Geraghty & Miller, Inc.

EXPLORATORY DRILLING AND TESTING AT PORT LABELLE, FLORIDA FEBRUARY - MAY 1980

GENERAL DEVELOPMENT CORPORATION
MIAMI, FLORIDA

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FEBRUARY - MAY 1980

GENERAL DEVELOPMENT CORPORATION
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ABSTRACT

In 1980, General Development Corporation authorized Geraghty & Miller to conduct an investigation of the availability of potable ground water at Port LaBelle. The existing water supply at Port LaBelle consists of one well tapping a sand and shell aquifer occurring between 200 and 300 feet below land surface. The water produced by this well is of good quality.

Six holes were drilled by the mud-rotary method; three to depths as great as 313 feet and three to 150 feet. Small-diameter monitor wells were completed, developed, and pumped at two locations where screenable material was encountered. Two potential production well sites were found where yields in excess of 1000 gallons per minute are anticipated. Borehole geophysical logs and earth resistivity surveys were conducted; data correlated well with known geologic conditions.

INTRODUCTION

In 1980, General Development Corporation of Miami, Florida contracted Geraghty & Miller, Inc., of West Palm Beach, Florida to provide hydrogeologic consulting services for General Development's Port LaBelle properties, LaBelle, Florida. Services were performed in conjunction with the Increment II ADA (Application for Development Approval) as authorized by Contract 816, Addendum 9.

As part of General Development's continuing program of exploration and water-supply development in the Port LaBelle area, Geraghty & Miller,in February 1980, conducted exploratory drilling, geophysical logging, construction of monitoring wells, and water sampling under the authorization. In addition, as requested by General Development, Geraghty & Miller performed experimental electrical resistivity surveys in May 1980. This report discusses the results of previous drilling and testing programs and the findings of the recent program. The potential for future water-supply development is considered. Recommendations are made for future drilling, testing, and development.

PREVIOUS EXPLORATION AND DEVELOPMENT

General Development began to explore the ground-water resources at Port LaBelle in 1971. A test well (71-1) was installed near the present golf course maintenance area to a depth of 142 feet below land surface. (This well is often referred to as the Jimmy Miller Well). Geologic material (principally sand and shells) that appeared to be favorable for the installation of high-capacity wells was encountered from about 100 feet below land surface to the total drilled depth. A ten-foot-long well screen was installed in this well between 127 and 137 feet below land surface; the well was developed and specific capacity of 47.7 gpm/ft (gallons per minute per foot of drawdown) was recorded in a one-hour test at 240 gpm. The well was left in place as a monitoring well at a potential future production well site and is designated as Well 71-1 (2) on Plate 1.

In 1972, seven exploratory borings were installed at widely separated locations in Port LaBelle (see Plate 1). The first five borings (72-1 through 72-5) did not encounter material that could be considered to be highly productive,and they were abandoned by backfilling with drill cuttings and bentonite clay. A water sample was collected for analysis from Boring 72-5. Borings

72-6 and 72-7, located at the present water treatment plant site, encountered material between 200 and 300 feet below land surface that appeared to be favorable for the installation of high capacity wells. An eight-inch-diameter test-production well was installed at the location of Boring 72-6 and is designated as Well 72-6(1) in this report. An observation well was installed at Site 72-7 and has remained as a permanent monitoring well.

Well 72-6(1) has been put into service as Production Well 1 and is the principal water source for Port LaBelle. Although the present pump capacity is 500 gpm, a pumping test performed on this well in 1973 indicated that, at this location, the aquifer is capable of yielding 1000 to 2000 gpm to properly constructed wells. Table 1 gives total drilled depth and completion status of all test borings to date at Port LaBelle.

TABLE 1

TEST BORING AT PORT LABELLE
GENERAL DEVELOPMENT CORPORATION
PORT LABELLE, FLORIDA

Boring Number	Total Drilled Depth (feet below land surface)	Completion Status
71-1	142	Plugged *
72-1	200	Plugged
72-2	250	Plugged
72-3	250	Plugged
72-4	150	Plugged
72-5	260	Plugged
72-6	150	Plugged **
72-7	155	Monitoring Well
80-1	313	Plugged
80-2	300	Monitoring Well
80-3	300	Monitoring Well
80-4	150	Plugged
80-5	150	Plugged
80-6	150	Plugged

* Redrilled as 71-1(2) with screened interval of 127 to 137 feet

** Redrilled as 72-6(1) with screened interval of 250 to 290 feet

1980 EXPLORATION

Well Construction

Six wells were installed at Port LaBelle in February, 1980. Geraghty & Miller contracted Drilling Services of Fort Pierce, Florida to install the borings under the direction of a staff hydrogeologist. Sites were selected for their present accessibility, future availability to General Development, and compliance with the Florida DER (Department of Environmental Regulation) Rules and Regulations Governing Water Wells. These sites are shown on Plate 1 and in Appendix A.

All borings were constructed by drilling a five-and-one-half-inch-diameter borehole by the mud-rotary method to total depth. Borings 80-1, 80-2, and 80-3, located 2000 feet west, east, and north of the existing water plant, were drilled to depths of 300 to 313 feet. Borings 80-4, 80-5, and 80-6, located progressively west of Boring 80-3, were each drilled to 150 feet below land surface. A geologic log was compiled by the hydrogeologist as each boring was drilled. These are found in Appendix B along with the logs of all previous borings and wells. After completing Borings 80-1, 80-2, and 80-3 to total depth, spontaneous potential, single-point resistivity, gamma ray, and caliper logs were made. Copies of these are included in Appendix C.

Geologic material that appears to be potentially suitable for the construction of high-capacity wells was encountered from 100 to 200 feet in Borings 80-2 and 80-3. These were converted to permanent monitoring wells by the installation of a gravel pack around two-inch-diameter PVC casing and screen. The construction details of the monitoring wells are shown in Appendix D. At all other locations (80-1, 80-4, 80-5, 80-6), the material was judged to be not sufficiently productive to warrant the installation of future high-capacity wells. These holes were backfilled with drilled cuttings and bentonite.

Upon completion, Wells 80-2 and 80-3 were developed by pumping for one-half hour with a one-and-one-quarter-inch centrifugal pump. After development, each well was pumped to determine discharge rate and to obtain a water sample. Wells 80-2 and 80-3 both pumped 60 gpm with the one-and-one-quarter-inch pump. Static water levels were between 5 and 6 feet below land surface.

Water Quality

The water samples collected were forwarded to the Environmental Quality Laboratory, Inc., at Port Charlotte for analysis. The results of the analysis of the water samples from Wells 80-2 and 80-3, along with earlier results from Wells 71-1(2), 72-5, 72-6(1), and 72-7, are included in Appendix E.

Ground water in the productive zones discovered to date is of good quality. Sulfate and chloride concentrations are low; the hardness is typically high, and the average total dissolved solids content is below potable limits. On the sample from Well 80-2, analyses were also conducted for trace metals, pesticides, and herbicides. Except for barium which was just slightly above, trace metals were below the limits for potable water established by the Florida DER. The probable reason for the higher than normal barium concentration is that during development all of the drilling mud was not removed from the hole. Drilling mud contains large amounts of soluble barium sulfate that probably contributed to the total barium content in the sample. Therefore, the high barium level is considered to be not representative. The results of the analyses for pesticides and herbicides showed that none were present in the sample.

One of the limitations to water-supply development at GDC's other properties has been water quality. Production from potential well-field areas has been limited by proximity to poor-qualtiy water beneath formerly heavily irrigated farmland, near abandoned wells tapping the Floridan aquifer, and in drainage canals. It would appear that these sources of poor-quality water are not a problem in areas investigated to date at LaBelle. Irrigation for agricultural use from the Floridan aquifer appears to have been limited, and existing information indicates that only one flowing well exists in Port LaBelle. To protect the quality of the fresh water aquifer, GDC personnel have been alerted to note the location of potential sources of ground-water contamination and any other abandoned flowing wells on the property.

Geophysical Well Logs

Geophysical well logging includes all techniques in which sensing devices are lowered into a borehole to record some physical parameter that may be interpreted in terms of the characteristics of the subsurface material or the fluids contained in the subsurface material. A series of geophysical logs (spontaneous potential, single-point resistivity, gamma, and caliper) were performed on Borings 80-1, 80-2, and 80-3 at Port LaBelle upon completion of the borings to total depth.

A spontaneous potential (SP) log is a continuous recording of the natural voltage potential between a surface ground electrode and a point electrode as the point electrode is lowered into or raised out of a borehole. Variations in the recorded voltage difference will occur as the electrode in the hole passes different formations. These variations are due to electro-chemical effects between dissimilar materials, borehole fluid, and other effects associated with movement of water through the various layers. The SP curve is relative in value; therefore, it may be shifted right or left at will. Since potentials associated with shales and clays are normally the least negative, the maximum spontaneous deflection opposite shales and clays is to the right-hand side of the SP section of the graph. This is called the shale (clay) line.

The maximum left-side deflection of the recorder tracing is called the sand line because it represents more permeable strata such as sand, gravels, and rock with good porosity. The SP log is normally recorded simultaneously with resistivity and is displayed on the left-hand side of the log paper.

A single-point resistivity log is a continuous recording of the relative apparent resistivity between a surface ground electrode and a point electrode as the point electrode is lowered into or raised out of the borehole. Variations in the recorded apparent resistivity will occur as the electrode in the hole passes different formations or zones with differing water quality. The resistivity of a water-bearing formation depends on the water quality and the porosity of the material. Apparent resistivity values are highest for dense, solid rock and lowest for clays. Moderate resistivities in combination with negative spontaneous potentials are indicative of fresh water aquifers.

