GEOTECHNICAL INVESTIGATION TO ESTIMATE AQUIFER PARAMETERS

FES STORMWATER DESIGNER'S COURSE

Note the word is estimate & not determine.

Must appreciate the physical meaning of each aquifer parameter.

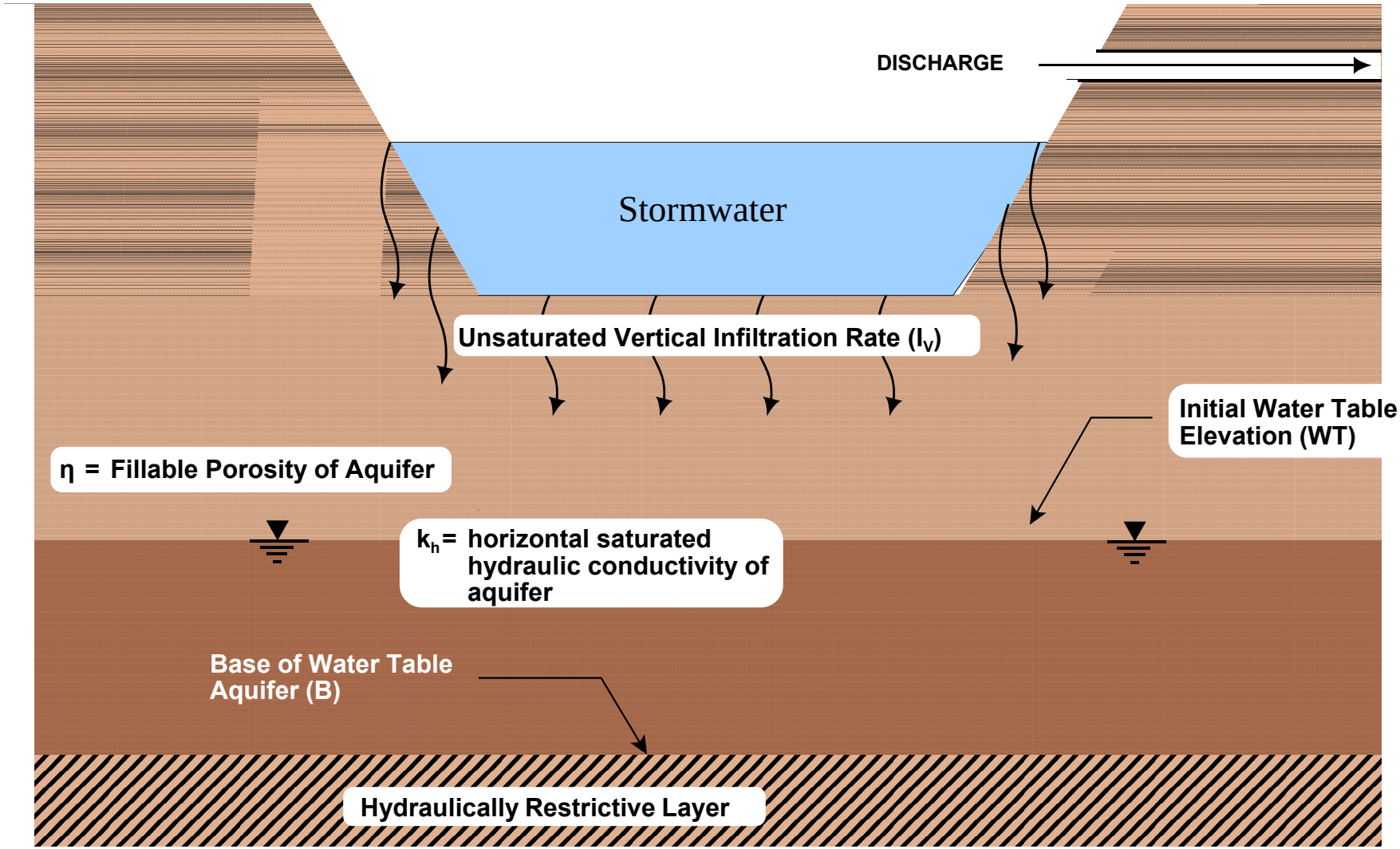
Aquifer, in this sense, does not refer to the Floridan aquifer but usually the uppermost sand aquifer into which the pond is excavated.

This task should be conducted by an experienced geotechnical engineer.

