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Geraghty & Miller, Inc.

TEST AND PRODUCTION WELL DRILLING AT NORTH AND SOUTH PORT SAINT LUCIE

JANUARY THROUGH JULY 1974

Prepared for:
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INTRODUCTION

During 1974, test and production-well drilling operations continued at North and South Port St. Lucie, Florida, under the supervision of Geraghty & Miller, Inc., personnel. The purpose of this report is to furnish the results of test and production-well drilling during the first seven months of the year, to give recommendations regarding locations of additional production wells, and to provide guidelines for future test drilling programs. Well locations are shown on Plates 1 through 3. Well-construction diagrams and plots of water-level behavior during pumping tests are given in Appendix A. The geologic logs of the wells are given in Appendix B, and basic data from pumping tests in Appendix C.

SUMMARY

At South Port St. Lucie, 18 test wells were drilled and four production well sites were selected on the basis of the evaluation of the geologic data. During the period from January through July of 1974, 21 test wells were completed at North Port St. Lucie, resulting in the location of five production well sites. Drilling results indicate that present and near-future water demands can be met by constructing production wells at sites within favorable material trends identified in the drilling program of 1973, and further outlined under the present test drilling program. During the course of test drilling, some large areas unfavorable for the development of municipal water supply wells were located.

The principal water-bearing zone occurs 20 to 40 feet below land surface and extends to a depth of 100 to 110 feet. Aquifer materials consist of fine- to medium-grained sand, uncemented shells, coquina and limestone. The nature of these materials is such that production wells must be carefully designed, constructed and developed in order to ensure maximum productivity will be attained.

CONCLUSIONS AND RECOMMENDATIONS

South Port St. Lucie

1. Test drilling should continue on a regular basis.
2. In undeveloped areas, any test drilling should be conducted prior to development so that land can be set aside for future water-supply needs.
3. Water quality and water levels in production and observation wells should be monitored on a regular basis. Monthly water samples should be collected and analyzed; water levels should be taken at weekly intervals as well as maintaining records of when a production well is in operation.
4. Future production wells can be drilled by either rotary or cable-tool methods.
5. Sources of water supplies in addition to the shallow aquifer should be considered for long-term development.
6. Production wells can be installed at the locations of four of the 18 test wells drilled in the first half of 1974, at the sites of Wells 74-1, 74-3, 74-11, and 74-18.

7. Well yields can be expected to range from 100 to 250 gpm within the area tested.

8. The two test-monitor wells 73-8M and 73-9M have been damaged by golf course construction activities and should be repaired to permit sampling and monitoring.

9. The test program results verify the lens or linear channel shape of favorable aquifer materials, showing that not every test well site will be a productive one.

10. The pump in Production Well 6 should be pulled and a 3/4-inch I.D. open-ended plastic tube should be installed by taping the tube to the pump column from the top of bowls to the pump base. The top of the tube should be capped with a removable cap and located for M-Scope accessibility (see Recommendation #1, Report - Test & Production Well Drilling During 1973).

11. Water samples should be taken from the North Fork of the St. Lucie River near test-monitor wells 73-8M and 73-9M on the schedule indicated in Report - Results of Test & Production Well Drilling, 1973.

12. Three production wells should be drilled as soon as possible at the sites of test wells 73-3, 73-5 and 73-7.

13. No additional wells should be drilled west of the sites for the production wells listed in recommendation 12 until evaluation of the quality data from Wells 73-8M and 73-9M and the North Fork of the St. Lucie River are evaluated.

14. Negotiations should be continued with the owner of the property located east of the North Fork of the St. Lucie River, west of Pruitt Drive and south of St. Lucie Boulevard, in order to obtain access for test drilling. No drilling should be done until quality data from the monitor wells and the river are evaluated.

15. A continuous well recorder should be installed in Production Well 9 until such time as the well is equipped with a pump.

North Port St. Lucie

1. The presence of productive aquifer material has been proved on the north and east sides of the open

tract north of Prima Vista Boulevard and west of Airoso Boulevard.

2. Locations for six production wells have been discovered in this tract at the sites of Wells 74-1, 74-2, 74-3, 74-4, 74-5 and 74-14.

3. Test drilling on the Sharitt Ranch property indicates that any future exploration should be conducted in the eastern half of the tract.

4. Production Well 4 was completed, and evaluation of the test data shows it has an estimated yield of 125 gpm.

5. Six production wells should be drilled in the near future to satisfy projected water requirements.

6. A 3/4-inch I.D. open-ended plastic tube should be installed along with the permanent pump in Production Well 4.

7. A continuous well recorder should be installed on Production Well 4 until such time as the well is equipped with a pump.

TEST DRILLING

South Port St. Lucie

During the first half of 1974, 18 test wells were drilled in areas on and surrounding the new golf course, as shown on Plate 1. These wells were spaced approximately 1,000 feet apart, except where conflict with golf course layout was encountered. All wells penetrated the entire section of materials occurring between ground surface and the top of the Hawthorn Formation (green clay) which occurs as a continuous bed underlying the entire project area at an average depth of 125 feet.

The more permeable zones within the shallow aquifer are classified by the relative amounts of clay present either as a matrix or interbedded with other materials. Where the clay is present as discrete layers (interbedded) within beds of sand, the aquifer has the highest permeability. As outlined in the 1973 report, potentially productive aquifer materials occur as north-south channel trends and lenses. Owing to the irregular nature of these deposits, it is impossible to predict well yields in the absence of test drilling, and it is possible for comparatively impermeable materials to be present

in an area where test drilling has shown permeable materials to be present. Nevertheless, the data are useful in delineating broad areas where test wells should be installed as well as selecting sites for future production wells.

Seven of the test holes penetrated permeable materials suitable for the installation of production wells, which are estimated to have potential yields ranging from 100 to 250 gpm (gallons per minute). Production wells could be drilled at the sites of Wells 74-1, 74-3, 74-11 and 74-18.

Drilling operations should be held in abeyance at the remaining locations (Wells 74-14, 74-15 and 74-16). These are located west of the treatment plant and are fairly close to the North Fork of the Saint Lucie River, which reportedly contains brackish water. Due to the proximity of the river to these three sites, no drilling should be done until after sufficient quality data have been collected from the two monitoring wells (73-8M and 73-9M) and the river to determine whether salt-water encroachment is a problem. Details of the proposed sampling program are contained in the Geraghty & Miller report of January 1973 entitled "Test and

Production Well Drilling During 1973 at South Port St. Lucie, North Port St. Lucie and Port Malabar, Florida."

North Port St. Lucie

During this exploration program, 21 test wells were drilled in existing subdivided areas (Plate 2) and on the Sharitt Ranch property (Plate 3). Test Wells 1 and 13 were drilled to locate the first production well site close to the existing water treatment plant. Information on these wells was sent to the State Health Department in order to obtain a variance with regard to production well spacing and possible sources of contamination because the geologic data indicated the presence of a clay bed overlying the aquifer which would inhibit or prevent the downward movement of fluids contained in nearby canals and ditches. The request for the variance was denied, causing a change in the order of production well development and necessitating the drilling of additional test wells. The school tract north of Prima Vista Boulevard was further evaluated by drilling Test Wells 74-2 through 74-6. Permeable materials were penetrated in the depth interval between 70 and 100 feet below

grade at these sites, indicating that production wells can be drilled at each of these locations.

