See Also Orders No. R-11133
R-11133-A

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION DIVISION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

CASE NO. 12479
ORDER NO. R-11133-B

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC. FOR APPROVAL TO RESTORE ITS CHACO WELL NO. 2-R TO PRODUCING STATUS, SAN JUAN COUNTY, NEW MEXICO.

ORDER OF THE DIVISION

BY THE DIVISION:

This case came on for hearing at 8:15 a.m. on August 24, 2000 and October 24, 2002, at Santa Fe, New Mexico, before Examiner Michael E. Stogner.

NOW, on this 29th day of October, 2002, the Division Director, having considered the record and the recommendations of the Examiner,

FINDS THAT:

The applicant's request for dismissal should be granted.

IT IS THEREFORE ORDERED THAT:

Case No. 12479 be dismissed.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

SEAL

STATE OF NEW MEXICO
OIL CONSERVATION DIVISION

Lori Wrotenbery

LORI WROTENBERY
Director

Correspondence

Sept. 1, 1999 to May 16, 2000

for Re Novo

Case No. 11996

MILLER, STRATVERT & TORGERSON, P.A.

LAW OFFICES

RANNE B. MILLER
ALAN C. TORGERSON
ALICE T. LORENZ
GREGORY W. CHASE
LYMAN G. SANDY
STEPHEN M. WILLIAMS
STEPHAN M. VIDMAR
ROBERT C. GUTIERREZ
SETH V. BINGHAM
JAMES B. COLLINS
TIMOTHY R. BRIGGS
RUDOLPH LUCERO
DEBORAH A. SOLOVE
GARY L. GORDON
LAWRENCE R. WHITE
SHARON P. GROSS
VIRGINIA ANDERMAN
MARTE D. LIGHTSTONE
J. SCOTT HALL
THOMAS R. MACK
TERRI L. SAUER
JOEL T. NEWTON

THOMAS M. DOMME
RUTH O. PREGENZER
JEFFREY E. JONES
MANUEL I. ARRIETA
ROBIN A. GOBLE
JAMES R. WOOD
DANA M. KYLE
KIRK R. ALLEN
RUTH FUESS
KYLE M. FINCH
H. BROOK LASKEY
KATHERINE W. HALL
FRED SCHILLER
PAULA G. MAYNES
MICHAEL C. ROSS
CARLA PRANDO
KATHERINE N. BLACKETT
JENNIFER L. STONE
ANDREW M. SANCHEZ
M. DYLAN O'REILLY
AMINA QUARGNALI-LINSLEY
BEATE BOUDRO

COUNSEL

PAUL W. ROBINSON
ROSS B. PERKAL
JAMES J. WIDLAND
BRADLEY D. TEPPER
GARY RISLEY

OF COUNSEL

WILLIAM K. STRATVERT
RALPH WM. RICHARDS

ALBUQUERQUE, NM

500 MARQUETTE N.W., SUITE 1100
POST OFFICE BOX 25687
ALBUQUERQUE, NM 87125-0687
TELEPHONE: (505) 842-1950
(800) 424-7585
FACSIMILE: (505) 243-4408

SANTA FE, NM

150 WASHINGTON AVE., SUITE 300
POST OFFICE BOX 1986
SANTA FE, NM 87504-1986
TELEPHONE: (505) 989-9614
FACSIMILE: (505) 989-9857

FARMINGTON, NM

300 WEST ARRINGTON, SUITE 300
POST OFFICE BOX 869
FARMINGTON, NM 87499-0869
TELEPHONE: (505) 326-4521
FACSIMILE: (505) 325-5474

LAS CRUCES, NM

500 S. MAIN ST., SUITE 800
POST OFFICE BOX 1209
LAS CRUCES, NM 88004-1209
TELEPHONE: (505) 523-2481
FACSIMILE: (505) 526-2215

PLEASE REPLY TO SANTA FE

May 16, 2000

HAND-DELIVERED

Ms. Florene Davidson
New Mexico Oil Conservation Commission
2040 South Pacheco Street
Santa Fe, New Mexico 87505

Re: NMOCC Case No. 11996 (*De Novo*); Application of Pendragon Energy Partners, Inc., et al., To Confirm Production From The Appropriate Common Source Of Supply, San Juan County, New Mexico

Dear Ms. Davidson:

Enclosed are the original and two copies of the Application For Rehearing filed on behalf of Pendragon Energy Partners, Inc., Pendragon Resources, LP, and Edwards Energy Corporation in the above matter.

Thank you.

Very Truly Yours,

J. Scott Hall

JSH:ao
Enclosure(s) – as stated

cc: J.E. Gallegos
Steve Ross

6304/20253/Davidson6ltr.doc

STATE OF NEW MEXICO
ENERGY MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, L.P., AND EDWARDS ENERGY CORPORATION, INC. TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO

OCD CASE NO. 11996

APPLICATION FOR REHEARING

Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation, (collectively referred to as "Pendragon"), move pursuant to NMSA 1978 Section 70-2-25 of the New Mexico Oil & Gas Act and 19 NMAC 15.N.1222 for rehearing on the issuance of Order No. R-11133-A issued by the Commission on April 26, 2000.

BACKGROUND FACTS

On August 12 – 21st, 1999, the New Mexico Oil Conservation Commission convened a hearing on Pendragon's Application brought pursuant to, inter alia, Rule (3) of the Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool set forth in NMOCD Order No. R-8768, as amended, seeking a determination that its Chaco wells, completed within the vertical limits of the WAW Fruitland Sand-Pictured Cliffs Gas Pool, and that Whiting Petroleum's Gallegos Federal wells completed within the Basin-Fruitland Coal Gas Pool were producing from the appropriate common source of supply. Pendragon also sought further relief, including an order bringing Whiting's non-conforming wells back into compliance with the Division's rules, regulations and orders. At the hearing, both parties contended that the other's well stimulation treatments caused their separately owned formations to come into communication. Both sides

also contended that their wells experienced interference and that gas was being produced out of formation as a result. Significantly, at the hearing, Whiting's witnesses admitted that the high volume, high pressure and high injection rate fracture stimulation treatments performed on the Gallegos Federal wells by Maralex Resources likely caused their wells to come into communication with the Pictured Cliffs formation owned by Pendragon. Conversely, Pendragon asserted and presented evidence that the acid jobs and relatively mild fracture stimulation treatments performed on its Chaco wells remained contained within the Pictured Cliffs formation and did not communicate with the Fruitland Coal Formation owned by Whiting.

On April 26, 2000, after hearing, the Commission issued Order No. R-11133-A which found that all of Pendragon's subject Chaco wells were perforated within the Pictured Cliffs formation of the WAW Fruitland Sand-Pictured Cliffs Gas Pool. By so finding and concluding, the Commission reaffirmed the long-standing interpretation of industry, regulatory agencies and the larger geologic community establishing the vertical boundaries of the Pictured Cliffs formation. The Order also effectively rejected the request of Whiting and Maralex to re-define and re-establish those boundaries. Order R-11133-A affirmed that the vertical boundaries between the Pictured Cliffs and Fruitland Coal formations conformed to the respective lease ownership of Pendragon and Whiting.[1]

In addition, Order R-11133-A found that the fracture stimulation treatments Maralex performed on five of the Whiting Fruitland Coal wells in 1992 established communication with the Pictured Cliffs formation. (Finding 32.) The Order also found that the fracture treatments

[1] **Pendragon does not challenge the geologic findings and decretal portions of Order R-11133-A.**

performed on four of the Chaco wells in 1995 communicated with the Fruitland Coal formation.[2] As a result of this communication between the separately owned formations, the Order identified three categories of gas capable of being produced from the Chaco 1, 2R, 4 and 5 wells: Category I: Gas originally in place in the Pictured Cliffs formation; Category II: Gas from the Fruitland Coal formation that has migrated to the Pictured Cliffs formation through fractures around the Pendragon Chaco wells; and Category III: Gas from the Fruitland Coal formation that has migrated to the Pictured Cliffs formation through fractures around the Whiting Fruitland Coal wells. (Finding 44.) The Order then requires further proceedings before the Division to place these wells back on production. (Decretal Paragraph 4.)

Pendragon respectfully submits that portions of Order No. R-11133-A are erroneous for the following reasons:

In many respects, Order No. R-11133-A is an order that is at war with itself. A number of the Order's findings and conclusions are inconsistent or are in direct conflict. Other findings are contradicted by the evidence or, in some cases, have no evidentiary basis at all. Certain provisions of the Order exceed the agency's authority while others indicate the agency's statutory mandates under the New Mexico Oil and Gas Act have been disregarded. Most importantly, the Order fails to resolve fully a number of the issues that were brought before the Commission for determination. Until these matters are addressed, the future drilling, production and development by these parties and by other operators in the WAW field or in areas of similar geologic composition will be clouded by uncertainty. The Division's ability to meaningfully regulate drilling and development in accordance with its rules, regulations and orders is similarly

[2] Pendragon continues to dispute this particular finding.

impaired. In many cases, the findings contravene the public interest. These particular matters must be resolved by a rehearing before either the parties or the Division is able to move forward. All of these matters are discussed in greater detail as follows:

1. Order R-11133-A fails to afford meaningful regulatory relief in accordance with the applications before the Commission and the Division's statutes, regulations and prior orders. Pendragon specifically sought regulatory relief under the following authority: 19 NMAC 15.C,106,A; 19 NMAC 15,C,113; 19 NMAC 15.E.303A; NMSA 1978 Sections 70-2-2, 70-2-11 and 70-2-12B(2),(4),(7) and (8); and, Order No. R-8768. The findings and decretal portions of Order R-11133-A make the affirmative determination that the Whiting Fruitland Coal wells are not producing from their "appropriate common source of supply" as required under, inter alia, Order No. R-8768. Order R-11133-A expressly determined that the Whiting coal wells are producing gas from both the Basin-Fruitland Coal Gas Pool and the WAW Fruitland Sand-Pictured Cliffs Gas Pool. Production from the Pictured Cliffs formation by the offending coal wells would include Category I, II and III gas identified in the Order. Such production is in ongoing violation of Section 70-2-12(B)(7) of the Oil and Gas Act, as well as the statutes, regulations and order cited above, and consequently, the Order fails to "afford such relief as necessary to bring the wells into compliance with the Division's rules, regulations and orders."
2. Although Order R-11133-A allows the Division to approve restoring the four Chaco wells to producing status, the Order omits any similar provision requiring Whiting to demonstrate how its five Fruitland Coal wells may be produced without interfering with the Chaco wells or otherwise producing gas out of the separately owned Pictured Cliffs formation. The

omission is an inconsistency and further demonstrates how the Order fails to afford meaningful regulatory relief. In this regard, the practical effect of the Order reaches beyond the Subject Area. In 1992 and 1993, Maralex performed similarly aggressive fracture stimulation treatments on a number of other Fruitland Coal wells outside the Subject Area that are also underlain by separately owned drilled and undrilled Pictured Cliffs reserves.[3] In view of the findings in the Order, it is likely that those other coal wells are in communication with the Pictured Cliffs formation.

3. The policy implications of Order R-11133-A are also broad reaching by effectively pre-empting the use of heretofore accepted fracture stimulation completion technology. Pendragon submits that the preponderance of evidence in this case establishes that properly designed and controlled fracture treatments can be successfully contained within a formation. However, because the Order fails to take such evidence into consideration, the use of hydraulic fracture stimulation treatments by operators in either the Fruitland Coal formation or in adjacent sandstone formations is now precluded in the Subject Area and the remainder of the WAW field and most likely anywhere else in the San Juan Basin with similar geologic composition. Although certainly unintended, the chilling effect of the Order on drilling and development in these areas is likely immediate. The public interest is contravened as a consequence. This important issue deserves further consideration.

4. Findings 34, 45 and 46 in Order R-11133-A state that the unspecified Pendragon Chaco wells "nearly depleted" or "depleted" the Pictured Cliffs formation prior to 1995 and that the Chaco Wells No. 1, 2R,4 and 5 have produced their "fair share" of gas. Yet, at the same time, the Order provides that the Chaco 1J and 2J may proceed to produce and that the Chaco 1, 2R, 4 and 5 wells may be restored to production. While the overwhelming preponderance of

[3] Some of these wells were the subject of the Whiting/Maralex Application in NMOCD Case No. 11921.

the pressure and production data evidence establishes that the Pictured Cliffs is not depleted, findings 34, 45 and 46 pre-suppose that all the Chaco wells are uneconomic. Pendragon presented evidence that the wells continue to be economic with production as low as 30 mcfpd, and at pressures falling below 50 psi. Moreover, there is no evidentiary basis supporting these findings that effectively pre-judge future economic conditions. Once again, the Order has a chilling effect on the recovery of additional Pictured Cliffs reserves in the Subject Area and elsewhere. The order has the further unintended effect of condemning the Pictured Cliffs reserves of a number of interest owners in the area.

5. Finding 46 of the Order provides that the Chaco No. 1, 2R, 4 and 5 wells have produced their "fair share" of the gas in the Pictured Cliffs. However, there is neither a definition or quantification of what may constitute the "fair share" of gas. Moreover, the Commission is without the statutory authority, either express or implied, to determine that an owner may recover only a "fair" share of its reserves in circumstances such as these. Here, Pendragon owns one hundred percent of the Pictured Cliffs; it does not "share" ownership with anyone. Consequently, it is entitled to produce one-hundred percent of the gas reserves it owns.[4] The legal basis for the "fair share" finding in this case is not clear. The finding may have analogous support in Sections 70-2-16(C), 70-2-17(A) and 70-2-33(B) and (H) where correlative rights may be at issue, but the parties agree that such is not the case here. This dispute involves wholly separate pools created by the Division in Orders R-8768 and R-8768-A, R-8769 and R-4260. Consequently, finding 46 is either a misapplication of law to the facts, or was made in excess of the agency's authority.

[4] Under the law, Pendragon owns and is entitled to produce all the recoverable Category I and Category III gas in the Pictured Cliffs formation, at the least.

6. Of all the evidence presented, the most meaningful and the most probative of the various engineering issues are the pressure data. These data are directly relevant to the communication and gas migration issues, as well as to the "depletion" and remaining recoverable reserves issues. However, it is apparent the Order gave little or no consideration to the considerable reservoir and well pressure data presented. The pre- and post-fracture treatment pressure data appear to have been wholly disregarded. Until the pressure data are addressed, the remaining findings are not meaningful.
7. Finding 33: The preponderance of evidence does not support the finding that the fracture treatments on the Chaco 1, 2R, 4 and 5 wells extended into the Fruitland Coal formation. The finding is further erroneous as it disregards the evidence presented establishing that fractures extending upwards would not have effectively communicated with the coal formation due to the downward settlement of propants.
8. Finding 35: The finding of "steady gas production" from the Chaco wells is directly inconsistent with the depletion finding (45).
9. Finding 37: Neither side presented any evidence of the existence of any "high-pressure gas compartments." This finding is wholly unsupported by the evidence. Moreover, the finding that the fracture stimulation treatments on the Chaco wells broke into such "compartments" is directly at odds with the tracer survey exhibits and testimony on the Bartlesville well and the Dome Federal well establishing that such fracture treatments were successfully contained within the appropriate zone.
10. Findings 36 and 39: There was no evidence presented establishing the existence of a "gas bubble". Moreover, the finding is inconsistent with the evidence on the Chaco Plant No. 5 well originally completed in the Pictured Cliffs in 1975 and successfully fracture stimulated

in 1993. A number of Fruitland Coal wells were located in the area of the Chaco Plant No. 5. At the time of the fracture treatment of the Chaco Plant No. 5, those coal wells were only in the initial stages of dewatering and were producing minimal amounts of gas. Yet, the pressure and production data from the Chaco Plant No. 5 shows no indication that the fractures from the 1993 stimulation treatment encountered any "gas bubble" or "gas compartment." In fact, no such "gas bubbles" existed anywhere near the Chaco Plant 5 wellbore, if at all.

11. Finding 39: The Order erroneously finds that no "third bench" of the Pictured Cliffs formation has been reported and that there is "no geological basis for this kind of formation."[5] These findings are directly inconsistent with the substantial amount of testimony and exhibits that clearly establish the existence of the third bench and that the zone contributes considerable Pictured Cliffs reserves. Among other things, the evidence included geologic "literature", cross-sections, well completion information, production data and calculations based on actual well logs. These materials conclusively established the existence of the third bench. There is ample evidence that this zone contributed Pictured Cliffs reserves to the Chaco wells.

12. Finding 39: The finding raises "the possibility" that the hydraulic fractures extended upward from the Chaco wells to the Fruitland Coal formation. This "possible" finding disregards the tangible evidence presented identifying the existence of shale and stress barriers between the formations, as well as actual tracer surveys showing fracture treatments remain contained within the Pictured Cliffs formation in such conditions. Moreover, Pendragon presented ample evidence establishing that fractures extend downward. The finding otherwise

[5] Significantly, the Third Bench is a zone of the Pictured Cliffs formation. The bench, itself, may not be properly classified as a "formation".

disregards the actual tracer survey evidence and the considerable testimony and literature evidence presented on fracture technology. The finding that there is "no scientific basis" for believing the fractures moved downwards is clear error.

13. Finding 40: The Order finds it is "unlikely" that the Chaco wells had suffered from significant reservoir damage. Yet, Pendragon presented unrefuted testimony and exhibit evidence establishing scale damage, water blockage and clay migration into rock pores. Indeed, the Maralex witness testified that the volumetric and material balance analyses on the Chaco Plant 5 and the Chaco No. 4 indicated those wells had substantially under-produced the recoverable gas in place. This testimony substantiates the existence of damage and further contradicts the conclusion that the formation was depleted.

14. Finding 41: The finding that the BTU analysis supports the conclusion that these wells communicated with the Fruitland Coal formation is in error. The finding is not supported by the BTU data presented by both parties which shows post-shut in BTU values for the Chaco wells to be well within the range of values measured for those wells when they were originally completed in the 1970's. The finding also ignores the data presented for the Chaco 2R which showed high BTU values and increasing pressure during the period the coal wells were producing. In addition, the erroneous finding is at odds with the BTU data for the Chaco 1J and 2J wells. These wells, which were found not to have communicated with the Fruitland Formation (Finding 44) showed lower BTU values.

15. Finding 43: The Order finds that the acid jobs on the Chaco 1J and 2J wells did not establish communication with the Fruitland Coal formation and that these treatments "did not alter these wells' rates of production." This finding is not in error, but demonstrates why the failure to address the well and reservoir pressure data is so significant. If these two wells did

not connect with the Fruitland Coal formation, then the pressures reported for the wells are true Pictured Cliffs reservoir pressures, both before and after the acid treatments. Consequently, the finding that the Pictured Cliffs is a depleted reservoir is contra-indicated by Finding 43, as well as by the clearly relevant pressure data. In this regard, the pressure data for the Chaco No. 4 well is equally compelling: The high pressures measured immediately after the January, 1995 acid job and before the subsequent fracture treatment in May of 1995 also establish that (1) the Pictured Cliffs was not depleted, and (2) the pressures (and production) in the Pictured Cliffs were not a result of any communication with the Fruitland Coal formation. (Unless, of course, the Gallegos Federal coal wells that were previously fractured in 1992 established the communication.)

16. Finding 44: The finding establishes that three categories of gas exist in the Pictured Cliffs formation that is "now capable of production" from the Chaco Wells No. 1, 2R, 4 and 5.[6] At the same time, the Order provides for ongoing production from the Whiting Gallegos Federal wells that affects production from the Chaco wells, while simultaneously providing for restoring four of the Chaco wells back to production. However, the finding is erroneous and is not meaningful in practical effect without a determination of the volumes of gas that exist in the Pictured Cliffs formation attributable to each of the three categories.

17. Finding 46: As discussed above, the finding that the Chaco wells have produced their "fair share" is an apparent misapplication of the law and is also inconsistent with those findings contemplating further production from the Pictured Cliffs formation. The "fair share" is undetermined. In addition, as the evidence and findings of this Order establish that the Whiting Fruitland Coal wells are producing from the Pictured Cliffs formation, the Order

[6] Again, Pendragon asserts that the finding with respect to Category II gas is in error.

cannot be meaningfully applied unless the "fair share" of production attributable to these wells is also determined.

WHEREFORE, Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation respectfully request the Commission set this matter for rehearing for the purposes of taking additional evidence and argument on the matters set forth above.

Respectfully submitted,

MILLER, STRATVERT & TORGERSON, PA.

By_____

J. Scott Hall, Esq.
Post Office Box 1986
Santa Fe, New Mexico 87504
(505) 989-9614

ATTORNEYS FOR PENDRAGON ENERGY PARTNERS, PENDRAGON RESOURCES, L.P. AND EDWARDS ENERGY CORPORATION

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing Application for Rehearing was mailed on this 16 day of May, 2000 to the following:

Lori Wrotenbery
New Mexico Oil Conservation Commission
2040 South Pacheco
Santa Fe, New Mexico 87505

Dr. Robert Lee
Petroleum Resource Recovery Center
801 Leroy Place
Socorro, New Mexico 87801

Jamie Bailey
New Mexico State Land Office
310 Old Santa Fe Trail
Santa Fe, New Mexico 87504

Steve Ross
New Mexico Oil Conservation Commission
2040 South Pacheco
Santa Fe, New Mexico 87505

J.E. Gallegos
460 St. Michaels Drive, #300
Santa Fe, New Mexico 87505

J. Scott Hall, Esq.

6304/20253/Application 4 Rehrg.doc

MILLER, STRATVERT & TORGERSON, P. A.

LAW OFFICES

RANNE B. MILLER
ALAN C. TORGERSON
ALICE TOMLINSON LORENZ
GREGORY W. CHASE
ALAN KONRAD
LYMAN G. SANDY
STEPHEN M. WILLIAMS
STEPHAN M. VIDMAR
ROBERT C. GUTIERREZ
SETH V. BINGHAM
JAMES B. COLLINS
TIMOTHY R. BRIGGS
RUDOLPH LUCERO
DEBORAH A. SOLOVE
GARY L. GORDON
LAWRENCE R. WHITE
SHARON P. GROSS
VIRGINIA ANDERMAN
MARTE D. LIGHTSTONE
J. SCOTT HALL
THOMAS R. MACK
TERRI L. SAUER

JOEL T. NEWTON
JUDITH K. NAKAMURA
THOMAS M. DOMME
RUTH O. PREGENZER
JEFFREY E. JONES
MANUEL I. ARRIETA
ROBIN A. GOBLE
JAMES R. WOOD
DANA M. KYLE
KIRK R. ALLEN
RUTH M. FUESS
KYLE M. FINCH
H. BROOK LASKEY
KATHERINE W. HALL
FRED SCHILLER
LARA L. WHITE
PAULA G. MAYNES
DEAN B. CROSS
CARLA PRANCO
KATHERINE N. BLACKETT
JENNIFER L. STONE
ANDREW M. SANCHEZ

ALBUQUERQUE
500 MARQUETTE N.W. SUITE 1100
POST OFFICE BOX 25687
ALBUQUERQUE, NM 87125-0687
TELEPHONE: (505) 842-1950
FACSIMILE: (505) 243-4408

LAS CRUCES
500 S. MAIN ST., SUITE 800
POST OFFICE BOX 1209
LAS CRUCES, NM 88004-1209
TELEPHONE: (505) 523-2481
FACSIMILE: (505) 526-2215

FARMINGTON
300 WEST ARRINGTON
POST OFFICE BOX 869
FARMINGTON, NM 87499-0869
TELEPHONE: (505) 326-4521
FACSIMILE: (505) 325-5474

SANTA FE
150 WASHINGTON AVE., SUITE 300
POST OFFICE BOX 1986
SANTA FE, NM 87504-1986
TELEPHONE: (505) 989-9614
FACSIMILE: (505) 989-9857

WILLIAM K. STRATVERT, COUNSEL
PAUL W. ROBINSON, COUNSEL
RALPH WM. RICHARDS, COUNSEL
ROSS B. PERKAL, COUNSEL
JAMES J. WIDLAND, COUNSEL

PLEASE REPLY TO SANTA FE

FACSIMILE TRANSMISSION COVER SHEET

DATE: May 16, 2000

TO: Florene Davidson FAX NO.: 827-8177

FROM: J. Scott Hall, Esq. OPERATOR: Amanda Olsen

MESSAGE: James is on his way right now to file the attached Application for Rehearing. Thanks.

NUMBER OF PAGES INCLUDING COVER SHEET: 14

IF YOU DO NOT RECEIVE THE ENTIRE DOCUMENT, PLEASE CALL OUR SANTA FE OFFICE AS SOON AS POSSIBLE AT (505) 989-9614.

* * * * * * * *

MILLER, STRATVERT & TORGERSON, P.A.
LAW OFFICES

RANNE B. MILLER
ALAN C. TORGERSON
ALICE T. LORENZ
GREGORY W. CHASE
LYMAN G. SANDY
STEPHEN M. WILLIAMS
STEPHAN M. VIDMAR
ROBERT C. GUTIERREZ
SETH V. BINGHAM
JAMES B. COLLINS
TIMOTHY R. BRIGGS
RUDOLPH LUCERO
DEBORAH A. SOLOVE
GARY L. GORDON
LAWRENCE R. WHITE
SHARON P. GROSS
VIRGINIA ANDERMAN
MARTE D. LIGHTSTONE
J. SCOTT HALL
THOMAS R. MACK
TERRI L. SAUER
JOEL T. NEWTON

THOMAS M. DOMME
RUTH O. PREGENZER
JEFFREY E. JONES
MANUEL I. ARRIETA
ROBIN A. GOBLE
JAMES R. WOOD
DANA M. KYLE
KIRK R. ALLEN
RUTH FUESS
KYLE M. FINCH
H. BROOK LASKEY
KATHERINE W. HALL
FRED SCHILLER
PAULA G. MAYNES
MICHAEL C. ROSS
CARLA PRANDO
KATHERINE N. BLACKETT
JENNIFER L. STONE
ANDREW M. SANCHEZ
M. DYLAN O'REILLY
AMINA QUARGNALI-LINSLEY
BEATE BOUDRO

COUNSEL
PAUL W. ROBINSON
ROSS B. PERKAL
JAMES J. WIDLAND
BRADLEY D. TEPPER
GARY RISLEY

OF COUNSEL
WILLIAM K. STRATVERT
RALPH WM. RICHARDS

ALBUQUERQUE, NM
500 MARQUETTE N.W., SUITE 1100
POST OFFICE BOX 25687
ALBUQUERQUE, NM 87125-0687
TELEPHONE: (505) 842-1950
(800) 424-7585
FACSIMILE: (505) 243-4408

SANTA FE, NM
150 WASHINGTON AVE., SUITE 300
POST OFFICE BOX 1986
SANTA FE, NM 87504-1986
TELEPHONE: (505) 989-9614
FACSIMILE: (505) 989-9857

FARMINGTON, NM
300 WEST ARRINGTON, SUITE 300
POST OFFICE BOX 869
FARMINGTON, NM 87499-0869
TELEPHONE: (505) 326-4521
FACSIMILE: (505) 325-5474

LAS CRUCES, NM
500 S. MAIN ST., SUITE 800
POST OFFICE BOX 1209
LAS CRUCES, NM 88004-1209
TELEPHONE: (505) 523-2481
FACSIMILE: (505) 526-2215

PLEASE REPLY TO SANTA FE

May 16, 2000
HAND-DELIVERED

Ms. Florene Davidson
New Mexico Oil Conservation Commission
2040 South Pacheco Street
Santa Fe, New Mexico 87505

Re: NMOCC Case No. 11996 (*De Novo*); Application of Pendragon Energy Partners, Inc., et al., To Confirm Production From The Appropriate Common Source Of Supply, San Juan County, New Mexico

Dear Ms. Davidson:

Enclosed are the original and two copies of the Application For Rehearing filed on behalf of Pendragon Energy Partners, Inc., Pendragon Resources, LP, and Edwards Energy Corporation in the above matter.

Thank you.

Very Truly Yours,

J. Scott Hall

JSH:ao
Enclosure(s) – as stated

cc: J.E. Gallegos
Steve Ross

6304/20253/Davidson6ltr.doc

STATE OF NEW MEXICO
ENERGY MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, L.P., AND EDWARDS ENERGY CORPORATION, INC. TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO

OCD CASE NO. 11996

APPLICATION FOR REHEARING

Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation, (collectively referred to as "Pendragon"), move pursuant to NMSA 1978 Section 70-2-25 of the New Mexico Oil & Gas Act and 19 NMAC 15.N.1222 for rehearing on the issuance of Order No. R-11133-A issued by the Commission on April 26, 2000.

BACKGROUND FACTS

On August 12 – 21st, 1999, the New Mexico Oil Conservation Commission convened a hearing on Pendragon's Application brought pursuant to, inter alia, Rule (3) of the Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool set forth in NMOCD Order No. R-8768, as amended, seeking a determination that its Chaco wells, completed within the vertical limits of the WAW Fruitland Sand-Pictured Cliffs Gas Pool, and that Whiting Petroleum's Gallegos Federal wells completed within the Basin-Fruitland Coal Gas Pool were producing from the appropriate common source of supply. Pendragon also sought further relief, including an order bringing Whiting's non-conforming wells back into compliance with the Division's rules, regulations and orders. At the hearing, both parties contended that the other's well stimulation treatments caused their separately owned formations to come into communication. Both sides

also contended that their wells experienced interference and that gas was being produced out of formation as a result. Significantly, at the hearing, Whiting's witnesses admitted that the high volume, high pressure and high injection rate fracture stimulation treatments performed on the Gallegos Federal wells by Maralex Resources likely caused their wells to come into communication with the Pictured Cliffs formation owned by Pendragon. Conversely, Pendragon asserted and presented evidence that the acid jobs and relatively mild fracture stimulation treatments performed on its Chaco wells remained contained within the Pictured Cliffs formation and did not communicate with the Fruitland Coal Formation owned by Whiting.

On April 26, 2000, after hearing, the Commission issued Order No. R-11133-A which found that all of Pendragon's subject Chaco wells were perforated within the Pictured Cliffs formation of the WAW Fruitland Sand-Pictured Cliffs Gas Pool. By so finding and concluding, the Commission reaffirmed the long-standing interpretation of industry, regulatory agencies and the larger geologic community establishing the vertical boundaries of the Pictured Cliffs formation. The Order also effectively rejected the request of Whiting and Maralex to re-define and re-establish those boundaries. Order R-11133-A affirmed that the vertical boundaries between the Pictured Cliffs and Fruitland Coal formations conformed to the respective lease ownership of Pendragon and Whiting.[1]

In addition, Order R-11133-A found that the fracture stimulation treatments Maralex performed on five of the Whiting Fruitland Coal wells in 1992 established communication with the Pictured Cliffs formation. (Finding 32.) The Order also found that the fracture treatments

[1] **Pendragon does not challenge the geologic findings and decretal portions of Order R-11133-A.**

performed on four of the Chaco wells in 1995 communicated with the Fruitland Coal formation.[2] As a result of this communication between the separately owned formations, the Order identified three categories of gas capable of being produced from the Chaco 1, 2R, 4 and 5 wells: Category I: Gas originally in place in the Pictured Cliffs formation; Category II: Gas from the Fruitland Coal formation that has migrated to the Pictured Cliffs formation through fractures around the Pendragon Chaco wells; and Category III: Gas from the Fruitland Coal formation that has migrated to the Pictured Cliffs formation through fractures around the Whiting Fruitland Coal wells. (Finding 44.) The Order then requires further proceedings before the Division to place these wells back on production. (Decretal Paragraph 4.)

Pendragon respectfully submits that portions of Order No. R-11133-A are erroneous for the following reasons:

In many respects, Order No. R-11133-A is an order that is at war with itself. A number of the Order's findings and conclusions are inconsistent or are in direct conflict. Other findings are contradicted by the evidence or, in some cases, have no evidentiary basis at all. Certain provisions of the Order exceed the agency's authority while others indicate the agency's statutory mandates under the New Mexico Oil and Gas Act have been disregarded. Most importantly, the Order fails to resolve fully a number of the issues that were brought before the Commission for determination. Until these matters are addressed, the future drilling, production and development by these parties and by other operators in the WAW field or in areas of similar geologic composition will be clouded by uncertainty. The Division's ability to meaningfully regulate drilling and development in accordance with its rules, regulations and orders is similarly

[2] Pendragon continues to dispute this particular finding.

impaired. In many cases, the findings contravene the public interest. These particular matters must be resolved by a rehearing before either the parties or the Division is able to move forward. All of these matters are discussed in greater detail as follows:

1. Order R-11133-A fails to afford meaningful regulatory relief in accordance with the applications before the Commission and the Division's statutes, regulations and prior orders. Pendragon specifically sought regulatory relief under the following authority: 19 NMAC 15,C,106,A; 19 NMAC 15,C,113; 19 NMAC 15.E.303A; NMSA 1978 Sections 70-2-2, 70-2-11 and 70-2-12B(2),(4),(7) and (8); and, Order No. R-8768. The findings and decretal portions of Order R-11133-A make the affirmative determination that the Whiting Fruitland Coal wells are not producing from their "appropriate common source of supply" as required under, inter alia, Order No. R-8768. Order R-11133-A expressly determined that the Whiting coal wells are producing gas from both the Basin-Fruitland Coal Gas Pool and the WAW Fruitland Sand-Pictured Cliffs Gas Pool. Production from the Pictured Cliffs formation by the offending coal wells would include Category I, II and III gas identified in the Order. Such production is in ongoing violation of Section 70-2-12(B)(7) of the Oil and Gas Act, as well as the statutes, regulations and order cited above, and consequently, the Order fails to "afford such relief as necessary to bring the wells into compliance with the Division's rules, regulations and orders."
2. Although Order R-11133-A allows the Division to approve restoring the four Chaco wells to producing status, the Order omits any similar provision requiring Whiting to demonstrate how its five Fruitland Coal wells may be produced without interfering with the Chaco wells or otherwise producing gas out of the separately owned Pictured Cliffs formation. The

omission is an inconsistency and further demonstrates how the Order fails to afford meaningful regulatory relief. In this regard, the practical effect of the Order reaches beyond the Subject Area. In 1992 and 1993, Maralex performed similarly aggressive fracture stimulation treatments on a number of other Fruitland Coal wells outside the Subject Area that are also underlain by separately owned drilled and undrilled Pictured Cliffs reserves.[3] In view of the findings in the Order, it is likely that those other coal wells are in communication with the Pictured Cliffs formation.

3. The policy implications of Order R-11133-A are also broad reaching by effectively pre-empting the use of heretofore accepted fracture stimulation completion technology. Pendragon submits that the preponderance of evidence in this case establishes that properly designed and controlled fracture treatments can be successfully contained within a formation. However, because the Order fails to take such evidence into consideration, the use of hydraulic fracture stimulation treatments by operators in either the Fruitland Coal formation or in adjacent sandstone formations is now precluded in the Subject Area and the remainder of the WAW field and most likely anywhere else in the San Juan Basin with similar geologic composition. Although certainly unintended, the chilling effect of the Order on drilling and development in these areas is likely immediate. The public interest is contravened as a consequence. This important issue deserves further consideration.

4. Findings 34, 45 and 46 in Order R-11133-A state that the unspecified Pendragon Chaco wells "nearly depleted" or "depleted" the Pictured Cliffs formation prior to 1995 and that the Chaco Wells No. 1, 2R,4 and 5 have produced their "fair share" of gas. Yet, at the same time, the Order provides that the Chaco 1J and 2J may proceed to produce and that the Chaco 1, 2R, 4 and 5 wells may be restored to production. While the overwhelming preponderance of

[3] Some of these wells were the subject of the Whiting/Maralex Application in NMOCD Case No. 11921.

the pressure and production data evidence establishes that the Pictured Cliffs is not depleted, findings 34, 45 and 46 pre-suppose that all the Chaco wells are uneconomic. Pendragon presented evidence that the wells continue to be economic with production as low as 30 mcfpd, and at pressures falling below 50 psi. Moreover, there is no evidentiary basis supporting these findings that effectively pre-judge future economic conditions. Once again, the Order has a chilling effect on the recovery of additional Pictured Cliffs reserves in the Subject Area and elsewhere. The order has the further unintended effect of condemning the Pictured Cliffs reserves of a number of interest owners in the area.

5. Finding 46 of the Order provides that the Chaco No. 1, 2R, 4 and 5 wells have produced their "fair share" of the gas in the Pictured Cliffs. However, there is neither a definition or quantification of what may constitute the "fair share" of gas. Moreover, the Commission is without the statutory authority, either express or implied, to determine that an owner may recover only a "fair" share of its reserves in circumstances such as these. Here, Pendragon owns one hundred percent of the Pictured Cliffs; it does not "share" ownership with anyone. Consequently, it is entitled to produce one-hundred percent of the gas reserves it owns.[4] The legal basis for the "fair share" finding in this case is not clear. The finding may have analogous support in Sections 70-2-16(C), 70-2-17(A) and 70-2-33(B) and (H) where correlative rights may be at issue, but the parties agree that such is not the case here. This dispute involves wholly separate pools created by the Division in Orders R-8768 and R-8768-A, R-8769 and R-4260. Consequently, finding 46 is either a misapplication of law to the facts, or was made in excess of the agency's authority.

[4] Under the law, Pendragon owns and is entitled to produce all the recoverable Category I and Category III gas in the Pictured Cliffs formation, at the least.

6. Of all the evidence presented, the most meaningful and the most probative of the various engineering issues are the pressure data. These data are directly relevant to the communication and gas migration issues, as well as to the "depletion" and remaining recoverable reserves issues. However, it is apparent the Order gave little or no consideration to the considerable reservoir and well pressure data presented. The pre- and post-fracture treatment pressure data appear to have been wholly disregarded. Until the pressure data are addressed, the remaining findings are not meaningful.
7. Finding 33: The preponderance of evidence does not support the finding that the fracture treatments on the Chaco 1, 2R, 4 and 5 wells extended into the Fruitland Coal formation. The finding is further erroneous as it disregards the evidence presented establishing that fractures extending upwards would not have effectively communicated with the coal formation due to the downward settlement of propants.
8. Finding 35: The finding of "steady gas production" from the Chaco wells is directly inconsistent with the depletion finding (45).
9. Finding 37: Neither side presented any evidence of the existence of any "high-pressure gas compartments." This finding is wholly unsupported by the evidence. Moreover, the finding that the fracture stimulation treatments on the Chaco wells broke into such "compartments" is directly at odds with the tracer survey exhibits and testimony on the Bartlesville well and the Dome Federal well establishing that such fracture treatments were successfully contained within the appropriate zone.
10. Findings 36 and 39: There was no evidence presented establishing the existence of a "gas bubble". Moreover, the finding is inconsistent with the evidence on the Chaco Plant No. 5 well originally completed in the Pictured Cliffs in 1975 and successfully fracture stimulated

in 1993. A number of Fruitland Coal wells were located in the area of the Chaco Plant No. 5. At the time of the fracture treatment of the Chaco Plant No. 5, those coal wells were only in the initial stages of dewatering and were producing minimal amounts of gas. Yet, the pressure and production data from the Chaco Plant No. 5 shows no indication that the fractures from the 1993 stimulation treatment encountered any "gas bubble" or "gas compartment." In fact, no such "gas bubbles" existed anywhere near the Chaco Plant 5 wellbore, if at all.

11. Finding 39: The Order erroneously finds that no "third bench" of the Pictured Cliffs formation has been reported and that there is "no geological basis for this kind of formation."[5] These findings are directly inconsistent with the substantial amount of testimony and exhibits that clearly establish the existence of the third bench and that the zone contributes considerable Pictured Cliffs reserves. Among other things, the evidence included geologic "literature", cross-sections, well completion information, production data and calculations based on actual well logs. These materials conclusively established the existence of the third bench. There is ample evidence that this zone contributed Pictured Cliffs reserves to the Chaco wells.

12. Finding 39: The finding raises "the possibility" that the hydraulic fractures extended upward from the Chaco wells to the Fruitland Coal formation. This "possible" finding disregards the tangible evidence presented identifying the existence of shale and stress barriers between the formations, as well as actual tracer surveys showing fracture treatments remain contained within the Pictured Cliffs formation in such conditions. Moreover, Pendragon presented ample evidence establishing that fractures extend downward. The finding otherwise

[5] Significantly, the Third Bench is a zone of the Pictured Cliffs formation. The bench, itself, may not be properly classified as a "formation".

disregards the actual tracer survey evidence and the considerable testimony and literature evidence presented on fracture technology. The finding that there is "no scientific basis" for believing the fractures moved downwards is clear error.

13. Finding 40: The Order finds it is "unlikely" that the Chaco wells had suffered from significant reservoir damage. Yet, Pendragon presented unrefuted testimony and exhibit evidence establishing scale damage, water blockage and clay migration into rock pores. Indeed, the Maralex witness testified that the volumetric and material balance analyses on the Chaco Plant 5 and the Chaco No. 4 indicated those wells had substantially under-produced the recoverable gas in place. This testimony substantiates the existence of damage and further contradicts the conclusion that the formation was depleted.

14. Finding 41: The finding that the BTU analysis supports the conclusion that these wells communicated with the Fruitland Coal formation is in error. The finding is not supported by the BTU data presented by both parties which shows post-shut in BTU values for the Chaco wells to be well within the range of values measured for those wells when they were originally completed in the 1970's. The finding also ignores the data presented for the Chaco 2R which showed high BTU values and increasing pressure during the period the coal wells were producing. In addition, the erroneous finding is at odds with the BTU data for the Chaco 1J and 2J wells. These wells, which were found not to have communicated with the Fruitland Formation (Finding 44) showed lower BTU values.

15. Finding 43: The Order finds that the acid jobs on the Chaco 1J and 2J wells did not establish communication with the Fruitland Coal formation and that these treatments "did not alter these wells' rates of production." This finding is not in error, but demonstrates why the failure to address the well and reservoir pressure data is so significant. If these two wells did

not connect with the Fruitland Coal formation, then the pressures reported for the wells are true Pictured Cliffs reservoir pressures, both before and after the acid treatments. Consequently, the finding that the Pictured Cliffs is a depleted reservoir is contra-indicated by Finding 43, as well as by the clearly relevant pressure data. In this regard, the pressure data for the Chaco No. 4 well is equally compelling: The high pressures measured immediately after the January, 1995 acid job and before the subsequent fracture treatment in May of 1995 also establish that (1) the Pictured Cliffs was not depleted, and (2) the pressures (and production) in the Pictured Cliffs were not a result of any communication with the Fruitland Coal formation. (Unless, of course, the Gallegos Federal coal wells that were previously fractured in 1992 established the communication.)

16. Finding 44: The finding establishes that three categories of gas exist in the Pictured Cliffs formation that is "now capable of production" from the Chaco Wells No. 1, 2R, 4 and 5.[6] At the same time, the Order provides for ongoing production from the Whiting Gallegos Federal wells that affects production from the Chaco wells, while simultaneously providing for restoring four of the Chaco wells back to production. However, the finding is erroneous and is not meaningful in practical effect without a determination of the volumes of gas that exist in the Pictured Cliffs formation attributable to each of the three categories.

17. Finding 46: As discussed above, the finding that the Chaco wells have produced their "fair share" is an apparent misapplication of the law and is also inconsistent with those findings contemplating further production from the Pictured Cliffs formation. The "fair share" is undetermined. In addition, as the evidence and findings of this Order establish that the Whiting Fruitland Coal wells are producing from the Pictured Cliffs formation, the Order

[6] Again, Pendragon asserts that the finding with respect to Category II gas is in error.

cannot be meaningfully applied unless the "fair share" of production attributable to these wells is also determined.

WHEREFORE, Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation respectfully request the Commission set this matter for rehearing for the purposes of taking additional evidence and argument on the matters set forth above.

Respectfully submitted,

MILLER, STRATVERT & TORGERSON, P.A.

By_____

J. Scott Hall, Esq.
Post Office Box 1986
Santa Fe, New Mexico 87504
(505) 989-9614

ATTORNEYS FOR PENDRAGON ENERGY PARTNERS, PENDRAGON RESOURCES, L.P. AND EDWARDS ENERGY CORPORATION

GALLEGOS LAW FIRM
A Professional Corporation

460 St. Michael's Drive
Building 300
Santa Fe, New Mexico 87505
Telephone No. 505-983-6686
Telefax No. 505-986-1367
Telefax No. 505-986-0741

December 3, 1999
(Our File No. 98-266.00)

J.E. GALLEGOS *

Ms. Lori Wrotenbery
New Mexico Oil Conservation Commission
2040 South Pacheco
Santa Fe, New Mexico 87505

Ms. Jamie Bailey
New Mexico State Land Office
310 Old Santa Fe Trail
Santa Fe, NM 87504

Dr. Robert Lee
Petroleum Recovery Research Center
New Mexico Institute of Mining Technology
801 Leroy Place
Socorro, New Mexico 87801-4796

Re: Application of Pendragon Energy Partners, De Novo; OCC No. 11996

Dear Members of the Commission:

The Applicant's counsel has submitted a fifty-five page proposed Order in this matter replete with representations as to the alleged facts in this matter. Of course, it is the province of the Commission to determine on the record before it what, if any, of those representations are supported by credible evidence.

We cannot stand by, however, when the proposed Order contains untruths on a subject not on the record. On page 3 at Paragraph (3), Pendragon refers to the injunction hearing before the district court held on June 29, 1998. Pendragon represents that : "Pendragon was not afforded the opportunity to present evidence at the hearing." This statement is obviously intended to suggest that the resoundingly unfavorable decision against Pendragon by Honorable Art Encinias was unfairly or capriciously rendered. On the contrary, the Judge heard sworn expert testimony, subjected to full cross examination from approximately 1:30 – 5:30 p.m. Mr. Hall on behalf of Pendragon opted not to present any evidence and took the position – unsuccessfully – that the injunction should be denied based on Whiting's evidence.

Attached to this letter is a portion of the transcript of the stated court hearing which reflects the proceedings as they actually transpired. When Judge Encinias asked

* New Mexico Board of Legal Specialization
Recognized Specialist in the area of
Natural Resources-Oil and Gas Law

"Anything else?", Pendragon offered nothing having argued that the injunction should be denied on the testimony already presented (pps. 182-183.)

Sincerely,

GALLEGOS LAW FIRM, P.C.

By J. E. Gallegos

JEG:sa
Enclosures
cc: J. Scott Hall
John Hazlett
Mickey O'Hare
ioc: Michael J. Condon

FIRST JUDICIAL DISTRICT COURT
COUNTY OF SANTA FE
STATE OF NEW MEXICO

WHITING PETROLEUM CORPORATION, a corporation, and MARALEX RESOURCES, INC., a corporation, Plaintiffs,	)	
vs.	)	No. D-0101-CV-98-1295
PENDRAGON ENERGY PARTNERS, INC., a corporation, and J.K. EDWARDS ASSOCIATES, INC., a corporation, Defendants.	)	

The above-entitled matter came duly on for hearing before the Honorable ART ENCINIAS, District Judge, Division V, First Judicial District Court, Santa Fe, New Mexico, on the 29th day of June, 1994, 1:30 p.m.

* * *

Reported by: STEVEN T. BRENNER, NM CCR #7

* * *

INDEX

(Continued...)

PLAINTIFFS' WITNESSES (Continued):

* * *

A P P E A R A N C E S

FOR THE PLAINTIFFS:

GALLEGOS LAW FIRM
460 St. Michael's Drive, #300
Santa Fe, New Mexico 87505
By: J.E. GALLEGOS
and
MICHAEL J. CONDON

FOR THE DEFENDANTS:

MILLER, STRATVERT and TORGERSON, P.A.
150 Washington
Suite 300
Santa Fe, New Mexico 87501
By: J. SCOTT HALL

MILLER, STRATVERT and TORGERSON, P.A.
Attorneys at Law
500 Marquette, N.W., Suite 1100
P.O. Box 25687
Albuquerque, New Mexico
87125
By: MARTE D. LIGHTSTONE
and
ALAN KONRAD

* * *

Q. -- in the Pictured Cliff.

A. Their perforations are right here, communicating Fruitland Coal -- I mean the Pictured Cliff formation, and taking the Fruitland gas, communicating with the gas up here.

MR. GALLEGOS: That's all the redirect, your Honor.

THE COURT: Thank you, sir, for your testimony. You may step down.

THE WITNESS: Thank you.

THE COURT: We've run out of time today. Any suggestions as to how we proceed at this point?

MR. GALLEGOS: Well, your Honor, I think we need some more time to finish this. We had hoped to have -- and I understood the Court's schedule. We had hoped to have a day, an estimated day, and we did have an hour worth of motions hearing today, but we would have a bit more evidence, unless the Court wants to --

THE COURT: Wants to -- ?

MR. GALLEGOS: -- to rule based on what we've presented.

THE COURT: Mr. Hall?

MR. HALL: Yes, your Honor, I certainly don't want to waive the right to put on our own testimony. But in view of the Court's earlier ruling that you're deferring

the trespass issue to the OCD, I'm not sure what their testimony established today for purposes of you rendering an injunction order. I don't think any of their testimony established that there is no damages that they will -- may be likely to incur, if any, that the OCD were -- you know, remedy.

Based on that, I think the Application for Injunction has to be denied.

THE COURT: I'm prepared to rule, if the parties want a ruling.

MR. GALLEGOS: We submit the matter for the Court's ruling.

THE COURT: Anything else?

This is the Court's ruling.

Under a traditional analysis to obtain a preliminary injunction, the Plaintiff must show that the Plaintiff will suffer irreparable injury unless the injunction is granted, that the threatened injury outweighs any damage injunction might cause the Defendant, that the issuance of the injunction will not be adverse to the public's interest -- that's really not a point here -- and that there is a substantial likelihood that the Plaintiff will prevail on the merits.

In this case, the Court earlier recognized that certain issues raised in the present lawsuit are more

properly addressed and determined by an action already presently pending before the New Mexico Oil Conservation Division. This decision was largely determined by reason of the parties' voluntary submission to the OCD jurisdiction over the issues of Pendragon's alleged pirating of Whiting's gas.

Essentially the same issue is raised in the present lawsuit, although framed here in more recognizably legal terms.

I still hold the view that those issues raised by the lawsuit which, one, relate to the parties' relative rights in the lands at issue and, two, are subject to meaningful relief to the parties through the OCD should be recognized by this Court as within the jurisdiction of the OCD.

This is not to say that this Court does not have jurisdiction. To the contrary, this Court can assert jurisdiction over all claims raised by the Plaintiffs. However, by application of the doctrine of primary jurisdiction, this Court has determined to defer to the jurisdiction of the OCD in view of the greater expertise of the OCD in this particular field, in order to promote more uniform decision-making.

What would remain to the Court are those claims which may or may not relate to the relative rights of the

parties to the lands at issue, but which claims, regardless of how they are denominated, are not susceptible of relief through the OCD action. Let me make it simple: All claims which may permit relief in damages, which is a remedy unavailable to the OCD.

A paradox immediately arises. The Plaintiffs seek injunctive relief, that is, a request that the Defendant stop operating wells which they claim are effectively hijacking their natural gas. But injunctive relief is simply not available where money damages are. After all, it is only injury which is irreparable which can be reached by injunction. Where money will salve the wound, no injunction should issue. This is black-letter law.

In New Mexico, however, there are a significant number of cases which find exceptions to this rule, that a plaintiff would be without a plain, speedy, adequate and complete remedy at law to deserve injunctive relief. Generally, these cases permit exception to the rule where it is impossible, or even simply very difficult to determine money damages.

The most recent case on the point is probably *Cafeteria Operators vs. Coronado Santa Fe* out of this District. You can find that at 952 P. 2nd 435, last year's case.

Similarly in this case, I find that the evidence supports the following view:

Whiting and Pendragon each own rights to fairly specifically identifiable gas- and coal-bearing formations. Whiting owns Fruitland, Pendragon owns Pictured Cliffs. The former overlays the latter. Each has a number of wells drilled to produce gas from their respective formations.

As it turns out, the Pendragon wells, which are apparently nicknamed Chaco wells, are far less productive, and appropriately so, since the Pictured Cliff formation is low in permeability and produces less gas.

It is likely that at least four of the Pendragon wells are perforated within the Fruitland formation, although the placement of the perforations may be the result of an error in identifying the boundary between the two formations.

However, in 1995 Pendragon attempted to stimulate production in the same four wells by frac'ing them. This is a process which is designed to improve the permeability of the formation and thereby produce more gas. It is likely that the process created fractures into the overlying Fruitland formation, creating a communication between the Fruitland high-production gas reservoirs and the Pictured Cliffs low-production gas reservoirs. It is likely that Pendragon would have known that their frac jobs

would have precisely this effect.

