Hydrogeologic Study to Quantify Fresh Groundwater Input Into Phosphogypsum Stack System

Piney Point Phosphates, Inc. Facility
Manatee County, Florida

File Number: 02-13-099

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Louis J. Timchak, Jr., Receiver
18810 Place Antibes
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Subject: Hydrogeologic Study to Quantify Fresh Groundwater Seepage Into Phosphogypsum Stack System, Piney Point Phosphates, Inc. Facility, Manatee County, Florida

Dear Mr. Timchak:

As authorized, Ardaman & Associates, Inc., (Ardaman) performed a study to assess the hydrogeology of the surficial aquifer in proximity of the perimeter below-grade seepage ditches, sumps, and collection drains of the Piney Point Phosphates, Inc. phosphogypsum stack system in Manatee County, Florida. The primary objective of the study was to confirm the extent to which fresh groundwater is being collected in the perimeter seepage ditches, drains and sumps, and to estimate the average rate at which fresh groundwater seepage collection is contributing to the positive water balance of the phosphogypsum stack system.

The study included: (i) reviewing pertinent data from prior test borings, monitor and test wells, aerial photographs and topographic surveys, and prior hydrogeologic reports; (ii) conducting a field exploration program including additional soil borings, piezometer installations and field permeability testing; (iii) conducting limited laboratory index testing to aid in soil sample classification; (iv) developing stratigraphic profiles representing conditions around the perimeter of the phosphogypsum stack system; (v) modeling of piezometric levels and corresponding local and regional flow directions and gradients within the surficial aquifer; and (vi) estimating the rate of fresh groundwater seepage into the process water system.

Results of the hydrogeologic study confirmed that there is a significant year-round contribution of fresh groundwater seepage to the process water balance of the Piney Point phosphogypsum stack system (as had been expected, considering that water levels in the process water seepage collection system are intentionally maintained below the prevailing natural water table levels to minimize surficial aquifer impacts).

The data indicate that the direction of flow of the surficial aquifer system is generally west-northwest, but is locally influenced by the presence and operation of the perimeter seepage ditches, i.e., the east seepage collection ditch and sump, the northeast seepage collection ditch and sump, and the continuous dewatering of Basin No. 2.

Considering the anticipated range in prevailing groundwater levels in the surficial aquifer, which fluctuate due to season rainfall conditions, it is estimated that the fresh groundwater seepage flow into the phosphogypsum stack system ranges from about 100 gallons per minute (during the peak dry season) to approximately 215 gallons per minute (during the peak wet season) with an overall annual average seepage inflow rate of about 145 gallons per minute. These rates include an estimated contribution of 15 gallons per minute of treated water that is "lost" (i.e., re-circulated back into the process water system) while en-route to Outfall 001 via seepage from the Buckeye Road drainage ditch into the adjacent south toe ditch of the South Cooling Pond. Moreover, since activation of the new aeration ponds in the area between the Old Gypsum Stack and the South Cooling Pond, an additional 12 gallons per minute of treated water is currently being lost to seepage into adjacent process water ditches. The new aeration ponds, on the other hand, have occluded an approximately 5.2-acre area from the watershed of the process system, with a corresponding 6 gallons per minute reduction in net rainfall (less evapotranspiration) input to the water balance of the process system. Hence, the new aeration ponds are contributing a net of 6 gallons per minute (i.e., 12 gal/min minus 6 gal/min) to the process water system. The total net average groundwater seepage input is, therefore, estimated at about 151 gallons per minute.

In addition to groundwater seepage, two (2) point source locations were identified where fresh stormwater runoff enters the process water system adding approximately 10 gallons per minute of fresh water to the system during 5 months of the year (i.e., during the rainy season), which is equivalent to a contribution of about 4 gallons per minute year round. Hence, the overall average annual fresh water flow rate into the seepage collection system is estimated to be 155 gallons per minute, which amounts to nearly 0.22 MGD or 81.5 million gallons per year.

Based on these findings, it is our opinion that installation of a perimeter soil-bentonite admix cut-off wall on the outboard side of the seepage ditch system would significantly improve the phosphogypsum stack system water balance. A 20 to 25-foot deep cut-off wall installed around the approximately 17,500 lineal foot perimeter of the seepage collection system (excluding ditches adjacent to the new aeration pond) would virtually eliminate fresh groundwater seepage into the process water system. It is estimated that the cost of installing such a cut-off wall would be on the order of 1.2 million dollars. Alternatively, the extent of the cut-off wall could be reduced to about 13,000 lineal feet by limiting the alignment to the north, east and south sides of the phosphogypsum stack system and by excluding less critical portions of the seepage collection system perimeter (i.e., the north and west sides of the south cooling pond, and west side of the north cooling pond), which could reduce the installation cost to about 0.9 million dollars while still achieving up to 86 percent reduction in fresh groundwater seepage inflow into the system.

Site Setting

The former Piney Point Phosphates, Inc., plant complex is located east of U.S. Highway 41 and north of Buckeye Road, approximately 9.3 miles north-northeast of Bradenton, Manatee County, Florida. The phosphogypsum (gypsum) stack system is located on unmined natural ground east and south of the idled chemical plant within portions of Section 5, 6, 7 and 8, Township 33 South, Range 18 East in northwest Manatee County.

Lands to the east and north are seasonally farmed. Lands to the south include citrus groves and a sand mine. The western side of the plant area is bounded by U.S. Highway 41. The land surfaces on the east and southeastern sides rise gently to a plateau ranging form 25 to 30 feet above sea level. Lands to the northwest and southwest of the plant area drop gently to elevations of 8 to 15 feet above sea level.

History of Gypsum Stack System

The original 120-acre gypsum stack starter system (i.e., the Old Gypsum Stack), the North Cooling Pond and two South Cooling Pond compartments were constructed in 1966, and the chemical plant began operation during the latter part of that year. The original gypsum stack was expanded laterally in northward and eastward directions in 1979-1980, forming the north and south compartments of the New Gypsum Stack. It is believed that the existing "engineered" perimeter and interior below-grade ditches, sumps, and drains were constructed in their final form and alignment during the stack expansion construction program in 1979 and 1980. The open channel perimeter ditches were intentionally constructed with invert elevations below ambient groundwater table elevations in order to impose slight inward hydraulic gradients to preclude lateral outward seepage of process water and gypsum stack pore water from the ditches into the surficial aquifer system. Consequently, some fresh groundwater is collected in the process water system under design operating conditions.

Field Exploration Program

A field exploration program, including thirteen (13) Standard Penetration Test (SPT) borings and eight (8) Mechanical Auger (MA) borings, was undertaken in November 2002 to obtain specific information regarding the engineering properties and thickness of the transmissive part of the surficial aquifer system. Soil samples were collected at selected depths from each boring for laboratory index testing and visual classification. A temporary piezometer was installed at each of the thirteen test boring locations to monitor water table levels in the surficial aquifer system. Water levels in twelve (12) historical surficial aquifer test and monitor wells were also monitored.

The soil boring and piezometer locations are shown, along with locations of historical monitor and test wells used in this study, on Figure 1.

Soil Boring Results

In November 2003, thirteen (13) Standard Penetration Test (SPT) borings were drilled in general accordance with ASTM D 1586 (see Appendix I). Additionally, eight (8) Mechanical Auger (MA) borings were performed. A representative portion of each recovered SPT sample was classified in our laboratory. Laboratory index tests, including moisture content and fines content (i.e., percent of soil by dry weight passing the U.S. No. 200 sieve) determinations were performed and used to aid in soil classification. The generalized soil profiles presented on Figures 2 through 7 were developed by the project engineering staff, after reviewing both the driller's logs and laboratory classification test results, and after visually examining the collected soil samples.

The subsurface soil conditions encountered at the test boring locations include near-surface sequences of loose to dense, variably cemented, silica fine to silty fine sands of Recent and Holocene Epoch terraces. The variably-thick near-surface sands are underlain by phosphatic silty sands and clayey sands. For this study, the clayey soils that underlie the upper surficial sands were assumed to be the lower boundary of the transmissive zone of the surficial aquifer system. The lower boundary of the transmissive part of the surficial aquifer was found to range from about elevation +8.5 feet, NGVD to -19.5 feet, NGVD. The saturated thickness of the transmissive zone of the aquifer was estimated to range from 6 to 25 feet.

Temporary Piezometers and Auger Borings

In November 2003, thirteen (13) temporary hydraulic piezometers were installed by Ardaman at selected study sections around the perimeter of the seepage collection system to determine and monitor the total head in the transmissive part of the surficial aquifer. The hydraulic piezometers consist of PVC standpipes connected to a variable length of collection tube (slotted PVC) embedded in a coarse graded filter sand pack. The collection zone is isolated in its borehole by a

2-foot length of neat cement slurry backfill. Piezometer as-built construction details are contained in the soil boring profiles in Figures 3 through 5, as well as in Table 1. The water levels in the auger boreholes (see Figures 6 and 7) were measured inside of a short section of slotted PVC standpipe placed in each auger boring.

Piezometric levels were read in the temporary piezometers and selected existing monitor and test wells by Ardaman at different times. Temporary piezometers, auger boreholes, and selected monitor and test wells were all read on November 23, 2002, except as noted. The water level readings were determined by lowering an electronic sounding device inside the standpipe and measuring the distance from the measuring point (top of standpipe) to the water level in the standpipe. The water level was recorded, and the water elevation head determined, by subtracting the depth of the water from the altitude of the top of the standpipe. The elevations of the top of the temporary piezometer and auger boring standpipes were estimated by adding the amount of standpipe length above the ground surface to the interpreted elevation of the ground surface (based on the Rooks topographic survey). The recorded water level data for piezometer and auger holes are presented in Table 1.

Monitor and Test Wells

Ten (10) historical surficial aquifer monitor wells (MW-prefix), seven (7) FSU test wells, and one (1) USGS test well were used in the water level study. The monitor and test well labels and as-built information are shown in Table 2. In the case of the test and monitor wells with prefix FSU, USGS, and MW, the altitude of the top of the standpipe was previously determined and reported by a surveyor. The recorded water level data for monitor and test wells are presented in Table 2.

Variable Head Permeability Testing

Thirteen (13) temporary piezometers, eight (8) MW monitor wells, three (3) FSU wells, and one (1) USGS test well were selected for variable (rising) head field permeability testing. A small electric submersible pump was lowered to the bottom of the well casing or piezometer standpipe and operated to remove any accumulated sediment. After the pumped water stream was clear, the pump was removed quickly. The water level at the initiation of recovery (time = 0) of the water level was measured with an electronic sounding device. Thereafter, the recovering water level was recorded in time intervals until a pre-selected cumulative time was reached, or near equilibrium water table conditions were reached. The analyses of field permeability were performed using the U.S. Department of Navy, Naval Facilities Engineering Command Manual (1974), or Hvorslev method, considering that the piezometers and wells were installed in isotropic soils. Where applicable, effective collection zone shape factors were used to account for unsaturated portions of collection zones above the equilibrium groundwater level.

Results of the variable head field permeability tests are summarized in Table 3, and are presented on Figures 3 through 5. Horizontal coefficients of permeability computed from results of tests performed in the thirteen (13) new piezometers ranged from 0.56 to 8.18 feet per day, with an overall average of 2.8 feet per day. Permeability values computed from results of tests performed in the twelve (12) monitor and test wells ranged from 0.3 to 5.4 feet per day, with an average permeability of 2.8 feet per day. When results for wells and piezometers having collection zones in deeper clayey strata are excluded (i.e., MW-1, USGS-9, P-112 and P-113), the overall average from all tests in the sandy surficial soils is approximately 3.0 feet per day.

Stratigraphic Profiles

A series of twelve (12) stratigraphic profiles were constructed using the September 2002 Rooks aerial topographic survey and the soil boring data. The locations of the profiles are shown in Figure 1. The geometric and stratigraphic profiles are presented in Figures 8 through 19, and are briefly described below.

<u>South Cooling Pond - South Side</u>

One (1) SPT boring (TH-104) was performed and one (1) temporary piezometer (PZ-104) was installed on the inside edge of the berm situated between the existing seepage collection seepage ditch and the Buckeye Road drainage ditch as illustrated on Figure 8. The estimated water level elevation in the seepage collection ditch was observed to be just slightly above the ditch bottom during the study period (i.e., at Elevation +3.4 feet, NGVD). The water level elevation in piezometer PZ-104 measured on November 23, 2002, was +3.75 feet, NGVD. These data confirm that fresh water in the Buckeye Road drainage ditch, which has an invert elevation about 5 feet higher than the seepage ditch, seeps into the seepage collection ditch. (The Buckeye Road drainage ditch is presently being used to convey treated water westward to Outfall 001.)

<u>South Cooling Pond - West Side</u>

Two (2) SPT borings (TH-102 and TH-103) and one auger boring (AB-1) were performed and two (2) piezometers (PZ-102 and PZ-103) were installed adjacent to the west wall of the South Cooling Pond, as shown on Figures 9 and 10. Piezometer PZ-103 is located on the berm between Basin No. 2 and the seepage ditch that parallels the west earthen dike of the south compartment. During the study period, Basin No. 2 was kept dewatered by intermittent pumping from ditches excavated to invert elevations of about 0 to +1 feet, NGVD, along each side of the basin bottom. The estimated water level in the South Cooling Pond west seepage ditch was +3.4 feet, NGVD. The water level elevation in piezometer PZ-103 measured on November 23, 2002 was +2.1 feet, NGVD, confirming a positive seepage gradient from the seepage ditch into the dewatered Basin No. 2. The water level elevation in auger boring AB-1 measured on November 23, 2002 was +1.6 feet, NGVD, slightly above the pumped water level elevation in the Basin No. 2 dewatering ditch. Therefore, a positive seepage gradient exists from the fresh water ditch eastward into the Basin No. 2 dewatering system.

Similar seepage conditions were encountered along the west wall of the South Cooling Pond north compartment (i.e., at piezometer PZ-102).

<u>South Cooling Pond - North Side</u>

On the north side of the South Cooling Pond, Figure 11 illustrates a detailed cross-section and stratigraphic profile at the location of boring TH-101 and piezometer PZ-101, and MW-4A. During the study period, it was estimated that the water level in the seepage collection ditch was kept near the ditch bottom, i.e., elevation 3.4 feet, NGVD by the seepage pumps. The adjacent fresh water drainage ditch usually contains a shallow depth of water. A head difference is demonstrated from PZ-101 to the seepage collection ditch as indicated by a recorded level of elevation 4.0 feet, NGVD in the piezometer. There also exists a head difference from MW-4A (elevation 5.82 feet, NGVD) to PZ-101 The section demonstrates the direction of flow of fresh groundwater from the north into the seepage ditch.

Old South Gypsum Stack - South Wall

Along the south wall of the Old South Gypsum Stack, the stratigraphic profile and geometric details (boring TH-105 and piezometer PZ-105) are illustrated in Figure 12. The seepage collection ditch had very little standing water (estimated at elevation 11.2 feet, NGVD) at the time of the study. A gradient resulting from a total head at PZ-105 of 12.9 feet, NGVD, toward the seepage ditch, drives fresh groundwater into the ditch.

New South Gypsum Stack - South Side

The stratigraphic profile and geometric section at boring TH-106 and piezometer PZ-106, and auger boring AB-2 are illustrated in Figure 13. Along this section, a perforated drain buried under the outside gypsum dike embankment is used to control gypsum stack pore water seepage. On November 23, 2002, the total head in PZ-106 was 24.9 feet, NGVD, or approximately 2.9 feet higher than the invert of the drain, i.e., 22 feet, NGVD. A gradient resulting from a total head at PZ-106 at elevation 24.9 feet, NGVD drives fresh water into the covered perforated pipe drain. There also is present a groundwater mound between AB-2 and the covered drain as demonstrated by the water level elevation of 24.7 feet, NGVD, in AB-2. Groundwater also flows westward toward the open seepage collection ditch, and southward toward the Buckeye Road right-of-way.

