

Report of Columbia Natural Resources, Inc.  
On  
Glodes Corners Road Field

I. Overview of Field History and Development

Glodes Corners Road Field is located in northeastern Steuben County between Pulteney and Prattsburgh, New York, and is currently defined by thirteen existing wells drilled by Columbia Natural Resources, Inc. (“Columbia” or “CNR”). These wells are:

WELL NAME	CNR WELL NO.	API NO.
M. Evangelos No. 1	621436	31-101-19497
C. Gray No. 1	621625	31-101-21592-00
S. Levandowski No. 1	623088	31-101-21688
D. Covert No. 1	622302-A	31-101-21689-01
J. Pizura No. 1	623143	31-101-21692
Smith/Button No. 1	623142	31-101-21705
C. Fox No. 1	623217	31-101-21706
M. Kozak No. 1	623221	31-101-21712
Bergstresser No. 1	623268	31-101-21710
Radigan No. 1	623267-A	31-101-21703-01
Egresi No. 1	623634	31-101-22772
Covert No. 2	623222	31-101-22768
Carter No. 1	623218	31-101-22769

The proposed spacing units shown in Exhibit A to the executed Stipulation dated January 25, 2000, form a narrow ribbon that encompasses an area approximately seven-and-a-half miles long by four thousand feet wide. Wells in the Glodes Corners Road Field produce natural gas from the Ordovician Trenton-Black River carbonates at an average depth of approximately seven thousand feet. The Trenton-Black River carbonates are present throughout Columbia's leasehold acreage. To date, production from Glodes Corners is concentrated in the Towns of Pulteney and Prattsburgh. The field was discovered by the successful drilling and completion of the Evangelos #1 in October, 1985.

The thirteen existing wells in the Glodes Corners Road Field were successfully drilled through the Trenton-Black River for the production of natural gas. In October 1995, ten years after its initial discovery, Columbia began to aggressively expand its Steuben County exploration program, first with the drilling of the Gray #1 and thereafter with additional wells, eleven of which were successful. For purposes of selecting drill sites and forming spacing units, Columbia has relied on seismic data as well as information gained from drilling. Seismic data is the result of a common method of geophysical analysis to define subsurface geologic structures using the generation, reflection, refraction, detection and analysis of elastic waves in the earth. CNR's extensive seismic coverage of the Field area is approximately depicted on the map attached hereto as Exhibit "A(G)".

## II. Geologic Overview

The Glodes Corners Road Field is a seismically defined gas field in the Ordovician Black River Dolomite. The northern and southern extent of the Field are defined by high angle normal faults (a fracture in the rock in which there has been displacement or movement of the sides relative to one another) with up to 130 feet of throw. The area between the faults are nonregional secondary dolomite in the Black River having the configuration of a structural graben. The graben is an isolated structural feature described as a long narrow trough within the earth's crust bounded by faults which is conducive to the migration of gas within its boundaries. However, in the absence of transcurrent faults (a fault which cuts across the main body of the graben parallel to the fault's strike), gas will not migrate beyond the boundaries of the graben. The subject graben is offset by a tear fault (a fault in which there has been lateral movement of the reservoir body) on the east side of the field between the Bergstresser and the Radigan Wells on the east and the Pizura Well on the west with the northwest-southeast tear intersecting the Egresi well and physically separating the reservoir. The faulted limit of the reservoir to the north and south are respectively 660' south of the north unit lines and 660' north of the south unit lines. The eastern and western extent of the Field is not well defined. Seismic definition is excellent over the proposed spacing units. Regional limestone provides a trapping mechanism to the north of the bounding fault on the reservoir. The cap on the reservoir is the entire Trenton Carbonate group.

Secondary vugular and fracture porosity create the reservoir and the hydrocarbons present have an indigenous source in the Black River Carbonates. The reservoir appears to have a water leg at 5850 – 5900 feet subsea. Exclusively, solution/dolomitization and collapse create the south side of the graben. The faults on the south do not extend below the base of the upper Tribes Hill member of the Black River Group. Extensive seismic surveys have been performed across this feature with the north fault exhibiting roughly 130 feet of throw, and the south fault showing about 60 feet of throw.

Production has been encountered in a “wing” of dolomite in the Covert well extending just north of the collapse boundary. The initial Covert well showed 100% limestone (which is unproductive) in the pay interval and was “kicked” less than 300 feet to the south into the reservoir. A well is “kicked” when its original bottom-hole location is unsuccessful. The well is then drilled directionally to a new bottom-hole location. This is done to avoid the time and cost involved in plugging an unsuccessful well and drilling a second well in close proximity to the first.

