



Analytic Resource Assessment Method for Continuous (Unconventional) Oil and Gas Accumulations – The “ACCESS” Method

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**U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY**

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INTRODUCTION

The U.S. Geological Survey periodically assesses petroleum resources of areas within the United States and the world. The purpose of this report is to explain the development of an analytic probabilistic method and spreadsheet software system called Analytic Cell-based Continuous Energy Spreadsheet System (ACCESS). The ACCESS method is based upon mathematical equations derived from probability theory. The ACCESS spreadsheet can be used to calculate estimates of the undeveloped oil, gas, and NGL (natural gas liquids) resources in a continuous-type assessment unit. An assessment unit is a mappable volume of rock in a total petroleum system. First, the geologic assessment model is defined; second, the analytic probabilistic method is derived; and third, the spreadsheet ACCESS is described.

GEOLOGIC ASSESSMENT MODEL

The geologic assessment model is called the FORSPAN model and is described in Schmoker (1999). The geologic assessment model for an assessment unit consists of the following components (see figures 1 and 2 for additional descriptions):

A. A set of four assessment-unit probabilities:

1. Charge
2. Rocks
3. Timing
4. Access

B. A set of eight random variables for an oil assessment unit or a similar set for a gas assessment unit:

1. Assessment-unit area
2. Potential percentage of assessment-unit area
3. Area per cell
4. Total recovery per cell
5. Ratio of coproduct A
6. Ratio of coproduct B
7. Percent allocation to parcel (or land entity)
8. Percent allocation to offshore portion of parcel

The assessment-unit area, potential percentage of assessment-unit area, and area per cell are used to determine the number of potential cells, as explained later.

C. A set of three descriptive parameters for each of the eight given random variables:

1. Minimum (F100)
2. Median (F50)
3. Maximum (F0)

Examples of the basic input data form for the FORSPAN model are given in figures 1 and 2. The test assessment unit, called Bakken Fairway Continuous Oil, was originally assessed by James W. Schmoker in the USGS 1995 National Assessment of United States Oil and Gas Resources (U.S. Geological Survey National Oil and Gas Resource Assessment Team, 1995). He also assessed a second test assessment unit called Wasatch (East of Green River) Continuous Gas.

FORSPAN ASSESSMENT MODEL FOR CONTINUOUS ACCUMULATIONS--BASIC INPUT DATA FORM

IDENTIFICATION INFORMATION

Assessment Geologist:..... J. W. Schmoker Date: 5/5/99
 Region:..... Rocky Mountains and Northern Great Plains Number: 4
 Province:..... Williston Basin Number: 4031
 Total Petroleum System:..... Bakken Source Number: 403101
 Assessment Unit:..... Bakken Fairway Continuous Oil Number: 40310101
 * Notes from Assessor Test 1 - match 1995 (vertical well model)

CHARACTERISTICS OF ASSESSMENT UNIT (A.U.)

Assessment-Unit type: Oil (<20,000 cfg/bo) or Gas (≥20,000 cfg/bo) oil
 What is the minimum total recovery per cell?.... .003 (mmbo for oil A.U.; bcfg for gas A.U.)
 Number of evaluated cells: ... 315
 Number of evaluated cells with total recovery per cell ≥ minimum: 240
 Established (>24 cells ≥ min.) X Frontier (1-24 cells) _____ Hypothetical (no cells) _____
 Median total recovery per cell (for cells ≥ min.): (mmbo for oil A.U.; bcfg for gas A.U.)
 (vertical wells) 1st 3rd discovered .090 2nd 3rd .115 3rd 3rd .073

Assessment-Unit Probabilities:

<u>Attribute</u>	<u>Probability of occurrence (0-1.0)</u>
1. CHARGE: Adequate petroleum charge for an untested cell with total recovery ≥ minimum	<u>1</u>
2. ROCKS: Adequate reservoirs, traps, seals for an untested cell with total recovery ≥ minimum..	<u>1</u>
3. TIMING: Favorable geologic timing for an untested cell with total recovery ≥ minimum.....	<u>1</u>

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

4. ACCESS: Adequate location for necessary petroleum-related activities for an untested cell with total recovery ≥ minimum 1

NO. OF UNTESTED CELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES IN NEXT 30 YEARS

Total assessment-unit area (acres): (uncertainty of a fixed value)
 minimum 223x10⁶ median 514x10⁶ maximum 792x10⁶

Percentage of total assessment-unit area that is untested (%): (uncertainty of a fixed value)
 minimum 47 median 71 maximum 81

Percentage of total assessment-unit area that is untested and has potential for additions to reserves in next 30 years (%): (a necessary criterion is that total recovery per cell ≥ minimum)
 (uncertainty of a fixed value) minimum 34 median 50 maximum 57
 (x.7 success ratio)

Area per cell of untested cells having potential for additions to reserves in next 30 years (acres); (values are inherently variable) minimum 240 median 480 maximum 960

Figure 1. Example of basic input data form for FORSPAN assessment model.
 (Assessment-unit type: oil)

Assessment Unit (name, no.) Balton Fairway Continuous Oil
 40310101

TOTAL RECOVERY PER CELL

Total recovery per cell for untested cells having potential for additions to reserves in next 30 years:
 (values are inherently variable)
 (mmbo for oil A.U.; bcfg for gas A.U.) minimum .003 median .090 maximum .550

AVERAGE COPRODUCT RATIOS FOR UNTESTED CELLS

(uncertainty of a fixed value)

<u>Oil Assessment Unit:</u>	minimum	median	maximum
Gas/oil ratio (cfg/bo).....	<u>600</u>	<u>900</u>	<u>1200</u>
NGL/gas ratio (bngl/mmcfg).....	<u>30</u>	<u>60</u>	<u>90</u>
<u>Gas Assessment Unit:</u>			
Liquids/gas ratio (bliq/mmcfg).....	<u> </u>	<u> </u>	<u> </u>

SELECTED ANCILLARY DATA FOR UNTESTED CELLS

(values are inherently variable)

<u>Oil Assessment Unit:</u>	minimum	median	maximum
API gravity of oil (degrees).....	<u>35</u>	<u>41</u>	<u>47</u>
Sulfur content of oil (%).....	<u> </u>	<u> </u>	<u> </u>
Drilling Depth (m)	<u>3000</u>	<u>3200</u>	<u>3360</u>
Depth (m) of water (if applicable).....	<u> </u>	<u> </u>	<u> </u>
<u>Gas Assessment Unit:</u>			
Inert-gas content (%).....	<u> </u>	<u> </u>	<u> </u>
CO ₂ content (%).....	<u> </u>	<u> </u>	<u> </u>
Hydrogen-sulfide content (%).....	<u> </u>	<u> </u>	<u> </u>
Drilling Depth (m).....	<u> </u>	<u> </u>	<u> </u>
Depth (m) of water (if applicable).....	<u> </u>	<u> </u>	<u> </u>

