Subsurface Investigation Overview

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December 5, 2008

Subsurface Investigation Overview

- **Drilling and Sampling**
- **Geophysical Testing**
- **CPT Testing**
- **Laboratory Testing**
- **Ground Water Monitoring Well Installation and Monitoring**

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Summary of Subsurface Investigation for Units 6 and 7

Field Investigation Summary

- **Drilling and Sampling**
  - 88 soil borings with SPT and rock coring
  - 2 additional borings with down-hole geophysical testing only drilled
    - -- SPT N values, Rock recovery and RQD measured)
- **Geophysical testing in 12 borings by P-S Suspension and downhole methods**

Boring Location Plan

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Drilling, Sampling, and Geophysical Summary

Unit 6

- 39 borings
- Maximum depth of 400 feet
- One boring with undisturbed (tube) samples
- 6 borings with geophysical testing
- SPT sampling every 5' to 100' and every 10 feet thereafter

Unit 7

- 38 borings
- Maximum depth of 616 feet
- 6 borings with geophysical testing
- SPT sampling every 5' to 100' and every 10 feet thereafter

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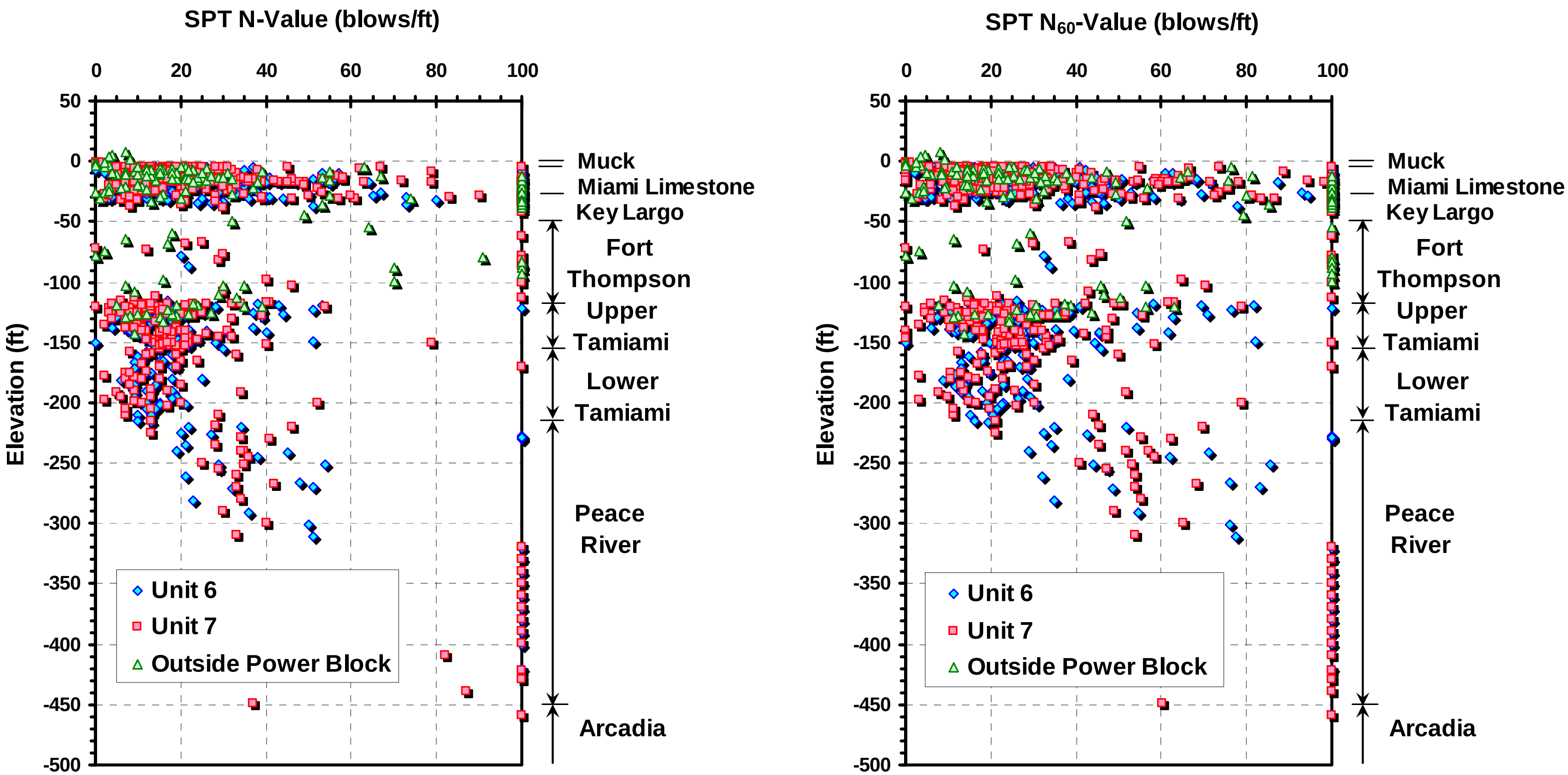
Summary of Measured and Corrected Blow Counts



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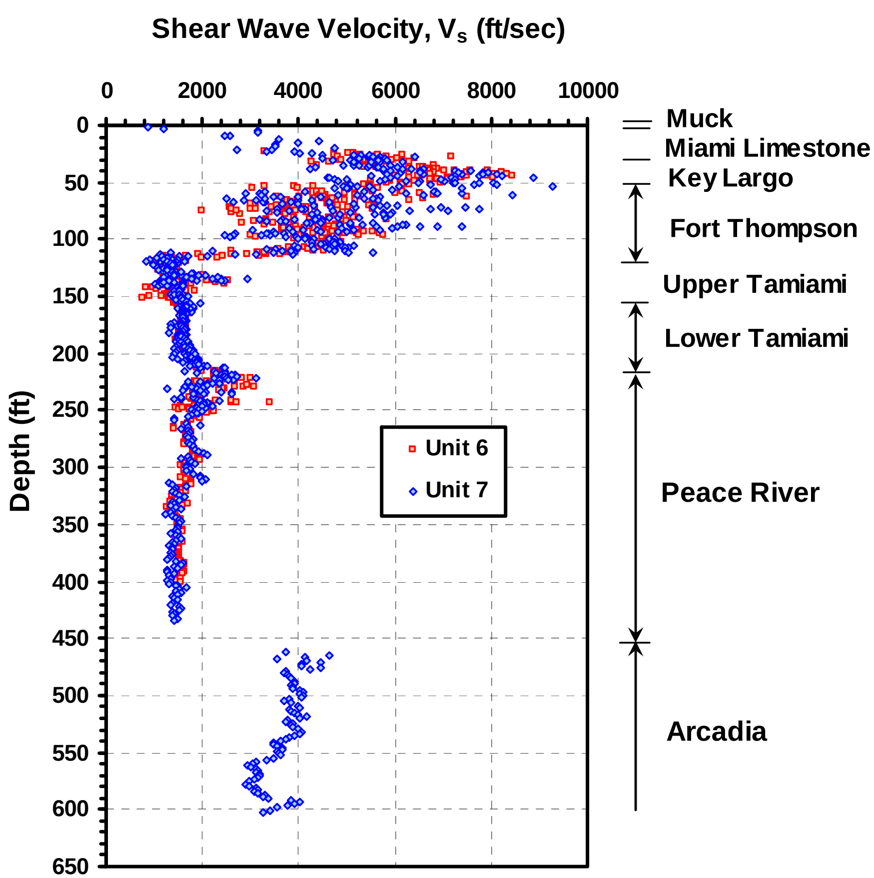
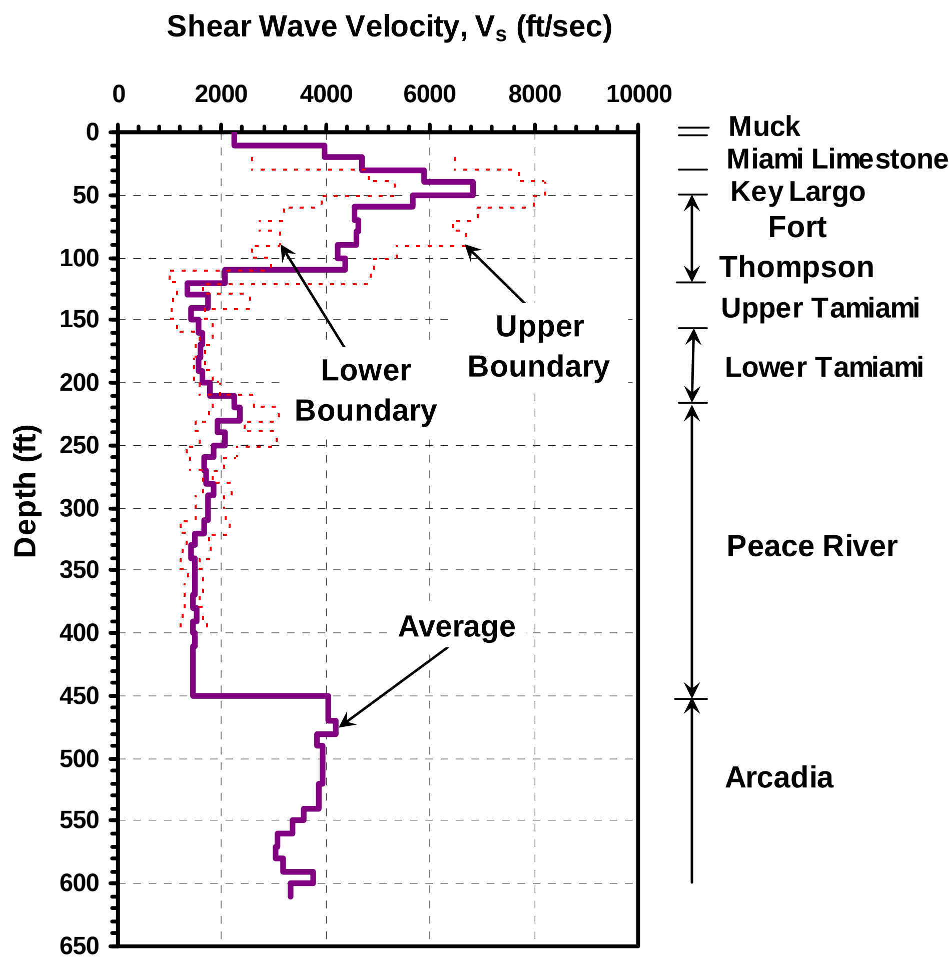
Geophysical Testing

- **Primary Method for Vs and Vp measurements: P-S suspension logging (GEOVision Inc.) – 10 borings**
- **Down-hole velocity measurements – 2 borings**
- **Caliper/Natural Gamma Measurements – 2 borings**
- **Resistivity/Spontaneous Potential – 2 borings**
- **Acoustic Televiewer/Boring Deviation – 2 borings**

Shear Wave Velocity Results (Suspension Logs)





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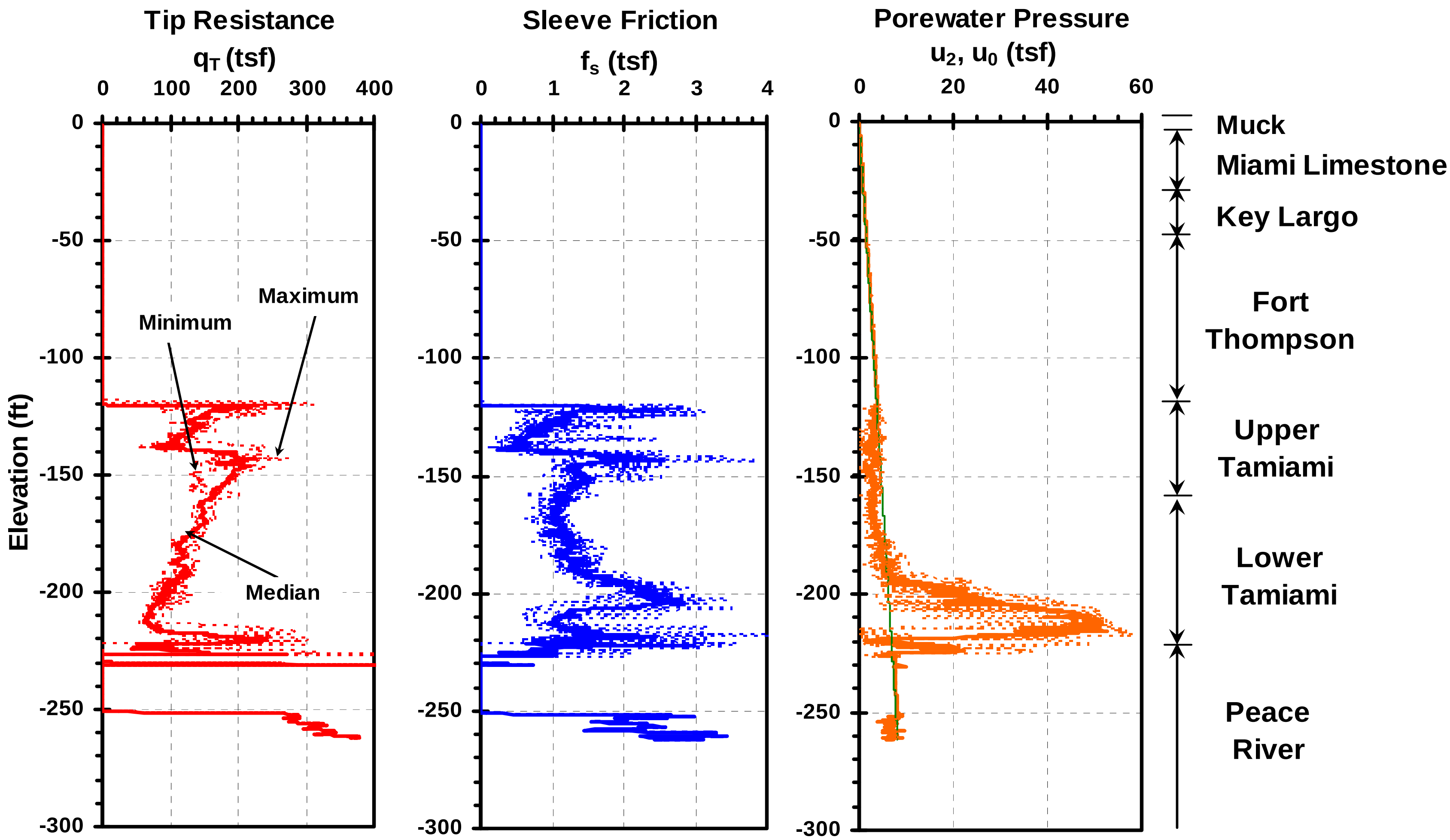
CPT Testing

