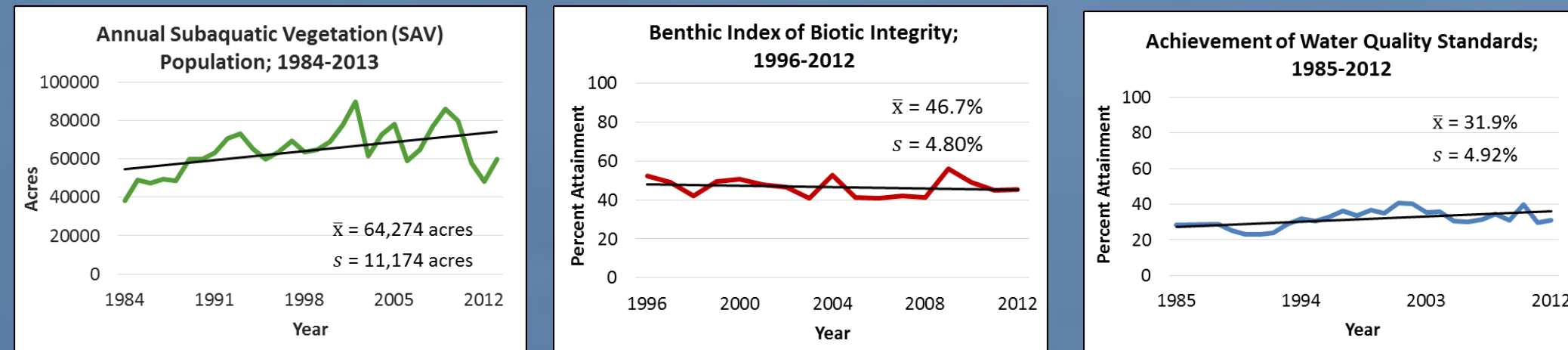


Design of a Sediment Removal and Processing System to Reduce Sediment Scouring Potential from the Lower Susquehanna River Dams

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Context

Sediment and Nutrient Pollution: SAV, Benthic, and Water Quality



- Subaquatic vegetation has declined, in the Chesapeake Bay, by 140,000 acres (as of 2013) from 1937 levels; no significant increasing or decreasing trend since 1984
- On average, only 47% of the Bay has met acceptable benthic index levels for the past 16 years; no significant increase or decrease
- On average, only 31% of the Bay has met water quality standards for the past 27 years; no significant increase or decrease

