



Petroleum Services Division

6316 Windfern

Houston, Texas 77040 USA

Tel: 713-328-2565

Fax: 713-328-2567

# **South Florida Water Management**

**EXBRY- 1**

**Caloosahatchee River ASR Pilot Project  
Hendry County, Florida**

**CONVENTIONAL CORE ANALYSIS  
FINAL REPORT**

**CL File No.: HOU-030903**

**November 24, 2004**



Petroleum Services Division  
6316 Windfern  
Houston, Texas 77040 USA  
Tel: 713-328-2565  
Fax: 713-328-2567

November 24, 2004

South Florida Water Management  
P.O. Box 24682  
West Palm Beach, FL 33416.  
Attn: Mr. Michael Bennett

Final Core Analysis Report  
EXBRY-1 Well  
Caloosahatchee River ASR Pilot Project  
Hendry County, Florida  
Core Lab File No. HOU-030903

Dear Mr. Bennett,

Conventional cores from the subject well were delivered to Core Laboratories' Houston, Texas facility via motor freight. Analysis was performed as directed by representatives of South Florida Water Management.

The following documentation includes procedures for sample preparation, petrophysical measurements, and the resultant data reported in tabular, digital, and graphical formats.

We appreciate this opportunity to be of service. If we can be of further assistance, please do not hesitate to contact us.

Sincerely,

CORE LABORATORIES

Michael R. Long  
Laboratory Supervisor

## **SAMPLE PREPARATION & PETROPHYSICAL MEASUREMENTS**

**CORE LAYOUT:** Upon arrival at the lab, the core was placed on a layout table and fitted together. Depth marks and orientation stripes were then placed on the core.

**TOTAL CORE GAMMA:** The natural gamma radiation count of the core was recorded as a function of depth. Results were recorded in API units of gamma activity. The instrument was calibrated against API standards and adjusted for background radiation.

**CORE PHOTOGRAPHY:** The core was photographed under white light conditions. An overview format was used.

**PLUG DRILLING and TRIMMING:** Plug samples were drilled at points designated by South Florida Water Management representatives. The 1.0-inch diameter plugs were drilled and clipped using nitrogen mist as the drilling and trimming lubricant. The plugs were faced with a diamond facing tool to provide right circular cylinders. Trimmed ends were catalogued and stored.

**PLUG ENCAPSULATION:** Each sample was encapsulated in nickel foil. Sets of 100 mesh and 250 mesh stainless steel screens were placed at the ends of each plug.

**SAMPLE DRYING:** All samples were dried in a convection oven at 240 degrees F. until weight stabilization was achieved.

**GRAIN VOLUME:** Direct grain volume measurements were made using an automated helium porosimeter. This instrument utilizes the principle of gas expansion as described by Boyle's Law. Corrections were made for sleeve and screen volumes. The instrument was calibrated daily and test standards were run to verify instrument accuracy.

**GRAIN DENSITY:** Calculated grain densities were obtained utilizing grain volume measurements and clean, dry sample weights. Corrections were made for sleeve and screen weights. Grain densities were checked against lithology standards.

**PLUG DIMENSIONS:** Sample lengths and diameters were measured using digital metric calipers. Corrections were made for sleeve and screen thickness.

**POROSITY:** Pore volumes were determined at a net confining stress (NCS) of 800 psi in a hydrostatic core holder using the Boyle's Law double-cell technique (API RP-40, Sec 5.3.2.2). Porosity was calculated by the following equation:

$$\text{Porosity} = \text{Pore Volume} / (\text{Pore Volume} + \text{Grain Volume}) \times 100$$

**PERMEABILITY:** Air permeability values were measured using the steady state method at 800 psi in a hydrostatic core holder (API RP-40, Sec 6.3.1.1). The sample permeability was calculated by the following equation:

$$K_{air} = \frac{Q \times \mu \times L \times P_a}{\Delta P \times P_m \times A}$$

where:

- Q = Gas Flow Rate (cc/sec)
- $\mu$  = Gas Viscosity (centipoise)
- L = Sample Length (cm)
- $\Delta P$  = differential pressure across sample (atms)
- $P_m$  = mean pressure (atms)
- A = Sample cross-sectional area (cc)
- $P_a$  = atmospheric pressure (atms)

**FULL DIAMETER SAMPLING:** Sixteen (16) core segments were designated for full diameter analysis by South Florida Water Management representatives. The segments were shipped to Core Laboratories' Midland, Texas facility for analysis.