- **Four probes**
- **Advanced through rock by boring**
- **Advanced 120 to about 220 feet bgs in 3 borings**
- **Advanced to 290 feet after coring through 220-250 feet in one boring**

CPT Data (Uncorrected)



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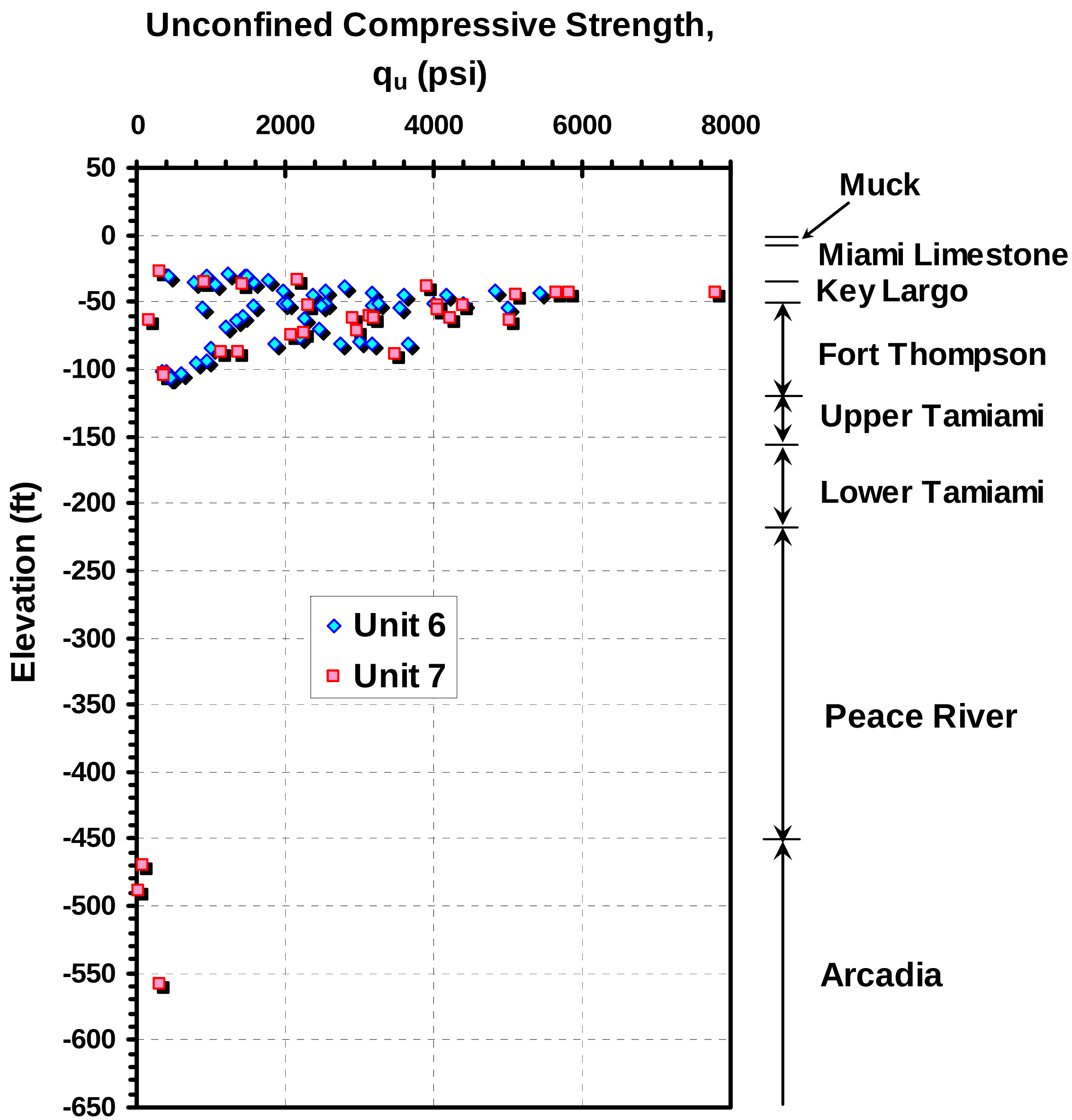
Laboratory Testing

Rock

- Unconfined Compressive Strength
- Unit Weights
- Moisture Content
- Carbonate
- Unconfined Strength with Stress-Strain (2 samples)

Rock UCS with Depth

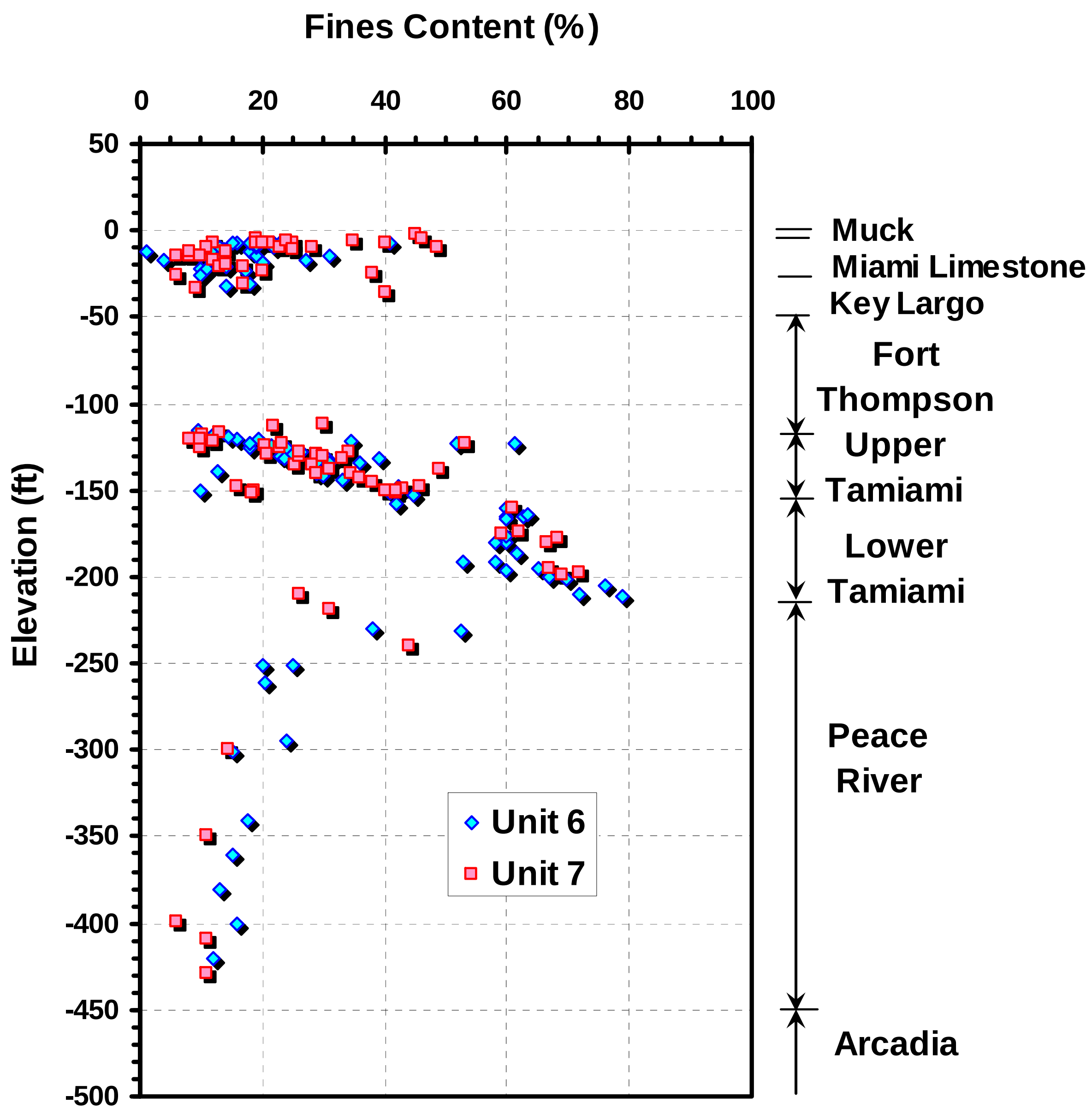


Laboratory Testing

Soil

- Index Testing
- Carbonate
- pH, Choride and Sulfate
- 7 RCTS in Upper and Lower Tamiami
- 1 CIU test in Lower Tamiami

Fines Content with Depth



Ground Water Monitoring Well Drilling and Installation

- **8 well pairs around perimeter and within island area**
- **2 clusters of 3 wells (606 & 706) with deeper wells (into Upper Tamiami)**
- **Wells screened in 3 zones**
- **Approx 15 to 25 feet bgs**
- **Approx 95 to 110 feet bgs**
- **Approx 125 to 135 feet bgs (606 and 706 only)**

Geotechnical Considerations

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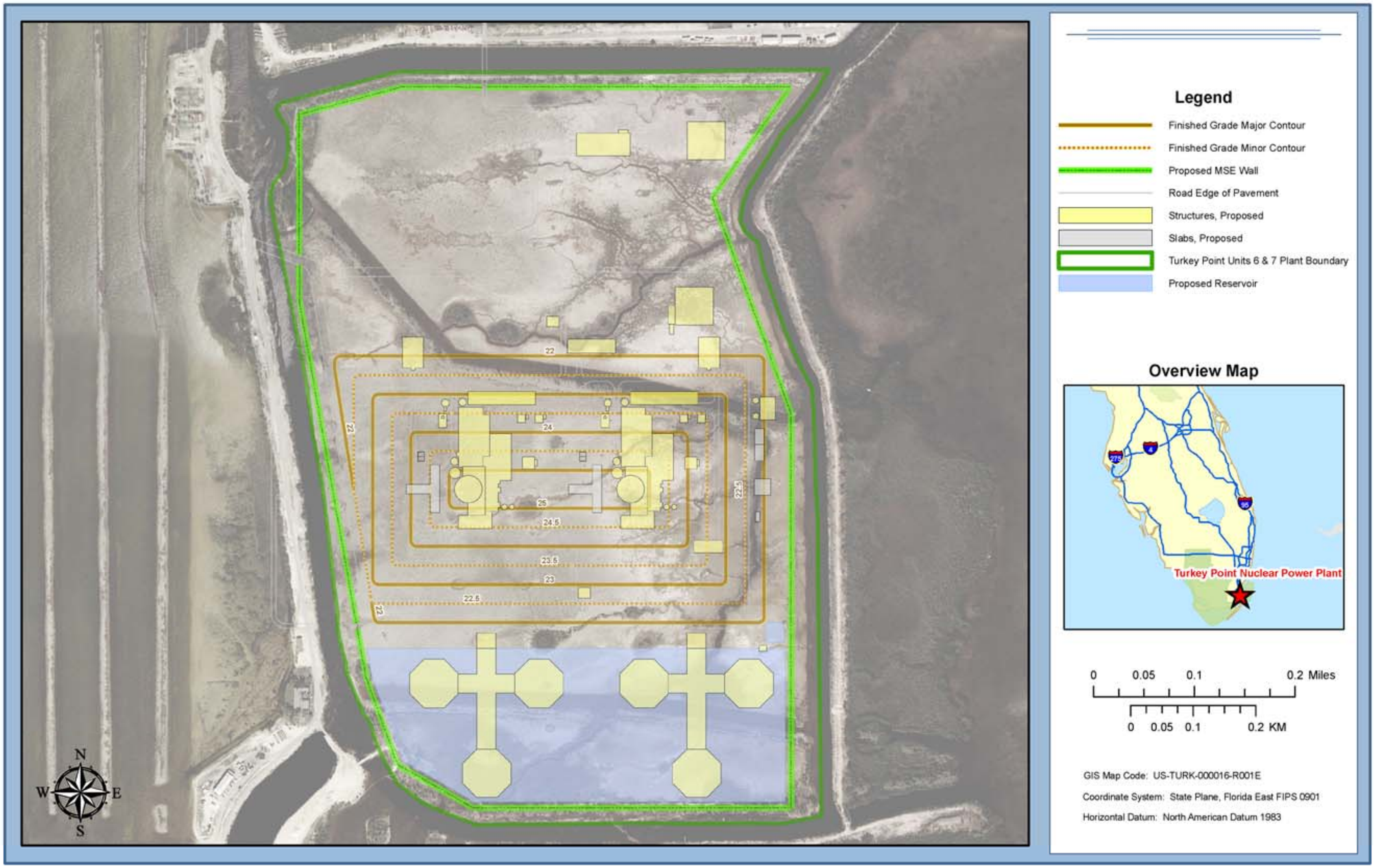
December 5, 2008