As part of the overall evaluation of the potential for ground-water development, a number of widely spaced test wells were drilled on GDC property located adjacent to the east side of the Florida Turnpike and south of the Florida Power and Light right-of-way and on the Sharitt Ranch as shown on Plate 3. Only two of these wells, 74-7 and 74-9, penetrated materials judged to be sufficiently permeable to warrant the drilling of production wells. However, because of the considerable distance between test wells, it is possible that some permeable materials may have been missed. Therefore, in the future, some consideration should be given to drilling a few more wells in these areas to fill in these gaps. In addition, test drilling could only be conducted in the western portion of the Sharitt Ranch property because of the absence of access roads and flooding. Consequently, any plans for future test well drilling should include provisions for the installation of test wells in the eastern half of the property.

PRODUCTION WELL DRILLING

North Port St. Lucie

Production Well 4 was drilled during the early summer of 1974 as the first of six production wells to be drilled outside the old well field area during the year. The well site was selected on the basis of the evaluation of the data from Wells 73-13 and 73-15 and because it is quite near the planned route of a major pipeline along Airoso Boulevard. The construction details of the well are shown in Figure 1 and its location is given on Figure 2. The well is an 8-inch by 16-inch gravel-packed installation. The 16-inch casing was driven to 114 feet and 8-inch diameter (pipe size) wire-wound stainless steel screen was set from 79 to 109 feet. An 8-inch stainless steel blank pipe with a welded plate on the bottom was set from 109 to 114 feet as a sump. Wells in the area have a history of gradually silting in the bottom portion of the screen and the sump was added to collect these sediments without plugging the screen. The presence of the sump should prolong well life, provide a more efficient installation, and reduce maintenance costs for redevelopment. A gravel pack consisting of No. 620 material was installed

from 114 feet back to land surface and the 16-inch casing pulled back to 79 feet.

The well was developed by a combination of surge block and compressed air pumping. A vertical turbine pump was used to complete the development by backwashing.

The controlled pumping test was conducted for a period of 24 hours at a rate of 140 gpm. The water level declined from a static of 2.73 feet from the measuring point one foot above land surface to 63.91 feet after 1,110 minutes of pumping. Thereafter, the water level fluctuated slightly between 63.12 and 63.63 feet. At the end of the test, the water level was at 62.99 feet.

A semi-logarithmic graph of the water level versus time is shown on Figure 3. Examination of the plot shows that the water level declined rather rapidly for the first 25 minutes after the start of pumping. Thereafter, there was a sharp reduction in the rate of decline as the water level approached the point of stabilization. During the time interval from approximately 500 minutes through the end of the test, the water level was stabilized. This type of behavior is characteristic of the effect of the vertical leakage from

overlying or underlying confining beds. As the water level declines, an hydraulic gradient is created from the confining beds to the aquifer which induces water to move into the aquifer by means of vertical leakage. When the quantity of water derived from vertical leakage equals the amount being pumped, the water level stabilizes. Thereafter, no additional decline will occur as a result of pumping and the water level will fluctuate only in response to variations to recharge, or because of interference from other nearby wells. It is believed that the stabilization in Production Well 4 occurred as a result of leakage from beds overlying the aquifer and not from below. The underlying Hawthorn Formation is thick and relatively impermeable and if any upward leakage occurred, it would have been very small.

At stabilization, approximately 60.9 feet of drawdown occurred, giving the well a specific capacity of 2.3 gpm per foot. Therefore, the theoretical maximum yield of the well would be approximately 177 gpm, based on a maximum available drawdown of 77 feet. However, pumping at the theoretical maximum rate would result in the water level being lowered to the top of the screen. Since the water level also will

fluctuate in response to seasonal variations in recharge and pumpage from other nearby production wells, the total drawdown in the well would result in part of the screen being dewatered, exposing it to the atmosphere. This could lead to corrosion and/or encrustation of the screen which would eventually impair the well's performance. In the absence of any valid data, it is estimated that the drawdown resulting from these outside influences could be from 10 to 20 feet. Consequently, the well's actual yield should be less than the theoretical maximum because the total drawdown in the well should not exceed that which is available, in this case 77 feet. Assuming only a 15-foot drawdown due to interference and seasonal water-level fluctuations, and 60.9 feet of self-induced drawdown which will be caused by a 140-gpm pumping rate, the total drawdown would be 75.9 feet for a pumping level of about 77 feet below grade. This would result in a pumping level too close to the top of the screen. Therefore, to provide adequate protection, it is recommended that the well be equipped to pump at a 125-gpm rate to prevent exposing, either as a result of drought or interference, the screen to the atmosphere. In estimating the total head

requirements for the permanent pump, a water level of 70 feet below grade should be used.

WATER QUALITY AND MONITORING

South Port St. Lucie

During the 1973 drilling program, two wells (73-8M and 73-9M) were installed at the locations shown on Plate 1. These two-inch wells are located close to the North Fork of the St. Lucie River and Kitchings Cove, and will serve as monitor wells to be sampled periodically to determine long-term water quality trends, particularly with respect to concentrations of the chloride ion.

Based on results of pumping tests at both South and North Port St. Lucie, stabilization of water-levels occurs as the result of vertical leakage from overlying confining beds. Thus, it is possible that salt-water encroachment could occur in the area when additional production wells are put into operation and greater stress is placed on the aquifer.

One of the recommendations contained in the Geraghty & Miller report of January 1974 dealt with procedures to be

used in sampling these wells. It is strongly recommended that these be implemented as soon as possible. In addition, each time a well is sampled, the water level should be measured and referenced to a known datum such as sea level. All of this information should be kept for reference.

Recently, it was noted that the casings of both these observation wells had been bent and twisted by earth-moving equipment. This condition should be corrected as soon as is practical.

North Port St. Lucie

At the conclusion of the pumping test on Production Well 4, a water sample was collected and submitted to T. G. Hussey of General Development for chemical analysis. The results are shown on Table 1. It should be noted that the concentrations of the chloride ion and total dissolved solids are comparatively high, 170 ppm and 654 ppm respectively. The concentrations of these constituents in the water from the wells at the treatment plant are much lower.

Considering the location of Production Well 4, it is unlikely that the high chloride content is a natural condition or the result of salt water encroachment, either

TABLE 1: Chemical Analysis of Water from Production Well 4, North Port St. Lucie, Florida (Concentrations expressed in parts per million, except for color, odor, taste, pH and stability index)

Total Dissolved Solids, @ 103°C	664
Total Hardness, as $CaCO_3$	272
Alkalinity, as $CaCO_3$	292
Non-carbonates, as $CaCO_3$	0
Bicarbonate, as NCO_3	356
Iron, as Fe	0.0
Sulfate, as SO_4	65
Chlorides, as Cl	170
Calcium, as Ca	91
Magnesium, as Mg	10.7
Fluoride, as F	0.3
Color	15
Odor	H_2S
Taste	H_2S
Carbon Dioxide, as CO_2	18*
Bicarbonate, as $CaCO_3$	292*
Carbonate, as $CaCO_3$	0*
Hydroxide, as $CaCO_3$	0*
Temperature, at time of collection, °F	76
pH, laboratory	7.5
pHs	7.1
Stability Index (2pHs - pH)	6.7

* = Calculated value

Date collected: 7/24/74

Date Analyzed: 8/9/74

Analyzed by: T. G. Hussey

laterally or by upconing from below. The probable source is a nearby artesian well, tapping the Floridan aquifer, which is either flowing at the surface or leaking water directly into the shallow aquifer because of a corroded or improperly sealed casing. Consequently, an effort should be made to locate the well and plug it with cement to assist in alleviating this problem.