Attributed to: excess sediment and nutrient (nitrogen/phosphorous) loads

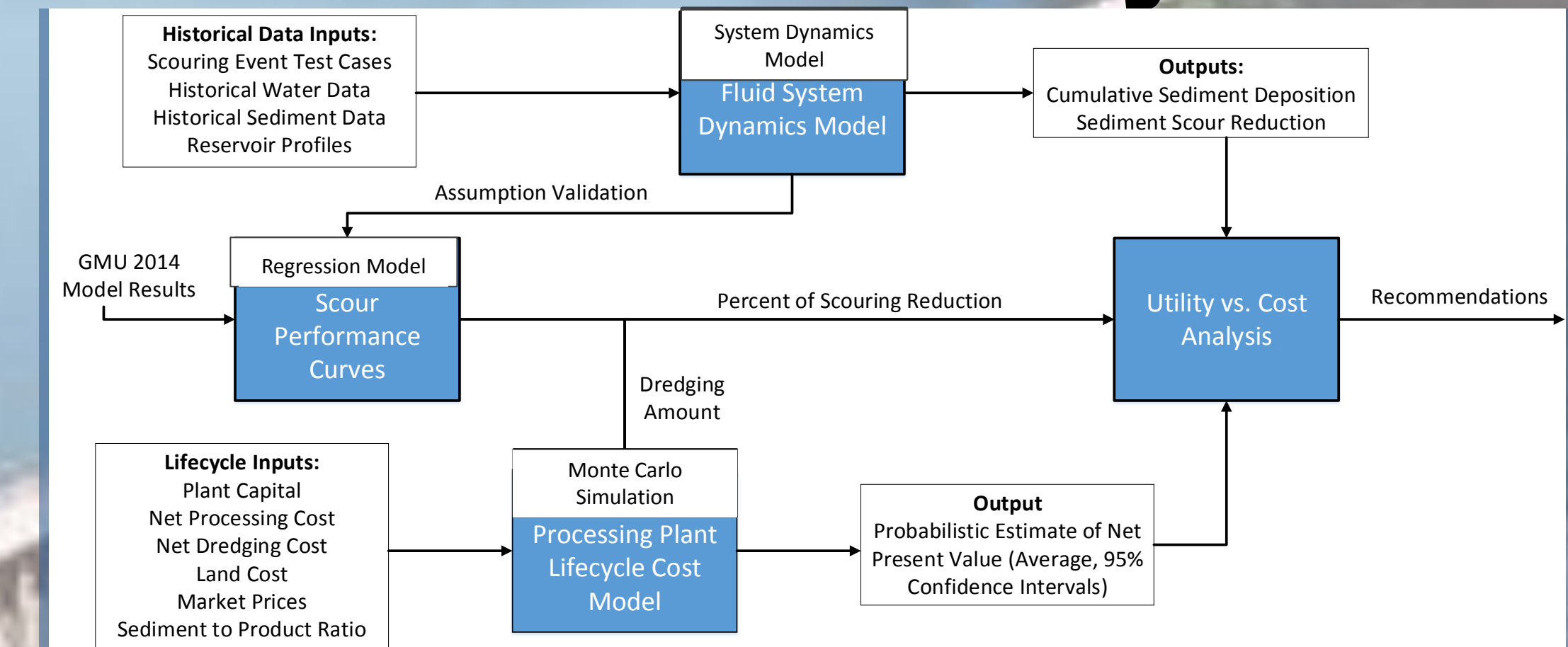
- Susquehanna contributes 27% of the sediment, 41% of the nitrogen, 40% of the phosphorous load annually into the Bay

Problem & Need

Problem: The Lower Susquehanna River Dams have acted as a sediment and nutrient trap for approximately 80 years. However the Safe Harbor, Holtwood, and Conowingo dams have reached near maximum sediment storage capacity. Due to the increased deposition, the predicted amount of harmful sediment that will enter the Upper Chesapeake Bay during a major scouring event will surpass TMDL limits, and significantly damage the Bay's ecosystem more than previously.

Need Statement: There is a need to develop a sediment removal and processing system to reduce the sediment build up in the Lower Susquehanna River Dams, in order to reduce the ecological impact of future scouring events.

Method of Analysis



Processing Design Alternatives

Plasma Vitrification: Piloted by Westinghouse Plasma Corp. Uses plasma torches reaching 5000 deg. C destroying nearly all toxic and microbiological contaminants

Product: Glass Slag, replacement for coal slag, glasphalt, talc/feldspar, three-mix glass

Cement-Lock: Piloted by Gas Tech. Institute and Unitel Technologies. Thermochemical process involving a rotary kiln reaching temperatures from 1315 – 1425 deg. C.