Gamma ray logging is the measurement of the natural radioactivity of various formations in the borehole. In most cases, clays contain a higher concentration of naturally occurring radioactive materials than limestones, sandstones, or sands; thus, high readings are associated with clays and low readings with permeable materials. A major exception to this that can occur in South Florida is the occurrence of phosphate minerals in sand and shell layers. Phosphate minerals are naturally radioactive and will cause high gamma ray readings despite the fact that they are found in sand and shell beds.

Caliper logs show the variation in the diameter of the borehole. Such logs are useful in interpreting other geophysical logs that can be influenced by hole diameter variations. Caliper logs may also show the cohesiveness of the subsurface material, since a borehole is usually washed out to a larger diameter when poorly consolidated or permeable materials are penetrated.

On the SP logs of Borings 80-2 and 80-3, there is a very distinct negative potential from 100 to 240 feet; the apparent resistivity logs in the same zone show resistivities in the moderate range, confirming the presence of sand as noted in the geologic logs of the borings. The gamma ray logs of these two wells are very similar, with the very high relative natural gamma radiation reading from the surface of 100 feet indicating high clay content and the occurrence of phosphate. From 100 to 190 feet in Well 80-2 and 100 to 200 feet in Well 80-3, a very low relative natural gamma radiation occurs which is indicative of very clean material such as sand. Below 200 feet, the relative natural gamma radiation increases, indicating a higher concentration of clays. The washed-out sections of these boreholes between 100 and 200 feet indicate that material in this interval is unconsolidated. These results confirm the presence of the sand layer encountered between 100 and 200 feet in Borings 80-2 and 80-3.

In Boring 80-1, the results contrast with those from Borings 80-2 and 80-3 for all geophysical logs run. On the SP log, there is little or no negative potential, and the resistivity log shows a very low apparent resistivity, indicating clay. The caliper log does not indicate that very much washout occurred during the drilling. The gamma ray log at Boring 80-1 showed very high relative natural gamma radiation throughout the entire borehole. These data indicate that the entire borehole consists of clay with small amounts of sand and shells, supporting the observations made in the geologic log. Because of the excellent correlation between the geophysical logs performed on Borings 80-1, 80-2, and 80-3 and the geologic logs of these wells, borehole geophysics should be considered a valuable tool in interpreting the subsurface conditions at Port LaBelle and determining the extent of productive zones.

Earth Resistivity Survey

An electrical resistivity study was performed during the last week of May 1980. The resistivity method was selected in an attempt to determine the extent to which reliable information about hydrogeologic conditions and ground-water quality could be obtained in the Port LaBelle area with reduced drilling costs. The principle behind electrical resistivity investigation is that natural material at shallow depths below the surface exhibits a characteristic electrical resistance which depends primarily on the nature of the materials and the amount, distribution, and ionic strength of water contained in the material. Because the earth resistivity method had not been used in the Port LaBelle area in the past, the program was of a limited nature to determine if resistivity surveys would be useful in future exploration programs to obtain data at lower costs than by drilling. Six resistivity surveys were conducted, namely, four vertical and two horizontal profiles. Plate 1 shows the lines of each survey.

To perform the resistivity surveys, four equally-spaced metal electrode stakes were driven into the ground along a straight line (Wenner array). An electric current was introduced between the two outer electrodes, and the voltage drop in the ground between the two inner electrodes was measured. The volume of material being investigated by resistivity is a function of the electrode spacing. The data gathered in the survey reflect the apparent electrical resistivity of the earth material between the inner electrodes. Variation in apparent resistivity values may reflect changes in the nature of the subsurface material or the water contained in the material.

For vertical profiles, electrodes were spaced 20 feet apart, and the resistivity value was measured and recorded. The electrode spacing was then increased arithmetically (20, 40, 60 feet, and so on) until a spacing of 300 feet was reached. As the electrode spacing is increased, the subsurface penetration also increases. Thus larger measurements of electrode spacing reflect deeper penetration. Several methods of resistivity data interpretation are available for vertical profiling. The simplest is to compare apparent resistivity values to the electrode spacing. An empirical method of interpretation, but one that has been frequently successful, is to compare cumulative resistivity values to electrode spacing. Both methods have been used to evaluate the data from these vertical profiles. Experience has demonstrated that fine-grained materials such as clay have low resistivities, whereas coarser materials such as sand have higher resistivities. If there is a mixture of various sized materials, the resistivity is an intermediate value which will tend towards the material comprising the greatest proportion. Sand saturated with salty water will have a lower resistivity than the same sand saturated with fresh water. A dry sand will have a higher resistivity than a wet sand.

For each vertical profile, apparent resistivity values and cumulative values were plotted with respect to the electrode spacing. Apparent resistivity values were connected by a series of best-fit straight lines. Graphs for Profiles 80-A, 80-B, 80-BB and 80-C are shown, respectively, in Figures 1 through 4. Profiles 80-B and 80-BB were run with the same center point with 80-B expanded in a north-south direction and 80-BB in an east-west direction.

Figures 1, 2, 3, and 4 indicate that materials with similar characteristic resistivities were encountered by Profiles 80-B, 80-BB, and 80-C. The apparent resistivity curves in all four figures show that material with decreasing apparent resistivity was sensed from electrode spacing of 20 to 80 feet. This is due to the clays and organic material found at shallower depths in the LaBelle area. In Profile 80-A, the apparent resistivity continued to decrease to a low of 110 ohm-feet. Using these data, the data from water quality and geologic logs in the LaBelle area, this very

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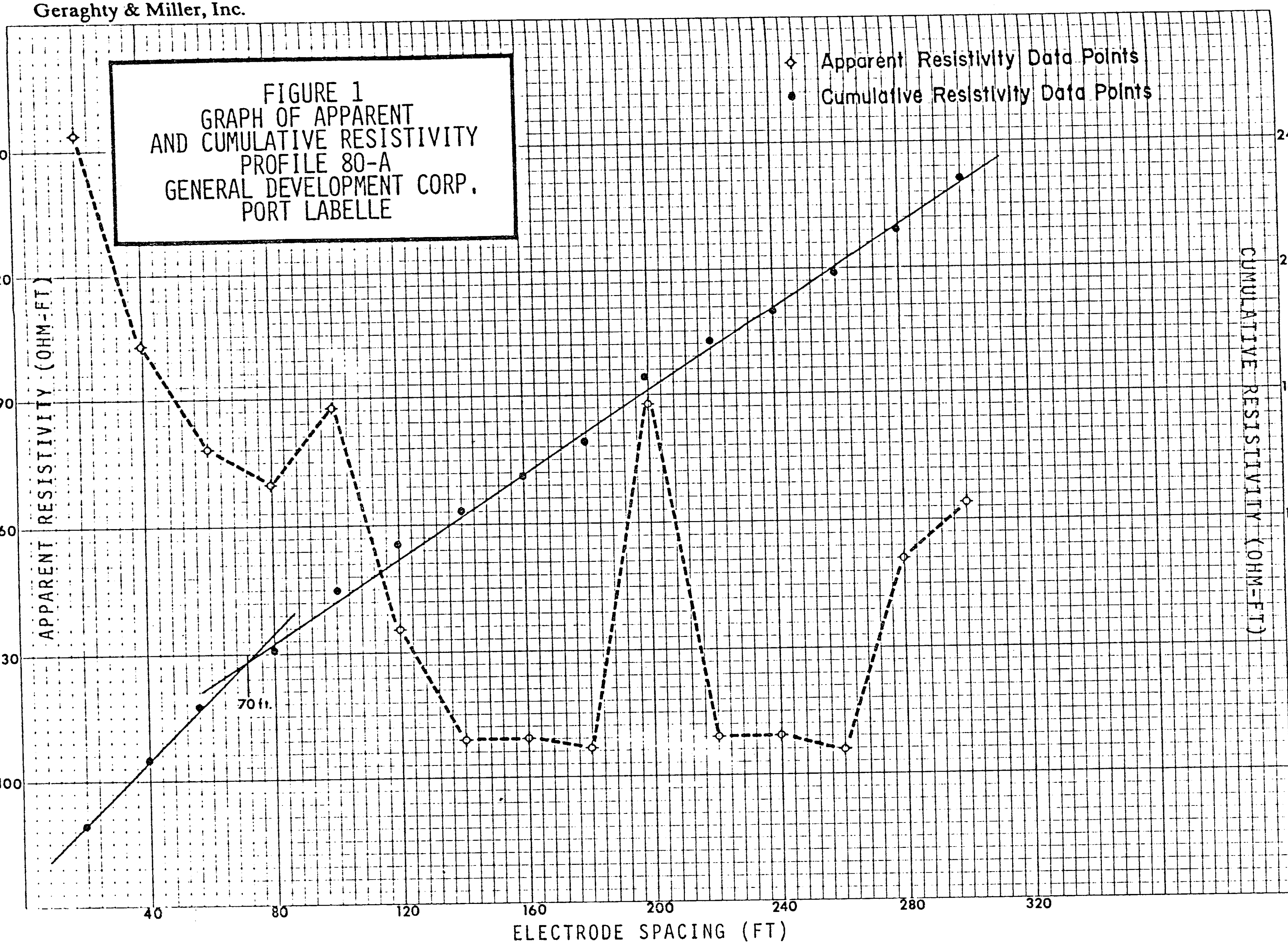