The result was that the Pendragon gas production from these wells shot up significantly, and it is likely that the greater gas production is owing to Pendragon's new ability to draw gas from a reservoir within a formation it doesn't own.

If the Court were to enjoin Pendragon from operating these four wells, it would delay but not prevent eventual production from these wells. It would also create an opportunity for the parties, with or without the help of the Oil Conservation Division, to determine how much gas Pendragon is stealing.

I conclude from these facts the following:

One, it is likely that Whiting will prevail on the merits of its claim that Pendragon hijacked its gas.

Two, without an injunction it's likely that Whiting will suffer irreparable injury.

Three, an injunction may harm Pendragon, but the harm to Whiting greatly outweighs this harm.

Therefore, the Plaintiff's Application for Preliminary Injunction is well taken, and it should be granted but limited to Chaco Wells 1, 2R, 4 and 5 and also limited in time to no more than 90 days to permit review and action by OCD on the issues within their jurisdiction.

Before the expiration of the preliminary

injunction, the matter should be reviewed by this Court to learn the progress on the OCD matter. No bond shall be required of the Plaintiffs, but the Defendants should be encouraged to track production loss for compensation in the event that they have been wronged by the injunction.

Mr. Gallegos, let me ask that you prepare a Form of Preliminary Injunction in line with the Court's decision, circulate it to Mr. Hall for his approval as to form, and then back to this Court within seven days for signature.

In the event of objection to the form of the Order, the Court sets the matter for formal presentment on July 6th, 1998, at 1:30 p.m.

Anything else?

MR. GALLEGOS: No, your Honor. Thank you.

MR. HALL: Your Honor, I'm --

THE COURT: Yes?

MR. HALL: -- not sure I caught everything.

We'd like to be able to put on some testimony about the need for a bond and the damages that the bond would need to cover. I'm not sure I caught your statement --

THE COURT: No bond shall be required of the Plaintiffs. However, I encourage the Defendants to track their production loss for compensation in the event they

have been wronged by the Court's Injunction.

There being nothing further before the Court, this matter of Whiting, et al., versus Pendragon, et al., D-0101-CV-98-1295, we now stand adjourned.

Thank you for your presentations.

(Thereupon, these proceedings were concluded at 5:45 p.m.)

* * *

CERTIFICATE OF REPORTER

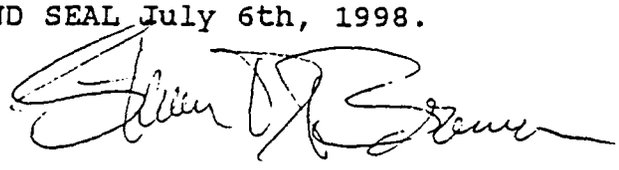
STATE OF NEW MEXICO)
) ss.
COUNTY OF SANTA FE)

I, Steven T. Brenner, Certified Court Reporter and Notary Public, State of New Mexico, HEREBY CERTIFY that on the 29th day of June, 1998, there was a hearing in the above-entitled matter before the Honorable Art Encinias;

That the hearing was taken by me stenographically and by audiotape, that I produced the foregoing transcript using both sources, and that the foregoing is a true and accurate record of the proceedings;

I FURTHER CERTIFY that I am not a relative or employee of any of the parties or attorneys involved in this matter and that I have no personal interest in the final disposition of this matter.

WITNESS MY HAND AND SEAL July 6th, 1998.



STEVEN T. BRENNER
CCR No. 7

My commission expires: October 14, 1998

MILLER, STRATVERT & TORGERSON, P.A.
LAW OFFICES

RANNE B. MILLER
ALAN C. TORGERSON
ALICE TOMLINSON LORENZ
GREGORY W. CHASE
LYMAN G. SANDY
STEPHEN M. WILLIAMS
STEPHAN M. VIDMAR
ROBERT C. GUTIERREZ
SETH V. BINGHAM
JAMES B. COLLINS
TIMOTHY R. BRIGGS
RUDOLPH LUCERO
DEBORAH A. SOLOVE
GARY L. GORDON
LAWRENCE R. WHITE
SHARON P. GROSS
VIRGINIA ANDERMAN
MARTE D. LIGHTSTONE
J. SCOTT HALL
THOMAS R. MACK
TERRI L. SAUER
JOEL T. NEWTON
THOMAS M. DOMME

RUTH O. PREGENZER
JEFFREY E. JONES
MANUEL I. ARRIETA
ROBIN A. GOBLE
JAMES R. WOOD
DANA M. KYLE
KIRK R. ALLEN
RUTH M. FUESS
KYLE M. FINCH
H. BROOK LASKEY
KATHERINE W. HALL
FRED SCHILLER
LARA L. WHITE
PAULA G. MAYNES
DEAN B. CROSS
MICHAEL C. ROSS
CARLA PRANDO
KATHERINE N. BLACKETT
JENNIFER L. STONE
ANDREW M. SANCHEZ
M. DYLAN O'REILLY
AMINA QUARGNALI-LINSLEY
BEATE BOUDRO

COUNSEL
PAUL W. ROBINSON
ROSS B. PERKAL
JAMES J. WIDLAND
BRADLEY D. TEPPER
GARY RISLEY

OF COUNSEL
WILLIAM K. STRATVERT
RALPH WM. RICHARDS

ALBUQUERQUE, NM
500 MARQUETTE N.W., SUITE 1100
POST OFFICE BOX 25687
ALBUQUERQUE, NM 87125-0687
TELEPHONE: (505) 842-1950
(800) 424-7585
FACSIMILE: (505) 243-4408

SANTA FE, NM
150 WASHINGTON AVE., SUITE 300
POST OFFICE BOX 1986
SANTA FE, NM 87504-1986
TELEPHONE: (505) 989-9614
FACSIMILE: (505) 989-9857

FARMINGTON, NM
300 WEST ARRINGTON, SUITE 300
POST OFFICE BOX 869
FARMINGTON, NM 87499-0869
TELEPHONE: (505) 326-4521
FACSIMILE: (505) 325-5474

LAS CRUCES, NM
500 S. MAIN ST., SUITE 800
POST OFFICE BOX 1209
LAS CRUCES, NM 88004-1209
TELEPHONE: (505) 523-2481
FACSIMILE: (505) 526-2215

PLEASE REPLY TO SANTA FE

November 30, 1999

Ms. Jamie Bailey
New Mexico State Land Office
310 ~~Old~~ Santa Fe Trail
Santa Fe, New Mexico 87504

Dr. Robert Lee
Petroleum Recovery Research Center
New Mexico Institute ~~of~~ Mining Technology
801 Leroy Place
Socorro, New Mexico 87801-4796

Re: NMOCC Case No. 11996; Application of Pendragon Energy Partners, *et al.*, San Juan County, New Mexico

Dear Commissioners:

Enclosed, are courtesy copies of the Draft Order of the Commission and Closing Statement Memorandum filed on behalf of Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation in the above proceeding.

Thank you.

Very Truly Yours,

J. Scott Hall

JSH/ao

Enclosure(s)- as stated

Cc: Lori Wrotenbery (w/o enclosures)
Marilyn Hebert (w/o enclosures)
Michael Condon (w/o enclosures)

6304/20253/Bailey&Leeltr4.doc

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

De Novo
CASE NO. 11996

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, LP AND EDWARDS ENERGY, INC., TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO.

PENDRAGON'S
CLOSING STATEMENT MEMORANDUM

Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation, (together, "Pendragon"), offer this memorandum for its brief closing statement in this proceeding.

Statement of the Case

Pendragon, the owner and operator of the six Chaco Pictured Cliffs wells, on the one hand, and Whiting Petroleum, the owner and operator of the five Fruitland Coal gas wells, on the other, each contend that the other's well stimulation treatments caused their separately owned formations to become communicated. Both sides contend that their wells are experiencing interference and that gas is being produced out of zone as a result. In addition, Whiting asserts that the upper sandstone interval that was perforated in four of the Chaco wells is a non-marine Fruitland sand, while Pendragon contends that same interval is a marine Pictured Cliffs sand.

flat, stable base and a source of sand with consistent grain size spread by tidal or wave energy. These are marine conditions that do not occur onshore and behind the shoreline.

Whiting contended that the disputed interval is a Fruitland sand deposited in an inland-terrestrial or fluvial-type environment. Whiting's consulting geologist offered varying theories to support his conclusion, arguing that the sand was the product of a crevasse splay deposit, or alternatively, the product of a wash-over fan mechanism. However, Whiting's geologist produced no evidence indicating the existence of the very huge river that would have necessarily been at work to deposit the observed sand over several townships in such a crevasse splay. Further, the geologist's alternative "non-marine" wash-over fan theory is inconsistent with the accepted definitions of such a depositional environment. A wash-over fan mechanism includes oceanfront, storm and wave dominated action, all of which are consistent with a marine environment.

Whiting's geologist, without explanation, also excluded lagoons such as exist behind the Padre Island chain from consideration as marine. Yet, such bodies of water are created and are directly influenced by the sea, and as such are within the geologically accepted definition of a marine environment. Pendragon showed that sands in these areas are wave and tidal current dominated deposits.

Pendragon showed that the Spontaneous Potential (SP) readings for both the main body and Upper Pictured Cliffs tongues appearing on electrical logs from wells in the subject area exhibit a higher (40 to 80 millivolt) response, consistent with readings for

sands that have been deposited in a more conductive saline marine environment. Whiting's consulting geologist produced an SP isopach and well log exhibits showing the SP response in Fruitland sands were consistently in the zero to less than 10 millivolt range, as would be expected for non-marine depositions. Tellingly, however, the Whiting exhibits showed the SP responses in the disputed interval were consistently in the 40 to 80 millivolt range. By Whiting's own exhibits, the disputed interval is shown to be marine in origin.

A significant body of geological literature has labeled the tongues in the subject area as the "Upper Pictured Cliffs" sandstone, recognizing their origins in a marine depositional environment.[1] Moreover, this technical interpretation of the disputed interval as Pictured Cliffs sandstone is accepted by the larger body of experts in the field of geology and conforms to definitional standards set forth in the North American Stratigraphic Code and the International Stratigraphic Guide.[2] Perhaps even more significantly, numerous operators in the area have completed producing wells in these tongues. For decades, those operators have identified the top of the Upper Pictured Cliffs sandstone interval as the top of the vertical boundary for the Pictured Cliffs formation and have reported their completions accordingly. For nearly thirty years now, the Division, the BLM and the BIA have accepted and relied on this interpretation as the pick

[1] In 1994, Whiting's geologist published a type log reflecting a tongue of the Pictured Cliffs occurring within the Fruitland formation above the so-called "massive" sand of the main body of the Pictured Cliffs. The author referred to the tongue as UP1 which explained stood for "upper Pictured Cliffs sandstones or upper Pictured Cliffs tongues."

[2] As explained in Dynacon, Inc. v. D&S Contracting, Inc., 120 N.M. 170, 177, 899 P.2d 613, 620 (Ct.App. 1995), when an adjudicatory body's analysis involves the interpretation of technical language it "can and should be informed by evidence concerning how those technical terms are interpreted by experts in the pertinent field."

for the top of the Pictured Cliffs formation. By long standing custom and practice, industry has similarly relied on this interpretation, accepting and adopting the interpretation in numerous assignments, transfers and farm-outs.

Whiting now says all those operators were wrong.

By its pleadings and testimony, Whiting requests the Commission to adopt a new definition for the boundary of the Fruitland formation. Whiting asks the Commission to re-establish the base of the Fruitland formation at the top of the "massive" sandstone below the lowermost continuous coal. Yet, the term "massive" is undefined and its use is at odds with industry custom and practice. The implications of what Whiting is asking the Commission to do is far-reaching. It is without question that the arbitrary reclassification of an accepted Pictured Cliffs sandstone tongue as Fruitland will disrupt the property and economic interests of scores of operators throughout the San Juan Basin. The regulatory implications of Whiting's request will be no less significant. Moreover, the reclassification of the formation also undermines a number of the findings and assumptions under Order No. R-8768, making that order's application and operation uncertain in a number of respects. In that sense, then, Whiting's request is tantamount to an impermissible collateral attack on the Division's earlier order.

Whiting's request should be denied. Instead, the Commission should base its decision on the preponderance of the geologic evidence that supports a finding that the disputed interval is a Pictured Cliffs sand deposited in a marine environment.

Additionally, the Commission should accord significant weight to the established and accepted custom and practice of industry and governmental agencies which have identified and utilized the Upper Pictured Cliffs sandstone to establish the vertical boundaries of the Pictured Cliffs formation in the area. The adoption and incorporation of such an established practice offers an effective solution that preserves the stability and predictability vested property rights. Moreover, there is adequate support in the authorities for the application of practical definitions relied on by industry. See Amoco Production Company v. Southern Ute Indian Tribe, 119 S. Ct. 1719 (1999); and Silver Surprize, Inc. v. Sunshine Mining Co., 547 P.2d 1240 (Wash. App. 1976).

The Fruitland Coal and Pictured Cliffs Formations Are in Communication

Whiting has argued that the Pictured Cliffs reservoir in the subject area was depleted by the time Pendragon restimulated the Chaco wells in 1995. Consequently, Whiting contended that the post-stimulation treatment production increased experienced by the Chaco wells was attributable to production from the Fruitland Coal formation as a result of the communication between zones. However, Pendragon presented material balance and gas in place analysis data showing sufficient reserves in the Pictured Cliffs formation to support the historic and projected production from the Chaco wells. In addition, Pendragon established through a preponderance of the evidence that the pre-stimulation production rates exhibited by the Chaco wells was attributable to well and reservoir damage caused by scale precipitation, water blockage and migration of clay fines. Once the well and reservoir damage was overcome by the stimulation treatments,

the production from the Chaco wells was restored to commercial rates, although the restored production did not match the IP's for the wells.

In furtherance of its theory that the Pictured Cliffs was a depleted reservoir, Whiting argued that post-stimulation pressures in the Pictured Cliffs were higher than can be expected from a depleted reservoir and were caused by communication with the coal. However, Whiting presented no evidence to show why the Chaco well pressures were not the same as the pressure in the coal at the time. Moreover, Whiting was unable to explain why the pressures seen the Chaco wells prior to the fracture stimulations did not model coal pressures at the time.

The original reservoir pressures in the Pictured Cliffs in the late 1970's were approximately 230 psi. By 1995, reservoir pressures ranged from between approximately 150 to 170 psi, or higher. In 1995, post-fracture stimulation pressures were 170 lbs. in the Chaco No. 1, 151 to 153 lbs. in the Chaco No. 4 and No. 5 wells and in July, 1996, 150 lbs. in the Chaco 2-R well. During the same period of time, pressures in the Fruitland Coal formation measured in the Gallegos Federal Coal wells were approximately 220 lbs. Correspondingly, there is no evidence that the pressures exhibited in the Chaco wells increased to Fruitland Coal formation pressures during this period.

At approximately 150 psi, the 1995 Pictured Cliffs reservoir pressures in the area were approximately 62 percent of original pressures, indicating that the reservoir is only

partially depleted. In addition, volumetrics and material balance data presented by Pendragon establish that the Pictured Cliffs reservoir has significant additional reserves remaining to be produced. Whiting, of course, reached the opposed conclusion. However, at the hearing, it was established that Whiting's engineering witnesses did not utilize accurate reservoir clay thicknesses and failed to take into account all the reserves available in the main and lower benches of the Pictured Cliffs formation, despite the fact that Whiting's own witness acknowledged that the lower bench contained 30 percent gas saturation.

The volumetric and material balance analyses for the five subject Fruitland Coal wells establishes that the basal coal contains an average of 1,262,661 MCF for each of the 320 acre spacing units. Although they are relatively early in their productive lives, the coal wells have produced an average of 54.1 percent of the original gas in place. This evidence shows that the coal wells are producing much more gas than can be calculated to exist on each of their 320 acre spacing units. Moreover, a well performance and decline curve analysis demonstrates that Whiting's wells are draining 545 acres on average. The wells have produced and are expected to produce much more gas than can be accounted for from the Fruitland Coal formation on 320 acre spacing. The performance of the subject coal wells and subsequent gas recoveries indicate that the Chaco wells are not producing Fruitland Coal gas reserves and are not interfering with the Gallegos Federal wells.

The data collected subsequent to the June 30, 1998 shut-in of the Chaco wells is more instructive on the issue of communication between the formations. These data establish that the Chaco 1-J, 2-J and 2-R wells are not responding to continuing production from Whiting's Gallegos' Federal Coal wells. Conversely, the Chaco No. 1, Chaco No. 4 and Chaco No. 5 wells all exhibited pressure decreases from approximately 14 to 19 psig. The measured shut-in pressures in the Pictured Cliffs showed no evidence of equilibration with the average reservoir pressure in the Fruitland Coal formation. In several instances, where the entire field was shut-in, the coal wells had pressures within a few days of shut-in which were higher than those of the nearby Chaco wells which had been shut-in for weeks or months. This could not occur if the Chaco wells were completed in or producing from the coal.

Pendragon presented data and interpretation of the pressure transients that were observed in the Chaco wells when the field experienced system-wide gathering system shut-downs. Pressure transients were observed in the Chaco No. 4 and No. 5 wells within one to two days after the Fruitland wells were shut it. The observed time of a response is a consequence of the different permeabilies, thickness and compressibilities in the Pictured Cliffs and Fruitland Coal formations. From this analysis and the pressure interference responses observed, there is a reasonable basis for the Commission to conclude that the relatively rapid responses were a result a pressure transient moving through the high permeability and lower compressibility conditions existing in the thin upper Pictured Cliffs formation. This evidence supports the conclusion that the pressure interference is moving from a location in very close proximity to the coal bed methane

wells through the Pictured Cliffs formation to reach the Chaco wells. The pressure response transients were most readily observed in the Chaco No. 4, Chaco No. 5 wells, and the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and the 26-13-12 No. 1 wells. Accordingly, this shut-in and pressure interference evidence establishes that the Whiting/Gallegos Federal 26-12-6 No. 2 and the 26-12-7 No. 1 wells are in direct communication with the Pictured Cliffs formation. The pressure interference formation also establishes that it is possible that the 26-13-12 No. 1 well may be directly connected to the Pictured Cliffs.

The Cause of the Communication

That the Fruitland Coal and Pictured Cliffs formations are in communication is now established fact. It is equally well-established that the communication between zones was caused by the aggressive, high-pressure, high-volume and high-injection rate fracture stimulation treatments that were applied to the Gallegos Federal Fruitland coal wells in 1993. Indeed, Whiting's own in-house production manager and its consulting engineering witnesses both stated in their pre-filed testimony that the relatively heavy stimulation treatments initiated in the Fruitland coal caused fractures to grow down into the Pictured Cliffs formation. (See excerpts from the testimony of James T. Brown and Bradley D. Robinson, Exhibits A and B, attached.) In fact, the testimony established that Maralex purposefully stepped-up the sand and fluid volumes and injection rates to overcome the reduced viscosity caused by the elimination of certain surfactants from its fracture fluids.

On the other hand, the preponderance of evidence established that the acid jobs and the relatively light fracture treatments on the Chaco wells remain contained within the Pictured Cliffs sandstone intervals.

Pendragon showed that hydraulic fractures can be designed with fracturing fluids and pumping programs to control or prevent breaching into bounding formations. Pendragon presented evidence showing that fractures can be contained if the bounding reservoir rock above and below the pay interval is stronger or has higher in-situ stresses or if the interface between the two rocks can slip and absorb the energy of the fracture extension. As the evidence demonstrated, the treating volumes and injection rates utilized by Pendragon did not generate the pressures necessary to overcome the stress contrast between the brittle, lower-pressured coal and the more ductile, higher-pressured coal. The efficacy of designs such as used by Pendragon on its 4 Chaco wells was corroborated by tracer survey evidence showing that similar hydraulic fracture treatments initiated in the Pictured Cliffs remained contained within the formation. Whiting offered no similar countervailing evidence.

The evidence did not support Whiting's assertions that the acid treatments on two of the Chaco wells caused communication with the coal. Moreover, Maralex's president testified that even if the acid had come into contact with the coal, it would not have stimulated production of coalbed methane.

Significantly, however, the evidence and testimony established that it is likely that the fractures that grew downward from the coal into the Pictured Cliffs experienced the settlement of proppant into the bottom of those fractures, thus maintaining an effective conduit for the communication of Pictured Cliffs gas reserves into the Fruitland coal. It is less likely that any upward growing fractures would have been similarly propped open.

That the communication between the formations was caused by the fracture stimulation treatments on the Gallegos Federal Coal wells is supported by a preponderance of the evidence.

The Effect of the Communication

The evidence establishes that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly connected to the Pictured Cliffs formation in or very near that wellbore. The evidence further establishes that it is more probable than not that the Gallegos Federal 26-12-7 No. 1 and the 26-13-12 No. 1 wells are directly communicated to the Pictured Cliffs formation. The evidence presented by Pendragon shows that the Chaco No. 4 and Chaco No. 5 wells are unquestionably experiencing production and pressure interference. Significantly, in every instance where the Gallegos Federal 26-12-6 No. 2 well was shut-in for more than one day, between July and December of 1998, a pressure increase was observed in the Chaco No. 4 and Chaco No. 5 wells. In addition, at the time of the hearing in this matter, the 26-12-6 No. 2 well had not reached its peak gas production rate, yet the well had already produced 83 percent of the calculated OGIP in the Fruitland Coal underlying the 320 acre spacing unit. Data extrapolated from current production rates and material balance indicate the well may ultimately recover two to

four times as much gas as it has already produced. The 26-12-7 No. 1 well has similarly caused a pressure increase to be observed in the Chaco No. 4 and No. 5 wells each time that coal well has been shut-in. This well, too, has produced 83 percent of the OGIP and shows a current gas flow capacity that is almost three times the initial water flow capacity.

In addition to the 26-12-6 No. 2 and the 26-12-7 No. 1, it appears that the Gallegos Federal 26-13-12 No. 1 coal well may be directly connected to the Pictured Cliffs formation. All three of these wells are causing production and pressure interference to the Chaco No. 4 and Chaco No. 5 wells. It also appears that the Chaco No. 1 well is experiencing some pressure and production interference from other Pictured Cliffs wells as well as from indirect communication by the Fruitland Coal wells to the Pictured Cliffs formation.

During the yearlong shut-in, the Chaco No. 1, Chaco No. 4 and Chaco No. 5 wells all exhibited a decrease in pressure. The pressure losses in these wells were determined to be from approximately 14 to 19 psig. Pendragon's evidence with respect to the P/Z versus cumulative production for the Chaco No. 1, No. 4 and No. 5 wells establish the volumes of gas that would need to be produced in order to lower the pressures between 14 and 19 psig over the yearlong period. At a minimum, the Chaco No. 1 lost 19 psig with a resulting loss of reserves of 60,500 MCF. The Chaco No. 4 experienced a 15 psig loss in pressure, resulting in a loss of reserves of 63,500 MCF. The Chaco No. 5 experienced a 14 psig pressure loss, resulting in a loss of reserves of 52,900 MCF. The

total lost reserves for all three of the wells for the period from June 30, 1998 to June 30, 1999 was approximately 176,900 MCF. The engineering evidence presented inequitably establishes that the Chaco No. 1, No. 4 and No. 5 wells have experienced drainage by the Gallegos Federal Fruitland Coal wells as well as a loss of reservoir energy in the Pictured Cliffs. As a further consequence of the communication, volumes of water have been injected into the Pictured Cliffs from the Fruitland Coal formation, causing the additional dissipation of reservoir energy and the waste of Pictured Cliffs' gas reserves.

Conclusion

By a preponderance of the evidence, Pendragon has proved that:

(1) The disputed interval is a Pictured Cliffs sandstone tongue deposited in a marine environment;

(2) The Chaco wells were properly completed in and have produced from the Pictured Cliffs formation;

(3) The Pictured Cliffs formation in the subject area is not a depleted reservoir;

(4) The 1995 acid and fracture stimulation treatments on the Chaco wells did not cause the Pictured Cliffs and Fruitland Coal formations to become communicated; and

(5) Production by the Chaco wells did not result in interference with Whiting's Gallegos Federal Fruitland Coal wells.

Pendragon's evidence shows, further, that:

(1) The hydraulic fracture stimulation treatments performed on two or more of the Whiting Gallegos Federal Coal wells in 1993 created fractures that grew downward into the Pictured Cliffs formation;

(2) The Fruitland Coal and Pictured Cliffs formations became communicated as a result;

(3) The Chaco No. 4, No. 5 and No. 1 wells experienced production and pressure interference by two or more of the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and the 26-13-12 No. 1 wells;

(4) Two or more of the referenced Gallegos Federal coal wells have produced some 176,900 Mcf of gas reserves from the Pictured Cliffs from the period between June 30, 1998 and June 30, 1999 and continue to produce additional Pictured Cliffs volumes today.

At the same time, Whiting's evidence failed to establish that the disputed sandstone interval originated in a non-marine depositional environment. Whiting also failed to demonstrate that it drilled, completed and operated its Gallegos Federal wells in a manner that would maintain the segregation of production between zones.

In order to halt the further drainage and waste of Pictured Cliffs gas by the Gallegos Federal wells and to bring Whiting's wells back into regulatory compliance, it is appropriate for the Commission to authorize that all of the Chaco wells be immediately restored to production while the Gallegos Federal 26-12-6 No. 2, the 26-13-12 No. 1 and the 26-12-7 No. 1 are immediately shut-in.

Restoration of the Chaco wells will allow Pendragon to determine whether any of the wells have been lost and to quantify lost reserves. Restoration will also allow those wells that are capable of production to re-establish a steady state of decline that will enable the parties and the Commission to determine the curtailed production rates the Fruitland Coal wells can be restored to in order to equalize drainage areas and minimize or eliminate future production out of zone. If it proves infeasible to simultaneously produce both the Chaco and Gallegos Federal wells without further interference, then

Whiting should be required to either recomplete the three offending coal wells or permanently shut them in.

Respectfully submitted,

MILLER, STRATVERT & TORGERSON, P.A.

By _____

J. Scott Hall, Esq.
Post Office Box 1986
Santa Fe, New Mexico 87504
(505) 989-9614

ATTORNEYS FOR PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, L.P. AND EDWARDS ENERGY CORPORATION

CERTIFICATE OF SERVICE

I hereby certify that I have caused a true and correct copy of the foregoing to be forwarded on this 24 day of November, 1999 to the following:

Marylyn Hebert, Esq.
New Mexico Oil Conservation Commission
2040 South Pacheco
Santa Fe, New Mexico 87505

J.E. Gallegos, Esq. and
Michael Condon, Esq.
Gallegos Law Firm, P.C.
460 St. Michael's Drive, Bldg. 300
Santa Fe, New Mexico 87505

J. Scott Hall

6304/20253/memobrief.doc

STATE OF NEW MEXICO
ENERGY MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

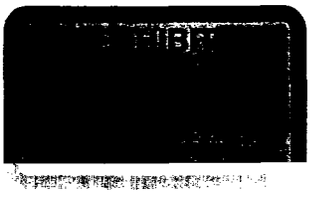
APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, L.P., AND J.K EDWARDS ASSOCIATES, INC. TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO

OCD CASE NO. 11996

PRE-FILED EXPERT TESTIMONY OF JAMES T. BROWN IN BEHALF OF WHITING PETROLEUM COMPANY AND MARALEX RESOURCES INC.

GALLEGOS LAW FIRM, P.C.
J. E. GALLEGOS
MICHAEL J. CONDON
460 St. Michaels Drive, Sutie 300
Santa Fe, New Mexico 87505

July 26, 1999



operator at that time was to plug and abandon. The prior owners, both Bob Bayless and Merrion Oil and Gas, are long-time, knowledgeable and well qualified operators in the San Juan Basin, so they offered the properties for sale at auction.

B. The fracture stimulations performed in 1995 on the Chaco wells Nos. 1, 2R, 4 and 5 established communication with the coals and resulted in large volumes of coalbed methane being produced from three of those Chaco wells until shut-in by Court order in July 1998. The acidization in 1995 by Pendragon/Edwards on the Chaco Ltd. 1J and 2J has resulted in communication with the coals as reflected by shut-in pressure data, but has not resulted in significant volume of coal bed methane being produced from those wells.

C. The fracture stimulation of the Whiting Federal wells when they were completed in 1993 may have resulted in fractures extending into the Pictured Cliffs formation but, if so, those fractures were ineffective and did not cause the gas from the Fruitland Coal formation to be produced from any of the Chaco wells.

V. BASIS FOR OPINIONS

The reasons and basis of my opinions can be demonstrated by a series of exhibits I have prepared. All of the exhibits I will refer to were prepared by me and utilize the data sources that I described earlier in my testimony.

A starting point is to observe the combined production and wellhead shut-in pressures (WHSIP) over time for this group of Pictured Cliffs wells under investigation.

PREPARED DIRECT TESTIMONY OF

BRADLEY M. ROBINSON

NMOCC CASE NO. 11996

I. QUALIFICATIONS

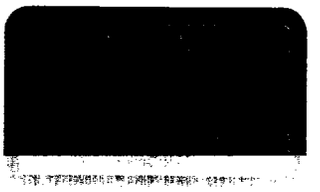
I am Bradley M. Robinson, College Station, Texas. I am currently employed by Holditch-Reservoir Technologies. My title is Principal Consultant – Well Stimulation.

I graduated in 1977 from Texas A&M University with a bachelor's of science degree in petroleum engineering. I went to work for two years for Marathon Oil Company in west Texas. In the latter part of 1979, I went to work for S.A. Holditch and Associates, Inc. While employed by Holditch and Associates, I went back to school on a part-time basis and received my master of science degree in petroleum engineering from Texas A & M in May 1986. A copy of my resumé is attached to this testimony.

Since I have been employed by Holditch I have primarily dealt with the completion, evaluation and stimulation of unconventional reservoirs: tight-gas sands, Devonian shales, fractured shales and coalbed methane reservoirs. I have been involved in numerous projects for the Gas Research Institute over the past 10 to 12 years regarding unconventional gas reservoirs.

I have authored and co-authored numerous articles addressing hydraulic fracturing and relation subjects on well stimulations.

I teach courses in hydraulic fracture stimulation, well completions and reservoir engineering. I have taught courses to the major service companies and stimulation to numerous large oil companies including the national oil companies of Venezuela, Mexico and Colombia, as well as numerous independents. I have testified as an expert



in the 6-2 well, the top of the Pictured Cliffs is at a depth of approximately 1,170 ft. These results show that the fracture likely grew downward into the Pictured Cliffs formation.

In order to analyze the 6-2 well, it was necessary to model multiple hydraulic fractures in the Fruitland Coal. The creation of multiple fractures within a coal seam is very common due to the complex fracture geometry that can result. However, because of this complex geometry in coalbeds, we have less confidence in the final estimated fracture dimensions. Even so, it is my opinion that the fracture likely grew into the Pictured Cliffs formation.

IV. FRACTURE WIDTHS

A fracture that extends through both the Fruitland Coal and Pictured Cliffs formations will have substantially different fracture widths in each zone due to the large difference in Young's modulus between the two formations.

Coal seams are relatively soft formations with a Young's modulus ranging from 100,000 psi to 1,000,000 psi. Sandstones, on the other hand, are much harder rocks with a Young's modulus ranging from 2,000,000 psi up to 8,000,000 psi. It is expected that the contrast in Young's modulus between the Pictured Cliffs formation and the Fruitland Coal is at least a factor of 10. Such a large contrast will mean that the fracture width in the coal seam will be at least two times the fracture width in the Pictured Cliffs assuming only a single fracture exists. The relative difference in propped width is illustrated in exhibit BR-13. If more than one fracture exists, which is probably the case in the 6-2 well, then the cumulative widths in the coal will be significantly greater than the Pictured Cliffs. The effect of multiple fractures is illustrated in Exhibit BR-14.

All these results prove that the Chaco wells have been producing Fruitland Coal gas since their fracture stimulation in 1995. A summary of these results is as follows:

- Analysis of fracture stimulation treatments on the indicated Chaco wells show that the fractures grew vertically up through the Fruitland Coal from the Pictured Cliffs;
- The post-fracture production increased an abnormally large amount;
- The pressure in the Chaco wells increased after fracture stimulation to the same level as the Fruitland Coal; and
- The post-fracture production is almost identical to Fruitland Coal wells in the area including the production of water which was not reported, but has been observed from each of these wells.

Even though we believe that hydraulic fracturing the Whiting Fruitland Coal wells has created a fracture that extended down into the Pictured Cliffs, it is probable that the Whiting wells have not produced Pictured Cliffs gas since the formation was essentially depleted at the point when Whiting completed their wells. If anything, there could have been a small amount of water cross-flowing, initially from the Fruitland Coal into the Pictured Cliffs during the early stages of de-watering the coal. This is the point in time when the pressure differential between the Fruitland Coal and the depleted Pictured Cliffs would have been greatest. However, it is doubtful that much water actually cross-flowed into the upper portion of the Pictured Cliffs since this interval was primarily gas saturated and would have relatively low permeability to water.

VI. CAUSATION OF CROSS FLOW

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

De Novo
CASE NO. 11996
Order No. R-11133

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, LP AND EDWARDS ENERGY, INC., TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION
(Pendragon's Draft)

BY THE COMMISSION:

This case came on for hearing at 9:00 a.m. on August 12-21, 1998, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission".

NOW, on this ___ day of _____, 1999, the Commission, a quorum being present, and having considered the record,

FINDS THAT:

(1) Due public notice has been given and the Commission has jurisdiction of this case and its subject matter.

(2) The applicants, Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation (collectively "Pendragon"), pursuant to Rule (3) of the Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool set forth in Division Order No. R-8768, as amended, seek an order, *inter alia,* confirming that the following described wells, completed within the vertical limits of the WAW Fruitland Sand-Pictured Cliffs Gas Pool or the Basin-Fruitland Coal Gas Pool, are producing from the appropriate common source of supply and providing further relief as the Commission deems necessary:

WAW Fruitland Sand-Pictured Cliffs Gas Pool Producing Wells

Operator	Well Name & API Number	Well Location
Pendragon Energy Partners, Inc.	Chaco No. 1 (API No. 30-045-22309)	1846' FNL & 1806' FWL, Unit F, Section 18, T-26N, R-12W
Pendragon Energy Partners, Inc.	Chaco No. 2R (API No. 30-045-23691)	1850' FSL & 1850' FWL, Unit K, Section 7, T-26N, R-12W
Pendragon Energy Partners, Inc.	Chaco No. 4 (API No. 30-045-22410)	790' FNL & 790' FWL, Unit D, Section 7, T-26N, R-12W
Pendragon Energy Partners, Inc.	Chaco No. 5 (API No. 30-045-22411)	790' FSL & 790' FEL, Unit P, Section 1, T-26N, R-13W
Pendragon Energy Partners, Inc.	Chaco Limited No. 1J (API No. 30-045-25134)	1850' FSL & 1750' FWL, Unit K, Section 1, T-26N, R-13W
Pendragon Energy Partners, Inc.	Chaco Limited No. 2J (API No. 30-045-23593)	790' FNL & 1850' FEL, Unit B, Section 1, T-26N, R-13W

Basin-Fruitland Coal Gas Pool Producing Wells

Operator	Well Name & API Number	Well Location
Whiting Petroleum Corp.	Gallegos Fed 26-12-6 No. 2 (API No. 30-045-28898)	886' FSL & 1457' FWL, Unit N, Section 6, T-26N, R-12W
Whiting Petroleum Corp.	Gallegos Fed. 26-12-7 No. 1 (API No. 30-045-28899)	2482' FSL & 1413' FWL, Unit K, Section 7, T-26N, R-12W
Whiting Petroleum Corp.	Gallegos Fed. 26-13-1 No. 1 (API No. 30-045-28881)	828' FNL & 1674' FEL, Unit B, Section 1, T-26N, R-13W
Whiting Petroleum Corp.	Gallegos Fed. 26-13-1 No. 2 (API No. 30-045-28882)	1275' FSL & 1823' FWL, Unit N, Section 1, T-26N, R-13W
Whiting Petroleum Corp.	Gallegos Fed. 26-13-12 No. 1 (API No. 30-045-28903)	1719' FNL & 1021' FEL, Unit H, Section 12, T-26N, R-13W

(3) Whiting Petroleum Corporation, and Maralex Resources, Inc. (Collectively "Whiting") the owners and operators of the subject Fruitland Coal Gas wells on the one hand, and Pendragon Energy Partners, Inc., the owner and operator of the subject Pictured Cliffs wells on the other, each contend that the other's well stimulation treatments caused their separately owned formations to become communicated. Both sides contend that their wells are experiencing interference and that gas is being produced out of zone as a result.

(4) On January 3, 1998, Whiting Petroleum Corporation and Maralex Resources, Inc. filed an application with the New Mexico Oil Conservation Division in Case Number 11921, followed subsequently on February 10, 1998 with an Amended Application seeking an order shutting-in certain wells in San Juan County. The Whiting/Maralex application identified five Fruitland Coal gas wells that Whiting and Maralex contended were encountering interference from six of Pendragon's Pictured Cliffs wells and two Pictured Cliffs wells owned by Coleman Oil and Gas Company. In their application, Whiting and Maralex contended that the drilling or fracture stimulation or restimulation of the Pictured Cliffs wells resulted in ~~production~~ increases from the Pictured Cliffs wells with simultaneous production declines in their nearby Fruitland Coal wells.

(5) The Maralex application cited to the NMOCD's statutory authority to prevent the escape of natural gas from strata in which it is found into other strata and the requirement that wells be drilled, operated and produced in such a manner as to prevent injury to neighboring leases or properties and to fix the spacing of wells (Section 70-2-12(B)(2)(7) and (10) 1995 Repl. Pamp.) The application further referred to the Division's authority to require the operators to submit data demonstrating that a well is producing from the appropriate common source of supply pursuant to Order No. R-8678 and Special Rules 2 and 3, thereunder.

(6) On May 26, 1998, Whiting and Maralex requested that their applications in Case Number 11921 be withdrawn and that the case dismissed. By order dated August 6, 1998, the case was dismissed by the Division. Also on May 26, 1998, Whiting and Maralex filed an action against Pendragon in the First Judicial District Court, Santa Fe County, New Mexico. In that same proceeding, Whiting and Maralex also filed an application for preliminary injunction, shutting-in Pendragon's Chaco Pictured Cliffs wells. On May 26, 1998, Pendragon filed its initial application in this case with the Division.

(7) Pursuant to a hearing convened in the District Court proceeding on June 29, 1998, the Court issued its Preliminary Injunction ordering the shut-in of the Chaco 1, Chaco 2-R, Chaco 4 and Chaco 5. Pendragon was not afforded the opportunity to present evidence at the hearing. The Court's order on the Preliminary Injunction was issued on July 7, 1998, and was based solely on the evidence presented by Whiting and Maralex.

(8) On July 6, 1998, pursuant to a hearing on Whiting's Motion for an Order Enjoining Defendants from Prosecuting an Administrative Proceeding, the District Court denied the Motion and determined that it would defer jurisdiction over this case to the New Mexico Oil Conservation Division. Subsequently, by memorandum decision dated October 30, 1998, the District Court granted Pendragon's motion for a stay of discovery in the District Court proceeding, pending consideration of this case by the Division and subsequently the Commission.

(9) On July 28 through 30, 1998, a hearing was held before the Division in Santa Fe and on February 5, 1999, Division Order No. R-11133 was issued. On separate applications of both Whiting/Maralex and Pendragon on February 23, 1999 and February 18, 1999, respectively, this case was heard *de novo* on August 12-21, 1999. The parties also filed comprehensive expert testimony and exhibits before the *de novo* hearing.

(10) T. H. McElvain Oil and Gas Limited Partnership, ("McElvain"), entered its appearance as a party of record in the proceeding before the Division, but it did not file an Application for Hearing *De Novo*. McElvain did not appear or otherwise participate in the De Novo proceeding.

(11) On four occasions, through separate motions to the District Court and the Division and Commission, Whiting and Maralex sought to enjoin or otherwise prevent this administrative proceeding from going forward. Each of those motions was denied. The parties were allowed the opportunity to conduct pre-hearing discovery and were otherwise afforded a full and fair hearing before the Commission.

(12) In connection with its application, Pendragon appeared and presented testimony and evidence supporting its contentions that:

(a) Pendragon's wells were completed in and are producing the appropriate common sources of supply, specifically the Pictured Cliffs interval of the WAW Fruitland Sand Pictured Cliffs Pool.

(b) Pendragon's Chaco No. 1, Chaco No. 4 and Chaco No. 5 wells are experiencing substantial interference from production by the Whiting Gallegos Federal 26-12-6 No.2, 26-12-7 No.1, and 26-13-12 No. 1 wells. These Fruitland Coal wells have drained substantial reserves from the Pictured Cliffs formation owned by Pendragon, and the drainage is on-going.

(c) The Fruitland Coal formation became communicated with the Pictured Cliffs formation as a result of the high volume, high pressure and high injection rate fracture stimulation treatments performed on the Gallegos Federal wells by Maralex Resources, Inc.

(d) The acid and hydraulic fracture stimulation treatments performed on the Pendragon Chaco wells in 1995 remained contained within the Pictured Cliffs formation and did not result in the communication with the Fruitland Coal formation.

(13) In addition, Pendragon requested the Commission to exercise its authority under the provisions of Order No. R-8768 to determine if the subject Pictured Cliffs wells and Basin Fruitland Coal wells are producing from their appropriate common source of supply. In order to make such a determination, Order No. R-8768 provides that the Division or Commission may take into consideration the following matters, among others: log data, completion data, gas analysis, water analysis, reservoir performance, and "other evidence which may be utilized in making such determination." Pendragon also requested the Commission to afford such relief as necessary to bring the wells into compliance with the Division's rules, regulations and orders.

(14) Whiting Petroleum Corporation and Maralex Resources, Inc., (collectively "Whiting"), interest owners within the Gallegos Federal 26-12-6 No. 2, 26-12-7 No. 1, 26-13-1 No. 1, 26-13-1 No. 2 and 26-13-12 No. 1, appeared at the hearing in opposition to the application and to present evidence and testimony to support their position that the Pendragon Chaco wells, described in Finding No. (2) above, are producing:

a) from a sandstone interval located within the Fruitland formation; and
b) coal gas from the Basin-Fruitland Coal Gas Pool due to the establishment of communication between the Basin-Fruitland Coal and WAW Fruitland Sand-Pictured Cliffs Gas Pools within the Pendragon Chaco wellbores.

(15) In the Pre-Hearing Statement it filed in this case, citing to Order No.s R-8768 and R-8768-A, Whiting specifically requested that the Commission establish the base of the Fruitland formation in the area in question at the top of the "massive" sandstone below the lower most continuous coal in the area.

(16) All eleven wells that are the subject of this application are located within an area (hereinafter referred to as the "subject area") that comprises:

TOWNSHIP 26 NORTH, RANGE 12 WEST, NMPM
Section 6: W/2
Section 7: W/2
Section 18: NW/4

TOWNSHIP 26 NORTH, RANGE 13 WEST, NMPM,
Section 1: All
Section 12: N/2

(17) The "subject area" is located within the horizontal boundaries of the Basin-Fruitland Coal Gas Pool created by Division Order No. R-8768 dated October 17, 1988. The vertical limits of this pool, as defined by Ordering Paragraph (1) of Order No. R-8768, are as follows:

> "all coal seams within the equivalent of the stratigraphic interval from a depth of approximately 2,450 feet to 2,880 feet as shown on the Gamma Ray/Bulk Density log from Amoco Production Company's Schneider Gas Com "B" Well No. 1 located 1110 feet from the South line and 1185 feet from the West line of Section 28, Township 32 North, Range 10 West, NMPM, San Juan County, New Mexico".

(18) Order No. R-8768 further establishes Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool including provisions for standard 320-acre gas spacing and proration units with wells to be located no closer than 790 feet from the outer boundary of the proration unit nor closer than 130 feet from any quarter section line nor closer than 10 feet from any quarter-quarter section line or subdivision inner boundary. In addition, wells are to be located in the NE/4 or SW/4 of a single governmental section.

(19) The "subject area" is also located within the horizontal boundaries of the WAW Fruitland Sand-Pictured Cliffs Gas Pool. The vertical limits of this pool comprise all of the Pictured Cliffs formation (Order No. R-4260 dated February 22, 1972) and all the sandstone intervals of the Fruitland formation (Order No. R-8769 dated October 17, 1988). At the time the Chaco wells were drilled, the WAW Fruitland Sand-Pictured Cliffs Gas Pool was governed by Division Rule 104.C., which required standard 160-acre gas spacing and proration units with wells to be located no closer than 790 feet from the outer boundary of the spacing unit nor closer than 130 feet from any quarter-quarter section line or subdivision inner boundary.

(20) The evidence and testimony presented by both parties in this case is generally in agreement that Pendragon and Whiting received assignments of oil and gas leases in all or portions of the "subject area" from common grantors, Robert Bayless (Bayless) and Merrion Oil and Gas Corporation (Merrion), during the period from 1992-94. The assignments of rights to Whiting are as follows:

> "Operating rights from the surface of the earth to the base of the Fruitland (Coal gas) Formation subject to the terms and provisions of that certain Farmout Agreement, dated December 7, 1992 by and between Merrion Oil & Gas et al., Robert L. Bayless, Pitco Production Company, and Maralex Resources, Inc."

(21) The assignment of rights to Pendragon is as follows:

"Leases and lands from the base of the Fruitland Coal formation to the base of the Pictured Cliffs formation."

(22) A brief history of the Pendragon wells, obtained from the evidence and Division records, is described as follows:

a) the Chaco Well No. 1 was drilled by Merrion and Bayless in February, 1977 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,113' to 1,139'. The well initially tested in this interval at a rate of approximately 342 MCFGD, 0 BOPD and 0 BWPD. In January, 1995, J. K. Edwards & Associates, Inc. (Edwards) became operator of the well. In January, 1995, the well was fracture stimulated in the perforated interval. In January, 1996, Pendragon became operator of the well;

b) the Chaco Well No. 2-R was drilled by Merrion and Bayless in October, 1979 to test the Pictured Cliffs formation. ~~The~~ well was perforated and completed in the Pictured Cliffs formation from a depth of 1,132' to 1,142'. The well initially tested in this interval at a rate of approximately 150 MCFGD, 0 BOPD and 0 BWPD. In January, 1995, Edwards became operator of the well. In January, 1995, the well was fracture stimulated in the perforated interval. In January, 1996, Pendragon became operator of the well;

c) the Chaco Well No. 4 was drilled by Merrion and Bayless in April, 1977 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,163' to 1,189'. The well was initially tested in this interval at a rate of approximately 480 MCFGD, 0 BOPD, and 0 BWPD. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7 ½ percent HCl. In May, 1995, the well was re-perforated in the interval from 1,163' to 1,189' and fracture stimulated in this interval. In January, 1996, Pendragon became operator of the well;

d) the Chaco Well No. 5 was drilled by Merrion and Bayless in April,1977 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,165' to 1,192'. The well initially tested in this interval at a rate of approximately 1029 MCFGD, 0 BOPD and 0 BWPD. In May, 1979 the well was fracture stimulated in this interval. In January, 1995, Edwards became operator of the well. In January 1995, the well was re-perforated in the interval from 1,165' to 1,192 feet and was fracture stimulated in this interval in April 1995. In January, 1996, Pendragon became operator of the well;

e) the Chaco Limited Well No. 1-J was drilled by Merrion and Bayless in April, 1982 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,200' to 1,209'. The well initially tested in this interval at a rate of approximately 10 MCFGD, 0 BOPD and a trace of water. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7 ½ percent HCl. In January, 1996, Pendragon became operator of the well; and

f) the Chaco Limited Well No. 2-J was drilled by Merrion and Bayless in September, 1979 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,186' to 1,202'. The well initially tested in this interval at a rate of approximately 208 MCFGD, 0 BOPD and 4 BWPD. In December 1979, the well was fracture stimulated in this interval. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7 ½ percent HCl. In ~~January, 1996~~, Pendragon became operator of the well.

(23) A brief history of the Whiting wells, obtained from the evidence and Division records, is described as follows:

a) the Gallegos Federal 26-12-6 No. 2 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,138' to 1,157'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well;

b) the Gallegos Federal 26-12-7 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,131' to 1,150'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well;

c) the Gallegos Federal 26-13-1 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,158' to 1,177'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well;

d) the Gallegos Federal 26-13-1 No. 2 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,047' to 1,208'. The

well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well; and

e) the Gallegos Federal 26-13-12 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,178' to 1,197'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well.

(24) Pendragon's application, in the context of the Division's rules and regulations and the provisions of the New Mexico Oil and Gas Act cited herein, as well as the terms of Order No. R-8768, presented the Commission with certain primary issues that can be identified as follows:

I. Geology: Fruitland Sand vs. Pictured Cliffs Sand.

II. Communication Between the Fruitland Coal and Pictured Cliffs Formations

III. The Cause of the Communication

IV. The Effect of the Communication

V. Regulatory Compliance and Relief

I. GEOLOGY: FRUITLAND SAND VS. PICTURED CLIFFS SAND

(25) In its Chaco Wells No. 1, 4, 5 and its Chaco Limited Well No. 2-J, Pendragon is producing from two separate sandstone intervals, hereinafter referred to as the "Upper Sandstone" and "Lower Sandstone" intervals and in its Chaco Well No. 2-R and Chaco Limited Well No. 1-J, Pendragon is producing only from the "Lower Sandstone" interval. It is the position of Pendragon that the top of the Pictured Cliffs formation occurs in this area at or above the top of the "Upper Sandstone" interval. The perforated intervals in each of the Chaco wells are as follows:

Well Name & Number	"Upper Sandstone" Perforations	"Lower Sandstone" Perforations
Chaco Well No. 1	1,113'-1,119'	1,134'-1,139'
Chaco Well No. 4	1,163-1,166'	1,173'-1,189'
Chaco Well No. 5	1,165'-1,169'	1,174'-1,192'
Chaco Limited Well No. 2J	1,186'-1,188'	1,200'-1,202'
Chaco Well No. 2R	None	1,132'-1,142'

Chaco Limited Well No. 1J	None	1,200'-1,209'

(26) Whiting agrees that the "Lower Sandstone" interval is within the Pictured Cliffs formation; however, it contends that the top of the Pictured Cliffs formation occurs in this area only at the top of the "Lower Sandstone" interval.

(27) The discovery well for the WAW Pictured Cliffs field, was the WAW No. 1 drilled in the NW/4 (Unit L) of Section 32, T-27-N, R-13-W, NMPM and completed on June 30, 1970 by Dugan Production Corporation. The pick for the top of the Pictured Cliffs formation sandstone by Dugan geologists for the WAW No. 1 was at a depth of 1317 feet, which is above the "Upper Sandstone" interval.

(28) The discovery well for the NIPP Pictured Cliffs field was the Chaco Plant No.1 Well drilled in the SW/SE Section 17, T-26-N, R-12-W, NMPM and competed on April 11, 1975 by Dugan Production Corporation. The pick for the top of the Pictured Cliffs formation by Dugan was at a depth of 1,149 feet at the top of the "Upper Sandstone" interval.

(29) The parties have stipulated that the Pictured Cliffs formation was deposited in a marine environment and that the Fruitland formation was deposited in a non-marine or inland terrestrial environment (*i.e.* fluvial channels, deltaic distributory channels, *etc.*).

(30) In Order No. R-8768, the Division defined the vertical limits of Basin Fruitland Coal Gas Pool as all coal seams within the equivalent of the stratigraphic interval from a depth of approximately 2450 feet to 2880 feet as shown on the well log from the Amoco Schneider Gas Com "B" well No. 1. The pick for the base of the pool is the top of the Pictured Cliffs. The pick is also the break between marine and non-marine sediments. It is undisputed that those coals or shale layers occurring below the stratigraphic pick set forth in Order No. R-8768 would not be included in the Fruitland Coal pool or in the Fruitland formation.

(31) The geologic evidence presented by Pendragon shows that the Chaco wells are producing from a zone that is stratigraphically equivalent to an interval below the bottom of the Fruitland Coal gas pool.

(32) In its cross section C-C Pendragon identified the "stratigraphic equivalent", as that term is used in Order No. R-8768 and reflected on the well log for the Amoco Schneider Gas Com "B" Well No. 1 as the first marine sandstone below the Fruitland Coal formation. Evidence also presented by Pendragon establishes that the term "stratigraphic equivalent" means "the same kind of rock material".

(33) Pendragon's isopach of the Upper Pictured Cliffs sand shows the occurrence of that sandstone along the shoreline trending from a northwest to a southeast direction in a barrier bar marine littoral environment. Pendragon's exhibit also

establishes that the Upper Pictured Cliffs sand occurs in a continuous sheet sand that coalesces into the main body or bench of the Pictured Cliffs formation as the sand trends from the shoreline environment on the southwest toward the center of the San Juan basin to the northeast.