**FULL DIAMETER GRAIN VOLUME:** Direct grain volume measurements were made using a full diameter matrix cup and a calibrated Heise gauge porosimeter. This instrument utilizes the principle of gas expansion as described by Boyle's Law. Helium was used as the test gas. The instrument was calibrated daily and test standards were run.

**FULL DIAMETER GRAIN DENSITY:** Calculated grain densities were obtained utilizing direct grain volume measurement and clean, dry sample weight. Grain densities were checked against lithology standards.

**FULL DIAMETER POROSITY:** The bulk volume of each sample was determined using the full diameter DEB unit. The device uses Archimedes' principle of buoyancy to determine the bulk volume of large samples. Porosities were calculated using the bulk volume from the full diameter DEB and the grain volume from the matrix cup.

**FULL DIAMETER SAMPLE DIMENSIONS:** Sample length and diameter were measured using metric calipers.

**FULL DIAMETER HORIZONTAL AND VERTICAL PERMEABILITIES:** Each sample was placed in a full diameter Hassler cell. The confining pressure used was 400 psig. The permeability was measured by flowing air through the sample and measuring the flow rate and pressure drop across the sample with an air permeameter. The permeameter was calibrated before measurements were made and all applicable leak checks were performed.

**THIN SECTION SAMPLES:** Twenty seven (27) thin sections samples were prepared using material from the full diameter samples and end trims from the 1.0-inch plugs. The completed thin sections were shipped to Dr. Hughbert Collier at Collier Consulting, Inc., 741 West College Street, Stephenville, TX, 76401.



**CONVENTIONAL PLUG ANALYSIS**

Sample Number	Depth ft	Net Confining Stress psig	Porosity %	Permeability	Grain Density g/cm3	Footnote
				Kair mD		
1	302.20	800	43.13	517	2.534	(1)
2	304.30	800	34.17	42.0	2.674	
3	305.80	800	34.18	1640	2.717	
4	308.00	800	30.77	33.0	2.723	
5	309.65	800	27.65	12.4	2.718	
6	558.10	800	44.83	52.2	2.709	
7	558.90	800	38.49	398	2.708	
8	756.60	800	29.60	9.6	2.726	
9	760.25	800	20.87	2.36	2.697	
11	1090.40	800	38.34	30.8	2.701	
10	1092.20	800	40.36	53.1	2.703	

**Footnotes :**

(1) : Denotes fractured or chipped sample. Permeability and/or porosity may be optimistic.

NOTE: All samples were encapsulated in nickel sleeves prior to analysis.



**FULL DIAMETER CORE ANALYSIS**

Sample Number	Depth Span (ft)	Permeability			Porosity (Helium) (%)	Grain Density (g/cm <sup>3</sup> )	Description
		(Maximum) Kair (mD)	(90 Deg) Kair (mD)	(Vertical) Kair (mD)			
1	555.9 - 56.3	437	339	193	31.9	2.71	Lim, foss, moldic, chalk
2	555.2 - 55.5	679	587	399	37.3	2.71	Lim, foss, moldic, chalk
3	562.0 - 62.7	28.7	22.1	10.3	27.3	2.70	Lim, foss, sli moldic, chalk
4	903.3 - 3.9	4720	3145	2070	34.2	2.69	Lim, foss, moldic
5	901.6 - 1.9	2852	2470	998	37.0	2.71	Lim, foss, moldic, chalk
6	905.4 - 5.9	4794	718	1809	26.7	2.70	Lim, foss, moldic
7	906.8 - 7.6	488	455	243	37.2	2.71	Lim, foss, sli moldic, chalk
8	910.3 - 10.8	1990	1861	819	35.2	2.70	Lim, foss, sli moldic, chalk
9	908.7 - 9.2	5154	5044	60.8	32.3	2.71	Lim, foss, moldic, chalk
10	911.1 - 11.8	1070	489	297	33.8	2.71	Lim, foss, sli moldic, chalk
11	1305.0 - 5.4	4.25	4.18	4.29	29.7	2.68	Lim, chalk
12	1309.0 - 9.7	56.0	54.2	9.37	24.0	2.74	Lim, foss, vf xln dol
13	1307.6 - 8.7	48.2	46.0	19.9	26.0	2.79	Dol, foss frag limy, vf xln dol
14	1322.0 - 22.7	28.9	27.1	11.3	24.6	2.79	Dol, foss frag limy, vf xln dol
15	1323.6 - 24.0	39.5	30.5	8.69	23.4	2.80	Dol, foss frag limy, vf xln dol
16	1324.4 - 24.7	73.4	44.8	10.4	24.7	2.76	Lim, foss, vf xln dol