Two important references:

- **SWFWMD Training Workshop on SHWT (1998 Edition)**
- **Section 7.2 of SJRWMD Special Publication SJ93-SP10**

VISUALIZATION OF THE AQUIFER PARAMETERS



GEOTECHNICAL INVESTIGATION -STORMWATER PONDS

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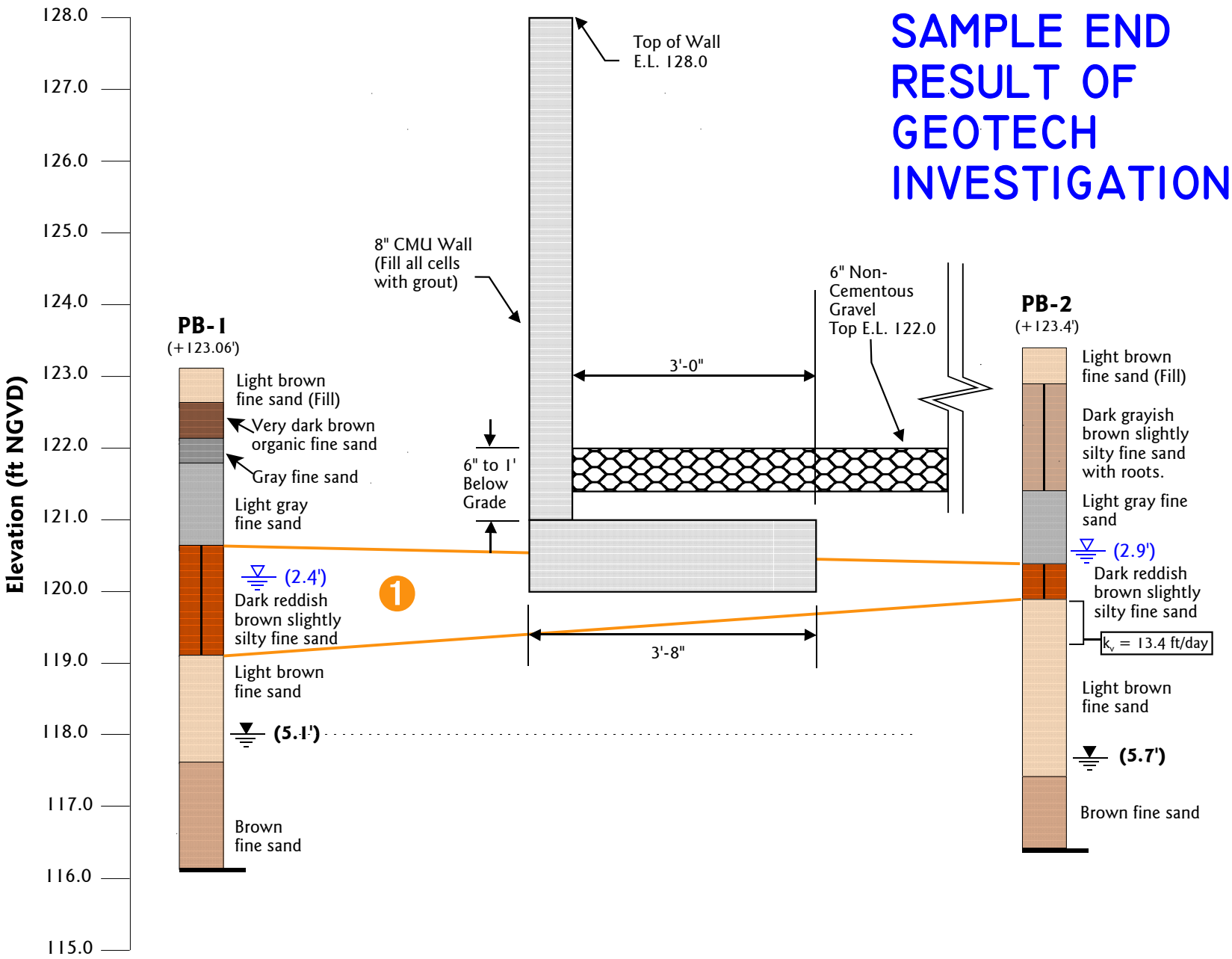
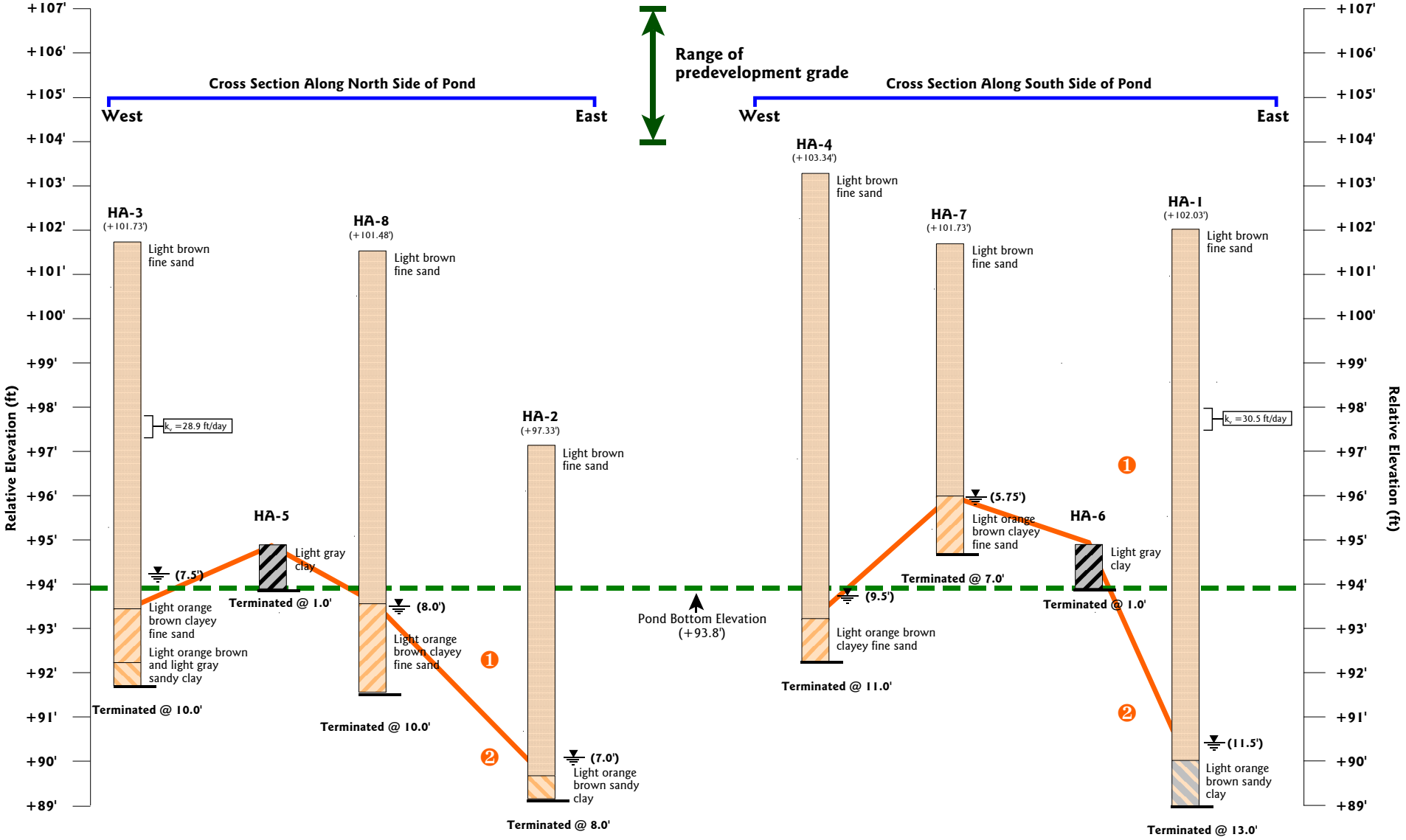
- Objective of the soils report is to provide numerical values for the following aquifer parameters:
  - Seasonal high water table (ft NGVD)
  - Seasonal fluctuation of water table (ft) [only for wet pond]
  - Base of effective aquifer (ft NGVD)
  - Weighted horizontal hydraulic conductivity of effective aquifer (ft/day)
  - Fillable porosity
  - Unsaturated vertical infiltration rate (ft/day) [only for dry pond where unsaturated flow is being considered]
- Parameters should be clearly stated in one section or in a table of the soils report. It should not be buried within the verbage of the report.


