NORTH COUNTY REGIONAL WATER TREATMENT PLANT INJECTION WELL SYSTEM COMPLETION REPORT

VOLUME II - APPENDICES

Prepared For

Collier County Utilities Division
Water and Wastewater Services
3050 North Horseshoe Drive
Naples, Florida 33942

Prepared By The

ViroGroup
Air • Water • Soil
TECHNOLOGY

Missimer Division

NORTH COUNTY REGIONAL WATER TREATMENT PLANT INJECTION WELL SYSTEM COMPLETION REPORT

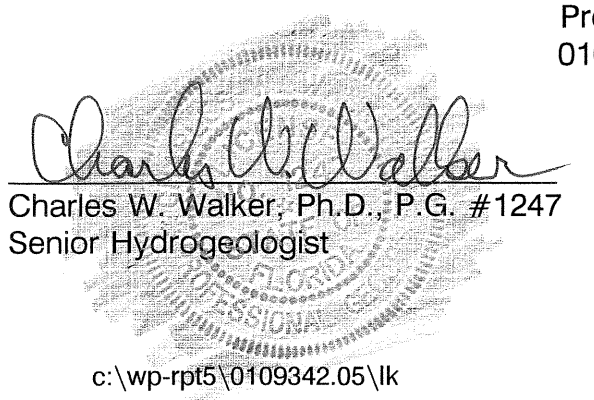
VOLUME II - APPENDICES

Collier County Utilities Division
Water and Wastewater Services
3050 North Horseshoe Drive
Naples, Florida 33942

August, 1993

ViroGroup, Inc./Missimer Division
428 Pine Island Road, S. W.
Cape Coral, Florida 33991

Project No.
0109342.05



Charles W. Walker, Ph.D., P.G. #1247
Senior Hydrogeologist

Lloyd E. Horvath, P.E. #25260
Vice President of Water Resources

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APPENDICES

A	FDEP Class I-Test/Injection Well Construction and Testing Permit and Related TAC Correspondence
B	Correspondence
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APPENDIX A

FDEP Class I-Test/Injection Well Construction and Testing Permit and Related TAC Correspondence

M&A MISSIMER & ASSOCIATES, INC.

Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

428 Pine Island Road, S.W.
Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

May 17, 1991

Mr. Harley Young
Florida Department of Environmental Regulation
2269 Bay Street
Fort Myers, Florida 33901

RE: Application Submittal for Two Class I Test/Injection Wells - Collier County Utilities North County Regional Water Treatment Plant (NCRWTP)

Dear Mr. Young:

Enclosed is the completed application for the construction and testing of Class I injection wells. Accompanying the application is a check for $3000.00 for the application fee.

I would like to clarify a couple of points presented in our "Conceptual Design Program" previously submitted to the TAC. The "Area of Review" encompasses a radius of one mile from the injection well sites. Within this radius there are no known faults and no wells known to penetrate the injection zone or confining sequence below the USDW. The first 4 wells listed in Table I (1040, 1053, 1074 and 1167) are shallow test wells with the deepest well being 80 feet deep.

The enclosed revised "Technical Specifications" incorporates the items discussed at the May 7, 1991 TAC pre-application meeting. For example, several logs of oil and oil-test wells were obtained for better stratigraphic control, with this information presented in Figures A-1 and A-2. The conductor casing length in both the injection well and monitor well has been charged to about 300 feet from 60 feet in order to case through the Peace River Formation clays and dolosilts (See Figure 2).

Please feel free to contact me should you have any questions or comments regarding this matter.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng
encl.

pc: Fred Bloetscher, Collier County Utilities

Board of County Commissioners
COLLIER COUNTY COURTHOUSE COMPLEX
NAPLES, FLORIDA 33962-4977
(813) 774-8097

ANNE GOODNIGHT
COMMISSIONER

BURT L. SAUNDERS
COMMISSIONER

RICHARD S. SHANAHAN
COMMISSIONER

MICHAEL J. VOLPE
COMMISSIONER

MAX A. HASSE, JR.
COMMISSIONER

JAMES C. GILES
CLERK

July 11, 1991

UTILITIES ADMINISTRATION

JUL 22 1991

AM 7 8 9 10 11 12 1 2 3 4 5 6 PM

Mr. Phillip R. Edwards
Director of District Management
Department of Environmental Regulation
2269 Bay Street
Ft. Myers, Florida 33901-2896

RE: Collier County UIC
North County Regional Water Treatment Plant
Class I Injection Well Permit
Application No. 198532
Utilities Division File No. 221.16

Dear Mr. Edwards:

Per your letter dated June 28, 1991, please be advised that the Board of County Commissioners at their meeting of March 19, 1991, authorized staff to proceed with the design and permitting of deep well for injection of concentrate water from our membrane softening plant. A subsequent contract was approved by the Board of County Commissioners with Missimer and Associates, Inc. to effect this on June 18, 1991.

Should you have any further questions on this, please let us know.

Yours for good government,

Patricia Anne Goodnight

Patricia Anne Goodnight, Chairman
Commissioner, District 5

PAG:FB:smc

cc: Michael K. Arnold, Utilities Administrator
Fred Bloetscher, P.E., Assistant Utilities Administrator
Michael R. Newman, Water Department Director

M&A **MISSIMER & ASSOCIATES, INC.**

Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

428 Pine Island Road, S.W.
Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

May 9, 1991

Mr. Joe Haberfeld
Florida Department of Environmental Regulation
2600 Blairstone Road
Tallahassee, Florida 32399-2400

Dear Mr. Haberfeld:

I am enclosing a copy of the 5/7/91 minutes of the TAC Pre-application meeting for the Collier County Utilities Class I injection wells. The minutes were derived from my notes taken during the meeting and are therefore, subject to omissions and errors. I would appreciate it if you would review the minutes at your earliest convenience. Should you find the need to make changes, please FAX them to me at (813) 574-8106.

Thank you very much for your time.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng
encls.

Collier County Class I Injection Well TAC Pre-Application meeting for North County Regional Water Treatment Plant concentrate disposal.

Meeting held at 1:30 p.m., May 7, 1991 at the FDER, Ft. Myers, Florida.

Present at meeting:

(HY)	Harley W. Young	FDER
(JM)	Jack Myers	FDER
(MF)	Marian Fugitt	FDER
(JH)	Joe Haberfeld	FDER
(DD)	Dan Duerr	USGS
(FB)	Fred Bloetscher	CCU
(MN)	Michael R. Newman	CCU
(CW)	Charles W. Walker	M&A
(JMC)	Jim McGrath	M&A
(KM)	Kirk Martin	M&A
(PB)	Paul Bowdoin	Boyle Eng.

MINUTES

(CW) Introduction - Listed other possible options for disposal. Determined that deep injection was the most environmentally safe, economical, and can be expidited in an allowable time frame. Water quality and quantity to be injected was discussed. The "Boulder Zone" is proposed to receive the injectant. Conceptual well design discussed. New water treatment plant planned to come on line in late 1992. Need to have injection well constructed and tested by this time.

(JMC) Concluded introduction by describing some aspects of the technical design.

(JM) Questioned how deep into the Oldsmar Formation is the injection zone expected to occur?

(CW) This would be determined by site specific information.

(JMC) The injection zone is best detected by drilling parameters (i.e., weight on bit, rate of penetration, etc.).

(JM) Questioned what kind of problems are encountered when drilling the Boulder Zone.

(JMC) Stuck drill pipe most common problem. To minimize this, it is necessary to drill slow through these zones.

(JH) Questioned if the mechanical packer could be released to remove tubing?

(JMC) It is designed to do so, but had no experience in doing it.

(JM) Asked if any oil wells were used to correlate the Boulder Zone to the proposed site.

(CW) No oil well logs were used but they would be obtained for correlation.

(JH) The area of review radius needs to be stated.

(DD) Would like to have core samples of the dolomites collected for lab analysis.

(JMC) Indicated that dolomite cores would be collected, if at all possible.

(DD) Questioned how many samples will be analyzed from each core?

(JMC) Said 3 samples out of each recovered core would be sent for lab analysis.

(JH) Needs more information regarding well construction details of the first 4 wells listed in Table 1.

(JH) Indicated that the 6 MG on site tank can handle emergency back up for about 4 days with a concentrate volume of 1.4 MGD.

(DD) Needs 1 gallon samples from the 2 monitoring zones and the injection zone.

(JH) Questioned in an emergency and plant shut-down, who would provide the public with potable water.

(FB) The presently operating WTP would provide this water.

(CW) Questioned what Collier County needs to do to satisfy financial responsibility regarding P&A, if necessary.

(JH) Collier County should contact Mary Woodworth with the FDER in Tallahassee.

(CW) Asked if the cost of the Class I injection well construction permit is still $3000.00.

(JH) Said it is still, for the time being, $3000.00.

(JH) Questioned if the annular monitoring device would be the same as at the Marco well?

(JMC) Indicated it would be the same and then briefly explained the monitoring system.

(JH) Said there should be extra pressure in the annulus, approximately 1.5 times the injection pressure.

(JMC) Explained normal pressures and potential surge pressures.

(DD) Indicated that a TV survey of the entire injection zone would be desirable.

(JMC) Said may be able to only get 100 to 200 feet of open hole video.

(JH & DD) Would like TV film of the open hole from the bottom of the casing (about 1350 feet) to the bottom of the pilot hole.

(JMC) Indicated this could probably be done but it may take several tapes to do it.

(JH) Discussed the need for Primary and Secondary water quality analyses for both monitor zones.

(CW) Indicated that this will be done and also discussed the parameters to be analyzed for in the sampled injection zone.

(JH) Injection testing should be done using the maximum volumes at the permittable velocity of 8 ft/sec.

(CW) We will recalculate the maximum volume and test at that rate.

(JH) Questioned why the injection zone needs to be reamed to a nominal 20-inch diameter hole.

(JMC) Indicated that the bridge plug would need to be drilled out any way, the need to remove drill cuttings from the hole and the increased efficiency of the well.

(JH) Questioned the reason to temporarily stop drilling after setting the 16-inch diameter casing in the monitor well.

(JMC) Indicated the procedure only limits the upper position of the upper monitor zone only.

(JH) Said the upper monitor zone needs to be near the base of the USDW.

(CW) Correlation projections show that the base of the USDW should be between 1200 and 1300 feet below land surface.

(DD) Questioned which well would be drilled first, the injection or the monitor?

(CW) Indicated they may be drilled simultaneously, but if not, probably the injection first.

(DD) Questioned the length of time that data would be collected preceding the injection testing - perhaps one week?

(JMC) Indicated the testing program would be similar to the Marco program which is 24 or 48 hours before the test and 24 or 48 hours after the test. The time of 72 hours was also mentioned. Explained the expensive nature of these tests.

(JH) Questioned if the water source for the injection tests would be potable water?

(CW) Indicated the water would be the raw water to the WTP.

(FB) Said the water would come directly from the existing wellfield.

(JH) Questioned if the geophysical logging program for the monitor well is sufficient? Believes fluid velocity important.

(DD) Would like to have run flow meter (pumping) and temperature (pumping) logs in both the injection and monitoring wells. In the injection well pilot hole from bottom of 30-inch casing (about 1350 feet deep) to bottom of the hole. Run temperature first and then flow meter in selected zones.

(JH) Questioned why the upper 200 feet would be temporarily ungrouted outside the 16-inch casing?

(JMC) Indicated primarily for temperature log calibration.

(JH) Questioned if the annular pressure would be measured during the injection test?

(JMC) Said it would be, but probably manually.

(JMC) Told the TAC members that the technical specification would be revised based on this meeting's discussions.

(CW) Said the construction application, revised technical specs and $3000.00 would soon be submitted.

(CW) Thanked all attendees for their involvement and the meeting adjourned at 3 p.m.

NOTE: Minutes prepared from notes taken by Charles W. Walker during the TAC meeting.

IW-1

STATE OF FLORIDA

DEPARTMENT OF ENVIRONMENTAL REGULATION

SOUTH FLORIDA
DISTRICT

2269 BAY STREET
FORT MYERS, FLORIDA 33901

APPLICATION TO CONSTRUCT/OPERATE/ABANDON CLASS I, III, OR V INJECTION WELL SYSTEMS

PART I. Directions

A. All applicable items must be completed in full in order to avoid delay in processing this application. Where attached sheets or other technical documentation are utilized in lieu of the blank space provided, indicate appropriate cross-reference in the space and provide copies to the department in accordance with (C) below. Where certain items do not appear applicable to the project, indicate N/A in the appropriate spaces. When this form is used in conjunction with DER Form 17-1.205(1), duplicative information requests need to be completed only once.

B. All information is to be typed or printed in ink.

C. Four (4) copies of this application and four (4) copies of supporting information such as plans, reports, drawings and other documents shall be submitted to the appropriate District/Subdistrict office. An engineering report is also required to be submitted to support this application pursuant to the applicable sections of Florida Administrative Code Rule 17-28. The attached lists* shall be used to determine completeness of supporting data submitted or previously received. A check for the application fee in accordance with Florida Administrative Code Rule 17-4.05 made payable to the Department shall accompany the application.

D. For projects involving construction, this application is to be accompanied by four (4) sets of engineering drawings, specifications and design data as prepared by a Professional Engineer registered in Florida, where required by Chapter 471, Florida Statutes.

E. Attach 8 1/2" x 11" USGS site location map indicating township, range and section and latitude/longitude for the project.

PART II. General Information

A. Applicant: Name Collier Co. Utilities Division Title _____

Address 2800 North Horseshoe Drive

City Naples Zip 33942

Telephone Number 813/643-8480

B. Project Status: [X] New [ ] Existing

[ ] Modification (specify) _____

*"Engineering and Hydrogeologic Data Required for Support of Application to Construct, Operate and Abandon Class I, III, or V Injection Wells"

C. Well Type:

( ) Exploratory Well (X) Test/Injection Well

D. Type of Permit Application:

( ) Class I Exploratory Well Construction and Testing Permit

(X) Class I Test/Injection Well Construction and Testing Permit

( ) Class I Well Operating Permit

( ) Class I Well Plugging and Abandonment Permit

( ) Class III Well Construction/Operation/Plugging and Abandonment Permit

( ) Class V well Construction Permit

( ) Class V Well Operating Permit

( ) Class V Well Plugging and Abandonment Permit

E. Facility Identification:

Name: North County Regional Water Treatment Plant

Facility Location: Street: 8th Ave., Approx. 0.6 mile east of Highway 95

City: Golden Gate County: Collier

SIC Code:

F. Proposed facility located on Indian Lands: Yes_____ No X

G. Well Identification:

Well No. IW-1 & 2 of 2 (total #) Wells

Purpose (Proposed Use): Dispose of WTP concentrate reject

Well Location: Latitude: 26° 14'35"N Longitude 81°41'10"W

(attach separate sheet, if necessary, for multiple wells.)

Subpart B. General Projection Description:

(1) Describe the nature, extent and schedule of the injection well project. Refer to existing and/or future pollution control facilities, expected improvement in performance of the facilities and state whether the project will result in full compliance with the requirements of Chapter 403, Florida Statutes, and all rules and regulations of the Department. Attach additional sheet(s) if necessary or cross-reference the engineering report.

Initially, only one injection well and monitoring wells will be constructed with the second injection well drilled at a later date. The first well is designed to inject 6.3 MGD of WTP reject into the "Boulder Zone". Please see accompanying report for detail

PART III Statement by Applicant and Engineer

A. Applicant

I, the owner/authorized representative* of Collier County Utilities, certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment. I understand that this certification also applies to all subsequent reports submitted pursuant to this permit. Where construction is involved, I agree to retain the design engineer, or other professional engineer registered in Florida, to provide inspection of construction in accordance with Florida Administrative Code Rule 17-28.34(1)(c).

Michael R Newman — 5-16-91

Signed — Date

Michael R. Newman, Water Department Director

~~Frederick Bloetscher, Asst. Util. Admin.~~ — 813/643-8490

Name and Title (Please Type) — Telephone Number

*Attach a Letter of Authorization.

B. Professional Engineer Registered in Florida

This is to certify that the engineering features of this injection well have been designed/examined by me and found to be in conformity with modern engineering principles applicable to the disposal of pollutants characterized in the permit application. There is reasonable assurance, in my professional judgement, that the well, when properly maintained and operated, will discharge the effluent in compliance with all applicable statutes of the State of Florida and the rules and regulations of the Department. It is also agreed that the undersigned will furnish the applicant a set of instructions for proper maintenance and operation of the well.

Signed: Lloyd E. Horvath

Lloyd E. Horvath, P.E.
Name (Please Type)

Missimer & Associates, Inc.
Company Name (Please Type)

(Please Affix Seal)

P.O. Box 151306, Cape Coral, FL33915
Mailing Address (Please Type)

FLORIDA REGISTRATION NUMBER 25260 Date: 5-14-91 Phone No. 813/574-1919

PROCEDURES AND COSTS FOR THE PLUGGING AND ABANDONMENT OF THE INJECTION AND MONITORING WELLS, IF REQUIRED

The costs associated with implementing a plugging and abandonment plan for the proposed wells would cost approximately $340,000 under current market conditions. The abandonment plan for these wells include 7 major bid items.

Bid Item 1 includes all work associated with mobilization and demobilization of the drilling rig and supporting equipment suitable for the task. This bid item also includes work required to retrofit the drilling pad with new pad walls to ensure that accidental spillage of injected or formation fluids are not spilled on the ground.

Pad retro-fit	$10,000
Mobilization-demobilization	$75,000

INJECTION WELL

Bid Item #2 includes the materials and work required to "Kill" the injection well.

Drilling mud	$ 5,000
Rig time	$12,000

Bid Item #3 includes all work required to remove the 16-inch diameter tubing string from the hole and retrieve the packer, if possible.

$18,000

Bid Item #4 includes all materials and work required to place a cement basket/plug at bottom of the 20-inch diameter casing, and fill the 20-inch diameter casing with neat cement.

Note Section 17-28.270(7), FAC includes the statement "neat cement grout or approved equivalent"; for the purposes of this document we will assume that the FDER would not approve the use of extended cement in implementing this plan.

Cement basket/plug	$ 2,000
4,925 cubic feet of cement	$73,875
Rig time	$18,000

MONITORING WELL

Bid Item #5 consists of the materials and work required to "Kill" the monitoring well.

Drilling mud	$ 3,000
Rig time	$ 8,000

Bid Item #6 includes all materials and work required to place a cement basket/plug at bottom of 6 5/8-inch diameter casing and fill the 6 5/8 and 16-inch diameter casings with neat cement.

Cement basket/plug	$ 1,500
3145 cubic feet of cement	$47,200
Rig time	$12,000

BOTH WELLS

Bid Item #7 includes all materials and work necessary to clean up site including transportation and disposal of the used casing and packer.

Transportation and disposal	$14,000
Rig time (manpower)	$20,000

TOTAL CONTRACTOR COSTS	$319,575

Additional costs would be required to design, submit, and obtain approval of the abandonment plan itself, as well as the design, permitting and implementation of the post closure monitoring plan. The specific requirements for the post closure monitoring plan would determine the final cost of abandonment of the proposed injection well.

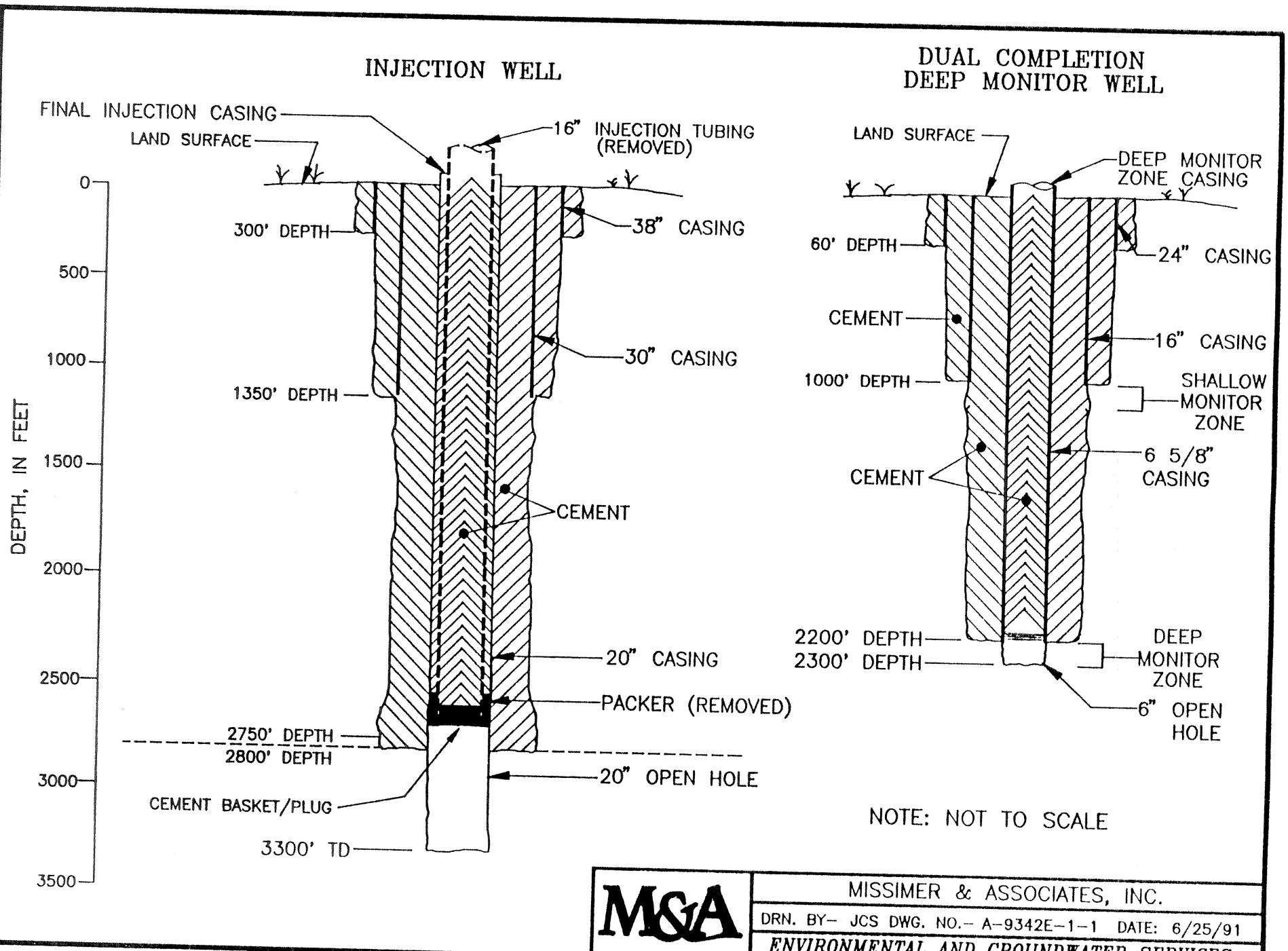

FIGURE . PROPOSED PLUGGING AND ABANDONMENT OF THE INJECTION WELL AND DUAL ZONE MONITOR WELL.