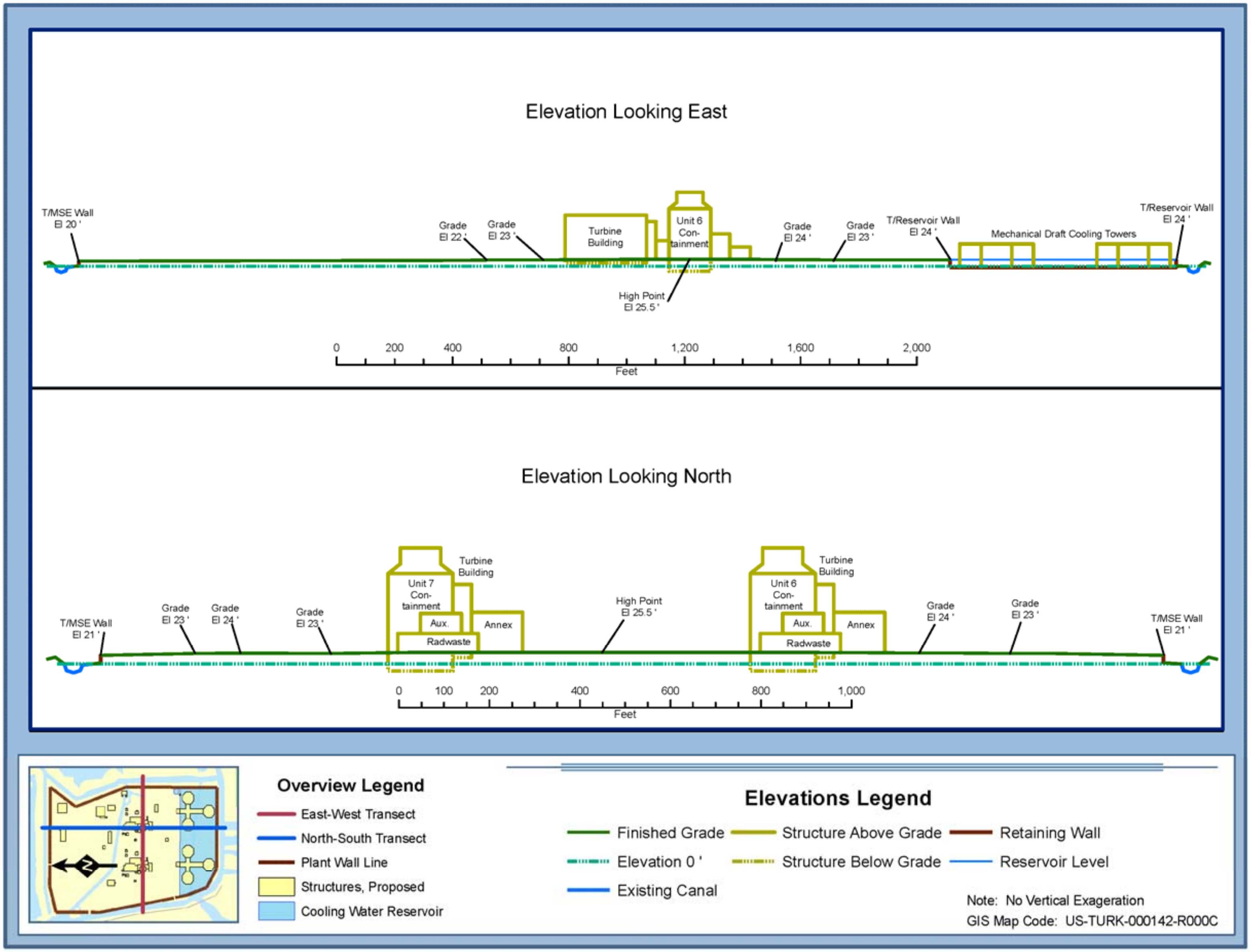
Geotechnical Considerations

- **Foundations**
- **Slopes**
- **Liquefaction**
- **Lateral Earth Pressures**

Planned Final Grading for Nuclear Island

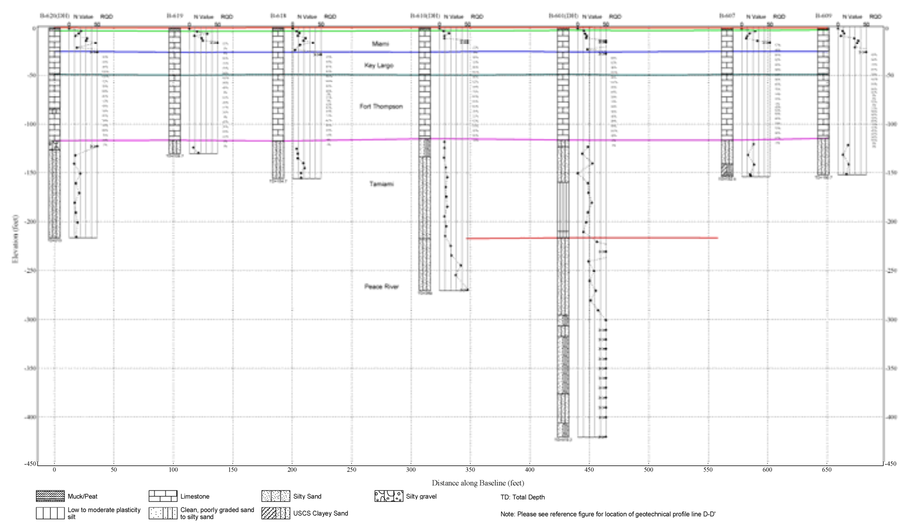


Planned Final Grading Sections for Nuclear Island

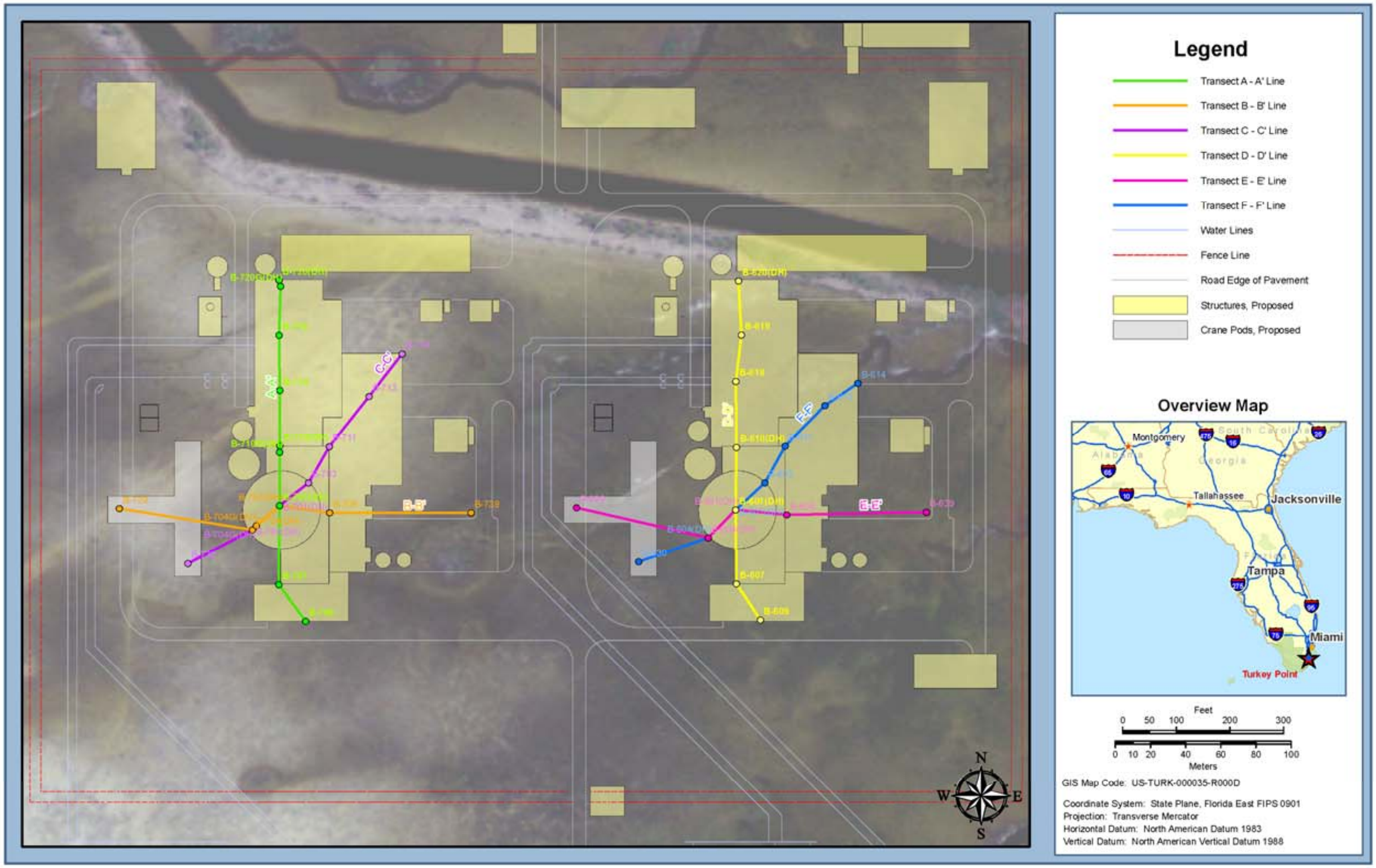


Field Investigation Conclusions

- **8 Strata Identified**
  - 4 soil/unconsolidated (including surficial muck)
  - 4 rock
  - Strata generally horizontally bedded and consistent across site
  - All strata below ground water
- **“Inverted” Shear Wave Velocity Profile in upper 450 feet**



Subsurface Sections in Power Block



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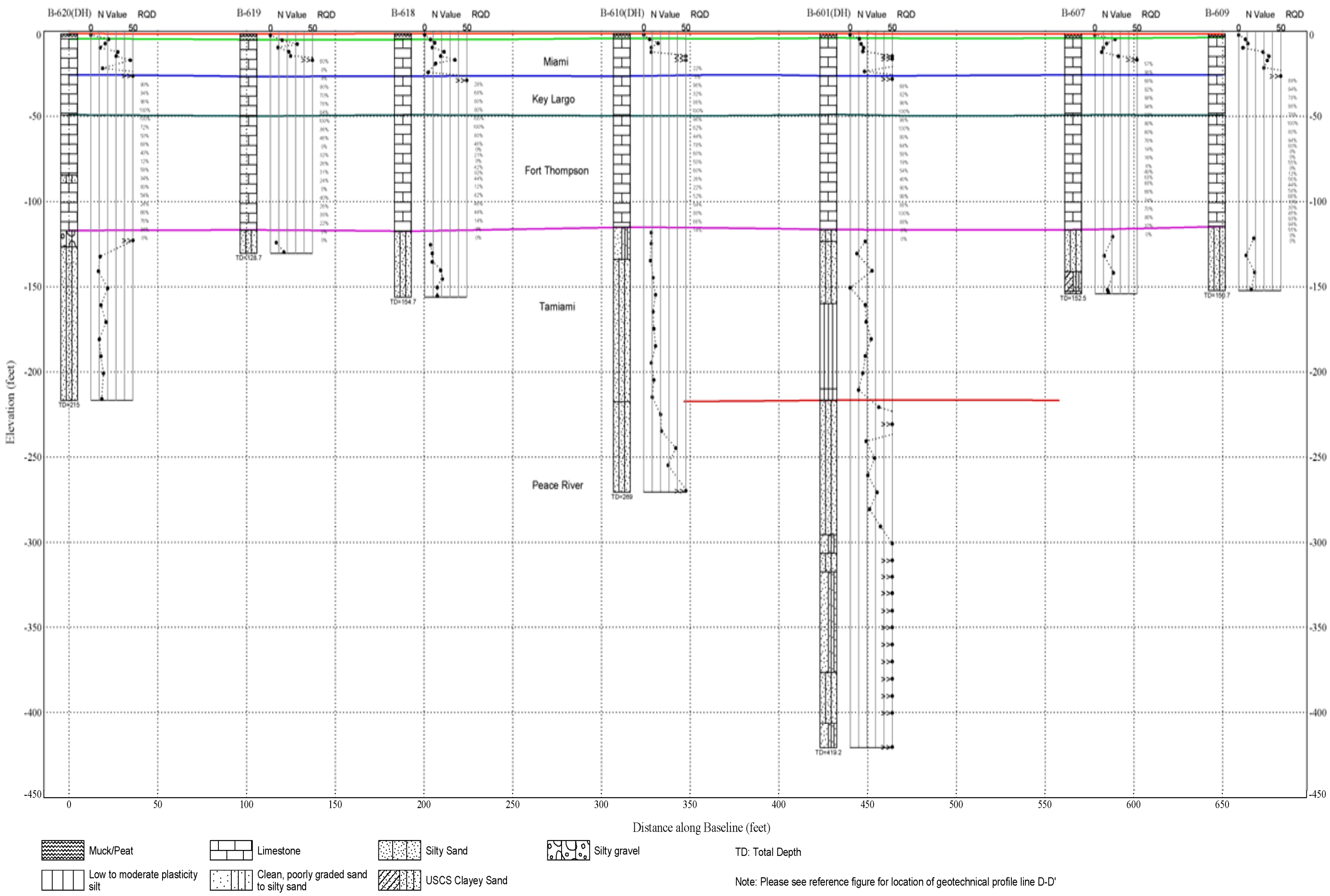
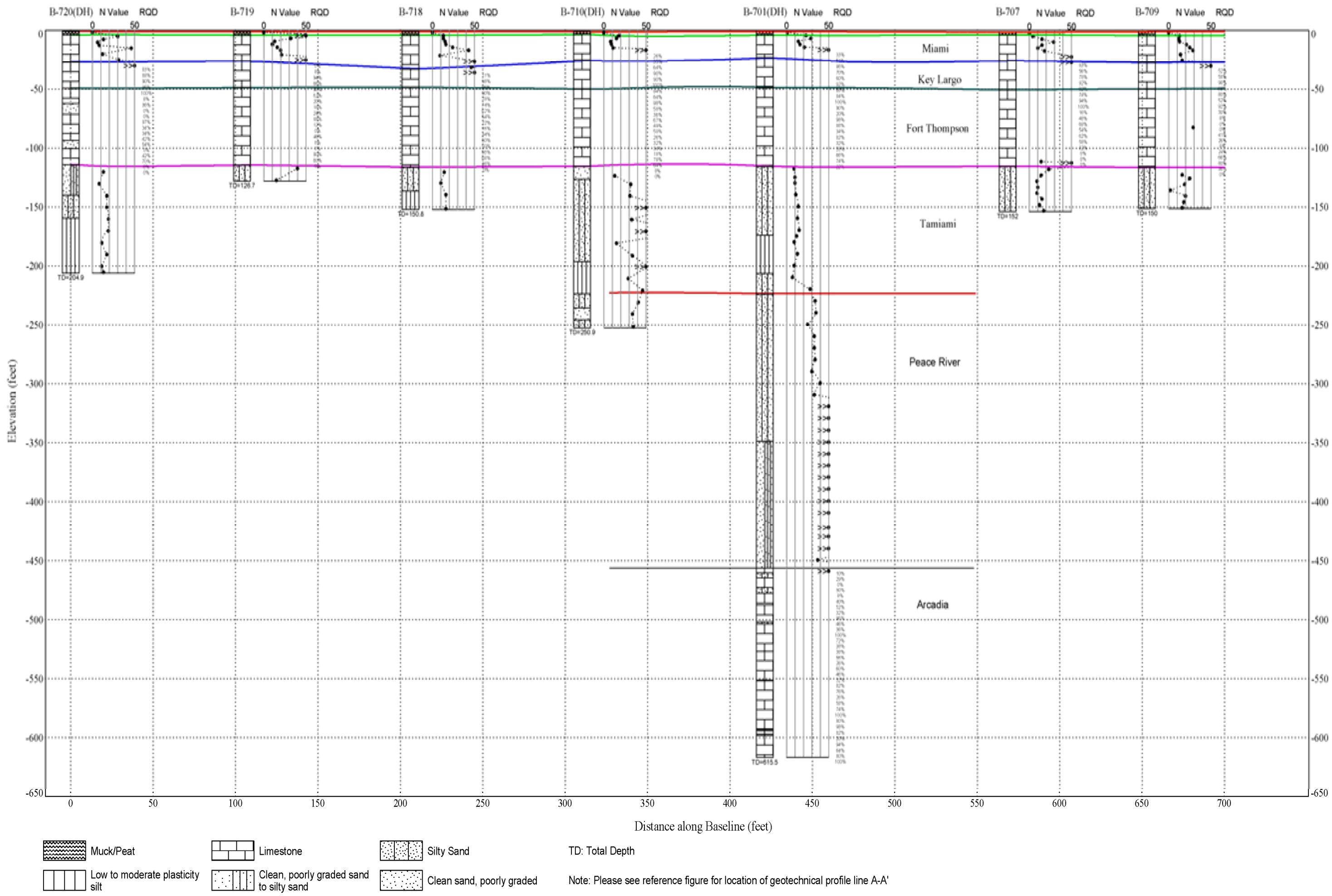
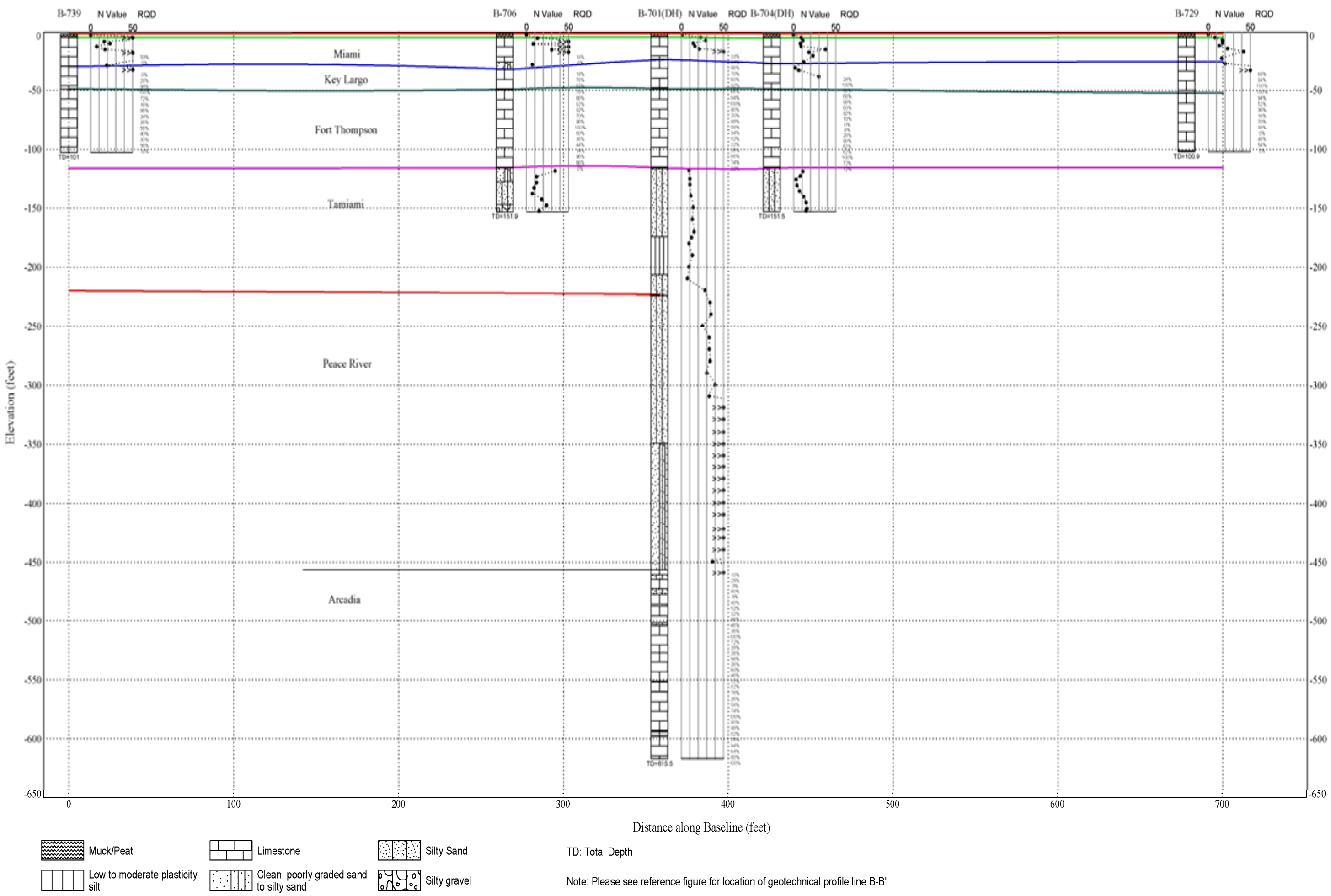
N-S Section Through Unit 6



