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Input-Form Data for the U.S. Geological Survey Assessment of the Devonian and Mississippian Bakken and Devonian Three Forks Formations of the U.S. Williston Basin Province, 2013

By U.S. Geological Survey Bakken-Three Forks Assessment Team

Open-File Report 2013–1094

U.S. Department of the Interior
U.S. Geological Survey

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By U.S. Geological Survey Bakken-Three Forks Assessment Team:

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Introduction

In 2013, the U.S. Geological Survey (USGS) assessed the technically recoverable oil and gas resources of the Bakken and Three Forks Formations of the U.S. portion of the Williston Basin (Gaswirth and others, 2013). The Bakken and Three Forks Formations were assessed as continuous and hypothetical conventional oil accumulations using a methodology similar to that used in the assessment of other continuous- and conventional-type assessment units (AUs) throughout the United States. The purpose of this report is to provide supplemental documentation and information used in the Bakken-Three Forks assessment.

Assessment Methodology

The 2000 Energy Policy and Conservation Act legislation requires the USGS to assess the undiscovered, technically recoverable oil and gas resources of priority geologic provinces of the United States using an unbiased and scientific-based assessment methodology. The USGS developed two peer-reviewed methodologies, one for conventional resources and one for continuous resources. Since 2000, these methodologies have been used in the assessments of provinces throughout the United States. The methodology for the assessment of conventional and continuous resources is summarized in several documents (Klett and Charpentier, 2003; Crovelli, 2005; Klett and Schmoker, 2005; Klett and others, 2005; Schmoker, 2005; Schmoker and Klett, 2005; Charpentier and Cook, 2012).

The assessment team developed a geologic framework for the priority basins and assessment areas. They also completed statistically based summary data forms that include descriptive information for each geologic assessment unit. The data were subsequently used in the assessment calculations.

Summary Data-Input Forms for Assessment

The data-input forms for the six Bakken Formation AUs (five continuous, one conventional) are provided in tables 1 and 3–7. The input forms for the two Three Forks AUs (one continuous, one conventional) are provided in tables 8 and 2.

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Table 1. Input parameters for the Middle Bakken Conventional Assessment Unit (50310101), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; mmboe, million barrels of oil equivalent; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit]

SEVENTH APPROXIMATION
DATA FORM FOR CONVENTIONAL ASSESSMENT UNITS (Version 6, 9 April 2003)

IDENTIFICATION INFORMATION

Assessment Geologist:	S. Gaswirth	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Middle Bakken Conventional	Number:	50310101
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008), Saskatchewan Bakken pool sizes used as analog		

CHARACTERISTICS OF ASSESSMENT UNIT

Oil (<20,000 cfg/bo overall) **or** Gas (≥20,000 cfg/bo overall): Oil

What is the minimum accumulation size? 0.5 mmboe grown
(the smallest accumulation that has potential to be added to reserves)

No. of discovered accumulations exceeding minimum size: Oil: 0 Gas: 0
Established (>13 accums.) _____ Frontier (1-13 accums.) _____ Hypothetical (no accum:) X

Median size (grown) of discovered oil accumulations (mmbo):
1st 3rd _____ 2nd 3rd _____ 3rd 3rd _____
Median size (grown) of discovered gas accumulations (bcfg):
1st 3rd _____ 2nd 3rd _____ 3rd 3rd _____

Assessment-Unit Probabilities:

Attribute	Probability of occurrence (0-1.0)
1. **CHARGE:** Adequate petroleum charge for an undiscovered accum. ≥ minimum size:	1.0
2. **ROCKS:** Adequate reservoirs, traps, and seals for an undiscovered accum. ≥ minimum size:	1.0
3. **TIMING OF GEOLOGIC EVENTS:** Favorable timing for an undiscoverd accum. ≥ minimum size:	1.0

Assessment-Unit GEOLOGIC Probability (Product of 1, 2, and 3): 1.0

UNDISCOVERED ACCUMULATIONS

No. of Undiscovered Accumulations: How many undiscovered accums. exist that are ≥ min. size?:
(uncertainty of fixed but unknown values)

Oil Accumulations:	minimum (>0)	1	mode	2	maximum	10
Gas Accumulations:	minimum (>0)	0	mode	0	maximum	0

Sizes of Undiscovered Accumulations: What are the sizes (**grown**) of the above accums?:
(variations in the sizes of undiscovered accumulations)

Oil in Oil Accumulations (mmbo):	minimum	0.5	median	0.8	maximum	10
Gas in Gas Accumulations (bcfg):	minimum		median		maximum	

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

AVERAGE RATIOS FOR UNDISCOVERED ACCUMS., TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Accumulations:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	200	400	600
NGL/gas ratio (bngl/mmcfg)	35	85	115

Gas Accumulations:	minimum	mode	maximum
Liquids/gas ratio (bliq/mmcfg)			
Oil/gas ratio (bo/mmcfg)			

SELECTED ANCILLARY DATA FOR UNDISCOVERED ACCUMULATIONS

(variations in the properties of undiscovered accumulations)

Oil Accumulations:	minimum	mode	maximum
API gravity (degrees)	25	40	50
Sulfur content of oil (%)	0.01	0.1	1
Depth (m) of water (if applicable)			

	minimum	F75	mode	F25	maximum
Drilling Depth (m)	750		2000		2750

Gas Accumulations:	minimum	mode	maximum
Inert gas content (%)			
CO_2 content (%)			
Hydrogen-sulfide content (%)			
Depth (m) of water (if applicable)			

	minimum	F75	mode	F25	maximum
Drilling Depth (m)					

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES
Surface Allocations (uncertainty of a fixed value)

1. Montana represents 15.76 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		15.00	
Gas in Gas Accumulations: Volume % in entity			

2. North Dakota represents 84.24 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		85.00	
Gas in Gas Accumulations: Volume % in entity			

3. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

4. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

5. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

6. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO LAND ENTITIES
Surface Allocations (uncertainty of a fixed value)

1. Federal Lands		represents	8.55	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			9.00		
Gas in Gas Accumulations:					
Volume % in entity					
2. Private Lands		represents	83.42	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			83.00		
Gas in Gas Accumulations:					
Volume % in entity					
3. Tribal Lands		represents	3.82	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			3.00		
Gas in Gas Accumulations:					
Volume % in entity					
4. Other Lands		represents	0.63	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			1.00		
Gas in Gas Accumulations:					
Volume % in entity					
5. MT State Lands		represents	1.83	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			2.00		
Gas in Gas Accumulations:					
Volume % in entity					
6. ND State Lands		represents	1.75	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			2.00		
Gas in Gas Accumulations:					
Volume % in entity					