# South Florida Water Management

## EXBRY- 1

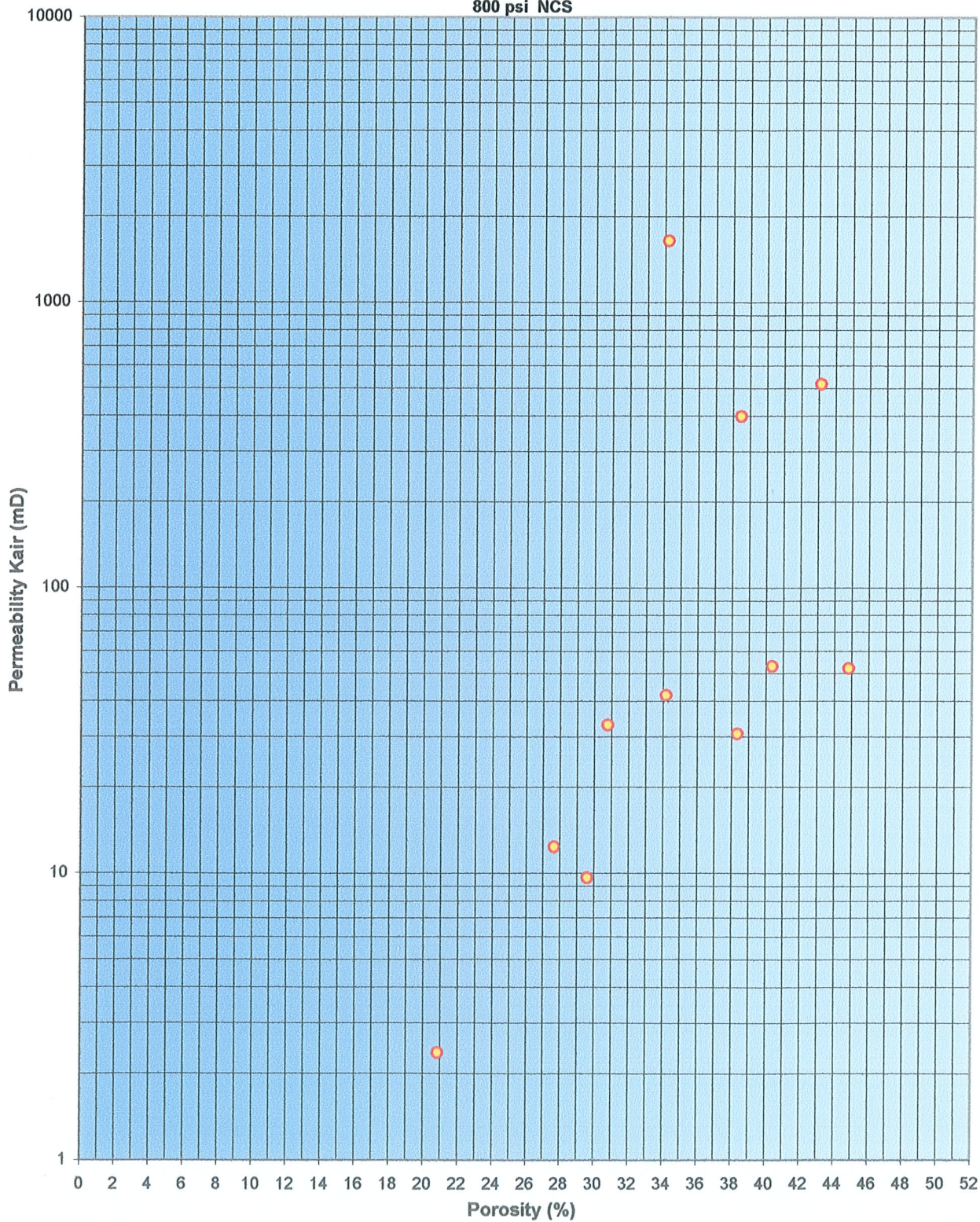
### Caloosahatchee River ASR Pilot Project

