The Dare County Water Department
600 Mustian Street
Kill Devil Hills, North Carolina

Report on the Construction and Testing of a Mid-Yorktown Aquifer Test Well at Future Production Well Site 17 (North RO Plant)

September 2002

W. Kirk Martin, P.G.
North Carolina Registered Professional
Geologist #1112

Wm. Scott Manahan
Project Manager

CDM Missimer
8140 College Parkway, Suite 202
Fort Myers, FL 33919

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Section 1
Conclusions and Recommendations

A test well was constructed at future production well site 17 in Nags Head, North Carolina to evaluate the feasibility of constructing a production well at the site to supply additional raw water to the Dare County North Reverse Osmosis (RO) water plant in Kill Devil Hills. The conclusions and recommendations presented below are based on the results of the test well construction project.

1.1 Conclusions

- A 4-inch diameter test well (test well 17) was installed at future production well site 17, approximately 4 miles south of the Kill Devil Hills RO plant. The well was completed within the Mid-Yorktown aquifer with a screened interval between 298 and 398 feet below land surface.

- A step-drawdown test was conducted on test well 17 after drilling and development were completed. A specific capacity value of 5.6 gpm/ft was calculated for the well at a pumping rate of 104 gpm.

- The transmissivity of the Mid-Yorktown aquifer is estimated to be approximately 65,000 gpd/ft at the future production well site 17 based on analyses of test data.

- Water samples were obtained from test well 17 near the end of testing and sent to a laboratory for analyses. A dissolved chloride concentration of 1400 mg/l and total dissolved solids of 3000 mg/l were determined. The production wells that currently supply the RO plant have dissolved chloride concentrations that range from approximately 2500 to 2600 mg/l.

- The installation of a production well on the subject property is feasible. A properly installed and developed production well at this location would likely be capable of yielding 400 to 500 gpm on a sustained basis, similar to the capacity of the existing production wells.

1.2 Recommendations

- Consideration should be given to constructing a production well at the proposed well 17 site. The well would provide additional raw water supply to the Kill Devil Hills RO plant and allow expansion of the plant finished water capacity by up to 0.5 MGD.

- The proposed production well should be constructed with 12-inch diameter PVC casing to a depth of at least 150 feet below land surface and 8-inch diameter PVC casing below 150 feet to the appropriate setting depth (approximately 300 feet). The well should be screened with 8-inch diameter stainless steel continuous wrap screen from the casing bottom to approximately 400 feet below land surface. A coarse sand filter pack should be placed around the screen. A hydrogeologist should supervise construction of the well and select final cased and total depths based on lithologic analysis of formation samples obtained during drilling. A biodegradable type drilling fluid should be used to drill through the production zone interval. The well should be thoroughly developed by compressed air pumping and horizontal jetting of the screen after drilling is complete.

- A step-drawdown test should be conducted on the new production well. Specific capacity values calculated based on the test results can be used to assess the well yield and confirm the proposed pump setting depth and withdrawal rate. The new well should be disinfected following development and pump testing.

- A submersible well pump similar to those used on the existing production wells near the RO plant should be installed in the new production well. Piping from the well would be placed adjacent to Highway 158 and connected to the existing PVC raw water transmission main going to the RO plant.

- Test well 17 should be included in the on-going water level and water quality monitoring program conducted by the county. Water quality and water levels should also be monitored in the proposed new production well. The data collected will enable an evaluation of the performance of the new well and help to identify potential problems.

Section 2
Introduction

The Dare County Water Department operates a reverse osmosis plant (North RO plant) in Kill Devil Hills, North Carolina that produces potable water for public supply purposes. Brackish water supplied by ten Mid-Yorktown aquifer production wells is the raw water source for the RO plant. Currently, the RO plant has a finished water production capacity of approximately 3.0 million gallons per day (MGD). The average pumping rate for the existing supply wells ranges between 400 and 500 gallons per minute (gpm). Expansion of the RO plant capacity to meet the increasing demand for potable water will be required. CDM Missimer was authorized by the Dare County Water Department in August 2002 to construct a test well approximately four miles south of the RO plant on property that is being considered for purchase by the county as a permanent production well site. The RO plant and production well locations are shown on **Figure 1**.

The purpose of the project was to evaluate aquifer yield and water quality conditions within the Mid-Yorktown aquifer to determine the feasibility of installing a permanent production well at the subject property. Additional supply wells will be needed to increase the raw water supply capacity of the existing wellfield in order to expand the RO plant capacity. The scope of the project included well construction, aquifer testing, water quality sampling, data analyses, and preparation of this summary report. The methods and procedures used during the investigation and the results obtained are presented herein. A map of the test well 17 site is provided as **Figure 2**.

