GULF TROUGH AND SATILLA LINE DATA ANALYSIS

By

Applied Coastal Research Laboratory
Georgia Southern University

Department of Natural Resources
Environmental Protection Division
Georgia Geologic Survey

Contract 738-890175
Amendment 1

March 2002

PROJECT REPORT 48

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Performed as part of the Georgia Environmental Protection Division's Interim Strategy to protect coastal Georgia from salt-water intrusion

by
Applied Coastal Research Laboratory
Georgia Southern University

DEPARTMENT OF NATURAL RESOURCES
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Introduction

The purpose of this project was twofold: 1) to determine if the Gulf Trough is present in Bulloch, Screven and Effingham counties, Georgia; and 2) to determine the stratigraphy and structural character of the upper Floridan aquifer and overlying formations along the hypothetical Satilla Line in Camden and Brantley counties, Georgia.

The project included (1) analysis of three reflection seismic lines shot by Blackhawk Geometrics, Inc, in 1999 together with an evaluation of their findings as presented in their final report to EPD (Blackhawk Geometrics, Inc., 2000); and (2) analysis of geophysical logs and cuttings from 9 boreholes drilled along, or in the vicinity of, the seismic lines.

Discussion Of Results

Gulf Trough: Seismic Lines 1,1a and 2,2a

Locations of Lines 1,1a and 2,2a are shown in Figure 1. Shotpoint locations, upper Floridan elevations, borehole locations, the proposed presence of the Gulf Trough in Bulloch and Effingham counties and stratigraphic and structural profiles along the seismic lines are shown in Figures 1-7. Correlative stratigraphic and borehole location information is presented in Table 1. Lithostratigraphic logs of the seismic transect boreholes based on analysis of cuttings and geophysical logs are shown on Plate 1.

Analysis of Seismic Line 1,1a

We are in general agreement with the structural/stratigraphic interpretation of Line 1,1a as described in the Blackhawk Inc. report. Particularly, that the presence of the northern edge of the Gulf Trough is indicated by the "flexure" between shotpoints 680 and 700 (Figure 2) where the top of the upper Floridan abruptly deepens to the south (Figures 3 and 4; Plate 1). It appears that Line 1 did not extend enough to the southeast to confirm the southern edge of the Gulf Trough. Note that the upper Floridan elevations below MSL are located to the right of seismic lines and those at or above MSL to the left. Other features identified at shotpoints 1283, 1660 and 3973 are arguably structures related to faults and/or acoustic anomalies caused by surficial features such as stream/flood plains, power lines and highways.

Analysis of Seismic Line 2,2a

Again, we generally agree with the conclusions of Blackhawk, Inc. on Line 2,2a as to the proposed presence of the Gulf Trough in Bulloch County. However, our interpretation of the seismic records differs from that of Blackhawk, Inc. Stratal truncations and channel fill indicated by extensive crossbedding (Figure 7) suggests the

erosional nature of the Trough and documents the presence of the trough across both line 2 and 2a from shotpoints 600-1550. While it is possible that the Gulf Trough is divergent at this location as the Blackhawk report suggests, the gap in the data makes this impossible to confirm. In any case, the cross-channel profile is quite asymmetrical. In addition to documentation in the literature (Miller, 1985; Krause and Randolph, 1989; Kellam and Gorday, 1990) our analysis of the geophysical and lithologic data for Lines 2,2a strongly indicate the presence of the Gulf Trough.

Satilla Line: Seismic Line 3

Line 3 is located in western Camden and eastern Brantley counties (Figure 1). Although record quality was poor, five structural features were observed and are depicted along the stratigraphic/structural profile in Figure 9. Feature 5 appears to be a graben or a very large sink hole of unknown depth. The other features appear to be vertical faults or zones of faults. Because the line was oriented along strike, the data may be biased as to the true nature of these features. As this is a region of high transmissivity in the Floridan aquifer system, the presence of vertical faults is credible. The stratigraphy along Line 3 is shown in Figure 9. Based on the lithostratigraphy of boreholes 2 and 3 (Plate 1), together with our interpretation of the seismic record and correlation with relevant literature, the tops of Miocene units B and C and the upper Floridan were identified. The thickness of the Miocene section is several hundred feet. It is our conclusion that while the data do not provide evidence for an obvious relationship with the Southeast Georgia Embayment or the hypothetical Satilla Line, the structures observed may be features that affect the flow and quality of water in the Upper and Lower Brunswick aquifers.

Summary and Conclusions

The Blackhawk, Inc. report and seismic records for Lines 1,1a and Lines 2,2a were analyzed (Figure 1-7). The borehole cuttings from six of the boreholes located on or in the vicinity of the seismic lines were washed and described, and a lithologic log was made for each borehole. A lithostratigraphic log of each borehole was prepared by combining the lithologic data with analyses of the associated geophysical (electric) logs and presented in Plate 1. Confirmation of the depth of the upper Floridan in each borehole was provided by a comparison of the lithologic/electric logs, seismic records and pertinent literature and presented in Table 1. Based on our analysis of the data described above we conclude that as shown in Figure 10 the Gulf Trough is present in Bulloch and Effingham counties and curving eastward, extends at least to the Savannah River and even beyond as suggested by Popenoe et al., 1987.

Acknowledgements

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Gulf Trough References

Blackhawk Geometrics, Inc., 2000. High resolution seismic surveys near Brunswick, Sylvania and Statesboro, Georgia. Final preliminary report to the Georgia Geologic Survey. Atlanta, 24 p.

Huddlestun, P.F., 1993. A revision of the lithostratigraphic units of the coastal plain of Georgia: the Oligocene. Georgia Geologic Survey Bulletin 105, 152 p.

Kellam, M.F. and Gorday, L.L., 1990. Hydrogeology of the Gulf Trough - Apalachicola Embayment area, Georgia. Georgia Geologic Survey Bulletin 94, 75 p.

Krause, R.E. and Randolph, R.B., 1989. Hydrology of the Floridan Aquifer system in southeast Georgia and adjacent parts of Florida and South Carolina. U.S. Geological Survey Professional Paper 1403-D, 65 p.

McFadden, S.S., Hetrick, J.H., Kellam, M.F., Rodenbeck, S.A., and Huddlestun, P.E., 1986. Geologic data of the Gulf Trough area, Georgia. Georgia Geologic Survey Information Circular 56, 345 p.