Hendry County, Florida

Petroleum Services Division  
6316 Windfern  
Houston, Texas 77040 USA  
Tel: 713-328-2565  
Fax: 713-328-2567

### Permeability vs Porosity (Plug)

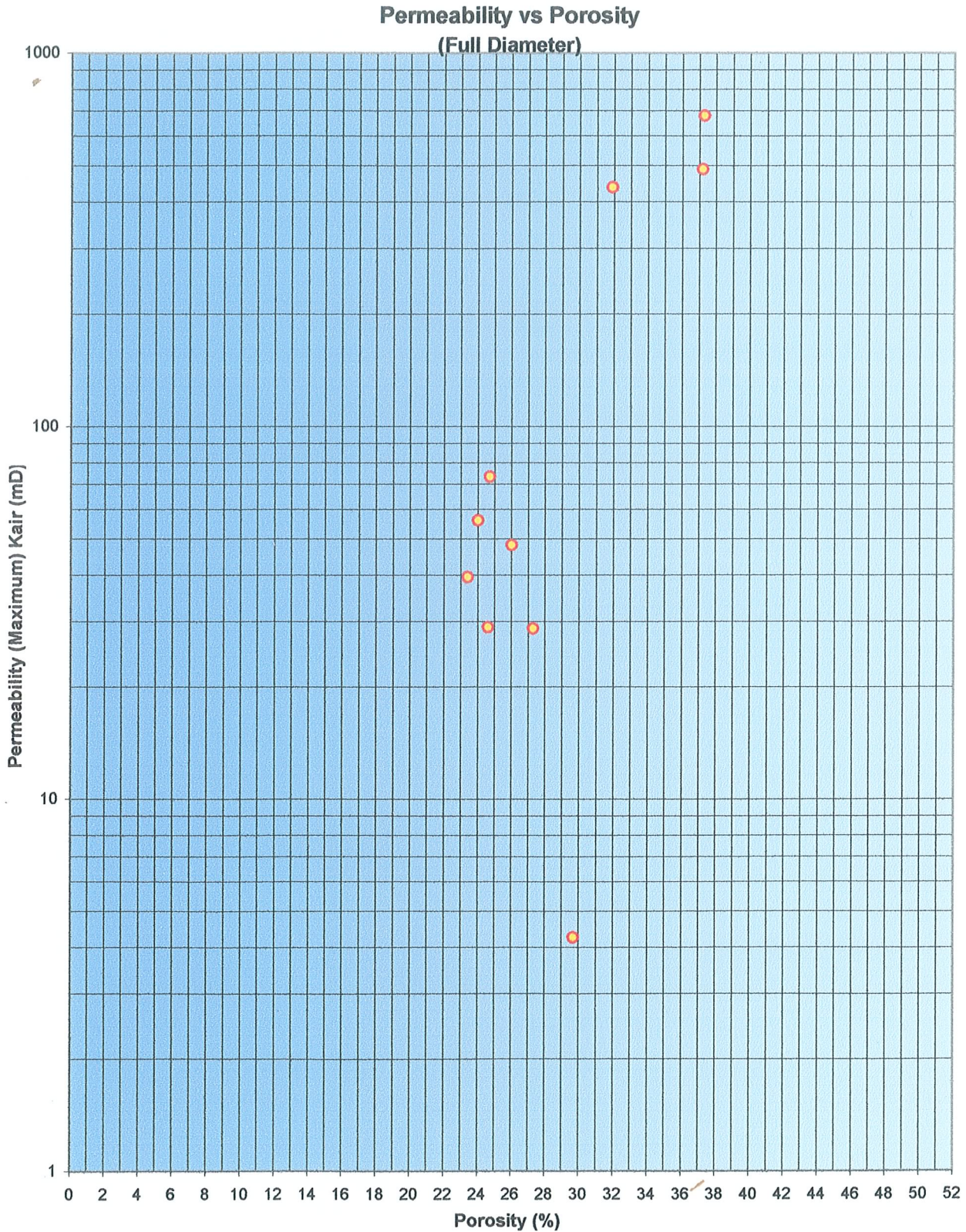
800 psi NCS





**South Florida Water Management**  
**EXBRY- 1**  
Caloosahatchee River ASR Pilot Project  
Hendry County, Florida

Petroleum Services Division  
6316 Windfern  
Houston, Texas 77040 USA  
Tel: 713-328-2565  
Fax: 713-328-2567



