GEOPHYSICAL INVESTIGATION OF CYPRESS DOMES, WEST CENTRAL FLORIDA.

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Geophysical Investigation of Cypress Domes, West Central Florida

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BACKGROUND:

This report is part of a larger project, "Hydrogeologic investigation of cypress domes in wellfields near Tampa, Florida", being conducted by the Southwest Florida Water Management District (SWFWMD). As an extension of the wetlands monitoring program, the Environmental Section at the District has identified anomalous cases where cypress domes with significantly reduced hydroperiods exist in close proximity to cypress domes with normal to near normal hydroperiods. Preliminary investigations of these affected and non-affected cypress domes indicate that they represent two general types of hydrogeologic frameworks. Affected sites appear to be sinkhole systems with considerably different stratigraphies than surrounding areas; unaffected domes appear to be shallow depressions in the surficial units and therefore have consistent stratigraphic relations with the surrounding sediments. The reduction of hydroperiods and the presence of thicker surficial sand units within the affected domes suggests a more direct connection with the underlying Floridan aquifer.

In order to determine which cypress domes might be affected by pumping stresses and to assess a potential degree of effect, it is necessary to develop a reliable and relatively inexpensive method(s) for quickly determining the hydrogeologic framework of cypress domes in large drawdown areas. Geophysical methods can be used to determine variations in shallow stratigraphy if the stratigraphic changes create recognizable geophysical signatures. This report summarizes the methods and results of geophysical

studies conducted in Starkey and Eldridge-Wilde wellfields between June and September, 1989, to determine which geophysical method or methods can be used to recognize wetlands that are susceptible to pumping stresses.

OBJECTIVES OF PROJECT:

The objectives of this project are to characterize the hydrogeologic setting of seven preselected cypress domes using geophysical methods, and to determine the most effective and efficient geophysical method(s) for future investigations of this type.

METHODS:

- Direct current resistivity in the horizontal electrical profiling mode (HEP) using an ABEM Terrameter.
- 2. Very Low Frequency (VLF) using the Omniplus system.
- 3. Loop-Loop Electromagnetics (LLEM) using Geonics EM-34.
- 4. Ground Penetrating Radar (GPR) using GSI radar.

EQUIPMENT:

- 1. DC-Resistivity survey.
 - 1-ABEM Terrameter
 - 5-stainless steel electrodes
 - 2-100m measuring tapes
 - 4-shielded electrical wire rolls
 - 1-hammer
 - crew of three
- 2. VLF survey
 - 1-Omniplus VLF instrument with resistivity option
 - 2-100m measuring tapes
 - 1-IBM compatible PC for transfer of Omniplus data crew of two

3. LLEM survey

1-Geonics EM-34-3 2-100m measuring tapes supply of C and D cell batteries crew of 2

4. GPR survey

1-skilled operator 1-120mhz radar antenna and signal processor/recorder 2-100m measuring tapes 100-small flags

STUDY AREAS AND LOCATION OF GEOPHYSICAL TRANSECTS:

Two wellfields were chosen by the SWFWMD for this study. Figure 1 shows locations of both Starkey and Eldridge-Wilde Five cypress domes were selected at Starkey wellfield, three with known geologic settings; Starkey east (STE), Starkey central (STC), Starkey west (STW), and two with unknown settings Unknown 1 (UN1), and Unknown 2 (UN2). cypress domes were selected at Eldridge-Wilde; Eldridge-Wilde west (EWW), and Eldridge-Wilde east (EWE), both have known geologic settings. The geologic cross-sections and drilling logs for STC and EWW were withheld at the beginning of the project for verification of the geophysical profiles. The sink-type cypress domes are EWE, STW, STC. The shallow-depression type are EWW and UN2 has shown a significant reduction in its hydroperiod in recent years while UN1 is little affected. The geophysical transects are oriented as follows (figures 2 and 3).

1. STE - Trend N11W This transect follows the major trail into the center of the dome. All of the transects either begin or end near the ET station in the center.

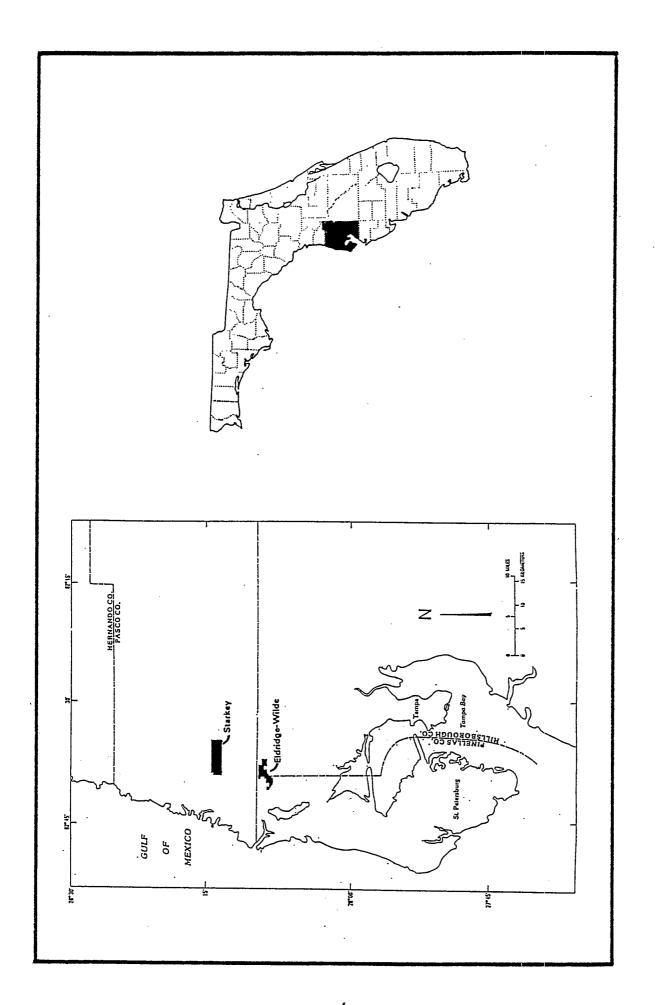


Figure 1. Location of Starkey and Eldridge-Wilde wellflelds

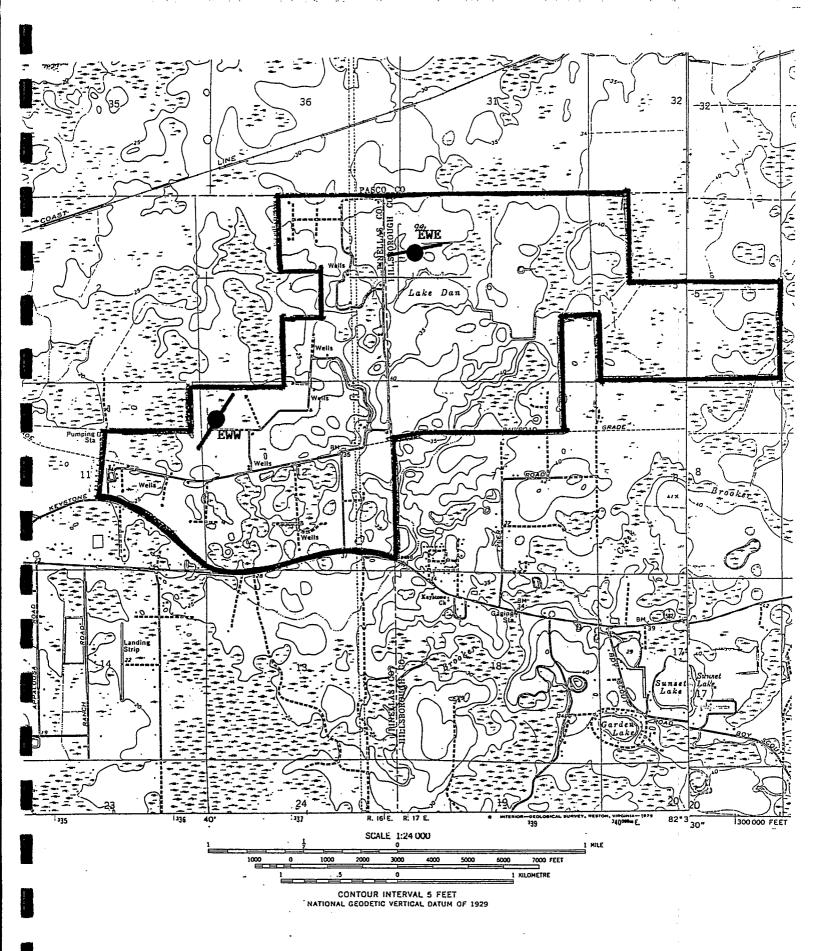


Figure 2. Location of cypress domes at Eldridge-Wilde Wellfield.

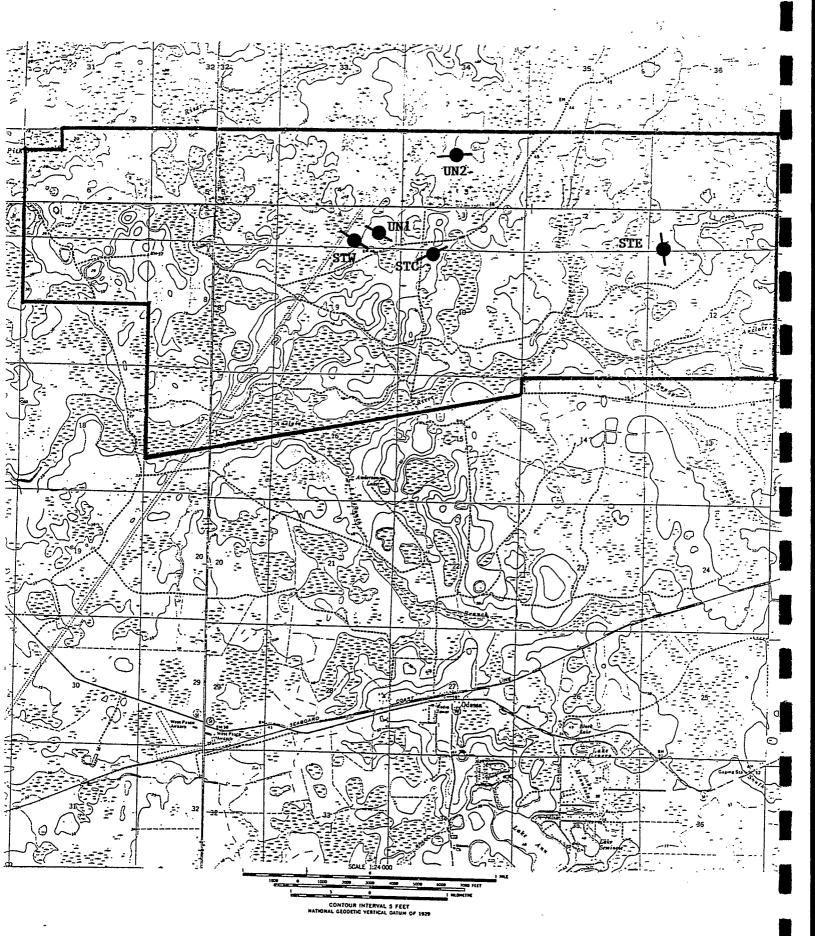


Figure 3. Location of cypress domes at Starkey Wellfield.

- 2. STC Trend N41E This transect follows the major trail cut through the dome. All of the transects begin or end at the shallow depression at the NW edge of the dome.
- 3. STW Trend N45W This transect enters the dome on the southeastern edge next to the monitor well 3AW and ends just past well 2AW.
- 4. UN1 Trend N44W This transect enters the dome from the south west along the No. 7 wellhouse road and ends at the subsidence station in the center.
- 5. UN2 Trend N72E This transect enters the dome from the southwest and crosses the dome completely.
- 6. EWW Trend N20E This transect parallels the monitor well line and completely crosses the dome.
- 7. EWE Trend N40E This transect parallels the monitor well line and ends at the center near monitor well 2AE.

PRELIMINARY ANALYSIS:

A photolinear analysis was conducted prior to the geophysical surveys to determine the spatial relationships of the photolinears to the seven cypress domes. Photolinears are linear trends identified on aerial photographs that may represent zones of increased fracture density. Photolinears that are determined to represent zones of increased fracture density are termed fracture traces. Fracture traces are vertical zones of generally higher hydraulic conductivity that can be vertical pathways for ground-water flow between the surficial and semi-confined aquifers. A strong correlation between fracture traces and affected wetlands might be useful for identifying potentially problematic wetlands. The aerial photo analysis, conducted for

this study, indicates a moderate but non-conclusive correlation between affected cypress domes and photolinears (figures 4 and 5). Affected sites EWE, STW and UN2 are intersected by photolinears. However, unaffected site STE appears to have a high concentration of photolinears near its northern edge. A more statistically significant analysis might provide a stronger correlation. Furthermore, the physical character of the photolinements needs to be determined. This involves determining those photolinears which represent fracture traces and those which are not related to geological features. Geophysical methods, such as the EM-34 method used for this report, have been used for determining zones of increased fracture density. Clearly, a preliminary analysis using aerial photographs could help to limit the number of wetlands to be studied. importantly, if a larger data base were collected, the relationship between affected domes and photolinears might become a primary method for predicting the effects of ground-water withdrawals on cypress domes.

GEOPHYSICAL METHODS:

Horizontal electrical profiling

Horizontal electrical profiling (HEP) is a direct current resistivity method used for determining lateral changes in subsurface stratigraphy. In general, a current is applied to two electrodes that are driven into the soil and the resulting electrical potential is measured by a second pair of electrodes. The apparent resistivity is calculated from the separation and

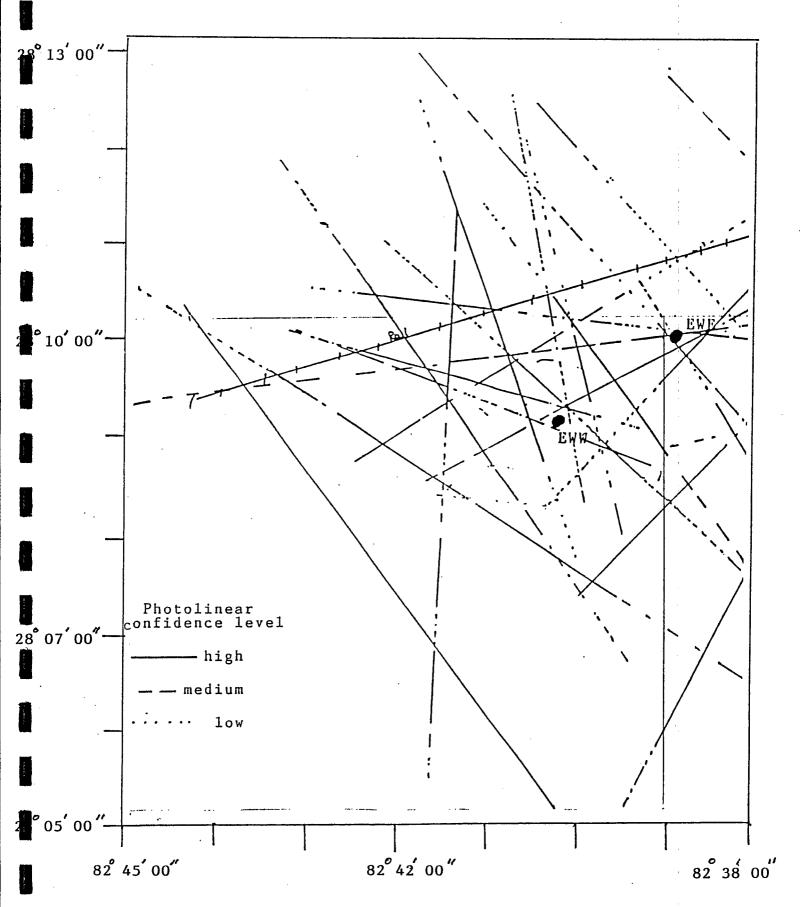


Figure 4. Photolinear analysis of Eldridge-Wilde wellfield from color infrared 1:56,000 aerial photo 35-24.

Date of photography 2-7-84.

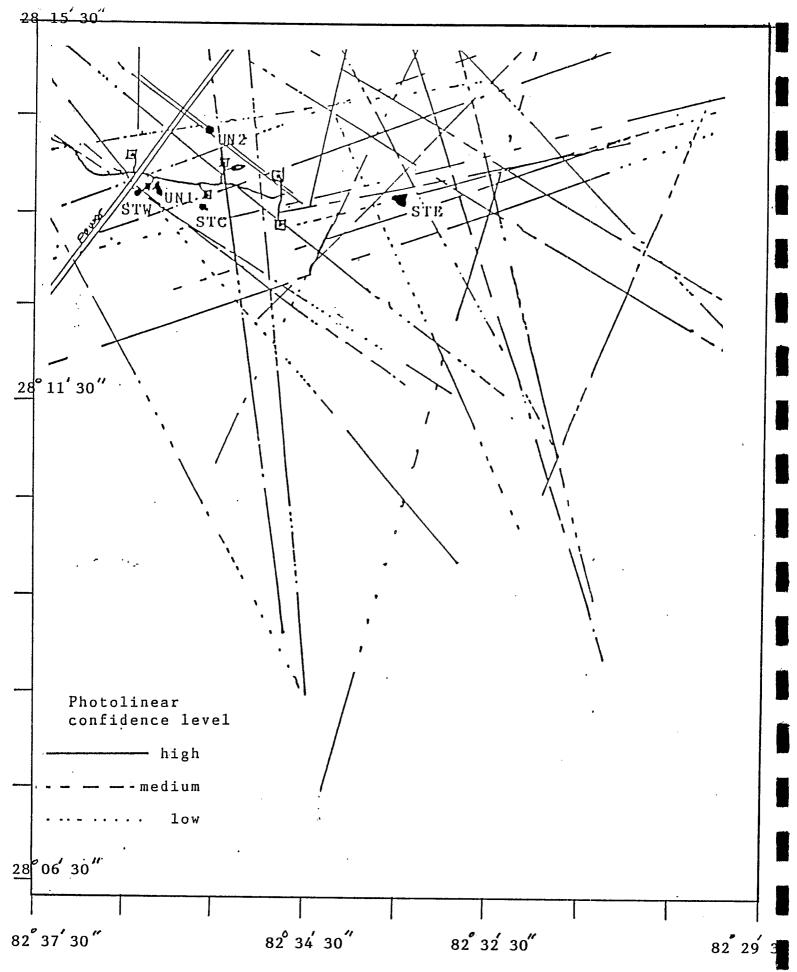


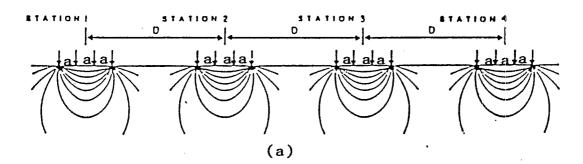
Figure 5. Photolinear analysis of Stakey wellfield from color infrared 1:56,000 aerial photo 33-173. Date of photograp by 2-7-84.

geometry of the electrodes, and the measured resistance value in ohms. The entire array is then moved along a profile line and the procedure repeated. Dobrin and Savit, 1988 provide a detailed description of the theory and application of HEP.

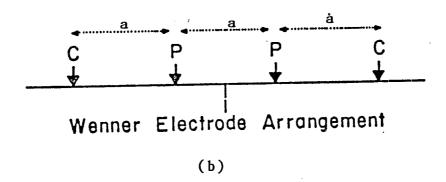
In this study the Wenner array was used. The Wenner array is a four-electrode arrangement where there are equal distances between adjacent electrodes ("a" spacing, figure 6a). For the Wenner array, the equation for apparent resistivity is;

 $f_{\mathbf{q}} = 2 \text{ Tr a}(\Delta V/I);$ where $f_{\mathbf{q}} = \text{apparent resistivity},$ $\mathbf{a} = \text{electrode spacing (M)}$ (V/I) = resistivity in ohm.

By increasing the "a" spacing, successively deeper layers are included in the apparent resistivity reading measured at the surface. The "a" spacings selected for this study were 10,20, and 30 meters (32.8, 65.6, and 99.4 feet), which correspond to effective exploration depths (EED) of roughly 6,12, and 18 meters(19.7, 39.4, and 59.1 feet), respectively. Materials above the EED contribute 70% of the total apparent resistivity measured at the surface. This is an important concept since it is easy to mistakenly think of the EED as the depth from which the resistivity measurement is being taken. Rather, it is the total thickness of material above the EED which is contributing 70% of the response measured at the surface. Therefore, apparent resistivity cannot be used to describe any individual geologic unit's resistivity. For each station readings were taken for each "a" spacing and the entire array was then moved 10 meters (32.8 feet) and the process repeated. Figure six(b) is a schematic diagram of the HEP method. The vertical arrows



D = distance between stations.



a = electrode spacing

Figure 6a. Schematic diagram of HEP method.
6b. Schematic diagram of WEnner electrode arrangement.
(from Benson, 1981)

represent the electrodes (figure 6a), with the distance between them equal to the "a" spacing and the distance between sucessive stations the distance "D". The results for each "a" spacing were plotted versus distance to form horizontal electrical profiles. Anomalies associated with vertical features or boundaries are often indicated by rapid increases or decreases in apparent resistivity.

Very Low Frequency (VLF)

Very low frequency (VLF) radio transmissions can be used to obtain subsurface geologic information by measuring the interaction between powerful, low frequency (17-25 kHz) radio transmissions and earth materials. These transmissions are intended for military communications; however, far from their sources they are excellent for geophysical studies. United States there are three VLF transmitters; Cutler, ME (24.0 kHz), Seattle, WA (24.8 kHz), and Annapolis, MD (21.4 kHz). VLF signal provides a primary electromagnetic field that can used to locate vertical geologic contacts. At long distances from the transmitters (exceeding 500 miles) the VLF field consists of a vertical electrical component, a horizontal electrical component, and a primary horizontal magnetic field. For conventional VLF surveys (tilt angle) measurement is made of the magnetic field which, in the absence of subsurface conductors, is horizontal and linearly polarized (Wright, 1989). Subsurface changes in resistivity, such as vertical geologic contacts, cause the field to become elliptically polarized and the major axis (Ez) to tilt in relation to the size of the horizontal axis (Ex) (figure 7).

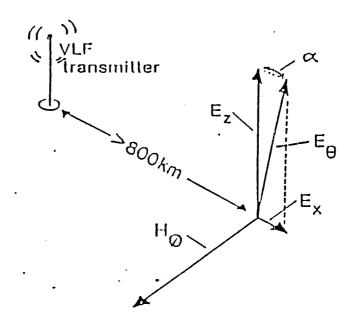


Figure 7. Principle components of the primary VLF field at distances greater than 500 mi from the transmitter. Es and Hs are the electrical and magnetic components of the field, respectively. Es and Ex are the vertical and horizontal components of Es. The angle & is the tilt of field Es from the vertical. Both & and Es increase with increasing apparent resistivity. (from Wright, 1988)

On figure 7 E₀ is the vector sum of Ez and Ex. For measurements of VLF resistivity to be made, two electrodes are placed into the ground at right angles. The electrodes measure the shallow earth materials response (ratio of the horizontal electric field to the horizontal magnetic field) to the propagating electromagnetic field (figure 7). The resulting ratio of the two fields is directly related to the apparent resistivity of the shallow earth materials. Figure 8 shows the typical tilt angle response over a vertical contact with varying resistivity. In the resistivity mode, the response is identical to a conventional DC resistivity survey. In either, the conventional VLF or the VLF resistivity modes, the resulting data (tilt angle or apparent resistivity) are generally plotted versus distance and qualitatively interpreted.

In this study, the Omniplus VLF system was used. The Omniplus is a self-contained unit which samples three VLF stations at the same time. The Omniplus measures the tilt angle and apparent resistivity (if VLF resistivity option is used) and stores the values electronically for later transfer to a PC for processing. The survey is conducted by initializing the Omniplus to the selected VLF stations and taking readings at a preselected station spacing which was 5 meters (16.4 feet) for this study. The Omniplus automatically increments the station spacing after each reading and also stores the relative strength of the primary VLF fields, so that the strongest stations can be determined. For this study, two people operated the Omniplus, one took the readings and the other placed the electrodes for the VLF

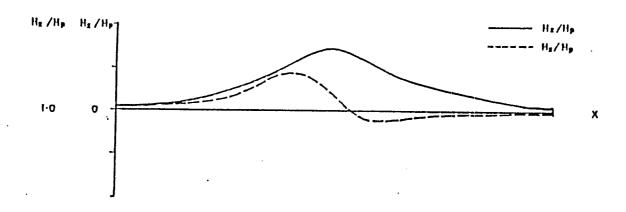
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E_{p}(h) & \sigma_{0}, \rho_{0} \\
\hline
 & H_{p} \\
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 & \sigma_{0} > \sigma_{1} \\
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\end{array}$

 ρ = apparent resistivity

 σ - conductivity

 E_{ρ} Primary horizontal electric field

 $H_P = Primary magnetic field$



resistivity measurements.

The effective exploration depth (EED) is approximately 3.6 times the square root of the apparent resistivity. The apparent resistivity for a specific site can be determined by the VLF resistivity option or by preliminary DC resistivity surveys. This calculation results in an average EED of 25 meters (82.02 feet) for Starkey and Eldridge-Wilde wellfields, when an average apparent resistivity of 50 ohm-m is used.

