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Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas Quantitative Hydrocarbon Assessment Update

Kenneth J. Drummond

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>>> NORTHWEST TERRITORIES GEOSCIENCE OFFICE

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Northwest Territories
PROTECTED AREAS
STRATEGY

the land takes care of us, we take care of the land

Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas Quantitative Hydrocarbon Assessment Update

Kenneth J. Drummond

Drummond Consulting

September 2011

Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas
Quantitative Hydrocarbon Assessment - Update

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Introduction

The Northwest Territories Protected Areas Strategy (PAS) is a partnership process to establish protected areas in the Northwest Territories. The PAS process requires that as areas are identified, the known cultural, ecological and economic values are studied, documented and discussed. As part of this work, Non-Renewable Resource Assessments of mineral and hydrocarbon potential are conducted on the proposed candidate protected areas. This report will provide an updated quantitative assessment of the hydrocarbon potential for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas (figure 1).

Earlier reports have been completed for the two areas. These are: Morrow, D.W., 2008, Sambaa' K'e Candidate Protected Area Hydrocarbon Assessment Summary Report, Morrow, D.W., 2007, Ka'a'gee Tu area of interest hydrocarbon assessment summary report, and Drummond, 2010, Ka'a'gee Tu Candidate Protected Area Quantitative Hydrocarbon Assessment. The purpose of the present study is to provide an update to these reports with the latest information to better define the geological plays and give a better distribution of undiscovered oil and gas for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. The update is based on the undiscovered oil and gas volumes from Drummond Consulting, 2004, Oil and Gas Resources of the Deh Cho Territory, prepared for the Deh Cho Land Use Planning Committee. This report uses the geological plays of Gal, L.P. and Jones, A.L, 2003, Evaluation of Oil and Gas Potential in the Deh Cho Territory NWT Open File 2003-03.

Geological Summary

The present discussion will present only a brief summary of the geology of the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. For a more detailed discussion of the geology the reader is referred to Morrow, D.W., 2007, Morrow, D.W., 2008, Hannigan et al, 2011 and Gal, L.P. and Jones, A.L., 2003.

The Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas are located in the Interior Plains of the Great Slave Plain Geological Province. Exposed bedrock across the two Candidate Protected Areas consists of a gently southwestward dipping succession of Upper Devonian strata along the northeastern part, unconformably overlain by Cretaceous strata along the south, as shown on the geological map of figure 2. The subsurface consists of pre-Devonian clastics unconformably on Precambrian basement, overlain by Middle Devonian carbonates and minor shale. The Middle Devonian is characterised by a series of carbonate barrier reef complexes with associated carbonate platforms, which are the primary prospective horizons for the candidate protected areas. The stratigraphic section is about 500 metres thick in the northeast in the vicinity of Big Island, Ka'a'gee Tu Candidate Protected Area and thickens to about 2,000 metres in the south western part of the Sambaa K'e Candidate Protected Area.

A total of thirteen geological plays prospective for oil and gas have been delineated for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. A description of the prospective

DESCRIPTION OF GEOLOGICAL PLAYS

(Modified from L. Gal and A. Jones, 2003 - NWT Open File 2003-03)

Deh Cho Play	Play Name	Play Desciption
Play 3	Slave Point edge	This is an established, non-associated sour gas play that includes all pools and prospects hosted in stratigraphic traps in dolomitized Sulphur Point and Slave Point Formations along a narrow belt at the margin of the Slave Point edge.
Play 4	Slave Point back barrier	This established play encompasses all pools and prospects in Middle Devonian carbonate platform rocks, back from the shelf edge. These include biostromal and platform carbonates of Sulphur Point Formation, as well as Slave Point Formation. The pools contain sour gas, associated with oil east of Cordova Embayment.
Play 5	Sulphur Point - Bistcho	This established play includes both oil and gas prospects hosted in stratigraphic traps composed of Bistcho shelf facies carbonates of the Sulphur Point Formation.
Play 6	Lonely Bay/Horn Plateau reefs	The play is a gas play and includes all pools and prospects in isolated reefs and bioherms located basinward (outboard) from the Slave Point edge.
Play 7	Basal Cretaceous clastics	This established play includes oil and gas prospects within the Lower Cretaceous clastic rocks of the Fort St. John Group.
Play 8	Jean Marie	This is a stratigraphic gas only play that includes pools and prospects in the vicinity of the Cordova Embayment hosted in silty to dolomitic biostromal shelf carbonates of the Jean Marie Member of the Redknife Formation. Also included are pools and prospects in dolomitized reef front carbonates and possible pinnacle reefs that developed at the western margin of the platform.
Play 9	Keg River-Cordova Embayment	The play is a gas play with prospects hosted in dolomitized Lonely Bay Formation (lower Keg River) ramp and platform carbonates within the Cordova Embayment.
Play 10	Basal Devonian clastics	This play includes all pools and prospects in structural and stratigraphic traps where the transgressive basal Devonian clastic rocks unconformably onlap rocks of the Tathlina and other basement highs. The play is analogous to basal Devonian clastics onlapping the Peace River Arch. It is a gas only play.
Play 11	Keg River reefs	This plays includes oil and gas prospects in dolomitized pinnacle reefs growing from the Keg River platform, south of the Middle Devonian carbonate barrier.
Play 12	Arnica/Landry platform	This non-associated gas play includes all pools and prospects hosted in dolomitic Arnica or Landry formation platform carbonates.
Play 13	Lonely Bay (Nahanni) platform	This is a gas play hosted in dolomitized Lonely Bay and Nahanni formation platform carbonates, outboard of the middle Devonian carbonate barrier.
Play 14	Kakisa (Redknife) platform	This play includes all pools and prospects in dolomitized shelf edge shoals, platformal biohermal buildups and subcrop traps associated with the quartzose, dolomitic Kakisa limestone member of the Redknife Formation. It is a gas play.
Play 15	Upper Paleozoic (Sub-Cretaceous) subcrop	The play includes all oil and gas prospects hosted in stratigraphic traps of several potential Upper Paleozoic (Carboniferous and Permian) reservoirs. The most likely reservoir beds are Carboniferous Pekisko, Prophet, and Flett formations. Traps are associated with the sub-Cretaceous unconformity and local faulting.

Table 1. Desciption of the geological plays which occur in the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas that have been quantitatively assessed in this report.

geological plays, adapted from L.P. Gal and A.L. Jones, 2003, for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas is presented in table 1. The distribution of the geological plays is shown in the play maps of figures 3, 4, and 5 adapted from L.P. Gal and A.L. Jones, 2003. Seven of the plays are common to both the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. These are; Slave Point reef edge, Lonely Bay (Nahanni) platform, Lonely Bay Horn Plateau reefs, Kakisa platform, Basal Cretaceous clastics, and Upper Paleozoic (sub Cretaceous) subcrop. Three plays, Sulphur Point Bistcho, Keg River (Rainbow) reefs and basal Devonian clastics are only in the Ka'a'gee Tu Candidate Protected Area. Three plays, Jean Marie, Keg River Cordova Embayment and Arnica/Landry Platform are only in the Sambaa K'e Candidate Protected Area.

Methodology

The present study is based on an update of the assessed volumes of undiscovered oil and gas in the Deh Cho Territory from the Drummond Consulting, 2004, Oil and Gas Resources of the Deh Cho Territory, prepared for the Deh Cho Land Use Planning Committee. In the original Drummond Consulting report (Drummond, 2004) the undiscovered oil and gas resource was distributed evenly across the play area. For many of the plays there are certain parts that are better than others. One important factor is the depth of the prospective reservoir. Deeper depths will contain greater amount of gas per unit volume and also have a better chance of generation and preservation of hydrocarbons. Also uneven reservoir distributions are likely to cause within-play gas volume inhomogeneities, however these are difficult to map, without detailed information. Another factor is that many of the plays come to the surface along or north of the northern margin of the candidate area. There is the risk of flushing of the reservoir in these areas. For formations that outcrop, the play area has been moved further south, than previously defined, to account for some of this risk.

For this 2011 update the plays that occur in the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas were subdivided to reflect the relative potential across the play area. This resulted in the assessment of 28 sub-plays for the thirteen plays that occur in the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. The remaining nine plays in the Deh Cho Territory were not re-evaluated for this study.

For the update assessment of the Deh Cho Territory the Palisade Corporation @Risk simulation add-in program for Excel (appendix A) was used to make new assessments for all the plays or sub-plays of the Deh Cho Territory. This methodology is similar to other probabilistic methods, such as PRIMES (Petroleum Resource Information Management and Evaluation System), used by the Geological Survey of Canada (Hannigan, et al, 2011).

The undiscovered oil and gas for each geological play or sub-play of the Deh Cho Territory was distributed evenly by quarter grid across the play area. For the present study a quarter grid assignment has been done for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. The volumes for these quarter grids is retrieved from the Deh Cho assessment to get the undiscovered oil and gas by play for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. The plays are then summed by quarter grid to derive the total volumes of undiscovered oil and gas for the candidate areas.

Discovered Resources of the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas

A good discussion of hydrocarbon resources was given in the reports, Morrow 2007 and Morrow, 2008, and the reader is referred to those reports for more details. Estimates of discovered resources for the area have been made by the National Energy Board (1993), Janicki (2003), Janicki (2005), and Drummond (2009).

Table 2 shows the discovered oil and gas resources for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. The location of the discoveries in and adjacent to the candidate areas is shown in figure 1. The total discovered recoverable gas resource for the Ka'a'gee Tu Candidate Protected Area is 180 million cubic metres (6.4 billion cubic feet) of natural gas. There are two discovered gas fields in the area and part of the Cameron Hills oil and gas field occurs in the Ka'a'gee Tu Candidate Protected Area. The total discovered recoverable gas resource for the Sambaa K'e Candidate Protected Area is 324 million cubic metres (11.3 billion cubic feet) of natural gas. The total discovered recoverable gas resource for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas is 504 million cubic metres (11.7 billion cubic feet).

Gas Field	Billion Cubic Metres	Billion Cubic Feet
Ka'a'gee Tu		
Tathlina N-18	0.070	2.5
Kakisa F-35	0.010	0.4
Cameron Hills (part)	0.100	3.5
Total Ka'a'gee Tu	**0.180**	**6.4**
Sambaa K'e		
Celibeta H-78	0.154	5.4
Trainor Lake C-39	0.108	3.8
South Island M-41	0.062	2.1
Total Sambaa K'e	**0.324**	**11.3**
Total Candidate Areas	**0.504**	**17.7**

Table 2. Volumes of discovered recoverable gas in the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas

The most relevant discovery in the area is the Cameron Hills oil and gas field, which has estimated initial recoverable resources of 715 thousand cubic metres (4.5 million barrels) of oil and 1,500 million cubic metres (53.25 billion cubic feet) of natural gas. Cumulative production from the field to July 31, 2011 is 372 thousand cubic metres (2.3 million barrels) of oil and 850 million cubic metres (30.2 billion cubic feet) of natural gas.

Other discoveries in the area, shown in figure 1, include Rabbit Lake B-07, with estimated recoverable gas of 318 million cubic metres (11.3 billion cubic feet) and Cameron M-31, with estimated recoverable gas of 60 million cubic metres (2.1 billion cubic feet).

PLAY	UNDISCOVERED RECOVERABLE RESOURCE - DEHCHO TERRITORY						
	GEOLOGICAL PLAY	GAS - Billion Cubic Feet			OIL - Million Barrels		
Number	**Play Name**	**2004**	**2011**	**Change**	**2004**	**2011**	**Change**
3	Slave Point edge	287.8	341.0	53.3	0.0	0.0	0.0
4	Slave Point back barrier	376.0	548.1	172.1	26.2	30.6	4.3
5	Sulphur Point/Bistcho	134.7	137.9	3.2	6.6	7.5	0.9
6	Lonely Bay platform	300.2	295.7	-4.5	0.0	0.0	0.0
7	Basal Cretaceous clastics	198.6	193.5	-5.1	5.9	5.8	-0.1
8	Jean Marie Member	275.5	218.5	-57.0	0.0	0.0	0.0
9	Keg River/Cordova embayment	21.0	21.0	0.0	0.0	0.0	0.0
10	Basal pre-Devonian Clastics	219.7	174.0	-45.8	0.0	0.0	0.0
11	Keg River reef (Rainbow)	80.1	81.9	1.8	5.5	5.3	-0.2
12	Arnica/Landry platform	375.2	375.2	0.0	0.0	0.0	0.0
13	Lonely Bay/Nahanni platform	462.6	311.9	-150.8	0.0	0.0	0.0
14	Kakisa/Redknife platform	70.8	102.5	31.6	0.0	0.0	0.0
15	Upper Paleozoic subcrop	25.4	17.3	-8.0	10.0	8.5	-1.6
	TOTAL PLAYS IN CANDIDATE AREAS	**2,827.7**	**2,818.5**	**-9.2**	**54.2**	**57.6**	**3.4**
	TOTAL OTHER DEH CHO PLAYS	**1,764.6**	**1,764.6**	**0.0**	**0.0**	**0.0**	**0.0**
	TOTAL DEH CHO TERROTORY	**4,592.3**	**4,583.1**	**-9.2**	**54.2**	**57.6**	**3.4**

Table 3. Comparison of 2011 Update Assessment of Undiscovered Ol and Gas Resources (Imperial units) for Plays of the Candidate Protected Areas in the Deh Cho Territory with the 2004 Deh Cho Assessment

PLAY	UNDISCOVERED RECOVERABLE RESOURCE - DEHCHO TERRITORY						
	GEOLOGICAL PLAY	GAS - Million Cubic Metres			OIL - Thousand Cubic Metres		
Number	**Play Name**	**2004**	**2011**	**Change**	**2004**	**2011**	**Change**
3	Slave Point edge	8,107	9,608	1,500	0	0	0
4	Slave Point back barrier	10,592	15,441	4,849	4,170	4,858	688
5	Sulphur Point/Bistcho	3,796	3,886	89	1,042	1,186	144
6	Lonely Bay platform	8,458	8,330	-128	0	0	0
7	Basal Cretaceous clastics	5,594	5,452	-143	939	923	-16
8	Jean Marie Member	7,763	6,157	-1,606	0	0	0
9	Keg River/Cordova embayment	592	592	0	0	0	0
10	Basal pre-Devonian Clastics	6,191	4,901	-1,290	0	0	0
11	Keg River reef (Rainbow)	2,257	2,307	50	866	842	-24
12	Arnica/Landry platform	10,572	10,572	0	0	0	0
13	Lonely Bay/Nahanni platform	13,035	8,787	-4,248	0	0	0
14	Kakisa/Redknife platform	1,996	2,887	891	0	0	0
15	Upper Paleozoic subcrop	715	489	-226	1,597	1,348	-249
	TOTAL PLAYS IN CANDIDATE AREAS	**79,668**	**79,408**	**-260**	**8,614**	**9,157**	**543**
	TOTAL OTHER DEH CHO PLAYS	**49,716**	**49,716**	**0**	**0**	**0**	**0**
	TOTAL DEH CHO TERROTORY	**129,384**	**129,124**	**-260**	**8,614**	**9,157**	**543**

Table 4. Comparison of 2011 Update Assessment of Undiscovered Ol and Gas Resources (metric units) for Plays of the Candidate Protected Areas in the Deh Cho Territory with the 2004 Deh Cho Assessment

Update of the Undiscovered Oil and Gas Potential for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas

The updated assessment resulted in a minor revision of the undiscovered oil and gas potential for the Deh Cho Territory (tables 3 and 4). The undiscovered recoverable gas decreased slightly by 260 million cubic metres (9.2 billion cubic feet), from 81,432 to 81,172 million cubic metres (4,592 billion cubic feet to 4,583 billion cubic feet). The undiscovered recoverable oil potential has increased by 543 thousand cubic metres (3.4 million barrels), from 8,614 to 9,157 thousand cubic metres (54.2 million barrels to 57.6 million barrels0. Although the changes in the total undiscovered potential are minor, the distribution of the undiscovered resources has changed, resulting in significant changes to the undiscovered oil and gas resources of the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas.

	Recoverable Oil (10^3m^3)			Recoverable Gas (10^6m^3)		
	2004	2011	Change	2004	2011	Change
Ka'a'gee Tu	1,108.5	1,064.2	-44.3	6,457.7	4,888.1	-1,569.6
Sambaa K'e	1,020.0	1,510.2	490.2	11,636.0	14,604.4	2,968.4
Total	2,128.5	2,574.4	445.9	18,093.7	19,492.5	1,398.8

	Recoverable Oil (MMB)			Recoverable Gas (BCF)		
	2004	2011	Change	2004	2011	Change
Ka'a'gee Tu	7.0	6.7	-0.3	229.2	173.5	-55.7
Sambaa K'e	6.4	9.5	3.1	413.0	518.4	105.4
Total	13.4	16.2	2.8	642.2	691.9	49.7

Table 5. Undiscovered oil and gas resources for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas, 2011 update assessment with comparison to earlier assessments (earlier assessments in Morrow (2007, 2008) and Drummond (2010) were based on the Deh Cho Assessment of Drummond, 2004)

The undiscovered potential for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas is estimated to be 2,574 thousand cubic metres (16.2 million barrels) of recoverable oil and 19,943 million cubic metres (692 billion cubic feet) of recoverable gas. As shown in table 5, this compares to 2,128 thousand cubic metres (13.4 million barrels) of recoverable oil and 18,094 million cubic metres (642 billion cubic feet) of recoverable gas from the earlier assessments. In total for the two areas the update results show an increase of 1,399 million cubic metres (49.7 billion cubic feet) for recoverable gas and an increase of 446 million cubic metres (2.8 million barrels) for recoverable oil. As indicated in the table volumes decreased in the Ka'a'gee Tu Candidate Protected Area and increased in the Sambaa K'e Candidate Protected Area. The following discussion will review each of the proposed candidate protected areas separately.

