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Remediation of a Paper Sludge Lagoon

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Background

- West Linn Paper Company (WLPC) produces 700 tons of coated free sheet (magazine) paper daily
- Sludge, composed of kaolin clay, calcium carbonate, and paper pulp, is a byproduct of their paper making process
 - ~12 tons of sludge is produced daily in their waste water treatment facilities consisting of a primary clarifier and stabilization lagoon
 - ~15,000 dry tons of sludge has accumulated in the lagoon since it was last dredged in 1993

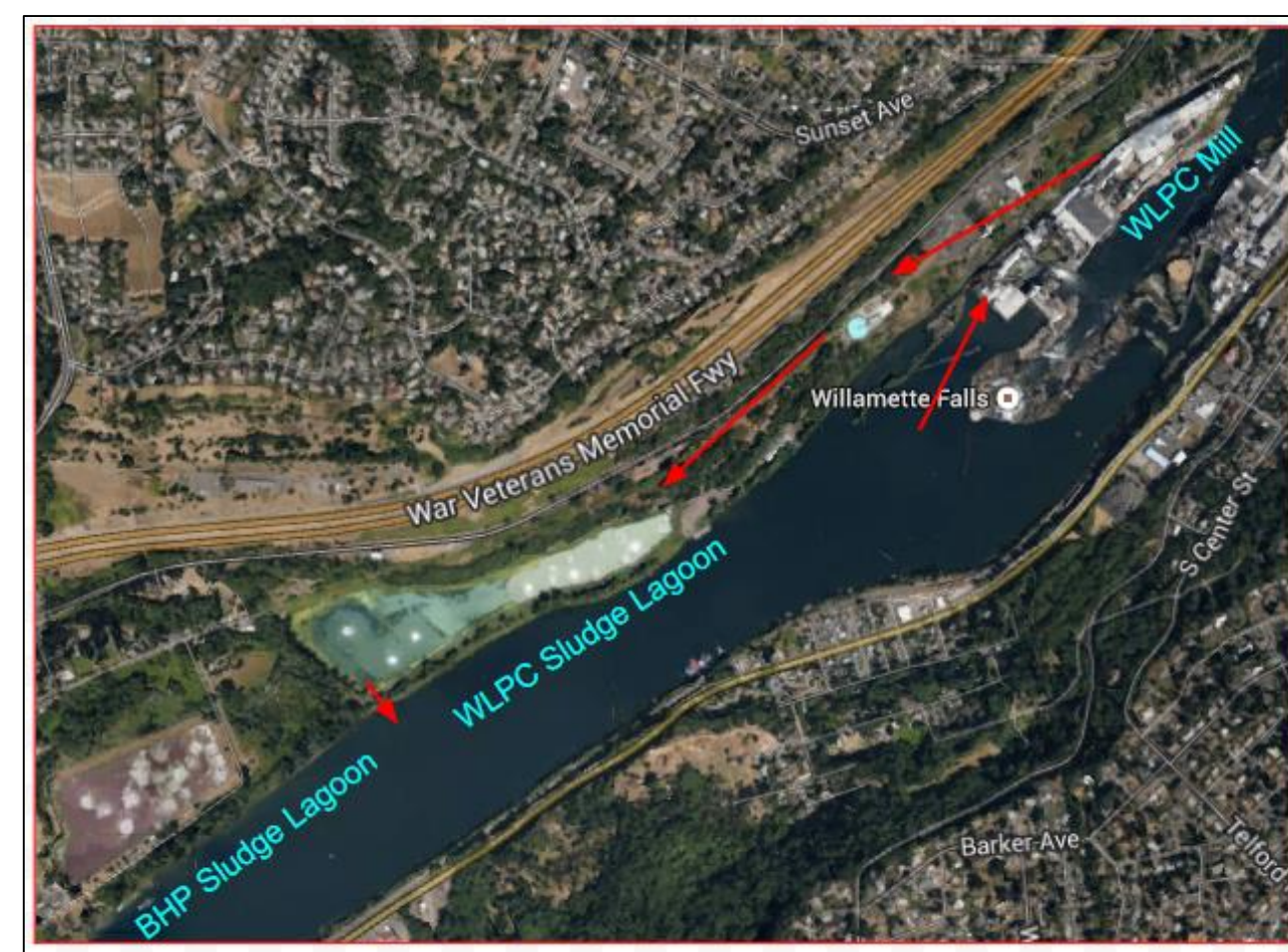


Figure 1 Aerial image of West Linn Paper Company Campus and Blue Heron Lagoon; Google Earth

