COAL MINE METHANE IN UKRAINE:

Business Plan for a Development Project at Komsomolets Donbassa Mine

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BUSINESS PLAN
FOR A DEVELOPMENT PROJECT
AT KOMSOMOLETS DONBASSA MINE

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ABBREVIATIONS AND TERMS

CBM	Coalbed Methane
CIS	Commonwealth of Independent States
CMM	Coal Mine Methane
CO_2	Carbon Dioxide
DAF	Dry Ash Free
°C	Degrees Centigrade
DCF-ROI	Discounted Cash Flow-Return On Investment
G&A	General and Administrative (Expense)
GCAL	Giga-calories
KCM	Thousand Cubic Meters
KM	Kilometer
M	Meter
MOB/DE-MOB	Mobilization/De-Mobilization
PV	Present Worth
VAT	Value Added Tax

1.0 EXECUTIVE SUMMARY

The objective of this business plan is to demonstrate the financial feasibility of a coal mine methane development project at the Komsomolets Donbassa Mine located in the Donetsk Region of Ukraine (See Exhibit 1). The business plan incorporates the utilization of Western technology and equipment and is patterned after similar projects that have been successfully implemented in other parts of the World. The project will entail three phases; pilot project, evaluation, and the full-scale development program.

The pilot project phase will consist of the drilling and completion of five standard wells and one gob well. An evaluation phase will follow the pilot project to assess the results of the drilling and completion conducted during the pilot project phase and to allow time for making the decision to continue into the development program. The business plan assumes a full year to complete the pilot project and the evaluation period at a cost of approximately $6 million.

The full-scale development program consists of the drilling and completion of four holes per month over a three-year period resulting in a total of 144 wells. The drilling program will include 125 standard wells and 19 gob wells. Selected coal seams and sandstones in the standard wells will be hydraulically stimulated (fractured) to provide an avenue for the gas and water to flow from the formation to the well bore. The gob wells will not be hydraulically stimulated. The gob wells will produce gas from the relaxed fractured coal seams and sandstones resulting from the longwall mining operations in the Komsomolets Donbassa Mine.

The project Cash Flow and Economics (See Table 1) yields a discounted cash flow rate of return of 36.18% over the project evaluation period of thirteen years. Excluding working capital requirements, the maximum capital required for implementing the project is approximately $20.0 million. This projection includes income tax benefits associated with the project receiving Free Economic Zone designation. The pilot project costs are reflected in Year 0, or the year before the development program begins. The pilot project's first year of methane production is to be vented while the wells are being evaluated. The pilot project's well production for the second through the tenth year is reflected in the first through the ninth year of the development phase. All wells are assumed to have a ten-year life including the year it was drilled which results in a project life of thirteen years. A ten-year well life is very conservative as coal mine methane wells in the United States are expected to have a fifteen to twenty year life.

The project has additional prospects to increase the financial returns. There is the potential that gob wells and standard wells drilled in the near vicinity of an existing mine may qualify for greenhouse gas credits. Also, there is a good possibility that gas recovery rates may exceed those shown in the forecast.

An analysis of all factors indicates that the project has the potential to be financially viable. The resource density is very large and terrain demographics are suitable for a large-scale development project and a high-sustained rate of methane flow during and after mining indicates that adequate permeability will exist.

2.0 IMPORTANCE OF COAL-BED METHANE IN UKRAINE

Commercial development and utilization of methane in Ukraine will have many positive benefits to the economy, the environment, and to the coal industry. A fully implemented methane development project will result in the following:

- creating an alternative energy source that would mitigate Ukraine's dependency on imported fuel; primarily natural gas from Russia and other CIS countries,
- reducing the amount of methane, a potent greenhouse gas, that Ukrainian coal mines release to the atmosphere, and
- improving coal mine safety, coal mine employee health, and productivity.

In 1999, the Cabinet of Ministers of Ukraine considered a national energy program for 2000 to 2010. This program includes a set of goals for the energy sector to achieve a more balanced supply/demand situation through a combination of alternative energy sources and energy efficiency programs. One of the goals is to have eight billion cubic meters of methane produced per year by the year 2010.

For the purpose of this business plan, the following definitions apply:

- coalbed methane (CBM) – methane contained in coal seams and the rock strata surrounding the coal seams and
- coal mine methane (CMM) – methane contained in coal seams and the rock strata surrounding the coal seams in reserve areas that have been assigned to specific mines.

2.1 COALBED METHANE AS AN ALTERNATIVE FUEL SOURCE

The large-scale capture and utilization of CBM could contribute greatly towards Ukraine's energy requirements. Ukraine currently consumes approximately 75 billion cubic meters of natural gas on an annual basis while only producing approximately 18 billion cubic meters from domestic sources. This shortfall, of approximately 57 billion cubic meters per year, is being imported creating a serious increase in foreign debt. Ukraine receives 30 billion cubic meters of natural gas from Russia each year as compensation to transport Russian natural gas to Europe through pipelines located in Ukraine. The remaining 27 billion cubic meters of natural gas is sold to Ukraine at $80 per thousand cubic meters thus creating a negative balance of trade in excess of $2 billion per year.

Increasing domestic standard natural gas and oil production is not an economically feasible option for Ukraine. Under the Soviet Union, the larger and shallower natural gas and oil reserves were depleted; leaving small, deep, and more expensive reserves that will require vast capital resources to develop that Ukraine does not possess.

It is clear that the gas produced from a commercial CBM development project would have a ready market that would enhance the economic conditions in Ukraine.

2.2 ENVIRONMENTAL BENEFITS OF USING COAL MINE METHANE

Methane is one of a number of gases that scientists believe contribute to the greenhouse effect, the trapping of heat in the Earth's atmosphere. The extent to which any given greenhouse gas traps heat is measured relative to the heating effect of carbon dioxide. Methane is estimated to be 21 times as potent as carbon dioxide in trapping atmospheric heat over a hundred year period. Methane and other greenhouse gases are released to the atmosphere through various natural processes and through many human activities, such as the mining of coal.

Capturing and utilizing CMM in Ukraine can significantly reduce the amount of greenhouse gas that coal mines presently emit into the atmosphere. During 1999, Ukrainian coal mines generated approximately 2,060 million cubic meters of methane. Through degasification systems, the mines captured approximately 257 million cubic meters of methane (13% of the total generated) and used only 79 million cubic meters of the captured methane; thus emitting approximately 1,981 million cubic meters of methane into the atmosphere. Not only this is a waste of a vitally needed energy source but CMM emissions contribute to the greenhouse gas effect.

The development of CMM projects in Ukraine can reduce the amount of gas coal mines emit into the atmosphere. In addition, with the advent of the trading of carbon credits, Ukrainian coal mines could be considered as candidates to generate these credits. As of July, 2000 over $30 million of carbon credit transactions have taken place on a worldwide basis. Total potential market for carbon trading could reach in excess of $10 billion by the year 2010. Thus far, the carbon credit transaction values have only been a fraction of the costs that would be incurred to reduce greenhouse gas emissions. However, there is not a consensus among economists in determining the total mitigation costs that should be included in reducing greenhouse gas emissions. Mitigation costs of CMM development projects in Ukraine may be considerably less than those expected in the United States.

2.3 COAL MINE METHANE AS A HEALTH AND SAFETY ISSUE

The development of CMM projects at coal mines in Ukraine can greatly reduce the number of accidents and fatalities that Ukrainian mines are presently experiencing. In 1999, Ukraine coal mines experienced 296 fatalities, or 3.7 deaths per one million raw tonnes of coal produced. This grave statistic is one of the worse in the world. Many of the fatalities are the result of outbursts caused by high gas content and from explosions caused by the ignition of explosive concentrations of methane. Pre-mining degasification of the coal reserves, with the drilling of vertical wells and utilizing enhanced underground degasification system, would greatly reduce the accident and fatality rates in Ukrainian coal mines. In addition, removal of the methane from the mines will increase productivity by reducing the number of mine slowdowns or shutdowns due to high methane levels.

CMM development projects can reduce coal mine accidents and fatalities, while at the same time lower their mining costs by increasing productivity.

3.0 KOMSOMOLETS DONBASSA MINE PROJECT

3.1 INTRODUCTION

This business plan for a commercial CMM development project at the Komsomolets Donbass Mine demonstrates the financial viability of such a project utilizing Western equipment and technology. The business plan was developed in cooperation with Western CBM development experts, Western energy experts, and data and information provided from Ukrainian CBM and energy professionals.

The project includes a Pilot Project Phase, an Evaluation Phase, and a Development Phase. Each Phase will be implemented in a manner to maximize the project cash flow and is patterned after development projects that have been successfully implemented in other countries. Prior to the start of the Pilot Project, additional time and expenses will be required to confirm the status of current Ukrainian laws and current tax regulations, creating a business structure to implement the project, contracting with Western drilling and completion organizations, and other necessary steps that are required to start a project in a developing country. These related expenses have not been included in this business plan and have been assumed that they will be absorbed by the project developer.

