

APPENDIX X:
PROJECT SUMMARY SHEETS

PhosLock (Nutrient Inactivation)

Description: PhosLock is a clay-based, non-aluminum-based nutrient inactivator that has been used in a variety of ways to inactivate phosphorus, making it unavailable for algal growth. PhosLock is not considered an EPA registered pesticide, since it does not directly affect plants or algae, and does not currently require a permit in New Jersey.

Goal of Management Measure: PhosLock applications are intended to inactivate phosphorus generated from deep, anoxic sediments, as well as shallow sediments where there is a mobilization of phosphorus from both chemical and biological processes. PhosLock can also be used to strip the water column of dissolved phosphorus as it moves towards the sediment. The inactivation and reduction of phosphorus concentrations is intended to limit the availability of phosphorus.

Advantages:

- Non-aluminum or metal-based.
- Effective under anoxic and oxic conditions.
- Effective at low pH values.
- Does not affect water pH values.
- Does not require a buffer.
- Safe for aquatic organisms.
- Can inactivate both inorganic and organic forms of phosphorus.
- Can provide multi-year inactivation of phosphorus in the sediments.



Limitations:

- More expensive than traditional nutrient inactivants, such as aluminum or iron-based products.
- Starting in 2023 PhosLock will no longer be available in the US; however, an alternative product with the same formulation will be available by the manufacturer, SePRO, and is named EutroSORB G.

Permits: There are currently no permits required in New Jersey specifically for PhosLock applications. However, treatments equal to or larger than 80 acres will more than likely trigger the need for a NJ Pollutant Discharge Elimination System (NJPDES) permit.

Range of Costs: Specific treatment costs would vary based on the type of treatment (sediment vs. stripping), dosage rates and mode of application. However, including product and labor a PhosLock treatment is preliminarily estimated to cost between \$1,000 and \$2,500 per acre.

Biochar (Lentic Systems; Standing Waters)

Description: Biochar is a processed wood material that has a high affinity to adsorb a variety of nutrients, including phosphorus. Biochar can be placed into floatation balls, sleeves, or cages and tethered along a beach area, swimming line in stormwater ponds, or where an inlet enters the lake.

Goal of Management Measure: The installation of Biochar sleeves in lentic systems is intended to reduce nutrient concentrations, with an emphasis on dissolved phosphorus. Thus, Biochar is a nutrient management measure.

Maintenance: Biochar sleeves need to be replaced every few months to maintain efficient nutrient removal rates. Such replacement rates may vary between 3 and 6 months; however, for standing waters 6 months seems to be an appropriate replacement rate. Once removed, the material can then be used as mulch for upland landscaping.

Advantages:

- Low product cost.
- Recycled, organic material.
- Biochar can be re-used as a form of mulch after it is removed from the water
- Easy installation and maintenance for homeowners and volunteers.

Limitations:

- Must be replaced every few months, or at least once per growing season to maintain nutrient removal capabilities.
- While it can be purchased in bulk and sleeves be built, it is recommended purchasing the sleeves pre-made to avoid dealing with issues such as



particles in the air while handling the material.

Permits: No permits are typically required for the installation in standing waters.

Range of Costs: The cost of the Biochar and the sleeve, in bulk, is about \$11 per sleeve (3-4 ft long and 8" in diameter). However, pre-made Biochar sleeves cost approximately \$25 to \$30 per sleeve. Neither of these cost estimates includes shipping of the product, material to anchor / install the Biochar or the labor for installation and retrieval of the material.

Biochar (Stormwater Structures)

Description: Biochar is a processed wood material that has a high affinity to adsorb a variety of nutrients, including phosphorus. Biochar can be placed into sleeves and then installed into stormwater structures, such as Manufactured Treatment Devices (MTDs), where it can remove phosphorus as stormwater flows through the media.

Goal of Management Measure: The installation of Biochar sleeves in stormwater structures is intended to reduce stormwater nutrient concentrations, with an emphasis on dissolved phosphorus, before the water discharges into the receiving pond lake, stream or other waterway. Thus, Biochar is a nutrient management measure.

Maintenance: In stormwater structures, Biochar sleeves need to be replaced every 3 to 5 months to maintain efficient nutrient removal rates. Biochar sleeves should be replaced approximately every three months in stormwater structures that receive significant storm-related flows. Once removed, the material can then be used as mulch for upland landscaping.

Advantages:

- Low product cost.
- Recycled, organic material.
- Biochar can be re-used as a form of mulch after it is removed from the water
- Enhances the capacity of stormwater structures to remove nutrients from the flowing stormwater.

