



# Effects of Unsaturated Soil Properties in Piping Susceptibility in Water Retaining Structures



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## Introduction

The Herbert Hoover Dike (HHD) is a 143-mile earthen dam that surrounds Lake Okeechobee in South Central Florida. This dike was built in the 1920s by the United States Army Corps of Engineers (USACE) after a deadly flood struck the area. Since 2001 there have been numerous repairs performed and planned that total around 1.4 billion dollars. The investment has gone towards creating seepage barriers and water control structures around the dike. The original dike was built on highly erodible, coarse-grain material that is subject to change and settle.

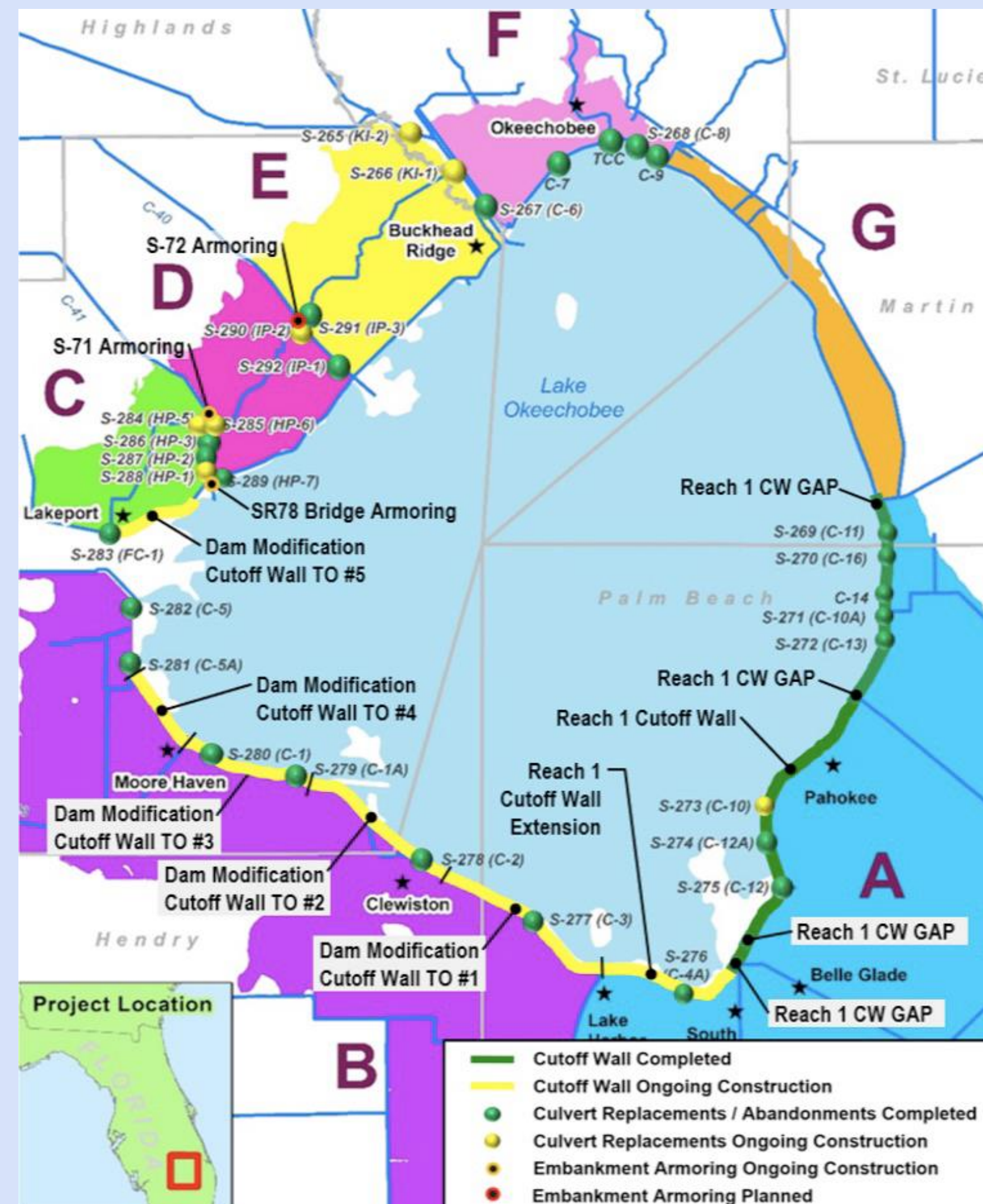


Figure 1: HHD Common Inundation Zones



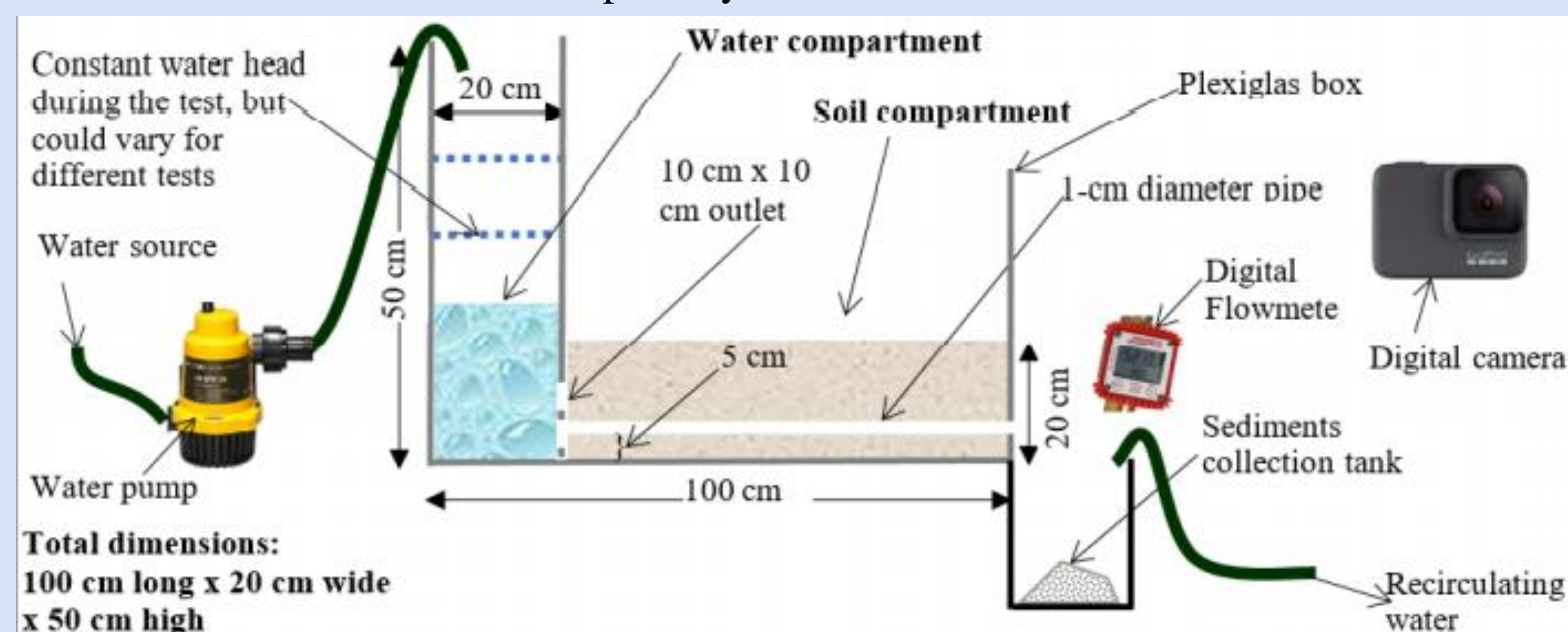
Image 1: Current conditions at HHD

## Purpose of Research

- 50 % of dam failures are due to piping
- Tests will expose potential failures and vulnerabilities in the samples
- Research will provide more knowledge about unsaturated soil properties of sand with shell material
- Tell us more about the susceptibility of these material types to piping and erodibility
- Changing lake levels due to climate change exposes more weaknesses

