Community Strategies for Water Supply in the Bakken Region

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Outline

New water management challenges in the Bakken.

Water management in the Bakken.

Growth and expansion of community water systems.

Long – term development.

Water reallocation scenarios.

Conclusions and North Dakota strategies.

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New water management challenges in the Bakken.

North Dakota oil production is concentrated in the western third of the state.

Western North Dakota is semi-arid with average annual precipitation averaging between 13 and 20 inches, with approximately 75% of precipitation between April and September

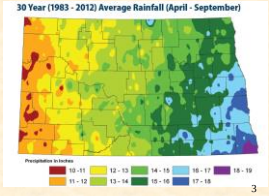

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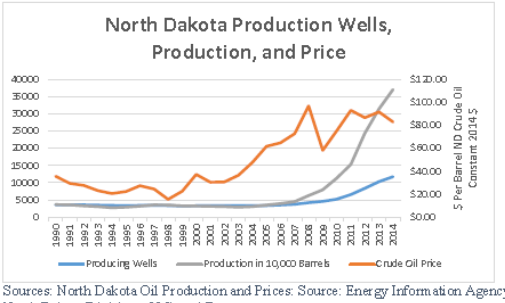
Table 1: North Dakota Counties with Oil Production (>1,000 barrels November 2014)

County	July 2013 Population	Population Change % 1/2010-7/2013	Projected 2025 Population	Land in Farms 2012	Irrigated Acres 2012	Barrels of Oil Produced 11/14
Ward	67,990	9.9	77,490	1,073,283	240	3,587
Williams	29,595	32.1	51,106	1,063,109	5,571	5,126,912
Stark	28,212	16.6	42,191	829,547	809	558,083
McLean	9,517	6.2	9,237	1,112,659	7,403	71,439
Mountrail	9,376	22.2	13,575	963,672	205	7,908,730
McKenzie	9,314	46.4	17,110	1,064,191	19,913	12,030,147
Bottineau	6,736	4.8	10,721	899,431	D*	225,364
McHenry	5,992	9.8	7,784	1,061,267	1,235	1,210
Dunn	4,162	17.7	5,433	1,031,359	379	5,593,474
Bowman	3,214	2.0	3,804	730,327	1,453	635,216
Renville	2,608	5.6	3,589	500,082	0	70,776
Divide	2,314	5.4	4,948	564,975	2,368	1,279,643
Burke	2,306	17.2	2,989	595,094	D	581,149
Golden Valley	1,823	8.5	2,354	562,453	D	74,206
Billings	874	11.6	1,315	722,275	0	411,748
Slope	761	4.7	1,095	674,345	D	35,369
Total 16 counties	184,794	15.9	254,741	13,448,069	39,576	34,607,053
North Dakota	723,857	7.6	841,820	39,262,613	218,407	35,630,535

Sources: USDA, 2012; United States Census Bureau, undated; North Dakota Department of Mineral Resources, undated; North Dakota Statewide Housing Assessment Resource Project. * "D" implies that information is withheld to protect information on individual farms.

4



Sources: North Dakota Oil Production and Prices: Source: Energy Information Agency, North Dakota Division of Mineral Resources,

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5

New water management challenges in the Bakken

Industrial Water Demand

- A well consumes
  - On average 11 acre feet (13,570 cubic meter) of water for fracking
  - Additional 0.93 acre feet as drilling fluid
  - Another 11 acre feet over the production life
- Only a small fraction of this water is recyclable under current technology
  - Most of this water is trucked to deep saltwater wells
  - The oil industry and the state vehemently deny: Fracking and wastewater disposal can have a negative impact on groundwater aquifers
  - But wastewater spills have been recorded

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New water management challenges in the Bakken.

Community and Rural Water Demand

•The region's growing hub cities
Williston, Minot, Dickinson, and Watford City

•In addition, smaller communities need improved water service

•More high-quality water for households and service industries

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Water Management in the Bakken

•Land use in western North Dakota is traditionally crop production and pasture

•Despite oil production, agriculture remains the preeminent industry in North Dakota

- There is very limited irrigation, most is from groundwater sources
- Most crops are rainfed and there are significant livestock operations.
- Eighty four percent of agricultural income in the sixteen county area comes from crop production.
- Aquifers are limited and often have poor quality water

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Water Management in the Bakken

- To meet the needs of the population and industry, limited groundwater is available
- Limited flows in the Souris/Mouse River.
- Also available is Missouri River water
- Much of the Missouri River water is impounded in Lake Sakakawea which is managed by the US Army Corps of Engineers (USACE)