Miller, J.A., 1985. Hydrogeologic framework of the Floridan Aquifer system in Florida and in parts of Georgia, South Carolina, and Alabama. U.S. Geological Survey Professional Paper 1403-B, 91 p.

Popenoe, P., Henry, Jr., V.J., and Idris, F.M., 1987. Gulf trough - the Atlantic connection. Geology, Volume 15, p. 327-332.

Seismic Line Locations

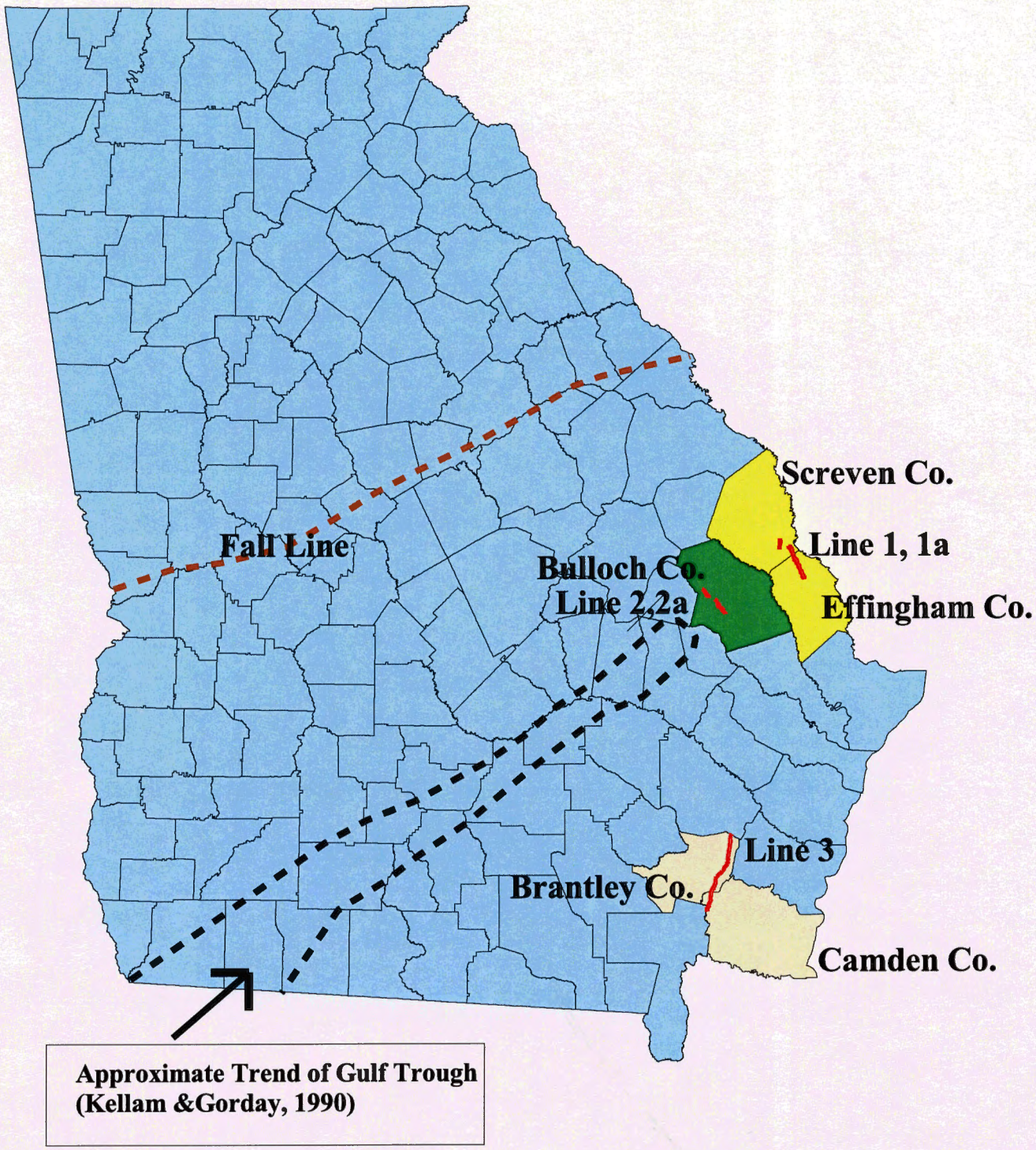


Figure 1

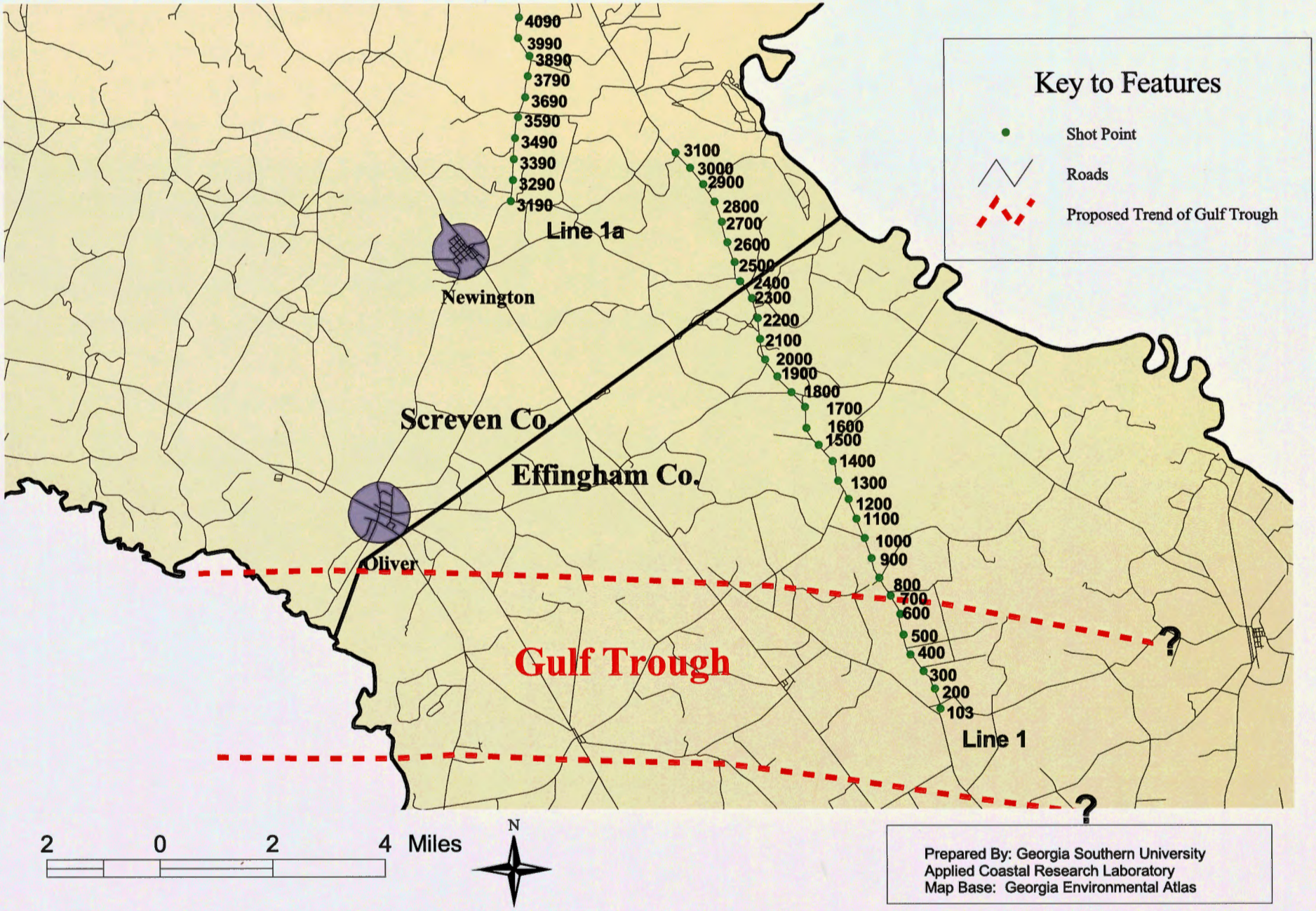

Line 1 and Line 1a Shot Point Locations
Key to Features
Shot Point
Roads
Proposed Trend of Gulf Trough
4090
3990
3890
3790
3690
3590
3490
3390
3290
3190
Line 1a
3100
3000
2900
2800
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
900
800
700
600
500
400
300
200
103
Line 1
Newington
Screven Co.
Effingham Co.
Oliver
Gulf Trough
?
?
2 0 2 4 Miles
N
Prepared By: Georgia Southern University
Applied Coastal Research Laboratory
Map Base: Georgia Environmental Atlas