Brine encountered in the Black River is acidic and is saturated, with high concentrations of magnesium, calcium, sodium, and potassium. The thermal gradient is still higher than the Appalachian Basin average, with bottom hole temperatures around 150 degrees Fahrenheit. Saddle dolomite seen in the samples is suggestive of hydrothermal alteration. A significant amount of dead oil is present in the upper 60 feet of the reservoir and occludes a significant amount of available porosity. Conodont alteration shows the reservoir to be well within the gas window, but too thermally mature for oil production.

CNR’s interpretation of the graben, based on analysis of its seismic data, is depicted on the map attached hereto as Exhibit “B(G)”. A visual representation of the structural graben is illustrated on the constructed cross section attached hereto as Exhibit “C(G)”. These separate geophysical and geological works independently and collectively reflect subsurface conditions in the Trenton-Black River formation consistent with the Department’s proposal for well spacing and compulsory integration of Glodes Corners Road Field.

### III. Overview of Proposed Units:

The proposed units were formed to maximize recovery of the gas underlying the Field, to optimize economics for each well drilled or to be drilled in the Field and to fairly compensate all affected landowners. Efforts were made to adhere to legislative intent with respect to uniformity in the unit size; however, due to the undulating nature of the graben structure, the location of the existing wells, and true complex nature of the reservoir, there are exceptions to these efforts. As a result, units vary between 161.97 to 247.50 acres. The criteria used in forming these units are:

- Geologic and seismic description of the reservoir indicates rectangular in shape with preferential flow in east-west direction.
- Initial data obtained in the drilling of the wells as reflected on the chart attached hereto as Exhibit “D(G)“. This chart reflects information which is no longer subject to confidentiality provisions of ECL § 23-0313(1)(d).
- Well Completion Reports which are no longer subject to the confidentiality provisions of ECL §23-0313(1)(d) are attached hereto as Exhibits “E(G) – N(G).”
- Well logs which are no longer subject to the confidentiality provisions of ECL §23-0313(1)(d) are available for public review at NYSDEC, Division of Mineral Resources, 50 Wolf Road, Room 290, Albany, New York, and NYSDEC, Region 8 Headquarters, 6274 East Avon-Lima Road, Avon, New York.

- Pressure testing provided the flow characteristics and boundary effects of the reservoir that were used in positioning the north and south limits of the graben to maximize depletions within the drainage area.
- Performance of the existing production was recognized for common drainage boundaries between wells. Therefore, units are placed abutting each other.
- Location of existing wells is another controlling factor that was used in designing the units.

Interpretation of pressure transient tests conducted on the Smith/Button, the Kozak, the Fox, the Gray, the Levandowski, and the Bergstresser wells involved a series of sequential steps to arrive at final answers. These steps included data processing, model identification, and the incorporation of other relevant geological, geophysical and completion data. Radial flow and log- log plots were used to calculate reservoir parameters. The results indicate that the Trenton Black – River reservoir possesses the following:

1. Rectangular in shape.
2. High flow capacity.
3. Multiple no flow boundaries.
4. Little or no matrix capacity.
5. Presence of interference (communication) between some wells in the northern tier of the proposed units and between some wells in the southern tier of the proposed units. There is evidence of limited leakage between wells in the northern tier and wells in the southern tier.

Department staff and Columbia staff analyzed well information using volumetric and material balance methods, which are accepted petroleum engineering techniques to estimate drainage area and unit size. Volumetric analysis is a method used to define the amount of gas in a reservoir on a per-acre basis. Material balance is a method based on well performance which uses production and pressure measurements obtained from the well to project the well's future ultimate recovery.

Both Department and Columbia staff used available production histories from wells in the Glodes Corners Road Field to estimate recoverable reserves in drainage areas. Bottom hole pressure versus cumulative production plots were made. The information provides evidence to support the spacing of Trenton-Black River wells at distances other than those prescribed by current regulations and further justifies the size and shape of the units as proposed.

#### IV. Individual Unit Justifications

##### **Covert 1, Well No. 622302-A**

Northern unit line – generally 660 feet north of the northern side of the Black River Graben (hereinafter “graben”);

Eastern unit line – located midway between the subject well and the Kozak, Well No. 623221. Although characterized in Mr. Covert's testimony as a “dry” or “useless” well, the Kozak Well produces natural gas from a zone approximately 250 feet deeper than in the Covert 1. These two distinct zones do not have the same production potential. When the Kozak Well is recompleted in the upper equivalent zone as the Covert 1, the wells are expected to communicate. Therefore, the placement of the eastern unit line was made to fairly compensate the landowners whose land is located between these two wells.