Loop-Loop Electromagnetics

The Geonics EM-34-3 is a loop-loop electromagnetic instrument designed to read terrain conductivity directly. The unit is composed of a transmitter coil, a receiver coil, and two control The transmitter coil creates a time-varying electromagnetic field which induces eddy currents in the earth. The eddy currents generate a secondary magnetic field which , along with the primary field, is sensed by the receiver coil (McNeil, 1980). In general, the secondary magnetic field is a non-linear function of the intercoil spacing, the operating frequency, and the ground conductivity. McNeil (1980) developed the EM-34 with specific frequencies (1600, 800, and 400 Hz) and coil spacings (10, 20, and 40 meters or 32.8, 65.6, and 131.2 feet) which make the ratio of the secondary to primary magnetic field linearly proportional to the terrain conductivity. Under these conditions, known as operating under low induction numbers, the instrument reads directly in terrain conductivity and no conversions are needed. The EM-34 can also be operated with the coils (always co-planer) in either the vertical (horizontal

coils) or horizontal (vertical coils) dipole modes. The vertical dipole mode is more sensitive to vertical geologic contacts.

For this study the unit was usually operated with horizontal coils and 10 and 20 meter (32.8 and 65.6 feet) coil spacings. Stations were spaced at three meter intervals and the transects were oriented from the center toward the edge of the dome. The 10 and 20 meter coil spacings in the horizontal mode correspond to an EED of 15 and 30 meters (49.2 and 98.4 feet). Terrain conductivity is basically the inverse of apparent resistivity and can be easily converted by dividing the conductivity value (milliSiemens/M) into 1000 for resistivity in ohm-m. McNeil (1980) provides a complete analysis of the theory and use of the EM-34.

Ground Penetrating Radar (GPR)

Ground penetrating radar (GPR) is a very effective method for mapping shallow subsurface features quickly. Basically, a radar beam is transmitted into the ground at a fixed frequency. As the signal passes down through the earth, part of the signal is reflected back to the surface and part continues to penetrate to deeper layers (figure 9). The energy that is reflected back to the surface is picked up by a receiver, processed, and converted to a graphic display. The graphic display shows two-way travel time in nanoseconds (nsec) versus horizontal distance.

Interfaces between layers with different dielectric constants show up as three black bands on the strip chart. Generally the second black band is interpreted as the interface between layers (Geoscan, 1988; figure 10). The vertical time scale can be

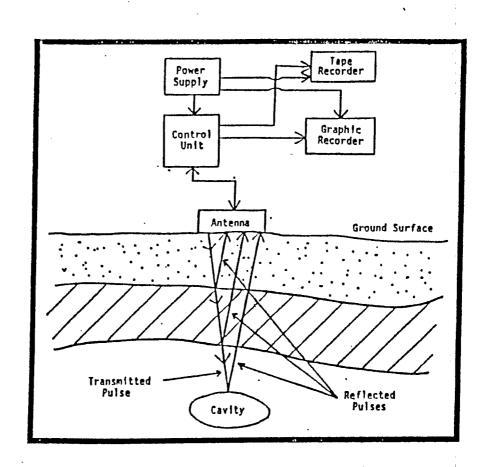
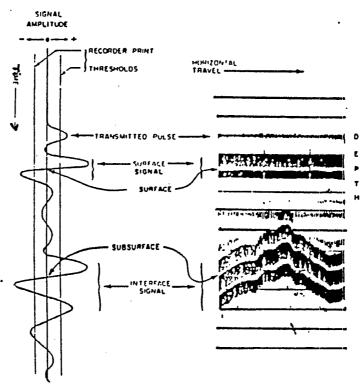


Figure 9. Functional diagram of GPR system. (from Geoscan, 1988)



Sketch of a single impulse and reflections as seen by the receiver.

Example of profile information as displayed by the graphic recorder.

Figure 10. The major features of a graphic GPR record.

There are typically three dark bands produce.

There are typically three dark bands produced at each interface. The reflections are produced when the radar signal crosses layers with different dielectric constants. (from Geoscan, 1988)

converted to a depth scale provided the velocity of propagation is known. The depth of penetration for a fixed frequency is related to the resistivity, degree of saturation, and dielectric constant (measured in electromagnetic units or emu) of the earth material. Depth of penetration is inversely proportional to the frequency of the transmitted signal. The general equation for the depth of penetration is:

 $D = ct/2(e)^{0.5}$ Where e = dielectric constant (emu) t = two way travel time (sec)c = velocity of light (m/sec)

The approximate vertical scale conversion for a typical semisaturated loose packed sand is 5 nsec/foot. If resistivity is known, the total exploration depth is approximately 0.3 meters per ohm-meter of resistivity. Therefore, a 300 nsec sweep of 100 ohm-m sediment yields 30 meters of total penetration. By towing the antenna along the surface of the ground, lateral changes in near-surface stratigraphy can be mapped. GPR works well in resistive environments, but the signal is strongly attenuated in conductive environments (refer to table 1). Clay layers often completely attenuate the signal. Two important concepts to understand are reflection-free zones and attenuation. Reflection-free zones are zones with no apparent interfaces to reflect the signal. They are typically "white", reflection free zones on the graphic display. Attenuation absorbs the downward propagating signal. Once the signal is completely attenuated, no further reflections can be recorded. On a graphic display the complete attenuation of the signal results in a reflectionless zone similar to a "true" reflection free zone. The difference is

Notes	Transparent to radar when dry. Highly conductive when wet.	Attenuates radar. Conductive target for EM and VLF.	Produces some strong radar reflections. Moderately conductive.	Can be reflection free when "clean" Resistor for HEP.	Generally below the depth of exploration. Reflection free for radar.
Conductivity (millimho/m)	10 to 100	100 to 1000	10 to 100	.1 to 50	.5 to 25
Resistivity (ohm-m)	10 to 100	1 to 10	10 to 100	20 to 10,000	40 to 2000
GPR Two-Way Travel time	0.25-0.50 dry 0.15-0.35 wet	0.125-0.20	0.125-0.25	0.20-0.35 dry 0.10-0.30 wet	0.10-0.20
Material	Peat	Clay/Marl	Silt	Sand	Limestone

Table 1. Common electrical properties of earth materials found at Starkey and Eldridge-Wilde wellfields. Note: GPR

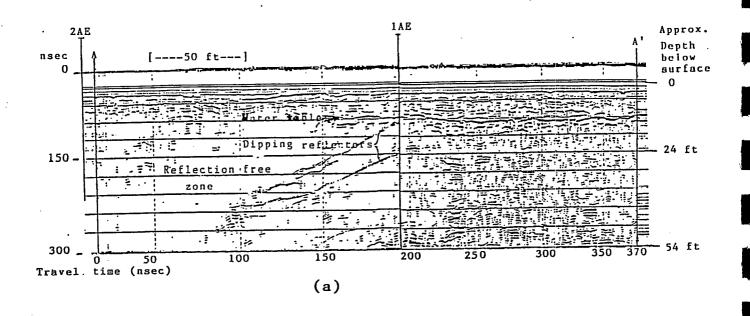
that signals can be returned from below a reflection free zone and can not below a reflectionless zone, ie complete attenuation.

For this study a 120 mHz antenna was used because it provides deeper penetration (lower frequency). However, the increased penetration of the 120 mHz antenna caused a decrease in the resolution, but since this study is concerned with large scale features the loss of resolution does not affect interpretations. The instrument was pulled by hand through the cypress dome and lateral distance was recorded on the graphic display. The graphic recorder/signal processor has a control which allows the total two-way travel time, recorded on the graphic display, to be adjusted to the specific conditions encountered at a site. During this study, the control unit was set so that the graphic display recorded either 200 or 300 nsecs of two-way travel time. Using a maximum average apparent resistivity of 100 ohm-m (none of the sites exceeded this average value) for conversion, the GPR unit was able to delineate features as deep as 30 meters or approximately 100 feet. Other controls on the recorder/signal processor were set to the specific condition encountered in the cypress domes.

RESULTS: GPR

<u>Calibration to known geologic profiles</u>

Figure 11_a shows the 300 nsec sweep of EWE (an affected site) extending from the center of the dome near well 2AE (also refer to the geologic cross-section figure 11_b ; A to A') to approximately 65 meters (213.2 feet) outside of the dome. The



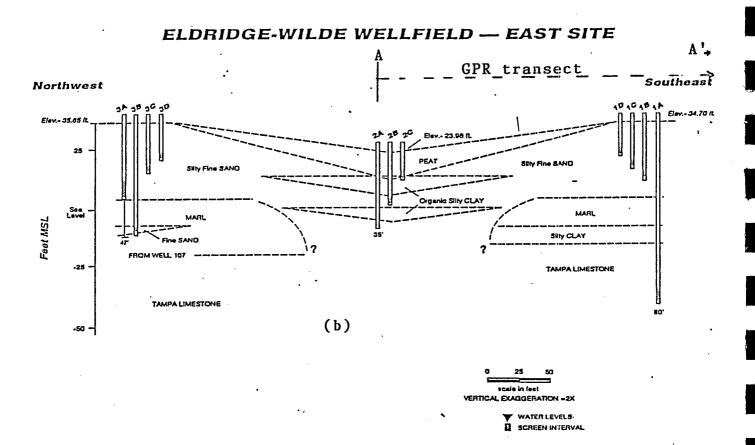


Figure 11_a . 300 nsec sweep of EWE showing major features. (note: horizontal scale on 11a is not constant) Geologic cross section of EWE showing location of GPR transect A to A'.

most notable features of this line are: the surface at 30 nsec, the reflection-free zone near the center of the dome, the water table at 90 nsec, and the steeply dipping reflectors indicated on figure 11a.

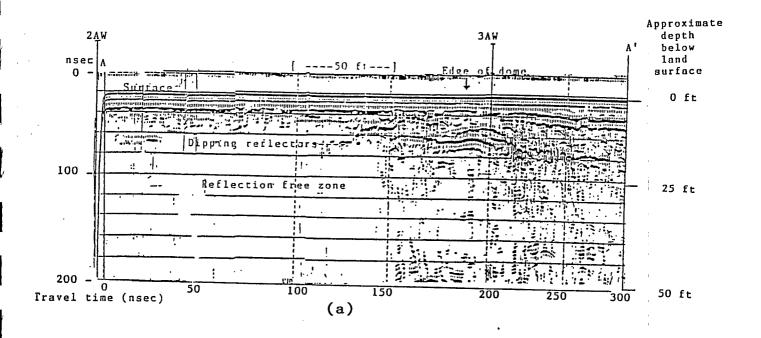
{Important note: the estimates of depth to reflectors contained in the remainder of the GPR section are intended to show approximate time-to-depth conversions and are therefore, only approximations. For studies requiring exact depth conversion, velocity of propagation must be determined directly. This can be done by measuring the dielectric constant in a laboratory or by determining the function (generally non-linear) which describes the changes in the dielectric constant with depth.}

Using 0.20 ft/nsec for conversion indicates that the water table is located at approximately 12 feet below land surface.

0.20 ft/nsec is a good first approximation for depth conversions on radar lines conducted over the types of sediments encountered at Starkey and Eldridge-Wilde wellfields (personal communication Bill Wilson Sinkhole Research Institute, refer to table 2). This correlates well with "true" depth to the water table, 13 feet, calculated from the hydrographs of well 1BE in late May, 1988 (appendix A). Notice the steeply dipping reflectors between 100 and 200 feet east from well 2AE. The dipping layers lie approximately 180 to 240 nsec below the surface. Using the same conversion factor (0.20 ft/nsec), the depths to the upper reflector is approximately 30 feet below the surface and the lower reflector approximately 42 feet below land surface. The well log from 1AE, which is east of the reflectors on figure 11b,

indicates that a silty sand/marl interface is located at 33.5 feet below the surface and a marl/silty clay interface is located 48.0 feet below the surface (figure 11a and appendix B). The close correspondence between the interfaces and the reflections on the profile provides a high degree of confidence in this interpretation. Furthermore the depth conversion factor chosen for this dome appears to be within 5 percent of the true average velocity.

Figure 12a is a 200 nsec sweep of STW (an affected site) which starts near well 2AW (also refer to geologic cross-section figure 12,b; A to A') and terminates approximately 100 feet outside of the dome. The most obvious features are the ground surface at 20 nsecs, the water table at 50 nsecs, the dipping reflectors that terminate at 100 feet from 2AW and at approximately 80 nsecs, and the zone with no reflections near the center of the dome (below well 2AW). Average resistivity is about 100 ohm-m from the HEP survey which should yield a higher average velocity of about 0.25 ft/nsec. This is slightly faster than EWE because the average resistivity is higher. In late May the water table at well 3AW was approximately 10 feet below the land surface (appendix A). Using an estimated average velocity of 0.25 ft/nsec, the depth to the water table is calculated to be approximately 7.5 feet. The calculated depth is slightly less than the actual depth below land surface, therefore the velocity might be sightly higher in the unsaturated zone. The dipping reflectors, between 60-80 nsecs indicated on figure 12a, do not correspond to any known layers (well log 3AW), and therefore may



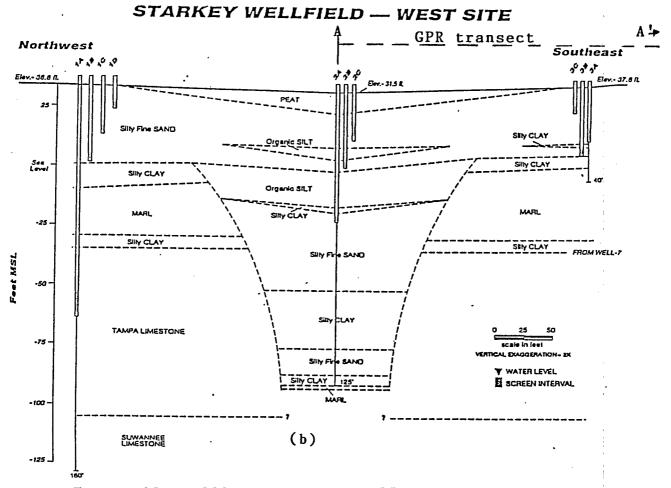


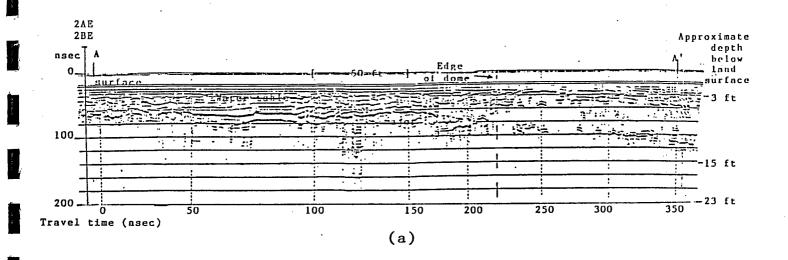
Figure 12a. 200 nsec sweep of STW with major features indicated.(note: horizontal scale not constant).

12b. Geologic cross section of STW showing location of GPR transect A to A'.

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represent thin clay/silt layers which were not detected during well logging. The reflectors at 180 nsecs correspond to the silty clay/marl interface, from well log 3AW, when the velocity is reduced to 0.20 ft/nsec (Figure 12a,b). (Note: The HEP apparent resistivity profiles for STW show a general decrease in resistivity with depth therefore it is reasonable to adjust the velocity accordingly.) Using 0.20 ft/nsec velocity, for depth to time conversion, the depth to the interface is calculated as 32 feet which is very close to the 34 feet below land surface value from well log 3AW. The zone with no reflections near the center may be a reflection-free zone, however no coherent reflections are visible below this zone. The absence of further reflectors suggests that the signal may have been completely attenuated. There are a series of organic silty layers indicated on the well log 2AW (appendix B) that may have caused attenuation of the signal; however, there is no way of determining the cause without further GPR surveys. It is sufficient to note the zone may be an attenuated or reflection free zone for reconnaissance type surveys.

Figure 13a is the 200 nsec profile taken at STE (an unaffected site) from the ET station in the middle to 115 feet outside of the dome. The important features to note are: the surface at 20 nsecs, the water table at 45 nsecs, the strong reflector at 70 nsec, and the attenuated zone below 80 nsecs. The average resistivity of STE is much lower than either EWE or STW and therefore the average velocity is expected to be less. Using an estimated average velocity of 0.125 ft/nsec yields a



STARKEY WELLFIELD — EAST SITE

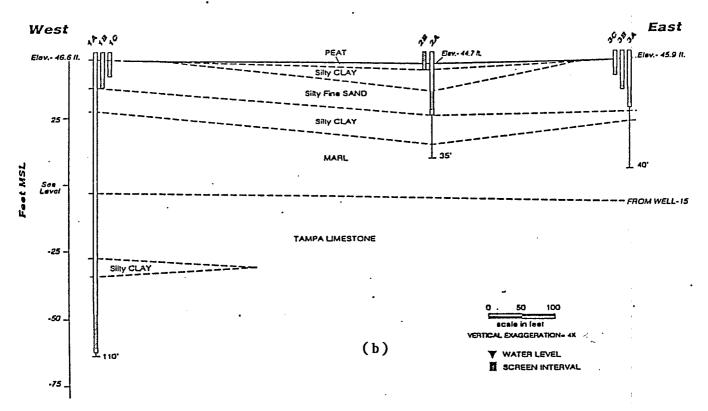


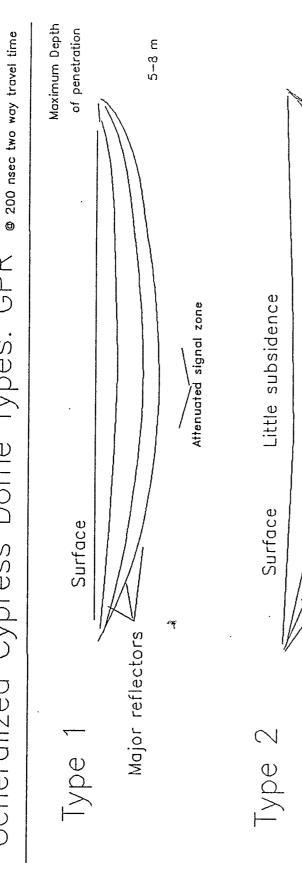
Figure 13a. 200 nsec sweep of STE with major features indicated. (note: horizontal scale is not constant)

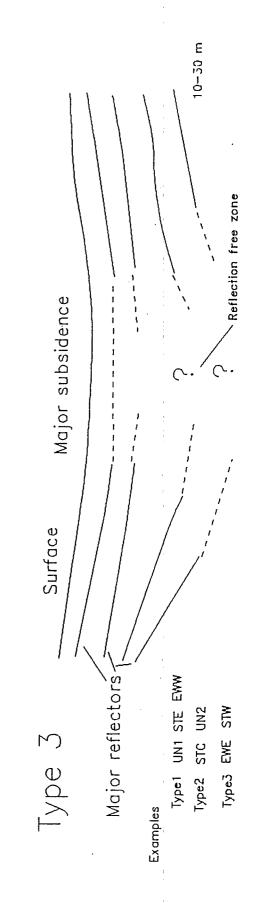
Figure 13b. Geologic cross section of STE with wells indicated. (note: the cross section is not co-planer with the GPR profile)

depth of 3 feet below the surface for the water table. The hydrograph for well 2BE in late May indicates that the water table was approximately 2.75 feet below land surface (appendix A). Therefore 0.125 ft/nsec is a good approximation of the average velocity. The depth to the strong reflector at 70 nsecs is calculated to be 6.25 feet. According to well log 2AE the silty clay unit changes from stiff to very stiff at approximately 7.5 feet (refer to figure 13a and appendix B). The interface on the GPR profile, figure 13b, may represent this change in clay compaction. The upper silty clay unit is approximately 6.5 feet thick which would tend to completely attenuate the signal. This is suggested as the reason for the attenuated zone below 80 nsecs.

It is clear from these three sites with known geology that there are significant differences between the two types of domes. Figure 14 shows the relationships that distinguish the affected from unaffected cypress domes on GPR profiles. The differences as noted on the three calibration GPR profiles characterize type 1 and type 3 cypress domes which correspond to unaffected and affected domes respectively. A third type which is distinguishable from the other two (type 2) was discovered during the analysis of the domes with withheld geologic data. It is, however, essentially a type 3 dome. The important features of the type 3 dome (an affected site) include; a reflection-free or attenuated zone near the center which is surrounded by reflections on either side (only on one side if the line did not cross the entire dome), steeply dipping reflections, and a

120 mhz transmitter Generalized Cypress Dome Types: GPR





8- 12 m

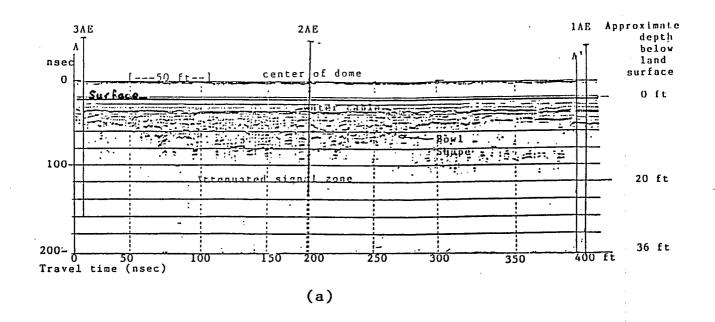
Major reflectors

relatively high velocity for the radar signal (as determined from comparison to well log data or hydrographs). The important features of a type 1 dome (an unaffected site) are; generally shallow penetration of the signal which terminates in a bowl shape below the dome, continuous reflections across the entire dome with no abrupt terminations, and a generally lower average velocity for the signal propagation.

Comparison of GPR types to withheld geologic profiles

Figure 15a shows a 200 nsec sweep of EWW from the southwest near well 3AW to the northeast and well 1AW (also refer to figure 15b). The general features of this profile are the shallow depth of penetration indicated by the termination of reflectors below 80 nsecs, and the bowl shape of the reflection pattern. Also note the generally shallow dip of the reflectors, especially near the center of the dome. These features indicate that this is a type 1 dome.

Following the interim report the previously withheld geologic logs and profiles for site EWW were released (figure 15b and appendix B). Using an estimated approximate velocity of 0.20 ft/nsec to convert to depth, shows that this profile shows no major reflections below approximately 20 feet. Evidently the signal was completely attenuated by the silty clay layer which has an average depth of about 22 feet below the surface. The clay layer is shallower near the edges which may account for the general bowl shape of the reflections. The absence of steeply-dipping or laterally-terminating reflectors is substantiated by the well logs provided in the interim report (appendix B).



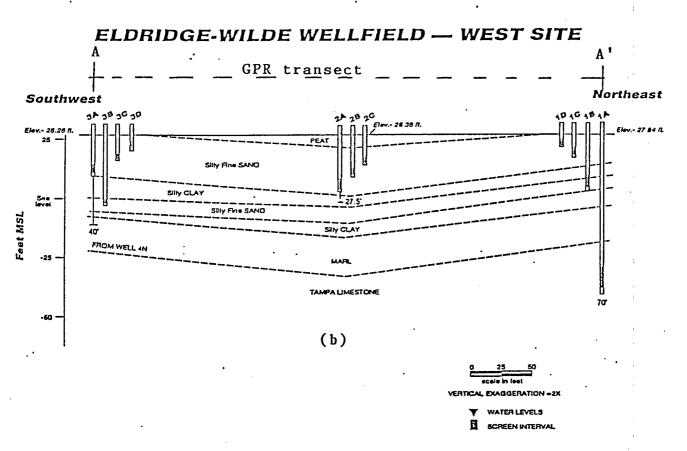


Figure 15a. 200 nsec sweep of EWW with major features indicated. (note: horizontal scale is not contant)

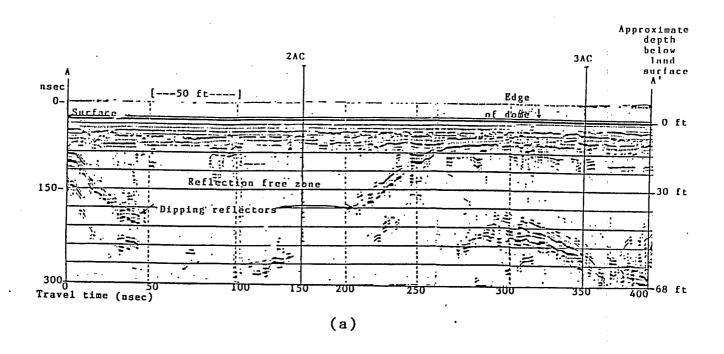
15b. Geologic cross section of EWW with location of GRP transect.

Figure 16a is a 300 nsec sweep of STC. The most notable features are the steeply-dipping reflectors and the reflectionfree zone near the center of the dome. These features indicate that this is a type 3 dome, however the reflectors do not terminate near the center as they do in the profiles from STW and The interim report indicates that this is a sink type dome EWE. (figure 16b and appendix B) and the reflection pattern is similar to the type 3 dome, however the presence of continuous reflections below the center of the dome indicates a type 2 GPR signature (refer to figure 14). There are no layers indicated on figure 16b which correlate with the deep reflections because they are below the depth which well 2AC was logged. For the purposes of this report type 2 and 3 are geologically similar cypress domes which appear slightly different on radar lines. Type 2 domes may represent an intermediate stage in the development of fully developed sinkhole systems represented by type 3.

