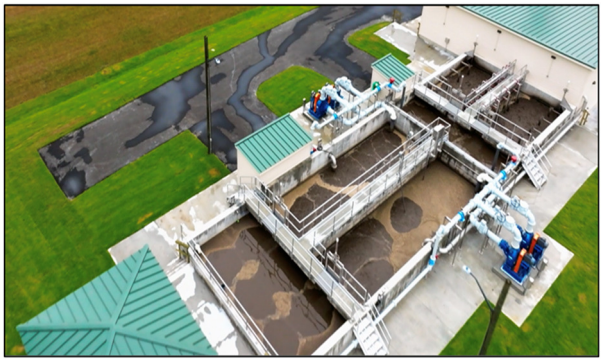
November, 2025

Pluris Hampstead completes its 5th Generation Advanced Membrane Bio-reactor ("MBR") Treatment Facility in North Carolina

Pluris is pleased to announce that it has completed its latest and 5th generation MBR wastewater treatment facility in North Carolina. The above photograph shows the water reclamation pond as part of the facility and readers are encouraged to view the short 2 minute aerial video showing the entire MBR treatment plant.

https://drive.google.com/file/d/1l1bj2NaZpTlueRpl8x2MvODxINETWZjj/view?usp=share_link

This 1.0 mgd advanced MBR wastewater treatment plant, which serves approximately 17,000 people, is unique in a number of ways. The plant is designed to meet strict limits set forth in the emerging North Carolina legislation for NPDES disposal. The plant has both NPDES and Non-Discharge permits for a conjunctive disposal regime. Disposal of highly treated effluent is achieved through High Rate Infiltration ("HRI") Basins that utilize engineered materials. This design allows for exceptional infiltration capabilities in basins that are much smaller than typical HRI basins. This reduces the plant footprint substantially and lowers land acquisition costs.



MBR treatment allows for bacterial elimination without the use of any disinfection system. The plant does have a peracetic acid disinfection system in place, and the utilization of this system allows for 4-log virus removal. This is an emerging regulatory concern, and the design achieves this goal with a low-cost low energy peracetic drip in the effluent, resulting in significant savings to rate payers.

The plant utilizes the MBR treated effluent instead of potable water as a water supply, for cleaning the fine screens and for the Clean In Place ("CIP") system for membrane cleaning.

Following treatment, MBR treated effluent is infiltrated in the high rate infiltration ("HRI") basins, and underdrains below the basins outside of the basins' footprint collect a portion and direct the groundwater to an impoundment. This impoundment serves as a source of irrigation water for the facility grounds as well as a supply for third-party developers to use the water for developments in irrigation and amenity ponds within common areas. The overall system approach is to take raw wastewater, treat it to a high level, infiltrate and then take the product of that infiltration (that by State statute is considered groundwater) and use it as a usable source of water for a myriad of purposes, and in doing so this reduces stress on existing potable water aquifers.

In every aspect of the disposal system, including the HRI basins and the groundwater impoundment, the goal has been to create areas that mimic the natural surroundings and provide a thriving wildlife habitat.

One of the principal design features of this plant is that treatment zones are designed within a commonwall tank system. This decreases line lengths for pumped systems like the feed forward and dentrification processes as well as allowing gravity flow through slide gates and weirs from the Pre Anoxic Zone to the Pre Aeration Zone and from the Post Anoxic Zone to the MBR Zones. This allows for lower initial construction capital costs as well as reduced energy operating and maintenance costs related to pumps.

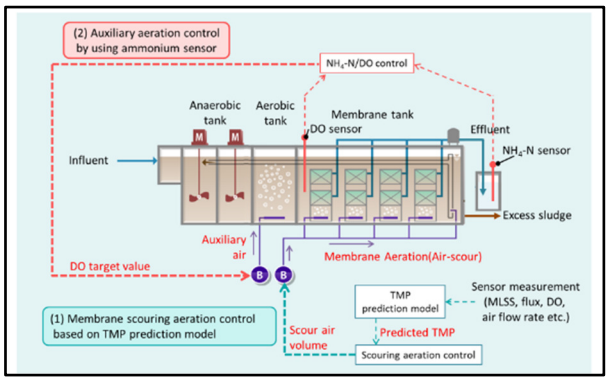
The MBR process includes four stages of biological wastewater treatment, finishing with high level membrane filtration. Two stages of anoxic mixing and treament are included for enhanced nitrogen removal. Total phosphorus removal is achieved using biological and chemical precipitation and filtration. Specifc volumes were selected to maximize treatment while minimizing chemical usage.