It is recognized that in Ukraine, as in most developing countries, many legal, economic, and administrative barriers will have to be overcome for the successful implementation of such a project as set out in this business plan. Many of the assumptions that have been made in assembling this business plan must be verified and/or revised based on current conditions prior to implementing the project.

3.2 BACKGROUND

Komsomolets Donbass Mine, located 25 kilometers northeast of Donetsk, is one of the 241 underground coal mines in Ukraine. This mine was selected for evaluation based on its methane reserves, specific methane content of its coal seams, its annual coal production, and projected economic life. Komsomolets Donbass Mine includes a reserve area of 62.5 square kilometers that contains methane in excess of seven billion cubic meters. The mine reserve area contains fifteen coal seams that have an aggregate thickness of seven meters and the methane content of the coal seams range from 20 to 35 meters/tonne daf. During 1999, the mine produced approximately 1.4 million raw tonnes from three different seams that individually ranged in thickness from 0.95 to 1.45 meters.

Komsomolets Donbass is a privately owned enterprise that was 100% privatized during 2000 and it is not part of a collection of mines often referred to as an association. Komsomolets Donbass is unique in that it is the only mine in Ukraine that has been privatized.

Komsomolets Donbass Mine management and personnel have actively participated in gathering information and data for this business plan and have been supportive of the project.

3.3 PROJECT DESCRIPTION

This business plan for a CMM development project at the Komsomolets Donbassa Mine was initiated after gathering and evaluating data and information regarding the mine and reserve area. The geology, hydrogeology, and structure of the area are well known from the extensive mining and coring in the area. An overview of the geology of the area is presented in Section 3.5 of this business plan.

The well drilling envisions the use of Western drilling and completion equipment and the utilization of proven technologies that have been successfully implemented in similar projects in other parts of the World. All of the assumptions that have been utilized in developing this business plan are based on similar projects and then modified to adjust to conditions that are expected to be encountered in Ukraine. All of the operating and equipment costs are those in effect as of January 1, 2000 and all of the financial projections are based on a constant dollar basis.

The business plan is based on drilling and capturing gas from vertical wells only. The business plan does not include additional gas that is available from the mine ventilation shafts and from their underground degasification system. The business plan assumes a stand-alone business structure so as not to burden the project with the financial constraints often found with the coal mines in Ukraine.

3.3.1 Pilot Project Phase

A Pilot Project Phase has been included in the business plan as a method to determine the viability of a commercial CMM project in Ukraine before a full development project would be initiated. The Pilot Project will be used to assess the potential production characteristics, confirmation of in-place gas volume, determination of fracturing characteristics, and to assess the water regime in the area. The Pilot Project Phase assumes the drilling and testing of five standard wells and one gob well. Selected coal seams and standstones within the five standard wells will be hydraulically stimulated to create a passageway, or avenue, for gas and water to flow from the formation to the wellbore. During the Pilot Project, the most suitable drilling and completion techniques and the target seam combination that will maximize the production potential from the development project will be defined. The gob well will not be hydraulically stimulated. The gob well will produce gas from the relaxed fractured coal seams and standstones located above the longwall mining operations.

Suitable drilling and completion equipment and related required services are not available in Ukraine to implement the Pilot Project. In addition, due to the limited size and scope of the Pilot Project, it would be cost prohibitive to purchase and use the appropriate suite of equipment and services exclusively for such a small project. Therefore, the costs for the Pilot Project are based on using a drilling contractor from Central or Western Europe, a hydraulic fracturing contractor from Western Europe, and the technical services and support being provided by experienced United States CBM operators.

The Pilot Project costs for drilling and completing the six wells are estimated to be approximately $5.8 million (See Table 2) and have been included in Year 0 of the project cash flow analysis (See Table 1). The estimated costs do not include provisions for extensive coring and desorbtion tests as the gas content in the coal seams is known with a high degree of confidence and the gas content for the sandstones is considered to be a minimum of 0.8 cubic meters per cubic meter of sandstone. The gas produced from the six wells during Year 0 has assumed to be vented until after the Evaluation Phase has been completed. However, gas produced from the six wells are included in the project cash flow analysis for the five standard wells (See Table 3) and for the one gob well (See Table 4) starting with Year 1 of the project economic analysis.

3.3.2 Project Evaluation Phase

It is recognized that after the completion of the Pilot Project Phase a period of time for evaluation must be considered before the start of the full development program. Drilling and completing wells for CMM is new for Ukraine and no historical data and information are available for a comparative analysis. The exact amount of time required for this evaluation is unknown and will vary in length based on the results obtained from the Pilot Project and the experience and knowledge of the developer. Sufficient time has been included in the project cash flow analysis by assuming that a full year (Year 0) will be required for the Pilot Project and Evaluation Phases. The costs associated for the evaluation period have not been included in the project cash flow and that they will be absorbed by the project developer.

3.3.3 Project Development Phase

The Project Development Phase assumes the successful completion of the Pilot Project and that a decision to proceed with the project was reached during the Evaluation Phase. Similar to the Pilot Project, the same equipment and services have been assumed to be available for implementing the full development program. It has been further assumed that the drilling and stimulation contractors have secured sufficient business in Ukraine to establish a base of operations. All of the associated costs for these services are based on this assumption and are critical to the financial viability of the project.

3.3.3.1 Drilling Program

The drilling program will be completed over a three-year period and that four wells per month will be drilled. During this period, 144 wells will be drilled that includes a combination of standard wells and gob wells (See Table 5). The standard wells, drilled to a depth of 1,000 meters, will have a density of three wells per square kilometer while the gob wells, drilled to a depth of 750 meters, will have an effective density of six wells per square kilometer.

The location of the 144 wells to be drilled during the Drilling Program was determined after reviewing the geology of the mine area, a mine map containing areas that had been previously mined, and projections of areas for future mine development. In the selected area for drilling, the wells will encounter 24 coal seams and 13 layers of sandstone. The drilling area has an average gas content of over 20 cubic meters per tonne in the coal seams and a minimum of 0.8 cubic meters of gas per cubic meter of sandstone.

The density of the selected area is assumed to be as shown in the table below.

The development costs for each standard well are estimated to be $316,000 and for each gob well to be $211,000 (See Table 6). The following is a general overview of the sequence of events associated with the drilling and completion of a standard well that will be followed during both the Pilot Project and the Project Development Phases. Standard wells drilled during the Pilot Project will be prepared for the hydraulic stimulation process before any well will be stimulated. During the Project Development Phase, the timing of the hydraulic stimulation will be scheduled to achieve the most cost-effective results. The sequence of events for the drilling and completion of a standard will are as follows:

- Prepare well site,
- Move in drilling rig and equipment,
- Set conductor casing,
- Drill surface hole,

Density of gas resources

Interval	Coal seams			Sandstones			Total Density, Million m^3/km^2
	Number	Total Thickness, m	Density, Million m^3/km^2	Number	Total Thickness, m	Density, Million m^3/km^2	
$l_2^1Sl_3$-M_7Sm_6 (standard wells)	16	10.35	282.46	9	288.20	182.56	465.02
m_2Sm_3-M_7Sm_6 (gob wells)	8	4.10	96.15	4	82.00	65.60	161.75

- Run and set surface casing,
- Drill production hole,
- Run open hole electric log,
- Move drill rig off and clean-up site,
- Run and set production casing with either drill rig or workover rig,
- Run cement bond log,
- Move in hydraulic stimulation and perforating equipment,
- Perforate bottom zone,
- Hydraulically stimulate the bottom zone,
- Run and set a bridge plug above the perforations just stimulated and below the next zone to be stimulated,
- Perforate the next zone to be stimulated,
- Hydraulically stimulate the zone just perforated,
- Run and set bridge plug and continue the sequence until all zones have been stimulated,
- Flow the well back to a pit or a tank,
- During the flow back period, move in and set up surface equipment,
- Use workover rig to circulate water or nitrogen through the tubing to clean sand and coal fines out of the well,
- Use workover rig to run pump, tubing, and rods.
- Hook up surface equipment, which will include drive head and electric motor for the pump, meter, separator, and a tank for produced water, and
- Begin pumping water and production gas.

It should be noted that during the flow back operation the water and nitrogen used in the stimulation process should be allowed to flow back slowly. This will allow the sand to stay in the formation rather than flowing back with the water and nitrogen. This process may take from two to six days depending upon the type of bridge plugs that are utilized. The characteristics of different bridge plugs are the following:

- Flow through bridge plugs: flow back process will take two to three days and a workover rig will not be necessary,
- Non-flow through bridge plugs: flow back process will take four to six days and a workover rig will be necessary,
- Retrievable bridge plugs: a wireline truck will be used to remove the plugs, and
- Drillable bridge plugs: a workover rig will be required.

The following is a general overview of the sequence of activities associated with the drilling and completion of a gob well that will be followed for gob wells that are drilled during both the Pilot Project and the Project Development Phases:

- Prepare well site,
- Move in drilling rig and equipment,
- Set conductor casing,
- Drill surface hole,
- Run and set surface casing,
- Drill production hole,
- Run open hole electric log,
- Move drill rig off and clean-up site,
- Run and set slotted production casing insert with either the drill rig or a workover rig,
- Hook up surface equipment which will include drive head and electric motor for the pump, meter, separator, and a tank for produced water, and
- Begin pumping water and production gas.

