat is proposed endangered, while the rufa red knot and Dakota skipper are proposed threatened. Designated critical habitat for the piping plover, as well as proposed critical habitat for the Dakota skipper, is also located within the study area. The US Fish and Wildlife Service (USFWS) will make a determination for each of these species within one year of each proposed rule. Two candidate species, Sprague's pipit and the greater sage grouse, were reviewed by the USFWS in November 2013 and are currently precluded from listing in North Dakota. Surveys are required prior to construction to determine potential impacts to each species and its associated habitat. In the event a listed species or suitable habitat are present, actions are taken to avoid, mitigate or minimize impacts.

Assumption: The list of threatened and endangered species will increase during the study period. Based on the life cycle and habitat requirements of newly listed species, additional mitigation techniques may be required and planning timelines extended. Oil and gas companies will prioritize infill wells and focus less on exploration.

Technology

Drilling and Hydraulic fracturing Advancements

Description: Since 2008, oil and gas companies have made significant advances in penetrating multiple benches in the Three Forks Formation of the Williston Basin. Drilling rigs are faster and more mobile. Oil production has surpassed forecasts each year and the cost to drill and complete short and long horizontal wells has almost been reduced by 50 percent.

Assumption: Drilling, oil recovery, and production technology advancement will start to slow as oil and gas companies will concentrate future advancements on labor efficiency. During the study period implementation of automated system monitoring and controls will either reduce or transition a segment of the labor force. Robotic compact drilling rigs will require smaller crews, just as automated production systems will continue to reduce production personnel. Workforce will become more diversified instead of specialized.

Monitoring and automation implementation

Description: Process automation and instrumentation includes five segments: process automation, process instrumentation, process analyzer, and flow compute and leakage detection system. The process automation and instrumentation market in the oil and gas industry are driven by the need to upgrade outdated oil and gas platforms and emphasize safety and security.

Assumption: Automation will likely be geared toward improving pipeline gathering and remotely controlled/monitored transportation systems. When full gathering systems operate with automation, all industry-related traffic will see significant reductions, however, as the field matures, maintenance traffic will increase. Wear and tear on the road system will decrease when heavy truck use is reduced. Automation will create additional demands for labor skilled in Information Technology. Operators will catch small problems before they become bigger, more costly problems, and gain enhanced production efficiencies.

CO_2 Enhanced Oil Recovery in Conventional Oil Fields

Description: An increasing trend has been observed that oil and gas producers are actively seeking to develop tertiary recovery projects that are applicable in the near term for conventional reservoirs within the Williston Basin and eventually for the unconventional reservoirs (e.g. Bakken/ Three Forks). This study is limited to the conventional reservoirs.

Assumption: Large potential incremental oil recovery is used as a screen for candidate fields, which is primarily based on high values of original oil in place and a successful water flood (secondary recovery). Amortizing capital over small volumes of incremental oil is economically challenging; therefore, a strong economic drive is needed to

initiate a CO_2 EOR flood. Only two substantial sources of CO_2 were identified that had high likelihood of availability within the next five years. Without a significant and sustained CO_2 supply, CO_2 EOR development in the study area cannot move forward.

Socio-economic

Labor

Description: In the near term the majority of industry employment will be associated with industry development activities, including the following: construction of gas, oil and water gathering systems, development of processing facilities and related infrastructure and well development (e.g., drilling and hydraulic fracturing activities). Growth in employment is the driving metric in population estimates. Separate estimates are made for both employment related to development activities (temporary employment) and oil field service and maintenance activities (permanent employment). Batch drilling and completions in combination with North Dakota weather patterns are causing development to be more cyclical, creating more of a demand for labor associated with well completions in the spring, summer and fall and less demand in the winter.

Assumption: Permanent employment, defined as long-term jobs relative to oil field life, will steadily grow as the State adds more wells. Uncertainty still remains as to what percentage of long-term jobs are held by individuals not likely to become North Dakota residents. The industry will continue to show labor efficiency improvements, both in terms of increased output per labor unit and in reductions in labor requirements for some activities. The total labor required to develop and operate wells will decrease. Secondary job response has been clearly identified as lagging within western North Dakota. Despite high housing costs, wage rate inflation and labor shortages, secondary job growth is expected to expand over the next five years. Labor requirements will continue to be cyclic, requiring higher levels of temporary labor in the spring, summer and fall and lower levels during the winter months.