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO LAND ENTITIES

(uncertainty of a fixed value)

1. North Dakota represents 100 areal % of the assessment unit

<u>Oil in Oil Assessment Unit:</u>	minimum	median	maximum
Volume % in entity.....	<u> </u>	<u>100</u>	<u> </u>
Portion of volume % that is offshore (0-100%).....	<u> </u>	<u>0</u>	<u> </u>
<u>Gas in Gas Assessment Unit:</u>			
Volume % in entity.....	<u> </u>	<u> </u>	<u> </u>
Portion of volume % that is offshore (0-100%).....	<u> </u>	<u> </u>	<u> </u>

(repeat above sequence as necessary to include all land entities of interest)

Figure 1--Continued. Example of basic input data form for FORSPAN assessment model.
 (Assessment-unit type: oil)

FORSPAN ASSESSMENT MODEL FOR CONTINUOUS ACCUMULATIONS--BASIC INPUT DATA FORM

IDENTIFICATION INFORMATION

Assessment Geologist:..... J. W. Schmoker Date: 5/10/99
 Region:..... Colorado Plateau and Basin and Range Number: 3
 Province:..... Uinta-Piceance Basin Number: 3020
 Total Petroleum System:..... Mesaverde Sourced Number: 302001
 Assessment Unit:..... Wasatch (East of Green River) Continuous Gas Number: 30200101
 * Notes from Assessor Test 1 - match 1995 Play 2015 (Natural Buttes area)

CHARACTERISTICS OF ASSESSMENT UNIT (A.U.)

Assessment-Unit type: Oil (<20,000 cfg/bo) or Gas (≥20,000 cfg/bo) gas
What is the minimum total recovery per cell?.... .055 (mmbo for oil A.U.; bcfg for gas A.U.)
 Number of evaluated cells: ... 492
 Number of evaluated cells with total recovery per cell ≥ minimum: 432
 Established (>24 cells ≥ min.) X Frontier (1-24 cells) _____ Hypothetical (no cells) _____
Median total recovery per cell (for cells ≥ min.): (mmbo for oil A.U.; bcfg for gas A.U.)
 1st 3rd discovered ? 2nd 3rd ? 3rd 3rd ?

Assessment-Unit Probabilities:

<u>Attribute</u>	<u>Probability of occurrence (0-1.0)</u>
1. CHARGE: Adequate petroleum charge for an untested cell with total recovery ≥ minimum	<u>1</u>
2. ROCKS: Adequate reservoirs, traps, seals for an untested cell with total recovery ≥ minimum..	<u>1</u>
3. TIMING: Favorable geologic timing for an untested cell with total recovery ≥ minimum.....	<u>1</u>

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

4. **ACCESS:** Adequate location for necessary petroleum-related activities for an untested cell with total recovery ≥ minimum 1

NO. OF UNTESTED CELLS WITH POTENTIAL FOR ADDITIONS TO RESERVES IN NEXT 30 YEARS

Total assessment-unit area (acres): (uncertainty of a fixed value)
 minimum .118 × 10⁶ median .198 × 10⁶ maximum .385 × 10⁶

Percentage of total assessment-unit area that is untested (%): (uncertainty of a fixed value)
 minimum 47 median 68 maximum 84

Percentage of total assessment-unit area that is untested **and** has potential for additions to reserves in next 30 years (%): (a necessary criterion is that total recovery per cell ≥ minimum)
 (uncertainty of a fixed value) minimum 41 median 60 maximum 74

Area per cell of untested cells having potential for additions to reserves in next 30 years (acres):
 (values are inherently variable) minimum 40 median 128 maximum 216

Figure 2. Example of basic input data form for FORSPAN assessment model.
 (Assessment-unit type: gas)

Assessment Unit (name, no.) Wasatch (East of Green River)

Continuous Gas 30200101

TOTAL RECOVERY PER CELL

Total recovery per cell for untested cells having potential for additions to reserves in next 30 years:

(values are inherently variable)

(mmbo for oil A.U.; bcfg for gas A.U.) minimum .055 median 1.100 maximum 6.500

AVERAGE COPRODUCT RATIOS FOR UNTESTED CELLS

(uncertainty of a fixed value)

<u>Oil Assessment Unit:</u>	minimum	median	maximum
Gas/oil ratio (cfg/bo).....	_____	_____	_____
NGL/gas ratio (bngl/mmcfg).....	_____	_____	_____
<u>Gas Assessment Unit:</u>			
Liquids/gas ratio (bliq/mmcfg).....	<u>5.0</u>	<u>7.4</u>	<u>9.8</u>

SELECTED ANCILLARY DATA FOR UNTESTED CELLS

(values are inherently variable)

<u>Oil Assessment Unit:</u>	minimum	median	maximum
API gravity of oil (degrees).....	_____	_____	_____
Sulfur content of oil (%).....	_____	_____	_____
Drilling Depth (m).....	_____	_____	_____
Depth (m) of water (if applicable).....	_____	_____	_____
<u>Gas Assessment Unit:</u>			
Inert-gas content (%).....	_____	_____	_____
CO ₂ content (%).....	_____	_____	_____
Hydrogen-sulfide content (%).....	_____	_____	_____
Drilling Depth (m).....	<u>910</u>	<u>1620</u>	<u>2470</u>
Depth (m) of water (if applicable).....	_____	_____	_____

ALLOCATIONS OF POTENTIAL ADDITIONS TO RESERVES TO LAND ENTITIES

(uncertainty of a fixed value)

1. Utah represents 100 areal % of the assessment unit

<u>Oil in Oil Assessment Unit:</u>	minimum	median	maximum
Volume % in entity.....	_____	_____	_____
Portion of volume % that is offshore (0-100%).....	_____	_____	_____
<u>Gas in Gas Assessment Unit:</u>			
Volume % in entity.....	_____	<u>100</u>	_____
Portion of volume % that is offshore (0-100%).....	_____	<u>0</u>	_____

(repeat above sequence as necessary to include all land entities of interest)

Figure 2--Continued. Example of basic input data form for FORSPAN assessment model. (Assessment-unit type: gas)

ANALYTIC PROBABILISTIC METHOD

The geologic assessment model FORSPAN is a description of a complex probability problem that needs to be solved for the estimates of the undeveloped petroleum resources (potential additions to reserves). The method derived herein, called ACCESS, is a system that solves the problem. That is, the model FORSPAN poses the problem, and the method ACCESS offers a solution. Simply stated, ACCESS is a solution of FORSPAN.