New South Gypsum Stack - East Side

Along the east wall of the New South Gypsum Stack, Figure 14 presents the stratigraphic profile and geometry of the system in proximity of boring TH-10, piezometer PZ-107, and well MW-11. The total head at piezometer PZ-107 was elevation 24.1 feet, NGVD, and at MW-11, elevation 24.7 feet, NGVD. It is estimated that the water level in the seepage ditch was elevation 21 feet, NGVD. A westward gradient resulting from a total head in the surficial aquifer that is higher than the ditch invert forces fresh groundwater flow into the seepage ditch.

Along the east wall of the New South Gypsum Stack, Figure 15 presents the stratigraphic profile and geometry of the system in proximity of boring TH-108, piezometer PZ-108 and well MW-10A. The total head at piezometer PZ-108 was elevation 22.8 feet, NGVD, and at MW-10A, elevation 23 feet, NGVD. It is estimated that the water level in the ditch was elevation 21 feet, NGVD. The resulting gradient forces fresh groundwater flow westward into the seepage ditch.

New North Gypsum Stack - North Side

Along the north wall at boring location TH-109, piezometer PZ-109, and auger borings AB-7 and AB-6, the stratigraphic profile and geometric section are presented in Figure 16. The total head in PZ-109 was elevation 23.0 feet, NGVD on November 23, 2002. Auger boring AB-7, near the property line demonstrated a water level at elevation 23.1 feet, NGVD, and auger boring AB-6 (near the ditch) demonstrated a water level at elevation 22.5 feet, NGVD. The ditch invert was estimated at elevation 19 feet, NGVD. The resulting gradient forces fresh groundwater flow southward into the seepage ditch.

Along the north wall at boring location TH-110 and piezometer PZ-110, and well MW-9, the stratigraphic profile and geometric section are presented in Figure 17. The total head in PZ-110 was elevation 18.0 feet, NGVD on November 23, 2002. Well MW-9, near the property line demonstrated a water level at about elevation 19.0 feet, NGVD. The ditch invert was estimated at elevation 17 feet, NGVD. The resulting gradient forces fresh groundwater southward into the seepage ditch.

North Cooling Pond - North Side

The stratigraphic conditions and geometric section at boring TH-111 and piezometer PZ-111 are illustrated in Figure 18. The total head in piezometer PZ-111 was elevation 17.0 feet, NGVD on November 23, 2002. The water level in the seepage ditch was estimated at elevation 10.2 feet, NGVD, thus indicating southward flow of groundwater into the seepage ditch.

North Cooling Pond - West Side

A stratigraphic profile and geometric section representing the west wall of the North Cooling Pond at boring TH-112 and piezometer PZ-112 are presented in Figure 19. The total head in PZ-112 was elevation 13.0 feet, NGVD on November 23, 2002. The water level in the seepage ditch was estimated at elevation 10.2 feet, NGVD, thus indicating an eastward flow of groundwater into the seepage ditch.

New Aeration Ponds

New aeration ponds have been constructed in the area between the Old Gypsum Stack and the South Cooling Pond to increase the ammonia removal capacity of the double-lime process water treatment air-stripping system. The soil profile encountered in this area at test boring TH-113 is shown on Figure 5. The water level elevation in the corresponding piezometer PZ-112 was 11.3 feet, NGVD on November 23, 2002, which is just slightly above the water level in the process water seepage ditches around the west, south and east perimeter of the area. The operating water level for the new aeration ponds is reportedly elevation 13 feet, NGVD. Thus, additional fresh (i.e., treated) water seepage into the process water system will result from operation of the new aeration ponds.

Water Table Contours

Groundwater level elevation contours for the surficial aquifer were developed based on piezometric levels recorded in the thirteen (13) temporary piezometers and twelve (12) monitor and test wells on November 23, 2002. Further, the invert elevations of the engineered ditches and drains that were interpreted from the historical Rooks topographic survey map were entered into the data base. In order to assist in interpreting water table levels offsite, we used information historically gathered during a study of the borrow pit water levels on the south side of Buckeye Road. Moreover, we considered field observations on adjacent lands made during the study period, e.g., the water levels in ponds and ditches around the site, and the surface conditions in wetlands and ditches adjacent to the site.

The water table contour map was developed using a Windows®-based contouring grid and surface mapping software package called Surfer®. The locations of piezometers, test and monitor wells, and other points were inserted onto the master site map using the Florida State Plane Coordinate System as shown on Figure 20. Each boring, piezometer, and monitor well was mapped using a hand-held GPS receiver. The locations of other onsite and offsite grid points were digitized and added to the site map. The elevation of the water levels in each piezometer, test well, and auger borings read on November 23, 2002 was also recorded on the site map. The offsite grid point locations and their respective water levels interpreted from topographic maps and field observations were also inputted on the site map. All compiled data points and respective recorded and interpreted water level elevations are presented on Figure 20.

The Surfer® grid method allowed the production of a prevailing water table contour map using the randomly distributed data points. The water levels in ditches and sumps were assumed to be consistently drawn down by efficient operation of the pumps at all times, and it was assumed that Basin No. 2 would be kept drained down to elevation 1 foot, NGVD by a sump pump. The water table contour map produced from the hydraulic head data collected on November 23, 2002 is presented in Figure 21. Note that the water table contour map shown in Figure 21 reflects conditions at the beginning of the dry season. It is also worth noting that cumulative rainfall recorded at Piney Point through November 23, 2002 was 3 inches below year-to-date normal rainfall. Therefore, the groundwater table is subject to be higher during the wet season, as well as being lower during the peak of the dry season, than the water table indicated on the map.

Groundwater Flow

The regional and local flow patterns of the surficial aquifer are demonstrated by the directional arrows shown in Figure 21. The gradient is defined as the difference in hydraulic head between the equal total head contour lines divided by the distance between the contours. The aquifer's horizontal flow rate is governed by the horizontal hydraulic conductivity (permeability) and the saturated thickness of the transmissive zone. The flow quantity per unit length perpendicular to the flow direction is governed by the hydraulic gradient and the transmissivity, i.e., the saturated thickness of the aquifer unit multiplied by the average horizontal hydraulic conductivity or coefficient of permeability.

Groundwater Seepage

Due to the complexities of the geometry of the ditch and drain system along its total length of 17,500 feet, i.e., that portion predisposed to collecting fresh groundwater, a simplified mathematical spreadsheet model was used to quantify fresh groundwater seepage using the water table map, the estimated invert elevations of the ditches, and the transmissivity of the surficial aquifer. Once the base model was established for the (November 23, 2002) "dry season" condition, simulations of groundwater flow quantity during the peaks of the dry and wet season, and periods in-between, were modeled by varying the hydraulic heads.

The basic flow per unit length perpendicular to the horizontal flow direction of the surficial aquifer was calculated using Dupuit's assumption, by setting the lower boundary of the transmissive zone at the interface of the sandy and clayey soils. The 17,500 lineal feet of ditches and drains were divided into five basic ditch segments (labeled A-E) ranging from 1,940 to 5,360 feet, as shown in Figure 22. The five segments were subdivided into smaller reaches ranging in length from 131 to 1,160 feet, as shown in Figure 22. An average hydraulic conductivity and aquifer thickness value were assigned to each reach. The gradient was averaged over each reach, i.e., the difference between the total hydraulic head level at a selected point and the water level in the ditch or drain. The estimated groundwater flow into the part of the ditch system exposed to fresh groundwater, based on the November 23, 2003 water table map is 144 gal/min.

In order to determine the average annual contribution of fresh groundwater to the system, we simulated flow into the ditch, on a monthly basis, assuming that the water table would rise and fall during the wetter and dryer parts of the year. Therefore, we assumed that December, January, February, and March would have a water table 0.5 feet lower than the November (base case) water table; April and May would have a water table 1.0 feet lower than the base case water table; June and July and October would have a water table 0.5 higher than the base case, and August and September would have a water table 1.0 and 1.5 feet higher, respectively, than the base case. Considering the above assumptions, the April-May (peak dry season) groundwater seepage is estimated to be 100 gal/min, and the September (peak wet season) seepage quantity is estimated to be 215 gal/min. The overall average annual seepage is estimated to be 145 gal/min. Moreover, since activation of the new aeration ponds in the area between the Old Gypsum Stack and the South Cooling Pond, an additional 12 gal/min of treated water is currently being lost as seepage input into adjacent process water ditches. The new aeration ponds, on the other hand, have occluded an approximately 5.2-acre area from the watershed of the process system, with a corresponding 6 gal/min reduction in net rainfall (less evapotranspiration) input to the water balance of the process system. Hence, the new aeration ponds are contributing a net of 6 gal/min (i.e., 12 gal/min minus 6 gal/min) to the process water system. The total net weighted average groundwater seepage input is, therefore, estimated at about 151 gal/min.

Figure 23 presents the average seepage inflow rates for the segments of ditches adjacent to the stack and pond walls. The average fresh groundwater inflow rates range from 0.6 to 15.0 gal/min per 1,000 lineal feet of reach. The lowest inflow rate was calculated adjacent to the south side of the south compartment of the Old Gypsum Stack. This low rate of inflow is primarily controlled by low gradients. The highest average inflow rate was calculated adjacent to the north sides of the north cooling pond and the north compartment of the new gypsum stack. This relatively high rate of inflow is controlled by both higher gradients and higher transmissivity values. Average inflow rates ranged from 4.0 to 6.1 gal/min per 1,000 lineal feet of reach for the south cooling pond, except during periods of treated water flow into the Buckeye Road ditch, along the south side of the south compartment of the South Cooling Pond. An average inflow rate of 12.7 gal/min per 1,000 lineal feet of reach was calculated during periods of treated water flow in the ditch. Along the south and east sides of the south compartment of the New Gypsum Stack, average inflow rates of 9.5 and 5.1 gal/min per 1,000 lineal feet of reach were calculated, respectively

Surface Water Contribution

There are two surface water input points (during the normal wet season months) as noted in Figure 1; one is a 6-inch pipe that discharges about 5 gal/min of collected surface water into the seepage ditch on the north side of the north cooling pond; and one is a pipe (with a partially open blind cover) that discharges about 5 gal/min into the seepage ditch on the east side the new south gypsum stack. Reportedly, these historical input points exist to help prevent a backup of potentially contaminated surface water onto neighboring lands. Specifically, the input pipe along the north side of the north cooling pond relieves a short section of a historical surface water collection/conveyance ditch on the Piney Point property that has been blocked off at one end to help prevent potentially contaminated surface water from migrating onto the neighboring (north) property. The blind-controlled input pipe on the east side of the New South Gypsum Stack relieves buildup of potentially contaminated surface water that collects in a low-lying area on the Piney Point property. This controlled relief of surface water into the seepage ditch helps prevent a backup of potentially contaminated surface water onto the neighboring farm land. On a prorated basis, we estimate that the combined point source inflows average 4 gal/min on an annual basis. The source of contamination is not known. We recommend that a followup study be made to identify sources of contamination. Redirection of surface water collection/ conveyance will be address in the conceptual closure plan.

Overall, the net fresh surface water and groundwater input to the ditch system on an average annual basis is, therefore, estimated to be about 155 gal/min, which amounts to nearly 0.22 MGD or 81.5 million gallons per year.

Conclusions and Recommendations

Since Circa 1980, and during normal rainfall years, we estimate that an annual average of 130 gal/min of fresh groundwater seepage from the surficial aquifer has been flowing continuously into 17,500 linear feet of engineered ditches, drains and sumps that were intended to provide effective hydrologic controls around the perimeter of the gypsum stack system. More recently, the estimated annual average seepage inflow rate is estimated to have increased by about 15 gal/min to a total seepage rate of 145 gal/min resulting from use of the Buckeye Road drainage ditch for conveyance of treated water between Outfalls 003 and 001 (without even including the net inflow contribution of about 6 gal/min from the new treated water aeration ponds). Considering an estimated 10 gal/min of surface water point source flows into the system during the normal wet season months, the overall average fresh water flow into the perimeter seepage collection system .is estimated to be approximately 145 gal/min (i.e., 78 million gallons per year).

Based on these findings, it is our opinion that a soil-bentonite admix cut-off wall installed on the outboard side of the seepage ditch system, using the slurry trench technique, would significantly improve the phosphogypsum stack system water balance. In concept, the soil-bentonite cut-off wall would be installed to a depth several feet below the interface between the transmissive surficial sandy soils and underlying clayey sand, i.e., to depths ranging from about 20 to 25 feet below land surface.. A cut-off wall installed around the approximately 17,500 lineal foot perimeter of the seepage collection system (excluding ditches adjacent to the new aeration pond), would virtually eliminate 145 gal/min (78 million gallons per year) of fresh groundwater seepage input into the process water system. The cost of such a cut-off wall is estimated to be on the order of 1.2 million dollars. Considering that the cost of process water consumption (treatment and transfers) is in excess of $20/1000 gal, the investment in the cut-off wall would be recovered in less than 9 months.

Alternatively, the extent of the cut-off wall could be reduced to about 13,000 lineal feet (reaches E2, E1, C1 through C9, A1 through A4, B1 through B6, and D1 through D3 in Figure 22) by limiting the alignment to the north, east and south sides of the phosphogypsum stack system and by excluding less critical portions of the seepage collection system perimeter (i.e., the north and west sides of the South Cooling Pond, and west side of the North Cooling Pond). This would reduce the installation cost to about 0.9 million dollars, while still achieving up to 86 percent reduction in fresh groundwater seepage inflow into the system. Such a cut-off wall would curtail as much as 124 gal/min of fresh water seepage inflow, which is equivalent to a process water consumption rate of 65 million gallons per year, each and every year. The investment in such a cut-off wall would be recovered in less than 8 months.

If the length of the recommended cut-off wall is limited further to 9,200 lineal feet (reaches E2, E1, C1 through C9, A1 through A4, B1, and B2 in Figure 22), the cost of the installation would be on the order of $0.65 million dollars only, while still curtailing as much as 94 gal/min of fresh water seepage inflow (equivalent to a process water consumption rate of about 49.5 million gallons per year).

The proposed cut-off wall would also be advantageous in facilitating the design and operation of a toe drain system during closure of the stack, by minimizing post-closure fresh groundwater input along those segments of the ditch alignment where fresh water intrusion is currently occurring, without raising concerns relating to triggering seepage of process water leachate off-property.

The surface water input points are estimated to contribute an average of 4 gal/min to the seepage ditch, on an average annual basis, which is about 2 million gallons per year. We recommend that the surface water input disposition be resolved by a study that identifies the contamination source and by the conceptual closure design.

The hydrogeologic study has confirmed that there is significant fresh water intrusion into the seepage collection ditch system, as had been suspected. We trust that the recommended soil-bentonite cut-off wall will be moved to the forefront of the approved action items because the cut-off wall has been determined to be a most cost-effective process water "consumption" option.

We recommend that additional field measurement and observation data be gathered by Shaw Environmental on a quarterly basis, commencing June 1, 2003, and forwarded to Ardaman upon tabulation. These include:

- Water level readings in piezometers and test wells listed in Tables 1 and 2.
- Field observations of water levels in seepage ditches in alignment with transects referenced in Figure 1, with observations of water level made relative to ditch bottom (e.g., water level is 1/2-foot above ditch bottom, etc.).

If you have any questions or need additional clarification, please contact us.

Very truly yours,
ARDAMAN & ASSOCIATES, INC.

4-9-03

Thomas J. Leto, P.E.
Vice President
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Enclosures

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H:\2002 Jobs\02-099 PINEY POINT Misc\02-099 Groundwater Monitoring & Test Wells.wpd

TABLES

Table 1
Temporary Piezometer and Auger Boring Water Levels

Project: Piney Point Phosphates, Inc.