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) represents 4.88 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		5.00	
Gas in Gas Accumulations: Volume % in entity			

2. BLM Wilderness Areas (BLMW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

3. BLM Roadless Areas (BLMR) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

4. National Park Service (NPS) represents 0.02 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		0.00	
Gas in Gas Accumulations: Volume % in entity			

5. NPS Wilderness Areas (NPSW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

6. NPS Protected Withdrawals (NPSP) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

7. US Forest Service (FS) represents 0.01 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		0.00	
Gas in Gas Accumulations: Volume % in entity			

8. USFS Wilderness Areas (FSW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

9. USFS Roadless Areas (FSR) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

10. USFS Protected Withdrawals (FSP) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

11. US Fish and Wildlife Service (FWS) represents 1.88 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		2.00	
Gas in Gas Accumulations: Volume % in entity			

12. USFWS Wilderness Areas (FWSW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

13. USFWS Protected Withdrawals (FWSP) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

14. Wilderness Study Areas (WS) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

15. Department of Energy (DOE) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

16. Department of Defense (DOD) represents 0.00 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		0.00	
Gas in Gas Accumulations: Volume % in entity			

17. Bureau of Reclamation (BOR) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

18. Tennessee Valley Authority (TVA) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

19. Other Federal represents 1.76 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations:			
Volume % in entity		2.00	
Gas in Gas Accumulations:			
Volume % in entity			

20. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations:			
Volume % in entity			
Gas in Gas Accumulations:			
Volume % in entity			

Assessment Unit (name, no.)
Middle Bakken Conventional, 50310101

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS

Surface Allocations (uncertainty of a fixed value)

1. Northeastern Glaciated Plains (NEGP) represents 52.98 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		53.00	
Gas in Gas Accumulations: Volume % in entity			

2. Northern Glaciated Plains (NGPL) represents 22.92 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		23.00	
Gas in Gas Accumulations: Volume % in entity			

3. Northwestern Glaciated Plains (NWGL) represents 15.75 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		16.00	
Gas in Gas Accumulations: Volume % in entity			

4. Northwestern Great Plains (NWGP) represents 8.35 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		8.00	
Gas in Gas Accumulations: Volume % in entity			

5. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

6. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Table 2. Input parameters for the Three Forks Conventional Assessment Unit (50310103), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; mmboe, million barrels of oil equivalent; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit]

SEVENTH APPROXIMATION
DATA FORM FOR CONVENTIONAL ASSESSMENT UNITS (Version 6, 9 April 2003)

IDENTIFICATION INFORMATION

Assessment Geologist:	K. Marra	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Three Forks Conventional	Number:	50310103
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008), Saskatchewan Bakken pool sizes used as analog		

CHARACTERISTICS OF ASSESSMENT UNIT

Oil (<20,000 cfg/bo overall) **or** Gas (≥20,000 cfg/bo overall): Oil

What is the minimum accumulation size? 0.5 mmboe grown
(the smallest accumulation that has potential to be added to reserves)

No. of discovered accumulations exceeding minimum size: Oil: 0 Gas: 0
Established (>13 accums.) _____ Frontier (1-13 accums.) _____ Hypothetical (no accums:) X

Median size (grown) of discovered oil accumulations (mmbo):
1st 3rd _____ 2nd 3rd _____ 3rd 3rd _____
Median size (grown) of discovered gas accumulations (bcfg):
1st 3rd _____ 2nd 3rd _____ 3rd 3rd _____

Assessment-Unit Probabilities:

Attribute	Probability of occurrence (0-1.0)
1. **CHARGE:** Adequate petroleum charge for an undiscovered accum. ≥ minimum size:	0.7
2. **ROCKS:** Adequate reservoirs, traps, and seals for an undiscovered accum. ≥ minimum size:	1.0
3. **TIMING OF GEOLOGIC EVENTS:** Favorable timing for an undiscovered accum. ≥minumum size:	1.0

Assessment-Unit GEOLOGIC Probability (Product of 1, 2, and 3): 0.7

UNDISCOVERED ACCUMULATIONS

No. of Undiscovered Accumulations: How many undiscovered accums. exist that are ≥ min. size?:
(uncertainty of fixed but unknown values)

Oil Accumulations:	minimum (>0)	1	mode	2	maximum	10
Gas Accumulations:	minimum (>0)	0	mode	0	maximum	0

Sizes of Undiscovered Accumulations: What are the sizes (**grown**) of the above accums?:
(variations in the sizes of undiscovered accumulations)

Oil in Oil Accumulations (mmbo):	minimum	0.5	median	0.8	maximum	5
Gas in Gas Accumulations (bcfg):	minimum		median		maximum	

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

AVERAGE RATIOS FOR UNDISCOVERED ACCUMS., TO ASSESS COPRODUCTS

(uncertainty of fixed but unknown values)

Oil Accumulations:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	200	400	600
NGL/gas ratio (bngl/mmcfg)	35	85	115

Gas Accumulations:	minimum	mode	maximum
Liquids/gas ratio (bliq/mmcfg)			
Oil/gas ratio (bo/mmcfg)			

SELECTED ANCILLARY DATA FOR UNDISCOVERED ACCUMULATIONS

(variations in the properties of undiscovered accumulations)

Oil Accumulations:	minimum	mode	maximum
API gravity (degrees)	25	40	50
Sulfur content of oil (%)	0.01	0.1	1
Depth (m) of water (if applicable)			

	minimum	F75	mode	F25	maximum
Drilling Depth (m)	1250		2200		3100

Gas Accumulations:	minimum	mode	maximum
Inert gas content (%)			
CO_2 content (%)			
Hydrogen-sulfide content (%)			
Depth (m) of water (if applicable)			

	minimum	F75	mode	F25	maximum
Drilling Depth (m)					

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES
Surface Allocations (uncertainty of a fixed value)

1. Montana		represents	24.20	area % of the AU
Oil in Oil Accumulations:	minimum		mode	maximum
Volume % in entity			20.00	
Gas in Gas Accumulations:				
Volume % in entity				
2. North Dakota		represents	45.54	area % of the AU
Oil in Oil Accumulations:	minimum		mode	maximum
Volume % in entity			75.00	
Gas in Gas Accumulations:				
Volume % in entity				
3. South Dakota		represents	30.26	area % of the AU
Oil in Oil Accumulations:	minimum		mode	maximum
Volume % in entity			5.00	
Gas in Gas Accumulations:				
Volume % in entity				
4.		represents		area % of the AU
Oil in Oil Accumulations:	minimum		mode	maximum
Volume % in entity				
Gas in Gas Accumulations:				
Volume % in entity				
5.		represents		area % of the AU
Oil in Oil Accumulations:	minimum		mode	maximum
Volume % in entity				
Gas in Gas Accumulations:				
Volume % in entity				
6.		represents		area % of the AU
Oil in Oil Accumulations:	minimum		mode	maximum
Volume % in entity				
Gas in Gas Accumulations:				
Volume % in entity				