Limitations:

- Must be replaced every few months, or at least once per growing season to maintain nutrient removal capabilities.



- Confined Space Certification may be required for installation and maintenance in certain, large stormwater structures.
- May need to evaluate varying particle sizes of Biochar and the MTD design to avoid any potential localized flooding associated with the structure.

Permits: Typically, no permits are required.

Range of Costs: The cost of the Biochar and the sleeve, in bulk, is about \$11 per sleeve (3-4 ft long and 8" in diameter). However, pre-made Biochar sleeves cost approximately \$25 to \$30 per sleeve. Neither of these cost estimates includes shipping of the product, material to anchor / install the Biochar or the labor for installation and retrieval of the material.

Biochar (Lotic Systems; Flowing Waters)

Description: Biochar is a processed wood material that has a high affinity to adsorb a variety of nutrients, including phosphorus. Biochar can be placed into sleeves or cages and anchored to the streambed or streambank where it can remove phosphorus as the water flows through.

Goal of Management Measure: The installation of Biochar sleeves in flowing systems is intended to reduce nutrient concentrations, with an emphasis on dissolved phosphorus, before the water discharges into the receiving pond or lake. Thus, Biochar is a nutrient management measure.

Maintenance: For flowing waters, Biochar sleeves need to be replaced every 2 to 5 months to maintain efficient nutrient removal rates; the removal frequency is based on the magnitude of the pollutant load and the base / storm flows. For example, Biochar sleeves should be replaced approximately every 2-3 months in streams that experience higher flows. Once removed, the material can then be used as mulch for upland landscaping.

Advantages:

- Low product cost.
- Recycled, organic material.
- Biochar can be re-used as a form of mulch after it is removed from the water
- Reduces nutrient concentrations before the water discharges into the receiving pond or lake.



Limitations:

- Must be replaced every few months to maintain nutrient removal capabilities.
- Permits may be required.
- There have been instances where the installed sleeves have been displaced during large / severe storm events.
- While it can be purchased in bulk and sleeves be built, it is recommended purchasing the sleeves pre-made to avoid dealing with issues such as particles in the air while handling the material.

Permits: Any work proposed within a State open water (Freshwater Wetlands Protection Act) and/or regulated water (Flood Hazard Area Control Act) requires approval via permit(s) that are specific to each Act.

Range of Costs: The cost of the Biochar and the sleeve, in bulk, is about \$11 per sleeve (3-4 ft long and 8" in diameter). However, pre-made Biochar sleeves cost approximately \$25 to \$30 per sleeve. Neither of these cost estimates includes shipping of the product, material to anchor / install the Biochar or the labor for installation and retrieval of the material.

Air Curtain

Description: Air Curtain aeration systems are designed to form a barrier of moving water around beaches, marinas, or other high-density nearshore areas. Aeration diffusers are placed on the bottom of the lake, along the perimeter of the protected area, and are supplied with air from a compressor on shore.



Goal of Management Measure: Air Curtains are designed to prevent the accumulation of algae, cyanobacteria, plant fragments, and other nuisance debris along the designed area. The accumulation of cyanobacteria in nearshore areas can otherwise lead to elevated cell counts. The accumulation of plant fragments and other organic matter can lead to nutrient release and low dissolved oxygen levels upon decomposition.

Advantages:

- Prevents the wind-blown accumulation of harmful cyanobacteria along high-density nearshore areas.
- Increases water movement and dissolved oxygen levels along nearshore areas.
- Allows the passage of boats and other watercraft.
- Safe for aquatic wildlife.

Limitations:

- Prevents the establishment of thermal stratification. Thus, Air Curtains should not be used in deeper waters that would

otherwise develop a stratification pattern unless the entire limnetic portion of the target lake is to be destratified (in such as case a different type of aeration is required).

- Needs a reliable and safe source of electricity close to the shoreline.
- Annual costs associated with power and routine maintenance.

Permits: NJDEP does not specifically have a permitting process for the installation of an aeration system. However, any shoreline compressor housing units would need to consider any potential wetlands, flood hazard and riparian zones, and would potentially require a Freshwater Wetlands Permit and/or a Flood Hazard Permit. However, most Air Curtains intended for relatively small areas such as a beach or marina should not require a permit.

Range of Costs: Highly dependent on the area targeted for treatment. Capital costs are expected to start around \$15,000 to \$25,000. Costs can be substantially higher if a nearshore source of power is not readily available.