Figure 2

Line 1 and 1a Floridan Elevations and Well Locations

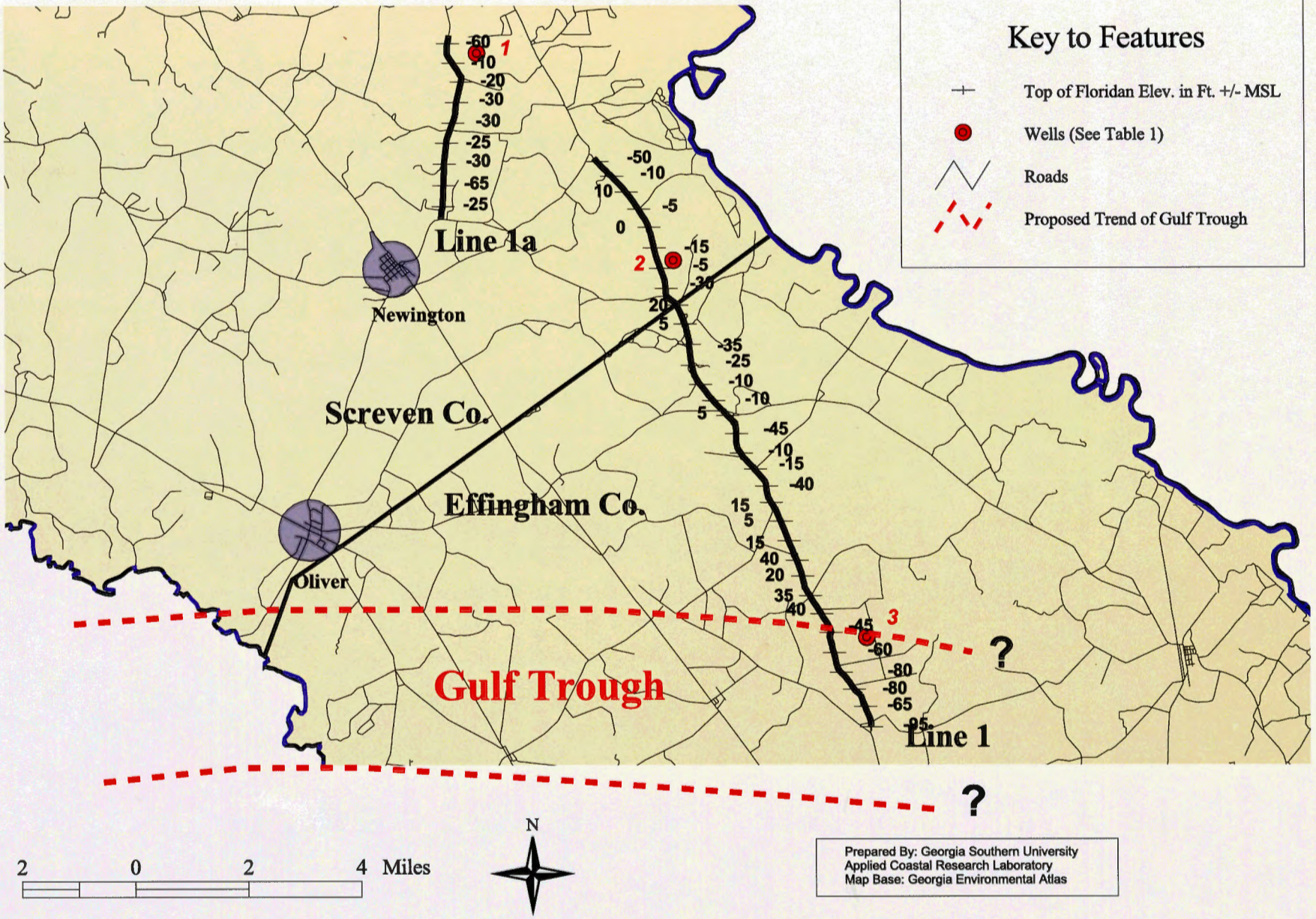


Figure 3

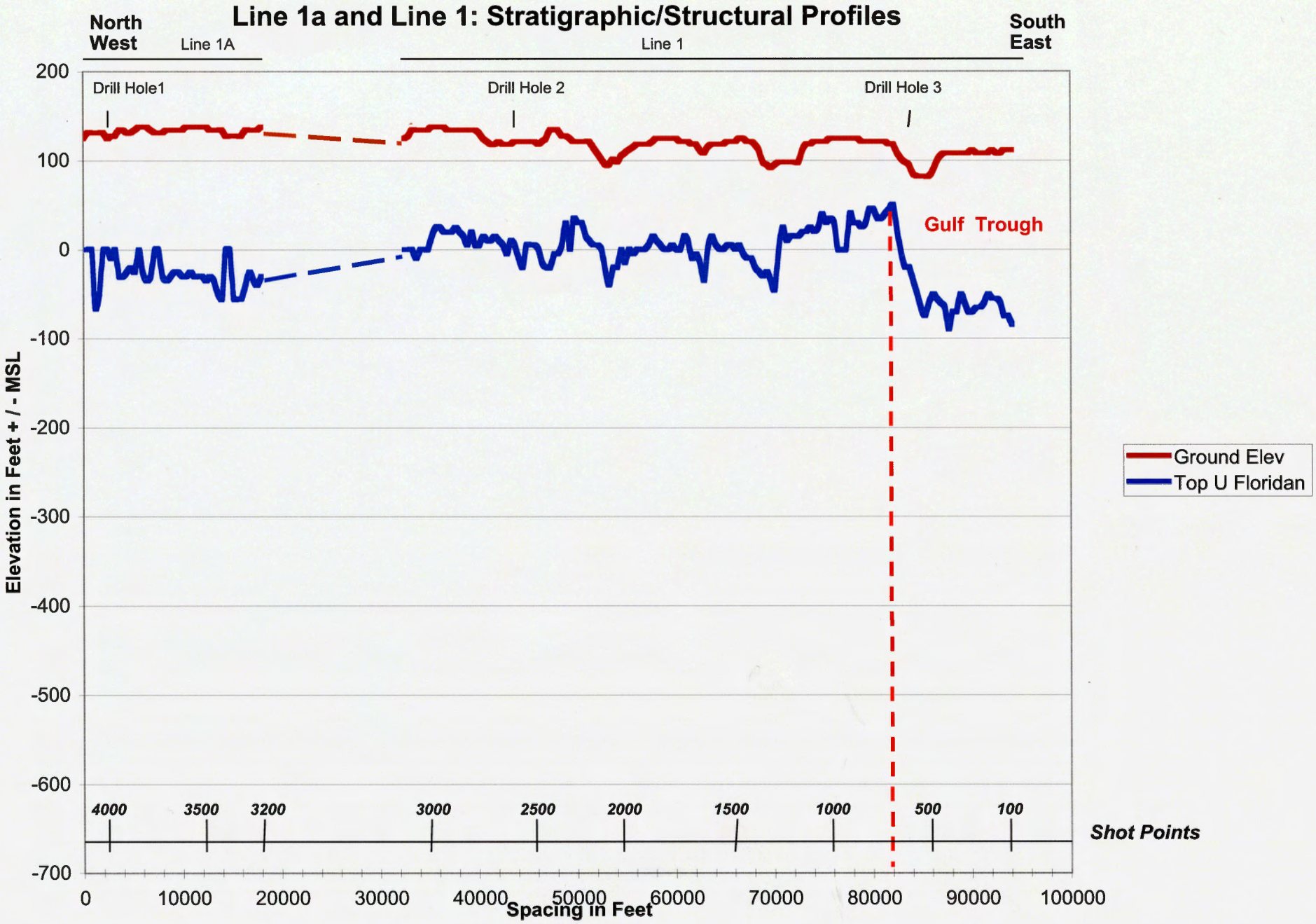

Line 1a and Line 1: Stratigraphic/Structural Profiles
North West
South East
Line 1A
Line 1
Drill Hole1
Drill Hole 2
Drill Hole 3
Gulf Trough
Ground Elev
Top U Floridan
Elevation in Feet + / - MSL
200
100
0
-100
-200
-300
-400
-500
-600
-700
4000
3500
3200
3000
2500
2000
1500
1000
500
100
Shot Points
0
10000
20000
30000
40000
50000
60000
70000
80000
90000
100000
Spacing in Feet