In the project area there is a layer of silty type clay above the coal seam that is being mined. This layer of clay will tend to bend and not break thus blocking direct communication between the mine and the gob well. Without direct communication, well bore water that enters the well will impede gas production and must be pumped out. In addition, without direct communication, well pressure can be maintained without the use of a compressor.

In addition to the sequence of activities enumerated for the drilling and completion of the standard and gob wells, the basic infrastructure must be constructed. The infrastructure will include the gas and water gathering systems, the monitoring system, compression equipment to gather and transport the gas, and a water disposal system. Additional infrastructure will be constructed as additional wells are developed and connected for ultimate utilization of the produced gas.

3.3.3.2 Gas Production And Economics

Based on a review of the geological information, the assumption of the availability of Western equipment and technology, and the experience from similar projects in other parts of the World, production profiles were developed for both the standard and gob wells (See Tables 7 and 8; Exhibits 2 through 5). The well production profiles have been forecasted for a ten-year period only. The total project gas production on an annual basis is shown on Table 9.

Each standard well has been placed at a density of three wells per square kilometer and will be drilled to a depth of 1,000 meters. With these parameters, the gas reserves per standard well have been calculated to be 93,800 thousand cubic meters (kcm) in the coal seams and 60,200 kcm in the standstones. Thus, each standard well will have a gas reserve base of 154,000 kcm. Utilizing Western fracturing equipment and technology, it has been projected that each standard well will recover a total of 29,525 kcm over a ten-year production cycle. Gas from the coal seams is estimated to be 23,465 kcm (approximately 25% of the gas-in-place) and gas from the sandstones is estimated to be 6,060 kcm (approximately 10% of the gas-in-place).

Each gob well will be placed at an effective density of six wells per square kilometer and will be drilled to a depth of 750 meters. With these parameters, the gas reserves per gob well have been calculated to be 16,025 kcm in the coal seams and 10,975 kcm in the sandstones. Thus, each gob well will have a gas reserve base of 27,000 kcm. It has been projected that over a ten-year production cycle, each gob well will produce 12,232 kcm. Gas from the coal seams is estimated to be 7,292 kcm (approximately 45% of the gas-in-place) and 4,940 kcm (approximately 45% of the gas-in-place) from the sandstones.

With the production profiles and various financial assumptions, economic evaluations were calculated for a typical standard well (See Table 10) and for a typical gob well (See Table 11). Over a ten-year production cycle a standard well is projected to have a positive cash flow of approximately $726,000 and a discounted cash flow rate of return (DCF-ROI) of 49.73% assuming special tax benefits. With similar assumptions, the typical gob well has a positive cash flow of approximately $230,000 and a DCF-ROI of 24.44%. The financial assumptions are listed on the respective Tables.

The special tax benefits that are assumed on Tables 10 and 11 are in regards to the recently passed law on Free Economic Zones. The Komsomolets Donbassa Mine is included within one of the established Free Economic Zones and it is assumed that the tax benefits will be available for a commercial CMM development project. The particular tax benefits of a Free Economic Zone include a zero income tax rate for the first three years of an approved project and an income tax rate of 50% of the prevailing income tax rate for the next three years of the project. To reflect the benefits of this special tax treatment, economic evaluations were calculated without the tax benefits for a typical standard well (See Table 12) and for a typical gob well (See Table 13). Without the tax benefits the standard well DCF-ROI is reduced to 36.43% and the gob well in reduced to 18.26%.

3.3.3.3 Gas Markets, Pricing, and Payment

Key elements that are required for the successful implementation of this project include the following:

- A ready market to accept the gas that is produced,
- Consumers that are willing to pay a competitive price for the gas, and
- Consumers that have the ability to pay with cash for the gas.

As noted in Section 2, there is a ready market for gas that would be produced from a commercial CMM development project in Ukraine. For simplicity, the business plan has assumed that the produced gas would be sold into the existing natural gas system. For developers that wish to convert the produced gas into electricity, there are sufficient details in the business plan to form the basis of a new economic analysis.

The current official State price for natural gas in Ukraine is $80 per kcm plus a transportation fee of $3 per kcm. It has been assumed for the economic analysis of the business plan that the project would net $60 per kcm at the project site. The $20 reduction in the price is for rents, royalties, VAT, and other payments to the State but does not include income tax on the project profits.

It has been assumed for the economic analysis that the project would be paid in cash for all of the gas produced and sold. Historically in Ukraine, this would have been a gross assumption as most payments were made with the barter system. However, during the year 2000 there has been a significant increase in cash payments for services such as gas, electricity, and water. The State has established this as a high priority issue and is now allowing service providers the right to shut off consumers that have not paid. During the first six months of 2000 the cash payments have reached over 45% and the State has established a goal of reaching 50% by the end of the year. In addition, there are many large gas consumers that have the financials resources to pay in cash for their obligations that the project can seek out and secure.

3.4 THE ROLE OF KOMSOMOLETS DONBASSA MINE

The successful implementation of this project will require the establishment and maintenance of a strong relationship with the mine. The project developer must be kept aware of all current coal production, future coal development plans, and any deviations from these plans that are being considered. In addition, the mine may be considered as a consumer of a portion of the gas that is produced.

The Komsomolets Donbass Mine can utilize the captured methane at the mine as boiler fuel. The mine has eight boilers that primarily consume coal with one boiler using methane captured from the degasification system. During 1999, the mine consumed 71,000 Gcal of heat in their boilers. In addition, if electricity is generated with the captured methane, the mine could utilize a portion of the output. During 1999, the mine consumed approximately 10 million kilowatts per month of electricity at a cost of over $300,000 per month.

Not included in this business plan is the potential additional source of funds through the trading of carbon credits. The Komsomolets Donbass Mine is a contributor of methane emissions into the atmosphere. During 1999, the mine liberated approximately 128 million cubic meters of methane; including 116 million cubic meters via the ventilation shafts and 12 million through their degasification system. Of this total the mine only captured and consumed approximately 4.2 million cubic meters in their boilers.

The Komsomolets Donbass Mine will encourage a coalbed development project to reduce their accidents and fatalities while at the same time reducing their costs by increasing productivity. Due to the high level of methane in the mining areas during production, the mine is limited to taking only two passes per shift with the longwall shear and are then required to wait for the areas to stabilize before resuming production. With a properly implemented pre-mine degasification program the mine could realize a fifty- percent increase in production by being allowed to take three cuts per shift.

3.5 GEOLOGY OVERVIEW

3.5.1 General Information

The Komsomolets Donbassa Mine is located in the Shakhtiorsky Rayon of the Donetsk Region. The mine reserve area covers 62.5 square kilometers and stretches 15 kilometers from southeast to northwest and 3.8 to 6 kilometers from south to north. The mine area occupies a southern slope of the main watershed of the Donetsk Region including the Klenovaya and Olkhovka Rivers and the area between the Krynka and Olkhovka Rivers. Topographically, it is a hilly plain (steppe) with a highest elevation of 250 meters and a lowest of 148 meters above the sea level with the general relief lowering towards the south.

The climate in the mine area is considered as continental with a maximum and minimum temperatures of +40°C and -32°C respectively, and an average yearly temperature of +7°C. The soil tends to freeze to a depth of 0.6 meters and the area is normally frost-free for 250 days per year. Average yearly precipitation is 0.47 meters.

Electric power for the mine is provided through the high-voltage grid system of Donbassenergo and water is supplied from the canal Seversky Donets-Donbass through water mains. The main gas pipeline Zuevka-Yenakievo is laid through the mine property. There are no State preserves or any other protected areas within the mine area.

3.5.2 Stratigraphy and Lithology

The mine reserve area is located in the western part of the Torezsko-Snezhniansky geologic/industrial zone of the Donetsk Region, which occupies the central and western parts of the Chistiakovo-Snezhnianskaya syncline. Geologically, the mine area includes Upper and Middle Carboniferous deposits, namely coal-bearing strata C_3^1, C_2^6, and C_2^7 that are overlapped with Quaternary deposits through the whole area. There are some insignificant deposits found on the slopes of some ravines and water partings that have exposed coal seams. The top part of the Quaternary deposits is represented by soil (0.3 to 1.0 meters thick) and yellow-brown and light loam (0 to 15 meters, 3 to 5 meters on an average) with limestone and gypsum inclusions. The thickness of the Quaternary deposits depends on configuration and composition of underlying coal-bearing strata. Typically, with lower relief, the thickness of Quaternary deposits is higher, while with higher relief, and in the locations of exposed sandstone and limestone, the thickness becomes less (See Exhibit 6).

Carboniferous deposits are represented by terrigenous sediments with alternating bands of clay shale, sandy shale, sandstone of different grain size and layers of thin limestone, coal and coal type shale. Coal strata C_2^6 and C_2^7 are considered mineable in the area. The Table below shows some lithological/stratigraphical characteristics of the coal strata C_3^1, C_2^6, and C_2^7.