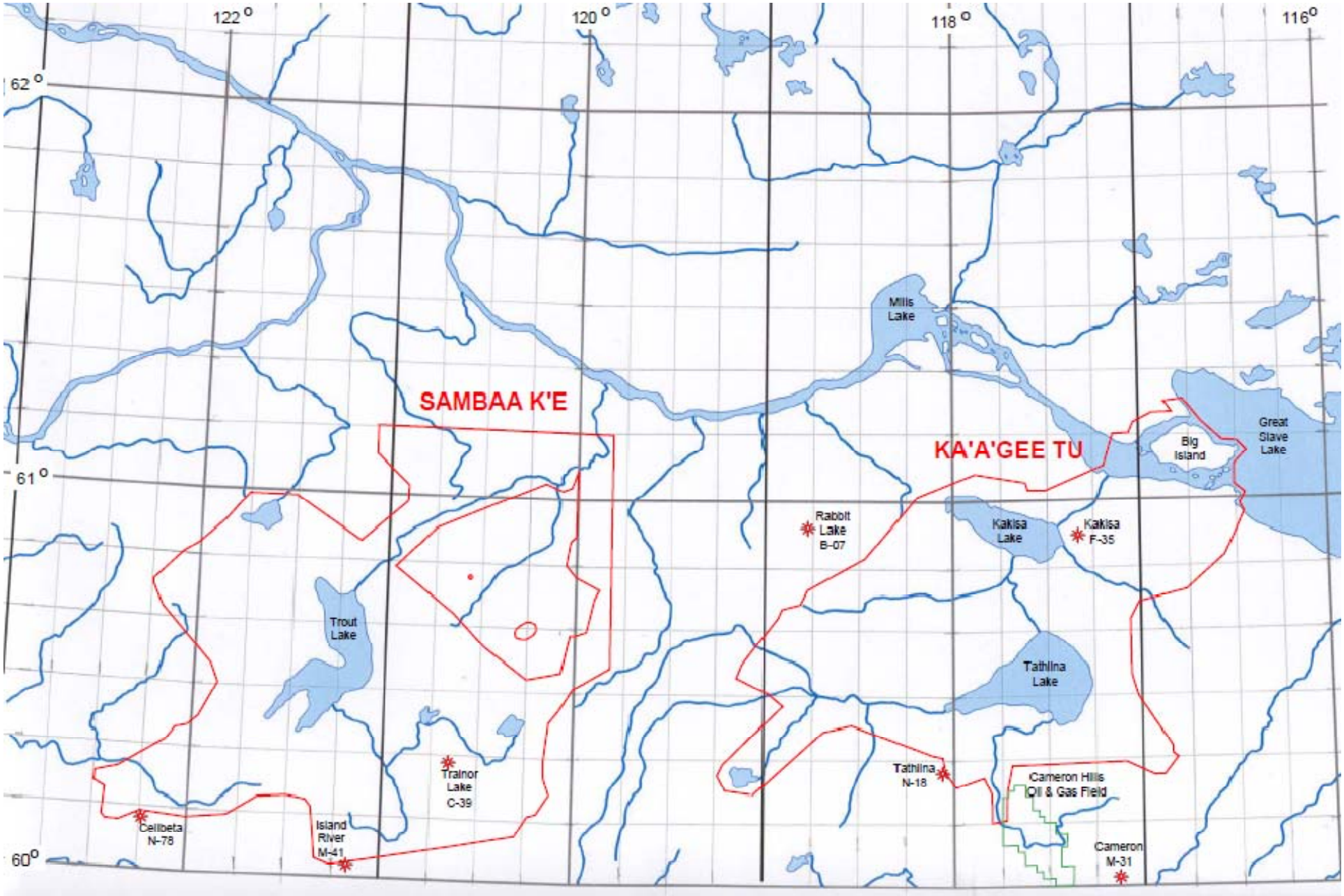


Figure 1. Index Map of the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas , showing Oil and Gas Discoveries in and adjacent to the Candidate Areas

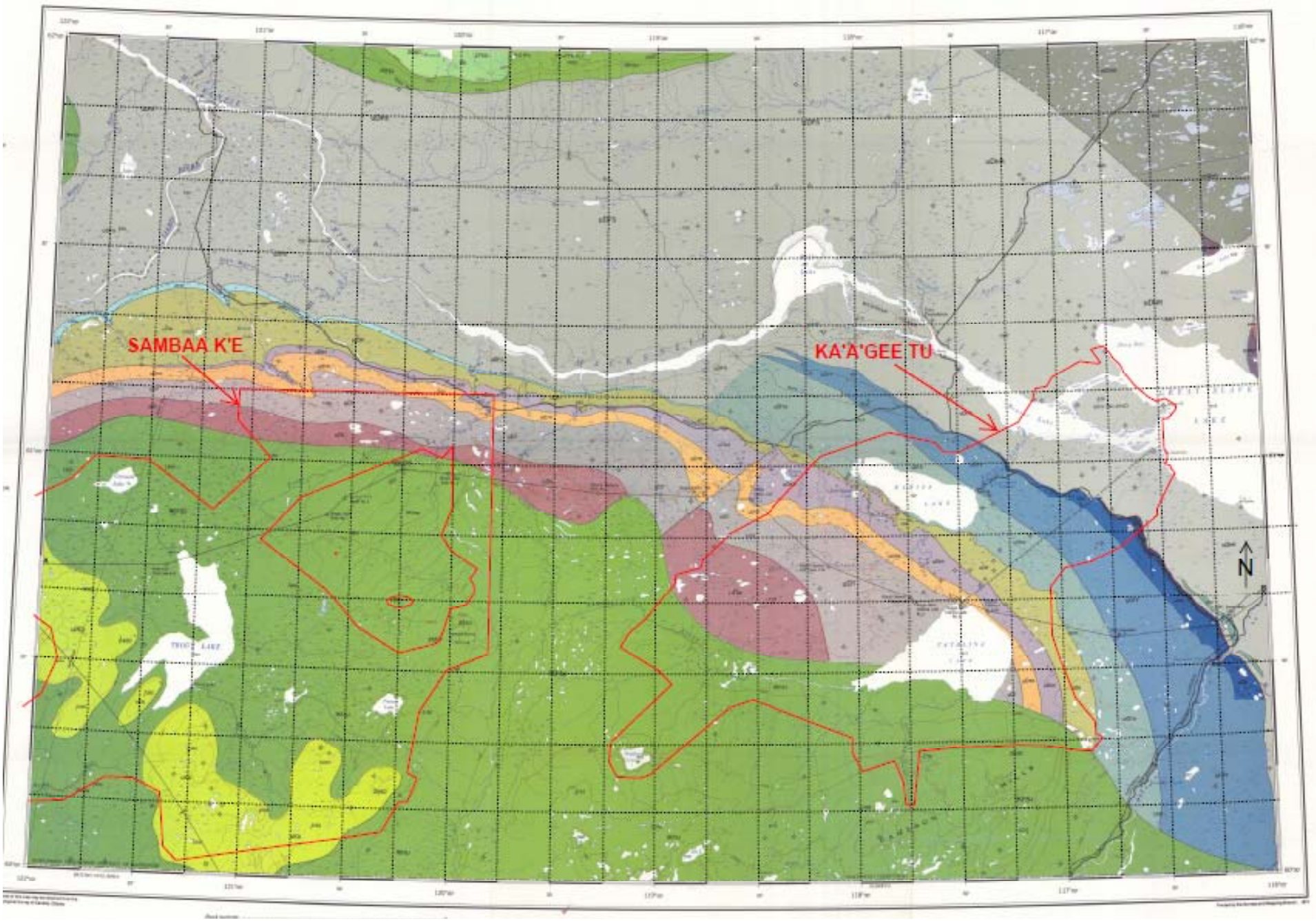


Figure 2. Geological Map of Ka’a’gee Tu and Sambaa K’e Candidate Protected Areas (GSC Map 1371A)

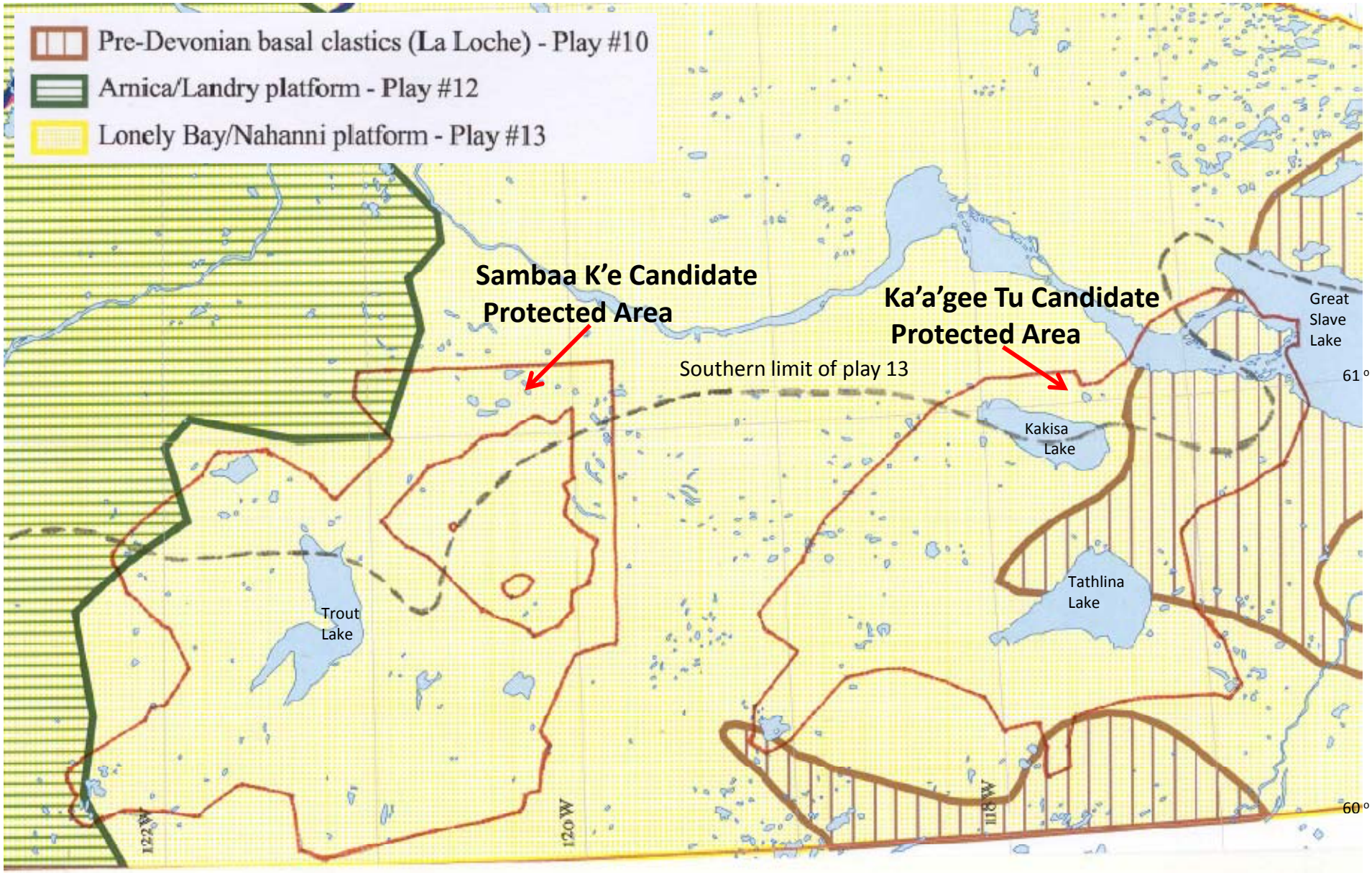


Figure 3. Lower Paleozoic play areas in the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas
From Gal, L.P. and Jones, A.L. (NWT Open File 2003-03)

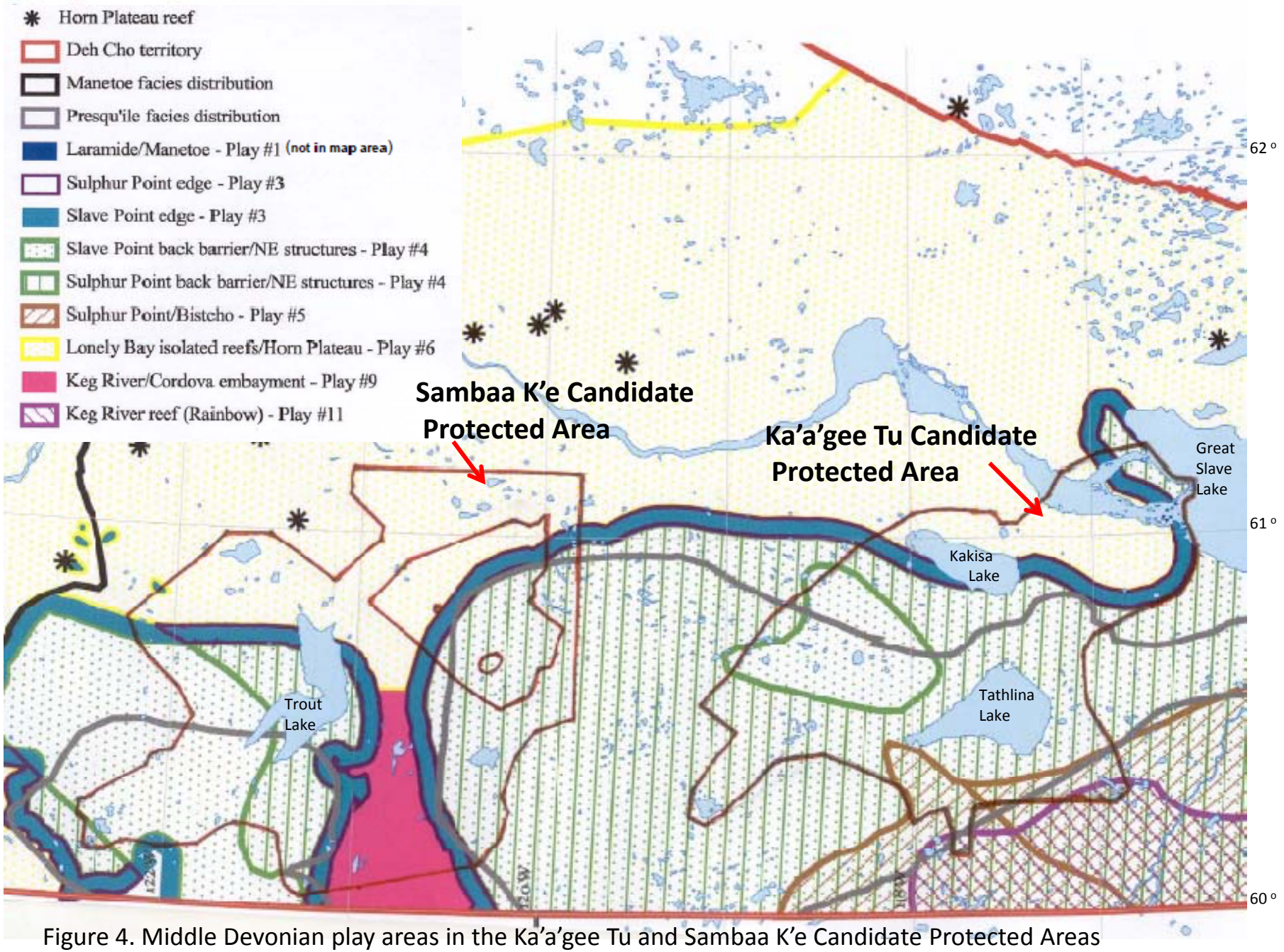


Figure 4. Middle Devonian play areas in the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas
From Gal, L.P. and Jones, A.L. (NWT Open File 2003-03)

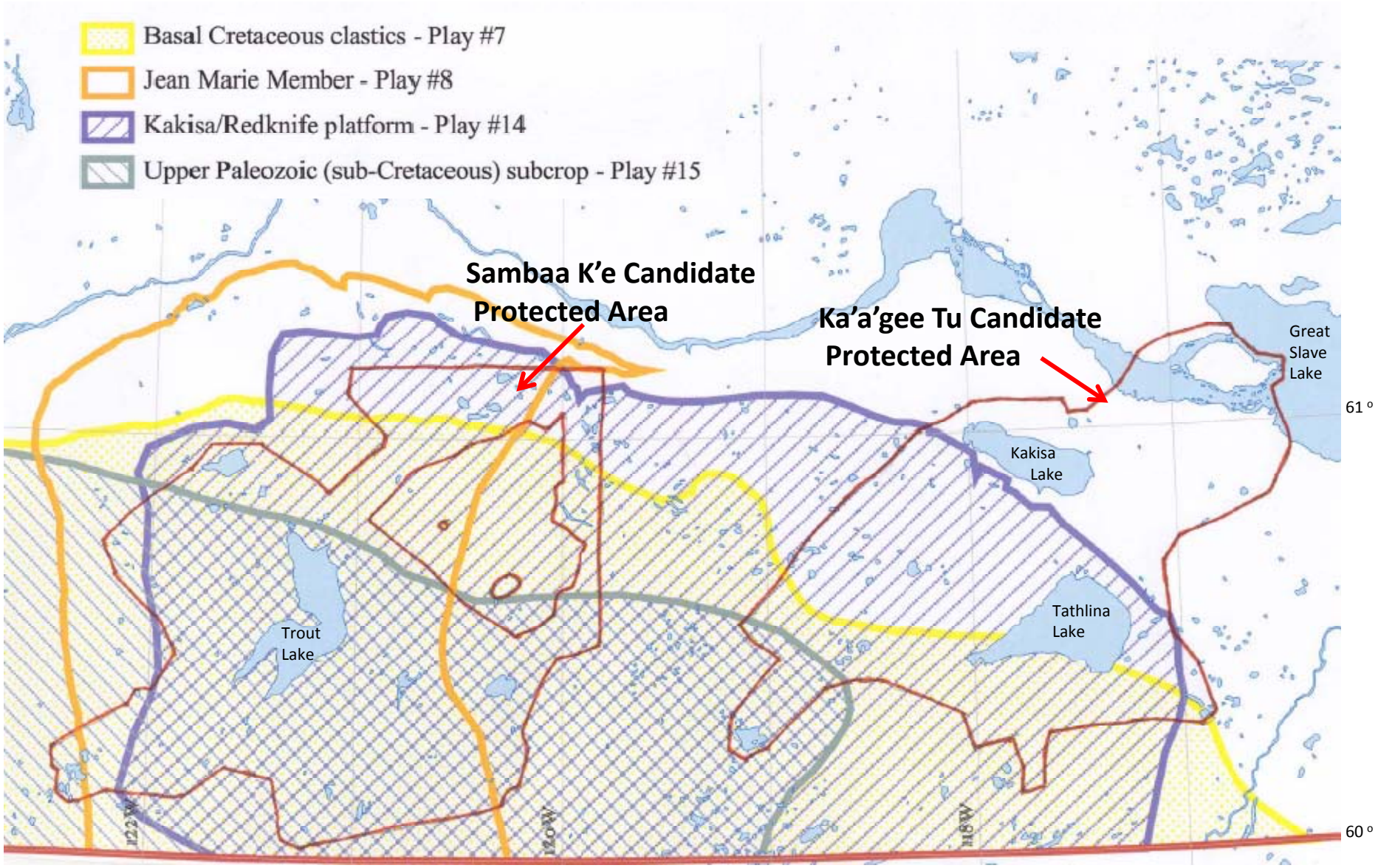


Figure 5. Upper Paleozoic and Cretaceous play areas in the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas From Gal, L.P. and Jones, A.L. (NWT Open File 2003-03)

Update of the Hydrocarbon Potential for the Ka'a'gee Tu Candidate Protected Area

The geological setting for the Ka'a'gee Tu Candidate Protected Area, from GSC map 1371-A is shown in figure 6. The area is characterized by a westward dipping succession of Devonian rocks, primarily carbonate, overlain by Cretaceous rocks, mainly sandstone, along the southwest. The rocks are successively younger from northeast to the southwest.

The cross-section (figure 7) extending from Alexandra No 6 (M-19) in the Dogface Lake area in the southwest to Big Island G-56 in the northeast shows the sedimentary section for the Ka'a'gee Tu Candidate Protected Area. The wells for the section are designated by letter symbol only, without the well name. The sedimentary section overlying the Precambrian granitic basement dips to the southwest. The sedimentary section thickens from about 500 metres (1,640 feet) in the Big Island area to about 1,700 metres (5,630 feet) in the Dogface Lake area. The dominant lithology for the formation is shown by color. The main geological plays for the area are shown; Basal Devonian sandstone (La Loche), the carbonates of the Keg River, Sulphur Point, and Slave Point , the late Paleozoic (Mississippian) subcrop below the Cretaceous and Cretaceous sandstone.

One of the significant factors considered in the sub-division of plays was the depth of prospective reservoirs, which affects the gas volumes to be expected. Also the deeper reservoirs are more likely to have generated and preserved hydrocarbons. As illustrated on this slide there is considerable difference in the depth of the formations. For example the Slave Point is at a depth of 198 metres (650 feet) in Big Island G-56, compared to a depth of 1,398 metres (4,587 feet) in Alexandra M-19. As a result of compressibility a much greater volume of natural gas will occur in the same rock pore space at deeper depths.

The known occurrences of oil and gas in and adjacent to the Ka'a'gee Tu Candidate Protected Area are shown in figure 8. Three Significant Discovery Licences (SDL) have been granted in the area; Rabbit Lake O-16, with 318.4 million cubic metres (11.3 BCF) of recoverable gas, Tathlina N-18, with 70.4 million cubic metres (2.5 BCF) of recoverable gas, and Cameron M-31, with 59.2 million cubic metres (2.1 BCF) of recoverable gas. The Cameron Hills field has initial recoverable resources estimated at 715 thousand cubic metres (4.5 MMB) of oil and 1,499 million cubic metres (53.2 BCF) of gas. Cumulative production from the Cameron Hills field to June 30, 2011 is 371 thousand cubic metres (2.3 MMB) of oil and 844 million cubic metres (30.0 BCF) of natural gas. Kakisa F-35, with no SDL is estimated to have 0.4 BCF (.01 $10^6 m^3$) of recoverable gas (Morrow, 2007). Gull Creek A-63, although no resources are assigned, tested gas at a maximum rate of 20,700 cubic metres per day (734 mcf/day). The total discovered resources for the Ka'a'gee Tu Candidate Protected Area, as shown in table 2, is 180 million cubic metres (6.4 billion cubic feet) of recoverable natural gas.

The undiscovered oil and gas resources by geological play for the Ka'a'gee Tu Candidate Protected Area is summarized in table 6. The total undiscovered potential for the Ka'a'gee Tu Candidate Protected Area is estimated to be 1,108 thousand cubic metres (7 million barrels) of recoverable oil and 6,458 million cubic metres (229 billion cubic feet) of recoverable gas. A statistical @Risk summary of the undiscovered oil and gas for the Ka'a'gee Tu Candidate Protected Area is presented in table 7. Overall the undiscovered oil and gas potential is considered to be moderate for the Ka'a'gee Tu Candidate Protected Area.