Online membrane capacity is matched to demand to optimize overall system energy utilization. When flow is lower to the facility, membrane zones are automatically taken offline and put into a "sleep" mode. This allows membrane utilization, and energy optimization, to be maximized. Energy efficieny is further enhanced by providing variable speed drives to control blower speed and output to match demand.

At lower flow conditions, the MBR system controls are "smart" in that the system will automatically reduce air scour rates as well as the number of membrane units online to match specific demand requirements. In approaching the controls in this manner, MBR system scour energy can be reduced by 30% from typical system demands.

Similarly, variable speed drives are utilized for the Denitrification process. This system is combined with the feed forward pumping system so that one pump does both jobs for each train. This saves capital costs as well as electrical costs. When influent flow to the MBR facility drops, the control system is programmed to reduce the recycle rate of the pumping system and thus save significant energy in the process. The return activated sludge system is a gravity design that utilizes zero electricity.

Upgrades are planned for the controls of the MBR facility which include Kubota enhanced process aeration and membrane scour controls. A transmembrane prediction module will be calibrated and used to achieve lower air scour demand on the membranes and thus reduce overall energy by up to 33% versus similar membrane systems.



Technology selection and system design both contribute to a reduction in environmental impact. The advanced MBR treatment plant encompasses significantly less area (footprint) than traditional wastewater treatment facilities. Pluris utilizes Kubota's membranes which allows MLSS concentrations over 15,000 mg/L, resulting in significantly less footprint area required.

This MBR plant is the 5th generation plant Pluris has designed, permitted, built and operates since its first plant in 2012. With 14 years of MBR design and operating experience, many improvements have been incorporated into this plant including the following metrics.

Wastewater Constituent	MBR Treated Effluent Consistent Results	Units
BOD5	< 2	mg/L
Fecal Coliform	< 2	col/100 mL
TSS	< 2.5	mg/L
NH_3	< 0.2	mg/L
Nitrate	< 0.5	mg/L
Total Nitrogen	< 1	mg/L
Total Phosphorus	< 1	mg/L
Turbidity	< 0.2	NTU

Innovative engineering design in non-discharge high rate infiltration ("HRI") ponds use an engineered center berm. The HRI pond incorporates an angular fine-to-course grain sand medium (ASTM Testing classification) improving infiltration, reducing the footprint of historical designed infiltration ponds. In addition to a reduced footprint, the engineered sand material, with greater than 50 feet of horizontal distance that the MBR treated wastewater travels to reach underdrains, provides an environment for confirmed bacterial growth that further reduces nutrients of the MBR treated wastewater prior to introduction into subsurface groundwater aquifers.

Confirmation of the bacterial presence and development was documented in a nine-month study and report by Dr. Francis L. de los Reyes III, Ph.D., BCEEM, F. WEF, and his Department of Civil, Construction, and Environmental Engineering at North Carolina State University. Dr. L. de los Reyes III provided four conclusions which are presented here.

I. Measurement of DNA, ATP and the detection of bacteria and archaea within the

engineered media provide proof of microbial growth in the berm.

II. There is a high similarity in the microbial communities at different sampling points in the berm. In contrast, the communities are very dissimilar to those in the MBR mixed liquor, indicating a unique environment and assembly in the engineered media.

III. The microbial communities present in the engineered media include carbon and nitrogen metabolizing organisms.

IV. The presence of nitrogen-removing bacteria, including ammonia oxidizers (both Bacteria and Archaea), nitrite oxidizers, and denitrifiers indicate that nitrogen is being removed within the berm. There is potentially phosphorus removal also occurring, based on the presence of phosphate-accumulating organisms.

At this facility, Pluris has created an onsite water reclamation pond with original plans of serving as an educational tool for elementary, middle and high school student field trips to show how the environment and advanced membrane treatment technology can coexist, with benefits to impaired wetland complexes. Koi fish are being introduced to the pond to show elementary, middle and high school students on field trips that aquatic life can thrive in the MBR treated water.

In addition, and in collaboration with Dr. Francis L. de los Reyes III, discussions led to the introduction of floating wetlands within the pond to enhance nutrient reduction further. Pluris is installing floating wetlands, and the first floating wetland was recently installed with additional ones to be installed in the Spring. The wetlands are planted with specific plants that allow roots to extend below the floating islands into the water column, allowing the roots to absorb nutrients in the water, providing necessary food to the plants.

All of the above referenced features contribute to reducing impact on the environment.

Due to the growth in southeastern North Carolina, Pluris has purchased a 32-acre parcel of land at the north end of its 16-mile force main and contemplates the next phase of expansion within a year.