Coal Characteristics

Strata	*Thickness, m*	*Lithological Composition, %*				
		Sandstone	*Siltstone*	*Argillite*	*Limestone*	*Coal*
C_3^1	570	57.9	8.2	31.6	1.4	0.9
C_2^7	709	25.0	55.9	14.4	3.5	1.2
C_2^6	365	43.0	45.2	7.2	2.2	2.4

Coal strata C_3^1 is developed in the central part of the mine area stretching along the axle of Chistiakovo-Snezhniansky syncline. This strata is specific for sandy-clayey deposits with thick uniform sandstones, $n_1SN_1^6$ and $n_0^5SN_1^3$, with some limestone and coal represented. Coal strata C_3^1 is not considered commercially mineable.

Coal strata C_2^7 is specific for the predominance of alternating sandy-clay rocks with a number of coal seams and bands. The strata also include high sandstones, $m_9SM_{10}^1$, M_8SM_9, M_7SM_8, $M_6^1Sm_4^4$, and M_1SM_2 with low porosity and therefore high rank metamorphic.

Coal strata C_2^6 is typical for thick uniform sandstones. Most stable quartzite sandstones are the L_7Sl_7 and L_5Sl_5 while the sandstone l_3Sl_6, $l_2^1Sl_3$, and $l_1^{1B}Sl_2^1$ are considered less uniform.

Rock temperature at a depth of 100 meters averages 17.6°C and increases with depth. The geothermal index is 2.3° C per 100 meters.

3.5.3 Tectonics

Structurally, the mine area occupies the central and western areas of the Chistiakovo-Snezhnianskaya syncline, which is an asymmetric linear fold with steep northern and flat southern flanks.

Rock strata deposited in the southern flank dip at an angle of 5 to 17° while those in the northern flank from 15 to 25°. The dip of both flanks rises up to 47° westward and goes down from 2 to 8° approaching the fold axle. The axle gradually lowers northwest at 5 to 6°. The Yunkomovsky thrust, a natural boundary of the mine area, strikes northeast (at 26 to 45°) and dips southeast (at 35 to 60°). The Yunkomovsky thrust is split into three branches. The top branch is predominant with amplitude of 51 to 85 meters while the other two have amplitudes of 10 to 42 meters and 43 meters respectively. These branches have some smaller apophyses with amplitude of 2 to 15 meters; coal crushed zones range between 30 and 150 meters. The mine area itself has no significant disjunctions. Some minor disturbances with amplitude of 0.04 to 0.80 meters stretching from 50 to 650 meters were found while mining the coal seams l_7, l_6, l_4 and l_3.

3.5.4 Coal Strata

The Komsomolets Donbassa Mine coal reserves includes commercially mineable coal seams that total 7.07 meters in thickness while that of the non-recoverable seams total 11.4 meters. All of the coals are considered vitrainous. The inherent ash content ranges between 8.9 and 20.1% and the sulfur content ranges from 1.7 to 4.3%.

The coal strata C_3^1 includes 19 coal seams and layers; most of which are less than 0.2 meters thick, with only one, n_0^B, reaching 0.45 meters in some locations.

The coal strata C_2^7 contains 23 coal seams and layers, of which only seven are considered mineable: m_9, m_5^1, m_4^4, m_4^1, m_4, m_3, and m_2.

The coal strata C_2^6 include 17 coal seams and layers. The following seams reach mineable thickness within the mine area: l_8^1, l_7, l_6, l_4, l_3, and l_1^{1B}.

3.5.5 Coal Methane Content

Significant CBM reserves are found starting from a depth of 40 to 260 meters in both coal matter (the gas is in a sorbed state) and in porous or fractured gas reservoirs within the total area of the coal strata (the gas is in a free state). At depth of 500 to 600 meters, the gas content of coal increases reaching a maximum of 30 to 35 m^3/t daf; at deeper depths the gas content remains constant. The main component of the gas retained in coal seams and enclosing rocks is methane (89.8 to 98%) with some hydrogen (0 to 2.8%), carbon dioxide (0.1 to 1.2%), nitrogen (1.2 to 6%), ethane and propane (less than 1%), and helium (from traces to 0.265%). CBM reserves in the coal seams and the contiguous seams total approximately 12 billion cubic meters, including approximately 3 billion cubic meters within the active mining levels.

Data available on gas content of sandstone contained in the coal strata are inconsistent due to the low level of open porosity, which ranges between 0.7 and 5.7%. Numerous tests have shown that the sandstones contained only traces of gas although logging showed gas content up to 4.6 cubic meters/tonne in some locations. Gas manifestations were observed in 11 prospect boreholes drilled through the sandstone of strata C_2^7 and C_2^6.

3.5.6 Hydrogeology

Aquifers of the Quaternary deposits are developed in some areas with confining beds or strata, although water content of such deposits are insignificant as they are replenished mainly through rainfall. Major aquifers within the mine area are considered sandstone and limestone of the Carboniferous period. Water abundance of the rock strata goes down with depth, although increasing in fractured zones. Coal strata deposited deeper than 500 to 600 meters are basically water-free. Chemical composition of waters changes from hydrocarbonacious calcium, hydrocarbonacious calcium-magnesium and hydrocarbonacious calcium-sodium (at a depth of up to 100 meters) to chloride-hydrocarbonacious sodium and chloride-sulfate sodium (deeper than 600 meters). Mineralization of underground waters increases with depth from 1.3 to 1.8 grams/liter to 2.0 to 2.5 grams/liter.

3.6 PROJECT RISKS

The primary risks in a CBM project are the lack of resource and low gas production. In addition, regulations for disposal of produced water, restraints on the acquisition of surface rights, and poor market conditions for natural gas can adversely affect projects. Also, implementing a project in a developing country contains its own sets of risks involving legal and tax issues. Some of these factors are addressed below:

- Resource: The Komsomolets Donbassa Mine coal seam depth and thickness are known from coring and mining. The gas content has been determined from a long history of mining and gas emission measurements. There is a high degree of confidence in the accuracy of the resource estimate but even with some degree of error the resource density is extremely high.

- Gas production rate: High sustained rate of gas flows during after termination of mining indicates potential for good permeability. However, the only definitive way to determine permeability and other production characteristics is to drill and evaluate wells. The best available technology has been assumed to be employed by experienced personnel to design and complete the project. The combination of high resource density and the potential for satisfactory permeability gives a high degree of confidence that commercial production can be achieved.
- Water Disposal: Problems with wastewater disposal can be an impediment to CBM/CMM development projects. Wastewater produced from the operations will be discharged into local streams. There is an adequate stream system in or near the project area to receive the wastewater produced from the project. There should be no regulatory problems since the water quality will be the same or similar to the wastewater discharged from the coal mine.
- Acquisition of drill sites and rights-of-way: Demographics and terrain in the project area are suitable for the planned scope of the project. The method to obtain the right to use the surface for drilling and production activities is unclear and warrants farther investigation.

Exhibit 1: General Location Map

Table 1: Cash Flow and Economics

	Year 1	Year 2	Year 3	Year 4	Year 5
Gob Wells Started	7	6	6	0	0
Investment Per Well	$211 000	$211 000	$211 000	$211 000	$211 000
Pilot Wells in Production	1	1	1	1	1
Total Gob Wells in Production	8	14	20	20	20
Standard Wells Started	41	42	42	0	0
Investment Per Well	$316 000	$316 000	$316 000	$316 000	$316 000
Pilot Wells in Production	5	5	5	5	5
Total Standard Wells in Production	46	88	130	130	130

Gob Well Cash Flow - (each)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Net Production Revenue	$ 74 990	$ 90 887	$ 65 818	$ 51 987	$ 42 943	$ 36 416	$ 31 463	$27 593	$ 24 477	$ 21 915	$ 468 489
Depreciation	($ 29 540)	($ 29 540)	($ 29 540)	($ 29 540)	($ 29 540)	($ 29 540)	($ 29 540)	($ 4 220)	—	—	($ 211 000)
Taxable Income	$ 45 450	$ 61 347	$ 36 278	$ 22 447	$ 13 403	$ 6 876	$ 1 923	$23 373	$ 24 477	$ 21 915	$ 257 489
Standard Well Cash Flow - (each)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Total
Net Production Revenue	$ 181 006	$ 219 382	$ 158 868	$ 125 471	$ 103 640	$ 87 899	$ 75 949	$ 66 604	$ 59 097	$ 52 892	$ 1 130 808
Depreciation	($ 44 240)	($ 44 240)	($ 44 240)	($ 44 240)	($ 44 240)	($ 44 240)	($ 44 240)	($ 6 320)	—	—	($ 316 000)
Taxable Income	$ 136 766	$ 175 142	$ 114 628	$ 81 231	$ 59 400	$ 43 659	$ 31 709	$ 60 284	$ 59 097	$ 52 892	$ 814 808