Figure 4

Line 2 and 2a Shot Point Locations

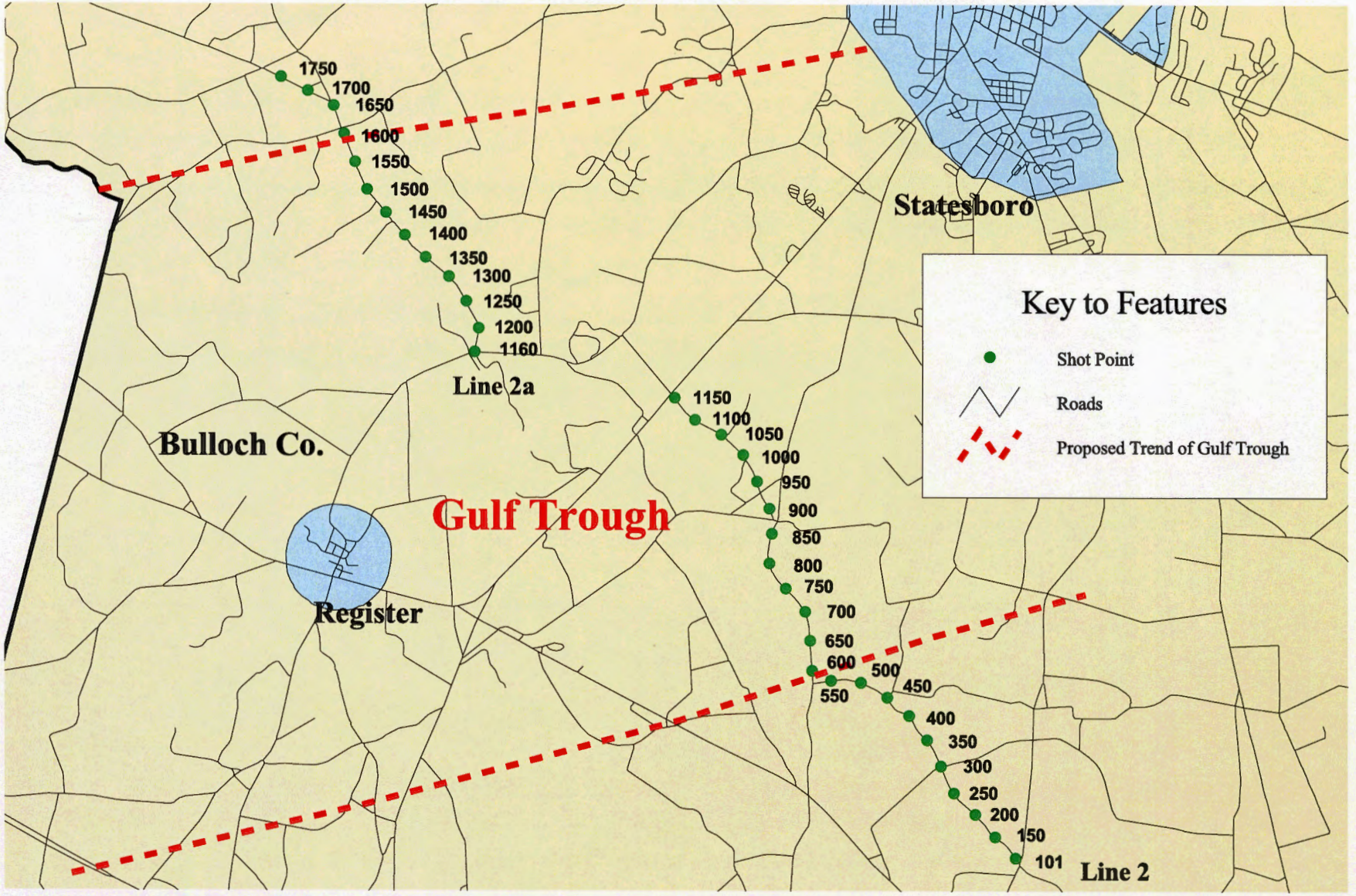


Figure 5

Line 2 and 2a Floridan Elevations and Well Locations

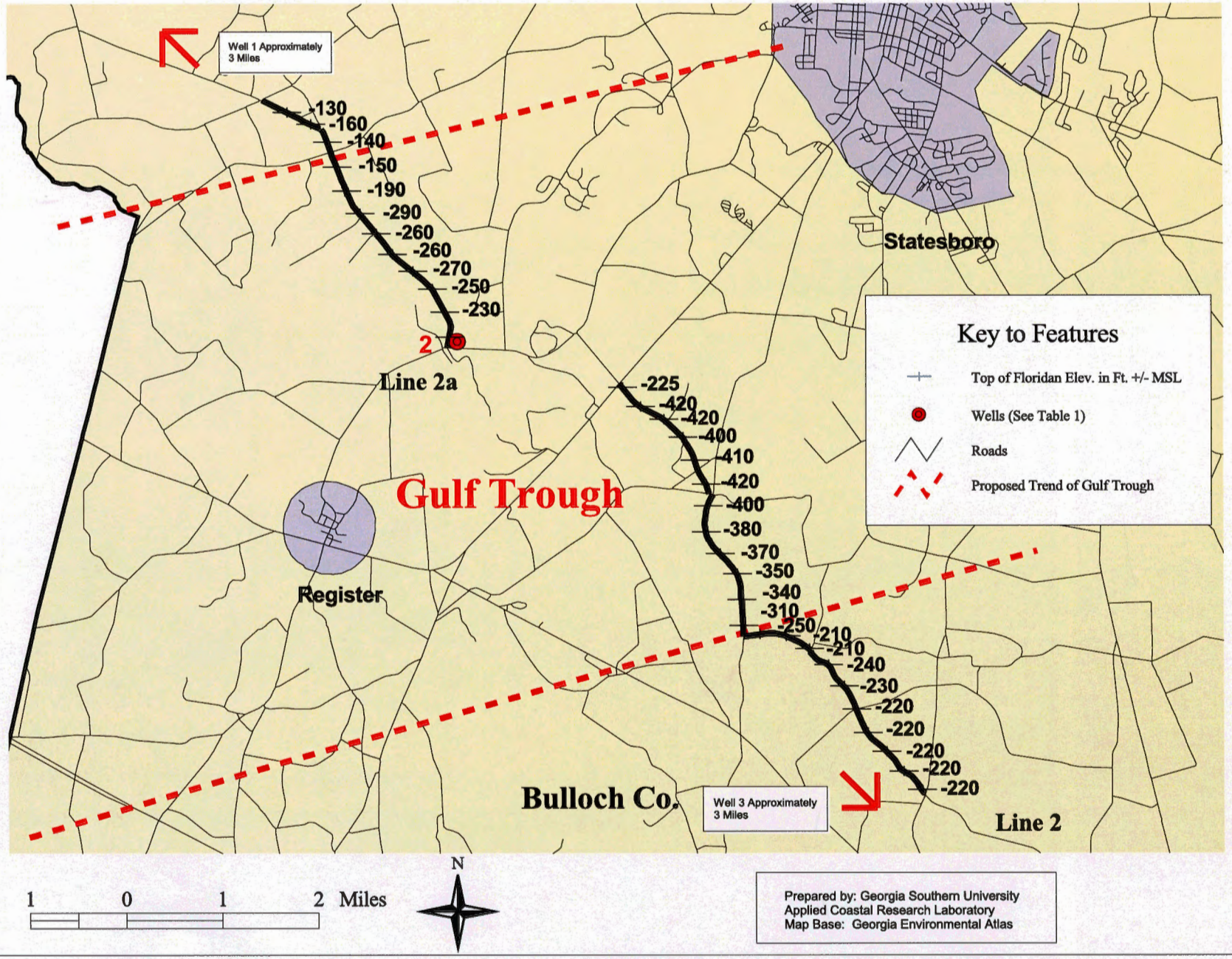


Figure 6

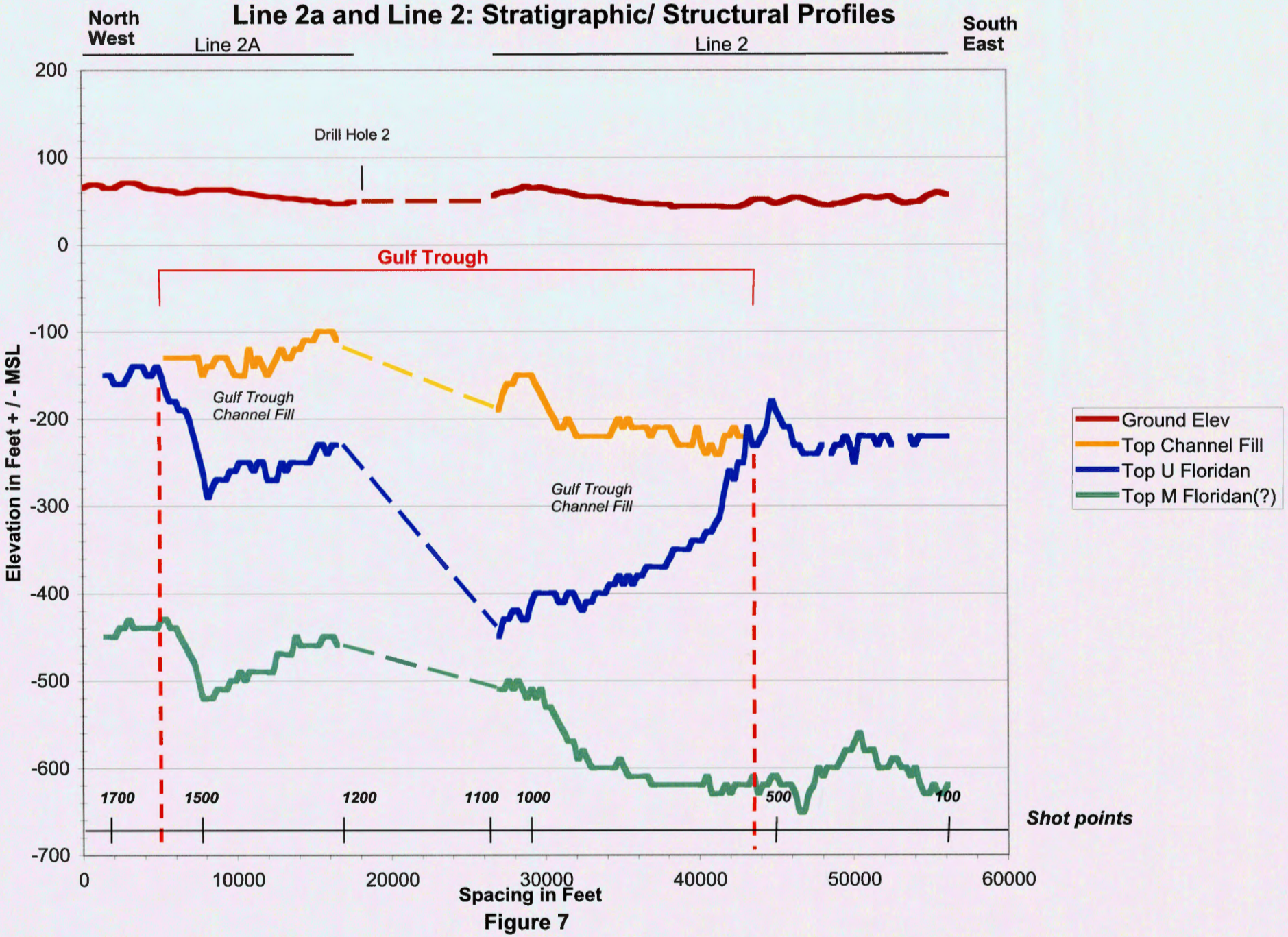

Line 2a and Line 2: Stratigraphic/ Structural Profiles
North West
South East
Line 2A
Line 2
Drill Hole 2
Gulf Trough
Gulf Trough Channel Fill
Gulf Trough Channel Fill
Ground Elev
Top Channel Fill
Top U Floridan
Top M Floridan(?)
Elevation in Feet + / - MSL
200
100
0
-100
-200
-300
-400
-500
-600
-700
1700
1500
1200
1100
1000
500
100
Shot points
0
10000
20000
30000
40000
50000
60000
Spacing in Feet