File No: 02-099

	Piezometer & Auger Boring Number	Piezometer Diameter (inches)	Total Depth (Feet bls)[1]	Screened Interval (Feet bls)	Top of PVC Casing Elevation (Feet, NGVD)[2]	Ground Elevation (Feet, NGVD)[2]	Aquifer Unit	Ground Water Levels Elevation (Feet, NGVD)[2] 11/18/02	Ground Water Levels Elevation (Feet, NGVD)[2] 11/23/02
Piezometers	PZ-101	2.0	20	8-20	13.5	10.5	Surficial	NA	4.0
	PZ-102	2.0	20	10-20	15.7	12.7	Surficial	NA	2.2
	PZ-103	2.0	20	10-20	15.5	12.5	Surficial	NA	2.6
	PZ-104	2.0	20	7-20	13.5	10.5	Surficial	NA	3.8
	PZ-105	2.0	20	8-20	24.0	21.0	Surficial	NA	12.9
	PZ-106	2.0	18	3-18	29.0	26.0	Surficial	NA	24.9
	PZ-107	2.0	12	4-12	29.0	26.0	Surficial	NA	24.1
	PZ-108	2.0	16	4-16	27.0	24.0	Surficial	NA	22.8
	PZ-109	2.0	20	2-20	27.0	24.0	Surficial	NA	23.0
	PZ-110	2.0	18	4-18	28.0	25.0	Surficial	NA	18.0
	PZ-111	2.0	12	4-12	18.0	15.0	Surficial	NA	12.0
	PZ-112	2.0	17	4-17	18.0	15.0	Surficial	NA	13.0
	PZ-113	2.0	15	4-15	18.0	15.0	Surficial	NA	11.3
Auger Boreholes	AB-1	NA	NA	NA	14.0	11.0	Surficial	1.8	1.6
	AB-2	NA	NA	NA	29.5	26.5	Surficial	25.1	24.7
	AB-3	NA	NA	NA	29.1	26.0	Surficial	25.1	24.7
	AB-4	NA	NA	NA	29.0	26.0	Surficial	25.1	24.8
	AB-5	NA	NA	NA	27.0	24.0	Surficial	22.1	21.9
	AB-6	NA	NA	NA	31.0	28.0	Surficial	22.8	22.5
	AB-7	NA	NA	NA	27.2	24.0	Surficial	23.3	23.1
	AB-8	NA	NA	NA	18.0	14.0	Surficial	13.2	NR

FOOTNOTES: [1] Feet Below Land Surface [2] Feet Above the National Geodetic Datum of 1929 (Estimated from I.F. Rooks Topographic Survey of 2002)

LEGEND: NA - Not Applicable

NR - Not Read

Table 2
Test and Monitor Well Water Levels

Project: Piney Point Phosphates, Inc.

File No: 02-099

	Well Number	Well Diameter (inches)	Total Depth (Feet bls)[1]	Screened Interval (feet bls)	Top of PVC casing Elevation (Feet, NGVD)[2]	Ground Elevation (Feet, NGVD)[2]	Aquifer Monitored	Ground Water Levels				
								Elevation (Feet, NGVD)[2]	Elevation (Feet, NGVD)[2]	Elevation (Feet, NGVD)[2]	Elevation (Feet, NGVD)[2]	Elevation (Feet, NGVD)[2]
								10/15/02 10/16/02	10/29/02	11/07/02 11/08/02	11/13/02 11/14/02	11/23/02
GROUND WATER MONITOR WELLS	MW-1	2	20	15-20	30.82	27.7	Surficial	NR	25.15	24.6	NR	25.67
	MW-3	2	20	15-20	14.47	12.5	Surficial	NR	NR	NR	10.47	11.18
	MW-4A	2	20	15-20	12.00	9.5	Surficial	NR	5.58	5.22	NR	5.82
	MW-8	2	18	8-18	12.34	9.5	Surficial	NR	5.79	5.45	NR	6.09
	MW-9	2	17	7-17	26.20	23.3	Surficial	19.80	NR	NR	18.4	19.01
	MW-10A	2	15	5-15	27.47	25.1	Surficial	NR	22.47	21.84	NR	22.99
	MW-11	2	12	4-12	29.34	26.6	Surficial	NR	24.14	23.59	NR	24.73
	MW-12	2	16	6-16	10.71	8.2	Surficial	NR	NR	NR	NR	3.61
	MW-13	2	15	5-15	9.93	6.7	Surficial	3.43	NR	NR	2.63	2.81
	MW-17	2	12	4-12	10.96	11.5	Surficial	NR	NR	NR	8.06	8.46
TEST WELLS	FSU-9	4	21	11-21	30.56	27.9	Surficial	NR	18.96	18.66	NR	19.11
	FSU-11	4	24	14-24	20.96	16.5	Surficial	8.96	NR	NR	8.59	8.78
	FSU-13	4	25	15-25	18.27	15.7	Surficial	NR	NR	9.77	NR	NR
	FSU-16	4	22	12-22	11.54	8.9	Surficial	NR	5.82	5.64	NR	6.06
	FSU-20	4	21.5	11.5-21.5	17.76	14.8	Surficial	NR	NR	12.09	NR	12.89
	FSU-22	4	18	8-18	15.87	13.2	Surficial	NR	NR	10.34	NR	NR
	FSU-24	4	15	5-15	15.06	11.9	Surficial	NR	NR	NR	9.33	NR
	USGS-9	4	21	16-21	20.71	18.0	Surficial	13.51	NR	NR	12.58	12.91

FOOTNOTES: [1] Feet Below Land Surface [2] Feet Above the National Geodetic Datum of 1929

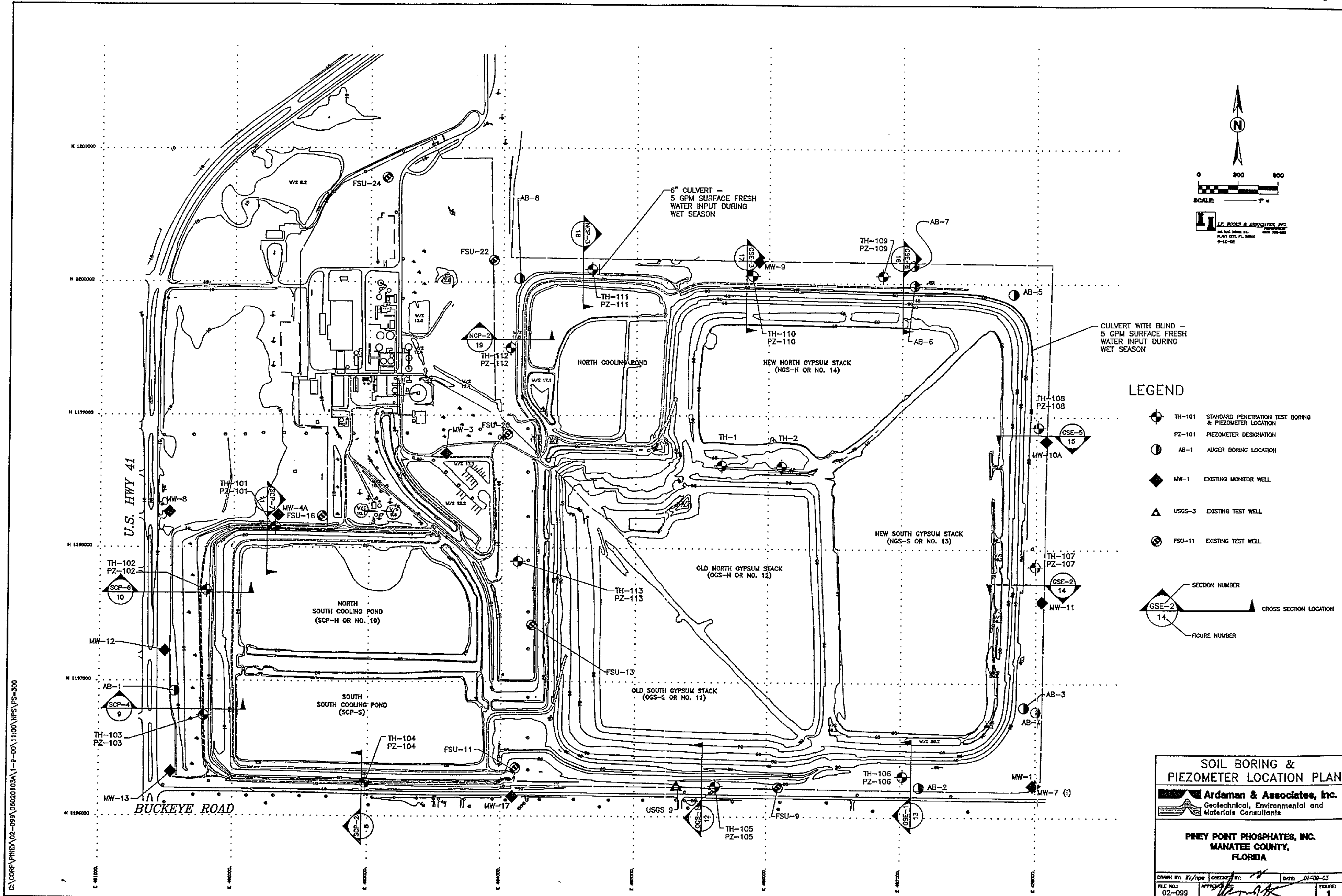
LEGEND: NR- Not Read

Table 3
Field Permeability Test Results

	Well Number	Ground Surface Elevation (ft, NGVD)	Top of Casing Elevation (ft, NGVD)	Collection Interval Depth (ft - bls)	Collection Interval Elevation (ft, NGVD)	Effective Collection Length (ft)	Initial Water Level Elevation (ft, NGVD)	Soil Type Monitored: USCS	Soil Type Monitored: SPT N-Value blows/ft	Soil Type Monitored: -200 (%)	k_h (ft/day)
MONITOR WELLS	MW-1	27.7	30.82	14 to 20	7.7 to 13.7	6	24.6	SC	4	-	0.3
	MW-4A	9.5	12.00	14 to 20	-10.5 to -4.5	6	5.2	SP	4	-	2.7
	MW-8	9.5	12.34	7 to 18	-8.5 to 0.5	11	5.5	SP	20	3	5.4
	MW-9	23.3	26.20	6 to 17	6.3 to 17.3	11	19.8	SP	3 , 5	-	3.3
	MW-10A	25.1	27.47	4 to 15	10.1 to 21.1	11	21.8	SP-SM	7-28 (19)	6	1.6
	MW-11	26.6	29.34	3 to 12	14.6 to 23.6	9	23.6	SP to SM	5-11 (18)	-	1.8
	MW-13	6.7	9.93	4 to 15	-8.3 to 2.7	8.5	3.4	SP	7, 17	9	3.2
TEST WELL	FSU-9	27.9	30.56	10 to 21	6.9 to 17.9	11	18.7	SP	10-44 (24)	3	3.1
	FSU-11	16.5	20.96	13 to 24	7.5 to 18.5	11	9.0	SP to SM	4, 9	16	4.4
	FSU-16	8.9	11.54	11 to 22	-13.1 to -2.1	11	5.6	SP	49	-	1.2
	USGS-9	18.0	20.71	14 to 21	-3.0 to 3.0	6	13.5	CL	5, 6	-	1.1
PIEZOMETERS	PZ-101	10.5	13.5	7 to 20	-9.5 to 3.5	12.5	4.0	SP	28-49 (40)	-	3.2 *
	PZ-102	12.5	15.5	9 to 20	-7.5 to 3.5	8	2.1	SP	9-20 (15)	3	2.9 *
	PZ-103	10.5	13.5	9 to 20	-9.5 to 1.5	8.5	0.8	SP	8-17 (11)	9	3.2 *
	PZ-104	10.5	13.5	6 to 20	-9.5 to 4.5	11	3.6	SM	3-9 (6)	16	2.2 *
	PZ-105	21.0	24.0	7 to 20	1.0 to 14.0	11.5	12.5	SP / SP-SM	9-44 (27)	3 / 11	2.9 *
	PZ-106	27.0	30.0	2 to 18	9.0 to 25.0	11.5	24.8	SP	4-13 (9)	6, 10	1.2
	PZ-107	26.0	29.0	3 to 12	14.0 to 23.0	9	23.9	SP to SM	5-11 (8)	-	2.7
	PZ-108	24.0	27.0	3 to 16	8.0 to 21.0	13	23.8	SP-SM	7-28 (17)	76	2.1
	PZ-109	24.0	27.0	1 to 20	4.0 to 23.0	19	23.5	SP	3-22 (13)	4, 5	3.0 *
	PZ-110	24.0	27.0	3 to 18	6.0 to 21.0	11	17.0	SP	2-7 (4)	-	8.2 *
	PZ-111	15.0	18.0	3 to 12	3.0 to 12.0	9	12.1	SP	1-19 (12)	-	2.8 *
	PZ-112	15.0	18.0	3 to 17	-2.0 to 12.0	14	13.2	SP-SM / SC	9-19 (14)	-	0.6
	PZ-113	15.0	18	3 to 15	0.0 to 12.0	8	11.9	SP & SC	3, 50/1"	3	1.4 *

NOTES: Effective collection length excludes upper portions if above the equilibrium groundwater surface and/or lower portion is in clay ;
USCS is the soil type designation according to the Unified Soil Classification System
SPT N-Values are from adjacent or nearby test borings (values in parentheses represent average values within the collection depth interval)
-200 = Percent by dry weight of material finer than the U.S. Standard #200 sieve size (<0.074 mm)
k_h = Horizontal coeeficient of permeability computed using the Hvorslev method
* Indicates that an effective collection zone radius was used in the Hvorslev equation where the static water level is within the collection zone

FIGURES



U.S. HWY 41
BUCKEYE ROAD
6" CULVERT - 5 GPM SURFACE FRESH WATER INPUT DURING WET SEASON
CULVERT WITH BLIND - 5 GPM SURFACE FRESH WATER INPUT DURING WET SEASON
NORTH COOLING POND
NEW NORTH GYPSUM STACK (NGS-N OR NO. 14)
NEW SOUTH GYPSUM STACK (NGS-S OR NO. 13)
OLD NORTH GYPSUM STACK (OGS-N OR NO. 12)
OLD SOUTH GYPSUM STACK (OGS-S OR NO. 11)
NORTH SOUTH COOLING POND (SCP-N OR NO. 19)
SOUTH SOUTH COOLING POND (SCP-S)
FSU-24
FSU-22
FSU-20
FSU-16
FSU-13
FSU-11
FSU-9
AB-8
AB-7
AB-6
AB-5
AB-3
AB-4
AB-2
AB-1
MW-9
MW-3
MW-4A
MW-8
MW-12
MW-13
MW-17
MW-10A
MW-11
MW-1
MW-7 (i)
USGS 9
TH-101 PZ-101
TH-102 PZ-102
TH-103 PZ-103
TH-104 PZ-104
TH-105 PZ-105
TH-106 PZ-106
TH-107 PZ-107
TH-108 PZ-108
TH-109 PZ-109
TH-110 PZ-110
TH-111 PZ-111
TH-112 PZ-112
TH-113 PZ-113
TH-1
TH-2
NCP-3 18
NCP-2 19
GSE-3 17
GSE-6 16
GSE-5 15
GSE-2 14
GSE-1 13
OGS-1 12
SCP-7
SCP-6 10
SCP-4 9
SCP-2 8
N
0 300 600
SCALE: 1" =
LEGEND
TH-101 STANDARD PENETRATION TEST BORING & PIEZOMETER LOCATION
PZ-101 PIEZOMETER DESIGNATION
AB-1 AUGER BORING LOCATION
MW-1 EXISTING MONITOR WELL
USGS-3 EXISTING TEST WELL
FSU-11 EXISTING TEST WELL
SECTION NUMBER
GSE-2 14
CROSS SECTION LOCATION
FIGURE NUMBER
SOIL BORING & PIEZOMETER LOCATION PLAN
Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants
PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA
DRAWN BY: Mr/npe
DATE: 01-09-03
FILE NO.: 02-099
FIGURE: 1
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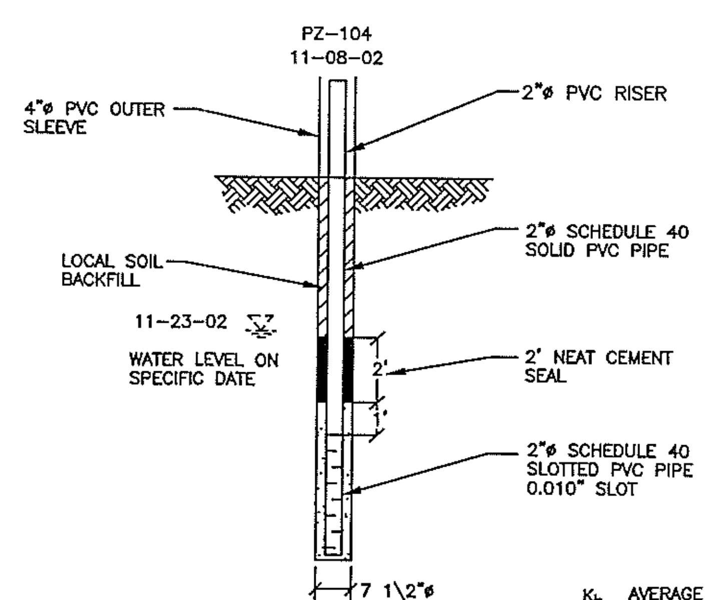
SOILS LEGEND