N-S Section Through Unit 7



E-W Section Through Unit 7



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Support of Nuclear Island

Support Structures on Competent Rock of Key Largo Limestone

- Although a coralline structure, this stratum has high compressive strength and Vs
- This stratum is generally encountered at El -27 feet
- To confirm competent material at subgrade, assume El -35 feet for base
- Use lean concrete to bring reactor base elevation to El. -16 feet
- Bearing and settlement requirements satisfied
- No solution cavities anticipated

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Slope Stability

- Slopes are minimal (0.5% or less)
- Grade changes achieved through MSE walls
- No offsite slopes to consider

Liquefaction

- Considered for Upper and Lower Tamiami and Peace River
- Upper Tamiami – starts at El. -115 ft, generally SM
- Lower Tamiami – starts at El. -159 feet, generally ML
- Peace River – starts at El. -215 feet, SM/ML (but fewer data points)
- Liquefaction resistance considered using N, q, and Vs data
- Not considered significant due to age and depth of sediments and rock overburden

Lateral Earth Pressure

- Considered for long-term case at-rest
- Considered for excavation support case as active case

Groundwater

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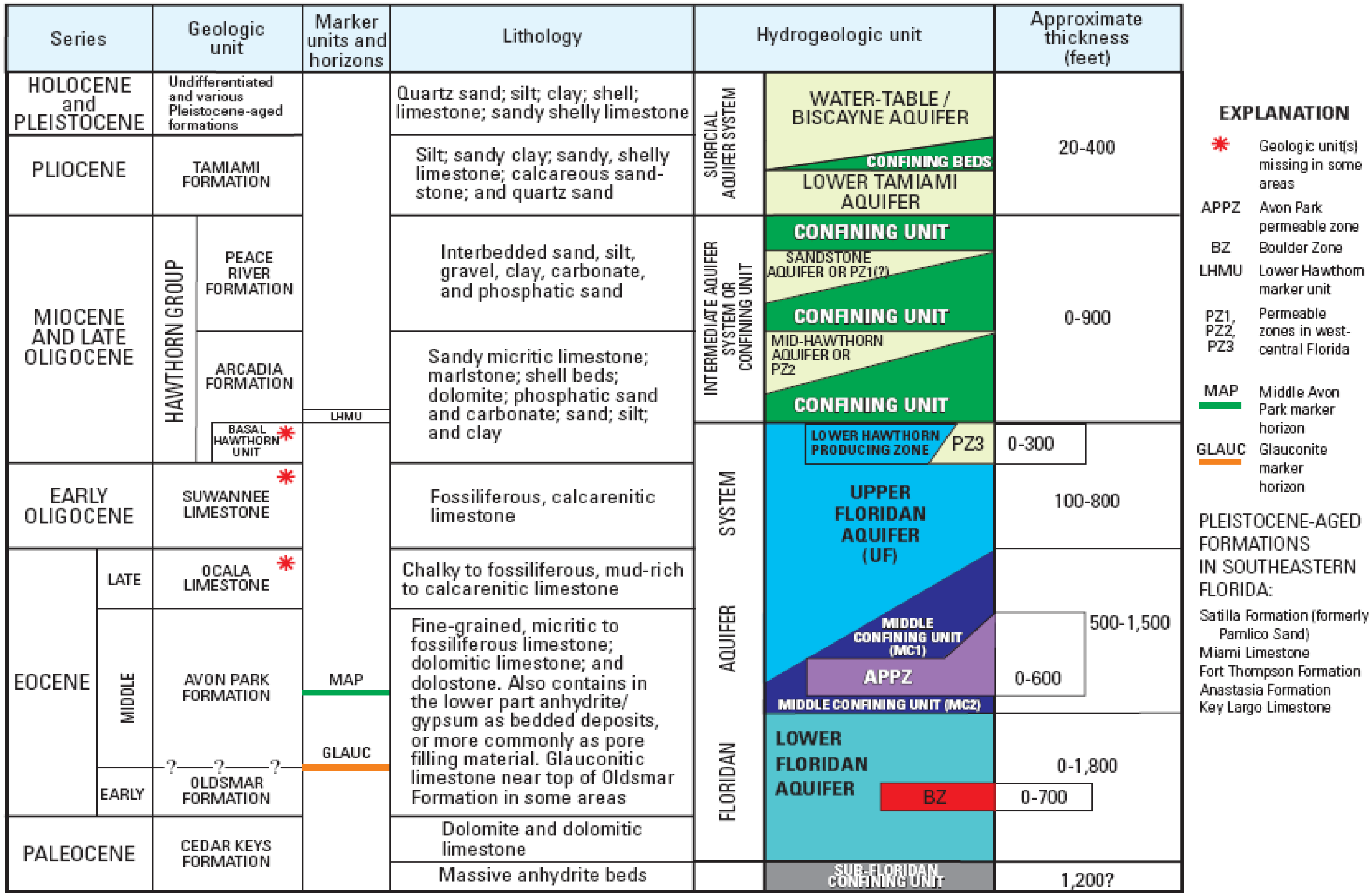
December 5, 2008

Regional Hydrogeology

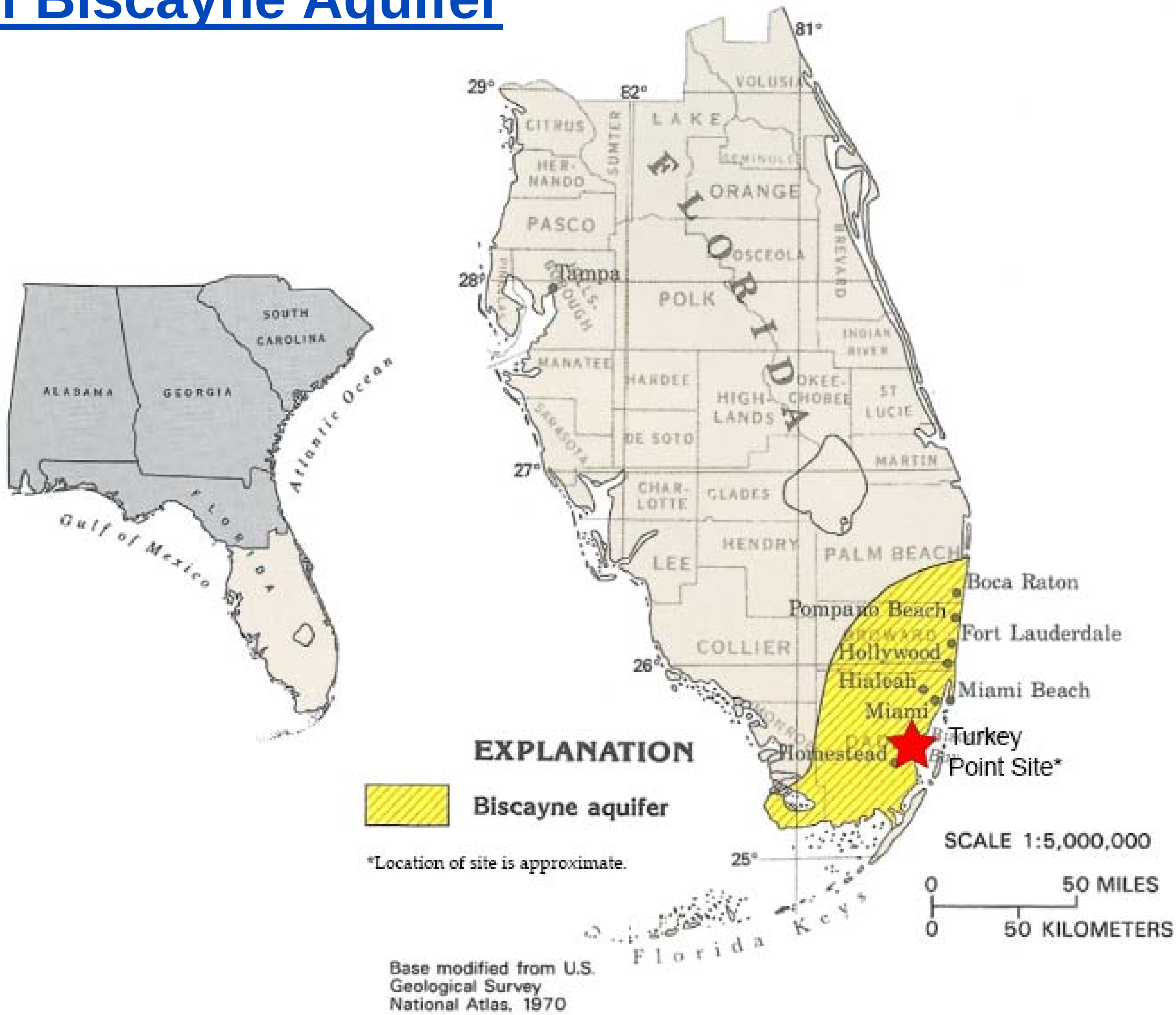
- **Two aquifer systems present in the region**
  - Biscayne Aquifer
  - Floridan Aquifer
- **Both systems exhibit saline/freshwater interfaces**
- **Groundwater flow in both systems is generally toward the ocean**
- **Both systems are highly transmissive**