As it stands now, the chlorides in the water from Production Well 4 are not excessive and the well can be utilized. However, when it is placed in operation, water samples should be collected on a monthly basis and analyzed to determine if there is any variation or degradation of water quality. A simple chloride analysis should be adequate. Also, as other production wells are placed in operation, a similar program of water-quality monitoring should be undertaken for each facility.

GROUND WATER CONTAMINATION

During the course of the ground-water development program, it has become apparent that the numerous abandoned flowing wells on GDC land and adjacent properties pose a

significant threat to the quality of the fresh water present in the shallow aquifer. These wells, many of which are quite old, tap the limestone of the Floridan aquifer and produce water containing excessive amounts of chlorides, sulfates and total dissolved solids. Most of the Floridan wells were improperly constructed, as the casings were not driven deep enough to seal off the shallow aquifer, and in many instances the casings have corroded. As a consequence, brackish water has migrated upward through these wells, entered the shallow aquifer and degraded the quality of the water. These bodies of contaminated water are of local extent and are the cause of the anomalously high chloride values noted in areas where the shallow aquifer should contain fresh ground water.

Recognizing that the abandoned, deep wells are sources of contamination, General Development undertook a well sealing program during the first half of 1974 which resulted in the plugging of six wells with cement. The average cost for plugging each well was about $4,000.

Because of the considerable expense involved in plugging all known abandoned wells, it would be impractical to attempt to plug all the wells in a single program. Nevertheless, the well program should be continued at an annual

expenditure satisfactory to General Development. A suggested program would be to examine the areas within a mile of existing and proposed well fields and attempt to locate and seal all abandoned deep wells within this distance, starting with the nearest wells, if this is economically feasible. As the program progresses, wells at greater distances can be inventoried and sealed, thereby protecting the quality of water in the shallow aquifer.

Respectfully submitted,
GERAGHTY & MILLER, INC.

Lars E. Persson

Lars E. Persson

Vincent P. Amy

Vincent P. Amy

July 2, 1975

APPENDIX A

ILLUSTRATIONS

Geraghty & Miller, Inc.