Figure 14 shows the three types of domes as seen on the GPR profiles. Notice that the type 2 appears to be a transitional form between type 1 and type 3. Both the type 2 and type 3 domes are clearly subsidence domes and are easily distinguished from type 1 domes. Type 1 domes are shallow depressions and the profiles graphically display this feature.

GPR interpretation of unknown cypress domes

Figure 17 is a 200 nsec sweep of UN2 from the southwest to the northeast. The most obvious features of this profile are the steeply dipping reflectors and the reflection-free zone near the center. These features along with the presence of reflections



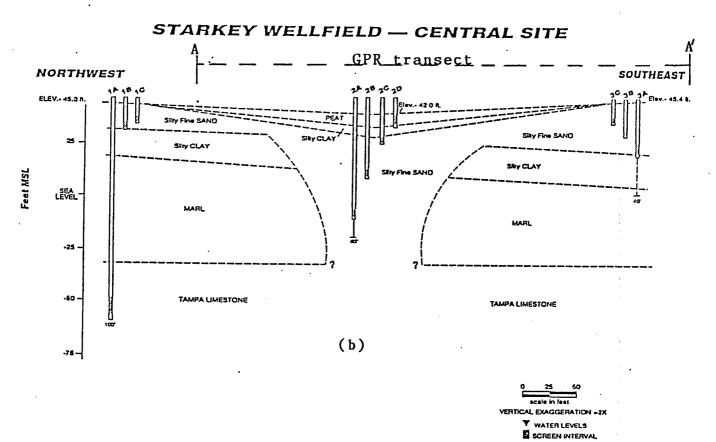


Figure 16a. 300 nsec sweep of STC showing major features. (note: horizontal scale is not constant)

16b. Geologic cross section of STC showing location of GPR transect A to A'.

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300 nsec sweep of UN2 cypress dome with major features indicated. Figure 17.

beneath the reflection free zone indicate that this is a type 2 dome. The reduction in hydroperiod that this dome has experienced in recent years seems to support this conclusion.

Figure 18 is the 200 nsec sweep of UN1 from the inside of the dome (northeast) to the outside (southwest). The general reflection pattern is that of a bowl shape with very shallow penetration (using the approximate 5 nsec/ft conversion). These features indicate that this is a type 1 dome. The general health of the dome seems to support this conclusion.

RESULTS: LLEM

The EM-34 surveys of the sites with known geologic conditions (STE,STW, and EWE) resulted in terrain conductivity profiles that lack any unique or distinctive anomalies which could be used to classify the domes. McNeil (1980), modelled EM-34 responses to various geologic settings, however none of the models match the geologic conditions at the affected domes. Therefore, matching the responses to known geologic settings (and the corresponding EM-34 signitures) was not possible. nineteen and twenty are EM-34 profiles of STE (unaffected) and EWE (affected) respectively. Notice the high frequency fluctuations and lack of any distinguishing features which might be correlated with the known geology. While the EM-34 is an excellent tool for many shallow exploration geophysical surveys it may not be suited for use in the well field environment. Probably the greatest problem to plague the surveys was the interference caused by the electromagnetic fields from the large

0 nsec

200 nsec sweep of UN1 cypress dome with major features indicated. Figure 18.

Travel time (nsec)

Starky east $EM-34^{\circ}XL$

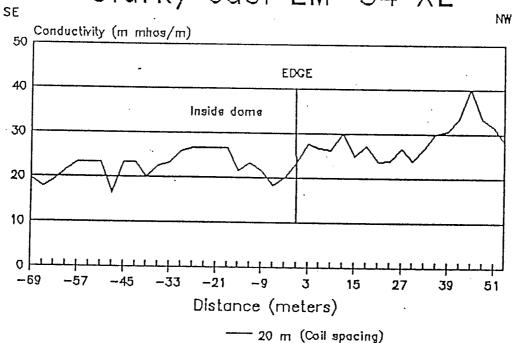


Figure 19. EM-34 profile of STE.

Eldridge-Wilde east EM 34 XL vertical dipole

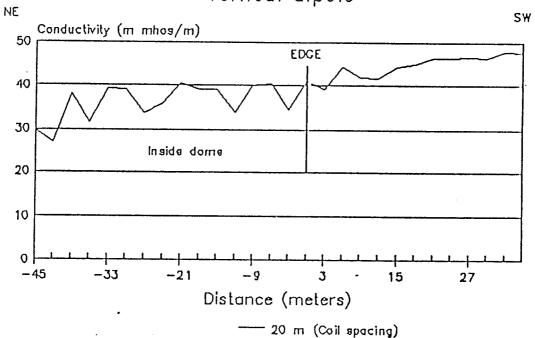


Figure 20. EM-34 profile of EWE.

unshielded electric motors used for pumping ground water. resulting local electromagnetic fields made using the 40 meter coil separation impossible. The 10 and 20 meter separations were less prone to the effects of the electric motors, but resulted in basically uninterpretable data in the context of this study. More specifically, it was not possible to identify distinctive anomalies on the profiles and associate them with any degree of certainty to specific geologic conditions. This is probably due to the complex near surface stratigraphy of the cypress domes which produced many overlapping anomalies. Therefore, the resulting profile represented the average of a number of different anomalies and was not indicative of the overall structure of the dome. It's possible that the 40 meter (131.2 foot) coil separation would have been less prone to this problem because of the increased effective exploration depth, however it was not possible to test this hypothesis.

RESULTS: VLF and HEP

The VLF and HEP surveys are considered together because neither method could be used alone to produce reliable results. The VLF resistivity measurements did not produce recognizable geophysical signatures (possibly due to shallow penetration), and therefore are not considered a plausible method for determining cypress dome type.

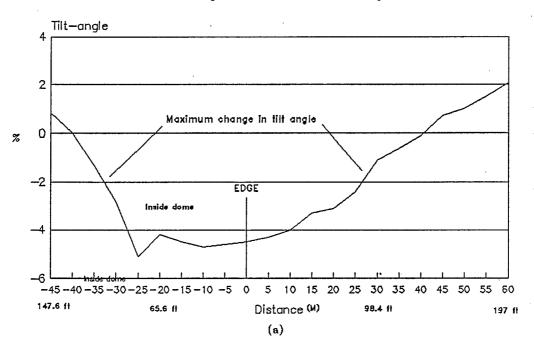
An apparent change in resistivity at depth produces the tilt angle anomaly shown in figure 8 of the preceeding section. This figure represents an ideal case in which the change in

resistivity is a vertical boundary. Most field conditions are much more complex, and therefore the resulting anomalies are often difficult to interpret. A HEP profile from left to right across the same vertical contact would show a simple increase in apparent resistivity, which would correspond to the subsurface increase in resistivity. To simplify interpretations in this study, sinkhole-type domes are assumed to have an abrupt resistivity contrast with the surrounding undisturbed sediments. Complicating factors that change the shape, or number of anomalies, were simply ignored or removed visually in the interpretation process, and the overall character of the profiles examined. Therefore, the VLF and HEP of the sinkhole type domes should produce recognizable anomalies based on an assumed resistivity contrast. This convention is derived from the geologic cross-sections of the cypress domes which show generally thicker sand columns in the sinkhole-type domes, replacing the collapsed or absent marl/silty clay confining layer, which generally lies just above the Tampa limestone (refer to figures 11a, 12a, and 16a). The depth, thickness, and number of intervening clay/marl/organic silt layers is critical for this assumption because they tend to lower the apparent resistivity measured at the surface (refer to table 1). Where lower resistivity layers are absent, the sand-filled sinkhole represents a higher apparent resistivity target, when compared with the surrounding undisturbed sediments. However, in cases where a number of thin, lower resistivity layers are present in the sand column, the apparent resistivity measured at the surface

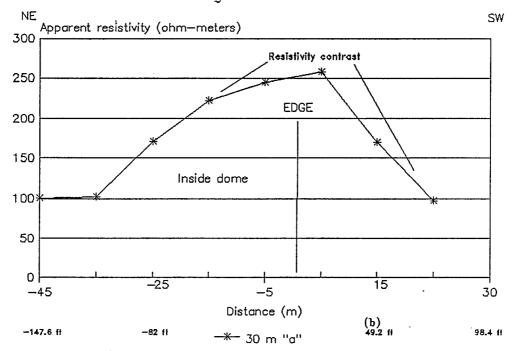
will be reduced and the contrast with surrounding sediments negated (refer to figure 11a). Therefore, it is possible for some sinkhole-type domes to have no apparent resistivity contrast with the surrounding undisturbed sediments, and thus, appear to be a shallow depression-type domes on either the VLF or HEP surveys. This is known as the problem of equivalence and is the main reason why supporting data from other geophysical methods, and/or drillers log information is necessary for reliable determination of cypress dome type with either VLF or DC resistivity methods.

Figure 21a shows tilt angle and figure 22b the 30 meter (98.4 foot "a" spacing) HEP profiles for EWE an affected site. The 30 meter "a" profile has an effective exploration depth (EED) of 18 meters (59 feet). With this EED, the marl layer or the sand/organic silt layers replacing the marl (near the center of the dome), compose approximately 50% of the total thickness being measured and therefore contribute a significant amount to the apparent resistivity measured at the surface (refer to figure The HEP profile shows a general increase in apparent resistivity toward the edge of the dome (from the outside and inside), which corresponds with termination of the marl due to karst subsidence. The apparent resistivity drops toward the center of the dome because the organic silty clay layers indicated on the geologic cross section, are thicker and compose a greater percentage of the EED. The tilt angle profile in figure 21a shows a minimum value near the edge, and has maximum relative change in percent tilt on either side of the edge.

Eldridge-Wilde east tilt angle



Eldridge-Wilde east HEP



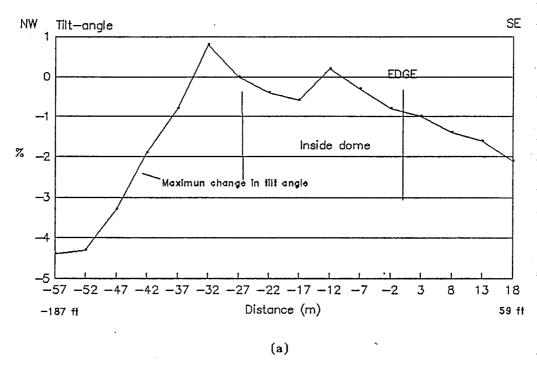
Figures 21a (upper) and 21b (lower). VLF tilt angle and HEP apparent resistivity profiles.

corresponds with figure 8, however the sign of the tilt angle is different because VLF is a directional geophysical method (by directional method we mean that the sign of the tilt angle is dependent on the survey orientation relative to the transmitter and to the vertical structure). Therefore, the sign can be ignored because the general shape and position of the anomaly provides the pertinent information.

Figure 22a shows the tilt angle and figure 22b the apparent resistivity profiles for STW an affected site. The 30 meter "a" HEP profile shows a general increase in resistivity into the dome. This increase corresponds with the termination of the marl/silty clay layer (from the geologic cross section figure 12a) which occurs just east of the edge on figure 22b. Comparing figure 22b with 21b shows the similarities in responses of the affected sites. The only major difference between the HEP responses (21b and 22b) is that the apparent resistivity decreases toward the center of the dome on 21b and not on 22b. This suggests that the organic silty clay layers in-filling the sinkhole at STW are either not as resistive (less clay) as they are at EWE or they represent less of the total EED (figure 12a).

Figure 22a is the tilt angle response at STW. In general, the response corresponds with the tilt angle profile of EWE, which indicates the sediments in-filling the sinkhole display an apparent resistivity contrast with the surrounding undisturbed sediments. As in figure 21a the maximum relative change in tilt angle occurs on either side of the edge of the dome ie. change in resistivity. The tilt angle response of STW approximates the

Starkey west tilt angle profile



Starkey west HEP

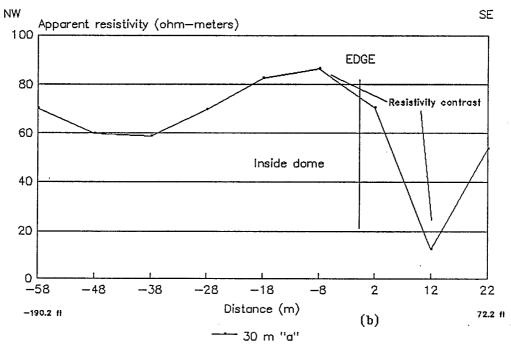


Figure 22a (upper) and 22b (lower). VLF tilt angle and HEP apparent resistivity profiles.

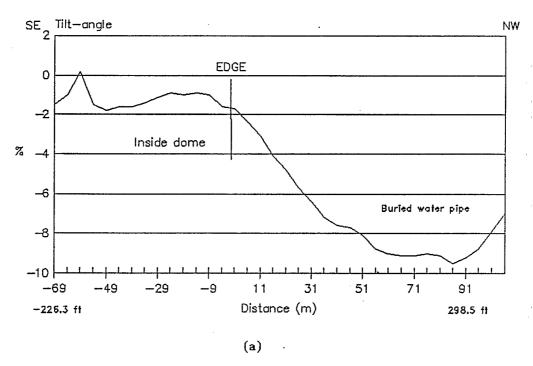
modelled response shown in figure 8. Therefore, comparison of figures 22a and 22b with the expected modelled responses, reveals the presence of a vertical resistivity contrast, which suggests that STW is a sinkhole system. This conclusion is supported by the geologic cross-section of STW, figure 12a.

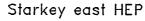
Figures 23a and 23b are tilt angle and 30 meter "a" HEP profiles of STE an unaffected site. The 30 meter "a" HEP profile shows a strong apparent resistivity contrast between the inside of the dome, approximately 40 ohm-m, and the outside, approximately 80 ohm-m average. The contrast indicated on figure 23b suggests that STE is a sinkhole-type dome, however the geologic cross sections show STE as a simple shallow depression in the surficial sand unit (refer to figure 13a). The increase in resistivity may be due to thickening of the surficial sand unit away from the dome.

Figure 23a is the tilt angle response at STE. The response is generally flat inside the dome, however the tilt angle changes dramatically from 8 to 51 meters (26 to 168 feet) outside of the dome. This change is not entirely due to geologic factors, but rather, represents the tilt angle response to a large steel water pipe buried approximately 90 meters (295 feet) from the edge of the dome. The increase in apparent resistivity indicated by figure 23b probably adds to the response caused by the water pipe. Therefore, the tilt angle response minus the water pipe affects would be relatively flat.

Analysis of the three cypress domes with known geologic cross-sections indicates that neither the VLF tilt angle, or the

Starkey east tilt angle





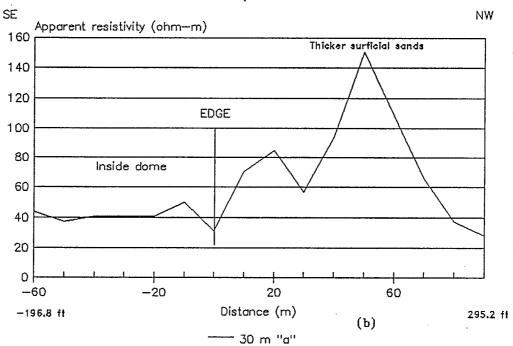


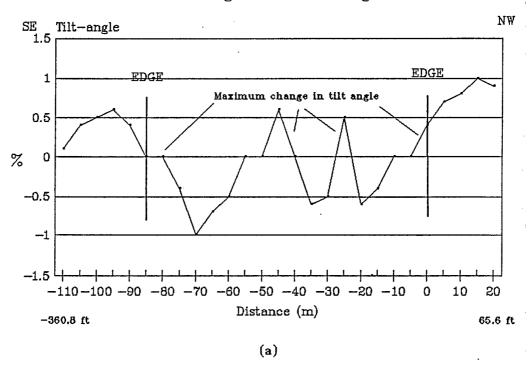
Figure 23a (upper) and 23b (lower). VLF tilt angle and HEP apparent resistivity profiles.

HEP apparent resistivity surveys, when considered alone, provide reliable estimation of cypress dome type. However, further analysis indicates that when a moderate to strong resistivity contrast exists between the sediments in-filling the karst subsidence features (affected domes), and surrounding undisturbed sediments, VLF tilt angle and HEP profiles display characteristic responses. For the tilt angle profiles, the characteristic anomaly is shown in figure 8. The HEP anomaly associated with the affected domes is an abrupt change in apparent resistivity near the edge of the dome. When both, the VLF and HEP, anomalous responses occur, at a site with unknown geology, there is better than a 50% probability that the site is a sinkhole-type system. However, as noted earlier, the problems of equivalence make absolute determination impossible without other constraining data.

Comparison with STC, EWW, UN1, and UN2

Figures 24a and 24b are tilt angle and HEP apparent resistivity profiles of EWW (an unaffected site). Notice how the tilt angle on figure 24a is different from the responses measured over the affected sites. The maximum relative change in tilt angle occurs directly over the edge of the dome on the EWW profile (figure 24a), whereas the maximum change in tilt angle occurs either, inside or outside of the domes on figures 21a and 22a. The shift in the maximum slope of the tilt angle appears to be the only distinguishing characteristic between, the affected and unaffected VLF tilt angle responses. The geologic feature(s) which cause this shift are not readily apparent on either, the

Eldridge-Wilde tilt angle



Eldridge-Wilde west HEP

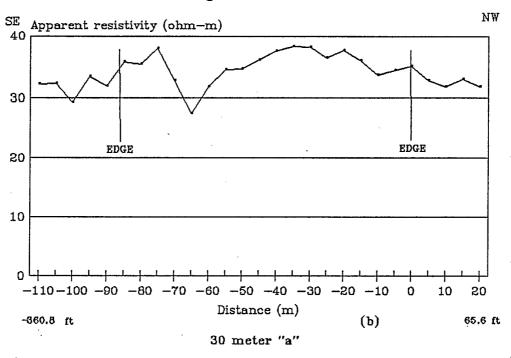


Figure 24a (upper) and 24b (lower). VLF tilt angle and HEP apparent resistivity profiles.

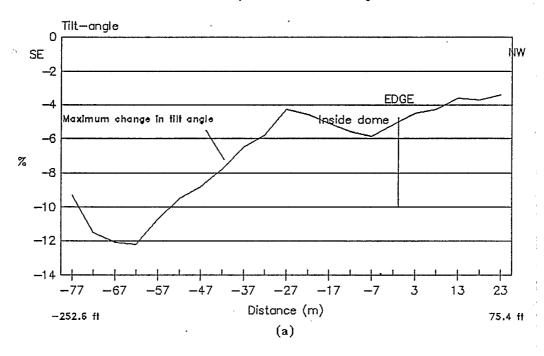
well logs or the geologic profiles (appendix B and figures 13a and 15a). However, it is probably related to the discontinuance of the conductive marl layer beneath the affected cypress domes.

The HEP profile of EWW, figure 24b, shows no apparent resistivity contrast between the dome and the surrounding sediments. Therefore, the VLF and HEP profiles of EWW are characteristic of an unaffected dome. The interim report supports this conclusion.

Figures 25a and 25b are tilt angle and HEP apparent resistivity profiles of STC (an affected dome). Note that the maximum change in tilt angle is away from the edge of the dome (figure 25a). This correlates well with the response at affected site EWE (figure 21a). However the apparent resistivity profile, figure 25b, does not show a resistivity contrast across the edge of the dome. This suggests the STC is an unaffected dome, which contradicts the tilt angle analysis results. The interim report shows that STC is an affected site (appendix B and figure 16a). It is interesting that STC appeared different on the GPR profiles (figure 16b) and therefore necessitated the creation of the type 2 GPR signature. The lack of resistivity contrast across the edge supports the conclusion that STC is an intermediate stage in the development of sinkhole-type domes.

Figure 26a and 26b are tilt angle and HEP apparent resistivity profiles of UN2. UN2 has experienced a decrease in hydroperiod recently and is therefore classified as an affected site. The tilt angle response has maximum relative change away from the edge of the dome which is an affected dome signature.

Starkey central tilt angle



Starkey central HEP

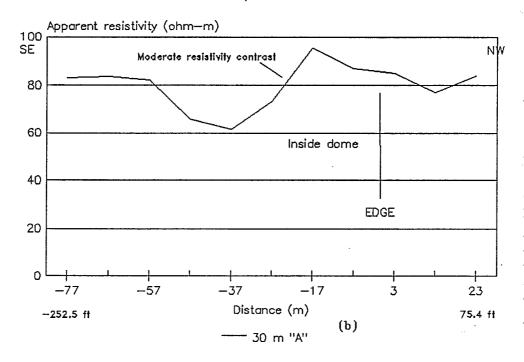
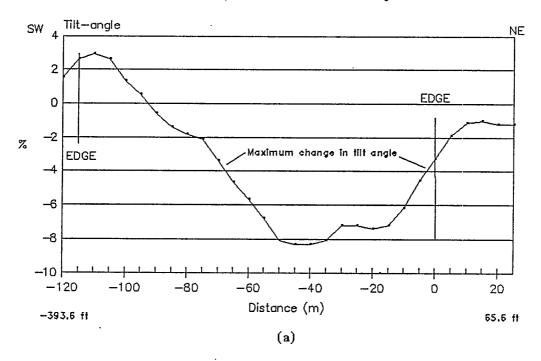


Figure 25a (upper) and 25b (lower). VLF tilt angle and HEP apparent resistivity profiles.

Starkey unknown 2 tilt angle



Starkey unknown 2 HEP

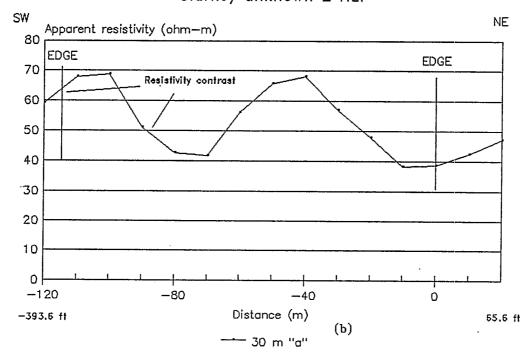


Figure 26a (upper) and 26b (lower). VLF tilt angle and HEP apparent resistivity profiles.

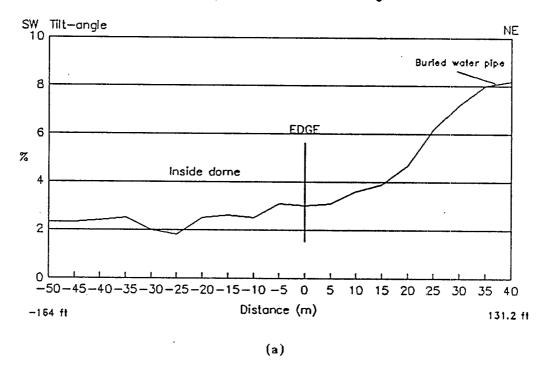
There is an apparent resistivity contrast across the edge of the dome indicated on figure 26b. Therefore, the VLF and HEP surveys seem to support the conclusion that UN2 is an affected site.

Figures 27a and 27b are tilt angle and HEP apparent resistivity profiles for UN1. The "good" health of UN1, in an area of large drawdown, indicates that UN1 is an unaffected site. The tilt angle response appears to correlate with the responses shown over affected sites; however, there is a large water pipe about 40 meters (122 feet) to the NE of the edge of the dome which probably caused the tilt angle anomaly shown on figure 27a. The apparent resistivity profile, figure 27b, does not show a resistivity contrast across the edge of the dome. Thus, the "apparent" tilt angle anomaly shown on figure 27a is probably not geologically significant. Therefore, the profiles, shown in figures 27a and 27b, support the conclusion that UN1 is an unaffected site.

CONCLUSION:

All four of the geophysical techniques employed in this study have applicability to hydrogeologic investigations. In this study, the four methods were employed to determine the position and/or presence of lateral change in subsurface stratigraphy. The data were interpreted qualitatively as either indicating or not indicating a subsurface change. For each of these methods a variety of "features", both natural and man-made, can cause an anomaly that might be interpreted as a lateral change in stratigraphy. This is known as the problem of

Starkey unknown 1 tilt angle



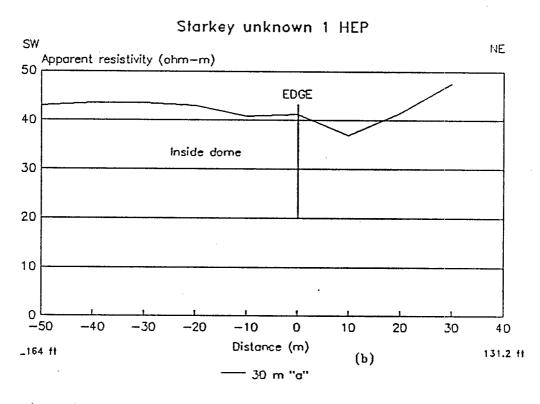


Figure 27a (upper) and 27b (lower). VLF tilt angle and HEP apparent resistivity profiles.

equivalence. Therefore developing reliable methods for interpreting the anomalies resulting from most geophysical surveys of this type is very difficult. A large data base is necessary to determine the responses and anomalies associated with complex geologic structures. The VLF, HEP, and LLEM surveys are more prone to equivalence problems and therefore require more time for correct interpretations. Furthermore, without supporting well log data even simple interpretations are often questionable. GPR is less prone to problems of equivalence. However, GPR does have some problems, including near surface clay layers which tend to attenuate the signal, and problems in determining average signal velocity for time to depth conversions. Table 1 summarizes the results of the four methods as to efficiency, cost, time, and reliability.