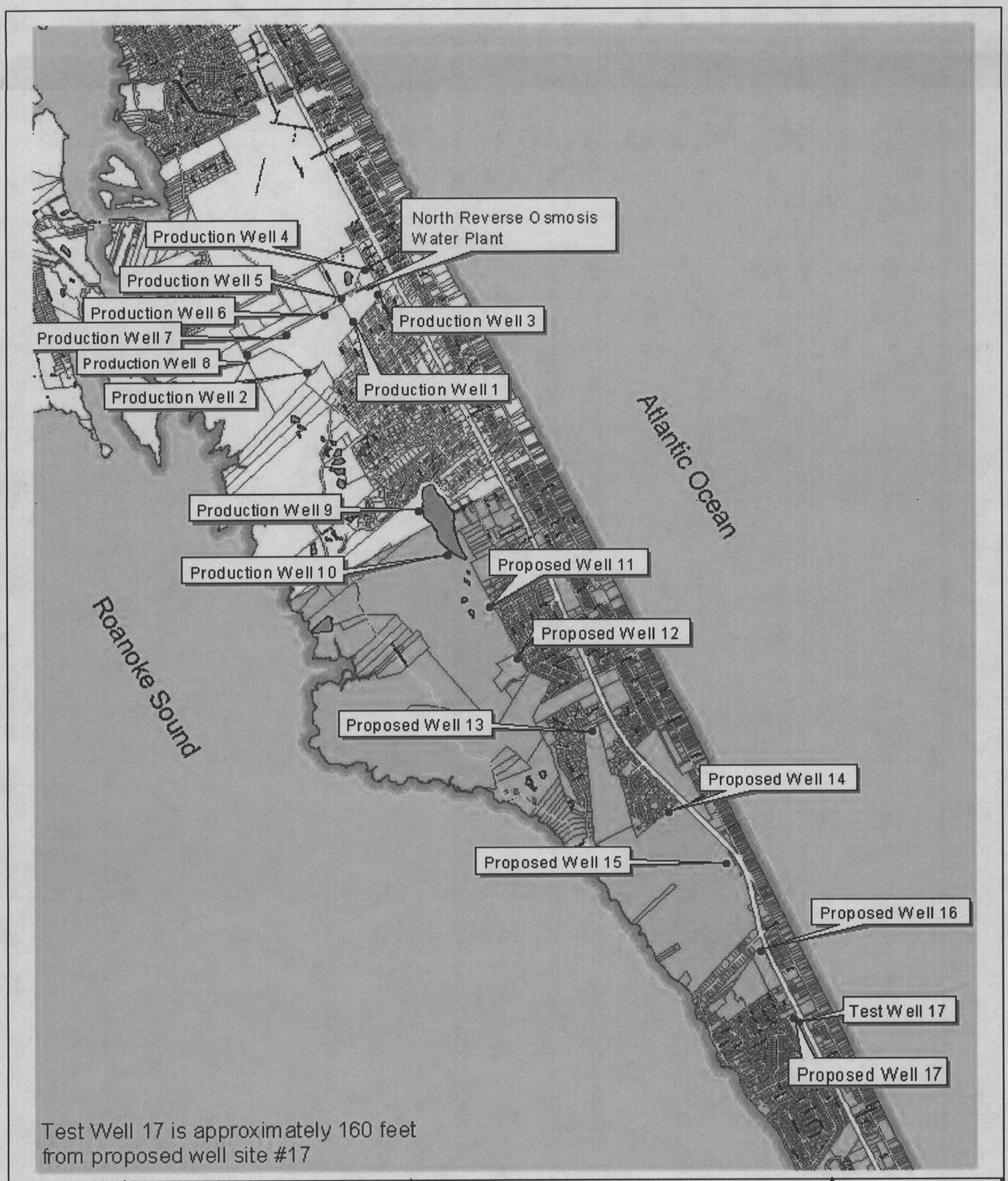


Figure 1. North RO Plant and Wellfield Location

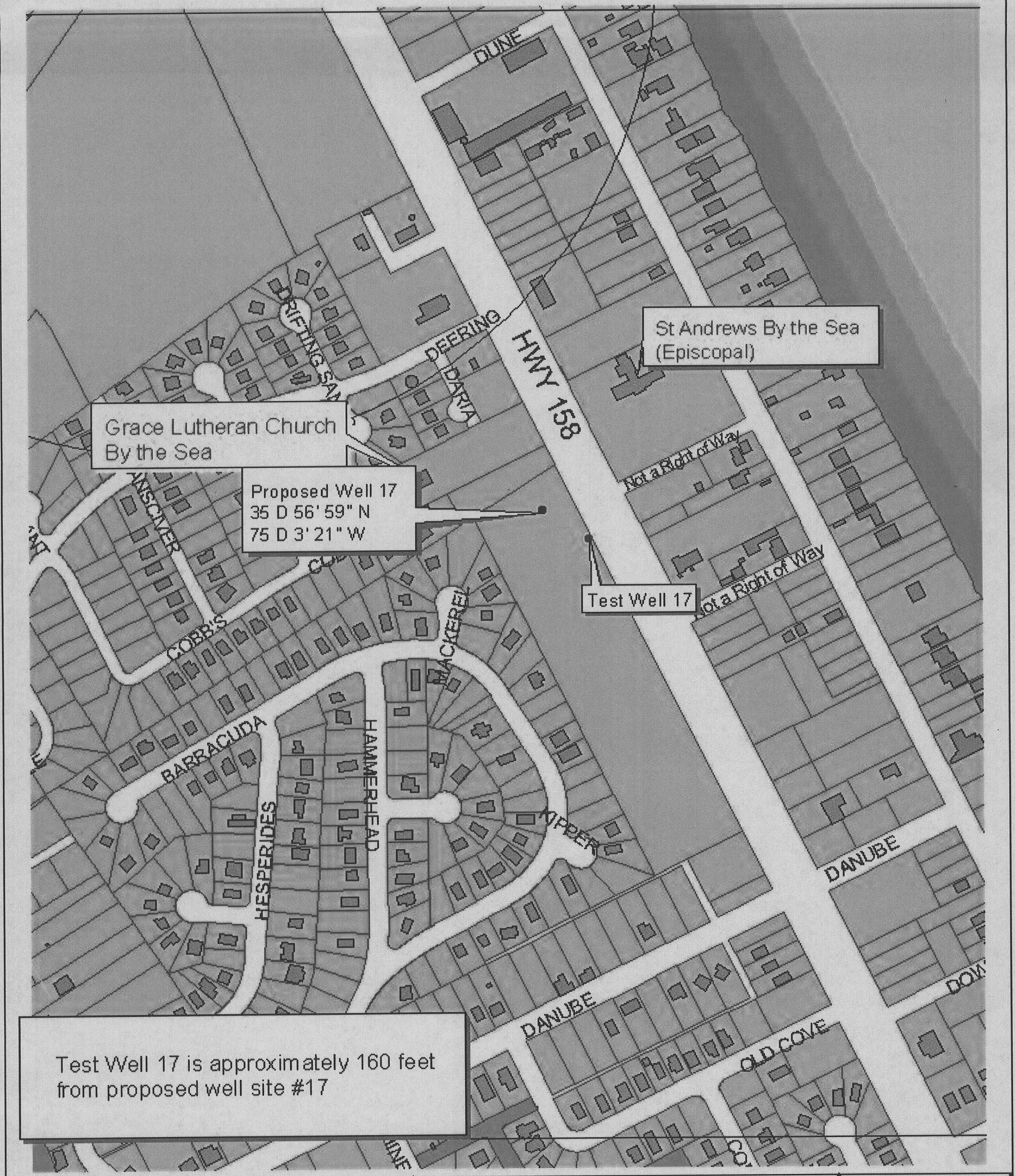


Figure 2. Test Well Location

Section 3
Field Investigation Methods

3.1 Drilling

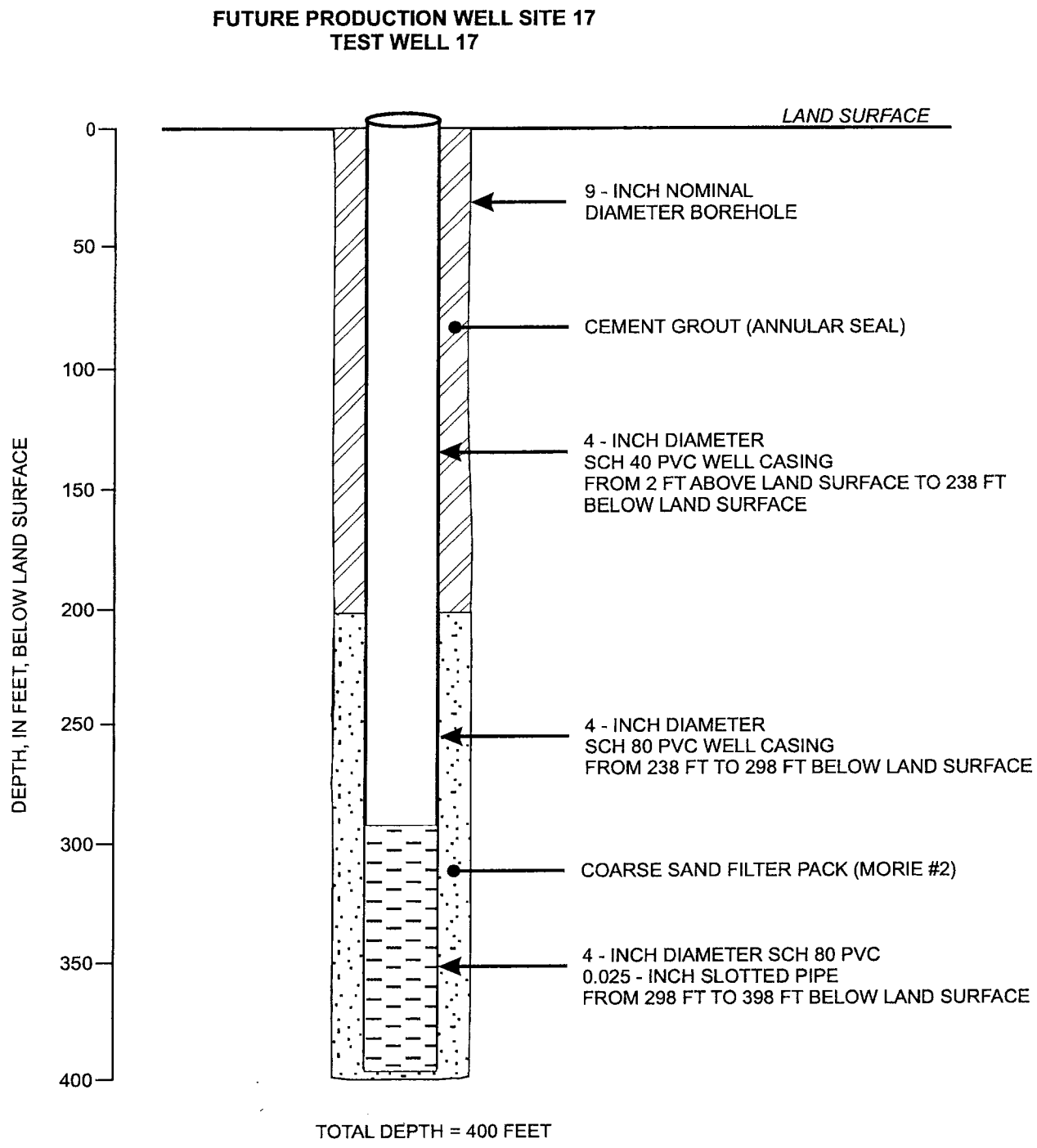
Test well 17 was installed approximately four miles south of the Dare County North RO plant (Figure 1). Skipper's Well Drilling from Leland North Carolina was subcontracted to construct the well, conduct geophysical logging, and perform a pumping test. Staff with CDM Missimer provided on-site supervision during drilling and collected formation samples for lithologic analyses.

Drilling commenced on the morning of August 26, 2002. A nominal 9-inch diameter borehole was drilled using the mud rotary method to a depth of 400 feet below land surface. Electric and natural gamma ray geophysical logs were conducted on the bentonite mud filled borehole after the drill pipe had been removed. The on-site hydrologist selected the screen interval and determined final well design based on analysis of the formation samples and geophysical logs. Copies of the geologist's log and geophysical log are included in the appendix. A very fine to coarse grained sand unit was encountered during drilling within the interval between approximately 300 and 400 feet below land surface. This is the approximate depth interval tapped by the ten existing raw water wells that currently supply the RO plant.

A well string consisting of 100 feet of 4-inch diameter, 0.025-inch slotted Schedule 80 PVC pipe was placed in the borehole followed by 60 feet of 4-inch diameter Schedule 80 PVC casing and 240 feet of Schedule 40 PVC casing to land surface. Construction details for the well are shown on **Figure 3**. A coarse sand gravel pack (Morie #2) was placed around the screen and the well was then developed with compressed air. The well was developed for approximately five hours and subsequently grouted with neat Portland cement from the top of the gravel pack to land surface.

3.2 Aquifer Testing

A 5-hp electric submersible pump was placed in test well 17 with the intake set at 86 feet below land surface. The well was pumped at three separate rates ranging from 67 to 104 gpm. Drawdown in the well was measured with a pressure transducer coupled to an electronic data logger. Results of the step-drawdown test are summarized in **Table 1**. A specific capacity value of 5.6 gpm/ft was determined at a pumping rate of 104 gpm. An additional test was conducted by pumping test well 17 at a constant rate of 104 gpm for approximately 24 hours. Drawdown in the well was measured at closely spaced time intervals and a semi-log plot of drawdown vs. time was constructed for analysis purposes (**Figure 4**).