Project Description

- Determine application of WLPC sludge as fill material
- Primary clarifier sludge is delivered to Salem farms at the expense of WLPC and costs roughly \$15,000 monthly
- There is an opportunity to use WLPC sludge to fill the nearby abandoned Blue Heron Paper Company lagoon which the Clackamas County Water Environment Services wishes to remediate

Primary Objectives

- Characterize physical properties of WLPC clarifier and lagoon sludge
- Determine feasibility of sludge as fill material for remediation of the Blue Heron Paper (BHP) lagoon
- Perform initial design of a cooling tower as a new unit operation in replacement of the lagoon

Results

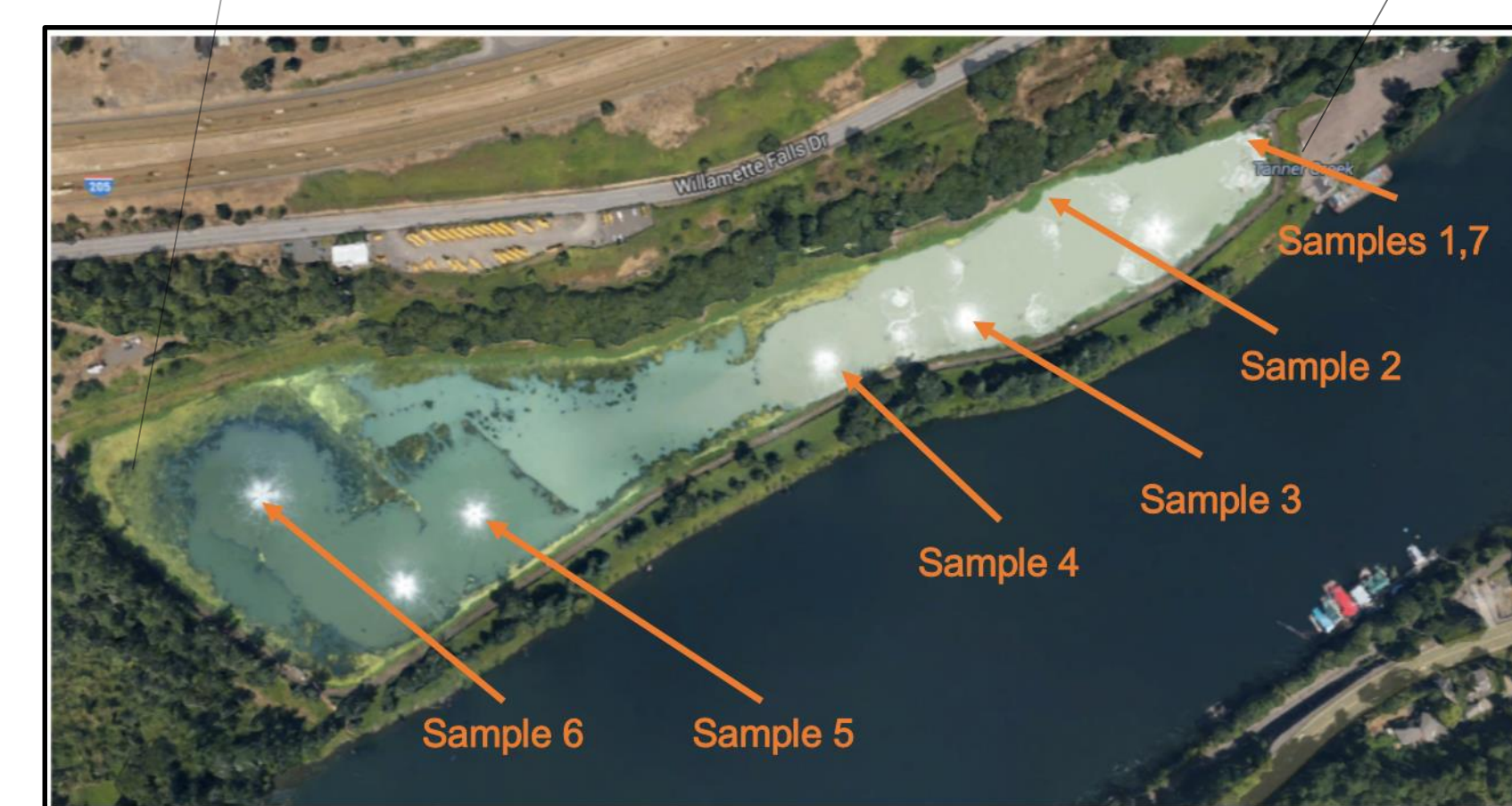
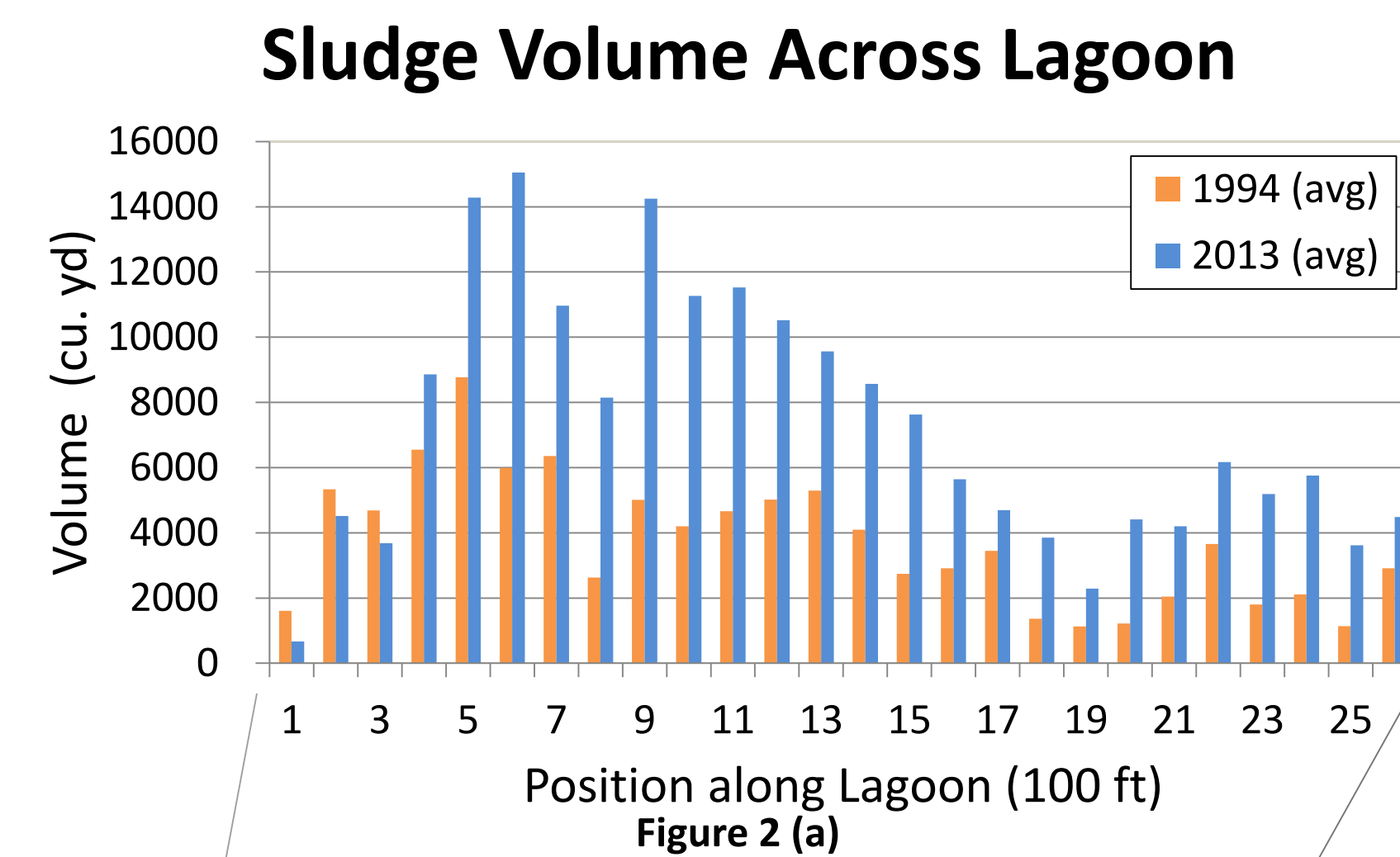