LLEM has been used in the past to detect vertical geologic structures, however cultural interference (large unshielded electric well pumps) made collecting and interpreting EM data at Starkey and Eldridge-Wilde very difficult.

VLF was also affected by cultural interference such as power lines and underground pipes. These features did not appear to completely degrade the data and therefore some interpretations were possible. It appears that it is possible to distinguish the sink type domes from the shallow depressions on the tilt angle profiles with moderate reliability when correlated with HEP profiles. Without constraints, either HEP or well log information, the tilt-angle profiles of the sink types are not readily distinguished from the shallow depression types.

RELIABILITY	Excellent	Good to fair	Fair to good	Not applicable	not applicable
<u> </u>	ø	13	-		ω
OTAL TIME EFFECTIVENESS	Excellent in resistive areas	Good with limited well data	Fair better with well data	Poor too shallow penetration	Poor for this survey due to cultural interference
TOTAL TIME	2 hr survey 2 hr analysis	3 hr survey 4 hr analysis	1.5 hour survey 4 hr analysis	Ѕате вз вроvе	2 hr survey 3 hr analysis
COST	125.00 hr	50.00 per day	500.0 per week	Same as above	500 per week
METHOD	GPR	HEP	VLF	VLF resistivity	LLEM

Table 2. Description of headings:

Cost: rental only does not include man hours.

Total time: represents average time for a 600 foot profile. Effectiveness: detection of affected cypress domes. Reliablility: confidence in cypress dome type identification The HEP surveys were very time consuming to conduct in the dense underbrush of the cypress domes. Interpretation of anomalies is not as difficult as the VLF and it is aided greatly by well log information. The larger "a" spacing surveys were effective in delineating some of the sink type domes. Generally a resistivity contrast is associated with the sink type domes. Many conditions can cause resistivity contrast anomalies and therefore it is not possible to determine cypress dome type with great confidence with HEP without additional information.

The GPR surveys provided the best results. The surveys took the least amount time to complete and resulted in a graphic display that was almost immediately interpretable. The profiles showed a graphic display of the subsurface structures and therefore the type of cypress dome could be easily determined in a short period of time. The well data helped in determining depths to reflectors but are not necessary for the reconnaissance surveys.

RECOMMENDATIONS:

For studies of this type in similar geologic environments, we would recommend using ground penetrating radar. GPR appears to be the most efficient and effective method for studying the shallow structural features of cypress domes. Average velocities for the radar signal can be estimated to determine approximate depth to interfaces. The velocity in most saturated sediments ranges from 0.125 to 0.30 ft/nsec. For regional studies a preliminary photolinear analysis should be used to identify

possible zones of increased sink development. Furthermore, the transects for the HEP, EM-34, and VLF should be conducted perpedicular to photolinears to detect associated anomalies. Also GPR lines should be conducted next to areas of known geology to calibrate the instrument to well logs. For small-scale studies resistivity surveys can be used in conjunction with the GPR lines for cross correlation. A word of caution: select GPR operators carefully. The quality of the data is dependent on the skill and experience of the person controlling the signal processing unit. Finally, as was alluded to in the preliminary analysis, a stronger correlation of affected sites, type three geologic settings and fracture traces, might be established by studying a greater number of dome sites, using GPR and photolinear analysis.

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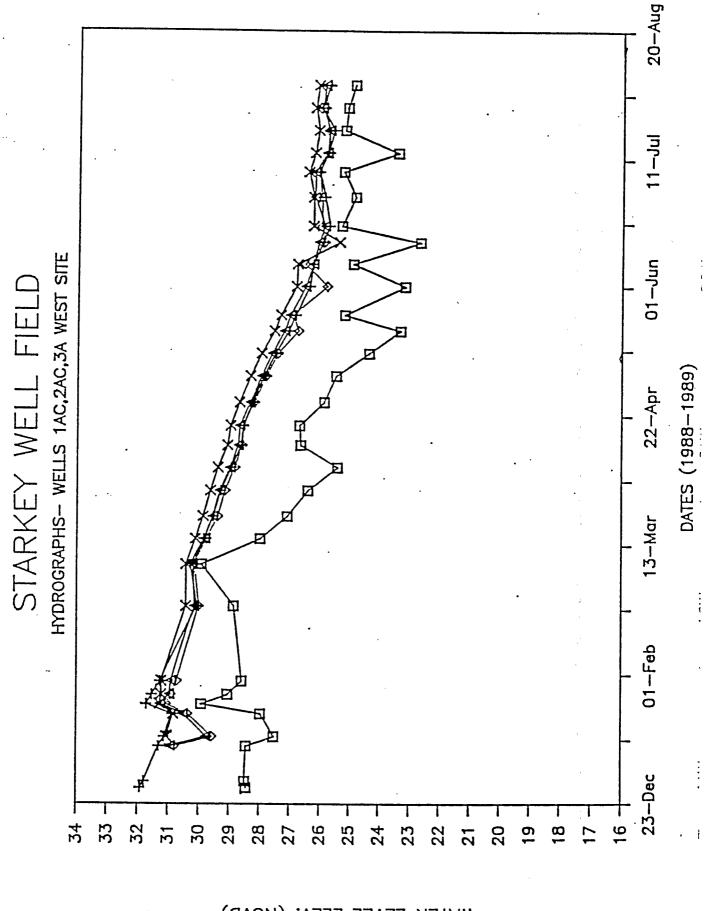
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APPENDIX A

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WATER LEVEL HYDROGRAPHS

WATER LEVEL ELEV. (NGVD)

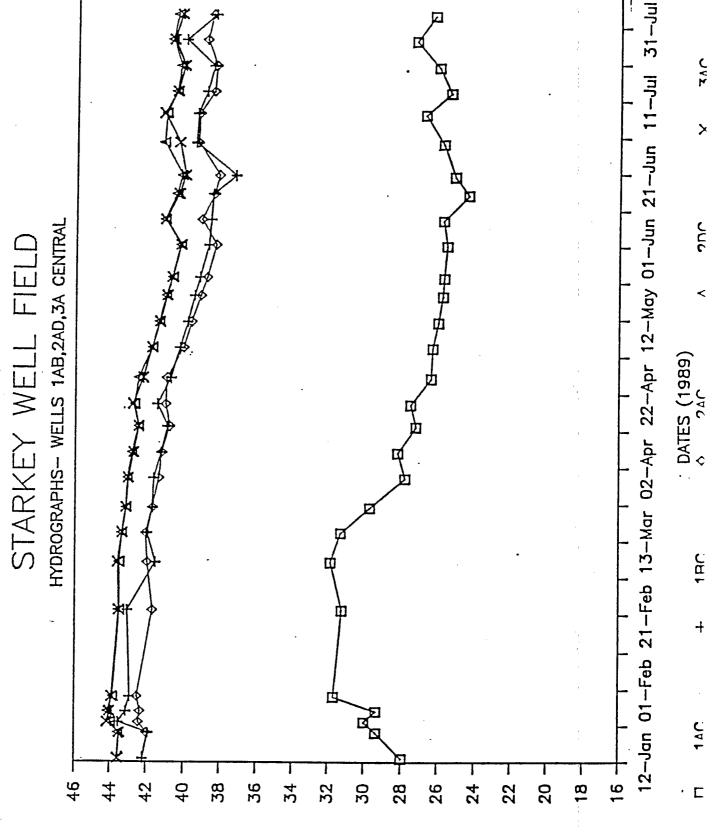


20-Aug 11-Jul 01-Jun HYDROGRAPHS - WELLS 2A,B,C WEST SITE STARKEY WELL FIELD 22-Apr 13-Mar 01-Feb 23-Dec 26 | 25 -22 _ 32 – 28 -27 -24 -20 + 29 23 – 21 -30 -33 31 WATER LEVEL ELEY. (NGVD)

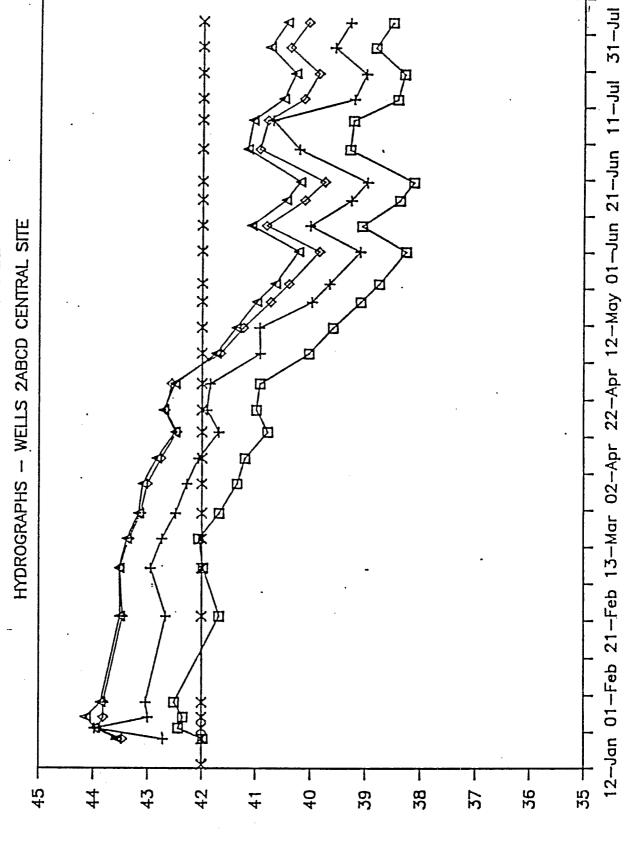
DATES (1988_1989)

WATER LEVEL ELEV: (NGVD)

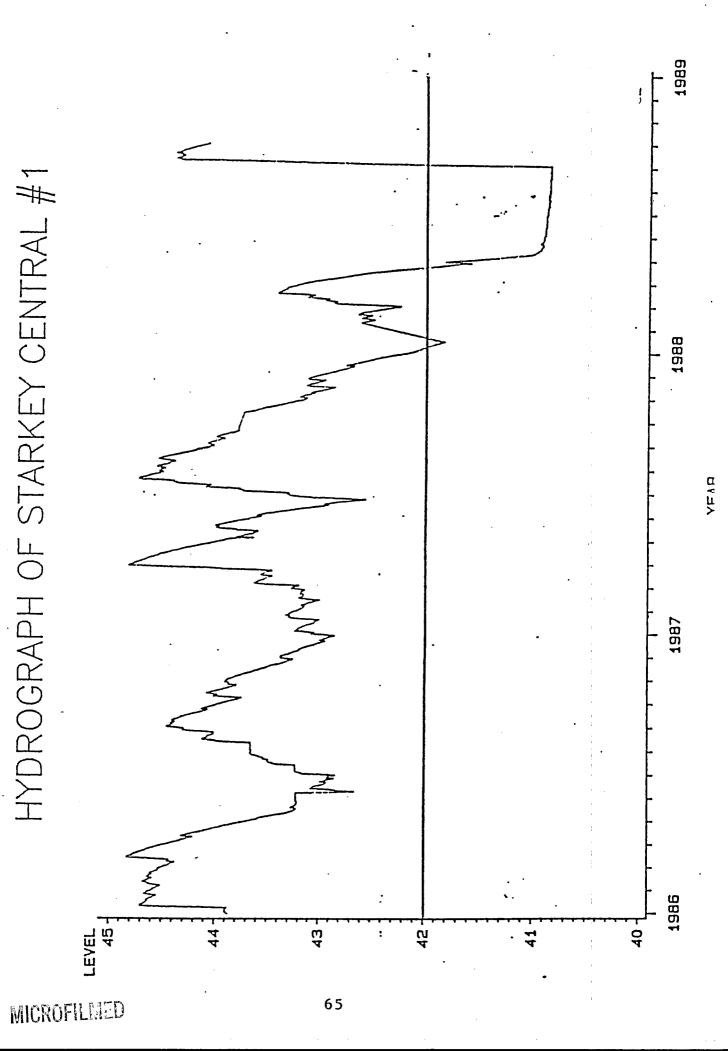
36 — 40 — 30 — 38 -34 -32 -26 -28 -46 44 42



STARKEY WELL FIELD

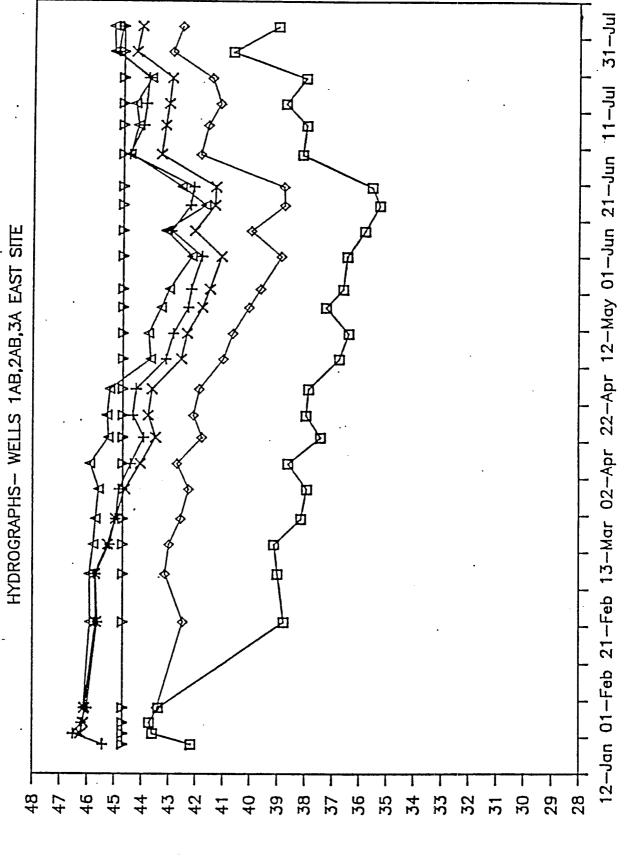


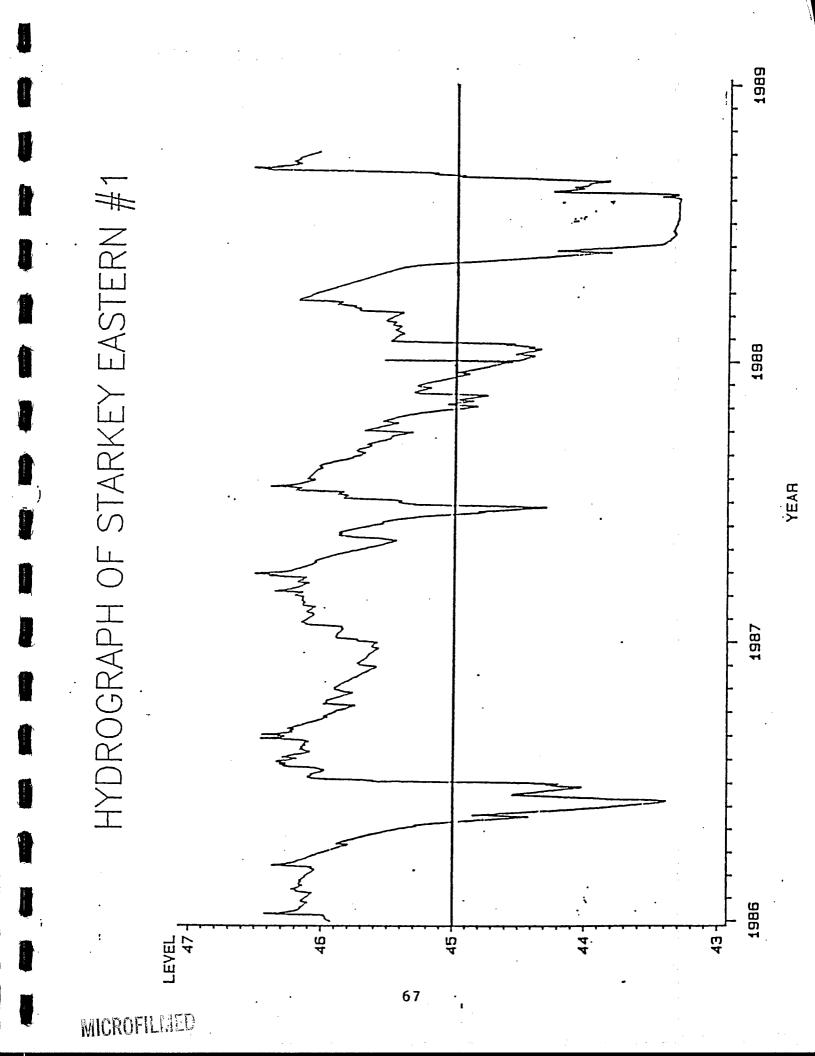
WATER LEVEL ELEV. (NGVD)



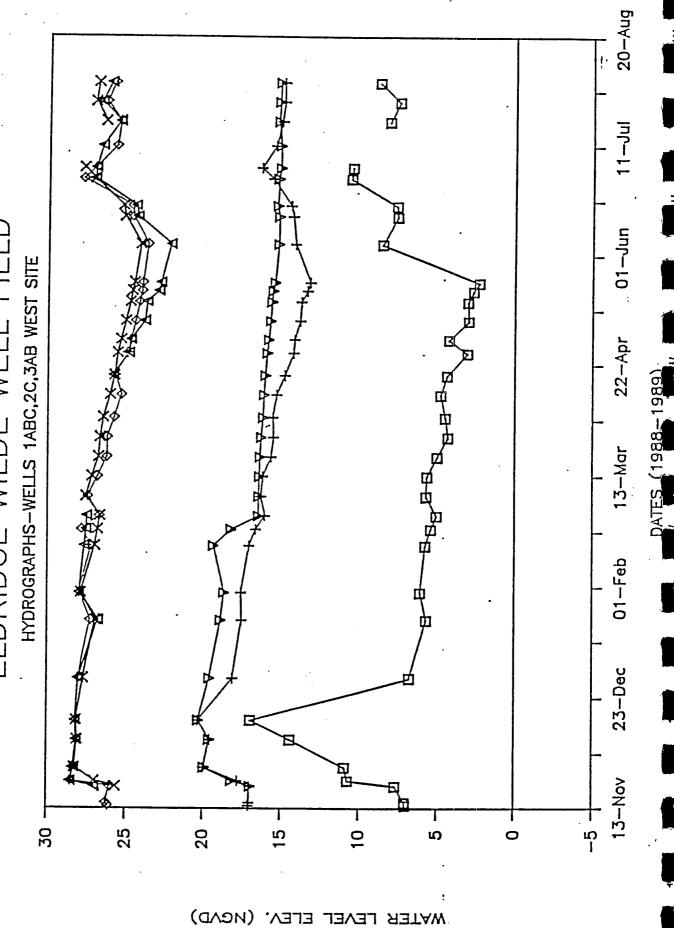
STARKEY WELL FIELD

WATER LEVEL ELEV. (NGVD)

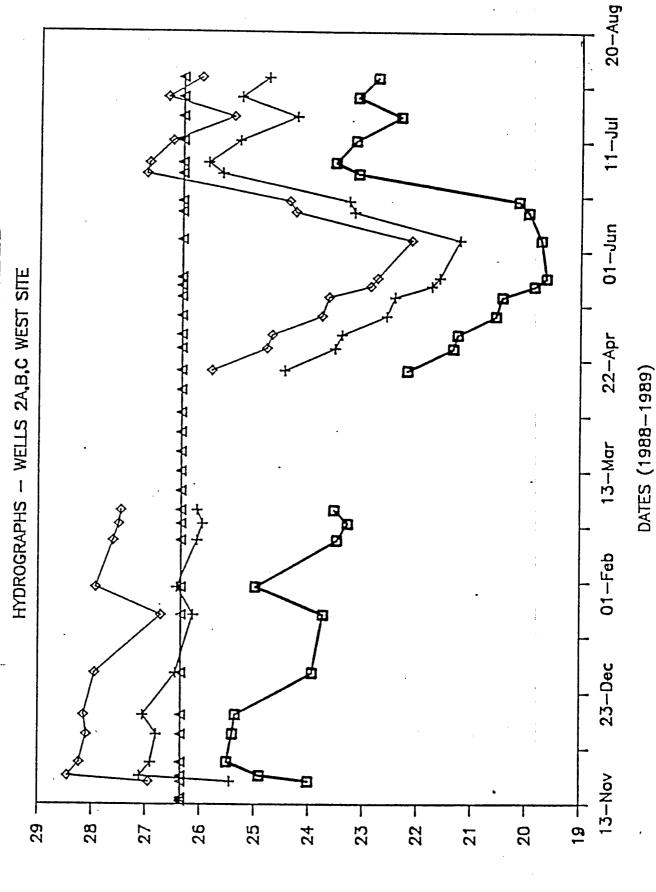




ELDRIDGE WILDE WELL FIELD

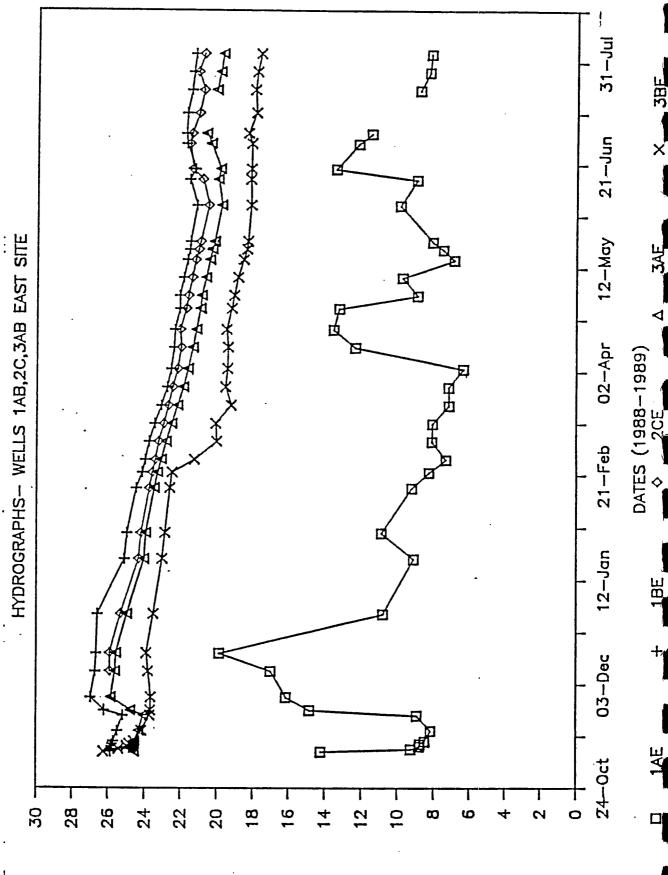






WATER LEVEL ELEV. (NGVD)

ELDRIDGE WILDE WELL FIELD



WATER LEVEL ELEV. (NGVD)

APPENDIX B

DRILLING LOGS

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	ring C		Amer	ican Dril ge DeGroo	ling, Inc	. Bodge local					File		
	remar VFWN		GEOT	ge DeGroo ohn Wacco	t.	Ground Elev	allon_	36	R'		USI FI	d	0 12
						Date Started	12	1121	88		Date or	ided12	/20/
		у т	CASING	•		SAMPLER	•	<u></u>		G	oundwal	er Reading	78:
	o:		Rotary		_ Type: <u>·</u>	Split SpoonOther:		Dali	10	epih	Casin	g ad Sta	Diliz a
Fall	mmer: i:	·		IF	. Hamme)r:140			士				
					_ Fall:	30 inch			4				
DEPTH	CAS			SAMPLE			٦,		_ـــ				
띰	I BL	. NO	PENJREC	DEPTH	BLOWS/6	SAMPLE DESCRIPTION	E Y	<u> </u>	: 당	IN	WELL STALLAT	י ארא	FIELD
1		ī	18/16	1-2,5	7-4-6		1		<u>'</u>			1.011	23110
•	<u> </u>	-			1	Hedium dense, brown, fine SA little Silt, root fibers.	TK P				1.		
	_	╁╾	 		 								
3 _					 	-							
	 	+-	18/16	3-4.5	6-9-9	Hedium dense, brown, fine							
				 	 	SAND, little (+) Silt.	.1		j		İ		
_	-	+			:	1					j		
5 -		13	18/16	5-6.5									
			11111	7-0.3	3-6-6	Similar to above.	1				-Gro	ut	
]	1						•
7		1				4			ı				
7		4	18/10	7-8.5	3-5-9	Hedfum dages dage		_					
ł		-				Medium dense, dark brown, fine SAND, little (+) Silt.		lty ne					
Ì								ND .	ľ	į	1		
10-						j	1.		- 1	ı			
ŀ		5	18/10	_10-11.5	7-4-4	Loose, dark brown, fine SAND,	,						
					<u> </u>	little (+) Silt.							
. }		_]			- {	\perp	6-inc	h	
3.5		6	18/10	13.5-15	3_5_5	Maddus					PVC W		
					3-3-3	Hedium dense, dark brown, fine SAND, little (+) Silt.			-		l		
ŀ		-				, , , , , , , , , , , , , , , , , , , ,	1						
, I							1		- 1	l		Ì	
3.\$		7	18/10	18.5-20	2-4-6	Similar to above.			- 1			.	
ŀ			<u> </u>		<u>.</u>	•					1		
							1.	٠.		ļ		[: ,	
1.5									-			.	
ŀ		-8_	8/12	23_5-25	4-7-7	Similar to above.					l	1	
										1			
-							1				l		
•\$		9	8/13	28.5-30	3-7-10	Maddin dan -	1						
F		\Box	•			Medium dense, brown, fine SAND, little Silt.		_	- '				
-	- 			I							ŀ		
.\$		二				•		•-					
-		10_1	8/18	33.5-35	3-2-4	Hedium stiff, grey-brown.	-		4				
-		\dashv				CLAY & SILT, little fine Sand, medium (-) plasticity.	Si	lty ndy					
						(-/ prescicity.	CL					,	
L						-		. 35	.				
EMA	RKS:		•			•				<u></u>			
					•								
						-							
								G	RANI	LAR	SOILS	COHE	SIVE
					_	4		-)WS/F		DENSITY	BOWSET	
•					•			0.4		,	V. LOOSE	42	1
					*		•	41	,		FOOSE	24	
								10.	30		L DENSE	44 FIS	и
						•		30.	50		DENSE	15-30	Y
						pproximate boundary between soil types		> 51			Y. DENSE	>30	