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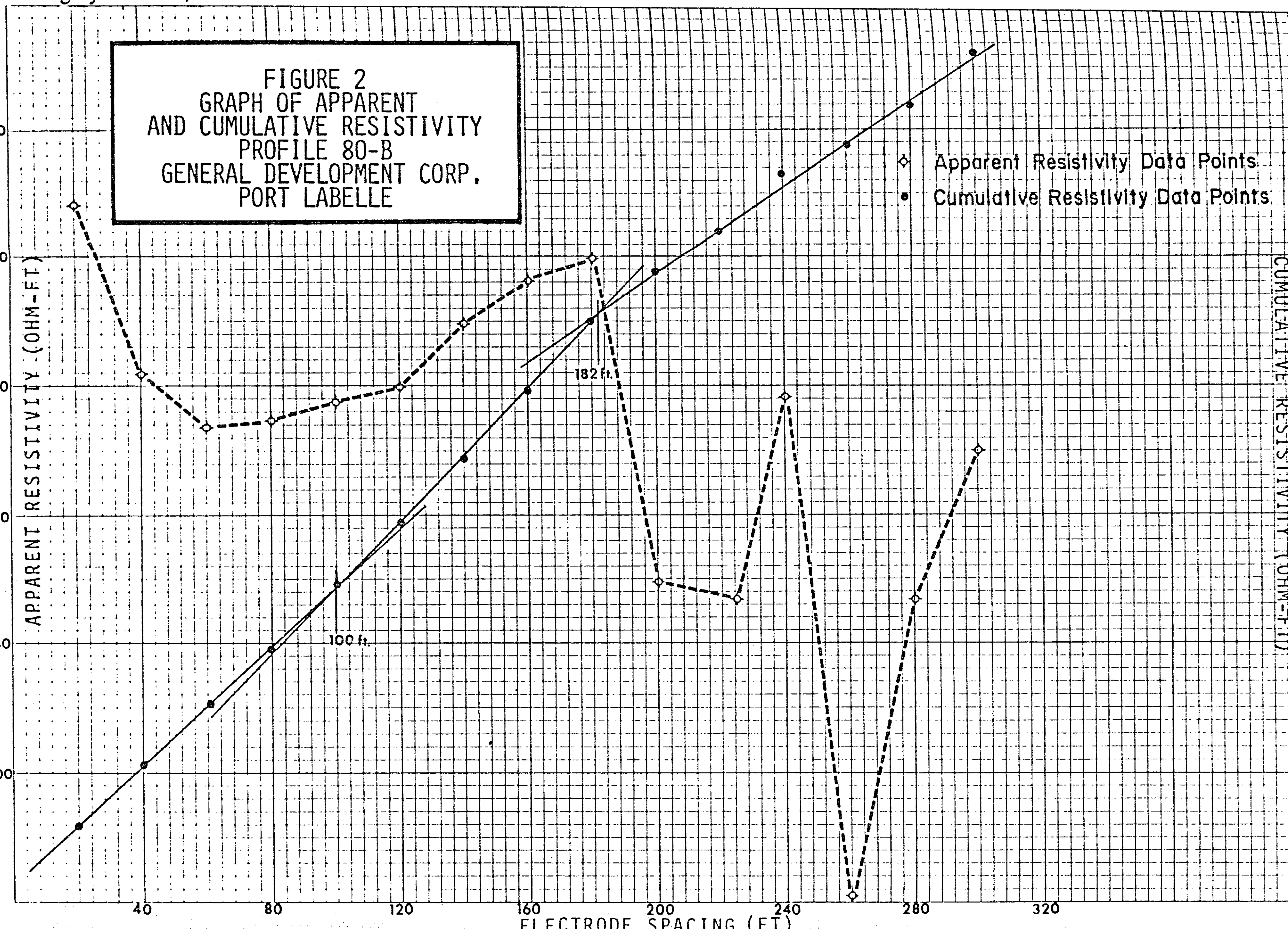

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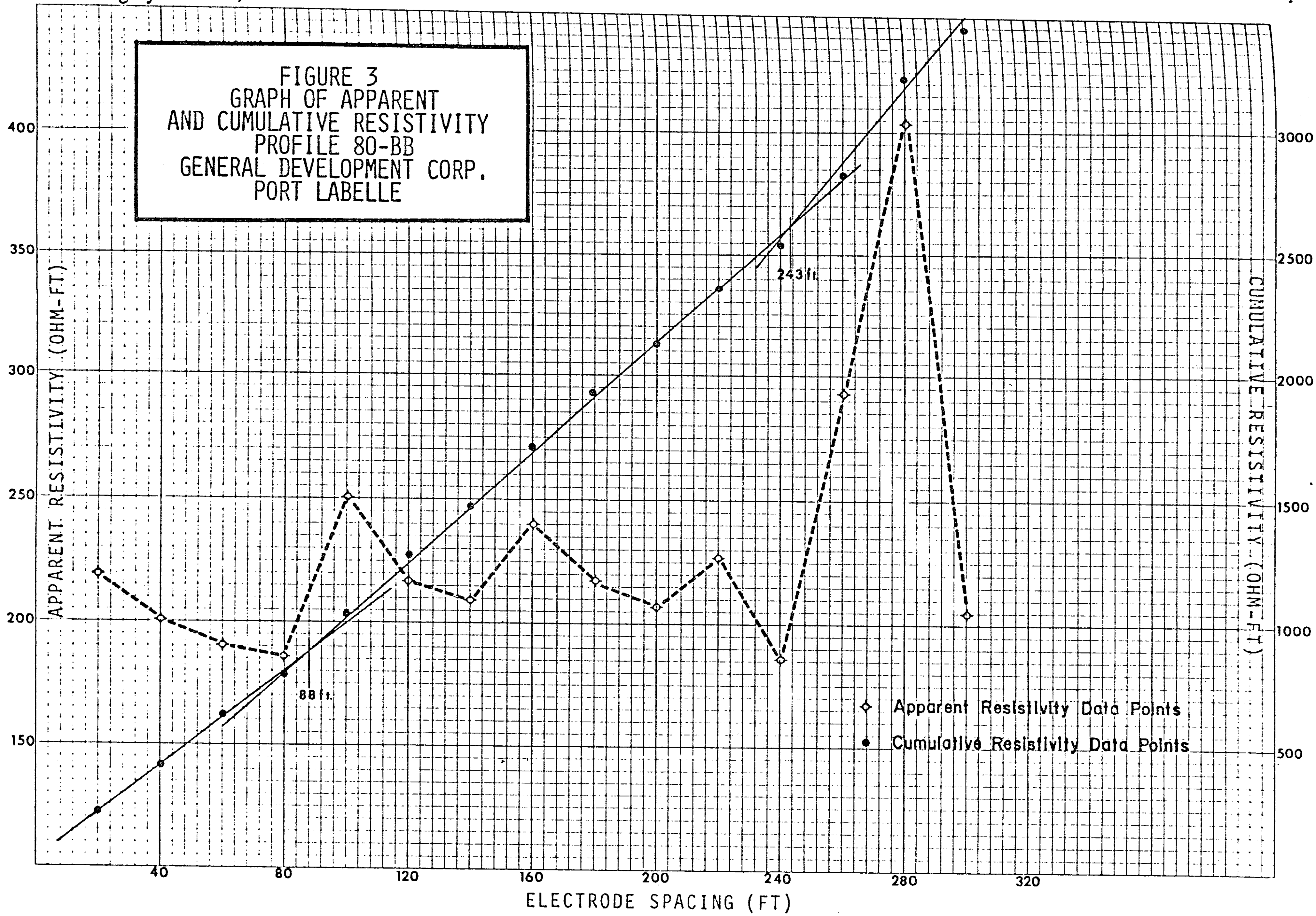

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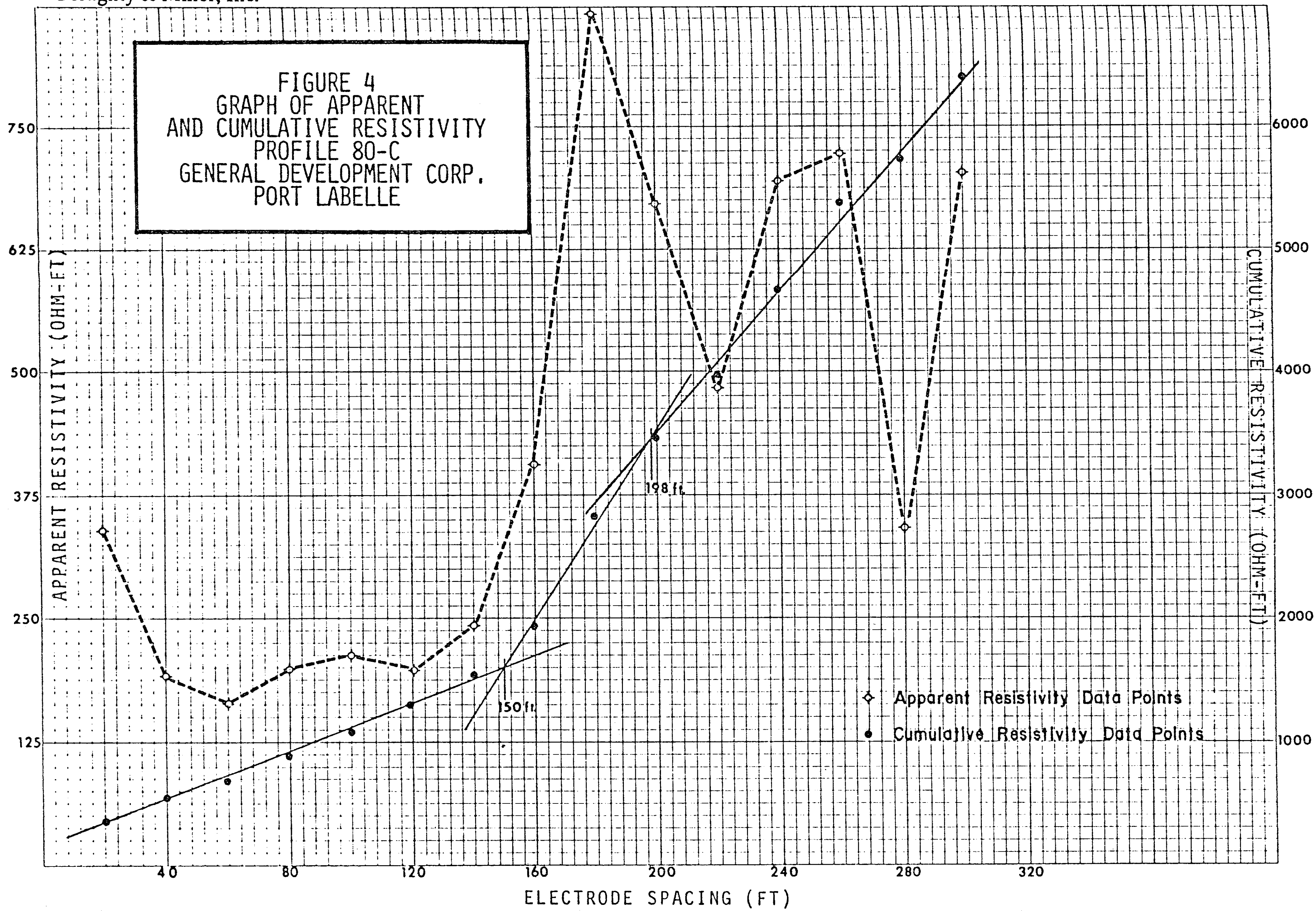

low apparent resistivity is indicative of the presence of very fine-grained material such as clay.