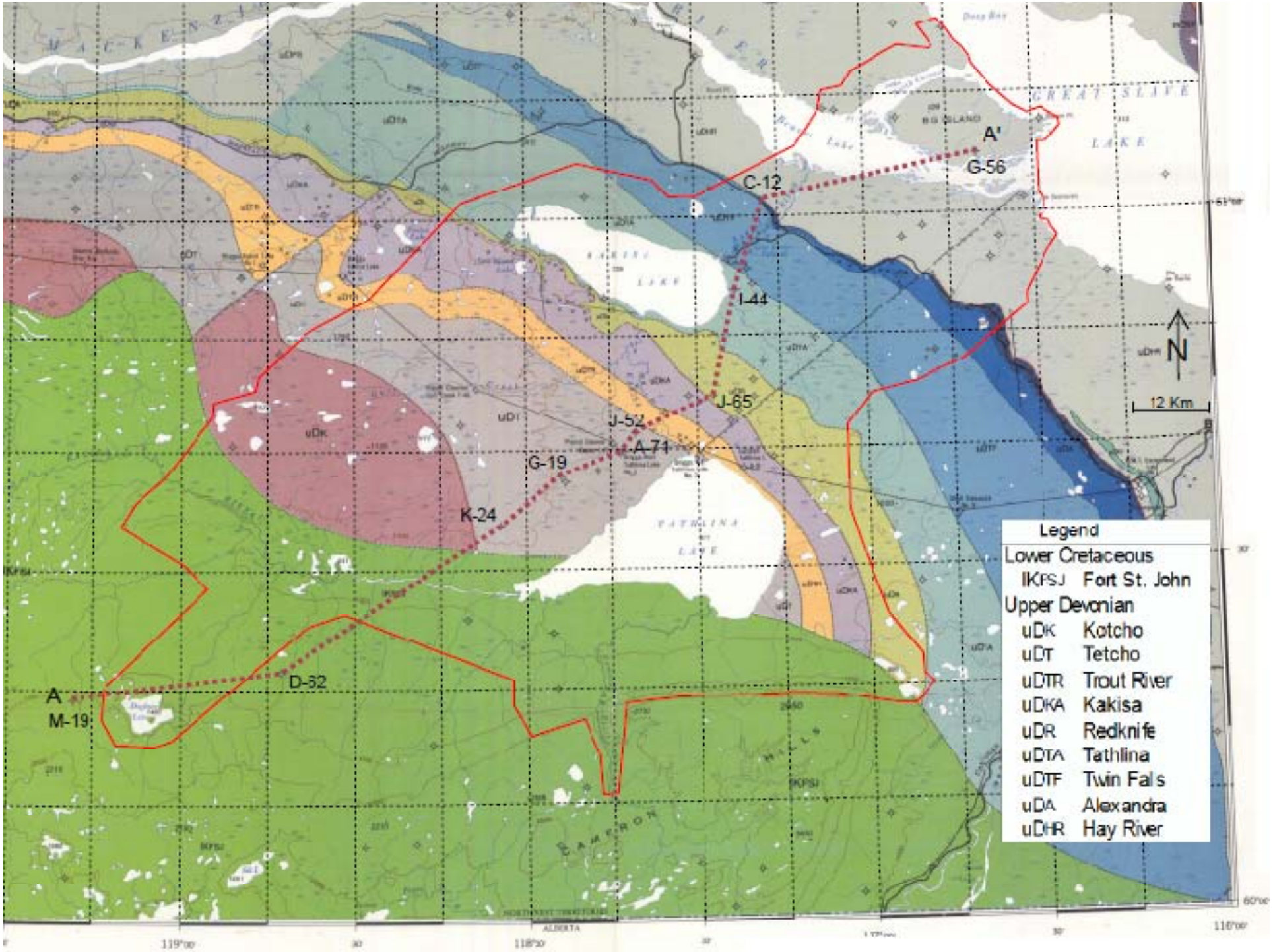


Figure 6. Geological map (GSC map 1371-A) of the Ka'a'gee Tu Candidate Protected Area showing line of cross-section from Alexandra M-19 to Big Island G-56.

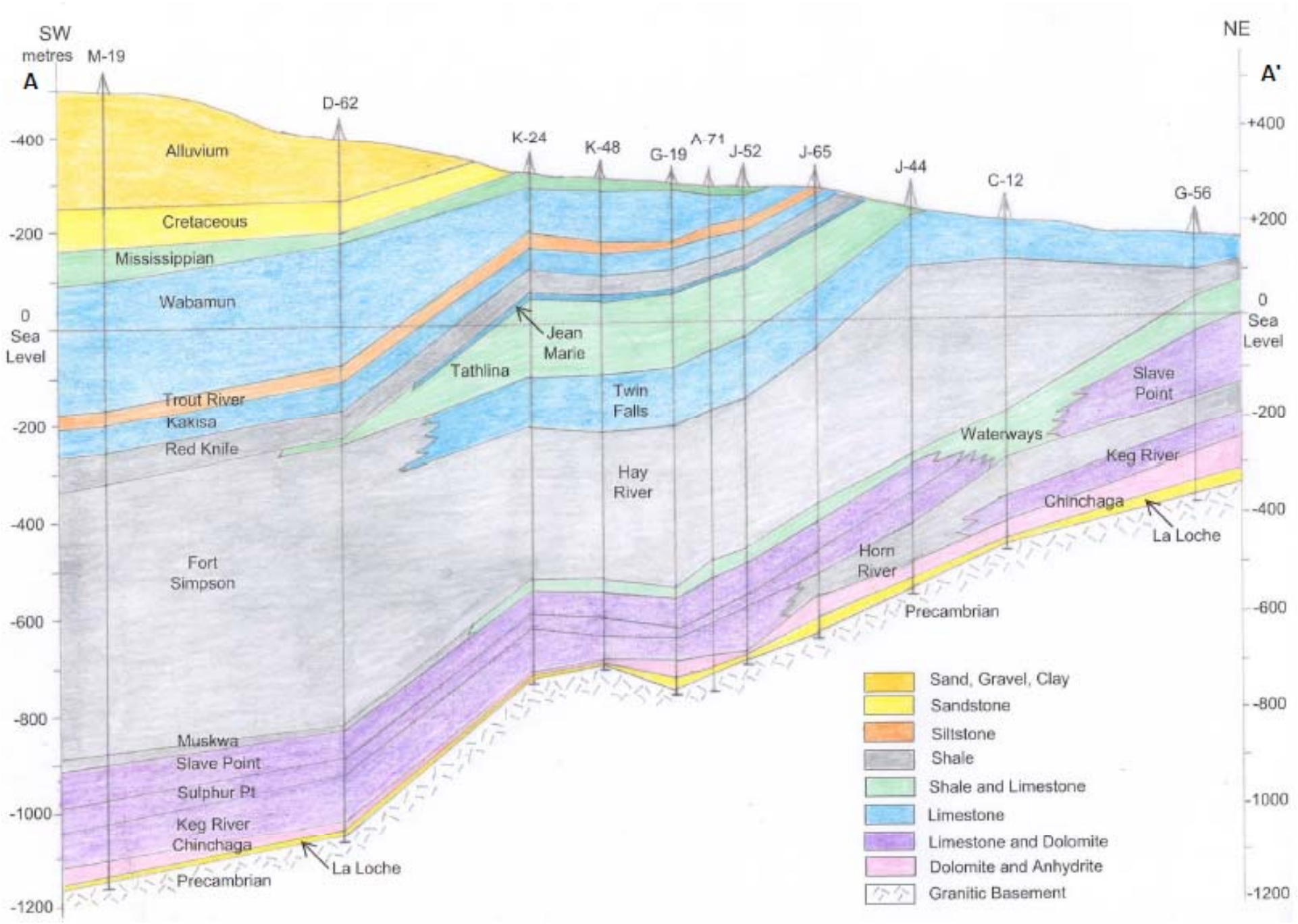


Figure 7. Southwest to northeast cross-section AA' from Alexandra M-19 to Big Island G-56 showing the stratigraphic section across the Ka'a'gee Tu Candidate Protected Area.

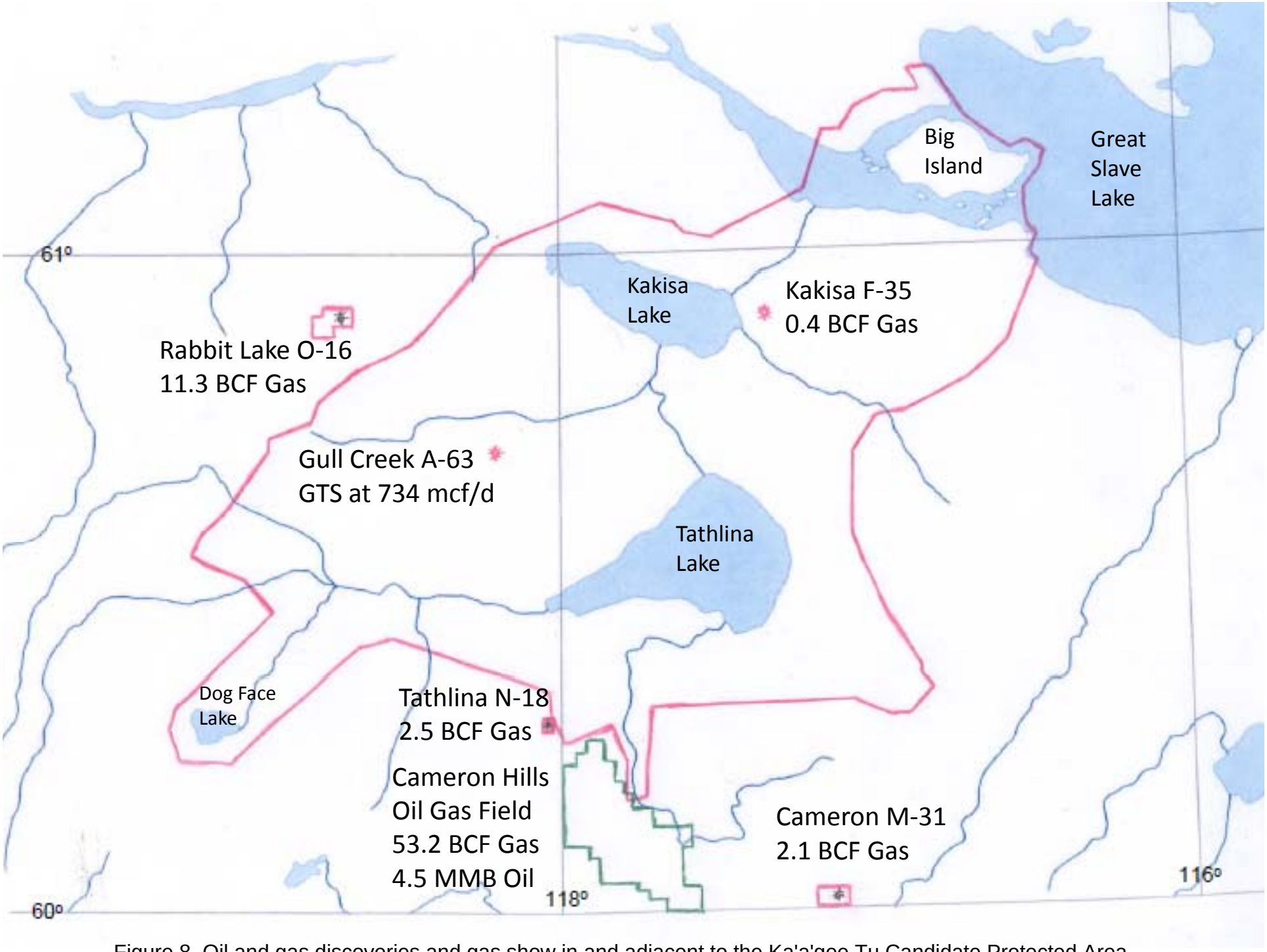


Figure 8. Oil and gas discoveries and gas show in and adjacent to the Ka'a'gee Tu Candidate Protected Area.

UNDISCOVERED OIL AND GAS POTENTIAL KA' A' GEE TU CANDIDATE PROTECTED AREA

GAS - MILLION CUBIC METRES , OIL - THOUSAND CUBIC METRES

PLAY_NAME	Deh Cho Play	Gas in Place	Recoverable Gas	Marketable Gas	Oil in Place	Recoverable Oil
Slave Point back barrier	4	2,838.1	2,181.4	1,979.2	5,319.5	886.2
Basal Devonian clastics	10	1,316.8	877.8	699.6	0.0	0.0
Slave Point edge	3	1,011.5	720.2	638.8	0.0	0.0
Sulphur Point - Bistcho	5	582.5	432.0	395.9	871.5	113.1
Lonely Bay/Horn Plateau reefs	6	344.9	252.9	223.3	0.0	0.0
Kakisa (Redknife) platform	14	374.8	243.5	223.3	0.0	0.0
Lonely Bay (Nahanni) platform	13	115.6	82.8	70.8	0.0	0.0
Keg River reefs	11	76.0	52.8	47.0	148.5	19.3
Basal Cretaceous clastics	7	45.0	36.2	32.1	44.7	9.7
Upper Paleozoic (Sub-Cret) subcrop	15	11.7	8.6	8.0	166.1	35.9
	TOTAL	**6,716.9**	**4,888.1**	**4,317.9**	**6,550.4**	**1,064.2**

GAS - BILLION CUBIC FEET , OIL - MILLION BARRELS

PLAY_NAME	Deh Cho Play	Gas in Place	Recoverable Gas	Marketable Gas	Oil in Place	Recoverable Oil
Slave Point back barrier	4	100.7	77.4	70.2	33.475	5.577
Basal Devonian clastics	10	46.7	31.2	24.8	0.000	0.000
Slave Point edge	3	35.9	25.6	22.7	0.000	0.000
Sulphur Point - Bistcho	5	20.7	15.3	14.1	5.484	0.712
Lonely Bay/Horn Plateau reefs	6	12.2	9.0	7.9	0.000	0.000
Kakisa (Redknife) platform	14	13.3	8.6	7.9	0.000	0.000
Lonely Bay (Nahanni) platform	13	4.1	2.9	2.5	0.000	0.000
Keg River reefs	11	2.7	1.9	1.7	0.935	0.121
Basal Cretaceous clastics	7	1.6	1.3	1.1	0.282	0.061
Upper Paleozoic (Sub-Cret) subcrop	15	0.4	0.3	0.3	1.045	0.226
	TOTAL	**238.4**	**173.5**	**153.3**	**41.221**	**6.697**

Table 6. Undiscovered oil and gas for Ka'a'gee Tu Candidate Protected Area by geological play, ranked by recoverable gas. Deh Cho Play number reference is geological plays outlined in L.Gal and A. Jones, 2003.

@RISK Output Results — KA'A'GEE TU UNDISCOVERED RESOURCES

Performed By: Ken Drummond
Date: July 25, 2011 12:23:24 PM

TOTAL ALL PLAYS

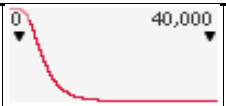
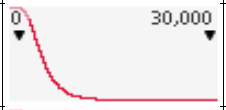
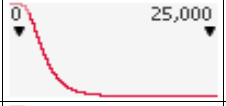
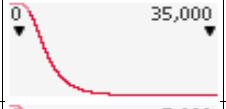
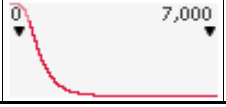
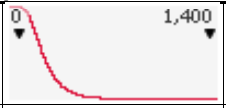
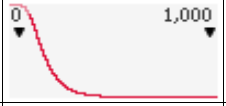
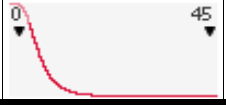
	Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Ka'a'gee Tu Undiscovered Resource (Metric)									
	GAS IN PLACE (106m3)	SumOutput	B10		6,716.752	6,080.116	3,132.600	3,464.383	10,733.240
	RECOVERABLE GAS (106m3)	SumOutput	B11		4,888.129	4,420.249	2,293.075	2,512.119	7,825.401
	MARKETABLE GAS (106m3)	SumOutput	B12		4,318.036	3,905.327	2,024.550	2,220.722	6,910.066
	OIL IN PLACE (103m3)	SumOutput	B13		6,550.297	5,908.762	3,115.656	3,331.088	10,537.770
	RECOVERABLE OIL (103m3)	SumOutput	B14		1,064.269	951.305	530.501	525.067	1,737.256
Range: Ka'a'gee Tu Undiscovered Resource (Imperial)									
	GAS IN PLACE (BCF)	SumOutput	B3		238.403	215.806	111.188	122.964	380.963
	RECOVERABLE GAS (BCF)	SumOutput	B4		173.498	156.891	81.390	89.164	277.753
	MARKETABLE GAS (BCF)	SumOutput	B5		153.263	138.615	71.859	78.822	245.264
	OIL IN PLACE (MMB)	SumOutput	B6		41.220	37.183	19.606	20.962	66.313
	RECOVERABLE OIL (MMB)	SumOutput	B7		6.697	5.986	3.338	3.304	10.932

Table 7. Statistical summary of total undiscovered oil and gas resources for the Ka'a'gee Tu Candidate Protected Area.

Update for Natural Gas Resources of the Ka'a'gee Tu Candidate Protected Area

A relatively small amount of natural gas has been discovered to date in the Ka'a'gee Tu Candidate Protected Area. The initial discovered natural gas resource in the Ka'a'gee Tu Candidate Protected Area, as of December 31, 2010 is:

	Billion cubic metres (Bcf)
Initial discovered gas-in-place	0.24 (8.5)
Initial recoverable raw gas	0.18 (6.4)
Initial marketable gas	0.17 (6.0)

The updated undiscovered natural gas potential for the Ka'a'gee Tu Candidate Protected Area is estimated to be 6,717 million cubic metres (238.4 billion cubic feet) gas-in-place, 4,888 million cubic metres (173.5 billion cubic feet) recoverable, and 4,318 million cubic metres (153.3 billion cubic feet) of marketable gas. The cumulative frequency distribution for undiscovered gas is shown in figure 9. There is an 80% probability the undiscovered recoverable gas is in the range of 2,512 to 7,825 million cubic metres (89.1 to 277.8 billion cubic feet), with a mean of 4,888 million cubic metres (173.5 billion cubic feet) at a probability of 40%.The median (50%) value is 4,420 million cubic metres (156.9 billion cubic feet).

The distribution of recoverable gas resources by million cubic metres and billion cubic feet per quarter grid for the Ka'a'gee Tu Candidate Protected Area is shown in Excel map format of figure 10. The highest gas potential is in an arc that follows the Slave Point edge (Play #3) of figure 3, along the southern half of Kakisa Lake, east to the eastern boundary of the Ka'a'gee Tu Candidate Protected Area to the Big Island area. An area of somewhat lower potential occurs to the southwest of Kakisa Lake.

Overall the average undiscovered recoverable gas is estimated at 7,080 cubic metres per hectare (102 thousand cubic feet per acre) for the Ka'a'gee Tu Candidate Protected Area. This compares to an estimated ultimate (discovered plus undiscovered) recoverable gas of 72,000 cubic metres per hectare (one million cubic feet per acre) for the Western Canada Sedimentary Basin, and estimated ultimate for the Beaufort Mackenzie Basin of 42,800 cubic metres per hectare (615 thousand cubic feet per acre).

The undiscovered gas potential, ranked by recoverable gas, for the various plays is shown in table 6. The number one ranked play with the largest volume, 2,181 million cubic metres (77.4 billion cubic feet) of undiscovered recoverable gas is the Slave Point Back Barrier Play. This play represents 44.6% of the total estimated undiscovered natural gas potential for the Ka'a'gee Tu Candidate Protected Area.