Taxable Income	Year 0*	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Total
Gob Wells Started in Year 1		$318 151	$429 432	$253 943	$157 128	$93 818	$48 130	$13 463	$163 613	$171 341	$153 404			$1 802 424
Gob Wells Started in Year 2			$272 701	$368 084	$217 666	$134 681	$80 416	$41 255	$11 539	$140 240	$146 863	$131 489		$1 544 935
Gob Wells Started in Year 3				$272 701	$368 084	$217 666	$134 681	$80 416	$41 255	$11 539	$140 240	$146 863	$131 489	$1 544 935
Gob Well Pilot Project		$38 489	$13 420	($411)	($9 455)	($15 982)	($20 935)	($24 805)	$16 992	$21 915				$19 227
Standard Wells Started in Year 1		$5 607 398	$7 180 838	$4 699 764	$3 330 463	$2 435 392	$1 789 999	$1 300 065	$2 471 632	$2 422 973	$2 168 584			$33 407 108
Standard Wells Started in Year 2			$5 744 164	$7 355 981	$4 814 393	$3 411 694	$2 494 792	$1 833 657	$1 331 774	$2 531 915	$2 482 070	$2 221 477		$34 221 915
Standard Wells Started in Year 3				$5 744 164	$7 355 981	$4 814 393	$3 411 694	$2 494 792	$1 833 657	$1 331 774	$2 531 915	$2 482 070	$2 221 477	$34 221 915
Standard Wells Pilot Project		$233 834	($42 693)	($195 240)	($294 998)	($366 990)	($421 617)	($464 302)	$160 185	$241 722				($1 150 099)
Total Taxable Income		$6 197 873	$13 597 861	$18 498 986	$15 939 261	$10 724 671	$7 517 159	$5 274 540	$6 030 646	$6 873 419	$7 623 077	$4 981 899	$2 352 966	$105 612 359
Income Tax Rate		**0.00%**	**0.00%**	**0.00%**	**15.00%**	**15.00%**	**15.00%**	**30.00%**	**30.00%**	**30.00%**	**30.00%**	**30.00%**	**30.00%**	
Income Tax		$0	$0	$0	($2 390 889)	($1 608 701)	($1 127 574)	($1 582 362)	($1 809 194)	($2 062 026)	($2 286 923)	($1 494 570)	($705 890)	($15 068 128)
Income After Taxes		$6 197 873	$13 597 861	$18 498 986	$13 548 372	$9 115 970	$6 389 585	$3 692 178	$4 221 452	$4 811 394	$5 336 154	$3 487 329	$1 647 076	$90 544 231
Add non cash items:														
Depreciation		$2 841 675	$4 876 995	$6 912 315	$6 912 315	$6 912 315	$6 912 315	$6 912 315	$4 476 594	$2 326 080	$290 760	$0	$0	$49 373 682
Net Cash Flow From Operations		$9 039 548	$18 474 857	$25 411 302	$20 460 687	$16 028 286	$13 301 901	$10 604 493	$8 698 046	$7 137 474	$5 626 914	$3 487 329	$1 647 076	$139 917 913
Investment in Gob Wells	($374 272)	($1 477 000)	($1 266 000)	($1 266 000)	$0	$0								($4 383 272)
Investment in Standard Wells	($5 490 410)	($12 956 000)	($13 272 000)	($13 272 000)	$0	$0								($44 990 410)
Cash Flow After Investment	($5 864 682)	($5 393 452)	$3 936 857	$10 873 302	$20 460 687	$16 028 286	$13 301 901	$10 604 493	$8 698 046	$7 137 474	$5 626 914	$3 487 329	$1 647 076	$90 544 231
Cumulative Cash Flow	($5 864 682)	($11 258 134)	($7 321 277)	$3 552 025	$24 012 712	$40 040 997	$53 342 898	$63 947 392	$72 645 438	$79 782 911	$85 409 825	$88 897 155	$90 544 231	
Discount Rate		**36.18%**							* Pilot Project Evaluation Year					
PV of Cash Flows in		$30 059 720	Assumes flows come in at end of period											
PV of Cash Flows Out		($30 059 720)	Assumes flows go out at beginning of period											
Net Present Value		0												
Internal Rate of Return		**36.18%**												

Table 2: Pilot Project Drilling and Completion Cost Estimate

		Standard	Gob
	Well Type	**Standard**	**Gob**
	Number of Wells	**5**	**1**
	Total Depth - feet	**3,300**	**2,450**
	- meters	**1,000**	**750**
Drilling			
	Survey	$1 000	$1 000
	Location & Road	$15 000	$15 000
	Water	$5 000	$5 000
	Fuel	$30 000	$23 000
	Mob / De-mob	$72 000	$72 000
	Rig Cost	$117 600	$98 000
	Cementing	$25 000	$25 000
	Cementing Overhead	$11 000	$11 000
	Transportation	$5 000	$5 000
	Welding	$1 000	$1 000
	Logging	$20 000	
	Conductor Casing - Cost	$1 500	$1 500
	Surface Casing - Cost	$5 520	$5 520
	Production Casing - Cost	$16 000	$10 000
	Mud	$7 500	$7 500
	Bits	$12 000	$12 000
	Drilling Cost per Well	$345 120	$292 520
	Contingency (10%)	$34 512	$29 252
	Total Drilling Cost Per Well	$379 632	$321 772
Completion			
	CEMENT PRODUCTION CASING		
	Cementing Overhead	$5 500	
	Equipment	$18 000	
	Materials	$3 700	
	Personnel	$6 600	
	Sub-Total	$33 800	$0
	CEMENT BOND LOGS		
	Mob / De-Mob - Prorated: 5 Wells	$900	
	Service	$5 850	
	Sub-Total	$6 750	$0
	FRACTURE STIMULATION		
	Mob / De-mob - Prorated: 5 Wells	$54 000	
	Equipment	$260 000	
	Materials	$208 000	
	Personnel	$48 000	
	Bridge Plugs	$15 000	
	Perforating	$2 000	
	Sub-Total	$587 000	$0
	WELL CLEANOUT		
	Rig Time	$29 400	
	Tools	$4 000	
	Sub-Total	$33 400	$0
	TANGIBLES		
	2-7/8" Production Tubing	$7 500	$5 000
	Rods & Pump	$10 000	$7 500
	Pumping Unit	$30 000	$30 000
	Surface Equipment	$10 000	$10 000
	Sub-Total	$57 500	$52 500
	Total Completion Cost (Per Well)	$718 450	$52 500
Summary			
	Total Cost Per Well	**$1 098 082**	**$374 272**
	Total Project Costs	**$5 490 410**	**$374 272**
	GRAND TOTAL	**$5 864 682**	

Table 3: Pilot Project Economic Evaluation for Five Standard Wells

Assumptions:

Capital Cost	$5 490 410
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op'g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%

Production Profile for Five Standard Wells

Reserves (kcm*) 385 000

Year of Operation	*Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
0	59.17	21 596	21 596	5.61%	
1	71.71	26 175	47 771	12.41%	21.20%
2	51.93	18 955	66 726	17.33%	-27.58%
3	41.02	14 972	81 698	21.22%	-21.01%
4	33.88	12 367	94 065	24.43%	-17.40%
5	28.73	10 487	104 552	27.16%	-15.20%
6	24.83	9 061	113 613	29.51%	-13.60%
7	21.77	7 947	121 560	31.57%	-12.30%
8	19.31	7 049	128 609	33.40%	-11.29%
9	17.29	6 311	134 921	35.04%	-10.47%

Results:(Year)	*0 ***	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Gas Production (kcm/yr)	21 596	26 175	18 955	14 972	12 367	10 487	9 061	7 947	7 049	6 311
Gross Revenue	$0	$1 570 483	$1 137 281	$898 304	$742 025	$629 244	$543 667	$476 798	$422 965	$378 677
Gathering Costs	$0	($293 157)	($212 292)	($167 683)	($138 511)	($117 459)	($101 484)	($89 002)	($78 954)	($70 686)
Pipeline Tariff	$0	($91 612)	($66 341)	($52 401)	($43 285)	($36 706)	($31 714)	($27 813)	($24 673)	($22 090)
Misc. Operating Costs	$0	($137 417)	($99 512)	($78 602)	($64 927)	($55 059)	($47 571)	($41 720)	($37 009)	($33 134)
G & A	$0	($45 806)	($33 171)	($26 201)	($21 642)	($18 353)	($15 857)	($13 907)	($12 336)	($11 045)
Net Production Revenue	$0	$1 002 492	$725 964	$573 417	$473 659	$401 667	$347 041	$304 356	$269 993	$241 722
Depreciation	$0	($768 657)	($768 657)	($768 657)	($768 657)	($768 657)	($768 657)	($768 657)	($109 808)	$0
Taxable Income	$0	$233 834	($42 693)	($195 240)	($294 998)	($366 990)	($421 617)	($464 302)	$160 185	$241 722

*1,000 cubic meters

** Pilot Project Evaluation Year

Table 4: Pilot Project Economic Evaluation for One Gob Well

Assumptions:

Capital Cost	$374 272
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op'g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%