Profiles 80-B, 80-BB, and 80-C show an increase in apparent resistivity from an electrode spacing of 80 to 180 feet with slight intermittent decreases. The increases in value range from 870 ohm-feet in Profile 80-C to 220 ohm-feet in Profile 80-B. These values of apparent resistivity are from two to eight times greater than in Profile 80-A and are interpreted to indicate the presence of coarser-grained material. The decrease in apparent resistivity from electrode spacing of 180 to 260 feet in these three profiles indicates that there is a greater amount of fine-grained material. The variable measurements of all profiles after the electrode spacings is extended beyond 260 feet is not known at this time, but is most likely due to local geologic conditions and the resistivity equipment approaching its practical working limit.

Cumulative resistivity curves from all four profiles were then analyzed using the Moore Cumulative Resistivity Method. This empirical method is based on the premise that as the electrode spacing is expanded during vertical profiling, changes in the nature of the material encountered, the water content, or its ionic strength are reflected as changes in slope of the data curve. For Profiles 80-A, 80-B, 80-BB, and 80-C, straight lines were drawn through as many of the data points as possible on the graphs of cumulative resistivity. According to this method, changes in slope represent changes in resistivity and the electrode spacing at which these changes occur correspond to the specific depths. These depths are indicated on Figures 1 and 4. For Profile 80-A, the change in slope occurred at 70 feet. This correlates very well with the depth at which a thick clay layer was first encountered in Boring 80-1. In Profiles 80-B, 80-BB, and 80-C, two changes in slope occurred; these changes correlate with the top and bottom sand and shell layers in geologic logs of Borings 80-2 and 80-3.

Following the vertical resistivity surveying, horizontal resistivity profiling was carried out in an attempt to distinguish productive material from unproductive material. In horizontal profiling, a convenient electrode spacing that is expected to penetrate to the approximate depth of interest is selected for use in a Wenner array. After recording apparent resistivity, the electrode spacing is kept constant as the whole electrode array is moved across the land surface and successive readings are taken. Two sets of horizontal profiles with an electrode spacing of 180 feet were completed during this investigation. Profile 80-D was conducted at stations 300 feet apart along a line due south of Well 80-2 (Plate 1). Profile 80-E was conducted at stations 300 feet apart along a line due east of Well 80-2. The results of these surveys are given in Table 2.

The data from Profile 80-E shows that apparent resistivity values decreased to the east of Well 80-2 with increasing distance from that well. This decrease is most likely due to a large increase in the amount of clay or fines in the material being probed. The data from Profile 80-D show only minor fluctuations in apparent resistivity, indicating that the material "sensed" was the same at each station. As with the vertical profiles, a very good correlation between the resistivity data and the geologic logs can be made. Because of this good correlation between the resistivity profiles and the geologic conditions found in the borings, earth resistivity can be a useful tool in the Port LaBelle area when used in conjunction with some control data such as from geologic or geophysical logs. The use of earth resistivity methods can improve the rate of success during test drilling, thereby reducing drilling costs.

TABLE 2

HORIZONTAL RESISTIVITY SURVEY DATA
GENERAL DEVELOPMENT CORPORATION
PORT LABELLE, FLORIDA

Site Number	Apparent Resistivity (ohm-ft)
80-D1	183
80-D2	145
80-D3	166
80-E1	232
80-E2	173
80-E3	144

Note: Locations are shown on Plate 1

AQUIFER PRODUCTIVITY AND FUTURE EXPLORATION

From the testing performed to date, it appears that the most favorable material for the installation of high capacity production wells is found in the vicinity of the water plant at depths of 100 to 300 feet below land surface. Here, an aquifer consisting of sand and shell layers has been tapped by a test well(71-1(2)and the existing production well (72-6(1)), and yields in excess of 400 gpm have been obtained. From the testing of these wells, it is predicted that yields as great as 1500 to 2000 gpm can be obtained from properly designed production wells in this area. General Development should act to reserve and protect all potential production well sites in this area.

Production zones have not been encountered in wells drilled west, south, or southeast of the water plant. It appears that the western "boundary" of the aquifer occurs within 2000 feet west of Well 72-6(1) and within 1000 feet west of Well 80-3. This is illustrated in the generalized geologic cross-sections shown in Figures 5 and 6. The extent of this aquifer in other directions away from the water plant is unknown although it must disappear within two miles south of the water plant because it was not found in Borings 72-1, 72-2, 72-3, and 72-5.