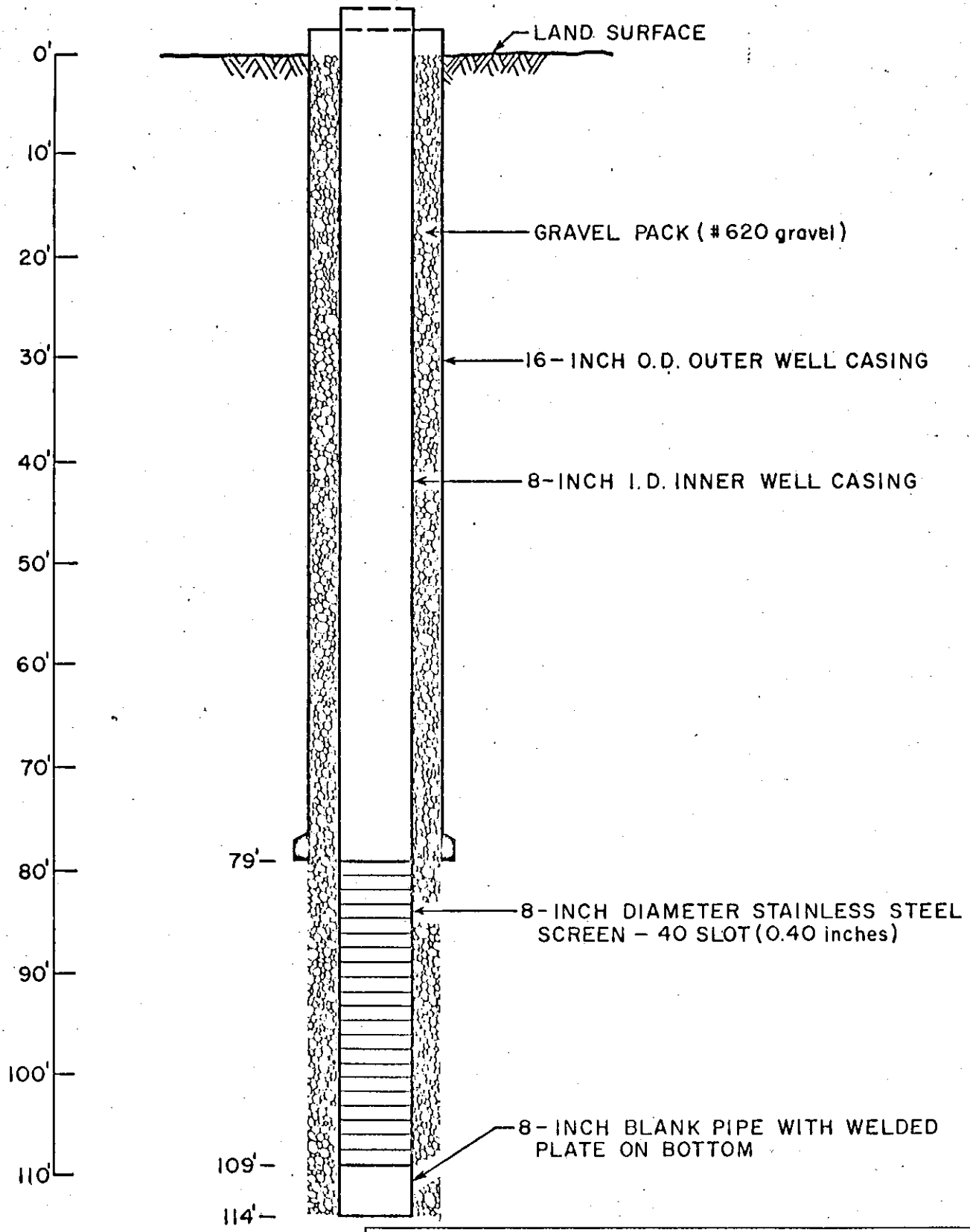

FIGURE 1

CONSTRUCTION DETAILS OF PRODUCTION WELL 4

GENERAL DEVELOPMENT UTILITIES
NORTH PORT ST. LUCIE, FLORIDA

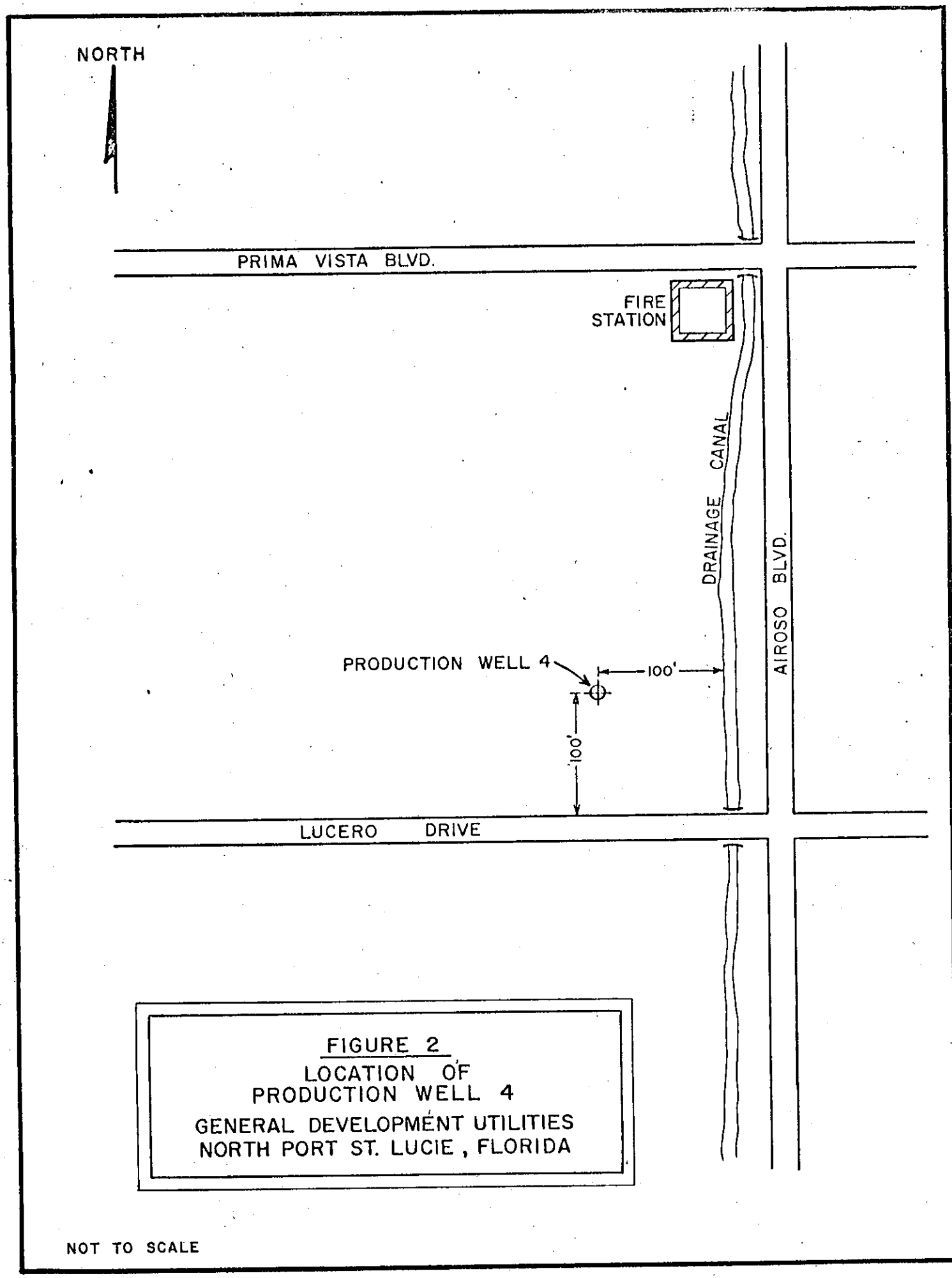

FIGURE 2
LOCATION OF
PRODUCTION WELL 4
GENERAL DEVELOPMENT UTILITIES
NORTH PORT ST. LUCIE, FLORIDA

NOT TO SCALE

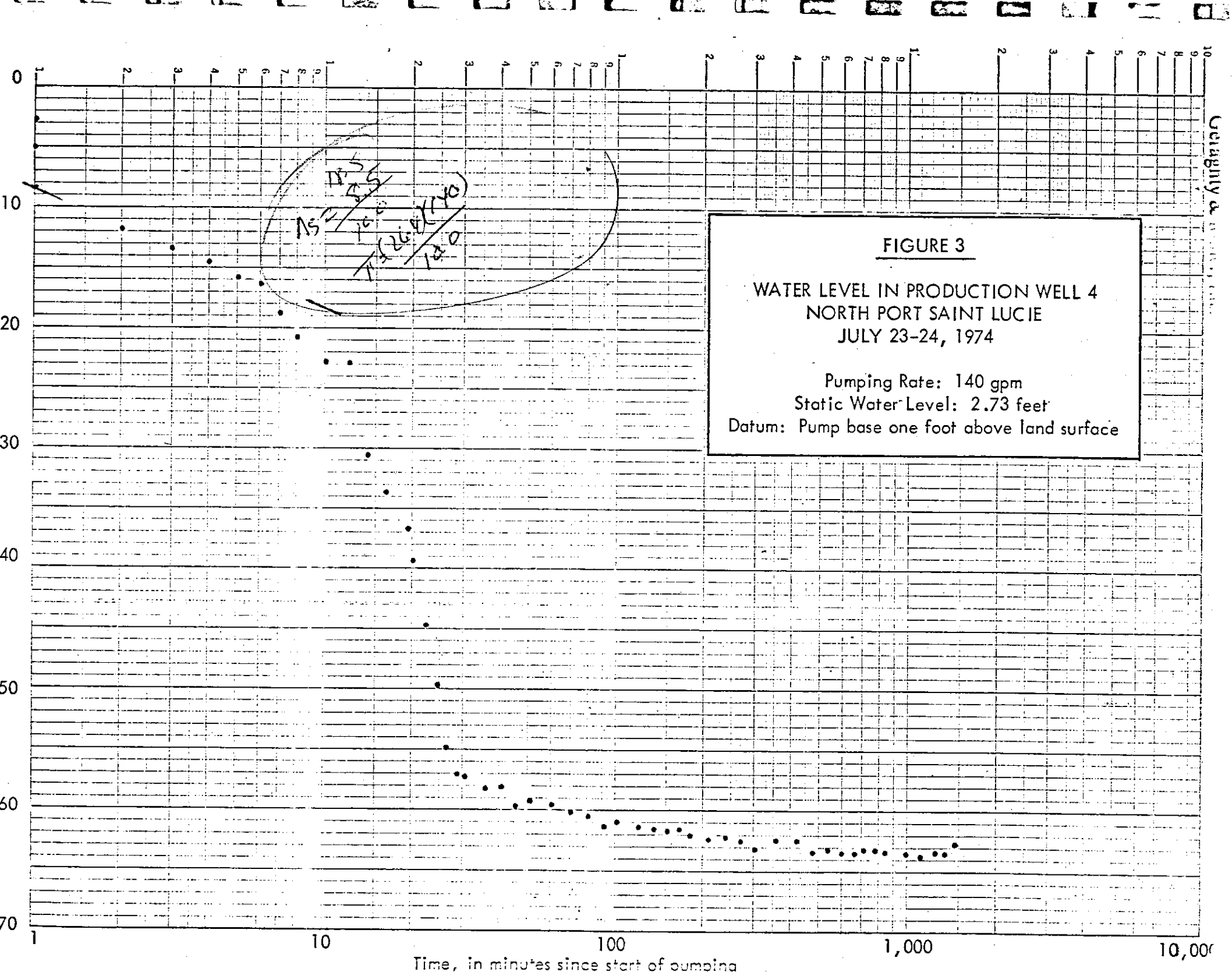

FIGURE 3

WATER LEVEL IN PRODUCTION WELL 4
NORTH PORT SAINT LUCIE
JULY 23-24, 1974

Pumping Rate: 140 gpm
Static Water Level: 2.73 feet
Datum: Pump base one foot above land surface