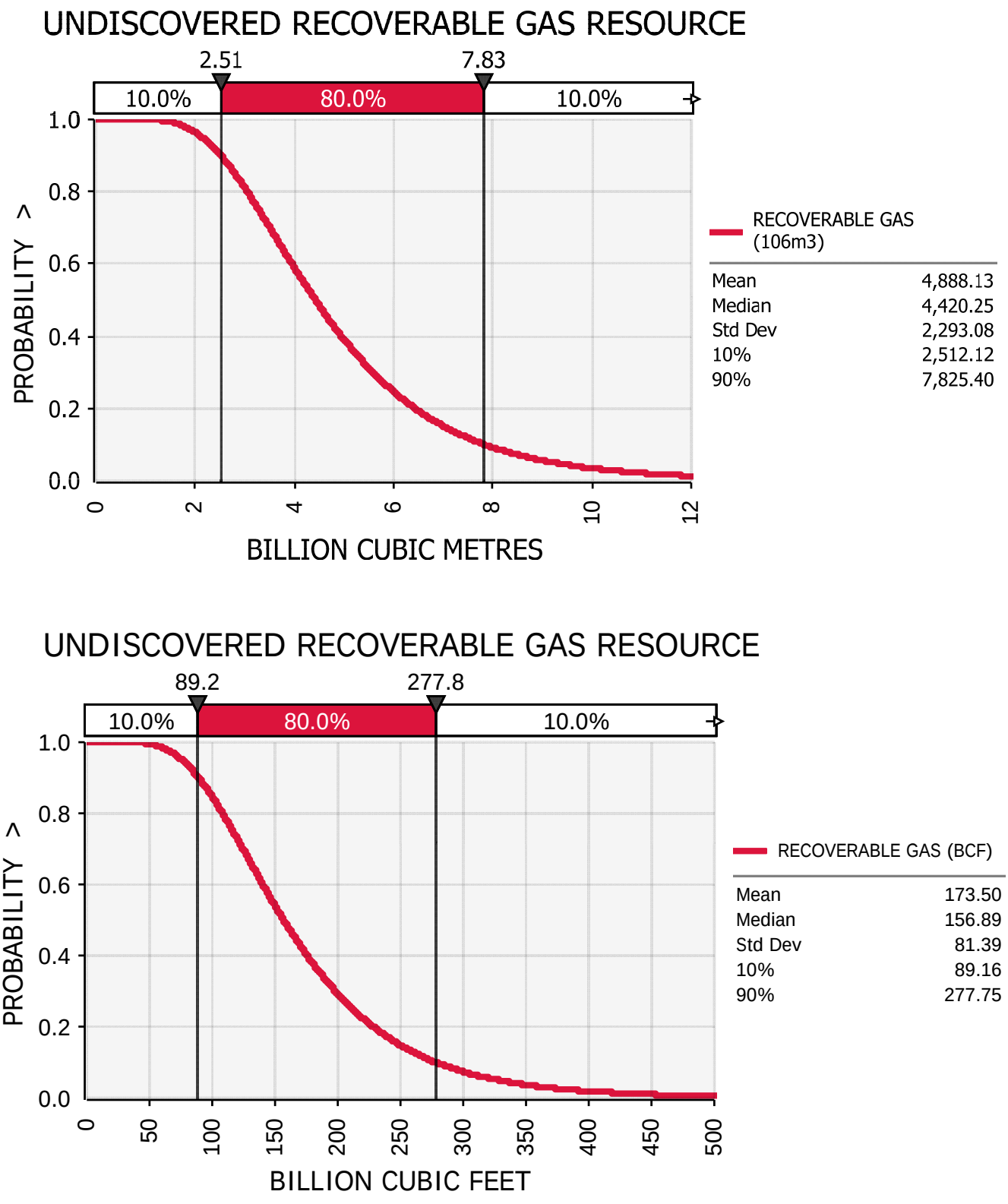


Figure 9. Cumulative frequency distribution of undiscovered recoverable gas for the Ka'a'gee Tu Candidate Protected Area

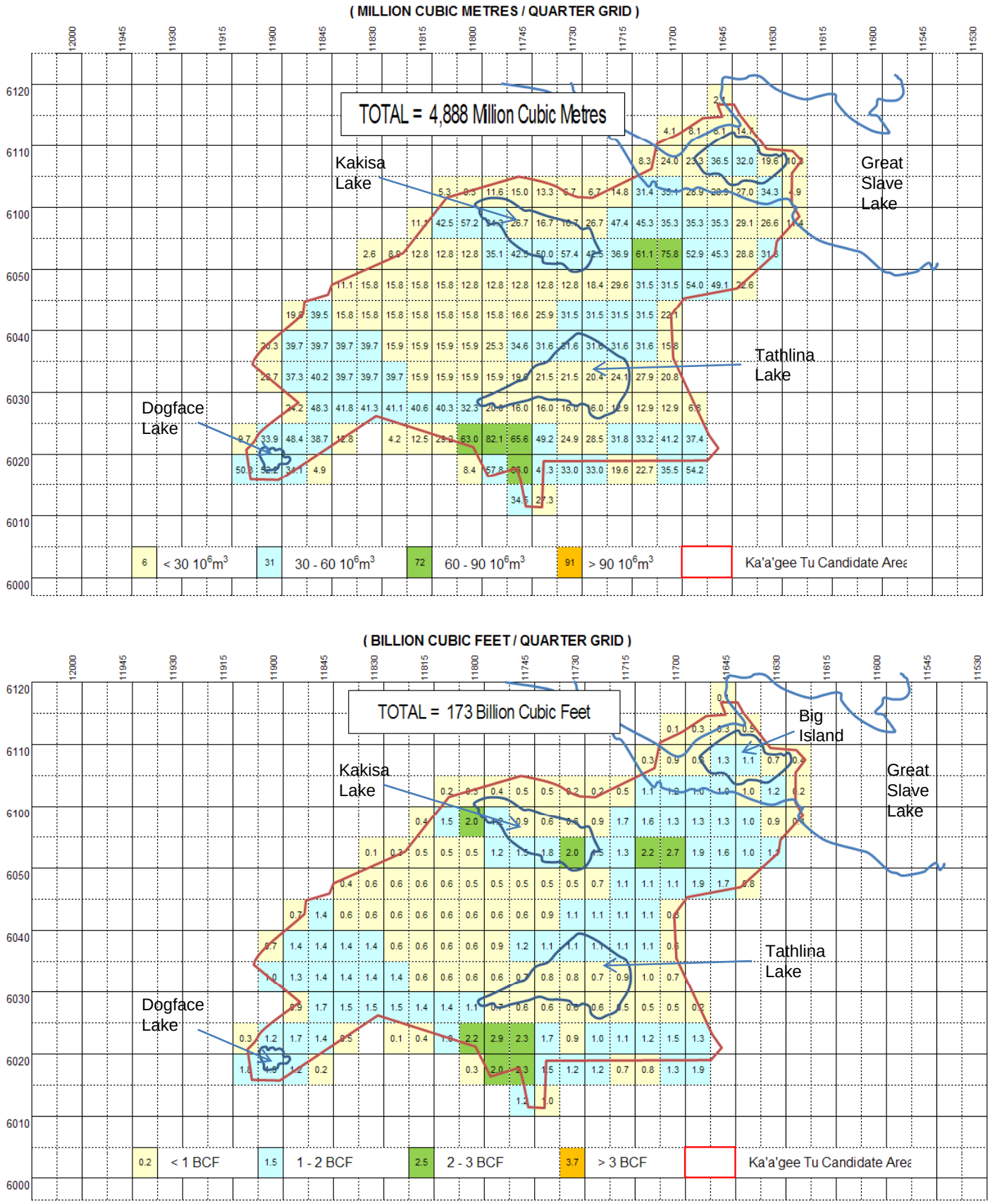


Figure 10. Ka’a’gee Tu Candidate Protected Area – Distribution of undiscovered recoverable gas by quarter grid

Update of Oil Resources for the Ka'a'gee Tu Candidate Protected Area

There is no discovered oil resource for the Ka'a'gee Tu Candidate Protected Area, although oil has been discovered and is producing from the Cameron Hills field, immediately to the south of the area.

The undiscovered recoverable oil potential for the Ka'a'gee Tu Candidate Protected Area is estimated to be 6,650 thousand cubic metres (41.2 million barrels) oil-in-place, and 1,064 thousand cubic metres (6.7 million barrels) of recoverable oil. The cumulative frequency distribution for undiscovered oil is shown in figure 11. There is an 80% probability the undiscovered recoverable oil is in the range of 525 to 1,737 thousand cubic metres (3.3 to10.9 million barrels), with a mean of 1,064 thousand cubic metres (6.7 million barrels) at a probability of 40%. The median (50%) value is 951 thousand cubic metres (6.0 million barrels).

The distribution of undiscovered recoverable oil resources by thousand cubic metres and thousand barrels per quarter grid for the Ka'a'gee Tu Candidate Protected Area is shown in Excel map format in figure 12. The undiscovered oil potential for the Ka'a'gee Tu Candidate Protected Area lies south of 60^{o} 55' and in the Big Island area. The greatest oil potential is concentrated along the southern boundary immediately north of the Cameron Hills, where discoveries have been made.

Overall the average undiscovered recoverable oil is estimated at 1.2 cubic metres per hectare (3.0 barrels per acre) for the Ka'a'gee Tu Candidate Protected Area. This compares to an estimated ultimate (discovered plus undiscovered) recoverable oil of 34 cubic metres per hectare (86 barrels per acre) for the Western Canada Sedimentary Basin, and estimated ultimate for the Beaufort Mackenzie Basin of 33 cubic metres per hectare (83 barrels per acre).

The undiscovered recoverable oil potential for the various plays is shown in table 6. The number one ranked play for recoverable oil is the Slave Point Back Barrier play, with 886 thousand cubic metres (5.6 million barrels). The Slave Point Back Barrier play represents 83.3% of the total estimated undiscovered recoverable oil potential.

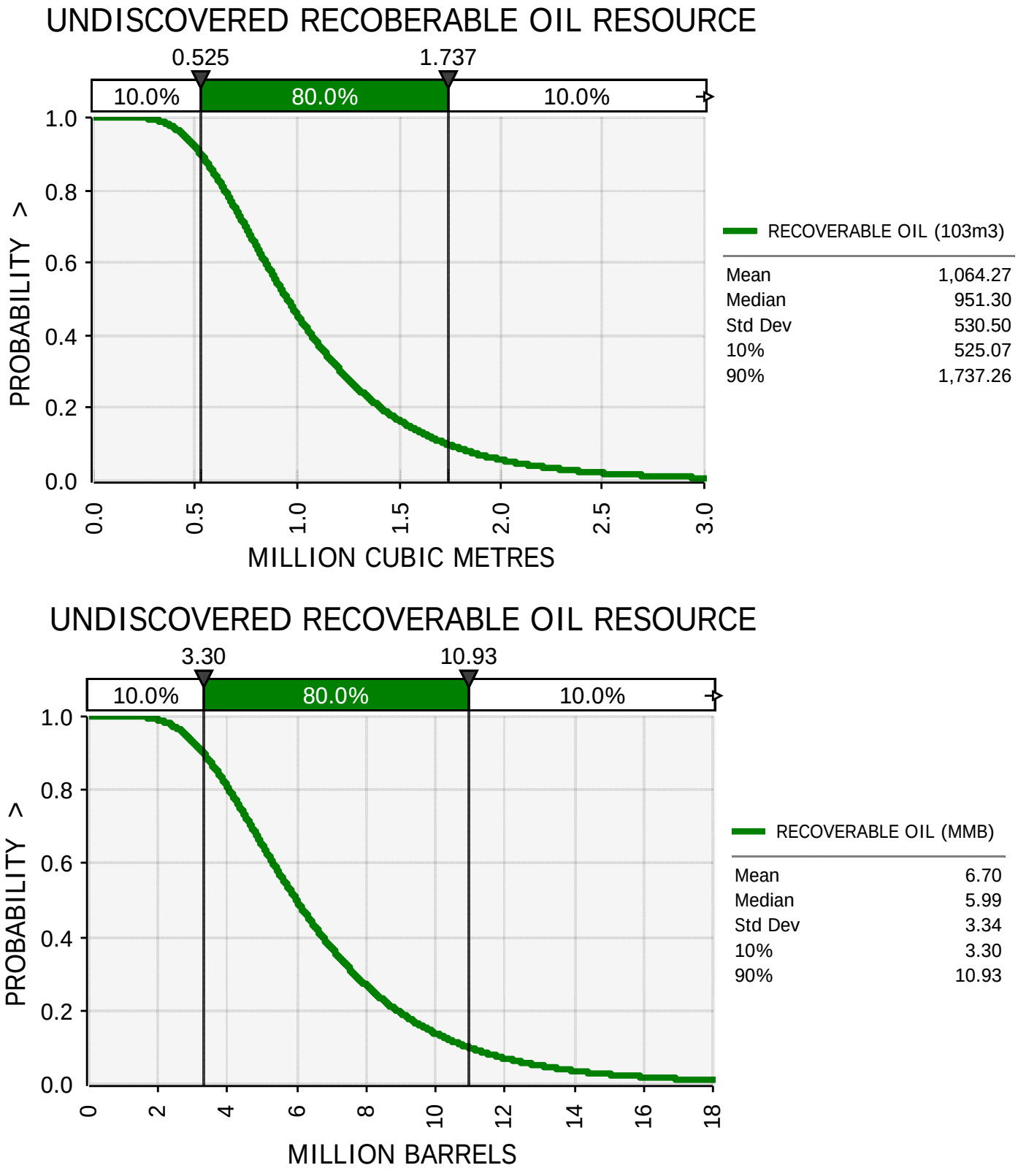


Figure 11. Cumulative frequency distribution of undiscovered recoverable oil for the Ka'a'gee Tu Candidate Protected Area.

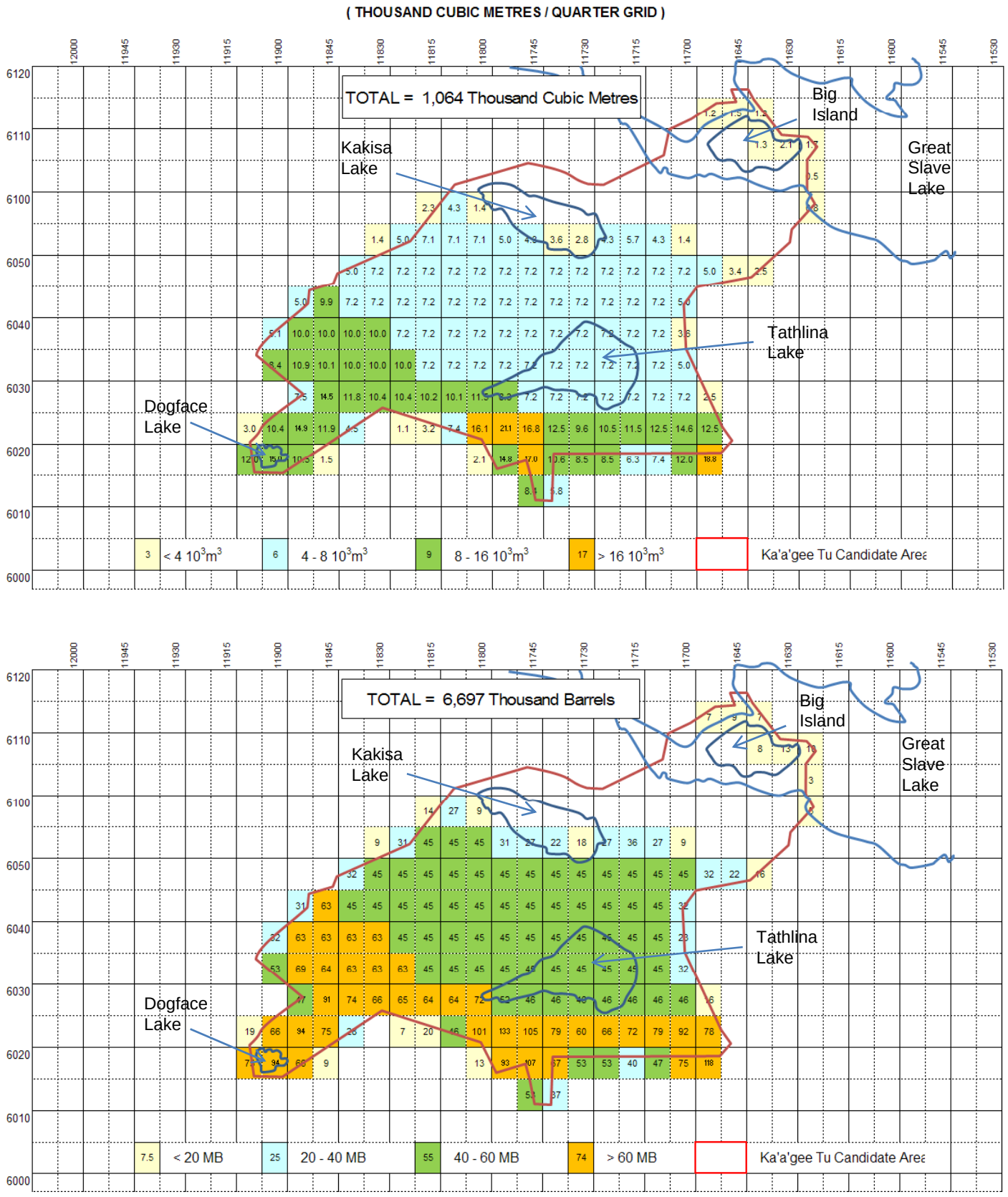


Figure 12. Ka'a'gee Tu Candidate Protected Area – Distribution of undiscovered recoverable oil by quarter grid

Comparative Analysis of the Ka'a'gee Tu Candidate Protected Area with Dehcho Territory and Total Mackenzie Valley

Table 8 shows the comparison of the sedimentary area, discovered, undiscovered and ultimate recoverable oil and gas resources for the Ka'a'gee Tu Candidate Protected Area, the Dehcho Territory and the total Mackenzie Valley. The sedimentary area, which is the area with sediments prospective for oil and/or gas, for the Ka'a'gee Tu Candidate Protected Area represents 5.5% of the Dehcho Territory and 2.1% of the total Mackenzie Valley. The Ka'a'gee Tu Candidate Protected Area has only 0.9% of the discovered recoverable gas, 3.8% of the undiscovered recoverable gas, and 3.4 % of the ultimate recoverable gas in the Dehcho territory. There is no discovered oil in the Ka'a'gee Tu Candidate Protected Area, and it is estimated to have 11.6% of the undiscovered recoverable oil and 10.8% of the ultimate recoverable oil in the Dehcho territory. As a percentage of the ultimate resource in the Mackenzie Valley, the Ka'a'gee Tu Candidate Protected Area is estimated to have 1.2% of the recoverable gas and 1.1% of the recoverable oil.

Table 9 is the ultimate recoverable oil and gas resources per unit area (richness) for the Ka'a'gee Tu Candidate Protected Area, the Dehcho territory and the total Mackenzie Valley. Recoverable oil is given in cubic metres per hectare and barrels per acre and recoverable gas in thousand cubic metres per hectare and thousand cubic feet per acre. This is often referred to as richness. The Ka'a'gee Tu Candidate Protected Area, in terms of oil, is about twice as rich as the overall Dehcho territory, one third of the other Mackenzie Valley and about half that of the overall Mackenzie Valley. In terms of natural gas, the Ka'a'gee Tu Candidate Protected Area is 56% of the values for the overall Deh Cho territory and 62% of the Mackenzie Valley.

Table 10 (metric units) and table 11 (imperial units) show the undiscovered oil and gas resources for all plays of the Dehcho Territory and the portion of the resource that is in the Ka'a'gee Tu Candidate Protected Area. In total 3.8% of the undiscovered recoverable natural gas in the Dehcho territory is estimated to be in the Ka'a'gee Tu Candidate Protected Area. For oil, 11.6% of the estimated recoverable oil of the Dehcho territory is in the Ka'a'gee Tu Candidate Protected Area. The plays with the largest percentage of natural gas are the basal pre-Devonian clastics (17.9%), Slave Point back barrier (14.1%), Sulphur Point Bistcho (11.1%), Kakisa/Redknife platform (8.4%), and the Slave Point edge play (7.5%). The Slave Point back barrier play has 18.2% of the undiscovered recoverable oil for the Dehcho territory, followed by the Sulphur Point/Bistcho play at 9.5%. These are all a function of the percentage of the Dehcho play that is in the Ka'a'gee Tu Candidate Protected Area.

In summary the Ka'a'gee Tu Candidate Protected Area is 5.5% of the area of the overall Deh Cho Territory, with 3.4% of the ultimate recoverable gas and 10.8% of the ultimate recoverable oil. Similarly with 2.1% of the area of the overall Mackenzie Valley the Ka'a'gee Tu Candidate Protected Area has 1.2% of the recoverable gas and 1.1% of the recoverable oil. For gas the Ka'a'gee Tu Candidate Protected Area is relatively lower than both the overall Dehcho Territory and the overall Mackenzie Valley. For oil the Ka'a'gee Tu Candidate Protected Area is higher than the Deh Cho and lower than the overall Mackenzie Valley.