Florida Department of Environmental Regulation
Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400
Lawton Chiles, Governor
Carol M. Browner, Secretary

CERTIFICATE OF DEMONSTRATION

Florida Underground Injection Control Program

Demonstration of Financial Responsibility

Facility Name: Collier County - North Country Regional Water Treatment Plant - R.O. DIW

Facility Address: Vanderbilt Beach Road Extension
Naples, Florida

Facility Contact: Fred Bloetscher 813/643-8487

DER/EPA Identification Number: Not assigned

DER Permit Number: PATS 198532

Date Financial Information Received: July 22, 1991

Current Plugging and Abandonment Cost Estimate: $247,875

Current Post-Closure Monitoring Estimate: n/a

Mechanism(s) Used to Demonstrate Financial Responsibility	Date of Expiration
Local Government Guarantee	Written Consent of DER Secretary

Date Mechanism(s) Approved: July 22, 1991

By: Mary J. Woodworth

Mary J. Woodworth
Management Analyst
(904) 488-3601

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Lawton Chiles, Governor

Carol M. Browner, Secretary

CERTIFICATE OF DEMONSTRATION

Florida Underground Injection Control Program

Demonstration of Financial Responsibility

Facility Name: Collier County - North Country Regional Water Treatment Plant - R.O. Monitor Well

Facility Address: Vanderbilt Beach Road Extension
Naples, Florida

Facility Contact: Fred Bloetscher 813/643-8487

DER/EPA Identification Number:

DER Permit Number: PATS 198532

Date Financial Information Received: July 22, 1991

Current Plugging and Abandonment Cost Estimate: $71,700

Current Post-Closure Monitoring Estimate: n/a

Mechanism(s) Used to Demonstrate Financial Responsibility	Date of Expiration
Local Government Guarantee	Written Consent of DER Secretary

Date Mechanism(s) Approved: July 22, 1991

By: Mary J. Woodworth

Mary J. Woodworth
Management Analyst
(904) 488-3601

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

NOTICE OF PERMIT

CERTIFIED MAIL # P 021 092 877
RETURN RECEIPT REQUESTED

In the matter of an
Application for Permit
by:

Michael R. Newman
Water Dept. Director
Collier County Utilties Div.
2800 North Horseshoe Drive
Naples, FL 33942

_____/

DER File No. 5211C03217
Collier County - UIC
IW-1 North Collier Regional Water Plant

Enclosed is Permit Number UC11-198532 to construct a Class 1 test injection well, issued pursuant to Section(s) 403.087, Florida Statutes.

Any party to this Order (permit) has the right to seek judicial review of the permit pursuant to Section 120.68, Florida Statutes, by the filing of a Notice of Appeal pursuant to Rule 9.110, Florida Rules of Appellate Procedure, with the Clerk of the Department in the Office of General Counsel, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400; and by filing a copy of the Notice of Appeal accompanied by the applicable filing fees with the appropriate District Court of Appeal. The Notice of Appeal must be filed within 30 days from the date this Notice is filed with the Clerk of the Department.

Executed in Fort Myers, Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL REGULATION

Philip R. Edwards
Director of
District Management
South District Office
2295 Victoria Avenue, Suite 364
Fort Myers, Florida 33901
(813)332-6975

CERTIFICATE OF SERVICE

The undersigned duly designated deputy agency clerk hereby certifies that this NOTICE OF PERMIT and all copies were mailed before the close of business on March 19, 1992 to the listed persons.

Clerk Stamp

FILING AND ACKNOWLEDGMENT

FILED, on this date, pursuant to §120.52(11), Florida Statutes, with the designated Department Clerk, receipt of which is hereby acknowledged.

Karen L. Mialy (Clerk) 3/19/92 (Date)

PRE/VNM/jrh

Enclosures

Copies furnished to:

L. Horvath, P.E.
TAC

Florida Department of Environmental Regulation

South District • 2295 Victoria Avenue • Fort Myers, Florida 33901

Lawton Chiles, Governor

Carol M. Browner, Secretary

PERMITTEE:
Michael R. Newman
Water Dept. Director
Collier County Utilities Div.
2800 North Horseshoe Drive
Naples, FL 33942

I.D.No: 5211C03217
Permit/Certification
Number: UC11-198532
Date of Issue: March 18, 1992
Expiration Date: March 18, 1997
County: Collier
Latitude: 26° 14′ 35" N
Longitude: 81° 41′ 10" W
Section/Town/Range: 35/48S/26E
Project: IW-1 North Collier
Regional Water Plant

This permit is issued under the provisions of Chapter 403, Florida Statutes (F.S.), and Florida Administrative Code (F.A.C.) Rules 17-3, 17-4 and 17-28. The above named permittee is hereby authorized to perform the work or operate the facility shown on the application and approved drawing(s), plans, and other documents, attached hereto or on file with the Department and made a part hereof and specifically described as follows:

Construct a nominal 16 inch diameter Class I test injection well using tubing and packer with a 20 inch cemented final steel casing to a total depth of 2800 feet below land surface (bls). The injection well will be used to dispose of 6.3 million gallons per day of non-hazardous membrane softening (reject) concentrate from the North Collier Regional Water Plant. A dual zone monitor well will monitor from approximately 1,000 to 1,100 feet bls and 2,200 to 2,300 feet bls. The application was received May 20, 1991 with plans and technical specifications with addition information received on July 29, 1991, August 29, 1991, November 26, 1991 which included a final technical specification document containing all changes dated November 1991. The Certificate of Financial Responsibility was issued July 22, 1991. Project will be located on 8th Ave., approximately 0.6 miles east of Highway 951, Golden Gate.

Subject to General Conditions 1 through 16 and Specific Conditions 1 through 8.

PERMITTEE:
Michael R. Newman
Water Dept. Director
Collier County Utilities Div.

I.D. No.: 5211C03217
Permit/Cert. No.: UC11-198432
Date of Issue: March 18, 1992
Expiration Date: March 18, 1997

GENERAL CONDITIONS:

1. The terms, conditions, requirements, limitations, and restrictions set forth in this permit are "permit conditions" and are binding and enforceable pursuant to Sections 403.141, 403.727, or 403.859 through 403.861, F.S. The permittee is placed on notice that the Department will review this permit periodically and may initiate enforcement action for any violation of these conditions.

2. This permit is valid only for the specific processes and operations applied for and indicated in the approved drawings or exhibits. Any unauthorized deviation from the approved drawings, exhibits, specifications, or conditions of this permit may constitute grounds for revocation and enforcement action by the Department.

3. As provided in Subsections 403.087(6) and 403.722(5) F.S., the issuance of this permit does not convey any vested rights or any exclusive privileges. Neither does it authorize any injury to public or private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations. This permit is not a waiver of or approval of any other Department permit that may be required for other aspects of the total project which are not addressed in the permit.

4. This permit conveys no title to land or water, does not constitute State recognition or acknowledgement of title, and does not constitute authority for the use of submerged lands unless herein provided and the necessary title or leasehold interests have been obtained from the State. Only the Trustees of the Internal Improvement Trust Fund may express State opinion as to title.

5. This permit does not relieve the permittee from liability for harm or injury to human health or welfare, animal, or plant life, or property caused by the construction or operation of this permitted source, or from penalties therefore; nor does it allow the permittee to cause pollution in contravention of Florida Statutes and Department rules, unless specifically authorized by any order from the Department.

6. The permittee shall properly operate and maintain the facility and systems of treatment and control (and related appurtenances) that are installed and used by the permittee to achieve compliance with the conditions of this permit, as required by Department rules. This provision includes the operation of backup or auxiliary facilities or similar systems when necessary to achieve compliance with the conditions of the permit and when required by Department rules.

PERMITTEE:
Michael R. Newman
Water Dept. Director
Collier County Utilities Div.

I.D. No.: 5211C03217
Permit/Cert. No.: UC11-198432
Date of Issue: March 18, 1992
Expiration Date: March 18, 1997

GENERAL CONDITIONS:

7. The permittee, by accepting this permit, specifically agrees to allow authorized Department personnel, upon presentation of credential or other documents as may be required by law, and at reasonable times, access to the premises where the permitted activity is located or conducted to:

a. Have access to and copy any records that must be kept under the conditions of the permit;
b. Inspect the facility, equipment, practices, or operations regulated or required under this permit; and
c. Sample or monitor any substances or parameters at any location reasonably necessary to assure compliance with this permit or Department rules.

Reasonable time may depend on the nature of the concern being investigated.

8. If, for any reason, the permittee does not comply with or will be unable to comply with any condition or limitation specified in this permit, the permittee shall immediately provide the Department with the following information:
a. A description of and cause of non-compliance; and
b. The period of non-compliance, including dates and times; or, if not corrected, the anticipated time the non-compliance is expected to continue, and steps being taken to reduce, eliminate, and prevent recurrence of the non-compliance. The permittee shall be responsible for any and all damages which may result and may be subject to enforcement action by the Department for penalties or revocation of this permit.

9. In accepting this permit, the permittee understands and agrees that all records, notes, monitoring data and other information relating to the construction or operation of this permitted source, which are submitted to the Department, may be used by the Department as evidence in any enforcement case involving the permitted source arising under the Florida Statutes or Department rules, except where such use is prescribed by Section 403.111 and 403.73, F.S. Such evidence shall only be used to the extent it is consistent with the Florida Rules of Civil Procedure and appropriate evidentiary rules.

10. The permittee agrees to comply with changes in Department rules and Florida Statutes after a reasonable time for compliance, provided however, the permittee does not waive any other rights

GENERAL CONDITIONS:

granted by Florida Statutes or Department rules. A reasonable time for compliance with a new or amended surface water quality standard, other than those standards addressed in Rule 17-3.051, shall include a reasonable time to obtain or be denied a mixing zone for the new or amended standard.

11. This permit is transferable only upon Department approval in accordance with F.A.C. Rules 17-4.120 and 17-30.300, F.A.C. as applicable. The permittee shall be liable for any non-compliance of the permitted activity until the transfer is approved by the Department.

12. This permit or a copy thereof shall be kept at the work site of the permitted activity.

13. This permit also constitutes:

(a) Determination of Best Available Control Technology (BACT)
(b) Determination of Prevention of Significant Deterioration (PSD)
(c) Certification of compliance with State Water Quality Standards (Section 401, PL 92-500)
(d) Compliance with New Source Performance Standards

14. The permittee shall comply with the following:

(a) Upon request, the permittee shall furnish all records and plans required under Department rules. During enforcement actions, the retention period for all records will be extended automatically, unless otherwise stipulated by the Department.

(b) The permittee shall hold at the facility or other location designated by this permit records of all monitoring information (including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation), required by the permit, copies of all reports required by this permit, and records of all data used to complete the application for this permit. These materials shall be retained at least three years from the date of the sample, measurement, report or application unless otherwise specified by Department rule.

(c) Records of monitoring information shall include:
1. the date, exact place, and time of sampling or measurements;

GENERAL CONDITIONS:

2. the person responsible for performing the sampling or measurements;
3. the dates analyses were performed;
4. the person responsible for performing the analyses;
5. the analytical techniques or methods used;
6. the results of such analyses.

15. When requested by the Department, the permittee shall within a reasonable time furnish any information required by law which is needed to determine compliance with the permit. If the

permittee becomes aware the relevant facts were not submitted or were incorrect in the permit application or in any report to the Department, such facts or information shall be corrected promptly.

16. In the case of an underground injection control permit, the following permit conditions also shall apply:

(a) All reports or information required by the Department shall be certified as being true, accurate and complete.

(b) Reports of compliance or noncompliance with, or any progress reports on, requirements contained in any compliance schedule of this permit shall be submitted no later than 14 days following each schedule date.

(c) Notification of any noncompliance which may endanger health or the environment shall be reported verbally to the Department within 24 hours and again within 72 hours, and a final written report provided within two weeks.

1. The verbal reports shall contain any monitoring or other information which indicate that any contaminant may endanger an underground source of drinking water and any noncompliance with a permit condition or malfunction of the injection system which may cause fluid migration into or between underground sources of drinking water.

2. The written submission shall contain a description of an a discussion of the cause of the noncompliance and, if it has not been corrected, the anticipated time the noncompliance is expected to continue, the steps being taken to reduce, eliminate, and prevent recurrence of the noncompliance and all information required by Rule 17-28.230(4)(b), F.A.C.

(d) The Department shall be notified at least 180 days before conversion or abandonment of an injection well, unless abandonment within a lesser period of time is necessary to protect waters of the State.

PERMITTEE:
Michael R. Newman
Water Dept. Director
Collier County Utilities Div.

I.D. No.: 5211C03217
Permit/Cert. No.: UC11-198432
Date of Issue: March 18, 1992
Expiration Date: March 18, 1997

SPECIFIC CONDITIONS:

1. Site Requirements

a. A drilling pad shall be provided to collect spillage of contaminants and to support the heaviest load that will be encountered during drilling.

b. The disposal of drilling fluids, cuttings, formation water or waste shall be in a sound environmental manner that avoids violation of surface and ground water quality standards. The disposal method shall be approved by the Department prior to start of construction.

c. Provide specific drilling pad dimensions and design details prior to commencing construction and shortly after selection of drilling contractor.

d. The four water table monitoring wells shall be sampled and analyzed prior to drilling this injection well and then weekly thereafter. Sampling shall include specific conductance, chloride, temperature and water level.

e. A survey indicating the exact location in metes and bounds of all wells authorized by this permit shall be provided prior to issuance of an operating permit.

2. Construction and Testing Requirements

a. The permittee shall contact the TAC chairman so that he may schedule progress review meetings at appropriate times with the TAC and permittee for the purpose of reviewing the results of tests, geophysical logging, surveys, drilling records and construction problems. At a minimum, meetings shall be scheduled for the purpose of selecting final setting depth for the 20 inch casing and for the inner casing of the dual zone monitor well.

b. All drilling shall be inside a blow out preventer upon penetration of the Florida Aquifer.

c. Mechanical integrity testing is a two part demonstration which includes a pressure test to demonstrate that no leaks are present in the casing and a temperature or noise log and radioactive tracer survey to demonstrate the absence of leaks behind the casing. Verification of pressure guage calibration must be provided at the scheduled tests.

SPECIFIC CONDITIONS:

d. Department approval and Technical Advisory Committee (TAC) review pursuant to F.A.C. Rule 17-28 is required for the following stages of construction:

(1) Intermediate casing seat selection (injection and monitor wells).
(2) Final casing seat selection (injection and monitor wells).
(3) Operational (long term) testing with effluent.

e. The cementing program, as required in Section 17-28.220(5), Florida Administrative Code, shall be submitted to the Department and the technical Advisory Committee for review. Cementing shall not commence prior to approval being granted.

f. All temperature surveys (except for mechanical integrity demonstration) shall be run within 48 hours after cementing.

g. TAC meetings are scheduled on the 1st Tuesday of each month subject to a 5 working day prior notice and timely receipt of critical data by all TAC members. Emergency meetings may be arranged when justified to avoid undue construction delay.

h. The Engineer of Record shall insure that safe internal pressures are maintained during the cementing of all casings.

i. The background water quality of the injection zone shall be established prior to commencement of any injection testing. Parameters to be measured are contained on Pages 22-23 of the November, 1991 tecnical specifications.

The parameters listed in section 03060 of the technical specifications will be analyzed in the monitor zones prior to the injection of any effluent into the well. Included in these parameters are the primary and secondary water quality standards and the list on pages 25-27 of the November, 1991 technical specficiations. These parameters shall also be analyzed in the effluent prior to submitting application for an operating permit.

j. The injection and monitor well(s) at the site shall be abandoned when no longer usable for their intended purpose, or when posing potential threat to the quality of the waters of the State. The permittee shall devise a plan for plugging and abandonment of the injection and monitor wells at the site and

submit this information in the Final Report. Within 180 days of well abandonment, the permittee shall submit to the Department and the TAC the proposed plugging method, pursuant to Rule 17-28.350, F.A.C.

k. All salt used in well drilling shall be stored in an environmentally sound manner. Accurate records shall be kept on the amount of salt used.

3. Quality Assurance/Quality Control Requirements

a. This permit approval is based upon evaluation of the data contained in the application dated May 20, 1991, and the plans and/or specifications submitted November 26, 1991, in support of the application. Any changes in the plans and/or technical specifications, except as provided elsewhere in this permit, must be approved by the Department before being implemented.

b. A professional engineer registered pursuant to Chapter 471, Florida Statutes shall be retained throughout the construction period to be responsible for the construction operation and to certify the application, specifications, completion report and other related documents. The Department shall be notified immediately of any change of engineer.

c. Where required by Chapter 471 (P.E.) or Chapter 492 (P.G.) F.S., applicable portions of permit applications and supporting documents which are submitted to the Department for public record shall be signed and sealed by the professional(s) who approved or prepared them.

d. The Department shall be notified immediately of any problems that may seriously hinder compliance with this permit, construction progress, or good construction practice. The Department may require a detailed written report describing the problem, remedial measures taken to assure compliance and measures taken to prevent recurrence of the problem.

e. Issuance of a Class I Test/Injection well construction and testing permit does not obligate the Department to authorize operation of the injection or monitor wells, unless the wells qualify for an operation permit applied for by the permittee and approved by the Department.

PERMITTEE:
Michael R. Newman
Water Dept. Director
Collier County Utilities Div.

I.D. No.: 5211C03217
Permit/Cert. No.: UC11-198432
Date of Issue: March 18, 1992
Expiration Date: March 18, 1997

SPECIFIC CONDITIONS:

4. Reporting Requirements

a. All reports and surveys required by this permit must be submitted concurrently to all the members of the TAC. The TAC consists of representatives from these agencies:

Department of Environmental Regulation
South District
2269 Victoria Avenue, Suite 364
Fort Myers, FL 33901

Department of Environmental Regulation
Bureau of Drinking Water and Ground Water Resources
UIC Section
2600 Blair Stone Rd.
Tallahassee, FL 32399-2400

South Florida Water Management District
P. O. Box 24860
West Palm Beach, FL 33416

United States Environmental Protection Agency
Ground Water Management Unit
345 Courtland Street
Atlanta, Georgia 30065

United States Geological Society
4710 Eisenhower Blvd.
Tampa, FL 33614

b. Members of the TAC shall receive a weekly summary of the daily log kept by the contractor. The weekly reporting period shall run Friday through Thursday and reports shall be mailed each Friday. The report shall include but is not limited to the following:

(1) Description of daily footage drilled by diameter of bit or size of hole opener or reamer being used;
(2) Description of formation and depth encountered; and specific conductance of water samples collected during drilling. Description of work during installation and cementing of casings include amounts of casing and actual cement used versus calculated volume required.
(3) Lithological description of drill cuttings collected every ten (10) feet or at every change in formation. Description of work and type of testing accomplished geophysical logging,

pumping tests, and coring results.

(4) Description of any construction problems that develop and their status to include a description of what is being done or has been done or correct the problem.

(5) Description of the amount of salt used.

(6) Results of any water quality analyses performed as required by this permit.

(7) Copies of the driller's log is to be submitted with the weekly summary.

c. The Department must be notified seventy-two (72) hours prior to all testing for mechanical integrity on the injection and monitor wells. Testing should begin during daylight hours Monday through Friday.

d. Annotated copies of geophysical logs, lithologic descriptions and logs and water quality data (from drilling and packer tests) must be submitted to the TAC for intermediate and final casing seat selection approvals by the Department.

e. An evaluation of all test results and geophysical logs must be submitted with all test data.

f. After completion of construction and testing, a final report shall be submitted to the Department and the TAC. The report shall include, but not be limited to, all information and data collected under Rule 17-28.330(2) and Rule 17-28.330(3), F.A.C., with appropriate interpretations. Mill certificates for the casing(s) shall be included in this report. To the extent possible, the transmissivity of the injection zone and maximum capacity within safe and economical pressure limits shall be estimated.

5. Operational Testing Requirements

a. The Department shall require operational testing to demonstrate that the well can absorb the design and peak daily flows that are expected over the next five years, prior to granting approval for operation.

b. No effluent shall be injected into the well without written authorization from the Department. The letter authorizing

SPECIFIC CONDITIONS:

operational testing with effluent shall list specific conditions for operation and monitoring during the operational testing phase of the project.

c. If any monitoring data indicates the movement of injection fluids or formation fluid into underground sources of drinking water, the Department shall prescribe such additional requirements for construction, corrective action (including possible closure of the injection well), operation, monitoring, or reporting as are necessary to prevent such movement. These additional requirements shall be imposed by modifying the permit, or by enforcement action if the permit has been violated.

d. A draft operation and maintenance manual with emergency procedures must be submitted to and approved by the Department and TAC prior to a request for system operation testing.

e. Prior to operational testing approval, at a minimum the following items must be submitted to and approved by the Department and TAC review:

(1) Borehole television survey of final casing;
(2) Geophysical logs with interpretations;
(3) Certification of mechanical integrity and interpreted test data;
(4) Injection test data and evaluation;
(5) Confining zone data (cores, etc.) and confirmation of confinement;
(6) Background water quality data (monitor zones);
(7) Waste stream analysis;
(8) Surface equipment completion certified pursuant to Rule 17-600.540(4), FAC.

f. The permittee shall use continuous indicating and recording devices to monitor injection flow rate, injection pressure and monitor zone pressures. The case of operational failure of any of these instruments for a period of more than 48 hours, the permittee shall report to the Department in writing the remedial action to be taken and the date when the failure will be corrected.