Cenozoic-Aged Formations in Southeastern Florida



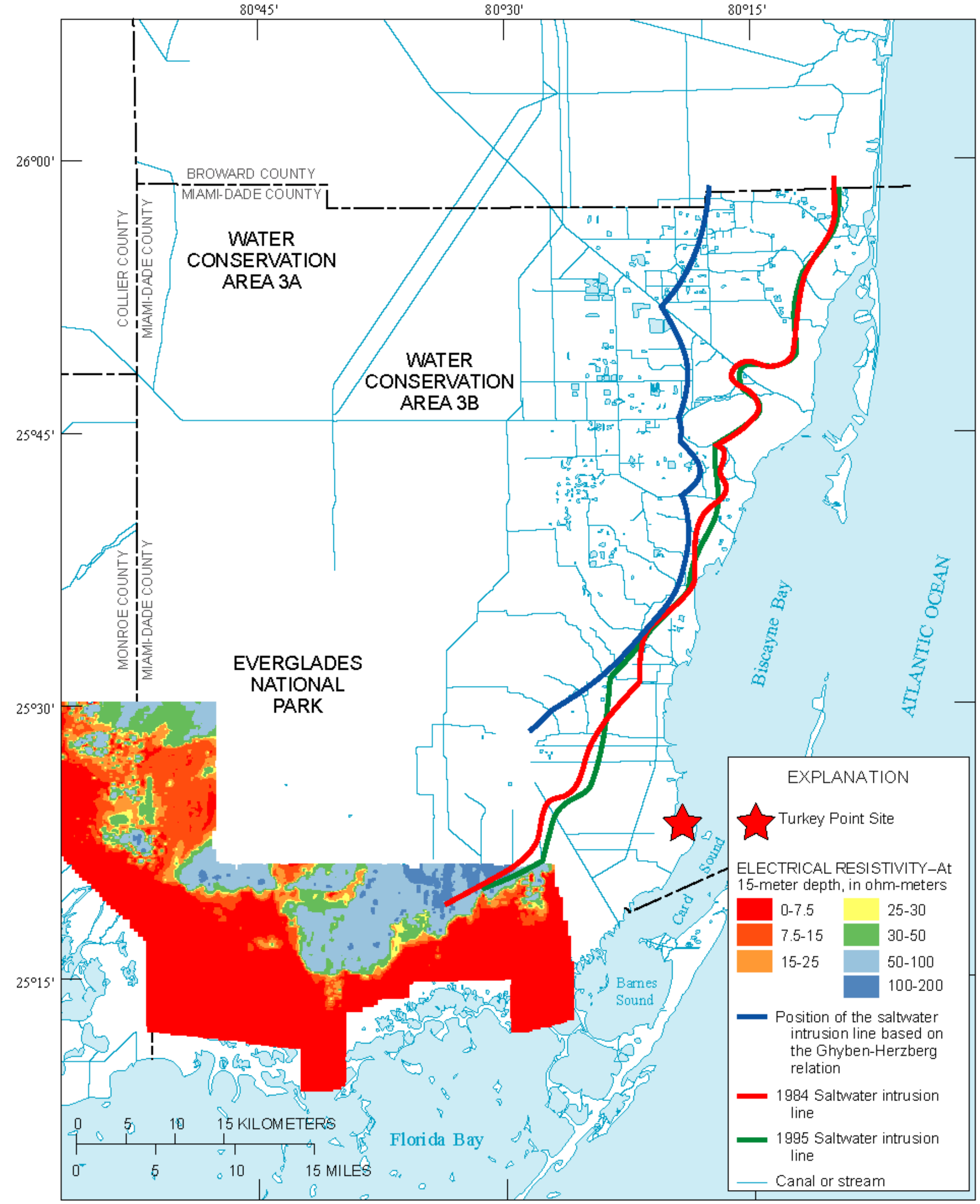
Source: USGS Scientific Investigations Report 2007-5207

Extent of Biscayne Aquifer



Source: USGS Groundwater Atlas of the United States HA 730-G

Saline-Fresh Water Interface <u>Biscayne Aquifer</u>



Source: USGS Water-Resources Investigations Report 00-4251

Extent of Floridan Aquifer System

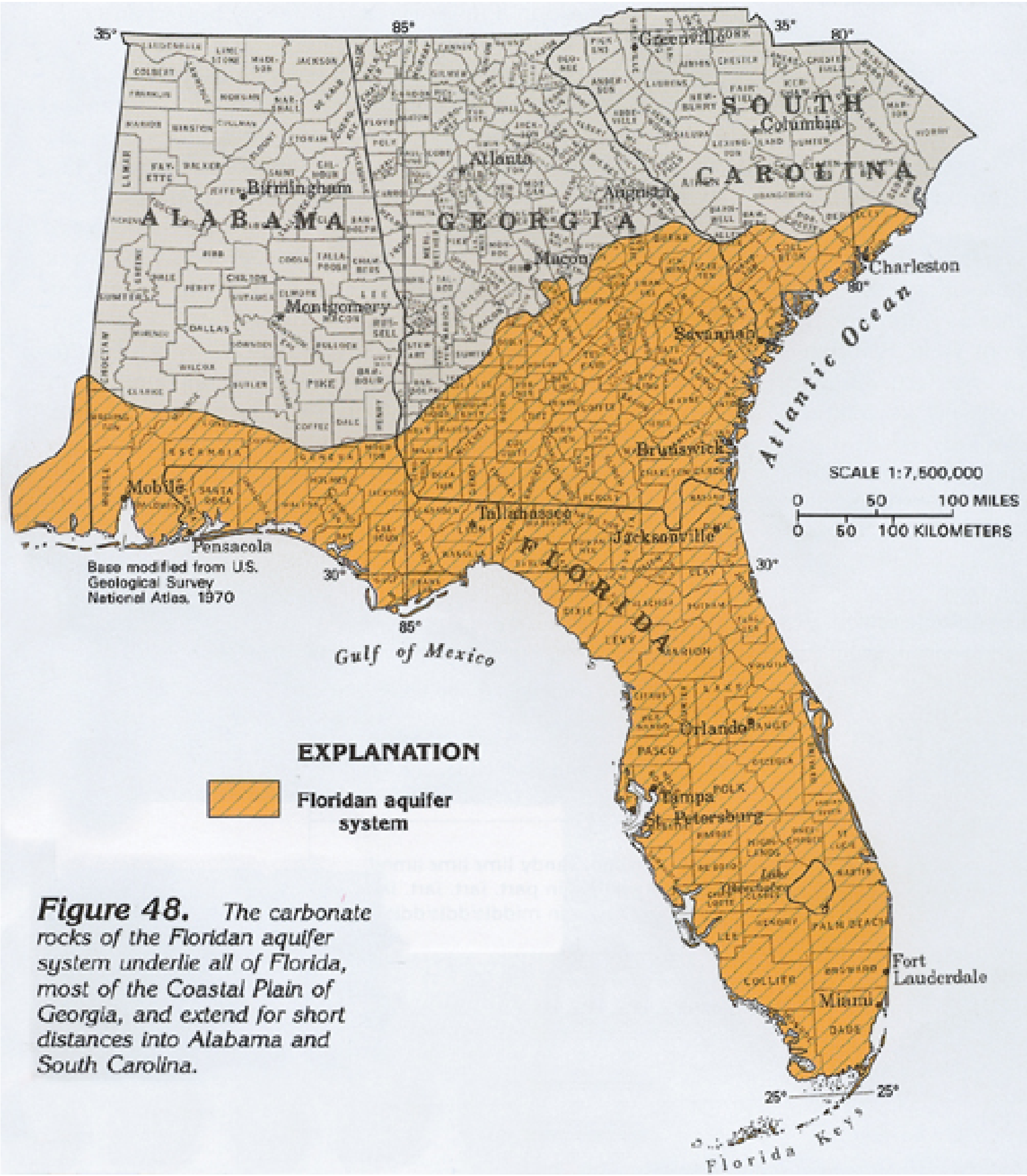
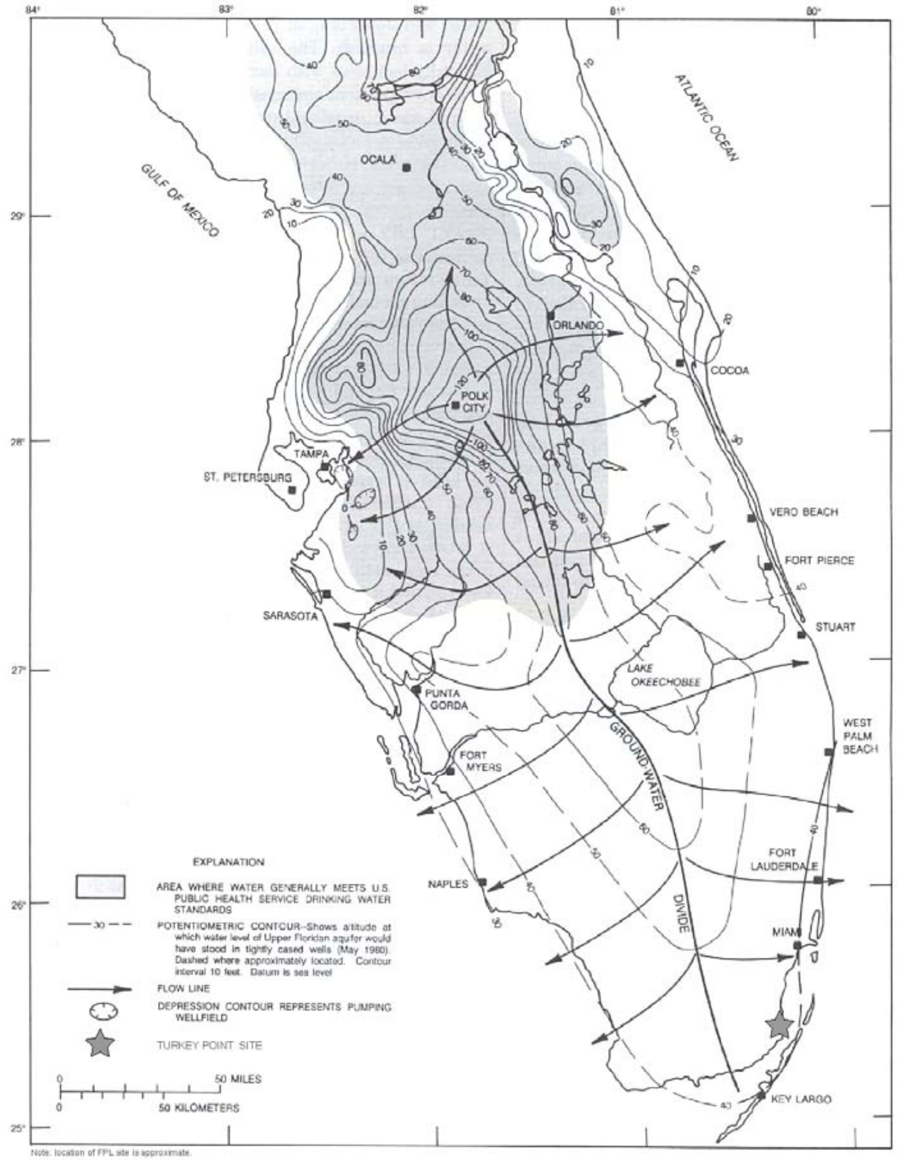


Figure 48. *The carbonate rocks of the Floridan aquifer system underlie all of Florida, most of the Coastal Plain of Georgia, and extend for short distances into Alabama and South Carolina.*

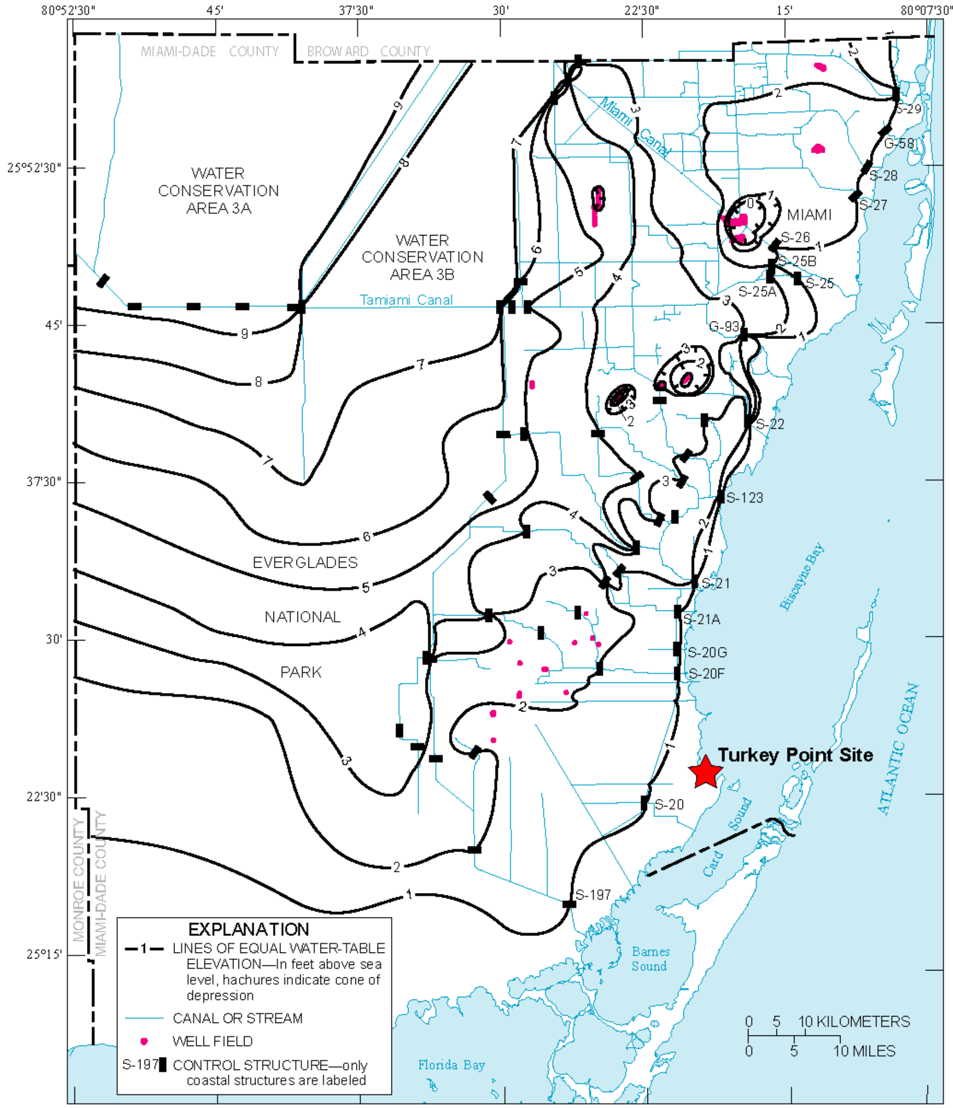
Source: USGS Groundwater Atlas of the United States HA 730-G