The eight given random variables are assigned probability distributions as probability models that are based on the descriptive parameters (F100, F50, and F0). That is, each given random variable is assigned a probability distribution with the specified descriptive parameters: minimum, median, and maximum. It is important to realize that the ACCESS method does not depend upon the specific assignment of probability distributions in that many assignments could be accommodated by a modification of ACCESS. The assignment is an operational decision. The following probability distributions were assigned to the set of eight given random variables for an oil assessment unit or for a gas assessment unit:

1. Assessment-unit area: Median-based triangular distribution
2. Potential percentage: Median-based triangular distribution
3. Area per cell: Median-based triangular distribution
4. Total recovery per cell: Truncated shifted lognormal distribution
5. Ratio of coproduct A: Median-based triangular distribution
6. Ratio of coproduct B: Median-based triangular distribution
7. Percent allocation to parcel (or land entity): Median-based triangular distribution
8. Percent allocation to offshore: Median-based triangular distribution

The mathematical equations for the median-based triangular distribution are derived from probability theory in Crovelli (1999). The basic probability theory of the triangular distribution can be found in Law and Kelton (1991). The probability theory of the lognormal distribution is given in Aitchison and Brown (1957).

A probabilistic method must be derived that combines given random variables of the geologic assessment model (FORSPAN) to determine parameters (especially, the mean, standard deviation, F95, and F5) of new random variables of interest, which are functions of the given random variables. The new random variables of interest are the following measures of undeveloped petroleum resources (potential additions to reserves):

- Oil in oil assessment unit
- Gas in oil assessment unit
- NGL in oil assessment unit
- Gas in gas assessment unit

- NGL in gas assessment unit
- Oil in gas assessment unit

A probabilistic method is required to compute the estimates in the form of parameters (especially, the mean for a point estimate, and fractiles F95 and F5 for an interval estimate) of a probability distribution. An analytic probabilistic method is a probabilistic method that uses mathematical equations from probability theory to obtain the estimates of the undeveloped petroleum resources in an assessment unit. The ACCESS method is an analytic probabilistic method that was developed by deriving the necessary mathematical equations based upon conditional probability theory and laws of expectation and variance. Three features of ACCESS are the following:

- ACCESS relates the parameters with mathematical equations.
- ACCESS computes the means, standard deviations, minimums, and maximums exactly.
- ACCESS computes the estimates instantaneously.

For example, in the case of gas in gas assessment unit the following relationships are developed for the random variables:

N : Number of potential cells

X : Total recovery per cell (bcfg)

Y : Gas in gas assessment unit (bcfg)

$$Y = \sum_{i=1}^N X_i$$

The random variable Y is equal to the sum of a random number of random variables (total recoveries per cell). The mean and standard deviation of Y can be derived from the theory of conditional probability and conditional expectation (Ross, 1993). Parameters of particular interest for gas in gas assessment unit are the mean, standard deviation, minimum, and maximum:

$$\mu_Y = \mu_N \mu_X$$

$$\sigma_Y = \sqrt{\mu_N \sigma_X^2 + \mu_X^2 \sigma_N^2}$$

$$\text{Min}(Y) = \text{Min}(N) \text{Min}(X)$$

$$\text{Max}(Y) = \text{Max}(N) \text{Max}(X)$$

Many of the mathematical equations for parameters of the new random variables of interest in the ACCESS method are derived using conditional probability theory in

Crovelli (1992). A simplified flow chart of the analytic probabilistic method for resource assessment of continuous (unconventional) oil and gas accumulations – the ACCESS method – is displayed in figure 3. The number of potential cells and the total recovery per cell are combined probabilistically to obtain the undeveloped petroleum resources (potential additions to reserves) in an assessment unit.

How the assessment-unit area, potential percentage of assessment-unit area, and area per cell are used to determine the number of potential cells will now be explained. The assessment-unit area and potential percentage of assessment-unit area are multiplied probabilistically to obtain the potential area of the assessment unit. Then the potential area of the assessment unit and area per cell are combined to generate the number of potential cells. This sequence of calculations for the number of potential cells is described in the flow chart of figure 4.

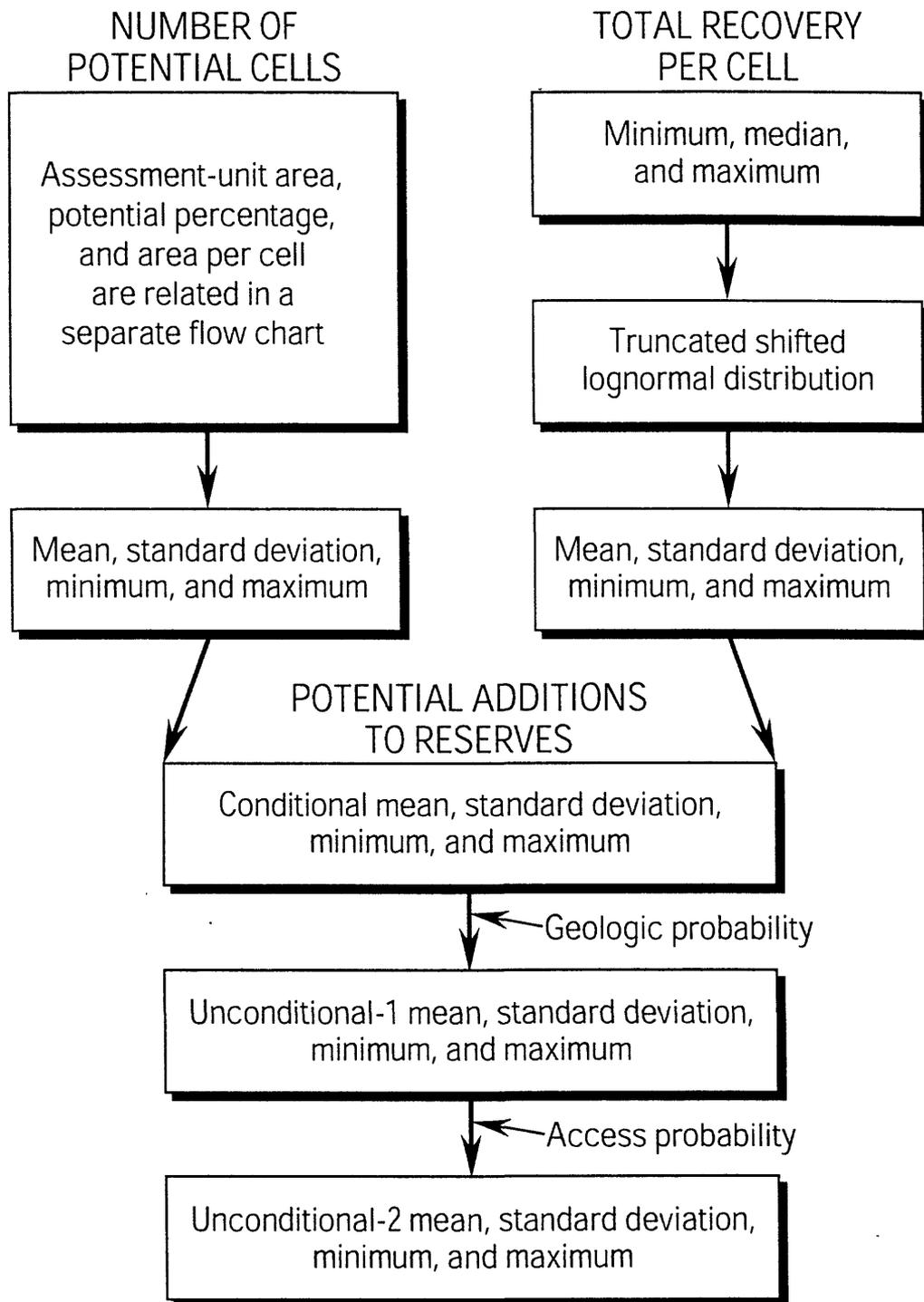


Figure 3. Simplified flow chart of the analytic probabilistic method for resource assessment of continuous (unconventional) oil and gas accumulations – the ACCESS method.