		DISCOVERED RESOURCES					UNDISCOVERED RESOURCES					ULT. RECOVERABLE	
		GAS - Billion Cubic Metres			OIL - Million Cubic Metres		GAS - Billion Cubic Metres			OIL - Million Cubic Metres		E9m3	E6m3
Area	Sedimentary Area (Ha)	In Place	Recoverable	Marketable	In Place	Recoverable	In Place	Recoverable	Marketable	In Place	Recoverable	GAS	OIL
DEHCHO	16,994,225	43.818	19.784	17.666	2.860	0.715	187.918	129.124	111.573	55.315	9.157	148.908	9.872
OTHER MACKENZIE VALLEY	27,823,486	45.428	33.895	31.122	105.101	48.924	349.093	253.553	232.119	189.266	40.759	287.448	89.683
TOTAL MACKENZIE VALLEY	**44,817,711**	**89.246**	**53.679**	**48.788**	**107.961**	**49.639**	**537.011**	**382.677**	**343.692**	**244.581**	**49.916**	**436.356**	**99.555**
KA'A'GEE TU CANDIDATE PROTECTED AREA													
KA'A'GEE TU	**937,598**	**0.239**	**0.180**	**0.169**	**0.000**	**0.000**	**6.717**	**4.888**	**4.318**	**6.550**	**1.064**	**5.068**	**1.064**
% of DEHCHO	5.5%	0.5%	0.9%	1.0%	0.0%	0.0%	3.6%	3.8%	3.9%	11.8%	11.6%	3.4%	10.8%
% of NWT	2.1%	0.3%	0.3%	0.3%	0.0%	0.0%	1.3%	1.3%	1.3%	2.7%	2.1%	1.2%	1.1%

IMPERIAL UNITS

		DISCOVERED RESOURCES					UNDISCOVERED RESOURCES					ULT. RECOVERABLE	
		GAS - Billion Cubic Feet			OIL - Million Barrels		GAS - Billion Cubic Feet			OIL - Million Barrels		BCF	MMB
Area	Sedimentary Area (Ac)	In Place	Recoverable	Marketable	In Place	Recoverable	In Place	Recoverable	Marketable	In Place	Recoverable	GAS	OIL
DEHCHO	41,993,644	1,555.267	702.218	627.035	18.000	4.500	6,669.909	4,583.090	3,960.140	348.092	57.625	5,285.308	62.125
OTHER MACKENZIE VALLEY	68,753,331	1,612.411	1,203.051	1,104.624	661.385	307.871	12,390.610	8,999.553	8,238.758	1,191.027	256.491	10,202.604	564.362
TOTAL MACKENZIE VALLEY	**110,746,975**	**3,167.678**	**1,905.269**	**1,731.659**	**679.385**	**312.371**	**19,060.519**	**13,582.643**	**12,198.898**	**1,539.119**	**314.116**	**15,487.912**	**626.487**
KA'A'GEE TU CANDIDATE PROTECTED AREA													
KA'A'GEE TU	**2,316,855**	**8.500**	**6.400**	**6.000**	**0.000**	**0.000**	**238.407**	**173.498**	**153.259**	**41.221**	**6.697**	**179.898**	**6.697**
% of DEH CHO	5.5%	0.5%	0.9%	1.0%	0.0%	0.0%	3.6%	3.8%	3.9%	11.8%	11.6%	3.4%	10.8%
% of MACKENZIE VALLEY	2.1%	0.3%	0.3%	0.3%	0.0%	0.0%	1.3%	1.3%	1.3%	2.7%	2.1%	1.2%	1.1%

Table 8. Comparison of Ka'a'gee Tu Protected Area oil and gas resources with the Dehcho Territory and the Mackenzie Valley

METRIC UNITS

Area	Sedimentary Area (hectares)	Ultimate Recoverable Oil (106m3)	Ultimate Recoverable Gas (109m3)	Ultimate Recoverable Oil (m3/Ha)	Ultimate Recoverable Gas (103m3/Ha)
DEH CHO	16,994,225	9.872	148.908	0.581	8.762
OTHER MACKENZIE VALLEY	27,823,486	89.683	287.448	3.223	10.331
TOTAL MACKENZIE VALLEY	**44,817,711**	**99.555**	**436.356**	**2.221**	**9.736**
KA'A'GEE TU CANDIDATE PROTECTED AREA					
KA'A'GEE TU	**937,598**	**1.064**	**5.068**	**1.135**	**5.406**

IMPERIAL UNITS

Area	Sedimentary Area (acres)	Ultimate Recoverable Oil (MMB)	Ultimate Recoverable Gas (BCF)	Ultimate Recoverable Oil (B/Ac)	Ultimate Recoverable Gas (MCF/Ac)
DEH CHO	41,993,644	62.125	5,285.308	1.479	125.860
OTHER MACKENZIE VALLEY	68,753,331	564.362	10,202.604	8.209	148.394
TOTAL MACKENZIE VALLEY	**110,746,975**	**626.487**	**15,487.912**	**5.657**	**139.850**
KA'A'GEE TU CANDIDATE PROTECTED AREA					
KA'A'GEE TU	**2,316,855**	**6.697**	**179.898**	**2.890**	**77.648**

Table 9. Ultimate Recoverable Resource per Unit Area for the Ka'a'gee Tu Candiadte Protected Area Compared with the Dehcho Territory and the Total Mackenzie Valley

GEOLOGICAL PLAY	UNDISCOVERED - DEHCHO TERRITORY					UNDISCOVERED - KA'A'GEE TU CANDIDATE PROTECTED AREA						
	GAS - Million Cubic Metres			OIL - Thousand Cubic Metres		GAS - Million Cubic Metres			OIL - Thousand Cubic Metres		% of Recoverable	
Play Name	**In Place**	**Recoverable**	**Marketable**	**In Place**	**Recoverable**	**In Place**	**Recoverable**	**Marketable**	**In Place**	**Recoverable**	**Gas**	**Oil**
Laramide/Manetoe	31,558.4	20,197.4	16,864.8	0.0	0.0							
Laramide/Windflower	21,443.1	13,226.9	11,533.9	0.0	0.0							
Slave Point edge	13,415.0	9,607.8	8,210.5	0.0	0.0	1,011.5	720.2	638.8	0.0	0.0	7.5%	
Slave Point back barrier	20,089.2	15,441.1	14,009.4	29,175.8	4,858.4	2,838.1	2,181.4	1,979.2	5,319.5	886.2	14.1%	18.2%
Sulphur Point/Bistcho	5,245.8	3,885.6	3,561.6	9,153.3	1,186.0	582.5	432.0	395.9	871.5	113.1	11.1%	9.5%
Lonely Bay platform	11,359.6	8,329.8	7,355.2	0.0	0.0	344.9	252.9	223.3	0.0	0.0	3.0%	
Basal Cretaceous clastics	6,789.3	5,451.8	4,838.0	4,261.4	922.5	45.0	36.2	32.1	44.7	9.7	0.7%	1.0%
Jean Marie Member	9,361.3	6,156.9	5,584.3	0.0	0.0							
Keg River/Cordova embayment	845.5	591.9	556.3	0.0	0.0							
Basal pre-Devonian Clastics	7,353.0	4,901.2	3,906.3	0.0	0.0	1,316.8	877.8	699.6	0.0	0.0	17.9%	
Keg River reef (Rainbow)	3,323.3	2,307.1	2,053.4	6,491.8	842.4	76.0	52.8	47.0	148.5	19.3	2.3%	2.3%
Arnica/Landry platform	15,856.4	10,571.9	9,039.0	0.0	0.0							
Lonely Bay/Nahanni platform	12,262.3	8,786.6	7,512.5	0.0	0.0	115.6	82.8	70.8	0.0	0.0	0.9%	
Kakisa/Redknife platform	4,442.9	2,887.0	2,647.4	0.0	0.0	374.8	243.5	223.3	0.0	0.0	8.4%	
Upper Paleozoic subcrop	697.0	488.8	453.1	6,233.0	1,348.0	11.7	8.6	8.0	166.1	35.9	1.8%	2.7%
Triassic subcrop	162.6	113.8	106.2	0.0	0.0							
Bovie structure	10,608.2	6,897.1	5,683.2	0.0	0.0							
Silurian-Ordovician platform	6,071.3	3,826.0	3,558.2	0.0	0.0							
Basal Cambrian clastics	5,884.2	4,707.5	3,483.6	0.0	0.0							
Plateau Overthrust	1,149.9	747.7	616.1	0.0	0.0							
TOTALS	**187,917.9**	**129,123.9**	**111,572.9**	**55,315.3**	**9,157.2**	**6,716.9**	**4,888.1**	**4,317.9**	**6,550.4**	**1,064.2**	**3.8%**	**11.6%**

Table 10. Undiscovered Oil and Gas Resources (Metric units) by Play for the DehCho Territory and the Ka'a'gee Tu Candidate Protected Area

		UNDISCOVERED - DEHCHO TERRITORY					UNDISCOVERED - KA'A'GEE TU CANDIDATE PROTECTED AREA						
	GEOLOGICAL PLAY	GAS - Billion Cubic Feet			OIL - Million Barrels		GAS - Billion Cubic Feet			OIL - Million Barrels		% of Recoverable	
Play	Play Name	In Place	Recoverable	Marketable	In Place	Recoverable	In Place	Recoverable	Marketable	In Place	Recoverable	Gas	Oil
1	Laramide/Manetoe	1,120.12	716.879	598.594	0.000	0.000							
2	Laramide/Windflower	761.095	469.473	409.380	0.000	0.000							
3	Slave Point edge	476.147	341.018	291.420	0.000	0.000	35.903	25.563	22.675	0.000	0.000	7.5%	
4	Slave Point back barrier	713.040	548.063	497.244	183.599	30.573	100.734	77.427	70.248	33.475	5.577	14.1%	18.2%
5	Sulphur Point/Bistcho	186.193	137.916	126.415	57.600	7.463	20.673	15.332	14.051	5.484	0.712	11.1%	9.5%
6	Lonely Bay platform	403.194	295.656	261.064	0.000	0.000	12.240	8.976	7.926	0.000	0.000	3.0%	
7	Basal Cretaceous clastics	240.976	193.504	171.717	26.817	5.805	1.598	1.284	1.139	0.282	0.061	0.7%	1.0%
8	Jean Marie Member	332.267	218.531	198.207	0.000	0.000							
9	Keg River/Cordova embayment	30.010	21.007	19.747	0.000	0.000							
10	Basal pre-Devonian Clastics	260.986	173.963	138.649	0.000	0.000	46.738	31.155	24.830	0.000	0.000	17.9%	
11	Keg River reef (Rainbow)	117.955	81.887	72.884	40.852	5.301	2.698	1.873	1.667	0.935	0.121	2.3%	2.3%
12	Arnica/Landry platform	562.804	375.236	320.827	0.000	0.000							
13	Lonely Bay/Nahanni platform	435.234	311.868	266.647	0.000	0.000	4.102	2.939	2.513	0.000	0.000	0.9%	
14	Kakisa/Redknife platform	157.694	102.472	93.967	0.000	0.000	13.304	8.644	7.927	0.000	0.000	8.4%	
15	Upper Paleozoic subcrop	24.737	17.348	16.084	39.224	8.483	0.417	0.305	0.283	1.045	0.226	1.8%	2.7%
16	Triassic subcrop	5.770	4.039	3.769	0.000	0.000							
17	Bovie structure	376.524	244.803	201.717	0.000	0.000							
18	Silurian-Ordovician platform	215.494	135.800	126.294	0.000	0.000							
19	Basal Cambrian clastics	208.851	167.087	123.645	0.000	0.000							
20	Plateau Overthrust	40.814	26.540	21.869	0.000	0.000							
	TOTALS	**6,669.909**	**4,583.090**	**3,960.140**	**348.092**	**57.625**	**238.407**	**173.498**	**153.259**	**41.221**	**6.697**	**3.8%**	**11.6%**

Table 11. Undiscovered Oil and Gas Resources (Imperial units) by Play for the DehCho Territory and the Ka'a'gee Tu Candidate Protected Area

Update of the Hydrocarbon Potential for the Sambaa K’e Candidate Protected Area

The geological setting for the Sambaa K'e Candidate Protected Area, from GSC maps 1371-A and 1379-A is shown in figures 13 and 14. The Sambaa K'e Candidate Protected Area is characterized by a south-southwest dipping succession of Devonian rocks, primarily carbonate, overlain by Cretaceous rocks, mainly sandstone, along the south. Rocks as young as Upper Cretaceous are present to the south and southwest of Trout Lake. Wells drilled in and adjacent to the Sambaa K'e Candidate Protected Area are shown in figure 16.

The cross-section (figure 15) extending from Island River D-29 in the south to Jean Marie E-07 in the north shows the sedimentary section for the Sambaa K’e Candidate Protected Area. The wells for the section are designated by letter symbol only, without the well name. The sedimentary section overlying the Precambrian granitic basement dips to the south. The sedimentary section thickens from about 900 metres (2,950 feet) in the north to about 2,500 metres (8,200 feet) in the south. The dominant lithology for the formation is shown by color. The main geological plays for the area are shown; Basal Devonian sandstone (La Loche), the carbonates of the Keg River, Sulphur Point, and Slave Point , Jean Marie and Cretaceous sandstone.

The undiscovered oil and gas resources by geological play for the Sambaa K’e Candidate Protected Area are summarized in table 12. The total undiscovered potential for the Sambaa K’e Candidate Protected Area is estimated to be 1,510 thousand cubic metres (9.5 million barrels) of recoverable oil and 14,604 million cubic metres (518 billion cubic feet) of recoverable gas. A statistical @Risk summary of the undiscovered oil and gas for the Sambaa K’e Candidate Protected Area is presented in table 13. Overall the undiscovered oil and gas potential is considered to be moderate for the Sambaa K’e Candidate Protected Area.

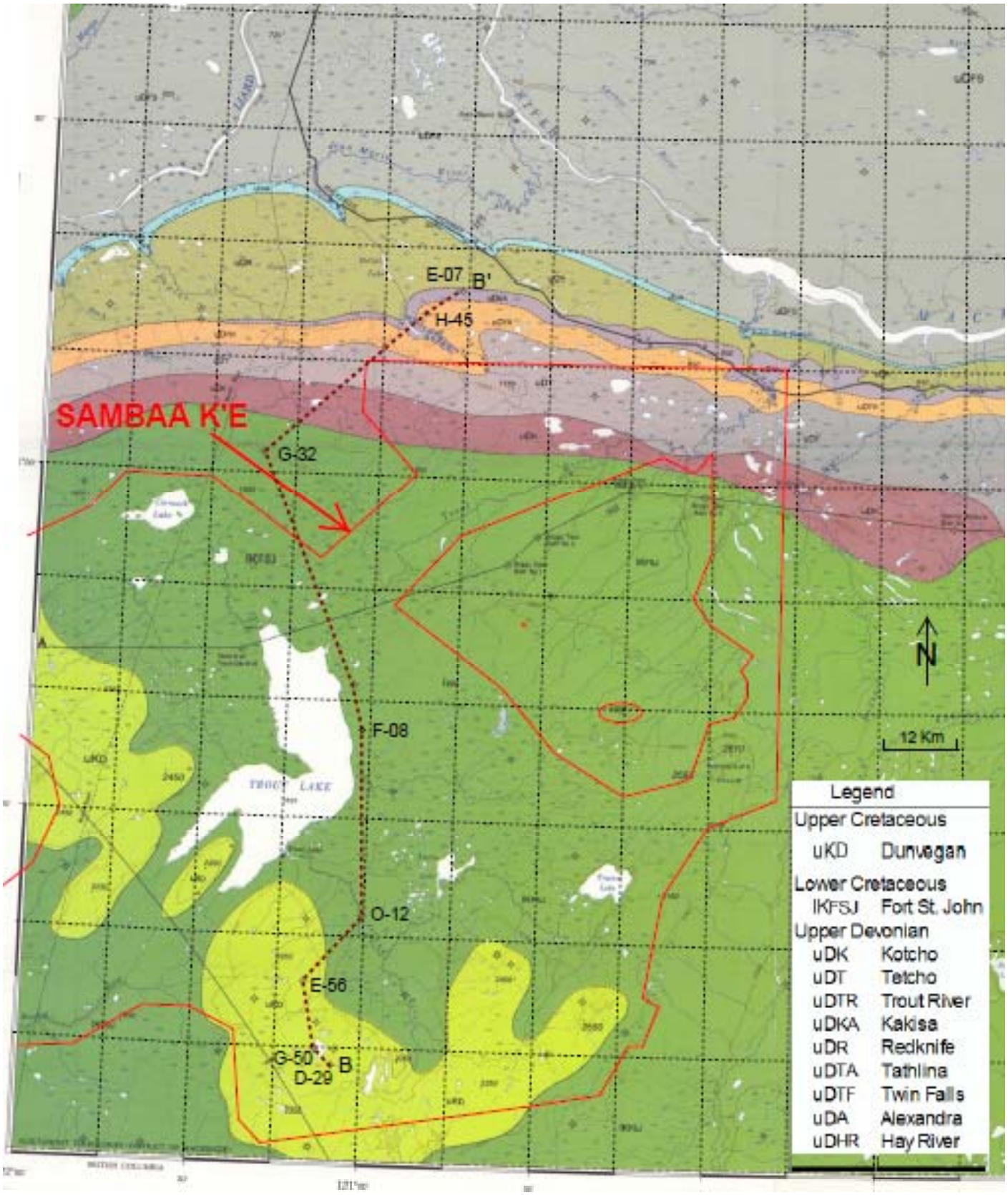


Figure 13. Geological map (GSC map 1371-A) of the Sambaa K'e Candidate Protected Area showing line of cross-section BB' from Island River D-29 to Jean Marie E-07

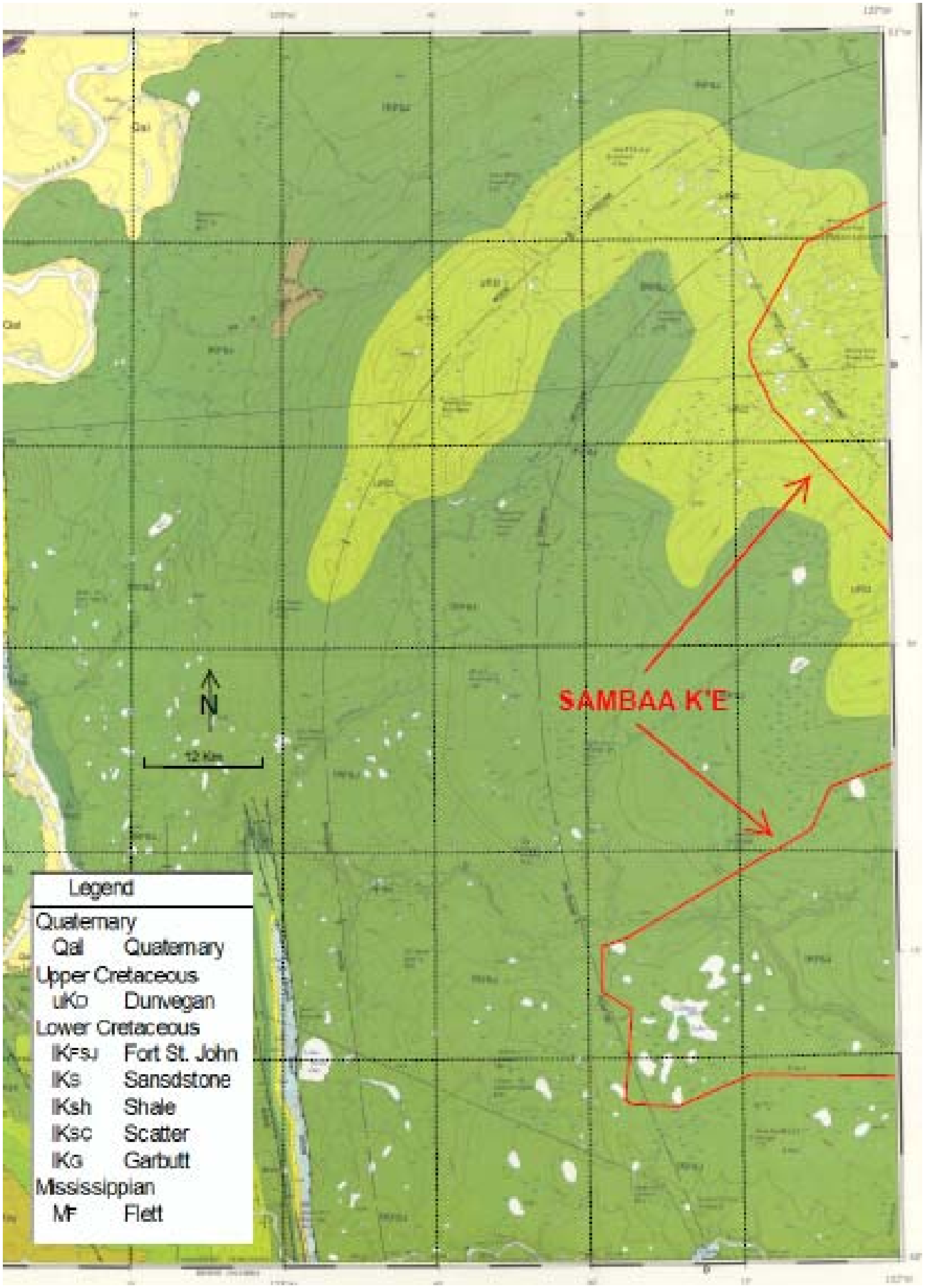


Figure 14. Geological map (GSC map 1379-A) of the western part of the Sambaa K'e Candidate Protected Area