	SV	V F	=W	MD	Hydrogeola	PROJECT ogic Investigation of Cypres	Re	port o	of Bork	yg No	ımbe	r1A	West		
_				GLUG	Domes in	Wellfields near Tampa	Ī					ol]90			
Во	ring Co			-		Boring Loc	ation								
						Ground Ele	evali	on			W	oli Eleva	tion		
			CASING			Date Stand	od	-					d Readings:		
Siz	a:	•	_	_	7	SAMPLER			Date	Des	oth	Casing a	Stabil	iz ation	Tlme
Har	nmer:). Hammer	Other:							┪		
Fall	:				_ Fall:			-							
DEPTH	CAS.			SAMPLE				٦.	d 1	1		WELL .	<u> </u>		1.4
-	/FT.		PENJREC		BLOWS/6	1		STRI		3	INST	ALLATION	TÉS	ald Ting	RMKS.
38.	┪	114	18/18	38.5-39.	WOH/18"		E y			_	П		_		_
		11B		39.5-40		CLAY, high plasticity. Very soft, white Silty CLAY	۲,		Silty CLAY	ı					
43.					 	high plasticity.			43			Grout	:		
		12	6/6	43.5-44	50/6"	Very dense, brown-grey, CLAY				4					
						SILT, little (-) limestone fragments, medium plasticit	.y.	}	IARL						
48.7					 										
10.		13	3/3	48.5-48.	50/3"	Similar to above.									
	·						ĺ								
53.															
		14	3/3	53.5-53.7	50/3"	Similar to above.						•			
							l		57	. -		6-inch PVC Wel		.	
58.							Ì		2/	_		ryc wej	L		1.
		-		 		·	i	V	OID	İ					
						•					11				
				<u> </u>					63	·			-		
ب. 63		15	18/18	63.5-65		Stiff, green, Silty CLAY, .		s	ilty						
				 		high plasticity.		С	LAY						
68.															
00.		-16	18/10	68.5-70	28-32-38	Grey-White, Silty, Sandy,	H		68	4					2.
						LIMESTONE.									
							j								
73~		17	18/15	77.5-79	22-18-32	Similar to above.			TAHPA	1					
		\dashv			· · · ·										
							ĺ	LIM	ESTON	E				Ì	
78.		18	12/8	78.5-79.5	23-27	Similar to above.	-						ĺ		
	·		•			ounties to above.						30-65			
							-				Ш	Silica			
83 -			18/12								H	Sand -20-30			
			10/1/	A3-5-85	10-14-24	Similar to above.			85	1	1	Silica	.		
		_	·	 			ļ					Sand		- [
		\Box				•						Screen Interva	1		
REW	ARKS:	1.	Encour	itered a v	oid from S	57' to 63 feet below land su			7	.11		4	11		
			+reeT	CASTUS CO	OG LEEL D	pelow land surface and conting approximately 68.5 feet be		:	4114-	_		THEN (, , ame t e	Ľ	l
		-•	F 01	ya ul	acout 11	pproximatery oc.) lest be	TOM	120	d sur	IAC	e.				.
									٦	RANU	LAR !	SOILS	COHES	VE SO	LS .
									—)WS/F1		DENSITY	BLOWS/FT.		rSIT Y

GRANULA	R SOILS	COHESI	E SOILS .
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4 6-10 10-30	V. LOOSE LOOSE N. DENSE	42 24 48 ,	V. SOFT SOFT II. STFF
20-54 , 50	DENSE V. DENSE	8-15 15-78 > 78	SIFF Y, SIFF HARD

MICROFILMED

CASING SAMPLER Groundwate Readings:	Borli	ng Co.					Hellfields near Tampa Botion Loc	ation	Starke	Well	field	1	
CASING SAMPLER Cherry	LOL6	тал					Ground Ele	vation_		Υ	Veil Elevat	lon	
SAMPLE Type:	2441	-WMU	Eng	neer			Date Starte	od	,				
Hammer:							SAMPLER		Date				on Tim
Fall: SAMPLE SAM	Size: Ham					Type:	Other:		-				
CAS										· ·			
18.5. 20 15/12 55.3-59.7 17-18-50 3" Grey-white, Silty, Sandy, Limitan, Sandy,				·		 -	•			1		<u> </u>	
18.5. 20 15/12 55.3-59.7 17-18-50 3" Grey-white, Silty, Sandy, Limitan, Sandy,	EPI	RI I	_	DEN GEO			SAMPLE DESCRIPTION	H.	SEE 3	INS		FIELD	
	,				1	1 ,	•		0 00		,		
				23, 22	50.5-03.7	17-18-50		'•		· 🗐 -	_		
										目	1		-
119	3.4											1	
Similar to above Tampa Limestone 119 21 18/8 119-120.5 23-24-28 Similar to above Fragments of Suvannee Limestone Limestone Sump Sump Sump Sump Tampa Limestone Sump Sump Tampa Limestone Sump Sump Tampa Limestone Limestone 139 24 7/1 139-119.5 48-50/1" Fragments of Suvannee Limestone Limestone Limestone			21_	18/10	93.5-95	36-40-38	Similar to above		95	目			
122 9/8 98.5-99.3 28-50/4" Similar to above Tampa Linestone						·:	•				ł	ļ	
119	8.5							•		Sui	zb ∩		3.
Limestone Limestone	٦		22 ·	9/8	98.5-99.3	28-50/4"	Similar to above			1		1	
139 24 7/3 139-139.5 48-50/1" Fragments of Suwannee Limestone Limestone	- 1							1	•	}			`
21 18/8 19-120.5 23-24-28								LI	mescon	1			
21 18/8 19-120.5 23-24-28	+					ļ							
21 18/8 19-120.5 23-24-28													
21 18/8 19-120.5 23-24-28	1				<u> </u>					1			
139 24 7/3 139-139.5 48-50/1" Limestone, Shell fossils. Suvannee Limestone	19												
139			23	18/8	119-120.5	23-24-28	Similar to above						
139							•					1	
139				-	<u> </u>		•						
139	7						٠,					;	
139					<u> </u>	 							
139	i											' '	Ì
24 7/3 139-139.5 48-50/1" Fragments of Suvannee Limestone, Shell fossils. Suvannee Limestone	-					ļ:							ļ
24 7/3 139-139.5 48-50/1" Fragments of Suvannee Limestone, Shell fossils. Suvannee Limestone												1 .	
24 7/3 139-139.5 48-50/1" Fragments of Suvannee Limestone, Shell fossils. Suvannee Limestone					<u> </u>					ŀ			
24 7/3 139-139.5 48-50/1" Fragments of Suvannee Limestone, Shell fossils. Suvannee Limestone	.39		$\overline{}$						139.	1			4.
Linestone			24	7/3	119-119.5	48-50/1"	_						
							Limestone, Shell fossil			- I	•		
	-					l				.	-		
Bottom of boring at 160'													
Bottom of boring at 160'							•			1		*	-
Bottom of boring at 160'	-												
160 Bottom of boring at 160'						 							
Bottom of boring at 160'			 										1
	L60	 		 	 	 	Bottom of boring at 160'						
	L60						Sottom of boring at 160°	,					
			3.	Monito	r vell lA	West inst	alled at completion of bor	ing.			•	1	
3. Monitor well 1A West installed at completion of boring.			4.										
4. Top of Suwannee Limestone is approximately 139.5 feet below land surface.								rinding				colican	£ 600
4. Top of Suvannee Limestone is approximately 139.5 feet below land surface. Drilling bit responded with more resistance and a grinding noise from 139.5							-··•						VE SOIL
4. Top of Suwannee Limestone is approximately 139.5 feet below land surface. Drilling bit responded with more resistance and a grinding noise from 139.5 to 160 feet below land surface. GRANULAR SOILS COHESIVE SO												42	V. 50
4. Top of Suvannee Limestone is approximately 139.5 feet below land surface. Drilling bit responded with more resistance and a grinding noise from 139.5 to 160 feet below land surface. GRANULAR SOILS COHESIVE SO BLOWSFT. DENSITY BLOWSFT. DENSITY BLOWSFT. DENSITY BLOWSFT.										•	LOOSE	2-4	\$0
4. Top of Suvannee Limestone is approximately 139.5 feet below land surface. Drilling bit responded with more resistance and a grinding noise from 139.5 to 160 feet below land surface. GRANULAR SOILS COHESIVE SO BLOWSFT. DENSITY BLOWSFT. DE 44 V.LOOSE 47 V.LOOSE 47 V.LOOSE 44 V.LO				;						-	M. DENSE	44 , . 1-15	u sti
4. Top of Suwannee Limestone is approximately 139.5 feet below land surface. Drilling bit responded with more resistance and a grinding noise from 139.5 to 160 feet below land surface. GRANULAR SOILS COHESIVE SO BLOWSFT. DENSITY ALD LOSSE 419 LOSSE 44 M.5									25	50	DEHSE	15:30	V. 511
4. Top of Suvannee Limestone is approximately 139.5 feet below land surface. Drilling bit responded with more resistance and a grinding noise from 139.5 to 160 feet below land surface. GRANULAR SOILS COHESIVE SO BLOWSFT. DENSITY R.OWSFT. DE 419 LOOSE 44 M.S 1838 M.DENSE B-15	1								ورا		V. DENSE	30	· HW

	SV	V _F	=W	MD	Hydrogeo1	PROJECT ogic Investigation	o	Repor	1 01 6	Boring I	Numb	or		2A Wes	t	_
<u> Y</u>	VELI	DF	RILLIN	GLOG	Domes in	Wellfields near Tan	OF CABLES					ol File				-
Bor	ing Co	·	Amer	ican Dril	ling, Inc.	·	•		_							=
1	·······						Boring Loca Ground Ele	valion.	1	5'	<u> </u>	Wall Elevi	atio	n34_7	,,	
	·) ent	ineer_1	ohn Watso	·		Date Starte	d12	/28/	88		Date end	ed_	1/5/89		_
			CASING			SAMPLER			F	1 5		oundwater				<u> </u>
Size	:- <u>-</u>	Hud	Rotar	у	_ Туре:	Split Spoon	Other:		۲	410	еріп	Casing	+	Stabilizati	on Tie	ne ·
					, Hammer	:160	.lb.									_
						30 Inch			-	- -		 	+			
ОЕРТН	CAS. BL	L	· · · · · · · · · · · · · · · · · · ·	SAMPLE				1	···			·	_	5:5: 5	Т	
ä	/FT.	NO.	PENJAEC	DEPTH	BLOWS/5	SAMPLE DESCRI	PTION		3		INS	TALLATIO	N	· FIELD	:	RWKS.
1		1	18/6	1-2,5	WOR	PEAT, fibrous.					-	1:	_			_
		 	 	-	 		•	- 1								
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3 _		-2	18/8	3-4.5	мон .							1				
		 	2070	1 3 4.3	INUIT	Similar to above.	•	- 1				1				
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5 -				 	 				PE	AT						
		3	18/8	5-6.5	мон	Similar to above.						1.	ı	•		
		-		 	 						╽.	Grout	.	••		
															\cdot	
7 -			10/10	 	<u> </u>								- [
			18/10	7-8.5	МОН	.Similar to above.				:			ı	•		
												İ				
10-					 			•	_							
107		5	18/12	10-11.5	4-4-2	Loose, grey-brown	. fine SA	םא.	11	0.0'	.					
- }						little (+) Silt.								•		
l			 	 	 							2-inch				
3.5		Ź	10/17									1				
		6	18/14	13.5-15	7-9-7	Hedium dense, gre fine SAND, little	y-brown,			ilty					1	i.
		. ,			 	izae samb, iittie	; (+) 211¢	•		Lne LND		Ì	ı			
ŀ								İ				ļ				
8.5		7	18/10	18.5-20	7-4-1	loose down bearing	64 01						٠			
ļ				10.7-20	,	Loose, dark brown and (-) Silt.	, line SA	מא				1				
-				<u> </u>	<u> </u>			- 1					İ		ı	
3.5		- -		 	 						i	1				
		8_	18/12	23_5-25	1-1/12"	Very loose, black	-brown.	0	rgat	23_5'		1	ı		ŀ	
ŀ				 	 	SILT, organic.			SILT	1	- 1		1		1	
								1		-						
8.5		9	18/10	70 5 70		•		_		8.5]			1	
t				28.5-30	D-4-4	Loose, black-brown SAND, some Silt.	n, fine			Lty	"					
F	\Box					VIII.			fir						ļ	
3.5				 		•			SAN	- 1			1			i
"7		10	18/12	31.5-15	1-2-2	Very loose, black-	-hrom	- <i>,</i>		nic						į
}						SILT, organic.	- ATOME!	- '	SIL					•	1	
H					 											
						<u> </u>				I						
REM	ARKS:											<u></u>				ı
		1.	Conduct	ed a fall	ing head p	ermeability test at	: 13 to 1	5 feet	t 1n	bore	ho1@	2C				
	•		-114 #5	40 ED 30	reet in bo	rehole 2B.									. ••	
															•	
			•			•	•		j	GRA	NULAR	SOILS	(COHESIVE	SOILS	5 .
						•				MOWS		DENSTLA			DENSI	1
•					•					94		Y. LOOSE	<2		v. sof	
								•		410		FOORE	2-4		SOF	- 1

N. DENSE DENSE SIFF 8-15 1530 20-50 V. STEF

> 20

HUNO

VV F	=WI	MD	Hydrogeolo	PROJECT PROJECT Investigation of Cypress	leport ~	of Borin	g Nu	mbe	- 2A W	est 3	<u> </u>
		LOG	Domes in F	Vellfields near Tampa.							
Co			· · · · · · · · · · · · · · · · · · ·	Boring Local	on						
VMD Eng	ineer			GI OUTU CIO	TION_			^	Vell Eleval Date ended	ion i	
	CASING			SAMPLER				Gro	undwater P	leadings:	ion Time
or:			Type:	Other:							
···			. Hammer . Fall:	:lb.				-		 	
			·								
AI	PENJAEC		BLOWS/F	SAMPLE DESCRIPTION	SIRTA	옷 모양	<u>بر</u> پر	INS	NETT:	FIELD	
	18/16	38.5-40	2-2-4	Loose, black-brown, SILT,	+			Τ		 	- -
				trace (-) line Sand, organic		SILT	۱	-	Grout		
					ľ						
12	18/14	43-5-45	1-1-1	Very loose, black-brown, SIL	T.		.		2-inch		İ
		•		1/2 to 1 inch.			-		LAC MeT	.1	
						4R 4			1		.
134	18/16	48.5-50	1-1-1	Very soft, dark brown, Silty		Silty			30-65		j
176	27.70	60.63		ount, high princity.					Silica Sand		2.
135	24/0	30-32	MOH			£ £	,		ľ.		
14	18/12	53.5-55	10-9-9	Hedium dense, light-brown,			V	┫_	20_30	1	
				rine SAND, little Silt.	1		-		Silica	.	3.
-						56	٧,		Sand		
15	18/10	58.5-60	3-5-6	Hedium dense, dark brown fir			Г	abla	Sump		
				SAND, littl Silt.	"]						
						Silty	<u> </u>				
16	18/10	63.5-65	2-2-4	loose derk bass 64-2 cup		fine					
-				little Silt.		SAND					`
										•	
. 17	18/10	68 5-70	1 1/12!!							١	
	20/20		1-1/12	SAND, little Silt.	l						
_ _										1	
						,					
	18/10	73_5_75	1-2-3	Loose, dark brown, fine SAND,						1.	
-										1	
				•						1	
19	18/12	78.5-80	2-2-2	Similar to above.							
_		· · · · · · · · · · · · · · · · · · ·		•		27	╌	1]	
	18/18	83.5-85		dedium stiff, black-brown,		83. Silty	_				
<u>- -2</u> c				kilon cray to the		-	- 1	1		1	
20				Silty CLAY, high plasticity.		CLAY	-	╀	Grout	1	-
20				pricy clair, nigh plasticity.		CLAY	-	十	Grout		
	Co	Co	CO	CO	Co.	Co. Boring Location Ground Elevation Date Standed	Co. Boring Location Co. Boring Location Ground Elevation Date Stande	Co. Boring Location Co. Boring Location Ground Elevation Co.	Doi: Doi: Sample Doi: Sample Doi: Sample Doi: Sample Doi:	Co.	Co. Boring Location

MICROFILME

	SI	W.	FW	MD	Hydrogeol	PROJECT ogic Investigation of Cypress	Repor	1 of Boni	ng Ni	mbor2	A W	st	
-	WEL	LD.	RILLIN	IG LOG	Domes in	Wellfields near Tampa.		Sheet Date		ol File		320	
Bo	ring (rema	Co				Boring Local							
			gineer_			Ground Elev	ation.			Well Fla	vatio	n .	
			CASING		···	Date Staned		7		Groundwall			
Siz	e:			-	Tyna	SAMPLER		Date	Dep	oth Casing		Slabilizatio	n Time
Ha		ŗ:		1	. Hamme	Other:							
_				· · · · · · · · · · · · · · · · · · ·	Fall:	·							
ОЕРТН	CA:	_		SAMPLE			1						1
-	/F	r. NO	PEN/RE		BLOWS/6	•	STRI	A BR	3	WELL INSTALLATE	ON	FIELD' TESTING	RMKS
88.		- 21	24/20	88-5-90	Pushed_	Black-brown, Silty CLAY, hig	h		7	T			4.
1		4-				plasticity, pieces of wood 1/2" to 1".							1.
93.	二	上				╣ .							
	\vdash	22	18/16	93.5-95	2-4-4	Hedium stiff, black-brown,	1		1				
		1				Silty CLAY, trace fine Send, high plasticity.		Silty					1
98.	<u> </u>	\pm	<u> </u>					CLAY		ŀ			
	-	23	18/16	98.5-100	4-3-3	Similar to above.			-				į
											ĺ		
103	5	+-							١.	Grout			
		24	18/16	103.5-105	2-2-3	Hedium stiff, black-brown,			1		- 1		
						Silty CLAY, trace fine Sand, high plasticity, pieces of woo	, d			<u> </u>			
108		-				1/2" to 1".							
100		25	18/14	108.5-110	4-8-7	Medium dense, black-brown,	-	108.5	4				
Į		╫┈	 			fine SAND, little (+) Silt.					ļ		
		1						Silty fine					
113	5	26	19/16	113 5-115				SAND			.		
		-	-	1133-113	5=8=13	Medium dense, dark brown, fine SAND, little Silt.							1
			-	<u> </u>									
118_	5	27	24/24	118 5-120	5 D	D		118.5'	_]				
				110.5-120	J Pusnea	Dark-brown, Silty CLAY, trace fine Sand, high plasticity.	ı	Silty					
						-	1	CLAY					1 1
123	5										- 1		
		28	18/10	123.5-124	5 12-12	Very stiff, green, Silty CLAY.		124.3'	4	٠			
				124.5-125	42	Hard, white, CLAY & SILT, and				•	-		1 1
						Limestone fragments, medium plasticity.		HARL					
						Bottom of boring at 125°			Τ'				
-											.		
1:													
Ŧ													
ļ	<u> </u>												
ŀ		$\left - \right $											
REM	ARKS:		Observe				<u></u>						'
		٠.	votain:	ed a sampl	e for labe	oratory permeameter testing at	88.	5 to 9	0.5	feet in	bore	hole 2A.	. }
										AR SOILS	 	OHESIVE SC	
			:					#L01	YS/FT.	V. LOOSE	4.2		SOFT
			•					ı		** ****	,,		ence

GRANULA	RSOILS	COHEZI	E SOILS
MONS/FT,	DENSITY	BLOWS/FT.	DENSITY
н	V. LOOSE	-12	V. SOFT
410	LOOSE	24	SOFT
18-30	M. DENSE	44 ,	IL STFF
	•	8-15	SIFF
20 54	DEMSE	15-38	V. STFF
» 50	Y. DEMSE	30 د	HARD

	WEL	L DI	- VV I	G LOG	Hydrogeol	ogic Investigation of Cypres	She	ol	1	of	JA West 2	
	oring C				Domes in Ling, Inc.	Wellfields near Tampa.	Dat	e <u>12/</u>	29/8	8 FUe	07620	
F	oreman		Geor	ge DeGroot	.	· · · · · · · · · · · · · · · · · · ·	on	Star	key '	Wellfield		
s	WFWN	D En	gineer_1	ohn Vatsor		Ground Elev:	_12/2	3/ <u>.6'</u> 8/88		Well Eleva Date endo	ulon <u>40 </u>	38' /88
	•		CASING			SAMPLER				Groundwater	Readings:	
	Z0:				_ Type: <u>-</u>	Split Spaan Other:		Date	Depi	h Casing a	1 Stabiliz	alion Time
. F	ammer: ali:			lb	. Hammer	:	j					
L	-;-				- FBH:	30 inch					-	
7030	CAS		,	SAMPLE			.≼,		3	WELL	- FIEL	n 4
-	-		PEN./REC		BLOWSIE	SAMPLE DESCRIPTION	ESE	S.E.	ĝ	NSTÄLLÄTION	TESTI	
1	-	┤-	18/10	1-2.5	2-5-9	Hedium dense, brown, fine	_		\top	 		
						SAND, little Silt, root fibe	r = .] [
3	-	-	 	 			-			'		1
		2	18/12	3-4.5	7-8-8	Hedium dense, light brown,					,	1
		:	 	ļ	 	fine SAND, little Silt.			-	6-1nch		
		-								PVC We	11	
5		3	18/12	5-6.5	3-3-9	Similar to above.		*				ł
1					, ,	oracial to apove.			1			
					 						ſ	
7	-						s	ilty			1	
		4-	18/12	7-8-5	5-8-8	Similar to above.	1	ine		Grout		.
	-						i i	AND				
10	,		 		 		•					1.
-		5	18/10	10-11.5	4-9-17	Similar to above.	1				_	1.
	-	-		·	 	•				.	1	
. .							1			4-		ļ
13.	5	-	18/0	13.5-15	11-32-40	No Recovery.				30-65 Silic		2.
										Sand	1	1 2.
		 			 			1	·L	H		
18.	5					-				Screen		
		-6-	18/10	18.5-20	6-15-18	Dense, brown, fine SAND, little (+) Silt.				Interv	1	
						TITLE (7) SITE.		••	.≣	20-30	1.	- 1
23.	5	-						22	E	Silica Sand		j
[7A	18/14	23.5-25		Very stiff grey, Silty CLAY,		y2		Sump		3.
		7B	24/14	25-27		high plasticity.			ម			
					2-0-0	Medium dense, brown, fine SAN little Silt.	D 511		-	-Bentonit		
28.	5	В	24/20	28-5-30.5	1-1-1-3	Soft, brown-grey, Silty CLAY,	SAN	ID 28	٠.	Hole Plu	5	4.
	<u> </u>		·			high plasticity.	1		H			
					-		SI	lty			l	
33.	5					-	1	AY		•	_	
			13/10	33.5-34	4	Green-grey, Silty CLAY,	-		악크	Formatio- Haterial	-1	
		9B		34-34.6	28-50.2"	igh plasticity. lard, grey-white, SILT & CLAY,	,					.
				:		little Limestone fragments, Low plasticity		ARL				
RE	MARKS:	1.	Conduct	ed e f-11			1		لــــــــــــــــــــــــــــــــــــــ		٠	∣
		2.	The den	sity and	recovery t	permeability test at 10 to 12 attempt at 13.5 to 15 feet was	feet	in bo	re h	ole 3A.	 	
	•	3.	Honitor	Vell 3A	vious pers	seability test.	. p.00	7		cced by E	ie Elsa	•
		4	23-40 f	eet.	AUSCI	illed at completion of boring.	Used	bent	onit	e hole pl	ug from	
		7.	30.5 fe	d a sample et in bore	e for labo chole 3A.	oratory permeameter testing at	28.5	- G	RANUL	AR SOILS	COHESIV	E SOILS .
Ì					,			R	WS/FT.	DENSITY	BLOWS/FT.	DENSITY
	•							14		V. LOOSE	42 24	Y, SOFT SOFT
							-	10:		LOOSE LOOSE	<i>a</i>	M, STFF
								30.		DEMSE	8-15 15-28	SIFF V. SIFF
-			· · · · · · · · · · · · · · · · · · ·					> 54		Y. DENSE	> 30	HUNO
N	OTES:	1) Th	e stratilica	ation lines re	present the a	pproximate boundary between soil types	s and th	e Icen	ition i	nav ha orad	uni	