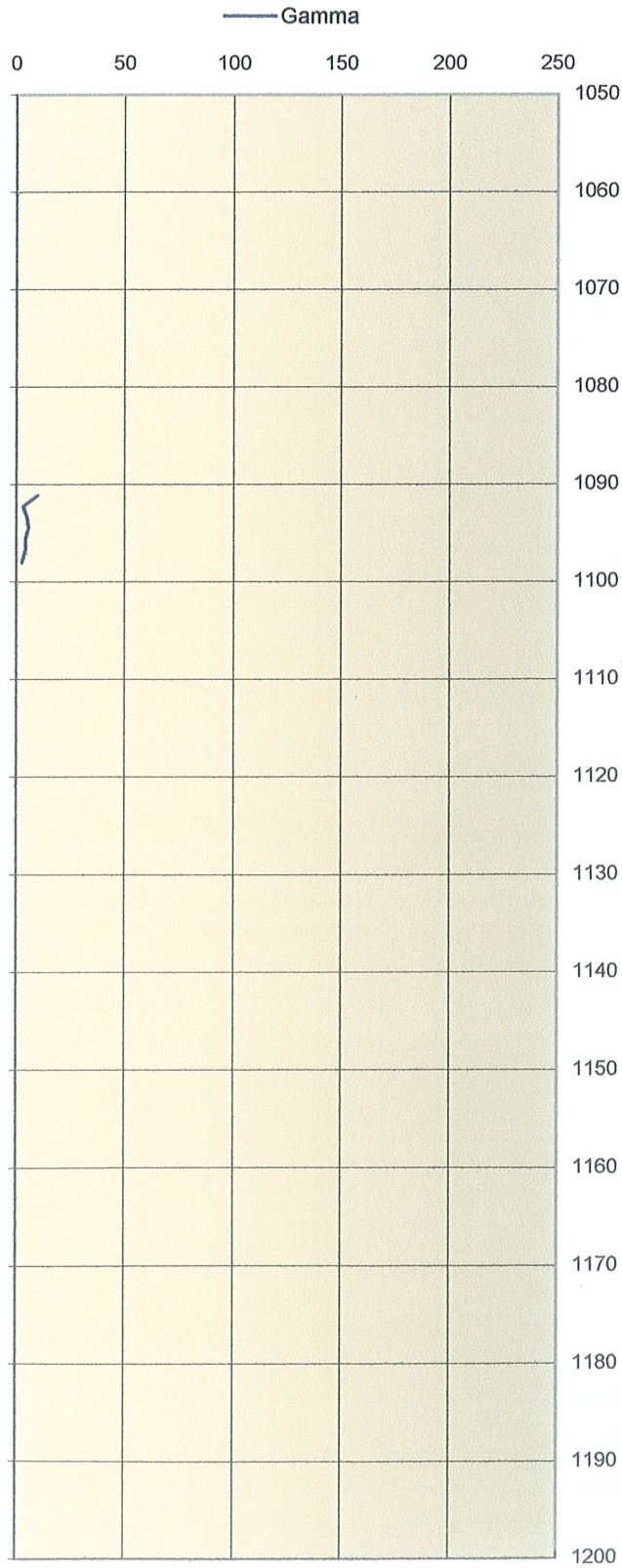




**South Florida Water Management  
EXBRY- 1  
Hendry County, Florida**

**Petroleum Services Division**  
6316 Windfern  
Houston, Texas 77040 USA  
Tel: 713-328-2565  
Fax: 713-328-2567

**Core Gamma Log  
(5" = 100')**



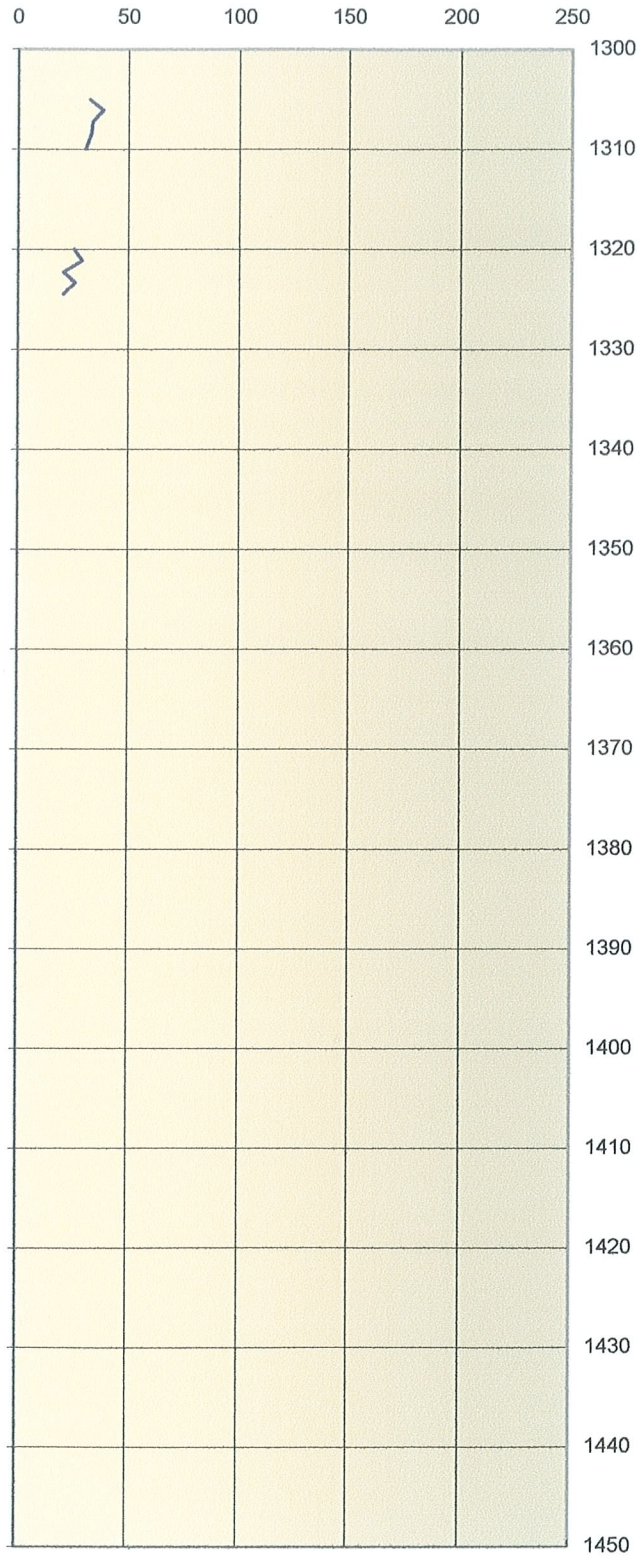


South Florida Water Management  
EXBRY- 1  
Hendry County, Florida

Petroleum Services Division  
6316 Windfern  
Houston, Texas 77040 USA  
Tel: 713-328-2565  
Fax: 713-328-2567

Core Gamma Log  
(5" = 100')

— Gamma



**FINAL REPORT DISTRIBUTION**

**CORE LABORATORIES FILE NO. HOU-030903**

**South Florida Water Management  
EXBRY-1 Well  
Caloosahatchee River ASR Pilot Project  
Hendry County, Florida**

1 copy to:

Mr. Michael Bennett  
South Florida Water Management  
P.O. Box 24682  
West Palm Beach, FL 33416

1 copy to:

Mr. Hughbert Collier  
Collier Consulting, Inc.  
741 West College Street  
Stephenville, TX 76401