6. Emergency Disposal

a. All applicable federal, state and local permits must be in place to allow for any alternate discharges due to emergency or planned outage conditions.

PERMITTEE:
Michael R. Newman
Water Dept. Director
Collier County Utilities Div.

I.D. No.: 5211C03217
Permit/Cert. No.: UC11-198432
Date of Issue: March 18, 1991
Expiration Date: March 18, 1997

SPECIFIC CONDITIONS:

b. Any changes in emergency disposal methods must be submitted for Technical Advisory Committee (TAC) review and Department approval.

7. Financial Responsibility

a. The permittee shall maintain the resources necessary to close, plug, and abandon the injection and associated monitor wells, at all times (Rule 17-28.270(9), F.A.C.).

b. The permittee shall review annually the plugging and abandonment cost estimates. An increase in any one year shall require the permittee to submit documentation to obtain an updated Certificate of Demonstration of Financial Responsibility.

c. In the event that the mechanism used to demonstrate financial responsibility should become invalid for any reason, the permittee shall notify the Department of Environmental Regulation in writing within 14 days of such invalidation. The permittee shall, within 30 days of said notification, submit to the Department for approval, new financial documentation in order to comply with Rule 17-28.270(9), F.A.C., and the conditions of this permit.

8. The permittee is reminded of the necessity to comply with the pertinent regulations of any other regulatory agency, as well as any county, municipal, and federal regulations applicable to the project. These regulations may include, but not limited to, those of the Federal Emergency Management Agency in implementing flood control measures. This permit should not be construed to imply compliance with the rules and regulations of other regulatory agencies.
Note: In the event of an emergency the permittee shall contact the Department by calling (904)488-1320. During normal business hours, the permittee shall call (813)332-6975.

Issued this 18th day of March, 1992.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

Philip R. Edwards
Director of
District Management

PRE/VNM/jrh

Florida Department of Environmental Regulation

Twin Towers Office Bldg. • 2600 Blair Stone Road • Tallahassee, Florida 32399-2400

Lawton Chiles, Governor

Virginia B. Wetherell, Secretary

June 28, 1993

Mr. Frederick Bloetscher
Assistant Utilities Administrator
Collier County Utilities
2800 North Horseshoe Drive
Naples, Florida 33942

Dear Mr. Bloetscher:

Enclosed is the report for the Department's June 16, 1993 inspection of the injection facilities at the North Collier County Utilities WTP. Please note any corrective actions needed on page 2 of the report.

If you have any questions, please call me at 904/488-3601.

Sincerely,

Joseph L. Haberfeld
Professional Geologist
UIC, Ground Water Technical Support
Bureau of Drinking Water and
Ground Water Resources

JLH/lq

Enclosure

cc: Vince Mele
Buzz Walker, Missimer & Assoc.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

UNDERGROUND INJECTION CONTROL
COMPLIANCE INSPECTION REPORT - CLASS I WELLS

Facility Name: North Collier Regional Water Treatment Plant

Facility Location: 8th Ave, Golden Gate; Collier County

Site Representatives/Titles: Buzz Walker - Project Manager (M&A)
Cliff Harrison - Site Geologist (M&A)
M&A=Missimer & Assoc. Kirk Martin - Hydrogeologist (M&A)

Permit(s): # UC11-198532 Expires:
Expires:

Is there an existing State and/or Federal compliance schedule for this facility? No

Is this facilty in conformance with the above schedule (if applicable)? NA

Number of injection wells: 1

Number of monitor wells: 2

Permitted Flow Rate(s):

Well # 1 , NA GPM/MGD
, GPM/MGD
, GPM/MGD

Flow(s) during inspection:

Well # 1 , NA GPM/MGD
, GPM/MGD
, GPM/MGD

Permitted Wellhead Pressure(s):

Well # 1 , NA PSI
, PSI
, PSI

Pressures during inspection:

Well # 1 , NA PSI
, PSI
, PSI

Annular Pressure(s) during inspection:

Well # 1 , NA PSI
, PSI
, PSI

Monitor Well Measurement(s):

Well # shallow , NA PSI/FT Sampling Frequency: NA
deep , NA PSI/FT Sampling Frequency: NA
, PSI/FT Sampling Frequency:
, PSI/FT Sampling Frequency:
, PSI/FT Sampling Frequency:

Laboratory responsible for water quality analyses: NA

Gauges - General Condition: NA Calibration Schedule: NA

Were all general permit conditions being met: Yes

Were all specific permit conditions being met: Yes

Comments: Approved setting of 16" monitor well casing to 900'. Current depth of monitor well 1331'. Reaming with 22" bit. Depth of injection well at 336' (drilling 48" hole). Sure shot of 1.75 degrees was rerun on 7/15, was 0.375 degrees.

Only barite is being used as weighting material in monitor well (no salt) until base of USDW is reached.

Overall System Condition: Good

Corrective Action(s) Needed: None

DER Inspector: Joseph Haberfeld Title: PG I

Other Inspectors: Vince Mele Agency: DER

Inspection Date: July 23, 1992

M&A **MISSIMER & ASSOCIATES, INC.**

Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

428 Pine Island Road, S.W.
Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

November 13, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1

Dear TAC Member:

I am enclosing a copy of the 9/23/92 minutes of the TAC casing setting meeting for the Collier County Class I injection wells. The minutes were derived from Jack Breland's notes taken during the meeting and are therefore, subject to omissions and errors.

I would appreciate it if you would review the minutes at your earliest convenience. Should you find the need to make changes, please FAX them to me at (813) 574-8106.

Thank you very much for your time.

Sincerely,

Charles W. Walker

Charles W. Walker, PhD., P.G.
Senior Hydrogeologist

pc: Fred Bloetscher, Collier County Utilities

Collier County Class I Injection Well TAC Casing Setting meeting for North County Regional Water Treatment Plant concentrate disposal.

Meeting held at 1:30 p.m., September 23, 1992 at FDER, Ft Myers, Florida.

Present at Meeting

(JH)	Joe Haberfeld	FDER
(JM)	Jack Myers	FDER
(RO)	Richard Orth	FDER
(DD)	Dan Duerr	USGS
(KM)	Kirk Martin	M&A
(CW)	Charles Walker	M&A
(JB)	Jack Breland	M&A

Minutes

(CW) Introduction - Updated present status of the injection well and the monitor well.

(DD) Wanted CW to explain more in detail about the cave-in problems Youngquist is having at the 2600 ft. depth.

(CW) Outlined his reasons for setting the 30" diameter steel casing at the proposed depth of 2492 ft. below pad level (BPL), with 8 feet of overdrill.

(CW) Discussed in detail the geophysical logs, single packer tests, drill cores, and TV log of the injection well. From this information, gave an explanation of why M&A wants to set casing depths in the injection well, monitor well, the upper & lower monitor zone intervals.

(CW) Showing the TV survey from 2480 to 2520 ft. bpl to back up his proposed casing depth in the injection well at 2492 ft. bpl.

(CW) Began discussing the lower monitor zone.

(RO) Questioned whether or not the FDER received the core analyses from the lab.

(CW) Concluded reasons for placing the lower monitor zone between 1820 and 1900 feet.

Minutes - Continued:

1) First porous zone below proposed casing setting.
2) From geophysical logs
3) cores
4) packer tests
5) geologists field logs
6) TV survey

(CW) Showing TV survey of the lower zone in the injection well for comparison

(DD) Indicated a desire for the lower zone to be at 2300 to 2320 ft. bpl because of the highly porous matrix.

(CW) That would place the lower zone to close to the injection zone. Would loose most of our confinement and this zone may be connected.

(JM) Place a packer on the proposed zone between 1820-1900 feet to see if the desired water quantity is there.

(CW) The cost to our client would be significant.

(JH) Would like more evidence on the proposed zone than just the TV survey.

(JH) Will not rule out proposed zone between 1820 and 1900 ft. bpl. Does not want the zone placed any higher than this.

(JM) Would like to see more information on the proposed zone before making a judgment call.

(DD) Not much evidence of porosity from the temperature log.

(JB) The base of the proposed zone could be deepened if need be.

(JM) Could a zone be found around the depth of 2100 feet?

(CW) Showing TV survey from 1930 ft. to 2500 ft. bpl.

(JM) The zone at 2316 to 2335 looks very good.

(CW) This zone is too close to the boulder zone. Suggested extending base of proposed zone from 1900 ft. to 1930 ft. bpl.

Minutes - Continued:

(JH) Drill down to 1920 ft. bpl. and run a sweep of geophysical logs and set a packer to see just how much water is there.

(DD) Indicated a desire to run a temperature log of proposed zone.

(KM) Would need to drill past observed location in order to get a true temperature log.

(JH) Questions on the flowmeter that was run on the zone in the injection well.

(DD) Noticed larger vuggs between 1837-1890 ft. bpL.

(CW) Lets change the lower zone to 1820-1930 ft. bpL.

(KM) Lets run a swuip of logs on the proposed interval, if not enough porosity, have TAC write a letter indicating a desire to have a packer test performed on the lower zone.

Everyone agreed with this at 0245 hours.

(CW) Explaining the confinement interval between USDW zone and boulder zone. The limestone of the Avon Park - some porosity, Ocala formation - some porosity, but mostly tight.

(KM) Showing TV survey where cores were taken to illustrate confinement.

(CW) The coring points shown in the TV survey are very tight.

(DD) Wants to see TV survey below the super zone located at 2317 ft. bpL.

(CW) Showing TV survey of Boulder Zone.

(DD) There were no indication that drill rods dropped inside the boulder zone.

(JB) Weight of cuttings that dropped on top of the 11 inch diameter drill collars increased friction and the weight on bit was at a minimum.

Minutes - Continued:

(JH) Casing setting at 2492 ft. bpl in the injection well is okay.

(JH) Run geophysical logs on the lower zone from 1920 to 1930, if the logs are inconclusive, a packer test maybe needed before approving this zone.

(RO) Where will the water from the monitor well be stored when pumping?

(JB) Pump the formation water into the injection well.

(JH) Pump lower zone formation water into injection well. If the zone is inconclusive a packer test will be recommended. A deeper zone may have to be implemented if formation water is not producing enough for monitoring purposes.

(CW) If casing is set at 1820, what happens if the formation water is not there?

(RO) Run a packer test before setting casing.

(CW) The cost of a packer test to our client will cost very much.

At this point a discussion from everyone broke out about a solution to indicate how much formation water can be produced within the lower monitor zone. The final analysis was to go ahead with setting casing at 1820 feet and hope enough water is in the formation.

(JH) The upper monitor zone will be from 900 to no more than 1000 ft. bpl. Final TD at 3330 ft. bpl.

(JH) What about the water source for the injection test?

(CW) Of the four options, we are proposing to tap into the fire hydrant located approximately 1/2 mile away.

(RO) May need permit to do that.

(CW) Thanked all attenders for their involvement and the meeting adjourned at 1600 hours.

Note: Minutes prepared by Jack Breland during TAC meeting.

Florida Department of Environmental Regulation

Twin Towers Office Bldg. ● 2600 Blair Stone Road ● Tallahassee, Florida 32399-2400

Lawton Chiles, Governor

Carol M. Browner, Secretary

July 29, 1992

Mr. Frederick Bloetscher
Assistant Utilities Administrator
Collier County Utilities
2800 North Horseshoe Drive
Naples, Florida 33942

Dear Mr. Bloetscher:

Enclosed is the report for the compliance inspection of the injection well system at Collier County's North Regional Water Plant. No corrective actions are necessary. If you have any questions, please call me at 904/488-3601.

Sincerely,

Joseph L. Haberfeld

Joseph L. Haberfeld
Professional Geologist
UIC, Criteria and Standards
Bureau of Drinking Water and
Ground Water Resources

JLH/lh

Enclosure

cc: Vince Mele
Buzz Walker, Missimer & Assoc.

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL REGULATION

UNDERGROUND INJECTION CONTROL
COMPLIANCE INSPECTION REPORT - CLASS I WELLS

Facility Name: North Collier County Regional Water Treatment Plant

Facility Location: 8th Ave, Golden Gate; Collier County

Site Representatives/Titles: Buzz Walker, Project Manager; Missimer & Assoc.

Permit(s): # UC11-198532 Expires: 3/18/97
Expires:

Is there an existing State and/or Federal compliance schedule for this facility? No

Is this facilty in conformance with the above schedule (if applicable)? NA

Number of injection wells: 1

Number of monitor wells: 2

Permitted Flow Rate(s):

Well # , NA GPM/MGD
, GPM/MGD
, GPM/MGD

Flow(s) during inspection:

Well # , NA GPM/MGD
, GPM/MGD
, GPM/MGD

Permitted Wellhead Pressure(s):

Well # , NA PSI
, PSI
, PSI

Pressures during inspection:

Well # , NA PSI
, PSI
, PSI

Annular Pressure(s) during inspection:

Well # , NA PSI
, PSI
, PSI

Monitor Well Measurement(s):

Well # shallow , NA PSI/FT Sampling Frequency: NA
deep , NA PSI/FT Sampling Frequency: NA
, PSI/FT Sampling Frequency:
, PSI/FT Sampling Frequency:
, PSI/FT Sampling Frequency:

Laboratory responsible for water quality analyses: NA

Gauges - General Condition: NA Calibration Schedule: NA

Were all general permit conditions being met: Yes

Were all specific permit conditions being met: Yes

Comments: Well construction completed February 1993.
No gauges or charts at the site yet. Piping from the plant to the injection well not constructed yet. Earliest well can be used estimated to be mid-September, 1993.

Monitor well purge water from both zones will be sent to the wet well. Cement pads for injection and monitor wells were poured.

It was agreed on-site that upon start-up of operational testing, another controlled injection test will be done because of questionable data from the first test. The new test will probably be at a lower rate than the first injection test.

Overall System Condition: Good

Corrective Action(s) Needed: None

DER Inspector: Joseph L. Haberfeld Title: PG I

Other Inspectors: Vince Mele Agency: FDER
Roxanne Gause FDER

Inspection Date: June 16, 1993

APPENDIX B

Correspondence

COLLIER COUNTY GOVERNMENT

UTILITIES DIVISION
WATER AND WASTEWATER SERVICES

3050 NORTH HORSESHOE DRIVE
NAPLES, FL 33942
(813) 434-5050
FAX (813) 434-5039

A CERTIFIED BLUE CHIP COMMUNITY

June 16, 1992

Mr. Tim Youngquist
Youngquist Brothers, Inc.
15465 Pine Ridge Road
Fort Myers, FL 33908

Re: NCRWTP Injection and Monitor Wells
Collier County Bid #92-1868
Utilities File No. 221.17

Dear Tim:

Attached hereto please find a copy of the Notice to Proceed and construction contract, together with plans, for the above-referenced project.

Should you have any further questions, please let me know.

Sincerely,

Tom Satterfield, P.E.
Utilities Engineering

amk
Enc.

cc: Michael K. Arnold, Utilities Administrator
Michael Newman, Water Director
Ron Cook, Utilities Finance Director (w/enc.)
Ann Marie Saylor, Administrative Assistant
Steve Carnell, Purchasing Director (w/enc.)
Buzz Walker, Missimer & Associates (w/enc.)

COLLIER COUNTY GOVERNMENT

UTILITIES DIVISION
WATER AND WASTEWATER SERVICES

3050 NORTH HORSESHOE DRIVE
NAPLES, FL 33942
(813) 434-5050
FAX (813) 434-5039

A CERTIFIED BLUE CHIP COMMUNITY

NOTICE TO PROCEED

Mr. Tim Youngquist
Youngquist Brothers, Inc.
15465 Pine Ridge Road
Fort Myers, Florida 33908

June 16, 1992

Project: NCRWTP Injection and Monitor Wells
Collier County Bid #92-1868
Utilities File #221.17

You are hereby notified to commence WORK on or before June 16, 1992 in accordance with the terms of your contract with Collier County Water-Sewer District executed ~~June~~ 4/28, 1992. The time of completion for the PROJECT is one hundred eighty (180) calendar days. Therefore; the date of completion is DECEMBER 12, 1992.

Please execute the acknowledgement below and return the original to this office, retaining a copy for your records.

Collier County Water-Sewer District
Owner

By: _____
Fred Bloetscher, P.E.
Assistant Utilities Administrator

Acceptance of Notice to Proceed

Receipt of the above NOTICE TO PROCEED is hereby acknowledged by Youngquist Brothers, Inc.

By: _____

Title: V.P./P.O.O.

This 17 day of June, 1992

cc: Michael K. Arnold, Utilities Administrator
Michael Newman, Water Director
Ronald Cook, Utilities Finance Director
Ann Marie Saylor, Administrative Assistant
Steve Carnell, Purchasing

M&A MISSIMER & ASSOCIATES, INC.

Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

428 Pine Island Road, S.W.
Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

June 18, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1

Dear TAC Member:

This letter is to advise you that Collier County on June 16, 1992, issued the "Notice to Proceed" to Youngquist Brothers, Inc.

Drilling pad dimensions and design details are being provided to the FDER, South District office. No drilling fluids, cuttings, formation water or waste will be removed from the site prior to approval by the FDER of the disposal method. This disposal method and location is expected to be determined in the next day or two.

Site preparation has begun and the shallow monitor wells (8) will be constructed 6/19/92. The weekly summary reports will be initiated immediately with the first report to be mailed June 26, 1992.

Please contact me should you have any questions or comments regarding this matter.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Fred Bloetscher, Collier County Utilities

MISSIMER & ASSOCIATES, INC.
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June 26, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending June 25, 1992

Dear TAC Member:

Both drill pads are now completed. The 8 shallow monitor wells are constructed and sampled for the TAC required parameters-results are included with this report.

Youngquist, the drilling contractor, plans to install the pit pipes and set up drill rigs on the pads. They expect that the initial drilling of the dual zone monitor well will begin early next week.

Our field office is now being set up. I will inform you of phone and FAX numbers for that office when I get them.

Sincerely,

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier Co. Utilities

M&A MISSIMER & ASSOCIATES, INC.

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Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

July 2, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myers, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending July 2, 1992

Dear TAC Member:

This report is being sent a day early because of the 4th of July holiday (July 3). The pit pipe for the dual zone monitor well is now in place. Youngquist's expects to begin drilling for the conductor casing this evening. The shallow monitor wells were sampled this day with results included with this report.

Alico Lakes, Inc. have agreed with Youngquist to receive and deposit on its site the drill cuttings and used mud. A letter confirming this is included in this report. Our field office is now operational. The telephone number is (813) 455-5427.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:tf

pc: Fred Bloetscher, Collier County

Alico Lakes, Inc.

"WE'LL FILL YOUR NEEDS"
15401 ALICO RD. FORT MYERS, FL 33913
(813) 267-2700

Youngquist Brothers Inc.
15000 Pine Ridge Road
Ft.Myers.Florida

Attention: Mr.Troy Moore

June 29.19[illegible]

Dear Sir,
This letter is to confirm our agreement reached earlier today by which Alico Lake, Inc. agrees to allow Youngquist Brothers to deposit on it's site the drill cuttings from their project on Naples Injection Well. It is understood this material is to consist of fresh water drill cuttings and washed salt water limerock,no other waste or any hazardous materials is to be included in these cuttings.

Respectfully.
Edwin P Huston
Edwin P. Huston
Superviser

M&A MISSIMER & ASSOCIATES, INC.

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July 17, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending July 16, 1992

Dear TAC Member:

We have reached 1050 feet below pad level (BDL) with the 9-inch diameter pilot hole in the dual zone monitor well. Drillers are tripping out of hole this a.m. We will run a caliper log in the hole and set a single packer near the bottom and conduct a short test for water quality and specific capacity. The 24-inch diameter casing was run 7/10/92 to a depth of 425 feet BPL. The annulus was pressure grouted 7/11 in early a.m. and they ran a temperature log later that same day. This log indicates a satisfactory grout job. At IW-1, they are drilling a nominal 46-inch diameter hole and have reached 106 feet BPL.

No major problems were encountered during this past week. Items included in this weekly report are arranged the same as in last week's report.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Fred Bloetscher, Collier County Utilities

YOUNGQUIST BROTHERS, INC.

MISSIMER & ASSOCIATES, INC.
428 PINE ISLAND ROAD, S.W.
CAPE CORAL, FLORIDA 33991

ATTENTION: DR. BUZZ WALKER

SUBJECT: PILOT HOLE SIZE
MONITOR WELL
COLLIER COUNTY NCRWTP JULY 9,1992

Dear Sir,
Section 01020 A.4. of the Contract Documents for the NCRWTP Injection Well Project is asking for a twelve and one quarter inch pilot hole to be drilled to aproximately twelve hundred and fifty feet. We would like to change the pilot hole diameter to nine inches .The smaller size would be more in line with our rig tooling and would have no bearing on the logging or testing to be done during this phase of construction.
Please contact this office if there are any questions.

Sincerely,
Youngquist Brothers Inc.
Ken R. Greu
~~Kevin Greuel~~

I called Vince Mele & discussed the Youngquist request for a smaller diameter pilot hole in the MW. Vince said this would not be a problem & to go ahead with the smaller hole.
I informed Youngquist of the FDER position.
CEW 7/13/92

MISSIMER & ASSOCIATES, INC.
Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

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Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

July 24, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTPIW-1
Weekly Report Ending July 23, 1992

Dear TAC Member:

On July 23, Vince Mele and Joe Haberfeld of FDER visited the job site. Two packer tests had just been conducted in the monitor well. The upper test at about 1000 feet below land surface produced 4500 mg/l TDS water and the lower test at about 1300 feet produced 16,600 mg/l TDS water. The base of the USDW is projected to occur at about 1200 feet below land surface. Based on the above data, we agreed that the top of the upper monitor zone will be at 900 feet and the base of this zone to be between 950 and 1000 feet. The contractor is presently preparing the well for the 900 feet of 16-inch diameter casing.