Southern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben; and

Western unit line – located near a transcurrent fault between two seismic lines shot along and near McMichael Road which does show the graben and a seismic line shot to the west of McMichael Road which does not show the graben. There is no evidence of reservoir extension beyond the western unit line so gas does not migrate beyond the transcurrent fault. As noted in Mr. Covert's testimony, this is further confirmed by the fact that CNR's Prattsburgh Town Farm, Well No. 623220, and its kick, Well No. 623220-A, both located approximately 7500 feet west of the Covert 1, were unproductive. This indicates that somewhere west of the Road the graben does not continue to the west along the same general east-west direction. Therefore, as shown on Exhibits B(G) and C(G) the productive reservoir extends beyond the boundaries of the Coverts' property.

**Kozak, Well No. 623221:**

Northern unit line – generally 660 feet north of the northern side of the graben;

Eastern unit line – located midway between the subject well and the Gray, Well No. 621625. Although the Kozak Well has not yet been completed to the same zone as the Gray Well, when it is, it is expected to communicate with the Gray;

Southern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben; and

Western unit line – located midway between the subject well and the Covert 1, Well No. 622302. Although the Kozak Well has not yet been completed to the same zone as the Covert 1, when it is, it is expected to communicate with the Covert 1.

**Gray, Well No. 621625:**

Northern unit line – generally 660 feet north of the northern side of the graben;

Eastern unit line – located midway between the subject well and the Evangelos, Well No. 621436;

Southern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the south side of the graben; and

Western unit line – located midway between the subject well and the Kozak, Well No. 623221. Although the Kozak Well has not yet been completed to the same formation as the Gray, when it is, it is expected to communicate with the Gray.

**Evangelos, Well No. 621436:**

Northern unit line – generally 660 feet north of the northern side of the graben;

Eastern unit line – located midway between the subject well and the Smith-Button, Well No. 623142;

Southern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben; and

Western unit line – located midway between the subject well and the Gray, Well No. 621625.

**Smith-Button, Well No. 623142:**

Northern unit line – generally 660 feet north of the northern side of the graben;

Eastern unit line – located midway between the subject well and Pizura, Well No. 623143;

Southern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben; and

Western unit line – located midway between the subject well and the Evangelos, Well No. 621436.

**Pizura, Well No. 623143**

Northern unit line – generally 660 feet north of the northern side of the graben;

Eastern unit line – determined by the presence of a tear fault.

Southern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben; and

Western unit line – located midway between the subject well and the Smith-Button, Well No. 623142.

To further address Mr. Pizura's concerns, the depiction of the graben, as shown in Exhibit B(G), determined "the sharp Southerly turn" of the shape of the proposed unit. The placement of the Pizura and the Smith/Button wells determined the western unit line between the wells as it is anticipated that the wells will communicate. The eastern unit line was determined by a tear fault which physically displaces the reservoir. Mr. Pizura testified that the Bergstresser and Radigan wells have a different pressure than the remaining wells in the field. While these wells did have a slightly lower original pressure, the presence of transcurrent faults along the tear fault indicate that there is limited communication between the wells. Therefore, based on this limited communication as well as the shape of the graben, these wells should be included in the Field. Finally, the southern line of the proposed unit was placed generally midway between the northern unit line of the Field and the southern unit line of the Field in recognition of the fact that testing has shown communication among the wells in the northern tier of the proposed units and among the wells in the southern tier of the proposed units but only leakage between wells in the northern and the southern tiers of the proposed units.

**Bergstresser, Well No. 623268:**

Northern unit line – generally 660 feet north of the northern side of the northern fork graben;

Eastern unit line – Keuka Lake;

Southern unit line – to the extent possible given the location of the bottom hole of the Radigan, Well No. 623267-A, located midway between 660 feet north of the northern side of the northern fork of the graben and 660 feet south of the southern side of the northern fork of the graben; and

Western unit line – located near a tear fault which coincides with a split in the graben.

To further address the concerns of Mr. Spence and Mr. Bedient, the Spence and Bedient property is not included within the proposed unit for the Bergstresser Well because it is clearly outside of the area which will be drained by the wells. The western line of the proposed unit is located near a tear fault which defines a curve in the graben as shown on Exhibit B(G). A pressure transient test was conducted on the Bergstresser Well. The results and analysis

based on the pressure data show that one of the boundaries of the reservoir is only six feet from the wellbore. This supports the geologic depiction of the graben as shown in Exhibit B(G). There is no technical or scientific evidence to support the theory of Mr. Spence and Mr. Bedient that their property will be drained by the Bergstresser Well regardless of the distance between their property and the well. Although the well is not located at the center of the proposed unit, there is geologic justification for the unit as it is proposed. In addition, the well will eventually drain the gas from the lands along the eastern side of the proposed unit. It would be uneconomic to place an additional well closer to the lake.

**Radigan, Well No. 623267-A:**

Northern unit line – to the extent possible given the location of the bottom hole of the subject well, located midway between 660 feet north of the northern side of the north fork of the graben and 660 feet south of the southern side of the north fork of the graben;

Eastern unit line – Keuka Lake;

Southern unit line – generally 660 feet south of the southern side of the north fork of the graben; and

Western unit line – determined by a tear fault which coincides with a split in the graben.