APPENDIX B

WELL LOGS

APPENDIX B

GEOLOGIC LOGS OF TEST WELLS DRILLED AT SOUTH PORT ST. LUCIE DURING FIRST HALF 1974

Description	Depth (feet)	Interval (feet)
Well 74-1		
Sand, very fine to fine, gray, trace of silt and clay, brown	0 - 4	4
Clay and silt, light gray	4 - 10	6
Clay and silt, light gray	10 - 28	18
Clay, olive, trace of sand, very fine	28 - 31	3
Coquina, gray	31 - 40	9
Shells, lightly cemented, trace of sand, very fine, and clay	40 - 50	10
Shells, sandy, and clay interbedded with limestone, gray	50 - 60	10
Coquina and limestone, interbedded, trace of clay, silty	60 - 70	10
Coquina and limestone, gray	70 - 80	10
Shells and limestone, gray, lightly cemented	80 - 115	35
Clay, green	115 - 116	1
Well 74-2		
Sand, very fine to medium, silty, gray	0 - 4	4
Clay, silty, soft, buff	4 - 43	39
Shells, small, interbedded with silt and clay, brownish-gray	43 - 54	11
Shells, small, cemented (coquina), trace of silt and clay, brown	54 - 57	3
Coquina and clay, interbedded, trace of silt, dark gray, trace of limestone in thin beds	57 - 66	9
Coquina and limestone, interbedded, trace of clay, gray, very hard, variably cemented	66 - 122	56
Clay, green, soft	122 - 123	1

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-3		
Sand, very fine to fine, trace of silt and clay, brown	0 - 5	5
Clay, gray, trace of silt and sand, very fine, interbedded with clay, brown	5 - 44	39
Shells and coquina and clay, thinly bedded, gray	44 - 66	22
Coquina, gray	66 - 83	17
Limestone and shells, interbedded, gray	83 - 100	17
Limestone and shells, trace of sand and clay, gray	100 - 116	16
Clay, green, soft	116 - 117	1
Well 74-4		
Sand, very fine, trace of clay, brown	0 - 4	4
Clay, olive and gray, soft, trace of silt	4 - 45	41
Shells, gray, small, interbedded with trace of limestone and silt	45 - 81	36
Coquina limestone and silty clay, interbedded, gray	81 - 117	36
Clay, green, soft	117 - 118	1
Well 74-5		
Sand and clay, fine, brown	0 - 3	3
Clay, soft, gray and olive, trace of shells, small	3 - 40	37
Clay, dark gray, trace of silt and shells	40 - 52	12
Clay, interbedded with thin streaks of limestone and coquina, dark gray	52 - 69	17
Limestone and coquina, interbedded, trace of silt and clay, dark gray	69 - 117	48
Clay, soft, green	117 - 118	1

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-6		
Sand, very fine to medium, white	0 - 5	5
Sand, very fine to medium, light gray, trace of silt and clay	5 - 21	16
Clay and shells, loose and partially cemented, interbedded with thin beds of sand and silt	21 - 33	12
Limestone and coquina, gray, trace of clay, gray	33 - 38	5
Clay, gray, firm, silty	38 - 51	13
Clay and silt, gray, trace of coquina and limestone	51 - 96	45
Sandstone, green, friable	96 - 100	4
Clay, green, soft	100 - 101	1
Well 74-7		
Sand, very fine and silt, trace of clay, gray	0 - 4	4
Silt, trace of sand, very fine to fine, gray	4 - 33	29
Silt, trace of sand, fine, and shells, interbedded with clay, soft	33 - 39	6
Sand, very fine to medium, trace of cemented sand and loose shells	39 - 82	43
Clay, light green, trace of shells and limestone	82 - 98	16
Sandstone and coquina, interbedded with clay	98 - 102	4
Clay, Hawthorne clay, green, soft	102 - 103	1

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-8		
Soil, brown	0 - 4	4
Clay, trace of silt, light brown	4 - 24	20
Clay, green to olive, soft	24 - 27	3
Clay, silty, trace of shells, gray	27 - 41	14
Limestone and shells, interbedded, trace of clay, gray	41 - 70	29
Limestone and shells, interbedded with clay, thin beds	70 - 84	14
Shells and clay, light green, soft	84 - 103	19
Coquina, gray	103 - 105	2
Coquina and clay, trace of silt	105 - 112	7
Clay, green, soft	112 - 113	1
Well 74-9		
Clay and silt, interbedded, light and dark brown and dark green	0 - 38	38
Clay and limestone and shells, gray	38 - 49	11
Limestone and shells, trace of clay	49 - 61	12
Limestone and shells, interbedded with clay	61 - 81	20
Limestone and shells, trace of clay and silt, gray	81 - 115	34
Clay, soft, green	115 - 116	1
Well 74-10		
Soil, brown	0 - 2	2
Clay, silty, light brown	2 - 15	13
Silt, trace of shells and clay, gray	15 - 31	16
Clay and shells, interbedded, trace of silt	31 - 48	17
Silt and sand, fine, interbedded with coquina	48 - 59	11

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-10 (cont.)		
Coquina, trace of silt, gray	59 - 81	22
Silt and sand, fine, interbedded, trace of shells, small	81 - 119	38
Clay, green, soft	119 - 120	1
Well 74-11		
Clay, silty, brown	0 - 30	30
Clay and shells, interbedded, olive green	30 - 41	11
Shells, lightly cemented and loose, trace of clay and silt, gray	41 - 79	38
Limestone and coquina, trace of clay, silt, and sand	79 - 116	37
Clay, green, soft	116 - 117	1
Well 74-12		
Soil, brown	0 - 4	4
Clay, silty, light brown	4 - 28	24
Clay, soft, olive green, interbedded with shells, loose, trace of silt	28 - 42	14
Coquina and shells, loose, trace of silt and clay	42 - 83	41
Coquina and limestone, trace of silt	83 - 115	32
Clay, soft, green	115 - 116	1
Well 74-13		
Soil and clay, brown	0 - 3	3
Clay, silty, light gray, trace of sand, fine	3 - 17	14
Clay, silty, light gray, interbedded with lightly cemented shells	17 - 30	13
Clay, soft, olive green, interbedded with shells	30 - 40	10