Drilling the nominal 46-inch diameter hole continues in the injection well. Presently, they are at about 390 feet and have 40 more feet to drill. Casing seat depth will be 425 feet, similar to the adjacent monitor well.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:jmh

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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July 28, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
IW-1 30-inch Diameter Casing Depth

Dear TAC Member:

This morning I discussed the depth to which the 30-inch diameter casing should be set to in the injection well with Vince Mele and Joe Haberfeld in telephone conversations. The importance of this setting depth is that the casing seat be below the base of the USDW. The last single packer test in the deep monitor well, at a depth of 1300 feet below land surface, proved that the base of the USDW occurs at about 1200 feet.

It was agreed by the three of us that the casing seat be placed at a minimum depth of 1300 feet below land surface. I suggest that the nominal 38-inch diameter hole be reamed to a depth of 1320 feet below land surface and the casing seat set at 1310 feet, leaving 10 feet of overdrill.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Fred Bloetscher, Collier County Utilities
Kevin Greuel, Youngquist Bros., Inc.

MISSIMER & ASSOCIATES, INC.
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Cape Coral, Florida 33991

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July 31, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer USEPA
Mr. Steve Anderson. SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending July 30, 1992

Dear TAC Member:

In the monitor well, the hole has been reamed to a nominal 24-inch diameter down to a depth of 910 feet. The 16-inch diameter casing is being prepared to be placed in the hole.

In the injection well, the 12¼-inch diameter pilot hole from 425 feet to 1325 feet has been completed. They should begin reaming to a nominal 38-inch diameter hole soon. It was decided (see July 28, 1992 letter) to set the base of the 30-inch diameter casing at 1310 feet below land surface. The 38-inch diameter casing was placed to a depth of 425 feet early in the week. This casing was pressure grouted in one stage to the surface. Temperature log of the cased well indicates an appropriate cementing job.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:tf
pc: Fred Bloetscher

encls.

MISSIMER & ASSOCIATES, INC.
Environmental and Groundwater Services

Post Office Box 151306
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Cape Coral, Florida 33991

(813) 574-1919
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August 7, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending August 6, 1992

Dear TAC Member:

The drilling crew completed reaming a nominal 38-inch diameter hole to a depth of 1319 feet in the injection well. They are now preparing the borehole for the 30-inch diameter casing installation.

In the monitor well, we determined that the 9-inch diameter pilot hole had filled only to 1147 feet during reaming to accommodate the 16-inch diameter casing. Since the upper monitor zone is between 900 and 1000 feet, we decided to back fill the open hole with sand prior to grouting in order to protect this zone from being impregnated with cement. The back fill job was successfully completed last evening. The first grout stage should be done early next week.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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August 14, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending August 13, 1992

Dear TAC Member:

In the injection well, the 30-inch diameter casing was set to a depth of 1310 feet. This casing was grouted in by a series of 7 stages. After each stage, a temperature log was run with each log indicating sufficient grout placement. The 12 1/4-inch diameter pilot hole is now being drilled and they are presently at a depth of 1530 feet.

The 16-inch diameter casing in the monitor well was grouted in 6 stages up to about 150 feet below land surface. A temperature log was run after each stage with each log indicating sufficient grout placement. A cement bond log was then run. We plan to pressure test this casing on 8/19/92 about noon. I informed Vince Mele about this test on 8/13/92. All geophysical logs to date will be sent to you early next week.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

Environmental and Groundwater Services

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August 21, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP-IW-1
Weekly Report Ending August 20, 1992

Dear TAC Member:

Construction of the injection well is proceeding at a rapid pace. We obtained our first core in tight limestone and dolomite at a depth of 2012 to 2022 feet and recovered approximately 90%. We then set a single packer at 1990 feet and conducted a 3 stage step-drawdown test. The specific capacity of this zone tested less than 0.05 GPM/FT. We ran a second packer test with the packer set at 2050 feet and the bottom of the pilot hole at 2120 feet. The specific capacity of this interval is estimated to be about 0.06 GPM/FT. The pilot hole was then deepened to 2252 feet, at which point we are preparing to take the second core.

A pressure test was conducted on the grouted in 16-inch diameter casing of the monitor well. The maximum allowable pressure loss is specified to be 5% over a period of 60 minutes. Duplicate tests showed a loss of 9%. A previous pressure test of the casing hanging in the hole with a packer placed at the base of the casing showed practically no pressure loss which indicates the problem to be related to the first grout stage. I suggested that the contractor conduct a cement squeeze job in the well to repair the problem. This will then be followed by another pressure test.

Your next weekly report will be mailed on Monday, August 31 instead of Friday, August 28 due to my Keys fishing vacation.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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Cape Coral, Florida 33991

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Fax (813) 574-8106

August 28, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending August 27, 1992

Dear TAC Member:

Needless to say, my Keys fishing vacation was blown out of the water by Andrew, therefore, this weekly report is being mailed on time. Youngquist Bros. prepared for the storm by lowering the masts on the rigs and securing other equipment. Their efforts proved fruitful as no damage was realized at the site.

In the injection well, we have been drilling, coring and packer testing this last week. Approximately 336 feet of new pilot hole was drilled. All cores are mostly complete, with the exception of the last core attempt. The plan was to core from 2582 to 2595 feet but the bit plugged up at 2588 feet. The core barrel was pulled and only about 6-inches of core was obtained. We will drill approximately 10 feet and then attempt another core at about 2600 feet.

There was no activity this past week at the monitor well other than storm related work.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Fred Bloetscher, Collier County Utilities

YOUNGQUIST BROTHERS

5000 Pine Ridge Road Fort Myers, Florida 33908 (813) 489-4444

MISSIMER & ASSOCIATES, INC.
428 PINE ISLAND ROAD,S.W.
CAPE CORAL, FLORIDA 33991

ATTENTION; DR. BUZZ WALKER

SUBJECT; SIXTEEN INCH CASING PRESSURE TEST

AUGUST 28,1992

Dear Dr. Walker,
The proceedure we used to seal the bottom of the sixteen inch casing at the cement plug is as follows.

After failing the original test we removed the test well head and installed 100 pounds of N.L. BAROID HOLE PLUG. This product was allowed to settle to bottom for 48 hours. The drill string was tripped into the hole and the bottom was tagged at 886 feet. The drill pipe was removed following the huricane and the test well head was welded back in place and preliminary pressure testing was done with results indicating that the problem has been taken care of.
If there are any questions please call. (813)455-4024

Kevin R. Greuel
Youngquist Brothers

MSA MISSIMER & ASSOCIATES, INC.

Environmental and Groundwater Services

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September 4, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending September 3, 1992

Dear TAC Member:

We are now below 3000 feet in the injection well pilot hole. Lithology is dense dolomite and very fractured dense and sometimes vuggy dolomite. Drilling is slow and the fractured rock tends to fall in on top of the drill collars which requires pulling a few rods out and then dredging back down. No major caverns have been encountered as yet but I do believe this is the "Boulder Zone". Core No. 4 will undoubtedly be the last core and only about 2 feet of this core was recovered. It has been sent in for analysis.

Youngquist placed 100 pounds of N.L. Baroid Hole Plug in the 16-inch diameter casing in the monitor well (see letter dated 8-28-92 from Youngquist to me explaining their procedure). The pressure test for this casing is scheduled for noon today.

Sincerely,

Charles W. Walker
by: Cliff Harris

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Fred Bloetscher, Collier County Utilities

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September 4, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1

Dear TAC Member:

Construction specification 05040 COATING states "... the entire casing string shall be coated with an epoxy-polyamide coating..." Youngquist has requested that only the non-grouted portion plus 50 feet be coated. In this monitor well, about 1050 feet would be coated since the base of the upper monitor zone will be set at approximately 1000 feet.

I received verbal agreement to allow Youngquist this change from Vince Mele and Joe Haberfeld September 3, 1992.

Sincerely,

Charles W. Walker
by: Cliff Hoenisch

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Kevin Greuel, Youngquist Bros.

M&A MISSIMER & ASSOCIATES, INC.

Environmental and Groundwater Services

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Fax (813) 574-8106

September 9, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP MW

Dear TAC Member:

Technical specification 01020 OUTLINE SPECIFICATIONS OF WELLS, section C.12. states "Drilling will not proceed until the lower monitor zone had been determined from testing on IW-1 and approval obtained from TAC process". Youngquist requested that they be allowed to ream and drill the nominal 16-inch diameter hole prior to determining the lower monitor zone. The technical specification estimates the lower monitor zone will be set between 2200 and 2300 feet. I now believe it will be set somewhat higher than originally specified.

I suggested to Vince Mele and Joe Haberfeld that Youngquist be allowed to proceed to a depth not exceeding 1600 feet. Verbal agreement was received to do this on September 8, 1992.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Kevin Greuel, Youngquist Bros., Inc.

M&A MISSIMER & ASSOCIATES, INC.

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(813) 574-1919
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September 11, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending September 10, 1992

Dear TAC Member:

The pilot hole in the injection well was drilled to a total depth of 3380 feet. I estimate that we encountered the Cedar Keys Formation at about 3350 feet. The upper most "Boulder Zone" occurs at approximately 2670 feet and is composed of a highly fractured dolomite. Material from this zone constantly falls into the hole and tends to stick the drill string. Youngquist has made several trips from just above this zone to TD attempting to clean the hole. They have a very difficult time pulling the pipe due to the small diameter hole (12 1/4") and the large diameter drill collars (9"). At this point in time they are preparing to go back down to clean the hole. Hopefully, we will be able to log the well within the near future. I will forward field copies of these logs ASAP to you and then arrange a TAC meeting to determine final casing depth and lower monitor zone interval.

The 16-inch diameter casing pressure test in the monitor well was successful. They began reaming the nominal 16-inch diameter hole and are presently down to 1084 feet (see following letter).

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng
encls.

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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September 16, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1

Dear TAC Member:

As I stated in may September 11, 1992 weekly report letter, we were having problems keeping the pilot hole open below about 2700 feet. Continued efforts resulted in slight improvement and the hole tended to stay open above 2800 feet. Because of this problem, Youngquist requested that they run the geophysical logs and TV survey down to at least 2800 feet in this pilot hole. They would then repeat these operations in the reamed hole from the base of the 20-inch diameter casing down to an approximate depth of 3330 feet.

The general sequence of events would then be:

1. Clean hole to 2800 + feet.
2. Run geophysical logs and TV survey.
3. Conduct TAC meeting and select lower monitor zone and 20-inch casing seat.
4. Set bridge plug.
5. Ream hole to just below 20-inch casing seat.
6. Install 20-inch casing - run tests and logs.
7. Drill out bridge plug and ream hole to about 3330 feet.
8. Run geophysical logs from base of 20-inch casing to T.D.
9. Run TV survey from surface to T.D.

I agreed with the above procedure and presented it verbally to Vince Mele and Joe Haberfeld. They also agreed with the procedure and I then related this information to Youngquist by phone.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Kevin Greuel, Youngquist Bros., Inc.

M&A MISSIMER & ASSOCIATES, INC.

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September 16, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1

Dear TAC Member:

Enclosed are the geophysical logs of the injection well pilot hole down to a depth of 2840 feet. The accompanying letters explain why we did not log down to total depth of 3380 feet.

These logs, TV surveys (soon to be forwarded to you - I hope), core analyses, packer test data and lithologic data should be adequate to choose the 20-inch diameter casing seat and the lower monitor zone in the monitor well.

I am looking forward to meeting with you Wednesday, September 23, 1992.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng
encls.

M&A MISSIMER & ASSOCIATES, INC.

Environmental and Groundwater Services

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September 18, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending September 17, 1992

Dear TAC Member:

In the injection well pilot hole, we were able to obtain geophysical logs down to a depth of 2840 feet and a TV survey to 2668 feet. These data are now being evaluated in order to determine the optimum placement of the 20-inch diameter injection casing and the lower monitor zone. I will Fed Ex a copy of the TV survey this afternoon to each of you. My tentative pick for the base of the 20-inch diameter casing is around 2500 feet. I have tentatively chosen the lower monitor zone interval to be between 1820 to 1900 feet.

First evidence of the "Boulder Zone" was at about 2527 feet where the TV survey shows highly fractured blocks of dolomite. This phenomena becomes more frequent below the depth of approximately 2558 feet. Even through we do not yet have the geophysical logs and TV survey completed to total depth, I believe we will have a very good, well confined injection zone that will take most any volume of injectate that is pumped down the well.

Youngquist has begun reaming the nominal 30-inch diameter hole and is allowed to do so down to a depth of 2400 feet or TAC placement of the casing seat, whichever occurs first.

In the monitor well, the nominal 16-inch diameter hole was drilled to a depth of 1584 feet. Activity is now on hold until final decision is made on the placement of the lower monitor zone interval.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

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September 22, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfield, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Dir, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
TAC Meeting, September 23, 1992

We have analyzed all of the data gathered during the construction of both the injection well and the dual zone monitor well. These data include lithologic descriptions, geophysical logs, TV surveys, core analyses, single-packer drill-stem tests, geolograph records, water quality information and daily drilling records. We then utilized this information to select the lower monitor zone interval and to select the injection well final 20-inch diameter casing depth. A brief statement supporting our proposed casing set points is presented below. These points are:

Injection Well Final Casing - 2,492 feet below pad level (BPL)
Dual Zone Monitor Well Final Casing - 1,820 feet BPL
Dual Zone Monitor Well Deep Zone Open Hole - 1,820 to 1,900 feet (BPL)

The top of the Oldsmar Formation was chosen at about 2,020 feet BPL. This pick was based on the first occurrence of hard, dense dolomite below the Avon Park Formation and also on geophysical log character. The Boulder Zone within the Oldsmar is typically composed of highly fractured blocks of dolomite which have been subjected to significant solutional activity. The usually very high transmissivity of the Boulder Zone results from both fracture and solution derived permeability.

A small sector of Boulder Zone type material occurs at a depth of approximately 2,307 to 2,325 feet BPL. The major Boulder Zone within this well begins at about 2,570 feet and continues to a depth of approximately 3,330 feet, resulting in this zone being 760 feet thick. It is desired that the entire 760 feet be utilized for the injection zone. This then requires that the final injection casing seat be placed at the first suitable location above 2,570 feet BPL.

In determining this casing seat, the BHC Sonic-VDL log, X-Y Caliper log, lithologic log and the TV scan were carefully examined. Based on the above analysis the first suitable point occurs at a depth of 2,492 feet BPL. This level consists of interbedded layers of limestone and dolomite with both rock types having a fairly dense matrix. Small cavities were observed at 2,488, 2,491 and 2,504 feet and some fracturing between 2,487 and 2,490 feet. We propose that the pilot hole be reamed to a depth of 2,500 feet, the casing placed to 2,492 feet which would leave 8 feet of overdrill.

An evaluation of the degree of confinement above 2,492 feet was conducted using both qualitative and quantitative data. Lithologic descriptions provide a means to determine rock matrix properties as well as other phenomena such a fracture and solution surface features. The television survey provided rock matrix, fracture and solution features as well as their relationship to each other. The BHC Sonic-VDL log is a very useful tool in confinement qualitative analysis. Core laboratory analyses and single-packer drill-stem tests provide quantitative data.

Lithologic logs, TV scans, and geophysical logs have been previously provided. Listed in Table 1 are my observations of the TV scans. I would like to point out that when I refer to "porous or dense", I am only describing the rock matrix and not the rock's capacity to store or transmit fluids through solution or fracture features. Core data and packer tests were also previously provided.

Based on the qualitative and quantitative information available, I have attempted to semi-quantitatively categorize the various intervals from total depth up to 1,310 feet. The degree of confinement is listed as:

Poor = Vertical permeability greater than 100 md
Moderate = Vertical permeability between 5 and 99 md
Good = Vertical permeability less than 5 md

TABLE 1.

M&A MISSIMER & ASSOCIATES, INC.
Environmental and Groundwater Services

COLLIER COUNTY
NCRWTP INJECTION WELL
TELEVISION SURVEY OF PILOT HOLE FROM
1310 TO 2668 FEET BELOW LAND SURFACE

The following comments relate to observations of the TV scans conducted in the borehole September 15-17, 1992. These comments are very general and are not quantitative in any sense. However, they may be useful as an aid in interpretation of the lithologic and geophysical logs of this interval.

DEPTH (ft)	COMMENTS
1310 - 1385	Water very murky - no observations.
1385 - 1400	Porous
1400 - 1405	Dense
1405 - 1410	Porous
1410 - 1440	Dense, high angle fracture 1021 to 1025 feet.
1440 - 1443	Porous
1443 - 1659	Dense, small cavernous zones at 1500, 1520, 1561, 1630 and 1655.
1659 - 1661	Porous
1661 - 1674	Dense
1674 - 1678	Porous - small cavities present.
1678 - 1718	Dense
1718 - 1719	Small cavities present.
1719 - 1729	Dense
1729 - 1731	Porous
1731 - 1736	Small cavities present.
1736 - 1744	Dense
1744 - 1754	Porous
1754 - 1755	Dense
1755 - 1776	Porous - cavities observed at 1762, 1765 and 1774.
1776 - 1782	Dense

COLLIER COUNTY
NCRWTP INJECTION WELL
TELEVISION SURVEY OF PILOT HOLE FROM
1310 TO 2668 FEET BELOW LAND SURFACE
Continued:

DEPTH (ft)	COMMENTS
1782 - 1792	Dense with small cavities.
1792 - 1805	Porous with small cavities.
1805 - 1830	Dense with small cavities.
1830 - 1848	Porous, cavity at 1835.
1848 - 1868	Dense, small cavities between 1856 and 1860.
1868 - 1906	Porous, cavities between 1885-1892 and 1896-1906.
1906 - 1908	Dense
1908 - 1920	Porous
1920 - 1922	Dense
1922 - 1933	Porous, small cavity at 1927.
1933 - 1956	Dense, small cavities at 1942, 1951-1952 and 1955.
1956 - 1966	Porous, small cavities at 1961 to 1965.
1966 - 1973	Porous
1973 - 1981	Dense
1981 - 1983	Porous
1983 - 2004	Dense, small cavities at 1196 and 2003.
2004 - 2007	Porous
2007 - 2013	Dense
2013 - 2016	Porous to dense, small fractures.
2016 - 2022	Dense
2022 - 2028	Porous
2028 - 2029	Dense

COLLIER COUNTY
NCRWTP INJECTION WELL
TELEVISION SURVEY OF PILOT HOLE FROM
1310 TO 2668 FEET BELOW LAND SURFACE
Continued:

DEPTH (ft)	COMMENTS
2029 - 2068	Porous, few small fractures.
2068 - 2088	Dense, few small cavities.
2088 - 2121	Dense, cavity at 2105.
2121 - 2141	Porous, small cavities between 2130 and 2140.
2141 - 2151	Dense
2151 - 2158	Porous, small cavity at 2152.
2158 - 2164	Dense
2164 - 2168	Small cavernous zone.
2168 - 2220	Dense, cavity at 2174.
2220 - 2225	Dense, hard nodules (dolomite ?) present.
2225 - 2233	Dense, vertical fractures between 2234 and 2235.
2233 - 2244	Dense, small cavities present.
2244 - 2266	Dense, small cavity at 2258.
2266 - 2283	Small cavernous zone.
2283 - 2295	Dense
2295 - 2301	Cavernous, medium size.
2301 - 2307	Dense
2307 - 2325	Cavernous with large blocks.
2325 - 2330	Porous and cavernous.
2330 - 2342	Dense, small cavity at 2338.
2342 - 2346	Porous with small cavities.
2346 - 2350	Dense
2350 - 2357	Porous and cavernous.

COLLIER COUNTY
NCRWTP INJECTION WELL
TELEVISION SURVEY OF PILOT HOLE FROM
1310 TO 2668 FEET BELOW LAND SURFACE
Continued:

DEPTH (ft)	COMMENTS
2357 - 2366	Dense
2366 - 2371	Porous, small cavities present.
2371 - 2380	Dense, cavities at 2376 and 2378.
2380 - 2391	Porous, fairly large cavity 2385 to 2388.
2391 - 2398	Dense, cavities at 2395 and 2397.
2398 - 2400	Porous
2400 - 2406	Dense, few cavities present.
2406 - 2414	Porous and cavernous.
2414 - 2431	Dense, small cavities 2419, 2412 and 2430.
2431 - 2439	Porous and cavernous.
2439 - 2440	Dense
2440 - 2461	Porous and cavernous, fractures at 2445 and 2452.
2461 - 2474	Dense, cavities and fractures present.
2474 - 2478	Dense
2478 - 2499	Dense, cavities at 2488 and 2491, fractures between 2487 and 2490.
2499 - 2516	Porous, cavities at 2504, 2507, 2511, 2515 and 2516.
2516 - 2668	Dense, cavities at 2544 to 2545, fracture at 2547, cavities at 2552 and 2555, fractures and blocky at 2558 to 2562 and 2564 to 2612, fractured at 2612 to 2625 cavernous and fractures between 2626 and 2635, fractures and blocky between 2635 and 2643, fractured at 2643 to 2645, large blocks and fractures between 2645 and 2668.