Figure 2 (b) Google Earth

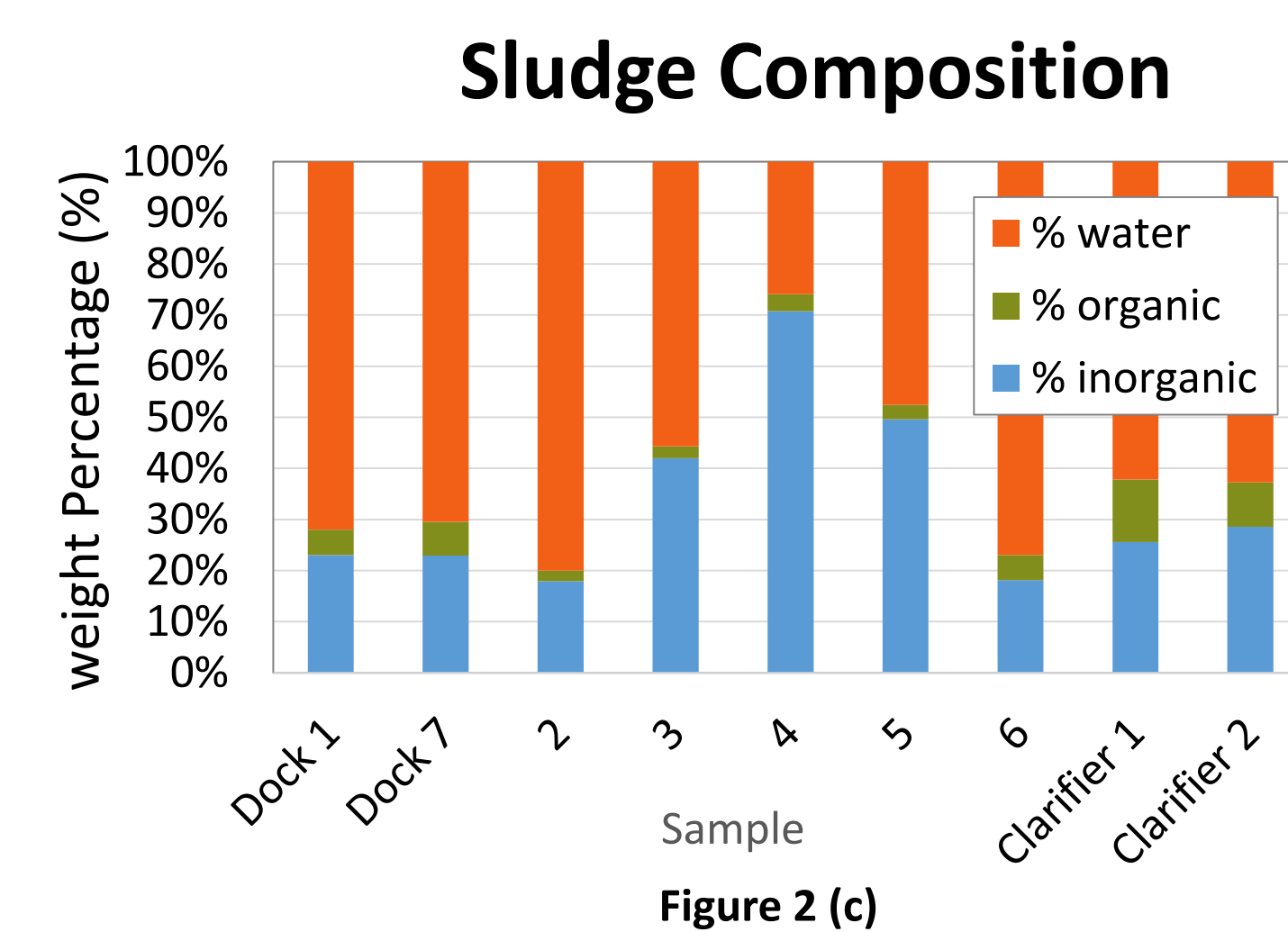


Figure 2 (a) Profile of sludge volumetric deposition in the lagoon. Large amounts of sludge deposited in western (left) portion of lagoon; (b) map of the lagoon depicting sampling points taken with an AMS core sampler; (c) sludge composition at sampling points along the lagoon and from the primary clarifier. Variation in composition is due to inability to collect samples in areas where largest amount of sludge may have deposited.