(34) The Upper Pictured Cliffs sand coalesces into thicker and undifferentiated Pictured Cliffs sands to the east, northeast and north, indicating that it is part of the same depositional environment. The Upper Pictured Cliffs sand also correlates and is continuous in character over a large area covering portions of four townships.

(35) The geologic evidence presented by Pendragon also establishes that the Fruitland sands are deposited along a trend from the Southwest to the Northeast on a channelized basis and that those sands thin toward the Northeast to the edge of the Pictured Cliffs sandstone body.

(36) In the area of the subject lands, the Upper Pictured Cliffs sand appears as a classic shoreline or chenier-type sand grading from 0 to approximately 13 feet toward the northeast where it coalesces into the main body of the Pictured Cliffs where the thin underlying shale stringers are not present. The Upper Pictured Cliffs sands cannot be differentiated from the main body of the Pictured Cliffs formation.

(37) The preponderance of the evidence, including the geologic literature and cross-sections shows that the Pictured Cliffs marine sandstone abruptly wedges out and is replaced by chrono-stratigraphically correlative coals. In Exhibit W-9, the pinch-out of the Pictured Cliffs sandstone and replacement with Coal B occurs across an interval of less than 1.4 miles. In Exhibit W-10, the stratigraphic wedge-out of the Pictured Cliffs sandstone and replacement by Fruitland formation inter-bedded coals and non-coals occurs across an interval of less than 0.88 mile. Thus, marine Pictured Cliffs sandstones contemporaneous with thick "basal Fruitland Coals" occur in close proximity to each other.

(38) The geologic testimony and literature further establishes that Fruitland sands are consistently recognized as non-marine (continental) deposits such as fluvial channels, deltaic-distributory channels and other landward deposits. Additionally, the geologic literature indicates that the pick for the top of the Pictured Cliffs formation is often at the base of the basal Fruitland Coal. The Fruitland formation is the non-marine facies tract consisting of inter-bedded sandstone, mudstone, and coal beds deposited landward of the marine facies tract of the Pictured Cliffs sandstone.

(39) The testimony and evidence established that directly beneath the Basin Fruitland Coal throughout this portion of the San Juan Basin is a shale, or "underclay" deposited directly upon the Pictured Cliffs sandstone. The underclay is continuous over a large area, thinning to the northeast and is usually highly conductive on electrical logs. It appears in a uniform deposit on a marine platform and is not cut by channels or downward coarsening sands. There is no sand body or separately identifiable shale in the

several hundred feet above the base of the basal Fruitland Coal, which demonstrates anything near the areal extent or uniformity of this underclay shale. It is correspondingly different from Fruitland deposits. The Pictured Cliffs section immediately below the underclay thickens towards the northeast, indicative of a time of subsidence, which caused the deposition of the upper Pictured Cliffs sandstone interval. Conversely, a non-marine sand-shale-sand sequence can be expected to thin out to the northeast and should trend from the northeast to the southwest instead of the northwest to the southeast.

(40) Whiting's geologist witness defined a "marine" environment as that which is influenced by the sea and the action of the sea. While the witness acknowledged that lagoons are under a marine influence, he would exclude lagoonal environments from the definition of "marine" environments.

(41) Lagoons may be described as "...of, belonging to, or caused by the sea" in conformity with the definition of "marine" as set forth in the AGI Dictionary of Geological Terms.

(42) In its geologic testimony, Whiting asserted that the disputed upper Pictured Cliffs sandstone interval was deposited in a non-marine, crevasse splay deposit, resulting from a large, sediment-laden river breaking through its natural boundaries during a flood stage and spreading, clean, well-sorted sand over an area more than sixteen miles long and up to three miles wide parallel to the shoreline.

(43) Whiting, through its expert consulting geologist, contended that peat forming coals occur only at distances significantly inland of the beach and shore-face sands of the Pictured Cliffs, and therefore, the "upper Pictured Cliffs sand" in the area of the subject lands was most likely the product of non-marine sediments deposited by a crevasse splay mechanism which formed far inland from the beach and shore-face sediments of the Pictured Cliffs sandstone. However, the witness's cross-section exhibit showed that coals were also formed or deposited within the Pictured Cliffs formation.

(44) Pendragon presented aerial photographs of modern day deposits of sands comparable in mode of deposition and areal extent to the Upper Pictured Cliffs sand located in the marine lagoonal areas behind barrier islands, thus demonstrating both the validity of the depositional model and the opportunity for muds and coal-forming organic materials to be deposited in this environment. Pendragon demonstrated in these exhibits that these sands are wave and tidal current dominated deposits, and further showed that the seaward beach of a barrier island is not to be confused with the true ocean shoreline which lies behind the island.

(45) The core analysis for the Lansdale Federal No. 1 located in the SE/4 of Sec. 7, T-26-N, R-12-W establishes the average permeability and porosity for the Upper Pictured Cliffs sand and that grain size and sorting throughout the Upper Pictured Cliffs sand are uniform, consistent with a marine depositional environment. The physical descriptions of the sand appearing in the Upper Pictured Cliffs bench and the two lower

benches are gray, fine grained with little variation in clay content, consistent with a marine sand that has been laterally transported to the point where the energy available sorts the sand into uniform size. Sand sorting characteristics of this sort are not consistent with a fluvial deposit with graded bedding and coarsening downward.

(46) The descriptions for the disputed sandstone upper tongue interval and the main body of the Pictured Cliffs sandstone on the core analysis of the nearby Landsdale Federal No. 1 well are identical. The uniform description for both as gray, fine-grained with some clay content is consistent with marine sand, which was sorted and deposited by currents and waves. This evidence further supports the conclusion that the upper tongue is Pictured Cliffs sandstone.

(47) The Upper Pictured Cliffs sand is elongated along a northwest to southeast strike parallel to the ancient shoreline. The sand thickens consistently to the northeast, which is not consistent with a fluvial or crevasse splay deposit.

(48) There is no evidence establishing that the upper Pictured Cliffs sandstone in the area of the subject wells is associated with any stream channels or down-cutting as would be the case in a fluvial environment. Rather, the deposition of a sand with the consistency in geometry of the upper Pictured Cliffs sand requires a marine setting with a flat, stable base and a source of sand with consistent grain size spread by tidal or wave energy. Such conditions do not occur onshore and behind the shoreline.

(49) Whiting failed to establish by a preponderance of the evidence, the existence of any crevasse splay, or any depositional materials indicative of a sand-laden flood of tremendous velocity scouring or cutting down through the area where the sand would have been deposited. Moreover, there is no evidence of the transporting river or river channel or the thinning of sand deposits in both directions at right angles to the river, adjacent deltaic deposits or any other non-marine mechanism with the capability of forming the thin, but areally extensive sand of the dimensions seen in the upper Pictured Cliffs sandstone. The available core analysis data showed none of the characteristics consistent with the fluvial depositional materials or mechanics.

(50) Whiting's geological consultant presented an isopach of the Upper Sandstone, which, at its northern edge implies the sand is lying directly upon the marine, thick Pictured Cliffs sand. Additional evidence established that it is not a geologically credible possibility that such a deposition would occur as a result of a crevasse splay.

(51) Whiting's expert consulting geologist testified that it was also possible that the disputed interval was deposited by a washover fan mechanism. The washover fan depositional mechanism includes oceanfront, storm and wave-dominated action, all of which are consistent with the accepted geologic definitions of a marine depositional mechanism. Such a theory also supports a conclusion that the Upper Pictured Cliffs sandstone was deposited in a marine environment.

(52) Pendragon presented evidence that the Spontaneous Potential readings on electrical logs are much greater in the Pictured Cliffs formation which was deposited in a marine setting than are those of the Fruitland sands which were deposited in a fluvial, fresh water environment. Pendragon then showed that the SP readings for the Upper Sandstone were comparable or identical to those of the Lower Pictured Cliffs and were much greater than those of the Fruitland sands above the Basal Coal. Examples of this fact were found on the geological cross-section prepared by Whiting's consulting geologist.

(53) The spontaneous potential (SP) map of the Pictured Cliffs introduced by Whiting's expert geologist showed 40 to 80 millivolt SP development in the Chaco area. The cross-section exhibit introduced by that expert demonstrated that the disputed interval also showed 40 to 80 millivolts SP, even though it was interpreted by the witness to be Fruitland sandstone, and all other Fruitland sands on his cross-section showed only zero to less than 10 millivolts. Additional testimony established that 40 to 80 millivolts is a significantly higher range than is typically associated with SP development in a fresh-water depositional environment and is more characteristic with the SP development in the Pictured Cliffs intervals observed on the well logs and cross-sections for the Chaco wells. The geologic evidence also established that Pictured Cliffs sandstones have higher SP development because they are deposited in a more saline marine environment. This evidence further supports the conclusion that the disputed interval is Pictured Cliffs sandstone that was deposited in a marine environment.

(54) In a number of instances, Whiting's consulting geologist witness misidentified shales as sandstones on his cross-section exhibit or otherwise failed to distinguish between the two types of rock where they occur adjacent to one another. As a consequence, the witness similarly failed to distinguish between the two in his discussion of core sample and well log response characteristics. Consequently, the witness's testimony in this area is unreliable and should not be considered.

(55) The geologic evidence shows that the upper Pictured Cliffs sandstone tongues are widespread and occur in the southern portion of the San Juan Basin, including the area of the subject lands.

(56) The evidence presented by Pendragon establishes that over the years, approximately 34 wells within approximately 2.5 miles of the Pendragon Chaco Wells were actually perforated in the Upper Pictured Cliffs sand in conjunction with other Pictured Cliffs intervals and reported by the numerous different operators of those wells as Pictured Cliffs completions, consistent with the picks for the top of the Pictured Cliffs for the Chaco Plant No. 1 and the Subject Chaco Wells (Exhibit N-61). The evidence also establishes that those reported completions were accepted by the Division and the Bureau of Land Management and that industry and geologists have placed substantial reliance on those reported completions as Pictured Cliffs completions for nearly thirty years.

(57) Whiting presented testimony and an exhibit to support its contention that the operators of approximately one hundred additional wells outside the area of the subject lands had identified the top of the Pictured Cliffs sandstone "massive" as the vertical boundary between the Pictured Cliffs and Fruitland formation. However, Whiting failed to present any additional evidence establishing whether the upper Pictured Cliffs interval was present in any of the wells identified. Similarly, Whiting failed to present any evidence tending to show that any operator identified the top of the Pictured Cliffs sandstone as the massive sand in those areas where tongues of the Pictured Cliffs are known to exist.

(58) Maralex's president testified that when he evaluated the Pictured Cliffs formation and wells in the area of the subject lands in 1994, he did not check the perforated intervals or otherwise question the identification of the top of the formation at the Upper Pictured Cliffs sandstone.

(59) In a written statement provided to the Division in conjunction with its hearing in Case No. 11996, Merrion Oil and Gas Corporation, the assignor of the interests in both the Fruitland Coal formation to Maralex/Whiting and Pictured Cliffs formation to Pendragon indicated its concurrence with Pendragon's identification of the upper Pictured Cliffs interval and the historic recognition of that interval as Pictured Cliffs by Merrion and other operators in the area. (Exhibit N-43.) Merrion further stated its belief that Pendragon's wells are appropriately perforated in the Pictured Cliffs formation and that it had no intention of conveying to Pendragon wells that were perforated in other zones. Merrion also stated that it never intended to farm-out to Whiting the rights to zones where its producing wells (the Chaco wells) were perforated.

(60) Whiting contends that the top of the first "massive" sandstone below the lowermost coal of the Fruitland formation should be the definitional basis for picking the top of the Pictured Cliffs formation. The geologic testimony and evidence shows that such a definition has little support in the geologic literature and that the arbitratrary and undefined term of "massive" makes its application impractical. The geologic literature for the area and industry practice indicates that it is more common to place the contact between the Fruitland and Pictured Cliffs formations at the top of the highest ophiomorpha-major bearing sandstone. Consequently, the more widely accepted technical definition of a Pictured Cliffs sandstone is whether the formation is of marine deposition, such as shoreline, wave-dominated, delta-front chenier, barrier bar and tidal channel-type environments. In addition, the use of the "massive" definition would be in conflict with Order No. R-8768, establishing the equivalent statigraphic interval designated as the Fruitland Coal gas pool.

(61) The evidence and testimony of the geologists established that the definition of "massive" utilized in the AGI Glossary of Geology includes beds that are more than ten centimeters (four inches) in thickness or more than 1.8 meters (six feet) in thickness. Accordingly, under this definition, the Upper Pictured Cliffs sandstone tongues would be considered as "massive" sands.

(62) Whiting's consulting geologist advocated the use of a twenty-foot cut-off for defining the boundaries of Pictured Cliffs sandstone tongues and urged the Commission to disregard any deposits thinner than twenty feet. The witness testified the twenty-foot cut-off was used in a mapping study over a very wide area in the northern part of the San Juan Basin. However, Whiting's geologist acknowledged that the cut-off is a product of a "good average" and that Pictured Cliffs sandstone tongues less than twenty feet thick do exist. Additional geological literature evidence documents the occurrence of the Upper Pictured Cliffs sandstone in the WAW field in tongues from fifteen feet to three feet in thickness. Consequently, while the selection of a twenty-foot cut-off may be appropriate for a broad, academic geological study, its use by the Commission in this proceeding would lead to an unnecessarily arbitrary result.

(63) The testimony further established that the use of a twenty-foot cut-off for mapping the extent of Pictured Cliffs tongues is not practical and would cause significant Pictured Cliffs gas reserves to be arbitrarily disregarded.

(64) A 1994 type log published by the consulting geologist for Whiting and Maralex (Exhibit W-4) reflects a tongue of the Pictured Cliffs within the Fruitland formation above the so-called the "massive" sand of the main body of the Pictured Cliffs sandstone. This tongue is referred to by the author as UP1, which the author explains to stand for "upper Pictured Cliffs sandstones or upper Pictured Cliffs tongues." Thus, the interpretation of Whiting's consulting geologist supports that of Pendragon's.

(65) The interval from the top of the "upper Pictured Cliffs sandstone," as mapped by Pendragon, to the top of the main body of the Pictured Cliffs is composed of a variety of rock types including marine sandstones, silt stones, shales, and thin coals. It has been the long-standing and accepted custom and practice of industry and the various regulatory agencies to place this entire interval within the Pictured Cliffs sandstone. This industry and regulatory agency practice conforms to the standards of the North American Statigraphic Code and the International Stratigraphic Guide that state, "where a rock unit passes into another by integrating or interfingering of two or more kinds of rock...the boundary is necessarily arbitrary and should be selected on the basis of practicality."

(66) The boundary between the Fruitland formation and the Pictured Cliffs sandstone has been placed by industry and accepted by regulatory agencies to be at the top of the "upper Pictured Cliffs sand" as that interval has been referred to in these proceedings. The "upper Pictured Cliffs sand" is marine and as such, conforms to the Fassett and Hinds (1971) definition of the top of the Pictured Cliffs as marked by the highest marine sandstone. The boundary placed by industry also meets the test of practicality, and as such, fully conforms to the dictates of the North American Stratigraphic Code and the International Stratigraphic Guide.

(67) The identification and utilization of the Upper Pictured cliffs sandstone tongue to establish the vertical boundaries of the Pictured Cliffs formation by industry

and the governmental regulatory agencies is a long-established custom and practice. Such custom and practice is to be accorded significant weight.

(68) The vertical boundary between the Fruitland formation and Upper Pictured Cliffs sandstone in the area of the subject lands conforms to the base of the "Fruitland (coal gas) formation" in the assignment from Merrion and Bayless, *et al.* to Maralex and with the base of the "Fruitland Coal formation" in the assignment from Merrion and Bayless to Edwards. This formational boundary also conforms to accepted industry and regulatory interpretation. It conforms to the intentions of the parties; Maralex to farm in the "Coal Gas Formation", and of Merrion to sell Pictured Cliffs producing wells.

(69) In defining the vertical limits of the basin Fruitland Coal gas pool, the Division's Order No. R-8768 utilizes the phrase "all coal seams within the equivalent of the stratigraphic interval..." to the rock occurring at a specified depth in the well log for the Amoco Production Company Snyder Gas Com B well No. 1. The term "equivalent" means that one can determine at geographically separated stations that the rocks in question are the same. Accordingly, the use of the phrase "stratigraphic equivalent" means "lithostratigraphic" equivalent. From the definition in Order No. R-8768, the vertical limits of the basin-Fruitland Coal gas pool are the coals in rocks which are lithostraphigraphically equivalent with the Fruitland formation. In the subject area, rocks downward from the top of the "upper Pictured Cliffs sand" mapped by Pendragon are part of the Pictured Cliffs sandstone and are not a lithostratigraphic equivalent to the Fruitland formation. Accordingly, the interval in question is not part of the Basin Fruitland Coal gas pool or the WAW Fruitland sand.

(70) The preponderance of the geologic evidence establishes that the Chaco wells are producing from a zone that is stratigraphically equivalent to an interval below the base of the Fruitland Coal gas pool. Moreover, the classification of the upper sandstone interval as Pictured Cliffs is supported by a preponderance of the geologic evidence and is consistent with the interpretation by the larger scientific community, by industry and by governmental agencies.

(71) The preponderance of the geologic evidence establishes that the subject Chaco wells are completed in and are producing from the Pictured Cliffs formation sandstone intervals and from their appropriate common source of supply.

(72) Whiting's request that the Commission establish the base of the Fruitland formation in the subject area at the top of the "massive" sandstone below the lowermost continuous coal should be denied.

II. COMMUNICATION BETWEEN THE FRUITLAND COAL AND PICTURED CLIFFS FORMATIONS

(73) Whiting contends that the Pictured Cliffs reservoir in the subject area was depleted by the time Pendragon re-stimulated the Chaco wells in 1995. Whiting further contends that the post-stimulation treatment production increases experienced by the Chaco wells is exclusively attributable to production from the Fruitland Coal formation as a result of communication between zones.

(74) Pendragon contends that the Pictured Cliffs is not a depleted reservoir. Pendragon contends that the stimulation treatments performed on the Chaco wells successfully overcame wellbore and reservoir damage. Pendragon also pointed to wells outside the subject area where it and other operators have successfully restored Pictured Cliffs wells to production through acid and hydraulic fracture stimulation treatments.

(75) Both sides presented testimony and evidence on reservoir pressures and reserves. Pendragon presented additional evidence on wellbore and reservoir damage.

(76) Pendragon's Pictured Cliffs restimulation program was based on the successful recompletion of the Chaco Plant 5 well located in the northwest quarter, Section 21, T 26 N, R 12 W, NMPM. The Chaco Plant 5 well was originally drilled and completed in the Pictured Cliffs formation in 1975. Original surface shut-in tubing and casing pressures were then 212 psi. The well was fracture-stimulated in the Pictured Cliffs by Edwards in June of 1993 and the well flowed without artificial lift or compression. In August of 1993, during a shut down of the El Paso Natural Gas Chaco Plant, the surface shut-in tubing and casing pressures were 160 psi. The production curve for the Chaco Plant 5 well peaked relatively soon after the fracture stimulation and then declined on a profile typical of that for Pictured Cliffs wells, and producing only small amounts of water. A number of Fruitland Coal wells had been drilled in the immediate vicinity of the Chaco Plant 5 well, but in 1993, were clearly in the early de-watering phase of production. Gas production from those wells was shown to have been in a long incline, and not peaking until 1995 or 1997. By August, 1993, none of the surrounding coal wells had made as much cumulative gas production as was being produced by the Chaco Plant 5 every two months. At no time has the Chaco Plant 5 required pump assist to lift water.

(77) The Pictured Cliffs sandstone and the Fruitland Coal are separated by approximately four feet of shale in the Chaco Plant No. 5 well. Edwards specifically designed a hydraulic fracture stimulation treatment taking these specific reservoir conditions into account. The fracture treatment consisted of 15,000 lbs. of sand injected at a maximum rate of 15 barrels of fluid per minute. Shortly after the fracture stimulation treatment, shut-in tubing and casing pressures on the Chaco Plant No. 5 well were measured at 160 psi. Reservoir pressure in the coal at that time was approximately 250 psi. By early 1994, the Chaco Plant No. 5 well was flowing at daily rates from between 165 to over 230 MCFd with very little water production and without the need for

artificial lift. The stabilized decline in production rates for the well did not approximate production decline curves of typical Fruitland Coal formation wells.

(78) The fracture stimulation treatment for the Chaco Plant 5 well consisted of 15,000 lbs. of sand injected at a maximum rate of fifteen barrels of fluid per minute. There is no indication that the Chaco Plant 5 well is in communication or ever has been in communication with the Fruitland Coal formation.

THE DEPLETION VS. NON-DEPLETION ISSUE

(79) The Whiting/Maralex contention that the Pictured Cliffs formation was depleted was based on an evaluation of the reservoir performed by Maralex in 1994.

(80) In 1994, Maralex evaluated the subject Chaco Pictured Cliffs wells, along with a number of other Pictured Cliffs and Fruitland Coal formation wells located on acreage outside the subject lands. Based on that evaluation, Maralex determined at the time that the Pictured Cliffs reservoir in the subject lands was depleted and declined to purchase the Pictured Cliffs rights in the immediate area and further declined to purchase a number of additional properties with Fruitland Coal rights. Other operators, including Pendragon, who acquired some of the acreage rejected by Maralex in 1994 have since developed significant Pictured Cliffs and Fruitland coal production on the properties.

(81) Because it had previously determined that the Pictured Cliffs was a depleted reservoir, Maralex concluded that the Chaco Pictured Cliffs wells were no longer capable of producing and that any production from those wells subsequent to the stimulation treatments was in fact the production from the Fruitland Coal formation.

(82) The testimony and evidence establish that the 1994 evaluation of the subject Chaco wells and the additional acreage outside the area of the subject lands consisted of a cursory economic analysis, being based largely on incomplete production information. Limited well log information was utilized for a "rough" volumetric analysis and Maralex's president confirmed that he did not check the perforated intervals or otherwise question the identification of the upper Pictured Cliffs formation. There was no effort to determine the existence of well or reservoir damage and reservoir pressures were not considered.

(83) Maralex's president also testified that he did not utilize reservoir pressures in making his volumetric gas in place calculations in conjunction with his evaluation of the Pictured Cliffs reservoir in 1994. Consequently, the 1994 evaluation was fundamentally flawed.

(84) In his written testimony, Maralex's president represented that the Bureau of Land Management had issued a number of plugging demand letters to Merrion and Bayless, the previous owners of the Chaco wells. Pendragon objected to the written

testimony and presented other evidence that the BLM's well files on the Chaco wells contained no plugging demand letters. Correspondingly, during the hearing *de novo*, the Commission ordered that portion of the Whiting/Maralex testimony stricken.

FORMATION PRESSURES

(85) Whiting asserted that as of 1995, the Pictured Cliffs formation was pressure depleted and that the gas produced and pressures measured subsequent to the 1995 stimulation treatments were a consequence of the Chaco wells having communicated with the coal formation.

(86) Pendragon presented pressure data for the Chaco wells taken from Division records and operator's reports. The relevant pressure history for the Chaco wells is summarized as follows:

Well No.	Wellhead Shut-In Pressure psi/Date	Treatment Date and Type
Chaco 1	137/(6/81)	
	137/(7/83)	
		1/95 frac
	170/(2/95)	
	154/(8/95)	
	151/(10/95)	
Chaco 1-J	193/(5/82)	
	87/(6/84)	
	158/(1/95)	1/95 acidized
	155/(2/95)	
	1/43/(8/95)	
	148/(10/95)	
Chaco 2-J	220/(12/79)	12/79 frac
	157/(8/80)	
	188/(3/95)	
	196/(4/95)	
	198/(6/95)	
	180/(10/95)	
Chaco 2-R	132/(6/81)	
	110/(7/83)	
		1/95 frac
	104/(3/95)	
	108/(7/95)	

(89) After the acid stimulation treatments in 1995 and following a pressure build-up period, pressure measurements in the Chaco No. 4 well over three months ranged between 140 to 147 lbs., which was approximately 60 percent of the original reservoir pressure of 230 lbs.

(90) In 1995, post-fracture stimulations pressures were 170 lbs. in the Chaco 1, 151 to 153 lbs. in the Chaco 4 and 5 wells, and, in July, 1996, 150 lbs. in the Chaco 2-R well, indicating a relatively uniform pressure throughout the Pictured Cliffs reservoir in the area. During this same period of time, pressures in the Fruitland Coal formation, measured in 1994 in the Gallegos Federal 6-2 well and the 7-1 well were approximately 220 lbs. Correspondingly, there is no evidence that the pressures exhibited in the Chaco wells increased to Fruitland Coal formation pressures during this period of time. Moreover, the Pictured Cliffs reservoir pressures are consistent both before and after the stimulation treatments.

(91) In 1998, the compression assistance installed on the Chaco 1 and Chaco 4 resulted in minimal increases over prior production. The response of these Chaco wells to compression is more characteristic of conventional sand reservoir production than coal reservoir production as producing rates did not substantially increase above historic levels. In contrast, the effect compression had on the Whiting Gallegos Federal Fruitland Coal wells was a significant production increase resulting from the dramatic drop in reservoir pressure, thereby liberating larger amounts of gas from the coal.

(92) The surface shut-in pressure of 158 psi measured on the Chaco 1-J well on January 28, 1995 is an accurate reflection of Pictured Cliffs reservoir pressures before any of the restimulation treatments were performed on the Chaco wells. This pre-stimulation pressure is in line with pressures taken subsequent to the acid job on that well (155 psi). Following a five-month shut-in period, the Chaco 2-J well had a shut-in pressure of 198 psi in June 1995, subsequent to the January 30, 1995 acid job. When the well was open to the atmosphere, it blew down to zero pressure in four minutes. Such well performance is not indicative of the high-rate, high-volume of the cross flow that could be expected if the well had communicated with the Fruitland Coal formation.

(93) The measured pressures in the Pictured Cliffs wells in 1995 were less than the average reservoir pressure in the Fruitland Coal formation at that time.

(94) Pictured Cliffs reservoir pressure evidence presented by Pendragon establishes that there is no correlation between pressures in the Pictured Cliffs and distances from coal wells. The relatively constant pressure or, in some instances, the slight pressure increases, is indicative of a stabilized pressure over a large reservoir area.

(95) Whiting contended that the higher Pictured Cliffs pressures found in the area of the Chaco No. 5 well were due to the invasion of pressure from the Fruitland Coal formation due to a casing leak. However, evidence establishes that the casing leak in the

well was located approximately 200 feet above the basal Fruitland Coal and that the leak was successfully repaired prior to the fracture stimulation treatment on that well.

(96) Whiting contended that the pressures seen in the Chaco wells in 1995 were not valid Pictured Cliffs formation pressures, but were instead caused by communication with the coal. Whiting presented no evidence to show why those Chaco well pressures were not the same as the pressure in the coal at the time, as should be the case if Whiting's premise were correct. Moreover, for Whiting's premise to be valid, the numerous pressures seen in the Chaco wells prior to the fracture stimulations must also be coal pressures. Whiting was unable to explain why the pressure of 158 psi in the Chaco 1-J prior to any well stimulation treatment should not be accepted as valid, and Whiting's operations manager was unable to provide information or evidence that any of the thousands of acid jobs done in Pictured Cliffs wells in the area over the years had ever shown a resulting communication with the coal.

(97) At approximately 150 psi, 1995 Pictured Cliffs reservoir pressures in the subject area, generally, are approximately 62 percent of original pressure, indicating that the reservoir is only partially depleted. Further reservoir analysis evidence that assumed a reservoir thickness of 25 feet with 25 percent porosity, at 65 percent gas saturation and a 75 percent recovery efficiency established that the Pictured Cliffs reservoir has significant additional reserves remaining to be produced.

(98) The rapid production decline experienced by the Chaco wells so soon after their initial completion is not consistent with the well production behavior that could be expected from a large, continuous reservoir with high permeabilities, therefore indicating the possibility of damage in the wellbore and in the reservoir in the immediate vicinity of the well.

(99) Pressure information obtained during the year-long shut-in of the Chaco Pictured Cliffs wells in 1998 confirms reservoir continuity and pressure communication over large areas which is additional evidence supporting the conclusion that each of the wells can produce reserves from a large area. In addition, the shut-in data show that pressure continues to build up in those areas with little withdrawal, except where the Pictured Cliffs gas is being produced by the coal wells.

(100) The long pressure build-up times observed during the year-long shut-in demonstrates that the short, periodic shut-ins measured in the early 1980's did not yield stabilized reservoir pressures data.

PICTURED CLIFFS FORMATION AND FRUITLAND COAL FORMATION VOLUMETRIC AND MATERIAL BALANCE ANALYSES

(101) Pendragon's engineering evidence established that the Pictured Cliffs formation in the subject area is a high porosity, high permeability reservoir with moderate

pressures. Water saturation varies from approximately 30 percent in the upper portion of the sand to near 100 percent in the lower sands. Log analysis and core data establish that porosities in the subject area are greater than 20 percent. The historically high initial flow rates at relatively modest reservoir pressure differentials also indicate the existence of good permeability.

(102) The recent drilling and fracture stimulation completion of the Pictured Cliffs formation in the last few years in the State 2-R well located in Section 2, T26N R13W, which produces approximately 400 Mcfd, is additional evidence establishing that the Pictured Cliffs is not depleted.

(103) Pendragon presented volumetric and material balance analysis evidence showing that there are sufficient reserves in the Pictured Cliffs formation to support the historic and projected production from the Chaco wells.

(104) Volumetric analysis for the Pictured Cliffs formation based on hydrocarbon pore volumes derived from log calculations range from as high as 4.7 BCF per 640 acres to an average of 3.1 BCF per section at initial reserve pressure. The estimated average drainage area for the Pictured Cliffs wells is calculated at 173 acres, based on volumetric estimates of the original gas in place (OGIP).

(105) In most cases, the Pictured Cliffs volumetrics analysis performed by the Whiting witnesses did not utilize accurate reservoir pay thicknesses and failed to take into account all the reserves available in the main and lower benches of the formation. For instance, the volumetrics analysis of the Chaco 2-R well performed by Whiting's consulting petroleum engineer assumed pay thickness of only 9 feet. The witness failed to honor well log information for the Chaco 2-R which showed approximately 24 feet of pay. Consequently, Whiting's volumetrics evidence is not reliable.

(106) Well log information presented by Pendragon establishes the absence of any lithologic barrier to the downward growth of fracture treatments initiated in the main body of the Pictured Cliffs into the lower, third bench of the Pictured Cliff sandstone. Correspondingly, Pendragon establishes by a preponderance of the evidence that it is probable that the third bench of the Pictured Cliffs sandstone contributes substantial reserves to the subject Chaco wells.

(107) Whiting's consulting petroleum engineer also testified that the lower bench of the Pictured Cliffs contained approximately 30 percent gas saturation.

(108) Generally, the evidence establishes that the Pictured Cliffs wells were producing volumes of gas that were less than their OGIP, whereas the Fruitland Coal wells have been and will produce more than their indicated OGIP on 320 acres.

(109) Pendragon presented material balance and gas-in-place analysis data for the subject Chaco wells. Those data showed a material balance OGIP of 3,117,000 MCF

for the five Pictured Cliffs wells. When compared with the performance history and estimated reserve analysis data, the subject Pictured Cliffs wells indicated an ultimate recovery of 2,301,525 MCF, or approximately 73.8 percent of the material balance reserves. Both the volumetric analysis and material balance analysis data show sufficient reserves in the Pictured Cliffs formation to support the historic and projected production from the Chaco wells.

(110) Volumetric analyses for the Fruitland Coal formation in the area establish that the basal coal contains an average of 1,262,661 MCF per 320-acre spacing unit. Altogether, the five subject Fruitland Coal wells are estimated to have 6,897,801 MCF OGIP per 320 acres. The ultimate recoveries for these Fruitland Coal wells were shown to be significantly high relatively early in their producing lives. For instance, the Gallegos Federal 26-12-6 No. 2 and are the 26-12-7 No. 1 have already produced more than 83 percent OGIP each. Together, all of the subject Gallegos Federal Fruitland Coal wells have produced 54.1 percent of the OGIP. This analysis shows that the subject Fruitland Coal wells are producing much more gas than can be calculated to exist on each of their 320-acre spacing units. In addition, well performance and decline curve analysis demonstrates that Whiting's wells have an average drainage area of 545 acres, pressuming they produce only coal gas.

(111) The gas production history for the subject coal wells shows cumulative production for all five wells at 3,733,295 MCF. Remaining recoverable reserves based on estimates are 4,557,865 MCF. At the 76 percent estimated recovery factor, ultimate recoveries are anticipated to be 8,291,160 MCF. The Whiting Fruitland Coal wells have produced and are expected to produce much more gas than can be accounted for from the Fruitland Coal formation on 320-acre spacing. The performance of the subject coal wells and subsequent gas recoveries indicate that the Chaco wells are not producing Fruitland Coal gas reserves and are not interfering with the Gallegos Federal wells.

(112) Following their original completions, the Pictured Cliffs wells exhibited significantly high IP's. The Chaco No. 1 well had an IP of 342 MCFd while the Chaco 4 had 480 MCFd. The reported IP of Chaco No. 5 was 1,029 MCFd. At no time since their original completions or subsequent to the stimulation treatments did the production levels on any of the Chaco wells exceed the reported IP's.

PICTURED CLIFFS WELL AND RESERVOIR DAMAGE

(113) Pendragon contended that the production decline and the relatively low pre-1995 recoveries from the Chaco wells is attributable to well and reservoir damages.

(114) Pressure build-up information derived from measured surface pressures and bottom hole pressures indicated the existence of reservoir damage that is more significant than what is typically attributed to skin damage. Pendragon's expert well-testing and reservoir engineer characterized the damage as "extreme, severe and very

deep" formation damage, extending to a great distance away from the wellbore. The extent of the damage is also reflected on the production curves for the subject Pictured Cliffs wells.

(115) Pendragon presented evidence establishing that the Chaco wells were damaged by one or more of the following: (1) scale precipitation, (2) water blockage and (3) migration of clay fines.

(116) Of the three types of damage determined may exist in the Chaco wells, the most likely cause of damage is water block that has plugged off the more permeable intervals of the Pictured Cliffs or those intervals with higher gas saturation levels. The testimony further established that even small volumes of water in a relatively low pressure reservoir such as the Pictured Cliffs formation can cause water block, making it more difficult for Pictured Cliffs wells to recover once water intrudes into the area around the wellbore.

(117) Outside substantiation for the possibility ~~of re~~servoir damage in the Pictured Cliffs is found in the Halliburton core sample analysis for the Lansdale Federal No. 1 well indicating that "the samples are basically fine to very fine grained kaolinite clay cemented sandstone. Permeabilities range from less than one millidarcy to 272 millidarcies. The main water sensitivity is kaolinite clay migration in the pores."

(118) Acidization and hydraulic fracture stimulation are prudent and appropriate means of overcoming the reservoir damage caused by the kaolinite clay migration in the sandstone pores.

(119) A reservoir simulation model was used to determine theoretical well performance of a Pictured Cliffs well having a reservoir thickness of twenty-four feet and a permeability of 25 millidarcies. The simulation establishes that such a well has the capability to efficiently drain a 640 acre reservoir. The simulation results are additional evidence supporting the conclusion that the relatively poor performance exhibited by the subject Pictured Cliffs wells is a result of reservoir damage.

(120) The petroleum engineering expert testimony concluding that Pictured Cliffs well and reservoir damage was caused in part by scale is based on actual observations in the field in the area of the subject lands.

(121) An analysis of the transmissibility in the Pictured Cliffs formation using reported shut-in and well head flowing pressures over time establishes that the transmissibility in the reservoir had decreased. Calculations of flow capacity for the Pictured Cliffs wells show they were capable of flowing at only 9 percent to 36 percent of the peak calculated permeability. This evidence established that significant reservoir damage had occurred by 1986, which was overcome by the fracture and acid stimulation treatments in 1995.

(122) Maralex's president testified that their evaluation of the Pictured Cliffs wells in the area that had not been stimulated showed no measurable response to the fracture stimulations in the Gallegos Federal Coal wells. Such testimony is further evidence that the existence of reservoir damage in the Pictured Cliffs would inhibit a measurable response.

(123) Maralex's president also testified that the volumetric and material balance analyses performed on the Chaco Plant 5 and the Chaco No. 4 indicated a component of damage had affected those wells as they had substantially underproduced the recoverable gas in place. This not only substantiates the existence of damage, it directly contradicts the premise that the formation was fully depleted.

(124) During the January 1995 acid stimulation treatment, the measured surface pressure on the Chaco No. 4 well reached 800 psi before the injection of 500 gallons of acid into the formation could commence, even though this well shows the highest permeability in the Pictured Cliffs. That such pressure was reached during the acid job is direct evidence of the existence of reservoir damage.

(125) The damage to the Pictured Cliffs formation resulted in a reduction in the "effective permeability" or "transmissibility" which impaired the productivity of the Chaco wells.

(126) The testimony and evidence established that once the skin was overcome by the acid and fracture stimulation treatments, the Chaco wells with their 50 millidarcy average permeabilities and their 150 psi Pictured Cliffs reservoir pressures were able to produce significant volumes of gas into a gathering system with 40 to 50 pound line pressures.

(127) Whiting's witnesses agreed that it was prudent for the operator of the Pictured Cliffs formation to stimulate the wells to increase production.

(128) Whiting presented no testimony or evidence that refuted the possibility of the existence of wellbore and reservoir damage in the Pictured Cliffs formation. Consequently, the existence of wellbore and reservoir damage is supported by a preponderance of the evidence.

(129) The pressure data and other reservoir pressure evidence presented by Pendragon establish that the Pictured Cliffs formation was not a depleted reservoir before the acid and fracture stimulation treatments applied to the Chaco wells in 1995. The same evidence also establishes that the Pictured Cliffs formation contained substantial remaining commercial reserves.

III. THE CAUSE OF THE COMMUNICATION

WELL COMPLETION AND STIMULATION TREATMENTS

(130) Hydraulic fracturing is the processing of using fluids pumped at high rates and pressures to create fractures in underground reservoirs. Once a fracture is created, the fluid causes the crack to widen sufficiently to permit the introduction of a solid proppant, usually sand, into the fracture to keep the fracture parted and to provide a very high permeability pathway for reservoir fluids to enter the wellbore. The process creates a crack in the rock, which is typically several feet high and less than an inch wide. The fracture can extend several hundred feet into a reservoir. When pumping starts and the fracture is initiated, the fracture fluid is pumped away from the wellbore and as pumping continues, the distance of leading edge of the fluid moves farther from the wellbore. Fractures may have highly irregular and unsymmetrical geometry.

(131) During the fracture stimulation process, fluid is introduced into the tubing and pressure is increased until a fracture is created and ~~a sudden~~ drop in pressure is observed. Fluid is then pumped at a desired rate and proppant is added. Once the full volume of treatment is pumped, the pumps are shut down and the instantaneous shut-in pressure or "ISIP" is measured, providing an estimate of fracturing pressure. Inside the fracture, the fluid will leak off into the reservoir and as the fracture closes, proppant is trapped between the walls of the fracture. Pressure data are utilized to determine the closure point in the fracture.

(132) Pendragon presented evidence which establishes that fractures will be likely to, and frequently do remain confined and not grow across the reservoir top or bottom if the bounding reservoir rock above or below the pay interval is stronger or has high in-situ stresses or if the interface between the two rocks can slip and absorb the energy of the fracture extension.

(133) Pendragon presented additional evidence, which establishes that the different types of rocks at a reservoir boundary will have different in-situ stresses. The difference in the stresses is known as the stress contrast. The stress contrast between the sandstone and the coal in the Chaco area is approximately 400 psi and is 125 psi between the sandstone and a shale. During a fracture stimulation treatment, assuming there is no slip at the boundary of the different rock types, the fracture fluid must attain sufficient pressure to exceed the stress contrast in order to breach the boundary. If slip is present, then yet more pressure is required to exceed both the stress contrast and to displace the rocks sufficiently to create a crack in the breached interval. Consequently, assuming no slip, fracture pressures must exceed the stress contrast of 400 psi in order to breach into the coal. If the coal is not breached, then fracturing pressures will be controlled by the stresses in the sand and shales themselves. Conversely, a fracture initiated in the coal will more easily breach out of formation and into the sandstone, as the sand will have much lower stress than the coal formation.

(134) The evidence presented by Pendragon's petroleum engineers and geological engineers establishes that artificially induced fractures are influenced and controlled by lithology and bedding planes. Softer, more ductile rocks deform plastically at stresses where more brittle, less compressible rocks like coal tend to fracture. Coals and soft shales will tend to deform while hard sandstones will tend to crack. On a microscopic scale, shales and coals will tend to shear and slide, extending and thinning, rather than cracking, until some higher critical stress threshold is reached. Thus, the plastic properties which allow the higher stress to exist control the method of deformation as well. Similarly, the bedding planes, themselves, are capable of absorbing large amounts of fracture energy effectively acting as a fracture barrier and confining fracture growth to a particular bed.

(135) The testimony and geologic literature establish that fracture stimulations will tend to remain contained within the more brittle rock, like sandstones. Conversely, fracture stimulations are prone to grow out of more compressible rock, such as a shale or a coal, into more brittle rock. Induced fractures also tend to migrate from a higher-pressure zone, such as the Fruitland Coal formation in this case, into a lower pressured zone, such as the Pictured Cliffs sandstone formation. Reservoir pressures directly control fracture geometry. All of these findings are widely accepted and are confirmed by radioactive tracer survey studies.

(136) Stimulation treatments can be designed with fracturing fluids and pumping programs to control or prevent breaching into bounding formations.

(137) Pendragon produced evidence of radioactive tracer survey data from the Edwards Bartlesville No. 1 well located in Section 3, T-26-N, R-13-W which in 1998 received a fracture stimulation treatment in the Pictured Cliffs formation similar to that which was applied to the Chaco wells. The radioactive tracer survey information showed conclusively that fractures initiated in the Pictured Cliffs remained contained within the formation and stopped at the bedding plane between a thin Pictured Cliffs coal and the thicker Pictured Cliffs sandstone. The Bartlesville well contained an Upper Pictured Cliffs sandstone interval very much like that encountered in the subject Chaco wells. The tracer survey information was confirmed by Nolte plot data, which showed no detectable vertical growth, indicating the fracture remained within the upper Pictured Cliffs sandstone interval. Similar results were also presented for the Dome Federal 17-27-13 No. 3 Well.

(138) Whiting had no exhibits showing that fractures induced in coal perforations remained contained within that formation. In fact, each of Whiting's exhibits of the geometry of the coal fractures showed those fractures penetrating well into the Pictured Cliffs.

(139) Fracture stimulation treatments using high viscosity fluids, high rates and high pressures are more likely to induce fractures which travel from a more ductile or

compressive zone to a harder, more brittle and more easily fractured zone by breaking through the available containment barriers.

(140) The normal in-situ properties of the Pictured Cliffs sandstone and the Fruitland Coal formation establish that it is more probable that a fracture initiated in the Fruitland Coal is more likely to break out of zone into the Pictured Cliffs sandstone than is a fracture initiated in the Pictured Cliffs likely to break into the coal.

(141) In this case, the evidence establishes that the Fruitland Coal was a higher pressured formation with higher *in-situ* stress than the Pictured Cliffs. Additionally, the coal fracture stimulations were of a significantly larger volume, and done at higher injection rates and at significantly higher pressures. These factors support the conclusion that the fractures initiated in the coal broke out into the Pictured Cliffs sandstone.

(142) A comparative summary of the fracture stimulation treatments performed on the subject Chaco Pictured Cliffs wells and the subject Gallegos Federal Fruitland Coal wells is as follows:

Fracture Stimulation Comparisons

WELL	TOTAL BBLS LIQUID	TOTAL SAND – lbs.	BREAK-DOWN PRESSURE – psi SURFACE	AVERAGE TREATING PRESSURE SURFACE Before Flush	MAXIMUM BPM	REPORTED ISIP
CHACO 1	197	35,000	1520	1328	30.2	390
CHACO 2R	230	38,900	1562	1780	37.2	500
CHACO 4	219	36,000	973	1583	32.8	600
CHACO 5	223	30,852	1371	1630	28.7	620
GALLEGOS FED. 7-1 From Halliburton Report	624	127,200	2700	2400	69.33	1704
GALLEGOS FED. 7-1 From Drilling Report	624	127,200	n.r.	1750	60	1060
GALLEGOS FED. 12-1	446	43,200	unk.	2500	60	n/a
GALLEGOS FED. 6-2	599	127,860	2471	2400	65	1050
GALLEGOS FED. 1-1	628	117,000	unk.	2550	unk.	1340
GALLEGOS FED. 1-2	455	32,218	1331	1950	77.8	unk.

(143) The fracture stimulation treatments for two of the subject Chaco wells included re-perforations in the wellbores across the same Pictured Cliffs intervals and at the same levels perforated by the original operator. The other two wells were not re-perforated. A thinner fluid consisting of 70 percent quality foam resulting in a lower viscosity with low leak-off was used. Pendragon's witnesses testified that these thinner

fluids were pumped at lower rates (20 to 25 barrels per minute) to specifically avoid creating an environment conducive to breaching into the coal.

(144) In comparison, the fracture stimulation treatments for the subject Gallegos Federal Fruitland Coal wells were designed and performed with significantly larger fracture fluid volumes, heavier sand weights and higher injection rates even though the total perforated intervals were roughly equal for both types of wells. For example, the Gallegos Federal 26-12-6 No. 2 well received injection volumes of 81,025 gallons at sand weights of 127,800 lbs. injected at rates of up to 65 barrels per minute. The Gallegos Federal 26-12-7 No. 1 had injection volumes of 85,223 gallons with sand weights of 127,200 lbs. injected at rates of up to 69 barrels per minute. The Gallegos Federal 26-13-12 No. 1 well had injection volumes of 18,760 gallons with sand weights of 43,200 lbs. injected at 60 barrels per minute rates.

(145) The Maralex witness testified that to overcome the problems of coal contamination caused by certain fracture fluids surfactants and bacteriacides, Maralex reduced or eliminated the use of these compounds in its fracture fluids. By eliminating or reducing these compounds, the viscosity of the fracture fluids decreased as a result. To overcome the reduction in viscosity, Maralex purposely increased the fluid volumes and significantly increased the fluid injection rates used during the fracture stimulation treatments. The use of the larger fluid volumes and the significantly higher fluid injection rates substantially increased the probability that the fractures initiated in the coal formations grew down into the more brittle, lower pressured Pictured Cliffs sandstone.

(146) The final ISIP for the fracture stimulation treatments on the Chaco wells ranged from 390 to 600 psi, resulting in an ISIP gradient ranging from 0.78 to 0.97 psi per foot. However, the lowest ISIP observed in the fracture stimulation treatments on the Fruitland Coal formation in the Gallegos Federal wells was 1,050 psi, resulting in an ISIP gradient of 1.33 psi per foot.

(147) The evidence presented establishes that the *in situ* stress in the coal formation is approximately 400 psi higher than in the Pictured Cliffs sandstone. Consequently, a large fracture initiated in the sandstone must be stepped up even further to impart the equivalent of a 400 psi incremental increase in fluid pressure if the fracture is to penetrate into the coal. This would be a substantial and unnecessary increase in treating pressure over that required to extend the fracture within the sandstone. The evidence further establishes that fractures are contained where there is boundary slippage at the interface between the coal and shale or sandstones. Where slippage occurs, the fluid pressure must be increased even higher in order to break down the higher stress layer before the fracture can grow into the coal. Such evidence is further substantiation for a finding that it is less likely that the fractures initiated in the Pictured Cliffs sandstone broke out into the Fruitland Coal formation.

(148) Actual field data shows that the pressure required to fracture the Pictured Cliffs sandstone is significantly lower than the pressure required to fracture stimulate the coals. The field data were verified by the computer simulations.

(149) The testimony of Whiting's consulting petroleum engineer at the hearing established that because of the higher stress gradient in the coal, the ISIP of any of the fracture treatments initiated in the Pictured Cliffs sand would not have been sufficient to overcome both the stress gradient and closure pressure in the coal to allow the placement of any proppant into a fracture into the coal.

(150) The evidence and testimony further established that it is more probable that the proppant circulated in any upward growing fracture in the Pictured Cliffs sandstone would settle downwards to the bottom of the fracture, thus allowing the upper portion of the fracture to close. Such closed, unpropped fractures could not serve as conduits for the production of water or gas out-of-zone.

(151) Conversely, it is more probable that fractures ~~growing~~ downward from the Fruitland Coal into the Pictured Cliffs formation will remain propped open by the settlement of proppants into the bottom portion of the fracture. Consequently, fractures growing downward from the coal are more likely to serve as conduits for the production of gas from the Pictured Cliffs formation.

(152) Pendragon established through a preponderance of the evidence that it is more probable that the stimulation treatments initiated by Maralex in the Fruitland Coal formation escaped from the coal formation and penetrated into the Pictured Cliffs formation.

(153) Although the president of Maralex disagreed, Whiting's consulting petroleum engineer from S. A. Holditch & Associates, Inc., and Whiting's own in-house petroleum engineer both testified that it was likely that the fracture stimulations in the Fruitland Coal wells created fractures that extended down into the Pictured Cliffs formation.

(154) Whiting and Maralex contended that the Chaco wells were re-perforated by Pendragon directly into the coal seams of the Fruitland formation. However, casing collar survey logs performed in May and June of 1998 conclusively establish that none of the subject Pictured Cliffs wells were perforated or re-perforated in the Fruitland Coal Formation.

(155) As evidence supporting its contention that the fracture stimulation treatments on the subject Chaco wells had been performed on the wrong formation, Whiting produced copies of the well service company fracture treatment summary reports showing that, in two instances, the covers of those reports were labeled to reflect the treatments as having been conducted in the Fruitland Coal formation. However, additional evidence presented by Pendragon, including the casing collar survey logs,

BLM and Division completion reports and perforation records from the well service company fracture treatment summary reports themselves all establish that the wells were completed in and the fracture stimulation treatments were performed at the appropriate perforated interval in the Pictured Cliffs formation. Accordingly, it is established that the covers of the service company treatment reports were mislabeled.

(156) The evidence establishes that the subject Chaco wells are perforated only in the Pictured Cliffs sandstone.

(157) Two of Pendragon's Chaco wells, the Chaco 1-J and 2-J wells, were not fractured stimulated. Rather, these wells received 500-gallon acid jobs pumped at only one barrel per minute rates at maximum pressures of 800 psi for the Chaco 4 and 450 psi for the Chaco 1-J. (The Chaco 2-J stayed on vacuum for the entire duration of its acid job.) The 500 gallon/one barrel per minute acid jobs performed on the Chaco wells are typical of the acid stimulation treatments that industry has historically performed on hundreds of Pictured Cliffs wells in the area.

(158) The Chaco No. 2-J is located only 180 feet from the Gallegos Federal No. 26-13-1 No. 1 well. Yet, there is no evidence to suggest that these two wells are in pressure communication.

(159) The testimony and evidence establish that it was unlikely that acid stimulation jobs performed within such parameters caused fractures to initiate and grow from the Pictured Cliffs formation into the Fruitland Coal formation.

(160) In his testimony, Maralex's president agreed that it was not possible for acidization to effectively stimulate production from the coal formation.

(161) The evidence presented by Pendragon establishes that it was not possible for the acid jobs performed on its Pictured Cliffs wells to have created cross-flow permeabilities and flow rates out of the coal formations sufficient to have repressurized the Pictured Cliffs reservoir with coal gas by more than 100 psi over the period of just a few weeks, as would have been necessary for the 150 psi readings consistently seen in the Chaco wells in early 1995, if the reservoir had been depleted.

(162) The shut-in pressures obtained from the Chaco wells since June 30, 1998 show that the acid stimulations done in 1995 did not break through or connect to the Fruitland Coal formation.

(163) Whiting's witnesses agreed that it was reasonable and prudent for the operator of the Pictured Cliffs formation to stimulate the wells to increase production.

BTU AND GAS ANALYSES DATA

(164) Both parties presented evidence relating to BTU data and gas composition analysis to address the issue of whether the composition of gas can be used to differentiate between production from the Pictured Cliffs formation and the Fruitland Coal formation in the San Juan Basin.

(165) Whiting presented BTU and gas analysis evidence to support its contention that gas produced from the Chaco wells had originated in the Fruitland Coal formation. Pendragon presented its own BTU data and gas composition analysis to support its contention that the composition of gas is not a reliable indicator to differentiate between production from the Pictured Cliffs formation and the Fruitland Coal formation in San Juan Basin.