## Test Being Conducted

- Index testing
  - Sieve analysis, specific gravity, hydraulic conductivity, compaction, direct shear
- Filter Paper test
  - Measures SWCC of a soil
- Small-scale piping model
  - Demonstrates soil's susceptibility to erosion



Small-scale Piping Model



## Initial Soil Testing

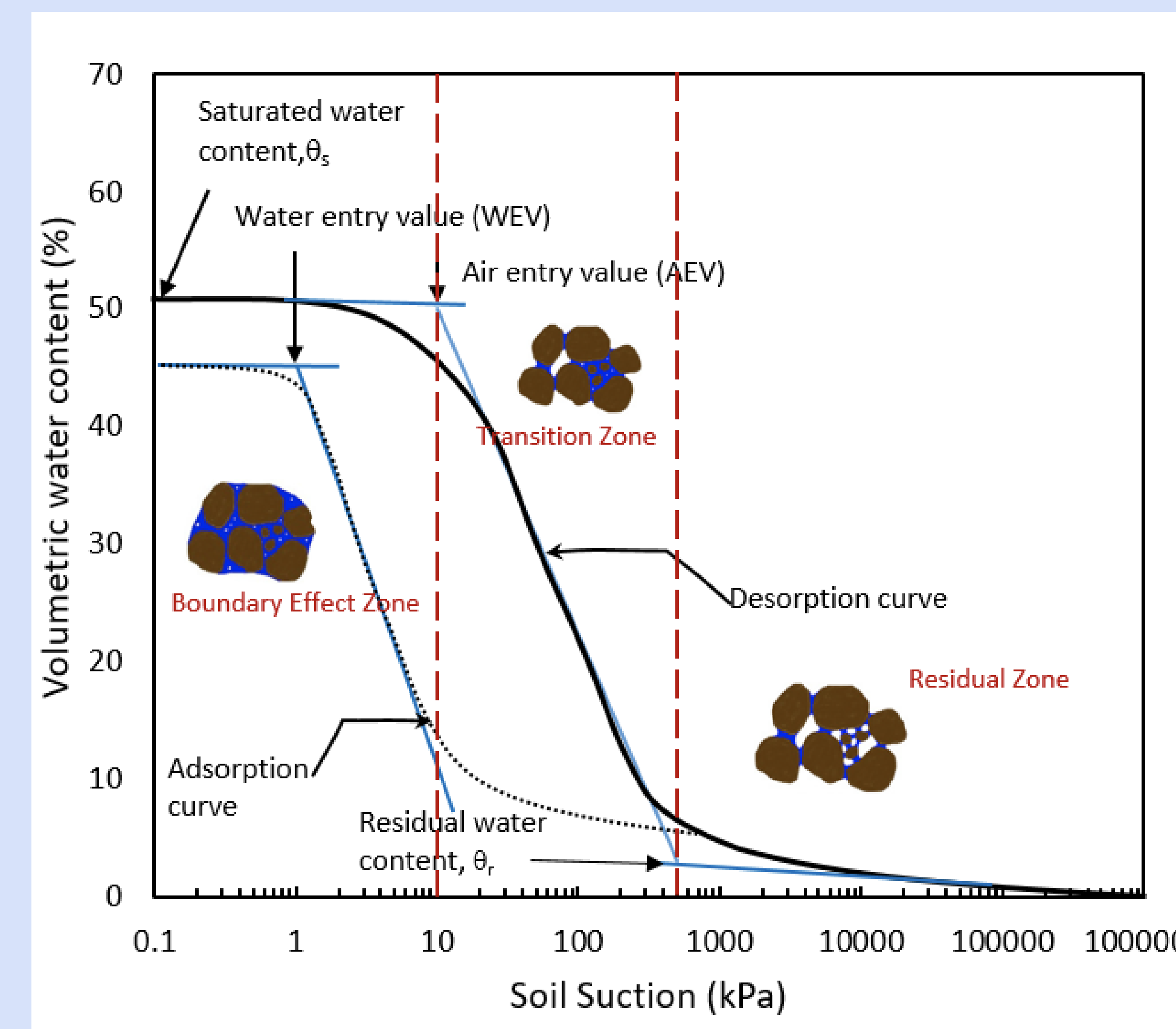


Figure 2: Soil Water Characteristic Curve

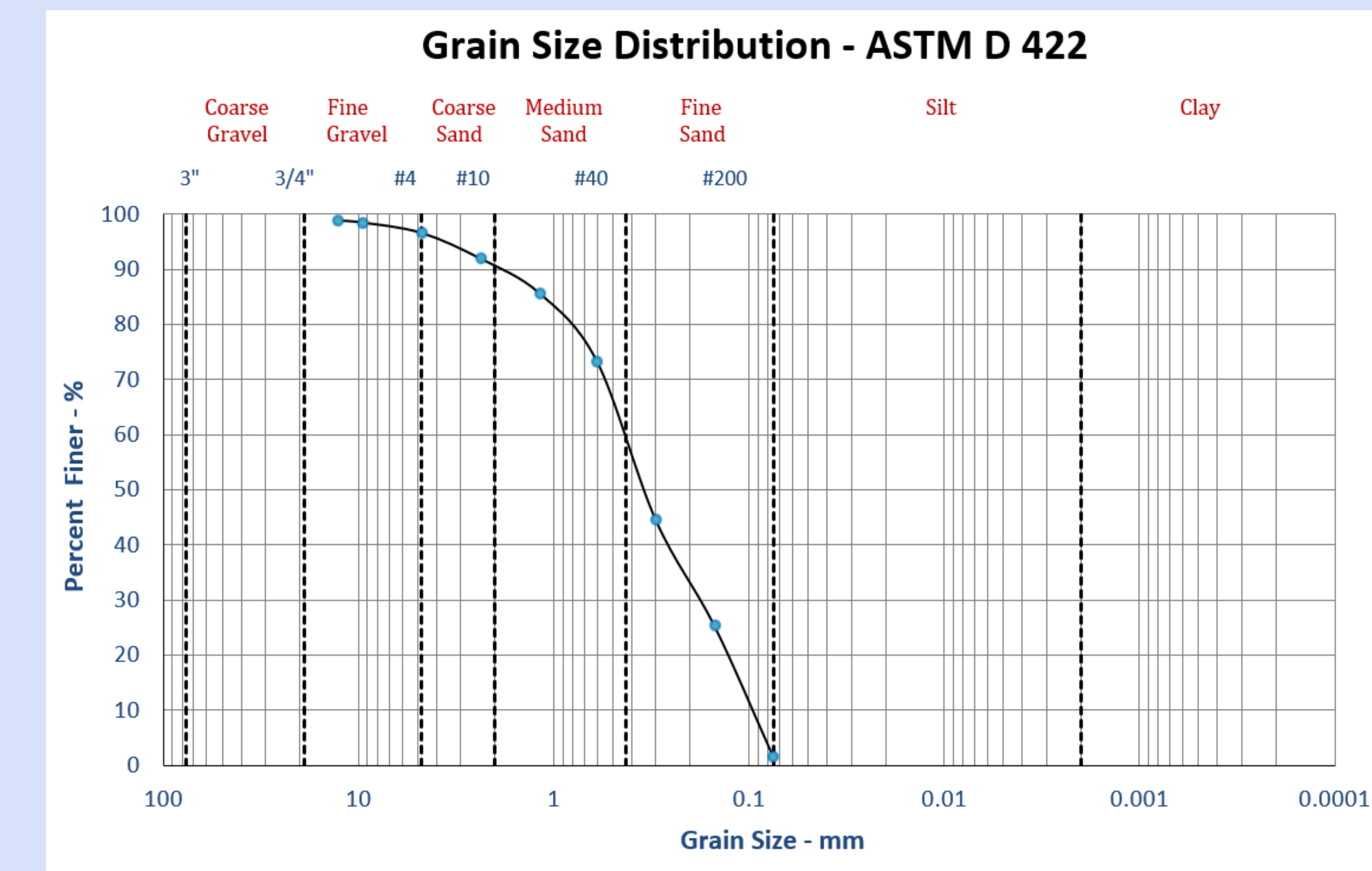


Figure 3: Example of SWCC (after Fredlung and Xing, 1994)