Consolidation

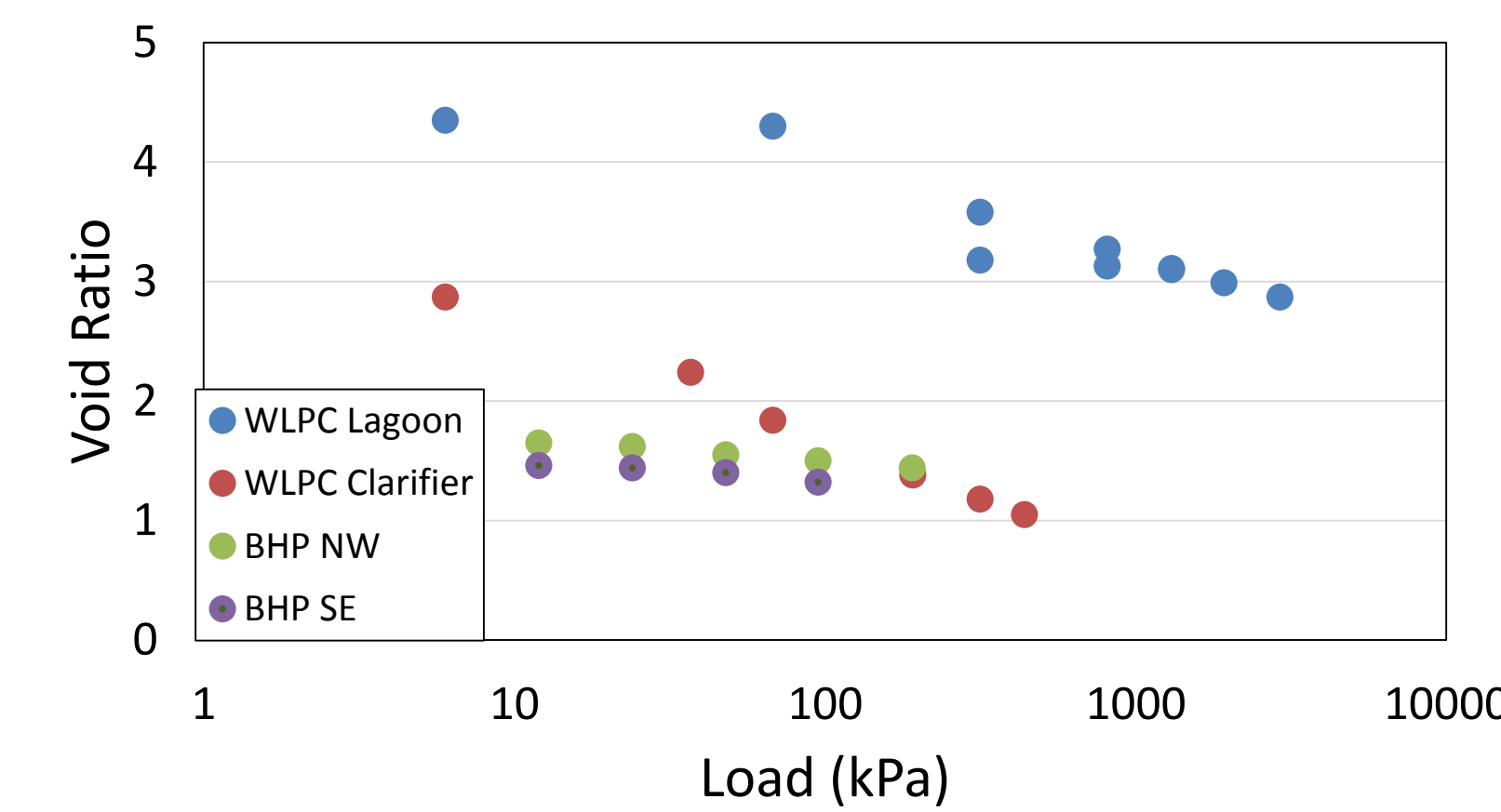


Figure 3 Settlement curves created for WLPC lagoon and clarifier sludge. From the graph a coefficient of compression was determined from the slope over one log cycle. The large slope for the clarifier and lagoon sample indicates a larger amount of settlement will likely occur. Settlement predictions for BHP lagoon sludge are provided for reference and context.