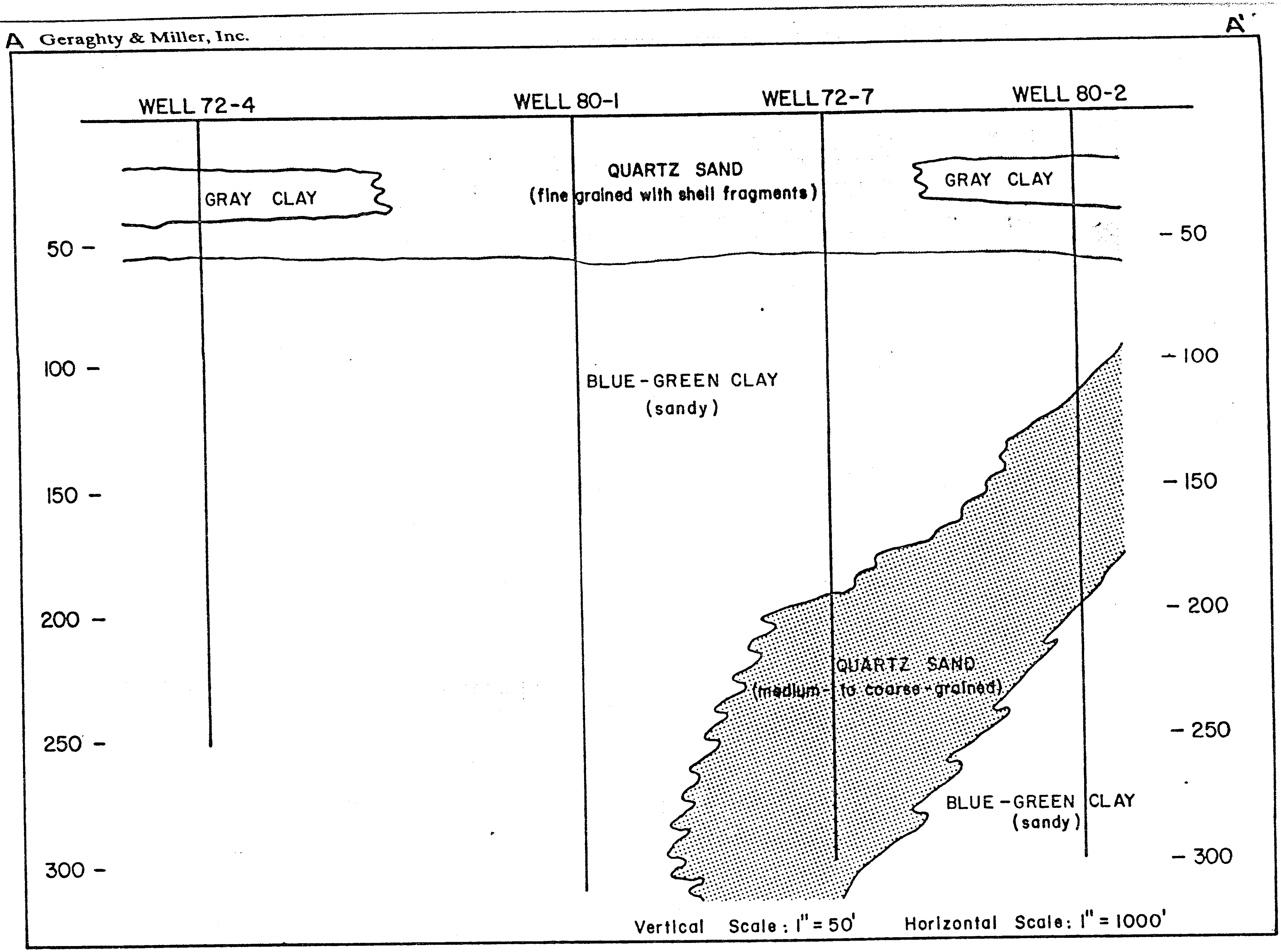

FIGURE 5 - GENERALIZED GEOLOGIC CROSS SECTION A-A', GDC, PORT LABELLE

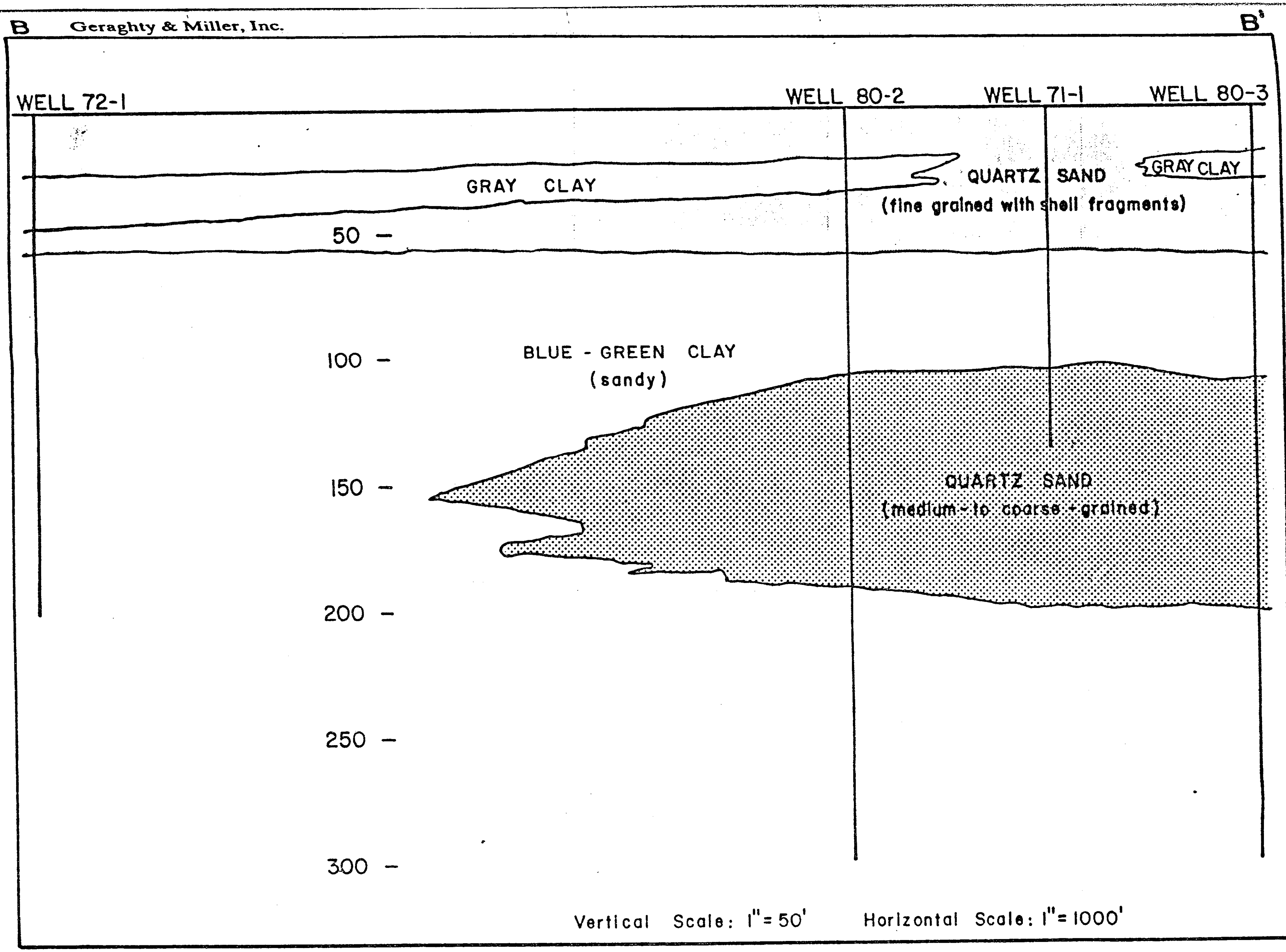

FIGURE 6 - GENERALIZED CROSS SECTION B-B', GDC, PORT LABELLE

Based on the present information, it is not known if the highly productive sand and shell aquifer is of limited extent in the vicinity of the water plant; occurs in a linear trend from northwest to southeast beyond the golf course; or is extensive beneath Port LaBelle east of the water plant. The U. S. Geological Survey in Miami has maintained a water-level recorder on Well 71-1(2) since February 1977. The data from this water-level recorder show drawdowns occurring in this well five days a week starting at approximately 7 a. m. and continuing until about 3 p. m. and corresponds to the times pumping occurs in Well 72-6(1). This relationship indicates that the screened zones from Wells 71-1(2) and 72-6(1) both penetrate the same aquifer, even though the screen in Well 72-6(1) is more than 100 feet deeper than in Well 71-1(2). Data from horizontal resistivity profiling suggests that the sand disappears 300 to 800 feet east of Well 80-2, but this must be confirmed by additional testing.

Table 3 lists all test sites with present status, present production and estimated yield from properly sized and constructed wells. Where present, the sand and shell deposits are productive. Based upon tests that were conducted on Wells 71-1(2) and 72-6(1), anticipated yields of properly constructed production wells are 1000 to 2000 gpm. Future pro-

TABLE 3

ESTIMATED YIELDS AND STATUS OF ALL TEST SITES AT PORT LABELLE GENERAL DEVELOPMENT CORPORATION

PORT LABELLE, FLORIDA

Location	Present Status	Present Production (gallons per minute)	Estimated Site Yield (gallons per minute)
71-1(2)	In place	240	1000 - 2000
72-1	Plugged		10 - 100
72-2	Plugged		< 10
72-3	Plugged		10 - 100
72-4	Plugged		10 - 100
72-5	Plugged		10 - 100
72-6(1)	In place	210	1000 - 2000
72-7	Monitoring Well		1000 - 2000
80-1	Plugged		< 10
80-2	Monitoring Well		1000 - 2000
80-3	Monitoring Well		1000 - 2000
80-4	Plugged		< 10
80-5	Plugged		< 10
80-6	Plugged		< 10

duction wells with these yields could be installed at the sites of Wells 80-2 and 80-3. Estimated ranges in yields for production wells at the locations of Borings 72-1, 72-3, 72-4, and 72-5 are based upon the testing of the shallow aquifer performed during the drilling of Well 71-1(2). The lower values represent quantities that most certainly could be developed at each location. The higher values represent quantities that might be obtained by using the most effective well design and construction techniques available. The values may be revised upward or downward as additional production wells are installed in this area and additional data become available. The final designs of future production wells should be determined from pilot hole samples during construction.

Additional ground water is available from other zones in the Port LaBelle area. The shallow aquifer extends to about 60 feet below land surface in the area of the water plant. This zone was tested during the installation of Well 71-1(2), and a water sample was collected for analysis. Although large-capacity wells probably cannot be developed, it is possible that wells yielding 10 to 100 gpm can be completed. This water is also available to residents of Port LaBelle for irrigation. The water is potable. There are also many abandoned irrigation wells located on GDC properties that are reported to be tapping this zone.

From data available, it can be seen that the local geologic conditions are variable in the Port LaBelle area. Because of this variability, it is possible that although the irrigation wells are reported to be shallow, they may be in a much more productive zone than around the present water treatment plant. Additional information could be gained about the local geologic and hydrologic conditions from these wells. Since the depths of these abandoned irrigation wells are not known,the first step should be to make this determination. When depths are determined, additional testing such as geophysical logging and possibly small-scale pumping tests could be conducted on selected wells. This testing could be done at a much lower cost than drilling test holes.

The Floridan Aquifer could be tapped for water supply at Port LaBelle also. To date, the Floridan Aquifer in this area appears to have been tapped for irrigation. However, this aquifer could be tapped for public supply if the raw water were blended or treated by demineralization to meet standards. Well capacities could be as great or greater than from shallow aquifers.

CONCLUSIONS

1. Production wells can be installed at the sites of Wells 80-2 and 80-3.

2. The water quality in all zones of the fresh water aquifer is good, and no major treatment should be required. Hardness is typically high; chloride concentrations are very low; total dissolved solids content is below potable limits.

3. The most productive zones of the fresh water aquifer found to date consist predominantly of sand and shells at depths from 100 to 300 feet. The aquifer is not areally extensive.

4. Earth resistivity and geophysical logging can be helpful in future exploration at Port LaBelle by increasing the percentage of success during test drilling.

5. The shallow aquifer extends to 60 feet below surface.

RECOMMENDATIONS

1. General Development Corporation should act to reserve and protect all potential production well sites identified in this and previous investigations.

2. The wells installed in this and previous investigations should be surveyed for elevation; these wells should be incorporated in an areawide water-level monitoring network in future well-field areas.

3. Additional testing should be conducted to the south, north and east to determine the areal extent of the fresh water aquifer consisting of sand and shell from 100 to 300 feet below land surface in the area of the water treatment plant. Earth resistivity and borehole geophysics will aid in this testing.

4. Testing should also be conducted in areas more remote from existing facilities so that productive sites may be reserved before development.

Acknowledgement

The contributions of Mr. Greg Kisela, Utility Manager of Port LaBelle, to the success of this investigation are appreciated. We would also like to thank the U. S. Geological Survey for providing water-level data from its records.

We are pleased to have performed these services for General Development Corporation.

Respectfully submitted,
GERAGHTY & MILLER, INC.