	(1)	LIGHT BROWN TO BROWN SAND TO SILTY SAND (SM) – FILL –
	(2)	LIGHT BROWN GYPSUM (ML) – FILL –
	(3)	LIGHT BROWN GYPSUM MIXED WITH SAND (ML W/SP) – FILL –
	(4)	DARK GRAY SAND WITH SILT TO SILTY SAND (SP–SM TO SM)
	(5)	BROWN SAND WITH CLAY (SP–SC)
	(6)	LIGHT BROWN TO BROWN SAND TO SILTY SAND (SP TO SM)
	(7)	LIGHT BROWN TO GRAYISH–BROWN SAND WITH SILT & FEW SHELL FRAGMENTS (SP–SM)
	(8)	LIGHT BROWN TO BROWN SAND WITH SILT TO SILTY SAND WITH PHOSPHATE FINES (SP–SM TO SM)
	(9)	LIGHT BROWN TO GRAYISH–BROWN SLIGHTLY CLAYEY TO CLAYEY SAND WITH PHOSPHATE FINES (SP–SC TO SC)
	(10)	LIGHT BROWN TO GRAYISH–BROWN CLAYEY SAND WITH PHOSPHATE FINES & SOME SHELL FRAGMENTS (SC)
	(11)	GRAY SANDY CLAY WITH PHOSPHATE FINES (SC)
	(12)	DARK GRAYISH–BROWN SAND TO SILTY SAND WITH PHOSPHATE GRAINS (SP TO SM)
	(13)	DARK GRAY SANDY CLAY (CL)
	(14)	LIGHT BROWN INDURATED CLAYEY SILT WITH PHOSPHATE FINES (ML)

TH–101	STANDARD PENETRATION TEST (SPT) BORING
50/3	50 BLOWS FOR 3–INCHES PENETRATION INTO SOIL
N	STANDARD PENETRATION RESISTANCE IN BLOWS PER FOOT
AB–1	AUGER BORING LOCATION
▽	WATER LEVEL MEASURED ON DATE DRILLED
▽	WATER LEVEL MEASURED ON SPECIFIC DATE
NM	NATURAL MOISTURE CONTENT IN PERCENT
–200	PERCENT PASSING NO. 200 SIEVE (PERCENT FINES)
↑	FILL
SP,SM	UNIFIED SOIL CLASSIFICATION SYSTEM



K_h AVERAGE HORIZONTAL PERMEABILITY COEFFICIENT DETERMINED BY RISING HEAD FIELD PERMEABILITY TEST (FEET PER DAY)

ENGINEERING CLASSIFICATION

COHESIONLESS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH T.S.F.	BLOW COUNT "N"
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING LOGS AND RELATED INFORMATION ARE BASED ON THE DRILLERS LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE LOGS IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING LOGS REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THOSE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE

SOILS LEGEND

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY,
FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-25-02
FILE NO. 02-099	APPROVED BY:	FIG. NO. 2

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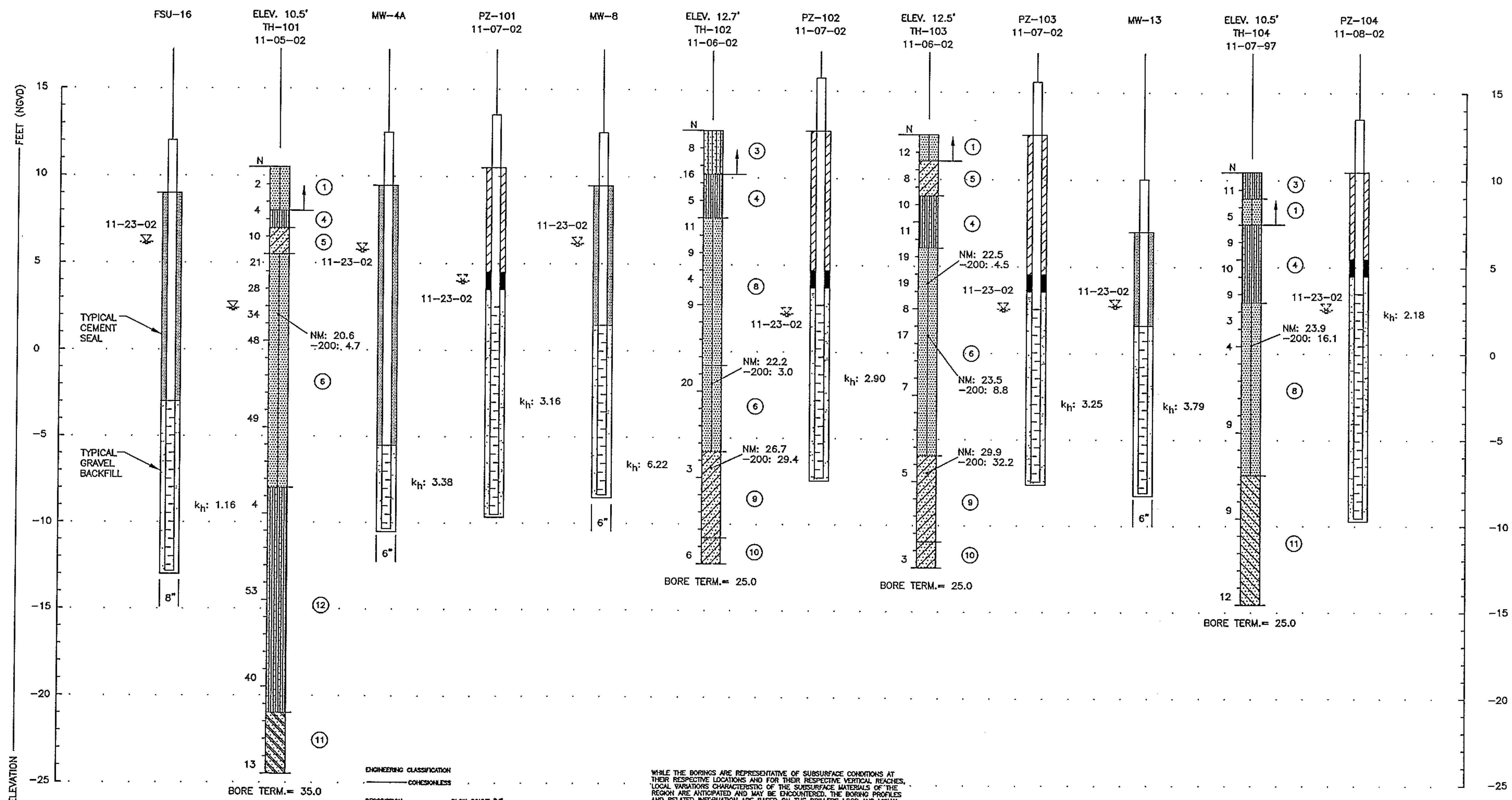
SOIL BORING PROFILES



ENGINEERING CLASSIFICATION

COHESIONLESS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH T.S.F.	BLOW COUNT "N"
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING PROFILES AND RELATED INFORMATION ARE BASED ON THE DRILLERS LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE BORING PROFILES IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING PROFILES REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THOSE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE

DATE DRILLED: SHOWN ABOVE

NOTE:

SEE FIG. 2 FOR SOIL DESCRIPTIONS AND OTHER INFORMATION

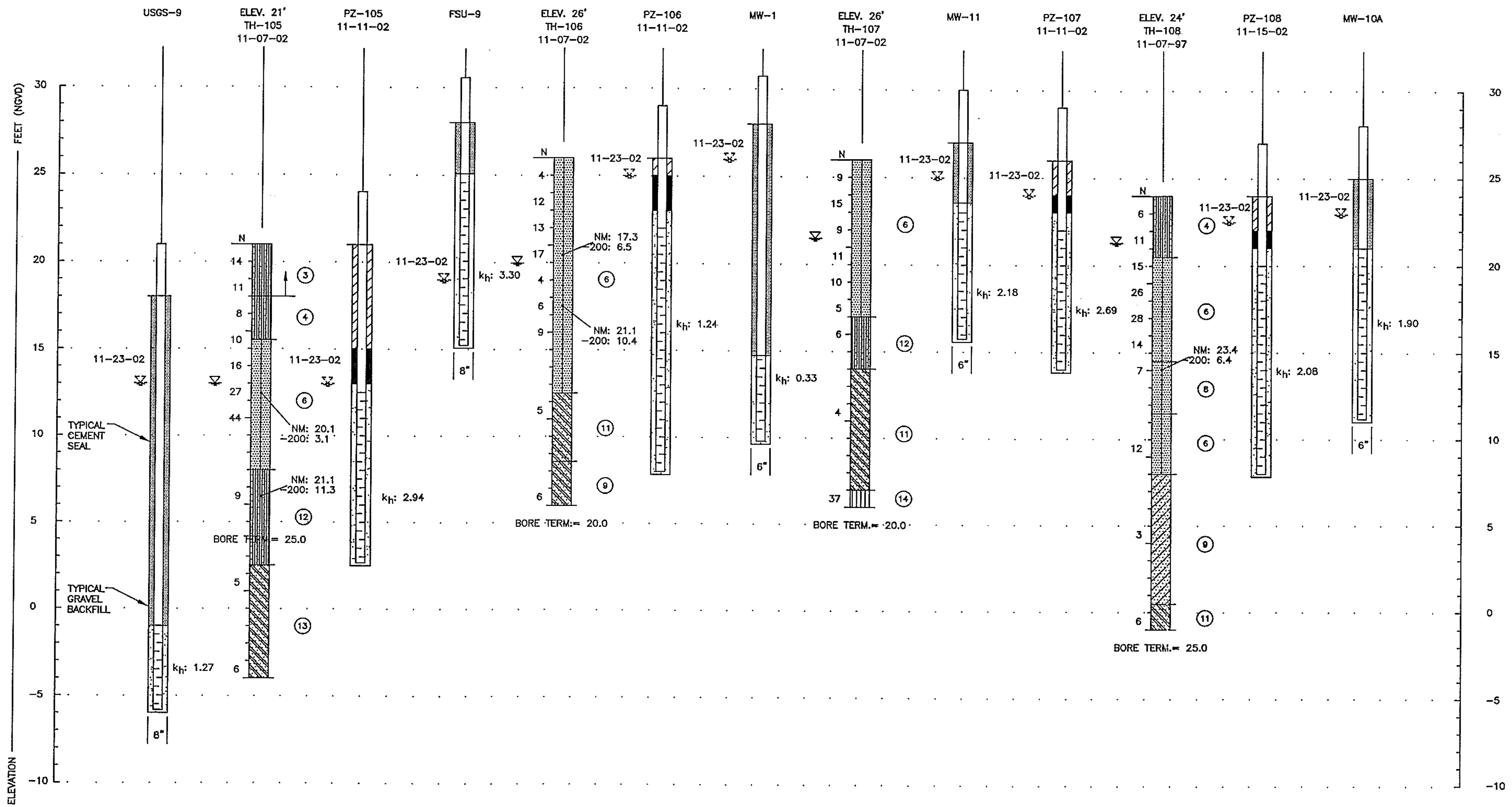
SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY,
FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-25-02
FILE NO. 02-099	APPROVED BY:	FIG. NO. 3

SOIL BORING PROFILES



ENGINEERING CLASSIFICATION

COHESIONLESS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH T.S.F.	BLOW COUNT "N"
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING PROFILES AND RELATED INFORMATION ARE BASED ON THE DRILLERS LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE BORING PROFILES IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING PROFILES REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THOSE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE

DATE DRILLED: SHOWN ABOVE

NOTE:

SEE FIG. 2 FOR SOIL DESCRIPTIONS AND OTHER INFORMATION

SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-25-02
FILE NO. 02-099	APPROVED BY:	FIG. NO. 4

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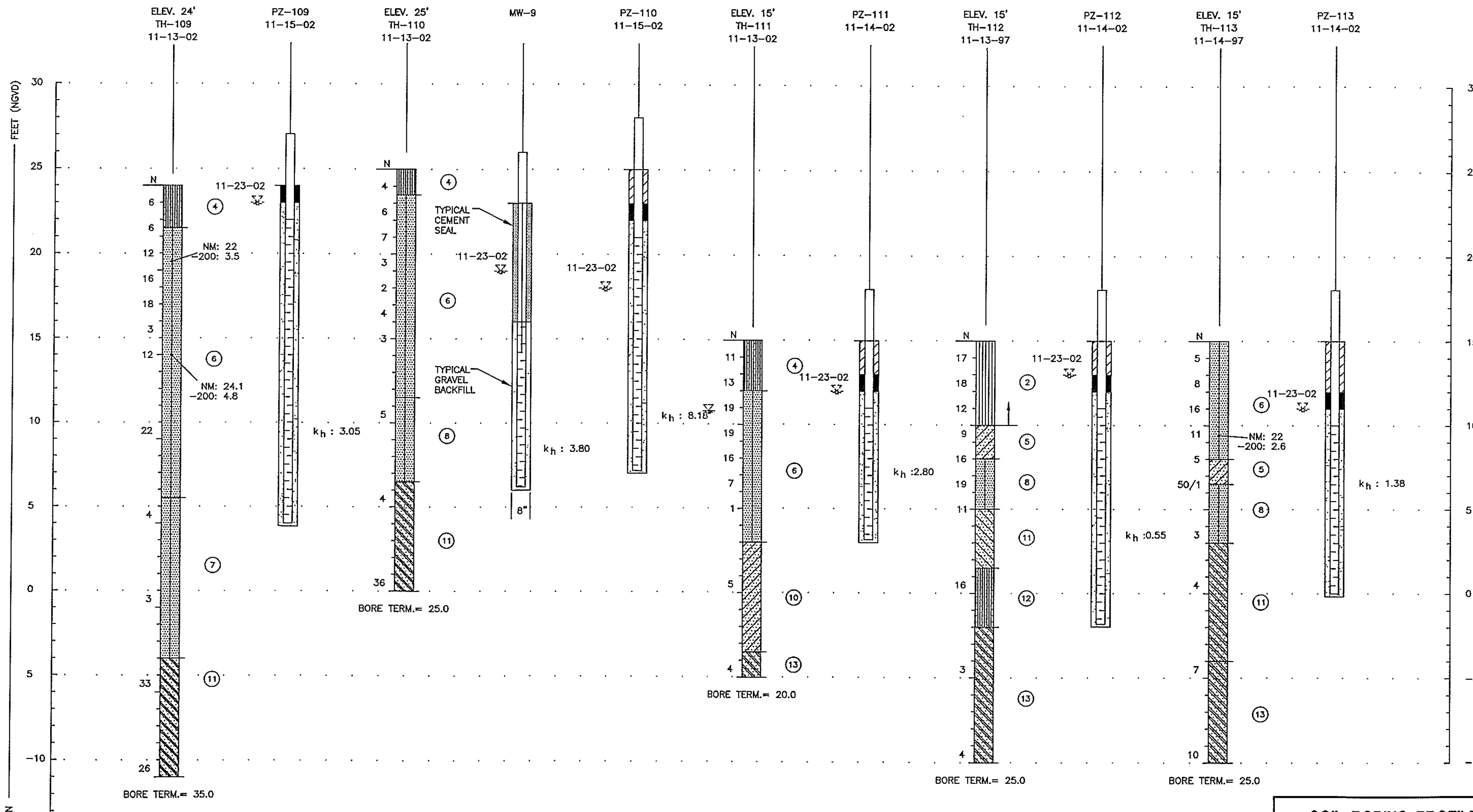
SOIL BORING PROFILES



ENGINEERING CLASSIFICATION

COHESIONLESS

DESCRIPTION	BLOW COUNT "N"
VERY LOOSE	0 TO 4
LOOSE	4 TO 10
MEDIUM DENSE	10 TO 30
DENSE	30 TO 50
VERY DENSE	ABOVE 50

COHESIVE

DESCRIPTION	UNCONFINED COMPRESSIVE STRENGTH T.S.F.	BLOW COUNT "N"
VERY SOFT	BELOW .25	0 TO 2
SOFT	.25 TO .50	2 TO 4
MEDIUM STIFF	.50 TO 1.0	4 TO 8
STIFF	1 TO 2	8 TO 15
VERY STIFF	2 TO 4	15 TO 30
HARD	ABOVE 4	ABOVE 30

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING PROFILES AND RELATED INFORMATION ARE BASED ON THE DRILLERS LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE BORING PROFILES IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING PROFILES REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THOSE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE.