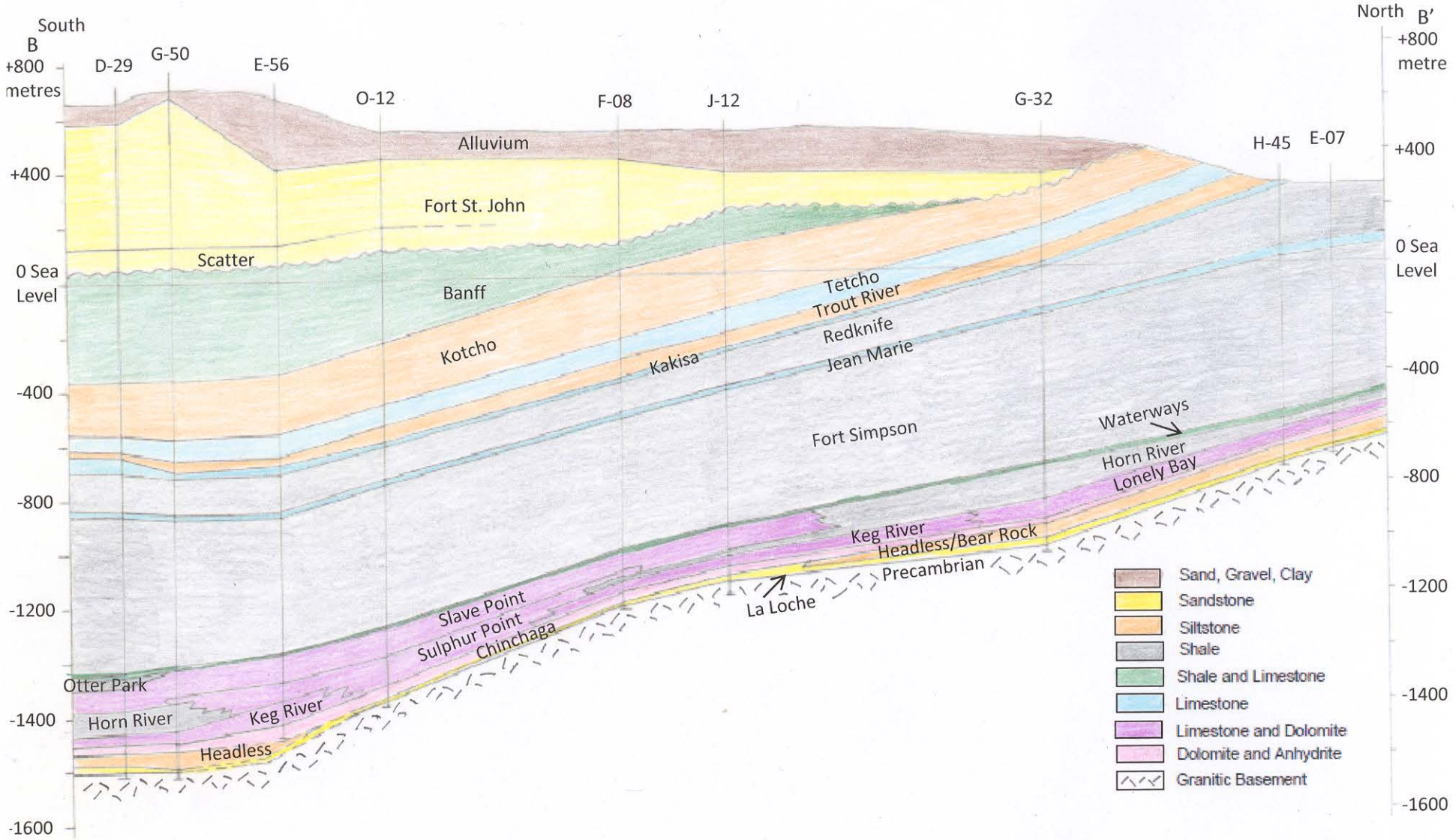


Figure 15. South to north cross-section BB' from Island River D-29 to Jean Marie E-07 showing the stratigraphic section across the Sambaa K'e Candidate Protected Area.

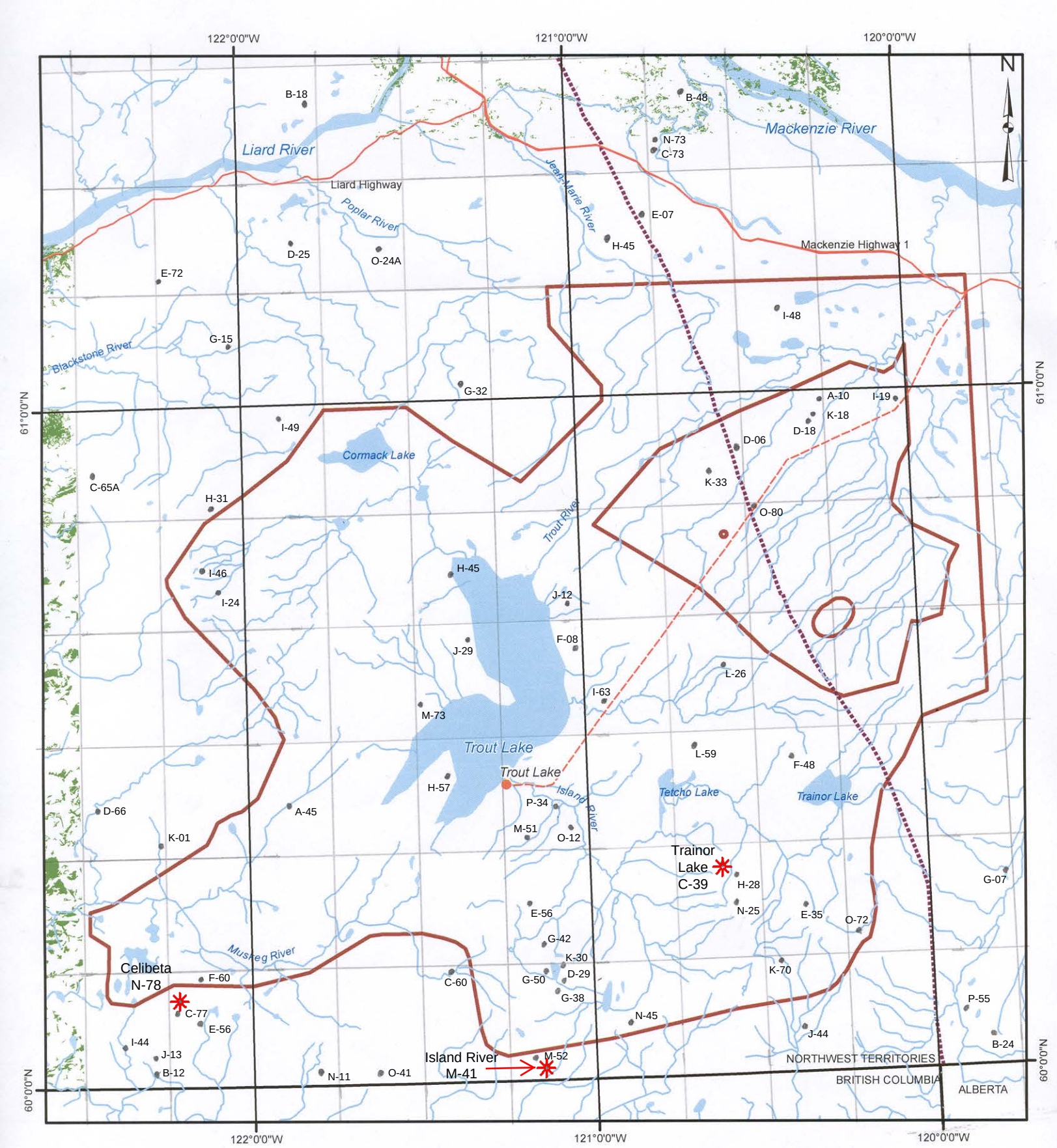


Figure 16. Wells Drilled in and Adjacent to Sambaa K'e Candidate Protected Area, with Significant Discovery Licence wells shown by red well symbol.

GAS - MILLION CUBIC METRES , OIL - THOUSAND CUBIC METRES

Play Number	PLAY_NAME	Deh Cho Play	Gas in Place	Recoverable Gas	Marketable Gas	Oil in Place	Recoverable Oil
3	Slave Point edge	3	5,450.4	3,909.1	3,325.8	0.0	0.0
4	Slave Point back barrier	4	4,420.7	3,398.2	3,083.1	4,573.8	761.2
8	Jean Marie	8	4,763.0	3,107.8	2,818.8	0.0	0.0
7	Basal Cretaceous clastics	7	1,852.4	1,487.3	1,319.8	921.8	199.6
14	Kakisa/Redknife platform	14	1,835.8	1,192.9	1,093.9	0.0	0.0
6	Lonely Bay/Horn Plateau reefs	6	756.5	554.8	489.9	0.0	0.0
9	Keg River/Cordova embayment	9	642.1	449.5	422.5	0.0	0.0
13	Lonely Bay/Nahanni platform	13	298.6	214.0	183.0	0.0	0.0
15	Upper Paleozoic (Sub-Cret) subcrop	15	289.3	202.6	187.8	2,540.1	549.3
12	Arnica/Landry platform	12	132.2	88.1	75.3	0.0	0.0
		TOTAL	**20,440.9**	**14,604.4**	**13,000.0**	**8,035.7**	**1,510.2**

GAS - BILLION CUBIC FEET , OIL - MILLION BARRELS

Play Number	PLAY_NAME	Deh Cho Play	Gas in Place	Recoverable Gas	Marketable Gas	Oil in Place	Recoverable Oil
3	Slave Point edge	3	193.5	138.7	118.0	0.0	0.0
4	Slave Point back barrier	4	156.9	120.6	109.4	28.783	4.790
8	Jean Marie	8	169.1	110.3	100.1	0.000	0.000
7	Basal Cretaceous clastics	7	65.7	52.8	46.8	5.801	1.256
14	Kakisa/Redknife platform	14	65.2	42.3	38.8	0.000	0.000
6	Lonely Bay/Horn Plateau reefs	6	26.8	19.7	17.4	0.000	0.000
9	Keg River/Cordova embayment	9	22.8	16.0	15.0	0.000	0.000
13	Lonely Bay/Nahanni platform	13	10.6	7.6	6.5	0.000	0.000
15	Upper Paleozoic (Sub-Cret) subcrop	15	10.3	7.2	6.7	15.984	3.457
12	Arnica/Landry platform	12	4.7	3.1	2.7	0.000	0.000
		TOTAL	**725.5**	**518.4**	**461.4**	**50.567**	**9.503**

Table 12. Undiscovered oil and gas for Sambaa K'e Candidate Protected Area by geological play, ranked by recoverable gas. Deh Cho Play number reference is geological plays outlined in L.Gal and A. Jones, 2003.

@RISK Output Results — SAMBAA K'E UNDISCOVERED RESOURCES

Performed By: Ken Drummond
Date: July 25, 2011 11:03:54 AM

TOTAL ALL PLAYS

	Name	Worksheet	Cell	Graph	Mean	Median	Std Dev	10%	90%
Range: Sambaa K'e Undiscovered Resource (Metric)									
	GAS IN PLACE (106m3)	SumOutput	B10	0 120,000	20,440.440	18,403.070	9,829.212	10,307.090	33,016.720
	RECOVERABLE GAS (106m3)	SumOutput	B11	0 90,000	14,604.480	13,135.600	7,059.472	7,343.210	23,623.750
	MARKETABLE GAS (106m3)	SumOutput	B12	0 80,000	13,000.270	11,702.510	6,257.123	6,557.563	20,995.430
	OIL IN PLACE (103m3)	SumOutput	B13	0 45,000	8,035.850	7,294.375	3,708.582	4,158.666	12,808.130
	RECOVERABLE OIL (103m3)	SumOutput	B14	0 9,000	1,510.154	1,361.127	725.013	760.457	2,438.918
Range: Sambaa K'e Undiscovered Resource (Imperial)									
	GAS IN PLACE (BCF)	SumOutput	B3	0 4,000	725.507	653.194	348.875	365.837	1,171.887
	RECOVERABLE GAS (BCF)	SumOutput	B4	0 3,000	518.367	466.231	250.567	260.638	838.495
	MARKETABLE GAS (BCF)	SumOutput	B5	0 3,000	461.428	415.366	222.089	232.752	745.206
	OIL IN PLACE (MMB)	SumOutput	B6	0 300	50.569	45.903	23.338	26.170	80.600
	RECOVERABLE OIL (MMB)	SumOutput	B7	0 60	9.503	8.565	4.562	4.785	15.348

Table 13. Statistical summary of total undiscovered oil and gas resources for the Sambaa K'e Candidate Protected Area.

Update for Natural Gas Resources of the Sambaa K'e Candidate Protected Area

A relatively small amount of natural gas has been discovered to date in the Sambaa K'e Candidate Protected Area. The initial discovered natural gas resource in the Sambaa K'e Candidate Protected Area, as of December 31, 2010 is:

	Billion cubic metres (Bcf)
Initial discovered gas-in-place	0.425 (14.8)
Initial recoverable raw gas	0.324 (11.3)
Initial marketable gas	0.305 (10.6)

The updated undiscovered natural gas potential for the Sambaa K'e Candidate Protected Area is estimated to be 20,441 million cubic metres (725.5 billion cubic feet) gas-in-place, 14,604 million cubic metres (518.4 billion cubic feet) recoverable, and 13,000 million cubic metres (461.4 billion cubic feet) of marketable gas. The cumulative frequency distribution for undiscovered gas is shown in figure 17. There is an 80% probability the undiscovered recoverable gas is in the range of 7,343 to 23,624 million cubic metres (261 to 838 billion cubic feet), with a mean of 14,604 million cubic metres (518.4 billion cubic feet) at a probability of 40%.The median (50%) value is 13,136 million cubic metres (466.2 billion cubic feet).

The distribution of recoverable gas resources by million cubic metres and billion cubic feet per quarter grid for the Sambaa K'e Candidate Protected Area is shown in Excel map format of figure 18. The highest gas potential is in an arc that follows the Slave Point edge (Play #3) of figure 3, along the southern half of Kakisa Lake, east to the eastern boundary of the Sambaa K'e Candidate Protected Area to the Big Island area. An area of somewhat lower potential occurs to the southwest of Kakisa Lake.

Overall the average undiscovered recoverable gas is estimated at 7,080 cubic metres per hectare (102 thousand cubic feet per acre) for the Sambaa K'e Candidate Protected Area. This compares to an estimated ultimate (discovered plus undiscovered) recoverable gas of 72,000 cubic metres per hectare (one million cubic feet per acre) for the Western Canada Sedimentary Basin, and estimated ultimate for the Beaufort Mackenzie Basin of 42,800 cubic metres per hectare (615 thousand cubic feet per acre).

The undiscovered gas potential, ranked by recoverable gas, for the various plays is shown in table 12. The number one ranked play with the largest volume, 3,909 million cubic metres (138.7 billion cubic feet) of undiscovered recoverable gas is the Slave Point edge play, followed by the Slave Point back barrier play with 3,398 million cubic metres (120.6 billion cubic feet) of undiscovered recoverable gas. These two plays represent 50.0% of the total estimated undiscovered natural gas potential for the Sambaa K'e Candidate Protected Area.

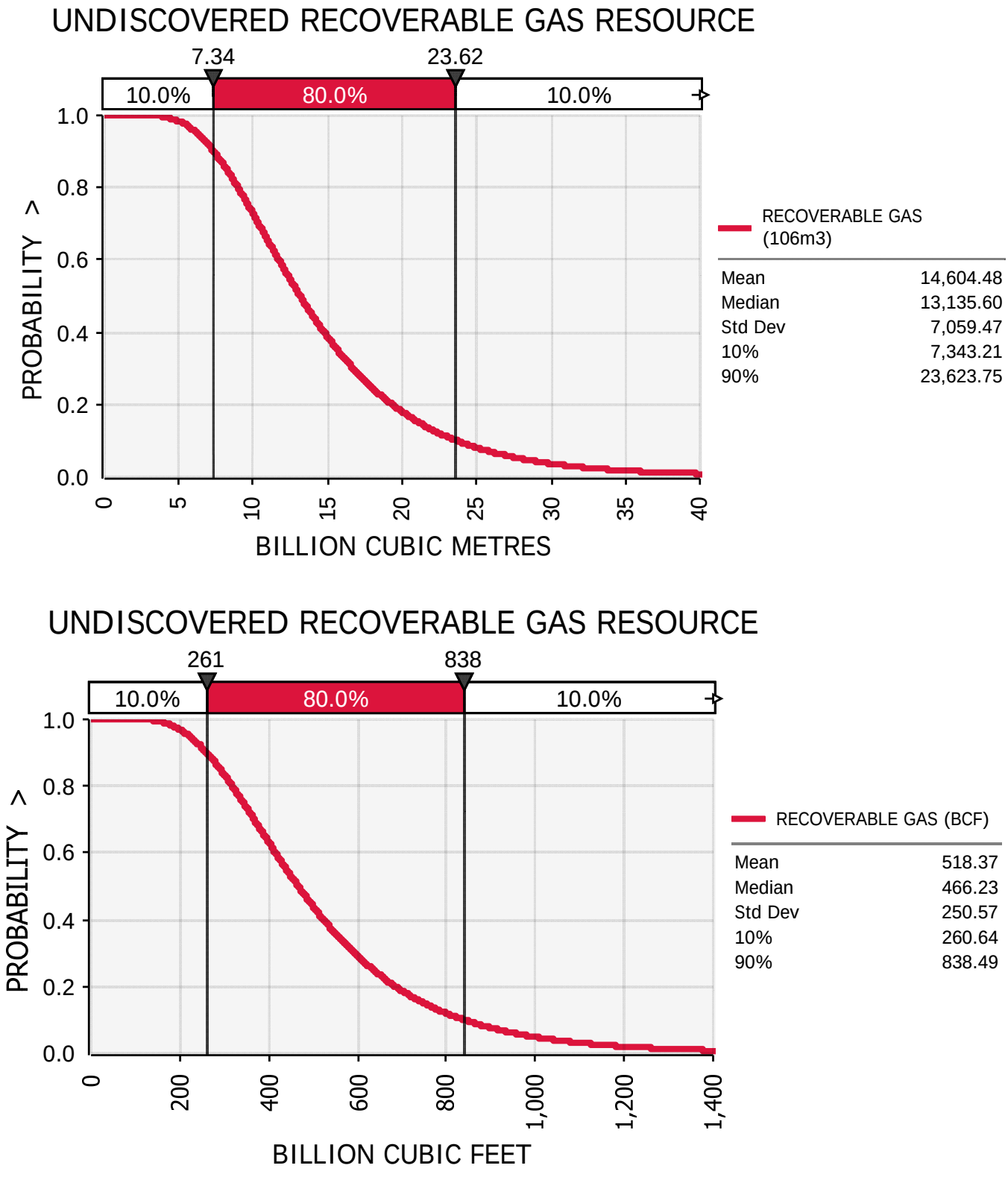


Figure 17. Cumulative frequency distribution of undiscovered recoverable gas for the Sambaa K'e Candidate Protected Area

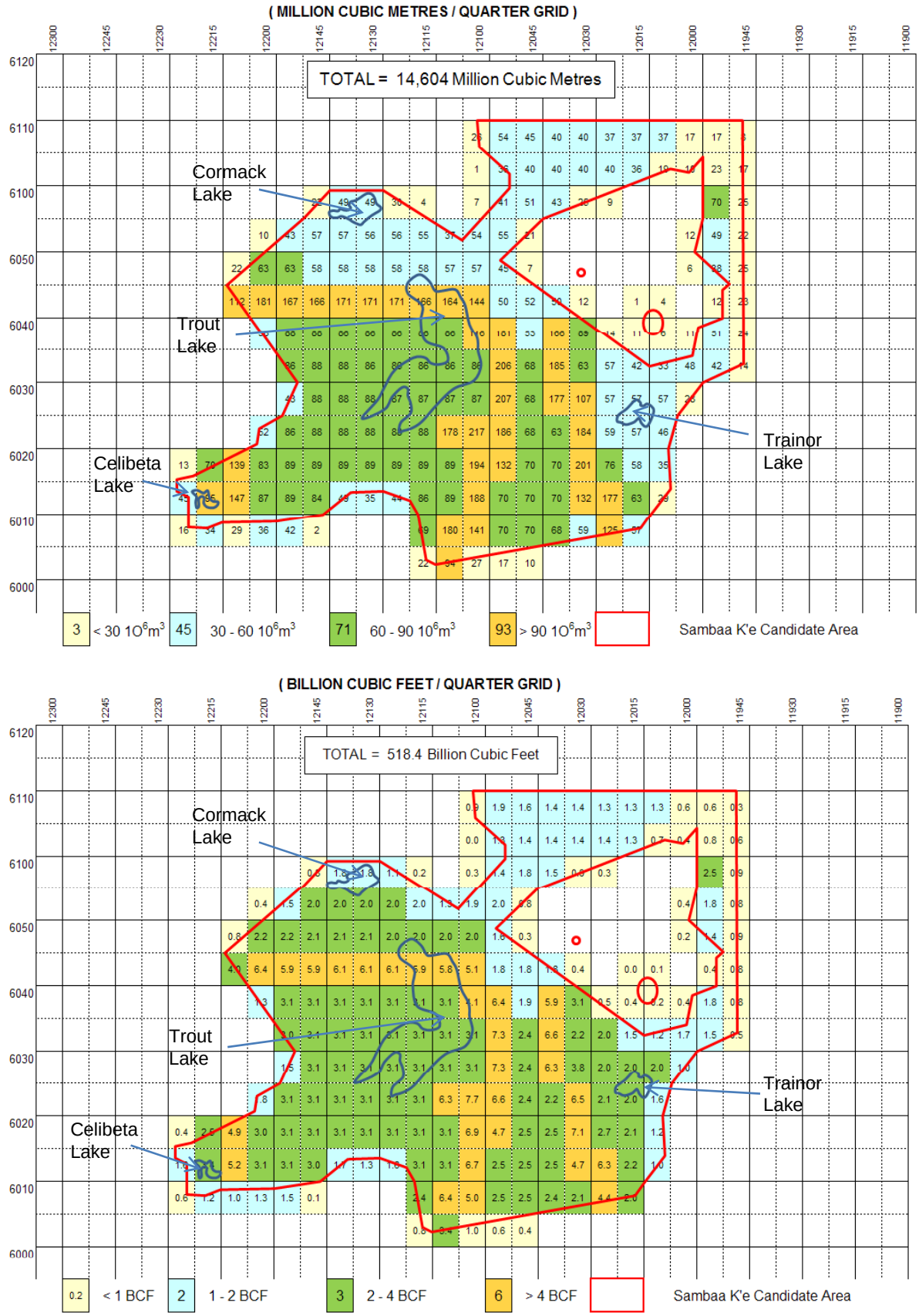


Figure 18. Sambaa K'e Candidate Protected Area – Distribution of undiscovered recoverable gas by quarter grid

Update of Oil Resources for the Sambaa K'e Candidate Protected Area

There is no discovered oil resource for the Sambaa K'e Candidate Protected Area.