TABLE 2

SEMI-QUANTITATIVE DESCRIPTION OF CONFINEMENT

DEPTH (ft)	DEGREE	THICKNESS (ft)
1,310-1,350	Poor	40
1,350-1,420	Moderate	70
1,420-1,440	Poor	20
1,440-1,770	Moderate	330
1,770-1,930	Poor	160
1,930-2,020	Moderate	90
2,020-2,290	Good	270
2,290-2,330	Poor	40
2,330-2,550	Good	220
2,550-TD	"Boulder Zone"	780

Adding the thickness of each degree of confinement above the Boulder Zone to 1,310 feet results in:

Poor Confinement = 260 feet
Moderate Confinement = 490 feet
Good Confinement = 490 feet

We propose the lower monitor zone in the dual completion monitor well be placed between 1,820 to 1,900 feet BPL. The degrees of confinement between the proposed base of the final injection casing and the lower monitor zone can be described as,70 feet as poor, 90 feet as moderate and 432 feet as good confinement.

Additionally, this proposed lower monitor interval is the first somewhat porous zone above the final injection casing. It is believed that the interval will yield a sufficient amount of water to enable water quality sampling. Lower zones would be difficult to obtain adequate water quantity.

I hope I have not confused the issues with my above thoughts.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:jmh

pc: Fred Bloetscher, Collier County Utilities
Kevin Greuel, Youngquist Bros., Inc.

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September 25, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending September 24, 1992

Dear TAC Member:

The TAC meeting was held in the Fort Myers FDER office on September 23, 1992. Attending this meeting were Joe Haberfeld, Jack Myers and Richard Orth of the FDER, Dan Duerr with USGS and Charles "Buzz" Walker, Kirk Martin and Jack Breland of Missimer & Associates. The major topics discussed were; 1) placement of the 20-inch diameter injection casing, 2) placement of the lower monitor zone interval and 3) adequacy of confinement above the injection zone. I had written a letter just prior to the meeting in which I presented my thoughts regarding the three major topics. This letter was given out at the meeting and is also included in this report.

Following what I believe to be a very productive discussion between the group, decisions were made by the TAC regarding casing set points, monitor zone intervals and confinement above the injection zone. The general consensus of opinion, in brief, is presented below:

Injection well final casing - 2,492 feet below pad level (BPL)
Injection well packer assembly - about 2450 feet BPL
Dual zone monitor well final casing - 1820 feet BPL
Dual zone monitor well deep zone open hole - 1820 to 1930 feet BPL
Dual zone monitor well shallow zone open hole - 900 to 950 - 1000 feet BPL
Injection well to be reamed to 3330 feet BPL
Adequate confinement appears to exist between injection zone and base of USDW.

Youngquist has begun drilling in the monitor well the nominal 16-inch diameter hole down to 1820 feet BPL and are presently at about 1600 feet BPL. Only a day shift crew is working on this rig at this time.

Reaming operations continue in the injection well at an average rate of 15 minutes per foot. Presently, they have reamed past 2300 feet BPL.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW: gng

pc: Fred Bloetscher, Collier County Utilities

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October 2, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending October 1, 1992

Dear TAC Member:

Most of this past week was spent running the 20-inch diameter casing in the injection well. Early this morning they reached the target depth of 2,492 feet BPL with this casing. Youngquist x-rayed all suspect welds and rewelded those areas that required it prior to lowering the casing into the hole. They will now set a packer near the base of the casing and perform a pressure test. Upon successful completion of this test, they will begin Stage 1 grouting operations.

Reaming and drilling the nominal 16-inch diameter hole in the monitor well has been completed to a depth of 1825 feet BPL. Youngquist is now preparing the borehole for geophysical logging and casing setting.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:ec

pc: Fred Bloetscher, Collier County Utilities

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October 9, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending October 8, 1992

Dear TAC Member:

The 20-inch diameter casing in the injection well has been grouted in and was pressure tested yesterday. The final pressure test did not exceed the 5% drop in pressure over the sixty minute period that is allowed. Youngquist began reaming operations following the test and are presently at 2530 feet.

Grouting the 6 5/8-inch diameter final casing was completed yesterday in the monitor well. The casing seat is at 1815 feet and they brought the cement up to 995 feet. A nominal 6-inch diameter hole will be drilled to a depth of 1930 feet resulting in 115 feet of open hole for the lower monitor zone. The upper zone is from 900 feet to 995 feet.

I am enclosing the geophysical logs that were run since the TAC meeting of September 23, 1992.

These logs are:

LOG DATE	LOG TIME	LOGGED INTERVAL (feet)	COMMENTS
MONITORING WELL CO-2318			
10/04/92	Caliper & Gamma Ray	880-1827	Prior to 6 5/8" Casing Installation
10/04/92	Flowmeter	890-1820	Pumping 18 gpm
10/04/92	Temperature	850-1827	Pumping 18 gpm
INJECTION WELL CO-2317			
09/28/92	Caliper & Gamma Ray	1300-2502	Prior to 20" Casing Installation
10/03/92 to 10/06/92	Temperature	0-2485	Grouting 20" Casing
10/06/92	Sonic Bond	50-2475	20" Casing

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

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October 16, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending October 15, 1992

Dear TAC Member:

Most of this past week was spent reaming and dredging the nominal 20-inch diameter hole in the injection well. The zone at about 2700 feet BPL continues to be a problem. Numerous truck loads of fill from this zone have been removed off site. Yesterday evening Youngquist tripped out of the hole to check the bit after reaming to 2792 feet. They then tripped back in and are presently at 2672 feet and hopefully will get past 2700 feet without too much trouble.

The pressure test of the 6 5/8-inch diameter casing was successful in the monitor well. Youngquist then began drilling the nominal 6-inch diameter lower monitor zone down to 1930 feet. Presently they are pumping this zone and will soon disinfect the well. The upper monitor zone is being air developed and it will also be disinfected. After disinfection of both zones they will again develop the zones and then have the water collected for quality analyses. The monitor well drill rig has been removed from the drill pad.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

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October 23, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfield, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending October 22, 1992

Dear TAC Member:

Presently, the injection well has been reamed to a depth of 3330 feet BPL. Youngquist plans to ream an additional 10 feet this morning for the final TD of 3340 feet. They will then circulate for a period of time and then collect water quality samples late this afternoon. This will be followed by a wiper trip through the Boulder Zone and if this is successful they will trip out of the hole. The entire well will then be geophysically logged and the TV survey will be conducted.

Both the upper and lower zones in the monitor well were developed; the upper zone by air surging and the lower zone by pumping. Following disinfection and developing, both zones were sampled for water quality analyses. Another step drawdown test of the lower zone was conducted on 10/18/92 following disinfection. A slight improvement in specific capacity was noted, that being from 0.077 to 0.093 at 10 gpm. At this rate, it takes approximately 14 hours to purge 3 casing volumes. The upper monitor zone was producing about 300 gpm during development.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:jmh

pc: Fred Bloetscher, Collier County Utilities

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November 2, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfield, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending October 30, 1992

Dear TAC Member:

The monitor well is now complete and all water quality samples have been obtained and sent in for analyses. The concrete pad surrounding the well has been removed. We will plug and abandon the four perimeter monitor wells upon approval.

In the injection well, water samples were collected from the injection zone and are being sent to the appropriate agencies. Geophysical logs were run to total depth (3340 feet) and the TV survey was conducted down to depth of 2850 feet where the water became to murky to see anything. A casing scraping operation was then done followed by setting the TIW packer at a depth of 2445 feet. Presently, the are now installing the 10-inch diameter tubing and have about 1200 feet of it in the hole. I estimate this task should be completed by Monday.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:jmh

pc: Fred Bloetscher, Collier County Utilities

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November 3, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfield, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1

Dear TAC Member:

I am submitting the final set of geophysical logs for both the monitor and injection wells. These logs are:

MONITOR WELL CO-2318			
Log Date	Log Type	Logged Interval	Comments
10/7/92 to 10/9/92	Temperature	800 - 1760	5 stages
10/9/92	Sonic Bond	850 - 1755	
10/15/92	Caliper and Gamma Ray	1800 - 1926	
10/15/92	Temperature	1700 - 1926	Pumping 2 gpm
10/15/92	Flowmeter	1750 - 1926	Pumping 2 gpm
INJECTION WELL CO-2317			
10/3/92 to 10/6/92	Temperature	0 - 2485	4 stages
10/6/92	Sonic Bond	50 - 2475	20" Casing
10/24/92	Temperature	2450 - 3342	Pumping 25 gpm

INJECTION WELL CO-2317 (cont)			
Log Date	Log Type	Logged Interval	Comments
10/24/92	Flowmeter	2450 - 3340	Pumping 25 gpm
10/24/92	Caliper and Gamma Ray	2450 - 3342	Injection Zone
10/24/92	BHC Sonic	2480 - 3342	Injection Zone
10/24/92	Dual Induction, SP and Gamma	2490 - 3342	Injection zone

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:jmh

pc: Fred Bloetscher, Collier County Utilities

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November 6, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending November 5, 1992

Dear TAC Member:

Construction of the injection well is now almost completed. The 16-inch diameter tubing and packer assembly was installed early in the week. Then the annulus between the 20-inch diameter casing and 16-inch diameter injection tubing was filled with Baracor 100. A pressure test was conducted on the annulus by pressuring up to 160 psi. There was no loss of pressure in the one hour test. The wellhead is now complete.

The raw water line to the new NCRWTP is way behind schedule. This water was supposed to be the source water for the injection test. An alternative water source, a potable water main about a half-mile from the well, is now being considered. It will require temporary plumbing to the well with substantial additional costs to the county. However, it is believed that conducting this injection test with the drill rig still on site would save a large sum of money should problems evolve.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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November 13, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending November 12, 1992

Dear TAC Member:

There was no contractor activity at the NCRWTP site this past week. The water supply for the injection test has yet to be determined. I am trying to help coordinate the effort to obtain an alternative water source but do not seem to be making much headway. Hopefully, progress relating to this matter can be realized next week.

Our site geologists are preparing drill cuttings for distribution. We have moved most of our office equipment off-site.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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November 20, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfield, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending November 19, 1992

Dear TAC Member:

We still have not yet resolved the water supply problem. Presently, negotiations are under way between Collier County and Youngquist Bros. to install a temporary pipeline to the injection well.

There has been no activity at the site this past week. No personnel from either Youngquist Bros. or Missimer & Associates were present at the site during this past week.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:jmh

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

Environmental and Groundwater Services

Post Office Box 151306
Cape Coral, Florida 33915-1306

428 Pine Island Road, S.W.
Cape Coral, Florida 33991

(813) 574-1919
Fax (813) 574-8106

December 1, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending November 26, 1992

Dear TAC Member:

Similar to last weeks report, the water supply issue has not been resolved. A meeting is to be held Tuesday, December 1, 1992 between Youngquist and Collier County to see if this problem can be overcome.

I am enclosing a copy of our observations of the TV scans of the open borehole. The videos will be sent to you soon.

This weekly report is late due to the Holidays and the lack of information to give you.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

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December 4, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending December 3, 1992

Dear TAC Member:

Once again there is really nothing to report of any substance. A meeting was held last Tuesday with Youngquist, Collier County, Missimer & Associates and attorney's present. The topic of temporary water for the injection test was discussed but no agreement was reached.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:lk

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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December 11, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending December 10, 1992

Dear TAC Member:

Once again, I really have nothing to report. I am still trying to get agreement on the temporary water issue.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

M&A MISSIMER & ASSOCIATES, INC.

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December 18, 1992

Mr. Vince Mele, FDER
Mr. Joe Haberfield, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending December 17, 1992

Dear TAC Member:

It was learned last week that the FDER injection zone water sample was spilled during shipment in early November. The shipper informed the contractor of this mishap but for some unknown reason the well was not resampled. I discussed this situation with Vince Mele and he later told me that this sample still needs to be taken. The contractor, Youngquist Bros., Inc., was then notified in writing that they will be required to obtain the sample prior to conducting the injection test. I have not yet been told when they plan to collect the sample.

The water source for the injection test is still not definite. Negotiation between Youngquist and Collier County to install a temporary water line continues.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:jmh

pc: Fred Bloetscher, Collier County Utilities

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January 5, 1993

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending December 31, 1992

Dear TAC Member:

This letter is being sent a week late due to the holidays and the fact that nothing has been accomplished in providing a temporary water source for the injection test.

Your next report from me will be immediately after I have some noteworthy information to pass on to you.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

ViroGroup
Air • Water • Soil
TECHNOLOGY

Missimer Division
ViroGroup, Inc.
428 Pine Island Road, S.W.
Cape Coral, FL 33991
Phone 813-574-1919
FAX 813-574-8106

January 29, 1993

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

RE: Permit No. UC11-198432 Collier County NCRWTP-IW-1

Dear TAC Member:

I believe this project has finally "gotten off of dead center". The Collier County Commissioners this last Tuesday approved the change order allowing Youngquist to install a temporary pipeline to provide water for the injection test. This line will run from an existing potable water main located a little over half a mile from the job site to the injection well. I estimate it will take about 3 weeks to obtain and install the pipe. Notification of the pending injection test will be given as soon as I find out the date. The RATS will follow immediately after the injection test.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

ViroGroup
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TECHNOLOGY

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FAX 813-574-8106

March 5, 1993

Mr. Vince Mele, FDER
Mr. Joe Haberfeld, FDER
Mr. Larry Myer, USEPA
Mr. Steve Anderson, SFWMD
Mr. Dan Duerr, USGS

Re: Permit No. UC11-198432 Collier County NCRWTP IW-1
Weekly Report Ending March 4, 1993

Dear TAC Member:

We have finally completed the testing of IW-1. The drilling contractor, Youngquist Bros., Inc., installed a temporary pipeline from an existing potable water main to the injection well in mid February, 1993. Instruments and gauges were installed in the injection and monitor wells and a 24 hour background data event initiated. This was followed by 24 hours of injection at the average rate of approximately 4340 gpm for a total of 6,248,370 gallons injected. Twelve hours of recovery following the injection test.

The radioactive tracer survey was conducted the following day and was witnessed by Joe Haberfeld and Vince Mele of the FDER. No problems were evident relating to the mechanical intrgraty of IW-1.

The construction summary and our daily logs during this past test period are enclosed. We are presently reducing the raw data from the tests and will forward this information at a later date.

Sincerely,

Charles W. Walker

Charles W. Walker, Ph.D., P.G.
Senior Hydrogeologist

CWW:gng

pc: Fred Bloetscher, Collier County Utilities

FLORIDA
GEOPHYSICAL LOGGING, INC.

21 March, 1993

Mr. H. Cliff Harrison, Hydrogeologist
Missimer Division, ViroGroup, Inc.
428 Pine Island Road, S.W.
Cape Coral, FL 33991

Dear Cliff:

It is my pleasure to assist you in regards to the questions you have about the anomalous patterns/features on the NCR wells in Collier County. The following are answers to (or attempts to answer) your questions as expressed in a letter dated 18 March and our phone conversation the following day:

1) No; we closed the valve to the annulus and then pressured up our wellet, with the pressure transducer in it, to 500 psi (in an attempt to seat our packoff rubber).

2) I have no clue why they fluctuated with exact opposite patterns! You asked if perhaps we calibrated or setup the transducer opposite of each other? No, we setup and calibrated them exactly the same. I am not sure I have a good mental picture of this wells design. At what depths are of the zones set?

3) I do not understand why the tidal cycles are nearly instantaneous on the monitor wells either.

4) The negative spikes on the wellhead pressure transducer correlate directly to filling up the annulus periodically. The water source for the pressure washer used to fill the annulus came off the wellhead wellet.

Cliff, if you have any further questions, beep me at 1-800-241-4653 PIN 2751229, and I'll get back to you as soon as possible. Thank you.

Sincerely,

Steve R. Miller

Steve Miller
Operations Manager

15465 PINE RIDGE ROAD • FORT MYERS, FLORIDA 33908 • (813) 489-0044 • FAX (813) 489-0288

FLORIDA
GEOPHYSICAL LOGGING, INC.

June 13, 1993

Mr. H. Cliff Harrison, Hydrogeologist
Missimer Division, ViroGroup, Inc.
428 Pine Island Road, S.W.
Cape Coral, FL 33991

RE: Pressure Anomalies -- Monitor Zones and Well Head

Dear Cliff:

In March, shortly after you brought to my attention the anomalies on the Monitor Wells' pressure profile from NCR Water Treatment Plant, I FAXed your plotted data to Instrumentation NorthWest, my vendor for the rented pressure transducer equipment. I was essentially ignored as I never got to talk to "the right people" and "they" never returned my calls.

Again in May, I FAXed your plots to INW as they had lost the first set. With the help of a sincerely concerned Sales Representative, Keith McManus, I was put in touch with their technical support group. Brian Shea agreed with our assessment that the curves did not look natural with the sharp jumps in the data. We reviewed how Florida Geophysical Logging, Inc. had setup the transducers and recording systems; in his assessment, their was nothing obviously wrong with our procedure. He started in on how the anomalies might have been due to mechanical stickege on the transducers themselves. A problem had been admitted.

I expressed to him how I doubted mechanical stickage was a viable explanation as all three transducer being monitored (1. upper monitor zone; 2. lower monitor zone; 3. well head pressure) were displaying breaks at the same time. The breaks are obvious in the upper and lower monitor zones, because of scale resolution, but the breaks can also be seen on the the transducer monitoring well head pressure on the Injection Well itself. I reminded him that the only reasonable link these three had was their shared recording device. He neither agreed or disagreed with my assessment.

Cliff, if you have any further questions, beep me at 1-800-241-4653 PIN 2751229, and I'll get back to you as soon as possible. Thank you.

Sincerely,

Steve Miller

Steve Miller
Operations Manager

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Geological, Environmental and Oceanographic Sciences, Inc.

5909A Breckenridge Parkway
Tampa, Florida 33610
(813) 626-0101
(813) 626-0746 Fax

Water
Soil
Air
Analysis and Consulting

Geos Inc.

July 30, 1993

Dr. Buzz Walker
EnviroGroup
Missimer & Associates Division
428 Pine Island Road SW
Cape Coral, FL 33991

Re: Injection Well Analysis for Youngquist Brothers

Dear Dr. Walker,

Geos performed a series of analyses on a water sample from an injection well in October 1993 (Geos Lab ID #10-264).

The analyses included, among other parameters, primary and secondary drinking water standards. Through a miscommunication at the laboratory, the radionuclides analyses were not performed on this sample.

Geos no longer has this sample in storage and cannot run the radionuclides. We apologize for the inconvenience this has caused you.

Sincerely,
GEOS, INC.

Meredith G. Mangan
Director of Operations

APPENDIX C

Injection Well Geologist's Log
Monitoring Well Geologist's Log
Rock Core Analyses

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
0-10	Limestone (40%), yellowish-gray (5Y 7/2) sandy biomicrite, hard, good porosity, and sand (30%), medium to very fine grained quartz, unconsolidated with common shell fragments (30%).
10-16	Limestone (80%), light olive-gray to yellowish-gray (5Y 6-8/1) biomicrite, moderately hard, sandy, good porosity, with common shell fragments (20%).
16-24	Limestone (100%), light olive-gray (5Y 6/1) biomicrite, moderately hard, good porosity.
24-28	Limestone (100%), medium light gray (N6), soft, marly, low to moderate porosity.
28-33	Marl (50%), medium light gray, soft, abundant shells (30%) and sand (20%), fine to very fine grained, loosely consolidated to unconsolidated.
33-39	Limestone (50%), light olive-gray (5Y 6/1) biomicrite, firm, sandy, excellent porosity, with very abundant shells (40%), and soft, medium light gray marl (10%).
39-45	Limestone (60%), light olive-gray micrite, marly, good porosity, and yellowish-gray biomicrite, sandy, friable, excellent porosity, with very abundant shells (35%) and light gray marl (5%).
45-55	Limestone (70%), yellowish-gray (5Y 8/10) biomicrite, moderately firm, sandy, excellent porosity, with abundant shells (25%) and sandstone (5%), light olive-gray, soft, consolidated with calcite cement, good porosity.
55-65	Limestone (70%), as above, with shells (20%) and light gray (N7) soft, marl (10%).
65-70	Limestone (70%), yellowish-gray (5Y 7/2) micrite, sandy, soft, friable, marly, fossiliferous, good porosity, and shells (30%).
70-80	Limestone (50%), light olive-gray (5Y 6/1) micrite, sandy, soft, friable, good porosity, and limestone (30%) light olive- gray biomicrite, sandy, firm, excellent porosity, and shells (20%).

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
80-90	Marl (50%), light gray (N7), soft, sandy, moderate porosity limestone (30%) as above, and shells (20%).
90-100	Limestone (80%), yellowish-gray (5Y 8/1) biomicrite, sandy, moderately hard, good porosity, trace of phosphate, and shells (20%).
100-105	Limestone (70%), yellowish-gray biomicrite, firm, sandy, marly, trace of phosphate; and shells (30%).
105-120	Limestone (85%), yellowish-gray (5Y 8/1) to light gray (N7), medium hard, biomicritic, sucrosic texture, with minor phosphate; shell fragments (15%).
120-140	Limestone (80%), white (N9) to very light gray (N8), medium soft to medium hard, micritic, sucrosic texture; common shell fragments (15%), with trace of fine grained phosphate (5%).
140-160	Limestone (60%), yellowish-gray (5Y 8/1), as above, with interbedded soft sandstone (25%), in a calcareous matrix (15%).
160-170	Sandstone (65%), very fine to fine grained, well sorted, rounded, medium hard, calcarious matrix (20%), common shell fragments (10%) and phosphatic grains (5%).
170-200	Limestone (90%), medium bluish-gray (5B 5/1) to light gray (N7), sandy (60% fine grained, well sorted, rounded quartz), medium hard, with minor shell and sparite fragments (10%), and trace of very fine grained phosphate.
200-210	Sandstone (50%), multicolored, medium hard, fine grained quartz, well sorted, with carbonate matrix (30%); with common shell fragments (20%), and trace of very fine grained phosphate.
210-230	Sandstone (60%), very light gray (5Y 8/1) to light gray (N7), as above, with increased shell content (40%).
230-240	Limestone (50%), light grey (N7), sandy, medium hard, with 20% medium grained, well rounded phosphate and 30% shell fragments.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
240-250	Limestone (70%), yellowish-gray (5Y 8/1), sandy as above, with common shell fragments (20%) and phosphate (10%).
250-280	Limestone (50%) as above; and marl (50%), light gray (N7), soft.
280-310	Marl (100%), greenish-gray (5GY 6/1), soft, with trace of sandy limestone.
310-320	Limestone (50%), yellowish-gray (5Y 7/2) micrite, moderately hard, phosphatic, good porosity; and marl (50%), medium light gray, soft, with trace of quartz sand and phosphate.
320-330	Marl (50%), medium light gray, soft, fossiliferous, low porosity, and clay (50%), olive-gray (5Y 4/1), soft, low porosity.
330-340	Clay (100%), olive-gray, soft, low porosity, trace of phosphate.
340-350	Clay (100%), dark greenish-gray (5GY 4/1), soft to firm, low porosity.
350-360	Clay (100%), olive-gray (5Y 4/1), soft, low porosity, trace of phosphate.
360-370	Clay (98%), olive-gray, soft, low porosity, and phosphate (2%).
370-380	Clay (100%), olive-gray, soft, phosphatic, low porosity, with trace of fossils.
380-390	Clay (97%), olive-gray, soft, low porosity, and phosphate (3%).
390-400	Clay (80%), olive-gray (5Y 4/1), soft to moderately firm, finely phosphatic; and limestone (20%), white (N9), hard, micritic, phosphatic.
400-410	Limestone (80%), white (N9) biomicrite, hard, microcrystalline, excellent moldic porosity; and clay (20%), as above.
410-430	Limestone (100%), white (N9), biomicritic, hard, very good moldic porosity, although molds commonly infilled with sandy (70%) and phosphatic (30%) limestone, white (N9).