(166) The evidence establishes that the BTU contents and the proportions of "higher end" or lighter molecular components in the gas produced from the wells in the area of the subject lands are not only highly variable from well to well, but also vary over time and with the producing conditions of the reservoir. Production from most Pictured Cliffs wells tends to contain heavier components during the early stages of production, although this characteristic can be affected by a number of factors. Moreover, there is no clear differentiation between gas produced from the Fruitland Coal formation and the Pictured Cliffs sandstone.

(167) The fact that the BTU or methane percentage may have decreased over the producing life of a Pictured Cliffs sandstone well is not evidence that the well is producing gas from another zone.

(168) Evidence from the geological and engineering literature establishes that Fruitland Coal and Pictured Cliffs formation wells in the area of the subject lands are frequently found to be producing similar gases which may come from source materials in the Lewis shales and/or from coal. The sources cannot be separated as being limited to coal for the coal wells or strictly Lewis shale for the Pictured Cliffs wells. Consequently, the gases cannot be clearly differentiated when they are produced. In addition, under the reduced pressures and at the reservoir temperatures measured in the Chaco area, the heavier components tend to drop out or move through the reservoir rock more slowly than methane, making the produced gas more lean.

(169) Whiting presented evidence purporting to show a decrease in the BTU content for the Chaco 1, 4 and 5 wells in 1995 to demonstrate that the fracture stimulation treatments on those wells had connected to the coal formation and that they were producing coal gas. Significantly, Whiting's BTU data did not correlate with the timing of the fracture stimulation treatments on the Chaco Pictured Cliffs wells. In more than one instance, Whiting's own data showed that the BTU values for production from the Chaco wells had declined or were declining well before those wells were fractured.

(170) In connection with this dispute, the Division staff from the Aztec area office supervised the collection of gas samples from the subject wells in 1998, as well as samples from other wells in the area. At the time, the Division and the parties concluded that the data could not be utilized to determine the source of production from the subject wells.

(171) The evidence presented establishes that changes in the heating value of natural gas mixtures are expected as a consequence of continually changing reservoir conditions and production operations and are not reliable indicators of existing reservoir conditions. Observed natural gas mixtures from Pictured Cliffs wells in the area of the subject lands are expected to have high initial heating values. As a well is continuously produced and the reservoir pressure gradually drops, the heating content may then be expected to fall. Heat content may increase during prolonged shut-in periods. This behavior has been observed in wells in the area of the subject lands.

(172) In February 1999, after more than seven months of shut-in, gas samples were taken from the Chaco No. 1, 4 and 5 Wells. The BTU analyses were all above 1,100 and were nearly identical to those at the times of original completion. This is clearly Pictured Cliffs gas that has returned to the higher BTU content during shut-in as compared to lower BTU measurements during the times that the wells were being produced at high rates and low bottom hole flowing pressures. This also shows conclusively that those wells are not cross-flowing Fruitland gas into the Pictured Cliffs during shut-in as Whiting contends.

(173) Pendragon provided evidence from the Designated Hitter No. 2 Well and the Chaco No. 1-J and 2-J Wells which showed that such BTU changes occur over time in Pictured Cliffs wells which are not fracture stimulated.

(174) The evidence establishes that it is likely reservoir conditions in Fruitland Coal and Pictured Cliffs formations are such that certain components of the natural gas obtained from these reservoirs may be present at the time of initial completion in the liquid phase and convert to the gaseous phase, as the reservoir is produced and the reservoir pressure is lowered. The phase behavior of natural gas constituents, the adsorption of hydrocarbons and diluents by reservoir materials, and the absorption of hydrocarbons and diluents are pressure-related phenomenon.

(175) Methane is more soluble in water and is more strongly adsorbed in common reservoir materials than heavier hydrocarbons. Thus, production from the Pictured Cliffs will show higher heat content during initial production and a reducing heat content and as the reservoir is produced, the reservoir pressure is reduced and the methane de-sorbed and/or moved out of solution in the reservoir water.

(176) Pressure changes in the reservoir caused by either depletion or pressure build-up during shut-in periods will affect the heating value of the produced gas as the

hydrocarbon and diluent constituents are either absorbed by the reservoir water or adsorbed from the reservoir rock material.

(177) Pendragon presented BTU evidence for the Chaco No. 5 well demonstrating that heating values for gas produced from the well on June 1, 1994, before it was fractured in January of 1995, and then subsequently on March 1, 1995 were identical (1022 BTU). Whiting's witnesses contended that the consistent BTU measurements for the Pictured Cliffs well were attributable to the production of Fruitland coal gas through a casing leak. However, Pendragon's contract pumper testified that the casing leak was discovered and repaired in January of 1995, before the March 1, 1995 BTU value was measured. Moreover, December 1997 data showed the well was producing gas with a higher heating value at 1149 BTU. Such evidence does not support the contention that the Chaco No. 5 well was producing coalbed methane following the May 1995 fracture stimulation.

(178) Pendragon presented evidence utilizing 155 gas analyses of numerous Pictured Cliffs and coal wells to demonstrate that there is no separation or stratification of BTU or other properties in the range between 1,000 BTU and 1,100 BTU which would allow the differentiation of coal from Pictured Cliffs gas in this area.

(179) The BTU analyses and gas composition information do not provide a reliable means for determining the source of gas production from the wells involved in this case. The evidence presented by Whiting does not establish that the BTU values and gas components of the subject wells were affected by the stimulation treatments on the Chaco wells.

COMPUTER SIMULATIONS OF FRACTURE STIMULATION TREATMENTS

(180) Both parties presented evidence of computer simulations of hydraulic fracture stimulation treatments on one or more of the subject Fruitland Coal wells and Chaco Pictured Cliffs wells. Computer simulation of fracture stimulations is a still-developing technology that attempts to model highly complex lithologic structures and reservoir conditions involving many unknown variables. As such, computer simulations cannot be regarded as providing definitive proof of the actual behavior of fractures in reservoirs. However, the simulators are useful to verify conclusions reached from independent analytical methodologies and provide additional confidence in the evidence supporting those findings.

(181) The FracPro hydraulic fracture stimulation simulator model that Whiting presented for the Chaco No. 1, 4 and 5 wells predicted symmetrical fracture geometry from the treatments resulting in fractures with equal upper and downward growth. However, the simulation results did not agree with data derived from two tracer surveys from actual fracture stimulation treatments performed on Pictured Cliffs wells in the

general vicinity: the Merrion and Bayless Bartlesville No. 1 well located in Section 2, T-26-N, R-13-W and the Dome Petroleum Dome Federal 17-27-13 No. 3 well located in Section 17, T-27-N, R-13-W. Those tracer survey results demonstrated that fractures initiated in the Pictured Cliffs formation were confined on top by shale and that the fractures exhibited significant downward growth into the Pictured Cliffs sand.

(182) The GOHFER simulator analysis presented by Pendragon shows that the ISIP observed in the Gallegos Federal 26-12-6 No. 2 is consistent with a treatment that breaks into the Pictured Cliffs sandstone at a location away from the wellbore. Testimony and literature presented by Pendragon showed further that even with relatively high after-frac ISIP's, the fracture had broken into the low-stress zone from the high-stress zone at the wellbore more than fifty percent of the time. This analysis is consistent with the independently observed phenomena and measured data establishing that there is communication between the Pictured Cliffs and the basal Fruitland Coal in the vicinity of the Chaco No. 4, Chaco No. 5 and the Gallegos Federal 26-12-6 No. 2.

(183) The GOHFER computer simulation analysis ~~provides~~ additional evidence supporting a conclusion that the hydraulic fracture stimulation treatments performed on Pendragon's Chaco wells did not create a conduit between the Pictured Cliffs and the basal Fruitland Coal formations.

IV. THE EFFECT OF COMMUNICATION

WELL AND RESERVOIR PERFORMANCE

(184) The testimony, the literature, production decline curves and other evidence establish that Pictured Cliffs wells typically experience their peak production immediately after completion. The evidence also establishes that Fruitland Coal wells typically experience a long period of inclining production after completion while reservoir pressure is reduced and the coal formation goes through a dewatering process. Such wells typically do not experience their peak gas production until three years or more after completion.

(185) The evidence also establishes that typical Fruitland coal wells produce large volumes of water during the dewatering process and throughout most of their productive lives. None of the Gallegos Federal Fruitland coal wells have been capable of lifting the water to the surface or producing gas without pump assistance.

(186) Maralex's president offered testimony and production history evidence purporting to show that after its fracture stimulation, the Chaco Plant No. 5 well had performed much like a Fruitland coal well with an inclining production curve showing a production peak occurring in 1996. However, testimony and evidence in the form of monthly operator's reports presented by Pendragon (Exhibits N-7-A through E) show

better production in 1993 and 1994 and that the production curve for the well more closely modeled those of other Pictured Cliffs wells than of the several nearby Fruitland coal wells. Moreover, the evidence indicated that sales from the well were combined with production from another well at a common delivery point (CDP) and that the formula-based allocation between the wells was not necessarily reflective of actual production. Accordingly, Whiting's conclusions were based on limited and misinterpreted data.

(187) After the Pictured Cliffs wells were initially drilled, they exhibited a steep decline in production for the first three to seven years before establishing very low flow rates, at approximately 10 MCFd for a number of years. Significant increases in gas production were achieved following the stimulation treatments in 1995 to the Chaco 1, Chaco 2-R, Chaco 4 and Chaco 5 wells. Compression was added to the Chaco 1 in March 1998 and the Chaco 4 in April 1998. After compression was added, production rates for the wells increased very little over the immediate prior month's production. Conversely, the addition of compression on the subject Fruitland Coal wells resulted in substantial production increases as would be expected for ~~coal bed~~ methane where large amounts of gas are liberated because of a drop in reservoir pressure. Consequently, it is clear that the Pictured Cliffs wells did not respond to the addition of compression as would be expected if the wells were producing from the coal reservoir.

(188) There is sufficient evidence to establish that the fracturing of the coal wells in 1993 caused the injection of water into the Pictured Cliffs formation. Moreover, because the Pictured Cliffs had reservoir pressures some 70 to 100 psi lower than the coal, the Pictured Cliffs would have served as a pressure sink to further de-water the coal.

(189) In the pre-filed testimony, Whiting's consulting petroleum engineer concluded that there was a cross-flow of water from the Fruitland Coal formation into the Pictured Cliffs.

(190) The evidence presented by both Pendragon and Whiting establishes that the Whiting Fruitland Coal wells experienced a significant production increase by early 1994. Also in early 1994, the Fruitland Coal wells began to experience interference from one another as well as from other Fruitland Coal wells outside the are of the subject lands. In 1995, by the time the Chaco Pictured Cliffs wells were put on production, all of the Gallegos Federal wells were experiencing declining water production rates and inclining gas production rates.

(191) Except for water-flow back from the hydraulic fracture and other work-over treatments, the Chaco wells produced only small quantities of water through 1996 and 1997. In 1997, following a period of rather steady production, the Chaco Pictured Cliffs wells began a significant decline in production. During the same period, the Pictured Cliffs wells experienced an increase in water production. Such well behavior is the opposite from that of a typical Fruitland Coal well. However, such performance is

consistent with water and gas being injected into the Pictured Cliffs formation at a significant distance from the producing wellbores.

(192) The evidence establishes that all the coal wells experienced a significant increase in gas production and an increase in the gas/water ratio when compression was added. However, when the Pictured Cliffs wells were placed on compression, the opposite occurred, as water rates increased and gas rates increased only moderately while the gas/water ratio declined significantly. Such production characteristics further support the conclusion that the Pictured Cliffs wells were not completed in the Fruitland Coal formation.

(193) The evidence presented by Pendragon establishes that even though the fractures growing down from the Fruitland Coal into the Pictured Cliffs formation existed in early 1993, the subject Chaco Pictured Cliffs wells exhibited no discernable effect from the communication until after those wells were fracture-stimulated in 1995 and the reservoir and well-bore damage was overcome.

(194) Maralex's president testified that he concluded gas from the Pictured Cliffs formation is now moving into the Fruitland Coal formation, thus supporting Pendragon's conclusions. To support his conclusion, Maralex's president pointed to the apparent equilibration in pressures between the Pictured Cliffs and Fruitland Coal formations.

(195) The combined production from the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and the 26-13-12 No.1 increased by approximately 500 MCFd from late 1997 to April 1998 when compression was installed on the Fruitland Coal wells. During the same period, combined production from the Chaco wells declined by more than 200 MCFd.

(196) Maralex's president acknowledged that some of the Gallegos Federal wells have been producing gas from the Pictured Cliffs formations, but disputed the amounts involved.

(197) In 1995, the water production rates for the Gallegos Federal coal wells were significantly higher. For example, the Gallegos Federal 26-12-6 No. 2 produced between 70 and 80 barrels a day. Witnesses testified that it would not have been possible for such daily volumes to have been lifted without pump assist, whereas the Chaco wells did not require pumping.

(198) The historic performance characteristics of the Chaco wells verify that they did not produce gas from the Fruitland Coal formation.

WATER PRODUCTION

(199) Pictured Cliffs wells that have been fracture stimulated can and do produce some water. The evidence establishes that it is more likely that the water produced by the subject Chaco wells is coming from the perforated interval or from the lower bench of the Pictured Cliffs sandstone which generally has a higher water saturation.

(200) The evidence presented, including the geologic literature, establishes that it is common for fracture stimulated Pictured Cliffs wells to produce some water. The production of water from the Pictured Cliffs is not conclusive evidence of a fracture having communicated with the Fruitland Coal formation.

(201) Pendragon produced evidence that established that as early as 1983, operators were fracture-stimulating Pictured Cliffs wells in the WAW Pictured Cliffs pool and that such wells experienced an increase in gas production as well as an increase in water production. (Exhibit N34). Pendragon produced additional evidence documenting the production of water from stimulated Pictured Cliffs wells in the subject area as far back as the early 1970's. (Exhibit N57).

(202) Pendragon presented evidence of historic accounts by other operators in the WAW Pictured Cliffs pool indicating that it was typical for such wells to experience an increase in water production along with an increase in gas production following stimulation treatments.

(203) The Chaco Pictured Cliffs wells produced little or no water except following the recovery of flow-back water from the stimulation treatments or the addition of compression. If the Chaco Pictured Cliffs wells had been in direct communication with the Fruitland Coal, they have produced significantly greater volumes of water and would have required pump assist to lift the water and produce any volumes of gas.

(204) In 1998, during the course of the investigation by the Division's Aztec area office, the Division and the parties all agreed that water test data and analyses would not be reliable indicators of the source of gas production from the subject wells in this case. Consequently, none of the parties presented evidence of water analysis in conjunction with their direct testimony.

(205) The water production information for both the Fruitland Coal and Pictured Cliffs wells was incomplete. Maralex testified that water from its Gallegos Federal Fruitland Coal wells was produced directly into the reserve pits constructed for drilling operations and that the water production was unreported until first gas sales, often as long as a year after completion.

(206) Whiting asserted that Pendragon had purposefully failed to report the production of water from the Chaco wells in order to hide data which Whiting contends

might have demonstrated the wells had producing characteristics similar to Fruitland coal wells. Pendragon's contract pumper testified that although the volumes were recorded, reported water production data were incomplete due to the omission of a column for reporting water volumes on a pumper's report form which was used for a period of time when the hand-written data were typed onto the forms.

(207) Pendragon's contract pumper testified that he supervised the operation of the Chaco wells from the time they were acquired by Pendragon in late 1994 to the present and that he was familiar with their water production. The testimony rendered by the contract pumper and his field employees consisted of their regular, periodic first-hand observations of the wells since 1994 to the present, without interruption. The witnesses' testimony established that wells did not make sufficient volumes of water to justify the expense of adding measurement equipment. According to the testimony, water volumes were determined by "bucket test" measurements usually performed once a week, a procedure that is accepted by the Division. Based on the bucket-test measurements and the witnesses' own observations, it was established that the Chaco wells typically produced from between five to ten barrels of water per day (BWPD) into unlined pits as permitted by the Division. Certain reports showed greater volumes of water reported, but the witness testimony established that those increases were temporary and corresponded to the flow-back of water from the hydraulic fracture stimulation treatments, work-overs or the addition of compression.

(208) The testimony of the contract pumper witnesses established that the production pits on the Chaco wells had never been full of water, except following the fracture stimulation and well work-over treatments. The witnesses' testimony also established that none of the Chaco wells were on pump at any time, and that from their observations, the wells were not behaving like coal wells. Coal fines were not observed in the Chaco well pits at any time.

(209) Maralex's president testified that the only pit he saw that was full of water at any time was on the Chaco 2R in 1996.

(210) In February 1998, during its investigation into the matter, the Division's Aztec area office required Pendragon to install temporary fiberglass pits on the Chaco wells in order to measure water production. Those measurements showed the highest production of water was by the Chaco 2-R well at 13.9 BWPD. However, the Chaco 4 produced only 5 BWPD, while the Chaco 5 and Chaco 1 produced no volumes of water. Because of the small volumes being produced, the Division authorized the removal of the fiberglass pits.

(211) To support his contention that the Chaco wells were producing substantial volumes of water, Maralex's president referred to certain water hauling invoices from March of 1998 to show that 640 barrels of water were hauled from the Chaco No. 1 well that month. Information from this and other water hauling invoices was also used by Whiting to calculate the water/gas ratios for the well. However, evidence in the form of

deposition testimony of the truck driver for the water hauling service (Exhibit O-4) established that the invoices aggregated volumes of water hauled from several wells that were simply billed to the first well on that day's route and could not be utilized to establish the actual volumes of water produced from any single well. Consequently, the evidence of water production from the Pictured Cliffs wells offered by Whiting was inaccurate and not reliable.

(212) Whiting introduced photographs of an amount of water standing in the pit of the Chaco Plant 5 well, contending that the water was being produced from the Fruitland coal formation as a result of the hydraulic fracture treatment performed on that well in 1993. However, the testimony of Pendragon's contract pumpers established that it is more probable that the source of the water is from a pivot-point circular irrigation sprinkler that slowly passed directly over the pit on a daily basis.

(213) The evidence presented by Whiting with respect to water production by the Chaco Pictured Cliffs wells and the occurrence of water in production pits was based on incomplete information, misinterpreted data or was only anecdotal. Consequently, such information cannot constitute the basis of any finding by the Commission that the Pictured Cliffs wells produced any significant volumes of water at any time.

THE SHUT-IN PRESSURE DATA

(214) Both parties presented testimony and other evidence with respect to interpretations derived from the pressure data accumulated since the shut-in of the Chaco wells one year earlier on June 30, 1998.

(215) Immediately following the court-ordered shut-in of the Chaco No. 1, 2-R, 4 and 5 wells and the subsequent shut-in of the Chaco Limited 1-J and Chaco Limited 2-J wells, Pendragon and Whiting agreed to coordinate the collection and exchange of pressure data from each other's wells on a daily basis.

(216) At the time of the hearing before the Division on July 28, 1998, there were only a few days of shut-in pressure data available.

(217) The pressure data collected subsequent to the 1998 shut-in establishes that the Chaco 1-J, 2-J and 2-R wells are clearly not responding to continuing production from Whiting's Fruitland Coal bed methane wells and are not otherwise connected to the Fruitland Coal formation. On April 21, 1999 Pictured Cliffs' measured bottom hole pressure were more than 150 psi in the 1-J well, 101 psi in the 2-R well, 125 psi in the 2-J well and at least 73 psi in the Chaco 1 well. The fact that the evidence shows that the Pictured Cliffs formation in the area of these wells is not in communication with the coal, establishes that the reservoir pressures measured are reflective of actual pressures in the Pictured Cliffs reservoir, which were higher in the Chaco 1 and 2-R well 1995.

(218) During the yearlong shut-in period, the Chaco No. 1J exhibited no pressure change while the Chaco 2R showed an increase in pressure. This pressure information is additional evidence supporting the conclusion that the stimulation treatments on these wells did not communicate with the coal formation.

(219) The Chaco No. 1, Chaco No. 4, and Chaco No. 5 wells all exhibited a decrease in pressure during the yearlong shut in. The pressure losses in these wells were from approximately from 14 to 19 PSIG.

(220) Pendragon presented testimony and exhibits with respect to the P/Z versus cumulative production for the Chaco No. 1, 4 and 5 wells demonstrating the volumes of gas that would need to be produced in order to lower the pressures between 14 and 19 PSIG over the yearlong shut-in. At a minimum, the Chaco No. 1 well lost 19 psi, with a resulting loss of reserves of 60,500 MCF. The Chaco No. 4 experienced a 15 psi loss in pressure, resulting in a loss of reserves of 63,500 MCF. The Chaco No. 5 experienced a 14 psi pressure loss, resulting in a loss of reserves of 52,900 MCF. The total lost reserves for all three of the wells for the period from June 30, 1998 to June 30, 1999 was approximately 176,900 MCF.

(221) The engineering evidence presented by Pendragon establishes that the Pictured Cliffs reserves in the area of the Chaco No. 1, Chaco No. 4 and Chaco No. 5 wells continue to be drained by Whiting's Gallegos Federal Fruitland Coal wells since the June 30, 1999 data was collected. Whiting's witnesses agreed that Pictured Cliffs gas was flowing into the Fruitland Coal formation.

(222) The pressure data showing direct communication between Whiting's Gallegos Federal Fruitland Coal wells and the Chaco No. 4 and 5 wells, and the possible communication with the Chaco No. 1 well, establish that the loss of the reserves is the result of the production of Pictured Cliffs gas by the Gallegos Federal Fruitland Coal wells.

(223) A comparison of shut-in pressure data taken from the Chaco No. 1 and the Gallegos Federal 26-12-7 No. 1 wells from 1994 through June 1999 shows that the Chaco No. 1 pressure has always been lower than the Fruitland Coal pressure in the 26-12-7 No. 1 well. The shut-in pressure data establishes that the Chaco No. 1 well did not establish communication with the Fruitland Coal formation.

(224) A comparison of the well shut-in pressure data collected from the Gallegos Federal 26-12-7 No. 1, 26-12-6 No. 2, and the Chaco No. 4 and Chaco No. 5 wells also shows that the reservoir pressures in the Chaco No. 4 and Chaco No. 5 wells were considerably lower than Fruitland Coal reservoir pressures. These pressures are inconsistent with the contention that the Chaco wells were communicated to the Fruitland Coal formation at locations in close proximity to the wellbores. During the later periods of time in their wellhead shut-in pressure histories, the pressures of the Gallegos Federal

Fruitland Coal wells and the Chaco No. 4 and Chaco No. 5 wells converge and the communication between formations is more evident. This later convergence of reservoir pressures is consistent with communication occurring at distances significantly far away from the Pictured Cliffs wellbores.

(225) The evidence establishes that the Chaco 4 and Chaco 5 wells and possibly the Chaco No.1 Well are experiencing interference from the Gallegos Fruitland Coal wells. The evidence further shows that none of the other subject Chaco wells are experiencing interference from the coal wells.

(226) The Chaco 1-J, the Chaco 2-J and the Chaco 2-R wells do not appear to be experiencing pressure communication or production interference from any other wells. There is no evidence indicating that the completions in these communicated with the Fruitland Coal formation.

(227) The evidence shows that the Gallegos Federal Fruitland Coal wells are and have been producing Pictured Cliffs' gas reserves.

(228) The long-term pressure build-up data obtained by Pendragon after the subject Chaco Pictured Cliffs wells shut-in on June 30, 1998 provided important information establishing the extent and source of communication between the various wells in the area of the subject lands.

(229) The measured pressures in the Pictured Cliffs wells since June 30, 1998 showed no evidence of equilibration with the average reservoir pressure in the Fruitland Coal formation. Pendragon presented evidence of several examples, when the field was shut in, that the Coal wells had pressures within a few days of shut-in which were higher than those of nearby Chaco wells which had been shut in for weeks or months. This could not occur if the Chaco wells were completed in or producing from the coal.

(230) The shut-in pressure data indicates that the Chaco No. 1, 4 and 5 wells were not influenced by production from the coal wells nearest to the Chaco No. 1-J, 2-J and 2-R wells.

(231) After the Chaco Pictured Cliffs wells were shut-in on June 30, 1998, the combined production from the Gallegos Federal 26-12-6 No.2, the 26-12-7 No. 1 and the 26-13-12 No. 1 wells increased by about 200 MCFd.

(232) In late 1997 and early 1998, Whiting placed the 26-12-6 No. 2, the 26-12-7 No.1 and 26-13-12 No. 1 wells on compression. Production from these wells immediately increased while the nearby Chaco No. 4 and No. 5 wells decreased. Following the shut-in of the Chaco wells at the end of June 1998, production from the Whiting wells increased significantly while the Chaco wells experienced a pressure decrease.

(233) Well production information shows that water production increased when the Chaco No. 1 and Chaco No. 4 wells were put on compression. However, the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and the 26-13-12 No. 1 reported a decrease in water production after they were placed on compression. In addition, gas/water ratio evidence establishes that the Fruitland Coal wells experienced a significant increase in the gas/water ratio when the Chaco wells were shut-in in 1998. The same evidence also reflects that the Chaco wells exhibited little if any change in the gas/water ratio production trend after the Chaco wells were restored to production in 1995. Such gas/water ratio production information is additional evidence establishing that the Whiting wells are producing Pictured Cliffs gas.

(234) Due to its proximity to the Whiting Gallegos Federal 26-12-7 No. 1 Fruitland Coal well, the Chaco No. 4 experienced pressure interference effects twice as large as those observed in the Chaco No. 5 well. Although the Chaco No. 2-R well is located closer to the 26-12-7 No. 1, the Chaco 2-R has not experienced a pressure response to the shut-in of the coal well. Significantly, the upper Pictured Cliffs sandstone is not present in either of the Chaco #2-R or the Gallegos Federal 26-12-7 No.1. Accordingly, it is more likely that the larger stimulation treatment of the 26-12-7 No. 1 well may have connected to the Upper Pictured Cliffs sand at some distance from the well bore.

(235) In his testimony, Whiting's in-house petroleum engineer testified that he agreed the Chaco 1J and 2J were not drawing down reservoir pressure in the Fruitland Coal formation or that the wells were producing from the coal formation. The witness also agreed that the production and pressure information for the Chaco wells did not show that the wells exceeded initial virgin gas flows and pressures at any time.

(236) Because of its distance away from the Chaco No. 4 and Chaco No. 5 wells, those wells did not produce an observable pressure response when the Gallegos Federal 26-13-12 No. 1 was shut in while the 7-1 and 6-2 coal wells continued to produce. However, because there are no closer shut-in Pictured Cliffs wells, the 26-13-12 No.1 well cannot be precluded from currently draining the Pictured Cliffs formation. This well has already produced 60 percent of the OGIP in the coal formation under its spacing unit before it has reached peak gas production rates. Moreover, production rate and material balance data establish that the well may ultimately recover two to four times as much gas as it has already produced.

(237) Only a slight correlation of pressures during field shut-ins was observed between the Gallegos Federal No. 26-13-1 No.2 and closest Pictured Cliffs producer, the Chaco No. 1-J. This was not detected when only the Whiting wells were shut-in. As it is possible that the reading may be attributable to measurement variability, or because the 1-J may have been reacting simply to pressure increase in the Pictured Cliffs since all reservoirs were shut-in, it is reasonable to conclude that the two wells are not in communication.

(238) Pendragon presented testimony and evidence establishing conventional gas reservoirs and coal bed methane reservoir have substantially different properties, including compressibilities, so that pressure transients move at different speeds through the different reservoir types.

(239) System-wide gathering systems shutdowns in the area during the period of the yearlong shut-in produced observable pressure transient data for analysis. Pressure transients were observed in the Chaco No. 4 and 5 wells within one to two days after the Fruitland wells were shut in. The evidence presented established the only way for this pressure transient to have occurred was if the pressure wave from shutting in the coal wells was directly communicated to the Pictured Cliffs formation at or near the location of the coal wells and then moved through the Pictured Cliffs formation to the Chaco No. 4 and 5 wellbores.

(240) Pendragon's reservoir engineering and well testing expert performed an analysis to illustrate the level of impact that differences of compressibility and permeability have on pressure interference in the Pictured Cliffs wells as a result of shutting-in a nearby Fruitland Coal well. The analysis generally determined pressure interference response that would be observed at a shut-in Pictured Cliffs wells from shutting a producing Fruitland Coal well, depending on whether the pressure transients move through the Fruitland or the Pictured Cliffs formations. The time differences in observing a response are a consequence of the different permeabilities, thickness and compressibilities in the Pictured Cliffs and Fruitland Coal formations. From this well test analysis and the pressure interference responses observed, there is a reasonable basis for the Commission to infer that the relatively rapid response is a result of a pressure transient moving through the higher permeability and lower compressibility conditions existing in the thin upper Pictured Cliffs formation. From this information, it can be concluded that the pressure interference is moving from a location in very close proximity to the coal bed methane wells through the Pictured Cliffs formation to reach the Chaco wells. Consistent with this conclusion, these pressure response transients were most readily observed in the Chaco No. 4 and Chaco No. 5 wells and the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and 26-13-12 No. 1 wells.

(241) The shut-in and pressure interference information evidence establishes that that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly communicated to the Pictured Cliffs formation. Included among such evidence is the fact that every time the well ceased production for more than one day, from July to December 1998, a pressure increase was observed in the Chaco No. 4 and 5 wells. In addition, the well has not reached its peak gas production rate yet by the August 1999 hearing. The well has already produced 83 percent of the indicated OGIP in the coal under 320 acres. Data extrapolated from current production rates and material balance indicate the well may ultimately recover two to four times as much gas as it has already produced.

(242) The shut-in and pressure interference information also establishes that it is more probable than not that the Whiting Gallegos Federal 26-12-7 No. 1 Fruitland Coal

well is directly connected to the Pictured Cliffs formation. Such evidence includes the fact that a pressure increase was observed in the Chaco No. 4 and 5 wells almost every time the Gallegos Federal 26-12-7 No. 1 was shut in from July to December 1998. This well also has already produced 83 percent of the OGIP in the coal formation under the spacing unit before the well has reached it peak gas production rate. Production rate and material balance data indicate that the well may ultimately recover two to four times as much gas as it has already produced. In addition, the current gas flow capacity (kh) connected to the well is almost three times the initial water flow capacity.

(243) The shut-in and pressure interference information further establishes that it is possible that the Whiting Gallegos Federal 26-13-12 No. 1 Fruitland Coal well may be directly connected to the Pictured Cliffs formation.

(244) There is no indication of interference between the Chaco 2-R and any other currently producing well of any type. The fact that the pressure at the Chaco No. 2-R well increased for the first ten months after the 1998 shut-in is a further indication that a substantial volume of gas exists in the Pictured Cliffs sandstone and that the well is not in communication with the Fruitland Coal formation.

(245) The evidence further establishes that the Chaco No. 1 well is experiencing production and pressure interference because of the likely existence of indirect communication between the well and the Fruitland Coal formation. The Chaco No. 1 well is also responding to production from other Pictured Cliffs wells.

(246) The evidence establishes that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly connected to the Pictured Cliffs formation in or very near that wellbore. The evidence further establishes that it is more probable than not that the Gallegos Federal 26-12-7 No. 1 and the 26-13-12 No. 1 wells are directly communicated to the Pictured Cliffs formation. The evidence is consistent with the other testimony, evidence and information supporting the conclusion that the fracture stimulation treatments performed on these wells caused them to become directly communicated to the Pictured Cliffs formation.

(247) The Chaco No. 4 and Chaco No. 5 wells are experiencing production and pressure interference because of indirect communication between the Pictured Cliffs formation and the Fruitland Coal formation caused by the Gallegos Federal 26-12-6 No. 2, 26-12-7 No. 1 and the 26-13-12 No. 1 wells in or near the coal wellbores

(248) The measured pressure responses, during shut-ins of the coal wells, at the Chaco No. 4 and the Chaco No. 5 wells are conclusive proof establishing that these two wells are not in direct communication with the Fruitland Coal formation.

(249) The Chaco No. 1 well is experiencing some pressure and production interference from other Pictured Cliffs wells and from the indirect communication by Fruitland Coal wells to the Pictured Cliffs.

(250) On April 22, 1999, Pendragon filed with the Commission its Motion to Conduct Reservoir Pressure Tests. On May 6, 1999, Whiting filed its Response opposing testing and urged the Commission not to grant Pendragon's motion. On May 19, 1999, the Commission entered its Order Allowing Reservoir Pressure Testing. Whiting, through the testimony of Maralex's president, continued to oppose the testing proposed by Pendragon in District Court, and consequently, Pendragon was prevented from performing the tests. During the hearing *de novo*, Maralex's president testified that he did not recall any proposed reservoir pressure tests and was consequently unable to explain Maralex's opposition to the tests.

(251) Whiting presented no testimony from a witness with expertise in well testing, relying instead on the testimony of a petroleum engineer who admitted that he had no expertise in the area of well testing.

(252) Whiting presented no evidence of its own with respect to the movement of pressure transients through the Fruitland Coal formation or ~~Pictured~~ Cliffs formation.

(253) Pendragon offered the use of its Chaco wells for both parties to participate in the conduct of reservoir pressure response tests utilizing both Pictured Cliffs and Fruitland Coal wells. Pendragon also offered to allow Whiting to use the Chaco wells in tests designed solely by Whiting. Rather than participate in tests using both types of wells, Whiting, on its own, instead performed injection fall-off tests using only one of its coal wells. Whiting did not afford Pendragon the opportunity to participate in or observe the testing.

(254) Whiting presented evidence and testimony on reservoir testing it performed on its Fruitland Coal wells in June of 1999. The tests were designed by Whiting's consulting petroleum engineer whose expertise does not include well testing design and analysis. The testimony established that the injection operations for the 12-hour test periods were timed for commencement in the early evenings and for completion the next morning before the Pendragon's pumpers were scheduled to arrive on their regular rounds to collect pressure data from the Gallegos Federal wells.

(255) The purpose of Whiting's injection fall-off test was to determine the permeability characteristics of the Fruitland Coal formation, among other things. However, the testimony establishes that numerous problems were experienced during the conduct of the test. In fact, the results from the June 1999 testing were so bad that the test was rerun in July 1999. Moreover, the test design ignored the fact that the coal well on which the test was run had received a hydraulic fracture treatment and utilized a Langmuir volume that overstated the gas content for the coal by a factor of four. Consequently, Whiting's conclusion that the injection fall-out test shows that the Fruitland Coal formation has a resulting permeability of 225 millidarcies is likewise substantially overstated and is otherwise erroneous and unreliable.

(256) In July of 1999, Whiting performed another injection fall-off test on the Gallegos Federal 26-13-1 No. 1 well to establish the permeability of the Fruitland coal reservoir. The test data and analysis were flawed for a number of reasons. Among other things, the unsupervised test procedure was performed without the required packer installed in the well and various mechanical problems were encountered during the test. In the data analysis, a gas compressibility component was used that was inappropriate for a high-compressibility coalbed methane reservoir. The calculations made from the data ignored the fact that the well had been hydraulically fractured and utilized testing assumptions designed for naturally fractured shales. During testimony, Whiting's consulting petroleum engineer who designed and analyzed the test testified that he was unfamiliar with calculations using Langmuir volume and was unable to explain why the Langmuir volume used in this case was overstated by a factor of four. In addition, the engineering witness calculated a total compressibility for the reservoir that appeared to be overstated by a factor of five to ten. As a result, the conclusions drawn from the test with respect to the permeability of the coal reservoir in the subject area are not reliable and should not be considered.

(257) Whiting's consulting petroleum engineer agreed that the storage coefficient used in the analysis of the injection fall-off test data was uncertain because the gas storage volumes attributable to the cleat system and hydraulic fractures was not known. As a consequence, the calculation of the skin factor is also made uncertain and the resulting calculation for coal reservoir permeability is not reliable. As a further consequence, the witness's assumptions and calculations of the pressure response times that utilized the derived permeability are also rendered less reliable.

(258) The evidence establishes that the initial pressure utilized at the beginning of the injection fall-off test were inaccurate by between 50 and 25 percent of the true pressure differential. As a consequence, the calculated permeability for the coal is two to four times too high because a pressure differential that was too low was utilized.

(259) The injection fall off test was also determined to be questionable due to the fact that three different measurement times were indicated on the bottom hole pressure bomb, the surface gage and then the pumper reports utilized by Maralex. In addition, the pre-testing build-up pressure conditions were uncertain as were the injection rates and the measurement methodology using orifice places and meter tube diameters of unreported size. Consequently, the test data cannot be calibrated and are therefore unreliable.

Based on the foregoing, the Commission concludes as follows:

(260) Whiting has failed to prove, by a preponderance of the evidence that its wells have been completed in and have produced from the appropriate common source of

supply and that it has otherwise maintained the segregation of production as required by Rule 303 (a) of the Division's rules and regulations.

(261) The Pictured Cliffs and Fruitland Coal are in communication in the area of the subject lands. None of the subject Chaco Pictured Cliffs wells directly communicate to the Fruitland Coal. One or more of the Whiting Fruitland Coal bed methane wells are directly communicated with the Pictured Cliffs formation. As a consequence, there is and has been a failure to maintain segregation of production from the separate common sources of supply.

(262) The Pictured Cliffs sandstone reservoir was not depleted at the time Pendragon re-stimulated the Chaco wells in 1995. The Pictured Cliffs formation was damaged in those wells and the re-stimulation treatments established a more effective connection between the wells and the Pictured Cliffs reservoir. The re-stimulation treatments did not connect to the Fruitland Coal.

(263) The hydraulic fracture stimulation treatments on the Whiting Gallegos Federal Fruitland Coal wells connected to the Pictured Cliffs formation in some of the wells. As a result of such connections, besides producing coal bed methane, one or more of the subject Gallegos Federal Fruitland Coal wells are also producing gas from the Pictured Cliffs formation.

(264) A preponderance of the evidence establishes that that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly communicated to the Pictured Cliffs formation.

(265) A preponderance of the evidence establishes that it is more probable than not that the Whiting Gallegos Federal 26-12-7 No. 1 Fruitland Coal well is directly connected to the Pictured Cliffs formation.

(266) A preponderance of the evidence establishes that it is possible that the Whiting Gallegos Federal 26-13-12 No. 1 Fruitland Coal well may be directly connected to the Pictured Cliffs formation.

(267) There is no indication of interference between the Chaco 2-R and any other currently producing well of any type. The Chaco Limited 1-J and 2-J wells do not appear to be experiencing interference from the Whiting Gallegos Federal wells.

(268) The evidence establishes that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly connected to the Pictured Cliffs formation in or very near that wellbore. The evidence further establishes that it is more probable than not that the Gallegos Federal 26-12-7 No. 1 and the 26-13-12 No. 1 wells are directly communicated to the Pictured Cliffs formation. It is established by a preponderance of the evidence that the fracture stimulation treatments performed on these wells caused them to become directly communicated to the Pictured Cliffs formation.

(269) The Chaco No. 4 and Chaco No. 5 wells are experiencing production and pressure interference because of indirect communication between the Pictured Cliffs formation and the Fruitland Coal formation caused by the Gallegos Federal 26-12-6 No. 2, 26-12-7 No. 1 and the 26-13-12 No. 1 wells in or near the coal wellbores.

(270) The Chaco No. 1 well is experiencing production and pressure interference because of indirect communication between the Pictured Cliffs formation and the Fruitland Coal formation though one or more of the Gallegos Federal Fruitland Coal wells. The Chaco No. 1 well is also experiencing interference from other Pictured Cliffs wells.

V. REGULATORY COMPLIANCE AND RELIEF

(271) The engineering testimony and evidence establish that the shut-in of the Chaco wells allows the Gallegos Federal Fruitland coal wells to produce gas reserves from the Pictured Cliffs formation. In addition, continuation of the shut-in allows water to imbibe back into the Pictured Cliffs formation in the area of the Chaco well bores, making restoration of production more difficult and increasing the risk that one or more of the wells cannot be placed back on production.

(272) Immediate restoration of the Chaco Pictured Cliffs wells to production is necessary to avoid further waste, dissipation of reservoir energy and loss of the state's valuable resources.

(273) As relief and to bring Whiting's wells into regulatory compliance, Pendragon requested that the Commission enter an order providing for the following:

(a) Ordering the immediate shut-in of the offending coal wells, the Gallegos Federal 26-12-6 No. 2, the 26-13-12 No. 1 and the 26-12-7 No.1.

(b) Restoration of the shut-in Chaco Pictured Cliffs wells to production to determine:

(i) Whether any of the Pictured Cliffs wells have been permanently lost as a result of the shut-in and, if so, the quantification of lost reserves;

(ii) The re-establishment of a steady state of decline in order to:

(iii) Determine the curtailed production rates the Fruitland Coal wells might be restored to so that drainage areas are equalized, in order to minimize or eliminate future damages; and

(iv) Alternatively, allow Whiting to demonstrate to the satisfaction of the Division how both the Pictured Cliffs and Fruitland Coal formation wells can be simultaneously produced without interference, and if they fail to do so, require the Gallegos Federal Fruitland Coal wells to be permanently shut-in or recompleted.

(274) Pendragon does not seek the shut-in of the Gallegos Federal 26-13-1 No.1 and the 26-13-1 No. 2 wells.

(275) As regulatory and statutory support for the relief requested, Pendragon cited to the following: 19 NMAC 15.C.106.A; 19 NMAC 15.C.113; 19 NMAC 15.E.303A of the Division's rules and regulations; NMSA 1978, Sections 70-2-2; 70-2-11; and 70-2-12B(2), (4), (7) and (8) of the New Mexico Oil and Gas Act; and Order No. R-8768 and the Special Rules and Regulations for the Basin-Fruitland Coal gas pool.

(276) The Commission's authority to identify production from the separate formations within the WAW Fruitland Sand Pictured Cliffs pool and otherwise afford the relief requested in the application and at the hearing is within the Commission's statutory and regulatory authority under, *inter alia*, Section 70-2-12(A), (B)(1), (B)(2), (B)(4), (B)(7) and (B)(8).

(277) Pendragon presented testimony establishing that under the circumstances of this case, it would not be possible to satisfy a number of criteria under Order No. R-8768 and Rule 303 of the Division's rules that allow downhole commingling as a possible means for effecting regulatory relief.

(278) Whiting and Maralex presented no evidence and made no suggestions with respect to bringing the wells into compliance with the Division's regulations, rules and orders.

IT IS THEREFORE ORDERED:

(1) Pursuant to the *de novo* application of Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy, Inc., the Commission determines that the following described wells were properly perforated and completed within and produced from the Pictured Cliffs formation of the WAW Fruitland Sand-Pictured Cliffs gas pool:

Chaco No. 1
Chaco No. 2-R
Chaco No. 4
Chaco No. 5

Chaco Limited No. 1-J
Chaco Limited No. 2-J.

(2) The Commission further determines that fracture stimulation treatments on the following described wells caused fractures to escape from the Fruitland Coal formation and penetrate directly into the Pictured Cliffs sandstone:

Gallegos Federal 26-12-6 No. 2
Gallegos Federal 26-12-7 No. 1
Gallegos Federal 26-13-12 No.1

(3) The Commission further determines that as a consequence of the fracture stimulation treatments performed by Maralex Resources, Inc., the following described wells have been and are continuing to produce gas from the Pictured Cliffs formation as well as from the Basin Fruitland Coal gas formation:

Gallegos Federal 26-12-6 No. 2
Gallegos Federal 26-12-7 No. 1
Gallegos Federal 26-13-12 No.1

(4) The Commission further determines that the following described Pictured Cliffs wells have experienced interference from and drainage by the production of the Fruitland Coal gas wells identified above:

Chaco No. 1
Chaco No. 4
Chaco No. 5

(5) The Commission further determines that the operator of the Fruitland Coal formation wells identified in Paragraph 2, above has failed to drill, complete and operate the wells so as to (1) prevent gas and water from escaping into the Pictured Cliffs formation, and (2) otherwise maintain the segregation of production between pools.

(6) The Commission further determines that the operator of the referenced Fruitland Coal formation wells has failed to prudently drill, complete and operate the wells in violation of the following rules, regulations and orders of the Division as well as provisions of the New Mexico Oil and Gas Act:

19 NMAC 15.C.106.A; 19 NMAC 15.C.113; and 19 NMAC 15.E.303.A of the Division's rules and regulations; NMSA 1978 Sections 70-2-2; 70-2-12 B(2); 70-2-12 B(4); and 70-2-12 B(7); and Order No. R-8768 and the Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool.

(7) The Commission further determines that as a consequence of the conduct of the operator of the Fruitland Coal formation wells, the producing Pictured Cliffs formation in neighboring properties and leases has been injured which has reduced the total ultimate recovery of gas from that formation. The reduced recovery of reserves constitutes waste.

(8) The Commission further determines the communication has also resulted in the loss of reservoir energy from the Pictured Cliffs formation in the subject area.

(9) The Commission further determines that since the shut-in of the subject Pictured Cliffs wells on June 30, 1998, to June 30, 1999, approximately 176,900 MCF of Pictured Cliffs gas has been produced from the Whiting Gallegos Federal Fruitland Coal wells. Those same coal wells have produced additional volumes of Pictured Cliffs gas since June 30, 1999 in cumulative amounts that should be determined in a subsequent proceeding before the Commission.

(10) Pendragon is hereby ordered to take such measures as may be reasonably necessary or appropriate to restore the Chaco Pictured Cliffs wells to production.

(11) Whiting is hereby ordered to shut-in its Gallegos Federal 26-12-6 No. 2, the Gallegos Federal 26-13-12 No. 1 and the Gallegos Federal 26-12-7 No. 1 wells, pending further order of the Commission.

(12) Pendragon should present evidence in a subsequent proceeding before the Commission in this case determinative of the volumes of Pictured Cliffs gas reserves that have been produced by Whiting Gallegos Federal coal wells since June 30, 1999, whether any of the Pictured Cliffs wells have been permanently lost, and if so, the quantification of lost reserves as a result of the shut-in. For the Pictured Cliffs wells that it is able to restore to production, Pendragon should present evidence demonstrating the re-establishment of a steady state of decline for those wells.

(13) In a subsequent proceeding before the Commission following the accumulation of relevant data pursuant to Paragraphs 9and 12 above, both parties should be afforded the opportunity to present evidence and make recommendations to the Commission to enable it to determine the curtailed production rates the Fruitland Coal wells may be restored to so that drainage areas are equalized and in order to minimize or eliminate future damage or interference. The parties should also be allowed the opportunity to demonstrate to the satisfaction of the Commission how both the Pictured Cliffs and the Fruitland Coal formation wells can be simultaneously produced without interference or drainage. If such evidence shows it is not reasonably possible to operate the Gallegos Federal Fruitland Coal wells without further damage, interference or drainage of the Pictured Cliffs formation, then Whiting should be ordered to recomplete the Fruitland Coal wells. Alternatively, the Gallegos Federal 26-12-6 No.2, the 26-13-12 No. 1 and the 26-12-7 No. 1 should be permanently shut-in.

(14) Whiting's request that the Commission establish the base of the Fruitland formation in the subject area at the top of the "massive" sandstone below the lowermost continuous coal is denied.

(15) Jurisdiction is hereby retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinafter designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

JAMI BAILEY, MEMBER

ROBERT LEE, MEMBER

LORI WROTENBERY, CHAIR

SEAL

STATE OF NEW MEXICO
ENERGY, MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

IN THE MATTER OF THE HEARING CALLED BY THE OIL CONSERVATION DIVISION FOR THE PURPOSE OF CONSIDERING:

De Novo
CASE NO. 11996
Order No. R-11133

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, LP AND EDWARDS ENERGY, INC., TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO.

ORDER OF THE COMMISSION
(Pendragon's Draft)

BY THE COMMISSION:

This case came on for hearing at 9:00 a.m. on August 12-21, 1998, at Santa Fe, New Mexico, before the Oil Conservation Commission of New Mexico, hereinafter referred to as the "Commission".

NOW, on this ___ day of _____, 1999, the Commission, a quorum being present, and having considered the record,

FINDS THAT:

(1) Due public notice has been given and the Commission has jurisdiction of this case and its subject matter.

(2) The applicants, Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy Corporation (collectively "Pendragon"), pursuant to Rule (3) of the Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool set forth in Division Order No. R-8768, as amended, seek an order, *inter alia,* confirming that the following described wells, completed within the vertical limits of the WAW Fruitland Sand-Pictured Cliffs Gas Pool or the Basin-Fruitland Coal Gas Pool, are producing from the appropriate common source of supply and providing further relief as the Commission deems necessary:

WAW Fruitland Sand-Pictured Cliffs Gas Pool Producing Wells

Operator	Well Name & API Number	Well Location
Pendragon Energy Partners, Inc.	Chaco No. 1 (API No. 30-045-22309)	1846' FNL & 1806' FWL, Unit F, Section 18, T-26N, R-12W
Pendragon Energy Partners, Inc.	Chaco No. 2R (API No. 30-045-23691)	1850' FSL & 1850' FWL, Unit K, Section 7, T-26N, R-12W
Pendragon Energy Partners, Inc.	Chaco No. 4 (API No. 30-045-22410)	790' FNL & 790' FWL, Unit D, Section 7, T-26N, R-12W
Pendragon Energy Partners, Inc.	Chaco No. 5 (API No. 30-045-22411)	790' FSL & 790' FEL, Unit P, Section 1, T-26N, R-13W
Pendragon Energy Partners, Inc.	Chaco Limited No. 1J (API No. 30-045-25134)	1850' FSL & 1750' FWL, Unit K, Section 1, T-26N, R-13W
Pendragon Energy Partners, Inc.	Chaco Limited No. 2J (API No. 30-045-23593)	790' FNL & 1850' FEL, Unit B, Section 1, T-26N, R-13W

Basin-Fruitland Coal Gas Pool Producing Wells

Operator	Well Name & API Number	Well Location
Whiting Petroleum Corp.	Gallegos Fed 26-12-6 No. 2 (API No. 30-045-28898)	886' FSL & 1457' FWL, Unit N, Section 6, T-26N, R-12W
Whiting Petroleum Corp.	Gallegos Fed. 26-12-7 No. 1 (API No. 30-045-28899)	2482' FSL & 1413' FWL, Unit K, Section 7, T-26N, R-12W
Whiting Petroleum Corp.	Gallegos Fed. 26-13-1 No. 1 (API No. 30-045-28881)	828' FNL & 1674' FEL, Unit B, Section 1, T-26N, R-13W
Whiting Petroleum Corp.	Gallegos Fed. 26-13-1 No. 2 (API No. 30-045-28882)	1275' FSL & 1823' FWL, Unit N, Section 1, T-26N, R-13W
Whiting Petroleum Corp.	Gallegos Fed. 26-13-12 No. 1 (API No. 30-045-28903)	1719' FNL & 1021' FEL, Unit H, Section 12, T-26N, R-13W

(3) Whiting Petroleum Corporation, and Maralex Resources, Inc. (Collectively "Whiting") the owners and operators of the subject Fruitland Coal Gas wells on the one hand, and Pendragon Energy Partners, Inc., the owner and operator of the subject Pictured Cliffs wells on the other, each contend that the other's well stimulation treatments caused their separately owned formations to become communicated. Both sides contend that their wells are experiencing interference and that gas is being produced out of zone as a result.

(4) On January 3, 1998, Whiting Petroleum Corporation and Maralex Resources, Inc. filed an application with the New Mexico Oil Conservation Division in Case Number 11921, followed subsequently on February 10, 1998 with an Amended Application seeking an order shutting-in certain wells in San Juan County. The Whiting/Maralex application identified five Fruitland Coal gas wells that Whiting and Maralex contended were encountering interference from six of Pendragon's Pictured Cliffs wells and two Pictured Cliffs wells owned by Coleman Oil and Gas Company. In their application, Whiting and Maralex contended that the drilling or fracture stimulation or restimulation of the Pictured Cliffs wells resulted in ~~production~~ increases from the Pictured Cliffs wells with simultaneous production declines in their nearby Fruitland Coal wells.

(5) The Maralex application cited to the NMOCD's statutory authority to prevent the escape of natural gas from strata in which it is found into other strata and the requirement that wells be drilled, operated and produced in such a manner as to prevent injury to neighboring leases or properties and to fix the spacing of wells (Section 70-2-12(B)(2)(7) and (10) 1995 Repl. Pamp.) The application further referred to the Division's authority to require the operators to submit data demonstrating that a well is producing from the appropriate common source of supply pursuant to Order No. R-8678 and Special Rules 2 and 3, thereunder.