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO LAND ENTITIES
Surface Allocations (uncertainty of a fixed value)

1. Federal Lands		represents	6.02	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			6.00		
Gas in Gas Accumulations:					
Volume % in entity					
2. Private Lands		represents	82.62	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			83.00		
Gas in Gas Accumulations:					
Volume % in entity					
3. Tribal Lands		represents	5.71	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			6.00		
Gas in Gas Accumulations:					
Volume % in entity					
4. Other Lands		represents	0.68	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			1.00		
Gas in Gas Accumulations:					
Volume % in entity					
5. MT State Lands		represents	1.41	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			1.00		
Gas in Gas Accumulations:					
Volume % in entity					
6. ND State Lands		represents	2.18	area % of the AU	
Oil in Oil Accumulations:	minimum		mode		maximum
Volume % in entity			2.00		
Gas in Gas Accumulations:					
Volume % in entity					

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

7. SD State Lands represents 1.38 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		1.00	
Gas in Gas Accumulations: Volume % in entity			

8. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

9. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

10. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

11. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

12. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) represents 2.73 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		3.00	
Gas in Gas Accumulations: Volume % in entity			

2. BLM Wilderness Areas (BLMW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

3. BLM Roadless Areas (BLMR) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

4. National Park Service (NPS) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

5. NPS Wilderness Areas (NPSW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

6. NPS Protected Withdrawals (NPSP) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

7. US Forest Service (FS) represents 2.48 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		2.50	
Gas in Gas Accumulations: Volume % in entity			

8. USFS Wilderness Areas (FSW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

9. USFS Roadless Areas (FSR) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

10. USFS Protected Withdrawals (FSP) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

11. US Fish and Wildlife Service (FWS) represents 0.44 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		0.50	
Gas in Gas Accumulations: Volume % in entity			

12. USFWS Wilderness Areas (FWSW) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

13. USFWS Protected Withdrawals (FWSP) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

14. Wilderness Study Areas (WS) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

15. Department of Energy (DOE) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

16. Department of Defense (DOD) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

17. Bureau of Reclamation (BOR) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

18. Tennessee Valley Authority (TVA) represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

19. Other Federal represents 0.37 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations:			
Volume % in entity		0.00	
Gas in Gas Accumulations:			
Volume % in entity			

20. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations:			
Volume % in entity			
Gas in Gas Accumulations:			
Volume % in entity			

Assessment Unit (name, no.)
Three Forks Conventional, 50310103

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS
Surface Allocations (uncertainty of a fixed value)

1. Northeastern Glaciated Plains (NEGP) represents 9.14 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		9.00	
Gas in Gas Accumulations: Volume % in entity			

2. Northern Glaciated Plains (NGPL) represents 8.27 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		8.00	
Gas in Gas Accumulations: Volume % in entity			

3. Northwestern Glaciated Plains (NWGL) represents 5.12 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		5.00	
Gas in Gas Accumulations: Volume % in entity			

4. Northwestern Great Plains (NWGP) represents 69.35 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		70.00	
Gas in Gas Accumulations: Volume % in entity			

5. Powder River Basin (PRBA) represents 8.11 area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity		8.00	
Gas in Gas Accumulations: Volume % in entity			

6. _____ represents _____ area % of the AU

	minimum	mode	maximum
Oil in Oil Accumulations: Volume % in entity			
Gas in Gas Accumulations: Volume % in entity			

Table 3. Input parameters for the Elm Coulee-Billings Nose Continuous Oil Assessment Unit (50310161), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS
(version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist:	S. Gaswirth	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Elm Coulee-Billings Nose Continuous Oil	Number:	50310161
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008)		

CHARACTERISTICS OF ASSESSMENT UNIT

Assessment-unit type: oil (<20,000 cfg/bo) X gas (>20,000 cfg/bo) _____
heavy oil (<10 API) _____

Well type: vertical _____ horizontal X

Major reservoir type (Choose one.):

shale		low-permeability clastics	
coal		low-permeability carbonates	X
		diatomite	

Minimum EUR per well 0.002 (mmbo for oil AU; bcfg for gas AU)

Number of tested wells: 1132
Number of tested wells with EUR > minimum: 1120
Historic success ratio, tested wells (%) 99

Assessment-Unit Probability:
What is the probability that at least one well within the AU will have production capacity of at least the minimum EUR? 1.0

NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES

1. Productive area of accumulation (acres): (triangular)

calculated mean	minimum	mode	maximum
1,600,000	1,400,000	1,600,000	1,800,000

2. Uncertainty about average drainage area of wells (acres): (triangular)

calculated mean	minimum	mode	maximum
440	320	400	600

3. Percentage of total assessment-unit area that is untested (%): (triangular)

calculated mean	minimum	mode	maximum
67	51	69	80

4. Percentage of untested assessment-unit area in sweet spots (%): (triangular)

calculated mean	minimum	mode	maximum
27	24	27	30

Assessment Unit (name, no.)
Elm Coulee-Billings Nose Continuous Oil, 50310161

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL

SWEET SPOTS

5a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
99	98	99	100

5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.182	0.15	0.18	0.22

NON-SWEET SPOTS

6a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
90	85	90	95

6b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.102	0.06	0.1	0.15

UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS
(triangular)

	minimum	mode	maximum
Oil assessment unit:			
Gas/oil ratio (cfg/bo)	500	1000	1500
NGL/gas ratio (bngl/mmcfg)	35	85	115
Gas assessment unit:			
Liquids/gas ratio (bliq/mmcfg)			

Assessment Unit (name, no.)
Elm Coulee-Billings Nose Continuous Oil, 50310161

SELECTED ANCILLARY DATA FOR UNTESTED WELLS
(no specified distribution type)

Oil assessment unit:	minimum		median		maximum
API gravity of oil (degrees)	34		41		50
Sulfur content of oil (%)	0.01		0.1		1
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum
	2130		2895		3200

Gas assessment unit:	minimum		median		maximum
Inert-gas content (%)					
CO_2 content (%)					
Hydrogen sulfide content (%)					
Heating value (BTU)					
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum

Completion practices:

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.9

Assessment Unit (name, no.)
Elm Coulee-Billings Nose Continuous Oil, 50310161

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES
Surface Allocations (uncertainty of a fixed value)

1. Montana is 52.10 % of the AREA of the AU
   mean VOLUME % in entity 52.00

2. North Dakota is 47.90 % of the AREA of the AU
   mean VOLUME % in entity 48.00

3. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Elm Coulee-Billings Nose Continuous Oil, 50310161

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS

Surface Allocations (uncertainty of a fixed value)

1. Federal Lands — is 29.66 % of the AREA of the AU
   mean VOLUME % in entity 30.00

2. Private Lands — is 63.93 % of the AREA of the AU
   mean VOLUME % in entity 64.00

3. Tribal Lands — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. Other Lands — is 0.70 % of the AREA of the AU
   mean VOLUME % in entity 0.50

5. MT State Lands — is 2.75 % of the AREA of the AU
   mean VOLUME % in entity 2.50

6. ND State Lands — is 2.96 % of the AREA of the AU
   mean VOLUME % in entity 3.00

7. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ — is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Elm Coulee-Billings Nose Continuous Oil, 50310161

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) is 1.15 % of the AREA of the AU
   mean VOLUME % in entity 1.00

2. BLM Wilderness Areas (BLMW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

3. BLM Roadless Areas (BLMR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. National Park Service (NPS) is 1.66 % of the AREA of the AU
   mean VOLUME % in entity 2.00

5. NPS Wilderness Areas (NPSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. NPS Protected Withdrawals (NPSP) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. US Forest Service (FS) is 26.85 % of the AREA of the AU
   mean VOLUME % in entity 27.00

8. USFS Wilderness Areas (FSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. USFS Roadless Areas (FSR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. USFS Protected Withdrawals (FSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
(continued)

11. US Fish and Wildlife Service (FWS) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

12. USFWS Wilderness Areas (FWSW) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

13. USFWS Protected Withdrawals (FWSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

14. Wilderness Study Areas (WS) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

15. Department of Energy (DOE) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

16. Department of Defense (DOD) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

17. Bureau of Reclamation (BOR) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

18. Tennessee Valley Authority (TVA) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

19. Other Federal is 0.00 % of the AREA of the AU
    mean VOLUME % in entity 0.00

20. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Elm Coulee-Billings Nose Continuous Oil, 50310161

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS
Surface Allocations (uncertainty of a fixed value)

1. Northern Glaciated Plains (NGPL) is 29.40 % of the AREA of the AU
   mean VOLUME % in entity 29.00

2. Northwestern Glaciated Plains (NWGL) is 0.73 % of the AREA of the AU
   mean VOLUME % in entity 1.00

3. Northwestern Great Plains (NWGP) is 69.87 % of the AREA of the AU
   mean VOLUME % in entity 70.00

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Table 4. Input parameters for the Central Basin Continuous Oil Assessment Unit (50310162), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS
(version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist:	S. Gaswirth	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Central Basin Continuous Oil	Number:	50310162
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008)		

CHARACTERISTICS OF ASSESSMENT UNIT

Assessment-unit type: oil (<20,000 cfg/bo) X gas (>20,000 cfg/bo) _____
heavy oil (<10 API) _____

Well type: vertical _____ horizontal X

Major reservoir type (Choose one.):

shale		low-permeability clastics	X
coal		low-permeability carbonates	
		diatomite	

Minimum EUR per well 0.002 (mmbo for oil AU; bcfg for gas AU)

Number of tested wells: 938
Number of tested wells with EUR > minimum: 938
Historic success ratio, tested wells (%) 100

Assessment-Unit Probability:
What is the probability that at least one well within the AU will have production capacity of at least the minimum EUR? 1.0

NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES

1. Productive area of accumulation (acres): (triangular)

calculated mean	minimum	mode	maximum
3,100,000	2,800,000	3,100,000	3,400,000

2. Uncertainty about average drainage area of wells (acres): (triangular)

calculated mean	minimum	mode	maximum
440	320	400	600

3. Percentage of total assessment-unit area that is untested (%): (triangular)

calculated mean	minimum	mode	maximum
86	80	87	91

4. Percentage of untested assessment-unit area in sweet spots (%): (triangular)

calculated mean	minimum	mode	maximum
41	24	29	70

Assessment Unit (name, no.)
Central Basin Continuous Oil, 50310162

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL

SWEET SPOTS

5a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
99	98	99	100

5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.254	0.225	0.25	0.325

NON-SWEET SPOTS

6a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
88	80	90	95

6b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.154	0.075	0.15	0.25

UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS
(triangular)

Oil assessment unit:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	500	1000	1500
NGL/gas ratio (bngl/mmcfg)	35	85	115
Gas assessment unit:			
Liquids/gas ratio (bliq/mmcfg)			

Assessment Unit (name, no.)
Central Basin Continuous Oil, 50310162

SELECTED ANCILLARY DATA FOR UNTESTED WELLS
(no specified distribution type)

Oil assessment unit:	minimum		median		maximum
API gravity of oil (degrees)	34		41		50
Sulfur content of oil (%)	0.01		0.1		1
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum
	2130		2895		3200

Gas assessment unit:	minimum		median		maximum
Inert-gas content (%)					
CO_2 content (%)					
Hydrogen sulfide content (%)					
Heating value (BTU)					
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum

Completion practices:

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.996

Assessment Unit (name, no.)
Central Basin Continuous Oil, 50310162

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES

Surface Allocations (uncertainty of a fixed value)

1. Montana is 47.95 % of the AREA of the AU
   mean VOLUME % in entity 30.00

2. North Dakota is 52.05 % of the AREA of the AU
   mean VOLUME % in entity 70.00

3. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Central Basin Continuous Oil, 50310162

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS

Surface Allocations (uncertainty of a fixed value)

1. Federal Lands — is 8.87 % of the AREA of the AU
   mean VOLUME % in entity 10.00

2. Private Lands — is 63.08 % of the AREA of the AU
   mean VOLUME % in entity 70.00

3. Tribal Lands — is 23.30 % of the AREA of the AU
   mean VOLUME % in entity 15.00

4. Other Lands — is 1.47 % of the AREA of the AU
   mean VOLUME % in entity 2.00

5. MT State Lands — is 1.35 % of the AREA of the AU
   mean VOLUME % in entity 1.00

6. ND State Lands — is 1.93 % of the AREA of the AU
   mean VOLUME % in entity 2.00

7. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ — is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Central Basin Continuous Oil, 50310162

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) is 1.22 % of the AREA of the AU
   mean VOLUME % in entity 1.00