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-13 (cont.)		
Limestone and shells and clay, trace of silt	40 - 50	10
As above, with larger fragments of limestone and shells, gray	50 - 61	11
Limestone with trace of shells and coquina, trace of clay	61 - 81	20
Limestone and shells, interbedded, trace of clay	81 - 101	20
Coquina, trace of clay	101 - 115	14
Clay, green, soft	115 - 116	1
Well 74-14		
Soil	0 - 3	3
Clay, silty, medium brown	3 - 21	18
Clay, light gray, soft	21 - 28	7
Clay, gray	28 - 39	11
Coquina and clay, interbedded	39 - 70	31
Limestone interbedded with clay, trace of shells, gray	70 - 81	11
As above, smaller fragments	81 - 96	15
Clay, light gray	96 - 98	2
Limestone and shells interbedded, trace of clay	98 - 107	9
Sandstone, green, and clay, interbedded	107 - 109	2
Clay, green, soft	109 - 110	1
Well 74-15		
Sand, very fine, gray	0 - 2	2
Clay, silty, gray	2 - 24	22
Shells, trace of silt and clay, gray	24 - 35	11
Coquina sand, fine, silt interbedded	35 - 63	28
Coquina, gray	63 - 79	16
Clay, silty, gray	79 - 81	2

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-15 (cont.)		
Coquina and shells, interbedded with sand, fine	81 - 96	15
Sand, very fine to medium, trace of silt and clay, gray	96 - 115	19
Clay, green, soft	115 - 116	1
Well 74-16		
Sand and clay, dark brown	0 - 5	5
Clay and sand, trace of silt, light gray	5 - 35	30
Shells and coquina, trace of silt and clay	35 - 55	20
As above, loose	55 - 77	22
Shells, loose	77 - 90	13
Coquina and sand, interbedded	90 - 101	11
Sandstone, soft, green	101 - 103	2
Clay, green, soft	103 - 104	1
Well 74-17		
Sand, very fine to fine, white	0 - 3	3
Clay, silty, light gray	3 - 8	5
Clay, silty, light brown	8 - 28	20
Clay, silty, dark gray	28 - 36	8
Shells, cemented, interbedded with clay, gray, soft, trace of sand, very fine	36 - 42	6
Clay, gray, trace of sand, fine	42 - 52	10
Limestone, cemented, gray	52 - 55	3
Shells, cemented, trace of silt and sand, fine, gray	55 - 61	6
Shells, cemented, trace of silt and clay, gray	61 - 70	9
Coquina, trace of sand	70 - 81	11

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-17 (cont.)		
Coquina, interbedded with clay, soft, gray	81 - 92	11
As above, increase in clay	92 - 97	5
Coquina, cemented tightly	97 - 99	2
Clay, light gray, soft	99 - 105	6
Sandstone, soft, green	105 - 108	3
Clay, green, soft	108 - 109	1
Production Well 7 (Pilot Hole)		
Sand and silt, brown	0 - 12	12
Sand and silt and clay, interbedded, light brown	12 - 32	20
Shells, lightly cemented, interbedded with silt and clay	32 - 36	4
Coquina, gray	36 - 41	5
Coquina and sand, interbedded, trace of silt	41 - 61	20
As above	61 - 90	29
As above, with coarser texture	90 - 101	11
Coquina, interbedded with clay, trace of sand and silt, gray	101 - 113	12
Sandstone, soft, green	113 - 115	2
Clay, green, soft	115 - 116	1
(Pilot hole for 74-7, 50' from 73-3)		
Production Well 8 (Pilot hole)		
Clay, brown, soft, trace of silt	0 - 5	5
Clay, silty, light gray	5 - 17	12
Clay, with cemented shells	17 - 19	2
As above	19 - 25	6
Clay, soft, blue-green	25 - 29	4

Geologic Logs of Test Wells
Drilled at South Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Production Well 8 (cont.)		
Shells, white and beige, interbedded with coquina, trace of clay and sand, fine	29 - 39	10
Coquina, interbedded with sand, fine, trace of clay and silt, gray	39 - 101	62
Production Well 9 (Pilot Hole)		
Clay, silty, trace of sand, fine, light gray	0 - 5	5
Clay, silty, light brown	5 - 31	26
Shells, loose and cemented, trace of sand and silt	31 - 61	30
Coquina, gray	61 - 81	20
Shells and limestone, cemented, trace of clay	81 - 101	20
Shells and limestone, cemented, interbedded with sand and clay, fine	101 - 114	13
Sandstone, green	114 - 118	4
Clay, soft, green	118 - 119	1

GEOLOGIC LOGS OF TEST WELLS DRILLED AT NORTH PORT ST. LUCIE DURING FIRST HALF 1974

Description	Depth (feet)	Interval (feet)
Well 74-1		
Sand, very fine to medium, trace of clay, gray	0 - 6	6
Clay, gray	6 - 11	5
Sand and shells, loose, trace of limestone and clay, gray	11 - 20	9
Sand and shells, trace of clay	20 - 32	12
Sand and shells, trace of clay	32 - 45	13
Sand and shells, fine to very coarse, gray	45 - 68	23
Sand, very fine to fine, trace of shells, somewhat cemented	68 - 70	2
Sand, very fine to fine, trace of shells, gray	70 - 78	8
Shells, fine to medium to coarse, gray, somewhat cemented, trace of limestone and sand, gray	78 - 91	13
Shells and limestone sand, gray, somewhat cemented	91 - 105	14
Sand, very fine to medium and shells, gray	105 - 120	15
Clay, bright green, soft	120 - 120½	½
Total depth	120½	
Well 74-2		
Sand, very fine to fine, interbedded with clay, gray	0 - 20	20
Sand, very fine to medium, shell fragments, gray, uncemented	20 - 40	20
Shells, medium, loose with 40% sand, very fine to medium, gray	40 - 80	40
Limestone, cemented and loose gravel with shells, 40%, gray	80 - 90	10

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-2 (cont.)		
Limestone, cemented and loose gravel with shells, slightly finer-grained, gray	90 - 100	10
Limestone gravel, fine, and shells 50-50, some cemented zones and some loose	100 - 129	29
Clay, green, soft	129 - 131	2
Total Depth	131	
Well 74-3		
Sand, very fine to fine, trace of clay, brown	0 - 10	10
Sand, very fine to medium with interbed-bed clay, gray	10 - 19	9
Shells and clay, trace of limestone sand, gray	19 - 42	23
Sand and shells and clay, thin beds of limestone, cemented	42 - 51	9
Clay, with shells and sand, gray	51 - 73	22
Shells and limestone gravel, gray, trace of sand, very fine to medium	73 - 104	31
Sand, fine to medium and limestone gravel, trace of shells	104 - 120	16
Clay, green, soft	120 - 121	1
Total Depth	121	
Well 74-4		
Sand, very fine to fine, and clay, gray	0 - 20	20
Sand, very fine with shells, trace of clay, gray	20 - 30	10
Shells and clay, trace of sand	30 - 40	10
Sand and shells, fine to medium, streaks of limestone, cemented, gray	40 - 50	10