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CDM Missimer

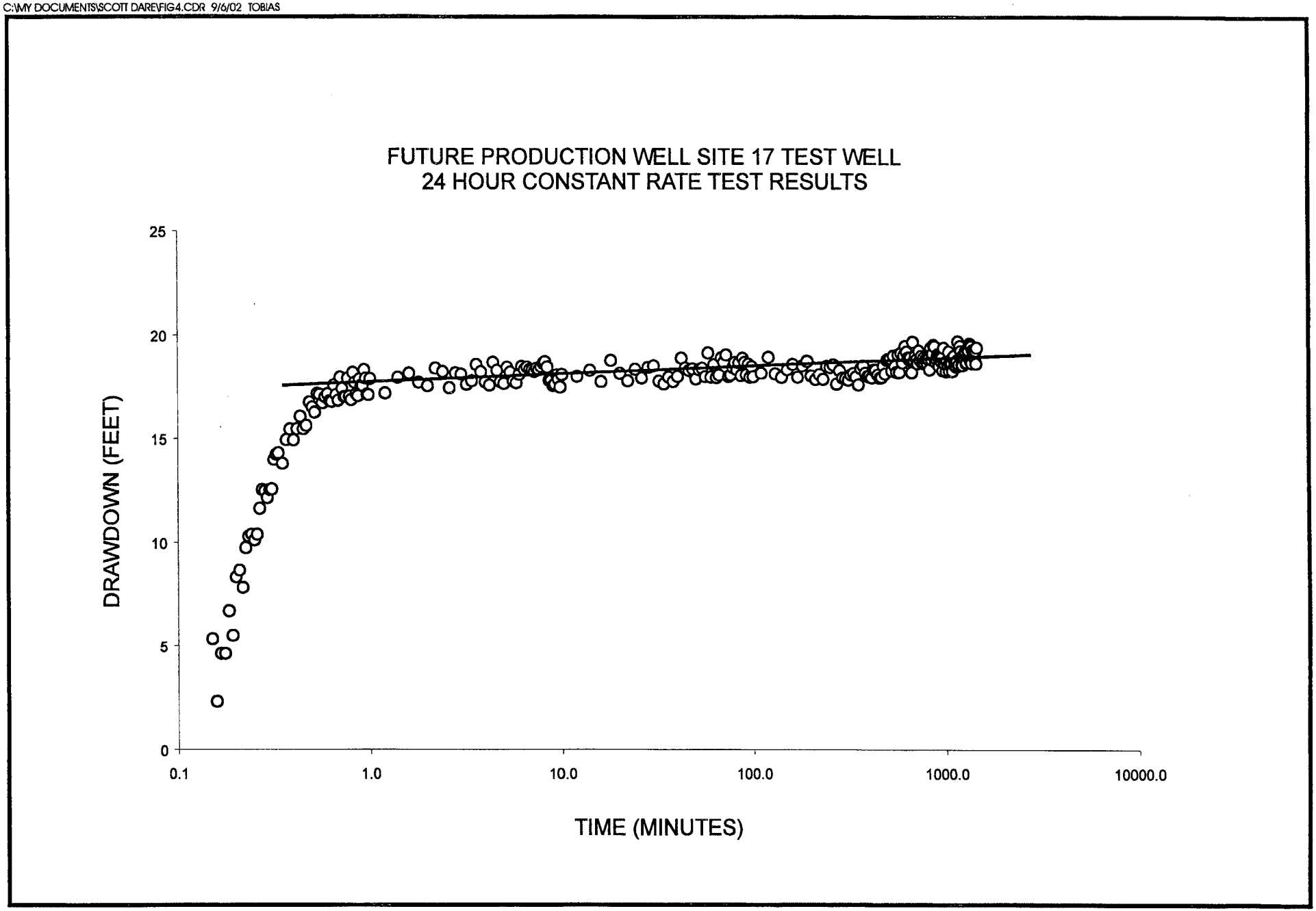
Figure 3
Dare County Test Well
Schematic Diagram Showing Construction Details of Test Well 17

Table 1. Step-Drawdown Test Results for Test Well 17 at the Future Production Well Site 17

Test Date: 28 August 2002 Recorded by: A. Tobias Static Water Level: 20.20 feet Below Measuring Point (BMP)*				
Pumping Rate (GPM)	Time (Minutes)	Pumping Water Level (Ft BLS)	Drawdown (Feet)	Specific Capacity (GPM/Ft)
67	0	00.00	0.00	
	5	28.28	9.93	
	10	28.39	10.04	
	20	28.51	10.16	
	30	28.57	10.22	
	40	28.49	10.14	
	50	28.61	10.26	
	60	28.53	10.18	6.5
72	0	28.53	10.18	
	5	29.31	10.96	
	10	29.23	10.88	
	20	29.37	11.02	
	30	29.39	11.04	
	40	29.29	10.94	
	50	29.43	11.08	
	60	29.43	11.08	6.5
104	0	29.43	11.08	
	5	36.38	18.03	
	10	36.40	18.05	
	20	37.74	19.39	
	30	36.82	18.47	
	40	36.59	18.24	
	50	37.56	19.21	
	60	36.81	18.46	5.6

*Measuring point is top of casing approximately 1.85 feet above land surface.

C:\MY DOCUMENTS\SCOTT DARE\FIG4.CDR 9/6/02 TOBIAS



CDM Missimer

Figure 4
Dare County Test Well
Semi-log Graph Showing Drawdown in Test Well 17
While Pumping at 104 GPM

3.3 Water Quality Sampling

Water samples were obtained from test well 17 near the end of constant rate testing after the well had been pumped at rates of up to 104 gpm for over 24 hours. Detailed analyses of the samples were conducted by the Dare County Water Department staff and also by STL Savannah Laboratories in Tampa, Florida. Analytical reports with the analyses results are included in the appendix. A discussion of the water quality analyses results is included in the following section of this report.

Section 4
Hydrogeology

4.1 Geology

The geology of Dare County has been investigated by various government agencies and private consultants including CDM Missimer. A brief description of the sediments underlying the test well 17 site is provided herein. Detailed discussions of the geologic conditions at Kill Devil Hills and throughout the Outer Banks are provided in the reports included in the reference section of this report.