Figure 7

Line 3 Shot Point and Well Locations

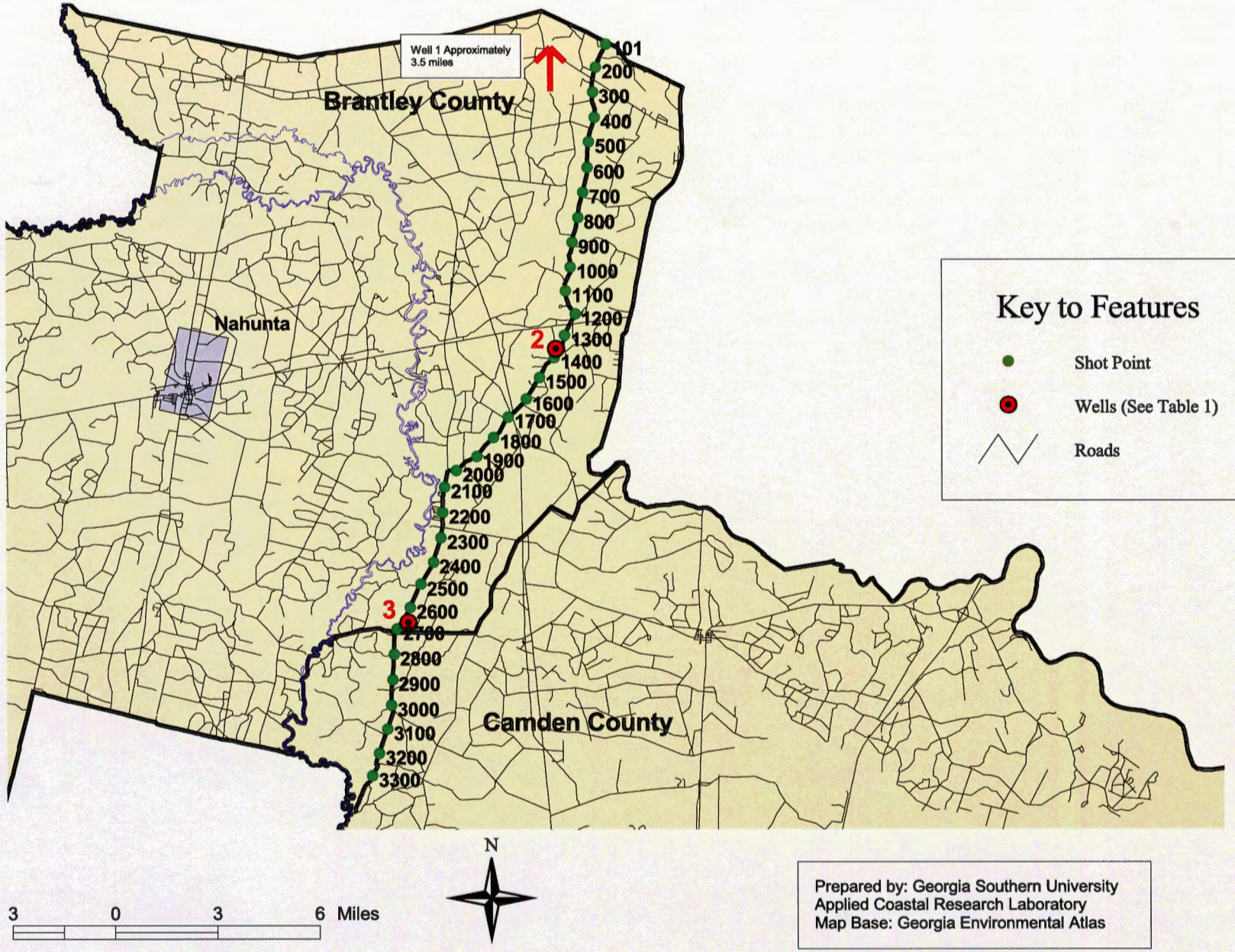


Figure 8


Line 3: Stratigraphic/ Structural Profiles
North
South
Drill Hole 2
Drill Hole 3
1
2
3
4
5
Structural Features (See Text)
Ground Elev
Top Miocene B
Top Miocene C
Top U Floridan
Elevation in Feet +/- MSL
100
0
-100
-200
-300
-400
-500
-600
-700
500
1000
1500
2000
2500
3000
3200
Shot Points
0
20000
40000
60000
80000
100000
120000
140000
Spacing in Feet

Figure 9

Table 1. Depth to Top of Upper Floridan Aquifer (feet below MSL)

	From Drill Holes (lith logs/electric logs)	From Seismic Records (Blackhawk Inc., 2000)	From Literature (Bull. 94, 113; IC 56)
LINE 1 (Gulf Trough)[1]			
Hole 1	10 / 12	25	0
Hole 2	10 / 12	75	to
Hole 3	80 / 85	100	100
LINE 2 (Gulf Trough)[2]			
Hole 1	125 / 140	150	130
Hole 2	250 / 240	240	215
Hole 3	250 / 250	230	195-278
LINE 3 (Satilla Line)[3]			
Hole 1	shallow TD[4] / no log	600	580
Hole 2	525 / 525	500	560
Hole 3	525 / 525	550	450