Bank & V & France Beil

=) V	A L	~ V V I	MD		PROJECT	Hepon	or Bound	Number	3A Hest	
W	ELL	. DF	RILLING	GLOG			S	hoot ale	of	2 P07620	
Bori	ng Ca					Boring Loc			key Wellfie		
LOIR	ıman.		ineer		·	Ground Ele	valion_		Well Ele	vation	
-							<u> </u>		Date end		
Cina	:		CASING			SAMPLER		Date D	Groundwate lepth Casing	r Readings: at Stabilization	n Ti
Ham	mer:			lb	. Type: . Hammer	Other:				- - -	
Fall:					. Fall:						
E	CAS.			SAMPLE	· · · · · · · · · · · · · · · · · · ·						_
DEPTH	BL. /FT.	NO.	PENJREC	DEPTH	BLOWS/6	SAMPLE DESCRIPTION	MY M	CHG CHG CHG CHG CHG CHG CHG CHG CHG CHG	WELL	FIELD TESTING	
38.5		10	 	38.5-38.8		Newd area white design	1	0 -02	- INSTRUMENT	A TESTING	_
		_			7.4.	Hard, grey-white, SILT & Cl and Limestone fragments, lo	OV	HARL	Format		
ŀ		_				plasticity. Bottom of boring at 38.8			Materia	11	Ì
4						porcon of politic at 20.9.		į			
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REMAI	RKS:										•
								6533	18 40 202 2	001100	_
				•				-	ULAR SOILS	COHESIVE SO	_
										BOWLET ~	
								SLOWS/		alows/FT, DE	
ÇII Î		D						84 410	V. LOOSE LOOSE	<2 Y.: 2-4 :	sc
								84	V. LOOSE	<2 V.: 2-4 : 4-8 M.S	sc

	Ý	VELL	DF	RILLING	LOG		ogic Investigation of Cypress Wellfields near Tampa,	Sheet	-89	olP	3 MAC	enical
1						ing, Inc.	Boring Location				07020	
	LOL	eman,		0002	hn Useson	•	Ground Elevati	on 45.3		Well Eleva	11011	.98
t		•		CASING			Date Started _	1-1-89		Date ende	d <u>1-5-8</u> 9	<u></u>
ľ	Size	:	Mud			Tyna	SAMPLER Split Spaan Other:	Date	Depth	Casing at	Stabiliza	ilon Time
- 1	uan	111191:				. Hammer						
Ŀ	raii				<u> </u>	. Fall:	30 inch		•	- 	 	
	DEPTH	CAS,		,	SAMPLE	·		.≼g=≥g		WELL	· FIELD). ki
-		/FT.		PEN./REC		BLOWS/6		SHTY. CHG. SEN. GEN. CHSC.	IN:	STALLATION	TEST	
	1		1	18/12	1-2.5	3-7-12	Medium dense, dark brown, fine SAND, little Silt, root fibers		\prod	1	•	
-	i									1.	İ	
	3 _		2	18/14	3-4.5	3-9-9	Hedium dense, brown, fine SAND				1	
1		<u> </u>		10/14	3-4.5	3-3-3	and Silt	31117				
							. •	fine SAND ·]		
	5 -		7							1		
			_ <u>-</u>	18/10	5-6.5	2-4-2	Loose, light brown, fine SAND, and Silt.	-		l		
1					<u> </u>			-				\cdot
	7 -		_	10/10			·			.		
			4	18/12	_7_8_5	3-1-1	Similar to above					
										Grout		
	10-		5	18/14	10 11 6	6-9-10		10'	4			
			_	10/14		9-3-10	Very stiff, grey-green, Silty CLAY, high plasticity	•				
\cdot								Silty				
Į.	3.5		6	18/15	13.5-15	2-2-3	Hedium stiff, white, Silty	CLAY			1	
							CLAY, high plasticity				1	
											1	İ
	3.5		7	18/12	18 5 20	3 10 00						Ì
	•••				10.5-20	4-12-23	Hard, grey-green, Silty CLAY, high plasticity.		1+	6-inch PVC We		
								••		1.10 42		İ
2:	3.5		·	14/8	23 5_26 B	10-20-50	4" Hard, white, CLAY & SILT,	23.5	4			
Ì	Ì				23.7-64.0	10-20-30	little Limestone Fragments,					
	ļ						medium plasticity					
þ٤	1.5		9	3/3	28 5-28 7	50/7"						
	F				30/8./		Similar to above	HARL				
	ļ											
33	1.5		10	2/1	33.5-33.6	50/2"	Similar to above					
	F	\neg	\dashv									.
											. ,	
1.	ا سعد	NAKS:		l			•	•		<u> </u>		
1	1614	uno.					•					
				•			•					٠.
					•							
						•	•			R SOILS	COHERIA	
								<u> </u>	MS/FT.	DENSILA	#LOWS/FT.	V. SOFT
								. 410		FOOSE A. FOOSE	24	SOFT
								18-3		IL DENSE	4.4 8-15	M. STFF STFF
					:		•	30-54	,	Y, DENSE	15:30 °	Y, STFF HATED
1	NO	TES: 1	1 Th	a etratific	ation lines so	second the	nnmyimala houndary hawaan ee i naac			.,,,,,,,,		WAIT.

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V	v ک VELL	v r . DF	- VV I			gic investigation of Cypress	Sh	eel	2 .	ol		
						dellfields near Tampa.				FileP(· · ·
						Boring Location Ground Elevat	n	· S	tarkey	Wellf1	eld .	
SW	FWME) Eng	ineer			Date Started _				Date euq	ad	
			CASING		•	SAMPLER		Date	Gre	Casing	Readings: 1 Stabiliza	
Size	nmer:			ib.	. Тура:	Other:		Jak	ОФрил	Casing	. Statemen	IION IIM
Fall	:				. Hammer . Fall:	:lb.						
=	CAS.			CALCUT					<u> </u>			
ОЕРТН	BL /FT.	NO.	PEN_AEC	SAMPLE DEPTH	BLOWS / 6"	SAMPLE DESCRIPTION	STRTA	FRE	SWI INS	MEIT .	FIELD	
38.5		_11	1/1"	38_5-38_6	50/1"	Limestone fragments			\dashv \vdash	T		1
								•				1
43.5												
		_12	3/1	43.5-43.7	50/3"	Limestone fragments						
			•			·						.
48.3												
40		_13	3/3	48.5-48.7	50/3"	Hard, white-green, SILT & CLAY						
						and Limestone fragments, low plasticity.			1+	6-inch PVC We		
53.5												
		_14	4/4	53.5-53.8	50/4"	Similar to above						
							١.			'		
58.							'			•		
		15	4/4	58.5-58.8	50/4"	Hard, white-green, CLAY & SILT	1 1	1ARL				
						little Limestone fragments, medium plasticity.						
						paddaday.	1					
63.4		16	1/1	63.5-63.6	50/1"	Similar to above						
				. ,								
							1			Grou	t	
68.		. 17	2/2	68. 5-68. 6	50/2"	Similar to above	ļ					r
73-			1/1	72 5 72 .				73.	s <u>'</u>			2
			-//-	73.5-73.6	50/1"	Limestone fragments						
78.	,		4/1				-	AMPA				
		- 13	9/1	78.5-78.8	50/4"	Limestone fragments						
							LIM	ESTON	ξ			
83.						•	l			30-65		
		_2q	6/4	83.5-84	50/6"	White, Silty, Sandy LIMESTONE				Silica Sand	۱	
	$\overline{-1}$									20-30		
88.		21	18/14	88.5-90	25-30-33	Similar to above		. 8		Silic: Sand	١	
REM	ARKS:	1. I	Prillin			h resistance and a grinding no	·			<u> </u>	1	
		j	and su	rface.	W16	and a grinding no	156	J8 to	45 fe	et belo	ч	
		2. 1	op of	Tampa lime	stone is	approximately 73.5 feet below	land	surf	ace.			
								_		I some	COULCUS	- CO!! 0
								-	RANULAP DWSÆT.	DENSITY	COHESIVI BLOWSÆT.	DEMSITY
								0-4		V. LOOSE	12	V. SOFT
1								- 1		i	2-4	SOFT

· W	S V VELL	VI⊢ .DR	ILLING	NIOC F		PHOJECT gic Investigation of Cypress ellfields near Tampa.	She	eet .	3	ol File	A Central	
												
						Boring Locatio Ground Elevat Date Started	llon			Well Eleval	lon	
			CASING			SAMPLER			Gi	oundwater F	leadings:	
Size	:		•		. Type:	Others		Date	Depth	Casing at	Stabilizatio	n Tin
				lb.	. Hammer:							
ran.					Fall:					 		
	CAS.			SAMPLE			٤,	i (3	MEIT	FIELD	T
			PENÆC		BLOWS / 6"	SAMPLE DESCRIPTION	SIR		ğ ın:	STALLATION	TESTING	
3.5		22	18/12	93.5-95	29-47-43	White, Silty, Sandy, LIMESTON	NE			Screen		十
					 		TA	MPA	目	Interva	1	
3.5							1	ESTON	<u>.</u> 🗐	- 20-30		Ì
		23	18/12	98.5-100	13-16-23	Similar to above			18	Silica Sand		
						Bottom of boring at 100'	1-		Si	nmb T		- -
						-	1					
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EN	MARKS:		Mon1to	r well 1A	Central w	as installed at completion of	bori	ng.				
									RANULA		COHESIVE	
									OWS/FT.	DENSITY		DEN:
								0-		V. LOOSE	42 24	v. sc
1	(OF	1 1	ITN .					10	.30 .30	LOOSE M. DENSE		M. 517
įΫ́	ULI	المسال	itald					- 1	-50	DENSE	8-15 15-30	517 V. STI
										V DENCE		

1 1	S V	V I	VV I	VID		ORIC investigation of Cypres	Report of She	Boring !	Vumb	ol	Centra 2	1	_
Bor	ing Co). <u> </u>	Ameri		ing. Inc.	rellfields near Tampa. Boring Loca	·				07620 d		=
1 1 01	AIIIMIT.			hn Watson		Ground Elev	ation.	42.0'		Well Eleva	llon_46. d_1-11-	73' 89	\equiv
Size	:Н	Wa	CASING nd Mud	Rotary	Tunes	SAMPLER		Date D	G≀ •pth	Casing a		llon T	m•
				lb	. Hammer:	Split Spoon Other: —Other:							
#	CAS.			CALMIC	. 1 411.								
ОЕРТН	BL /FT.		PEN_REC	SAMPLE DEPTH	BLOWS/6"	SAMPLE DESCRIPTION	STRTÁ. CHG.	and GEN. DESC.	INS	WELL STALLATION	FIELD TESTIN		RMKS.
1		1	18/6_	1-2.5	WOH	PEAT, fibrous.		•	П	1			
·						,				.			
3 _		2	18/0	3-4.5	мон .	No Recovery .				İ			
						no necovery	PEA	\T					
.													
5 -		3	18/8	5-6.5	WOH	PEAT, Fibrous.							
						•							
7		-			1		İ	-1		Grout		.	
		-4.4	18/14	7-8.5		Grey-brown, fine SAND,	SA	7' 8' GKL					1
		_AB	24/12	8-10	4-3-3-9	little Silt. Hedium stiff, grey-brown		llty			-		_
10-						Silty CLAY, trace fine Sand high plasticity.		AY ₁₀ ,		-	:		,
		.5	18/14	10-11.5	14-18-16	Dense, white-brown, fine SAN	D,				1.		3
					-	some silt.							
13.5		_	10/41										
		6	18/14	13.5-15	15-12-2	Medium dense, brown, fine SAND, some Silt.							
	•	-	<u> </u>			•:			+	2-inch			
18.5		7	10/10	10.5.00		•				PVC Wel			
			79/10	18.5-20	1-1-1	Very loose, black-brown, fine SAND, some (+) Silt.							3
					-								
23.5		8	18/10	22 6 25			Si	lty					
			107.10	23_5-25	4-7-6	Loose, brown, fine SAND, some (-) Silt.	fi	ne					
					<u> </u>		SAI	ND	.				
28.5		9	18/14	28.5-30	7-20-21	Dense, white-brown, fine SAN	NID.				.		
. {						little Silt.							
,]		_											
33.5		10_	18/14	33.5-35	10-16-17	Dense, dark brown, fine							
Ì						SAND, some Silt						\cdot	
ł									ŀ				
REM	NRKS:		1. Hat	mmer fall	was less	than 30 inches, blow counts	were no	t reco	Tde.	1	1		
			2. Ob	tained a :	sample for	laboratory permeameter took					ınd		
					oreliote 7	·• .			-	•		•	
			20	-22 feet	in borehol	ead permeability test at 10- e 2B	12 feet	1		le 2C ar	d at COHESIV	F SOII	S
					_		•	BLOWS		DENSITY	BLOWS/FT.	DEN	
•					•			0-4		Y. LOOSE	∢2 2-4	V. SC	OFT OFT
							•	10-30		LOOSE M. DENSE	44	M. ST	FF
						:		20-50		DEHSE	8-15 15-30	ST V. SI	FF YF
								,50		V. DEKSE	عدد. عدد	н	ı

٠ ي	3 V	J F	I W	$MD \perp$		PROJECT	Repor	t of Borin	Numl	or 2A Cer	cral	
N	/ELL	DF	ILLING	LOG			_	Sheet Date		ot	207620	
Borl	ing Co					Boring Lo						
	,,,,a,, "					Ground E	Elevation			Well Elevation	on	
	771416	City				Dale Sta	rted			Date ended		
			CASING	•		SAMPLER		Date	G Depth	Casing at	sadings: Stabilization	Tir
				lb	_ Type:	Other:	:					
all:				10		:1b.		-		-		
Ŧ	CAS.	_		CHET			·					
DEPTH	BI_		PENJAEC	SAMPLE		SAMPLE DESCRIPTION	1		[]	WELL STALLATION	FIELD	
3.9		11		DEPTH 38.5-40	8-10-15			,0 "02	5 "	3140711014	TESTING	\perp
			207.20	30.3-40	0-10-13	Medium dense, dark brown f SAND, some Silt	ine					1
							İ			Grout	:	
.5												
		12_	18/12	43_5-45	14-20-26	Dense, brown, fine SAND, s	ome		11	30-65		
					 	Silt	- 1	Silty		Silica		
							·	fine 4	,]	720-30		
•		13	18/10	48.5-50	11-14-17	Similar to above		SAND 4	"\	Silica		
					12 14-17	STWITHE CO SDOAS			.周、	Sand		
ł					ļ		İ	5("]]	Screen Interval		
.₫										Sump		ı
}		14	18/12	53.5-55	6-6-6	Medium dense, brown, fine	SAND				·	
ł						some Silt.		•				1
							1			formation		
.=		15	18/12	58.5-60	15-15-13	Similar to above			'	iaterial		
Ī						Bottom of boring at 60'					1	١.
-					ļ							
1									. '			
ł							.					ı
Ţ												ŀ
-			•								·	ŀ
1							Ì		1			
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GRANULA	R SOILS	COHESIV	Æ SOILS
BLOWS/FT,	DENSITY	BLOWS/FT.	DENSITY
04	Y. LOOSE	12	V. SOFT
		2-4	SOFT
410	LOOSE	14	M. STEF
10-30	M. DENSE	8-15	STFF
30-58	DEMSE	1530	V. STFF
>50	Y. DENSE	>30	HARO

MICROFILMED

1	<u> </u>	V_t	- VV		Hydrogeo1	ogic Investigation of Cypres	Hepoi	rt of Borin	g Nu	mber <u>3A</u>	Central	
<u> </u>	VELL	. DF	RILLIN	G LOG		Wellfields near Tampa.	э ; [Date 1/9	/89	ol	P07620	 -
Bor	ing Co)	Amer	ican Dril	ling, Inc.	•						
For	eman.		Geor	ge DeGroot	t .	- Coming Cock	ailon	Stark	ـــارده	Wallfield		
SW	FWM) Eng	lneer_I	ohn Warson	<u> </u>	Date Starte	d1	-6-89		Well Elev Date end	allon	-89
ĺ			CASING	· — · — ·		SAMPLER				Groundwater		
Size	:HW	the	n Mud	Rotary	Type		•	Date	Oer	th Casing		ation Time
Han	nmer:			Ib	. Hammer	Splir Spoon Other:						
Fall					_ Fall:	30 Inch						
Ξ	CAS.			SAMPLE								
DEPTH	/FT.	NO	PEN/REC		Di Ovio e e	SAMPLE DESCRIPTION		A SES		WELL	FIEL	
1	 	1.0.	18/12		BLOWS / 6"			30 "GE		INSTALLATIO	N TEST	MG 2
1			10712	1-2.5	1-6-7	Medium dense, dark brown, fi	lne			11		
		<u> -</u>				SAND, some Silt.	- 1					
3		-	 	 					-			
1		2	18/14	3-4.5	4-11-12	Medium dense, brown, fine				Grou	16	
		-				SAND, some Silt.					- 1	
					+						- 1	
5 -												
		3	18/10	5-6.5	3-3-5	Loose, light brown, fine SA	ND				1	
						and (+) Silt.					'	
_								Silty				
7 -					ļ	•		fine	1			1
				 				SAND				
- 1									_	6-inch	. [
				 -	ļi	•		•		PVC We		
10-		4	18/10	10-11.5	2-4-7	Hedium dense, black-brown,	-		1			
						fine SAND, some Silt.						
}			 	 		1				30-65	1	
13.5				 						Silic	: a	
		_5	18/10	13.5-15	5-8-9	Hedium dense, brown, fine .			.	20-30	,	
1						SAND, some Silt.		15	'	S111c		
					 					Sand	-	
18.5									≣	Screen		
ł		-6	18/12	18.5-20	5-6-7	Medium dense, light brown,			E	Interv	***	2
Ì						fine SAND, some (+) Silt.	-	20	<u>"</u> =	1 1		
									Г	Sump		
3.5		7.4	26/20	23.5-24.5	 	_		23.5	4			3
			207.20	2-2-2-2	Pushed	Green, Silty CLAY, high plasticity.						
- }		_7B		24.5-25.5		White, CLAY and SILT, some	1		1			
_ }				 	 	Limestone fragments, medium			1	•		
8.5		8	18/12	28.5-30	9-19-10	plasticity. Very stiff white-green Silt]	Silty				
-		\Box				CLAY, high plasticity.	۱.	CLAY			1	
ŀ						-		Amur I	-	-Formatio	1	
3.5						•				Material		3
}		9	24/18	32-34	PUSHED	Green, Silty CLAY, high			-			
ŀ						plasticity.						-
									-	Grout	-	
L								38.5				
REM	ARKS:	1. (Conduct	ed a fall	ing head p	ermeability test at 5 to 7 f	eet h	relow 1:	nd	surface i	n borebo	10.74
		2 1	No samp	le was ob	tained fro	m 7 to 8.5 feet due to grave	l use	d for p	rev	ious perm	eability	test.
				*CTT VV-	centrar in	stalled at completion of bor ratory permeameter testing a	· 4 m n					. 1
		:	in bore	hole 3A C	entral.	Permeameret cesting a	23.	. , - 43.3	ree	t and at	J∠ to 34	teet
						•		GR	ANU	AR SOILS	COHESIN	E SOILS .
								BLO	MS/FT.	DENSITY	BLOWS/FT,	DENSITY
٠								0-4		V. LOOSE	<2	V. SOFT
								410		1002E	2-4	SOFT
								10-30	,	M. DENSE	4-4 8-15	M. STFF
								30.50	,	DEMSE	15-20	V. STEFF
4								> 50		V. DENSE	> J0	HURO
NO	E5: 1) Th	e stratific.	ation lines re	present the B	pproximate boundary between soil type	es and	the trans	ition	may be grad	lual.	

MICROFILMED ' 85

oID Engineer								2
ID Engineer								· ·
ID Engineer			Boring Loc	ation				
				od		············ \	Mell Eleva Date ende	llon d
			SAMPLER		1	Gre	andwater F	Readings:
		. Тура:	Other:		Dale	Depth	Casing at	Stabilizatio
	lb.	. Hammer:	1b.					
·		. rau:			 			
· <u> </u>	SAMPLE			7	ರಾಷ	y,	WELL	FIELD
		BLOWS / 6"			5 7 8	ਸ਼ੂ lws	TALLATION	TESTING
10 10/10	38.5-39	46-50/3"		. и	ARL	1+	Grout	•
-	 		Bottom of boring at 39.2'					
	-	<u> </u>						
		<u> </u>						
- -			1					
	 							'
						1		
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	·						•	1 .
						1		1
	NO. PEN/AEC	. NO. PEN/REC DEPTH 10 10/10 38.5-39.	NO. PEN/REC DEPTH BLOWS / 6* 10 10/10 38.5-39. 46-50/3'	NO. PENJAEC DEPTH BLOWS/6 10 10/10 38.5-39 46-50/3' Hard, white, CLAY & SILT, some Limestone fragments Bottom of boring at 39.2'	NO. PENJAEC DEPTH BLOWS/6 10 10/10 3R.5-39.2 46-50/3' Hard, white, CLAY & SILT, some Limestone fragments Bottom of boring at 39.2'	NO. PENJACC DEPTH BLOWS/6 10. 10/10 38.5-39. 46-50/3' Bottom of boring at 39.2' MARL MARL	NO. PENJREC DEPTH BLOWS/6* SAMPLE DESCRIPTION 医光亮设置 INS 10/10 38.5-39. 46-50/3* Hard, white, CLAY & SILT, some Limestone fragments Bottom of boring at 39.2*	NO. PENJACC DEPIH BLOWS/6 SAMPLE DESCRIPTION ESTREE INSTALLATION I

1	SV	VF	I VV =	MD	Hydrogeo1	PROJECT R	Report o	ol Boring	Numt		A East	
					Domes in	Wellfields near Tampa		10	16-89	File PC	7620	
	ing Co eman_		Ameri Georg	can Dril	ing, Inc.	•						
sw	FWMC) Eng		hn Watsor		Ground Eleva Date Started		46)-89	.6'	Well Elevati	lon <u>49.67</u> 1–16–89	
	•		CASING			SAMPLER			G	oundwater R		
Size	:	Huc	Rotary	<u> </u>	_ Type: <u>·</u>	Split Spoon Other:	,	Date	Depth	Casing at	Stabilization	Time
Fall	umer: "			lb	 Hammer 	:						
 	010	-				JO INCH						
ОЕРТН	CAS.	100	neu osa	SAMPLE		SAMPLE DESCRIPTION	<u>بخ</u>			WELL	- FIELD	69
౼	/FT.	1	PENJREC		BLOWS / 6-		,	3 8 8 8	IN:	STALLATION	TESTING	RMKS.
1			LV/ L4	1-2.5	2-3-5	Loose, light brown, fine SAND some Silt, root fibers.),		Π		\cdot	
										1.		
3 _		2	18/14	3-4.5							1	
			10/14	3-4.3	5-8-10	Medium dense, brown, fine SAN some Silt.	ID, Si	llty	11			
					· .	·	· Et	lne	11			
5 -							SA	MD				
		3	18/16	5-6.5	9-7-11	Medium dense, grey-brown fine	.					
						SAND, and Silt.						
7 _					 	,					1	
		4	18/14	7-8.5	12-12-16	Similar to above.		•		Grout		
										l		
10-												
107		5_	18/16	10-11.5	14-12-11	Very stiff, white-green, Silt		10'	-		1	
						CLAY, high plasticity.	s	ilty				
	-						l c	LAY				
13.5		6	18/16	13.5-15	2-3-3	Medium stiff, white-green,				-6-inch		
			·			Silty CLAY, high plasticity,				PVC Wel	1	
						•			·		.	
18.5		7	18/16	18.5-20	1 2 3			_18_5	<u>.</u>	•		
						Soft, white, CLAY & SILT, trace, Limestone fragments.						
						5		••				
23.5		-	10/17									
Ì		R_	18/17	_23_5_25		Stiff, white, CLAY & SILT, little Limestone fragments,						
}	\dashv					medium plasticity.	١,	IARL				
8.5			-		<u> </u>			-				
٦.٠٠		9	18/14	28.5-30	2-4-4	Similar to above.						
3.5	\dashv	-				•						
-		10	2/2	3.5-33.6	50/2"	Hard white, CLAY & SILT,						
ŀ						some (+) Limestone fragments.					.	
ļ						medium plasticity.						
BEN	ARKS:					•		•		<u> </u>	<u> </u>	
· ·CM	willo:											
					•	_						
						••						.
						•		GF	ANULA	R SOILS	COHESIVE SC	ILS .