Image 2: Soil Sample Drying

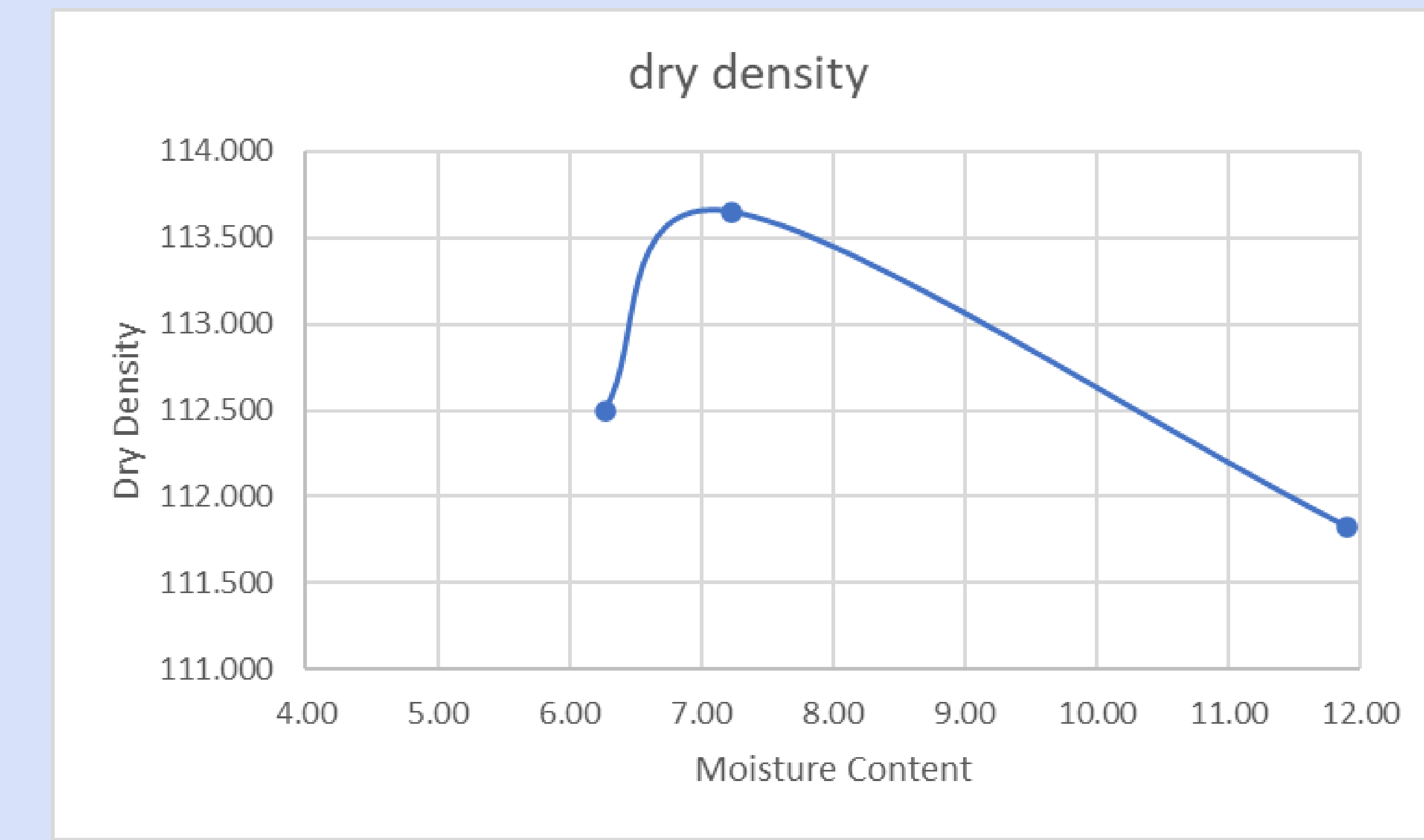


Figure 4: Compaction Test Results

## Summary and Conclusion

- Results from this research effort will provide a helpful tool to evaluate internal erosion susceptibility of a water retaining structures.
- Results from compaction test gave us the optimum moisture content to use for our small-scale piping experiment