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Water Management in the Bakken

- Water Allocation in North Dakota is handled by the State Water Commission (SWC),
  - Implement North Dakota water law based upon the doctrine of prior appropriation
- Due to low population density, soils that are not suitable for surface irrigation systems, and political difficulties in diverting water to the Red River basin, North Dakota has used very little Missouri River water

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Water Management in the Bakken

With oil industry development and an increase in demand for water, the SWC implemented a number of emergency measures to provide water for drilling and fracking. These include:

i) Temporary permits to utilize small surface water sources during a wet cycle
ii) Temporary sales of irrigation water of water depots serving industry needs
iii) Support for municipal water companies selling water to industry

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11

The Use of Missouri River Water in North Dakota

- Annual Missouri River flows in Williston, North Dakota, before the entrance to Lake Sakakawea
  - has varied between 9 and 26 million acre feet annually
  - with a mean annual flow of 17.6 million acre feet
- Only 570,000 acre feet are permitted for use in North Dakota
- 80% of these permitted withdrawals are for non-consumptive power generation and cooling, and returned to the river

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The Use of Missouri River Water in North Dakota

- North Dakota has consistently maintained water resource appropriate for use in the Bakken is the Missouri River and Lake Sakakawea
- Through its operation of the integrated dam and reservoir system, the USACE has become the *de facto* river master of the Missouri River
- The Pick-Sloan dams were built to provide multiple services: flood control, navigation, irrigation, municipal and industrial water use, hydroelectric generation, and recreation
- The particular priorities given to these designated uses along with the maintenance of the river's ecosystem has been subject to numerous court cases and ongoing disputes

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13

The Use of Missouri River Water in North Dakota

- As demand for water surged the USACE proposed a temporary sale of Lake Sakakawea water to supply North Dakota's oil industry
- Although the USACE does not claim the right to allocate water, it does control the reservoirs and can restrict water withdrawals for state allocated water because it controls the land immediately riparian to the reservoirs
- Since states have maintained constitutional authority to allocate water, North Dakota has perceived of this plan as a taking of its rightful water

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14

The Use of Missouri River Water in North Dakota

- With control over Lake Sakakawea and Lake Oahe, the USACE can restrict access to nearly 70% of North Dakota's portion of the Missouri River
- This USACE policy does not restrict North Dakota from appropriating Missouri River water, but it does restrict users from extracting water from the lakes
- This imposes a tax on North Dakota water users in the form of extra transportation costs

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15

Regional Water Systems

In order to address this challenge the state, with some federal support is investing in the expansion and improvement of three regional water systems which supply water to rural districts and municipalities:

i) The Western Area Water Supply Project (WAWS)
ii) The Northwest Area Water Supply Project (NAWS)
iii) The Southwest Pipeline Project (SWPP).

Improvements include:

i) New water treatment plants
ii) Pipeline upgrades and expansion
iii) Switching from groundwater to high quality Missouri River water

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16

Regional Water Systems

Funding for system upgrades includes:

i) Federal funding from the 2000 Dakota Water Resources Act
ii) ND's Resources Trust Fund from 20% of oil extraction tax
iii) Sales to the oil industry
iv) Sales to rural water districts and municipal systems

Oil industry demand for fracking and drilling water has created an opportunity to generate revenue for water systems. And the expansion of trust fund revenue has provided substantial revenue during 2010-2014.

The Dakota Water Resources Act also funds a number of tribal water systems in the region.

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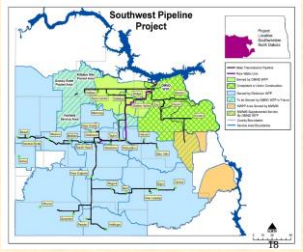
17

Regional Water Systems

The SWPP is owned by the state and managed by the Southwest Water Authority and serves more than 56,000 residents in 31 communities. The map shows gradual system expansion.

The SWPP is federally supported and can withdraw water from Lake Sakakawea. It has been selling limited quantities of water to drillers in order to support system expansion.



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18

Regional Water Systems

The NAWS project area is a ten county region north of the Missouri River. This are includes portions of the Mouse (Souris) River basin, which is part of the Hudson Bay drainage area, and thus entails an inter-basin transfer of water.

The federally funded NAWS project has been delayed by numerous lawsuits by Missouri and Manitoba against the interbasin transfer. Pipelines have been built and a recent BUREC decision will allow treated Mo River water to flow to the Minot WTP.