DATE DRILLED: SHOWN ABOVE

NOTE:

SEE FIG. 2 FOR SOIL DESCRIPTIONS AND OTHER INFORMATION

SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-25-02
FILE NO. 02-099	APPROVED BY:	FIG. NO. 5

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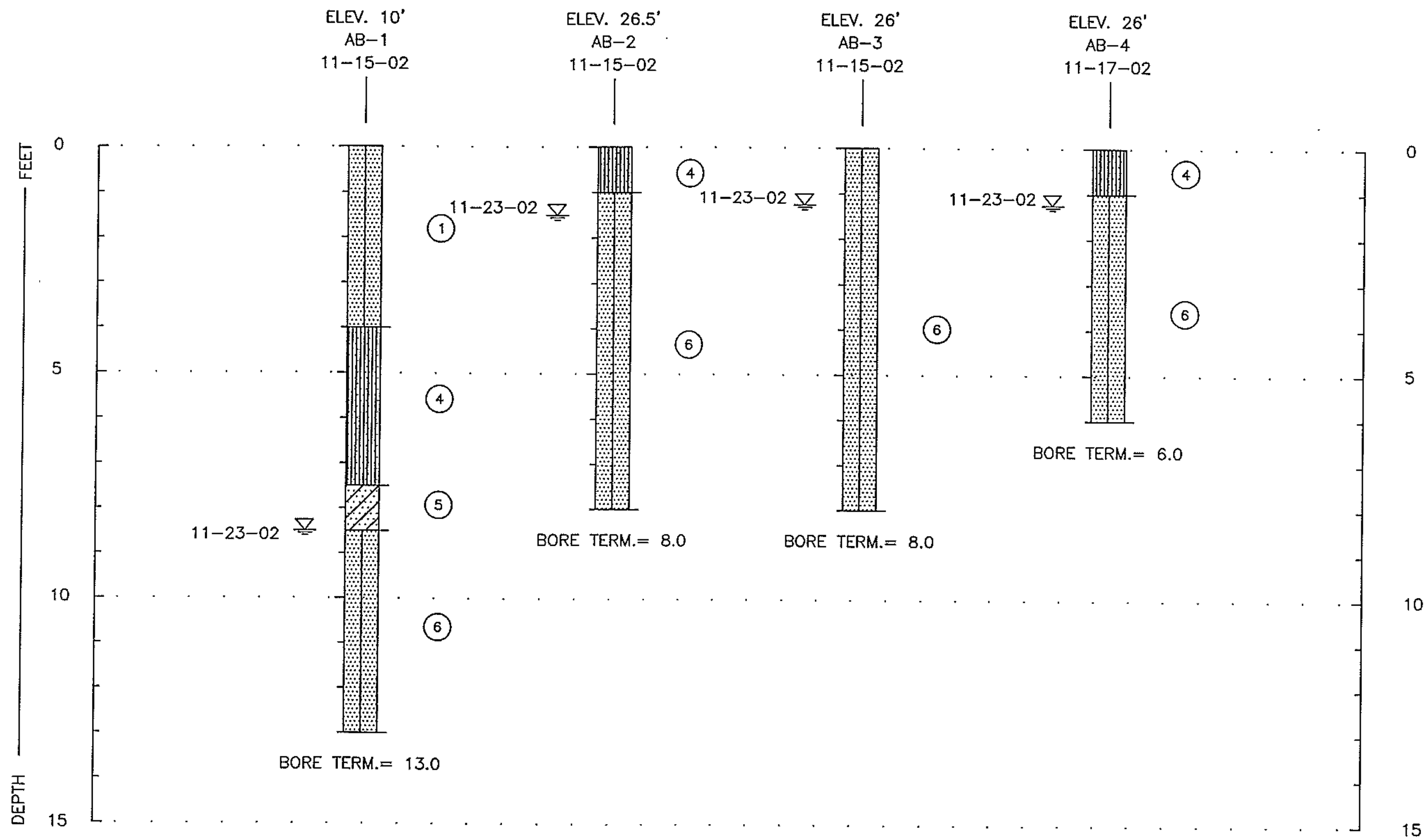
SOIL BORING PROFILES



NOTES:

1. SEE FIG. 2 FOR SOIL DESCRIPTIONS AND OTHER INFORMATION
2. A SHORT PIECE OF PVC PIPE PLACED IN AUGER BORING TO MARK THE LOCATION & ALLOW WATER LEVEL READING

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING PROFILES AND RELATED INFORMATION ARE BASED ON THE DRILLERS LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE BORING PROFILES IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING PROFILES REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THOSE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE

DATE DRILLED: SHOWN ABOVE

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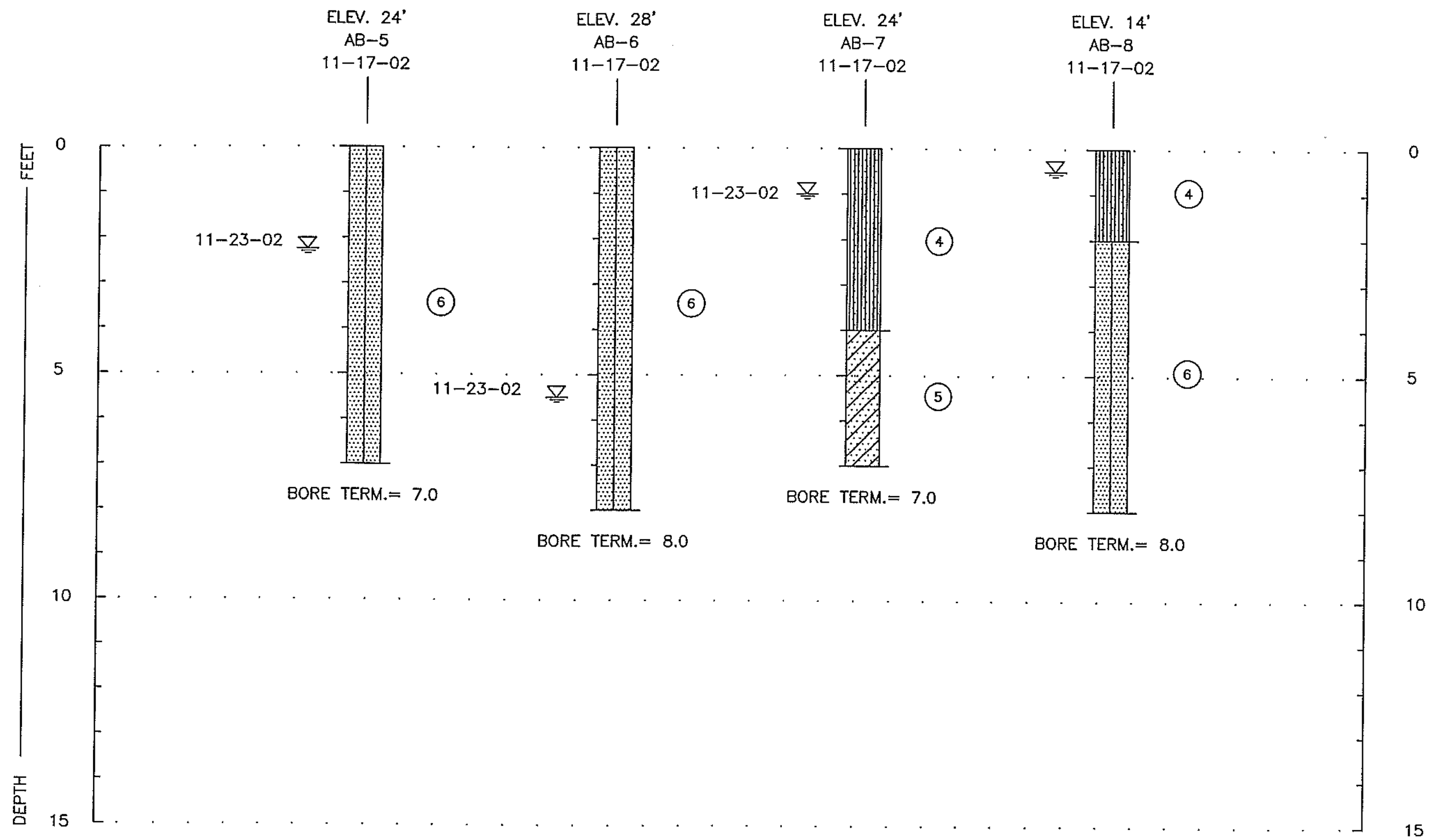
SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-25-02	
FILE NO. 02-099	APPROVED BY:		FIG. NO. 6

SOIL BORING PROFILES



NOTES:

1. SEE FIG. 2 FOR SOIL DESCRIPTIONS AND OTHER INFORMATION
2. A SHORT PIECE OF PVC PIPE PLACED IN AUGER BORING TO MARK THE LOCATION & ALLOW WATER LEVEL READING

WHILE THE BORINGS ARE REPRESENTATIVE OF SUBSURFACE CONDITIONS AT THEIR RESPECTIVE LOCATIONS AND FOR THEIR RESPECTIVE VERTICAL REACHES, LOCAL VARIATIONS CHARACTERISTIC OF THE SUBSURFACE MATERIALS OF THE REGION ARE ANTICIPATED AND MAY BE ENCOUNTERED. THE BORING PROFILES AND RELATED INFORMATION ARE BASED ON THE DRILLERS LOGS AND VISUAL EXAMINATION OF SELECTED SAMPLES IN THE LABORATORY. THE DELINEATION BETWEEN SOIL TYPES SHOWN ON THE BORING PROFILES IS APPROXIMATE AND THE DESCRIPTION REPRESENTS OUR INTERPRETATION OF SUBSURFACE CONDITIONS AT THE DESIGNATED BORING LOCATIONS ON THE PARTICULAR DATE DRILLED.

GROUNDWATER ELEVATIONS SHOWN ON THE BORING PROFILES REPRESENT GROUNDWATER SURFACES ENCOUNTERED ON THE DATES SHOWN. FLUCTUATIONS IN WATER TABLE LEVELS SHOULD BE ANTICIPATED THROUGHOUT THE YEAR. ABSENCE OF WATER DATA ON CERTAIN BORINGS IMPLIES THAT NO GROUNDWATER DATA IS AVAILABLE, BUT DOES NOT NECESSARILY MEAN THAT GROUNDWATER WILL NOT BE ENCOUNTERED AT THOSE LOCATIONS OR WITHIN THE VERTICAL REACHES OF THESE BORINGS IN THE FUTURE

DATE DRILLED: SHOWN ABOVE

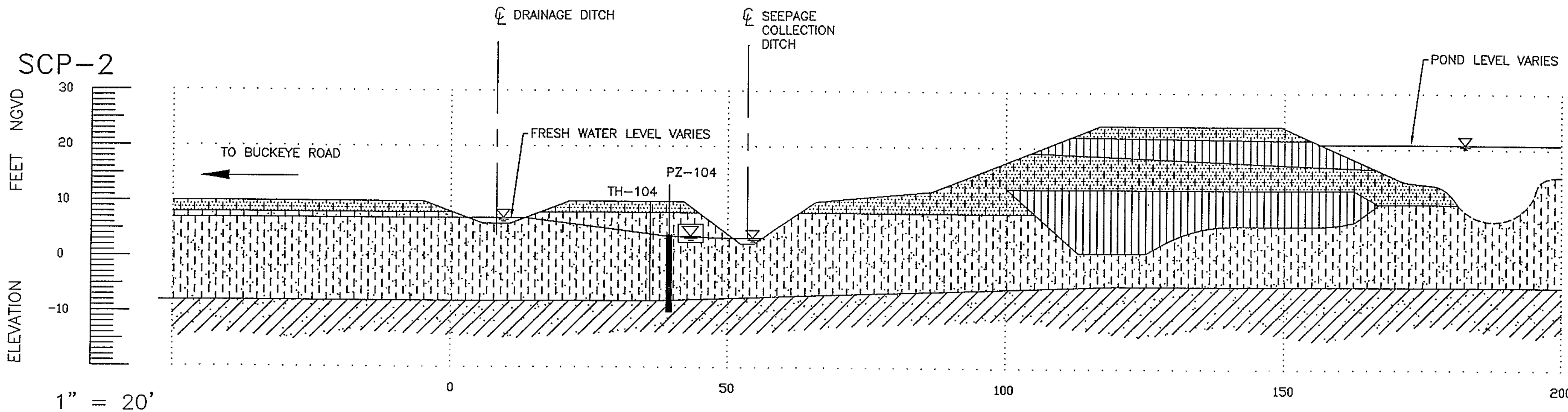
SOIL BORING PROFILES

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY,
FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-25-02
FILE NO. 02-099	APPROVED BY:	FIG. NO. 7

SOUTH COOLING POND
SOUTH WALL



CROSS SECTION

LOOKING WEST

LEGEND

SANDS TO SILTY SANDS – FILL –

GYPSUM – FILL –

SANDS TO SILTY SANDS

CLAYEY SAND TO SANDY CLAY

STANDPIPE PIEZOMETER

COLLECTION ZONE

TH-104 STANDARD PENETRATION TEST BORING NO. – TYPICAL

WATER LEVEL ON 11-23-02

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

EXISTING CONDITIONS SECTION

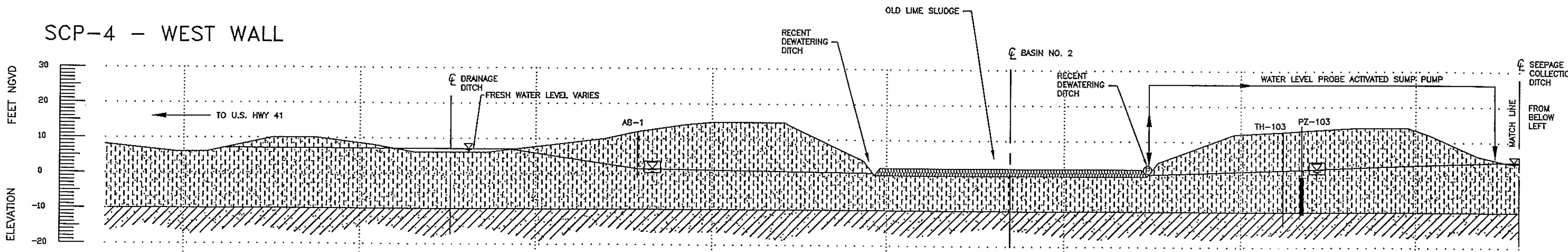
Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTH COOLING POND
PINEY POINT PHOSPHATES, INC
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-25-02
FILE NO. 02-099	APPROVED BY:	FIG. NO. 8