GRAN	IULAR SOILS	COHESI	VE SOILS .
BLOWS	FT. DENSITY	BLOWS/FT.	DENSITY
0-4	V. LOOSE	<2 2-4	V. SOFT SOFT
410 10-30	LOOSE M. DENSE	44	IL STFF
30.50	DENSE	15-70	STFF V. STFF
>50	V. DENSE	>10	N160

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V	S V VELL	V F	VV I	VID LOG	lydrogeolo	gic investigation of Cypress	port of Bor Sheet _	2	of		3		
Bor	Ing Co					ellfields near Tampa. Boring Localio	Date						
						Ground Eleval	lon		Well	Elevat	lon		
Size	:	····	CASING		Туре:	SAMPLER	Date			water F	leadings:		lme
Fall				10.								,	
ОЕРТН	CAS. BL.	NO	PENJAEC	SAMPLE DEPTH	DI QUID LO	SAMPLE DESCRIPTION	STRTA.	53	WE	u.	FIEL		RWKS
38.5	_				BLOWS/6"	Hard, white, CLAY & SILT, some (+) Limestone fragments.	18 0 8 0	8	INSTAU	AHON	TESTI	NG.	38
43.5			18/6	_43_5-45	43-27-24	medium plasticity. LIMESTONE FRAGMENTS, little		•					
						Clay & Silt.							
48.3		13	3/3	48.5-48.7	50/3"	Limestone fragments,			G1	rout			•
53		14	1/1	52.5-52.6	50/1"	Limestone fragments.	MARL				1		
58.5	•	14.	12/8			·					1		
			12/0	58.5-59.5	37-50/6"	White, Silty, Sandy, LIMESTONE				•	1	·	
63		16	2/2	63.5-63.6	50/2"	Similar to above				inch C Wel	1		
68		. 17	2/2	68.5-68.6	50/2"	Hand Clay o gram							
						Hard, CLAY & SILT, some Lime- stone fragments, medium plasticity.							
73~			10/10	73.5-74.3	27/50/4"	Hard, green, Silty CLAY, high plasticity.	73.	\neg					
78.		19	18/14	78.5-80	40-20-40	Similar to above.	CLAY				1		
835						•							
		_20	6/6	.83_5_84	50/6"	Thite, Silty, Sandy, LIMESTONE	TAMPA						
REM	ARKS:												
					•						1		
						·	Г	GRANU	ILAR SOII	s	COHESIV	Æ SOI	LS -
	•						⊢	OWS/FI			BLOWSÆT.	DEN	SITY
								10		ose	cz 2-1 4-8 ,	V. S. S. M. S.I	OFT
ROF)	•			1	1-50 1-50	M. CE	'	8-15 15-38	51 V. 51	FF FF

MIC

5	3 V	V F	I W	VID		PROJECT	Re	port o	of Borin	g Nun	nber1/	East	
M	/ELL	. DR	ILLING	LOG	· · · · · · · · · · · · · · · · · · ·		1				of		
Ror	lon Ca				·		<u> </u>						
						Boring Loc	alion	1	Sta	rkey	Wellfield		
sw	FWMD	Eng	ineer			Ground Cit	ed	on			_ Well Eleva _ Date ende	tlon d	
			CASING			SAMPLER				. (Groundwater I	Readings:	
Size	:				Tyna:	Other:			Date	Oepti	h Casing at	Stabiliza	tion Time
Han	ımer:			lb.	. Hammer:	lb.							
Fail					. Fall:	•						-	
ОЕРТН	CAS.			SAMPLE				7	<u> </u>	. T		 	
8	IFT.	NO.	PENJREC.	DEPTH	BLOWS 16	SAMPLE DESCRIPTION		E		g l	· WELL NSTALLATION	FIELD	
38.5		21	5/4	88.5-88.9	50/5"	Hard, white-green, CLAY &	_	 "			Grout	:	- -
		_			ļ	SILT, some Limestone fragments.					30-65		
						Alagmento.					Silica -Sand	•	ł
3.5		22	2/1	93 5-93 4	50 (0!)					•	H '		
				93.3-93.4	-511/7	Limestone fragments.			95		20-30 Silica		
							ı	T.	AMPA		Sand		
98.5		23	17/10	98.5-99.9	17-40-50/	5" :			ESTONE				
				· · · · · · · · · · · · · · · · · · ·		White, Silty, Sandy, LIMEST	ONE					İ	İ
											Screen Interva		
103.	ς											<u> </u>	
		24	18/10	103.5-105	24-37-17	Similar to above.							
						Dimilal to apove.			105	<u>'.</u>		1	
											Sump	-	
L08.										П			1
		25	18/12	108.5-110	20-17-20	Similar to above.				_			
						Bottom of boring at 110'							
						•							
						•							
						•							
							ļ			ı			
										1			- 1
				,									
										1	•		
										j		1	
												1	
												1	
REM	ARKS:						1						
		1_	Monitor	well lA	East inst	alled at completion of boris	ng.						
									G	RANUL	AR SOILS	COHESIA	E SOILS
									BLC	OWSÆT,	DENSITY	BLOWSÆT,	DENSIT
									0-4		V. LOOSE	<2 24	V. SOFT SOFT
						;			41		FOORE	44 .	M. STFF
	و وسي	MIR	-F						10.		M. DENSE DENSE	8 -15	STFF
JRC)FIL	loli	1		•	,			30- >5		V. DENSE	15-20 > 20	V. STEF HARD

Bor. Fore			IG LOG	Domes in	Wellffeld	Sheet Date _1/2	1 of	2	-
sw	ing Co. eman _	Ame Geo	rican Dril rge DeGroo	ling, Inc.					
-	FWMD	Engineer_	John Watec	n	. Boring Locatlo Ground Elevat Date Started	lon 44.7 1/24/89	Well E	levation 48	.64
		CASIN	-		SAMPLER		Groundwa	ater Readings:	
Size	uner:	and Mud I	lotzry	Type: _	Splir Spoon Other:	Date	Depth Casi	ng at Stabiliz:	atlon T
Fall:				v. mamme	r:			-	
E	CAS.		SAMPLE						
ОЕРТН	/FT.	NO. PENJRE		BLOWS/6	SAMPLE DESCRIPTION	STRTA. CHG. and GEN. DESC.	WELL	TION FIELD	D
1		1 24/8	0-2	1-3-4-5	<u> </u>	8000		TESTA	
						PEAT			
2				<u> </u>		FEAT			
		2 24/8	2-3	1-5	Similar to above.	 	Gro	out	-
-			3-4	. 5-5	Stiff, grey, Silty CLAY,	3'			
4-		3 2//6			high plasticity.]]-]		- 1
		3 24/6	4-6-	4-5-4	Similar to above.	i		i .	
			-				2-in		ı
6		4 24/6				Silty		Well	
-		- Z97B	6-8	3-4-5-7	Similar to above.	CLAY			
									Ì
8 +		5 24/16	8-10	4-8-15-21	Vary shiff and book as				
-					Very stiff, grey-brown, Silty CLAY, high plasticity.				
10							30-6	1	
10.		6 18/12	10-11.5	7-21-22	Dense, grey-white, fine SAND,	10'	Sil		
<u> </u>					little Silt.	111	20-3	0	
.3.5	-		·			Silty	Sili Sand	1 .	
F		7 18/12	13.5-15	5-6-5	Medium dense, light brown,	fine	Scre	en	
F					fine SAND, some (+) Silt.	SAND	Inter	rval	
LB.5		=				161			
-		18/14	18: 5=20	3-4-6	Stiff, brown-grey, Silty CLAY,	18.5'	Sump	,	
-				·	trace fine Sand, high plasticity.	,	Bentoni	te	
L						Silty	Hole Pl	ug	
3.5		24/18	23.5-25.5	1/12"-1/1	" Very soft, grey-green, Silty	CLAY		'	ı
3.5	{	1 .	B			ł			- 1
23.5					CLAY, high plasticity.				
23.5					CLAY, high plasticity.		Formati Materia		
	10				Very soft, white CLAY & SILT	28.5'			
	10				CLAY, high plasticity.	28.5'			

SILT, stose Limestone Iragents. Bottom of boring at 35' Bottom of boring at 35' GRANULAR SOULS COMESIVE BOOKST. DEMAT BOWST.	S	W	/ F	1 VV	ND		PROJECT	Repoi	t of Boring	Number2	A East	_
Boring Localion SVPFMO Edinary CASING CASING SAMPLER CASING SAMPLER CASING SAMPLER COUNTY CASING SAMPLER COUNTY CASING SAMPLER COUNTY CASING SAMPLER COUNTY CASING SAMPLER COUNTY CASING SAMPLER COUNTY CASING SAMPLE COUNTY CASING SAMPLE COUNTY CASING SAMPLE SAMPLE CASING SAMPLE SAMPLE								1 1	Date	or File		_
CASHG	Borin	g Co					Bodos Loc					_
CASING SAMPLER CASING							Ground Ele	evation.		Well Fleva	ition	_
CASING SAMPLE CASING C	-		- Cing				Date Start	ed		Date ende	od	_
TEMPORT: TEMPOR							SAMPLER		I	Groundwater	Readings:	
FOR THE PROPERTY OF THE PROPER	Size:					. Тура:	Other:		July 1	Jupin Casing a	1 SINONES	_
E CAS SAMPLE SAMPLE DESCRIPTION E SAMPLE DESCRIPTIO	Fall:	1101:-				. Hammer						_
11 18/10 23.5-35 20-17-8 Very Stiff, white, CLAY 6 SILT, some Limestone fragments MARL Formation Material	ļ					. raii:				-	- -	_
11 18/10 23.5-35 20-17-8 Very Stiff, white, CLAY 6 SILT, some Limestone fragments MARL Formation Material	든				SAMPLE			Τ.		T		-
REMARKS: GRANULAR SOULS COMESIVE ROWSET, DESCRIPTION	g ,	/řĭ.	_			<u> </u>	SAMPLE DESCRIPTION	I	ESE SE	INSTALLATION	TESTIN	
REMARKS: GRANULAS SOLLS CONESNER	33.5		11	18/10	-33_5r35	20-17-8	Very Stiff, white, CLAY &					-
REMARKS: GRANULAR SOILS COMESIVE ROWSFT. DENSTY ROWSFT. 14 VILOUSE 1-16 LOO							Silt, some Limestone fragments		MARL			
REMARKS: GRANULAR SOILS COHESIVE BLOWS/T, CHISTY BLOWS/T, 44 VLICOSE 45 VLICOSE 45 VLICOSE 46 VLICOSE 46 VLICOSE 47 VLICOSE 47 VLICOSE 48 VLIC	-							_		Material	·	
REMARKS: GRANULAR SOILS COHESIVE							Bottom of boring at 35'			ľ		
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15	-					:	i.					
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15												
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REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15												
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15	-	_					•					
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15			\dashv									
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15							•					
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15			\dashv									
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15							•					
REMARKS: GRANULAR SOILS COHESIVE BLOWSFT, DENSTY BLOWSFT, 2-1 V.LOOSE 42 4-10 LOOSE 44 10-30 M.EPISE 4-15			\Box				•			·	ŀ	
GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4 4-10 LOOSE 4-1 10-30 M. DENSE 4-1 8-15	-	╌┤										
GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4 4-10 LOOSE 4-1 10-30 M. DENSE 4-1 8-15								j				
GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4 4-10 LOOSE 4-1 10-30 M. DENSE 4-1 8-15	-											
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GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4 4-10 LOOSE 4-1 10-30 M. DENSE 4-1 8-15	-	-								_		
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GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4 4-10 LOOSE 4-1 10-30 M. DENSE 4-1 8-15	上								İ			
GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4 4-10 LOOSE 4-1 10-30 M. DENSE 4-1 8-15	-		-T									
GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4 4-10 LOOSE 4-1 10-30 M. DENSE 4-1 8-15		士	_					1				
GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4-10 LOOSE		\Box	二									
GRANULAR SOILS COHESIVE BLOWSFT. DENSITY BLOWSFT. 6-4 V. LOOSE 4-10 LOOSE		<u></u>]						_
BLOWSFT. DENSITY BLOWSFT.	HEMAR	KS:								-	-	
BLOWSFT. DENSITY BLOWSFT.							T is					
BLOWSFT. DENSITY BLOWSFT.						•		,				
BLOWSFT. DENSITY BLOWSFT.									CBA	NIII AD SOUR T	COLLEGIA	_
OFILITIED 0-1 V. LOOSE												
(OFILITIED) 24 1030 M. DENSE 1030 M. DENSE 1031 M. DENSE						•			-			-
OFILITIED M. DENSE 3-15					•				1.		2-4	
· I save a court	30FI	I fa	E)					ı	1		L
	e vage at a	• •				•			30.50		1530	١

		ン V WEL	V I	- VV	IVI D . G LOG	11/02/08/00	HOUSECT Logic Investigation of Cypres	Report o	of Baring	Num	ber	JA East	• • •	
•	Вс	ring C	o	Amer		Domes in	Wellfields near Tampa.	Da	le <u>1/</u>	19/8	File	P07620		_
		reman WW3V		lneer_1	ohn Watso	n .	Ground Ele	vatlon_	45.9		Well Ele	vallon	48.84	_
			-	CASING			Date Starte	q	-18-89		Date en		9-89	_
	Siz	o:_HW	the	n_Mud_R	ntary	_ Type:	SAMPLER Split Spoor Other:		Date	Depth	Casing	or Readings: al Stabil	ization 1	lme
	Ha	mmer: :				u. Hamme	or:	•	-					
,	<u> </u>	lava				Fail:	30 inch							
	DEPTH	CAS. BL /FT.	<u> </u>	PEN./REC	SAMPLE DEPTH	BLOWS/6	SAMPLE DESCRIPTION	TRTA.	GEN. DESC.	IN	WELL STALLATION		LD TING	AMKS.
	1:		-	18/12	1-2,5	5-7-9	Medium dense, brown, fine	- "		+		_		<u>«</u>
•		_	-				SAND, some (-) Silt.	İ					İ	
	3.		-			<u> </u>		.			-Grov	. D		
•			2	18/12	3-4.5	7-11-11	Similar to above.	-					İ	
		-										ł	- 1	
	5 -					 	-		•	-	6-inc	h		
			3	18/12	5-6.5	6-4-8	Similar to above.				PAC A	e11		
•							-	-			ļ			1.
	7					ļ.,	,					1 '		
			4	18/12	7-8-5	39-44-33	Very dense, brown, fine SAN		lty 1e		30-65	,	ŀ	
						 	and (+) Silt.	SAI	ID		Silic Sand	:a		
•	10~						·			-	-		j	
	10-		5	18/10	10-11.5	6-6-8	Medium dense, light brown,		10'_		20-30			٠
							fine SAND, some (-) Silt.				Silic Sand	а		
											Screen	,		
	13.5		6	1876	13.5-15	10-13-13	Medium, dense, brown-grey,				Interv			
				•			SILT, little fine Sand.		15'_			1.1		
•							٠.		_		Sump			
	18.5		7.4	19/10	10 5 05		Medium, stiff, grey-brown, CLAY	8					.	
			/ A	18/10	18.5-20	4-3-3	SILT, and fine Sand, trace lime stone fragments, low plastici				entonit ole Plu			2.
			7 B	24/10	20.5-22.5	Puched			20.5'					Ì
	23.5						Green, Silty CLAY, high plasticity.		1ty AY 23.5'			;		3.
			8	18/12	23_5-25		Stiff, white, CLAY & SILT, some Limestone fragments, medium	-	23.5'	\dashv				٦.
:							plasticity.				_			
	28.5							м	ARL			-		
	}		9	18/12	28.5-30	10-26-24	Hard, white, CLAY & SILT,				ormacio		ŀ	
							little, Limestone fragments, medium (-) plasticity.	1.		l H	aterial	l		
	13.5	_	_				•							
	F	j	n.	11/10 3	3.5-34.4	24/50/5"	Similar to above.				-	,		-
													.	
	-		- -											
	REM	RKS:					· .	<u></u>		4				
			2. 1	Conduct	ed a fall well lA	ing head East inst	permeability test at 5 to 7 f alled at completion of boring	eet an	d at 1	o~to	12 ft.	in bore	hole :	34
.			3. (Obtaine	d a sampl	e for lab	oratory permeameter testing a	:. t 20.5	-22.5	feet	in bor	ehole 3A		
													•	
									GRA	ULAR	SOILS	COHESIN	Æ SOILS	\exists
									BLOWS	FT.	DENSITY	BLOWS/FT.	DENSI	
	•								0-4		V. LOOSE	<2 2-1	V. SOF	- 1
MICR	ÖFI								10-70		FOOSE	44	M. STF	- 1
44112711						•	;		30-50		DENSE	8-15 15-30	STF. V. STF.	- 1.
ì						_			1		1		1. 311	/ I

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SV	NF	TW P	MD		PROJECT		Rep	on o	l Bor	Ing 1	- dumb	or	3A Eas 2	<u> </u>]
WEL	LDA	ILLING	LOG					She	ael _	. 2		ol	2		
							L								=
Foreman	.O				Boring	Loc	ation							:	
SWFWM	4D Eng	ineer			Groun	d Ele Nade	od ad	on			· Y	Vell Elev	allon		
		CASING									Gre	undwater	Reading:	:	==
Cina				_	SAMPLER				Date	D			at Stab		Time
Hammer	:		lb	. Type:	Oth	er:				-			 		
Fell:					10.					- -		- -	- 		
ļ				•			 ,			工					
E CAS	š.	· · ·	SAMPLE	1	CALIFIC DECORRATION			¥.	ខ្លួន	ပ္ပ	l	WELL	F	ELD:	છ
Ö /F1		PENJAEC		BLOWS / 6"				STR	3 86		INS	TALLATIO	N TE	STING	RMKS.
38.	_ _11	18/14	_38_5_40	48-38-36		Τ,					Π,	ormati			
		 			little Limestone fragme	nts	.	MA	RL.			nteria.			
	\bot				Bottom of boring at 40'		_				┢┵				
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REMARKS	S:									1					'
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										LOWS	ÆT.	DENSITY	BLOWS/F		нзпу
										9-4		V. LOOSE	<2		SOFT
									1.	L10		LOOSE	24 . 44 .		SOFT
									ı	10-38		IL DENSE	8-15		ner
					•				- 1	00-50	•	DENSE	15-70		STEF
									<u>ـــــــــــــــــــــــــــــــــــــ</u>	50		V. DENSE	>30	H	uno

Size:Hammer:_Fall:	CASING	SAMPLE C DEPTH 18.5-39	Type: Hammer Fall:	SAMPLER Other:	Date Date Vision Vision MARL 46'	Grou	Peadings: at Stabilizatio FIELD N TESTING
Fammer: Fall:	11 6/6 11 4/4 13 2/1	SAMPLE DEPTH 38.5-39 43.5-43.8	BLOWS / 6" 50 / 4"	SAMPLE DESCRIPTION Hard, grey-white, SILT & CLA low plasticity, some Limesto Fragments. MARL Similar to above	AT DESC.	WELL INSTALLATIO FYC We 30-65	al Stabilization FIELD TESTING
Fammer: Fall:	3	SAMPLE C DEPTH 18.5-39 43.5-43.8	BLOWS / 6" 50 / 4"	SAMPLE DESCRIPTION Hard, grey-white, SILT & CLA low plasticity, some Limesto Fragments. HARL Similar to above	AT DESC.	WELL INSTALLATION 6-incl PVC We	N FIELD TESTING
Fall: CAS. BL /FT. 38.5 60. 65. 70.	11 6/6 11 4/4 12 4/4	SAMPLE DEPTH 3.8.5-39	BLOWS / 6" 50 / 4"	SAMPLE DESCRIPTION Hard, grey-white, SILT & CLA low plasticity, some Limesto Fragments. MARL Similar to above	MARL 46'	Grou	N TESTING
日本 CAS、 BL /FT. 38.5	11 6/6 11 4/4 12 4/4	SAMPLE DEPTH 3.8.5-39	BLOWS / 6" 50 / 6" 50 / 4"	SAMPLE DESCRIPTION Hard, grey-white, SILT & CLA low plasticity, some Limesto Fragments. MARL Similar to above	MARL 46'	Grou	N TESTING
38.5 63.5 660 65	NO. PENJREC	DEPTH 3.8.5-39 43.5-43.8	50/6"	Hard, grey-white, SILT & CLA low plasticity, some Limesto Fragments. MARL Similar to above	MARL 46'	Grou	N TESTING
38.s 43.5 55. 60.	11 6/6	38.5-39 43.5-43.8 48.5-49.6	50/6"	Hard, grey-white, SILT & CLA low plasticity, some Limesto Fragments. MARL Similar to above	MARL 46'	Grou	111
55 60 70	13 2/1	43.5-43.8	50/4"	low plasticity, some Limesto Fragments. MARL Similar to above	MARL 46'		.11
55 60 70	13. 2/1	18.5-49.6		Fragments. MARL Similar to above	MARL 46'		.11
55 60 70	13. 2/1	18.5-49.6				Grau . 30-65	
55 60 70	13. 2/1	18.5-49.6				Grou	c
65			50/2"	Limestone fragment		Grou	c
65			50/2"	Limestone fragment		Grou . 30-65	c
65			50/2"	Limestone fragment		30-65	с .
65			50/2"	Limestone fragment		30-65	
65	14				;		
65	14						1
65	14						
65	14.					Silic:	
65	14				TAMPA	Sand	
65	14			·	LIMESTONE	-20-30	
65	14	-Ii		•	58	Silic Sand	a
65		+ 60'	WASH	I I mantana Guzat		Screen	
70				Limestone Cuttings		Interv	a1
70	 				İ		'
70	_ <u>i</u>						
	 						
				. ,		月丨	
					68'-		
	15	± 70¹	WASH	Limestone Cuttings			
	 	 		Bottom of boring at 70'		Sump	
-					ŀ		
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REMARKS:		of Tamps I	imestone i	le approvimentation de la contraction de la cont	· · · ·		
REMARKS:		of Tampa L	resistant	is approximately 46 feet below se and a grinding noise from 4 stalled at completion of boring	6 en 70 c	ce. Drillir	ng bit

\ \\	/ELL	. DF	ILLING	211112 1		Wellfields near Tampa.			1/10/8/		07620	<u> </u>
For	ing Co eman.		Georg	ican Drill ge DeGroot	ing, Inc.	Boring Locatio	lon _	27.84	<u> </u>	. Well Eleva	tlon31_5	
3,,,	FYYML	Zeng		ohn Watson		Date Started _	11/	9/88			d11/10	/88
Size	: <u></u>	d_ro	CASING	open hole		SAMPLER Split Spoon Other:		Date		Casing a		Ilon Time
Fall:				lb.	Fall:	140 lb.		<u> </u>	·			
ОЕРТН	CAS.		PEN <i>J</i> REC	SAMPLE	I	SAMPLE DESCRIPTION	ξ	동물편	<u>ي</u> اير	WEIT	FIELD	
1	/FT.	1	18/12		BLOWS / 6"	Loose, light brown, fine SAND	ST	ن ۳ ₀	<u> </u>	ISTALLATION	TESTIN	G ₹
						trace (+) Silt.						
3 _		2			-			Silty				
			18/10	3-4.5	4-8-8	Nedium dense, grey-brown, fin- SAND, little Silt, root		fine SAND				
					·	fibers.						
5 _		3	18/10	5-5-5	3	Stiff, grey-brown, CLAY & SILT	CL	AY 65				
				5.5-6.5	6-8	Medium dense, black-brown fine		J J.	뷥			
7			18/10		6.6.6	SAND, little Silt.						.
		•	10/10	7-8-5	6-6-6	Medium dense, dark brown, fine SAND, little (+) Silt.		Silty fine	'	Grout	: .	
10-						·		SAND				
10-		5	18/12	10-11.5	7-14-21	Dense, dark brown, fine SAND, little (+) Silt.						
												ļ
13.5		6	18/16	13.5-15	9-2-5	Walden and EE the land of the land	L		네			
						Medium stiff, black-brown, Silty CLAY, high plasticity.		Silty CLAY				
					,			CLAI				
18.5		7 A	18/12	18.5-19	15	Similar to above.	-	·	몍		1	
		7B		19-20	12-8	Medium dense, light brown, fine SAND, little (-) Silt.		Silty fine				
23.5		В_	18/12	23_5-25	9-8-5	Stiff, black-brown, mottled,	SI	Sand.				
						Silty CLAY and fine SAND, medium plasticity.	İ	.and ne SAt	11			
28.5					•	, , , , , , , , , , , , , , , , , , , ,			27			1
				·				VOID				
		9	4/6	11.5-31.8	50/4"	Hard, grey-white, SILT & CLAY,			5			
3.5		10_	6/6_	33.5-34	50/6"	low plasticity, some Limestone fragments. MARL. Similar to above.						
						Similar to above.		MARI	.			•
ł					•			. 38	.5'			2
REM	ARKS:		diame to fi Obser	ter steel	casing to id in the 3 inch ch	27 to 31.5 feet below land sur o 15 feet below land surface as borehole. unks of organic matter rising	nd a	dded	severs	l bags o	f stone	···
								Г	SRANUL	AR SOILS	COHESIV	E SOILS
								-	loy/s/ft,	DENSITY	BLOWS/FT.	DENSITY
•								4	-10	V. LOOSE	2-1	V. SOFT SOFT
								11	7 56	M. DENSE	4-4 8-15	M. STFF
					•			1)-50 50	DENSE V. DENSE	15J0 °	V. STIFF HARD
NO	TES:	1) Tì	ne stratific	cation lines re	present the	approximate boundary between soil types	and:	the tra	nsition i	nay be grad		