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
430-440	No samples obtained, circulation system plugged up.
440-450	Limestone (100%), yellowish-gray (5Y 8/1), biomicritic, hard, excellent moldic porosity.
450-460	Limestone (100%), yellowish-gray (5Y 8/1) biomicrite, hard, phosphatic, very good moldic porosity.
460-510	Limestone (100%), yellowish-gray (5Y 8/1) biomicrite, moderately hard to hard, phosphatic, fossiliferous, moldic porosity.
510-550	Limestone (75%), as above; and marl (25%), yellowish- gray (5Y 8/1), very soft, phosphatic.
550-570	Dolomite (100%), pale yellowish-brown (10YR 6/2), very hard, cryptocrystalline, excellent secondary porosity.
570-590	Limestone (100%), white (N9) micrite, moderately hard, phosphatic, fossiliferous.
590-600	Limestone (90%), yellowish-gray (5Y 8/1) micrite, hard, phosphatic; and lime mud (10%), white (N9), very soft.
600-610	Clay (90%), olive-gray (5Y 4/1), very soft, highly phosphatic; and limestone (10%), white (N9), micritic, moderately hard, phosphatic.
610-620	Clay (95%), grayish-olive (10Y 4/2), soft, phosphatic, cohesive; limestone (5%), as above.
620-630	Dolomite (60%), light olive-gray (5Y 5/2), moderately hard, sucrosic texture, excellent secondary porosity, phosphatic to very coarse size; and limestone (40%), very light gray (N8) biomicrite, firm, phosphatic, good porosity.
630-640	Dolomite (70%), as above; limestone (20%), as above; and marl (10%), soft, phosphatic, low porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
640-650	Limestone (60%), yellowish-gray (5Y 7/2) bryozoan biomicrudite, soft, moderate porosity; marl (30%), yellowish-gray, soft, low porosity; and clay (10%), olive- gray (5Y 4/1), soft, phosphatic, low porosity.
650-660	Limestone (90%) as above; and clay (10%) as above.
660-670	Marl (70%), yellowish-gray (5Y 8/1), soft, phosphatic, low porosity; limestone (30%), yellowish-gray biomicrite, soft, moderate porosity; and clay (10%), olive-gray, soft, finely phosphatic, low porosity.
670-680	Marl (80%) as above; and limestone (20%) as above.
680-690	Marl (70%), light olive-gray to yellowish-gray, soft to firm, low to moderate porosity; and limestone (30%), yellowish- gray biomicrite, firm, good porosity.
690-700	Clay (50%), light olive-gray, soft, low porosity; marl (30%), white (N9), soft, low porosity; and limestone (20%), yellowish-gray biomicrite, firm, good porosity.
700-710	Clay (50%), olive-gray, soft, low porosity; and dolomite (50%), light olive-gray, moderately soft, moderate porosity.
710-720	Dolomite (80%), as above, ranging to light brownish-gray (5YR 6/1), phosphatic; and limestone (20%), yellowish- gray biomicrite, firm, phosphatic, good porosity.
720-730	Limestone (70%), pinkish-gray biomicrite, firm, phosphatic, good moldic porosity; and dolomite (30%) as above.
730-740	Limestone (80%), white (N9) lime mud, soft, finely phosphatic, low porosity, and biomicrite as above; and dolomite (20%), dark yellowish-brown (10YR 4/2), sucrosic texture, good porosity.
740-760	Dolomite (100%), dark yellowish-brown (10YR 4/2) and pale yellowish-brown (10YR 6/2), very hard, microcrystalline and cryptocrystalline, very good moldic porosity.

Contined:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
760-770	Dolomite (100%), light olive-gray (5Y 5/2), very hard, cryptocrystalline, excellent moldic porosity.
770-780	Dolomite (100%), yellowish-gray (5Y 7/2), very hard, cryptocrystalline, conchoidal fracture, low to moderate moldic porosity.
780-790	Dolomite (100%), light olive-gray (5Y 5/2), very hard, crystalline texture, low porosity.
790-800	Dolomite (100%), light olive-gray to dark yellowish-brown (10YR 4/2), very hard, cryptocrystalline, conchoidal fracture, some small fractures evident in cuttings.
800-810	Dolomite (100%), light olive-gray, hard, finely phosphatic, variable porosity.
810-820	Dolomite (70%), pale yellowish-brown (10YR 6/2), hard, finely phosphatic; and marl (30%), medium light gray (N6), soft, low porosity.
820-830	Marl (70%), yellowish-gray (5Y 7/2), soft, low porosity; limestone (20%), yellowish-gray biomicrite, soft, marly, good intergranular porosity; and clay (10%), medium light gray, soft, low porosity.
830-840	Limestone (70%), yellowish-gray (5Y 8/1) micrite, firm, sandy, good intergranular porosity; and marl (30%) as above.
840-850	Limestone (80%), as above, and very pale orange (10YR 8/2) foraminifera biomicrite, firm, calcarenite texture, excellent porosity; and marl (20%), yellowish-gray, soft, low porosity.
850-860	Limestone (100%), very pale orange biomicrite as above, and medium light gray (N6) biomicrite, hard, good moldic porosity.
860-870	Limestone (100%), light gray (N7) foraminifera biomicrite, firm, calcarenitic texture, excellent intergranular and moldic porosity.
870-880	Limestone (100%), yellowish-gray biomicrite, firm, calcarenite texture, excellent porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
880-890	Marl (70%), very light gray (N8) soft lime mud, low porosity; and limestone (30%) as above.
890-900	Limestone (90%), yellowish-gray to light gray (N7) biomicrite, soft to firm, friable, excellent intergranular porosity; and marl (10%) as above.
900-910	Limestone (80%), yellowish-gray biomicrite, firm but friable, good porosity; and clay (20%), medium gray (N5), soft, low porosity.
910-930	Limestone (70%), as above but with increased porosity; marl (20%), yellowish-gray, soft lime mud; and clay (10%) as above.
930-940	Limestone (60%), very pale orange (10YR 8/2) micrite, firm but friable, calcarenite texture, good to excellent porosity; and marl (40%), yellowish-gray (5Y 7/2), soft, low porosity.
940-950	Limestone (70%), yellowish-gray micrite, good intergranular and moldic porosity; marl (25%) as above; and dolomite (5%), pale yellowish-brown, hard, low porosity.
950-960	Limestone (95%), yellowish-gray (5Y 7/2) biopelmicrite, firm but friable, calcarenite texture, good to excellent porosity; and dolomite (5%) as above.
960-970	Limestone (100%), very pale orange (10YR 8/2), very soft, calcarenitic, friable, fossiliferous, slightly moldic.
970-980	Limestone (100%), pinkish-gray (5YR 8/1) to very pale orange (10YR 8/2), moderately soft, calcarenitic, fossiliferous, slightly moldic.
980-990	Limestone (100%), very light gray (N8), moderately soft, calcarenitic, fossiliferous, moderately moldic.
990-1000	Limestone (100%), very pale orange (10YR 8/2), moderately soft, calcarenitic, highly fossiliferous, good moldic porosity.
1000-1020	Limestone (100%), very pale orange (10YR 8/2) biopelmicrite, moderately soft, minor moldic porosity, trace of biosparite.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
1020-1070	Limestone (90%), very pale orange (10YR 8/2), very soft, calcarenitic, friable; and limestone (10%), light gray (N7), hard, micritic, moldic porosity.
1070-1080	Limestone (60%), very light gray (N8) biomicrite, hard; marl (35%), very light gray (N8), soft, cohesive, finely phosphatic; and minor biosparite (5%).
1080-1090	Limestone (100%), very pale orange (10YR 8/2) micrite, very soft and friable, calcarenitic, fossiliferous.
1090-1100	Limestone (100%), very pale orange to white (N9) micrite, friable, calcarenitic, minor moldic porosity.
1100-1110	Limestone (100%), yellowish-gray (5Y 8/1) biomicrite, minor calcite spar infilling, good moldic porosity.
1110-1120	Limestone (100%), as above, with very fine phosphate grains.
1120-1130	Marl (75%), yellowish-gray (5Y 8/1), soft, clayey, cohesive; and limestone (25%), yellowish-gray micrite, slightly sandy, low apparent porosity.
1130-1140	Limestone (100%), yellowish-gray micrite, moderately soft, calcarenitic, fossiliferous, trace of phosphate, good porosity.
1140-1160	Limestone (100%), light gray (N7) biosparite and biomicrite, hard, finely phosphatic, very good moldic porosity.
1160-1170	Limestone (100%), light gray (N6-N7) biomicrite, hard, very good moldic porosity.
1170-1180	Limestone (100%), yellowish-gray (5Y 8/1) biopelmicrite, moderately soft, finely phosphatic, common spar infilling, good porosity.
1180-1190	Limestone (100%), as above, with decreased spar content.
1190-1200	Limestone (100%), yellowish-gray biopelmicrite, soft and friable, trace of phosphate.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
1200-1210	Limestone (90%), very pale orange (10YR 8/2) biomicrite, firm but friable, calcarenite texture, excellent intergranular porosity; and clay (10%), medium light gray (N6), soft, low porosity.
1210-1220	Limestone (95%), very pale orange biomicrite, moderately hard, good moldic porosity, and light olive-gray (5Y 6/1) biomicrite, hard, moldic; clay (5%) as above.
1220-1230	Limestone (100%), yellowish-gray (5Y 7/2) biopelmicrite, soft and friable, excellent intergranular porosity.
1230-1240	Limestone (100%), very pale orange (10YR 8/2) biopelmicrite, moderately hard, excellent primary and secondary porosity.
1240-1250	Limestone (100%), yellowish-gray calcarenite, moderately hard, slightly friable, fossiliferous, good intergranular porosity.
1250-1260	Limestone (95%), as above, and clay (5%), medium light gray (N6), firm, low porosity.
1260-1270	Limestone (100%), grayish-orange-pink (5YR 7/2) biopelmicrite, hard, calcarenite texture, excellent primary and secondary porosity.
1270-1280	Limestone (95%), as above, and clay (5%), medium light gray (N6), firm, low porosity.
1280-1290	Limestone (95%), grayish-orange-pink to yellowish-gray biomicrite, firm but friable, good intergranular and moldic porosity; and clay (5%), as above.
1290-1300	Limestone (100%), yellowish-gray (5Y 7/2) biomicrite, firm, slightly friable, excellent primary and secondary porosity.
1300-1310	Limestone (100%), as above.
1310-1320	Limestone (100%), yellowish-gray micrite, soft to firm, fossiliferous, marly, moderate to good porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
1320-1330	Limestone (100%), yellowish-gray (5Y 8/1) to pale yellowish-brown (10YR 6/2) biomicrite, hard, common molds.
1330-1350	Limestone (100%), very light gray (N8) to white (N9) biomicrite, moderately hard to hard, moderately moldic, good apparent porosity.
1350-1380	Limestone (100%), white (N9) micrite, moderately soft, minor molds, slightly fossiliferous.
1380-1390	Limestone (100%), as above, with increased moldic porosity.
1390-1400	Limestone (100%), white (N9) biopelmicrite, moderately soft, friable, calcarenitic texture.
1400-1410	Limestone (100%), white (N9) pelmicrite, soft, friable, calcarenitic texture, low apparent porosity.
1410-1440	Limestone (100%), white (N9) pelmicrite, soft, friable, minor secondary porosity.
1440-1450	Limestone (100%), white (N9) biomicrite, moderately hard, minor shell inclusions, moldic porosity.
1450-1460	Limestone (100%), white (N9) to yellowish- gray (5Y 8/1) biomicrite, hard, excellent moldic porosity.
1460-1670	Limestone (90%), yellowish-gray (5Y 8/1), medium soft, foraminiferal calcarenite; and lime mud (10%), yellowish-gray (5Y 8/1), medium soft.
1670-1680	Limestone (70%), yellowish-gray (5y 8/1) as above; and lime mud (30%) yellowish- gray, soft to medium soft.
1680-1700	Lime mud (50%), yellowish-gray (5Y 8/1), soft to medium soft, micritic texture; limestone (40%), as above, with common large echinoid fossils (Neolaganum dalli); and limestone (10%) light olive-gray (5Y 6/1) sparite, hard, crystalline texture.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
1700-1740	Limestone (100%), very pale orange (10YR 8/2) sparite to biomicrite, medium soft to hard, moldic, good apparent porosity.
1740-1770	Limestone (90%), very pale orange (10YR 8/2) biomicrite to biosparite, medium hard, calcarenitic, sucrosic to crystalline texture; and lime mud (10%), soft.
1770-1800	Limestone (100%), very pale orange (10YR 8/2) sparite with minor biosparitic layers, hard to very hard, crystalline texture.
1800-1830	Limestone (95%), yellowish-gray (5Y 8/1) biomicrite, friable, calcarenitic; and dolomite (5%).
1830-1860	Limestone (100%), yellowish-gray (5Y 8/1) biomicrite, moderately soft, calcarenitic texture, friable, good apparent porosity.
1860-1890	Limestone (100%), yellowish-gray (5Y 8/1) biomicrite to sparite, medium hard to medium soft, earthy to crystalline texture, with interbedded light gray (N6) layers.
1890-1920	Limestone (100%), yellowish-gray (5Y 8/1) medium hard to hard, sparitic, crystalline texture.
1920-1950	Limestone (85%), yellowish-gray (5Y 8/1) biomicrite to sparite, medium hard to hard, earthy to crystalline texture; and minor interbedded layers of soft, cohesive, marl (15%).
1950-1980	Limestone (80%), yellowish-gray (5Y 8/1) biomicrite to sparite, medium hard to hard, earthy to crystalline texture; minor interbedded layers of soft, cohesive, marl (15%); and dolomite (5%), brownish-gray (5 YR 4/1), hard, crystalline.
1980-1990	Limestone (80%), yellowish-gray (5Y 8/1) pelsparite, medium hard, sucrosic texture, pin hole porosity; with interbedded medium hard, sparry limestone (20%).

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
1990-2000	Limestone (90%), very light gray (N7) to yellowish-gray (5Y 8/1), medium hard to hard, sparitic, microcrystalline texture; with interbedded soft, cohesive, clay layers (10%).
2000-2015	Limestone (90%), very light gray (N7) to yellowish-gray (5Y 8/1), medium hard to hard, sparitic, microcrystalline texture; with interbedded hard, brownish-gray (5Y 2/1), dolomite (10%).
2015-2040	Limestone (70%), as above; and dolomite (30%), brownish-gray (5Y 2/1), hard, microcrystalline.
2040-2060	Limestone (100%), very light gray (N8) sparite, medium hard, earthy texture.
2060-2090	Limestone (90%), very light gray (N8) to light gray (N7) micrite, medium soft, sucrosic texture; and medium hard sparitic limestone (10%).
2090-2120	Limestone (80%), very light gray (N8) to light gray (N7) micrite, medium soft, sucrosic texture; with medium hard, sparitic limestone layers (20%).
2120-2130	Dolomite (60%), brownish-gray (4Y 2/1), hard, vuggy texture, soft, light grey lime mud infilling (30%), minor crystalline calcite layers (10%).
2130-2180	Limestone (70%), yellowish-gray (5Y 8/1) sparite, medium hard, crystalline texture; and dolomite (30%), brownish-gray, hard, vuggy, with soft yellowish-gray lime mud infillings.
2180-2200	Limestone (100%), yellowish-gray (5Y 8/1) sparite, hard, crystalline texture, minor pinhole porosity.
2200-2222	Limestone (100%), very pale orange (10 YR 8/2), very hard, microcrystalline texture, sparitic, very low apparent porosity.
2222-2230	Dolomite (80%), brownish-gray (4 Y 2/1), hard, vuggy texture infilled with soft, light grey lime mud (20%).