Population

Description: Population forecasts for the Williston Basin represent population potential. Current modeling practices include: assuming the region is willing and able to add housing equal to the projected level of demand; population potential is linked to historic occupancy rates that suggest future households in permanent housing have similar characteristics to traditional households in the region; and temporary residents are modeled to have similar household characteristics as permanent residents.

Assumption: Population will continue to be comprised on a growing number of permanent residents (i.e., analogous to census-based estimates) and a steady number of temporary or non-permanent residents. It remains necessary to generate two types of population: permanent population based on permanent employment and temporary population based on jobs related to oilfield development activities. The two estimates combine to produce a service population which includes individuals that work in North Dakota and live elsewhere.

Housing

Description: Housing demand utilizes separate estimates for permanent housing (based on permanent employment) and temporary housing (based on temporary or development employment). Housing constraints will remain in the study area. Housing stock has increased and hotel rooms are now available for short term stays. Overly inflated housing prices for both single family and multi-family units continues to affect likelihood of stabilizing the permanent workforce and overall livelihood of the study area.

Assumption: Demand for housing will continue to grow as the permanent workforce (and related secondary job response) continues to expand. Because housing demand still is greater than housing supply, the near term projections require nearly proportional changes in housing demand for proportional changes in employment.

It will be necessary to describe housing demand using separate estimates for permanent housing (based on permanent employment) and temporary housing (based on temporary or development employment).

Community Attributes

Description: For decades, most communities in the Williston Basin dealt with strategies for the provision of public goods and services in a climate of population stagnation or decline. Shale oil development has dramatically changed the economic landscape in the region, and now communities must manage unprecedented growth. Current development has focused largely on addressing infrastructure to provide basic needs, such as housing, roads, and water and sewer capacity. While communities struggle to meet those basic needs, long-term development also must incorporate the provision of public goods and services, community amenities, and other factors that address quality of life attributes in the region.

Assumption: In addition to the most basic public goods and services, community viability, livability, and other quality of life attributes are important elements of development for a regional economy undergoing tremendous growth. Residents of the Williston Basin will desire the same quality of life attributes generally found in other areas of the State and country. Recreational opportunities, access to health care and day care, quality education, arts, shopping, appropriate law enforcement and emergency services, and mitigation of noise, congestion, and crime all must be incorporated into community development. Continued development that does not incorporate quality of life amenities will contribute to workforce turnover, affect workforce recruitment, and reinforce negative images that the State is a place to work but not live.

VARIABLES

The following is a list of qualified variables tracked for different data points:

Fairly Consistent:

- US Refining Capacity
- ND county regulations
- ND state regulations
- Federal regulations
- Number of unitized fields (non Bakken)
- Number of wells operating in unitized fields (non Bakken)
- Oil production from the unitized fields (non Bakken)
- Drilling activity on the unitized fields (non Bakken)
- Estimated DGC CO2 pipeline capacity
- North Dakota gas rig counts

Variable:

- US crude oil importation
- ND Pipeline export capacity
- ND Gas processing plant numbers/capacities
- ND Crude-By-Rail (CBR) export capacity
- Bakken crude market destinations
- Oil rig counts on Federal surface ownership
- ND oil counties electric power supply
- ND Bakken/Three Forks “hotspots”
- ND Bakken/Three Forks “multi-pay regions”
- ND landowner issues

Highly Variable:

- ND oil production
- ND number of producing oil wells
- ND oil wells awaiting completion
- ND gas production
- Gas hub prices
- Williston Basin sweet crude price
- Brent crude versus West Texas Intermediate (WTI) price differential
- Williston Basin sweet crude versus WTI price differential
- Competing shale basin rig counts
- North Dakota Energy Related rig counts
- North Dakota oil rig counts
- North Dakota horizontal rig counts
- North Dakota non-Bakken/Three Forks rig counts
- ND weekly oil/gas permits
- ND weekly oil/gas well spuds
- ND ratio of leasehold/wildcat versus infill oil wells (statewide and by county and reservation)
- ND Bakken/Three Forks well costs
- Competing shale basin well costs
- ND gas flaring percentages/amounts