Production Profile for One Gob Well

Reserves (kcm*) 27 000

Year of Operation	*Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
0	5.36	1 958	1 958	7.25%	
1	6.50	2 373	4 331	16.04%	21.20%
2	4.71	1 718	6 049	22.41%	-27.58%
3	3.72	1 357	7 407	27.43%	-21.01%
4	3.07	1 121	8 528	31.59%	-17.40%
5	2.61	951	9 479	35.11%	-15.20%
6	2.25	821	10 300	38.15%	-13.60%
7	1.97	720	11 021	40.82%	-12.30%
8	1.75	639	11 660	43.18%	-11.29%
9	1.57	572	12 232	45.30%	-10.47%

Results:(Year)	*0 ***	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
Gas Production (kcm/yr)	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Gross Revenue	$0	$142 382	$103 109	$81 442	$67 273	$57 048	$49 290	$43 227	$38 346	$34 331
Gathering Costs	$0	($26 578)	($19 247)	($15 202)	($12 558)	($10 649)	($9 201)	($8 069)	($7 158)	($6 409)
Pipeline Tariff	$0	($8 306)	($6 015)	($4 751)	($3 924)	($3 328)	($2 875)	($2 522)	($2 237)	($2 003)
Misc. Operating Costs	$0	($12 458)	($9 022)	($7 126)	($5 886)	($4 992)	($4 313)	($3 782)	($3 355)	($3 004)
G & A	$0	($4 153)	($3 007)	($2 375)	($1 962)	($1 664)	($1 438)	($1 261)	($1 118)	($1 001)
Net Production Revenue	$0	$90 887	$65 818	$51 987	$42 943	$36 416	$31 463	$27 593	$24 477	$21 915
Depreciation	$0	($52 398)	($52 398)	($52 398)	($52 398)	($52 398)	($52 398)	($52 398)	($7 485)	$0
Taxable Income	$0	$38 489	$13 420	($411)	($9 455)	($15 982)	($20 935)	($24 805)	$16 992	$21 915

*1,000 cubic meters

** Pilot Project Evaluation Year

Table 5: Drilling Program Schedule

	YEAR 1		*YEAR 2*		*YEAR 3*	
	Standard Wells	*Gob Wells*	*Standard Wells*	*Gob Wells*	*Standard Wells*	*Gob Wells*
Month 1	3	1	4	0	3	1
Month 2	4	0	3	1	4	0
Month 3	3	1	3	1	3	1
Month 4	3	1	3	1	4	0
Month 5	3	1	4	0	4	0
Month 6	3	1	3	1	3	1
Month 7	4	0	3	1	3	1
Month 8	3	1	3	1	3	1
Month 9	3	1	4	0	3	1
Month 10	4	0	4	0	4	0
Month 11	4	0	4	0	4	0
Month 12	4	0	4	0	4	0
Category Total	**41**	**7**	**42**	**6**	**42**	**6**
Year Total	**48**		**48**		**48**	
Grand Total	**144**					

Table 6: Development Project Well Cost Estimates

Standard Well Specifications
Depth: 3,300ft (1,000m)
cased, cemented to surface, logged & perforated multiple zone hydraulic fracture stimulation progressive cavity pump with electric motor

Gob Well Specifications
Depth: 2,500ft (750m)
slotted production casing insert, progressive cavity pump with electric motor

Intangibles	*Standard Well*	*Gob Well*
Permits	$500	$500
Road & drill site construction	$5 000	$5 000
Survey	$500	$500
Drilling	$35 000	$30 000
Cementing	$12 000	$8 000
Logging	$5 000	$0
Perforating	$12 000	$0
Hydraulic frac	$75 000	$0
Workovers and cleanout	$10 000	$10 000
Miscellaneous services	$10 000	$10 000
Sub-Total	**$165 000**	**$64 000**
Tangibles		
Casing (conductor, surface & production)	$14 000	$10 000
Tubing	$4 000	$4 000
Wellhead	$10 000	$10 000
Pump & rods	$15 000	$15 000
Surface facilities & equipment	$13 000	$13 000
Flow line & meters	$20 000	$20 000
Separator	$5 000	$5 000
Sub-Total	**$81 000**	**$77 000**
Total Drilling & Completion Costs	**$246 000**	**$141 000**
Other Costs		
Pro rata portion of gas & water gathering system	$30 000	$30 000
Contingency	$20 000	$20 000
Overhead	$20 000	$20 000
Sub-Total	**$70 000**	**$70 000**
Total Well cost	**$316 000**	**$211 000**

Table 7: Production Profile for One Standard Well

Reserves (kcm*) 154 000

Year of Operation	*Average Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
1	12.95	4 726	4 726	3.07%	
2	15.69	5 728	10 454	6.79%	21.20%
3	11.36	4 148	14 602	9.48%	-27.58%
4	8.98	3 276	17 878	11.61%	-21.02%
5	7.41	2 706	20 584	13.37%	-17.40%
6	6.29	2 295	22 879	14.86%	-15.19%
7	5.43	1 983	24 862	16.14%	-13.59%
8	4.76	1 739	26 601	17.27%	-12.30%
9	4.23	1 543	28 144	18.28%	-11.27%
10	3.78	1 381	29 525	19.17%	-10.50%

Exhibit 2: Standard Well Daily Production Forecast

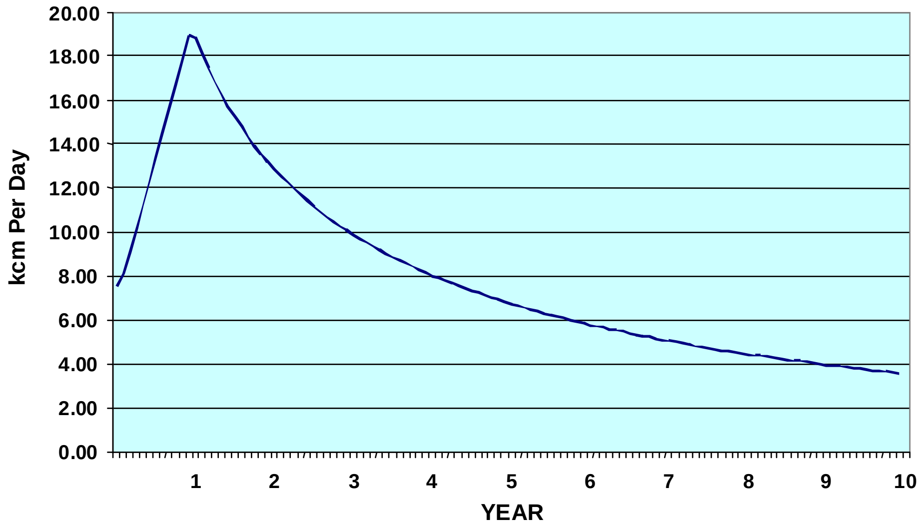
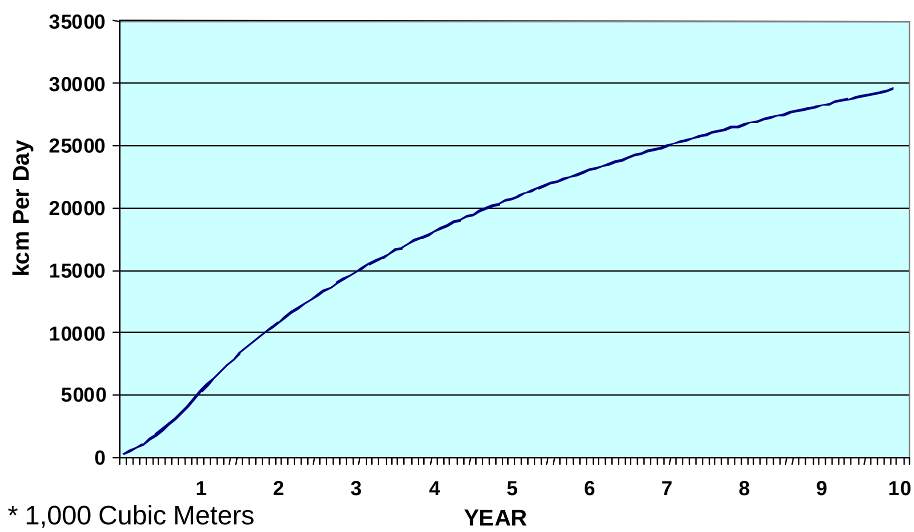


Exhibit 3: Standard Well Cumulative Production Forecast



* 1,000 Cubic Meters

Table 8: Production Profile for One Gob Well

Reserves (kcm*) 27 000

Year of Operation	*Average Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
1	5.36	1 958	1 958	7.25%	
2	6.50	2 373	4 331	16.04%	21.20%
3	4.71	1 718	6 049	22.41%	-27.58%
4	3.72	1 357	7 407	27.43%	-21.01%
5	3.07	1 121	8 528	31.59%	-17.40%
6	2.61	951	9 479	35.11%	-15.20%
7	2.25	821	10 300	38.15%	-13.60%
8	1.97	720	11 021	40.82%	-12.30%
9	1.75	639	11 660	43.18%	-11.29%
10	1.57	572	12 232	45.30%	-10.47%