	WELI	V I	V V RILLIN	G LOG	Hydrogeol	toxic investigation of Cypress	She	et		of	1		<u> </u>
Во	ring Co	·	Amer	ican Dril	ling, Inc.	Wellfields near Tampa. Boring Local					P07620		
Fo SV	reman VFWMI) Eng	Geor Jneer_1	ge DeGroo ohn Watso	E	Ground Elev	ation	<u> 26.36</u>	\	Nell Ele	vation	31.19	3
			CASING			SAMPLER Date Staned	1 11-	16-88			ded <u>1</u> r Reading		38
	o:				_ Type:	Snlit Snoon Other	Ì	Dale	Depth	Casing	ed Sia	silizatlon	ı Time
Fal	mmer: .			1t	r. Hammer	: 140 lb.							
=	CAS.	ι		011515	- 1011-	JO INCH						-:	
DEPTH	BL /FT.	_	PENJREC	SAMPLE DEPTH	BLOWS/6	SAMPLE DESCRIPTION	TRIA		i INS	WELL TALLATIO	ON TE	IELD STING	AMKS.
1		1	18/4	1-2.5	1/12"-1	PEAT	- "	•	+	Τ	. -		 "
													
3 .			-	-	 		P .	EAT		-			
	-	2A 2B	18/16	3-3.5	12-25	Similar to above		3.	5 '				
				3.3-4.3	12-23	Dense, grey-brown, fine SAND, trace Silt.			7 /				
5.	-												
٠.		3	18/16	5-6.5	9-15-15	Similar to above			1 +	2-incl PVC W	1		1
				 						"		٠.	-
7						•.							
′ -		4	18/16	7-8-5	4-15-12	Medium dense, brown, fine							
	-					SAND, little Silt							İ
						•	Sil fir						
10-		5	18/12	10-11.5	9-9-7	Similar to above	SAN						
										—Grou	.		
3.5		6	18/12	13.5-15	2-4-6	Maddum danna tart t							
				23.3-13	2-4-0	Medium dense, dark brown, fine SAND, little (+) Silt.		÷.		30-65 S1116			1
				 		.•			,│├≒	- Sand	•		_
8.5		7	10/11					18	1	-20-30 S111d			
			18/16	18.5-20	4-5-6	Similar to above				Sand	-		
		\dashv								Screen			
3.5						Loose, brown, fine SAND,		23		Interv	al		
		8	24/18	23 5-25 25-25.5	1-1-3	little Silt.	ļ	25	尸	ump			2
		9	24/18			Black-brown, Silty CLAY, high plasticity.	l	lty	$\ \cdot\ $	вшр			
			24/10	25.5-27 27-27.5	3-4-8-15	Stiff, black-brown, Silty CLAY high plasticity.	Y CL	A.I	11,	Grout			
ŀ						Dark brown, Organic Matter			Ш				
ļ						Bottom of boring at 27.5							3
ŀ		-										ı	- 1
Ţ													
ŀ		-]				
F											,		
L REM	ARKS:	1.	Conduc	ted a fal	ling head	permeability test at 5 to 7 f			<u> </u>				
) bor	ehole :	2C and	at		
	•	3.	Obtain boreho	еч ж ващор.	West inst le for lab	alled at completion of the bo oratory permeameter testing a	oring. it 25.5	i to	27.5 £	eet in	1		.
					*			<u></u>	100 42 -				
				,				-	ANULAR S	DENSITY	COHE	IVE SOI	ILS .
٠.								04		LOOSE	<2	V. 5	OFT
							•	4-10		LOOSE	24 44	S M. Si	OFT TIFF
						*		10-70		DENSE	8-15	s	TEF
								20.50		DENSE	1530	V. 51	TIFF

HWRO

<u> </u>	VELL	DRI	LLING	LOG		Wellfields near Tampa.				2 P07620	·
	ing Co.		Ameri	lean Drill	ing, Inc.						
			Georg	ge DeGroot hn Watson		Ground Eleval	lon2	8.28	Well Elev	atlon31.9	
-				hn Watson		Date Started	11-1	1-88		od_11-14-8	38
۱	_		CASING			SAMPLER	6	ale 0	Groundwater epth Casing	Readings: at Stabilizati	lan Time
Size	nmor:	W_th	en Mud	i_Rotary ib.		Split Spoon Other:	<u> </u>				
Fall						lb. lb.	-				
=	CAS.	•		011505			<u>, L</u>				
DEPTH			EN./REC	SAMPLE		SAMPLE DESCRIPTION	STRIA CHG.	SE SE	WELL	FIELD	
-	/FI.				BLOWS/6		र द्व	' 6H	INSTALLATIO	N TESTIN	G Z
1		-	18/8	1-2.5	4-6-8	Medium dense, brown, fine SAND, little Silt.					
		-				• =====================================			.		
3					ļ	•			-6-inct	· 1	
!		2	18/8	3-4.5	7-11-11				PVC We	:11	
	 	-				fine SAND, little Silt.				j	-
5 ~		, -	18/16	5-6.5	6-7-10	Cinilan be about					
					0-7-10	Similar to above.	511	_{ty}			
٠.		- -				ŧ	fine	· 1	Grou	E	
7 _							SANI	, ,			
		4- -	18/10	7-8-5	8-6-7	Medium dense, brown, fine					
						SAND, little (+) Silt.					١.
								j			1
10-		5	18/12	10-11.5	9-19-15	Dense, brown, fine SAND,			30-65 Silic		2
		_ _				little Silt.			Sand	*	
								12'-	20-30		-
3.5		6 1		13 6 18					Silic Sand	2	
	\dashv	•	18/10	13.5-15	5-3-3	Loose, brown, fine SAND, · little Silt.			=		-
						••			Screen Interv		
						•		17-	튀		
8.5		7 _A	24/14	18.5-20	1-3-4	Medium stiff, black-brown		· 10.	Sump		3
		7 B		20 20 5		Silty CLAY; high plasticity		ł			4
		<u>'' .</u>		20-20.5	7	Dark brown, Organic Matter.	S11	у			
3.5							CLAY	(
l		8	18/12	_23_5_25	3-4-4	Medium stiff, black-brown, Silty CLAY, high plasticity.]			
		\bot				oute, and prasticity.				-	
							Ι,	28.5	Grout		
8.5		9]	18/10	28.5-30	3-8-7	Hedium dense, dark brown,					
ŀ	\dashv					fine SAND, little (+) Silt.	Silt fine				
ſ							SANE			1	
3.5		DA 2	24/16	33-5-34	2	Loose, light brown, fine					
. [SAND, little Silt.	5110	у 3/4		į	
ŀ		ЭВ		34-35	2-2	Medium Stiff, green-grey Silty, high plasticity.	CLAY	35'			
į	10)C		35-35.5	3	Medium stiff, grey-white, SILT	MARI	.			
REM	ARKS:					Emestone Hagments.			-	——————————————————————————————————————	ت
	1.	Cond	lucted	a falling	g head per	meability test at 18.5-20.5 fe	et in	boreh	ole 3A.		
	3.	Moni	tor w	ell 3A We	pie o may st was ins	be attected by gravel used in talled at completion of boring	the fa	lling	head test.		
	4.	Obta	ined :	a sample i	for labora	tory permeameter testing at 18	.5-20.	5 fee	t in boreho	ole 3A.	
								GRAI	IULAR SOILS	COHESIVE	SOILS .
							1	BLOWS	FT. DENSITY	BLOWS/FT.	DENSITY
•		,						0-4	Y. LOOSE	42 24	V. SOFT SOFT
								10-30	LOOSE M. DENSE	· ·	u. Stff
				,				"""	m. Lense	\$-IS	STEF

DENSE

Y. DENSE

15-30

V. STFF

нлю

			W N			PROJECT		Sheet 🗀	2	of 2		
Bori	ng Co.			L			ation_		ldge-Wi	lde Wells	field	
			neer			Date Stand				Date ended		
Siza			CASING		Type	SAMPLER Other:		Date		undwater Re Casing at		ı Tim•
Han	ımer: _			lb.	Hammer:	lb.						
Fall:					Fall:			-				
ОЕРТН	CAS. BL			SAMPLE		SAMPLE DESCRIPTION		SHTA Gen GEN	SNI INS	WELL TALLATION	FIELD TESTING	RMKS.
38.	/FT.		PENJAEC 18/10	DEPTH 38_5=40	BLOWS/6	Very stiff, grey-white, S	SILT		$\dashv \top$			=
						& CLAY, low plasticity, a Limestone fragements.	some	MARL		Grout		
-						Bottom of boring at 40'					,	
		-								•		
											1	
-		_				•				. :		
		<u> </u>					.			•		
-	_	二				•				-	1	
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	-	-		 								
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١.		二	<u> </u>						Ì		1	
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.	-	<u> </u>				1					4	
		F]			.			
		-										
'									.	,		
			<u> </u>				1		-			
		+-	 									
	-	1				1						
		1	-			1				•		
		\pm			<u> </u>							
RE	MARKS	3:										
								-				· :
		•			•	•		}	GRANUL BLOWS/FT.	AR SOILS DENSITY	COHESIVE BLOWS/FT.	SOILS
	•							Ì	P4	V. LOOSE	<2	V. SOFT SOFT
				•				.	410	foose	24 44 .	µ, STFF
		;						ļ	10-30 30-50	IL DENSE DENSE	8-15 15-30	SIFF V. SIFF
y 3 4	been been									Y. DENSE		нило
لِمُوَّا إِسْا ا	iores	: 1)	The strati	lication lines	ropresent the	approximale boundary belween sol	il typos	and the t	ransilion	may bo gra	dval.	

Y	S V VELL	V F	ILLING	MD GLOG	Hydrogeol	ogic investigation of Cypres	S	of Boring	1	of 2		<u> </u>
For	ing Co.		Geor	ican Drill ge DeGroot	ing, Inc.	Wellfields near Tampa. Boring Local Ground Elevi	on	Eldridg	e-Wi		eld	
SW	-WMU	Eng	lueer_T	ohn Watson		Date Started	10-	31-88		Date ended.	/11	_
Нап	ımer: _		CASING tary-of	en hole	Hammer	SAMPLER Split Space Other: 140 b. 30 inch		Date	G Depth	Casing at	adings: Slabilization	Tlme
	CAS.	- -				I VY ANCH						
ОЕРТН	BL /FT.	NO.	PENJREC	DEPTH	BLOWS / 6"	SAMPLE DESCRIPTION .	STRIK	CHO GEN ESC.	IN	WELL NOITALLATION	· FIELD TESTING	RIMKS.
1	-	_1_	18/10	1-2.5	6-7-9	Medium dense, brown, fine	╅		\top	•	7	۳
·						SAND, trace (+) Silt.		٠		1.		
3 _		2			<u> </u>							
			18/10	3-4.5	4-5-5	Medium dense, light brown, fine SAND, trace (+) Silt.						
					:	, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1, 1	1					
5 -		3	10/0	5 (5				٠				
			18/8_	5-6.5	2-2-1	Very loose, brown, fine SAND	•					
						· ·				Grout		
7		. 4	18/10	7-8.5	3-4-7	Modday days	s	ilty				
				-/-8-3		Medium dense, dark brown, fine SAND, little (+) Silt.	£	ine		10.1		
							S	AND				
10-		5	-18/10	10-11.5	5-6-8	Similar to above.						
						•	Į				•	
3.5		6	18/10	13.5-15	3-6-8	Similar to above.						
									†	-6-inch PVC Well		
8.5		7	18/8	18.5-20	6-16-28	Dense, dark brown, fine SAND						
			-			little (+) Silt.						
		-						•				
3.5		8	18/8	23 5-25	8-8-16	Medium dense, dark brown,						
}		_			·,	fine SAND, little (+) Silt.						
				·								
8.5		9	18/12	28.5-30	10-20-21	Dense, dark brown, fine SAND,						
ł		$\overline{\cdot}$	•			little (+) Silt.						
, [•						
3.5		10 A	18/18	3 3.5-34. 5	2-3	Medium stiff, mottled, brown CLAY & SILT with dark brown	-	33.5				ı
t		10B	······································	34.5-35	3	Silty CLAY, medium (+) plasti	dity.					
Į						Brown, CLAY & SILT, medium plasticity, little (-) Limest fragments.	one	HARL				
REM	ARKS:								<u></u>			
					•							
						•					•	.

GRANULA	AR SOILS	COHESI	E SOILS .
BLOWS/FT.	DENSITY	BLOWS/FT.	DENSITY
0-4	Y. LOOSE	42	Y. SOFT
410	LOOSE	2-1 4-11	SOFT NL STIFF
10-30	IL DENSE	8-15	STIFF
20-50	DENSE	1530	V. STFF
>50	. V. DENSE	>30	HARO

MICROFILMED

:

	ا او الا	5 V	V F	= VV I	VID	lydrogeolo	PHOJECT Action of Cypres	eport o	l Boring	Numt	oor1/	East_	
						Jomes in h	ellfields near Tampa.	Dat			FileP	7620	
							Boring Location						
	SW	FWMC	Eng	ineer			Ground Eleval Date Started	llon			Well Eleva Date endo	atlon ad	
				CASING			SAMPLER				roundwater	Readings:	
	Size Han	:			i_lb.	. Туре:	Other:		O'die	Очри	Casing a	a Stabiliz	ation Time
	Fail:				10.	Fell:	b.				-		
	Ħ	CAS.			SAMPLE	-		, 		T		4	
.	• ОЕРТН	/FT.	_	PEN/REC		BLOWS/6"		_1	GEN. SE	IN	WELL STALLATION	FIEI TEST	
ĺ	8.5		LLIA	18/6_	38: 5-39_5	WOH-3-3	Soft, green-grey, Silty CLAY, high plasticity.						
-			11B		39.5-40		Grey-white, CLAY & SILT,	1.					
4	3.4		12	18/16		7-4-5	little Limestone fragments, medium plasticity.	. ни	ARL				l
				20/10		7-4-3	Stiff, grey-white, CLAY & SILT,						
	- {				:		little Limestone fragments, medium plasticity.			1 †	6-inch PVC We		
4	8.=		12	18/16	/0 F F0		•		48.5	1			
				10/10	48.3-30	13-24-31	Hard, green, Silty CLAY, high (-) plasticity.						
	ł						o. · · · · · · · · · · · · · · · · · · ·	Si	1ty				
5	3-{		14	18/16				CL.	AY				
	Ì		- 14	10/10	33.3-33	14-18-16	Similar to above					1.	
	}								56.5	4	Grout	-	
5	8.4											ĺ.	
			_15	4/2	58.5-58.8	50/4"	Limestone fragments						
	}								•	П	30-65 Silic		
1	65									1 -	Sand	1	
	}		ᅴ		<u> </u>		•					'	
۱	F						· "· ',	TA	MPA 68.		20-30		
1	70							LIM	ESTONE		Silic: Sand	•	1
	-												
	ļ										Screen		İ
	75				± 75'	WASH	T-1				Interv		
	}						Limestone cuttings						
l	ļ								78'				
	80								`	Ħ			
	7						Bottom of boring at 80'.			14	J .		
	Ŀ				·		•				Sump		
	-		\neg				•						
	†												
	ł		\dashv										
Ì	F	\Box	_										
l	L REM	ARKS:		Top of	14	l		<u> </u>	•	<u></u>			
			••	respond	ied with r	: 15 appro esistance	ximately 56.5 feet below land and a grinding noise from 56.	surfa 5 to	ace.	Drill	ing bit	 	
			۷.	nonitor	well lA	East inst	alled at completion of boring.		16	DE	.zo# 120	u suriac	.e.
												1	
									ļ ———		R SOILS		VE SOILS .
					•				-	rs/ft.	DENSITY	BLOWS/FT.	DENSITY V. SOFT
									4-10		V. LOOSE	2-4	SOFT
					:				10-70		M. DENSE	44 . 1-15	M, STIFF STIFF
1									30.50		DENSE	15-30	V, STFF

V. DENSE

HARD

	1	ک (د) انتار	VF	= VV	IVI D	Hydrogeo]	PHOJECT Logic Investigation of Cypres	noqof	ol Baring	Numb	or	A Eact		
}					G LOG	Swamps in	Wellfields ness Tames		1000			P07620		<u>:</u>
, ,					0	ling, Inc.		on_E	ldridge	-W11	de Well	field		
-	- A	-WME) Eng	ineerı	ohn Wateo	·	Ground Eleve Date Started	11-	21-88		Well Elev Date end	ration led11-	22-88	_
	170			CASING			SAMPLER		Date	Gr Depth	Casing	Readings:	izalion	Time
	lam	mer: .			it	- ·,,,,	Sp11r Spoon Other:							
-	_			·	· ·	_ Fall:	30 inch							
. {	מביומ	CAS. BL	_		SAMPLE			.≼.	i		MEIT	- FII	CI D	16
-	,	/FT.		PEN_REC		BLOWS/6"		STR	SEN. SEC.	าหร	DITALLATIO	N TES	TING	RMKS.
				-	1-2.5	1/10	PEAT, fibrous.				1	•		
	Ē								•		.			
	1		2	18/0	3-4.5	WOH/18"								
	ļ											İ		1.
5	1		_					P	EAT					
	ŀ		_3_	18/16	5-6.5	WOH/18"	Similar to Above.							2.
	-												:	
7	+			10/10										
	ļ			18/12	7-8.5	1/18"	Similar to above.							
			_			<u> </u>	·							
1	0-		5 A	18/12	10-11.1	1/18"	Similar to above.							
	E		5 B		11.1-11.5			-		1	2-inch PVC We			
.	+						Very soft, black-brown, Silt CLAY, organic, high (-) plastic	y S iry	ilty					3.
	•		6 A	18/16	13.5-15	1/18"	Similar to above	C	LAY			·		
				<u> </u>			• •							
1.8	<u>-</u>				<u> </u>		•		10.51					2.
	_		7	18/10	18.5-20	1-4-4	Loose, grey-brown, fine SAND, little (+) Silt.	,	18.5' Silty	-	Grout			- '
							11111 (4) 2111.		fine SAND			<u> </u>		1
k 3.	. \$								23_5!.					
			B	18/16	_23_5_25	WOH-1-1	Very soft, black-brown, Silty CLAY, organic, high		ilty					
							plasticity.		CLAY					
28.	+	_	9	18/16	28.5-30	1/12"-1	Cimilan by I				30-65			
					30.5-31.5		Similar to above. Similar to above				Silica Sand	`		
33.	F				31.5-32.5	WOH/12" 3-4	Loose, grey-brown, fine SAND.		31.5' Silty		20-30 -S111ca			3.
[].	F						little Silt.	1 1	Eine SAND		Sand Screen			4.
							Buttom of boring at 35'.	 	-mw	+	Interv		·	
	E		士							Sump				
RE	MAI	RKS:	1.	No reco	very with	in split :	spoon sampler.	.L		<u> </u>				
			2.	Conduct surface	ed a fall i in boreh	ing head i	permeability test at 5 to 7 fe							.
			3.	Obtaine	d a sampl	e for lab	oratory permeameter testing at feet in borehole 2A.	11.5	to 13	.5 fe	et in l	orehole		
			4. 1	Monitor	well 2A	East was	teet in borehole 2A. installed.at completion of the	bori	ng GRA	NULAR	SOILS	COHES	VE SO	LS .
						•			BLOWS	FT.	DENSITY	BLOWS/FT.		YIIZI
				•					0-1 4-10		V. LOOSE	<2 2-1	. V. S	OFT
									10-38	1	M. DENSE	44 1-15	M. 51	
<u>_</u>					•		•		30.50 > 50		DENSE V. DENSE	15J0 . >J0	¥. 51	
N	οτι	ES: 1	The	stratific	ation lines rep	oresent the a	pproximate boundary between soll types	and th				lual.	H	V10

ize:: ammer	n	Amer		DOMES III	logic Investigation of Cypres	n-				. ol	20766			
oremai WFWA	n	Cane	TOWN DETT	ling, Inc.	Wellfields near Tampa.						P0762			
ize:: ammer	ND SI		0- 200200	•	Boring Localid	oni ation	1dr1 35.	dge: 85	. W1	lde Well	lfiel	d 39	57	
		gineer	ohn Watso	a	Date Started	11-	-3-88		_	Date end	led 1	-4-88	3	
		CASING			SAMPLER		Date	Der	Gro	Casing	Readi	eadings:		
	HW_ +1	en Mud	Rotary lb	_ Type: <u>·</u>	Split Spoon Other:		Date		Depth Casin		Jai Stablizan		on i	
ـــــ:الـ		· · · · · · · · · · · · · · · · · · ·). Hammei	: 140 lb.	-								
1 24		·		-							士			
CAS BL /FI			SAMPLE	·	SAMPLE DESCRIPTION	یځ⊹	i pai	إز		WELL	1.	FIELD		
/FI	1. NO	PEN_AEC		BLOWS/6			ម្រ	5	INS	TALLATIC	N	TESTIN	G	
		18/12	1-2.5	3-4-5	Loose, brown, fine SAND, trac Silt, root fibers.	-			T		T			
-				-	- Inde libers.	1				1.				
				 	·									
 	2	18/10	3-4.5	4-9-10	Medium dense, light brown,		•						•	
			 	:	fine SAND, trace Silt.	.								
									1		İ	'		
┝	3	18/12	5-6.5	3-4-6	Similar to above.						-	1		
					diminal to above.									
<u> </u>	╌	 		ļ					┼-	6-incl	a			
						Ι.				PVC We	:11			
 		18/12	7-8-5	3-3-3	Loose, dark brown, fine SAND,									
	二				little (+) Silt.									
].		ł						
	5	18/10	10-11.5	2-2-4	Similar to above.		lty					r		
 	-			<u> </u>		fir SAN					'			
												•		
	6	18/10	13.5-15	2 / 6		'		1	_	Grout	ا ۽			
			13.5-13	2-4-5	Similar to above.									
 	-				*:		•	١.						
					·							٠,		
	7	18/6	18.5-20	1-2-4	Similar to above.									
	1-				•-					`		,		
	Ţ.,						٠.			30-65 Silic	- 1		- 1	
	8	18/10	23_5-25							Sand			-	
		20/10		4 - 1	Medium dense, brown, fine SAND little Silt.	'	25	ıL	H	-20-30			1	
	+				Table Value					Silica	.			
					•	ļ				Sand				
5	9	18/0	28.5-30	<u> </u>			20	Ē		Screen				
		18/0	30-31.5				30	툿	1	Interv	al		١	
	-				•			Г	7	Sump				
	9	18/16	33.5-35	1-2-2	Soft, mottled, grey-brown CLAY	 	33.5	-			1			
	-				& SILT with white-grev. CLAY A			-		ntonite			1	
	10	24/10	35-37	WOH-1-2-2	SILT, medium plasticity, little Limestone Fragments.	MA	RL		Ho.	le Plug	5			
					Similar to above. Dermeability test at 13.5 to 17	Ι.								

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SWFWMD					PROJECT			Report of Boring Number 3A East							
N	'ELL	DF	ILLING	LOG			1	Shee Date	et 9	2 of File	2				
Bori	ng Co				cation	Date File									
Por	ıman.					Ground E	levatio	on		Well Ele	vation				
			CASING				100			Date en	ded				
Size	:		•		Tvoo:	SAMPLER Other:		Oate D	epth Casing	at Stabi	ization	Time			
Han	mer:			It). Hammer	:lb.		·Ŀ				·			
<u> </u>	Fall:Fall:														
ОЕРТН	CAS. BL	<u> </u>	PENJREC	SAMPLE		CAMBLE DECOGRATION		ن≥خ	ಕತ್ತಣ್ಣ	WELL		ELD	si		
38.5					BLOWS/6*				GEN. DESC.	WELL INSTALLATION	ON TES	TING	HMKS.		
06.5			18/6	38.5-40	1-2-2	Soft, white-grey, CLAY & S medium plasticity, little	ILT,								
					-	Limescone Fragments.		MAR	L						
45-		12	21/22		-	,	ŀ		<i>(</i> = 1						
		12	. 24/10	45-46.5	WOH/18	Very loose, brown, fine SA	ND,	fine	45 SAND	Formati Materia			ĺ		
				46.5-47	10		.		46.5	1					
-						Grey-white CLAY & SILT, so Limestone fragments, mediu	me	MAR	L			:			
						plasticity.	_					•			
						Bottom of Boring at 47'	-			- J⋅	.				
4															
						•									
4											-		i		
ŀ											ŀ				
-						•				•	İ				
						•	İ								
							.		İ						
}	\dashv	\dashv				•			ļ						
ļ									l						
-		\dashv									l				
Ţ															
E										•					
-		\dashv							1	•					
t						•									
ŀ		\dashv	<u></u>						1						
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REPORT NAME

GEOPHYS.INVEST.OF CYPRESS DOME

AUTHOR

STEWART/STEDGE 1-90

KEY WORD

WEST CENTRAL FL.

BASIN

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Report belongs in **Storage Box** 11831