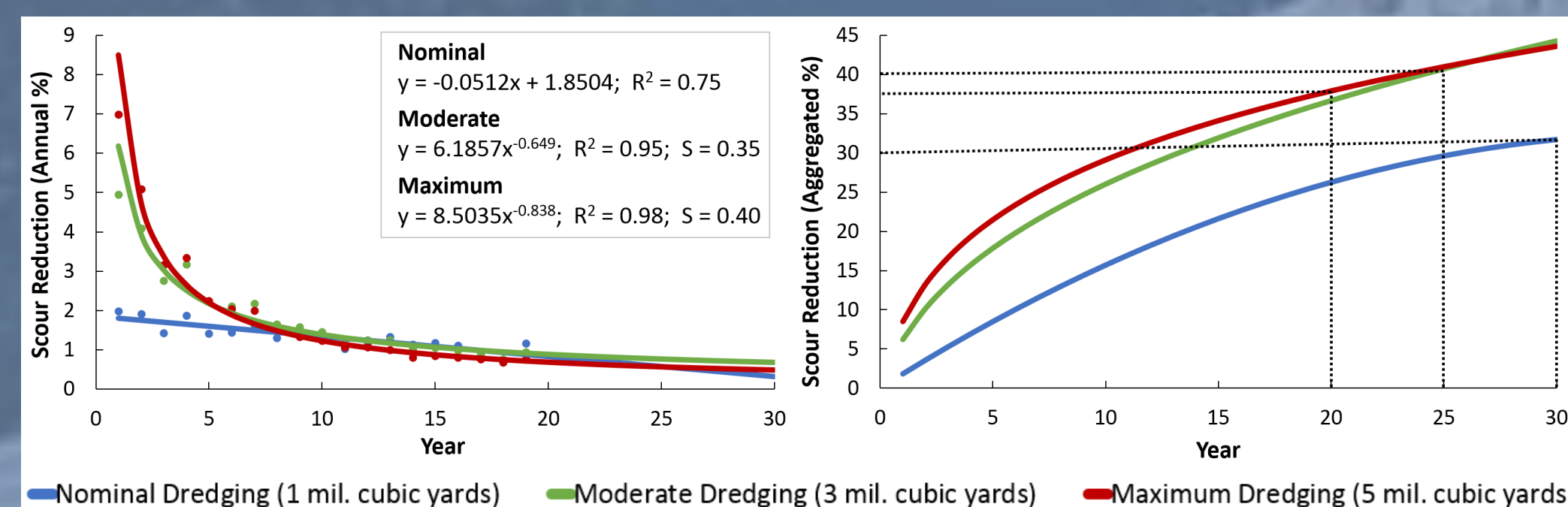
Product: Eco-Melt, 30-40% replacement for Portland cement

Quarry/Landfill: Removing dredged sediment and placing it in deposit sites. Serves as the control/base case.