Exhibit 4: Gob Well Daily Production Forecast

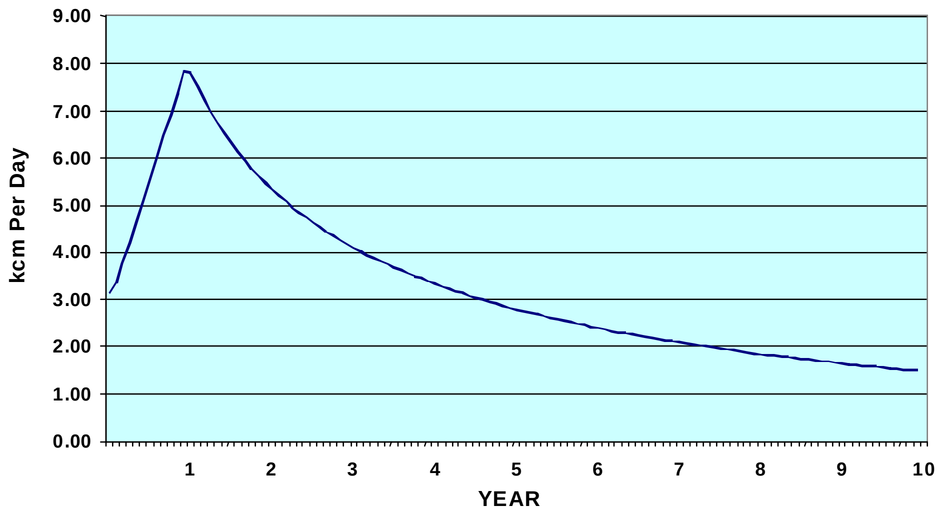
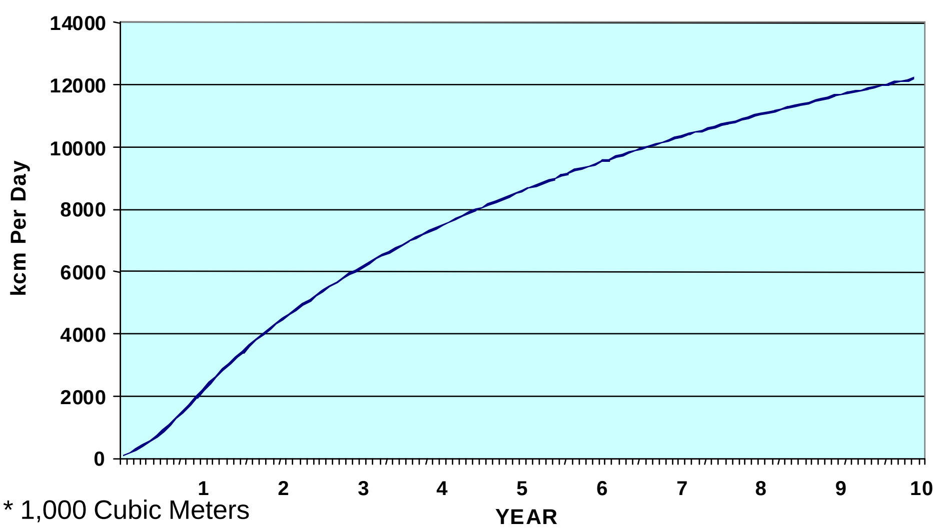


Exhibit 5: Gob Well Cumulative Production Forecast



* 1,000 Cubic Meters

Table 9: Project Gas Production

Wells Started:

Project Year:	**1**	**2**	**3**
Gob Wells Started	7	6	6
Pilot Gob Well	1	1	1
Standard Well Started	41	42	42
Pilot Standard Well	5	5	5

Well Production Year:	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Gob Well Flow	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Pilot Gob Well Flow	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Standard Well Flow	4 726	5 728	4 148	3 276	2 706	2 295	1 983	1 739	1 543	1 381
Pilot 5 Standard Wells Flow	21 596	26 175	18 955	14 972	12 367	10 487	9 061	7 947	7 049	6 311

Project Year:	**0**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Gob Well Started Year 1		13 706	16 611	12 026	9 499	7 847	6 657	5 747	5 040	4 473	4 004	—	—
Gob Well Started Year 2			11 748	14 238	10 308	8 142	6 726	5 706	4 926	4 320	3 834	3 432	—
Gob Well Started Year 3				11 748	14 238	10 308	8 142	6 726	5 706	4 926	4 320	3 834	3 432
Pilot Gob Well		2 373	1 718	1 357	1 121	951	821	720	639	572	—	—	—
Standard Well Started Year 1		193 766	234 848	170 068	134 316	110 946	94 095	81 303	71 299	63 263	56 621	—	—
Standard Well Started Year 2			198 492	240 576	174 216	137 592	113 652	96 390	83 286	73 038	64 806	58 002	—
Standard Well Started Year 3				198 492	240 576	174 216	137 592	113 652	96 390	83 286	73 038	64 806	58 002
Pilot 5 Standard Wells		26 175	18 955	14 972	12 367	10 487	9 061	7 947	7 049	6 311	—	—	—
Annual Total:		236 020	482 372	663 477	596 641	460 489	376 746	318 191	274 335	240 189	206 623	130 074	61 434
Project Total:		4 046 591											

Note: all volumes in kcm

Table 10: Economic Evaluation for One Standard Well w/Tax Benefits

Assumptions:

Capital Cost per well	$316 000
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op'g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%
Income Tax:	
First Three Years	0.0%
Next Three Years	15.0%
Thereafter	30.0%

Production Profile for One Standard Well

Reserves (kcm*) 154 000

Year of Operation	*Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
1	12.95	4 726	4 726	3.07%	
2	15.69	5 728	10 454	6.79%	21.20%
3	11.36	4 148	14 602	9.48%	-27.58%
4	8.98	3 276	17 878	11.61%	-21.02%
5	7.41	2 706	20 584	13.37%	-17.40%
6	6.29	2 295	22 879	14.86%	-15.19%
7	5.43	1 983	24 862	16.14%	-13.59%
8	4.76	1 739	26 601	17.27%	-12.30%
9	4.23	1 543	28 144	18.28%	-11.27%
10	3.78	1 381	29 525	19.17%	-10.50%

Results: (Year)	1	2	3	4	5	6	7	8	9	10
Gas Production (kcm/yr)	4 726	5 728	4 148	3 276	2 706	2 295	1 983	1 739	1 543	1 381
Gross Revenue	$283 560	$343 680	$248 880	$196 560	$162 360	$137 700	$118 980	$104 340	$92 580	$82 860
Gathering Costs	($52 931)	($64 154)	($46 458)	($36 691)	($30 307)	($25 704)	($22 210)	($19 477)	($17 282)	($15 467)
Pipeline Tariff	($16 541)	($20 048)	($14 518)	($11 466)	($9 471)	($8 033)	($6 941)	($6 087)	($5 401)	($4 834)
Misc. Operating Costs	($24 812)	($30 072)	($21 777)	($17 199)	($14 207)	($12 049)	($10 411)	($9 130)	($8 101)	($7 250)
G & A	($8 271)	($10 024)	($7 259)	($5 733)	($4 736)	($4 016)	($3 470)	($3 043)	($2 700)	($2 417)
Net Production Revenue	$181 006	$219 382	$158 868	$125 471	$103 640	$87 899	$75 949	$66 604	$59 097	$52 892
Depreciation	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($6 320)	$0	$0
Taxable Income	$136 766	$175 142	$114 628	$81 231	$59 400	$43 659	$31 709	$60 284	$59 097	$52 892
Income Tax	$0	$0	$0	($12 185)	($8 910)	($6 549)	($9 513)	($18 085)	($17 729)	($15 868)
Income After Taxes	$136 766	$175 142	$114 628	$69 046	$50 490	$37 110	$22 196	$42 199	$41 368	$37 025
Net Cash Flow From Oper	$181 006	$219 382	$158 868	$113 286	$94 730	$81 350	$66 436	$48 519	$41 368	$37 025
Initial Investment	($316 000)									
Cumulative Net Cash Flow	($134 994)	$84 388	$243 257	$356 543	$451 273	$532 622	$599 059	$647 577	$688 945	$725 970

Economic Indicators:

<u>Discount Rate</u> 49.73%

<u>Discounted Net Cash Flow</u> $316 000 <u>Net Present Value</u> $0

<u>Internal Rate of Return</u> 49.73%

* kcm = 1,000 cubic meters

Table 11: Economic Evaluation for One Gob Well w/Tax Benefits

Assumptions:

Capital Cost per well	$211 000
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op'g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%
Income Tax:	
First Three Years	0.0%
Next Three Years	15.0%
Thereafter	30.0%

Production Profile for One Gob Well

Reserves (kcm*) 27 000

Year of Operation	*Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
1	5.36	1 958	1 958	7.25%	
2	6.50	2 373	4 331	16.04%	21.20%
3	4.71	1 718	6 049	22.41%	-27.58%
4	3.72	1 357	7 407	27.43%	-21.01%
5	3.07	1 121	8 528	31.59%	-17.40%
6	2.61	951	9 479	35.11%	-15.20%
7	2.25	821	10 300	38.15%	-13.60%
8	1.97	720	11 021	40.82%	-12.30%
9	1.75	639	11 660	43.18%	-11.29%
10	1.57	572	12 232	45.30%	-10.47%