Nanobubble Aeration

Description: Nanobubble aeration systems utilize extremely small gas bubbles to oxygenate a waterbody. Due to their extremely small size and minimal buoyancy relative to traditional aeration systems, nanobubbles remain stable in the water for longer periods of time rather than traveling directly to the water surface and bursting, providing superior oxygenation.

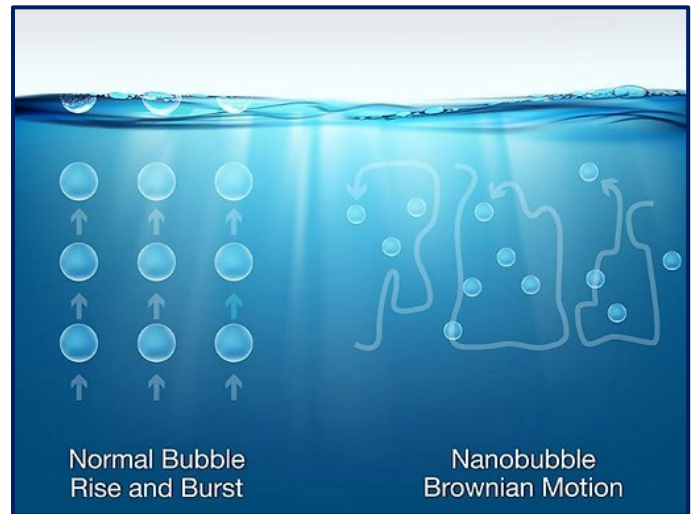
Goal of Management Measure: Nanobubble aeration systems are designed to saturate the water with significantly more oxygen than traditional aeration systems. In turn, this should decrease foul odors, increase the breakdown of organic matter in the water column (such as cyanotoxins and taste & odor compounds) and along the bottom of the lake, disrupt the formation of algae blooms, and promote beneficial bacteria growth.

Advantages:

- Nanobubbles remain suspended in the water longer than bubbles from traditional aeration systems.
- High surface area of bubbles per volume of water relative to bubbles from traditional aeration systems increases gas (oxygen) transfer to water.
- Suppose to provide a higher degree of oxidation of organic matter relative to standard aeration.

Limitations:

- More expensive than traditional aeration systems.
- Needs a reliable and safe source of electricity close to the shoreline.
- Annual costs associated with power and routine maintenance.



Source: Nanobubble Systems

Permits: NJDEP does not specifically have a permitting process for the installation of an aeration system. However, any shoreline compressor housing units would need to consider any potential wetlands, flood hazard and riparian zones, and would potentially require a Freshwater Wetlands Permit and/or a Flood Hazard Permit. However, most nanobubble systems intended for relatively small areas such as a beach or cove should not require a permit.

Range of Costs: Highly dependent on the area targeted for treatment. Capital costs are expected to start around \$25,000 to \$35,000. Costs can be substantially higher if a nearshore source of power is not readily available.

Nanobubble Aeration with Ozone

Description: Nanobubble aeration systems utilize extremely small gas bubbles to oxygenate a waterbody. Infusing the nanobubbles with ozone, a safe disinfecting and sanitizing gas, greatly increasing the oxidation power of the aeration system. Due to their extremely small size and minimal buoyancy relative to traditional aeration systems, nanobubbles remain stable in the water for longer periods, which also allows the ozone to remain stable for extended periods of time.

Goal of Management Measure: Nanobubble aeration systems with ozone are designed to provide the same aeration benefits associated with regular nanobubble systems, with additional oxidation and sanitization properties provided by ozone gas. The ozone nanobubbles offer the ability to degrade organic and inorganic pollutants and chemicals that may be present in the waterbody, which may include cyanotoxins and taste & odor compounds.

Advantages:

- Superior oxidation potential relative to traditional aeration or nanobubble systems.
- The nanobubbles allow the ozone to remain stable in the water for extended periods of time.
- Ozone provides the ability to degrade pollutants and chemicals such as cyanotoxins and taste & odor compounds.



Limitations:

- More expensive than traditional aeration systems.
- Needs a reliable and safe source of electricity close to the shoreline.
- Annual costs associated with power and routine maintenance.

Permits: NJDEP does not specifically have a permitting process for the installation of an aeration system. However, any shoreline compressor housing units would need to consider any potential wetlands, flood hazard and riparian zones, and would potentially require a Freshwater Wetlands Permit and/or a Flood Hazard Permit. However, most nanobubble systems intended for relatively small areas such as a beach or cove should not require a permit.

Range of Costs: Highly dependent on the area targeted for treatment. Capital costs are expected to start around \$25,000 to \$35,000. Costs can be substantially higher if a nearshore source of power is not readily available.