2. BLM Wilderness Areas (BLMW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

3. BLM Roadless Areas (BLMR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. National Park Service (NPS) is 0.68 % of the AREA of the AU
   mean VOLUME % in entity 1.00

5. NPS Wilderness Areas (NPSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. NPS Protected Withdrawals (NPSP) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. US Forest Service (FS) is 4.49 % of the AREA of the AU
   mean VOLUME % in entity 5.00

8. USFS Wilderness Areas (FSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. USFS Roadless Areas (FSR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. USFS Protected Withdrawals (FSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Central Basin Continuous Oil, 50310162

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
(continued)

11. US Fish and Wildlife Service (FWS) is 0.46 % of the AREA of the AU
    mean VOLUME % in entity 1.00

12. USFWS Wilderness Areas (FWSW) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

13. USFWS Protected Withdrawals (FWSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

14. Wilderness Study Areas (WS) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

15. Department of Energy (DOE) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

16. Department of Defense (DOD) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

17. Bureau of Reclamation (BOR) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

18. Tennessee Valley Authority (TVA) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

19. Other Federal is 2.02 % of the AREA of the AU
    mean VOLUME % in entity 2.00

20. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Central Basin Continuous Oil, 50310162

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS
Surface Allocations (uncertainty of a fixed value)

1. Northern Glaciated Plains (NGPL) is 77.18 % of the AREA of the AU
   mean VOLUME % in entity 77.00

2. Northwestern Glaciated Plains (NWGL) is 6.23 % of the AREA of the AU
   mean VOLUME % in entity 6.00

3. Northwestern Great Plains (NWGP) is 16.59 % of the AREA of the AU
   mean VOLUME % in entity 17.00

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Table 5. Input parameters for the Nesson-Little Knife Continuous Oil Assessment Unit (50310163), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS
(version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist:	S. Gaswirth	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Nesson-Little Knife Continuous Oil	Number:	50310163
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008)		

CHARACTERISTICS OF ASSESSMENT UNIT

Assessment-unit type: oil (<20,000 cfg/bo) X gas (>20,000 cfg/bo) ____
heavy oil (<10 API) ____

Well type: vertical ____ horizontal X

Major reservoir type (Choose one.):

shale		low-permeability clastics	X
coal		low-permeability carbonates	
		diatomite	

Minimum EUR per well 0.002 (mmbo for oil AU; bcfg for gas AU)

Number of tested wells: 1554
Number of tested wells with EUR > minimum: 1554
Historic success ratio, tested wells (%) 100

Assessment-Unit Probability:
What is the probability that at least one well within the AU will have production capacity of at least the minimum EUR? 1.0

NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES

1. Productive area of accumulation (acres): (triangular)

calculated mean	minimum	mode	maximum
2,800,000	2,600,000	2,800,000	3,000,000

2. Uncertainty about average drainage area of wells (acres): (triangular)

calculated mean	minimum	mode	maximum
440	320	400	600

3. Percentage of total assessment-unit area that is untested (%): (triangular)

calculated mean	minimum	mode	maximum
75	65	76	84

4. Percentage of untested assessment-unit area in sweet spots (%): (triangular)

calculated mean	minimum	mode	maximum
53	35	38	85

Assessment Unit (name, no.)
Nesson-Little Knife Continuous Oil, 50310163

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL

SWEET SPOTS

5a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
99	98	99	100

5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.302	0.26	0.3	0.35

NON-SWEET SPOTS

6a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
95	90	95	100

6b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.178	0.125	0.175	0.25

UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS
(triangular)

Oil assessment unit:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	500	1000	1500
NGL/gas ratio (bngl/mmcfg)	35	85	115
Gas assessment unit:			
Liquids/gas ratio (bliq/mmcfg)			

Assessment Unit (name, no.)
Nesson-Little Knife Continuous Oil, 50310163

SELECTED ANCILLARY DATA FOR UNTESTED WELLS
(no specified distribution type)

Oil assessment unit:	minimum		median		maximum
API gravity of oil (degrees)	34		41		50
Sulfur content of oil (%)	0.01		0.1		1
Depth (m) of water (if applicable)					
Drilling depth (m)	minimum	F75	median	F25	maximum
	2130		2895		3200

Gas assessment unit:	minimum		median		maximum
Inert-gas content (%)					
CO_2 content (%)					
Hydrogen sulfide content (%)					
Heating value (BTU)					
Depth (m) of water (if applicable)					
Drilling depth (m)	minimum	F75	median	F25	maximum

Completion practices:

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.95

Assessment Unit (name, no.)
Nesson-Little Knife Continuous Oil, 50310163

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES
Surface Allocations (uncertainty of a fixed value)

1. North Dakota is 100.00 % of the AREA of the AU
   mean VOLUME % in entity 100.00
2. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
3. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Nesson-Little Knife Continuous Oil, 50310163

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS

Surface Allocations (uncertainty of a fixed value)

1. Federal Lands is 6.84 % of the AREA of the AU
   mean VOLUME % in entity 7.00

2. Private Lands is 79.03 % of the AREA of the AU
   mean VOLUME % in entity 79.00

3. Tribal Lands is 9.08 % of the AREA of the AU
   mean VOLUME % in entity 9.00

4. Other Lands is 0.84 % of the AREA of the AU
   mean VOLUME % in entity 1.00

5. ND State Lands is 4.21 % of the AREA of the AU
   mean VOLUME % in entity 4.00

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Nesson-Little Knife Continuous Oil, 50310163

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) is 0.45 % of the AREA of the AU
   mean VOLUME % in entity 0.50

2. BLM Wilderness Areas (BLMW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

3. BLM Roadless Areas (BLMR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. National Park Service (NPS) is 0.08 % of the AREA of the AU
   mean VOLUME % in entity 0.00

5. NPS Wilderness Areas (NPSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. NPS Protected Withdrawals (NPSP) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. US Forest Service (FS) is 2.67 % of the AREA of the AU
   mean VOLUME % in entity 3.00

8. USFS Wilderness Areas (FSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. USFS Roadless Areas (FSR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. USFS Protected Withdrawals (FSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
(continued)

11. US Fish and Wildlife Service (FWS) is 0.38 % of the AREA of the AU
    mean VOLUME % in entity 0.50

12. USFWS Wilderness Areas (FWSW) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

13. USFWS Protected Withdrawals (FWSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

14. Wilderness Study Areas (WS) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

15. Department of Energy (DOE) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

16. Department of Defense (DOD) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

17. Bureau of Reclamation (BOR) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

18. Tennessee Valley Authority (TVA) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

19. Other Federal is 3.25 % of the AREA of the AU
    mean VOLUME % in entity 3.00

20. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Nesson-Little Knife Continuous Oil, 50310163