Settlement Predictions

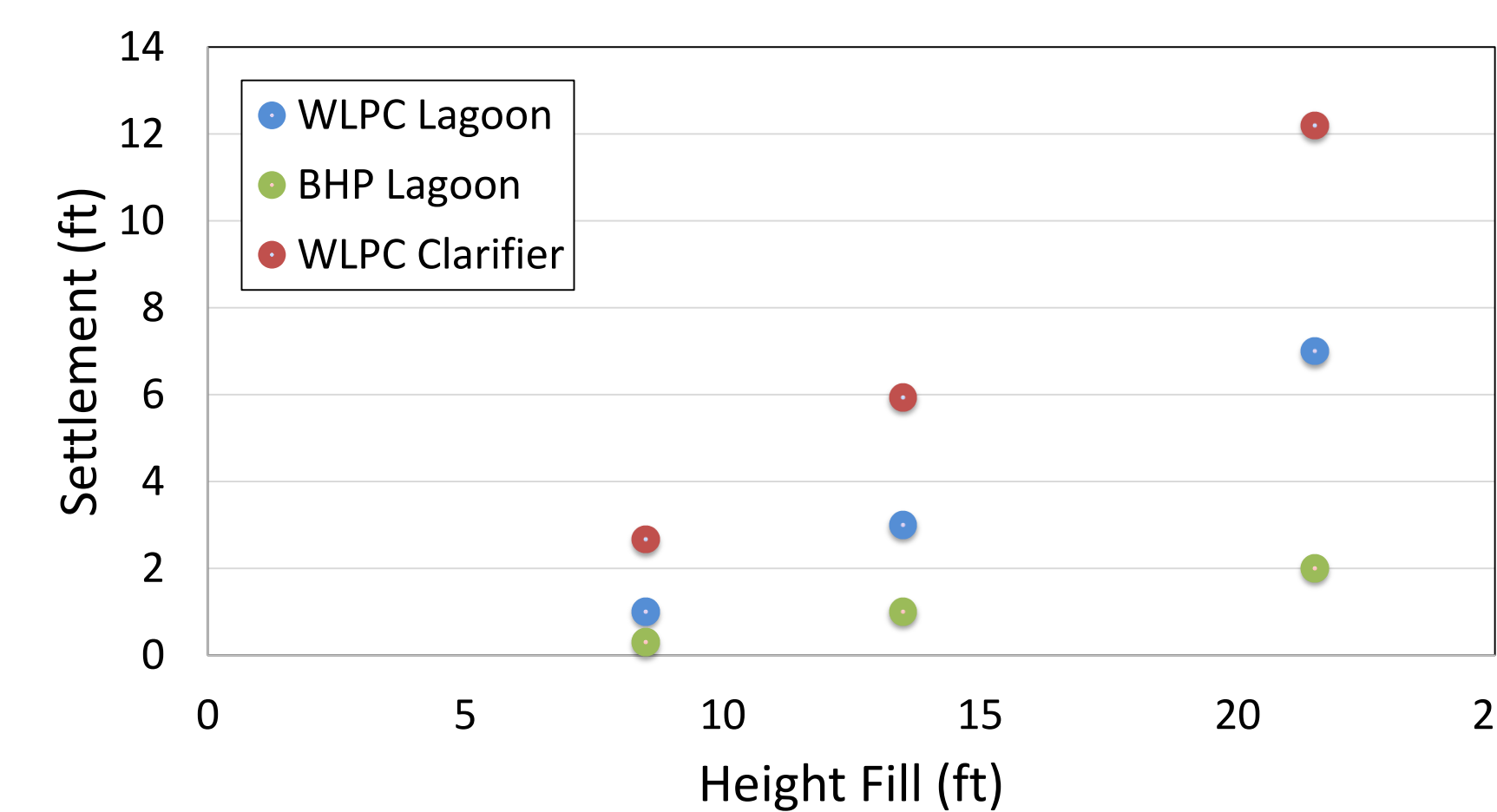


Figure 4 Prediction of settlement as a function of fill height. Large amounts of settlement reduce what land can be used for after backfilling has occurred. Results indicate WLPC's lagoon and clarifier sludge would not make a good backfill material.