(6) On May 26, 1998, Whiting and Maralex requested that their applications in Case Number 11921 be withdrawn and that the case dismissed. By order dated August 6, 1998, the case was dismissed by the Division. Also on May 26, 1998, Whiting and Maralex filed an action against Pendragon in the First Judicial District Court, Santa Fe County, New Mexico. In that same proceeding, Whiting and Maralex also filed an application for preliminary injunction, shutting-in Pendragon's Chaco Pictured Cliffs wells. On May 26, 1998, Pendragon filed its initial application in this case with the Division.

(7) Pursuant to a hearing convened in the District Court proceeding on June 29, 1998, the Court issued its Preliminary Injunction ordering the shut-in of the Chaco 1, Chaco 2-R, Chaco 4 and Chaco 5. Pendragon was not afforded the opportunity to present evidence at the hearing. The Court's order on the Preliminary Injunction was issued on July 7, 1998, and was based solely on the evidence presented by Whiting and Maralex.

(8) On July 6, 1998, pursuant to a hearing on Whiting's Motion for an Order Enjoining Defendants from Prosecuting an Administrative Proceeding, the District Court denied the Motion and determined that it would defer jurisdiction over this case to the New Mexico Oil Conservation Division. Subsequently, by memorandum decision dated October 30, 1998, the District Court granted Pendragon's motion for a stay of discovery in the District Court proceeding, pending consideration of this case by the Division and subsequently the Commission.

(9) On July 28 through 30, 1998, a hearing was held before the Division in Santa Fe and on February 5, 1999, Division Order No. R-11133 was issued. On separate applications of both Whiting/Maralex and Pendragon on February 23, 1999 and February 18, 1999, respectively, this case was heard *de novo* on August 12-21, 1999. The parties also filed comprehensive expert testimony and exhibits before the *de novo* hearing.

(10) T. H. McElvain Oil and Gas Limited Partnership, ("McElvain"), entered its appearance as a party of record in the proceeding before the Division, but it did not file an Application for Hearing *De Novo*. McElvain did not appear or otherwise participate in the De Novo proceeding.

(11) On four occasions, through separate motions to the District Court and the Division and Commission, Whiting and Maralex sought to enjoin or otherwise prevent this administrative proceeding from going forward. Each of those motions was denied. The parties were allowed the opportunity to conduct pre-hearing discovery and were otherwise afforded a full and fair hearing before the Commission.

(12) In connection with its application, Pendragon appeared and presented testimony and evidence supporting its contentions that:

(a) Pendragon's wells were completed in and are producing the appropriate common sources of supply, specifically the Pictured Cliffs interval of the WAW Fruitland Sand Pictured Cliffs Pool.

(b) Pendragon's Chaco No. 1, Chaco No. 4 and Chaco No. 5 wells are experiencing substantial interference from production by the Whiting Gallegos Federal 26-12-6 No.2, 26-12-7 No.1, and 26-13-12 No. 1 wells. These Fruitland Coal wells have drained substantial reserves from the Pictured Cliffs formation owned by Pendragon, and the drainage is on-going.

(c) The Fruitland Coal formation became communicated with the Pictured Cliffs formation as a result of the high volume, high pressure and high injection rate fracture stimulation treatments performed on the Gallegos Federal wells by Maralex Resources, Inc.

(d) The acid and hydraulic fracture stimulation treatments performed on the Pendragon Chaco wells in 1995 remained contained within the Pictured Cliffs formation and did not result in the communication with the Fruitland Coal formation.

(13) In addition, Pendragon requested the Commission to exercise its authority under the provisions of Order No. R-8768 to determine if the subject Pictured Cliffs wells and Basin Fruitland Coal wells are producing from their appropriate common source of supply. In order to make such a determination, Order No. R-8768 provides that the Division or Commission may take into consideration the following matters, among others: log data, completion data, gas analysis, water analysis, reservoir performance, and "other evidence which may be utilized in making such determination." Pendragon also requested the Commission to afford such relief as necessary to bring the wells into compliance with the Division's rules, regulations and orders.

(14) Whiting Petroleum Corporation and Maralex Resources, Inc., (collectively "Whiting"), interest owners within the Gallegos Federal 26-12-6 No. 2, 26-12-7 No. 1, 26-13-1 No. 1, 26-13-1 No. 2 and 26-13-12 No. 1, appeared at the hearing in opposition to the application and to present evidence and testimony to support their position that the Pendragon Chaco wells, described in Finding No. (2) above, are producing:

a) from a sandstone interval located within the Fruitland formation; and
b) coal gas from the Basin-Fruitland Coal Gas Pool due to the establishment of communication between the Basin-Fruitland Coal and WAW Fruitland Sand-Pictured Cliffs Gas Pools within the Pendragon Chaco wellbores.

(15) In the Pre-Hearing Statement it filed in this case, citing to Order No.s R-8768 and R-8768-A, Whiting specifically requested that the Commission establish the base of the Fruitland formation in the area in question at the top of the "massive" sandstone below the lower most continuous coal in the area.

(16) All eleven wells that are the subject of this application are located within an area (hereinafter referred to as the "subject area") that comprises:

TOWNSHIP 26 NORTH, RANGE 12 WEST, NMPM
Section 6: W/2
Section 7: W/2
Section 18: NW/4

TOWNSHIP 26 NORTH, RANGE 13 WEST, NMPM,
Section 1: All
Section 12: N/2

(17) The "subject area" is located within the horizontal boundaries of the Basin-Fruitland Coal Gas Pool created by Division Order No. R-8768 dated October 17, 1988. The vertical limits of this pool, as defined by Ordering Paragraph (1) of Order No. R-8768, are as follows:

> "all coal seams within the equivalent of the stratigraphic interval from a depth of approximately 2,450 feet to 2,880 feet as shown on the Gamma Ray/Bulk Density log from Amoco Production Company's Schneider Gas Com "B" Well No. 1 located 1110 feet from the South line and 1185 feet from the West line of Section 28, Township 32 North, Range 10 West, NMPM, San Juan County, New Mexico".

(18) Order No. R-8768 further establishes Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool including provisions for standard 320-acre gas spacing and proration units with wells to be located no closer than 790 feet from the outer boundary of the proration unit nor closer than 130 feet from any quarter section line nor closer than 10 feet from any quarter-quarter section line or subdivision inner boundary. In addition, wells are to be located in the NE/4 or SW/4 of a single governmental section.

(19) The "subject area" is also located within the horizontal boundaries of the WAW Fruitland Sand-Pictured Cliffs Gas Pool. The vertical limits of this pool comprise all of the Pictured Cliffs formation (Order No. R-4260 dated February 22, 1972) and all the sandstone intervals of the Fruitland formation (Order No. R-8769 dated October 17, 1988). At the time the Chaco wells were drilled, the WAW Fruitland Sand-Pictured Cliffs Gas Pool was governed by Division Rule 104.C., which required standard 160-acre gas spacing and proration units with wells to be located no closer than 790 feet from the outer boundary of the spacing unit nor closer than 130 feet from any quarter-quarter section line or subdivision inner boundary.

(20) The evidence and testimony presented by both parties in this case is generally in agreement that Pendragon and Whiting received assignments of oil and gas leases in all or portions of the "subject area" from common grantors, Robert Bayless (Bayless) and Merrion Oil and Gas Corporation (Merrion), during the period from 1992-94. The assignments of rights to Whiting are as follows:

> "Operating rights from the surface of the earth to the base of the Fruitland (Coal gas) Formation subject to the terms and provisions of that certain Farmout Agreement, dated December 7, 1992 by and between Merrion Oil & Gas et al., Robert L. Bayless, Pitco Production Company, and Maralex Resources, Inc."

(21) The assignment of rights to Pendragon is as follows:

"Leases and lands from the base of the Fruitland Coal formation to the base of the Pictured Cliffs formation."

(22) A brief history of the Pendragon wells, obtained from the evidence and Division records, is described as follows:

a) the Chaco Well No. 1 was drilled by Merrion and Bayless in February, 1977 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,113' to 1,139'. The well initially tested in this interval at a rate of approximately 342 MCFGD, 0 BOPD and 0 BWPD. In January, 1995, J. K. Edwards & Associates, Inc. (Edwards) became operator of the well. In January, 1995, the well was fracture stimulated in the perforated interval. In January, 1996, Pendragon became operator of the well;

b) the Chaco Well No. 2-R was drilled by Merrion and Bayless in October, 1979 to test the Pictured Cliffs formation. ~~The~~ well was perforated and completed in the Pictured Cliffs formation from a depth of 1,132' to 1,142'. The well initially tested in this interval at a rate of approximately 150 MCFGD, 0 BOPD and 0 BWPD. In January, 1995, Edwards became operator of the well. In January, 1995, the well was fracture stimulated in the perforated interval. In January, 1996, Pendragon became operator of the well;

c) the Chaco Well No. 4 was drilled by Merrion and Bayless in April, 1977 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,163' to 1,189'. The well was initially tested in this interval at a rate of approximately 480 MCFGD, 0 BOPD, and 0 BWPD. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7 ½ percent HCl. In May, 1995, the well was re-perforated in the interval from 1,163' to 1,189' and fracture stimulated in this interval. In January, 1996, Pendragon became operator of the well;

d) the Chaco Well No. 5 was drilled by Merrion and Bayless in April,1977 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,165' to 1,192'. The well initially tested in this interval at a rate of approximately 1029 MCFGD, 0 BOPD and 0 BWPD. In May, 1979 the well was fracture stimulated in this interval. In January, 1995, Edwards became operator of the well. In January 1995, the well was re-perforated in the interval from 1,165' to 1,192 feet and was fracture stimulated in this interval in April 1995. In January, 1996, Pendragon became operator of the well;

e) the Chaco Limited Well No. 1-J was drilled by Merrion and Bayless in April, 1982 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,200' to 1,209'. The well initially tested in this interval at a rate of approximately 10 MCFGD, 0 BOPD and a trace of water. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7 ½ percent HCl. In January, 1996, Pendragon became operator of the well; and

f) the Chaco Limited Well No. 2-J was drilled by Merrion and Bayless in September, 1979 to test the Pictured Cliffs formation. The well was perforated and completed in the Pictured Cliffs formation from a depth of 1,186' to 1,202'. The well initially tested in this interval at a rate of approximately 208 MCFGD, 0 BOPD and 4 BWPD. In December 1979, the well was fracture stimulated in this interval. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7 ½ percent HCl. In January, 1996, Pendragon became operator of the well.

(23) A brief history of the Whiting wells, obtained from the evidence and Division records, is described as follows:

a) the Gallegos Federal 26-12-6 No. 2 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,138' to 1,157'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well;

b) the Gallegos Federal 26-12-7 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,131' to 1,150'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well;

c) the Gallegos Federal 26-13-1 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,158' to 1,177'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well;

d) the Gallegos Federal 26-13-1 No. 2 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,047' to 1,208'. The

well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well; and

e) the Gallegos Federal 26-13-12 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,178' to 1,197'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well.

(24) Pendragon's application, in the context of the Division's rules and regulations and the provisions of the New Mexico Oil and Gas Act cited herein, as well as the terms of Order No. R-8768, presented the Commission with certain primary issues that can be identified as follows:

I. Geology: Fruitland Sand vs. Pictured Cliffs Sand

II. Communication Between the Fruitland Coal and Pictured Cliffs Formations

III. The Cause of the Communication

IV. The Effect of the Communication

V. Regulatory Compliance and Relief

I. GEOLOGY: FRUITLAND SAND VS. PICTURED CLIFFS SAND

(25) In its Chaco Wells No. 1, 4, 5 and its Chaco Limited Well No. 2-J, Pendragon is producing from two separate sandstone intervals, hereinafter referred to as the "Upper Sandstone" and "Lower Sandstone" intervals and in its Chaco Well No. 2-R and Chaco Limited Well No. 1-J, Pendragon is producing only from the "Lower Sandstone" interval. It is the position of Pendragon that the top of the Pictured Cliffs formation occurs in this area at or above the top of the "Upper Sandstone" interval. The perforated intervals in each of the Chaco wells are as follows:

Well Name & Number	"Upper Sandstone" Perforations	"Lower Sandstone" Perforations
Chaco Well No. 1	1,113'-1,119'	1,134'-1,139'
Chaco Well No. 4	1,163-1,166'	1,173'-1,189'
Chaco Well No. 5	1,165'-1,169'	1,174'-1,192'
Chaco Limited Well No. 2J	1,186'-1,188'	1,200'-1,202'
Chaco Well No. 2R	None	1,132'-1,142'

Chaco Limited Well No. 1J None 1,200'-1,209'

(26) Whiting agrees that the "Lower Sandstone" interval is within the Pictured Cliffs formation; however, it contends that the top of the Pictured Cliffs formation occurs in this area only at the top of the "Lower Sandstone" interval.

(27) The discovery well for the WAW Pictured Cliffs field, was the WAW No. 1 drilled in the NW/4 (Unit L) of Section 32, T-27-N, R-13-W, NMPM and completed on June 30, 1970 by Dugan Production Corporation. The pick for the top of the Pictured Cliffs formation sandstone by Dugan geologists for the WAW No. 1 was at a depth of 1317 feet, which is above the "Upper Sandstone" interval.

(28) The discovery well for the NIPP Pictured Cliffs field was the Chaco Plant No.1 Well drilled in the SW/SE Section 17, T-26-N, R-12-W, NMPM and competed on April 11, 1975 by Dugan Production Corporation. The pick for the top of the Pictured Cliffs formation by Dugan was at a depth of 1,149 feet at the top of the "Upper Sandstone" interval.

(29) The parties have stipulated that the Pictured Cliffs formation was deposited in a marine environment and that the Fruitland formation was deposited in a non-marine or inland terrestrial environment (*i.e.* fluvial channels, deltaic distributory channels, *etc.*).

(30) In Order No. R-8768, the Division defined the vertical limits of Basin Fruitland Coal Gas Pool as all coal seams within the equivalent of the stratigraphic interval from a depth of approximately 2450 feet to 2880 feet as shown on the well log from the Amoco Schneider Gas Com "B" well No. 1. The pick for the base of the pool is the top of the Pictured Cliffs. The pick is also the break between marine and non-marine sediments. It is undisputed that those coals or shale layers occurring below the stratigraphic pick set forth in Order No. R-8768 would not be included in the Fruitland Coal pool or in the Fruitland formation.

(31) The geologic evidence presented by Pendragon shows that the Chaco wells are producing from a zone that is stratigraphically equivalent to an interval below the bottom of the Fruitland Coal gas pool.

(32) In its cross section C-C Pendragon identified the "stratigraphic equivalent", as that term is used in Order No. R-8768 and reflected on the well log for the Amoco Schneider Gas Com "B" Well No. 1 as the first marine sandstone below the Fruitland Coal formation. Evidence also presented by Pendragon establishes that the term "stratigraphic equivalent" means "the same kind of rock material".

(33) Pendragon's isopach of the Upper Pictured Cliffs sand shows the occurrence of that sandstone along the shoreline trending from a northwest to a southeast direction in a barrier bar marine littoral environment. Pendragon's exhibit also

establishes that the Upper Pictured Cliffs sand occurs in a continuous sheet sand that coalesces into the main body or bench of the Pictured Cliffs formation as the sand trends from the shoreline environment on the southwest toward the center of the San Juan basin to the northeast.

(34) The Upper Pictured Cliffs sand coalesces into thicker and undifferentiated Pictured Cliffs sands to the east, northeast and north, indicating that it is part of the same depositional environment. The Upper Pictured Cliffs sand also correlates and is continuous in character over a large area covering portions of four townships.

(35) The geologic evidence presented by Pendragon also establishes that the Fruitland sands are deposited along a trend from the Southwest to the Northeast on a channelized basis and that those sands thin toward the Northeast to the edge of the Pictured Cliffs sandstone body.

(36) In the area of the subject lands, the Upper Pictured Cliffs sand appears as a classic shoreline or chenier-type sand grading from 0 to approximately 13 feet toward the northeast where it coalesces into the main body of the Pictured Cliffs where the thin underlying shale stringers are not present. The Upper Pictured Cliffs sands cannot be differentiated from the main body of the Pictured Cliffs formation.

(37) The preponderance of the evidence, including the geologic literature and cross-sections shows that the Pictured Cliffs marine sandstone abruptly wedges out and is replaced by chrono-stratigraphically correlative coals. In Exhibit W-9, the pinch-out of the Pictured Cliffs sandstone and replacement with Coal B occurs across an interval of less than 1.4 miles. In Exhibit W-10, the stratigraphic wedge-out of the Pictured Cliffs sandstone and replacement by Fruitland formation inter-bedded coals and non-coals occurs across an interval of less than 0.88 mile. Thus, marine Pictured Cliffs sandstones contemporaneous with thick "basal Fruitland Coals" occur in close proximity to each other.

(38) The geologic testimony and literature further establishes that Fruitland sands are consistently recognized as non-marine (continental) deposits such as fluvial channels, deltaic-distributory channels and other landward deposits. Additionally, the geologic literature indicates that the pick for the top of the Pictured Cliffs formation is often at the base of the basal Fruitland Coal. The Fruitland formation is the non-marine facies tract consisting of inter-bedded sandstone, mudstone, and coal beds deposited landward of the marine facies tract of the Pictured Cliffs sandstone.

(39) The testimony and evidence established that directly beneath the Basin Fruitland Coal throughout this portion of the San Juan Basin is a shale, or "underclay" deposited directly upon the Pictured Cliffs sandstone. The underclay is continuous over a large area, thinning to the northeast and is usually highly conductive on electrical logs. It appears in a uniform deposit on a marine platform and is not cut by channels or downward coarsening sands. There is no sand body or separately identifiable shale in the

several hundred feet above the base of the basal Fruitland Coal, which demonstrates anything near the areal extent or uniformity of this underclay shale. It is correspondingly different from Fruitland deposits. The Pictured Cliffs section immediately below the underclay thickens towards the northeast, indicative of a time of subsidence, which caused the deposition of the upper Pictured Cliffs sandstone interval. Conversely, a non-marine sand-shale-sand sequence can be expected to thin out to the northeast and should trend from the northeast to the southwest instead of the northwest to the southeast.

(40) Whiting's geologist witness defined a "marine" environment as that which is influenced by the sea and the action of the sea. While the witness acknowledged that lagoons are under a marine influence, he would exclude lagoonal environments from the definition of "marine" environments.

(41) Lagoons may be described as "...of, belonging to, or caused by the sea" in conformity with the definition of "marine" as set forth in the AGI Dictionary of Geological Terms.

(42) In its geologic testimony, Whiting asserted that the disputed upper Pictured Cliffs sandstone interval was deposited in a non-marine, crevasse splay deposit, resulting from a large, sediment-laden river breaking through its natural boundaries during a flood stage and spreading, clean, well-sorted sand over an area more than sixteen miles long and up to three miles wide parallel to the shoreline.

(43) Whiting, through its expert consulting geologist, contended that peat forming coals occur only at distances significantly inland of the beach and shore-face sands of the Pictured Cliffs, and therefore, the "upper Pictured Cliffs sand" in the area of the subject lands was most likely the product of non-marine sediments deposited by a crevasse splay mechanism which formed far inland from the beach and shore-face sediments of the Pictured Cliffs sandstone. However, the witness's cross-section exhibit showed that coals were also formed or deposited within the Pictured Cliffs formation.

(44) Pendragon presented aerial photographs of modern day deposits of sands comparable in mode of deposition and areal extent to the Upper Pictured Cliffs sand located in the marine lagoonal areas behind barrier islands, thus demonstrating both the validity of the depositional model and the opportunity for muds and coal-forming organic materials to be deposited in this environment. Pendragon demonstrated in these exhibits that these sands are wave and tidal current dominated deposits, and further showed that the seaward beach of a barrier island is not to be confused with the true ocean shoreline which lies behind the island.

(45) The core analysis for the Lansdale Federal No. 1 located in the SE/4 of Sec. 7, T-26-N, R-12-W establishes the average permeability and porosity for the Upper Pictured Cliffs sand and that grain size and sorting throughout the Upper Pictured Cliffs sand are uniform, consistent with a marine depositional environment. The physical descriptions of the sand appearing in the Upper Pictured Cliffs bench and the two lower

benches are gray, fine grained with little variation in clay content, consistent with a marine sand that has been laterally transported to the point where the energy available sorts the sand into uniform size. Sand sorting characteristics of this sort are not consistent with a fluvial deposit with graded bedding and coarsening downward.

(46) The descriptions for the disputed sandstone upper tongue interval and the main body of the Pictured Cliffs sandstone on the core analysis of the nearby Landsdale Federal No. 1 well are identical. The uniform description for both as gray, fine-grained with some clay content is consistent with marine sand, which was sorted and deposited by currents and waves. This evidence further supports the conclusion that the upper tongue is Pictured Cliffs sandstone.

(47) The Upper Pictured Cliffs sand is elongated along a northwest to southeast strike parallel to the ancient shoreline. The sand thickens consistently to the northeast, which is not consistent with a fluvial or crevasse splay deposit.

(48) There is no evidence establishing that the ~~upper~~ Pictured Cliffs sandstone in the area of the subject wells is associated with any stream channels or down-cutting as would be the case in a fluvial environment. Rather, the deposition of a sand with the consistency in geometry of the upper Pictured Cliffs sand requires a marine setting with a flat, stable base and a source of sand with consistent grain size spread by tidal or wave energy. Such conditions do not occur onshore and behind the shoreline.

(49) Whiting failed to establish by a preponderance of the evidence, the existence of any crevasse splay, or any depositional materials indicative of a sand-laden flood of tremendous velocity scouring or cutting down through the area where the sand would have been deposited. Moreover, there is no evidence of the transporting river or river channel or the thinning of sand deposits in both directions at right angles to the river, adjacent deltaic deposits or any other non-marine mechanism with the capability of forming the thin, but areally extensive sand of the dimensions seen in the upper Pictured Cliffs sandstone. The available core analysis data showed none of the characteristics consistent with the fluvial depositional materials or mechanics.

(50) Whiting's geological consultant presented an isopach of the Upper Sandstone, which, at its northern edge implies the sand is lying directly upon the marine, thick Pictured Cliffs sand. Additional evidence established that it is not a geologically credible possibility that such a deposition would occur as a result of a crevasse splay.

(51) Whiting's expert consulting geologist testified that it was also possible that the disputed interval was deposited by a washover fan mechanism. The washover fan depositional mechanism includes oceanfront, storm and wave-dominated action, all of which are consistent with the accepted geologic definitions of a marine depositional mechanism. Such a theory also supports a conclusion that the Upper Pictured Cliffs sandstone was deposited in a marine environment.

(52) Pendragon presented evidence that the Spontaneous Potential readings on electrical logs are much greater in the Pictured Cliffs formation which was deposited in a marine setting than are those of the Fruitland sands which were deposited in a fluvial, fresh water environment. Pendragon then showed that the SP readings for the Upper Sandstone were comparable or identical to those of the Lower Pictured Cliffs and were much greater than those of the Fruitland sands above the Basal Coal. Examples of this fact were found on the geological cross-section prepared by Whiting's consulting geologist.

(53) The spontaneous potential (SP) map of the Pictured Cliffs introduced by Whiting's expert geologist showed 40 to 80 millivolt SP development in the Chaco area. The cross-section exhibit introduced by that expert demonstrated that the disputed interval also showed 40 to 80 millivolts SP, even though it was interpreted by the witness to be Fruitland sandstone, and all other Fruitland sands on his cross-section showed only zero to less than 10 millivolts. Additional testimony established that 40 to 80 millivolts is a significantly higher range than is typically associated with SP development in a fresh-water depositional environment and is more characteristic with the SP development in the Pictured Cliffs intervals observed on the well logs and cross-sections for the Chaco wells. The geologic evidence also established that Pictured Cliffs sandstones have higher SP development because they are deposited in a more saline marine environment. This evidence further supports the conclusion that the disputed interval is Pictured Cliffs sandstone that was deposited in a marine environment.

(54) In a number of instances, Whiting's consulting geologist witness misidentified shales as sandstones on his cross-section exhibit or otherwise failed to distinguish between the two types of rock where they occur adjacent to one another. As a consequence, the witness similarly failed to distinguish between the two in his discussion of core sample and well log response characteristics. Consequently, the witness's testimony in this area is unreliable and should not be considered.

(55) The geologic evidence shows that the upper Pictured Cliffs sandstone tongues are widespread and occur in the southern portion of the San Juan Basin, including the area of the subject lands.

(56) The evidence presented by Pendragon establishes that over the years, approximately 34 wells within approximately 2.5 miles of the Pendragon Chaco Wells were actually perforated in the Upper Pictured Cliffs sand in conjunction with other Pictured Cliffs intervals and reported by the numerous different operators of those wells as Pictured Cliffs completions, consistent with the picks for the top of the Pictured Cliffs for the Chaco Plant No. 1 and the Subject Chaco Wells (Exhibit N-61). The evidence also establishes that those reported completions were accepted by the Division and the Bureau of Land Management and that industry and geologists have placed substantial reliance on those reported completions as Pictured Cliffs completions for nearly thirty years.

(57) Whiting presented testimony and an exhibit to support its contention that the operators of approximately one hundred additional wells outside the area of the subject lands had identified the top of the Pictured Cliffs sandstone "massive" as the vertical boundary between the Pictured Cliffs and Fruitland formation. However, Whiting failed to present any additional evidence establishing whether the upper Pictured Cliffs interval was present in any of the wells identified. Similarly, Whiting failed to present any evidence tending to show that any operator identified the top of the Pictured Cliffs sandstone as the massive sand in those areas where tongues of the Pictured Cliffs are known to exist.

(58) Maralex's president testified that when he evaluated the Pictured Cliffs formation and wells in the area of the subject lands in 1994, he did not check the perforated intervals or otherwise question the identification of the top of the formation at the Upper Pictured Cliffs sandstone.

(59) In a written statement provided to the Division in conjunction with its hearing in Case No. 11996, Merrion Oil and Gas Corporation, the assignor of the interests in both the Fruitland Coal formation to Maralex/Whiting and Pictured Cliffs formation to Pendragon indicated its concurrence with Pendragon's identification of the upper Pictured Cliffs interval and the historic recognition of that interval as Pictured Cliffs by Merrion and other operators in the area. (Exhibit N-43.) Merrion further stated its belief that Pendragon's wells are appropriately perforated in the Pictured Cliffs formation and that it had no intention of conveying to Pendragon wells that were perforated in other zones. Merrion also stated that it never intended to farm-out to Whiting the rights to zones where its producing wells (the Chaco wells) were perforated.

(60) Whiting contends that the top of the first "massive" sandstone below the lowermost coal of the Fruitland formation should be the definitional basis for picking the top of the Pictured Cliffs formation. The geologic testimony and evidence shows that such a definition has little support in the geologic literature and that the arbitratrary and undefined term of "massive" makes its application impractical. The geologic literature for the area and industry practice indicates that it is more common to place the contact between the Fruitland and Pictured Cliffs formations at the top of the highest ophiomorpha-major bearing sandstone. Consequently, the more widely accepted technical definition of a Pictured Cliffs sandstone is whether the formation is of marine deposition, such as shoreline, wave-dominated, delta-front chenier, barrier bar and tidal channel-type environments. In addition, the use of the "massive" definition would be in conflict with Order No. R-8768, establishing the equivalent statigraphic interval designated as the Fruitland Coal gas pool.

(61) The evidence and testimony of the geologists established that the definition of "massive" utilized in the AGI Glossary of Geology includes beds that are more than ten centimeters (four inches) in thickness or more than 1.8 meters (six feet) in thickness. Accordingly, under this definition, the Upper Pictured Cliffs sandstone tongues would be considered as "massive" sands.

(62) Whiting's consulting geologist advocated the use of a twenty-foot cut-off for defining the boundaries of Pictured Cliffs sandstone tongues and urged the Commission to disregard any deposits thinner than twenty feet. The witness testified the twenty-foot cut-off was used in a mapping study over a very wide area in the northern part of the San Juan Basin. However, Whiting's geologist acknowledged that the cut-off is a product of a "good average" and that Pictured Cliffs sandstone tongues less than twenty feet thick do exist. Additional geological literature evidence documents the occurrence of the Upper Pictured Cliffs sandstone in the WAW field in tongues from fifteen feet to three feet in thickness. Consequently, while the selection of a twenty-foot cut-off may be appropriate for a broad, academic geological study, its use by the Commission in this proceeding would lead to an unnecessarily arbitrary result.

(63) The testimony further established that the use of a twenty-foot cut-off for mapping the extent of Pictured Cliffs tongues is not practical and would cause significant Pictured Cliffs gas reserves to be arbitrarily disregarded.

(64) A 1994 type log published by the consulting geologist for Whiting and Maralex (Exhibit W-4) reflects a tongue of the Pictured Cliffs within the Fruitland formation above the so-called the "massive" sand of the main body of the Pictured Cliffs sandstone. This tongue is referred to by the author as UP1, which the author explains to stand for "upper Pictured Cliffs sandstones or upper Pictured Cliffs tongues." Thus, the interpretation of Whiting's consulting geologist supports that of Pendragon's.

(65) The interval from the top of the "upper Pictured Cliffs sandstone," as mapped by Pendragon, to the top of the main body of the Pictured Cliffs is composed of a variety of rock types including marine sandstones, silt stones, shales, and thin coals. It has been the long-standing and accepted custom and practice of industry and the various regulatory agencies to place this entire interval within the Pictured Cliffs sandstone. This industry and regulatory agency practice conforms to the standards of the North American Statigraphic Code and the International Stratigraphic Guide that state, "where a rock unit passes into another by integrating or interfingering of two or more kinds of rock...the boundary is necessarily arbitrary and should be selected on the basis of practicality."

(66) The boundary between the Fruitland formation and the Pictured Cliffs sandstone has been placed by industry and accepted by regulatory agencies to be at the top of the "upper Pictured Cliffs sand" as that interval has been referred to in these proceedings. The "upper Pictured Cliffs sand" is marine and as such, conforms to the Fassett and Hinds (1971) definition of the top of the Pictured Cliffs as marked by the highest marine sandstone. The boundary placed by industry also meets the test of practicality, and as such, fully conforms to the dictates of the North American Stratigraphic Code and the International Stratigraphic Guide.

(67) The identification and utilization of the Upper Pictured cliffs sandstone tongue to establish the vertical boundaries of the Pictured Cliffs formation by industry

and the governmental regulatory agencies is a long-established custom and practice. Such custom and practice is to be accorded significant weight.

(68) The vertical boundary between the Fruitland formation and Upper Pictured Cliffs sandstone in the area of the subject lands conforms to the base of the "Fruitland (coal gas) formation" in the assignment from Merrion and Bayless, *et al.* to Maralex and with the base of the "Fruitland Coal formation" in the assignment from Merrion and Bayless to Edwards. This formational boundary also conforms to accepted industry and regulatory interpretation. It conforms to the intentions of the parties; Maralex to farm in the "Coal Gas Formation", and of Merrion to sell Pictured Cliffs producing wells.

(69) In defining the vertical limits of the basin Fruitland Coal gas pool, the Division's Order No. R-8768 utilizes the phrase "all coal seams within the equivalent of the stratigraphic interval..." to the rock occurring at a specified depth in the well log for the Amoco Production Company Snyder Gas Com B well No. 1. The term "equivalent" means that one can determine at geographically separated stations that the rocks in question are the same. Accordingly, the use of the phrase "stratigraphic equivalent" means "lithostratigraphic" equivalent. From the definition in Order No. R-8768, the vertical limits of the basin-Fruitland Coal gas pool are the coals in rocks which are lithostraphigraphically equivalent with the Fruitland formation. In the subject area, rocks downward from the top of the "upper Pictured Cliffs sand" mapped by Pendragon are part of the Pictured Cliffs sandstone and are not a lithostratigraphic equivalent to the Fruitland formation. Accordingly, the interval in question is not part of the Basin Fruitland Coal gas pool or the WAW Fruitland sand.

(70) The preponderance of the geologic evidence establishes that the Chaco wells are producing from a zone that is stratigraphically equivalent to an interval below the base of the Fruitland Coal gas pool. Moreover, the classification of the upper sandstone interval as Pictured Cliffs is supported by a preponderance of the geologic evidence and is consistent with the interpretation by the larger scientific community, by industry and by governmental agencies.

(71) The preponderance of the geologic evidence establishes that the subject Chaco wells are completed in and are producing from the Pictured Cliffs formation sandstone intervals and from their appropriate common source of supply.

(72) Whiting's request that the Commission establish the base of the Fruitland formation in the subject area at the top of the "massive" sandstone below the lowermost continuous coal should be denied.

II. COMMUNICATION BETWEEN THE FRUITLAND COAL AND PICTURED CLIFFS FORMATIONS

(73) Whiting contends that the Pictured Cliffs reservoir in the subject area was depleted by the time Pendragon re-stimulated the Chaco wells in 1995. Whiting further contends that the post-stimulation treatment production increases experienced by the Chaco wells is exclusively attributable to production from the Fruitland Coal formation as a result of communication between zones.

(74) Pendragon contends that the Pictured Cliffs is not a depleted reservoir. Pendragon contends that the stimulation treatments performed on the Chaco wells successfully overcame wellbore and reservoir damage. Pendragon also pointed to wells outside the subject area where it and other operators have successfully restored Pictured Cliffs wells to production through acid and hydraulic fracture stimulation treatments.

(75) Both sides presented testimony and evidence on reservoir pressures and reserves. Pendragon presented additional evidence on wellbore and reservoir damage.

(76) Pendragon's Pictured Cliffs restimulation program was based on the successful recompletion of the Chaco Plant 5 well located in the northwest quarter, Section 21, T 26 N, R 12 W, NMPM. The Chaco Plant 5 well was originally drilled and completed in the Pictured Cliffs formation in 1975. Original surface shut-in tubing and casing pressures were then 212 psi. The well was fracture-stimulated in the Pictured Cliffs by Edwards in June of 1993 and the well flowed without artificial lift or compression. In August of 1993, during a shut down of the El Paso Natural Gas Chaco Plant, the surface shut-in tubing and casing pressures were 160 psi. The production curve for the Chaco Plant 5 well peaked relatively soon after the fracture stimulation and then declined on a profile typical of that for Pictured Cliffs wells, and producing only small amounts of water. A number of Fruitland Coal wells had been drilled in the immediate vicinity of the Chaco Plant 5 well, but in 1993, were clearly in the early de-watering phase of production. Gas production from those wells was shown to have been in a long incline, and not peaking until 1995 or 1997. By August, 1993, none of the surrounding coal wells had made as much cumulative gas production as was being produced by the Chaco Plant 5 every two months. At no time has the Chaco Plant 5 required pump assist to lift water.

(77) The Pictured Cliffs sandstone and the Fruitland Coal are separated by approximately four feet of shale in the Chaco Plant No. 5 well. Edwards specifically designed a hydraulic fracture stimulation treatment taking these specific reservoir conditions into account. The fracture treatment consisted of 15,000 lbs. of sand injected at a maximum rate of 15 barrels of fluid per minute. Shortly after the fracture stimulation treatment, shut-in tubing and casing pressures on the Chaco Plant No. 5 well were measured at 160 psi. Reservoir pressure in the coal at that time was approximately 250 psi. By early 1994, the Chaco Plant No. 5 well was flowing at daily rates from between 165 to over 230 MCFd with very little water production and without the need for

artificial lift. The stabilized decline in production rates for the well did not approximate production decline curves of typical Fruitland Coal formation wells.

(78) The fracture stimulation treatment for the Chaco Plant 5 well consisted of 15,000 lbs. of sand injected at a maximum rate of fifteen barrels of fluid per minute. There is no indication that the Chaco Plant 5 well is in communication or ever has been in communication with the Fruitland Coal formation.

THE DEPLETION VS. NON-DEPLETION ISSUE

(79) The Whiting/Maralex contention that the Pictured Cliffs formation was depleted was based on an evaluation of the reservoir performed by Maralex in 1994.

(80) In 1994, Maralex evaluated the subject Chaco Pictured Cliffs wells, along with a number of other Pictured Cliffs and Fruitland Coal formation wells located on acreage outside the subject lands. Based on that evaluation, Maralex determined at the time that the Pictured Cliffs reservoir in the subject lands was depleted and declined to purchase the Pictured Cliffs rights in the immediate area and further declined to purchase a number of additional properties with Fruitland Coal rights. Other operators, including Pendragon, who acquired some of the acreage rejected by Maralex in 1994 have since developed significant Pictured Cliffs and Fruitland coal production on the properties.

(81) Because it had previously determined that the Pictured Cliffs was a depleted reservoir, Maralex concluded that the Chaco Pictured Cliffs wells were no longer capable of producing and that any production from those wells subsequent to the stimulation treatments was in fact the production from the Fruitland Coal formation.

(82) The testimony and evidence establish that the 1994 evaluation of the subject Chaco wells and the additional acreage outside the area of the subject lands consisted of a cursory economic analysis, being based largely on incomplete production information. Limited well log information was utilized for a "rough" volumetric analysis and Maralex's president confirmed that he did not check the perforated intervals or otherwise question the identification of the upper Pictured Cliffs formation. There was no effort to determine the existence of well or reservoir damage and reservoir pressures were not considered.

(83) Maralex's president also testified that he did not utilize reservoir pressures in making his volumetric gas in place calculations in conjunction with his evaluation of the Pictured Cliffs reservoir in 1994. Consequently, the 1994 evaluation was fundamentally flawed.

(84) In his written testimony, Maralex's president represented that the Bureau of Land Management had issued a number of plugging demand letters to Merrion and Bayless, the previous owners of the Chaco wells. Pendragon objected to the written

testimony and presented other evidence that the BLM's well files on the Chaco wells contained no plugging demand letters. Correspondingly, during the hearing *de novo*, the Commission ordered that portion of the Whiting/Maralex testimony stricken.

FORMATION PRESSURES

(85) Whiting asserted that as of 1995, the Pictured Cliffs formation was pressure depleted and that the gas produced and pressures measured subsequent to the 1995 stimulation treatments were a consequence of the Chaco wells having communicated with the coal formation.

(86) Pendragon presented pressure data for the Chaco wells taken from Division records and operator's reports. The relevant pressure history for the Chaco wells is summarized as follows:

Well No.	Wellhead Shut-In Pressure psi/Date	Treatment Date and Type
Chaco 1	137/(6/81) 137/(7/83)	
		1/95 frac
	170/(2/95) 154/(8/95) 151/(10/95)	
Chaco 1-J	193/(5/82) 87/(6/84)	
	158/(1/95)	1/95 acidized
	155/(2/95) 1/43/(8/95) 148/(10/95)	
Chaco 2-J	220/(12/79)	12/79 frac
	157/(8/80) 188/(3/95) 196/(4/95) 198/(6/95) 180/(10/95)	
Chaco 2-R	132/(6/81) 110/(7/83)	
		1/95 frac
	104/(3/95) 108/(7/95)	

Well No.	Wellhead Shut-In Pressure psi/Date	Treatment Date and Type
	110/(8/95)	
	116/(10/95)	
	117/(1/96)	
	150/(7/96)	
Chaco 4	225/(5/77)	
	197/(8/78)	
	162/(5/79)	
	102/(5/81)	
	97/(7/83)	
		1/95 acidized
	140/(2/95)	
	147/(3/95)	
	147/(5/95)	
	153/(5/95)	5/95 frac
	162/(10/95)	
	135/(9/96)	
	144/(10/96)	
	136/(7/97)	
Chaco 5	227/(11/77)	
	201/(8/78)	
	142/(5/79)	5/79 frac
	121/(6/80)	
		5/95 frac
	151/(5/95)	
	158/(10/95)	
	140/(9/96)	
	143/(10/96)	

(87) The original reservoir pressure in the Pictured Cliffs formation in the late 1970's was approximately 230 psi. By 1995, reservoir pressures ranged from between approximately 150 to 170 psi, or higher. In 1999, Pictured Cliffs' reservoir pressures ranged from above 150 psi to 73 psi in those areas characterized by significant offset production. The testimony and evidence establish that Pictured Cliffs wells may be produced economically today at reservoir pressures falling below 50 psi.

(88) The pressure in the Chaco 1J had a surface shut-in casing pressure of 158 psi before any acidizing or other stimulation was done.

(89) After the acid stimulation treatments in 1995 and following a pressure build-up period, pressure measurements in the Chaco No. 4 well over three months ranged between 140 to 147 lbs., which was approximately 60 percent of the original reservoir pressure of 230 lbs.

(90) In 1995, post-fracture stimulations pressures were 170 lbs. in the Chaco 1, 151 to 153 lbs. in the Chaco 4 and 5 wells, and, in July, 1996, 150 lbs. in the Chaco 2-R well, indicating a relatively uniform pressure throughout the Pictured Cliffs reservoir in the area. During this same period of time, pressures in the Fruitland Coal formation, measured in 1994 in the Gallegos Federal 6-2 well and the 7-1 well were approximately 220 lbs. Correspondingly, there is no evidence that the pressures exhibited in the Chaco wells increased to Fruitland Coal formation pressures during this period of time. Moreover, the Pictured Cliffs reservoir pressures are consistent both before and after the stimulation treatments.

(91) In 1998, the compression assistance installed on the Chaco 1 and Chaco 4 resulted in minimal increases over prior production. The response of these Chaco wells to compression is more characteristic of conventional sand reservoir production than coal reservoir production as producing rates did not substantially increase above historic levels. In contrast, the effect compression had on the Whiting Gallegos Federal Fruitland Coal wells was a significant production increase resulting from the dramatic drop in reservoir pressure, thereby liberating larger amounts of gas from the coal.

(92) The surface shut-in pressure of 158 psi measured on the Chaco 1-J well on January 28, 1995 is an accurate reflection of Pictured Cliffs reservoir pressures before any of the restimulation treatments were performed on the Chaco wells. This pre-stimulation pressure is in line with pressures taken subsequent to the acid job on that well (155 psi). Following a five-month shut-in period, the Chaco 2-J well had a shut-in pressure of 198 psi in June 1995, subsequent to the January 30, 1995 acid job. When the well was open to the atmosphere, it blew down to zero pressure in four minutes. Such well performance is not indicative of the high-rate, high-volume of the cross flow that could be expected if the well had communicated with the Fruitland Coal formation.

(93) The measured pressures in the Pictured Cliffs wells in 1995 were less than the average reservoir pressure in the Fruitland Coal formation at that time.

(94) Pictured Cliffs reservoir pressure evidence presented by Pendragon establishes that there is no correlation between pressures in the Pictured Cliffs and distances from coal wells. The relatively constant pressure or, in some instances, the slight pressure increases, is indicative of a stabilized pressure over a large reservoir area.

(95) Whiting contended that the higher Pictured Cliffs pressures found in the area of the Chaco No. 5 well were due to the invasion of pressure from the Fruitland Coal formation due to a casing leak. However, evidence establishes that the casing leak in the

well was located approximately 200 feet above the basal Fruitland Coal and that the leak was successfully repaired prior to the fracture stimulation treatment on that well.

(96) Whiting contended that the pressures seen in the Chaco wells in 1995 were not valid Pictured Cliffs formation pressures, but were instead caused by communication with the coal. Whiting presented no evidence to show why those Chaco well pressures were not the same as the pressure in the coal at the time, as should be the case if Whiting's premise were correct. Moreover, for Whiting's premise to be valid, the numerous pressures seen in the Chaco wells prior to the fracture stimulations must also be coal pressures. Whiting was unable to explain why the pressure of 158 psi in the Chaco 1-J prior to any well stimulation treatment should not be accepted as valid, and Whiting's operations manager was unable to provide information or evidence that any of the thousands of acid jobs done in Pictured Cliffs wells in the area over the years had ever shown a resulting communication with the coal.

(97) At approximately 150 psi, 1995 Pictured Cliffs reservoir pressures in the subject area, generally, are approximately 62 percent of original pressure, indicating that the reservoir is only partially depleted. Further reservoir analysis evidence that assumed a reservoir thickness of 25 feet with 25 percent porosity, at 65 percent gas saturation and a 75 percent recovery efficiency established that the Pictured Cliffs reservoir has significant additional reserves remaining to be produced.

(98) The rapid production decline experienced by the Chaco wells so soon after their initial completion is not consistent with the well production behavior that could be expected from a large, continuous reservoir with high permeabilities, therefore indicating the possibility of damage in the wellbore and in the reservoir in the immediate vicinity of the well.

(99) Pressure information obtained during the year-long shut-in of the Chaco Pictured Cliffs wells in 1998 confirms reservoir continuity and pressure communication over large areas which is additional evidence supporting the conclusion that each of the wells can produce reserves from a large area. In addition, the shut-in data show that pressure continues to build up in those areas with little withdrawal, except where the Pictured Cliffs gas is being produced by the coal wells.

(100) The long pressure build-up times observed during the year-long shut-in demonstrates that the short, periodic shut-ins measured in the early 1980's did not yield stabilized reservoir pressures data.

PICTURED CLIFFS FORMATION AND FRUITLAND COAL FORMATION VOLUMETRIC AND MATERIAL BALANCE ANALYSES

(101) Pendragon's engineering evidence established that the Pictured Cliffs formation in the subject area is a high porosity, high permeability reservoir with moderate

pressures. Water saturation varies from approximately 30 percent in the upper portion of the sand to near 100 percent in the lower sands. Log analysis and core data establish that porosities in the subject area are greater than 20 percent. The historically high initial flow rates at relatively modest reservoir pressure differentials also indicate the existence of good permeability.

(102) The recent drilling and fracture stimulation completion of the Pictured Cliffs formation in the last few years in the State 2-R well located in Section 2, T26N R13W, which produces approximately 400 Mcfd, is additional evidence establishing that the Pictured Cliffs is not depleted.

(103) Pendragon presented volumetric and material balance analysis evidence showing that there are sufficient reserves in the Pictured Cliffs formation to support the historic and projected production from the Chaco wells.

(104) Volumetric analysis for the Pictured Cliffs formation based on hydrocarbon pore volumes derived from log calculations ~~range from~~ as high as 4.7 BCF per 640 acres to an average of 3.1 BCF per section at initial reserve pressure. The estimated average drainage area for the Pictured Cliffs wells is calculated at 173 acres, based on volumetric estimates of the original gas in place (OGIP).

(105) In most cases, the Pictured Cliffs volumetrics analysis performed by the Whiting witnesses did not utilize accurate reservoir pay thicknesses and failed to take into account all the reserves available in the main and lower benches of the formation. For instance, the volumetrics analysis of the Chaco 2-R well performed by Whiting's consulting petroleum engineer assumed pay thickness of only 9 feet. The witness failed to honor well log information for the Chaco 2-R which showed approximately 24 feet of pay. Consequently, Whiting's volumetrics evidence is not reliable.

(106) Well log information presented by Pendragon establishes the absence of any lithologic barrier to the downward growth of fracture treatments initiated in the main body of the Pictured Cliffs into the lower, third bench of the Pictured Cliff sandstone. Correspondingly, Pendragon establishes by a preponderance of the evidence that it is probable that the third bench of the Pictured Cliffs sandstone contributes substantial reserves to the subject Chaco wells.

(107) Whiting's consulting petroleum engineer also testified that the lower bench of the Pictured Cliffs contained approximately 30 percent gas saturation.

(108) Generally, the evidence establishes that the Pictured Cliffs wells were producing volumes of gas that were less than their OGIP, whereas the Fruitland Coal wells have been and will produce more than their indicated OGIP on 320 acres.

(109) Pendragon presented material balance and gas-in-place analysis data for the subject Chaco wells. Those data showed a material balance OGIP of 3,117,000 MCF

for the five Pictured Cliffs wells. When compared with the performance history and estimated reserve analysis data, the subject Pictured Cliffs wells indicated an ultimate recovery of 2,301,525 MCF, or approximately 73.8 percent of the material balance reserves. Both the volumetric analysis and material balance analysis data show sufficient reserves in the Pictured Cliffs formation to support the historic and projected production from the Chaco wells.

(110) Volumetric analyses for the Fruitland Coal formation in the area establish that the basal coal contains an average of 1,262,661 MCF per 320-acre spacing unit. Altogether, the five subject Fruitland Coal wells are estimated to have 6,897,801 MCF OGIP per 320 acres. The ultimate recoveries for these Fruitland Coal wells were shown to be significantly high relatively early in their producing lives. For instance, the Gallegos Federal 26-12-6 No. 2 and are the 26-12-7 No. 1 have already produced more than 83 percent OGIP each. Together, all of the subject Gallegos Federal Fruitland Coal wells have produced 54.1 percent of the OGIP. This analysis shows that the subject Fruitland Coal wells are producing much more gas than can be calculated to exist on each of their 320-acre spacing units. In addition, well performance and decline curve analysis demonstrates that Whiting's wells have an average drainage area of 545 acres, pressuming they produce only coal gas.

(111) The gas production history for the subject coal wells shows cumulative production for all five wells at 3,733,295 MCF. Remaining recoverable reserves based on estimates are 4,557,865 MCF. At the 76 percent estimated recovery factor, ultimate recoveries are anticipated to be 8,291,160 MCF. The Whiting Fruitland Coal wells have produced and are expected to produce much more gas than can be accounted for from the Fruitland Coal formation on 320-acre spacing. The performance of the subject coal wells and subsequent gas recoveries indicate that the Chaco wells are not producing Fruitland Coal gas reserves and are not interfering with the Gallegos Federal wells.

(112) Following their original completions, the Pictured Cliffs wells exhibited significantly high IP's. The Chaco No. 1 well had an IP of 342 MCFd while the Chaco 4 had 480 MCFd. The reported IP of Chaco No. 5 was 1,029 MCFd. At no time since their original completions or subsequent to the stimulation treatments did the production levels on any of the Chaco wells exceed the reported IP's.

PICTURED CLIFFS WELL AND RESERVOIR DAMAGE

(113) Pendragon contended that the production decline and the relatively low pre-1995 recoveries from the Chaco wells is attributable to well and reservoir damages.

(114) Pressure build-up information derived from measured surface pressures and bottom hole pressures indicated the existence of reservoir damage that is more significant than what is typically attributed to skin damage. Pendragon's expert well-testing and reservoir engineer characterized the damage as "extreme, severe and very

deep" formation damage, extending to a great distance away from the wellbore. The extent of the damage is also reflected on the production curves for the subject Pictured Cliffs wells.

(115) Pendragon presented evidence establishing that the Chaco wells were damaged by one or more of the following: (1) scale precipitation, (2) water blockage and (3) migration of clay fines.

(116) Of the three types of damage determined may exist in the Chaco wells, the most likely cause of damage is water block that has plugged off the more permeable intervals of the Pictured Cliffs or those intervals with higher gas saturation levels. The testimony further established that even small volumes of water in a relatively low pressure reservoir such as the Pictured Cliffs formation can cause water block, making it more difficult for Pictured Cliffs wells to recover once water intrudes into the area around the wellbore.

(117) Outside substantiation for the possibility ~~of re~~servoir damage in the Pictured Cliffs is found in the Halliburton core sample analysis for the Lansdale Federal No. 1 well indicating that "the samples are basically fine to very fine grained kaolinite clay cemented sandstone. Permeabilities range from less than one millidarcy to 272 millidarcies. The main water sensitivity is kaolinite clay migration in the pores."

(118) Acidization and hydraulic fracture stimulation are prudent and appropriate means of overcoming the reservoir damage caused by the kaolinite clay migration in the sandstone pores.

(119) A reservoir simulation model was used to determine theoretical well performance of a Pictured Cliffs well having a reservoir thickness of twenty-four feet and a permeability of 25 millidarcies. The simulation establishes that such a well has the capability to efficiently drain a 640 acre reservoir. The simulation results are additional evidence supporting the conclusion that the relatively poor performance exhibited by the subject Pictured Cliffs wells is a result of reservoir damage.

(120) The petroleum engineering expert testimony concluding that Pictured Cliffs well and reservoir damage was caused in part by scale is based on actual observations in the field in the area of the subject lands.

(121) An analysis of the transmissibility in the Pictured Cliffs formation using reported shut-in and well head flowing pressures over time establishes that the transmissibility in the reservoir had decreased. Calculations of flow capacity for the Pictured Cliffs wells show they were capable of flowing at only 9 percent to 36 percent of the peak calculated permeability. This evidence established that significant reservoir damage had occurred by 1986, which was overcome by the fracture and acid stimulation treatments in 1995.

(122) Maralex's president testified that their evaluation of the Pictured Cliffs wells in the area that had not been stimulated showed no measurable response to the fracture stimulations in the Gallegos Federal Coal wells. Such testimony is further evidence that the existence of reservoir damage in the Pictured Cliffs would inhibit a measurable response.

(123) Maralex's president also testified that the volumetric and material balance analyses performed on the Chaco Plant 5 and the Chaco No. 4 indicated a component of damage had affected those wells as they had substantially underproduced the recoverable gas in place. This not only substantiates the existence of damage, it directly contradicts the premise that the formation was fully depleted.