The undiscovered recoverable oil potential for the Sambaa K'e Candidate Protected Area is estimated to be 8,036 thousand cubic metres (50.6 million barrels) oil-in-place, and 1,510 thousand cubic metres (9.5 million barrels) of recoverable oil. The cumulative frequency distribution for undiscovered oil is shown in figure 19. There is an 80% probability the undiscovered recoverable oil is in the range of 760 to 2,439 thousand cubic metres (4.8 to15.3 million barrels), with a mean of 1,510 thousand cubic metres (9.5 million barrels) at a probability of 40%. The median (50%) value is 1,361 thousand cubic metres (8.6 million barrels).

The distribution of undiscovered recoverable oil resources by thousand cubic metres and thousand barrels per quarter grid for the Sambaa K'e Candidate Protected Area is shown in Excel map format in figure 20. The undiscovered oil potential for the Sambaa K'e Candidate Protected Area lies south of 60^{o} 55' latitude and in the Big Island area. The greatest oil potential is concentrated along the southern boundary immediately north of the Cameron Hills, where discoveries have been made.

Overall the average undiscovered recoverable oil is estimated at 1.2 cubic metres per hectare (3.0 barrels per acre) for the Sambaa K'e Candidate Protected Area. This compares to an estimated ultimate (discovered plus undiscovered) recoverable oil of 34 cubic metres per hectare (86 barrels per acre) for the Western Canada Sedimentary Basin, and estimated ultimate for the Beaufort Mackenzie Basin of 33 cubic metres per hectare (83 barrels per acre).

The undiscovered recoverable oil potential for the various plays is shown in table 12. The number one ranked play for recoverable oil is the Slave Point Back Barrier play, with 761 thousand cubic metres (4.8 million barrels). The Slave Point Back Barrier play represents 50.4% of the total estimated undiscovered recoverable oil potential for the Sambaa K'e Candidate Protected Area.

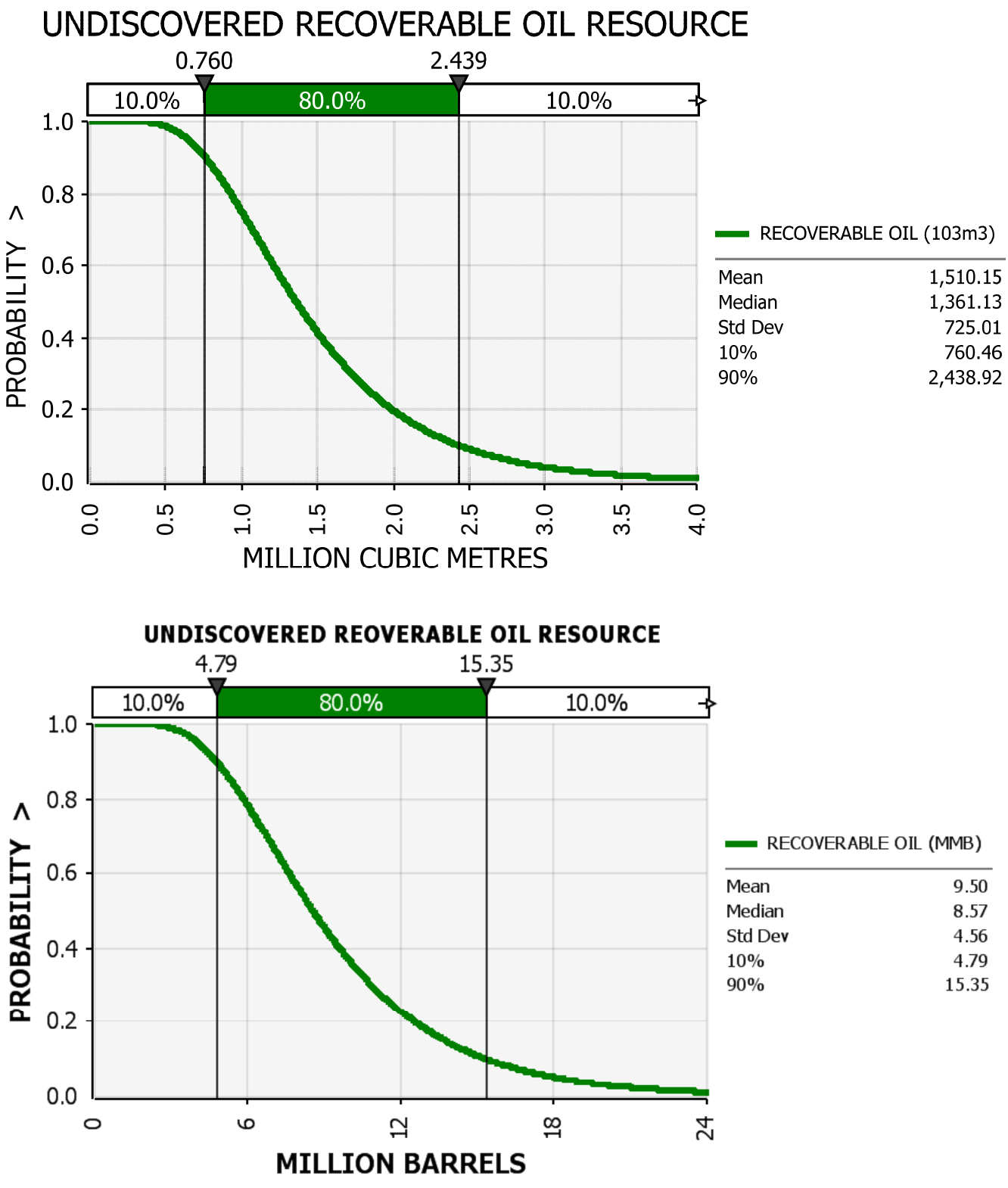


Figure 19. Cumulative frequency distribution of undiscovered recoverable oil for the Sambaa K'e Candidate Protected Area.

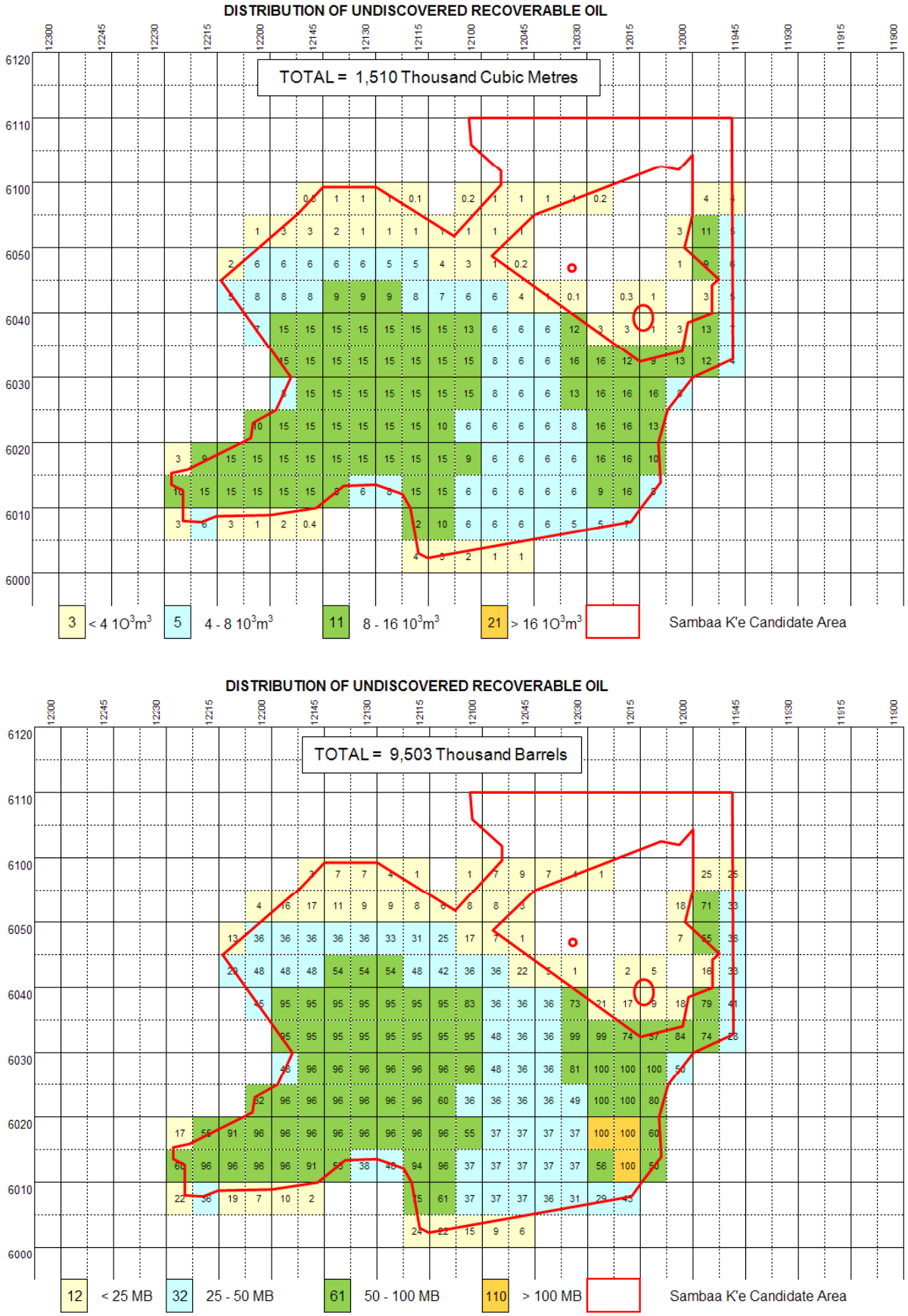


Figure 20. Sambaa K'e Candidate Protected Area – Distribution of undiscovered recoverable oil by quarter grid

Comparative Analysis of the Sambaa K'e Candidate Protected Area with Dehcho Territory and Total Mackenzie Valley

Table 14 shows the comparison of the sedimentary area, discovered, undiscovered and ultimate recoverable oil and gas resources for the Sambaa K'e Candidate Protected Area, the Dehcho territory and the total Mackenzie Valley. The sedimentary area, which is the area with sediments prospective for oil and/or gas, for the Sambaa K'e Candidate Protected Area represents 6.2% of the Dehcho Territory and 2.4% of the total Mackenzie Valley.The Sambaa K'e Candidate Protected Area has only 1.6% of the discovered recoverable gas, 11.3% of the undiscovered recoverable gas, and 10.0 % of the ultimate recoverable gas in the Dehcho territory. There is no discovered oil in the Sambaa K'e Candidate Protected Area, and it is estimated to have 16.5% of the undiscovered oil and 15.3% of the ultimate recoverable oil in the Dehcho territory. As a percentage of the ultimate resource in the total Mackenzie Valley, the Sambaa K'e Candidate Protected Area is estimated to have 3.4% of the recoverable gas and 1.5% of the recoverable oil.

Table 15 is the ultimate recoverable oil and gas resources per unit area (richness) for the Sambaa K'e Candidate Protected Area, the Dehcho territory and the total Mackenzie Valley. Recoverable oil is given in cubic metres per hectare and barrels per acre and recoverable gas in thousand cubic metres per hectare and thousand cubic feet per acre. This is often referred to as richness. The Sambaa K'e Candidate Protected Area, in terms of oil, is almost three times as rich as the overall Dehcho territory, one third of the other Northwest Territories and a little less than half that of the overall Mackenzie Valley. In terms of natural gas, the Sambaa K'e Candidate Protected Area is about one and a half times the overall Deh Cho territory and the Mackenzie Valley.

Table 16 (metric units) and table 17 (imperial units) show the undiscovered oil and gas resources for all plays of the Dehcho territory and the portion of the resource that is in the Sambaa K'e Candidate Protected Area. In total 11.3% of the undiscovered recoverable natural gas in the Dehcho territory is estimated to be in the Sambaa K'e Candidate Protected Area. For oil, 16.5% of the estimated recoverable oil of the Dehcho territory is in the Sambaa K'e Candidate Protected Area. The plays with the largest percentage of natural gas are the Keg River/Cordova Embayment (75.9%), Jean Marie member (50.5%), Kakisa/Redknife platform (41.5%), Upper Paleozoic subcrop (41.5%), and the Slave Point edge play (40.7%). The Upper Paleozoic subcrop play has 40.8% of the undiscovered recoverable oil for the Dehcho territory, followed by the basal Cretaceous clastics play at 21.6%, and the Slave Point edge play (15.7%). These are all a function of the percentage of the Dehcho play that is in the Sambaa K'e Candidate Protected Area.

In summary the Sambaa K'e Candidate Protected Area is 6.2% of the area of the overall Deh Cho Territory, with 10% of the ultimate recoverable gas and 15.3% of the ultimate recoverable oil. Similarly with 2.4% of the area of the overall Mackenzie Valley the Sambaa K'e Candidate Protected Area has 3.4% of the recoverable gas and 1.5% of the recoverable oil. For natural gas the Sambaa K'e Candidate Protected Area is relatively richer than both the overall Dehcho Territory and the overall Mackenzie Valley. For natural gas the Sambaa K'e Candidate Protected Area is relatively richer than the overall Dehcho Territory and less richer than the overall Mackenzie Valley.

METRIC UNITS

		DISCOVERED RESOURCES					UNDISCOVERED RESOURCES					ULT. RECOVERABLE	
		GAS - Billion Cubic Metres			OIL - Million Cubic Metres		GAS - Billion Cubic Metres			OIL - Million Cubic Metres		E9m3	E6m3
Area	Sedimentary Area (Ha)	In Place	Recoverable	Marketable	In Place	Recoverable	In Place	Recoverable	Marketable	In Place	Recoverable	GAS	OIL
DEHCHO	16,994,225	43.818	19.784	17.666	2.860	0.715	187.918	129.124	111.573	55.315	9.157	148.908	9.872
OTHER MACKENZIE VALLEY	27,823,486	45.428	33.895	31.122	105.101	48.924	349.093	253.553	232.119	189.266	40.759	287.448	89.683
TOTAL MACKENZIE VALLEY	**44,817,711**	**89.246**	**53.679**	**48.788**	**107.961**	**49.639**	**537.011**	**382.677**	**343.692**	**244.581**	**49.916**	**436.356**	**99.555**
SAMBAA K'E CANDIDATE PROTECTED AREA													
SAMBAA K'E	**1,061,310**	**0.425**	**0.324**	**0.305**	**0.000**	**0.000**	**20.441**	**14.604**	**13.000**	**8.036**	**1.510**	**14.928**	**1.510**
% of DEHCHO	6.2%	1.0%	1.6%	1.7%	0.0%	0.0%	10.9%	11.3%	11.7%	14.5%	16.5%	10.0%	15.3%
% of MACKENZIE VALLEY	2.4%	0.5%	0.6%	0.6%	0.0%	0.0%	3.8%	3.8%	3.8%	3.3%	3.0%	3.4%	1.5%

IMPERIAL UNITS

		DISCOVERED RESOURCES					UNDISCOVERED RESOURCES					ULT. RECOVERABLE	
		GAS - Billion Cubic Feet			OIL - Million Barrels		GAS - Billion Cubic Feet			OIL - Million Barrels		BCF	MMB
Area	Sedimentary Area (Ac)	In Place	Recoverable	Marketable	In Place	Recoverable	In Place	Recoverable	Marketable	In Place	Recoverable	GAS	OIL
DEHCHO	41,993,644	1,555.267	702.218	627.035	18.000	4.500	6,669.909	4,583.090	3,960.140	348.092	57.625	5,285.308	62.125
OTHER MACKENZIE VALLEY	68,753,331	1,612.411	1,203.051	1,104.624	661.385	307.871	12,390.610	8,999.553	8,238.758	1,191.027	256.491	10,202.604	564.362
TOTAL MACKENZIE VALLEY	**110,746,975**	**3,167.678**	**1,905.269**	**1,731.659**	**679.385**	**312.371**	**19,060.519**	**13,582.643**	**12,198.898**	**1,539.119**	**314.116**	**15,487.912**	**626.487**
SAMBAA K'E CANDIDATE PROTECTED AREA													
SAMBAA K'E	**2,622,554**	**14.800**	**11.300**	**10.600**	**0.000**	**0.000**	**725.522**	**518.363**	**461.417**	**50.567**	**9.503**	**529.663**	**9.503**
% of DEH CHO	6.2%	1.0%	1.6%	1.7%	0.0%	0.0%	10.9%	11.3%	11.7%	14.5%	16.5%	10.0%	15.3%
% of MACKENZIE VALLEY	2.4%	0.5%	0.6%	0.6%	0.0%	0.0%	3.8%	3.8%	3.8%	3.3%	3.0%	3.4%	1.5%

Table 14. Comparison of Sambaa K'e Candidate Protected Area oil and gas resources with the Dehcho Territory and the Mackenzie Valley

METRIC UNITS

Area	Sedimentary Area (hectares)	Ultimate Recoverable Oil (106m3)	Ultimate Recoverable Gas (109m3)	Ultimate Recoverable Oil (m3/Ha)	Ultimate Recoverable Gas (103m3/Ha)
DEH CHO	16,994,225	9.872	148.908	0.581	8.762
OTHER MACKENZIE VALLEY	27,823,486	89.683	287.448	3.223	10.331
TOTAL MACKENZIE VALLEY	**44,817,711**	**99.555**	**436.356**	**2.221**	**9.736**
SAMBAA K'E CANDIDATE PROTECTED AREA					
SAMBAA K'E	**1,061,310**	**1.510**	**14.928**	**1.423**	**14.066**

IMPERIAL UNITS

Area	Sedimentary Area (acres)	Ultimate Recoverable Oil (MMB)	Ultimate Recoverable Gas (BCF)	Ultimate Recoverable Oil (B/Ac)	Ultimate Recoverable Gas (MCF/Ac)
DEH CHO	41,993,644	62.125	5,285.308	1.479	125.860
OTHER MACKENZIE VALLEY	68,753,331	564.362	10,202.604	8.209	148.394
TOTAL MACKENZIE VALLEY	**110,746,975**	**626.487**	**15,487.912**	**5.657**	**139.850**
SAMBAA K'E CANDIDATE PROTECTED AREA					
SAMBAA K'E	**2,622,531**	**9.503**	**529.663**	**3.624**	**201.966**

Table 15. Ultimate Recoverable Resource per Unit Area for the Sambaa K'e Candiadte Protected Area Compared with the Dehcho Territory and the Total Mackenzie Valley