SOUTH COOLING POND
WEST WALL

SCP-4 – WEST WALL

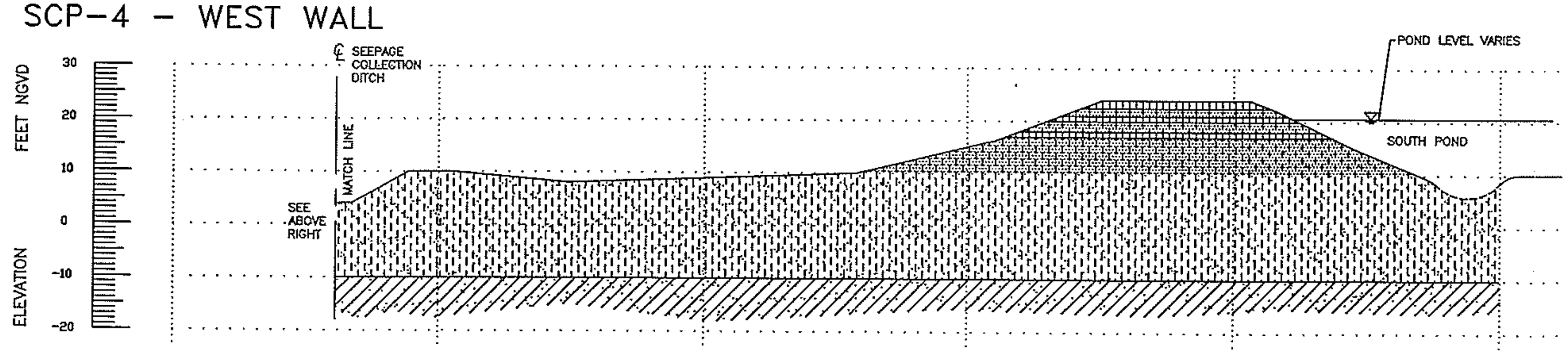


1" = 30'

CROSS SECTION

LOOKING NORTH

SCP-4 – WEST WALL



1" = 30'

CROSS SECTION

LOOKING NORTH

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH-103 STANDARD PENETRATION TEST BORING NO. – TYPICAL
- WATER LEVEL ON 11-23-02

EXISTING CONDITIONS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTH COOLING POND
PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 11-27-02
FILE NO. 02-099	APPROVED BY:	FIG. NO. 9

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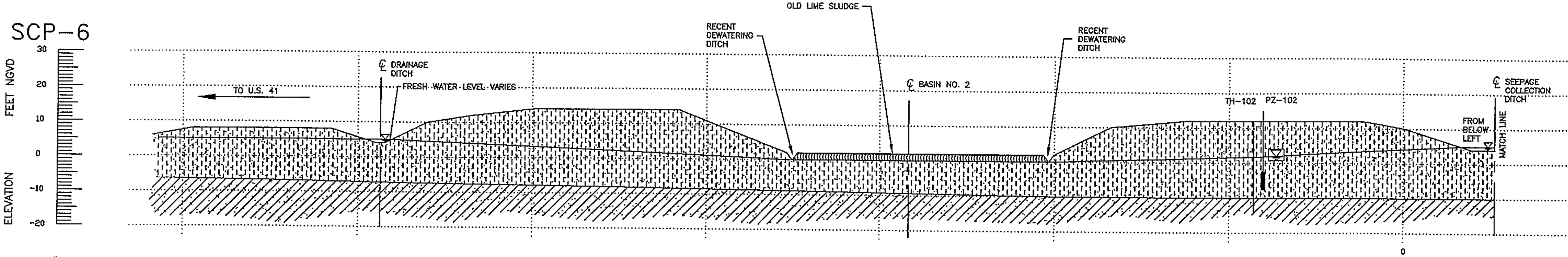
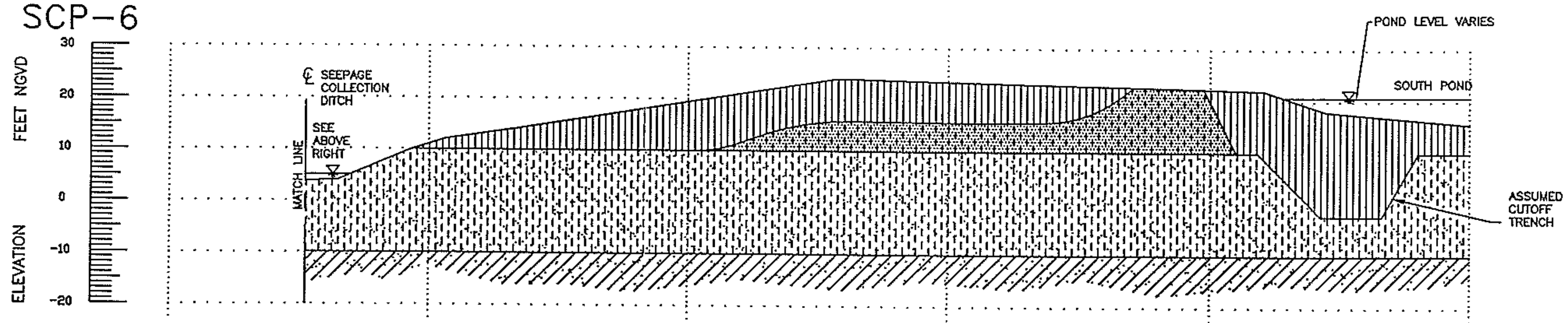
SOUTH COOLING POND
WEST WALL



1" = 30'

CROSS SECTION

LOOKING NORTH



1" = 30'

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH-102 STANDARD PENETRATION TEST BORING NO. – TYPICAL
- WATER LEVEL ON 11-23-02

EXISTING CONDITIONS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTH COOLING POND
PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 08-28-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 10

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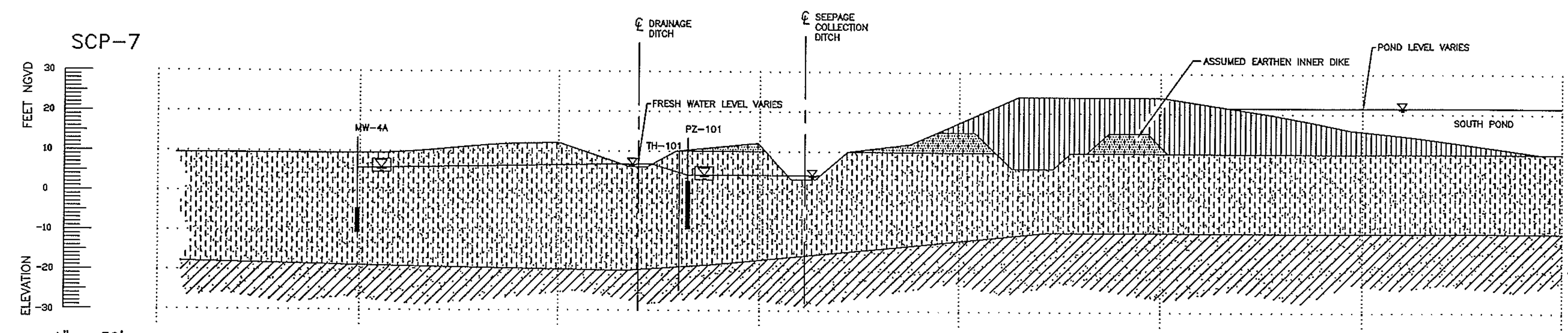
SOUTH COOLING POND
NORTH WALL



CROSS SECTION

LOOKING EAST

LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH-101 STANDARD PENETRATION TEST BORING NO. – TYPICAL
- WATER LEVEL ON 11-23-02

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

EXISTING CONDITIONS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

SOUTH COOLING POND
PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY,
FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 08-28-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 11

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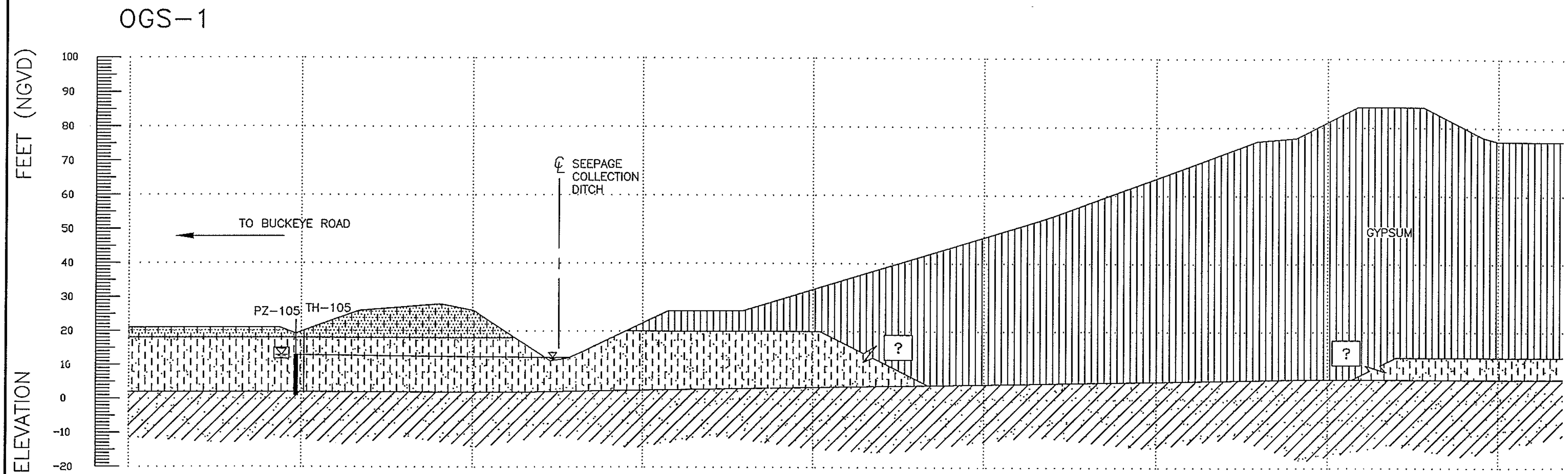
OLD SOUTH GYPSUM STACK
SOUTH WALL



1" = 30'

CROSS SECTION

LOOKING WEST

LEGEND

SANDS TO SILTY SANDS – FILL –

GYPSUM – FILL –

SANDS TO SILTY SANDS

CLAYEY SAND TO SANDY CLAY

STANDPIPE PIEZOMETER

COLLECTION ZONE

TH-105 STANDARD PENETRATION TEST BORING NO. – TYPICAL

WATER LEVEL ON 11-23-02

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

EXISTING CONDITIONS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

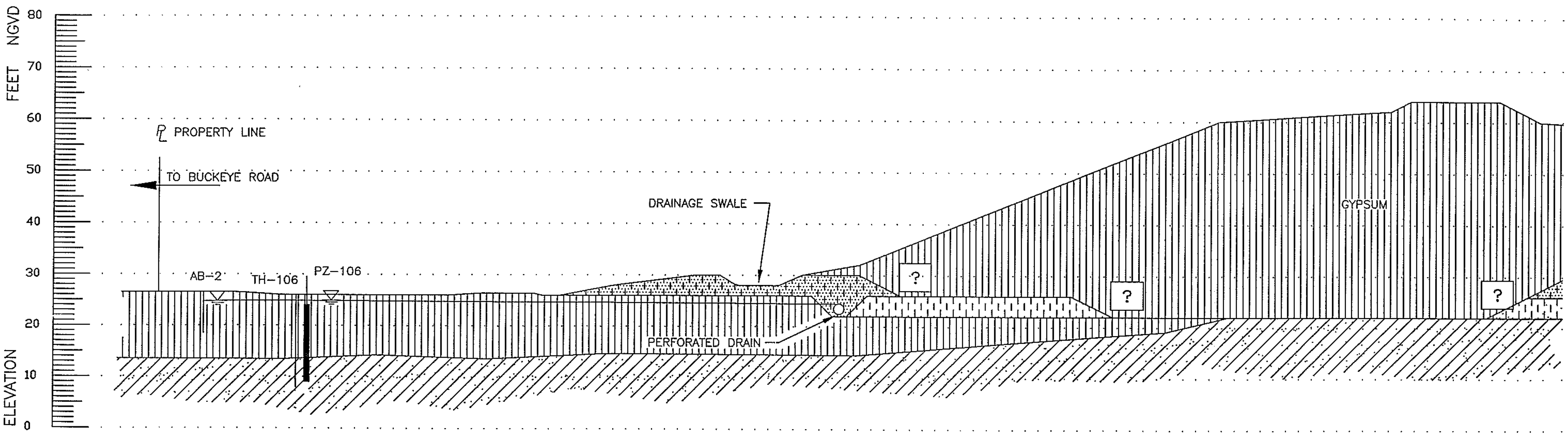
OLD GYPSUM STACK
PINEY POINT PHOSPHATES, INC
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 09-18-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 12

NEW SOUTH GYPSUM STACK

SOUTH WALL

GSE-1



1" = 20'

CROSS SECTION

LOOKING WEST

LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH-106 STANDARD PENETRATION TEST BORING NO. – TYPICAL
- WATER LEVEL ON 11-23-02

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

EXISTING CONDITIONS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

NEW SOUTH GYPSUM STACK
PINEY POINT PHOSPHATES, INC
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 09-25-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 13

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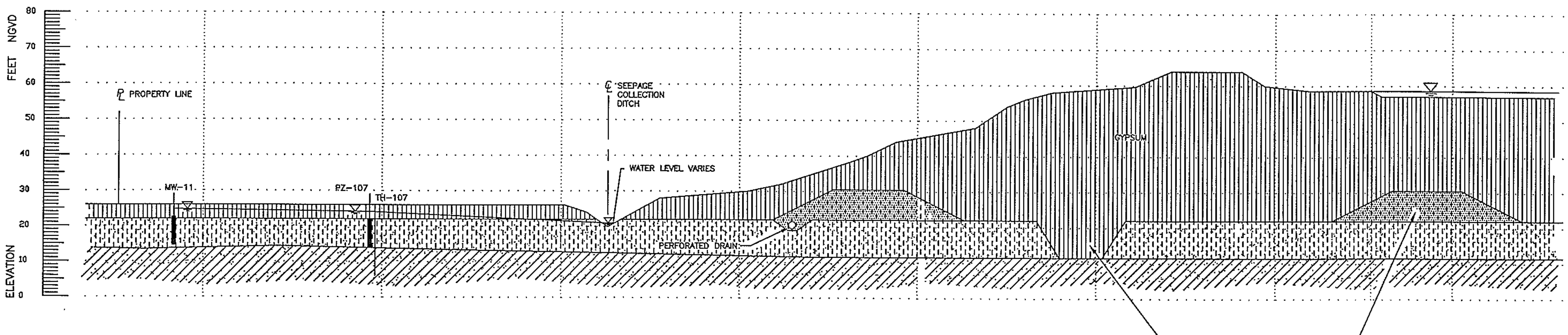
NEW SOUTH GYPSUM STACK
EAST WALL

GSE-2



1" = 30'

CROSS SECTION
LOOKING SOUTH

NOTES:
1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH-107 STANDARD PENETRATION TEST BORING NO. – TYPICAL
- WATER LEVEL ON 11-23-02

EXISTING CONDITIONS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

NEW SOUTH GYPSUM STACK
PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 09-17-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 14

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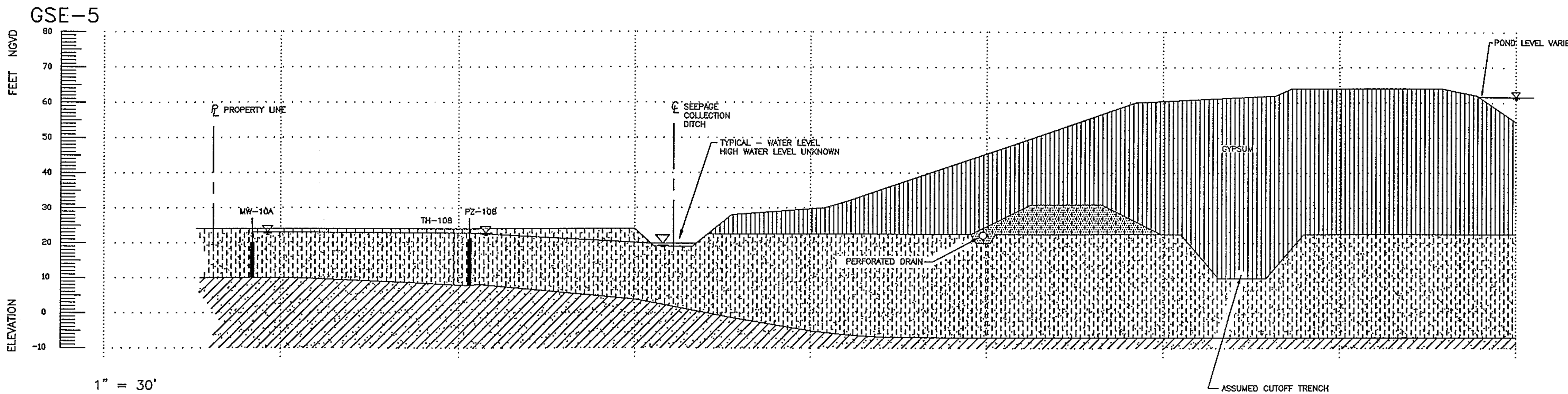
NEW SOUTH GYPSUM STACK
EAST WALL