Results: (Year)	1	2	3	4	5	6	7	8	9	10
Gas Production (kcm/yr)	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Gross Revenue	$117 478	$142 382	$103 109	$81 442	$67 273	$57 048	$49 290	$43 227	$38 346	$34 331
Gathering Costs	($21 929)	($26 578)	($19 247)	($15 202)	($12 558)	($10 649)	($9 201)	($8 069)	($7 158)	($6 409)
Pipeline Tariff	($6 853)	($8 306)	($6 015)	($4 751)	($3 924)	($3 328)	($2 875)	($2 522)	($2 237)	($2 003)
Misc. Operating Costs	($10 279)	($12 458)	($9 022)	($7 126)	($5 886)	($4 992)	($4 313)	($3 782)	($3 355)	($3 004)
G & A	($3 426)	($4 153)	($3 007)	($2 375)	($1 962)	($1 664)	($1 438)	($1 261)	($1 118)	($1 001)
Net Production Revenue	$74 990	$90 887	$65 818	$51 987	$42 943	$36 416	$31 463	$27 593	$24 477	$21 915
Depreciation	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($4 220)	$0	$0
Taxable Income	$45 450	$61 347	$36 278	$22 447	$13 403	$6 876	$1 923	$23 373	$24 477	$21 915
Income Tax	$0	$0	$0	($3 367)	($2 010)	($1 031)	($577)	($7 012)	($7 343)	($6 574)
Income After Taxes	$45 450	$61 347	$36 278	$19 080	$11 392	$5 844	$1 346	$16 361	$17 134	$15 340
Net Cash Flow From Oper	$74 990	$90 887	$65 818	$48 620	$40 932	$35 384	$30 886	$20 581	$17 134	$15 340
Initial Investment	($211 000)									
Cumulative Net Cash Flow	($136 010)	($45 122)	$20 695	$69 315	$110 247	$145 632	$176 518	$197 099	$214 233	$229 574

* kcm = 1,000 cubic meters

Economic Indicators:

Discount Rate	24.44%
Discounted Net Cash Flow	$211 000
Internal Rate of Return	24.44%
Net Present Value	$0

Table 12: Economic Evaluation for One Standard Well w/o Tax Benefits

Assumptions:

Capital Cost per well	$316 000
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op'g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%
Income Tax:	
First Three Years	30.0%
Next Three Years	30.0%
Thereafter	30.0%

Production Profile for One Standard Well

Reserves (kcm*) 154 000

Year of Operation	*Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
1	12.948	4 726	4 726	3.07%	
2	15.693	5 728	10 454	6.79%	21.20%
3	11.364	4 148	14 602	9.48%	-27.58%
4	8.975	3 276	17 878	11.61%	-21.02%
5	7.414	2 706	20 584	13.37%	-17.40%
6	6.288	2 295	22 879	14.86%	-15.19%
7	5.433	1 983	24 862	16.14%	-13.59%
8	4.764	1 739	26 601	17.27%	-12.30%
9	4.227	1 543	28 144	18.28%	-11.27%
10	3.784	1 381	29 525	19.17%	-10.50%

Results: (Year)	1	2	3	4	5	6	7	8	9	10
Gas Production (kcm/yr)	4 726	5 728	4 148	3 276	2 706	2 295	1 983	1 739	1 543	1 381
Gross Revenue	$283 560	$343 680	$248 880	$196 560	$162 360	$137 700	$118 980	$104 340	$92 580	$82 860
Gathering Costs	($52 931)	($64 154)	($46 458)	($36 691)	($30 307)	($25 704)	($22 210)	($19 477)	($17 282)	($15 467)
Pipeline Tariff	($16 541)	($20 048)	($14 518)	($11 466)	($9 471)	($8 033)	($6 941)	($6 087)	($5 401)	($4 834)
Misc. Operating Costs	($24 812)	($30 072)	($21 777)	($17 199)	($14 207)	($12 049)	($10 411)	($9 130)	($8 101)	($7 250)
G & A	($8 271)	($10 024)	($7 259)	($5 733)	($4 736)	($4 016)	($3 470)	($3 043)	($2 700)	($2 417)
Net Production Revenue	$181 006	$219 382	$158 868	$125 471	$103 640	$87 899	$75 949	$66 604	$59 097	$52 892
Depreciation	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($44 240)	($6 320)	$0	$0
Taxable Income	$136 766	$175 142	$114 628	$81 231	$59 400	$43 659	$31 709	$60 284	$59 097	$52 892
Income Tax	($41 030)	($52 543)	($34 389)	($24 369)	($17 820)	($13 098)	($9 513)	($18 085)	($17 729)	($15 868)
Income After Taxes	$95 736	$122 600	$80 240	$56 862	$41 580	$30 561	$22 196	$42 199	$41 368	$37 025
Net Cash Flow From Oper	$139 976	$166 840	$124 480	$101 102	$85 820	$74 801	$66 436	$48 519	$41 368	$37 025
Initial Investment	($316 000)									
Cumulative Net Cash Flow	($176 024)	($9 184)	$115 296	$216 397	$302 217	$377 018	$443 454	$491 973	$533 341	$570 365

Economic Indicators:

Discount Rate	36.43%
Discounted Net Cash Flow	$316 000
Internal Rate of Return	36.43%

Net Present Value $0

* kcm = 1,000 cubic meters

Table 13: Economic Evaluation for One Gob Well w/o Tax Benefits

Assumptions:	
Capital Cost per well	$211 000
Gas Price ($/kcm)	$60.00
Gathering Costs ($/kcm)	$11.20
Pipeline Tariff ($/kcm)	$3.50
Misc. Op'g Costs ($/kcm)	$5.25
G & A ($/kcm)	$1.75
Depreciation	14%
Income Tax:	
First Three Years	30.0%
Next Three Years	30.0%
Thereafter	30.0%

Production Profile for One Gob Well

Reserves (kcm*) 27 000

Year of Operation	*Production, kcm per day*	*Production, kcm per year*	*Cumulative Production, kcm*	*Cumulative Production, % of Reserves*	*Decline Rate % of Prior Year*
1	5.364	1 958	1 958	7.25%	
2	6.501	2 373	4 331	16.04%	21.20%
3	4.708	1 718	6 049	22.41%	-27.58%
4	3.719	1 357	7 407	27.43%	-21.01%
5	3.072	1 121	8 528	31.59%	-17.40%
6	2.605	951	9 479	35.11%	-15.20%
7	2.251	821	10 300	38.15%	-13.60%
8	1.974	720	11 021	40.82%	-12.30%
9	1.751	639	11 660	43.18%	-11.29%
10	1.568	572	12 232	45.30%	-10.47%

Results: (Year)	1	2	3	4	5	6	7	8	9	10
Gas Production (kcm/yr)	1 958	2 373	1 718	1 357	1 121	951	821	720	639	572
Gross Revenue	$117 478	$142 382	$103 109	$81 442	$67 273	$57 048	$49 290	$43 227	$38 346	$34 331
Gathering Costs	($21 929)	($26 578)	($19 247)	($15 202)	($12 558)	($10 649)	($9 201)	($8 069)	($7 158)	($6 409)
Pipeline Tariff	($6 853)	($8 306)	($6 015)	($4 751)	($3 924)	($3 328)	($2 875)	($2 522)	($2 237)	($2 003)
Misc. Operating Costs	($10 279)	($12 458)	($9 022)	($7 126)	($5 886)	($4 992)	($4 313)	($3 782)	($3 355)	($3 004)
G & A	($3 426)	($4 153)	($3 007)	($2 375)	($1 962)	($1 664)	($1 438)	($1 261)	($1 118)	($1 001)
Net Production Revenue	$74 990	$90 887	$65 818	$51 987	$42 943	$36 416	$31 463	$27 593	$24 477	$21 915
Depreciation	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($29 540)	($4 220)	$0	$0
Taxable Income	$45 450	$61 347	$36 278	$22 447	$13 403	$6 876	$1 923	$23 373	$24 477	$21 915
Income Tax	($13 635)	($18 404)	($10 883)	($6 734)	($4 021)	($2 063)	($577)	($7 012)	($7 343)	($6 574)
Income After Taxes	$31 815	$42 943	$25 394	$15 713	$9 382	$4 813	$1 346	$16 361	$17 134	$15 340
Net Cash Flow From Oper	$61 355	$72 483	$54 934	$45 253	$38 922	$34 353	$30 886	$20 581	$17 134	$15 340
Initial Investment	($211 000)									
Cumulative Net Cash Flow	($149 645)	($77 162)	($22 227)	$23 025	$61 947	$96 300	$127 187	$147 768	$164 902	$180 242

Economic Indicators:

Discount Rate	18.26%		
Discounted Net Cash Flow	$211 000	Net Present Value	$0
Internal Rate of Return	18.26%		

* kcm = 1,000 cubic meters

Exhibit 6: Stratigraphic Column