**Covert 2, Well No. 623222:**

Northern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben;

Eastern unit line – located midway between the subject well and the Levandowski, Well No. 623088;

Southern unit line – generally 660 feet south of the southern side of the graben; and

Western unit line – located near a transcurrent fault between a seismic line shot along McMichael Road which does show the graben and a seismic line shot to the west of McMichael Road which does not show the graben.

To further address Mr. Covert and Mr. Cronk's concerns, the northern unit line was placed generally midway between the northern unit line of the Field and the southern unit line of the Field in recognition of the fact that testing has shown communication among the wells in the northern tier of the proposed unit and

among the wells in the southern tier of the proposed units but only leakage between wells in the northern and southern tiers of the proposed units. Due to its placement within the graben as shown on Exhibit B(G), there is no evidence that the Cronk property will be drained by the Covert 1 Well. However, it is clearly along the southern tier of the graben and will be drained by the Covert 2 Well. Consistent with the explanation for the proposed unit for the Covert 1 Well, the graben extends beyond the property lines of Mr. Covert and the well will drain property in addition to the Covert land. The eastern unit line was placed midway between the Covert 2 and the Levandowski wells because the wells will communicate. The western unit line was placed near the transcurrent fault which defines the western boundary of the graben and is supported by seismic evidence which shows the presence of the graben beyond the boundary lines of the Covert property.

**Levandowski, Well No. 623088:**

Northern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben;

Eastern unit line – located midway between the subject well and the Carter, Well No. 623218;

Southern unit line – generally 660 feet south of the southern side of the graben; and

Western unit line – located midway between the subject well and the Covert 2, Well No. 623222.

**Carter, Well No. 623218:**

Northern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben;

Eastern unit line – located midway between the subject well and the Fox, Well No. 623217.

Southern unit line – generally 660 feet south of the southern side of the graben; and

Western unit line – located midway between the subject well and the Levandowski, Well No. 623088.

**Fox, Well No. 623217:**

Northern unit line – generally located midway between 660 feet north of the northern side of the graben and 660 feet south of the southern side of the graben;

Eastern unit line – located midway between the subject well and a proposed location to the east;

Southern unit line – generally 660 feet south of the southern side of the graben; and

Western unit line – located midway between the subject well and the Carter, Well No. 623218.

To further address Mr. Fox's concerns, based on the results of pressure testing, the Field contains high flow capacity wells which indicate that the Fox and Carter wells are expected to communicate. Therefore, the western unit line was placed midway between the two wells to fairly compensate all of the landowners between the two wells. There is no evidence that the drainage area for the Fox Well stops at Gay Road. Mr. Fox's testimony also implied that a portion of a 45-acre parcel which was once owned by Gregory A. Zerkel and Asa M. Bowers, who were vendors of CNR, was inappropriately included in the unit. Gregory A. Zerkel has conveyed his interest in the minerals to Mr. Bowers and his wife and Mr. and Mrs. Bowers no longer have any relationship to CNR or any of its vendors. As shown on Exhibit B(G), a portion of the 45-acre parcel is within the graben and will be drained by the Fox Well.

**Egresi, Well No. 623634:**

Northern unit line – located near the northern side of the south fork of the graben;

Eastern unit line – correlates to the known limits of the south fork of the graben;

Southern unit line – generally 660 feet south of the southern side of the south fork of the graben; and

Western unit line – located midway between the southern well and a proposed location to the west.

V. Future (Infill and Extension) Well Spacing and Units

On average, the existing Glodes Corners Road Field wells are spaced on strike (that is, generally on an east-west direction) at an approximate distance of

5,280' so as to accommodate the orientation and drainage characteristics of the reservoir. Requiring a default minimum 5,280 distance is the most reasonable from an administrative standpoint not knowing the characteristics of the reservoir outside of the present field limits and it establishes a protective threshold which must be addressed by an applicant if a closer distance is warranted. If an applicant desires to drill a well closer than 5,280 feet from an existing well in the field, information must be submitted with the application for Department approval to explain why the proposed well would not adversely affect the productive performance of existing wells. This process is embodied in the executed Stipulation dated January 25, 2000. Spacing of existing wells perpendicular to strike (that is, generally in a north-south direction) has heretofore been maintained at a minimum 2000' distance, although no evidence exists to suggest that the spacing of wells perpendicular to strike should exceed the 1320' mandated by New York State. In all instances, a minimum of 660' has been maintained from proposed unit boundary lines. Accordingly, it is proposed that the spacing of future wells conforms to all of these minimum distances unless shorter distances can be justified; and that units for future wells comprise not less than 150 acres and not more than 640 acres unless evidence exists to indicate the contrary.