The uppermost strata encountered at the test well 17 location include undifferentiated very fine to medium pebble sized sand units with some shell beds and interbedded clay. Permeable sediments within these deposits form the water-table aquifer, which is approximately 90 feet thick at the test well 17 site.

The Yorktown Formation of Miocene age lies beneath the surficial sand deposits. The formation consists of beds of fine to coarse grained sand and dense clay units with a thickness that can exceed 500 feet in eastern Dare County. The Yorktown Formation is described in more detail below beginning with the upper confining beds.

At the test well 17 site, the upper part of the Yorktown Formation includes olive-gray marine clay units with varying amounts of fine sand, shell, and phosphate material. The thickness of the upper confining unit is approximately 90 feet at the test site. The clay beds have a very low hydraulic conductivity and provide confinement between the surficial sands and underlying aquifer units.

Beneath the upper Yorktown confining beds is a unit of very fine to very coarse grained sand with minor amounts of shell and clay interbedded. The Principal or upper Yorktown aquifer occurs within this unit which ranges from a thickness of 100 feet or more in some locations to very thin or absent in southern Dare County. The Principal aquifer is approximately 50 feet thick at the test well 17 site.

A low permeability dense marine clay layer that contains minor amounts of silt, sand, and shell lies beneath the Principal aquifer and separates it from the underlying Mid-Yorktown aquifer. The thickness of this unit is approximately 50 feet at the test site. The contact between the confining unit and the Mid-Yorktown aquifer is not distinct. A clay layer approximately 5 feet thick occurs below a shell unit at the top of the aquifer.

The Mid-Yorktown aquifer was encountered at a depth of approximately 278 feet below land surface in test well 17. The aquifer consists primarily of very fine to very coarse grained sand with occasional shell and only trace amounts of clay. The formation sediments at the test well 17 site are similar to those encountered further to the north near the RO plant. However, the sand is poorly sorted within the aquifer at this location. The yield of a production well at this site could potentially be lower than the yield of existing wells near the water plant.

4.2 Aquifer Hydraulic Characteristics

The method developed by Jacob (1952) was used to analyze the data collected during the constant rate test on test well 17. A straight line segment is selected from the semi-log plot of drawdown vs. time (Figure 4) and the change in drawdown over one log cycle is determined and substituted into equation (1) to determine the aquifer transmissivity.

$$T = \frac{264\,Q}{\Delta S} \qquad (1)$$

where,

T = transmissivity (gpd/ft)
Q = pumping rate (gpm)
ΔS = head difference between log cycles (feet)

A transmissivity value of 65,000 gpd/ft was calculated for the Mid-Yorktown aquifer using the time and drawdown data obtained during testing. Aquifer performance testing conducted following the installation of the original eight raw water supply wells near the RO plant and production wells #9 and #10, which are located approximately one mile south of the plant, yielded transmissivity values that ranged from approximately 63,000 gpd/ft to over 100,000 gpd/ft. The calculated transmissivity for the Mid-Yorktown aquifer at the test well 17 site is consistent with the aquifer transmissivity near the RO plant. A large diameter, properly designed and constructed well should produce at a rate of 400 to 500 gpm, similar to the capacity of existing supply wells.

4.3 Water Quality

The laboratory analyses results for the samples obtained from test well 17 indicate that water quality in the Mid-Yorktown aquifer at the test site is brackish but less saline than the water obtained from the existing wellfield. Salinity parameters are summarized in the table below.

Table 2. Mid-Yorktown Aquifer Test Well 17 Water Quality (August 2002)

Dissolved Chloride Concentration (mg/l)		Total Dissolved Solids (mg/l)	
Dare County Lab	STL Savannah Lab	Dare County Lab	STL Savannah Lab
1400	1400	2820	3000

By comparison, the average dissolved chloride concentration of the raw water from the production wells currently supplying the RO plant is approximately 2500-2600 mg/l. It should be noted that production wells #9 and #10 produced water with a dissolved chloride concentration of approximately 1000 mg/l when they were initially put on-line and there was a relatively rapid increase in dissolved chloride concentration in the water obtained from these wells. Wells #9 and #10 currently produce water with a salinity level comparable to the original eight production wells.

Section 5
Water Supply Evaluation

Data collected during the installation and testing of test well 17 indicate that the subject property has potential for raw water supply development. A transmissivity value of approximately 65,000 gpd/ft was calculated for the Mid-Yorktown aquifer at the site. The aquifer transmissivity at the test site is within the range of transmissivity values calculated for the aquifer near the RO plant. A drawdown of 20 to 40 feet is anticipated in a production well at the site with a pumping rate of 450 gpm. Pumping water levels of 40 to 70 feet below land surface may be expected based on the static water level in the aquifer and anticipated interference drawdown effects. It should be noted that these are estimated pumping water levels based on yields of existing production wells and aquifer test results at the well 17 site. Actual production well yield and pumping water levels may vary. Step-drawdown testing of a newly constructed production well would be required to assess the production well yield.

Solute transport modeling to estimate water quality changes that might occur within the Mid-Yorktown aquifer due to withdrawals from an additional well at the subject property was beyond the scope of this investigation. However, previous modeling studies and operational data have shown that spreading pumpage over a larger area is effective in reducing the rate of water quality degradation in the source aquifer. The water obtained from a production well constructed on the test well 17 site would have a lower salinity level than water from the existing production wells. It is anticipated that salinity levels in a production well constructed at the well 17 site would increase over time due to pumpage. The rate of water quality degradation would be directly related to the magnitude and duration of pumpage.

Section 6
Selected References

CDM Missimer. 2000. Report on the Construction and Testing of a Mid-Yorktown Aquifer Test Well at the Wright Brothers Memorial Park: Rept. to the Dare County Water Department, Kill Devil Hills, North Carolina, 17 p.

Jacob, C. E., and Lohman, S. W. 1952. Nonsteady flow to a well of constant drawdown in an extensive aquifer: A Geophysical Union Trans., v. 33, p. 559-569.

Missimer & Associates, Inc. 1987. Modeling of pumping induced groundwater quality changes at the Dare County, North Carolina wellfield (Kill Devil Hills site): Rept. To Black & Veatch, Inc., Asheboro, North Carolina, 177 p.