(124) During the January 1995 acid stimulation treatment, the measured surface pressure on the Chaco No. 4 well reached 800 psi before the injection of 500 gallons of acid into the formation could commence, even though this well shows the highest permeability in the Pictured Cliffs. That such pressure was reached during the acid job is direct evidence of the existence of reservoir damage.

(125) The damage to the Pictured Cliffs formation resulted in a reduction in the "effective permeability" or "transmissibility" which impaired the productivity of the Chaco wells.

(126) The testimony and evidence established that once the skin was overcome by the acid and fracture stimulation treatments, the Chaco wells with their 50 millidarcy average permeabilities and their 150 psi Pictured Cliffs reservoir pressures were able to produce significant volumes of gas into a gathering system with 40 to 50 pound line pressures.

(127) Whiting's witnesses agreed that it was prudent for the operator of the Pictured Cliffs formation to stimulate the wells to increase production.

(128) Whiting presented no testimony or evidence that refuted the possibility of the existence of wellbore and reservoir damage in the Pictured Cliffs formation. Consequently, the existence of wellbore and reservoir damage is supported by a preponderance of the evidence.

(129) The pressure data and other reservoir pressure evidence presented by Pendragon establish that the Pictured Cliffs formation was not a depleted reservoir before the acid and fracture stimulation treatments applied to the Chaco wells in 1995. The same evidence also establishes that the Pictured Cliffs formation contained substantial remaining commercial reserves.

III. THE CAUSE OF THE COMMUNICATION

WELL COMPLETION AND STIMULATION TREATMENTS

(130) Hydraulic fracturing is the processing of using fluids pumped at high rates and pressures to create fractures in underground reservoirs. Once a fracture is created, the fluid causes the crack to widen sufficiently to permit the introduction of a solid proppant, usually sand, into the fracture to keep the fracture parted and to provide a very high permeability pathway for reservoir fluids to enter the wellbore. The process creates a crack in the rock, which is typically several feet high and less than an inch wide. The fracture can extend several hundred feet into a reservoir. When pumping starts and the fracture is initiated, the fracture fluid is pumped away from the wellbore and as pumping continues, the distance of leading edge of the fluid moves farther from the wellbore. Fractures may have highly irregular and unsymmetrical geometry.

(131) During the fracture stimulation process, fluid is introduced into the tubing and pressure is increased until a fracture is created and ~~a sudden~~ drop in pressure is observed. Fluid is then pumped at a desired rate and proppant is added. Once the full volume of treatment is pumped, the pumps are shut down and the instantaneous shut-in pressure or "ISIP" is measured, providing an estimate of fracturing pressure. Inside the fracture, the fluid will leak off into the reservoir and as the fracture closes, proppant is trapped between the walls of the fracture. Pressure data are utilized to determine the closure point in the fracture.

(132) Pendragon presented evidence which establishes that fractures will be likely to, and frequently do remain confined and not grow across the reservoir top or bottom if the bounding reservoir rock above or below the pay interval is stronger or has high in-situ stresses or if the interface between the two rocks can slip and absorb the energy of the fracture extension.

(133) Pendragon presented additional evidence, which establishes that the different types of rocks at a reservoir boundary will have different in-situ stresses. The difference in the stresses is known as the stress contrast. The stress contrast between the sandstone and the coal in the Chaco area is approximately 400 psi and is 125 psi between the sandstone and a shale. During a fracture stimulation treatment, assuming there is no slip at the boundary of the different rock types, the fracture fluid must attain sufficient pressure to exceed the stress contrast in order to breach the boundary. If slip is present, then yet more pressure is required to exceed both the stress contrast and to displace the rocks sufficiently to create a crack in the breached interval. Consequently, assuming no slip, fracture pressures must exceed the stress contrast of 400 psi in order to breach into the coal. If the coal is not breached, then fracturing pressures will be controlled by the stresses in the sand and shales themselves. Conversely, a fracture initiated in the coal will more easily breach out of formation and into the sandstone, as the sand will have much lower stress than the coal formation.

(134) The evidence presented by Pendragon's petroleum engineers and geological engineers establishes that artificially induced fractures are influenced and controlled by lithology and bedding planes. Softer, more ductile rocks deform plastically at stresses where more brittle, less compressible rocks like coal tend to fracture. Coals and soft shales will tend to deform while hard sandstones will tend to crack. On a microscopic scale, shales and coals will tend to shear and slide, extending and thinning, rather than cracking, until some higher critical stress threshold is reached. Thus, the plastic properties which allow the higher stress to exist control the method of deformation as well. Similarly, the bedding planes, themselves, are capable of absorbing large amounts of fracture energy effectively acting as a fracture barrier and confining fracture growth to a particular bed.

(135) The testimony and geologic literature establish that fracture stimulations will tend to remain contained within the more brittle rock, like sandstones. Conversely, fracture stimulations are prone to grow out of more compressible rock, such as a shale or a coal, into more brittle rock. Induced fractures also tend to migrate from a higher-pressure zone, such as the Fruitland Coal formation in this case, into a lower pressured zone, such as the Pictured Cliffs sandstone formation. Reservoir pressures directly control fracture geometry. All of these findings are widely accepted and are confirmed by radioactive tracer survey studies.

(136) Stimulation treatments can be designed with fracturing fluids and pumping programs to control or prevent breaching into bounding formations.

(137) Pendragon produced evidence of radioactive tracer survey data from the Edwards Bartlesville No. 1 well located in Section 3, T-26-N, R-13-W which in 1998 received a fracture stimulation treatment in the Pictured Cliffs formation similar to that which was applied to the Chaco wells. The radioactive tracer survey information showed conclusively that fractures initiated in the Pictured Cliffs remained contained within the formation and stopped at the bedding plane between a thin Pictured Cliffs coal and the thicker Pictured Cliffs sandstone. The Bartlesville well contained an Upper Pictured Cliffs sandstone interval very much like that encountered in the subject Chaco wells. The tracer survey information was confirmed by Nolte plot data, which showed no detectable vertical growth, indicating the fracture remained within the upper Pictured Cliffs sandstone interval. Similar results were also presented for the Dome Federal 17-27-13 No. 3 Well.

(138) Whiting had no exhibits showing that fractures induced in coal perforations remained contained within that formation. In fact, each of Whiting's exhibits of the geometry of the coal fractures showed those fractures penetrating well into the Pictured Cliffs.

(139) Fracture stimulation treatments using high viscosity fluids, high rates and high pressures are more likely to induce fractures which travel from a more ductile or

compressive zone to a harder, more brittle and more easily fractured zone by breaking through the available containment barriers.

(140) The normal in-situ properties of the Pictured Cliffs sandstone and the Fruitland Coal formation establish that it is more probable that a fracture initiated in the Fruitland Coal is more likely to break out of zone into the Pictured Cliffs sandstone than is a fracture initiated in the Pictured Cliffs likely to break into the coal.

(141) In this case, the evidence establishes that the Fruitland Coal was a higher pressured formation with higher *in-situ* stress than the Pictured Cliffs. Additionally, the coal fracture stimulations were of a significantly larger volume, and done at higher injection rates and at significantly higher pressures. These factors support the conclusion that the fractures initiated in the coal broke out into the Pictured Cliffs sandstone.

(142) A comparative summary of the fracture stimulation treatments performed on the subject Chaco Pictured Cliffs wells and the subject Gallegos Federal Fruitland Coal wells is as follows:

Fracture Stimulation Comparisons

WELL	TOTAL BBLS LIQUID	TOTAL SAND – lbs.	BREAK-DOWN PRESSURE – psi SURFACE	AVERAGE TREATING PRESSURE SURFACE Before Flush	MAXIMUM BPM	REPORTED ISIP
CHACO 1	197	35,000	1520	1328	30.2	390
CHACO 2R	230	38,900	1562	1780	37.2	500
CHACO 4	219	36,000	973	1583	32.8	600
CHACO 5	223	30,852	1371	1630	28.7	620
GALLEGOS FED. 7-1 From Halliburton Report	624	127,200	2700	2400	69.33	1704
GALLEGOS FED. 7-1 From Drilling Report	624	127,200	n.r.	1750	60	1060
GALLEGOS FED. 12-1	446	43,200	unk.	2500	60	n/a
GALLEGOS FED. 6-2	599	127,860	2471	2400	65	1050
GALLEGOS FED. 1-1	628	117,000	unk.	2550	unk.	1340
GALLEGOS FED. 1-2	455	32,218	1331	1950	77.8	unk.

(143) The fracture stimulation treatments for two of the subject Chaco wells included re-perforations in the wellbores across the same Pictured Cliffs intervals and at the same levels perforated by the original operator. The other two wells were not re-perforated. A thinner fluid consisting of 70 percent quality foam resulting in a lower viscosity with low leak-off was used. Pendragon's witnesses testified that these thinner

fluids were pumped at lower rates (20 to 25 barrels per minute) to specifically avoid creating an environment conducive to breaching into the coal.

(144) In comparison, the fracture stimulation treatments for the subject Gallegos Federal Fruitland Coal wells were designed and performed with significantly larger fracture fluid volumes, heavier sand weights and higher injection rates even though the total perforated intervals were roughly equal for both types of wells. For example, the Gallegos Federal 26-12-6 No. 2 well received injection volumes of 81,025 gallons at sand weights of 127,800 lbs. injected at rates of up to 65 barrels per minute. The Gallegos Federal 26-12-7 No. 1 had injection volumes of 85,223 gallons with sand weights of 127,200 lbs. injected at rates of up to 69 barrels per minute. The Gallegos Federal 26-13-12 No. 1 well had injection volumes of 18,760 gallons with sand weights of 43,200 lbs. injected at 60 barrels per minute rates.

(145) The Maralex witness testified that to overcome the problems of coal contamination caused by certain fracture fluids surfactants and bacteriacides, Maralex reduced or eliminated the use of these compounds in its fracture fluids. By eliminating or reducing these compounds, the viscosity of the fracture fluids decreased as a result. To overcome the reduction in viscosity, Maralex purposely increased the fluid volumes and significantly increased the fluid injection rates used during the fracture stimulation treatments. The use of the larger fluid volumes and the significantly higher fluid injection rates substantially increased the probability that the fractures initiated in the coal formations grew down into the more brittle, lower pressured Pictured Cliffs sandstone.

(146) The final ISIP for the fracture stimulation treatments on the Chaco wells ranged from 390 to 600 psi, resulting in an ISIP gradient ranging from 0.78 to 0.97 psi per foot. However, the lowest ISIP observed in the fracture stimulation treatments on the Fruitland Coal formation in the Gallegos Federal wells was 1,050 psi, resulting in an ISIP gradient of 1.33 psi per foot.

(147) The evidence presented establishes that the *in situ* stress in the coal formation is approximately 400 psi higher than in the Pictured Cliffs sandstone. Consequently, a large fracture initiated in the sandstone must be stepped up even further to impart the equivalent of a 400 psi incremental increase in fluid pressure if the fracture is to penetrate into the coal. This would be a substantial and unnecessary increase in treating pressure over that required to extend the fracture within the sandstone. The evidence further establishes that fractures are contained where there is boundary slippage at the interface between the coal and shale or sandstones. Where slippage occurs, the fluid pressure must be increased even higher in order to break down the higher stress layer before the fracture can grow into the coal. Such evidence is further substantiation for a finding that it is less likely that the fractures initiated in the Pictured Cliffs sandstone broke out into the Fruitland Coal formation.

(148) Actual field data shows that the pressure required to fracture the Pictured Cliffs sandstone is significantly lower than the pressure required to fracture stimulate the coals. The field data were verified by the computer simulations.

(149) The testimony of Whiting's consulting petroleum engineer at the hearing established that because of the higher stress gradient in the coal, the ISIP of any of the fracture treatments initiated in the Pictured Cliffs sand would not have been sufficient to overcome both the stress gradient and closure pressure in the coal to allow the placement of any proppant into a fracture into the coal.

(150) The evidence and testimony further established that it is more probable that the proppant circulated in any upward growing fracture in the Pictured Cliffs sandstone would settle downwards to the bottom of the fracture, thus allowing the upper portion of the fracture to close. Such closed, unpropped fractures could not serve as conduits for the production of water or gas out-of-zone.

(151) Conversely, it is more probable that fractures growing downward from the Fruitland Coal into the Pictured Cliffs formation will remain propped open by the settlement of proppants into the bottom portion of the fracture. Consequently, fractures growing downward from the coal are more likely to serve as conduits for the production of gas from the Pictured Cliffs formation.

(152) Pendragon established through a preponderance of the evidence that it is more probable that the stimulation treatments initiated by Maralex in the Fruitland Coal formation escaped from the coal formation and penetrated into the Pictured Cliffs formation.

(153) Although the president of Maralex disagreed, Whiting's consulting petroleum engineer from S. A. Holditch & Associates, Inc., and Whiting's own in-house petroleum engineer both testified that it was likely that the fracture stimulations in the Fruitland Coal wells created fractures that extended down into the Pictured Cliffs formation.

(154) Whiting and Maralex contended that the Chaco wells were re-perforated by Pendragon directly into the coal seams of the Fruitland formation. However, casing collar survey logs performed in May and June of 1998 conclusively establish that none of the subject Pictured Cliffs wells were perforated or re-perforated in the Fruitland Coal Formation.

(155) As evidence supporting its contention that the fracture stimulation treatments on the subject Chaco wells had been performed on the wrong formation, Whiting produced copies of the well service company fracture treatment summary reports showing that, in two instances, the covers of those reports were labeled to reflect the treatments as having been conducted in the Fruitland Coal formation. However, additional evidence presented by Pendragon, including the casing collar survey logs,

BLM and Division completion reports and perforation records from the well service company fracture treatment summary reports themselves all establish that the wells were completed in and the fracture stimulation treatments were performed at the appropriate perforated interval in the Pictured Cliffs formation. Accordingly, it is established that the covers of the service company treatment reports were mislabeled.

(156) The evidence establishes that the subject Chaco wells are perforated only in the Pictured Cliffs sandstone.

(157) Two of Pendragon's Chaco wells, the Chaco 1-J and 2-J wells, were not fractured stimulated. Rather, these wells received 500-gallon acid jobs pumped at only one barrel per minute rates at maximum pressures of 800 psi for the Chaco 4 and 450 psi for the Chaco 1-J. (The Chaco 2-J stayed on vacuum for the entire duration of its acid job.) The 500 gallon/one barrel per minute acid jobs performed on the Chaco wells are typical of the acid stimulation treatments that industry has historically performed on hundreds of Pictured Cliffs wells in the area.

(158) The Chaco No. 2-J is located only 180 feet from the Gallegos Federal No. 26-13-1 No. 1 well. Yet, there is no evidence to suggest that these two wells are in pressure communication.

(159) The testimony and evidence establish that it was unlikely that acid stimulation jobs performed within such parameters caused fractures to initiate and grow from the Pictured Cliffs formation into the Fruitland Coal formation.

(160) In his testimony, Maralex's president agreed that it was not possible for acidization to effectively stimulate production from the coal formation.

(161) The evidence presented by Pendragon establishes that it was not possible for the acid jobs performed on its Pictured Cliffs wells to have created cross-flow permeabilities and flow rates out of the coal formations sufficient to have repressurized the Pictured Cliffs reservoir with coal gas by more than 100 psi over the period of just a few weeks, as would have been necessary for the 150 psi readings consistently seen in the Chaco wells in early 1995, if the reservoir had been depleted.

(162) The shut-in pressures obtained from the Chaco wells since June 30, 1998 show that the acid stimulations done in 1995 did not break through or connect to the Fruitland Coal formation.

(163) Whiting's witnesses agreed that it was reasonable and prudent for the operator of the Pictured Cliffs formation to stimulate the wells to increase production.

BTU AND GAS ANALYSES DATA

(164) Both parties presented evidence relating to BTU data and gas composition analysis to address the issue of whether the composition of gas can be used to differentiate between production from the Pictured Cliffs formation and the Fruitland Coal formation in the San Juan Basin.

(165) Whiting presented BTU and gas analysis evidence to support its contention that gas produced from the Chaco wells had originated in the Fruitland Coal formation. Pendragon presented its own BTU data and gas composition analysis to support its contention that the composition of gas is not a reliable indicator to differentiate between production from the Pictured Cliffs formation and the Fruitland Coal formation in San Juan Basin.

(166) The evidence establishes that the BTU contents and the proportions of "higher end" or lighter molecular components in the gas produced from the wells in the area of the subject lands are not only highly variable from well to well, but also vary over time and with the producing conditions of the reservoir. Production from most Pictured Cliffs wells tends to contain heavier components during the early stages of production, although this characteristic can be affected by a number of factors. Moreover, there is no clear differentiation between gas produced from the Fruitland Coal formation and the Pictured Cliffs sandstone.

(167) The fact that the BTU or methane percentage may have decreased over the producing life of a Pictured Cliffs sandstone well is not evidence that the well is producing gas from another zone.

(168) Evidence from the geological and engineering literature establishes that Fruitland Coal and Pictured Cliffs formation wells in the area of the subject lands are frequently found to be producing similar gases which may come from source materials in the Lewis shales and/or from coal. The sources cannot be separated as being limited to coal for the coal wells or strictly Lewis shale for the Pictured Cliffs wells. Consequently, the gases cannot be clearly differentiated when they are produced. In addition, under the reduced pressures and at the reservoir temperatures measured in the Chaco area, the heavier components tend to drop out or move through the reservoir rock more slowly than methane, making the produced gas more lean.

(169) Whiting presented evidence purporting to show a decrease in the BTU content for the Chaco 1, 4 and 5 wells in 1995 to demonstrate that the fracture stimulation treatments on those wells had connected to the coal formation and that they were producing coal gas. Significantly, Whiting's BTU data did not correlate with the timing of the fracture stimulation treatments on the Chaco Pictured Cliffs wells. In more than one instance, Whiting's own data showed that the BTU values for production from the Chaco wells had declined or were declining well before those wells were fractured.

(170) In connection with this dispute, the Division staff from the Aztec area office supervised the collection of gas samples from the subject wells in 1998, as well as samples from other wells in the area. At the time, the Division and the parties concluded that the data could not be utilized to determine the source of production from the subject wells.

(171) The evidence presented establishes that changes in the heating value of natural gas mixtures are expected as a consequence of continually changing reservoir conditions and production operations and are not reliable indicators of existing reservoir conditions. Observed natural gas mixtures from Pictured Cliffs wells in the area of the subject lands are expected to have high initial heating values. As a well is continuously produced and the reservoir pressure gradually drops, the heating content may then be expected to fall. Heat content may increase during prolonged shut-in periods. This behavior has been observed in wells in the area of the subject lands.

(172) In February 1999, after more than seven months of shut-in, gas samples were taken from the Chaco No. 1, 4 and 5 Wells. The BTU analyses were all above 1,100 and were nearly identical to those at the times of original completion. This is clearly Pictured Cliffs gas that has returned to the higher BTU content during shut-in as compared to lower BTU measurements during the times that the wells were being produced at high rates and low bottom hole flowing pressures. This also shows conclusively that those wells are not cross-flowing Fruitland gas into the Pictured Cliffs during shut-in as Whiting contends.

(173) Pendragon provided evidence from the Designated Hitter No. 2 Well and the Chaco No. 1-J and 2-J Wells which showed that such BTU changes occur over time in Pictured Cliffs wells which are not fracture stimulated.

(174) The evidence establishes that it is likely reservoir conditions in Fruitland Coal and Pictured Cliffs formations are such that certain components of the natural gas obtained from these reservoirs may be present at the time of initial completion in the liquid phase and convert to the gaseous phase, as the reservoir is produced and the reservoir pressure is lowered. The phase behavior of natural gas constituents, the adsorption of hydrocarbons and diluents by reservoir materials, and the absorption of hydrocarbons and diluents are pressure-related phenomenon.

(175) Methane is more soluble in water and is more strongly adsorbed in common reservoir materials than heavier hydrocarbons. Thus, production from the Pictured Cliffs will show higher heat content during initial production and a reducing heat content and as the reservoir is produced, the reservoir pressure is reduced and the methane de-sorbed and/or moved out of solution in the reservoir water.

(176) Pressure changes in the reservoir caused by either depletion or pressure build-up during shut-in periods will affect the heating value of the produced gas as the

hydrocarbon and diluent constituents are either absorbed by the reservoir water or adsorbed from the reservoir rock material.

(177) Pendragon presented BTU evidence for the Chaco No. 5 well demonstrating that heating values for gas produced from the well on June 1, 1994, before it was fractured in January of 1995, and then subsequently on March 1, 1995 were identical (1022 BTU). Whiting's witnesses contended that the consistent BTU measurements for the Pictured Cliffs well were attributable to the production of Fruitland coal gas through a casing leak. However, Pendragon's contract pumper testified that the casing leak was discovered and repaired in January of 1995, before the March 1, 1995 BTU value was measured. Moreover, December 1997 data showed the well was producing gas with a higher heating value at 1149 BTU. Such evidence does not support the contention that the Chaco No. 5 well was producing coalbed methane following the May 1995 fracture stimulation.

(178) Pendragon presented evidence utilizing 155 gas analyses of numerous Pictured Cliffs and coal wells to demonstrate that there is no separation or stratification of BTU or other properties in the range between 1,000 BTU and 1,100 BTU which would allow the differentiation of coal from Pictured Cliffs gas in this area.

(179) The BTU analyses and gas composition information do not provide a reliable means for determining the source of gas production from the wells involved in this case. The evidence presented by Whiting does not establish that the BTU values and gas components of the subject wells were affected by the stimulation treatments on the Chaco wells.

COMPUTER SIMULATIONS OF FRACTURE STIMULATION TREATMENTS

(180) Both parties presented evidence of computer simulations of hydraulic fracture stimulation treatments on one or more of the subject Fruitland Coal wells and Chaco Pictured Cliffs wells. Computer simulation of fracture stimulations is a still-developing technology that attempts to model highly complex lithologic structures and reservoir conditions involving many unknown variables. As such, computer simulations cannot be regarded as providing definitive proof of the actual behavior of fractures in reservoirs. However, the simulators are useful to verify conclusions reached from independent analytical methodologies and provide additional confidence in the evidence supporting those findings.

(181) The FracPro hydraulic fracture stimulation simulator model that Whiting presented for the Chaco No. 1, 4 and 5 wells predicted symmetrical fracture geometry from the treatments resulting in fractures with equal upper and downward growth. However, the simulation results did not agree with data derived from two tracer surveys from actual fracture stimulation treatments performed on Pictured Cliffs wells in the

general vicinity: the Merrion and Bayless Bartlesville No. 1 well located in Section 2, T-26-N, R-13-W and the Dome Petroleum Dome Federal 17-27-13 No. 3 well located in Section 17, T-27-N, R-13-W. Those tracer survey results demonstrated that fractures initiated in the Pictured Cliffs formation were confined on top by shale and that the fractures exhibited significant downward growth into the Pictured Cliffs sand.

(182) The GOHFER simulator analysis presented by Pendragon shows that the ISIP observed in the Gallegos Federal 26-12-6 No. 2 is consistent with a treatment that breaks into the Pictured Cliffs sandstone at a location away from the wellbore. Testimony and literature presented by Pendragon showed further that even with relatively high after-frac ISIP's, the fracture had broken into the low-stress zone from the high-stress zone at the wellbore more than fifty percent of the time. This analysis is consistent with the independently observed phenomena and measured data establishing that there is communication between the Pictured Cliffs and the basal Fruitland Coal in the vicinity of the Chaco No. 4, Chaco No. 5 and the Gallegos Federal 26-12-6 No. 2.

(183) The GOHFER computer simulation analysis ~~provi~~des additional evidence supporting a conclusion that the hydraulic fracture stimulation treatments performed on Pendragon's Chaco wells did not create a conduit between the Pictured Cliffs and the basal Fruitland Coal formations.

IV. THE EFFECT OF COMMUNICATION

WELL AND RESERVOIR PERFORMANCE

(184) The testimony, the literature, production decline curves and other evidence establish that Pictured Cliffs wells typically experience their peak production immediately after completion. The evidence also establishes that Fruitland Coal wells typically experience a long period of inclining production after completion while reservoir pressure is reduced and the coal formation goes through a dewatering process. Such wells typically do not experience their peak gas production until three years or more after completion.

(185) The evidence also establishes that typical Fruitland coal wells produce large volumes of water during the dewatering process and throughout most of their productive lives. None of the Gallegos Federal Fruitland coal wells have been capable of lifting the water to the surface or producing gas without pump assistance.

(186) Maralex's president offered testimony and production history evidence purporting to show that after its fracture stimulation, the Chaco Plant No. 5 well had performed much like a Fruitland coal well with an inclining production curve showing a production peak occurring in 1996. However, testimony and evidence in the form of monthly operator's reports presented by Pendragon (Exhibits N-7-A through E) show

better production in 1993 and 1994 and that the production curve for the well more closely modeled those of other Pictured Cliffs wells than of the several nearby Fruitland coal wells. Moreover, the evidence indicated that sales from the well were combined with production from another well at a common delivery point (CDP) and that the formula-based allocation between the wells was not necessarily reflective of actual production. Accordingly, Whiting's conclusions were based on limited and misinterpreted data.

(187) After the Pictured Cliffs wells were initially drilled, they exhibited a steep decline in production for the first three to seven years before establishing very low flow rates, at approximately 10 MCFd for a number of years. Significant increases in gas production were achieved following the stimulation treatments in 1995 to the Chaco 1, Chaco 2-R, Chaco 4 and Chaco 5 wells. Compression was added to the Chaco 1 in March 1998 and the Chaco 4 in April 1998. After compression was added, production rates for the wells increased very little over the immediate prior month's production. Conversely, the addition of compression on the subject Fruitland Coal wells resulted in substantial production increases as would be expected for ~~coal bed~~ methane where large amounts of gas are liberated because of a drop in reservoir pressure. Consequently, it is clear that the Pictured Cliffs wells did not respond to the addition of compression as would be expected if the wells were producing from the coal reservoir.

(188) There is sufficient evidence to establish that the fracturing of the coal wells in 1993 caused the injection of water into the Pictured Cliffs formation. Moreover, because the Pictured Cliffs had reservoir pressures some 70 to 100 psi lower than the coal, the Pictured Cliffs would have served as a pressure sink to further de-water the coal.

(189) In the pre-filed testimony, Whiting's consulting petroleum engineer concluded that there was a cross-flow of water from the Fruitland Coal formation into the Pictured Cliffs.

(190) The evidence presented by both Pendragon and Whiting establishes that the Whiting Fruitland Coal wells experienced a significant production increase by early 1994. Also in early 1994, the Fruitland Coal wells began to experience interference from one another as well as from other Fruitland Coal wells outside the are of the subject lands. In 1995, by the time the Chaco Pictured Cliffs wells were put on production, all of the Gallegos Federal wells were experiencing declining water production rates and inclining gas production rates.

(191) Except for water-flow back from the hydraulic fracture and other work-over treatments, the Chaco wells produced only small quantities of water through 1996 and 1997. In 1997, following a period of rather steady production, the Chaco Pictured Cliffs wells began a significant decline in production. During the same period, the Pictured Cliffs wells experienced an increase in water production. Such well behavior is the opposite from that of a typical Fruitland Coal well. However, such performance is

consistent with water and gas being injected into the Pictured Cliffs formation at a significant distance from the producing wellbores.

(192) The evidence establishes that all the coal wells experienced a significant increase in gas production and an increase in the gas/water ratio when compression was added. However, when the Pictured Cliffs wells were placed on compression, the opposite occurred, as water rates increased and gas rates increased only moderately while the gas/water ratio declined significantly. Such production characteristics further support the conclusion that the Pictured Cliffs wells were not completed in the Fruitland Coal formation.

(193) The evidence presented by Pendragon establishes that even though the fractures growing down from the Fruitland Coal into the Pictured Cliffs formation existed in early 1993, the subject Chaco Pictured Cliffs wells exhibited no discernable effect from the communication until after those wells were fracture-stimulated in 1995 and the reservoir and well-bore damage was overcome.

(194) Maralex's president testified that he concluded gas from the Pictured Cliffs formation is now moving into the Fruitland Coal formation, thus supporting Pendragon's conclusions. To support his conclusion, Maralex's president pointed to the apparent equilibration in pressures between the Pictured Cliffs and Fruitland Coal formations.

(195) The combined production from the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and the 26-13-12 No.1 increased by approximately 500 MCFd from late 1997 to April 1998 when compression was installed on the Fruitland Coal wells. During the same period, combined production from the Chaco wells declined by more than 200 MCFd.

(196) Maralex's president acknowledged that some of the Gallegos Federal wells have been producing gas from the Pictured Cliffs formations, but disputed the amounts involved.

(197) In 1995, the water production rates for the Gallegos Federal coal wells were significantly higher. For example, the Gallegos Federal 26-12-6 No. 2 produced between 70 and 80 barrels a day. Witnesses testified that it would not have been possible for such daily volumes to have been lifted without pump assist, whereas the Chaco wells did not require pumping.

(198) The historic performance characteristics of the Chaco wells verify that they did not produce gas from the Fruitland Coal formation.

WATER PRODUCTION

(199) Pictured Cliffs wells that have been fracture stimulated can and do produce some water. The evidence establishes that it is more likely that the water produced by the subject Chaco wells is coming from the perforated interval or from the lower bench of the Pictured Cliffs sandstone which generally has a higher water saturation.

(200) The evidence presented, including the geologic literature, establishes that it is common for fracture stimulated Pictured Cliffs wells to produce some water. The production of water from the Pictured Cliffs is not conclusive evidence of a fracture having communicated with the Fruitland Coal formation.

(201) Pendragon produced evidence that established that as early as 1983, operators were fracture-stimulating Pictured Cliffs wells in the WAW Pictured Cliffs pool and that such wells experienced an increase in gas production as well as an increase in water production. (Exhibit N34). Pendragon produced additional evidence documenting the production of water from stimulated Pictured Cliffs wells in the subject area as far back as the early 1970's. (Exhibit N57).

(202) Pendragon presented evidence of historic accounts by other operators in the WAW Pictured Cliffs pool indicating that it was typical for such wells to experience an increase in water production along with an increase in gas production following stimulation treatments.

(203) The Chaco Pictured Cliffs wells produced little or no water except following the recovery of flow-back water from the stimulation treatments or the addition of compression. If the Chaco Pictured Cliffs wells had been in direct communication with the Fruitland Coal, they have produced significantly greater volumes of water and would have required pump assist to lift the water and produce any volumes of gas.

(204) In 1998, during the course of the investigation by the Division's Aztec area office, the Division and the parties all agreed that water test data and analyses would not be reliable indicators of the source of gas production from the subject wells in this case. Consequently, none of the parties presented evidence of water analysis in conjunction with their direct testimony.

(205) The water production information for both the Fruitland Coal and Pictured Cliffs wells was incomplete. Maralex testified that water from its Gallegos Federal Fruitland Coal wells was produced directly into the reserve pits constructed for drilling operations and that the water production was unreported until first gas sales, often as long as a year after completion.

(206) Whiting asserted that Pendragon had purposefully failed to report the production of water from the Chaco wells in order to hide data which Whiting contends

might have demonstrated the wells had producing characteristics similar to Fruitland coal wells. Pendragon's contract pumper testified that although the volumes were recorded, reported water production data were incomplete due to the omission of a column for reporting water volumes on a pumper's report form which was used for a period of time when the hand-written data were typed onto the forms.

(207) Pendragon's contract pumper testified that he supervised the operation of the Chaco wells from the time they were acquired by Pendragon in late 1994 to the present and that he was familiar with their water production. The testimony rendered by the contract pumper and his field employees consisted of their regular, periodic first-hand observations of the wells since 1994 to the present, without interruption. The witnesses' testimony established that wells did not make sufficient volumes of water to justify the expense of adding measurement equipment. According to the testimony, water volumes were determined by "bucket test" measurements usually performed once a week, a procedure that is accepted by the Division. Based on the bucket-test measurements and the witnesses' own observations, it was established that the Chaco wells typically produced from between five to ten barrels of water per day (BWPD) into unlined pits as permitted by the Division. Certain reports showed greater volumes of water reported, but the witness testimony established that those increases were temporary and corresponded to the flow-back of water from the hydraulic fracture stimulation treatments, work-overs or the addition of compression.

(208) The testimony of the contract pumper witnesses established that the production pits on the Chaco wells had never been full of water, except following the fracture stimulation and well work-over treatments. The witnesses' testimony also established that none of the Chaco wells were on pump at any time, and that from their observations, the wells were not behaving like coal wells. Coal fines were not observed in the Chaco well pits at any time.

(209) Maralex's president testified that the only pit he saw that was full of water at any time was on the Chaco 2R in 1996.

(210) In February 1998, during its investigation into the matter, the Division's Aztec area office required Pendragon to install temporary fiberglass pits on the Chaco wells in order to measure water production. Those measurements showed the highest production of water was by the Chaco 2-R well at 13.9 BWPD. However, the Chaco 4 produced only 5 BWPD, while the Chaco 5 and Chaco 1 produced no volumes of water. Because of the small volumes being produced, the Division authorized the removal of the fiberglass pits.

(211) To support his contention that the Chaco wells were producing substantial volumes of water, Maralex's president referred to certain water hauling invoices from March of 1998 to show that 640 barrels of water were hauled from the Chaco No. 1 well that month. Information from this and other water hauling invoices was also used by Whiting to calculate the water/gas ratios for the well. However, evidence in the form of

deposition testimony of the truck driver for the water hauling service (Exhibit O-4) established that the invoices aggregated volumes of water hauled from several wells that were simply billed to the first well on that day's route and could not be utilized to establish the actual volumes of water produced from any single well. Consequently, the evidence of water production from the Pictured Cliffs wells offered by Whiting was inaccurate and not reliable.

(212) Whiting introduced photographs of an amount of water standing in the pit of the Chaco Plant 5 well, contending that the water was being produced from the Fruitland coal formation as a result of the hydraulic fracture treatment performed on that well in 1993. However, the testimony of Pendragon's contract pumpers established that it is more probable that the source of the water is from a pivot-point circular irrigation sprinkler that slowly passed directly over the pit on a daily basis.

(213) The evidence presented by Whiting with respect to water production by the Chaco Pictured Cliffs wells and the occurrence of water in production pits was based on incomplete information, misinterpreted data or was ~~only~~ anecdotal. Consequently, such information cannot constitute the basis of any finding by the Commission that the Pictured Cliffs wells produced any significant volumes of water at any time.

THE SHUT-IN PRESSURE DATA

(214) Both parties presented testimony and other evidence with respect to interpretations derived from the pressure data accumulated since the shut-in of the Chaco wells one year earlier on June 30, 1998.

(215) Immediately following the court-ordered shut-in of the Chaco No. 1, 2-R, 4 and 5 wells and the subsequent shut-in of the Chaco Limited 1-J and Chaco Limited 2-J wells, Pendragon and Whiting agreed to coordinate the collection and exchange of pressure data from each other's wells on a daily basis.

(216) At the time of the hearing before the Division on July 28, 1998, there were only a few days of shut-in pressure data available.

(217) The pressure data collected subsequent to the 1998 shut-in establishes that the Chaco 1-J, 2-J and 2-R wells are clearly not responding to continuing production from Whiting's Fruitland Coal bed methane wells and are not otherwise connected to the Fruitland Coal formation. On April 21, 1999 Pictured Cliffs' measured bottom hole pressure were more than 150 psi in the 1-J well, 101 psi in the 2-R well, 125 psi in the 2-J well and at least 73 psi in the Chaco 1 well. The fact that the evidence shows that the Pictured Cliffs formation in the area of these wells is not in communication with the coal, establishes that the reservoir pressures measured are reflective of actual pressures in the Pictured Cliffs reservoir, which were higher in the Chaco 1 and 2-R well 1995.

(218) During the yearlong shut-in period, the Chaco No. 1J exhibited no pressure change while the Chaco 2R showed an increase in pressure. This pressure information is additional evidence supporting the conclusion that the stimulation treatments on these wells did not communicate with the coal formation.

(219) The Chaco No. 1, Chaco No. 4, and Chaco No. 5 wells all exhibited a decrease in pressure during the yearlong shut in. The pressure losses in these wells were from approximately from 14 to 19 PSIG.

(220) Pendragon presented testimony and exhibits with respect to the P/Z versus cumulative production for the Chaco No. 1, 4 and 5 wells demonstrating the volumes of gas that would need to be produced in order to lower the pressures between 14 and 19 PSIG over the yearlong shut-in. At a minimum, the Chaco No. 1 well lost 19 psi, with a resulting loss of reserves of 60,500 MCF. The Chaco No. 4 experienced a 15 psi loss in pressure, resulting in a loss of reserves of 63,500 MCF. The Chaco No. 5 experienced a 14 psi pressure loss, resulting in a loss of reserves of 52,900 ~~MCF.~~ The total lost reserves for all three of the wells for the period from June 30, 1998 to June 30, 1999 was approximately 176,900 MCF.

(221) The engineering evidence presented by Pendragon establishes that the Pictured Cliffs reserves in the area of the Chaco No. 1, Chaco No. 4 and Chaco No. 5 wells continue to be drained by Whiting's Gallegos Federal Fruitland Coal wells since the June 30, 1999 data was collected. Whiting's witnesses agreed that Pictured Cliffs gas was flowing into the Fruitland Coal formation.

(222) The pressure data showing direct communication between Whiting's Gallegos Federal Fruitland Coal wells and the Chaco No. 4 and 5 wells, and the possible communication with the Chaco No. 1 well, establish that the loss of the reserves is the result of the production of Pictured Cliffs gas by the Gallegos Federal Fruitland Coal wells.

(223) A comparison of shut-in pressure data taken from the Chaco No. 1 and the Gallegos Federal 26-12-7 No. 1 wells from 1994 through June 1999 shows that the Chaco No. 1 pressure has always been lower than the Fruitland Coal pressure in the 26-12-7 No. 1 well. The shut-in pressure data establishes that the Chaco No. 1 well did not establish communication with the Fruitland Coal formation.

(224) A comparison of the well shut-in pressure data collected from the Gallegos Federal 26-12-7 No. 1, 26-12-6 No. 2, and the Chaco No. 4 and Chaco No. 5 wells also shows that the reservoir pressures in the Chaco No. 4 and Chaco No. 5 wells were considerably lower than Fruitland Coal reservoir pressures. These pressures are inconsistent with the contention that the Chaco wells were communicated to the Fruitland Coal formation at locations in close proximity to the wellbores. During the later periods of time in their wellhead shut-in pressure histories, the pressures of the Gallegos Federal

Fruitland Coal wells and the Chaco No. 4 and Chaco No. 5 wells converge and the communication between formations is more evident. This later convergence of reservoir pressures is consistent with communication occurring at distances significantly far away from the Pictured Cliffs wellbores.

(225) The evidence establishes that the Chaco 4 and Chaco 5 wells and possibly the Chaco No.1 Well are experiencing interference from the Gallegos Fruitland Coal wells. The evidence further shows that none of the other subject Chaco wells are experiencing interference from the coal wells.

(226) The Chaco 1-J, the Chaco 2-J and the Chaco 2-R wells do not appear to be experiencing pressure communication or production interference from any other wells. There is no evidence indicating that the completions in these communicated with the Fruitland Coal formation.

(227) The evidence shows that the Gallegos Federal Fruitland Coal wells are and have been producing Pictured Cliffs' gas reserves.

(228) The long-term pressure build-up data obtained by Pendragon after the subject Chaco Pictured Cliffs wells shut-in on June 30, 1998 provided important information establishing the extent and source of communication between the various wells in the area of the subject lands.

(229) The measured pressures in the Pictured Cliffs wells since June 30, 1998 showed no evidence of equilibration with the average reservoir pressure in the Fruitland Coal formation. Pendragon presented evidence of several examples, when the field was shut in, that the Coal wells had pressures within a few days of shut-in which were higher than those of nearby Chaco wells which had been shut in for weeks or months. This could not occur if the Chaco wells were completed in or producing from the coal.

(230) The shut-in pressure data indicates that the Chaco No. 1, 4 and 5 wells were not influenced by production from the coal wells nearest to the Chaco No. 1-J, 2-J and 2-R wells.

(231) After the Chaco Pictured Cliffs wells were shut-in on June 30, 1998, the combined production from the Gallegos Federal 26-12-6 No.2, the 26-12-7 No. 1 and the 26-13-12 No. 1 wells increased by about 200 MCFd.

(232) In late 1997 and early 1998, Whiting placed the 26-12-6 No. 2, the 26-12-7 No.1 and 26-13-12 No. 1 wells on compression. Production from these wells immediately increased while the nearby Chaco No. 4 and No. 5 wells decreased. Following the shut-in of the Chaco wells at the end of June 1998, production from the Whiting wells increased significantly while the Chaco wells experienced a pressure decrease.

(233) Well production information shows that water production increased when the Chaco No. 1 and Chaco No. 4 wells were put on compression. However, the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and the 26-13-12 No. 1 reported a decrease in water production after they were placed on compression. In addition, gas/water ratio evidence establishes that the Fruitland Coal wells experienced a significant increase in the gas/water ratio when the Chaco wells were shut-in in 1998. The same evidence also reflects that the Chaco wells exhibited little if any change in the gas/water ratio production trend after the Chaco wells were restored to production in 1995. Such gas/water ratio production information is additional evidence establishing that the Whiting wells are producing Pictured Cliffs gas.

(234) Due to its proximity to the Whiting Gallegos Federal 26-12-7 No. 1 Fruitland Coal well, the Chaco No. 4 experienced pressure interference effects twice as large as those observed in the Chaco No. 5 well. Although the Chaco No. 2-R well is located closer to the 26-12-7 No. 1, the Chaco 2-R has not experienced a pressure response to the shut-in of the coal well. Significantly, the upper Pictured Cliffs sandstone is not present in either of the Chaco #2-R or the Gallegos Federal 26-12-7 No.1. Accordingly, it is more likely that the larger stimulation treatment of the 26-12-7 No. 1 well may have connected to the Upper Pictured Cliffs sand at some distance from the well bore.

(235) In his testimony, Whiting's in-house petroleum engineer testified that he agreed the Chaco 1J and 2J were not drawing down reservoir pressure in the Fruitland Coal formation or that the wells were producing from the coal formation. The witness also agreed that the production and pressure information for the Chaco wells did not show that the wells exceeded initial virgin gas flows and pressures at any time.

(236) Because of its distance away from the Chaco No. 4 and Chaco No. 5 wells, those wells did not produce an observable pressure response when the Gallegos Federal 26-13-12 No. 1 was shut in while the 7-1 and 6-2 coal wells continued to produce. However, because there are no closer shut-in Pictured Cliffs wells, the 26-13-12 No.1 well cannot be precluded from currently draining the Pictured Cliffs formation. This well has already produced 60 percent of the OGIP in the coal formation under its spacing unit before it has reached peak gas production rates. Moreover, production rate and material balance data establish that the well may ultimately recover two to four times as much gas as it has already produced.

(237) Only a slight correlation of pressures during field shut-ins was observed between the Gallegos Federal No. 26-13-1 No.2 and closest Pictured Cliffs producer, the Chaco No. 1-J. This was not detected when only the Whiting wells were shut-in. As it is possible that the reading may be attributable to measurement variability, or because the 1-J may have been reacting simply to pressure increase in the Pictured Cliffs since all reservoirs were shut-in, it is reasonable to conclude that the two wells are not in communication.

(238) Pendragon presented testimony and evidence establishing conventional gas reservoirs and coal bed methane reservoir have substantially different properties, including compressibilities, so that pressure transients move at different speeds through the different reservoir types.

(239) System-wide gathering systems shutdowns in the area during the period of the yearlong shut-in produced observable pressure transient data for analysis. Pressure transients were observed in the Chaco No. 4 and 5 wells within one to two days after the Fruitland wells were shut in. The evidence presented established the only way for this pressure transient to have occurred was if the pressure wave from shutting in the coal wells was directly communicated to the Pictured Cliffs formation at or near the location of the coal wells and then moved through the Pictured Cliffs formation to the Chaco No. 4 and 5 wellbores.

(240) Pendragon's reservoir engineering and well testing expert performed an analysis to illustrate the level of impact that differences of compressibility and permeability have on pressure interference in the Pictured Cliffs wells as a result of shutting-in a nearby Fruitland Coal well. The analysis generally determined pressure interference response that would be observed at a shut-in Pictured Cliffs wells from shutting a producing Fruitland Coal well, depending on whether the pressure transients move through the Fruitland or the Pictured Cliffs formations. The time differences in observing a response are a consequence of the different permeabilities, thickness and compressibilities in the Pictured Cliffs and Fruitland Coal formations. From this well test analysis and the pressure interference responses observed, there is a reasonable basis for the Commission to infer that the relatively rapid response is a result of a pressure transient moving through the higher permeability and lower compressibility conditions existing in the thin upper Pictured Cliffs formation. From this information, it can be concluded that the pressure interference is moving from a location in very close proximity to the coal bed methane wells through the Pictured Cliffs formation to reach the Chaco wells. Consistent with this conclusion, these pressure response transients were most readily observed in the Chaco No. 4 and Chaco No. 5 wells and the Gallegos Federal 26-12-6 No. 2, the 26-12-7 No. 1 and 26-13-12 No. 1 wells.

(241) The shut-in and pressure interference information evidence establishes that that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly communicated to the Pictured Cliffs formation. Included among such evidence is the fact that every time the well ceased production for more than one day, from July to December 1998, a pressure increase was observed in the Chaco No. 4 and 5 wells. In addition, the well has not reached its peak gas production rate yet by the August 1999 hearing. The well has already produced 83 percent of the indicated OGIP in the coal under 320 acres. Data extrapolated from current production rates and material balance indicate the well may ultimately recover two to four times as much gas as it has already produced.

(242) The shut-in and pressure interference information also establishes that it is more probable than not that the Whiting Gallegos Federal 26-12-7 No. 1 Fruitland Coal

well is directly connected to the Pictured Cliffs formation. Such evidence includes the fact that a pressure increase was observed in the Chaco No. 4 and 5 wells almost every time the Gallegos Federal 26-12-7 No. 1 was shut in from July to December 1998. This well also has already produced 83 percent of the OGIP in the coal formation under the spacing unit before the well has reached it peak gas production rate. Production rate and material balance data indicate that the well may ultimately recover two to four times as much gas as it has already produced. In addition, the current gas flow capacity (kh) connected to the well is almost three times the initial water flow capacity.

(243) The shut-in and pressure interference information further establishes that it is possible that the Whiting Gallegos Federal 26-13-12 No. 1 Fruitland Coal well may be directly connected to the Pictured Cliffs formation.

(244) There is no indication of interference between the Chaco 2-R and any other currently producing well of any type. The fact that the pressure at the Chaco No. 2-R well increased for the first ten months after the 1998 shut-in is a further indication that a substantial volume of gas exists in the Pictured Cliffs sandstone and that the well is not in communication with the Fruitland Coal formation.

(245) The evidence further establishes that the Chaco No. 1 well is experiencing production and pressure interference because of the likely existence of indirect communication between the well and the Fruitland Coal formation. The Chaco No. 1 well is also responding to production from other Pictured Cliffs wells.

(246) The evidence establishes that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly connected to the Pictured Cliffs formation in or very near that wellbore. The evidence further establishes that it is more probable than not that the Gallegos Federal 26-12-7 No. 1 and the 26-13-12 No. 1 wells are directly communicated to the Pictured Cliffs formation. The evidence is consistent with the other testimony, evidence and information supporting the conclusion that the fracture stimulation treatments performed on these wells caused them to become directly communicated to the Pictured Cliffs formation.

(247) The Chaco No. 4 and Chaco No. 5 wells are experiencing production and pressure interference because of indirect communication between the Pictured Cliffs formation and the Fruitland Coal formation caused by the Gallegos Federal 26-12-6 No. 2, 26-12-7 No. 1 and the 26-13-12 No. 1 wells in or near the coal wellbores

(248) The measured pressure responses, during shut-ins of the coal wells, at the Chaco No. 4 and the Chaco No. 5 wells are conclusive proof establishing that these two wells are not in direct communication with the Fruitland Coal formation.

(249) The Chaco No. 1 well is experiencing some pressure and production interference from other Pictured Cliffs wells and from the indirect communication by Fruitland Coal wells to the Pictured Cliffs.

(250) On April 22, 1999, Pendragon filed with the Commission its Motion to Conduct Reservoir Pressure Tests. On May 6, 1999, Whiting filed its Response opposing testing and urged the Commission not to grant Pendragon's motion. On May 19, 1999, the Commission entered its Order Allowing Reservoir Pressure Testing. Whiting, through the testimony of Maralex's president, continued to oppose the testing proposed by Pendragon in District Court, and consequently, Pendragon was prevented from performing the tests. During the hearing *de novo*, Maralex's president testified that he did not recall any proposed reservoir pressure tests and was consequently unable to explain Maralex's opposition to the tests.

(251) Whiting presented no testimony from a witness with expertise in well testing, relying instead on the testimony of a petroleum engineer who admitted that he had no expertise in the area of well testing.

(252) Whiting presented no evidence of its own with respect to the movement of pressure transients through the Fruitland Coal formation or ~~Pictured~~ Cliffs formation.

(253) Pendragon offered the use of its Chaco wells for both parties to participate in the conduct of reservoir pressure response tests utilizing both Pictured Cliffs and Fruitland Coal wells. Pendragon also offered to allow Whiting to use the Chaco wells in tests designed solely by Whiting. Rather than participate in tests using both types of wells, Whiting, on its own, instead performed injection fall-off tests using only one of its coal wells. Whiting did not afford Pendragon the opportunity to participate in or observe the testing.

(254) Whiting presented evidence and testimony on reservoir testing it performed on its Fruitland Coal wells in June of 1999. The tests were designed by Whiting's consulting petroleum engineer whose expertise does not include well testing design and analysis. The testimony established that the injection operations for the 12-hour test periods were timed for commencement in the early evenings and for completion the next morning before the Pendragon's pumpers were scheduled to arrive on their regular rounds to collect pressure data from the Gallegos Federal wells.

(255) The purpose of Whiting's injection fall-off test was to determine the permeability characteristics of the Fruitland Coal formation, among other things. However, the testimony establishes that numerous problems were experienced during the conduct of the test. In fact, the results from the June 1999 testing were so bad that the test was rerun in July 1999. Moreover, the test design ignored the fact that the coal well on which the test was run had received a hydraulic fracture treatment and utilized a Langmuir volume that overstated the gas content for the coal by a factor of four. Consequently, Whiting's conclusion that the injection fall-out test shows that the Fruitland Coal formation has a resulting permeability of 225 millidarcies is likewise substantially overstated and is otherwise erroneous and unreliable.

(256) In July of 1999, Whiting performed another injection fall-off test on the Gallegos Federal 26-13-1 No. 1 well to establish the permeability of the Fruitland coal reservoir. The test data and analysis were flawed for a number of reasons. Among other things, the unsupervised test procedure was performed without the required packer installed in the well and various mechanical problems were encountered during the test. In the data analysis, a gas compressibility component was used that was inappropriate for a high-compressibility coalbed methane reservoir. The calculations made from the data ignored the fact that the well had been hydraulically fractured and utilized testing assumptions designed for naturally fractured shales. During testimony, Whiting's consulting petroleum engineer who designed and analyzed the test testified that he was unfamiliar with calculations using Langmuir volume and was unable to explain why the Langmuir volume used in this case was overstated by a factor of four. In addition, the engineering witness calculated a total compressibility for the reservoir that appeared to be overstated by a factor of five to ten. As a result, the conclusions drawn from the test with respect to the permeability of the coal reservoir in the subject area are not reliable and should not be considered.

(257) Whiting's consulting petroleum engineer agreed that the storage coefficient used in the analysis of the injection fall-off test data was uncertain because the gas storage volumes attributable to the cleat system and hydraulic fractures was not known. As a consequence, the calculation of the skin factor is also made uncertain and the resulting calculation for coal reservoir permeability is not reliable. As a further consequence, the witness's assumptions and calculations of the pressure response times that utilized the derived permeability are also rendered less reliable.

(258) The evidence establishes that the initial pressure utilized at the beginning of the injection fall-off test were inaccurate by between 50 and 25 percent of the true pressure differential. As a consequence, the calculated permeability for the coal is two to four times too high because a pressure differential that was too low was utilized.

(259) The injection fall off test was also determined to be questionable due to the fact that three different measurement times were indicated on the bottom hole pressure bomb, the surface gage and then the pumper reports utilized by Maralex. In addition, the pre-testing build-up pressure conditions were uncertain as were the injection rates and the measurement methodology using orifice places and meter tube diameters of unreported size. Consequently, the test data cannot be calibrated and are therefore unreliable.