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-4 (cont.)		
Sand and shells, trace of limestone, gray	50 - 60	10
Shells, small and sand, very fine to medium, gray	60 - 70	10
Sand, very fine to medium with 30-40% shells, small, broken, gray	70 - 120	50
Clay, green	120 - 121	1
Total Depth	121	
Well 74-5		
Sand, very fine to fine, trace of clay, gray	0 - 10	10
Sand, very fine to fine, interbedded, sand and clay	10 - 20	10
Sand, fine to medium, and shells, small, loose, gray	20 - 30	10
Sand, very fine to fine, and shells, small, loose, gray	30 - 40	10
Shells, small to medium, trace of sand and limestone, gray	40 - 50	10
Sand, very fine, 20-30% shells and cemented limestone stringers, gray	50 - 60	10
Shells, medium, loose, trace of sand and limestone, gray	60 - 70	10
Shells and sand, very fine to fine, gray	70 - 80	10
Sand, very fine to fine and shells, small	80 - 110	30
Sand, very fine to fine and shells, small	110 - 120	10
Clay, green, soft	120 - 121	1
Total Depth	121	

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-6		
Artificial sand and gravel fill	0 - 5	5
Sand, cemented, white, with fossils	5 - 12	7
Sand, cemented, white, with fossils, interbedded with clay and sand, fine to medium, loose, gray	12 - 22	10
Shells and limestone, gray, trace of sand and clay	22 - 30	8
Shells and limestone, gray, trace of sand and clay, gray	30 - 40	10
Limestone and shells, loose and cemented, trace of clay, gray	40 - 63	23
Shells, medium, with limestone and sand, gray	63 - 72	9
Sand, fine to medium, and limestone fragments, 20 to 30% shells	72 - 84	12
Limestone, well cemented with shells	84 - 90	6
Sand, very fine to medium, trace of limestone and shells	90 - 120	30
Clay, green, soft	120 - 121	1
Total depth	121	
Well 74-7		
Sand, very fine, gray, and clay, tan, interbedded	0 - 10	10
Sand and clay, trace of shells, gray	10 - 20	10
Shells, medium large, loose limestone sand and gravel and sand, very fine to medium, gray	20 - 30	10
Shells, loose and coquina, limestone sand and gravel, trace of clay, gray	30 - 52	22

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-7 (cont.)		
Clay, white with trace of shells and limestone, limestone sand and gravel	52 - 60	8
Clay, limestone and shells, loose, interbedded	60 - 118	58
Clay, green, soft	118 - 121	3
Total Depth	121	
Well 74-8		
Silty sand, very fine, gray, and clay, brown	0 - 7	7
Clay, soft, gray	7 - 20	13
Sand, very fine to fine, trace of clay and shells	20 - 31	11
Sand and shells, very fine to fine, gray	31 - 43	12
Shells with 20% sand, trace of limestone and clay	43 - 46	3
Clay and sand, very fine to fine, trace of clay and limestone, gray	46 - 52	6
Sand and clay, very fine to fine, trace of shells and limestone	52 - 62	10
Shells (coquina and limestone), cemented, gray	62 - 69	7
Shells and sand (limestone), very fine to very coarse	69 - 103	34
Sand, very fine to medium, with shells, fine to silt, gray	103 - 120	17
Clay, green	120 - 121	1
Total Depth	121	

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-9		
Sand, very fine to medium, white	0 - 1	1
Sand and clay, cemented, gray	1 - 2	1
Clay, soft, gray	2 - 15	13
Clay and sand, very fine to fine, gray	15 - 23	8
Sand, very fine to medium, trace of shells, dark gray	23 - 41	18
Shells, medium, trace of sand, very fine to coarse, gray	41 - 61	20
Sand, fine to coarse, gray, 20 to 30% shells, some thin cemented zones, gray	61 - 83	22
Sand, very fine to medium, gray, trace of shells	83 - 96	13
Sand, very fine to medium, with shells and limestone, gray	96 - 104	8
Sand, very fine to medium, trace of shells and limestone, gray	104 - 131	27
Clay, green, soft	131 - 132	1
Total Depth	132	
Well 74-10		
Sand, very fine, gray	0 - 2	2
Clay, trace of sand, fine	2 - 20	18
Sand, fine, with 20% clay and shells	20 - 28	8
Shells, limestone, trace of sand, fine, gray	28 - 62	34
Sand, very fine to medium, trace of shells, silt and limestone, some well cemented zones	62 - 140	78
Clay, green, soft	140 - 141	1
Total Depth	141	

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-11		
Sand, very fine to medium, cemented, brown	0 - 3	3
Clay, gray and brown, trace of sand	3 - 21	18
Shells, limestone and sand, very fine to medium, gray, shells medium to coarse, loose	21 - 59	38
Sand, very fine to medium, interbedded with sand and cemented limestone, gray	59 - 91	32
Sand, very fine to medium and silt, gray, some cemented zones	91 - 123	32
Clay, green	123 - 125	2
Total Depth	125	
Well 74-12		
Sand, fine to medium, cemented, gray	0 - 10	10
Clay, trace of sand, gray	10 - 17	7
Sand, very fine to medium, trace of clay and shells, gray	17 - 35	18
Shells, trace of limestone and sand, loose	35 - 48	13
Shells with limestone and sand	48 - 61	13
Sand, very fine to medium, with limestone and shells, trace of clay	61 - 88	27
Shells, limestone, and sand, trace of clay, gray	88 - 120	32
Clay, green	120 - 121	1
Total Depth	121	
Well 74-13		
Sand, fine, white	0 - 3	3
Clay, trace of sand and shells	3 - 19	16
Shells, loose with sand, trace of limestone	19 - 38	19

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-13 (cont.)		
Shells, limestone, trace of sand, very fine to fine, gray	38 - 57	19
Sand, very fine to medium, some shells, streaks of limestone	57 - 78	21
Shells, sand, and limestone, trace of clay	78 - 90	12
Shells and limestone sand to fine gravel, (cemented coquina and limestone beds), very thin, gray	90 - 120	30
Clay, green, soft	120 - 121	1
Total Depth	121	
Well 74-14		
Sand, very fine, gray	0 - 4	4
Clay, brown, trace of silt and sand, very fine	4 - 22	18
Shells, trace of limestone and sand, very fine, gray	22 - 41	19
Sand, very fine to fine, and shells, trace of limestone and clay, gray	41 - 62	21
Coquina and shells, trace of sand, very fine to fine, gray	62 - 81	19
Sand, very fine to fine, trace of shells, limestone and clay	81 - 120	39
Clay, green, soft	120 - 121	1
Total Depth	121	
Well 74-15		
Clay, trace of silt and sand, very fine, brown	0 - 21	21
Clay, trace of silt, interbedded with shells, loose and cemented, dark gray	21 - 104	83

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-15 (cont.)		
Clay, light gray	104 - 120	16
Clay, green, soft	120 - 121	1
Total Depth	121	
Well 74-16		
Sand, very fine to fine, gray	0 - 4	4
Clay, trace of silt, trace of sand, very fine to fine	4 - 28	24
Clay, trace of silt, brown, trace of shells, small, and limestone	28 - 120	92
Clay, green, soft	120 - 121	1
Total Depth	121	
Well 74-17		
Clay, light brown, trace of silt	0 - 24	24
Clay, silty, and sand, very fine, trace of shells	24 - 60	36
Coquina and clay, interbedded, gray, trace of sand, very fine	60 - 123	63
Clay, green, soft	123 - 124	1
Total Depth	124	
Well 74-18		
Clay, silty, gray and brown, trace of sand, very fine	0 - 22	22
Clay and silt, interbedded, trace of shells, dark gray	22 - 52	30
Clay, white, trace of shells and limestone, trace of sand, fine	52 - 70	18