SAMPLE END RESULT OF GEOTECH INVESTIGATION
Elevation (ft NGVD)
128.0
127.0
126.0
125.0
124.0
123.0
122.0
121.0
120.0
119.0
118.0
117.0
116.0
115.0
Top of Wall
E.L. 128.0
8" CMU Wall
(Fill all cells
with grout)
6" Non-
Cementous
Gravel
Top E.L. 122.0
3'-0"
6" to 1'
Below
Grade
PB-1
(+123.06')
Light brown
fine sand (Fill)
Very dark brown
organic fine sand
Gray fine sand
Light gray
fine sand
(2.4')
Dark reddish
brown slightly
silty fine sand
Light brown
fine sand
(5.1')
Brown
fine sand
1
3'-8"
PB-2
(+123.4')
Light brown
fine sand (Fill)
Dark grayish
brown slightly
silty fine sand
with roots.
Light gray fine
sand
(2.9')
Dark reddish
brown slightly
silty fine sand
k_v = 13.4 ft/day
Light brown
fine sand
(5.7')
Brown fine sand

SAMPLE END RESULT OF GEOTECH INVESTIGATION



GEOTECHNICAL INVESTIGATION -STORMWATER PONDS

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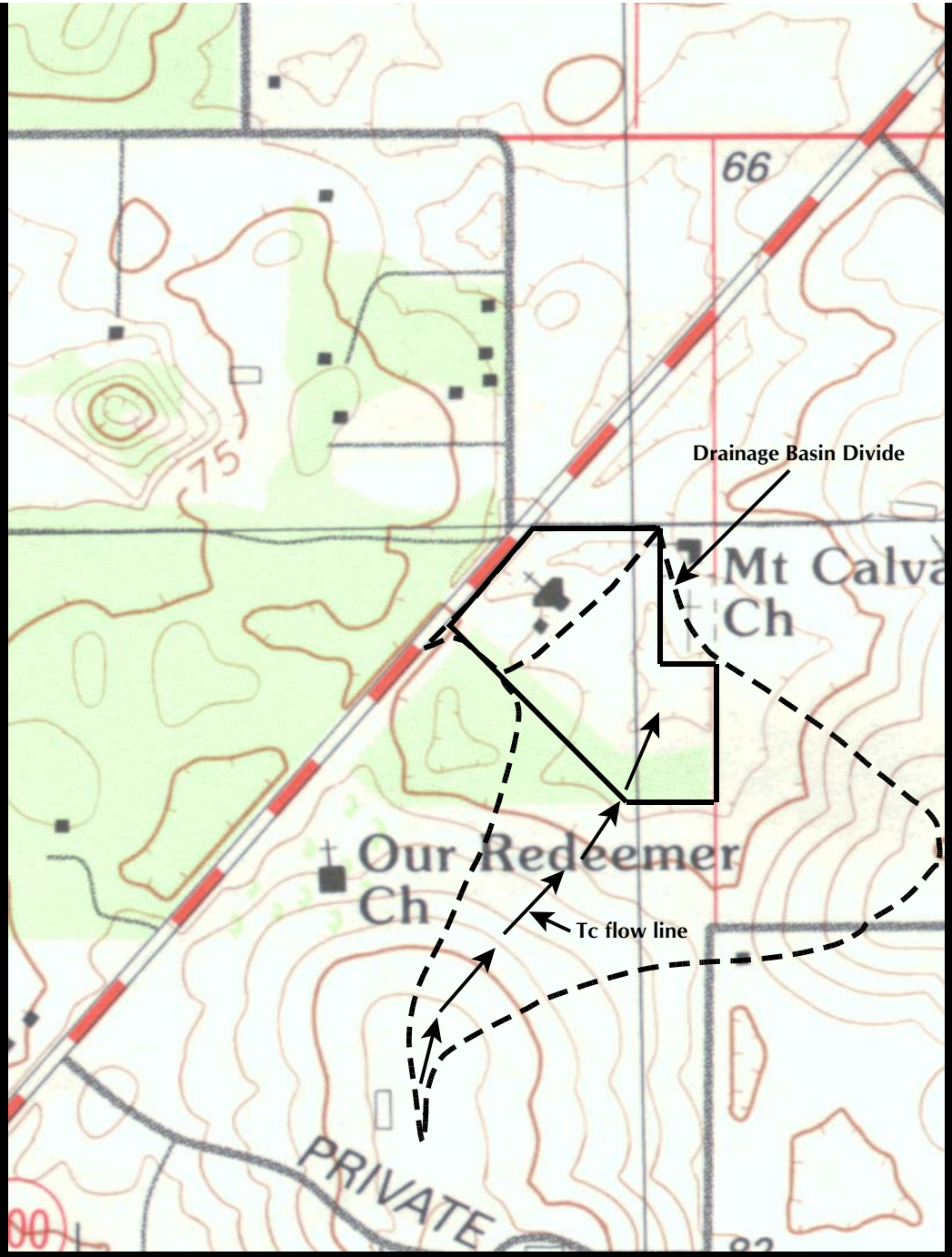
- Review of published data to include:
  - USGS quad map (look at lay of the land and any closed depressions, and contributing drainage basins; good practice to field verify drainage basin divides).
  - NRCS (formerly SCS) soils map. NRCS data is now available on the internet.
  - Aerial photos
  - Subregional map of potentiometric surface of Floridan aquifer and compare to land surface elevation or water table elevation
- Map data to include:
  - Location of pond within development
  - Location of adjacent water bodies and wetlands and their water elevations