Upper Floridan Aquifer Potentiometric Surface May 1980



Source: USGS Professional Paper 1403-G

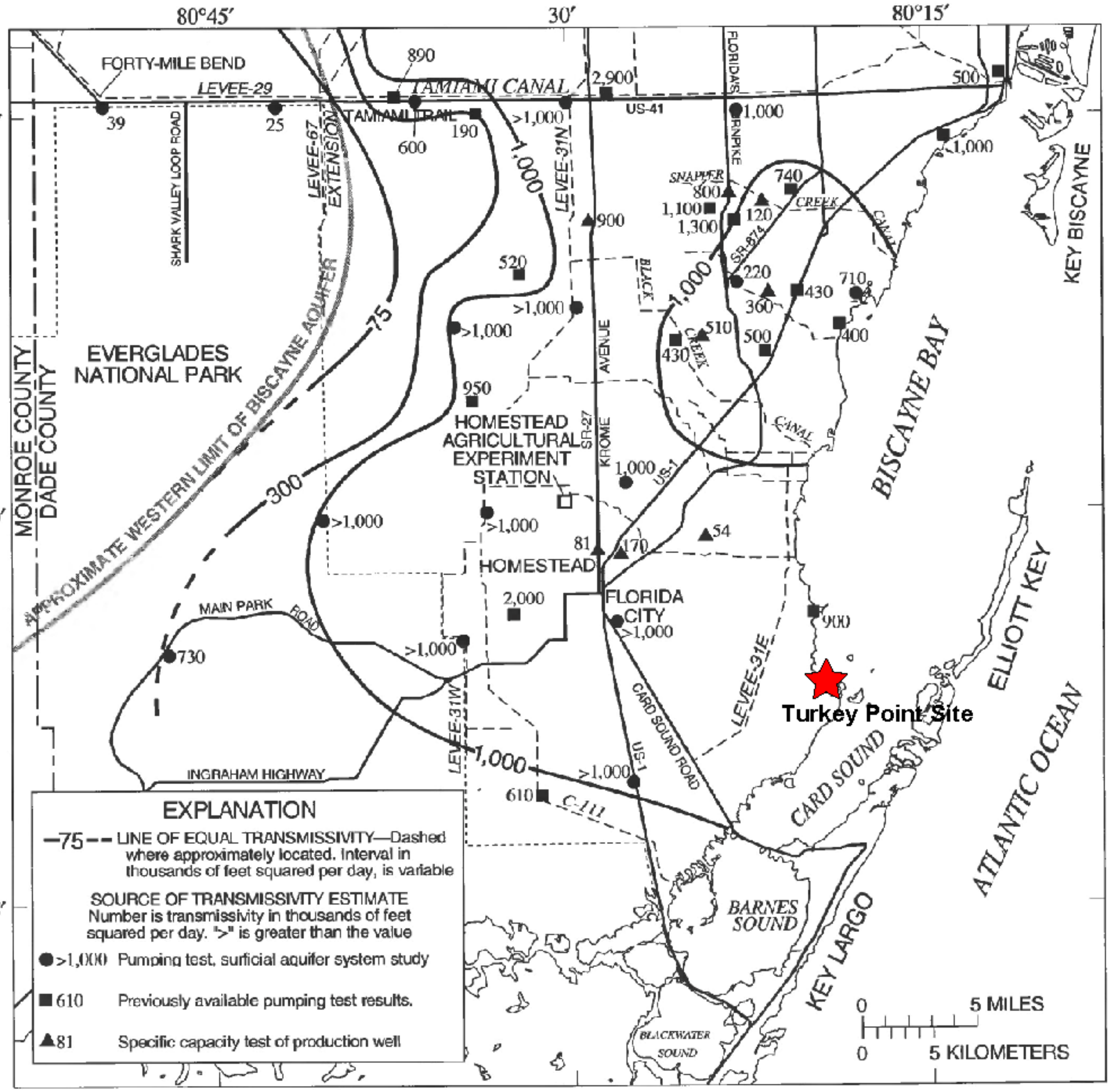
Biscayne Aquifer Potentiometric Surface May 1993



Note: location of FPL site is approximate.

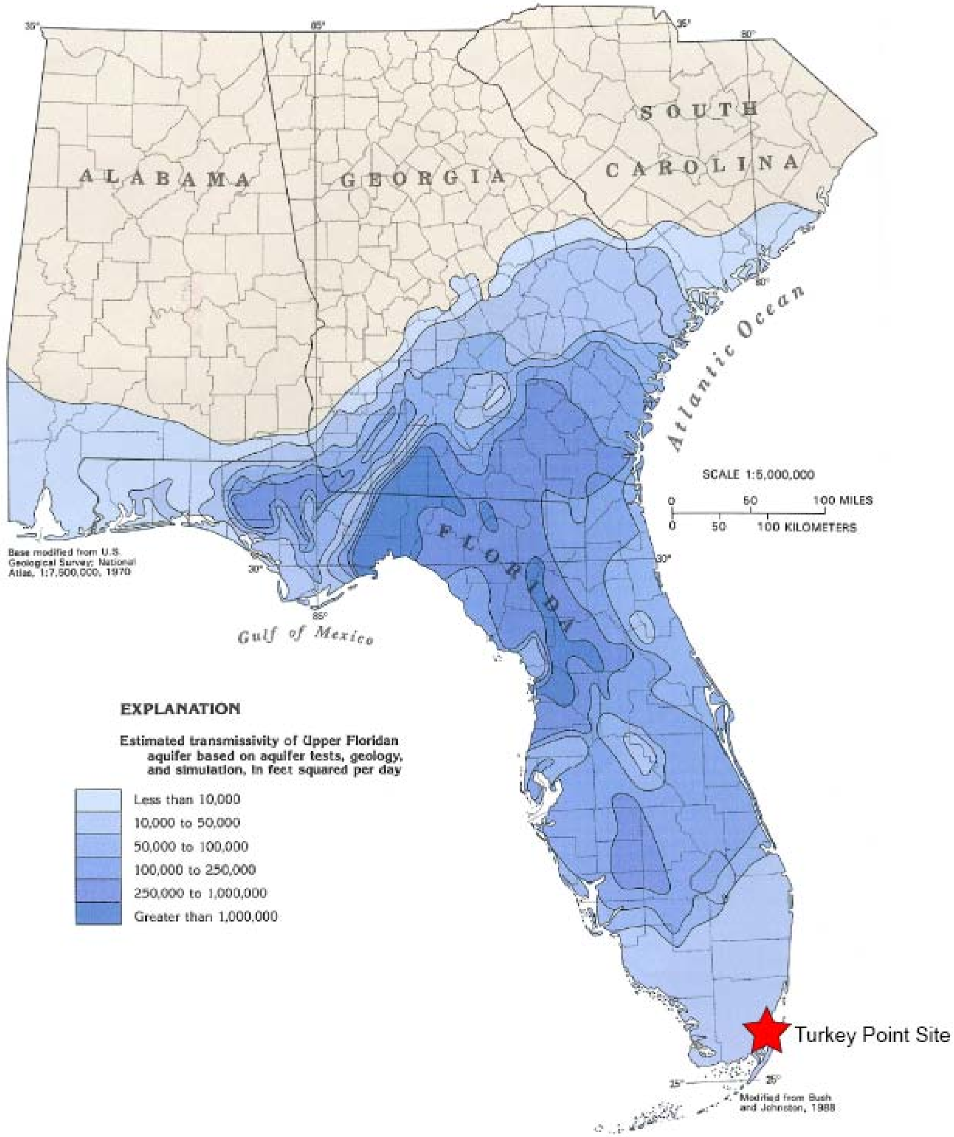
Source: USGS Water-Resources Investigations Report 00-4251

Transmissivity of the Biscayne Aquifer



Source: USGS Water-Supply Paper 2458

Transmissivity of Upper Floridan Aquifer



Source: USGS Groundwater Atlas of the United States HA 730-G

Groundwater Use

- Potable water use in southeast Florida is from the Biscayne Aquifer
- Most areas are serviced by suppliers such as the Miami-Dade Water and Sewer Department
- In the area of the site, the Biscayne Aquifer is used primarily for irrigation

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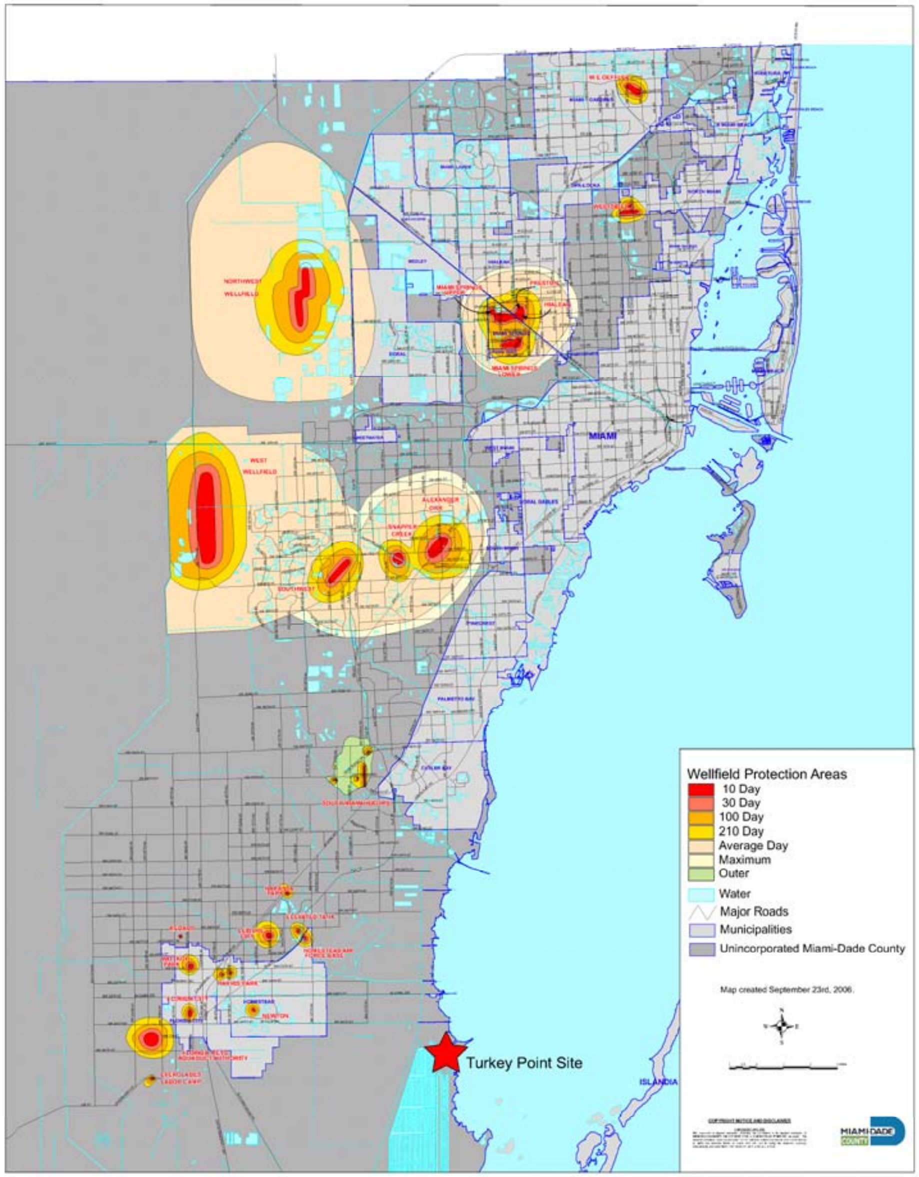
Major Wellfields in the Miami Area