Missimer & Associates, Inc., Investigation and predictive modeling of water quality changes within the Yorktown Aquifer, Dare County, North Carolina, V. 1: Rept. to the County of Dare Water Production Department, Kill Devil Hills, North Carolina, 129 p.

Missimer International, Inc. 1998. Dare County-Wide Hydrogeological Study and Groundwater Resource Evaluation: Rept. to the Dare County Water Department, Kill Devil Hills, North Carolina, 98 p.

Peek, H. M., Register, L. A., and Nelson, P. F. 1972. Potential Ground-Water Supplies for Roanoke Island and the Dare County Beaches, North Carolina: Rept. of investigations No. 9, Ground Water Division Office of Water and Air Resources, North Carolina Department of Natural and Economic Resources, Raleigh, North Carolina, 26 p.

ViroGroup, Inc. 1994. Report on the construction and testing of the Dare County Water Production Department Reverse Osmosis Wells #9 and #10, Dare County, North Carolina: Rept. to the Dare County Water Production Department, Kill Devil Hills, North Carolina, 39 p.

APPENDIX A

Geologist's Log

GEOLOGIST'S LOG
DARE COUNTY, NORTH CAROLINA
FUTURE PRODUCTION WELL 17 TEST WELL 17
(NC-10)
August 2002

Depth (feet)	Lithology
0 – 17	SAND, dusky yellow (5Y 6/4), fine to medium-grained, quartz, well-sorted, subrounded, very fine to fine-grained phosphate (1-2%).
17 – 25	SAND, pale olive (10Y 6/2), very fine to very coarse-grained (up to 2 mm), quartz, poorly sorted, subrounded, some shell 23-25'.
25 – 42	SAND, pale olive (10Y 6/2), very fine to fine pebble-sized (up to 6 mm), quartz, poorly sorted, subrounded.
42 – 62	CLAY, dark greenish gray (5G 4/1), sticky, some sand and shell, very fine-grained phosphate (1-2%).
62 – 75	SAND, dark greenish gray (5G 4/1) to multi-colored, fine to medium pebble-sized (up to 12 mm), quartz, poorly sorted, subrounded.
75 – 90	SAND, dark greenish gray (5G 4/1) to multi-colored, fine to fine pebble-sized (up to 6 mm), quartz, poorly sorted, subrounded.
90 – 100	CLAY, dark greenish gray (5G 4/1), sticky, sandy, very fine-grained phosphate (1-2%), interbedded with SAND, dark greenish gray (5G 4/1) to multi-colored, fine to fine pebble-sized (up to 8 mm), quartz, poorly sorted, subrounded, some shell.
100 – 120	CLAY, dark greenish gray (5G 4/1), sticky, sandy, very fine-grained phosphate (1-2%), interbedded with SAND, dark greenish gray (5G 4/1) to multi-colored, fine to a few very fine pebble-sized (up to 4 mm), quartz, poorly sorted, subrounded, some shell.
120 – 150	CLAY, dark greenish gray (5G 4/1), very sticky, some shell, very fine-grained phosphate (1-2%).
150 – 177	CLAY, grayish green (5G 5/2), very sticky, no major sand or shell, interbedded with very fine to fine-grained sand layers (more from 165-175').
177 – 200	SAND, grayish green (5G 5/2) and multicolored, very fine to very coarse-grained, quartz, poorly sorted, subrounded, very fine-grained phosphate (1-2%).

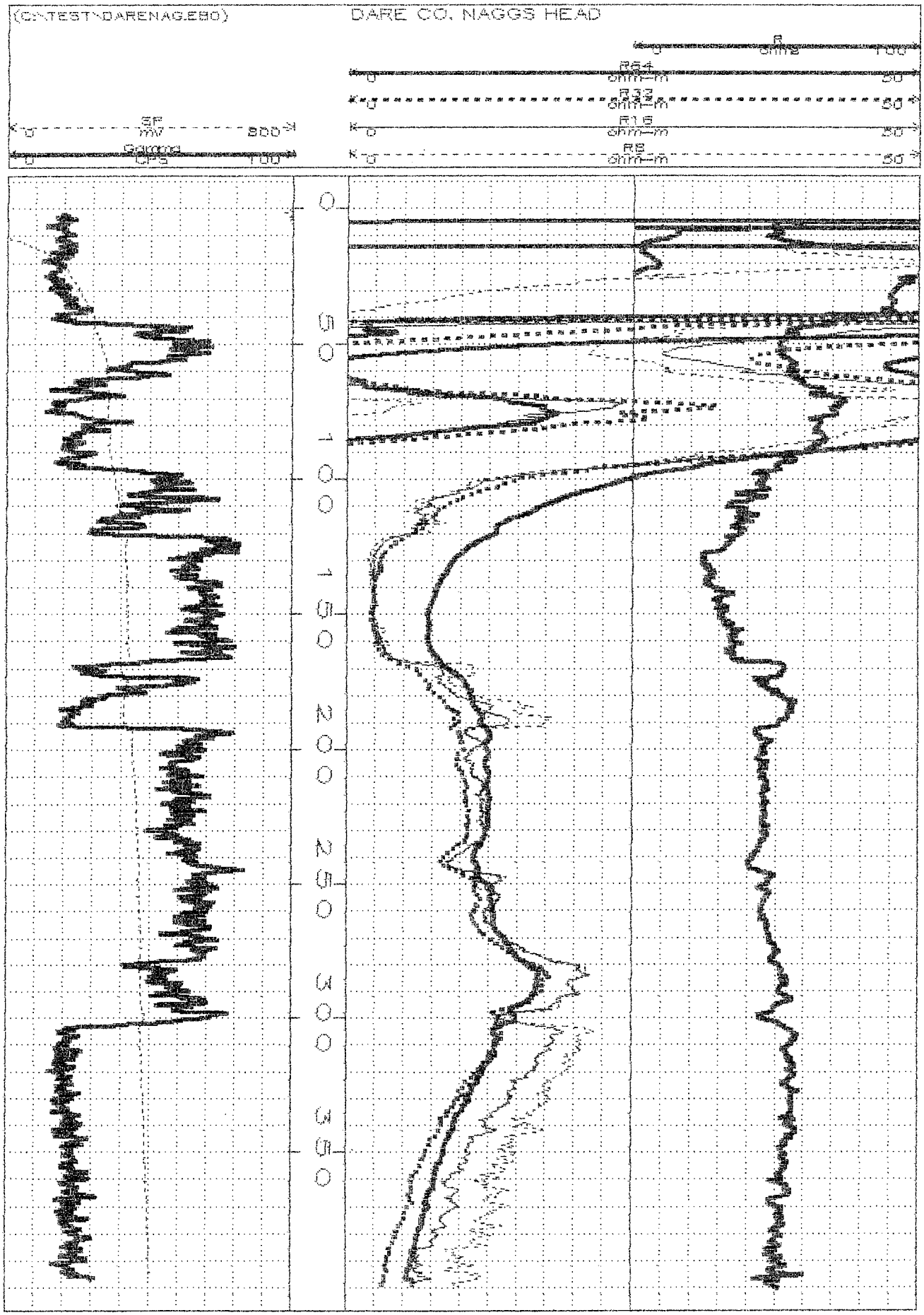
GEOLOGIST'S LOG
DARE COUNTY, NORTH CAROLINA
FUTURE PRODUCTION WELL 17 TEST WELL 17
(NC-10)
August 2002