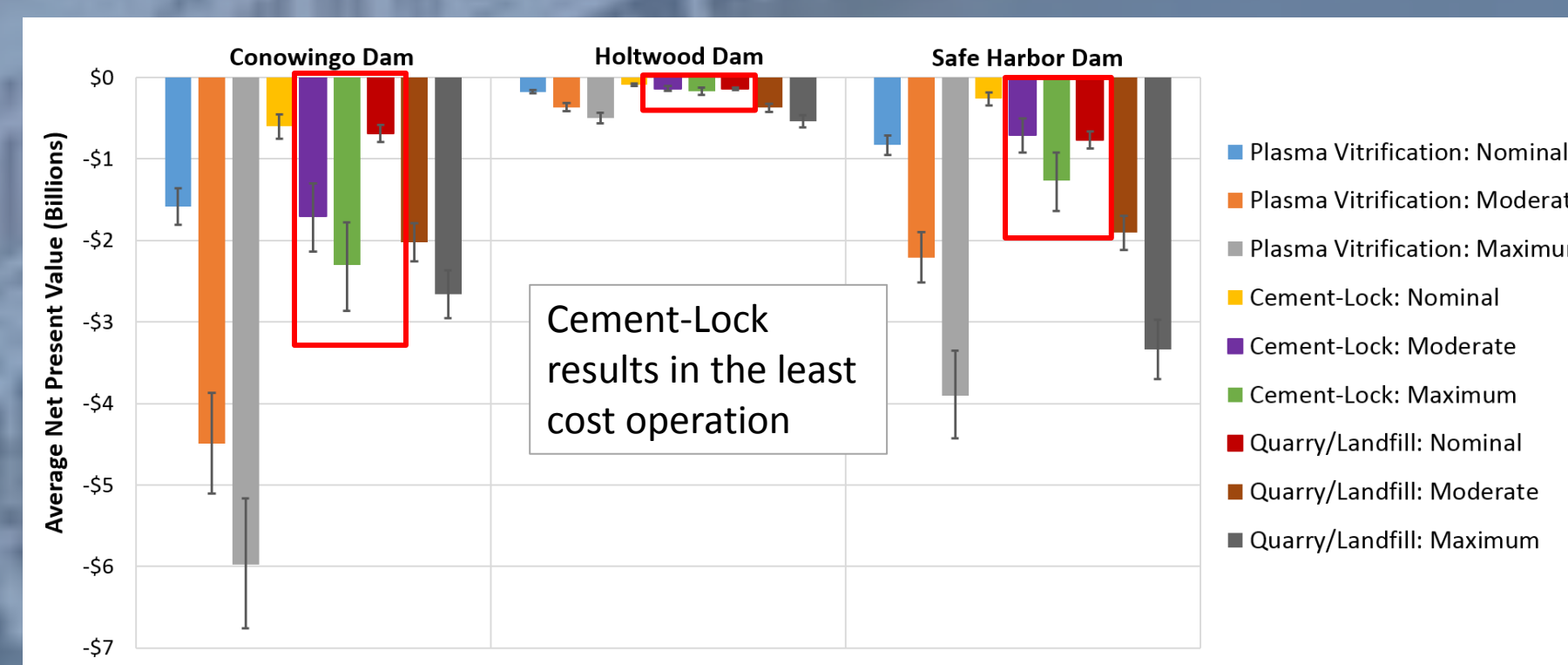
Product: None

Results

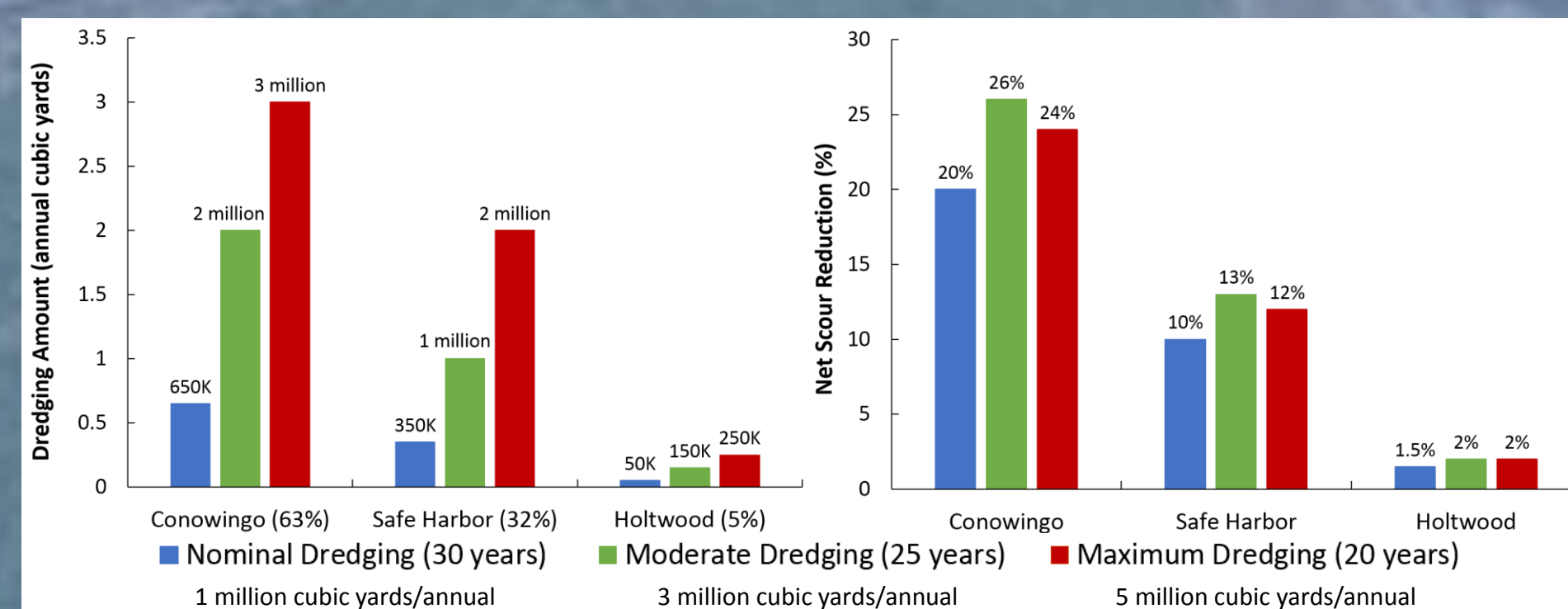
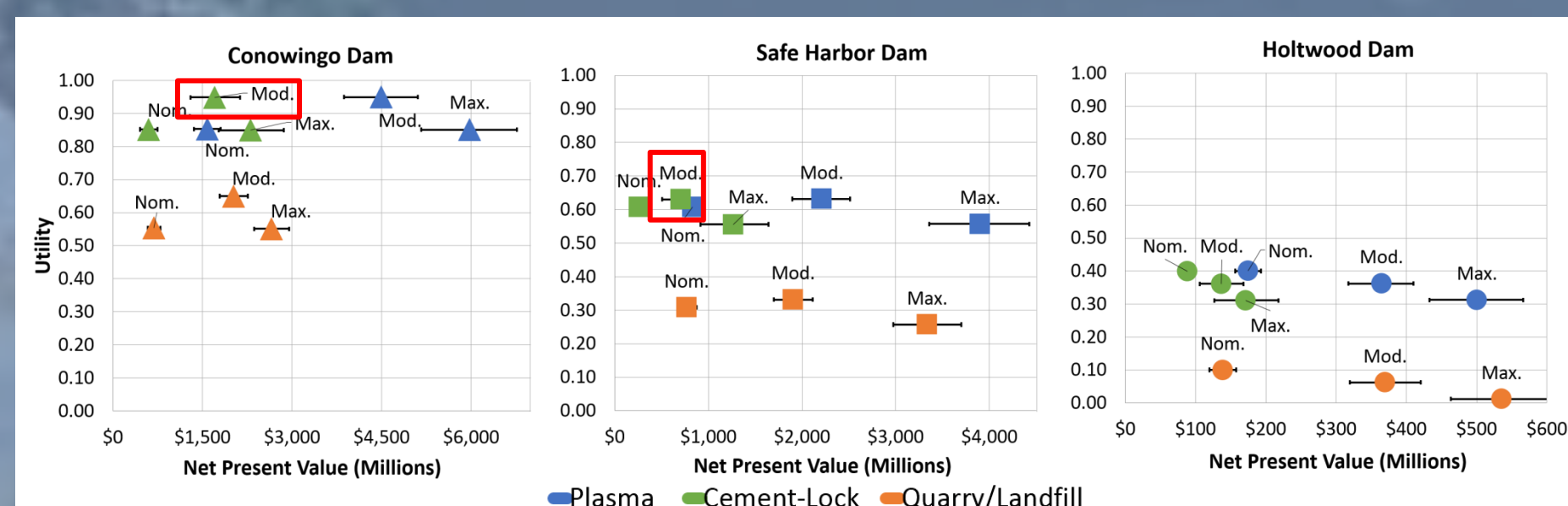
Scour Performance Curves



Processing Plant Lifecycle Cost Model



Utility vs. Cost Analysis



Conclusions

Conowingo: Cement-Lock at moderate dredging with a NPV of -\$2 to -1.3 billion and a lifecycle of 25 years

Holtwood: Not recommended due to low scour reduction potential

Safe Harbor: Cement-Lock at moderate dredging with a NPV of -\$900 to -\$500 million and a lifecycle of 25 years

Recommendations

- Dynamic Interaction During Major Scouring Events
 - If considerable, a removal and processing operation may be needed at only one dam
- Exhaustive Survey of Nutrient Management Strategies
 - Example: neutralizing the deposited sediment to remove nutrients and contaminants
- Pilot Study for Cement-Lock Technology on Lower Susquehanna Sediment
 - Volcano Partners LLC are the patent holders
- Further Research for an Integrated Plasma and Architectural Tile Processing Plant
 - Glass slag may be used as a substitute for three-mix glass, a material used in architectural tile production