Source: Florida Department of Environmental Protection - Drinking Water Program

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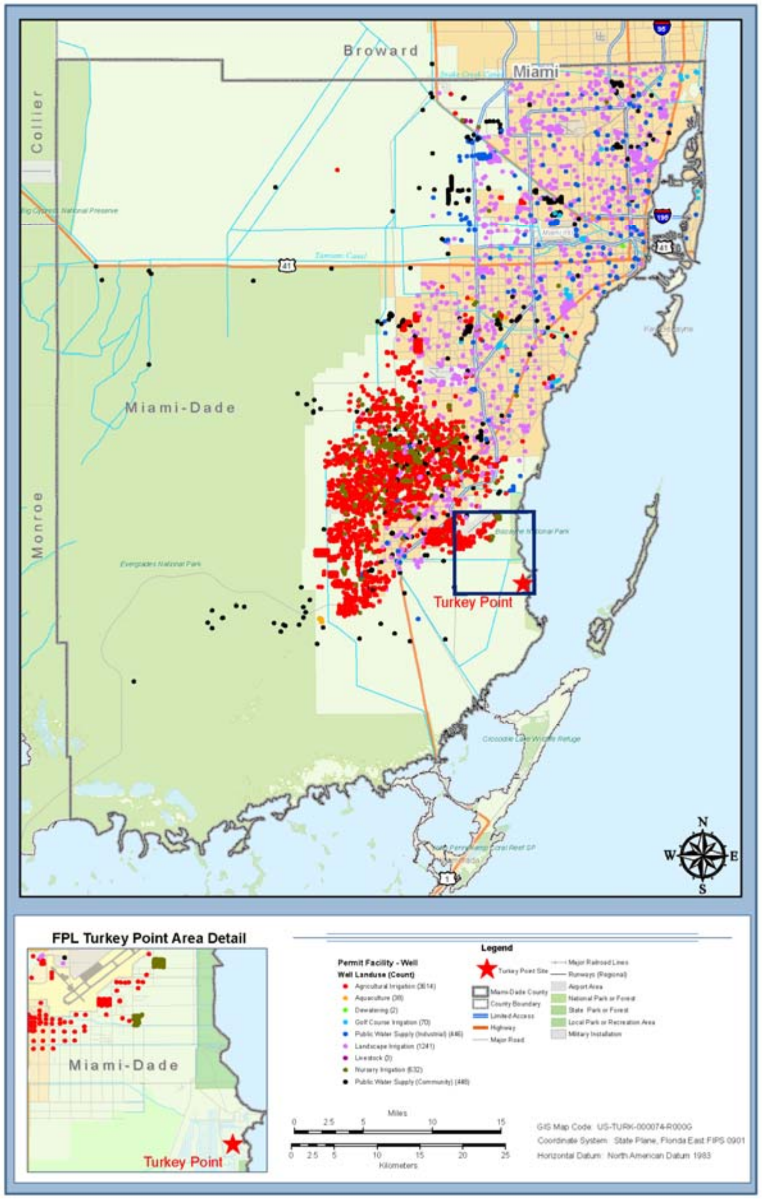

Biscayne Aquifer Water Use Permits in <u>Miami-Dade County</u>

Source: South Florida Water Management District – Regulatory Database

Site Hydrogeology Investigations

- **22 observation wells**
- **Two monitoring zones were defined in the subsurface investigation**
  - Upper Zone – Miami Limestone/Key Largo Limestone (~15 ft to 25 ft bgs)
  - Lower Zone – Lower Fort Thompson Fm (~95 ft to 105 ft bgs)
- **2 surface water locations**

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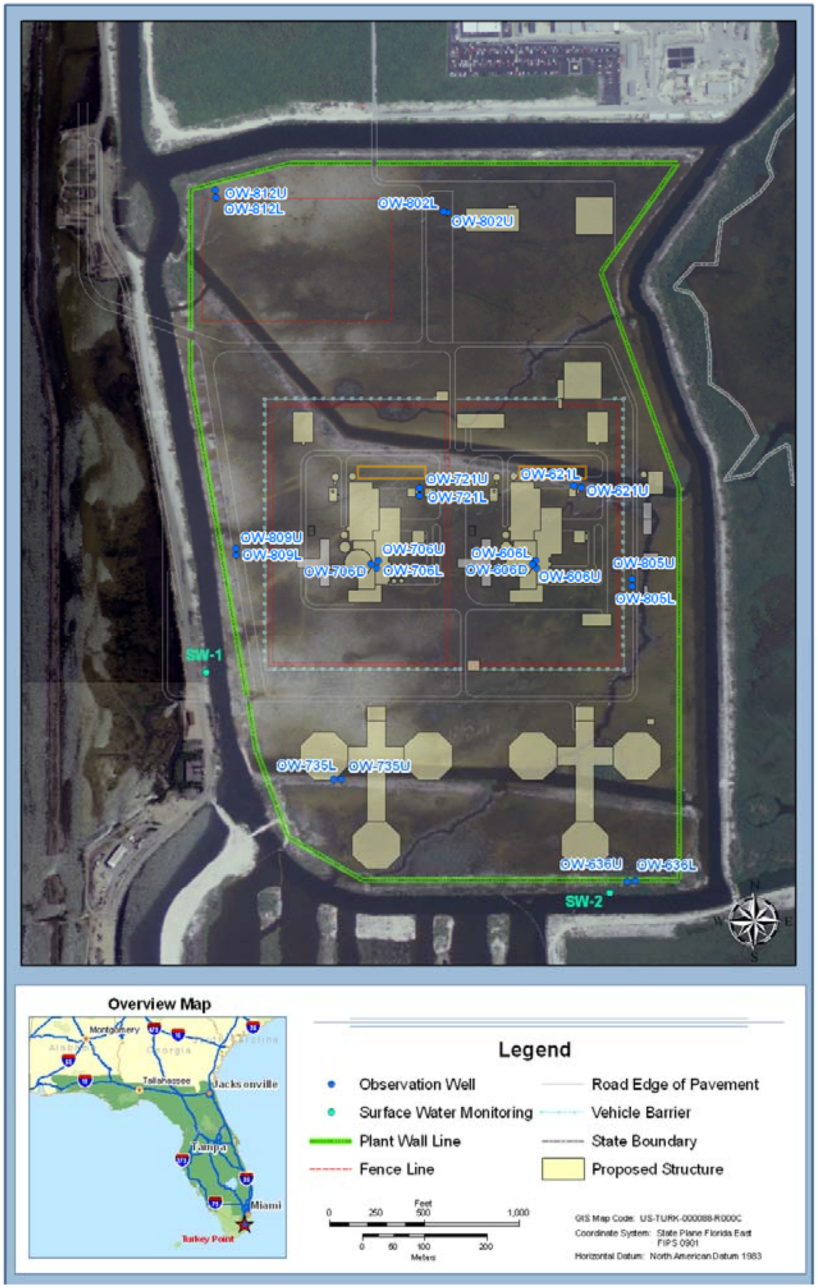
Observation Wells and Surface Water <u>Monitoring Locations</u>



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Site Hydrostratigraphic Column

<table>
<tr><th>ERATHEM</th><th>SYSTEM</th><th>SERIES</th><th colspan="2">HYDRO-GEOLOGIC UNIT</th><th colspan="2">STRATIGRAPHIC UNIT</th><th>LITHOLOGY</th><th>TOP ELEVATION</th><th>THICKNESS (ft)</th></tr>
<tr><td rowspan="7">CENEZOIC</td><td rowspan="4">QUATERNARY</td><td>HOLOCENE</td><td rowspan="5">Surficial aquifer system</td><td rowspan="4">Biscayne aquifer</td><td colspan="2">organic muck</td><td>organic soil and silt</td><td>0</td><td>3</td></tr>
<tr><td rowspan="3">PLEISTOCENE</td><td colspan="2">Miami Limestone</td><td>sandy, oolitic limestone</td><td>-3</td><td>25</td></tr>
<tr><td colspan="2">Key Largo Limestone</td><td>well indurated, vuggy, coralline limestone</td><td>-28</td><td>22</td></tr>
<tr><td colspan="2">Fort Thompson Formation</td><td>poor/well indurated fossiliferous limestone</td><td>-50</td><td>65</td></tr>
<tr><td rowspan="3">TERTIARY</td><td>PLIOCENE</td><td>Semi-confining unit</td><td colspan="2">Tamiami Formation</td><td>sand and silt with calcarenitic limestone</td><td>-115</td><td>105</td></tr>
<tr><td rowspan="2">MIOCENE</td><td colspan="2" rowspan="2">Intermediate confining unit</td><td rowspan="2">Hawthorn Group</td><td>Peace River formation</td><td>silty calcareous sand and silt</td><td>-220</td><td>235</td></tr>
<tr><td>Arcadia formation</td><td>calcareous wackestone with indurated limestones, sandstone, and sand</td><td>-456</td><td>>160</td></tr>
</table>

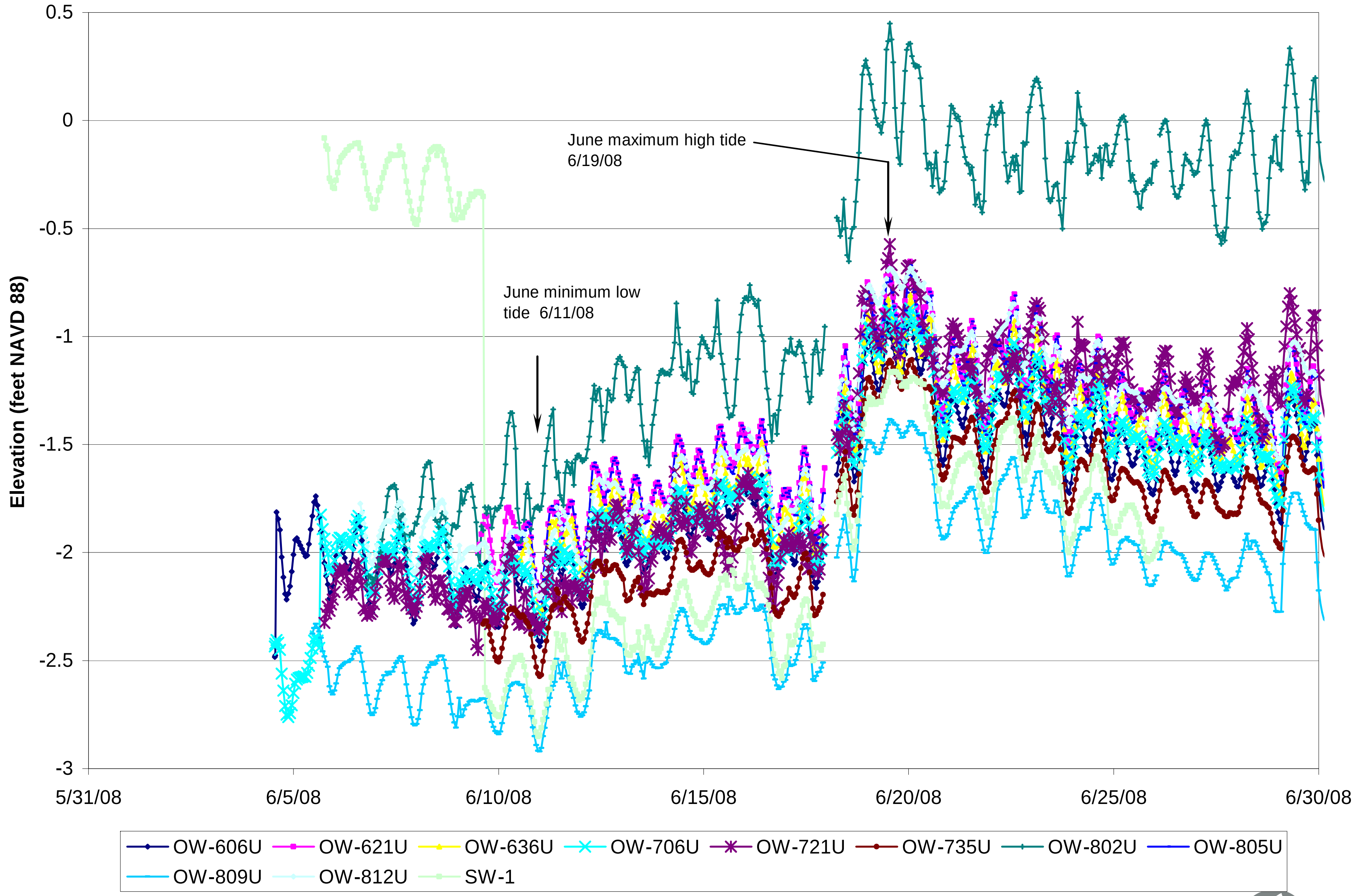
formation contact based on natural gamma signature

drilling ended at -616 ft

Site Hydrogeology

- **Groundwater and Surface Water Level Monitoring**
  - Remote monitoring system using recording transducers
  - Measure levels during a lunar tidal cycle
  - Measure salinity/specific conductivity to evaluate surface water – groundwater interactions

Sample Hydrograph of Groundwater & Surface Water Levels



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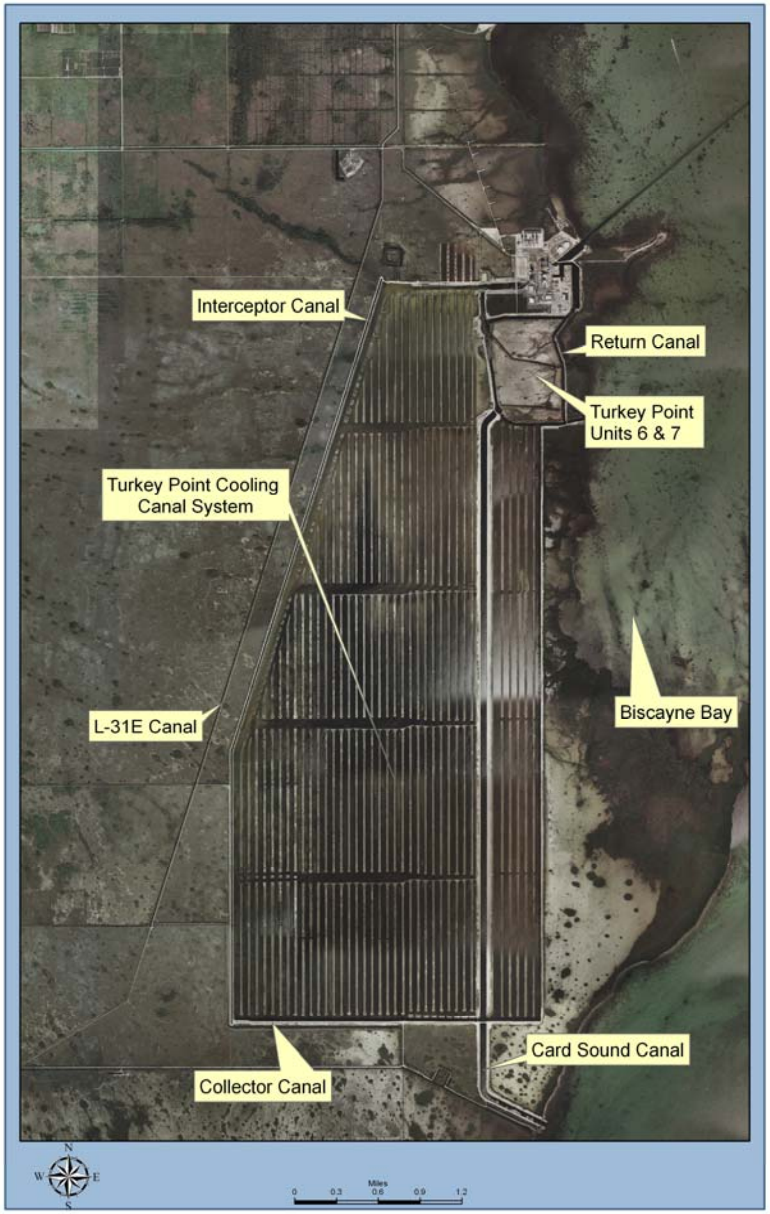
Plan View of Cooling Canal System