Depth (feet)	Lithology
200 – 225	SAND, grayish green (5G 5/2), very fine to fine-grained, quartz, well-sorted, subrounded, very fine-grained phosphate (1-2%), interbedded with CLAY, grayish green (5G 5/2), softer than above, minor shell.
225 – 250	CLAY, grayish green (5G 5/2), slightly stiffer than above, minor shell, interbedded with SAND, grayish green (5G 5/2), very fine to fine-grained, quartz, well-sorted, subrounded, very fine-grained phosphate (1-2%).
250 – 278	CLAY, grayish green (5G 5/2), soft to slightly stiff, minor shell, some very fine-grained sand, fine-grained phosphate (1-2%).
278 – 296	SHELL, yellowish gray (5Y 7/2), mollusks, scaphopods, some very fine to fine-grained sand, pale olive (10Y 6/2).
296 – 300	CLAY, grayish green (5G 5/2), soft, minor shell, fine-grained sand, fine-grained phosphate (1-2%).
300 – 325	SAND, grayish green (5G 5/2), very fine to very coarse-grained, quartz, poorly-sorted, subrounded, very fine-grained phosphate (1-2%), more sand with depth, and shell, yellowish gray (5Y 7/2) and black (N1), mollusks, scaphopods.
325 – 350	SAND, grayish green (5G 5/2), very fine to coarse-grained with a few larger pebbles, quartz, poorly-sorted, subrounded, very fine-grained phosphate (1-2%), minor clay and shell.
350 – 400	SAND, grayish green (5G 5/2), very fine to coarse-grained with a few larger pebbles, quartz, poorly-sorted, subrounded, very fine-grained phosphate (1-2%), trace clay and shell.

TD = 400 Feet Below Land Surface

APPENDIX B

Geophysical Log


(C:\TEST\DARENAGE.80)
DARE CO. NAGGS HEAD
SP
mV
800
Gamma
CPS
100
R
ohms
100
R64
ohm-m
50
R32
ohm-m
50
R16
ohm-m
50
R8
ohm-m
50
0
50
100
150
200
250
300
350

APPENDIX C

Water Quality Analyses

Dare County Water System
Water Sample Analyses

Parameter	Results	State Maximum
Total Hardness (mg/l as $CaCO_3$)	~~212~~	160 150
Iron (mg/l as Fe)	~~.053~~	.041 0.3
Chloride (mg/l as CL)	1400	250
Fluoride (mg/l as F)	.98	4.0
Color	~~31~~	90 15
pH	8.24	6.5 - 8.5
Turbidity, NTU	.56	1.0
Total Dissolved Solids (mg/l)	2820	500
Free Chlorine Residual (mg/l)	—	not less than 0.2
Total Chlorine Residual (mg/l)	—	N/A
Bacteriological Results		

Name: test well #17 Phone Number: _____

Address: _____

In house Test kit Arsenic < 2 PPB

Date & Time Sample Taken: 8/29/02 ___ : ___ (AM)/PM

Sample Drawn Location: _____

Date Analysis Completed: 8/29/02 Operator: NC

Date Bacteriological Completed: _____ Operator: _____

CDM

Amy E. Tobias
Hydrogeologist
tel: 239 432-9494
fax: 239 432-9453
e-mail: tobiasae@cdm.com
CDM Missimer
8140 College Parkway, Suite 202
Fort Myers, Florida 33919

consulting - engineering - construction - operations

Dare County Water System
Water Sample Analyses

Parameters	Results	State Max. Limit
Total Hardness (mg/l as $CaCO_3$)	152	150
Iron (mg/l as Fe)	.048	0.3
Chloride (mg/l as CL)	1400	250
Fluoride (mg/l as F)	.88	4.0
Color	~~2~~ 79	15
pH	8.18	6.5 - 8.5
Turbidity, NTU	.41	1.0
Total Dissolved Solids (mg/l)	2720	500
Free Chlorine Residual (mg/l)	.04	not less than 0.2
Total Chlorine Residual (mg/l)	N/A	N/A
Bacteriological Results	N/A	—

Name: Test well #17 Phone Number:

Address:

Date & Time Sample Taken: 8/30/02 1:00 PM

Sample Drawn Location: Test well #17

Date Analysis Completed: 8/30/02 Operator: CP

Date Bacteriological Completed: NA Operator: —

Well pumped for 24 hrs

SEVERN TRENT SERVICES

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STL Tampa

LOG NO: B2-13443
Received: 30 AUG 02
Reported: 16 SEP 02

Mr. Scott Manahan
CDM Missimer
8140 College Pkwy Suite 202
Fort Myers, FL 33919

Cl Project No: 17952-36774-RT.FLD

Project: PROD WELL 17 TEST WELL
Sampled By: Client
Code: 170020916

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED
13443-1	PROD. WELL 17 TEST WELL	08-29-02/14:29