CROSS SECTION
LOOKING SOUTH

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

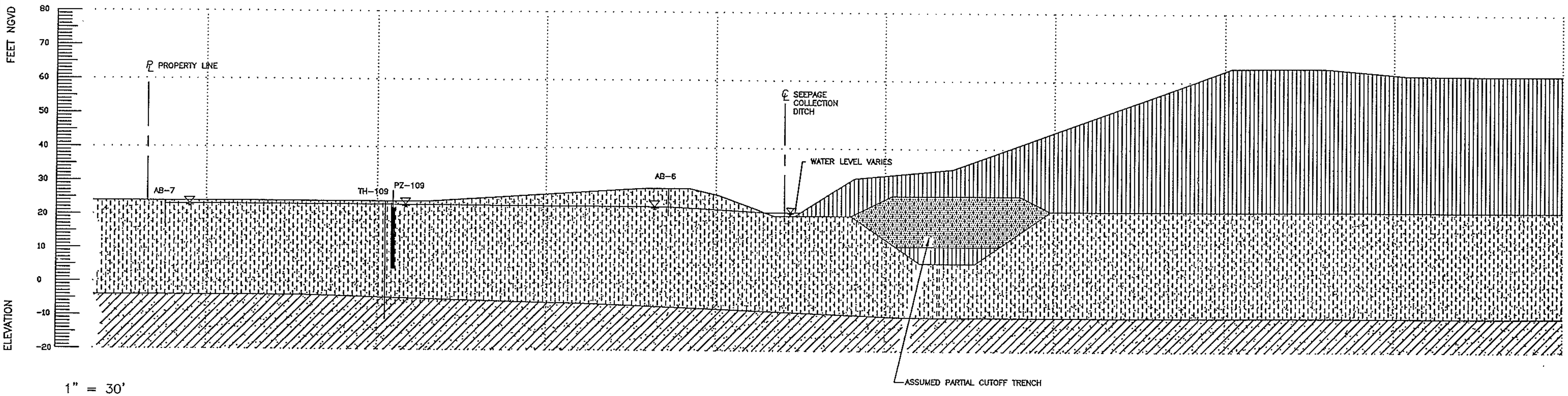
LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH-108 STANDARD PENETRATION TEST BORING
- WATER LEVEL ON 11-23-02

EXISTING CONDITIONS SECTION		
Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
NEW SOUTH GYPSUM STACK PINEY POINT PHOSPHATES, INC. MANATEE COUNTY, FLORIDA		
DRAWN BY: NPS	CHECKED BY:	DATE: 11-06-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 15

NEW NORTH GYPSUM STACK
NORTH WALL

GSE–6



1" = 30'

CROSS SECTION
LOOKING EAST

LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH–109 STANDARD PENETRATION TEST BORING NO. – TYPICAL
- WATER LEVEL ON 11–23–02

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA & SITE OBSERVATIONS

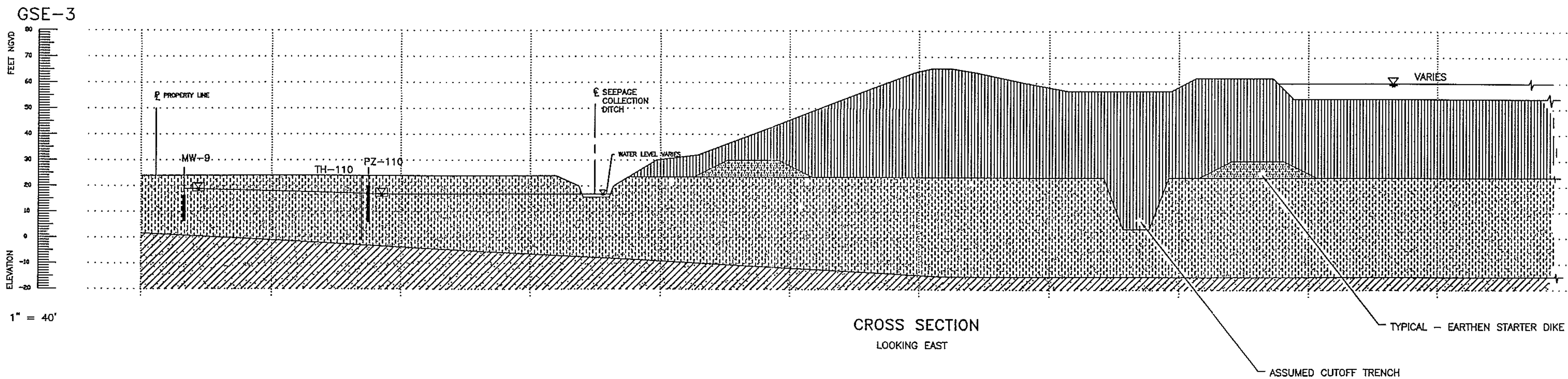
EXISTING CONDITIONS SECTION

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

NEW NORTH GYPSUM STACK
PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY,
FLORIDA

DRAWN BY: NPS	CHECKED BY:	DATE: 08-28-01
FILE NO. 02–099	APPROVED BY:	FIG. NO. 16

NEW NORTH GYPSUM STACK
NORTH WALL



CROSS SECTION
LOOKING EAST

NOTES:

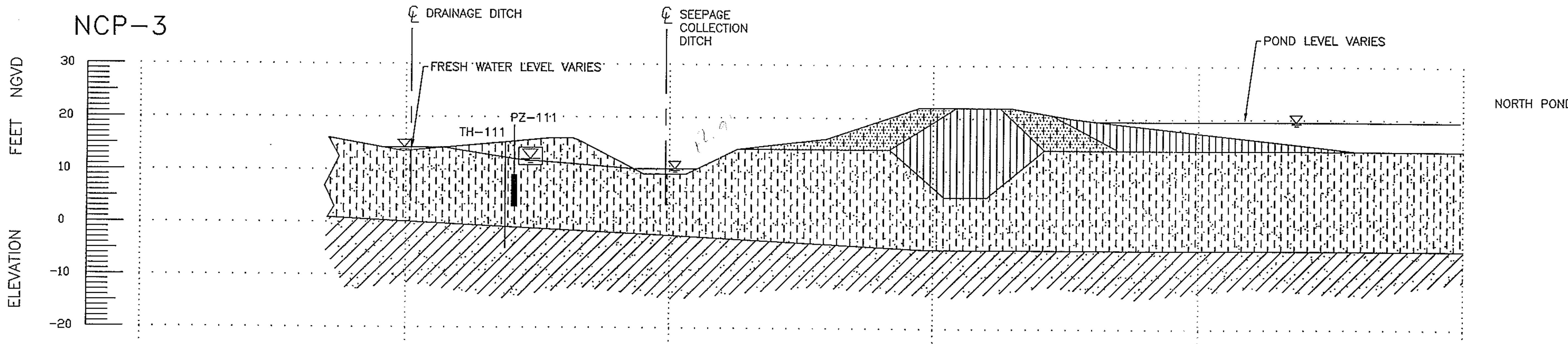
1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

LEGEND

- SANDS TO SILTY SANDS – FILL –
- GYPSUM – FILL –
- SANDS TO SILTY SANDS
- CLAYEY SAND TO SANDY CLAY
- STANDPIPE PIEZOMETER
- COLLECTION ZONE
- TH-110 STANDARD PENETRATION TEST BORING NO. – TYPICAL
- WATER LEVEL ON 11-23-02

EXISTING CONDITIONS SECTION		
Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
NEW NORTH GYPSUM STACK PINEY POINT PHOSPHATES, INC. MANATEE COUNTY, FLORIDA		
DRAWN BY: NPS	CHECKED BY:	DATE: 09-21-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 17

NORTH COOLING POND
NORTH WALL



1" = 20'

LEGEND

SANDS TO SILTY SANDS – FILL –

GYPSUM – FILL –

SANDS TO SILTY SANDS

CLAYEY SAND TO SANDY CLAY

STANDPIPE PIEZOMETER

COLLECTION ZONE

TH-111 STANDARD PENETRATION TEST BORING NO. – TYPICAL

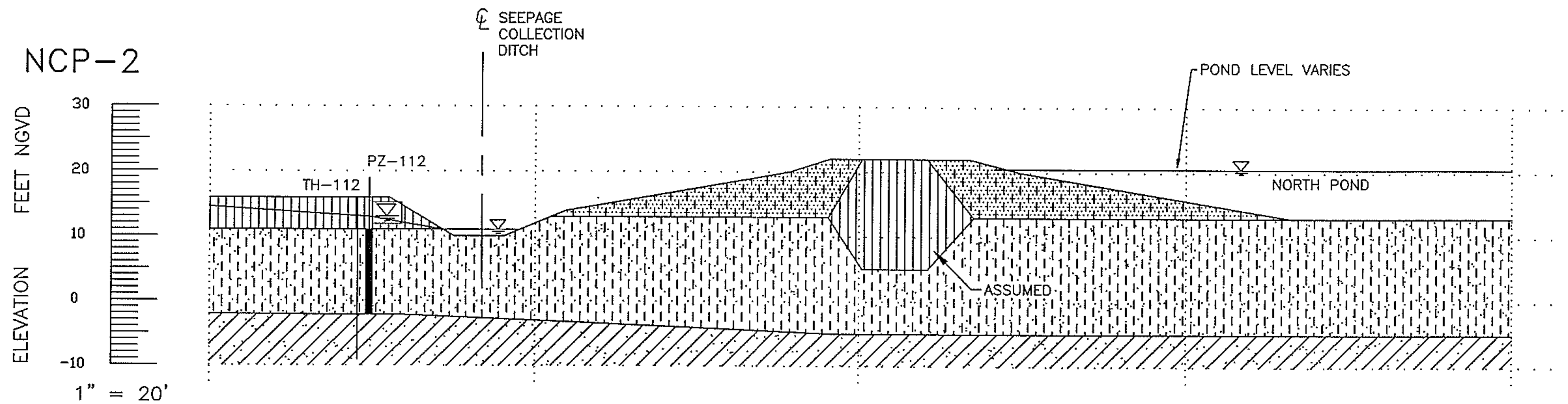
WATER LEVEL ON 11-23-02

NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

EXISTING CONDITIONS SECTION		
Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
NORTH COOLING POND PINEY POINT PHOSPHATES, INC MANATEE COUNTY, FLORIDA		
DRAWN BY: NPS	CHECKED BY:	DATE: 09-11-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 18

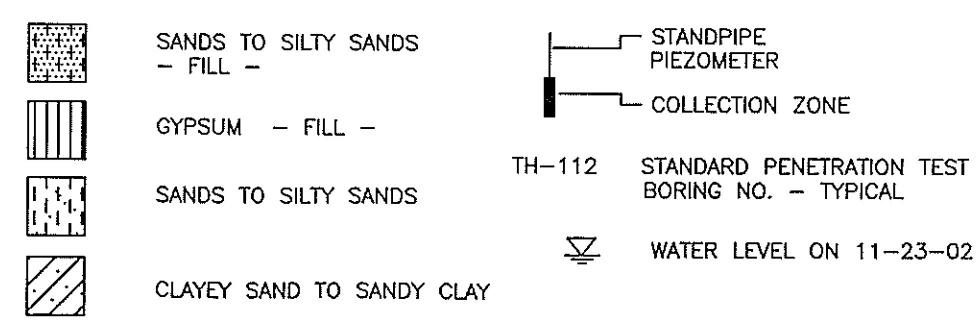
NORTH COOLING POND
WEST WALL



CROSS SECTION

LOOKING NORTH

LEGEND



NOTES:

1. EXISTING GEOMETRY BASED ON I.F. ROOKS INC. (JUNE 2001 & SEPT. 2002) TOPOGRAPHIC SURVEY
2. SOIL STRATIGRAPHY BASED ON LIMITED SOIL BORING DATA

EXISTING CONDITIONS SECTION		
Ardaman & Associates, Inc. Geotechnical, Environmental and Materials Consultants		
NORTH COOLING POND PINEY POINT PHOSPHATES, INC MANATEE COUNTY, FLORIDA		
DRAWN BY: NPS	CHECKED BY:	DATE: 08-28-01
FILE NO. 02-099	APPROVED BY:	FIG. NO. 19