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-18 (cont.)		
Shells, limestone, and sand, very fine to fine, gray, trace of clay	70 - 128	58
Clay, green, soft	128 - 129	1
Total Depth	129	
Well 74-19		
Clay, brown, trace of silt and sand	0 - 22	22
Clay, black, trace of silt and sand, very soft	22 - 38	16
Silt and clay, with thin beds of shells, dark brown, trace of cemented sand	38 - 82	44
Clay and thinly bedded limestone, trace of shells and coquina, light brown	82 - 123	41
Clay, green, soft	123 - 124	1
Total Depth	124	
Well 74-20		
Sand, very fine to fine, brown, trace of silt	0 - 4	4
Sand, very fine and silt, trace of clay, gray	4 - 18	14
Sand, very fine, gray, trace of silt and clay	18 - 24	6
Shells and silt, dark gray, soft, trace of clay	24 - 58	34
Shells and limestone, thinly bedded, trace of silt and clay, light gray	58 - 100	42
Shells and clay, trace of limestone, gray	100 - 120	20
Clay, green, soft	120 - 121	1
Total Depth	121	

Geologic Logs of Test Wells
Drilled at North Port St. Lucie
During First Half 1974
(continued)

Description	Depth (feet)	Interval (feet)
Well 74-21		
Sand, very fine to fine, gray	0 - 3	3
Clay, soft, gray, trace of silt	3 - 12	9
Shells and clay, gray	12 - 30	18
Shells, trace of limestone and sand, very fine to fine	30 - 52	22
Shells, trace of limestone and sand, very fine to fine, trace of clay	52 - 61	9
Sand, trace of shells and limestone, and coquina, gray	61 - 73	12
Shells, coarse, limestone, trace of sand	73 - 83	10
Shells, limestone, sand, and clay, gray	83 - 120	37
Clay, green, soft	120 - 121	1
Total Depth	121	

APPENDIX C

NORTH PORT SAINT LUCIE
PRODUCTION WELL 4
PUMPING TEST DATA

PROJECT GDC WELL 4 LOCATION North Fork St. Lucie PAGE 1 OF 3

SCREEN 79' x 109' M.P. Pump Base HT. ABOVE G.S. 1' W.L. MEAS. W/ M' scope

r --- PUMPING WELL 4' Q 140 gpm ORIFICE 3" x 4" WEATHER 85°F. - clear

X DRAWDOWN ___ RECOVERY X LOCATION SKETCH TEST START 10:00 a.m. - 7/23/74

END 10:00 a.m. - 7/24/74

TE ME	t	HELD	WET	D.T.W.	s			MANO-METER	Q	WATER TEMP.	
00		static		2.66							
30		"		2.66							pump setting - 70'
00		"		2.70							
30		"		2.73							
p.m.	0			2.73							
	1			5.00							
	2			11.92							
	3			13.08							
	4			14.33							
	5			15.75							
	6			16.18							
	7			18.83							
	8			20.92	---						
	9			-							
0:10	10			22.95							
	12			22.97							
	14			30.52							
	16			33.81							
	18			36.63							
0:20	20			39.26							
	22			44.58				11"	140		
	24			49.84							
	26			55.08							
	28			57.03							
30	30			57.29							
	35			58.24							
40	40			58.22							
	45			59.52							
50	50			59.02							
	55			-							
1 a.m.	60			59.54							
	65			60.02							
	70			60.17							
	75			60.37							
	80			60.75							
	85			61.05							
:30	90			61.38						76.5°F.	
	[illegible]			61.00				11"	140		

PROJECT GDC WELL 4 LOCATION North Fort St. Lucie PAGE 2 OF 3

SCREEN 79' x 109' M.P. Pump Base HT. ABOVE G.S. 1' W.L. MEAS. W/ M' scope

r --- PUMPING WELL 4 Q 140 gpm ORIFICE 3" x 4" WEATHER 85°F. - clear

X DRAWDOWN ___ RECOVERY ___ LOCATION SKETCH TEST START 10:00 a.m. - 7/23/74
END 10:00 a.m. - 7/24/74

TE E	t	HELD	WET	D.T.W.	s			MANO-METER	Q	WATER TEMP.	
:50	110			60.65				11"	140	76.5°F	
:n	120			61.32							
:5	135			61.63							
:30	150			61.68							
:5	166			61.74							
a.m.	180			62.21							
30	210			62.38							
p.m.	240			62.03							
:30	270			62.57							
p.m.	300			63.03							
30	330			62.02							
p.m.	360			62.51				11"	140		
30	390			62.50							
p.m.	420			62.59							
30	450			62.35							
p.m.	480			63.50							
30	510			63.75							
p.m.	540			63.13							
30	570			63.10							
p.m.	600			63.50							
30	630			63.67							
p.m.	660			63.33							
30	690			63.09							
p.m.	720			63.19							
30	750			63.46							
p.m	780			63.42							
:30	810			63.33							
nt	840			63.50							
:30	870			63.76							
a.m	900			63.72							
:30	930			63.57							
a.m	960			63.58							
	990			63.58							
a.m	1020			63.62							
:30	1050			63.61							
a.m	1080			63.63							
:30	1110			63.91							
a.m	1140			63.63				11"	140	76.5°F.	

PROJECT GDC WELL _____ LOCATION North Fork St. Lucie PAGE 3 OF 3

SCREEN 79' x 109' M.P. Pump Base HT. ABOVE G.S. 1' W.L. MEAS. W/ M' scope

r --- PUMPING WELL 4 Q 140 gpm ORIFICE 3" x 4" WEATHER 85°F. - clear

X DRAWDOWN X RECOVERY ___ LOCATION SKETCH TEST START 10:00 a.m. - 7/23/74 END 10:00 a.m. - 7/24/74

TIME	t	HELD	WET	D.T.W.	s			MANO-METER	Q	WATER TEMP.	
00	1170			63.55							
a.m	1200			63.48							
00	1230			63.42							
a.m	1260			63.63							
30	1290			63.32							
a.m.	1320			63.55							
30	1350			63.35							
a.m.	1380			63.28							
30	1410			63.12							
a.m.	1440	0		62.99							
	1			32.30							
	2			25.05							
	3			20.82							
	4			18.71							
	5			17.04							
	6			16.33							
	7			-							
	8			15.13							
	9			14.59							
10	10			13.91							
	12			13.25							
	14			12.46							
	16			11.82							
	18			11.19							
20	20			10.73							
	25			9.17							
30	30			8.66							
	35			8.05							
	40			7.42							
	45			7.00							
	50			6.66							
	55			6.44							
m.	60			6.25							

APPENDIX D

PLATES 1 THROUGH 3
WELL LOCATION MAPS