References

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Construction Methods

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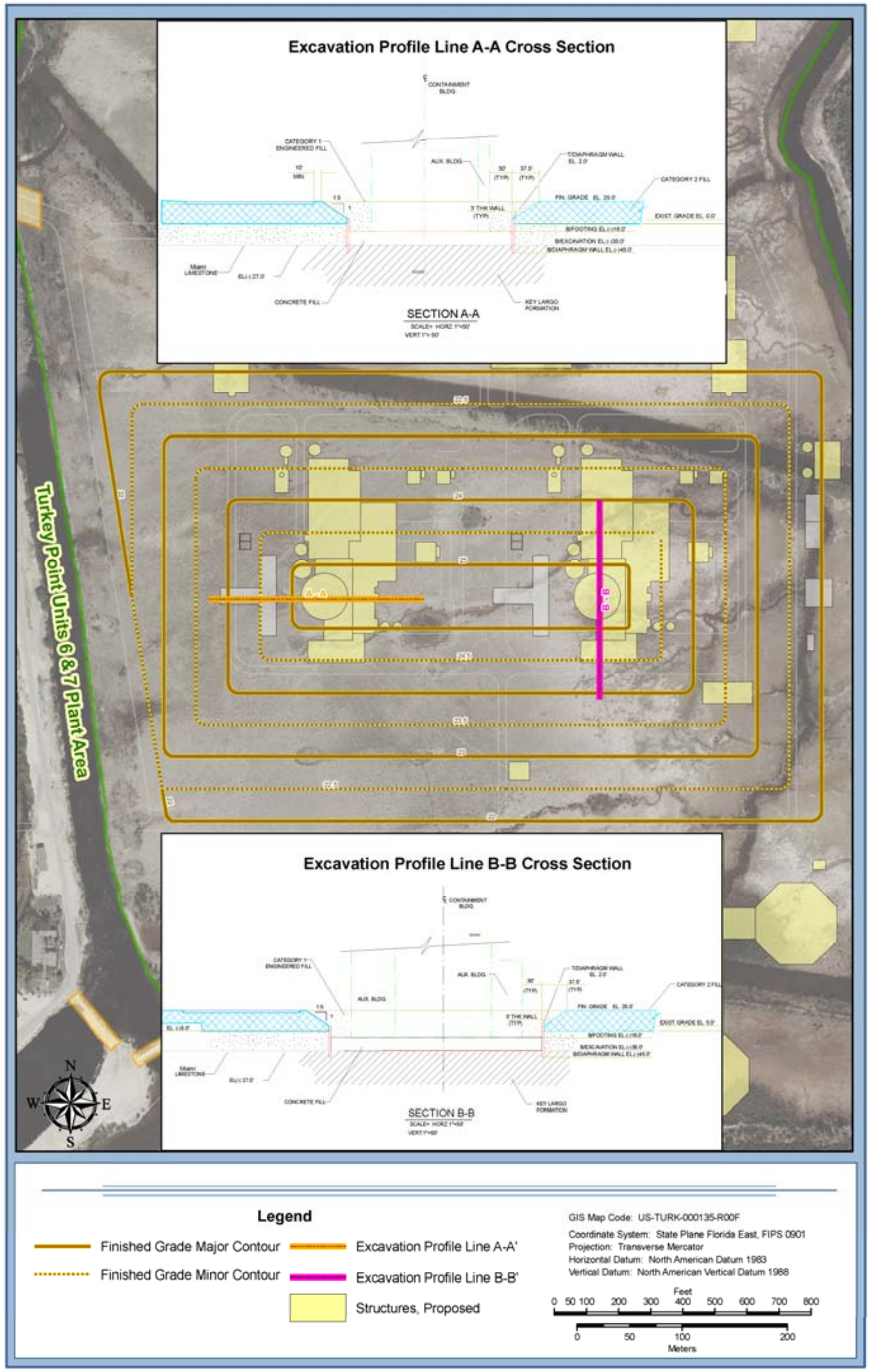
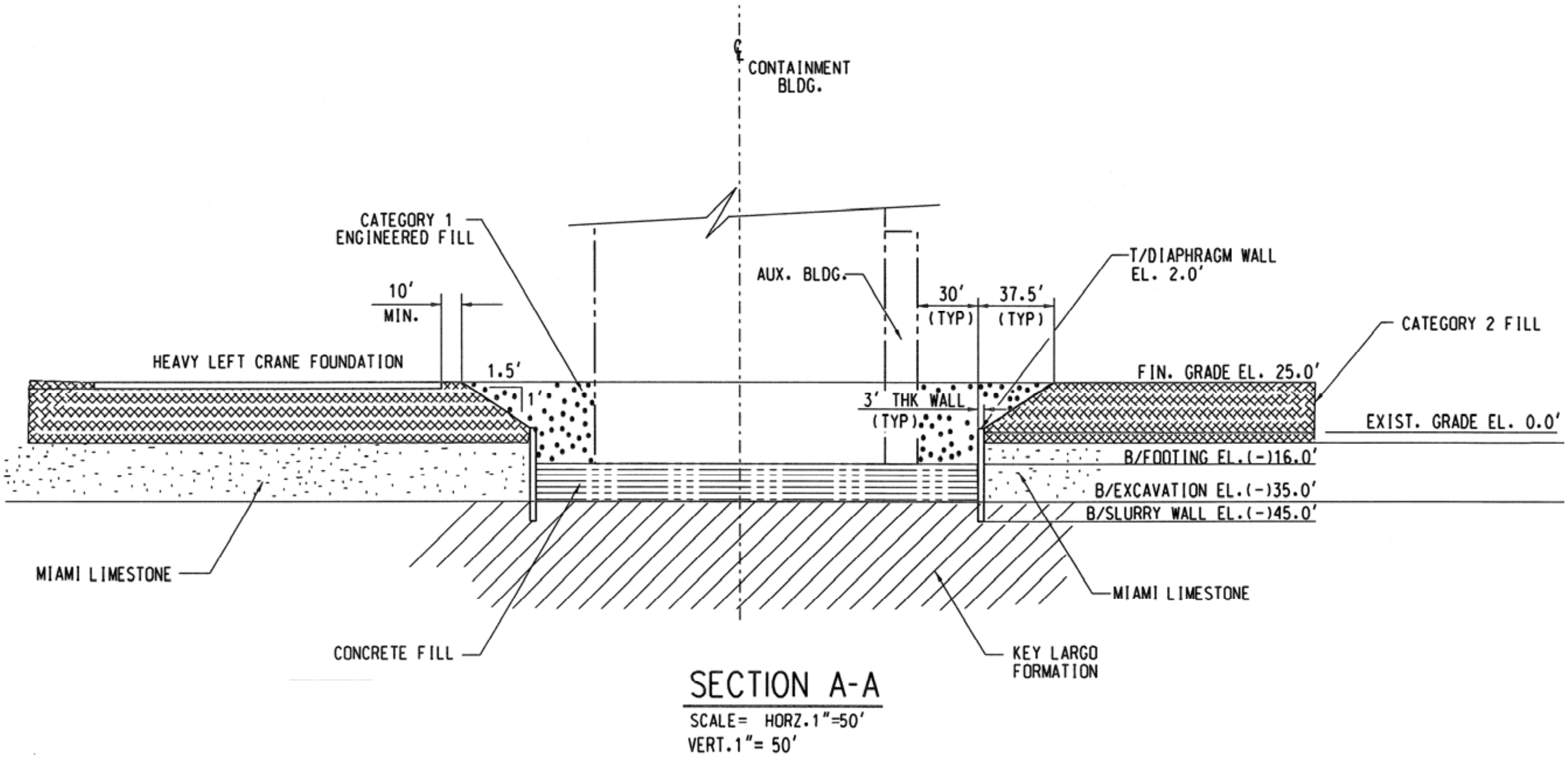
December 5, 2008

Construction Considerations

- **Excavation to approximately -35 feet**
- **Vertical groundwater barrier and excavation support required**
- **Competent confining layer at the top of the Fort Thompson limestone expected to control vertical groundwater flow**
- **Backfill with imported fill required around nuclear island and to finish grade**


Excavation Profile Line A-A Cross Section
SECTION A-A
Turkey Point Units 6 & 7 Plant Area
Excavation Profile Line B-B Cross Section
SECTION B-B
N
S
E
W
Legend
Finished Grade Major Contour
Finished Grade Minor Contour
Excavation Profile Line A-A'
Excavation Profile Line B-B'
Structures, Proposed
GIS Map Code: US-TURK-000135-R00F
Coordinate System: State Plane Florida East, FIPS 0901
Projection: Transverse Mercator
Horizontal Datum: North American Datum 1983
Vertical Datum: North American Vertical Datum 1988
Feet
0 50 100 200 300 400 500 600 700 800
0 50 100 200
Meters

Draft Excavation Profile Line A-A Cross Section



Construction Methods

- **Approximately the top 5 foot layer of the site is composed of organic material or "muck" that has no ability to support any buildings**
  - Approximately 1.8 million cubic yards of muck to be removed
  - Backfill with limestone fill will be performed in conjunction with de-mucking in segmented portions to control dewatering effort
- **The site will be raised up from approximate sea level elevation to 26 feet above sea level**
  - Limestone fill will be used to build up the island from about 20 feet above msl along the "island" edge to a finished grade elevation at the nuclear island of about 26 feet above msl
  - Approximately 11 million cubic yards of fill will be required

Construction Methods *(Continued)*

- **A mechanically stabilized earth (MSE) wall is planned as a retaining wall around the majority of site perimeter**
  - Will be designed to resist storm surge and tsunami wave forces
  - At the south end of the site, the exterior walls of the cooling water reservoir will also function as the exterior retaining wall
- **Reservoir structure will be constructed onsite to store several days of make-up water**
  - Reinforced concrete structure, will provide support for elevated mechanical draft cooling towers
  - Bottom of the reservoir will sit on the top layer of the exposed Miami limestone (after muck removal) to minimize dewatering during construction

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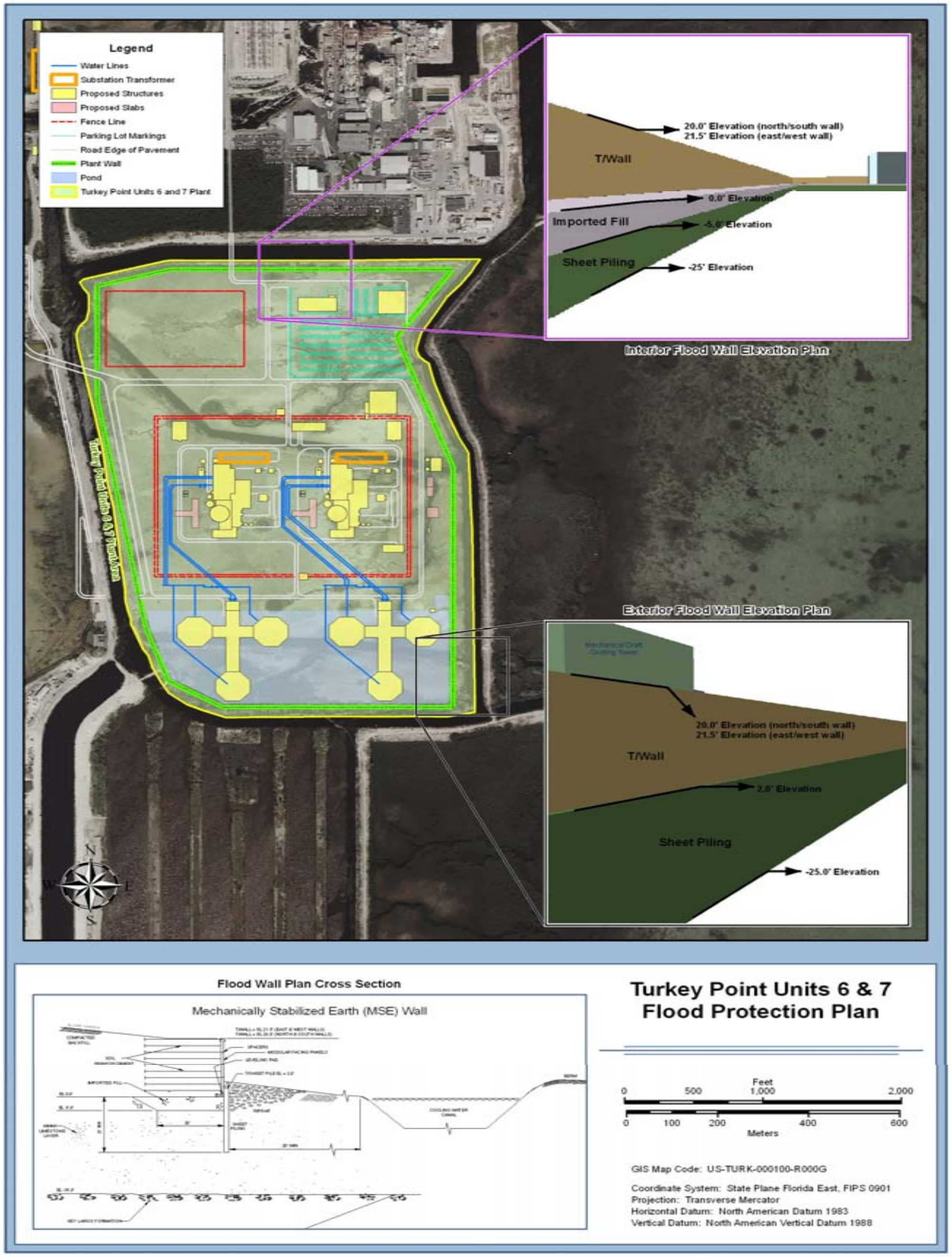
MSE Wall Detail



Questions and Discussion