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7 October 1980

APPENDIX A

MINI PLATS OF

BORING LOCATIONS

80-1 through 80-5

General Development Corporation

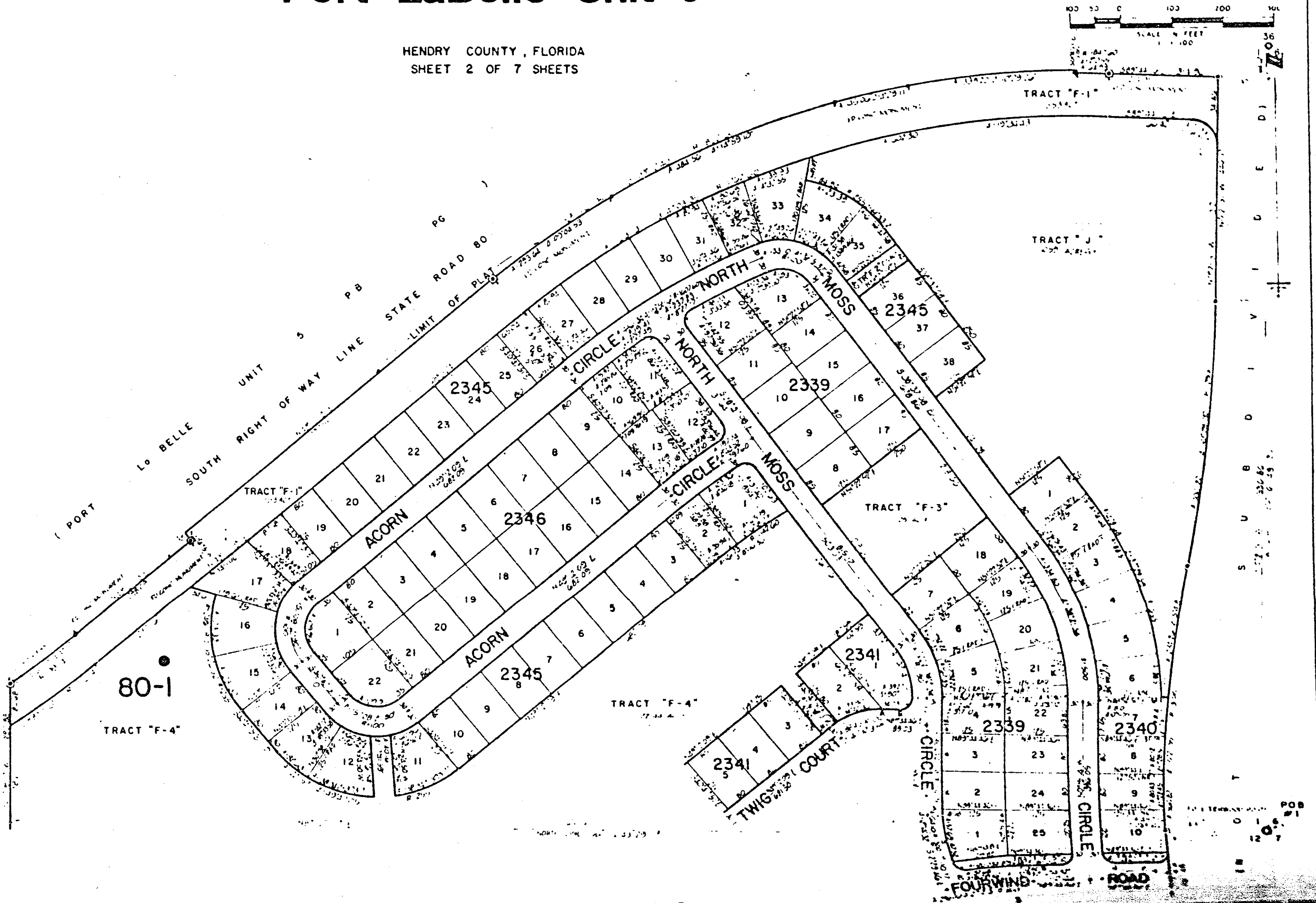
Port LaBelle, Florida

Port LaBelle Unit 6

Geraghty & Miller, Inc.

PLAT BOOK 3
AND PAGE 110

HENDRY COUNTY, FLORIDA
SHEET 2 OF 7 SHEETS



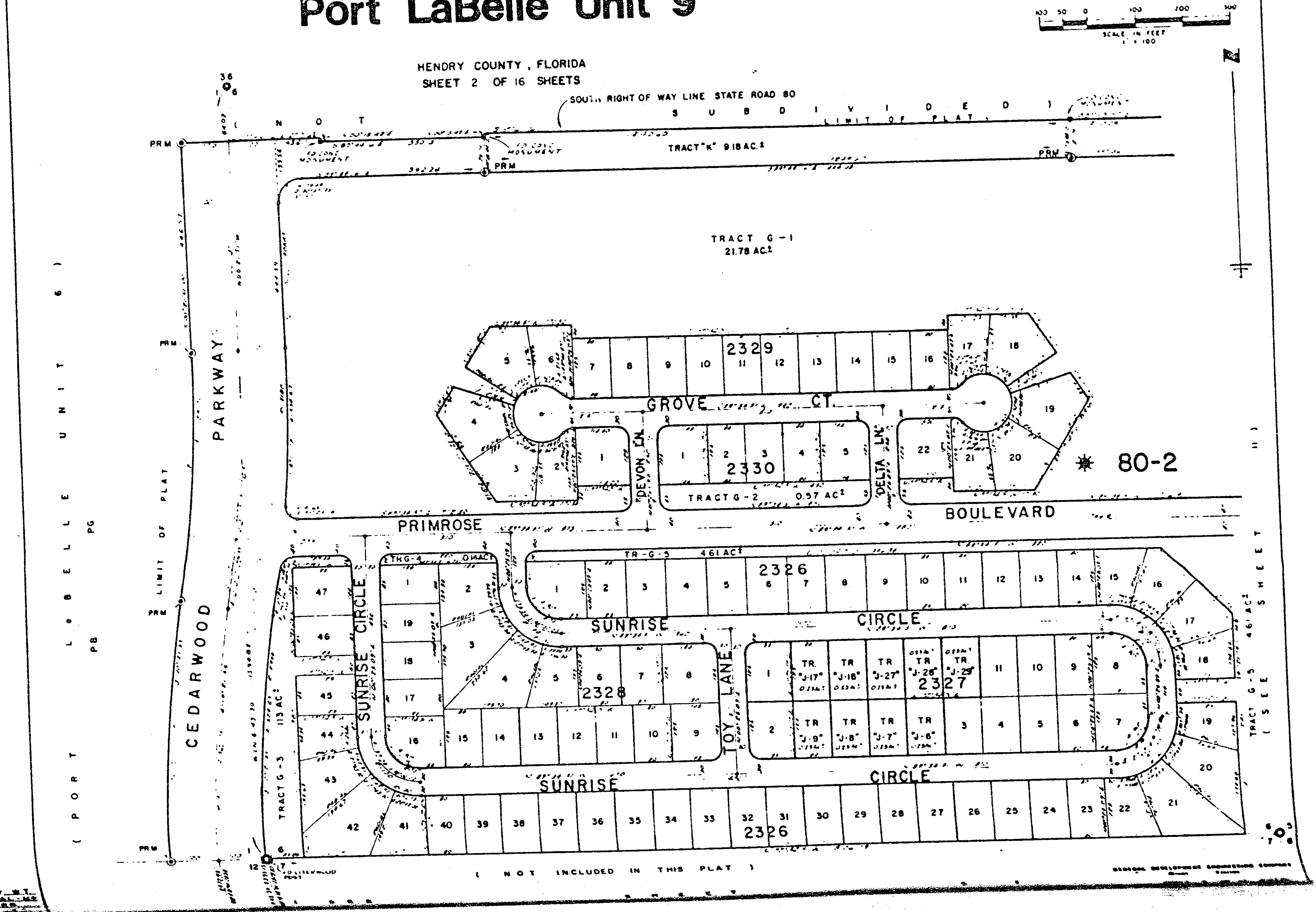
CALCULATED BY
DRAWN BY
CHECKED BY
APPROVED BY

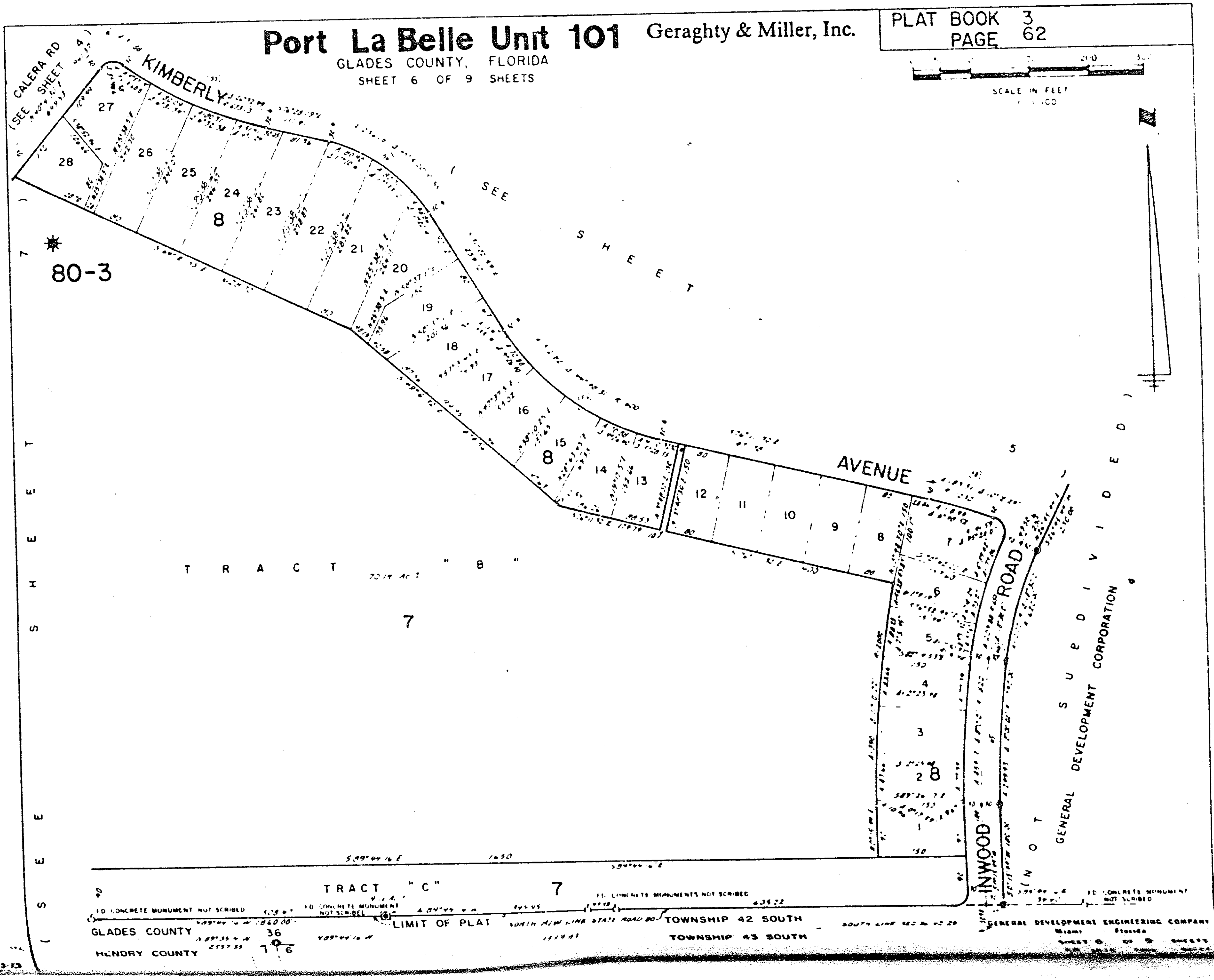
Port LaBelle Unit 9

Geraghty & Miller, Inc.