Lagoon Replacement

Cooling Tower

- Treat temperature to reduce summer thermal discharge load
- Preliminary design parameters
 - Flowrate = 2800 gal/min
 - Area = 1400 ft.²
 - Height = 25 – 30 ft.
 - Fan = 60 hp (45 kW)
 - Pump = 30 hp (25 kW)
- Estimated initial cost of \$1.3 MM with an operations and maintenance cost of \$62,800/yr.

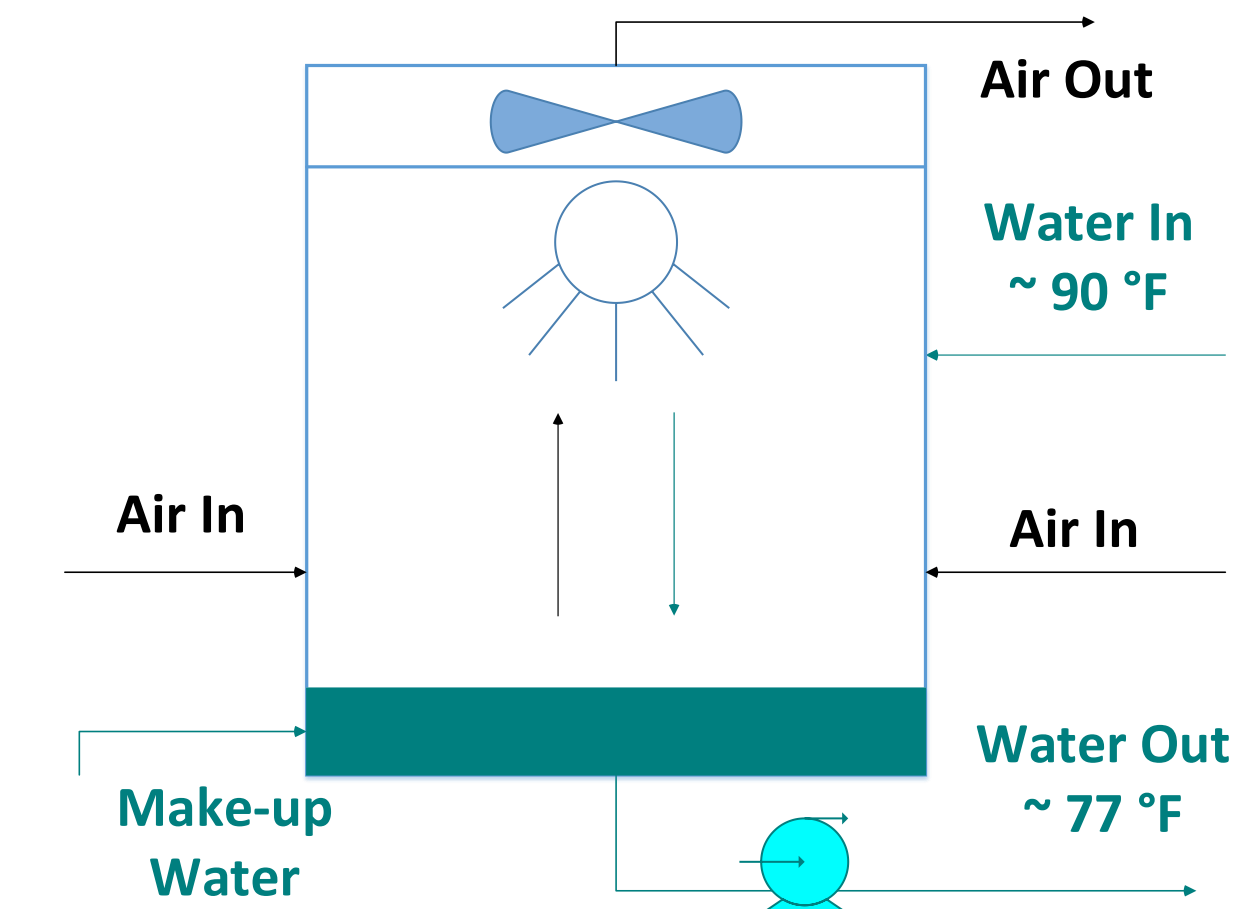


Figure 5: Process flow diagram of designed cooling tower.

Conclusions

- WLPC clarifier and lagoon sludge is not recommended as fill material due to predicted settlement.
- Physical properties were similar to BHP's lagoon sludge.
- Estimated 180,000 cubic yards of sludge present in WLPC's lagoon.

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