[1]Hole 1 – 1,000 ft offline
Hole 2 - 1,000 ft offline
Hole 3 – 3,500 ft offline

[2]Hole 1 – 16,000 ft offline
Hole 3 – 16,000 ft offline

[3]Line 3 – generally poor quality seismic record
Hole 1 – 21,000 ft offline

[4]Line 3 – TD above top of Upper Floridan

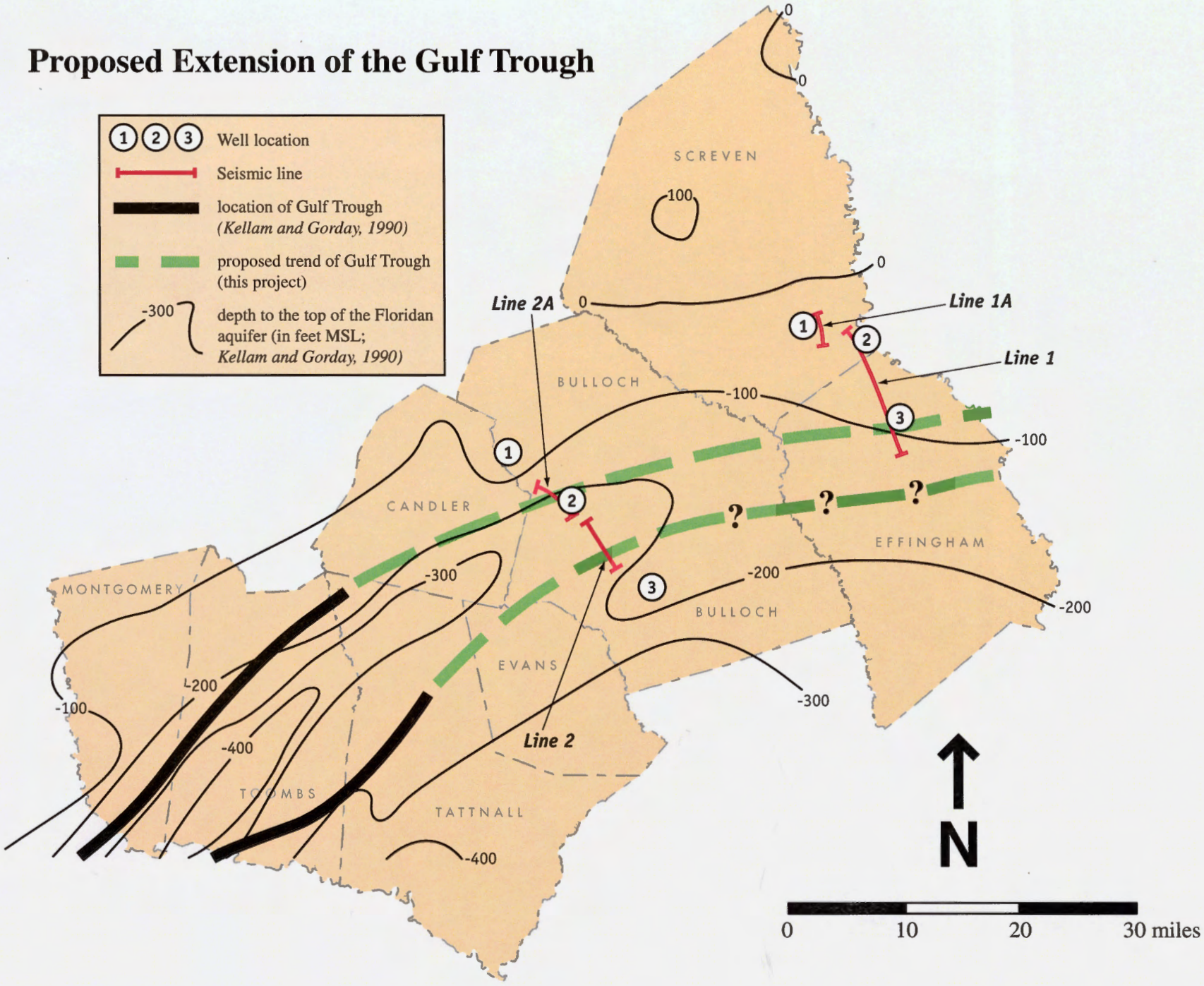
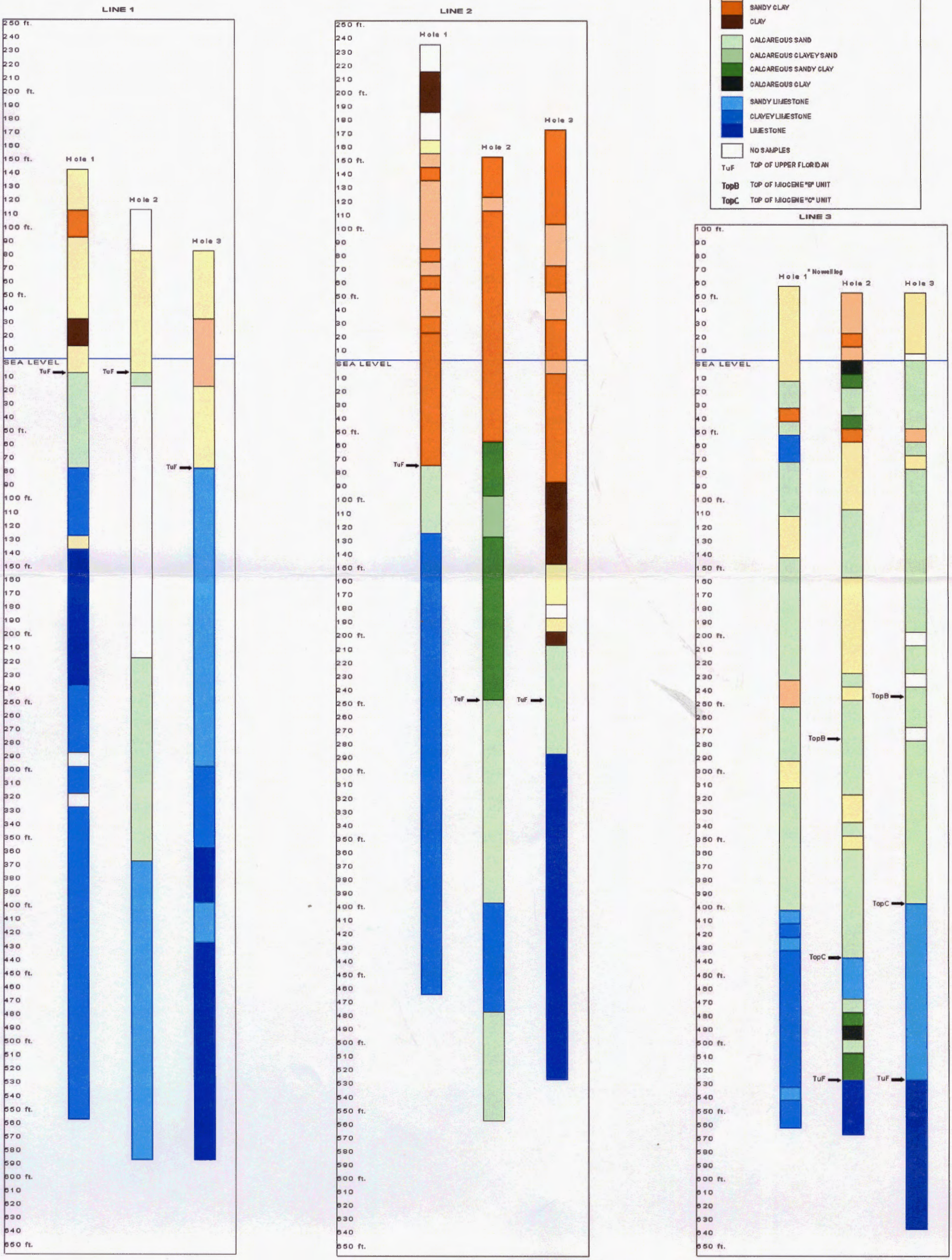

Proposed Extension of the Gulf Trough
1 2 3 Well location
Seismic line
location of Gulf Trough
(Kellam and Gorday, 1990)
proposed trend of Gulf Trough
(this project)
-300
depth to the top of the Floridan
aquifer (in feet MSL;
Kellam and Gorday, 1990)
SCREVEN
BULLOCH
CANDLER
EFFINGHAM
MONTGOMERY
EVANS
TOOMBS
TATTNALL
Line 2A
Line 1A
Line 1
Line 2
0
-100
-200
-300
-400
?
N
0
10
20
30 miles

Figure 10

PLATE 1. LITHOSTRATIGRAPHIC LOGS OF SEISMIC TRANSECT BORE HOLES

Contract deliverable for: Amendment #1, Attachment A
EPD Contract #738-890175



Cost: $1078
Quantity: 100