Based on the foregoing, the Commission concludes as follows:

(260) Whiting has failed to prove, by a preponderance of the evidence that its wells have been completed in and have produced from the appropriate common source of

supply and that it has otherwise maintained the segregation of production as required by Rule 303 (a) of the Division's rules and regulations.

(261) The Pictured Cliffs and Fruitland Coal are in communication in the area of the subject lands. None of the subject Chaco Pictured Cliffs wells directly communicate to the Fruitland Coal. One or more of the Whiting Fruitland Coal bed methane wells are directly communicated with the Pictured Cliffs formation. As a consequence, there is and has been a failure to maintain segregation of production from the separate common sources of supply.

(262) The Pictured Cliffs sandstone reservoir was not depleted at the time Pendragon re-stimulated the Chaco wells in 1995. The Pictured Cliffs formation was damaged in those wells and the re-stimulation treatments established a more effective connection between the wells and the Pictured Cliffs reservoir. The re-stimulation treatments did not connect to the Fruitland Coal.

(263) The hydraulic fracture stimulation treatments on the Whiting Gallegos Federal Fruitland Coal wells connected to the Pictured Cliffs formation in some of the wells. As a result of such connections, besides producing coal bed methane, one or more of the subject Gallegos Federal Fruitland Coal wells are also producing gas from the Pictured Cliffs formation.

(264) A preponderance of the evidence establishes that that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly communicated to the Pictured Cliffs formation.

(265) A preponderance of the evidence establishes that it is more probable than not that the Whiting Gallegos Federal 26-12-7 No. 1 Fruitland Coal well is directly connected to the Pictured Cliffs formation.

(266) A preponderance of the evidence establishes that it is possible that the Whiting Gallegos Federal 26-13-12 No. 1 Fruitland Coal well may be directly connected to the Pictured Cliffs formation.

(267) There is no indication of interference between the Chaco 2-R and any other currently producing well of any type. The Chaco Limited 1-J and 2-J wells do not appear to be experiencing interference from the Whiting Gallegos Federal wells.

(268) The evidence establishes that the Whiting Gallegos Federal 26-12-6 No. 2 Fruitland Coal well is directly connected to the Pictured Cliffs formation in or very near that wellbore. The evidence further establishes that it is more probable than not that the Gallegos Federal 26-12-7 No. 1 and the 26-13-12 No. 1 wells are directly communicated to the Pictured Cliffs formation. It is established by a preponderance of the evidence that the fracture stimulation treatments performed on these wells caused them to become directly communicated to the Pictured Cliffs formation.

(269) The Chaco No. 4 and Chaco No. 5 wells are experiencing production and pressure interference because of indirect communication between the Pictured Cliffs formation and the Fruitland Coal formation caused by the Gallegos Federal 26-12-6 No. 2, 26-12-7 No. 1 and the 26-13-12 No. 1 wells in or near the coal wellbores.

(270) The Chaco No. 1 well is experiencing production and pressure interference because of indirect communication between the Pictured Cliffs formation and the Fruitland Coal formation though one or more of the Gallegos Federal Fruitland Coal wells. The Chaco No. 1 well is also experiencing interference from other Pictured Cliffs wells.

V. REGULATORY COMPLIANCE AND RELIEF

(271) The engineering testimony and evidence establish that the shut-in of the Chaco wells allows the Gallegos Federal Fruitland coal wells to produce gas reserves from the Pictured Cliffs formation. In addition, continuation of the shut-in allows water to imbibe back into the Pictured Cliffs formation in the area of the Chaco well bores, making restoration of production more difficult and increasing the risk that one or more of the wells cannot be placed back on production.

(272) Immediate restoration of the Chaco Pictured Cliffs wells to production is necessary to avoid further waste, dissipation of reservoir energy and loss of the state's valuable resources.

(273) As relief and to bring Whiting's wells into regulatory compliance, Pendragon requested that the Commission enter an order providing for the following:

(a) Ordering the immediate shut-in of the offending coal wells, the Gallegos Federal 26-12-6 No. 2, the 26-13-12 No. 1 and the 26-12-7 No.1.

(b) Restoration of the shut-in Chaco Pictured Cliffs wells to production to determine:

  (i) Whether any of the Pictured Cliffs wells have been permanently lost as a result of the shut-in and, if so, the quantification of lost reserves;

  (ii) The re-establishment of a steady state of decline in order to:

  (iii) Determine the curtailed production rates the Fruitland Coal wells might be restored to so that drainage areas are equalized, in order to minimize or eliminate future damages; and

(iv) Alternatively, allow Whiting to demonstrate to the satisfaction of the Division how both the Pictured Cliffs and Fruitland Coal formation wells can be simultaneously produced without interference, and if they fail to do so, require the Gallegos Federal Fruitland Coal wells to be permanently shut-in or recompleted.

(274) Pendragon does not seek the shut-in of the Gallegos Federal 26-13-1 No.1 and the 26-13-1 No. 2 wells.

(275) As regulatory and statutory support for the relief requested, Pendragon cited to the following: 19 NMAC 15.C.106.A; 19 NMAC 15.C.113; 19 NMAC 15.E.303A of the Division's rules and regulations; NMSA 1978, Sections 70-2-2; 70-2-11; and 70-2-12B(2), (4), (7) and (8) of the New Mexico Oil and Gas Act; and Order No. R-8768 and the Special Rules and Regulations for the Basin-Fruitland Coal gas pool.

(276) The Commission's authority to identify production from the separate formations within the WAW Fruitland Sand Pictured Cliffs pool and otherwise afford the relief requested in the application and at the hearing is within the Commission's statutory and regulatory authority under, *inter alia*, Section 70-2-12(A), (B)(1), (B)(2), (B)(4), (B)(7) and (B)(8).

(277) Pendragon presented testimony establishing that under the circumstances of this case, it would not be possible to satisfy a number of criteria under Order No. R-8768 and Rule 303 of the Division's rules that allow downhole commingling as a possible means for effecting regulatory relief.

(278) Whiting and Maralex presented no evidence and made no suggestions with respect to bringing the wells into compliance with the Division's regulations, rules and orders.

IT IS THEREFORE ORDERED:

(1) Pursuant to the *de novo* application of Pendragon Energy Partners, Inc., Pendragon Resources, LP and Edwards Energy, Inc., the Commission determines that the following described wells were properly perforated and completed within and produced from the Pictured Cliffs formation of the WAW Fruitland Sand-Pictured Cliffs gas pool:

Chaco No. 1
Chaco No. 2-R
Chaco No. 4
Chaco No. 5

Chaco Limited No. 1-J
Chaco Limited No. 2-J.

(2) The Commission further determines that fracture stimulation treatments on the following described wells caused fractures to escape from the Fruitland Coal formation and penetrate directly into the Pictured Cliffs sandstone:

Gallegos Federal 26-12-6 No. 2
Gallegos Federal 26-12-7 No. 1
Gallegos Federal 26-13-12 No.1

(3) The Commission further determines that as a consequence of the fracture stimulation treatments performed by Maralex Resources, Inc., the following described wells have been and are continuing to produce gas from the Pictured Cliffs formation as well as from the Basin Fruitland Coal gas formation:

Gallegos Federal 26-12-6 No. 2
Gallegos Federal 26-12-7 No. 1
Gallegos Federal 26-13-12 No.1

(4) The Commission further determines that the following described Pictured Cliffs wells have experienced interference from and drainage by the production of the Fruitland Coal gas wells identified above:

Chaco No. 1
Chaco No. 4
Chaco No. 5

(5) The Commission further determines that the operator of the Fruitland Coal formation wells identified in Paragraph 2, above has failed to drill, complete and operate the wells so as to (1) prevent gas and water from escaping into the Pictured Cliffs formation, and (2) otherwise maintain the segregation of production between pools.

(6) The Commission further determines that the operator of the referenced Fruitland Coal formation wells has failed to prudently drill, complete and operate the wells in violation of the following rules, regulations and orders of the Division as well as provisions of the New Mexico Oil and Gas Act:

19 NMAC 15.C.106.A; 19 NMAC 15.C.113; and 19 NMAC 15.E.303.A of the Division's rules and regulations; NMSA 1978 Sections 70-2-2; 70-2-12 B(2); 70-2-12 B(4); and 70-2-12 B(7); and Order No. R-8768 and the Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool.

(7) The Commission further determines that as a consequence of the conduct of the operator of the Fruitland Coal formation wells, the producing Pictured Cliffs formation in neighboring properties and leases has been injured which has reduced the total ultimate recovery of gas from that formation. The reduced recovery of reserves constitutes waste.

(8) The Commission further determines the communication has also resulted in the loss of reservoir energy from the Pictured Cliffs formation in the subject area.

(9) The Commission further determines that since the shut-in of the subject Pictured Cliffs wells on June 30, 1998, to June 30, 1999, approximately 176,900 MCF of Pictured Cliffs gas has been produced from the Whiting Gallegos Federal Fruitland Coal wells. Those same coal wells have produced additional volumes of Pictured Cliffs gas since June 30, 1999 in cumulative amounts that should be determined in a subsequent proceeding before the Commission.

(10) Pendragon is hereby ordered to take such measures as may be reasonably necessary or appropriate to restore the Chaco Pictured Cliffs wells to production.

(11) Whiting is hereby ordered to shut-in its Gallegos Federal 26-12-6 No. 2, the Gallegos Federal 26-13-12 No. 1 and the Gallegos Federal 26-12-7 No. 1 wells, pending further order of the Commission.

(12) Pendragon should present evidence in a subsequent proceeding before the Commission in this case determinative of the volumes of Pictured Cliffs gas reserves that have been produced by Whiting Gallegos Federal coal wells since June 30, 1999, whether any of the Pictured Cliffs wells have been permanently lost, and if so, the quantification of lost reserves as a result of the shut-in. For the Pictured Cliffs wells that it is able to restore to production, Pendragon should present evidence demonstrating the re-establishment of a steady state of decline for those wells.

(13) In a subsequent proceeding before the Commission following the accumulation of relevant data pursuant to Paragraphs 9and 12 above, both parties should be afforded the opportunity to present evidence and make recommendations to the Commission to enable it to determine the curtailed production rates the Fruitland Coal wells may be restored to so that drainage areas are equalized and in order to minimize or eliminate future damage or interference. The parties should also be allowed the opportunity to demonstrate to the satisfaction of the Commission how both the Pictured Cliffs and the Fruitland Coal formation wells can be simultaneously produced without interference or drainage. If such evidence shows it is not reasonably possible to operate the Gallegos Federal Fruitland Coal wells without further damage, interference or drainage of the Pictured Cliffs formation, then Whiting should be ordered to recomplete the Fruitland Coal wells. Alternatively, the Gallegos Federal 26-12-6 No.2, the 26-13-12 No. 1 and the 26-12-7 No. 1 should be permanently shut-in.

(14) Whiting's request that the Commission establish the base of the Fruitland formation in the subject area at the top of the "massive" sandstone below the lowermost continuous coal is denied.

(15) Jurisdiction is hereby retained for the entry of such further orders as the Commission may deem necessary.

DONE at Santa Fe, New Mexico, on the day and year hereinafter designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

JAMI BAILEY, MEMBER

ROBERT LEE, MEMBER

LORI WROTENBERY, CHAIR

SEAL

GALLEGOS LAW FIRM

A Professional Corporation

460 St. Michael's Drive
Building 300
Santa Fe, New Mexico 87505
Telephone No. 505-983-6686
Telefax No. 505-986-1367
Telefax No. 505-986-0741

November 29, 1999
(Our File No. 98-266.00)

MICHAEL J. CONDON

OIL CONSERVATION DIV.
99 NOV 29 PM 2:58

VIA HAND-DELIVERY
Ms. Lori Wrotenbery
New Mexico Oil Conservation Commission
2040 South Pacheco
Santa Fe, New Mexico 87505

Re: Application of Pendragon Energy Partners, et al.; OCC No. 11996

Dear Commissioner Wrotenbery:

Enclosed please find an original and two copies of the following documents submitted by Whiting Petroleum Corporation and Maralex Resources, Inc.:

1. Proposed Order of the Commission (short form);
2. Proposed Order of the Commission (long form); and
3. Whiting's Memorandum in Lieu of Closing Statement.

The Commission should feel free to use either of Whiting's proposed forms of Order.

We will provide courtesy copies to Commissioners Bailey and Lee. If you need any additional information or have any questions, please feel free to contact me.

Sincerely,

GALLEGOS LAW FIRM, P.C.

By Michael J. Condon
MICHAEL J. CONDON

MJC:sa
Enclosures
cc: Scott Hall
John Hazlett
Mickey O'Hare
ioc: J.E. Gallegos

STATE OF NEW MEXICO
ENERGY MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, L.P., AND J.K EDWARDS ASSOCIATES, INC. TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO

CASE NO. 11996
DE NOVO

99 NOV 29 PM 2:58
OIL CONSERVATION DIV.

ORDER OF THE OIL CONSERVATION COMMISSION

[Proposed by Whiting Petroleum Corporation and Maralex Resources, Inc.]

BY THE COMMISSION:

The Oil Conservation Division on February 5, 1999, entered Order No. R-11133 in this docket. Thereafter the applicants, Pendragon Energy Partners, Inc., Pendragon Resources, L.P. and J.K. Edwards Associates, inc. (collectively "Pendragon") filed their Application for Hearing De Novo on February 18, 1999. Whiting Petroleum Corporation and Maralex Resources, Inc. (collectively "Whiting") on February 23, 1999, filed their Application for Hearing De Novo as to Limited Issues, challenging only certain specified findings, but not the disposition of the case by Order R-11133.

This cause came on for hearing de novo at 8:15 a.m. on August 12, 1999 at Santa Fe, New Mexico, before the New Mexico Oil Conservation Commission ("Commission"), and continued on August 13, 19, 20 and 21, 1999.

NOW, on this ____ day of _____, 1999, the Commission, having considered the testimony, the record, and being fully advised in the premises,

FINDS THAT:

(1) Due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

PARTIES AND NATURE OF DISPUTE

(2) The applicants, Pendragon, are interest owners in, and operate, the following wells in San Juan County, New Mexico:

Well Name	Location
Chaco No. 1	NW ¼, Section 18, T26N, R12W, N.M.P.M.
Chaco No. 2R	SW ¼, Section 7, T26N, R12W, N.M.P.M.
Chaco No. 4	NW ¼, Section 7, T26N, R12W, N.M.P.M.
Chaco No. 5	SE ¼, Section 1, T26N, R13W, N.M.P.M.
Chaco Ltd. No. 1J	SW ¼, Section 1, T26N, R13W, N.M.P.M.
Chaco Ltd. No. 2J	NE ¼, Section 1, T26N, R13W, N.M.P.M.

These wells are referred to as the "Chaco wells."

(3) Whiting owns working interests in and operates the following wells completed within the Basin-Fruitland Coal Gas Pool in San Juan County, New Mexico:

Well Name	Location
Gallegos Federal 26-12-6 No. 2	W ½, Section 6, T12N, R12W, N.M.P.M.
Gallegos Federal 26-12-7 No. 1	W ½, Section 7, T26N, R12W, N.M.P.M.
Gallegos Federal 26-13-1 No. 1	E ½, Section 1, T26N, R13W, N.M.P.M.
Gallegos Federal 26-13-1 No. 2	W ½, Section 1, T26N, R13W, N.M.P.M.
Gallegos Federal 26-13-12 No. 1	N ½, Section 12, T26N, R13W, N.M.P.M.

These wells are referred to as the "Gallegos Federal wells."

(4) Pendragon and Whiting received assignments of oil and gas leases in the acreage identified in paragraphs (2) and (3) above, San Juan County, from common grantors, Robert Bayless, Merrion Oil and Gas, et al. ("Merrion"), during the period 1992-94. The assignments of rights to Whiting are as follows:

> Operating rights **from the surface of the earth to the base of the Fruitland (Coal-Gas) Formation,** subject to the terms and provisions of that certain Farmout Agreement, dated December 7, 1992 by and between Merrion Oil & Gas et al., Robert L. Bayless, Pitco Production Company, and Maralex Resources, Inc.

(5) The assignments of rights to Pendragon read, in pertinent part, as follows:

Limited from the base of the Fruitland Coal Formation to the base of the Pictured Cliffs Formation.

(6) A brief history of the Chaco wells is as follows:

a) the Chaco Well No. 1 was drilled by Merrion and Bayless in February, 1977. The well was perforated and completed from a depth of 1,113' to 1,139'. In January, 1995, J.K. Edwards & Associates, Inc. (Edwards) became operator of the well. In January, 1995, the well was fracture stimulated through the perforated intervals. In January, 1996, Pendragon became operator of the well;

b) the Chaco Well No. 2R was drilled by Merrion and Bayless in October, 1979. The well was perforated and completed from a depth of 1,132' to 1,142'. In January, 1995, Edwards became operator of the well. In January, 1995, the well was fracture stimulated through the perforated intervals. In January, 1996, Pendragon became operator of the well;

c) the Chaco Well No. 4 was drilled by Merrion and Bayless in April, 1977. The well was perforated and completed from a depth of 1,163; to 1,189'. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7½ percent HCl. In May, 1995, the well was re-perforated in the interval from 1,163' to 1,189' and fracture stimulated through the perforations in this interval. In January, 1996, Pendragon became operator of the well;

d) the Chaco Well No. 5 was drilled by Merrion and Bayless in April, 1977. The well was perforated and completed from a depth of 1,165' to 1,192'. In May, 1979 the well was fracture stimulated in this interval. In January, 1995, Edwards became operator of the well. In January, 1995, during an attempt to fracture stimulate the well, a casing leak was discovered. The leak was repaired in February 1995. The well was reperforated in the same interval and fracture stimulated through the perforations in May, 1995. In January, 1996, Pendragon became operator of the well;

e) the Chaco Limited Well No. 1J was drilled by Merrion and Bayless in April, 1982. The well was perforated and completed from a depth of 1,200' to 1,209'. In January, 1995, Edwards became operator of the well. In January, 1995, the well was acidized with 500 gallons 7½ percent

HCl. In January, 1996, Pendragon became operator of the well;

f) the Chaco Limited Well No. 2J was drilled by Merrion and Bayless in September 1979 to test the Pictured Cliffs formation. The well was perforated and completed from a depth of 1,186' to 1,202'. In October 1979, the well was fracture stimulated through this interval. In January 1995, Edwards became operator of the well. In January 1995, the well was acidized with 500 gallons 7 ½ percent HCl. In January 1996, Pendragon became operator of the well.

(7) A brief history of the Whiting wells is as follows:

a) the Gallegos Federal 26-12-6 No. 2 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,138' to 1,157'. The well was subsequently fracture stimulated in this interval. In September, 1995, Whiting became operator of the well;

b) the Gallegos Federal 26-12-7 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,131' to 1,150'. The well was subsequently fracture stimulated through this interval. In September, 1995, Whiting became operator of the well;

c) the Gallegos Federal 26-13-1 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,158' to 1,177'. The well was subsequently fracture stimulated through this interval. In September, 1995, Whiting became operator of the well;

d) the Gallegos Federal 26-13-1 No. 2 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,047' to 1,208'. The well was subsequently fracture stimulated through this interval. In September, 1995, Whiting became operator of the well; and

e) the Gallegos Federal 26-13-12 No. 1 was drilled by Maralex in December, 1992 to test the Basin-Fruitland Coal Gas Pool. The well was perforated and completed in the Fruitland Coal from a depth of 1,178' to 1,197'. The well was

subsequently fracture stimulated through this interval. In September, 1995, Whiting became operator of the well.

(8) Pendragon filed its application with the Division on May 26, 1998, seeking an order that the Pendragon Chaco wells were producing from the appropriate common source of supply (Pictured Cliffs Formation) and the Whiting Gallegos Federal wells were producing from their appropriate common source of supply (Fruitland Formation). Pendragon maintained the position and presented evidence in the Division proceeding that there was no communication between the Pictured Cliffs Sandstone formation ("Pictured Cliffs Formation") and the Fruitland formation in the area in question, or in any of the wells at issue in the application, which wells are described in ¶¶ (2) and (3), supra.

(9) The matter came on for hearing before the Division Examiner, David R. Catanach, on July 28-30, 1998. The Division issued its Order R-11133 on February 5, 1999, finding that the fracture stimulations performed on Chaco wells 1, 2R, 4 and 5 had caused communication with the Fruitland formation, that there was pressure communication with the Fruitland formation in Chaco wells 1J and 2J, and that the Chaco wells were and had been producing Fruitland formation coal seam gas since those procedures were performed in 1995. The Division ordered that Pendragon's Chaco wells remain shut-in, but invited Pendragon to appear before the Division to suggest an allocation formula or a method by which Pendragon could operate its Chaco wells without producing Whiting's coal seam gas.

(10) Pendragon failed and refused to engage in any further proceedings before the Division, filing its Application for Hearing De Novo on February 18, 1999.

(11) Whiting accepts that its Gallegos Federal wells are producing from the appropriate common source of supply, i.e., coal seam gas from the Fruitland Formation. Whiting contends that the Chaco wells 1, 2J, 4 and 5 have perforations in the Fruitland Formation, that Chaco wells 1, 2R, 4 and 5 improperly produced coal seam gas from the Fruitland formation from 1995 until the wells were shut-in on June 30, 1998, and that there is a reasonable probability that Chaco wells 1J and 2J have communicated with the Fruitland Formation after they were acidized or fracture stimulated.

REGULATORY HISTORY

(12) The Subject Area is located within the horizontal boundaries of the Basin-Fruitland Coal Gas Pool created by Division Order No. R-8768 dated October 17, 1988. The vertical limits of this pool, as defined by Ordering Paragraph (1) of Order No. R-8768, are as follows:

> "all coal seams within the equivalent of the stratigraphic interval from a depth of approximately 2,450 feet to 2,880 feet as shown on the Gamma Ray/Bulk Density log from Amoco Production Company's Schneider Gas Com "B" Well

No. 1 located 1110 feet from the South line and 1185 feet from the West line of Section 28, Township 32 North, Range 10, West, NMPM, San Juan County, New Mexico." (Emphasis added).

(13) Order No. R-8768 was entered in Case No. 9420. That proceeding was initiated to consider the creation of a new pool for the production of gas from coal seams within the Fruitland formation underlying various Northwest New Mexico counties, the geographic area of which encompassed the properties at issue in this application. In companion Case No. 9421, the Division sought to contract the vertical limits of twenty-six existing Fruitland and/or Fruitland-Pictured Cliffs Gas Pools to include only the Pictured Cliffs Sandstone and/or Fruitland Sandstone intervals and to exclude the coal formations.

(14) Geologic evidence was presented at the hearing in Case No. 9420 by the Fruitland Coalbed Methane Committee, including evidence that the Fruitland formation is composed of alternating layers of shales, sandstones, and coal seams. Evidence was also presented at the hearing that the intent of the Committee was to include all of the coals beds as part of the Basin Fruitland Coal Gas Pool.

(15) Evidence was presented to the Division by the Committee in Case No. 9420 that there may be intertonguing between the Pictured Cliffs sandstones and the Fruitland coal formation in some parts of the San Juan Basin. This could make picking the boundary between the two formations difficult unless a specific marker is located. The Committee relied on the accepted definition of formation boundaries and the work of established experts, such as James E. Fassett and Jim S. Hinds, in a study titled "Geology and Fuel Resources of the Fruitland Formation and the Kirtland Shale of the San Juan Basin, New Mexico and Colorado, Geological Survey Professional Paper 676 (1971)." In that work, Fassett and Hinds placed the contact between the Pictured Cliffs formation and the overlying Fruitland formation "at the top of the massive sandstone below the lowermost coal of the Fruitland except in those areas where the Fruitland and the Pictured Cliffs intertongue." The Committee relied on industry-recognized boundaries in making their recommendations to the Division in Case No. 9420.

(16) The vertical boundary between the Fruitland formation and the Pictured Cliffs formation in the area in question is and has historically been the top of the massive marine sandstone below the lowermost coal of the Fruitland.

(17) Evidence was also presented to the Division in those 1988 proceedings that due to their close proximity, fracture stimulations of the Pictured Cliffs sandstone in the Basin frequently caused communication with the coal formations.

(18) By Order R-8768, the Division also established spacing and orthodox locations for coal gas wells on 320-acre proration units.

(19) In Order No. R-8768, the Division adopted Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool. Rule 3 authorizes the Director to require an operator of a proposed or existing Pictured Cliffs Sandstone well to submit certain data in order to demonstrate to the satisfaction of the Division that the well will be or is currently producing from the appropriate common source of supply. Rule 2 of the Special Rules identifies the following data to be used in such a determination:

a. Electric Log Data
b. Drilling Time
c. Drill Cuttings or Log Cores
d. Mud Logs
e. Completion Data
f. Gas Analysis
g. Water Analysis
h. Reservoir Performance
i. Other evidence which may be utilized in making such determination

(20) On July 16, 1991, the Division entered Order No. R-8768-A in reopened Case No. 9420. The Division considered in the course of that proceeding whether the Special Rules and Regulations promulgated by Order No. R-8768 afforded owners of properties in the Basin-Fruitland Coal Gas Pool the opportunity to produce their just and equitable share of gas in that pool, and concluded that the Special Rules and Regulations of Order R-8768 did satisfactorily provide owners with that opportunity.

(21) Order No. R-8768-A confirmed 320-acre spacing for coal gas wells in the Basin-Fruitland Coal Gas Pool, and amended Rule No. 3 which provided that confirmation that a well is producing exclusively from the Basin-Fruitland Coal Gas Pool would consist of approval of Division Form C-104, but that that approval would be for Division purposes only, and should not preclude any other governmental jurisdictional agency from making its own determination of production origination utilizing its own criteria.

(22) In Case No. 9421, the Division entered Orders R-8769 and R-8769-A on October 17, 1988 and April 11, 1989 respectively. Those Orders established the vertical limits of the WAW Fruitland-Pictured Cliffs Pool in San Juan County, New Mexico as follows:

(z) The vertical limits of the WAW Fruitland-Pictured Cliffs Pool in San Juan County, New Mexico, are hereby contracted to include only the Pictured Cliffs formation and the sandstone interval of the Fruitland formation and said pool is hereby redesignated as the WAW Fruitland Sand-Pictured Cliffs Pool.

PENDRAGON'S CHANGE OF POSITION IN THESE ADMINISTRATIVE PROCEEDINGS

(23) Pendragon's application seeks an order that the Chaco wells and the Gallegos Federal wells were each producing from their appropriate common source of supply. Pendragon has never amended its application.

(24) At the hearing before the Division in July, 1998, Pendragon argued, and submitted a proposed order seeking findings, that both Whiting's and Pendragon's wells were producing from the appropriate common source of supply. At the Division proceeding, Pendragon denied that there was any communication between the Pictured Cliffs formation and the Fruitland formation, or between the Chaco wells and the Gallegos Federal wells in the area in question.

(25) After Pendragon lost on this issue before the Division, Pendragon changed the entire theory of its evidence presentation at the Commission hearing, notwithstanding that it did not seek to amend its application. At the hearing before the Commission, Pendragon conceded that there is communication between the Pictured Cliffs formation and the Fruitland formation in the area in question. The Commission proceeding in August 1999 marked the first time in the three-year dispute between these parties, which dates back to 1996, that Pendragon conceded communication between the Pictured Cliffs formation and the Fruitland formation. Pendragon presented a theory, unsupported by competent evidence, that fracture stimulations of the Gallegos Federal wells caused communication with the Pictured Cliffs formation and were producing Pictured Cliffs gas.

(26) The reasons given by Pendragon for changing its evidentiary positions between the Division hearing in 1998 and the Commission hearing in August, 1999, were (1) that Pendragon witnesses did not have available to them shut-in pressure data prior to the Division hearing July 28-30, 1998, following the decision by the Santa Fe County District Court shutting in Pendragon's Chaco wells on June 29, 1998, and that a review of that shut-in data finally awakened the Pendragon witnesses that there was in fact communication between the two formations in the area in question, and (2) that Pendragon did not have data substantiating the adverse effect on the Chaco wells of Whiting's having put the Gallegos Federal wells on compression in November, 1997 – February, 1998.

(27) Approximately twenty-eight (28) days of shut-in data was available to both Whiting and Pendragon prior to the Division hearing in July, 1998. In fact, Whiting witnesses at the Examiner Hearing in July, 1998 utilized the shut-in pressure data which had been accumulated since the Pendragon Chaco wells were shut-in on June 30, 1998, to demonstrate evidence of communication between the Chaco wells and the Gallegos Federal wells in the area in question. Pendragon also had several months of production and pressure data available on the Chaco wells after the Gallegos Federal wells were put on compression prior to the 1998 Division hearing.

(28) Whiting's evidence has consistently shown that Pendragon produces its Pictured Cliffs wells from casing perforations in formations that are within the vertical limits owned solely by Whiting. Whiting has also consistently contended and demonstrated that in 1995, acidization and fracture stimulations performed by Pendragon on its Chaco wells Nos. 1, 1J, 2J, 2R, 4 and 5 have caused communication into the Fruitland formation, and that those wells produced coal gas from the Fruitland formation until they were shut-in. Whiting evidence is that the Gallegos Federal wells are producing no significant volumes of gas from the Pictured Cliffs formation.

(29) Whiting's evidence has consistently established that the WAW Fruitland Sands-Pictured Cliffs field was developed in the 1975-1982 era; that the wells were primarily low-cost, slim hole completions into a reservoir that even at initial pressures typically produced only 50-150 Mcf per day for the better wells; that by 1992 the WAW Fruitland Sands-Pictured Cliffs formation in the area was a depleted reservoir, and that years earlier most of the wells in the field had become incapable of economic production.

(30) Pendragon's application is inconsistent with its revised theory that the Gallegos Federal wells are communicated with the Pictured Cliffs formation and producing gas from that formation.

PENDRAGON'S PERFORATIONS IN
CHACO WELLS 1, 4, 5 and LIMITED 2J

GEOLOGIC EVIDENCE

(31) The Commission recognizes that while applicable Orders by the Division define gas pools in the area in question, i.e., the WAW Fruitland Sand-Pictured Cliffs Gas Pool and the Basin-Fruitland Coal Gas Pool, the assignments of interest and the ownership rights in the leases in question of Pendragon and Whiting are described by formations, not pools. The proper inquiry in this proceeding is not whether the parties are producing from the appropriate pool, but whether they are producing from the appropriate formation.

(32) The Chaco wells were originally drilled by Merrion in the late 1970s. At that time, Merrion owned unified interests from the surface of the earth to the base of the Pictured Cliffs formation in the Chaco wells. The well casings were perforated at various sandstone layers, and were usually classified as "Pictured Cliffs" formation wells producing from the WAW Fruitland PC or NIP PC Pool in notices filed with the Division. The Chaco wells were drilled and completed prior to the establishment of the Basin-Fruitland Coal Gas Pool.

(33) The lower Fruitland Formation is composed of interbedded shales, sandstones and coal beds in this study area. There are two continuous coal intervals in the lower part of the Fruitland Formation; the upper is approximately 20 feet thick and is called the "B" coal in Exhibit WA-3. The "Basal" Fruitland seam is commonly 2-4 feet

thick. It occurs just above the Pictured Cliffs Sandstone as illustrated on Exhibit WA-3. The correct contact between the Fruitland Formation and the Pictured Cliffs Sandstone is below the Basal coal, at the top of the uppermost massive, marine sandstone underlying the Fruitland Formation.

(34) The vertical boundary between the Fruitland formation and the Pictured Cliffs Sandstone formation in this area occurs below the Basal Coal stringer on Exhibit WA-3, at the top of the massive Picture Cliffs sandstone. This boundary is consistent with industry-accepted standards, the work of the U.S. Geological Survey, and the Coalbed Methane Committee. The Commission rejects the attempt by Pendragon to characterize a Fruitland sandstone stringer within the coals as an "Upper Pictured Cliffs Sand," a phrase coined by Pendragon's president for this hearing, which finds no support in the literature for this part of the San Juan Basin, prior geologic testimony taken before the Division, or in prior Orders of the Division.

(35) Cross sections of the wells in this area reveal a thin sandstone stringer which runs between the B Coal and the Basal coal which is the layer Pendragon sought to label as the upper Pictured Cliffs Sand. This sandstone stringer is approximately ten feet at its thickest but thins to zero to two-foot thickness at the Chaco 2R well. This sandstone layer is a Fruitland sandstone. Expert geologists for both Pendragon and Whiting concluded that the sandstone stringer is not a marine sandstone, but rather it is a coastal plain sandstone. The stringer is not a tongue of the Pictured Cliffs formation.

(36) Chaco wells Nos. 1, 4, 5 and 2J are perforated above the top of the Pictured Cliffs formation and within the sandstone stringer of the Fruitland Formation (the "Fruitland Sand"). The out-of-formation perforations of those Chaco wells occur as follows:

Well	**Fruitland Formation Perforation**
Chaco No. 1	1,113' – 1,119'
Chaco No. 4	1,163' – 1,166'
Chaco No. 5	1,165' – 1,169'
Chaco Ltd. No. 2J	1,186' – 1,188'

(37) Pendragon produces from perforations in the lower Fruitland Sandstone stringer in its Chaco wells Nos. 1, 2J, 4 and 5. These perforations are located above the base of the Fruitland formation and thus within the formation owned by Whiting.

(38) The upper perforations on Chaco wells 1, 4, 5, and Limited 2J were originally made at a time when there was single ownership from the surface to the base of the Pictured Cliffs formation. Consequently, when the original operator perfed these wellbores, there was no concern that the upper perforations might have been placed in a formation owned by an operator other than the operator with Pictured Cliffs rights. With split ownership in the formations caused by the transfers of interest from Bayless,

et al. to both Pendragon and Maralex, Pendragon failed to isolate those perforations and in fact applied hydraulic fracture stimulations through those perforations in the Chaco 4 and 5 wells within the midst of the Fruitland coal horizons.

(39) The Commission recognizes that correct identification of the geologic boundary between the Pictured Cliffs and Fruitland Formation may have implications for other operators utilizing perforations in wells which were opened at a time of uniform ownership from the surface to the base of the Pictured Cliffs formation. While many operators have made picks in the field of the boundary between the Pictured Cliffs and Fruitland Formations which are inconsistent with the Commission's findings in this case, such estimates of formation tops cannot take precedence over studied sedimentologic and geologic analysis and stratigraphic interpretation. The solution to situations where ownership of interests in the two formations no longer is uniform, or where an operator has incorrectly picked the boundary between the formations, may be isolation of a formation or allocations of production, not adoption or confirmation of an improper and unsupportable geologic boundary.

PENDRAGON PRODUCED COAL SEAM GAS FROM THE FRUITLAND FORMATION FROM CHACO WELLS 1, 2R, 4 AND 5 FROM 1995 TO JULY, 1998

PRODUCTION AND PRESSURE HISTORY

(40) After the Chaco wells were originally drilled in the late 1970s, they exhibited a classic production decline curve that one would expect from a conventional gas reservoir. The wells initially produced at rates from 50 to 200 MCF per day, with peak volumes in the late 1970s. Initial reservoir pressure in the Pictured Cliffs Formation was in the range of 230 to 250 psi in the subject area.

(41) By the mid-1980s, the WAW Pictured Cliffs reservoir in the subject area was depleted. The Chaco wells performed in a manner consistent with production from a depleting Pictured Cliffs sandstone reservoir. Pressures were steadily declining, and production levels had dropped to between 0 and 5 Mcf per well per day. No observations indicating skin damage or other mechanical problems with the wells that would account for the low production and reduced pressures is found in any of the Chaco well files which were made exhibits in this proceeding. The decline over time in both volume of gas and pressure is entirely consistent with a depleting sandstone reservoir producing conventional gas, and consistent with the behavior of other wells in the WAW Fruitland Sand-PC field shown on Whiting Exhibit W-30.

(42) The pressure and production history of the Chaco wells prior to 1995 was consistent with expected production decline curves for such wells. The Chaco wells were uneconomic and appropriate to be plugged and abandoned. They were sold at auction by the Bayless, Merrion Group to J.K. Edwards Associates.

(43) Whiting drilled its Gallegos Federal coal wells in late 1992. After completions in 1993 the wells exhibited performance typical of (non-conventional) coalbed reservoirs. They initially produced high volumes of water and little gas. Gas production inclined as the wells dewatered, and by 1995 gas production was at economic levels except for the 26-13-1 No. 1 and No. 2 wells.

(44) Pendragon began its activities in this immediate area in December 1994 by reworking the Lansdale Federal No. 1 well on a 160-acre tract in the SE/4 of Section 7, T-26-N, R-12-W. Pendragon owns rights in the Lansdale from a depth of 536 feet to a depth of 1340 feet, including the Fruitland formation and Pictured Cliffs sandstone. This well offsets the Gallegos Federal 26-12-7 No. 1 well.

(45) The well file reveals that when the Lansdale Federal No. 1 well was originally completed in March, 1980, the operator recovered black water and noted rising casing pressures. Water from the well showed a heavy coal content, and coal fines were recovered, indicating that the well was in communication with coal seams when it was originally completed.

(46) A Walsh Engineering (Paul Thompson) Production, Workover and Completion Report for the Lansdale Federal No. 1 well, dated December 19, 1994, shows that Pendragon (J.K. Edwards was the actual operator at this time) had expressly planned to perforate the Fruitland Coal and treat the well with acid. Pendragon in fact did perforate and acidize the Fruitland coal formation on December 20, 1994 in the Lansdale Federal No. 1 well from 1042' to 1056'.

(47) Pendragon failed to report the perforations in the Fruitland coal in sundry notices filed with the Division. Pendragon's regulatory filings misrepresented the well as a Pictured Cliffs well. The Lansdale Federal No. 1 well was on 160-acre proration unit and at a nonstandard location, illegal spacing and location for a Fruitland coal seam gas well.

(48) Pendragon illegally produced Fruitland coal seam gas from the Lansdale Federal No. 1 well from December, 1994 until the week prior to the Division hearing in this case in 1998. For 3 and 1/2 years, Pendragon operated the Lansdale Federal No. 1 well under false regulatory filings which failed to disclose that the well was perforated in, and producing from the Fruitland Coal. No water production was reported on the well until March, 1998 after a field inspection by OCD personnel. Pendragon squeezed off the perfs in the Fruitland formation less than one week before the hearing in this case on July 28-30, 1998. Since the well was restricted to the Pictured Cliffs perforations, it has produced at uneconomic levels. The same result would be expected for the Chaco wells were their production dependent on only the Pictured Cliffs formation as a source of supply.

(49) Pendragon began its rework program on the Chaco wells in January, 1995. Pendragon acidized and/or fracture stimulated the Chaco 1, 1J, 2J 2R, 4 and 5 wells during the period January, 1995 through May, 1995. These wells are direct

offsets to the Whiting coal wells which, by early 1995, had shown declines in water production and significant increases in coal seam gas production.

(50) In each case of reworking the Chaco wells Nos. 1, 2R, 4 and 5, Pendragon observed significant pressure increases in the wells following the acidization or fracture stimulation; pressure increases in the Chaco wells had not been observed after the offset Gallegos Federal wells were drilled and fracture stimulated in 1993. A chart demonstrating the pressure increases resulting from the rework of these wells is as follows:

Well Name	Pre-Treatment Wellhead Shut-in Pressure	Treatment Date and Type	Post-Treatment Wellhead Shut-in Pressure
Chaco 1	137 (07/05/83)	Frac (01/27/95)	170 (03/14/95)
Chaco 4	119(01/30/95)	Acid (01/30/95)	170 (02/14/95)
Chaco 5	121 (06/21/80)	Frac (05/10/95)	151 (05/19/95)

(51) Pendragon introduced evidence at the hearing that pressures in the Chaco No. 5 well had risen prior to any acidization or fracture stimulation on that well. However, the well file indicates that a casing leak occurred in that well prior to May, 1995. In January, 1995, Pendragon attempted to fracture treat the Chaco No. 5, but had to abort the procedure when black water was discovered flowing behind the casing and out the bradenhead. Given the evidence of the casing leak, and the evidence of coal in the water, it is probable that communication in the Chaco No. 5 well had already been established between the sandstone formations and the coal prior to the May 1995 fracture stimulation treatment.

(52) The shut-in wellhead pressure increases experienced by Pendragon in Chaco wells 1, 4, 5 and 2J following the acidization and/or fracture stimulations occurred as a result of those Pendragon acidizations and/or fracture stimulations communicating with the coal formation, which was at higher pressure than the depleted Pictured Cliffs formation.

(53) There is no pressure data available for the Chaco wells during the period from 1983-84 to 1995. The surface shut-in pressure for wells in the Pictured Cliffs formation during the early to mid-1980s, at which time the Chaco wells were producing at marginal rates, was in the range of 100 psi.

(54) Pendragon attempted to attribute the pressure increases in the Chaco wells following the Pendragon acidizations and/or fracture stimulations to overcoming skin damage in the wells or to connection with a "third bench" of the Pictured Cliffs formation. Pendragon witnesses varied in their theoretical notions of types of reservoir or near wellbore damage. None submitted any testing or scientific evidence to establish that the wells suffered from any skin damage which resulted in the premature production declines or the low pressure readings prior to the Pendragon acidizations

and/or fracture stimulations nor was any competent evidence of a connection with any "third bench" offered.

(55) Given the state of depletion within the Pictured Cliffs producing interval prior to 1995, the pressure increases that occurred within the Chaco wells during or subsequent to the Pendragon acidizations and/or fracture stimulations resulted from communication with the Fruitland Coal formation.

(56) Whiting utilized all available shut-in wellhead pressure readings without attempting to manipulate the data. The pressure data presented by Whiting were of the type commonly relied upon in the industry in evaluating gas wells. The shut-in wellhead pressure readings are most often the only, and therefore the best, available indicators of reservoir pressures.

(57) Pendragon selectively used pressure data in its presentation and ignored data which did not support its theory of the case.

(58) The significant production and pressure increases achieved in the Chaco wells immediately after treatments by Pendragon were markedly higher than the virgin production levels when the wells were first completed and demonstrate that the Chaco wells were in communication with the Fruitland coal formation following the acidizations or fracture stimulations.

(59) During late 1994, the surface shut-in pressures for the Fruitland coal formation within the area of the Gallegos Federal wells ranged from approximately 175 to 225 psi. At the time the Chaco wells were acidized and/or fracture stimulated, there existed sufficient pressure within the Fruitland coal formation to act as a gas production source for the Chaco wells.

(60) The following Chaco well production rates were observed:

	Initial Production Avg. MCFD	**After Offset GF Well Fracs MCFD**	**After Pendragon Treatment MCFD**
Chaco	80	0	300
Chaco 2R	65	10	100
Chaco 4	200	0	400
Chaco 5	190	0	350
Chaco 1J (Wellbore 740' from GF 1 #2)	10	0	0 Not frac'd
Chaco 2J	32	5	5 Not frac'd

(Wellbore 180' from GF 1 #1)

(61) The significant post-stimulation increases in producing rates obtained in Chaco wells 1, 2R, 4 and 5 cannot be attributable to overcoming skin damage in the wells, nor can it be attributable to communication between the Pictured Cliffs producing interval and the "third bench" of the Pictured Cliffs formation.

(62) Between 1978 and 1994, the Chaco 4 cumulative production was 201,805 Mcf and the Chaco 5 cumulative volume was 144,805. After the May 1995 fracture treatments by Pendragon those wells between June 1995 and June 1998 produced the following volumes: Chaco 4 – 359,943 Mcf and Chaco 5 – 335,408. Cumulative gas production from Chaco wells 4 and 5 (561 MMCFG and 480 MMCFG, respectively) has exceeded 100% of the original gas-in-place volumetric reserve estimates based upon 160 acre drainage for the Pictured Cliffs producing interval. Pendragon's decline curve and material balance gas reserve calculations presented to justify these production levels were based upon post-stimulation, post-May 1995 production data from the Chaco wells. These calculations improperly include production from the Fruitland coal formation achieved after the Pendragon fracture stimulations and acidizations on the Chaco wells.

(63) Following the Pendragon acidizations and/or fracture stimulations, the Chaco wells No. 1, 2R, 4 and 5 ranged in production from 100 to 425 MCF gas per day. These production levels were not characteristic of Pictured Cliffs restimulations. In each case, production levels exceeded sustained production levels experienced when the wells were originally drilled under virgin reservoir conditions. The increases in production from about 0 to 10 MCFD to sustained rates of 400 MCFD are far above any results that could be expected had Pendragon simply been overcoming "damage" by the stimulations.

(64) The evidence of production volumes and pressure data on Chaco wells 1, 2R, 4 and 5 since the acidization and fracture stimulations in 1995 is consistent with the conclusion that these wells produced significant volumes of coal seam gas from 1995 until they were shut-in by Order of the Santa Fe County District Court announced on June 29, 1998. The pressure and production history of the Chaco wells since 1995 is inconsistent with the conclusion that production was solely from the Pictured Cliffs formation.

(65) The communication between the Pictured Cliffs formation and the Fruitland formation in Chaco wells 1J and 2J, though caused by Pendragon, has not resulted in production of significant quantities of coal seam gas.

(66) Since the Chaco wells were shut-in by Order of the Santa Fe County District Court, pressure readings in the Chaco wells have confirmed communication with the Fruitland Coal Formation. As Whiting Exhibit 31 demonstrates, the pressure readings on the shut-in Chaco wells have fluctuated. The fluctuations in the Chaco wells' wellhead shut in pressures have coincided with periods when the Whiting Coal

wells were shut-in due to gathering system and plant restrictions or when the Whiting wells resumed production. These pressure responses in the Chaco wells have occurred instantaneously or within a very short period of time. This indicates communication at the Chaco wellbores. If there were no communication between the Pictured Cliffs and the Fruitland coal formations in the Chaco wells, the Chaco wells would exhibit a flat pressure, or gradually increasing or decreasing pressures once they achieved equilibrium following shut-in. They would not be instantaneously affected by the performance of the Gallegos Federal wells; the observed pressure response would require days or months to achieve.

(67) The production and pressure history of the Gallegos Federal wells since they were drilled and completed is characteristic of coal seam gas production. Each of the wells initially experienced high water production, which is characteristic of production from coal seam gas formations. After the drainage area surrounding the well was depressurized and dewatered, the wells experienced marked inclines in gas production, a factor also consistent with coal seam gas production.

(68) The production and pressure history of the Gallegos Federal wells is inconsistent with Pendragon's theory that the Gallegos Federal wells are producing Pictured Cliffs gas.

(69) Nothing in the pressure or production history of the Gallegos Federal wells indicates that those wells are producing any significant amount of gas from the Pictured Cliffs formation. Rather, the premature decline in production of Gallegos Federal wells 6-2, 12-1 and 7-1 indicates that Pendragon's offsetting Chaco wells have produced gas from the Fruitland formation contributing to the premature decline in production in the Gallegos Federal wells.

FRACTURE STIMULATIONS

(70) The evidence presented to the Commission demonstrates that fracture stimulations in the Pictured Cliffs Formation carry a reasonable probability of causing communication with the Fruitland Formation in the subject area. This potential consequence of fracture stimulations in the Pictured Cliffs formation was recognized by the Division in Case No. 9420. Because the Pictured Cliffs Formation in the subject area is relatively depleted at this time, while the coal seam gas formations in the Fruitland Formation remain productive, fracture stimulations in the Pictured Cliffs Formation carry with them the reasonable probability of a violation of correlative rights of interest owners in the Fruitland Formation, particularly where ownership between the two formations is not uniform.

(71) The evidence presented to the Commission indicates that the average foam fracture stimulation performed on the Chaco wells consisted of 31,248 gallons of fluid and 38,421 pounds of proppant injected at treating rates ranging from 22 to 34 barrels per minute. The evidence further indicates that the average low viscosity fluid fracture stimulation performed on the Gallegos Federal wells consisted of 41,030

gallons of fluid and 72,656 pounds of proppant injected at treating rates between 45 and 60 barrels per minute.

(72) Both Pendragon and Whiting presented evidence to the Commission in the form of fracture simulation computer programs designed to simulate the probable geometry of fracture stimulations on the Chaco wells and the Gallegos Federal wells. The results of the parties' simulation programs were contradictory, each program had limitations, and each allowed the operator to assume various rock properties and reservoir variables.

(73) Pendragon's fracture expert modeled the fracture stimulation on the Gallegos Federal well 26-12-6 #2. Using known factors, parameters and formation values, the Pendragon fracture model was unable to predict that the fracture grew out of zone. In order to force the fracture to grow vertically out of the coal and into the Pictured Cliffs formation, the Pendragon expert had to assume an anomaly in the Fruitland formation "by changing the rock properties between 750 ft. and 800 ft. from the wellbore" in the nature of an "ash pod." There was no geologic evidence presented to the Commission which would support such a theoretical and unique change in lithology.

(74) Tonstein (ash) layers do occur in the Fruitland coal in the San Juan Basin, but they exist as thin sheet layers typically only a few inches in thickness. There is no documented tonstein occurrence in the coal with the geometry described by Pendragon's fracture stimulation expert, and no scientific support for this model which simulated the Gallegos Federal well fracture growing vertically through shale and into the Pictured Cliffs sandstone some 700-800 feet from the Gallegos Federal 6 #2 wellbore.

(75) In an effort to demonstrate that the Pendragon hydraulic fractures remained in zone, Pendragon's expert modeled only the Chaco 2R, which is unique among the Chaco wells in that the lower Fruitland sandstone is thin or absent in the Chaco 2R. Consequently, the Chaco 2R is perforated only in the Pictured Cliffs formation and not within the Fruitland horizons like the other Chaco wells. In addition, Pendragon's expert assumed rock properties for his simulation unsupported by the data or literature. Nonetheless, that fracture simulation reflected a fracture growth up to and in contact with the base of the coal for several hundred feet. With the extensive natural fracture (cleating) system in the coal, that extensive contact between the fracture induced by Pendragon and the natural fractures in the coals would provide communication between the two zones.

(76) The Commission need not rely on the computer program fracture models in order to find that the results of fracture stimulations on the Chaco wells caused communication with the Fruitland formation, and that the fracture stimulations of the Gallegos Federal wells did not cause communication with the Pictured Cliffs formation. The uncontradicted evidence concerning the fracture stimulations on the Chaco wells is the incredible and unprecedented production increase observed immediately in the

Chaco wells beginning in 1995. Conversely, the fracture stimulations on the Gallegos Federal wells in 1993 had no effect on production or pressure in the Chaco wells.

(77) Whiting performed fracture stimulations on its Gallegos Federal wells in December, 1992 and August, 1993. The distances from the Gallegos Federal wells to the offset Chaco wells ranged from 180 feet (from the Gallegos Federal 26-13-1 No. 2 to the Chaco 2J) to 3,243 feet (from the Gallegos Federal 26-13-1 No. 2 to the Chaco 5). In each case, following the fracture stimulations on the Gallegos Federal wells at issue, the Chaco wells experienced no pressure or production response. This lack of response in the Chaco wells to the fracture stimulations in the Gallegos Federal wells indicates that the fracture stimulations on the Gallegos Federal wells did not cause communication with the Pictured Cliffs formation.

(78) There is little or no stress barrier between the massive Pictured Cliffs sandstone and overlying coal seams. Any fracture treatment in this massive sandstone is likely to communicate with the coal. Perforations in the Chaco wells though which hydraulic fractures were administered are located in the Fruitland sandstone between coal seam layers and within one to five feet of the coal zones. A fracture treatment in this sandstone is certain to communicate with the coal.

(79) The pressure and production response in the Chaco wells observed after fracture stimulations on the Chaco wells is clear evidence that the fracture stimulations on those wells caused communication with the Fruitland formation. Each of the Chaco wells which were fracture stimulated showed immediate pressure and production response to their fracture stimulations. These pressure and production responses were inconsistent with production from the depleted Pictured Cliffs formation alone, indicating that the fracture stimulations on the Chaco wells resulted in communication with the Fruitland formation, which was higher in pressure and contained substantial volumes of gas.

(80) Pendragon experienced no pressure or production response in Chaco wells 1J and 2J after the nearby Gallegos Federal wells were fracture stimulated. These wells were not stimulated by Pendragon and remain non-productive.

(81) Pendragon's theory of deep formation damage to explain why the Chaco wells did not respond to Gallegos Federal well fracture stimulations is unsupported by any competent data, studies or evidence.

(82) The evidence presented to the Commission established that Pendragon's fracture stimulations on Chaco wells No. 1, 2R, 4 and 5 extended into and through the lower and upper coal seams in the Fruitland formation (B Coal and Basal coal) which is owned by Whiting. These fracture stimulations caused communication between the Fruitland coal seams and the Pictured Cliffs sandstone and thence to the Chaco well bores, and have, since performed in 1995, resulted in the production of coal seam gas from these Chaco wells by Pendragon.