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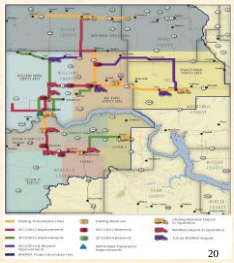
19

Regional Water Systems

The WAWS project was authorized by the Legislature in 2011 and is supported by the State with grants and loans, but will not receive federal funding. WAWS serves much of the core oil production area.

The WAWS withdraws and treats water at the Missouri River before it enters the lake. Without Federal funds the WAWS project can proceed quickly and also transfer treated water into the Mouse River basin without an EIA and court challenges.



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20

Regional Water Systems

With expected population growth, WAWS is being built for a capacity larger than the needs of the current residential population.

The WAWS funding model includes the use of the pipelines to sell water to oil drilling and production operations. Early projections estimated that the oil industry would fund 80% of project costs. Later industry sales were curtailed so that residential customers were asked to cover a greater share of costs.

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21

Regional Water Systems

All of these systems face numerous challenges, including:

i) Low population density and long distances;
   a. Distances increase due to blocked right-of-way to Lake Sakakawea
ii) Increased costs during boom construction period;
   a. Road congestion
   b. Labor costs
   c. Equipment shortages
iii) Difficulties getting right-of-way through private property;
   a. Landowner fatigue
   b. Oil pipelines pay for right-of-way
   c. Poor soil reclamation by some contractors

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22

Long-term Oil Development Perspective

- The drop in oil prices in 2015 has definitely slowed down the pace of shale oil drilling
- Dunn, Mckenzie, Mountrail, and Williams counties account for 80%-90% of the oil production and have a breakeven price of $30-$41/barrel.
- Even with the low oil prices it's still profitable to continue drilling in the four core counties.

Regions that undergo modern shale oil development are likely to experience repeated waves of mini-booms and mini-busts over the course of decades.

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Long-term Oil Development Perspective

- The slowdown caused by low oil prices should be considered to be advantageous to the development of public infrastructure, like the regional water projects.
- The slowdown should make it easier to hire contractors and to purchase needed equipment.

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24

Water Reallocation Scenarios

- Water is a scarce and valuable economic good.
- Services by surface and groundwater resources include:
  1) water supply for human consumption
  2) Irrigation
  3) Water supply for livestock
  4) Water supply for fracking and drilling activities
  5) Other industrial water uses including evaporative cooling
  6) Hydropower production
  7) Recreation
  8) Instream ecosystem maintenance.
- Rapid shift in demand has resulted in several emergency measures: temporary sale of irrigation water to oil industry and temporary permits to tap scarce groundwater sources.

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Water Reallocation Scenarios

- Assessing the benefits of reallocating water across uses requires an assessment of physical and legal feasibility as well and economic net benefits.
- Water is both physically and legally available in western North Dakota for use in oil drilling, livestock, and household needs.

The alternative use of this water is in maintaining minimal barge navigation along the lower Missouri River. The opportunity cost of the small volumes of water used in North Dakota are negligible.

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26

Conclusions and North Dakota Strategies

- North Dakota has a considerable financial incentive to facilitate the oil boom and the expansion of the western North Dakota economy
- The expansion of water supply systems for industrial, ranch, and household uses is necessary to support oil development and to ensure the sustainable growth in the region's economy
- The creation of the Resources Trust fund in the 1990s supports water supply needs
- Sales to the water industry should be considered a fortunate opportunity to support capital costs

The use of Missouri River water for oil development is highly beneficial compared to alternative uses

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27

Conclusions and North Dakota Strategies

- North Dakota needs to bring secure water supplies to remote areas of the Mouse River basin and North Dakota is experienced with the delays imposed upon the NAWS project
- Efforts should be made to minimize any risk of invasive species transfer
- Recommendations presented in the 2015 NAWS Environmental Impact Statement to treat water prior to an interbasin transfer should be considered to be a benchmark for further water transfers

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28

Conclusions and North Dakota Strategies

- Rural communities and households have relied upon groundwater for decades, the growing rural systems has increased opportunity to improve the quality of their water and their standard of living
- The WAWS project is currently being constructed to exceed current residential capacity
- Water that is surplus to residential needs is being sold to drilling operations
- This excess capacity should eventually make it feasible to diversify the regional economy with water intensive businesses such as food processing and bottling plants

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29

¿Do You Have Questions?
Comments?
Doubts?
Concerns?

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30

¿Do You Have More Questions?
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31