GEOLOGICAL PLAY	UNDISCOVERED - DEHCHO TERRITORY					UNDISCOVERED - SAMBAA K'E CANDIDATE PROTECTED AREA						
	GAS - Million Cubic Metres			OIL - Thousand Cubic Metres		GAS - Million Cubic Metres			OIL - Thousand Cubic Metres		% of Recoverable	
Play Name	**In Place**	**Recoverable**	**Marketable**	**In Place**	**Recoverable**	**In Place**	**Recoverable**	**Marketable**	**In Place**	**Recoverable**	**Gas**	**Oil**
Laramide/Manetoe	31,558.4	20,197.4	16,864.8	0.0	0.0							
Laramide/Windflower	21,443.1	13,226.9	11,533.9	0.0	0.0							
Slave Point edge	13,415.0	9,607.8	8,210.5	0.0	0.0	5,450.4	3,909.1	3,325.8	0.0	0.0	40.7%	
Slave Point back barrier	20,089.2	15,441.1	14,009.4	29,175.8	4,858.4	4,420.7	3,398.2	3,083.1	4,573.8	761.2	22.0%	15.7%
Sulphur Point/Bistcho	5,245.8	3,885.6	3,561.6	9,153.3	1,186.0							
Lonely Bay platform	11,359.6	8,329.8	7,355.2	0.0	0.0	756.5	554.8	489.9	0.0	0.0	6.7%	
Basal Cretaceous clastics	6,789.3	5,451.8	4,838.0	4,261.4	922.5	1,852.4	1,487.3	1,319.8	921.8	199.6	27.3%	21.6%
Jean Marie Member	9,361.3	6,156.9	5,584.3	0.0	0.0	4,763.0	3,107.8	2,818.8	0.0	0.0	50.5%	
Keg River/Cordova embayment	845.5	591.9	556.3	0.0	0.0	642.1	449.5	422.5	0.0	0.0	75.9%	
Basal pre-Devonian Clastics	7,353.0	4,901.2	3,906.3	0.0	0.0							
Keg River reef (Rainbow)	3,323.3	2,307.1	2,053.4	6,491.8	842.4							
Arnica/Landry platform	15,856.4	10,571.9	9,039.0	0.0	0.0	132.2	88.1	75.3	0.0	0.0	0.8%	
Lonely Bay/Nahanni platform	12,262.3	8,786.6	7,512.5	0.0	0.0	298.6	214.0	183.0	0.0	0.0	2.4%	
Kakisa/Redknife platform	4,442.9	2,887.0	2,647.4	0.0	0.0	1,835.8	1,192.9	1,093.9	0.0	0.0	41.3%	
Upper Paleozoic subcrop	697.0	488.8	453.1	6,233.0	1,348.0	289.3	202.6	187.8	2,540.1	549.3	41.5%	40.8%
Triassic subcrop	162.6	113.8	106.2	0.0	0.0							
Bovie structure	10,608.2	6,897.1	5,683.2	0.0	0.0							
Silurian-Ordovician platform	6,071.3	3,826.0	3,558.2	0.0	0.0							
Basal Cambrian clastics	5,884.2	4,707.5	3,483.6	0.0	0.0							
Plateau Overthrust	1,149.9	747.7	616.1	0.0	0.0							
TOTALS	**187,917.9**	**129,123.9**	**111,572.9**	**55,315.3**	**9,157.2**	**20,440.9**	**14,604.4**	**13,000.0**	**8,035.7**	**1,510.2**	**11.3%**	**16.5%**

Table 16. Undiscovered Ol and Gas Resources (Metric units) by Play for the DehCho Territory and the Sambaa K'e Candidate Protected Area

		UNDISCOVERED - DEHCHO TERRITORY					UNDISCOVERED - SAMBAA K'E CANDIDATE PROTECTED AREA						
	GEOLOGICAL PLAY	GAS - Billion Cubic Feet			OIL - Million Barrels		GAS - Billion Cubic Feet			OIL - Million Barrels		% of Recoverable	
Play	Play Name	In Place	Recoverable	Marketable	In Place	Recoverable	In Place	Recoverable	Marketable	In Place	Recoverable	Gas	Oil
1	Laramide/Manetoe	1,120.12	716.879	598.594	0.000	0.000							
2	Laramide/Windflower	761.095	469.473	409.380	0.000	0.000							
3	Slave Point edge	476.147	341.018	291.420	0.000	0.000	193.453	138.750	118.046	0.000	0.000	40.7%	
4	Slave Point back barrier	713.040	548.063	497.244	183.599	30.573	156.907	120.616	109.432	28.783	4.790	22.0%	15.7%
5	Sulphur Point/Bistcho	186.193	137.916	126.415	57.600	7.463							
6	Lonely Bay platform	403.194	295.656	261.064	0.000	0.000	26.850	19.691	17.387	0.000	0.000	6.7%	
7	Basal Cretaceous clastics	240.976	193.504	171.717	26.817	5.805	65.750	52.789	46.845	5.801	1.256	27.3%	21.6%
8	Jean Marie Member	332.267	218.531	198.207	0.000	0.000	169.056	110.309	100.050	0.000	0.000	50.5%	
9	Keg River/Cordova embayment	30.010	21.007	19.747	0.000	0.000	22.790	15.953	14.996	0.000	0.000	75.9%	
10	Basal pre-Devonian Clastics	260.986	173.963	138.649	0.000	0.000							
11	Keg River reef (Rainbow)	117.955	81.887	72.884	40.852	5.301							
12	Arnica/Landry platform	562.804	375.236	320.827	0.000	0.000	4.691	3.128	2.674	0.000	0.000	0.8%	
13	Lonely Bay/Nahanni platform	435.234	311.868	266.647	0.000	0.000	10.599	7.595	6.494	0.000	0.000	2.4%	
14	Kakisa/Redknife platform	157.694	102.472	93.967	0.000	0.000	65.158	42.342	38.827	0.000	0.000	41.3%	
15	Upper Paleozoic subcrop	24.737	17.348	16.084	39.224	8.483	10.268	7.191	6.667	15.984	3.457	41.5%	40.8%
16	Triassic subcrop	5.770	4.039	3.769	0.000	0.000							
17	Bovie structure	376.524	244.803	201.717	0.000	0.000							
18	Silurian-Ordovician platform	215.494	135.800	126.294	0.000	0.000							
19	Basal Cambrian clastics	208.851	167.087	123.645	0.000	0.000							
20	Plateau Overthrust	40.814	26.540	21.869	0.000	0.000							
	TOTALS	**6,669.909**	**4,583.090**	**3,960.140**	**348.092**	**57.625**	**725.522**	**518.363**	**461.417**	**50.567**	**9.503**	**11.3%**	**16.5%**

Table 17. Undiscovered Oil and Gas Resources (Imperial units) by Play for the DehCho Territory and the Sambaa K'e Candidate Protected Area

Comparative Analysis of Estimates of this Report with Hannigan et al, 2011

The Geological Survey of Canada (GSC) recently released Open File 6757, Petroleum resource potential of the Mackenzie Valley, by Hannigan, P.K., Morrow, D.W., and MacLean, B.C., 20011. In the report Hannigan et al, 20011 the total in place resource potential for the Mackenzie Valley is estimated to be 761.6 million cubic metres (4790 million barrels) of oil and 928.7 billion cubic metres (32.8 trillion cubic feet) of gas. The total potential includes discovered plus undiscovered. The discovered in place resource for the Mackenzie Valley is 103.0 million cubic metres (646 million barrels) of oil and 85.8 billion cubic metres (3.0 trillion cubic feet) of gas (Drummond, 2009). The undiscovered in place potential is 658.6 million cubic metres (4144 million barrels) of oil and 842.9 billion cubic metres (29.8 trillion cubic feet) of gas. A comparison of the undiscovered in place volumes is made with the estimates by Drummond, 2009, as shown in table 18. Hannigan, et al (GSC Open File 6757) has gas in place of 843 billion cubic metres (29.8 trillion cubic feet) compared to 537 billion cubic metres (19.1 trillion cubic feet) for Drummond, 2009. For oil in place Hannigan, et al, 2011 is 659 million cubic metres (4.1 billion barrels) compared to Drummond, 2009 of 245 million cubic metres (1.5 billion barrels). Again this points out the great uncertainty in the estimation of undiscovered oil and gas in frontier, relatively unexplored regions.

MACKENZIE VALLEY UNDISCOVERED RESOURCES		
METRIC UNITS	**HANNIGAN ET AL, 2011**	**DRUMMOND, 2009**
GAS IN PLACE (Billion Cubic Metres)	**842.9**	**537.0**
OIL IN PLACE (Million Cubic Metres)	**658.6**	**244.6**
IMPERIAL UNITS	**HANNIGAN ET AL, 2011**	**DRUMMOND, 2009**
GAS IN PLACE (Billion Cubic Feet)	**29,796.6**	**19,060.5**
OIL IN PLACE (Million Barrels)	**4,144.2**	**1,539.1**

Table 18. Comparison of in place estimates for the total Mackenzie Valley by Drummond, 2009 with Hannigan, et al, 2011.

As Open File 6757 reports total potential (discovered plus undiscovered) for the total play, which occurs both north and south of 60o north, it is difficult to compare the assessment results with the current assessment for the Sambaa K'e and Ka'a'gee Tu Candidate Protected Areas. There is insufficient detailed information to make a comparison of in place volumes for the proposed Sambaa K'e and Ka'a'gee Tu Candidate Protected Areas from Hannigan et al, 2001 with the estimates of this report. In general it is concluded that the estimates by Hannigan et al, 2011 for the Candidate areas would likely be somewhat higher.

Conclusions

The redistribution of undiscovered oil and gas resources for the Deh Cho Territory in this update has resulted in significant changes in the undiscovered oil and gas resources for the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas. For the Ka'a'gee Tu Candidate Protected Area the undiscovered gas potential has decreased by 24% from 6,458 million cubic metres to 4,888 million cubic metres (229.2 billion cubic feet to 173.5 billion cubic feet), and the undiscovered recoverable oil potential has been decreased by 4% from 1,109 thousand cubic metres to 1,064 thousand cubic metres (7.0 million barrels to 6.7 million barrels). For the Sambaa K'e Candidate Protected Area the undiscovered gas potential has increased by 20% from 11,636 million cubic metres to 14,604 million cubic metres (413 billion cubic feet to 518 billion cubic feet), and the undiscovered recoverable oil potential has increased by 32% from 1,020 thousand cubic metres to 1,510 million cubic metres (6.4 million barrels to 9.5 million barrels).

For the Ka'a'gee Tu Candidate Protected Area, the undiscovered oil potential is estimated to be 1,064 thousand cubic metres (6,697 thousand barrels) of recoverable oil. The oil potential is low to moderate, and possibly somewhat better than much of the Mainland Northwest Territories. The greatest oil potential is concentrated along the southern boundary immediately north of the Cameron Hills, where discoveries have been made, and decreases to the north.

The discovered recoverable gas resource is 180 million cubic metres (6.4 billion cubic feet), with an undiscovered potential of 4,888 million cubic metres (173.5 billion cubic feet). The undiscovered gas potential is moderate, and would compare with much of the Mainland Northwest Territories, except for the Colville Hills and Mackenzie Delta onshore which have higher potential. The highest gas potential is in the south, adjacent to the Cameron Hills, and in the southwestern part of the area. Higher potential also occurs along a band from $60^{o}50'$ north to $61^{o}00'$ north latitude.

For the Sambaa K'e Candidate Protected Area, the undiscovered oil potential is estimated to be 1,510.2 thousand cubic metres (9,503 thousand barrels) of recoverable oil. The oil potential is low to moderate, and possibly somewhat better than much of the Mainland Northwest Territories. The greatest oil potential is concentrated in the southwestern two-thirds of the Sambaa K'e Candidate Protected Area.

The discovered recoverable gas resource for the Sambaa K'e Candidate Protected Area is 324 million cubic metres (11.3 billion cubic feet), with an undiscovered potential of 14,604 million cubic metres (518 billion cubic feet). The undiscovered gas potential is moderate, and would compare with much of the Mainland Northwest Territories, except for the Colville Hills and Mackenzie Delta onshore which have higher potential. In general the southwest two thirds of the Sambaa K'e Candidate Protected Area is the most favorable for undiscovered natural gas. The highest gas potential follows the barrier reef edge with somewhat lower potential on the adjacent carbonate banks. The lowest potential for gas is in the northeastern third of the area.

The Ka'a'gee Tu Candidate Protected Area represents 5.5% of the area of the Deh Cho Territory, with an estimated 3.4% of the undiscovered recoverable gas resource and 10.8% of the undiscovered recoverable oil resource. The Candidate area is 2.1% of the area of the Mackenzie Valley, with 1.2% of the undiscovered recoverable gas resource and 1.1% of the undiscovered recoverable oil resource.

The Sambaa K'e Candidate Protected Area represents 6.2% of the area of the Deh Cho Territory, with an estimated 10.0% of the undiscovered recoverable gas resource and 15.3% of the undiscovered recoverable oil resource. The Candidate area is 2.4% of the area of the Mackenzie Valley, with 3.4% of the undiscovered recoverable gas resource and 1.5% of the undiscovered recoverable oil resource.

In total the Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas occupy 11.7% of the total Deh Cho Territory with 13.4% of the undiscovered recoverable gas resource and 26.1% of the undiscovered recoverable oil resource. The two candidate areas are 4.59% of the area of the Mackenzie Valley with 4.6% of the undiscovered recoverable gas resource and 2.6% of the undiscovered recoverable oil resource.

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Appendix A - RESOURCE ESTIMATION USING @RISK WITH EXCEL

Undiscovered resource estimation is done using the Palisade Corporation @Risk add-in for Excel. The probabilistic methodology used has been adapted from Roadifer, 1979. The methodology requires a set of input variables, which are sampled using a random sampling method such as Monte Carlo. The Monte Carlo simulation uses a range of input parameters to give a distribution of results. A probabilistic estimate of resources can be achieved by multiplying computer-generated numbers for volume, yield and risk (probability of success). The variable input parameters for the undiscovered resource methodology is summarized as follows:

Hydrocarbon Volume	Untested Play Area Fraction of Untested Play Area in Trap Areal Fill of Traps Average Net Pay
Yield	Porosity Hydrocarbon Saturation Recovery Factor
Risk	Probability of Hydrocarbons

Hydrocarbon Volume x Yield x Risk = Undiscovered Resource

@RISK

The @RISK program is an add-in, which adds simulation analysis capabilities to the Excel spreadsheet. It allows the user to define uncertain cell values as probability distribution functions in Excel. There are numerous distribution functions available, including triangular, lognormal, beta, cumulative, etc. The functions are entered for all the variables, as net pay, porosity, area, recovery factor, etc, used in the oil or gas equation. The equations for oil and gas, multiplying all the various variables, are entered into cells, which are designated as the output for @RISK. The program will then execute a Monte Carlo, or Latin Hypercube simulation a specified number of iterations, i.e. 5,000, and generate a cumulative frequency distribution, to give a range of probabilities for resource estimates. The program utilizes the graphics capabilities of Excel to generate graphical output for the results.

Probability Distribution Functions

Any number of distribution functions can be used for the various variables used in the template. The author prefers the triangular distribution as it is the easiest to understand. The triangular distribution requires estimates of, minimum, maximum, and most likely, for each of the parameters.

Reference

Roadifer, R. E., 1979, A probability approach to estimate volumes of undiscovered oil and gas, *in* M. Grenon, ed., Proceedings of the first IIASA conference on Energy Resources, Laxenburg, Austria: Oxford, Pergamon Press, p. 268-278.

Appendix B - Sub-division of plays of the Deh Cho Territory for Ka'a'gee Tu and Sambaa K'e Candidate Protected Areas

There are a total of thirteen plays between the two proposed candidate areas. Seven of the plays are common to both the Ka'a'gee Tu Candidate Protected Area and Sambaa K'e Candidate Protected Area. These are; Slave Point barrier reef edge (play 3), Slave Point back barrier (play 4), Lonely Bay Horn Plateau reefs (play 6), Basal Cretaceous clastics (play 7), Lonely Bay/Nahanni platform (play 13), Kakisa/Redknife platform (play 14) and Upper Paleozoic (sub-Cretaceous) subcrop (play 15). Three plays; Sulphur Point Bistcho (play 5), Basal pre-Devonian clastics (play 10), and Keg River Rainbow reef (play 11) are only in the Ka'a'gee Tu Candidate Protected Area. Three other plays; Jean Marie (play 8), Keg River reef – Cordova Embayment (play 9) and the Arnica/Landry platform (play 13) are only in the Sambaa K'e Candidate Protected Area.

Slave Point Barrier Reef Edge (Play 3)

The Slave Point barrier reef edge play has been subdivided into four segments (sub-plays). The eastern segment, designated 3a is in the Big Island area, where the reef is relatively shallow at an average depth of about 250 metres. The next segment to the west (3b) is along the northern edge of the carbonate bank at an average depth of 800 metres. Segment 3c is along the east side of the Cordova Embayment at an average depth of 1,750 metres. Segment 3d is the barrier reef edge along the western side of the Cordova Embayment, at an average depth of 2,000 metres. The carbonate bank on the west side of the Cordova Embayment is known as the Arrowhead Salient.

Slave Point Back Barrier (Play 4)

The Slave Point back barrier play has also been divided into four sub-plays. The northeast segment (4a) is in the Big Island area, at an average depth of about 300 metres. The northeast-central segment (4b) is at an average depth of 750 metres. The south-central segment (4c) is at an average depth of 1,500 metres. The Arrowhead Salient carbonate bank (4d) in the west is at an average depth of 2,000 metres.

Sulphur Point Bistcho (Play 5)

The Sulphur Point Bistcho play has been sub-divided into a northeast portion (5a), at an average depth of 350 metres and southwest portion (5b) at an average depth of 900 metres.

Lonely Bay Horn Plateau Reef (Play 6)

The Lonely Bay Horn Plateau reef play has two segments; a northern area at an average depth of 350 metres and a southern area at an average depth of 750 metres.

Basal Cretaceous Clastics (Play 7)

The Basal Cretaceous clastics play occurs in three distinct areas of the Deh Cho Territory, south, central and north. Only the southern one occurs in the candidate areas. The southern area has been subdivided into an eastern segment (3a), at an average depth of 250 metres, and a western segment at an average depth of 450 metres. The central area is designated 3c, with an average depth of 250 metres, and the northern area is designated 4d, at an average depth of 320 metres.

Jean Marie (Play 8)

The Jean Marie, as it is in Northeast British Columbia has been subdivided into a narrow barrier reef edge (8a) along the western margin and the carbonate platform (8b) to the east. More favourable reservoir parameters have been assigned to the barrier edge relative to the platform.

Keg River Reef – Cordova Embayment (Play 9).

This play is still considered as one play, with no subdivision, and the assessment of the play has not changed.

Pre-Devonian Basal Clastics (Play 10)

The pre-Devonian basal clastics play is in two separate areas. The two areas have been designated 10a for the south area, with an average depth of 1600 metres, and 10b for the northeast occurrence, with an average depth of 750 metres.

Keg River – Rainbow (Play 11)

The play has not been subdivided. A new assessment has been run with only slight modification to the input parameters, resulting in a minor change in the output results.

Arnica/Landry Platform (Play 12)

Only a small part of this play occurs in the Sambaa K'e Candidate Protected Area, and no new assessment has been done.

Lonely Bay/Nahanni Platform (Play 13)

The play has not been subdivided. A new assessment has been run with only slight modification to the input parameters, resulting in a minor change in the output results.

Kakisa/Redknife Platform (Play 14)

The Kakisa/Redknife platform play has been subdivided into a northern portion (14a), at an average depth of 350 metres, and a southern portion with an average depth of 1,000 metres.

Upper Paleozoic (sub-Cretaceous) subcrop (Play 15)

The Upper Paleozoic (sub-Cretaceous) subcrop Play has been subdivided into a northeast segment (15a), at an average depth of 350 metres, and a south-western segment (15b) with an average depth of 750 metres. The northern limit of the play has also been moved to the south away from the Cretaceous outcrop edge to reflect a minimum depth of about 200 metres.

The update for the total Deh Cho Territory has resulted in a slight decrease in the estimated undiscovered recoverable gas from 4,592.3 billion cubic feet to 4,583.1 billion cubic feet. This is a reduction of 9.2 billion cubic feet or 0.2%. The estimated recoverable oil resource has increased from 54.2 million barrels to 57.6 million barrels. This is an increase of 3.4 million barrels, or 3.6%. The changes are minor for the overall Deh Cho Territory. However when considering smaller areas within the Deh Cho Territory, such as the candidate protected areas, the changes are more significant.