REVIEW USGS QUADRANGLE MAP

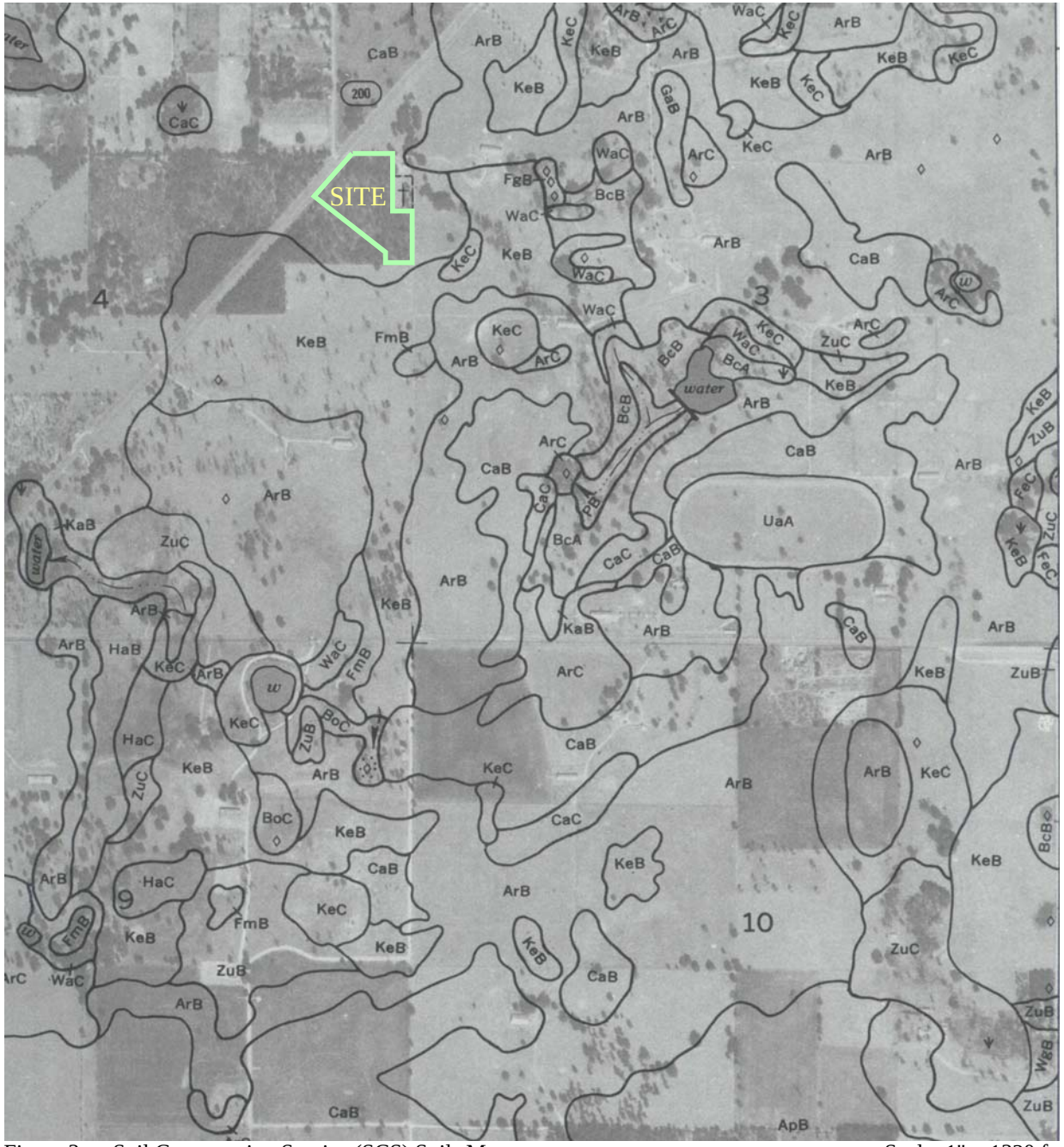


Figure 3. Soil Conservation Service (SCS) Soils Map Scale: 1" = 1320 ft.

Legend

CaB - Candler sand, 0 to 5 percent slopes

Table 3: Key SCS Characterization Data for Arredondo Sand [ArB (0-5% slopes)]

This is a nearly level to sloping, well drained soil that occurs as both large and small areas in the upland. The water table is at a depth of more than 72 inches.		
Hydrologic Soil Group (HSG)		**A**
REPRESENTATIVE SOIL PROFILE		
Depth	**Soil Color & Texture**	**Permeability**
0 - 7 in	dark grayish brown sand	12 to 40 ft/day
7 - 18 in	mixed yellowish brown and dark yellowish brown sand	
18 - 46 in	yellowish brown sand	
46 - 65 in	strong brown sand	
65 - 70 in	strong brown loamy sand	4 to 12 ft/day
70 - 90 in	strong brown fine sandy loam	

Minimum Requirements for Soils Reports

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- Site-specific geotechnical data to include:
  - Location of borings within or adjacent to pond. The geotechnical engineer should select the number of pond borings based on the size of the pond. For guidance on the number of borings, refer to page 162 of SJ93-SP10.
  - Soil profiles with stabilized water table measurements at time of drilling
  - Results of hydraulic conductivity tests (if performed). Report should also state type of hydraulic conductivity test performed and reference the location and depth of the test
  - Explicit recommendations for each aquifer parameter

Estimating Aquifer Parameters

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- **Aquifer thickness: Refer to Section 7.2.1 of SJRWMD SJ93-SP10 for the recommended type and number of soil borings. Also refer to this section for how the soil profile should be interpreted.**
- **Fillable porosity: Refer to Section 7.2.4 of SJRWMD SJ93-SP10 for recommendations on how to estimate fillable porosity. Rules of thumb: 30% for HSG "A", 25% for HSG "B" & "C", and 20% for HSG "D".**
- **Weighted horizontal hydraulic conductivity: Refer to Section 7.2.3 of SJRWMD SJ93-SP10 for recommended test procedures and how the weighted average should be computed.**
- **Unsaturated vertical infiltration rate: use Double Ring Infiltrometer test (described later). Apply minimum safety factor of 2 to measured rate.**