PLAT BOOK 3
AND PAGE 145

HENDRY COUNTY, FLORIDA
SHEET 2 OF 16 SHEETS





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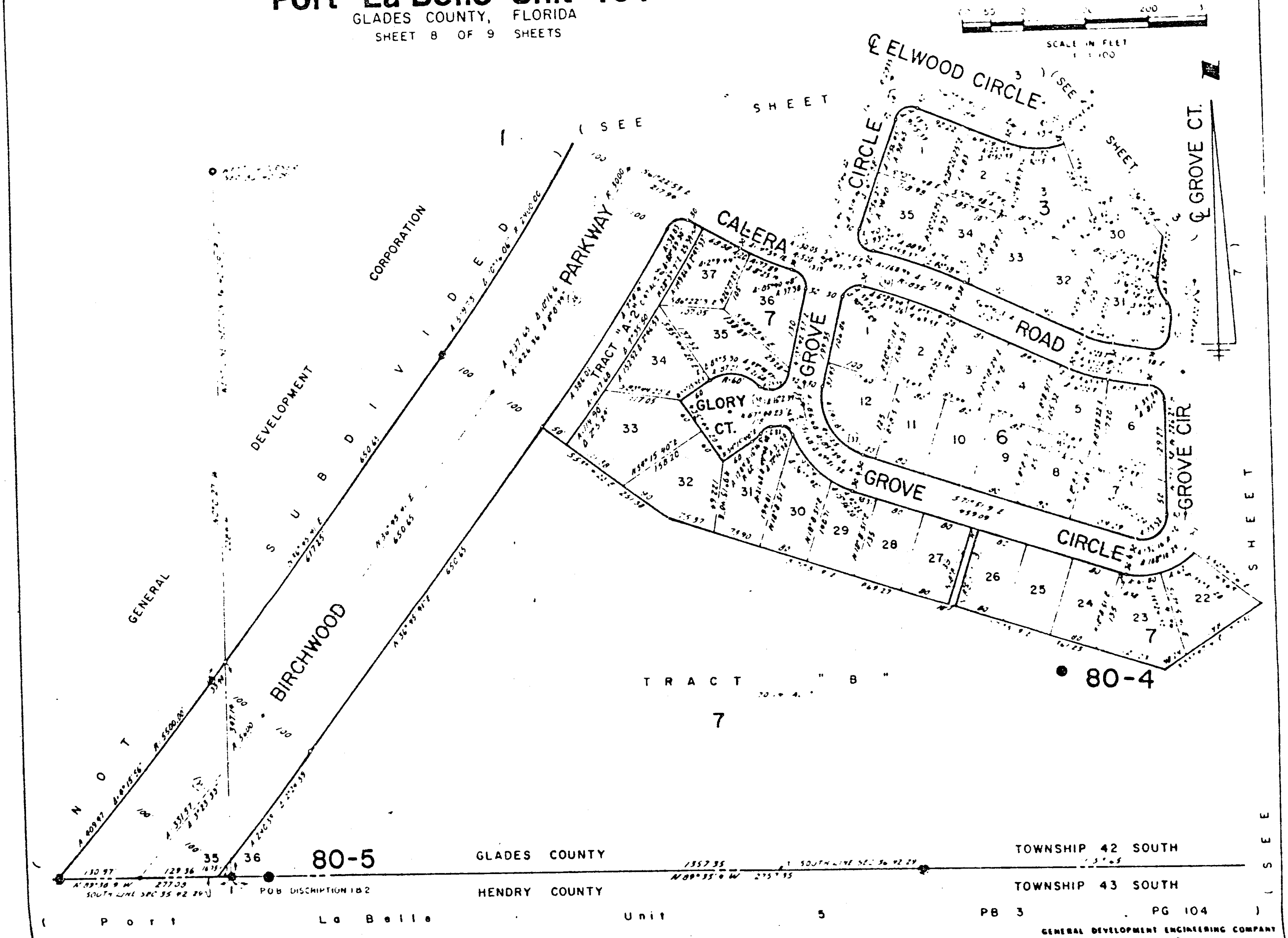
Port La Belle Unit 101

Geraghty & Miller, Inc.

PLAT BOOK 3
PAGE 64

GLADES COUNTY, FLORIDA
SHEET 8 OF 9 SHEETS



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APPENDIX B

GEOLOGIC LOGS OF ALL
TEST BORINGS TO DATE

General Development Corporation

Port LaBelle, Florida

Geraghty & Miller, Inc.

GEOLOGIST'S LOG
OF BORING 71-1(2)
JIMMIE MILLER WELL

1972

Sample Description	Depth Interval (feet)	Thickness (feet)
Sand, fine- to medium-grained, light gray, and streaks of clay	0-20	20
Sand, fine- to medium-grained, light tan, shell fragments and clay	20-37	17
Sandstone, light tan, porous, fossiliferous	37-37.5	0.5
Sand, fine- to medium-grained, light gray; fine to medium gravel composed of fragments of black to dark gray quartzite, traces of clay, numerous shell fragments	37.5-54	16.5
Sand, fine- to coarse-grained, light gray; fine- to coarse-grained, dark gray to black angular gravel and shell fragments	54-62	8
Clay, gray, with fine- to medium-grained quartzitic sand, shells and gravel fragments	62-75	13
Clay, gray-green, sandy	75-102	27
Sand, coarse-grained, light gray, quartzitic, with traces of clay	102-120	18
Sand, coarse-grained, light gray	120-132	12
Sand, medium- to coarse-grained, light gray	132-142	10
Total Depth	-142	

Geraghty & Miller, Inc.

DRILLER'S LOG OF TEST WELL 72-1

October 1972

TEST WELL 72-1 Sample Description	Depth Interval (feet)	Thickness (feet)
Brown sand and lime rock, hard streaks; some white rock	0-5	5
White rock and sand	5-10	5
White sand and shell streaks	10-20	10
Shells and blue clay	20-30	10
Brown lime and grey lime, clay and shell streaks (hard)	30-35	5
Brown lime, clay, blue and shells	35-40	5
Sand, shells and blue clay (hard streaks)	40-45	5
Lime rock, dark grey, some shell (hard)	45-50	5
Lime rock, dark grey (hard)	50-55	5
Blue clay	55-70	15
Blue and grey clay	70-75	5
Grey clay with shell streaks	75-80	5
Grey clay	80-90	10
Blue clay, some shells	90-95	5
Blue clay, some shells (some sand)	95-100	5
Blue clay, grey clay (some sand)	100-110	10
Grey clay, some blue, some shells	110-115	5
Grey & blue clay, some sand, & shells	115-125	10
Grey or greyish blue clay, sandy	125-170	45
Greyish blue clay, sandy	170-200	30

Geraghty & Miller, Inc.

DRILLER'S LOG OF BORING 72-2

November 1972

TEST WELL 72-2

Sample Description	Depth Interval (feet)	Thickness (feet)
Sand, some shells	0-5	5
Sand, and shells	5-10	5
Shells, some sand	10-15	5
Shells, some limerock	15-20	5
Shells, some limerock, some sand	20-25	5
Shells, some sand	25-30	5
Shells, sand, some limerock	30-35	5
Sand, shells, blue clay	35-40	5
Sand, shells, blue clay, some limerock	40-50	10
Sand, shells, some limerock, & blue clay	50-55	5
Shells, & limerock	55-60	5
Shells, limerock, trace of sand & blue clay	60-65	5
Shells, sand, some limerock & clay	65-70	5
Sandy blue clay, streaks of shell	70-95	25
Sandy blue clay and shells	95-120	25
Sandy blue clay	120-225	105
Blue sandy clay, some white limerock	225-230	5

Driller's Log
of Boring 72-2

Test Well 72-2

Sample Description	Depth Interval (feet)	Thickness (feet)
Grey sandy clay, streaks of lime-rock & shells	230-235	5
Grey sandy clay, streaks of white limerock & shells	235-240	5
Blue sandy clay, streaks of shells	240-245	5
Blue clay	245-250	5

DRILLER'S LOG OF BORING 72-3

November 1972

TEST WELL 72-3

Sample Description	Depth Interval (feet)	Thickness (feet)
Sand & shells	0-10	10
Shells & limerock	10-15	5
Shells & limerock, streaks of sand	15-20	5
Sand, streaks of shells	20-30	10
Shells, limerock, trace of sand and blue clay	30-35	5
Shells, limerock, blue clay	35-40	5
Sand, streaks of limerock, and shells, some blue clay	40-45	5
Sand, limerock and shells	45-55	10
Limerock and shells	55-60	5
Sand, shells and limerock	60-70	10
Sand, shells and blue clay	70-80	10
Shells, streaks of blue clay	80-90	10
Blue sandy clay	90-100	10
Blue clay, streaks of sand	100-105	5
Blue sandy clay	105-120	15
Blue sandy clay, some sand & shells	120-140	20
Blue sandy clay, trace of sand and shells	140-150	10
Blue sandy clay	150-230	80

Driller's Log
of Boring 72-3

Test Well 72-3

Sample Description	Depth Interval (feet)	Thickness (feet)
Blue sandy clay,streaks of shells and limerock	230-235	5
Shells and limerock, some blue clay	235-240	5
Shells and limerock, blue sandy clay	240-250	10

Geraghty & Miller, Inc.