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS
Surface Allocations (uncertainty of a fixed value)

1. Northeastern Glaciated Plains (NEGP) is 6.57 % of the AREA of the AU
   mean VOLUME % in entity 7.00

2. Northern Glaciated Plains (NGPL) is 46.09 % of the AREA of the AU
   mean VOLUME % in entity 46.00

3. Northwestern Great Plains (NWGP) is 47.34 % of the AREA of the AU
   mean VOLUME % in entity 47.00

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Table 6. Input parameters for the Eastern Transitional Continuous Oil Assessment Unit (50310164), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS
(version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist:	S. Gaswirth	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Eastern Transitional Continuous Oil	Number:	50310164
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008)		

CHARACTERISTICS OF ASSESSMENT UNIT

Assessment-unit type: oil (<20,000 cfg/bo) X gas (>20,000 cfg/bo) _____
heavy oil (<10 API) _____

Well type: vertical _____ horizontal X

Major reservoir type (Choose one.):

shale _____ low-permeability clastics X
coal _____ low-permeability carbonates _____
diatomite _____

Minimum EUR per well 0.002 (mmbo for oil AU; bcfg for gas AU)

Number of tested wells: 919
Number of tested wells with EUR > minimum: 919
Historic success ratio, tested wells (%) 100

Assessment-Unit Probability:
What is the probability that at least one well within the AU will have production capacity of at least the minimum EUR? 1.0

NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES

1. Productive area of accumulation (acres): (triangular)

calculated mean 1,900,000 minimum 1,800,000 mode 1,900,000 maximum 2,000,000

2. Uncertainty about average drainage area of wells (acres): (triangular)

calculated mean 440 minimum 320 mode 400 maximum 600

3. Percentage of total assessment-unit area that is untested (%): (triangular)

calculated mean 81 minimum 70 mode 79 maximum 93

4. Percentage of untested assessment-unit area in sweet spots (%): (triangular)

calculated mean 15 minimum 10 mode 15 maximum 20

Assessment Unit (name, no.)
Eastern Transitional Continuous Oil, 50310164

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL

SWEET SPOTS

5a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
99	98	99	100

5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.431	0.375	0.425	0.55

NON-SWEET SPOTS

6a. Future success ratio (%): (triangular)

calculated mean	minimum	mode	maximum
95	90	95	100

6b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean	minimum	median	maximum
0.231	0.175	0.225	0.35

UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS
(triangular)

Oil assessment unit:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	250	500	750
NGL/gas ratio (bngl/mmcfg)	35	85	115
Gas assessment unit:			
Liquids/gas ratio (bliq/mmcfg)			

Assessment Unit (name, no.)
Eastern Transitional Continuous Oil, 50310164

SELECTED ANCILLARY DATA FOR UNTESTED WELLS
(no specified distribution type)

Oil assessment unit:	minimum		median		maximum
API gravity of oil (degrees)	34		41		50
Sulfur content of oil (%)	0.01		0.1		1
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum
	2130		2895		3200

Gas assessment unit:	minimum		median		maximum
Inert-gas content (%)					
CO_2 content (%)					
Hydrogen sulfide content (%)					
Heating value (BTU)					
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum

Completion practices:

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	1

Assessment Unit (name, no.)
Eastern Transitional Continuous Oil, 50310164

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES
Surface Allocations (uncertainty of a fixed value)

1. North Dakota is 100.00 % of the AREA of the AU
   mean VOLUME % in entity 100.00
2. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
3. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____
10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Eastern Transitional Continuous Oil, 50310164

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS
Surface Allocations (uncertainty of a fixed value)

1. Federal Lands is 8.71 % of the AREA of the AU
   mean VOLUME % in entity 9.00

2. Private Lands is 69.52 % of the AREA of the AU
   mean VOLUME % in entity 69.00

3. Tribal Lands is 17.74 % of the AREA of the AU
   mean VOLUME % in entity 18.00

4. Other Lands is 1.03 % of the AREA of the AU
   mean VOLUME % in entity 1.00

5. ND State Lands is 3.01 % of the AREA of the AU
   mean VOLUME % in entity 3.00

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Eastern Transitional Continuous Oil, 50310164

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) is 0.02 % of the AREA of the AU
   mean VOLUME % in entity 0.00

2. BLM Wilderness Areas (BLMW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

3. BLM Roadless Areas (BLMR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. National Park Service (NPS) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. NPS Wilderness Areas (NPSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. NPS Protected Withdrawals (NPSP) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. US Forest Service (FS) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. USFS Wilderness Areas (FSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. USFS Roadless Areas (FSR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. USFS Protected Withdrawals (FSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
(continued)

11. US Fish and Wildlife Service (FWS) is 1.85 % of the AREA of the AU
    mean VOLUME % in entity 2.00

12. USFWS Wilderness Areas (FWSW) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

13. USFWS Protected Withdrawals (FWSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

14. Wilderness Study Areas (WS) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

15. Department of Energy (DOE) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

16. Department of Defense (DOD) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

17. Bureau of Reclamation (BOR) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

18. Tennessee Valley Authority (TVA) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

19. Other Federal is 6.83 % of the AREA of the AU
    mean VOLUME % in entity 7.00

20. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Eastern Transitional Continuous Oil, 50310164

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS
Surface Allocations (uncertainty of a fixed value)

1. Northeastern Glaciated Plains (NEGP) is 34.38 % of the AREA of the AU
   mean VOLUME % in entity 34.00

2. Northern Glaciated Plains (NGPL) is 53.04 % of the AREA of the AU
   mean VOLUME % in entity 53.00

3. Northwestern Great Plains (NWGP) is 12.58 % of the AREA of the AU
   mean VOLUME % in entity 13.00

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Table 7. Input parameters for the Northwest Transitional Continuous Oil Assessment Unit (50310165), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS
(version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist:	S. Gaswirth	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Northwest Transitional Continuous Oil	Number:	50310165
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008)		

CHARACTERISTICS OF ASSESSMENT UNIT

Assessment-unit type: oil (<20,000 cfg/bo) X gas (>20,000 cfg/bo) ____
heavy oil (<10 API) ____

Well type: vertical ____ horizontal X

Major reservoir type (Choose one.):

shale		low-permeability clastics	X
coal		low-permeability carbonates	
		diatomite	

Minimum EUR per well 0.002 (mmbo for oil AU; bcfg for gas AU)