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
2230-2245	Dolomite (70%) as above; and limestone (30%), very pale orange (10 YR 8/2) sparite, hard, microcrystalline, minor pinhole porosity.
2245-2250	Limestone (100%) very pale orange (10 YR 8/2), very hard, microcrystalline texture, sparitic, very poor apparent porosity.
2250-2265	Limestone (98%), yellowish-gray (5Y 8/1) micrite, dense, hard, moderate interparticle porosity; with minor intrasparite (2%), low apparent porosity.
2265-2270	Limestone (100%), as above, with coloration increasingly gray.
2270-2280	Dolomite (100%), dusky brown (5YR 2/2), very hard, cryptocrystalline to crystalline, moderately good vuggy porosity.
2280-2300	Limestone (100%), yellowish-gray (5Y 8/1) micrite, moderately hard, dense, minor interparticle and moldic porosity, low apparent permeability.
2300-2310	Dolomite (100%). moderate yellowish-brown (10YR 5/4) to dusky yellowish-brown (10YR 2/2), very hard, cryptocrystalline to crystalline, common vuggy porosity.
2310-2320	Dolomite (100%), brownish-black (5YR 2/2), very hard, cryptocrystalline to crystalline, moderately good vuggy porosity.
2320-2330	Dolomite (100%), brownish-gray (5YR 4/1), hard, micro- to coarsely crystalline, variable porosity with some excellent secondary porosity.
2330-2340	Dolomite (70%) as above; and limestone (30%), yellowish-gray (5Y 7/2) micrite, firm to hard, moderate porosity.
2340-2350	Limestone (70%), yellowish-gray micrite, firm, friable, fossiliferous, moderate to good porosity; and dolomite (30%) brownish-gray, hard, variable porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
2350-2360	Dolomite (80%), brownish-black to dark yellowish-brown (10YR 4/2), micro- to coarsely crystalline, variable secondary porosity; and limestone (20%) as above.
2360-2370	Limestone (95%), yellowish-gray to medium light gray (N5) micrite and biomicrite, firm, slightly friable, moderate porosity; and dolomite (5%), as above.
2370-2380	Limestone (80%), yellowish-gray micrite, firm, friable, moderate to good porosity; and dolomite (20%), as above.
2380-2390	Dolomite (60%), brownish-gray (5YR 4/1), moderately hard, microcrystalline to crystalline, low to moderate porosity; and limestone (40%), yellowish-gray micrite, firm but friable, moderate porosity.
2390-2400	Limestone (80%), yellowish-gray (5Y 7/2) micrite, firm, slightly friable, fossiliferous, moderate porosity; and dolomite (20%), as above.
2400-2410	Limestone (90%), yellowish-gray micrite with minor sparite, firm, slightly friable, moderate porosity; and dolomite (10%), as above.
2410-2420	Dolomite (50%), dusky yellowish-brown (10YR 2/2), very hard, low porosity; and limestone (50%), yellowish-brown, moderately hard, dolomitic, moderate porosity.
2420-2430	Limestone (80%), yellowish-gray (5Y 7/2) micrite, firm, slightly friable, moderate porosity; and limestone (20%) light olive- gray, firm, dolomitic, good porosity.
2430-2440	Dolomite (100%), pale yellowish-brown (10YR 6/2) and dark yellowish-brown (10YR 4/2), micro- to medium crystalline, low to good porosity, low to moderate apparent permeability.
2440-2450	Dolomite (100%), dark yellowish-brown (10YR 4/2), hard, microcrystalline, minor interparticle porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
2450-2460	Dolomite (50%), as above; and dolomite (50%), medium gray (N5), hard, cryptocrystalline, moderate interparticle porosity.
2460-2470	Dolomite (70%), medium gray, as above; and dolomite (30%), dark yellowish-brown (10YR 4/2), hard, microcrystalline, minor interparticle porosity.
2470-2480	Dolomite (100%), dark yellowish-brown (10YR 4/2), moderately hard, somewhat friable, crystalline, sucrosic texture, moderate interparticle porosity.
2480-2490	Limestone (70%), very pale orange (10YR 8/2) micrite, some fragments finely sandy, low apparent porosity; and dolomite (30%), grayish-brown (5YR 3/2), very hard, dense, cryptocrystalline.
2490-2510	Limestone (100%), very pale orange (10YR 8/2) to yellowish-gray (5Y 8/1) micrite, moderately hard, somewhat chalky, minor intrasparite, low apparent porosity.
2510-2520	Dolomite (90%), pale to dark yellowish- brown (10YR 6-4/2), hard, microcrystalline, low porosity; and limestone (10%), light gray (N7), soft, friable, moderate to good porosity.
2520-2540	Dolomite (80%), dark yellowish-brown (10YR 4/2), cryptocrystalline; and limestone (20%), very pale orange (10YR 8/2) micrite, moderately soft, somewhat friable, slight calcarenitic texture, minor interparticle porosity.
2540-2560	Dolomite (80%), dark yellowish-brown (10YR 4/2), hard, cryptocrystalline, moderate interparticle porosity, low apparent permeability.
2560-2570	Dolomite (100%), pale yellowish-brown (10YR 6/2), hard, micro- to cryptocrystalline, very good interparticle porosity.
2570-2580	Dolomite (100%), as above, but with decreased porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
2580-2600	Dolomite (90%), pale to dark yellowish- brown (10YR 6-4/2), hard, microcrystalline, low porosity; dolomite (10%), cryptocrystalline, moderate to good interparticle porosity.
2600-2620	Dolomite (80%), pale brown (5YR 5/2), very hard, cryptocrystalline, low porosity, low apparent permeability; dolomite (20%) pale yellowish brown (10YR 6/2), crystalline to microcrystalline, good porosity, good permeability.
2620-2640	Dolomite (100%), moderate brown (5YR 3/4), very hard, micro- to cryptocrystalline, very low porosity, very low apparent permeability.
2640-2660	Dolomite (80%), pale yellowish-brown (10YR 6/2) to moderate brown (5YR 3/4), very hard, micro- to cryptocrystalline, very low porosity, low apparent permeability; occasional vuggy dolomite (20%), medium hard with good interparticle porosity.
2660-2690	Dolomite (100%), pale brown (5YR 5/2) to pale yellowish-brown (10YR 6/2), very hard, cryptocrystalline, extremely low porosity and permeability.
2690-2700	Dolomite (80%), moderate brown (5YR 3/4), medium hard, microcrystalline, moderate to good interparticle porosity; dolomite (20%), dark yellowish-brown (10YR 4/2), siliceous, very hard, microcrystalline, with thin fractures filled with black calcite(?), low porosity and low apparent permeability.
2700-2720	Dolomite (100%), pale brown (5YR-5/2) to pale yellowish-brown (10YR-6/2), calcareous, hard, microcrytocrystalline, with occasional (15%) echinoid test fragments, low to moderate porosity and permeability.
2720-2740	Dolomite (80%), pale brown (5YR 5/2), very hard, cryptocrystalline, very low to low porosity, low apparent permeability; dolomite (20%) pale yellowish-brown (10YR 6/2), crystalline to microcrystalline, minor pin hole porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
2740-2760	Dolomite (100%), moderate brown (5YR 3/4), very hard, micro- to cryptocrystalline, very low porosity, very low apparent permeability.
2760-2790	Dolomite (100%), moderate brown (5 YR 3/4), very hard, micro- to cryptocrystalline, very low porosity, very low apparent permeability.
2790-2810	Dolomite (100%), pale brown (5 YR 5/2) to dark yellowish-brown (10 YR 4/2), siliceous, dense microcrystalline texture, very low porosity and apparent permeability.
2810-2840	Dolomite (70%), moderate brown (5 YR 3/4), very hard, micro- to cryptocrystalline, very low porosity, very low apparent permeability; dolomite (30%), pale brown (5 YR 5/2) to dark yellowish-brown (10 YR 4/2), siliceous, very hard, dense microcrystalline texture.
2840-2880	Dolomite (90%), pale brown (5 YR 5/2) to dark yellowish-brown (10 YR 4/2), siliceous, very hard, dense microcrystalline texture, very low porosity and apparent permeability; minor (10%) light grey (N7), very hard, cherty dolomite.
2880-2900	Dolomite (100%), moderate brown (5 YR 3/4), very hard, dense microcrystalline texture, very low porosity and apparent permeability; occasional rhobohedral dolomite crystals on fracture faces.
2900-2910	Dolomite (100%), moderate brown (5 YR 3/4), very hard, dense microcrystalline texture, low porosity and apparent permeability; occasional vugs lined with rhombohedral dolomite crystals.
2910-3020	Dolomite (100%), moderate brown (5 YR 3/4), very hard, dense microcrystalline texture, very low porosity and apparent permeability; occasional rhobohedral dolomite crystals on fracture faces.
3020-3060	Dolomite (100%), moderate brown (5 YR 3/4), very hard, dense microcrystalline texture, low porosity and apparent permeability; increasing vuggy porosity lined with rhombohedral dolomite crystals.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
3060-3090	Dolomite (100%), moderate brown (5 YR 3/4), very hard, dense microcrystalline texture, low porosity and apparent permeability; minor vuggy porosity.
3090-3100	Dolomite (100%), dark yellowish- brown (10YR 4/2), dense cryptocrystalline texture, very hard, low apparent porosity.
3100-3110	Dolomite (100%), pale yellowish-brown (10YR 6/2), hard, microcrystalline to medium crystalline, well cemented, moderate intercrystalline porosity, low apparent permeability.
3110-3130	Dolomite (100%), pale to dusky yellowish- brown (10YR 6-2/2), microcrystalline with minor coarsely crystalline subhedral crystals, low porosity to minor intercrystalline porosity, low apparent permeability.
3130-3140	Dolomite (100%), pale yellowish-brown (10YR 6/2), microcrystalline with minor coarsely crystalline subhedral crystals, low porosity with minor intercrystalline porosity (occasionally seen as apparent rhombehedral molds).
3140-3150	Dolomite (70%), grayish-brown (5YR 3/2), hard, dense cryptocrystalline texture with common microcrystalline rhombs, minor to moderate intercrystalline porosity; dolomite (30%), as above.
3150-3160	Dolomite (80%), brownish-gray (5YR 4/1), hard, finely crystalline, anhedral to subhedral, low porosity; and dolomite (20%), pale yellowish-brown (10YR 6/2), calcareous, hard, recrystallized grainstone, moderate interparticle porosity.
3160-3170	Dolomite (100%), pale yellowish-brown (10YR 6/2) to yellowish-gray (5Y 7/2), calcareous, hard, finely crystalline, subhedral, recrystallized grainstone, minor intercrystalline porosity, low apparent permeability.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
3170-3180	Dolomite (100%), pale to dark yellowish- brown (10YR 6-4/2) mottled coloration, hard, fine to coarsely crystalline, subhedral, abundant relic skeletal grains, moderate intercrystalline porosity.
3180-3190	Dolomite (100%), dark yellowish-brown (10YR 4/2), hard, microcrystalline, anhedral, low porosity, with lighter colored (10YR 7/2) euhedral rhombs on fracture surfaces.
3190-3210	Dolomite (100%), pale yellowish-brown (10YR 6/2) to dusky yellowish-brown (10YR 2/2), micro- to medium crystalline, anhedral with euhedral drusy coatings, relic skeletal fabric, low intercrystalline porosity but potentially high fracture/vuggy porosity.
3210-3220	Dolomite (100%), dark yellowish-brown (10YR 4/2) to dusky yellowish-brown (10YR 2/2), micro- to medium crystalline, anhedral, with lighter (10YR 7/2) rhombs on vuggy surfaces, good apparent porosity.
3220-3230	Dolomite (100%), light olive-gray (5Y 6/1) and medium dark gray (N4), hard, cryptocrystalline, mottled coloration.
3230-3240	Dolomite (100%), brownish-gray (5YR 4/1) to dusky yellowish-brown, very hard, micro- to medium crystalline, anhedral to subhedral, minor vuggy porosity, trace of white micritic limestone with foraminiferas.
3240-3250	Dolomite (100%), pale to dark yellowish- brown (10YR 6-4/2), very hard, microcrystalline, anhedral with euhedral lining vugs, low to moderate vuggy porosity.
3250-3270	Dolomite (100%), pale to dark yellowish- brown, very hard, microcrystalline, anhedral, low porosity.
3270-3280	Dolomite (100%), dark yellowish-brown (10YR 4/2), very hard, cryptocrystalline, dense, uniform, low apparent porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
INJECTION WELL (WELL CO-2317)

Depth (feet)	Lithology
3280-3290	Dolomite (100%), pale to dark yellowish- brown (10YR 6-4/2), very hard, micro- to cryptocrystalline, moderate vuggy porosity.
3290-3300	Dolomite (100%), dark yellowish-brown (10YR 4/2) and dusky yellowish-brown (10YR 2/2), very hard, cryptocrystalline, dense, low apparent porosity.
3300-3320	Dolomite (100%), pale yellowish-brown (10YR 6/2) to dark yellowish-brown (10YR 4/2), very hard, dense, cryptocrystalline, low apparent porosity.
3320-3330	Dolomite (100%), pale yellowish-brown, as above.
3330-3340	Limestone (100%), yellowish-gray (5Y 8/1) pellet grainstone, dolomitic, moderately soft good interparticle porosity.
3340-3356	Limestone (100%), yellowish-gray pellet grainstone, dolomitic, medium hard, commonly cemented with epitaxial gypsum (?) cement, low interparticle porosity.
3356-3370	Limestone (95%), yellowish-gray to very pale yellowish-brown (10YR 7/2) biopelmicrite (packstone), dolomitic, medium hard, good intraparticle porosity, reduced interparticle porosity with evaporite cement; and anhydrite (5%), white (N9), moderately soft, nodular.
3370-3375	Anhydrite (80%), white to light bluish gray (5B 7/1), moderately soft (H=3.5), massive, subhedral, low porosity; and limestone (20%), as above.
3375-3378	Anhydrite (100%), white (N9) with pale to dark yellowish-brown marbling, nodular "chicken wire" structure, calcareous, low porosity.
3378-3380	Dolomite (100%), light olive-gray (5Y 6/1), calcareous, moderately soft, finely crystalline, anhedral, with fine to coarse subhedral anhydrite, moderate to low porosity.

GEOLOGIST LOG OF NCRWTP
DUAL-ZONE MONITOR WELL
(WELL CO-2318)

Depth (feet)	Lithology
0-10	Limestone (40%), yellowish gray (5Y 7/2) sandy biomicrite, hard, good porosity, and sand (30%), medium to very fine grained quartz, unconsolidated with common shell fragments (30%).
10-16	Limestone (80%), light olive gray to yellowish gray (5Y 6-8/1) biomicrite, moderately hard, sandy, good porosity, with common shell fragments (20%).
16-22	Limestone (100%), light olive gray (5Y 6/1) biomicrite, moderately hard, good porosity.
22-25	Limestone (100%), light olive gray (5Y 6/1) biomicrudite, hard, moderate porosity.
25-33	Marl (70%), yellowish gray (5Y 8/1), soft to firm, very abundant shells (30%), low to moderate porosity.
33-45	Limestone (70%), medium light gray (N7) biomicrite, medium hard, sucrosic texture; with abundant shell fragments (30)%.
45-55	Limestone (65%), very light gray (N8) to yellowish grey (5Y 8/1) biomicrite, medium hard; with abundant shell fragments (35%).
55-65	Limestone (80%), medium gray (N5) to light olive gray (5Y 6/1) biomicrite, medium hard, minor hard biosparitic layers, moldic porosity; with common shell fragments (20%).
65-70	Limestone (75%), as above, with increased shell content (25%).
70-80	Limestone (70%), light olive gray (5Y 6/1) to yellowish gray (5Y 8/1) biomicrite, medium hard, moderate apparent porosity, with minor hard biosparite; common shells and shell fragments (20%); and minor phosphate (10%), fine to medium grained, sub-rounded to sub-angular.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
80-100	Limestone (80%), yellowish gray (5Y 8/1) biomicrite, medium soft to medium hard, minor hard biosparite; common shell fragments (15%); and phosphate (5%), fine grained, sub-angular.
100-110	Limestone (70%), light gray (N7) to very pale orange (10YR 8/2) biomicrudite, medium hard, good apparent porosity, occasional hard biosparite with moldic texture; common shells and shell fragments (20%); and fine grained phosphate (10%).
110-117	Limestone (80%), very light gray (N8) to yellowish gray (5Y 8/1) biomicrite, medium hard, with minor hard biosparite; common shell fragments (15%); and fine grained phosphate (5%).
117-125	Limestone (95%), white (N9) to very light gray (N8) micrite, hard, poor apparent porosity; and trace shell fragments (5%).
125-140	Limestone (65%), light olive gray (5Y 6/1) grainstone, medium soft, calcarenitic texture; quartz sand (20%), very fine to medium grained, subangular to subround; and shell fragments (15%).
140-160	Limestone (85%), yellowish gray (5Y 8/1) grainstone, medium soft, calcarenitic texture, good apparent porosity, minor biomicrite; and minor shell fragments (15%).
160-170	Limestone (70%), yellowish gray (5Y 8/1) calcarenite to calcirudite, medium soft to medium hard, coarse grained; very fine grained phosphate (15%); and minor discoidal foraminifera (15%).
170-180	Limestone (75%), yellowish gray (5Y 8/1) to pinkish gray (5YR 8/1) calcarenite, medium soft, coarse grained; sparry shell fragments (15%); and phosphate (10%), very fine grained, subround.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
180-190	Limestone (90%), light gray (N7) to light bluish gray (5B 7/1) dismicrite, hard; sparry shell fragments (5%); and phosphate (5%), very fine grained, sub-round.
190-206	Limestone (80%), as above; and sand (20%), medium grained, rounded, clear quartz.
206-210	Sandstone (70%), light gray (N7) to yellowish gray (5Y 8/1), fine to very fine grained, subrounded, well sorted, loosely consolidated with carbonate cement; sand (20%), very fine grained quartz, unconsolidated; and minor shell fragments (10%).
210-230	Sandstone (80%), as above but medium light gray (N6); phosphatic (10%); with minor shell fragments (10%).
230-240	Sandstone (60%), yellowish gray as above; and limestone (40%), biomicrite, medium hard, moldic porosity.
240-250	Limestone (95%), very pale orange (10 YR 8/2) to yellowish gray (5Y 8/1) biosparite, medium hard, good moldic porosity; with shell fragments (4%) and white lime mud (1%).
250-270	Limestone (60%), light gray (N7) wackestone, medium soft, calcarenitic, with quartz sand (15%), medium to fine grained, subrounded; limestone (25%) yellowish gray (5Y 8/1) biosparite, medium hard, moldic porosity; and trace of rounded, fine grained phosphate.
270-280	Limestone (95%), light gray (N7) wackestone, medium soft, calcarenitic texture, with well sorted, subround, fine grained quartz sand; limestone (3%) yellowish gray (5Y 8/1) biosparite, medium hard, moldic; and phosphate (2%), fine to medium grained, well rounded.
280-326	Clay (45%), light olive gray (5Y 6/1), very soft; quartz sand (35%), clear, fine grained, rounded; phosphate (15%), fine grained; and trace shell fragments (5%).

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
326-330	Limestone (80%), light olive gray (5Y 6/1) to greenish grey (5GY 6/1) biosparite to sparite, hard, crystalline texture, phosphatic (20%).
330-340	Clay (60%), greenish gray (5GY 6/1), very soft, calcareous, sandy to gravelly; limestone (35%) as above; and phosphate (5%), medium to coarse grained, rounded.
340-350	Clay (80%), medium gray (N 5) to dark greenish gray (5GY 4/1), very soft, calcareous, phosphatic, sandy; with limestone (15%) and phosphate (5%) as above.
350-360	Clay (90%), medium gray (N 5) to dark greenish gray (5GY 4/1), very soft, calcareous, phosphatic, sandy; with limestone and phosphate as above.
360-415	Clay (95%), as above, with traces of phosphate and limestone.
415-430	Limestone (75%), yellowish gray (5Y 8/1), hard, crystalline texture, phosphatic (20%); trace of shell fragments (5%).
430-440	Limestone (100%), yellowish gray biomicrite, firm to hard, good moldic porosity, phosphatic.
440-450	Limestone (80%), as above, and clay (20%), light olive gray (5Y 6/1), soft, low porosity.
450-470	Limestone (100%), yellowish gray (5Y 8/1) biomicrite, firm to hard, phosphatic, good to excellent intergranular and moldic porosity.
470-480	Limestone (90%), as above; and clay (10%), light gray (N7), soft, low porosity.
480-490	Limestone (100%), very pale orange (10YR 8/2) biomicrite, soft to firm, marly, phosphatic, moderate to good porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
490-500	Limestone (95%), yellowish gray (5Y 8/1) micrite and biomicrite, firm, phosphatic, trace of quartz sand, good porosity; and marl (5%), medium light gray, soft, low porosity.
500-510	Limestone (90%), yellowish gray biomicrite, soft to firm, marly, phosphatic, good porosity; and marl (10%), light gray (N7), soft, low porosity.
510-520	Limestone (100%), yellowish gray (5Y 7/2) micrite, soft, marly, fossiliferous, moderate porosity.
520-530	Limestone (95%), yellowish gray biomicrite, moderately firm, sparry shell fragments, phosphatic, excellent porosity.
530-540	Limestone (80%), pinkish gray (5Y 8/1) biomicrite, hard, phosphatic, good porosity; and clay (20%), olive gray (5Y 4/1), soft, low porosity.
540-550	Limestone (90%), pale yellowish brown (10YR 6/2) biosparite, moderately soft, dolomitic, sucrosic texture, good porosity; and marl (10%), light olive gray, soft, low porosity.
550-560	Limestone (80%), pinkish gray biomicrite, moderately hard, marly, moderate porosity; and limestone (20%), as above.
560-570	Limestone (100%), pinkish gray biomicrudite, moderately hard, phosphatic, good porosity.
570-580	Marl (60%), yellowish gray (5Y 8/1), soft, phosphatic, low porosity; limestone (20%), yellowish gray biomicrite, soft, marly, moderate porosity; and abundant shells (20%).
580-590	Marl (50%), yellowish gray (5Y 8/1), soft, finely phosphatic, cohesive; limestone (40%), light olive gray (5Y 6/1) to yellowish gray (5Y 8/1), microcrystalline, moderately hard, low apparent porosity; and shell fragments (10%).