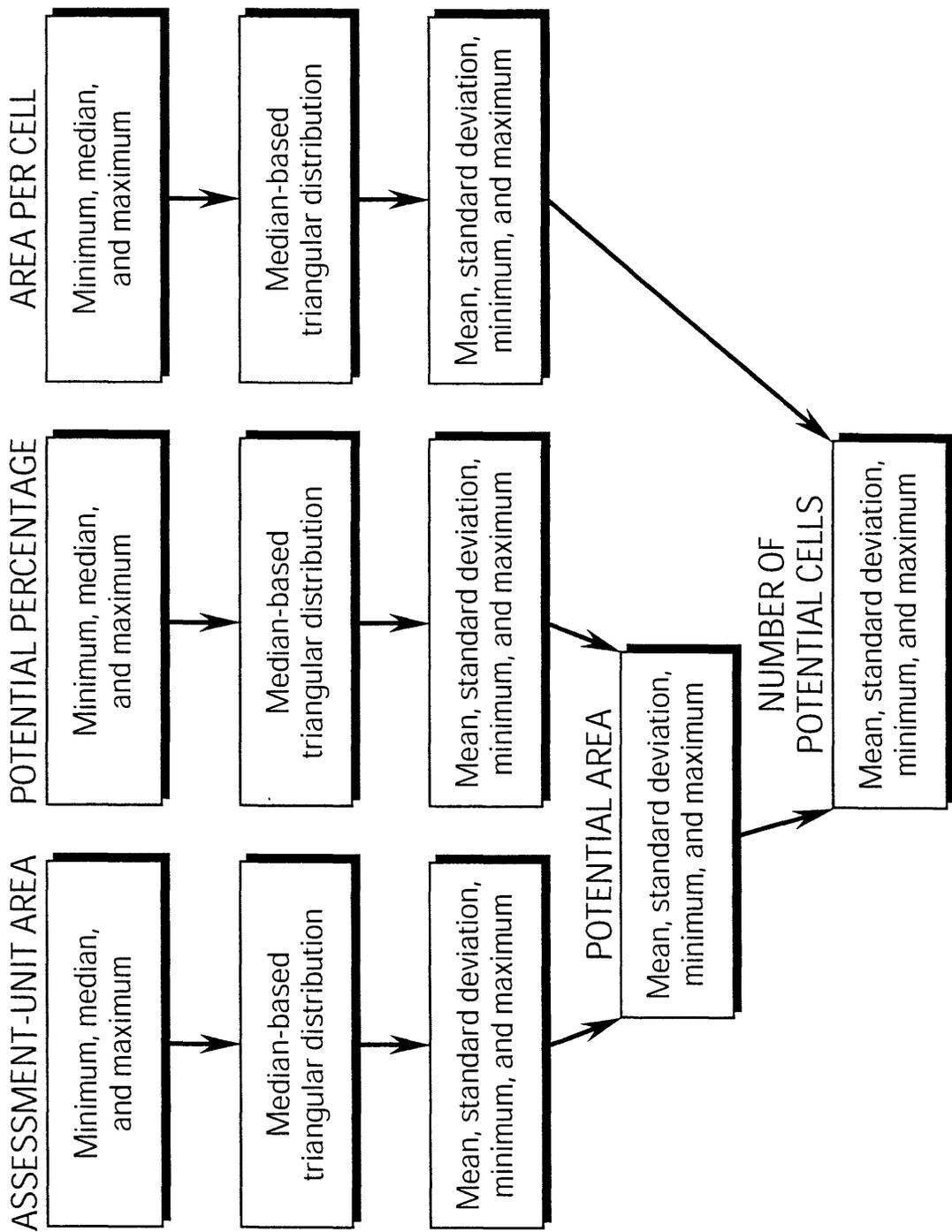


Figure 4. Flow chart of calculations for determining the number of potential cells.

SPREADSHEET SYSTEM

Given the geologic assessment model (the FORSPAN model, figures 1 and 2), the analytic probabilistic method is used to create a spreadsheet probability system. The analytic probabilistic method of the previous section is incorporated into a spreadsheet software system called Analytic Cell-based Continuous Energy Spreadsheet System (ACCESS). ACCESS consists of a series of 52 panels in the spreadsheet. A panel is a set of approximately 11 columns of related calculations. Because the total number of columns in ACCESS is 575, it was necessary to construct ACCESS as a workbook with four worksheets called Cond, Unc1, Unc2, and Numb. Cond is comprised of Panels 1-22, Unc1 has Panels 23-34, Unc2 has Panels 35-46, and Numb has Panels 47-52. Worksheet Cond is linked to the worksheet Numb. Worksheets Unc1 and Unc2 are linked to the worksheet Cond. The topics included in the worksheets Cond, Unc1, Unc2, and Numb are the following:

- Worksheet Cond: Input data (Panels 1-4), probability distribution calculations (Panels 5-10), and conditional (unrisked) resource estimates (Panels 11-22).
- Worksheet Unc1: Unconditional-1 resource estimates, risked using the geologic probability of the assessment unit.
- Worksheet Unc2: Unconditional-2 resource estimates, risked using both the geologic and the access (“geoacc”) probability of the assessment unit.
- Worksheet Numb: Input data (Panel 47), probability distribution calculations (Panels 48-52) for the number of potential cells.

The individual panel numbers and contents of the spreadsheet ACCESS are given in Table 1.

A probability system is an orderly collection of random variables logically related in terms of their probability distributions and parameters. The spreadsheet probability system ACCESS includes:

Conditional (unrisked) and unconditional (risked) estimates of undeveloped petroleum resources (potential additions to reserves) in

- Assessment unit
- Parcel (or land entity)
- Offshore portion of parcel

The total number of new random variables or sets of estimates (mean, standard deviation, F95, and F5) per assessment unit:

- 72 ($2*4*3*3$) if one parcel

- 120 (2*4*3*5) if two parcels

For illustrative purposes only, the ACCESS system is used here to compute the undeveloped petroleum resource estimates for two assessment units. Input data were prepared by James W. Schmoker. These input data are realistic in a geologic sense, but **DO NOT** represent an official USGS resource estimate; they are intended solely to help explain the ACCESS system.