Number of tested wells: 56
Number of tested wells with EUR > minimum: 54
Historic success ratio, tested wells (%) 98

Assessment-Unit Probability:
What is the probability that at least one well within the AU will have production capacity of at least the minimum EUR? 1.0

NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES

1. Productive area of accumulation (acres): (triangular)

calculated mean	minimum	mode	maximum
1,866,667	500,000	2,000,000	3,100,000

2. Uncertainty about average drainage area of wells (acres): (triangular)

calculated mean	minimum	mode	maximum
440	320	400	600

3. Percentage of total assessment-unit area that is untested (%): (triangular)

calculated mean	minimum	mode	maximum
97	94	98.8	99.5

4. Percentage of untested assessment-unit area in sweet spots (%): (triangular)

calculated mean	minimum	mode	maximum
23	10	15	45

Assessment Unit (name, no.)
Northwest Transitional Continuous Oil, 50310165

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL

SWEET SPOTS

5a. Future success ratio (%): (triangular)

calculated mean 88 minimum 80 mode 90 maximum 95

5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean 0.154 minimum 0.075 median 0.15 maximum 0.25

NON-SWEET SPOTS

6a. Future success ratio (%): (triangular)

calculated mean 43 minimum 10 mode 40 maximum 80

6b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean 0.055 minimum 0.005 median 0.05 maximum 0.15

UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS
(triangular)

Oil assessment unit:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	350	700	1050
NGL/gas ratio (bngl/mmcfg)	35	85	115
Gas assessment unit:			
Liquids/gas ratio (bliq/mmcfg)			

Assessment Unit (name, no.)
Northwest Transitional Continuous Oil, 50310165

SELECTED ANCILLARY DATA FOR UNTESTED WELLS
(no specified distribution type)

Oil assessment unit:	minimum		median		maximum
API gravity of oil (degrees)	34		41		50
Sulfur content of oil (%)	0.01		0.1		1
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum
	2130		2895		3200

Gas assessment unit:	minimum		median		maximum
Inert-gas content (%)					
CO_2 content (%)					
Hydrogen sulfide content (%)					
Heating value (BTU)					
Depth (m) of water (if applicable)					

Drilling depth (m)	minimum	F75	median	F25	maximum

Completion practices:

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	0.88

Assessment Unit (name, no.)
Northwest Transitional Continuous Oil, 50310165

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES
Surface Allocations (uncertainty of a fixed value)

1. Montana is 82.36 % of the AREA of the AU
   mean VOLUME % in entity 80.00

2. North Dakota is 17.64 % of the AREA of the AU
   mean VOLUME % in entity 20.00

3. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Northwest Transitional Continuous Oil, 50310165

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS
Surface Allocations (uncertainty of a fixed value)

1. Federal Lands — is 1.09 % of the AREA of the AU
   mean VOLUME % in entity 1.09

2. Private Lands — is 62.12 % of the AREA of the AU
   mean VOLUME % in entity 62.00

3. Tribal Lands — is 27.38 % of the AREA of the AU
   mean VOLUME % in entity 27.91

4. Other Lands — is 0.37 % of the AREA of the AU
   mean VOLUME % in entity 1.00

5. MT State Lands — is 8.21 % of the AREA of the AU
   mean VOLUME % in entity 7.00

6. ND State Lands — is 0.83 % of the AREA of the AU
   mean VOLUME % in entity 1.00

7. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ — is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Northwest Transitional Continuous Oil, 50310165

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) is 0.12 % of the AREA of the AU
   mean VOLUME % in entity 0.12

2. BLM Wilderness Areas (BLMW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

3. BLM Roadless Areas (BLMR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. National Park Service (NPS) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. NPS Wilderness Areas (NPSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. NPS Protected Withdrawals (NPSP) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. US Forest Service (FS) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. USFS Wilderness Areas (FSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. USFS Roadless Areas (FSR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. USFS Protected Withdrawals (FSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
(continued)

11. US Fish and Wildlife Service (FWS) is 0.97 % of the AREA of the AU
    mean VOLUME % in entity 0.97

12. USFWS Wilderness Areas (FWSW) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

13. USFWS Protected Withdrawals (FWSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

14. Wilderness Study Areas (WS) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

15. Department of Energy (DOE) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

16. Department of Defense (DOD) is 0.00 % of the AREA of the AU
    mean VOLUME % in entity 0.00

17. Bureau of Reclamation (BOR) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

18. Tennessee Valley Authority (TVA) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

19. Other Federal is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

20. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Northwest Transitional Continuous Oil, 50310165

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS
Surface Allocations (uncertainty of a fixed value)

1. Northern Glaciated Plains (NGPL) is 55.85 % of the AREA of the AU
   mean VOLUME % in entity 55.85

2. Northwestern Glaciated Plains (NWGL) is 44.15 % of the AREA of the AU
   mean VOLUME % in entity 44.15

3. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Table 8. Input parameters for the Three Forks Continuous Oil Assessment Unit (50310166), Bakken Total Petroleum System, Williston Basin Province. [bcfg, billion cubic feet of gas; mmcfg, million cubic feet of gas; cfg, cubic feet of gas; mmbo, million barrels of oil; bo, barrel of oil; bliq, barrel of liquid; bngl, barrel of natural gas liquids; m, meters; AU, assessment unit; EUR, estimated ultimate recovery]

INPUT DATA FORM FOR CONTINUOUS ACCUMULATIONS
(version 1.2, July 20, 2012)

IDENTIFICATION INFORMATION

Assessment Geologist:	K. Marra	Date:	29-Jan-13
Region:	North America	Number:	5
Province:	Williston Basin	Number:	5031
Total Petroleum System:	Bakken	Number:	503101
Assessment Unit:	Three Forks Continuous Oil	Number:	50310166
Based on Data as of:	IHS Energy Group (2012), NRG Associates (2010)		
Notes from Assessor:	Ancillary data from Pollastro (2008), Bakken as analog		

CHARACTERISTICS OF ASSESSMENT UNIT

Assessment-unit type: oil (<20,000 cfg/bo) X gas (>20,000 cfg/bo) ____
heavy oil (<10 API) ____

Well type: vertical ____ horizontal X

Major reservoir type (Choose one.):

shale		low-permeability clastics	
coal		low-permeability carbonates	X
		diatomite	

Minimum EUR per well 0.002 (mmbo for oil AU; bcfg for gas AU)

Number of tested wells: 924
Number of tested wells with EUR > minimum: 914
Historic success ratio, tested wells (%) 99