(83) The communication established between the Pictured Cliffs formation and the Fruitland formation as a result of the acidization and/or fracture stimulations on the Chaco wells has resulted in a violation of Whiting's correlative rights.

(84) Communication between the Pictured Cliffs formation and the Fruitland formation did not result in significant production of coal seam gas from the Chaco wells 1J and 2J, which were not fracture stimulated.

(85) Pendragon's theory of communication resulting from the Gallegos Federal well fracture stimulations, and its theory of communication at the Gallegos Federal wellbores, is unsupported by competent scientific evidence. Pendragon's conclusions in this regard are based largely on incorrect permeability values used for the coal formation and the Pictured Cliffs formation. Pendragon's experts consistently utilized permeability values for both the coal formation and the Pictured Cliffs formation that did not conform with actual permeability measurements in those formations.

(86) Even if communication between the formations were established by fracture stimulations of one or more Gallegos Federal wells, based on the undisputed production and pressure data which demonstrates that the Chaco wells experienced no pressure or production response following the Whiting fracture stimulations of the Gallegos Federal wells, any communication caused by Whiting's fracture stimulations has not resulted in any significant production of Pictured Cliffs formation gas by the Whiting wells.

WATER PRODUCTION

(87) Coal seam gas wells tend to produce high volumes of water production in the early stages of production, with water production declining as gas production increases. No significant water production would be expected from a well producing only from the Pictured Cliffs sandstone.

(88) The Chaco wells have produced significant volumes of water since the acidizations and fracture stimulations performed in 1995 on the Chaco wells Nos. 1, 2R, 4 and 5. The produced water volumes in these wells since 1995 are inconsistent with production of solely Pictured Cliffs sandstone gas, and are consistent with the conclusion that these wells are producing coal seam gas from the Fruitland formation.

(89) The problem with accurately quantifying volumes of produced water from the Chaco wells since 1995 exists because Pendragon failed to report water production as required by NMOCD Form C-115. The evidence in this case established that Pendragon did not begin reporting water volumes from its Chaco wells until, February, 1998, which coincided with a site visit to the Chaco wells by the Division.

(90) The problem with accurately quantifying volumes of produced water from the Chaco wells since 1995 is compounded because Pendragon utilized daily production reports provided by Paul Thompson which did not have a column for

reporting water production. As a result, recording of water production was sporadic and grossly underreported.

(91) Pendragon disposed of the produced water from its Chaco wells in unlined earthen pits in an area of sandy soils. Water was regularly observed in these unlined pits after 1995, indicating ongoing water production. The result of such disposal is that significant amounts of produced water were disposed of through evaporation and percolation into the soil, thus making it impossible to precisely quantify the volumes of water produced from the Chaco wells because the water production was not properly measured or recorded by the pumpers or contract operator.

(92) Evidence presented by Whiting at the August, 1999 hearing, based on documents first produced by Pendragon the day before the start of the Division hearing in 1998, indicated that Pendragon continued to produce water from the Chaco wells until at least June, 1998. Pendragon's C-115 reports for that period of time do not reflect water production, even though their internal files demonstrated water production and water hauling from the Chaco wells.

(93) Evidence presented at the Commission hearing established that the Chaco wells produced volumes of water since 1995 consistent with coal seam gas wells. For instance, daily production reports for Chaco wells 1, 2R, 4 and 5 for the time period beginning in March, 1995 after the acidizations and/or fracture stimulations showed only intermittent water production. However, the testimony of Mr. Paul Thompson, Pendragon's contract pumper, confirmed that each of the wells would have had substantial additional water production in the days before and after water was actually reported on the various daily reports, with water production since 1995 of 30,000 to 40,000 barrels.

(94) While water production evidence on the Chaco wells is sparse owing to Pendragon's non-preservation of the information and its failure to accurately measure and report water production from these wells, the water production records and other evidence in this case are consistent with a finding that the Pendragon Chaco wells have, since their acidizations and fracture stimulations in 1995, been producing coal seam gas in significant quantities from these Chaco wells. The water/gas ratio on the Chaco wells generally shows a higher water/gas ratio than the Whiting coal wells for the same period.

(95) Pendragon violated Division rules and regulations by failing to accurately report water production from the Chaco wells from 1995 until March, 1998 to the Division on the C-115 Operator's Monthly Report forms.

(96) Presumptions on the issue of water production from the Chaco wells will be made adverse to Pendragon in this proceeding in light of Pendragon's failure to accurately measure and report water production from its Chaco wells.

GAS ANALYSIS

(97) The Division has recognized that gas analysis is one method of differentiating coal seam gas from Pictured Cliffs sandstone gas. Pictured Cliffs sandstone gas typically has a BTU content in this area of between 1050 and 1100, whereas Fruitland coal seam gas in this area typically has a BTU content of approximately 1000.

(98) Historical data submitted in this case demonstrated that the Pendragon Chaco wells prior to the acidization and fracture stimulations in 1995 produced gas with a BTU content consistent with Pictured Cliffs sandstone gas.

(99) Following the acidizations and fracture stimulations in 1995, and continuing until the wells were shut-in in 1998, the Pendragon Chaco wells began producing gas with a BTU content consistent with Fruitland coal seam gas. The documentary evidence presented to the Commission demonstrated that the BTU readings on Whiting's coal seam gas and Pendragon's gas produced from the Chaco wells has become increasingly similar and consistent over time, thus indicating that the Chaco wells are producing significant volumes of coal seam gas.

(100) Gas analyses from the Gallegos Federal wells has been uniform since first production and indicates that those wells are presently and have historically produced coal seam gas. The gas analysis data from the Gallegos Federal wells is inconsistent with Pendragon's theory that the Gallegos Federal wells are producing Pictured Cliffs gas.

(101) BTU content and gas analysis trends can be utilized as an indicator of communication between the Fruitland Coal and Pictured Cliffs formations.

(102) The gas analyses on the Chaco wells taken in 1999, after 9 months of shut-in, showed a BTU content more consistent with Pictured Cliffs formation gas. This analysis was different than the analyses the Chaco wells had exhibited from 1995 until shutting-in in July, 1998. The most logical explanation for this change in composition during shut-in is the re-equilibration of the borehole gas with gas in the Pictured Cliffs. The flowing pressure in the Fruitland formation at the Chaco wellbores in 1999 was significantly lower than the shut-in pressure in the Pictured Cliffs formation at the Chaco wellbores as a result of the continuous operation of the Gallegos Federal wells while the Chaco wells have been shut-in for over one year. Because there would be no cross flow from the Fruitland formation into the Pictured Cliffs formation during operation of the Gallegos Federal wells and shut-in of the Chaco wells, what little PC gas remains in the reservoir would migrate to the Chaco wellbores, thus producing gas analyses more reflective of the Pictured Cliffs formation gas. However, if the Chaco wells were allowed to produce again, they would begin to draw down the pressure in the Chaco wellbores, thus causing additional Fruitland coalbed gas to be produced from the Chaco wellbores, thereby causing gas analyses from the Chaco wells to reflect coal seam gas.

(103) The BTU content and gas analysis data presented to the Commission indicates communication between the Pictured Cliffs and Fruitland Coal formations at the Chaco wellbores.

PENDRAGON TARGETED COAL SEAM GAS FROM THE FRUITLAND FORMATION

(104) The evidence presented to the Commission demonstrates that Pendragon's development project with respect to the Chaco wells was designed to cause communication with the Fruitland formation and allow Pendragon to improperly produce coal seam gas through its Chaco wells. Evidence supporting this conclusion includes the following:

(a) Pendragon began its activities in the area in December, 1994 by reworking the Lansdale Federal No. 1 well. The well had perfs in the coal formation and produced coal seam gas after the rework. Nevertheless, Pendragon misrepresented the well to the Division and other operators as a Pictured Cliffs well. Pendragon only had 160 acres to dedicate to the well, which was insufficient acreage for a coal seam gas well in this area. Pendragon illegally produced the Lansdale Federal No. 1 well from December, 1994 until July, 1998, just prior to the Division hearing in this case.

(b) Pendragon began its rework program on the Chaco wells in January, 1995, with a plan to acidize and fracture stimulate those wells. Although the Gallegos Federal wells in the area were operating, Pendragon failed to notify Whiting of its plans, notwithstanding that a reasonable, prudent Pictured Cliffs well operator would understand that acidizations and fracture stimulations of Pictured Cliffs wells could cause communication with the Fruitland formation.

(c) Pendragon representatives had monitored the water and gas production progress of the Gallegos Federal wells prior to initiating the rework procedures on the Chaco wells. The Chaco wells which Pendragon fracture stimulated were wells that offset the Gallegos Federal wells, that had the highest production rates at that time, and the Gallegos Federal wells which were furthest along in the dewatering process as of January, 1995.

(d) Following the acidizations and/or fracture stimulations on the Chaco wells, Pendragon, either independently or through its agent Paul Thompson, consciously utilized daily progress reports that did not include a column for recording and reporting water production from the wells. A reasonable, prudent operator should know that water production from the Chaco wells would be an indicator as to whether those wells were producing Pictured Cliffs gas or coal seam gas from the Fruitland formation.

(e) The use of unlined pits by Pendragon would make it difficult to quantify the water production and represents a violation of Division rules and

regulations given the volumes of water actually recorded by Pendragon, which volumes are substantially less than the actual water production volumes.

(f) Pendragon undertook no independent analysis of the proper contact between the Pictured Cliffs formation and the Fruitland formation in this area prior to reworking the Chaco wells. Pendragon left open the upper perforations in Chaco wells 1, 2J, 4 and 5, notwithstanding that those perforations are actually located above the base of the Fruitland formation and expressly excluded in its operating rights assignment. A reasonable, prudent operator would undertake such an examination prior to reworking the wells in order to confirm that the perforations are actually in a zone which the operator is legally entitled to produce prior to undertaking the work.

(g) Pendragon recognized that there was communication between the Pictured Cliffs and Fruitland formations in this area when it installed compression on the Chaco wells in early 1998. The installation of compressors on the Chaco wells followed a dramatic decline in production from the Chaco wells after Whiting installed compression on its Gallegos Federal wells in late 1997 and early 1998. There would be no reason for Pendragon to install compression on Pictured Cliffs wells producing from that source unless Pendragon recognized communication between the two formations. Nevertheless, with knowledge of and recognition of communication between the formations as early as February, 1998, Pendragon appeared before the Division and denied communication between the two formations at the Division hearing in July, 1998.

(105) Based on the evidence presented to the Commission, the Commission believes that there is a reasonable probability that any additional reworking of the Chaco 1J, 2J, and 2R would violate the correlative rights of Whiting, and that Pendragon should not be authorized to conduct any additional acidization, fracture stimulation, or reworking on those wells.

BASED ON THE FOREGOING, THE COMMISSION FINDS THAT:

(1) Pendragon, as the Applicant, has the burden to establish that its Chaco wells are producing from the appropriate common source of supply which would be the Pictured Cliffs formation below the base of the Fruitland formation.

(2) Pendragon has failed to meet its burden in this proceeding.

(3) Pendragon's Chaco wells Nos. 1, 2J, 4 and 5 include perforations open in the Fruitland sandstone above the base of the Fruitland formation and are therefore situated in a formation owned by Whiting. Between 1995 and July, 1998, these wells produced gas to which Whiting is solely entitled.

(4) Pendragon's acidizations and/or fracture stimulations on its Chaco wells Nos. 1, 1J, 2J, 2R, 4 and 5 caused communication with the coal seams in the Fruitland formation. Whiting is solely entitled to produce coal seam gas from this formation. The Chaco wells 1, 2R, 4 and 5 since 1995 and until ordered shut-in had been producing

predominantly coal seam gas. Chaco wells 1J and 2J have also produced coal seam gas since 1995. Any additional rework on Chaco wells 2R, 1J and 2J could cause further improper production of coal seam gas.

(5) Whiting established by the preponderance of evidence presented to the Commission that its fracture stimulations on the Gallegos Federal wells did not cause communication with the Pictured Cliffs formation, and that the Gallegos Federal wells are producing from the appropriate common source of supply; that if one or more of the fracture treatments on the Gallegos Federal wells, however, did cause communication with the Pictured Cliffs formation those wells nonetheless have not produced, are not producing, and will not produce Pictured Cliffs gas in any significant quantity.

(6) A fair and equitable allocation based upon the engineering evidence presented at the hearing demonstrates that following the 1995 stimulations, 90% of gas production from the Chaco wells would be allocated to production from Whiting's Fruitland formation, and 10% would be allocated to Pendragon's production from the Pictured Cliffs formation.

(7) Given the volumes previously produced by the Chaco wells before shut-in by court injunction and on the basis of the 90% source in Fruitland formation gas and 10% source in Pictured Cliffs sandstone gas, the Pendragon wells had produced more gas than they were capable of producing from the Pictured Cliffs sandstone long before June 30, 1998.

(8) Pendragon's Application seeking an order that Pendragon's Chaco wells are producing from the appropriate common source of supply is not supported by the evidence and should be denied.

(9) It would be violative of correlative rights, inequitable, and injurious to Whiting to allow the Pendragon Chaco wells to resume operations, because the Chaco wells would again produce coal seam gas.

(10) Pendragon has engaged in ongoing and consistent practices of violating Division rules and regulations by (a) operating the Lansdale Federal No. 1 well as a Pictured Cliffs well, fully knowing that the well was producing coal seam gas, (b) operating the Lansdale Federal No. 1 well on a 160-acre proration unit at a nonstandard location in violation of Order R-8768 and R-8768-A, and (c) failing to properly measure, document and report volumes of water production from the Chaco wells since the stimulation treatments in 1995 until February 1998.

(11) Pendragon intentionally targeted coal seam gas from the Fruitland formation in its Chaco well re-work project.

(12) Plugging and abandoning Pendragon's Chaco wells will prevent waste and protect the correlative rights of the parties.

IT IS THEREFORE ORDERED THAT:

(1) Pendragon is to plug and abandon Chaco wells Nos. 1, 1J, 2J, 2R, 4 and 5 within thirty (30) days and duly report such procedures by Sundry Notice, Form C-103, in accordance with the Rules and Regulations of the Division.

(2) Pendragon's Application is denied in its request for a finding that the Chaco wells are or were producing from the appropriate common source of supply.

(3) Pendragon's Application as it pertains to its request that the Commission find that Whiting's Gallegos Federal wells are producing from the appropriate common source of supply is granted.

(4) The rights and remedies and defenses between and among the parties that may exist under common law remain to be decided by the district court in which litigation between the parties is pending and are not within the jurisdiction of the Division.

(5) Jurisdiction of this cause is retained for the entry of such further orders as the Division may deem necessary within the scope of its regulatory authority.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

Lori Wrotenbery
Chairperson

STATE OF NEW MEXICO

ENERGY MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, L.P., AND J.K EDWARDS ASSOCIATES, INC. TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO

CASE NO. 11996

ORDER OF THE COMMISSION

(Proposed by Whiting Petroleum Corporation and Maralex Resources, Inc.)

BY THE DIVISION:

This cause came on for hearing on August 12, 1999 at Santa Fe, New Mexico, before the Oil Conservation Commission ("Commission"), and continued through August 21, 1999.

NOW, on this ____ day of _____, 1999, the Commission, having considered the testimony, the record, and being fully advised in the premises,

FINDS THAT:

(1) Due public notice having been given as required by law, the Commission has jurisdiction of this cause and the subject matter thereof.

PARTIES AND NATURE OF DISPUTE

(2) The applicants, Pendragon Energy Partners, Inc., J.K. Edwards Associates, Inc., and Pendragon Resources LP (collectively "Pendragon"), seek an order finding that Pendragon is producing from the appropriate common source of supply, i.e., the Pictured Cliffs Formation, from the following wells in San Juan County, New Mexico ("Chaco wells"):

Well Name	Location
Chaco No. 1	NW ¼, Section 18, T26N, R12W, N.M.P.M.
Chaco No. 2R	SW ¼, Section 7, T26N, R12W, N.M.P.M.
Chaco No. 4	NW ¼, Section 7, T26N, R12W, N.M.P.M.

Chaco No. 5	SE ¼, Section 1, T26N, R13W, N.M.P.M.
Chaco Ltd. No. 1J	SW ¼, Section 1, T26N, R13W, N.M.P.M.
Chaco Ltd. No. 2J	NE ¼, Section 1, T26N, R13W, N.M.P.M.

(3) Pendragon, as the Applicant, has the burden to establish that its Chaco wells are producing from the appropriate common source of supply which would be the Pictured Cliffs formation below the base of the Fruitland formation.

(4) Pendragon has failed to meet its burden in this proceeding.

(5) Pendragon also filed an Application seeking an order finding that Whiting Petroleum Corporation and Maralex Resources, Inc. (collectively "Whiting") are producing from the appropriate common source of supply, i.e., the Fruitland formation, from the following wells in San Juan County, New Mexico ("Gallegos Federal wells").

Well Name	Location
Gallegos Fed. 26-12-6 No. 2	Section 6, T26N, R12W, N.M.P.M.
Gallegos Fed. 26-12-7 No. 1	Section 7, T26N, R12W, N.M.P.M.
Gallegos Fed. 26-13-1 No. 1	Section 1, T26N, R13W, N.M.P.M.
Gallegos Fed. 26-13-1 No. 2	Section 1, T26N, R13W, N.M.P.M.
Gallegos Fed. 26-13-12 No. 1	Section 12, T26N, R13W, N.M.P.M.

(6) Although Pendragon's application seeks a finding that Whiting is producing from the appropriate common source of supply, much of Pendragon's evidence at the Commission hearing attempted to impeach Pendragon's own application and establish that Whiting's Gallegos Federal wells were producing from an inappropriate common source of supply, i.e., the Pictured Cliffs formation.

(7) Pendragon's position with respect to the Gallegos Federal wells is inherently contradictory, and the evidence Pendragon put on at the hearing attempting to impeach its application was unpersuasive. Moreover, Whiting put on substantial evidence at the Commission hearing that established that the Gallegos Federal wells were producing from the appropriate common source of supply, and were not producing from the Pictured Cliffs formation.

(8) Pendragon's Chaco wells have been shut-in by order of the Santa Fe County District Court in the proceeding styled Whiting, et al. v. Pendragon, et al., Cause No. D-0101-CV-98-01295, as well as the decision of the New Mexico Oil Conservation

Division, Order No. R-11133 issued February 5, 1999. The Commission expressly finds, based upon the evidence presented at the hearing in this matter, that the orders of the Santa Fe County District Court and the Oil Conservation Division should remain in full force and effect and that Pendragon continue to shut-in its Chaco wells.

IT IS THEREFORE ORDERED THAT:

(1) Pendragon's Application as it pertains to the Chaco wells is denied in its entirety.

(2) Pendragon's Application as it pertains to its request that the Commission find that Whiting's Gallegos Federal wells are producing from the appropriate common source of supply is granted.

(3) Pendragon is hereby ordered to shut-in its Chaco wells No. 1, 1J, 2J, 2R, 4 and 5.

(4) The rights and remedies and defenses between and among the parties that may exist under common law remain to be decided by the district court in which litigation between the parties is pending and are not within the jurisdiction of the Division.

DONE at Santa Fe, New Mexico, on the day and year hereinabove designated.

STATE OF NEW MEXICO
OIL CONSERVATION COMMISSION

Lori Wrotenbery
Chairman

STATE OF NEW MEXICO
ENERGY MINERALS AND NATURAL RESOURCES DEPARTMENT
OIL CONSERVATION COMMISSION

APPLICATION OF PENDRAGON ENERGY PARTNERS, INC., PENDRAGON RESOURCES, L.P., AND J.K EDWARDS ASSOCIATES, INC. TO CONFIRM PRODUCTION FROM THE APPROPRIATE COMMON SOURCE OF SUPPLY, SAN JUAN COUNTY, NEW MEXICO

CASE NO. 11996

99 NOV 29 PM 2:58 OIL CONSERVATION DIV.

WHITING'S MEMORANDUM IN LIEU OF CLOSING STATEMENT

Whiting Petroleum Corporation and Maralex Resources, Inc. ("Whiting"), submit this Memorandum in lieu of a closing statement discussing the evidence presented at the hearing on August 12-21, 1999.

I.

INTRODUCTION

This case arises out of a rework program initiated in 1994-1995 by Applicants (collectively "Pendragon") with respect to depleted Pictured Cliffs wells in T-26-N, R12 and 13W, San Juan County: Chaco wells Nos. 1,1J, 2J, 2R, 4 and 5 ("Chaco wells"). Pendragon's ownership in the leases underlying the Chaco wells is "Limited from the base of the Fruitland formation to the base of the Pictured Cliffs formation" ("PC"). (Emphasis added). Whiting owns interests in the same leases from the surface of the earth to "the base of the Fruitland formation." Whiting developed five Fruitland coal gas wells ("Gallegos Federal wells") in 1992-93 in the three sections within the subject area. The respective conveyances to Whiting and to Pendragon were from common grantors (Bayless, Merrion, et al.), describing the transferred interests by formations, not by New Mexico Oil Conservation Division ("Division") defined gas pools.

After Pendragon acidized and fracture stimulated the Chaco wells in 1995, Whiting observed that the wells were producing volumes of gas extraordinarily inconsistent with

restimulated wells in the old WAW Fruitland Sand - Pictured Cliffs reservoir. Investigations revealed that the shut-in pressures on the Chaco wells were higher than one would expect from the Pictured Cliffs in that area and were approximating pressure levels Whiting was seeing in its coal wells. Whiting also noted significant water production from the Chaco wells being dumped into unlined earthen pits. Simultaneously, Whiting observed a premature break on the incline of its offsetting coal gas production. Gas sample analyses pointed to the source of the Chaco wells remarkable production being the coalbeds owned by Whiting.

Not willing to make serious accusations based on work by its in-house technicians, Whiting engaged the independent expertise of Holditch Reservoir Technologies to study the evidence. Holditch experts concluded that the Pendragon restimulations of the Chaco wells had caused communication with the Fruitland coal zones so that the coals were the source of the pressures, gas production and water being produced at the Chaco wells.

Whiting filed suit on May 26, 1998 against Pendragon in Santa Fe County District Court, Cause No. SF-CV-98-01295 alleging trespass and conversion. A preliminary injunction hearing was held on June 29, 1998, and the district court ordered Chaco wells Nos. 1, 2R, 4 and 5 shut-in. District Judge Art Encinias found that Pendragon had created hydraulic fractures into the Fruitland coal and was "high-jacking" Whiting's gas. The district court granted a preliminary injunction against Pendragon shutting-in the Chaco wells, and deferred to the Commission on matters presented by Pendragon's Application which were peculiarly within the agency expertise. (Whiting Exhibit 5).

Pendragon quickly filed an application with the Division requesting an Order confirming that its Chaco wells are producing from the appropriate common source of supply, i.e., the PC formation, and that Whiting's Gallegos Federal coal seam gas wells are producing from their

appropriate common source of supply, i.e. the Fruitland Formation.[1] After three lengthy days of hearing before the Division (Examiner David Catanach) in July 1998, Pendragon not only failed to prove its allegations, but the Division held that Pendragon had caused communication with the coal formation by its stimulation treatments, had been producing coal gas, and ordered the Chaco wells to remain shut-in. Order R-11133, February 5, 1999.

On this de novo appeal the evidence presented to the Commission established that: (a) Pendragon's 1995 rework program targeted the Fruitland coal formation, just as the Whiting wells were dewatered and producing coal gas and reached economic levels of gas production; (b) the Chaco wells, excepting the 2R, are perforated in the Fruitland sands above the base of the Fruitland coal formation; (c) Pendragon acidized and fracture stimulated its Chaco wells Nos. 1, 1J, 2J, 2R, 4 and 5 in 1995 causing communication with Whiting's coal seam zones; (d) Pendragon from 1995 to 1998 produced from perforations in its Chaco wells Nos. 1, 2J, 4 and 5 in the Fruitland sandstone within the Fruitland formation owned by Whiting; (e) Pendragon has filed false reports with the Division and failed to report and properly dispose of water production from the Chaco wells, in violation of the Division's Rules and Regulations; and (f) the stimulations on the Gallegos Federal wells did not grow into the Pictured Cliffs formation, and even if such a theory had been proven, it has not resulted in gas cross flow from the lower pressured, depleted formation to the Gallegos Federal wells.

The Commission can simply dismiss Pendragon's Application for failure of proof, leaving the parties to resolve their dispute in the pending litigation in Santa Fe County District Court. If the Commission rules on the merits, it should find that Pendragon has, from 1995 until June 29, 1998, produced Fruitland Sandstone and Fruitland coal seam gas belonging to Whiting from its

[1] Fundamental legal principles provide that Pendragon, as Applicant, has the burden of proving the allegations it makes in order to prevail. Bank of Santa Fe v. Petty, 116 N.M. 261, 264, 867 P.2d 431 (Ct. App. 1993); Carter v. Burn Construction Co., 85 N.M. 27, 32, 508 P.2d 1324 (Ct. App. 1973); Imperial American Resources Fund v. Railroad Commission of Texas, (Tex. 1997) 557 S.W.2d 280, 286 ("the applicants [must] discharge their burden of proof that the exceptions are necessary to prevent waste or confiscation of property.")

Chaco wells Nos. 1, 2J, 2R, 4 and 5. All the Chaco wells must be plugged and abandoned to prevent further trespass and conversion by Pendragon.

II.

PENDRAGON IMPEACHES ITS OWN APPLICATION

One of the more curious aspects of this proceeding is Pendragon's impeachment of its own Application by a most extraordinary reversal in position. Pendragon's Application seeks an order that both the Pendragon Chaco wells and the Whiting Gallegos Federal wells are producing from their respective appropriate common source of supply. Pendragon's Application and the evidence Pendragon presented before the Division in the July, 1998 hearing were generally consistent; Pendragon denied any communication between the Pictured Cliffs formation and the Fruitland formation, or between the Chaco wells and the Gallegos Federal wells in the area in question.

Having lost before the Division on the communication issue, Pendragon did a 180 degree change in its evidentiary story before the Commission, but has not sought to amend its Application. Pendragon now concedes communication between the two formations. But Pendragon contends for the first time in this three year dispute that it is the Gallegos Federal wells that caused the communication, and that the Gallegos Federal wells are producing Pictured Cliffs gas. The malleability of Pendragon's "expert" evidence in switching from its old story to the contradictory new one should invoke a healthy dose of skepticism by the Commission, even before the flaws in that testimony are demonstrated below.

III.

DIVISION HISTORY CONCERNING THE FRUITLAND COALS AND STANDARDS FOR ANALYSIS

The issues here do not come before the Commission in a vacuum. There is a very significant regulatory history addressing the nature of the Fruitland coal formation and its relationship to the underlying Pictured Cliffs formation. It is a history which Examiner Catanach

has lived. When the Division entered Order R-8768 in 1988 in Case No. 9420, it had the benefit of testimony from industry experts and the lengthy, detailed study and recommendation of the special Coalbed Methane Committee on several issues which are germane to this case. That Order established the Basin-Fruitland Coal Gas Pool in the Fruitland formation. In 1988, testimony was presented by several witnesses on the issue of Fruitland Sand or Pictured Cliffs stimulations growing into and communicating with coal seams in the Basin, a matter of general industry knowledge in 1988.[2]

In order to address this situation, the Division adopted Special Rules in Order No. R-8768.[3] Rule 3 thereof authorizes the Director to require an operator of a proposed or existing Pictured Cliffs well, here Pendragon, to submit certain data in order to demonstrate to the satisfaction of the Division that the well will be or is currently producing from the appropriate common source of supply. Rule 2 specifies the data to be used in the analysis, including:

a. Electric Log Data
b. Drilling Time
c. Drill Cuttings or Log Cores
d. Mud Logs
e. Completion Data
f. Gas Analysis
g. Water Analysis
h. Reservoir Performance
i. Other evidence which may be utilized in making such determination

The hearing in July 1998 before Examiner David Catanach on behalf of the Division gave Pendragon the opportunity to provide the required data. At that hearing it was Whiting who by and large brought forth data contemplated by the Rule. The Division ultimately found that Pendragon had caused communication with the Fruitland formation by its acidizations and fracture stimulations on the Chaco wells, and that Pendragon had improperly produced coal

[2] Paul Thompson, Pendragon's contract operator who monitored the dewatering of the Gallegos Federal wells, and designed and supervised the hydraulic fractures in issue here, was a member of the Coalbed Methane Committee.

[3] Special Rules and Regulations for the Basin-Fruitland Coal Gas Pool, Case No. 9420, Order No. 9420, October 17, 1988. Case No. 9420 and 9421 were heard by Examiner David Catanach.

seam gas from those wells from 1995 until shut-in by Order of the District Court in late June, 1998. The Division ordered the Chaco wells shut-in.

IV.

THE EVIDENCE PRESENTED CONFIRMS THAT THE CHACO WELLS AND THE GALLEGOS FEDERAL WELLS PRODUCE COAL SEAM GAS

Whiting's Gallegos Federal wells are coal seam gas wells that have exhibited a classic dewatering and gas incline pattern. The wells were originally drilled in 1992 and fracture stimulated in 1993. Following the fracture stimulations of the Gallegos Federal wells there was no pressure or production response in the offsetting Chaco wells. See Whiting JTB Exs. 6 through 16.

The evidence demonstrated that the WAW Fruitland Sand - Pictured Cliffs pool was depleted in the subject area prior to 1992. From the initial completions in 1978-1980, pressures in the Chaco wells showed steady declines, and production rates declined to abandonment levels of 0-15 MCFD. The decline curves of the Chaco wells, along with essentially all the wells in the pool, were consistent with the depletion of a sandstone reservoir.

Unchallenged evidence presented to the Commission demonstrated incredible and uncommon pressure and production increases in the Chaco wells immediately after Pendragon performed fracture stimulations on Chaco wells 1, 4 and 5. The Chaco wells which Pendragon did not fracture stimulate, the 1J and 2J, had no significant production increase even though closely offset by Gallegos Federal wells 26-13-1 #1 and 26-13-1 #2. (The GF 13-#1 is on the same pad only 180 feet distant from the Chaco 2J). The correlation and cause-effect relationship is indisputable. Pendragon did not even attempt to explain why the Chaco wells did not respond to the Gallegos Federal wells fracture stimulations, but did respond immediately to the Pendragon fracture stimulations. These objectively ascertainable facts alone disprove Pendragon's theory that Whiting fracture stimulations caused communication. When faced with unfavorable facts Pendragon's approach was to either ignore them, try to avoid them as

"inconclusive," or argue that damaging data is unreliable.[4] For its affirmative case Pendragon offered theories built on self-serving assumptions. Pendragon experts used data in some calculations and ignored the same data in others when it would not fit the desired result. None of that constitutes "substantial evidence" which the Commission must have in order to make findings favorable to a party. Continental Oil Co. v. Oil Conservation Commission, 70 N.M. 310, 320, 373 P.2d 809 (1962).

A. Pre-1995 History of the Chaco Wells

The Chaco wells are shallow, inexpensive slim hole completions. They were completed in the 1978-80 era when the NGPA gas prices exceeded $3.00 per Mcf. By the mid-1980s, all of the Chaco wells, like virtually all the wells in that sandstone pool, were non-productive or making only 5 to 15 MCF of gas per day. Pressures in the wells, which were originally in the range of 200 to 250 psi, had declined by the mid-1980s to around 100 psi.[5]

Merrion Oil and Gas and Bob Bayless are two of the more expert and experienced operators in the San Juan Basin. They saw plugging liabilities and no rework potential in the Chaco wells. They offered Maralex the Pictured Cliffs rights in the Chaco wells and other Pictured Cliffs wells in 1992. Maralex turned them down. Mr. O'Hare evaluated the properties and determined that the Pictured Cliffs formation had no remaining economic reserves. Exhibit W-35. Correspondingly, it is significant that neither J.K. Edwards nor Pendragon produced any studies or investigations made before the 1995 reworks that justified the development of supposed untapped Pictured Cliffs reserves.

No evidence was presented to the Commission that any other operators in the area are reworking WAW Fruitland Sand - Pictured Cliffs wells to recover PC reserves. There is no literature discussing untapped reserves in the PC formation in this area. All Pendragon offers is

[4] Pendragon witnesses continually denigrated the value of gas analysis and implied that every unfavorable shut-in surface pressure reading that did not fit their theory must have been distorted by water in the wellbore, an assumption Pendragon never proved or substantiated.

[5] Deliverability tests were discontinued in 1984, so there is a hiatus in pressure readings of about ten years.

the after-the-fact theories of its experts who must now invent some explanation – other than the obvious – for the extraordinary pressure and volume response of the Chaco wells.

Pendragon points to the Chaco Plant No. 5 as the "poster well" providing inspiration for the Chaco well project. Interestingly, the Commission August 1999 hearing marked the first time Pendragon ever mentioned the Chaco Plant No. 5 as having been involved in any way in its decision to implement the Chaco well restimulation program.[6] The evidence, however, suggested that the Chaco Plant No. 5, like the Chaco wells, is actually producing coal seam gas as a result of communication with the Fruitland formation during the restimulation process.

In sum, only after a prolific volume of coal gas was flowing from the Chaco wells and Whiting discovered the trespass has Pendragon constructed theories that the gas somehow comes from the PC. This is not science. This is not the behavior of reputable operators. An operator studies the reservoir for potential before making an investment. The Commission has before it a disreputable operator who has been caught and is casting about for a way out.

B. Production Volumes and Pressure Readings Since Restimulation Confirmed the Production of Coal Seam Gas

With one notable exception, production and pressures rose in the Chaco wells following either acidization or fracture stimulation to levels resembling pressures in the Fruitland coal formation, while wells Pendragon did not fracture stimulate showed no significant pressure or production response. Whiting JTB Ex. 6 through 10, 15 and 16. The Chaco 4 well reflected a 97 psi WHSIP on a C-122A in July 1983; the rig report when acidization was to be done in January 1995 read 119 psi. In twelve years the reservoir had "repressured" 22 psi. Two weeks following Pendragon's acidization of the Chaco 4 the rig reported shut-in pressure of 170 psi – a 51 psi

---

[6] The most reasonable inference is that the Lansdale Federal No. 1 was the true Pendragon guinea pig. Pendragon justified investment in the Chaco well restimulations on the work that it had performed in December, 1994 when it intentionally completed the Fruitland coal formation in its Lansdale Federal No. 1 well. Pendragon failed to report the well as a coal well in notices filed with the Division, failed to document water production from the well, but began producing coal seam gas from what it falsely reported as a "Pictured Cliffs well" occupying a 160 spacing unit, rather than the 320 acres required for a coal well.

increase in two weeks! The only scientific conclusion to be drawn from the data is that the acidization caused communication between the Pictured Cliffs formation and the higher pressured and relatively untapped Fruitland coal formation. The Chaco 5 well, relied upon by Pendragon as having pressure increases prior to stimulation, had a casing leak that was discovered in February, 1995, prior to the stimulation. Communication with the coal was already established. In contrast, the Chaco 2R well did not respond immediately to the Pendragon fracture stimulation in 1995. This well produced considerable water and required the installation of a compressor for continuous production. Unlike the other three fracture treated wells, the 2R is not perforated in the Fruitland sandstone directly under the thick coal seam.[7]

C. The Overcoming "Damage" Notion

Before a summary of the evidence on this critical issue, it should be noted that so-called reservoir "damage" does not prevent a well from seeing true shut-in reservoir pressure. The tip-off to the presence of damage is that shut-in pressures are relatively good, while gas production is poor. This phenomena was grudgingly conceded by Pendragon. But when both pressures and production increased with the 1995 stimulations, Pendragon was quick to speculate the pre-1995 pressures readings were distorted by liquid in the wellbore.

There are diagnostic well tests to actually determine whether there is damage. Pressure-production differentials that would raise suspicions of damage are routinely noted in the well files by operators. There is no evidence of either testing or operator observations concerning damage. Indeed, the decline curve of the total wells in the WAW Fruitland-Pictured Cliffs pool illustrated on Whiting Ex. W-30 would say, according to Pendragon, that all wells in the pool had damage.

---

[7] This unique character of the Chaco 2R obviously made it the preferred candidate for Pendragon witness Conway to select for a fracture simulation study that would show the fracture staying in zone.

The "damage" theory was totally theoretical. Witnesses Nicol, McCartney and Cox each postulated the existence of damage in the Chaco wells, but each speculated a different type of damage or damage mechanism. Each was mere speculation, with neither testing nor documentation for substantiation.

The obvious explanation for the Chaco wells' uplift in production and pressure remains the correct explanation, viz:

1. The Chaco wells behaved the way they did before 1995 because their source of gas was depleted.

2. The Chaco wells behaved the way they did after the stimulations in 1995 because they became communicated with the high pressure and gas filled coals of the Fruitland formation.

D. Accounting for the Gas Produced

Pendragon faced a dilemma in light of its Chaco wells being miraculously transformed from dead dogs into live race horses. The excuse was the "damage" theories.

Pendragon faced yet another dilemma. Given the thickness and characteristics of the pay zone in the Pictured Cliffs, there was simply not enough remaining recoverable gas in place in the Pictured Cliffs to account for the volume produced from the Chaco wells before they were ordered shut-in in 1998. This issue inspired Pendragon's "third bench" theory.

Pardon the pun, but this theory is all wet. The lower Pictured Cliffs is highly water saturated as clearly reflected on all logs presented. What gas exists in the lower sandstone is unrecoverable. That is why all knowledgeable operators do not perforate that zone. Pendragon itself has not perforated the "third bench" and thus has not attempted to stimulate that zone in the very Chaco wells in question.

Whiting's evidence demonstrated that there is enough recoverable gas in the coal to account for all past and projected coal well production as well as the 1995 to July 1998 production of coal gas from the communicated Chaco wells. Experience in the San Juan Basin as well as recent literature is revealing that original estimates of 110-120 standard cubic feet per

ton of coal were significantly understated, and that 150-160 scf per ton is probably more accurate. The coals are a new gas resource, and more is constantly being learned about coal gas production and reserves in coal gas formations.

E. Fracture Stimulations

Whiting recognizes that both sides presented contradictory fracture simulation evidence to the Commission, and shares the Commission's questions about the efficacy of such studies. Computer programs are commonly used in the industry today for "modeling" what supposedly happens when a well is fracture stimulated. The outcomes are highly dependent upon the program operator selecting meaningful and accurate variables for use in the models.

The Commission could disregard the simulation evidence, yet readily conclude, as did the Division, that the Pendragon induced fractures caused the communication resulting in coal gas being produced by the Chaco wells. As previously discussed, there is substantial undisputed data and evidence which conclusively demonstrates that the Whiting fracture stimulations did not communicate with the PC. When the Gallegos Federal wells were fracture stimulated in 1993, the Chaco wells showed no production or pressure response. The Chaco wells did not show any production or pressure response until Pendragon fracture stimulated the wells in 1995, and then, only those wells which were fracture stimulated in the sandstone layer between the massive coal and the Basal coal in the area showed an immediate pressure and production response.

What can be learned from the fracture simulator evidence is this:

1. Pendragon Witness Conway. Dr. Conway selected for his analysis the Chaco 2R, the single Pendragon well not perforated and so not fracture stimulated in the sandstone stringer within the Fruitland formation directly below the main coal, as were the Nos. 1, 4 and 5. His simulation showed that the Chaco fracture grew up to the base of the coal and then ran along it for some distance. The coal is known to contain a natural, well developed cleat system so at a minimum the

Chaco well fracture opened a propped channel to the existing natural pathways in the coal. The Conway simulation did not predict a fracture that would penetrate the coal, nor establish a propped fracture into the coal. But he was able to obtain that result only because he assumed (a) the maximum theoretical stress value (>1.0 psi/ft) for the coal and (b) that the coal was impermeable, thus disregarding existence of the natural cleat system.

Dr. Conway's simulation of the Gallegos Federal 26-12-6 # 2 could not show that the Whiting fracture stimulation broke into the Pictured Cliffs sandstone at the wellbore (which is where the greatest pressure is normally expected). His initial analysis showed that the fracture stayed in the coal. He had to force his computer to assume a dramatic change in lithology (an ash "pod" in the coal) about 750 feet from away the wellbore in order to predict that the fracture escaped from the coal.[8]

2. Whiting Witness Robinson. The Whiting expert's simulator runs indicate that both Chaco well fractures and Whiting well fractures can grow out of zone near the wellbores. One run using the same data and rock properties supported by the literature was made by Brad Robinson for each case with no "tweaking" of the variables to get a desired result. This evidence showed that the fracture treatments of the sandstone create a conductive, proppant-filled channel in communication with the coal cleat system.

Expert Robinson went on to demonstrate how the data of observed pressures, flow rates and variations in the type of gas being produced from a well are consistent with communication between the zones occurring at the Chaco wellbores. The same data are not consistent with communication at the Gallegos Federal wellbores. Downhole cross-flow occurs from higher to

[8] The "pod" theory has no scientific support whatsoever. In fact, both Pendragon's witness Dr. Whitehead and Whiting's geologist Dr. Ayers confirmed that tonstein (ash) occurs in the coal as very thin sheets over large areas, not in concentrated pods.

lower pressures at the Chaco wellbores. The Chaco wells will steal gas from the coal seams when the Chaco wells are producing.

F. Pressure Interference Studies

As in the case of modeling fracture geometry, the pressure interference calculations are entirely dependent upon variables assumed for the estimates. The time within which a pressure wave will travel through test formations depends on the value used for the permeability of the relative formations in question. The difference between the credibility of the opinions of Pendragon's Dave Cox versus Whiting's Brad Robinson is readily resolved. Cox plucked out of thin air a permeability of 25 millidarcies for the coal. Robinson used 200 millidarcies for the coal, not from whole cloth, but based on the results of an injection test performed on one of the Gallegos Federal wells. With that, what was presented is summarized as follows:

1. Pendragon Witness Cox. Pendragon assumed pressure interference observed at the Chaco 4 and 5 was caused by communication at the Whiting wells. In order to support this theory, Mr. Cox grossly over estimated permeability in the Pictured Cliffs (150-200 md.) and used a drastically lower permeability for the coal than measured in Whiting's injection test. Mr. Cox even arbitrarily moved the wells closer together in order to generate his desired results!

2. Whiting Witness Robinson. Mr. Robinson established that if the true permeabilities of the coal and the PC are applied, the results are the opposite of Mr. Cox's conclusions. Mr. Robinson showed the flaws in the permeability assumptions by Mr. Cox. Then, he simply compared the data corresponding to shut-ins of the Whiting wells. The data showed that during each shut-in the Chaco 4 and 5 are virtually monitor wells for the coal, rising and falling with the Gallegos Federal well pressures. Pendragon's own Cox Exhibits C-10 and C-11 showed this obvious pressure tracking during the August 1998 week-long shut-in of the coal wells. Whiting also showed that the Chaco 4 logged off in April 1998

following the Whiting 6 # 2 coal well going on compression. When the compression took effect, the 6 # 2 drew down the pressure in the coal and, since the cleat system makes the coal very permeable, the coal zone pressure at the Chaco 4 wellbore was quickly reduced to a flowing pressure below the line pressure.

G. Water Analysis from the Chaco Wells Since Stimulation Confirms the Production of Coal Seam Gas

Ironically, Pendragon relies on its own malfeasance in water reporting as evidence in its favor. One of the spins Pendragon put on the evidence in this case has been to cite the supposed lack of water production from its Chaco wells as evidence that the wells were not in communication with the coal formations. When Pendragon recorded water production it was significant. Indeed, for a period in March, 1998, records demonstrated that Pendragon was hauling 80 barrels of water away from its Chaco 1 well site every two or three days. Given that the water was being dumped into unlined pits in porous soil, substantially larger volumes of water must have been produced by the Chaco wells during that period.

More importantly, the evidence demonstrates that the Pendragon Chaco wells produced significant volumes of water since the restimulations in 1995. Mickey O'Hare and Dennis Reimers testified that they observed substantial water production from the Chaco wells into the unlined earthen pits as early as 1995. Pictures submitted by Whiting at the hearing, Exhibits AMO-8, demonstrate that the unlined pits have, at various times in their existence, been completely full. Pendragon magically began reporting water production from the Chaco wells in March, 1998 following a site inspection by Ernie Busch of the Division's Aztec office. Pendragon offered no explanation, because there is no valid scientific or engineering explanation, to account for the Chaco wells producing no water for three years, then mysteriously starting to make significant volumes of water in 1998 corresponding to the time of the Division's field inspection.

The most damning evidence presented at the hearing on this issue came from Pendragon's agent, Paul Thompson. Mr. Thompson admitted during his rebuttal testimony that Pendragon utilized a daily progress report for the Chaco wells which did not include a column for reporting water production. Mr. Thompson conceded that the Chaco wells produced substantially larger volumes of water than was reported on the daily progress reports. For periods when the wells were recorded as having sporadically produced water, given that they were operating and producing gas on a daily basis, Mr. Thompson admitted that the wells would have produced equal volumes of water on all days during the period. For the month of March, 1995 for the Chaco 1, Mr. Thompson estimated that the actual water production for that well was some 10 to 20 times greater than the reported water production. Even when Mr. Thompson or his pumpers noted water production on their daily reports, Pendragon still failed to report even those sporadic observations to the Division as required on the C-115 forms. Pendragon did not even report water production on coal seam gas wells it operated in the area, notwithstanding that those wells produced substantial volumes of water.

The fact of the matter is Pendragon destroyed evidence, both by depositing produced water into unlined pits, where much of that water percolated into the loamy soil or evaporated, and by failing to report water production from the Chaco wells until it realized that the Aztec office staff had visual confirmation of water production. Under the doctrine of "spoliation" of evidence, all inferences regarding water production from the Chaco wells must be decided against Pendragon and in favor of Whiting in this proceeding.[9]

[9] Coleman v. Eddy Potash, Inc., 120 N.M. 645, 905 P.2d 185 (1995) (recognizing tort of intentional spoliation or destruction of evidence); Aranburu v. The Boeing Co., 112 F.3d 1398, 1407 (10th Cir. 1997) (bad faith destruction of document relevant to proof of issue generally gives rise to inference that evidence would be unfavorable to party responsible for destruction); Miller v. Montgomery County, 494 A.2d 761, 768 (Md. Ct. Spec. App. 1985) (the appropriate remedy for spoliation of evidence by party is evidentiary presumption that evidence is unfavorable).

IV.

LOG DATA AND GEOLOGIC EVIDENCE CONFIRM THE BOUNDARY BETWEEN THE FRUITLAND FORMATION AND THE PICTURED CLIFFS FORMATION AT THE TOP OF THE MASSIVE SANDSTONE

In 1988 when the Division created the Basin-Fruitland Coal Gas Pool, it recognized the Amoco Production Company Schneider Gas Com "B" Well No. 1 as the marker well for the pool. Order R-8768 found that the Fruitland coal gas pool was comprised of "all coal seams" (emphasis added) within the vertical limits of the stratagraphic interval in the Schneider well from a depth of approximately 2450 feet to 2880 feet as shown on the well's Gamma Ray/Bulk Density log. That log demonstrates two typical coal seams, one thick seam separated by a silt and sandstone interval from a lower coalbed stringer that overlies a massive sandstone formation. Exhibit WA-4. Since 1988, the accepted boundary between the Fruitland formation and the Pictured Cliffs formation has been identified at the top of the massive sandstone underlying the smaller continuous coal stringer.

Whiting introduced evidence at the hearing based upon log data from the Chaco wells and Whiting's coal seam wells in the area in question that demonstrated a remarkable similarity with the lithology of the Schneider well. Exhibit WA-3 shows a thick coal which is continuous in the area, designated on the Exhibit as the B Coal. The cross-section also demonstrates a continuous coal stringer, designated by Whiting as the basal coal, which underlies the B Coal and sits above the massive Pictured Cliffs sandstone Unit 1. Between the Basal and B Coal stringers is a small sandstone layer, similar to the sandstone layer which is seen between the two lower Fruitland coalbeds in the Schneider B Com log. That sandstone stringer is a "Fruitland Sandstone" and is not part of the Pictured Cliffs formation.

Since 1971, governmental and independent research geologists who have no reason for bias have picked the boundary between the Fruitland formation and the Pictured Cliffs sandstone formation "at the top of the massive sandstone below the lowermost coal of the

Fruitland except in those areas where the Fruitland and the Pictured Cliffs intertongue." Pendragon Exhibit N-44. An identical pick was made in the 1988 hearing in Case No. 9420. Tr. 39. In reopened Case No. 9420 before Examiner Catanach in February, 1991, experts uniformly recognized the existence of a lower basal coal stringer above the massive Pictured Cliffs sandstone.

Whiting's witness, Walter Ayers, is the dean of San Juan Basin geologists. Dr. Ayers testified the use of the massive sandstone as the boundary marker for the two formations is geologically accepted, and also offered a means to avoid the need to redefine the boundary in every well in the area, since there is a consistently recognizable, massive marine Pictured Cliffs sandstone in the logs. Dr. Ayers is an independent consultant with no financial interest in the dispute who has studied coal and sandstone deposition in the San Juan Basin for many years, and has published two dozen articles on the subject prior to this dispute. Even Dr. Whitehead admitted that the base of the Fruitland formation is below the last coal stringer where the PC intertongues, making the base of the Fruitland formation substantially lower than the self-serving geological pick by Pendragon's president.

It is undisputed that Pendragon stimulated and produces from perforations in the Chaco wells Nos. 1, 2, 4 and 5 in the sandstone formation which lies between the two coal seams. These perfs are in a zone which is above the base of the Fruitland formation. No witness characterized the Fruitland sandstone interval at issue here as massive. Dr. Ayers established that this sandstone interval is not a marine deposit, but rather is a coastal plain, non-marine deposit. Pendragon's president-geologist conceded that the sandstone interval was not a marine deposition. In fact, Mr. Nicol opined that the subject sandstone was deposited in a lagoon, which is not a marine setting.

Pendragon's president-geologist contended, without offering any supporting core data or sand analysis, that the sandstone interval between the B Coal and the Basal Coal was a marine deposit. This contention is unsupported by evidence from any other source or literature. Mr.

Nicol also admitted that he coined the phrase "Upper Pictured Cliffs Sand," which he tagged on this Fruitland sandstone stringer, in anticipation of this hearing, and that that designation found no support in the literature.

When the ownership of the subject formations was common in the 1980s there was no correlative rights problem. But Pendragon acquired only ownership "Limited from the base of the Fruitland coal formation. . ." Since it is undisputed that Pendragon's Chaco wells had produced from the upper perfs in the sandstone interval at issue, and given that that sandstone interval lies above the base of the Fruitland formation, it is undisputed that Pendragon has produced gas from the Fruitland formation since 1995 from its Chaco wells, excepting the case of the 2R. This conclusion follows without regard to the communication issues thoroughly discussed above.

Today where the Fruitland coal has become such an important supply source and where divided ownership occurs between the Fruitland formation and the PC formation in this area, it is essential to delineate the different producing formations based on sound geology. If there is a widespread problem that has been caused by informal operator labels or by administrative designations, that problem should be dealt with administratively in an above-board manner. Endorsing mislabels based on junk science is not the way to address a serious problem of correlative rights. NMSA 1978, section 70-2-17.

V.

CONCLUSION

The only conclusion available based upon the technical and substantive evidence presented at the hearing in this matter is that the Chaco wells have been producing coal seam gas since and because of the 1995 Pendragon stimulation treatments, and until shut-in by order of the Santa Fe County District Court. As of the shut-in date, June 30, 1998, Pendragon had already produced through its Chaco wells volumes of gas which greatly exceeded not only recoverable reserves but total gas in place for the wells in the PC formation.

Since Pendragon has already produced more than available reserves from the PC along with large volumes of coal gas through the Chaco wells following restimulation, it would be unfair and violative of Whiting's correlative rights to allow Pendragon to continue to operate these wells. Every Mcf of coal gas that is produced through the Chaco wells deprives Whiting of not only its reserves and sales revenues, but valuable I.R.C. Section 29 tax credits as well. Shutting in the Chaco wells will not cause waste, since the Pictured Cliffs gas has already been produced and the coal seam gas reserves will ultimately be produced by Whiting through its coal seam gas wells.

Respectfully submitted,

GALLEGOS LAW FIRM, P.C.

By _____
J.E. GALLEGOS
MICHAEL J. CONDON
460 St. Michael's Drive, Bldg. 300
Santa Fe, New Mexico 87505
(505) 983-6686

Attorneys for Whiting

CERTIFICATE OF SERVICE

I hereby certify that I have caused a true and correct copy of the foregoing to be mailed on this 29th day of November, 1999 to the following:

J. Scott Hall, Esq.
Miller, Stratvert & Torgerson, P.A.
P.O. Box 1986
Santa Fe, NM 87501-1986

_____
MICHAEL J. CONDON