The two test assessment units are entitled: (1) Bakken Fairway Continuous Oil, and (2) Wasatch (East of Green River) Continuous Gas. Note that these two assessment units were used as examples of the basic input data form for the FORSPAN model in figures 1 and 2. The computer printout of the 52 panels in the ACCESS spreadsheet for this illustration is presented on following pages. The panel captions explain how the panels are related with respect to their calculations. For examples of particular interest, we have the following:

Panel 11. Conditional estimates of undeveloped resources in assessment unit: oil in oil assessment unit and gas in gas assessment unit. Mean, standard deviation, minimum, and maximum are computed by combining parameters from Panels 5 and 6. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

Note that the number of potential cells (Panel 5) and the total recovery per cell (Panel 6) produce the estimates for an assessment unit (Panel 11). Recall that the corresponding mathematical equations were given in the previous section.

Panel 23. Unconditional-1 estimates of undeveloped resources in assessment unit: oil in oil assessment unit and gas in gas assessment unit. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 11. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

Note that the geologic probability (Panel 23) is applied to the conditional estimates (Panel 11) to generate the unconditional-1 (risked for geology) estimates (Panel 23).

Panel 35. Unconditional-2 estimates of undeveloped resources in assessment unit: oil in oil assessment unit and gas in gas assessment unit. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 11. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

Note that the geoacc probability (Panel 35) is applied to the conditional estimates (Panel 11) to generate the unconditional-2 (risked for geology and access) estimates (Panel 35).

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Table 1. Spreadsheet ACCESS panel numbers and contents.

- (1) Input data: Assessment-unit probabilities
- (2) Input data: Total recovery per cell
- (3) Input data: Ratios used to assess coproducts
- (4) Input data: Percent allocation to parcel and offshore portion of parcel
- (5) Number of potential cells: Computed parameters
- (6) Total recovery per cell: Truncated shifted lognormal distribution
- (7) Ratios used to assess coproducts: Median-based triangular distribution
- (8) Ratios used to assess coproducts: Median-based triangular distribution
- (9) Percent allocation to parcel: Median-based triangular distribution
- (10) Percent allocation to offshore: Median-based triangular distribution
- (11) Cond. estimates in assessment unit: Oil in oil fields and gas in gas fields
- (12) Cond. estimates in assessment unit: Gas in oil fields and NGL in gas fields
- (13) Cond. estimates in assessment unit: NGL in oil fields and oil in gas fields
- (14) Cond. estimates in assessment unit: Total in oil fields and total in gas fields
- (15) Cond. allocation to parcel: Oil in oil fields and gas in gas fields
- (16) Cond. allocation to parcel: Gas in oil fields and NGL in gas fields
- (17) Cond. allocation to parcel: NGL in oil fields and oil in gas fields
- (18) Cond. allocation to parcel: Total in oil fields and total in gas fields
- (19) Cond. allocation to offshore: Oil in oil fields and gas in gas fields
- (20) Cond. allocation to offshore: Gas in oil fields and NGL in gas fields
- (21) Cond. allocation to offshore: NGL in oil fields and oil in gas fields
- (22) Cond. allocation to offshore: Total in oil fields and total in gas fields
- (23) Unc1. estimates in assessment unit: Oil in oil fields and gas in gas fields
- (24) Unc1. estimates in assessment unit: Gas in oil fields and NGL in gas fields
- (25) Unc1. estimates in assessment unit: NGL in oil fields and oil in gas fields
- (26) Unc1. estimates in assessment unit: Total in oil fields and total in gas fields
- (27) Unc1. allocation to parcel: Oil in oil fields and gas in gas fields
- (28) Unc1. allocation to parcel: Gas in oil fields and NGL in gas fields
- (29) Unc1. allocation to parcel: NGL in oil fields and oil in gas fields
- (30) Unc1. allocation to parcel: Total in oil fields and total in gas fields

- (31) Unc1. allocation to offshore: Oil in oil fields and gas in gas fields
- (32) Unc1. allocation to offshore: Gas in oil fields and NGL in gas fields
- (33) Unc1. allocation to offshore: NGL in oil fields and oil in gas fields
- (34) Unc1. allocation to offshore: Total in oil fields and total in gas fields
- (35) Unc2. estimates in assessment unit: Oil in oil fields and gas in gas fields
- (36) Unc2. estimates in assessment unit: Gas in oil fields and NGL in gas fields
- (37) Unc2. estimates in assessment unit: NGL in oil fields and oil in gas fields
- (38) Unc2. estimates in assessment unit: Total in oil fields and total in gas fields
- (39) Unc2. allocation to parcel: Oil in oil fields and gas in gas fields
- (40) Unc2. allocation to parcel: Gas in oil fields and NGL in gas fields
- (41) Unc2. allocation to parcel: NGL in oil fields and oil in gas fields
- (42) Unc2. allocation to parcel: Total in oil fields and total in gas fields
- (43) Unc2. allocation to offshore: Oil in oil fields and gas in gas fields
- (44) Unc2. allocation to offshore: Gas in oil fields and NGL in gas fields
- (45) Unc2. allocation to offshore: NGL in oil fields and oil in gas fields
- (46) Unc2. allocation to offshore: Total in oil fields and total in gas fields
- (47) Numb. input data: Assess.-unit area, potential percentage, and area per cell
- (48) Numb. assessment-unit area: Median-based triangular distribution
- (49) Numb. potential percentage: Median-based triangular distribution
- (50) Numb. area per cell: Median-based triangular distribution
- (51) Numb. potential area: Lognormal distribution
- (52) Numb. number of potential cells: Lognormal distribution

ACCESS

ACCESS: Analytic Cell-based Continuous Energy Spreadsheet System							R.A. Crovelli		(Panel 1)
Assessment Unit			Assessment-Unit Probabilities						
Name	No.	Fields	Charge	Rocks	Timing	Geologic	Access	GeoAcc	
Test 1: Bakken Fairway	40310101	Oil	1	1	1	1	1	1	
Test 2: Wasatch	30200101	Gas	1	1	1	1	1	1	

Panel 1. Input data: assessment-unit name, number, and probabilities for charge, rocks, timing, and access. Geologic probability is the product of charge, rocks, and timing probabilities. “Geoacc” probability is the product of geologic and access probabilities.

						(Panel 2)	
						Total Recovery Per Cell	
Number of Potential Cells			Oil (mmbo) and Gas (bcfg)				
No.	Fields		Minimum	Median	Maximum		
40310101	Oil	See Panel 47 for input data	0.003	0.09	0.55		
30200101	Gas	See Panel 47 for input data	0.055	1.1	6.5		

Panel 2. Input data: total recovery per cell – minimum, median, and maximum. See Panel 47 for input data pertaining to number of potential cells.