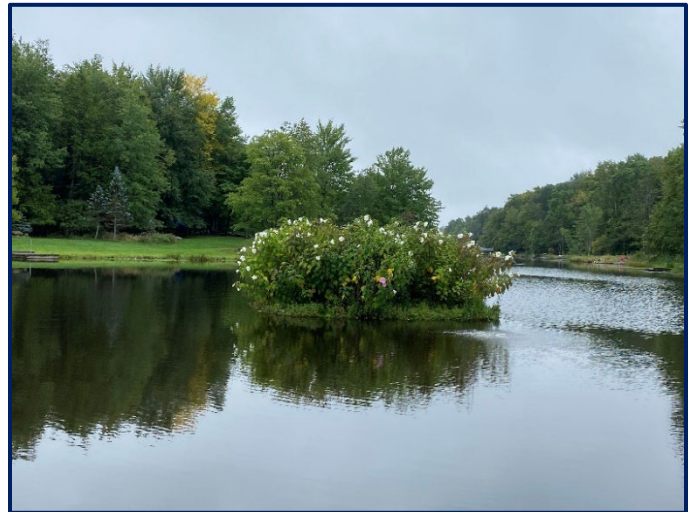
Floating Wetland Islands

Description: Floating wetland islands (FWIs) are constructed of recycled plastic material and are planted with a variety of native wetland vegetation. The plants are rooted in peat or other soil matrix, which eventually grow through the matrix material and into the water column where they assimilate nutrients to support vegetative growth. The high surface area of the constructed wetland material and root mass of planted vegetation serve as habitat for bacteria and other microbial life, which further assimilate and process phosphorus and nitrogen.

Goal of Management Measure: The main goal associated with the implementation of FWIs is the reduction of nitrogen and phosphorus concentrations in the water. Incorporating these nutrients into the FWI vegetation and microbial community reduces the nutrient pool in the water column. Additionally, the development of this microbial community underneath the FWI attracts a variety of aquatic life, including macroinvertebrates, small fish and, in turn, game fish.

Advantages:

- Environmentally friendly, aesthetically pleasing, and cost-effective.
- A green management measure in reducing nutrient concentrations.
- Provides structure and habitat for a variety of aquatic organisms including young fish. In turn, larger gamefish are also attracted to the structures.
- Provides shoreline stabilization when placed along shorelines.
- Can slow inflow rates when strategically placed.



Limitations:

- FWIs can detach from their anchors in larger systems due to excessive wind and wave action if not anchored properly.
- In some cases, FWIs may need to be tethered to the shoreline as well as anchored.
- Goose netting needs to be installed and maintained for at least one full growing season to prevent grazing of the planted vegetation by Canada geese. Once the plants are well established, the geese will leave the FWIs alone.

Permits: Typically, no permits are required.

Range of Costs: An estimated range of cost for the purchase, transport, planting, and installation of four (4) approximately 110 square foot FWIs is between \$25,000 and \$35,000. The assistance of volunteers in the planting and anchoring / installation of the FWI can reduce costs.

GreenClean

Description: GreenClean is an oxidizing algaecide that uses sodium carbonate peroxyhydrate, a form of hydrogen peroxide, as the active ingredient to break down algae cells. GreenClean is an EPA registered algaecide that requires a permit to be filed by a State licensed applicator. Treatments can only be done by licensed and experienced applicators

Goal of Management Measure: Reduce algae and cyanobacteria densities in waterbodies. The product is also supposed to break down and preclude the release of cyanotoxins as well break down taste & odor compounds such as geosmin and MIB.

Advantages:

- Does not contain copper like many traditional algaecides which remain in the sediments and can bioaccumulate in the environment.
- Completely breaks down into water and oxygen upon decomposition.
- Reported to breakdown cyanotoxins and taste & odor compounds.
- Begins to work immediately upon application and releases oxygen into the water.
- Effective in coves, small waterbodies, or any area with limited water exchange.



Limitations:

- Limited success with cyanobacteria control in areas with a high flushing rate and high degree of water exchange, such as a beach area situated along the main body of a lake.
- More expensive product cost than standard copper-based algaecides.
- Licensed applicators need to be well versed in how to safely handle and use the product.

Permits: Requires an Aquatic Pesticide Permit to be filed by a New Jersey State licensed applicator.

Range of Costs: While the actual cost of a treatment with GreenClean will depend on the targeted algae and dosage rates, the area being treated and the number of required treatments, a very preliminary estimate of cost is approximately between \$450 and \$650 per acre per treatment event.