PARAMETER	13443-1
Fluoride (340.2), mg/l	0.85
Analysis Date	09.11.02
Sulfate as SO4 (375.4), mg/l	<5.0
Analysis Date	09.06.02
Solids, Total Dissolved (160.1), mg/l	3000
Analysis Date	09.03.02
Alkalinity (to pH 4.5) as CaCO3 (310.1), mg/l	590
Analysis Date	09.09.02
Turbidity (180.1), NTU	0.15
Analysis Date	08.30.02
Sulfide (376.1), mg/l	1.1
Analysis Date	08.30.02
Silica as SiO2 (6010), mg/l	19
Prep Date	09.06.02
Analysis Date	09.06.02
Boron (6010), mg/l	2.1
Prep Date	09.05.02
Analysis Date	09.09.02

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Cl Project No: 17952-36774-RT.FLD

Project: PROD WELL 17 TEST WELL
Sampled By: Client
Code: 170020916

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED
13443-1	PROD. WELL 17 TEST WELL	08-29-02/14:29

PARAMETER	13443-1
ICP Metals (6010)	
Arsenic, mg/l	<0.010
Calcium, mg/l	14
Copper, mg/l	<0.020
Iron, mg/l	0.058
Magnesium, mg/l	30
Manganese, mg/l	<0.010
Nickel, mg/l	<0.040
Sodium, mg/l	990
Strontium, mg/l	0.57
Zinc, mg/l	<0.020
Prep Date	09.03.02
Analysis Date	09.04.02
Color (110.2), PCU	70
Analysis Date	08.30.02
Bicarbonate Alkalinity as CaCO3 (SM2320B), mg/l	590
Analysis Date	09.09.02
Bromide (300.0), mg/l	34
Analysis Date	08.30.02
Chloride (325.3), mg/l	1400
Analysis Date	09.04.02
Hardness as CaCO3 (2340B), mg/l	160
Prep Date	09.03.02
Analysis Date	09.04.02

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Sampled By: Client
Code: 170020916

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , LIQUID SAMPLES	DATE/ TIME SAMPLED
13443-1	PROD. WELL 17 TEST WELL	08-29-02/14:29

PARAMETER	13443-1
Noncarbonate Hardness as CaCO3 (2340B)	
Hardness as CaCO3, mg/l	<1
Prep Date	09.03.02
Analysis Date	09.04.02

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STL Tampa

LOG NO: B2-13443
Received: 30 AUG 02
Reported: 16 SEP 02

Mr. Scott Manahan
CDM Missimer
8140 College Pkwy Suite 202
Fort Myers, FL 33919

Cl Project No: 17952-36774-RT.FLD

Project: PROD WELL 17 TEST WELL
Sampled By: Client
Code: 170020916

REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES	DATE/ TIME SAMPLED
13443-2	Method Blank	
13443-3	Accuracy (%Rec)	
13443-4	Precision (%RPD)	

PARAMETER	13443-2	13443-3	13443-4
Fluoride (340.2), mg/l	<0.20	103 %	0.98 %
Analysis Date	09.11.02	09.11.02	09.11.02
Sulfate as SO4 (375.4), mg/l	<5.0	100 %	2.0 %
Analysis Date	09.06.02	09.06.02	09.06.02
Solids, Total Dissolved (160.1), mg/l	<5.0	102 %	1.7 %
Analysis Date	09.03.02	09.03.02	09.03.02
Alkalinity (to pH 4.5) as CaCO3 (310.1), mg/l	<1.0	105 %	0.81 %
Analysis Date	09.09.02	09.09.02	09.09.02
Turbidity (180.1), NTU	<0.10	99 %	0.46 %
Analysis Date	08.30.02	08.30.02	08.30.02
Sulfide (376.1), mg/l	<1.0	96 %	0 %
Analysis Date	08.30.02	08.30.02	08.30.02
Silica as SiO2 (6010), mg/l	<0.50	83 %	2.4 %
Prep Date	09.06.02	09.06.02	09.06.02
Analysis Date	09.06.02	09.06.02	09.06.02
Boron (6010), mg/l	<0.050	111 %	0 %
Prep Date	09.05.02	09.05.02	09.05.02
Analysis Date	09.09.02	09.09.02	09.09.02

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REPORT OF RESULTS

LOG NO	SAMPLE DESCRIPTION , QC REPORT FOR LIQUID SAMPLES	DATE/ TIME SAMPLED
13443-2	Method Blank	
13443-3	Accuracy (%Rec)	
13443-4	Precision (%RPD)	

PARAMETER	13443-2	13443-3	13443-4
ICP Metals (6010)			
Arsenic, mg/l	<0.010	110 %	0 %
Calcium, mg/l	<0.50	108 %	0.85 %
Copper, mg/l	<0.020	107 %	1.8 %
Iron, mg/l	<0.050	106 %	1.9 %
Magnesium, mg/l	<0.50	97 %	2.1 %
Manganese, mg/l	<0.010	103 %	0 %
Nickel, mg/l	<0.040	103 %	0 %
Sodium, mg/l	<0.50	94 %	2.0 %
Strontium, mg/l	<0.010	107 %	0.47 %
Zinc, mg/l	<0.020	108 %	1.6 %
Prep Date	09.03.02	09.03.02	09.03.02
Analysis Date	09.04.02	09.04.02	09.04.02
Color (110.2), PCU	<5	100 %	0 %
Analysis Date	08.30.02	08.30.02	08.30.02
Bicarbonate Alkalinity as CaCO3 (SM2320B), mg/l	<1.0	105 %	0.81 %
Analysis Date	09.09.02	09.09.02	09.09.02
Bromide (300.0), mg/l	<1.0	83 %	0.24 %
Analysis Date	08.30.02	08.30.02	08.30.02
Chloride (325.3), mg/l	<1.0	101 %	1.0 %
Analysis Date	09.04.02	09.04.02	09.04.02

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13443-2	Method Blank	
13443-3	Accuracy (%Rec)	
13443-4	Precision (%RPD)	

PARAMETER	13443-2	13443-3	13443-4

Methods: EPA SW-846, EPA 600/4-79-020
DOH Certification #'s E84282, E87052
These test results meet all the requirements of NELAC. All questions regarding this test report should be directed to the STL project manager who signed this test report. The estimated uncertainty associated with these reported results is available upon request.

Michael F. Valder, Project Manager

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