							(Panel 3)	
Oil fields:		Gas/oil ratio (cfg/bo)			NGL/gas ratio (bngl/mmcfg)			
Gas fields:		NGL/gas ratio (bngl/mmcfg)			Oil/gas ratio (bo/mmcfg)			
No.	Fields	Minimum	Median	Maximum	Minimum	Median	Maximum	
40310101	Oil	600	900	1200	30	60	90	
30200101	Gas	5	7.4	9.8	0	0	0	

Panel 3. Input data: ratios used to assess coproducts of undeveloped oil and gas fields – minimum, median, and maximum.

								(Panel 4)
Percent Allocation								
Parcel				Offshore				
Parcel	Fields	Minimum	Median	Maximum	Minimum	Median	Maximum	
N. Dakota	Oil	100	100	100	0	0	0	
Utah	Gas	100	100	100	0	0	0	

Panel 4. Input data: percent allocation to parcel and offshore portion of parcel – minimum, median, and maximum.

										(Panel 5)
Number of Potential Cells										
No.	Flds	Min,F100					Max,F0	Mean	S.D.	
40310101	Oil	79	See Panels 48-52 for calculations				1881	495.9231	125.2078	
30200101	Gas	224	See Panels 48-52 for calculations				7123	966.6908	311.3366	

Panel 5. Number of potential cells: computed parameters are imported from Panel 52. See Panels 48-52 for sequence of calculations.

											(Panel 6)
Total Recovery Per Cell (mmbo and bcfg) -- Truncated Shifted Lognormal Distribution											
No.	Flds	Min,F100	Med,F50	Mu	Sigma	E(X)	E(X^2)	Max,F0	Mean	S.D.	
40310101	Oil	0.003	0.09	-2.44185	0.595	0.10331	0.014948	0.55	0.10631	0.065381	
30200101	Gas	0.055	1.1	0.044017	0.58877	1.236563	2.127424	6.5	1.291563	0.773523	

Panel 6. Total recovery per cell: truncated shifted lognormal distribution. Mean and standard deviation are computed.

(Panel 7)										
Oil fields:		Gas/oil ratio (cfg/bo) -- Median-Based Triangular Distribution								
Gas fields:		NGL/gas ratio (bnl/mmcfg) -- Median-Based Triangular Distribution								
No.	Flds	Min,F100	Med,F50	Midpoint	Mode			Max,F0	Mean	S.D.
40310101	Oil	600	900	900	900			1200	900	122.4745
30200101	Gas	5	7.4	7.4	7.4			9.8	7.4	0.979796

Panel 7. Ratios used to assess coproducts: median-based triangular distribution. Midpoint, mode, mean, and standard deviation are computed.

(Panel 8)										
Oil fields:		NGL/gas ratio (bnl/mmcfg) -- Median-Based Triangular Distribution								
Gas fields:		Oil/gas ratio (bo/mmcfg) -- Median-Based Triangular Distribution								
No.	Flds	Min,F100	Med,F50	Midpoint	Mode			Max,F0	Mean	S.D.
40310101	Oil	30	60	60	60			90	60	12.24745
30200101	Gas	0	0	0	0			0	0	0

Panel 8. Ratios used to assess coproducts: median-based triangular distribution. Midpoint, mode, mean, and standard deviation are computed.

Percent Allocation of Undiscovered Resources by Volume to Parcel										(Panel 9)
		Percent Resources in Oil/Gas Fields -- Median-Based Triangular Distribution								
Parcel	Flds	Min,F100	Med,F50	Midpoint	Mode			Max,F0	Mean	S.D.
N. Dako	Oil	100	100	100	100			100	100	0
Utah	Gas	100	100	100	100			100	100	0

Panel 9. Percent allocation of undeveloped resources by volume to parcel: median-based triangular distribution. Midpoint, mode, mean, and standard deviation are computed.

Percent Allocation of Undiscovered Resources by Volume to Offshore										(Panel 10)
Percent Resources in Oil/Gas Fields -- Median-Based Triangular Distribution										
Parcel	Flds	Min,F100	Med,F50	Midpoint	Mode			Max,F0	Mean	S.D.
N. Dako	Oil	0	0	0	0			0	0	0
Utah	Gas	0	0	0	0			0	0	0

Panel 10. Percent allocation of undeveloped resources by volume to offshore portion of parcel: median-based triangular distribution. Midpoint, mode, mean, and standard deviation are computed.

CONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT											(Panel 11)
Oil in Oil Fields (mmbo)											
Gas in Gas Fields (bcfg)											
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0	
40310101	Oil	52.72158	13.39023	0.237	33.86971	43.16943	51.0992	60.48568	77.09343	1034.55	
30200101	Gas	1248.542	402.8293	12.32	708.1143	960.991	1188.23	1469.196	1993.865	46299.5	

Panel 11. Conditional estimates of undeveloped resources in assessment unit: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by combining parameters from Panels 5 and 6. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT											(Panel 12)
Gas in Oil Fields (bcfg)											
NGL in Gas Fields (mmbngl)											
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0	
40310101	Oil	47.44943	13.77006	0.1422	28.5457	37.61629	45.5693	55.20379	72.74519	1241.5	
30200101	Gas	9.239208	3.246269	0.0616	4.97316	6.924928	8.71681	10.97235	15.27856	453.74	

Panel 12. Conditional estimates of undeveloped resources in assessment unit: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by combining parameters from Panels 7 and 11. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 13)										
NGL in Oil Fields (mmbngl)										
Oil in Gas Fields (mmbo)										
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
40310101	Oil	2.846966	1.024096	0.00427	1.509291	2.117277	2.67892	3.389542	4.754947	111.73
30200101	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 13. Conditional estimates of undeveloped resources in assessment unit: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by combining parameters from Panels 8 and 12 for NGL in oil fields and parameters from Panels 8 and 11 for oil in gas fields. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 14)										
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
40310101	Oil	63.47679	16.20371	0.26497	40.68413	51.91686	61.5045	72.86275	92.97987	1353.2
30200101	Gas	217.3295	70.13093	2.11493	123.2469	167.2682	206.827	255.7427	347.0886	8170.3

Panel 14. Conditional estimates of undeveloped resources in assessment unit: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by combining parameters from Panels 7, 8, and 11. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 15)										
Oil in Oil Fields (mmbo)										
Gas in Gas Fields (bcfg)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	52.72158	13.39023	0.237	33.86971	43.16943	51.0992	60.48568	77.09343	1034.6
Utah	Gas	1248.542	402.8293	12.32	708.1143	960.991	1188.23	1469.196	1993.865	46300