Estimating Aquifer Parameters

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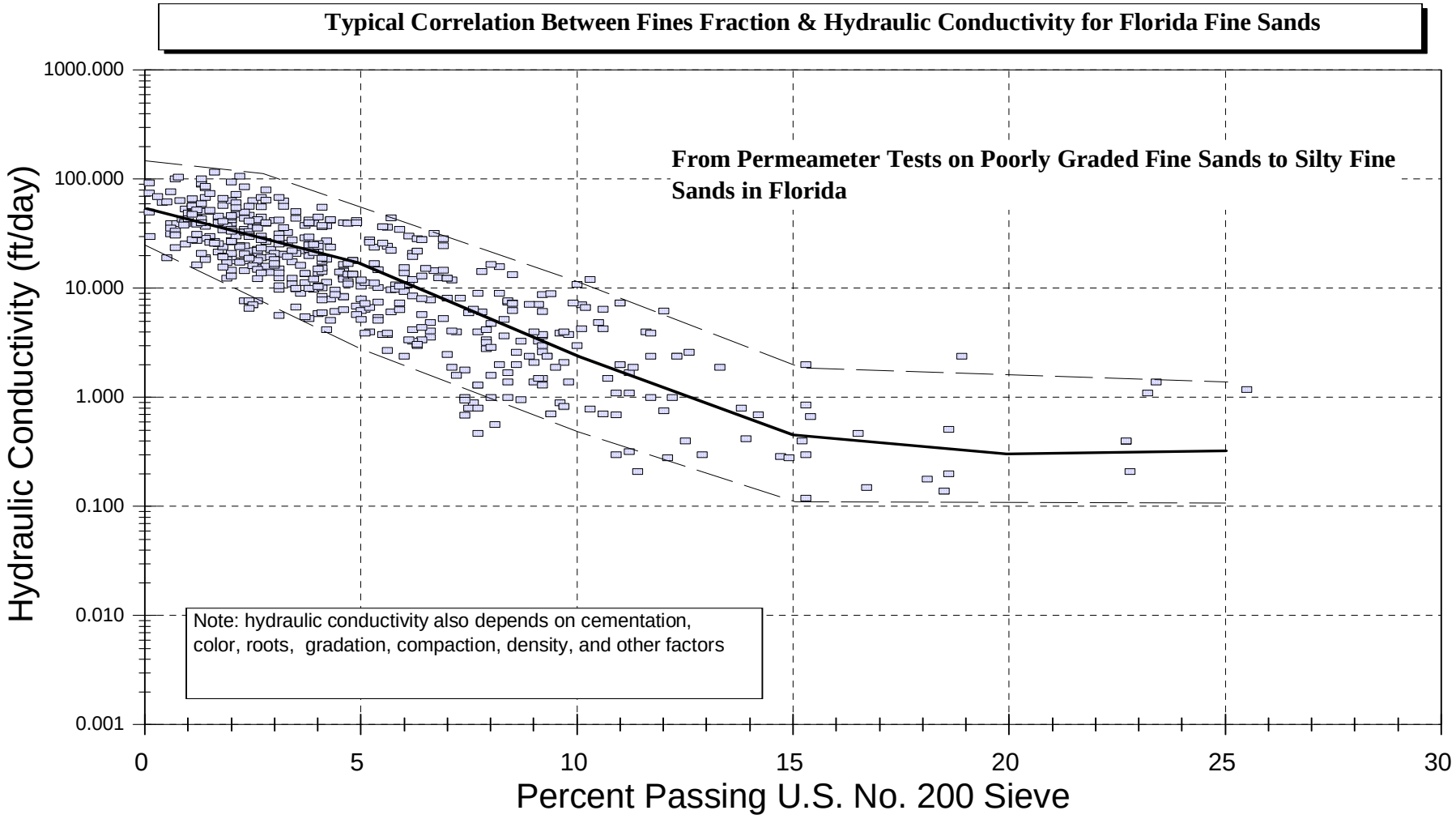
- Seasonal high water table: Refer to Section 7.2.2 of SJRWMD SJ93-SP10 for the recommended procedure. This technical procedure cross-references a paper I wrote on estimating the seasonal high water table. We will discuss this subject in some more detail in this workshop.
- Seasonal fluctuation of the water table: typically 3 to 4 ft in the pine flatwood soils and 6 ft or more in the sand ridge soils.


Typical Correlation Between Fines Fraction & Hydraulic Conductivity for Florida Fine Sands
From Permeameter Tests on Poorly Graded Fine Sands to Silty Fine Sands in Florida
Note: hydraulic conductivity also depends on cementation, color, roots, gradation, compaction, density, and other factors
Hydraulic Conductivity (ft/day)
1000.000
100.000
10.000
1.000
0.100
0.010
0.001
0
5
10
15
20
25
30
Percent Passing U.S. No. 200 Sieve

RESPONSE TO A FREQUENTLY ASKED QUESTION

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How can the unsaturated vertical infiltration rate be greater than the weighted horizontal saturated hydraulic conductivity?

Answer:

The unsaturated vertical infiltration rate controls how fast water can enter the soil infiltrative surface and fill the unsaturated zone above the water table. This infiltration rate is usually not affected by more hydraulically restrictive soils below the water table. A minimum factor of safety of 2 is usually applied to this parameter.

The weighted horizontal hydraulic conductivity is a weighted average of the assumed thickness of the aquifer which may include clayey sands (with low permeability) in the soil profile. This parameter multiplied by the assumed aquifer thickness controls the lateral transmission of water in the soil. The recommended safety factor for this parameter is unity since it is not subject to clogging as is the unsaturated vertical infiltrative surface.