DRILLER'S LOG OF BORING 72-4

November, 1972

TEST WELL 72-4

Sample Description	Depth Interval (feet)	Thickness (feet)
Sand, some shells & clay	0-5	5
Sand & shells	5-10	5
Sand, shells, some limerock	10-15	5
Shells, limerock (hard), some clay	15-20	5
Shells, limerock & white clay	20-40	20
Shells, limerock	40-55	15
Shells, limerock & blue clay	55-60	5
Blue, sandy clay	60-70	10
Blue, sandy clay, trace of sand & shells	70-80	10
Blue, sandy clay	80-90	10
Blue, sandy clay, trace of shells (11-16-72)-100'	90-95	5
Blue, sandy clay, trace of shells	100-120	20
Blue, sandy clay	120-200	80
Blue, sandy clay, streaks of lime-rock & shells	200-210	10
Blue, sandy clay	210-220	10
Blue, sandy clay, streaks of lime-rock	220-250	30

Geraghty & Miller, Inc.

DRILLER'S LOG
OF BORING 72-5

December 1972

TEST WELL 72-5

Sample Description	Depth Interval (feet)	Thickness (feet)
Sand	0-5	5
Sand, shells and limerock	5-10	5
Limerock, sand and shells	10-20	10
Shells, limerock	20-25	5
Shells, limerock, some sand and blue clay	25-30	5
Shells, limerock, some blue clay	30-35	5
Shells, limerock, some blue clay (12/1/72)	35-40	5
Shells, limerock	40-45	5
Shells and limerock	45-55	10
Blue clay and shells	55-60	5
Blue clay, sandy	60-65	5
Blue sandy clay	65-70	5
Blue sandy clay, streaks of shells	70-100	30
Blue sandy clay, some sand and shells	100-120	20
Blue sandy clay, some sand	120-140	20
Blue sandy clay	140-195	55
Blue sandy clay	195-200	5
Blue clay, streaks of sand	200-210	10

Test Well 72-5

Sample Description	Depth Interval (feet)	Thickness (feet)
Blue clay and sand	210-230	20
Sand and blue clay	230-240	10
Sand, blue clay, some shells	240-250	10
Blue clay, sand and shells	250-260	10

Geraghty & Miller, Inc.

DRILLER'S LOG OF BORING 72-6(1)

January 1973

TEST WELL 72-6(1)

Sample Description	Depth Interval (feet)	Thickness (feet)
Orange clay and limerock, hard	0-5	5
Limerock and shells	5-10	5
Shells, some limerock	10-15	5
Shells	15-20	5
Shells	20-25	5
Shells	25-35	10
Shells, streak of clay and limerock	35-40	5
Shells, streaks of limerock	40-50	10
Shells	50-55	5
Shells, streaks of limerock	60-65	5
Blue clay, some shells	65-80	15
Blue sandy clay, streaks of shells	80-100	20
Blue sandy clay, some shells	100-130	30
Blue sandy clay, some shell greyish green	130-140	10
Greyish green clay, some shells	140-155	15
Greyish green clay and shells	155-160	5
Green sandy clay, some sand and shells	160-175	15
Green clay, some sand and shells	175-205	30
Sand, some shells and clay	205-245	40
Sand and shells	245-300	55

Set 3 feet of 2 inch screen 280 feet, pumped with air for water sample

Geraghty & Miller, Inc.

DRILLER'S LOG OF BORING 72-7

January 1973

TEST WELL 72-7

Sample Description	Depth Interval (feet)	Thickness (feet)
Sand	0-5	5
Sand and shells	5-10	5
Shells	10-15	5
Shells and limerock	15-20	5
Shells, streaks of limerock	20-35	15
Shells and limerock (hard)	35-40	5
Limerock, some shells	40-55	15
Shells, streaks of limerock	55-60	5
Shells, streaks of rock and green clay	60-65	5
Green clay, some shells	65-80	15
Green clay	80-90	10
Green clay, streaks of shell and rock	90-120	30
Green sandy clay	120-150	30
Green sandy clay, some shells and sand	150-180	30
Green sandy clay, some sand	180-190	10
Sand and green clay	190-195	5
Sand, some green clay	195-200	5
Sand	200-210	10
Sand, streaks of shells	210-220	10

Driller's Log
of Boring 72-7

Test Well 72-7

Sample description	Depth Interval (feet)	Thickness (feet)
Sand, some shells	220-240	20
Sand	240-245	5
Sand, some shells	245-255	10
Sand	255-270	15
Sand and shells	270-285	15
Sand and shell streaks	285-295	10
Sand	295-300	5

GEOLOGIC LOGS OF TEST WELLS DRILLED AT PORT LA BELLE FEBRUARY 1980

Sample Description	Depth Interval (Feet)	Thickness (Feet)
WELL 80-1		
Sand, trace of organics; and shell fragments	0-5	5
Limestone, cream to tan; granular trace of shell fragments	5-9	4
Dolomite, light brown, very hard	9-12	3
Limestone, granular, with 30% shell fragments; and 20% fine quartzitic sand	12-25	13
Shell fragments in fine matrix	25-40	15
Shell fragments, some cementation with 25% fines	40-63	23
Clay, green, sandy, interbedded with thin layers of shell fragments	63-313	250
WELL 80-2		
Sand, medium- to fine-grained, quartzitic with trace of organics; and shell fragments	0-5	5
Limestone, tan, granular; with 20% cemented quartzitic sand	5-9	3
Limestone, gray to cream, granular with 20% cemented quartzitic sand; and 20% shell fragments	9-13	4
Shell fragments with fine-grained matrix	13-18	5
Limestone, gray, with 20% shell fragments; and 10% fine quartzitic sand	18-25	7

Geologic Logs of Test Wells Drilled At Port La Belle February 1980

Sample Description	Depth Interval (Feet)	Thickness (Feet)
Well 80-2 (Cont)		
Clay, blue gray, trace of shell fragments	25-32	7
Limestone, gray, with 20% shell fragments; and 10% fine quartzitic sand	32-35	3
Shell fragments, some cementation; with 25% fines	35-61	26
Clay, sandy, gray-green with trace of shell fragments	61-110	49
Shell fragments, with 40% coarse quartzitic sand	110-148	38
Sand, coarse, quartzitic; trace of shell fragments	148-185	36
Sand, coarse, quartzitic; with 25% fine shell fragments	185-198	13
Same with 10% to 40% gray-green clay	198-258	60
Clay, gray-green; with 10% to 40% coarse quartzitic sand	258-300	42

Geologic Logs of Test Wells Drilled at Port La Belle February 1980

Sample Description	Depth Interval (Feet)	Thickness (Feet)
WELL 80-3		
Sand, with organics	0-4	4
Shell fragments, with very fine matrix	4-6	2
Dolomite, light brown, very hard	6-8	2
Shell fragments, with very fine matrix	8-13	5
Limestone, granular, trace of shell fragments	15-17	2
Clay, light gray	17-29	12
Shell fragments, some cementation	29-36	7
Shell fragments; with 20% limestone	36-38	2
Limestone, with 30% shell fragments	38-46	8
Shell fragments with 20% fines	46-58	12
Limestone with 20% shell fragments; and 30% green clay	58-110	52
Shell fragments, medium-grained; with 10% medium-grained quartzitic sand	110-135	25
Sand, quartzitic, coarse-grained; trace of shell fragments	135-200	65

Geologic Logs of Test Wells Drilled at Port La Belle February 1980

Sample Description	Depth Interval (Feet)	Thickness (Feet)
Well 80-3 (Cont.)		
Same with 10 to 40% gray-green clay	200-250	50
Clay, gray-green, with 10% to 30% coarse-grained quartzitic sand	250-300	50
WELL 80-4		
Sand, medium-grained, quartzitic, trace of organics	0-5	5
Shell fragments in fine matrix	5-9	4
Dolomite, light brown, very hard	9-12	3
Shell fragments, some cementation; with 20% fines and trace of clay	12-26	14
Clay, grey, with 30% medium-grained quartzitic sand; trace of shell fragments	26-30	4
Shell fragments, with some cementation, 30% very fine quartzitic sand	30-58	28
Clay, gray-green, with 30% fine-grained quartzitic sand; trace of shell fragments	58-150	92
WELL 80-5		
Sand, medium-grained quartzitic, with organics	0-8	8
Shell fragments, with very fine matrix	8-14	6

Geologic Logs of Test Wells
Drilled at Port La Belle
February 1980

Sample Description	Depth Interval (Feet)	Thickness (Feet)
Well 80-5 (Cont.)		
Clay, grey, with 40% shell fragments	14-25	11
Shell fragments, with 10% fine quartzitic sand; and 30% clay	25-40	15
Clay, gray-green, with 30% fine-grained quartzitic sand, trace of shell fragments	40-150	110
WELL 80-6		
Sand, medium-grained, quartzitic, with organics	0-8	8
Shell fragments, with 20% clay	8-13	5
Dolomite, light brown, very hard	13-16	3
Clay, grey, with 20% fine-grained quartzitic sand; trace of shell fragments	16-48	32
Clay, gray-green, with 30% fine-grained quartzitic sand; trace of shell fragments	48-131	83
Gravel, quartzitic, very well-rounded	131-133	2
Clay, gray-green, with 30% fine-grained quartzitic sand; trace of shell fragments	133-150	17