Panel 15. Conditional allocation of undeveloped resources to parcel: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 9 to parameters from Panel 11. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 16)										
Gas in Oil Fields (bcfg)										
NGL in Gas Fields (mmbngl)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	47.44943	13.77006	0.1422	28.5457	37.61629	45.5693	55.20379	72.74519	1241.5
Utah	Gas	9.239208	3.246269	0.0616	4.97316	6.924928	8.71681	10.97235	15.27856	453.74

Panel 16. Conditional allocation of undeveloped resources to parcel: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 9 to parameters from Panel 12. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 17)										
NGL in Oil Fields (mmbngl)										
Oil in Gas Fields (mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	2.84696559	1.0240956	0.004266	1.509291	2.117277	2.678918	3.389542	4.754947	111.731
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 17. Conditional allocation of undeveloped resources to parcel: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 9 to parameters from Panel 13. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 18)										
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	63.47679	16.20371	0.26497	40.68413	51.91686	61.5045	72.86275	92.97987	1353.2
Utah	Gas	217.3295	70.13093	2.11493	123.2469	167.2682	206.827	255.7427	347.0886	8170.3

Panel 18. Conditional allocation of undeveloped resources to parcel: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 9 to parameters from Panel 14. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 19)										
		Oil in Oil Fields (mmbo)								
		Gas in Gas Fields (bcfg)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 19. Conditional allocation of undeveloped resources to offshore portion of parcel: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 10 to parameters from Panel 15. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 20)										
		Gas in Oil Fields (bcfg)								
		NGL in Gas Fields (mmbngl)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 20. Conditional allocation of undeveloped resources to offshore portion of parcel: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 10 to parameters from Panel 16. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 21)										
		NGL in Oil Fields (mmbngl)								
		Oil in Gas Fields (mmbo)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 21. Conditional allocation of undeveloped resources to offshore portion of parcel: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 10 to parameters from Panel 17. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

CONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE										(Panel 22)
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 22. Conditional allocation of undeveloped resources to offshore portion of parcel: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying parameters from Panel 10 to parameters from Panel 18. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT												(Panel 23)
Oil in Oil Fields (mmbo)												
Gas in Gas Fields (bcfg)												
Geologic	No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0	
1	40310101	Oil	52.72158	13.39023	0.237	33.86971	43.16943	51.0992	60.48568	77.09343	1034.55	
1	30200101	Gas	1248.542	402.8293	12.32	708.1143	960.991	1188.23	1469.196	1993.865	46299.5	

Panel 23. Unconditional-1 estimates of undeveloped resources in assessment unit: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 11. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT											(Panel 24)
Gas in Oil Fields (bcfg)											
NGL in Gas Fields (mmbngl)											
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0	
40310101	Oil	47.44943	13.77006	0.1422	28.5457	37.61629	45.5693	55.20379	72.74519	1241.5	
30200101	Gas	9.239208	3.246269	0.0616	4.97316	6.924928	8.71681	10.97235	15.27856	453.74	

Panel 24. Unconditional-1 estimates of undeveloped resources in assessment unit: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 12. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 25)										
NGL in Oil Fields (mmbngl)										
Oil in Gas Fields (mmbo)										
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
40310101	Oil	2.846966	1.024096	0.00427	1.509290918	2.117277	2.67892	3.389542	4.754947	111.73
30200101	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 25. Unconditional-1 estimates of undeveloped resources in assessment unit: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 13. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 26)										
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
40310101	Oil	63.47679	16.20371	0.26497	40.68413	51.91686	61.5045	72.86275	92.97987	1353.2
30200101	Gas	217.3295	70.13093	2.11493	123.2469	167.2682	206.827	255.7427	347.0886	8170.3

Panel 26. Unconditional-1 estimates of undeveloped resources in assessment unit: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 14. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 27)										
Oil in Oil Fields (mmbo)										
Gas in Gas Fields (bcfg)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	52.72158	13.39023	0.237	33.86971	43.16943	51.09924	60.48568	77.09343	1034.55
Utah	Gas	1248.542	402.8293	12.32	708.1143	960.991	1188.227	1469.196	1993.865	46299.5

Panel 27. Unconditional-1 allocation of undeveloped resources to parcel: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 15. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 28)										
Gas in Oil Fields (bcfg)										
NGL in Gas Fields (mmbngl)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	47.44943	13.77006	0.1422	28.5457	37.61629	45.5693	55.20379	72.74519	1241.46
Utah	Gas	9.239208	3.246269	0.0616	4.97316	6.924928	8.71681	10.97235	15.27856	453.735

Panel 28. Unconditional-1 allocation of undeveloped resources to parcel: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 16. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 29)										
NGL in Oil Fields (mmbngl)										
Oil in Gas Fields (mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	2.8469656	1.024096	0.004266	1.509291	2.117277	2.6789175	3.389542	4.754947	111.731
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 29. Unconditional-1 allocation of undeveloped resources to parcel: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 17. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 30)										
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	63.47679	16.20371	0.264966	40.68413	51.91686	61.50451	72.86275	92.97987	1353.19
Utah	Gas	217.3295	70.13093	2.114933	123.2469	167.2682	206.8275	255.7427	347.0886	8170.32

Panel 30. Unconditional-1 allocation of undeveloped resources to parcel: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 18. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 31)										
		Oil in Oil Fields (mmbo)								
		Gas in Gas Fields (bcfg)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 31. Unconditional-1 allocation of undeveloped resources to offshore portion of parcel: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 19. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 32)										
		Gas in Oil Fields (bcfg)								
		NGL in Gas Fields (mmbngl)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 32. Unconditional-1 allocation of undeveloped resources to offshore portion of parcel: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 20. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 33)										
		NGL in Oil Fields (mmbngl)								
		Oil in Gas Fields (mmbo)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 33. Unconditional-1 allocation of undeveloped resources to offshore portion of parcel: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 21. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 34)										
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 34. Unconditional-1 allocation of undeveloped resources to offshore portion of parcel: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geologic probability from Panel 23 to parameters from Panel 22. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 35)											
Oil in Oil Fields (mmbo)											
Gas in Gas Fields (bcfg)											
GeoAcc	No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
1	40310101	Oil	52.72158	13.39023	0.237	33.86971	43.16943	51.0992	60.48568	77.09343	1034.55
1	30200101	Gas	1248.542	402.8293	12.32	708.1143	960.991	1188.23	1469.196	1993.865	46299.5

Panel 35. Unconditional-2 estimates of undeveloped resources in assessment unit: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 11. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 36)											
Gas in Oil Fields (bcfg)											
NGL in Gas Fields (mmbngl)											
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0	
40310101	Oil	47.44943	13.77006	0.1422	28.5457	37.61629	45.5693	55.20379	72.74519	1241.5	
30200101	Gas	9.239208	3.246269	0.0616	4.97316	6.924928	8.71681	10.97235	15.27856	453.74	