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
590-600	Limestone (55%), white (N9) biomicrite, hard, phosphatic, slightly moldic; marl (40%), yellowish gray (5Y 8/1) to white (N9), soft, phosphatic, cohesive; and minor shells (5%).
600-610	Limestone (80%), white (N9) biomicrite, hard, fossiliferous, phosphatic, moderate apparent porosity; clay (10%), white, soft, phosphatic, cohesive; and shell (10%).
610-620	Clay (90%), light olive gray (5Y 6/1), very soft, slightly cohesive, highly phosphatic; with minor white limestone and shell fragments as above (10%).
620-630	Marl (70%), light olive gray (5Y 5/2), soft, cohesive, finely phosphatic; and limestone (30%), light olive gray (5Y 6/1) to white (N9) micrite, hard.
630-640	Limestone (95%), white (N9) biomicrite, hard, common phosphate (very fine sand-sized grains), moldic porosity; and lime mud (5%), white (N9), with trace of shells.
640-650	Limestone (65%), yellowish gray (5Y 8/1) calcarenite, very soft, chalky, fossiliferous, slightly moldic, slightly phosphatic; and marl (35%), yellowish gray (5Y 8/1), very soft, slightly phosphatic, low apparent porosity.
650-660	Limestone (100%), yellowish gray (5Y 8/1) biomicrite, very soft, fossiliferous, chalky, finely phosphatic, friable.
660-670	Limestone (93%), very pale orange (10YR 8/2) biomicrite, very soft, friable, fossiliferous, with sparry calcite (2%), very fine phosphate (2%); and minor clay (3%), white (N9), very soft.
670-680	Limestone (70%), light olive gray (5Y 6/1), moderately hard, dolomitic, cryptocrystalline; and clay (30%), light olive gray (5Y 6/1), firm, cohesive, trace phosphate, low apparent porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
680-690	Marl (60%), white (N9), soft, slightly cohesive, trace phosphate; and limestone (40%), white biomicrite, moderately hard, low apparent porosity.
690-700	Clay (90%), dark greenish gray (5GY 4/1), moderately soft, sticky, cohesive; and limestone (10%), white (N9), low apparent porosity.
700-710	Clay (80%), light olive gray (5Y 6/1) dolosilt, soft, moderate porosity; limestone (18%), very light gray (N8) micrite, soft, phosphatic; and phosphate (2%) to granule size.
710-720	Limestone (80%), yellowish gray biomicrite, hard, excellent moldic porosity; and dolomite (10%), light olive gray, soft, excellent intergranular porosity; dolosilt (9%) as above; and phosphate (1%) to granule size.
720-730	Dolomite (70%), pale yellowish brown (10YR 6/2) to light olive gray, hard, sucrosic texture, excellent intergranular porosity; and limestone (30%), white (N9) to very light gray (N8) micrite, soft, phosphatic, moderate porosity.
730-740	Dolomite (90%), light olive gray (5Y 5/2) to olive gray (5Y 3/2), hard, moldic, variable porosity from low to good; and limestone (10%), white (N9) micrite, soft, sandy, moderate porosity.
740-750	Dolomite (100%), yellowish gray (5Y 7/2), moderately hard, low porosity; trace of phosphate to granule size.
750-760	Dolomite (90%), light olive gray, hard, sucrosic texture, moderate to low porosity; and limestone (10%), very light gray (N8) micrite, soft, phosphatic, moderate porosity.
760-770	Dolomite (100%), pale yellowish brown (10YR 6/2) to yellowish gray, hard, good moldic porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
770-780	Dolomite (90%), olive gray (5Y 4/1), hard, sucrosic texture, moderate to low porosity; and limestone (10%), very light gray micrite, soft, sandy, phosphatic.
780-792	Dolomite (100%), light olive gray to olive gray, as above.
792-798	Limestone (80%), white (N9) micrite, soft, chalky, moderate porosity; and dolomite (20%), light olive gray, moderately hard, good intergranular and moldic porosity.
798-810	Dolomite (80%), medium light gray (N6), hard, cryptocrystalline, phosphatic; and limestone (20%), white, as above.
810-820	Limestone (100%), yellowish gray (5Y 8/1) biomicrite, moderately soft, good moldic porosity.
820-830	Limestone, as above, with increased porosity.
830-840	Limestone, as above, with calcarenite texture, softer than above.
840-850	Limestone (100%), yellowish gray (5Y 8/1) to very light gray (N8) biomicrite, soft, moderately friable, moldic, good apparent porosity.
850-870	Limestone (60%), very light gray (N8) micrite, soft; and limestone (40%), medium to medium light gray (N5-N6) biomicrite, hard, excellent moldic porosity.
870-890	Limestone (90%), as above, and limestone (10%), very pale orange (10YR 8/2) calcarenite, hard, with good interparticulate porosity.
890-900	Limestone (100%), very light gray (N8) biomicrite, soft, friable, fossiliferous, good interparticulate porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
900-910	Limestone (100%), light gray (N7) biomicrite, hard, good moldic porosity.
910-920	Limestone (70%), light gray (N7) to very light gray (N8) biomicrite, hard, fossiliferous; and limestone (30%), white (N9) biomicrite, very soft and friable, calcarenitic texture.
920-930	Limestone (100%), yellowish gray (5Y 8/1) biopelmicrite, hard, moldic, fossiliferous, good apparent porosity.
930-940	Limestone (100%), white (N9) to very light gray (N8) micrite, very soft and friable.
940-950	Limestone (100%), yellowish gray (5Y 7/2) micrite, very soft, friable, moderate apparent porosity.
950-970	Limestone (100%), very pale orange (10YR 8/2), moderately soft, calcarenitic texture, moderately good interparticulate porosity.
970-980	Limestone (100%), white (N9) biomicrite, hard, well indurated, good moldic porosity.
980-1000	Limestone (70%), yellowish gray (5Y 8/1) calcarinite, soft, sucrosic texture; and limestone (30%), hard, microcrystalline, vuggy, good interparticulate porosity.
1000-1030	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, soft, sucrosic texture.
1030-1060	Limestone (70%), as above, with increasing hard, crystalline limestone.
1060-1070	Limestone (70%), light gray (N7) biomicrite, medium hard, moldic porosity; and limestone (30%), dark yellowish brown (10YR 4/2) biosparite, dense, hard, with vuggy porosity.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
1070-1080	Limestone (95%), pinkish gray (5YR 8/1) biomicrite to dismicrite, medium hard, moderate moldic porosity; with fine grained phosphate (5%).
1080-1090	Limestone (90%), very light gray (N8) to very pale orange (10YR 8/2) biomicrite, medium soft; lime mud (5%), white (N9); and very fine grained phosphate (5%).
1090-1110	Limestone (95%), light olive gray (5Y 6/1) biomicrite to dismicrite, hard, moldic porosity; with minor sparry shell fragments and trace of fine grained phosphate.
1110-1150	Limestone (95%), white (N9) to pinkish gray (5YR 8/1) micrite, soft; with minor fine grained phosphate (5%).
1150-1180	Limestone, as above, with increased hardness and moldic porosity and decreased shell content with depth.
1180-1230	Limestone (90%), yellowish gray (5Y 8/1) calcarenite, medium soft, moderate moldic porosity; with minor (10%) very fine grained, subrounded phosphate. Moldic porosity increasing slightly with depth.
1230-1270	Limestone (100%), light gray (N7) to yellowish gray (5Y 8/1) calcarenite, medium soft, and minor hard, crystalline biosparite, moldic porosity; trace of fine grained phosphate.
1270-1300	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium soft, fine to very fine grained, good apparent moldic porosity. Very fast drilling.
1300-1330	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium soft, fine to very fine grained, good apparent moldic porosity.
1330-1350	Limestone (100%), yellowish gray (5y 8/1) to medium soft, very fine to fine grained, calcarenitic.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
1350-1370	Limestone (100%), white (N9) to very light gray (N8) biomicrite to micrite, moldic porosity.
1370-1400	Limestone (100%), as above, with increasing calcarenitic texture, moldic porosity.
1400-1430	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium soft, fine to very fine grained.
1430-1450	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium hard, fine grained.
1450-1490	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium soft, very fine to fine grained.
1490-1520	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, soft, very fine to fine grained.
1520-1540	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium soft, very fine to fine grained.
1540-1570	Limestone (100%), yellowish gray (5Y 8/1) medium hard, fine grained, calcarenitic.
1570-1580	Limestone (90%), yellowish gray (5Y 8/1) calcarenite, medium soft; and lime mud (10%) yellowish gray (5Y 8/1), medium soft.
1580-1610	Limestone (90-100%), yellowish gray (5Y 8/1) foraminifal calcarenite, medium soft; and lime mud (0-10%) yellowish gray (5Y 8/1), medium soft.
1610-1640	Limestone (90%), yellowish gray (5Y 8/1) foraminifal calcarenite, medium soft; and lime mud (10%) yellowish gray (5Y 8/1), medium soft.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
1640-1670	Limestone (95%), yellowish gray (5Y 8/1) calcarenite, medium soft; and lime mud (5%), yellowish gray (5Y 8/1), medium soft.
1670-1680	Limestone (70%), as above, and lime mud (30%), yellowish gray (5Y 8/1), soft to medium soft.
1680-1700	Lime mud (50%), yellowish gray (5Y 8/1), soft to medium soft, micritic texture; limestone (40%), yellowish gray (5Y 8/1) calcarenite, soft, with common large echinoid fossils; and limestone (10%), light olive gray (5Y 6/1) sparite, hard, crystalline texture.
1700-1740	Limestone (80%), very pale orange (10YR 8/2) sparite, hard to medium hard, moderate moldic porosity; and limestone (20%), biomicrite, medium soft to hard, good apparent porosity.
1740-1770	Limestone (90%), very pale orange (10YR 8/2) biomicrite and biosparite, medium hard, calcarenitic, sucrosic to crystalline texture; with minor, soft lime mud (10%).
1770-1775	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium soft to medium hard, sparse casts of small bivalves, moderate porosity.
1775-1790	Limestone (90%), pale yellowish brown (10 YR 6/2) biosparite, medium hard, calcarenitic, common small (2-5 mm) bivalve casts; and limestone (10%), medium gray (N5) to medium dark gray (N4) micrite, hard, poor porosity.
1790-1816	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium soft to medium hard, low to moderate porosity.
1816-1818	Clay (50%), medium light gray (N6), stiff; lime mud (30%), very light gray (N8), moderately soft; and limestone (20%), calcarenite as above.

Continued:

GEOLOGIST'S LOG OF NCRWTP
DUAL ZONE MONITOR WELL
(Well CO-2318)

Depth (feet)	Lithology
1818-1819	Limestone (100%), yellowish gray (5Y 8/1) calcarenite, medium hard, good apparent porosity.
1819-1825	Limestone (80%), medium gray (N5) sparite, hard, poor apparent porosity; and limestone (20%), as above.
1825-1855	Limestone (100%), yellowish gray (5Y 8/1) micrite, medium hard, earthy texture, moderate porosity.
1855-1885	Limestone (80%), as above; and limestone (20%), medium gray (N5) sparite, hard, moderate to low porosity.
1885-1910	Limestone (80%), sparite to micrite, medium hard, earthy texture, good to moderate porosity; and limestone (25%), as above.
1910-1930	Limestone (100%), light gray (N7) to brownish gray (4YR 1/4) sparite, medium hard to hard, earthy to microcrystalline texture.

CORE SAMPLE DESCRIPTION

PROJECT NUMBER H89-342E DATE 8/17/92 PERMIT NUMBER UCII-198432

WELL NUMBER CO-2317 (IW) CORE NUMBER 1

PERCENT RECOVERED 90% CORE DIAMETER 4"

SAMPLE DESCRIPTION BY: CLIFF HARRISON DEPTH INTERVAL 2012-2022

DEPTH INTERVAL	SAMPLE DESCRIPTION
2012-2014	Limestone, yellowish grey (5Y 8/1) to very pale orange (10YR 8/2) intrasparite, medium soft to medium hard, containing 2% micrite intraclasts. Moderate secondary porosity, low apparent permeability, minor fracturing and minor vuggy porosity. Micrite intraclasts occur in discrete to semi-discrete layers, with apparent rip-up clasts directly overlying an apparent unconformity within the limestone at the depth of 2014'.
2014-2018	Limestone, as above, but with low porosity and few intraclasts.
2018-2019.5	Core missing due to broken circulation during coring process.
2019.5-2022	Dolomite, moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2), hard, microcrystalline, low porosity, with occasional small vugs.

CORE SAMPLE DESCRIPTION

PROJECT NUMBER H89-342E DATE 08-21-92 PERMIT NUMBER UCII-198432

WELL NUMBER CO-2317 (IW) CORE NUMBER 2

PERCENT RECOVERED 98 CORE DIAMETER 4"

SAMPLE DESCRIPTION BY: Damon Matson DEPTH INTERVAL 2252'-2262'

DEPTH INTERVAL	SAMPLE DESCRIPTION
2252-2255	Limestone, yellowish gray (5Y 8/1) micrite, hard, containing trace micrite intraclasts, finely phosphatic, low apparent porosity and permeability.
2255-2255.4	Limestone, as above, with intrasparite infilling discrete, thin fracture zones.
2255.4-2256.5	Limestone, yellowish gray (5Y 8/1) micrite, hard, moderate interparticle and moldic porosity, low apparent permeability.
2256.5-2258.6	Limestone, as above, with intrasparite (5%) infilling thin fracture and solution voids, minor moldic porosity with sparry calcite infilling, moderate to low apparent permeability. Limestone intraclasts overlie apparent unconformity within limestone at a depth of 2258.6'.
2258.6-2260.2	Limestone, yellowish gray (5Y 8/1) intramicrite, hard, minor interparticle porosity, trace moldic porosity, low apparent permeability.
2260.2-2260.5	Limestone, dark yellowish brown (10YR 4/2) to brownish black (5YR 2/1) sparite, hard, vuggy, moderate to good moldic porosity.
2260.5-2262	Limestone, yellowish gray (5Y 8/1) micrite, hard, moderate to low moldic porosity.

CORE SAMPLE DESCRIPTION

PROJECT NUMBER H89-342E DATE 8/23/92 PERMIT NUMBER UCII-198432

WELL NUMBER CO-2317 (IW) CORE NUMBER 3

PERCENT RECOVERED 95 CORE DIAMETER 4 in.

SAMPLE DESCRIPTION BY: Gordon Kennedy DEPTH INTERVAL 2432-2443

DEPTH INTERVAL	SAMPLE DESCRIPTION
2432-2432.4	Dolomite, brownish black (5YR 2/1), hard, microcrystalline to finely crystalline, minor vuggy porosity, low apparent permeability.
2432.4-2433.5	Limestone, yellowish gray (5Y 7/2) biopelmicrite (packstone), with pure micrite intraclasts, moderate to good porosity.
2433.5-2434.5	Dolomite, medium dark gray (N4), very hard, microcrystalline with unconnected vuggy porosity, low apparent permeability.
2434.5-2435.5	Dolomite, pale yellowish brown (10YR 6/2), firm, microcrystalline to medium crystalline, good secondary porosity, good apparent permeability.
2435.5-2438	Dolomite, pale yellowish brown, hard, microcrystalline, moderate porosity, low apparent permeability.
2438-2439.5	Dolomite, pale yellowish brown, hard, microcrystalline to medium crystalline, good porosity, moderate apparent permeability.
2439.5-2442	Dolomite, pale to dark yellowish brown (10YR 6-4/2), hard, dense, microcrystalline, moderate to low porosity, low apparent permeability.
2442-2443	Dolomite, yellowish gray (5Y 7/2), very hard, microcrystalline, low porosity, with scattered unconnected vuggy porosity, low apparent permeability.

CORE SAMPLE DESCRIPTION

PROJECT NUMBER H89-342E DATE 8/28/92 PERMIT NUMBER UCII-198432

WELL NUMBER CO-2317 (IW) CORE NUMBER 4

PERCENT RECOVERED 33 CORE DIAMETER 4 inches

SAMPLE DESCRIPTION BY: Jack Breland DEPTH INTERVAL 2582-2588

DEPTH INTERVAL	SAMPLE DESCRIPTION
2582.3-2583.6	Dolomite, moderate brown (5YR 3/4), very hard, fractured, microcrystalline to cryptocrystalline, very low porosity, very low apparent permeabililty.
2583.6-2584.0	Dolomite, pale yellowish brown (10YR 6/2) to moderate brown (5YR 3/4), very hard, microcrystalline to cryptocrystalline, very low porosity, low apparent permeability, occasional pin hole to vuggy infills.
2584.0-2584.4	Dolomite, pale yellowish brown (10YR 6/2) to moderate brown (5YR 3/4), very hard, fractured, microcrystalline to cryptocrystalline, low to medium porosity, low apparent permeability; and fractured vuggy dolomite, medium hard with good interparticle porosity.
2584.4-2588.0	Missing from core.

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CORE LABORATORIES

MECHANICAL AND BASIC ROCK PROPERTIES

2317 INJECTION WELL

FINAL REPORT

Prepared for:
YOUNGQUIST BROTHERS, INC.
15465 Pine Ridge Road
Ft. Myers, Flordia 33908

File: DRES-92181
November 11, 1992

I PROCEDURES DOCUMENTATION

IA. SAMPLE PREPARATION

1. PLUG DRILLING: One inch diameter plugs were drilled at points selected by Core Laboratories personnel. Water was used as the bit lubricant/coolant. A total of 12 horizontal and 12 vertical plugs were taken. After the completion of permeability and porosity measurements the vertical plugs were shipped to Core Laboratories' Carrollton facility for additional tests.

4. PLUG DRYING: Plugs were dried in a convection oven at 240 degrees F. until weight stabilization was achieved.

IB. PETROPHYSICAL MEASUREMENTS

1. GRAIN VOLUME: Direct grain volume measurements were made using a small volume porosimeter (SVP). 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.

2. GRAIN DENSITY: Calculated grain densities were obtained utilizing sample grain volume and clean, dry sample weight. Grain densities were checked against lithology standards.

3. PLUG DIMENSIONS: Sample length and diameter were measured using metric calipers. Archimedes bulk volumes were also measured on selected samples.

4. CMS-300 OPERATIONS:

A. PERMEABILITY "K": Permeability was measured by flowing helium from a reference cell at the selected pressure through the core. The size of the reference cell used is optimized during a pre-test flow through. The chambers available are approximately 2,9,56, and 315 cc's. The actual size of each cell is calculated during calibration procedures. The cell combination used varies with each sample.The downstream end of the core was maintained at atmospheric pressure. The upstream pressure decline was monitored in real time, and was observed by digital readout and visually displayed in either graphic or tabular form. The difference between the confining stress and the mean pore pressure during flow is the net confining stress. The net confining stress used for this project was 800 psig.

a). K-air: permeability to air at 800 psig net confining stress was calculated from time pressure data.

b). K-Klinkenberg: unsteady state equations were used with time/pressure data to calculate the Klinkenberg slip corrected permeability at 800 pig net confining stress.

B. POROSITY: Porosities were calculated using one of the following 3 equations:

EQUATION ONE: (Samples 1H,2H,3H,4H,5H,6H,7H,9H,10H,11H)
CMS Pore Volume/(CMS Pore Volume + SVP Grain Volume)*100

EQUATION TWO: (Samples 1V,2V,3V,4V,5V,6V,7V,8V,12V)
CMS Pore Volume/Archimedes Bulk Volume * 100

EQUATION THREE: (Samples 8H,9V,10V,11V,12H)
(Archimedes Bulk Vol. - SVP Grain Volume)/Archimedes Bulk Vol. * 100

II TABULAR REPORT

CORE LABORATORIES

Company : YOUNGQUIST BROTHERS, INC.
Well : 2317 Injection Well
Location :
Co,State :

Field :
Formation :
Coring Fluid :
Elevation :

File No.: 57151-17275
Date : 26-Aug-1992
API No. :
Analysts: Weir

CORE ANALYSIS RESULTS

SAMPLE NUMBER	DEPTH ft	PERMEABILITY (HORIZONTAL) Kair md	PERMEABILITY (VERTICAL) Kair md	POROSITY (HELIUM) %	GRAIN DENSITY g/cm3
1H	2013.6	55.0		23.9	2.70
1V	2013.7		82.7	24.8	2.70
2H	2016.1	8.39		27.0	2.70
2V	2016.3		5.51	26.7	2.69
3H	2021.4	0.01		5.7	2.82
3V	2021.4		<.01	5.4	2.81
4H	2253.3	1.55		20.2	2.69
4V	2253.3		1.60	20.1	2.69
5H	2255.7	4.25		21.0	2.69
5V	2255.8		4.49	20.9	2.69
6H	2259.7	0.49		19.1	2.68
6V	2259.5		0.45	19.5	2.68
7H	2432.8	1.15		16.4	2.72
7V	2432.8		0.64	16.0	2.72
8H	2433.1	<.01		6.5	2.83
8V	2433.1		<.01	4.5	2.79
9H	2440.2	0.03		6.2	2.72
9V	2440.2		<.01	1.9	2.73
10H	2442.0	<.01		7.9	2.84
10V	2442.1		<.01	2.4	2.80
11H	2583.8	<.01		5.4	2.83
11V	2583.8		<.01	4.0	2.79
12H	2584.2	<.01		5.8	2.82
12V	2584.1		<.01	6.7	2.83

III MECHANICAL ROCK PROPERTIES

IIIA. EXPERIMENTAL PROCEDURES

Sample Preparation

Twelve 1" diameter, vertically oriented plug samples were received for analysis. Each sample was trimmed to approximately 2.0 inches in length. Plug endfaces were precision ground to achieve a parallelism within 0.002 of an inch which insures that the samples represent right cylinders as nearly as possible and also provides for good contact between sample endfaces and the transducers generating/receiving the acoustic waves. The samples were tested "as received" without additional cleaning or drying.

Acoustic Velocity

Each sample was mounted into the ultrasonic velocity apparatus where subsurface stress conditions were simulated. These pressures represent an average value for samples within a 300 ft interval. A normal pressure gradient of 0.45 psi/ft was assumed, then corrected for hydrostatic conditions. After allowing two hours for pressure equilibration, compressional and shear wave acoustic signals were generated and transmitted across the plugs, with the transit time determined using a high speed digital oscilloscope. Sample lengths were divided by transit times to calculate acoustic velocity. Using the velocity measurements and bulk density values, calculations of dynamic moduli at stress were completed for the all samples. This data is summarized in Section IIIB.

For more information regarding acoustic velocity measurements and the methods used to determine them, please refer to the paper "Ultrasonic Velocity Apparatus and Methods" in the appendix.

Compressive Strength

Uniaxial compressive strength was measured on the same samples used in acoustic measurements. These tests are performed in a hydraulic load frame in which force and load rate are monitored by a computer interface. Samples in the shape of right circular cylinders were loaded in the frame, then force was applied at a preselected rate. The maximum compressive strength is calculated from the greatest load supported by the sample divided by it's cross-sectional area. Details of this procedure are provided in the ASTM procedure D2938-79 which is included in the appendix. A summary of the measurements are presented in Section IIIB.

III PETROPHYSICAL MEASUREMENT TABLES

IIIB. ULTRASONIC VELOCITY AND DYNAMIC MODULI

Youngquist Brothers, Inc.
2317 Injection Well

SAMPLE ID	DEPTH	STRESS NET	BULK DENS	VELOCITY COMP	VELOCITY SHEAR	BULK MODULUS	YOUNG'S MODULUS	SHEAR MODULUS	POISSON'S RATIO
	ft	psi	gm/cc	ft/sec		psi	psi	psi	
1-V	2013.7	662	2.03	11496	6572	2.04e+06	2.98e+06	1.18e+06	0.257
2-V	2016.3	662	1.97	10771	6214	1.71e+06	2.56e+06	1.02e+06	0.251
3-V	2021.4	662	2.68	18875	9342	8.66e+06	8.43e+06	3.15e+06	0.338
4-V	2053.3	662	2.16	12944	7498	2.69e+06	4.08e+06	1.64e+06	0.248
5-V	2255.8	662	2.14	12745	7213	2.69e+06	3.80e+06	1.50e+06	0.264
6-V	2259.5	662	2.17	12736	7138	2.76e+06	3.79e+06	1.49e+06	0.271
7-V	2432.8	770	2.28	13478	7918	3.01e+06	4.76e+06	1.93e+06	0.237
8-V	2433.1	770	2.66	15439	9047	4.64e+06	7.27e+06	2.94e+06	0.239
9-V	2440.2	770	2.68	20544	10393	1.00e+07	1.03e+07	3.89e+06	0.328
10-V	2442.1	770	2.75	21899	11773	1.09e+07	1.33e+07	5.13e+06	0.297
11-V	2583.8	770	2.69	20402	11348	8.87e+06	1.19e+07	4.67e+06	0.276
12-V	2584.1	770	2.65	20575	11016	9.33e+06	1.12e+07	4.33e+06	0.299

Note: Samples tested as received

IIIB. COMPRESSIVE STRENGTH DATA SUMMARY

Youngquist Brothers, Inc.
2317 Injection Well

Sample I.D.	Depth (ft)	Length (in)	Diameter (in)	Compressive Strength (psi)	Description
1-V	2013.7	2.182	0.999	2052	Ls lt gry chlky
2-V	2016.3	2.292	0.999	2116	Ls lt gry chlky
3-V	2021.4	2.225	0.999	11439	Dol lt brn xln
4-V	2253.3	2.303	0.995	3834	Ls lt gry chlky
5-V	2255.8	2.369	0.995	4693	Ls lt gry chlky
6-V	2259.5	2.516	0.999	4386	Ls lt gry chlky
7-V	2432.8	2.206	1.008	7894	Ls lt gry chlky
8-V	2433.1	2.238	1.008	13017	Dol gry xln calc
9-V	2440.2	2.129	1.009	18223	Dol brn xln lam
10-V	2442.1	1.982	1.008	29125	Dol lt gry xln
11-V	2583.8	2.253	1.008	36290	Dol brn xln dns
12-V	2584.1	2.149	1.008	32187	Dol brn xln dns