Assessment-Unit Probability:
What is the probability that at least one well within the AU will have production capacity of at least the minimum EUR? 1.0

NUMBER OF UNDRILLED WELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES

1. Productive area of accumulation (acres): (triangular)

calculated mean	minimum	mode	maximum
13,333,333	5,000,000	10,000,000	25,000,000

2. Uncertainty about average drainage area of wells (acres): (triangular)

calculated mean	minimum	mode	maximum
407	220	400	600

3. Percentage of total assessment-unit area that is untested (%): (triangular)

calculated mean	minimum	mode	maximum
95	89	96.5	99.2

4. Percentage of untested assessment-unit area in sweet spots (%): (triangular)

calculated mean	minimum	mode	maximum
50	10	50	90

Assessment Unit (name, no.)
Three Forks Continuous Oil, 50310166

ESTIMATED ULTIMATE RECOVERY (EUR) PER WELL

SWEET SPOTS

5a. Future success ratio (%): (triangular)

calculated mean 88 minimum 80 mode 90 maximum 95

5b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean 0.222 minimum 0.18 median 0.22 maximum 0.275

NON-SWEET SPOTS

6a. Future success ratio (%): (triangular)

calculated mean 43 minimum 10 mode 40 maximum 80

6b. Uncertainty about average EUR (mmbo for oil; bcfg for gas): (shifted truncated lognormal)

calculated mean 0.085 minimum 0.01 median 0.08 maximum 0.2

UNCERTAINTY ABOUT AVERAGE COPRODUCT RATIOS FOR UNTESTED WELLS
(triangular)

Oil assessment unit:	minimum	mode	maximum
Gas/oil ratio (cfg/bo)	760	960	1160
NGL/gas ratio (bngl/mmcfg)	35	85	115
Gas assessment unit:			
Liquids/gas ratio (bliq/mmcfg)			

Assessment Unit (name, no.)
Three Forks Continuous Oil, 50310166

SELECTED ANCILLARY DATA FOR UNTESTED WELLS
(no specified distribution type)

Oil assessment unit:	minimum		median		maximum
API gravity of oil (degrees)	34		41		50
Sulfur content of oil (%)	0.01		0.1		1
Depth (m) of water (if applicable)					
Drilling depth (m)	minimum	F75	median	F25	maximum
	2200		3250		3400

Gas assessment unit:	minimum		median		maximum
Inert-gas content (%)					
CO_2 content (%)					
Hydrogen sulfide content (%)					
Heating value (BTU)					
Depth (m) of water (if applicable)					
Drilling depth (m)	minimum	F75	median	F25	maximum

Completion practices:

1.	Typical well-completion practices (conventional, open hole, open cavity, other)	open hole
2.	Fraction of wells drilled that are typically stimulated	1
3.	Predominant type of stimulation (none, frac, acid, other)	frac
4.	Historic fraction of wells drilled that are horizontal	1

Assessment Unit (name, no.)
Three Forks Continuous Oil, 50310166

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO STATES
Surface Allocations (uncertainty of a fixed value)

1. Montana is 25.18 % of the AREA of the AU
   mean VOLUME % in entity 25.00

2. North Dakota is 74.82 % of the AREA of the AU
   mean VOLUME % in entity 75.00

3. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

5. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Three Forks Continuous Oil, 50310166

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO GENERAL LAND OWNERSHIPS

Surface Allocations (uncertainty of a fixed value)

1. Federal Lands — is 6.68 % of the AREA of the AU
   mean VOLUME % in entity 7.00

2. Private Lands — is 77.56 % of the AREA of the AU
   mean VOLUME % in entity 78.00

3. Tribal Lands — is 10.42 % of the AREA of the AU
   mean VOLUME % in entity 10.00

4. Other Lands — is 1.03 % of the AREA of the AU
   mean VOLUME % in entity 1.00

5. MT State Lands — is 1.85 % of the AREA of the AU
   mean VOLUME % in entity 2.00

6. ND State Lands — is 2.46 % of the AREA of the AU
   mean VOLUME % in entity 2.00

7. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ — is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ — is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Three Forks Continuous Oil, 50310166

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
Surface Allocations (uncertainty of a fixed value)

1. Bureau of Land Management (BLM) is 0.46 % of the AREA of the AU
   mean VOLUME % in entity 0.50

2. BLM Wilderness Areas (BLMW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

3. BLM Roadless Areas (BLMR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

4. National Park Service (NPS) is 0.28 % of the AREA of the AU
   mean VOLUME % in entity 0.30

5. NPS Wilderness Areas (NPSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

6. NPS Protected Withdrawals (NPSP) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. US Forest Service (FS) is 3.14 % of the AREA of the AU
   mean VOLUME % in entity 3.20

8. USFS Wilderness Areas (FSW) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. USFS Roadless Areas (FSR) is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. USFS Protected Withdrawals (FSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Three Forks Continuous Oil, 50310166

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO FEDERAL LAND SUBDIVISIONS
(continued)

11. US Fish and Wildlife Service (FWS) is 1.05 % of the AREA of the AU
    mean VOLUME % in entity 1.00

12. USFWS Wilderness Areas (FWSW) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

13. USFWS Protected Withdrawals (FWSP) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

14. Wilderness Study Areas (WS) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

15. Department of Energy (DOE) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

16. Department of Defense (DOD) is 0.00 % of the AREA of the AU
    mean VOLUME % in entity 0.00

17. Bureau of Reclamation (BOR) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

18. Tennessee Valley Authority (TVA) is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

19. Other Federal is 1.75 % of the AREA of the AU
    mean VOLUME % in entity 2.00

20. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____

Assessment Unit (name, no.)
Three Forks Continuous Oil, 50310166

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO ECOSYSTEMS
Surface Allocations (uncertainty of a fixed value)

1. Northeastern Glaciated Plains (NEGP) is 25.16 % of the AREA of the AU
   mean VOLUME % in entity 25.16

2. Northern Glaciated Plains (NGPL) is 41.50 % of the AREA of the AU
   mean VOLUME % in entity 41.50

3. Northwestern Glaciated Plains (NWGL) is 8.62 % of the AREA of the AU
   mean VOLUME % in entity 8.62

4. Northwestern Great Plains (NWGP) is 24.66 % of the AREA of the AU
   mean VOLUME % in entity 24.66

5. Powder River Basin (PRBA) is 0.07 % of the AREA of the AU
   mean VOLUME % in entity 0.06

6. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

7. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

8. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

9. _____ is _____ % of the AREA of the AU
   mean VOLUME % in entity _____

10. _____ is _____ % of the AREA of the AU
    mean VOLUME % in entity _____