Panel 36. Unconditional-2 estimates of undeveloped resources in assessment unit: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 12. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 37)										
NGL in Oil Fields (mmbngl)										
Oil in Gas Fields (mmbo)										
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
40310101	Oil	2.846966	1.024096	0.00427	1.5092909	2.117277	2.67892	3.389542	4.754947	111.73
30200101	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 37. Unconditional-2 estimates of undeveloped resources in assessment unit: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 13. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ESTIMATES OF UNDISCOVERED RESOURCES IN ASSESSMENT UNIT (Panel 38)										
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
40310101	Oil	63.47679	16.20371	0.26497	40.68413	51.91686	61.50451	72.86275	92.97987	1353.2
30200101	Gas	217.3295	70.13093	2.11493	123.2469	167.2682	206.8275	255.7427	347.0886	8170.3

Panel 38. Unconditional-2 estimates of undeveloped resources in assessment unit: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 14. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 39)										
Oil in Oil Fields (mmbo)										
Gas in Gas Fields (bcfg)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	52.72158	13.39023	0.237	33.86971	43.16943	51.09924	60.48568	77.09343	1034.55
Utah	Gas	1248.542	402.8293	12.32	708.1143	960.991	1188.227	1469.196	1993.865	46299.5

Panel 39. Unconditional-2 allocation of undeveloped resources to parcel: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 15. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 40)										
Gas in Oil Fields (bcfg)										
NGL in Gas Fields (mmbngl)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	47.44943	13.77006	0.1422	28.5457	37.6163	45.5693	55.20379	72.7452	1241.46
Utah	Gas	9.239208	3.246269	0.0616	4.9731603	6.92493	8.71681	10.97235	15.2786	453.735

Panel 40. Unconditional-2 allocation of undeveloped resources to parcel: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 16. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 41)										
NGL in Oil Fields (mmbngl)										
Oil in Gas Fields (mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	2.846966	1.0240956	0.004266	1.5092909	2.117277	2.678918	3.389542	4.7549474	111.731
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 41. Unconditional-2 allocation of undeveloped resources to parcel: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 17. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO PARCEL (Panel 42)										
Total Resources in Oil Fields (mmbo & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	63.47679	16.20371	0.264966	40.68413	51.91686	61.50451	72.86275	92.97987	1353.19
Utah	Gas	217.3295	70.13093	2.114933	123.2469	167.2682	206.8275	255.7427	347.0886	8170.32

Panel 42. Unconditional-2 allocation of undeveloped resources to parcel: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 18. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 43)										
		Oil in Oil Fields (mmbo)								
		Gas in Gas Fields (bcfg)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 43. Unconditional-2 allocation of undeveloped resources to offshore portion of parcel: oil in oil fields and gas in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 19. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 44)										
		Gas in Oil Fields (bcfg)								
		NGL in Gas Fields (mmbngl)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 44. Unconditional-2 allocation of undeveloped resources to offshore portion of parcel: gas in oil fields and NGL in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 20. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 45)										
		NGL in Oil Fields (mmbngl)								
		Oil in Gas Fields (mmbo)								
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 45. Unconditional-2 allocation of undeveloped resources to offshore portion of parcel: NGL in oil fields and oil in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 21. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

UNCONDITIONAL ALLOCATION OF UNDISCOVERED RESOURCES TO OFFSHORE (Panel 46)										
Total Resources in Oil Fields (mmbp & mmboe & mmbngl)										
Total Resources in Gas Fields (mmboe & mmbngl & mmbo)										
Parcel	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0
N. Dak	Oil	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0
Utah	Gas	0	0	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	0

Panel 46. Unconditional-2 allocation of undeveloped resources to offshore portion of parcel: total resources in oil fields and total resources in gas fields. Mean, standard deviation, minimum, and maximum are computed by applying the geoacc probability from Panel 35 to parameters from Panel 22. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

(Panel 47)										
Assessment-Unit Area (acres)										
Potential Percentage (%)										
Area Per Cell (acres)										
No.	Flds	Minimum	Median	Maximum	Minimum	Median	Maximum	Minimum	Median	Maximum
40310101	Oil	223000	514000	792000	34	50	57	240	480	960
30200101	Gas	118000	198000	385000	41	60	74	40	128	216

Panel 47. Input data for number of potential cells: assessment-unit area, potential percentage of assessment-unit area, and area per cell – minimum, median, and maximum.

(Panel 48)									
Assessment-Unit Area (acres) -- Median-Based Triangular Distribution									
No.	Flds	Min,F100	Med,F50	Max,F0	Midpoint	Mode	Mean	S.D.	
40310101	Oil	223000	514000	792000	507500	520648.5	511882.8	116188	
30200101	Gas	118000	198000	385000	251500	123059.9	208686.6	62344.74	

Panel 48. Assessment-unit area: median-based triangular distribution. Midpoint, mode, mean, and standard deviation are computed.

									(Panel 49)
Potential Percentage (%) -- Median-Based Triangular Distribution									
No.	Flds	Min,F100	Med,F50	Max,F0	Midpoint	Mode	Mean	S.D.	
40310101	Oil	34	50	57	45.5	56.26087	49.08696	5.336178	
30200101	Gas	41	60	74	57.5	62.87879	59.29293	6.854363	

Panel 49. Potential percentage of assessment-unit area: median-based triangular distribution. Midpoint, mode, mean, and standard deviation are computed.

									(Panel 50)
Area Per Cell (acres) -- Median-Based Triangular Distribution									
No.	Flds	Min,F100	Med,F50	Max,F0	Midpoint	Mode	Mean	S.D.	
40310101	Oil	240	480	960	600	320	506.6667	161.1073	
30200101	Gas	40	128	216	128	128	128	35.92585	

Panel 50. Area per cell: median-based triangular distribution. Midpoint, mode, mean, and standard deviation are computed.

											(Panel 51)
Potential Area (acres)											
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0	
40310101	Oil	251267.7	63539.97	75820	161743	205942.9	243599.7	288142	366883.3	451440	
30200101	Gas	123736.4	39866.74	48380	70234.86	95278.07	117774.4	145582.5	197491.9	284900	

Panel 51. Potential area of assessment unit. Mean, standard deviation, minimum, and maximum are computed by combining parameters from Panels 48 and 49. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.

											(Panel 52)
Number of Potential Cells											
No.	Flds	Mean	S.D.	Min,F100	F95	F75	Med,F50	F25	F5	Max,F0	
40310101	Oil	495.9231	125.2078	79	319	407	481	569	724	1881	
30200101	Gas	966.6908	311.3366	224	549	744	920	1137	1543	7123	

Panel 52. Number of potential cells. Mean, standard deviation, minimum, and maximum are computed by combining parameters from Panels 50 and 51. Fractiles F95, F75, F50, F25, and F5 are approximated by a lognormal distribution.