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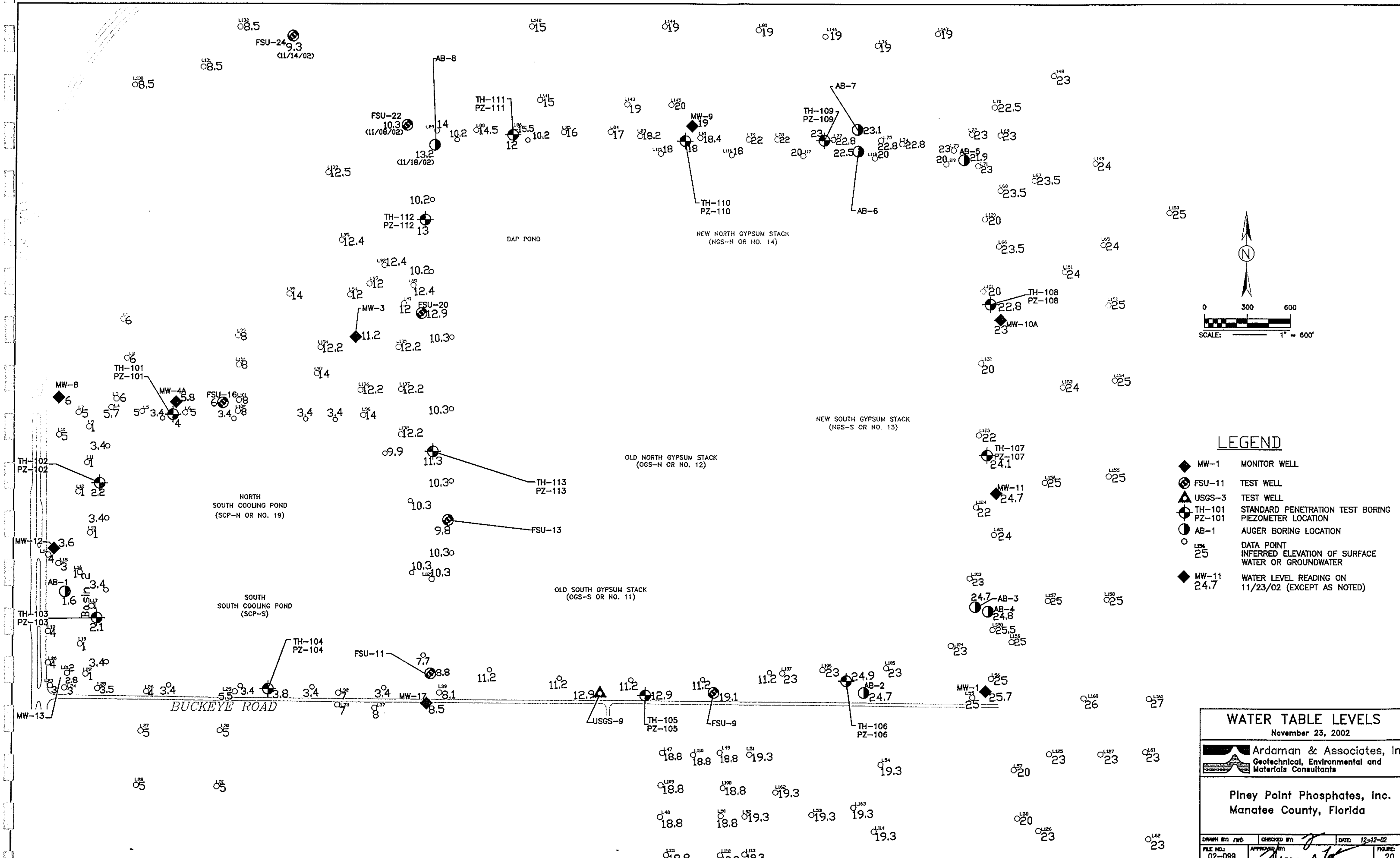
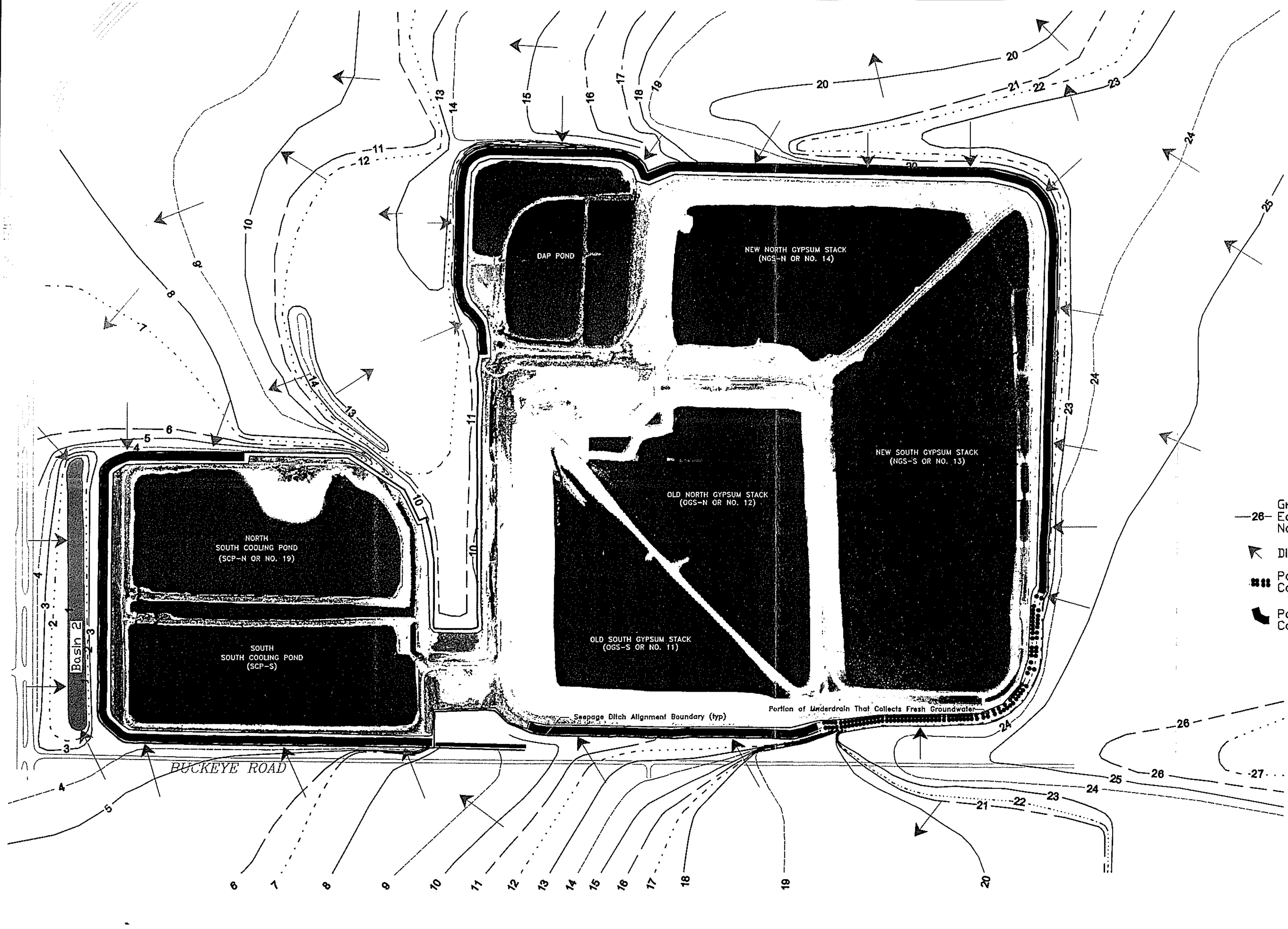


WATER TABLE LEVELS
November 23, 2002

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

Piney Point Phosphates, Inc.
Manatee County, Florida

DRAWN BY: mrb	CHECKED BY:	DATE: 12-12-02
FILE NO.: 02-099	APPROVED BY:	FIGURE: 20



N

0 300 600

SCALE: 1" = 600'

LEGEND

—26— Groundwater Elevation - Equal Contour - Feet (NGVD) November 23, 2002

Direction of Groundwater Flow

Portion of Underdrain That Collects Fresh Ground Water

Portion of Seepage Ditch That Collects Fresh Ground Water

WATER TABLE SURFACE MAP

November 23, 2002

Ardaman & Associates, Inc.
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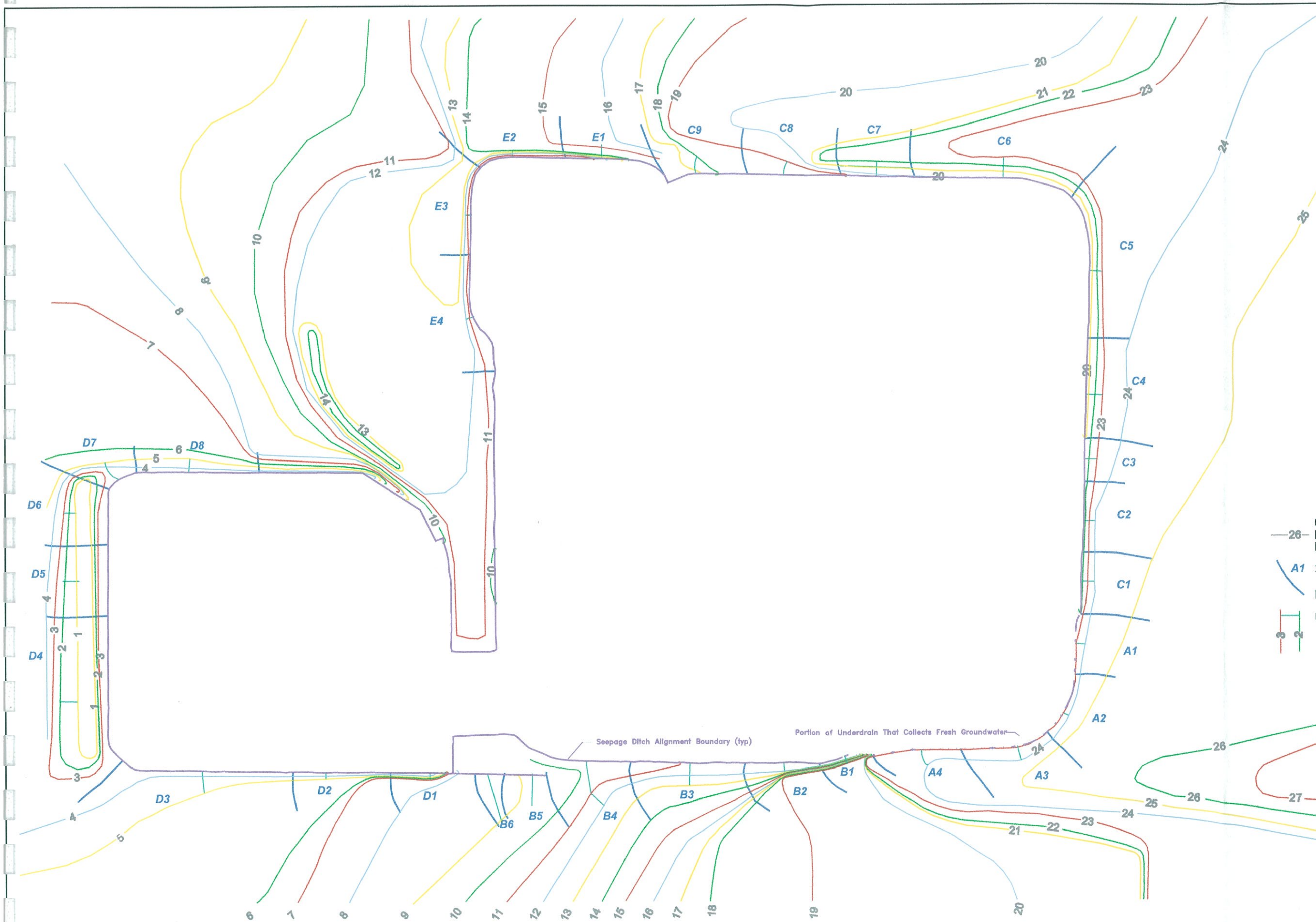
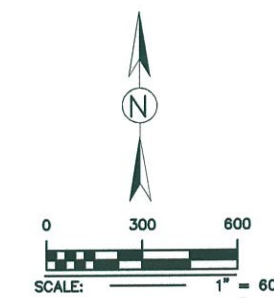
Piney Point Phosphates, Inc.
Manatee County, Florida

DRAWN BY: rwb	CHECKED BY:	DATE: 12-12-02
FILE NO.: 02-099	APPROVED BY:	FIGURE: 21





LEGEND

—26— Groundwater Elevation - Equal Contour - Feet (NGVD) November 23, 2002

A1 Seepage Ditch/Drain Reach Label

Reach Limit

Gradient Perpendicular to Reach

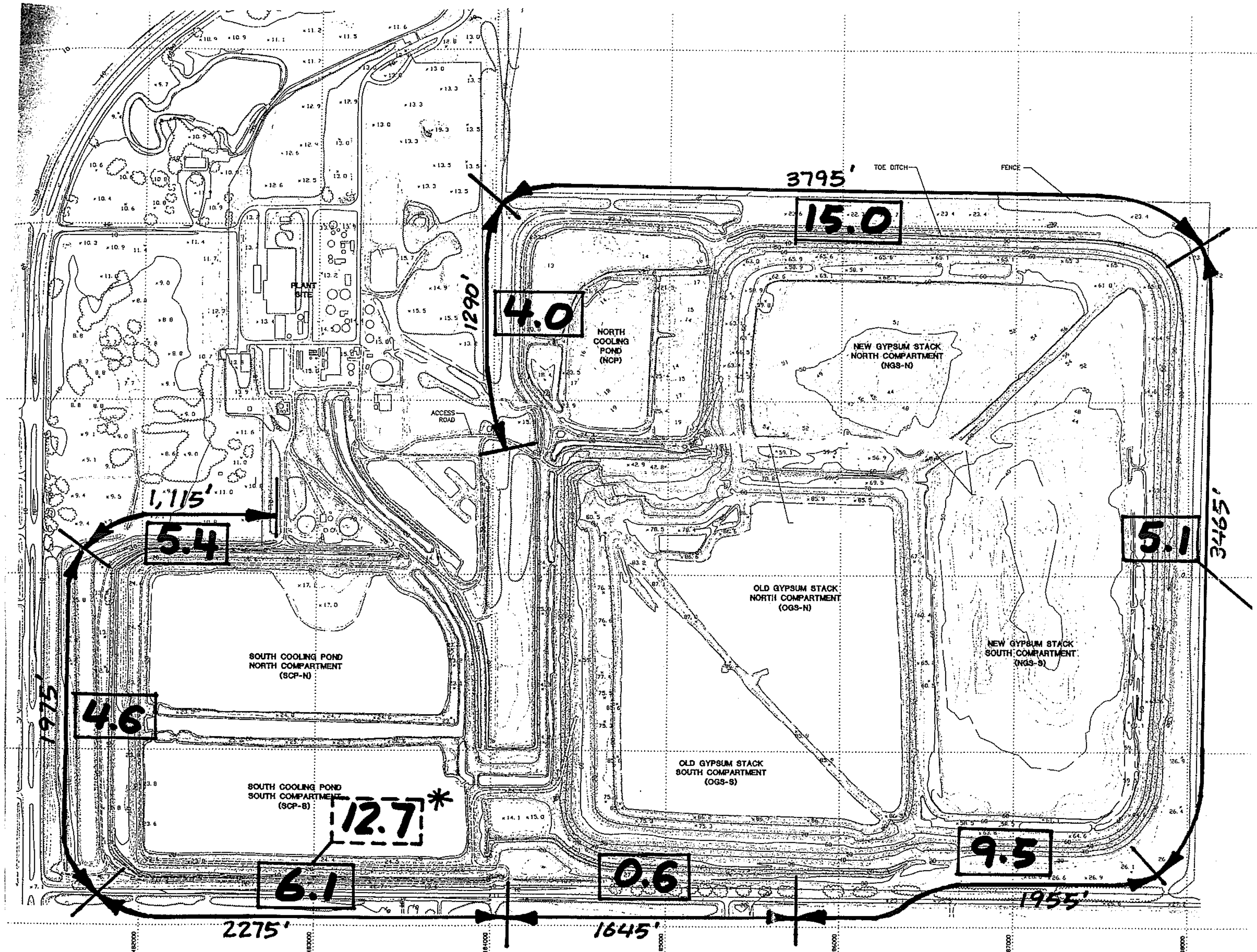
SEEPAGE DITCH REACH MAP

November 23, 2002

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

Piney Point Phosphates, Inc.
Manatee County, Florida

DRAWN BY: rwb	CHECKED BY:	DATE: 12-12-02
FILE NO.: 02-099	APPROVED BY:	FIGURE: 22



* ELEVATED SEEPAGE FLOW RATE DURING USE OF BUCKEYE ROAD DITCH FOR CONVEYING TREATED WATER TO OUTFALL 001

AVERAGE RATE OF FRESH GROUNDWATER SEEPAGE FLOW INTO PHOSPHOGYPSUM STACK SYSTEM; GPM/1000

SEEPAGE INFLOW RATE MAP

Ardaman & Associates, Inc.
Geotechnical, Environmental and Materials Consultants

PINEY POINT PHOSPHATES, INC.
MANATEE COUNTY, FLORIDA

DRAWN BY: RW	CHECKED BY:	DATE: 04-08-03
FILE NO. 02-099	APPROVED BY:	FIG. NO. 23

APPENDIX I

STANDARD PENETRATION TEST

The Standard Penetration Test is a widely accepted method of in-situ testing of foundation soils (ASTM D 1586). A two-foot long, two-inch outside diameter split-barrel ("spoon") sampler, attached to the end of drilling rods, is driven 18 inches into the ground by successive blows of a 140-pound hammer freely dropping 30 inches. The number of blows needed for each six inches of penetration is recorded. The sum of the blows required for penetration of the second and third six-inch increments of penetration constitutes the test result or N-value. After the test, the sampler is extracted from the ground and opened to allow visual examination and classification of the retained soil sample. The N-value has been empirically correlated with various soil properties allowing a conservative estimate of the behavior of soils under load.

The tests are usually conducted at five-foot intervals. However, more frequent or continuous testing is done by our firm through depths where a more accurate definition of the soils is required. The test holes are advanced to the test elevations by rotary drilling with a cutting bit, using circulating fluid to remove the cuttings and hold the fine grains in suspension. Usually, the circulating fluid, which is a bentonite drilling mud, also serves to keep the hold open below the water table by maintaining an excess hydrostatic pressure inside the hole. In some soil deposits, particularly highly pervious ones, flush-coupled casing must be driven to just above the testing depth to keep the hold open and/or to prevent the loss of circulating fluid.

Representative split-spoon samples from soils at every five feet of drilled depth and from every different stratum are brought to our laboratory in airtight jars for further evaluation and testing, if necessary. Samples not used in testing are stored for at least sixty (60) days prior to being discarded. After completion of a test boring, the hole is kept open until a steady state groundwater level is recorded. The hole is then sealed, if necessary, and backfilled.

C:\SHELLS\appendix.spt
11/99 - WP9