

Executive Summary

The St. Cloud Nutrient, Energy & Water (NEW) Recovery Facility serves over 120,000 people across six communities in the St. Cloud area. In the last decade, the facility has undergone various improvements to accommodate a growing population, satisfy more stringent regulatory requirements, improve cost effectiveness, and realize ambitious sustainability goals for energy efficiency, renewable energy production, and resource recovery.

The NEW Recovery Facility has become one of the most sustainable resource recovery facilities in the nation and a world-class example of how well-conceived sustainability initiatives can improve cost effectiveness. These tremendous accomplishments, due in large part to its recent Nutrient Recovery and Reuse (NR2) project, are improving the health of the planet and the financial wellbeing of the people and businesses within the NEW Recovery Facility service area.

The NR2 Project included two innovative processes: nutrient harvesting (the Ostara process) and thermal hydrolysis of biosolids (the Lystek process). This is the first time these two processes have been employed together at a resource recovery facility in North America. The Ostara process extracts phosphorus and produces a nutrient-rich fertilizer pellet. The Lystek thermal hydrolysis process produces a safe and nutrient-rich soil amendment.

The balance of the NR2 project included biofuel storage, biosolids dewatering, a phosphorus-release reactor, and hauled-in waste receiving and processing improvements. The hauled-in waste improvements have dramatically improved biofuel and renewable energy production, allowing the facility to regularly generate more electricity than it consumes.

The St. Cloud project team decided to take a calculated risk by installing two new technologies at the same time to keep user rates low, enhance resource recovery, and meet the City's sustainability goals. The end result has been a tremendous success.

The Role of Donohue and Other Consultants

The St. Cloud Nutrient, Energy & Water (NEW) Recovery Facility serves more than 120,000 people across six communities in the St. Cloud area. In the last decade, the facility has undergone various improvements to accommodate a growing population, satisfy more stringent regulatory requirements, improve cost effectiveness, and realize ambitious sustainability goals for energy efficiency, renewable energy production, and resource recovery.

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Donohue led NR2 planning and implementation, providing project management, process, structural, electrical, control systems, HVAC-mechanical, and civil engineering services as well as construction administration/observation and O&M, startup, and training. HTPO provided survey services and Chosen Valley Testing provided geotechnical services; these services comprised <0.5% of the engineering fees.

Uniqueness and/or Innovative Application of New or Existing Techniques

The project team was tasked with combining several innovative technologies for the NR2 project to enhance resource recovery and reuse.

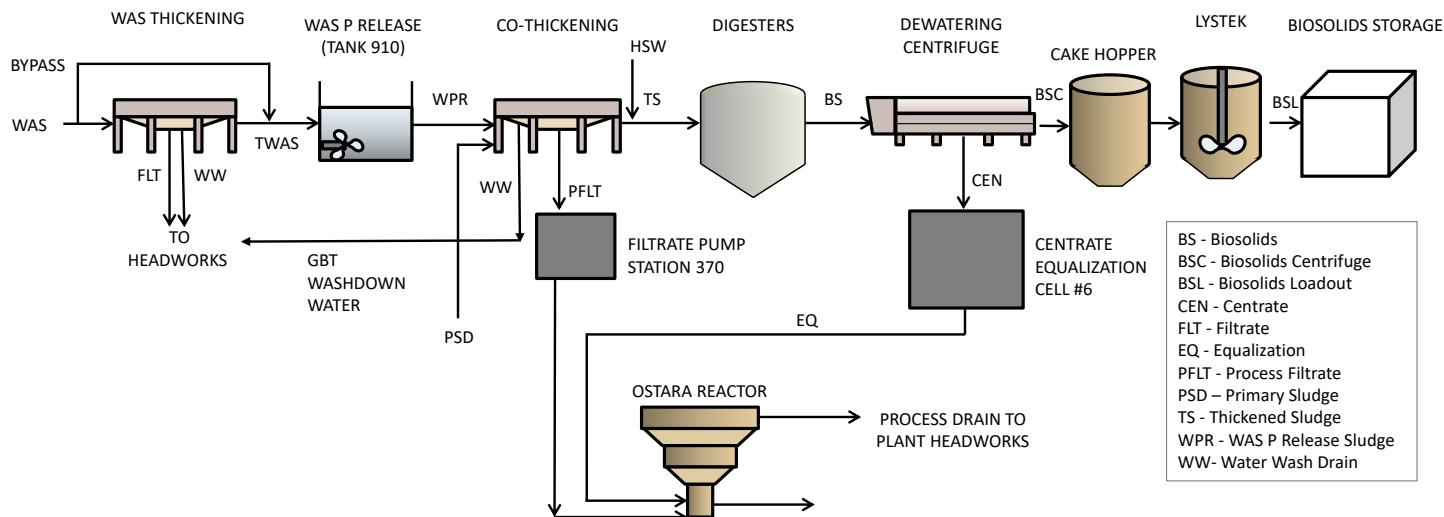
Beneficial Reuse of Biosolids. This project incorporated biosolids dewatering in combination with the Lystek biosolids stabilization and conditioning process, an innovative, energy efficient, and economic low-temperature physical-chemical hydrolysis technology that uses heat,

elevated pH, and high-shear mixing to break down the biological material in the biosolids to produce a homogeneous, pathogen-free, and nutrient-rich Class A EQ liquid soil amendment (LysteGro) for beneficial reuse. Compared to conventional thermal hydrolysis technologies, the Lystek technology uses milder process conditions, is fully automated, and requires a relatively small footprint. The product of these benefits is simplicity and cost effectiveness.

Nutrient Release and Recovery. The biosolids dewatering process creates a recycle stream rich in phosphorus. To achieve nutrient recovery targets, St. Cloud elected to harvest this phosphorous from the dewatering centrate and from phosphorus released from waste activated sludge (WAS) prior to digestion. Using the Ostara process, fertilizer pellets are created, dewatered, heat dried, and stored in a simple and fully automated process, producing a revenue-generating fertilizer product (Crystal Green).



Technology Synergies. One of the innovative outcomes of this resource recovery project was the leveraging of synergies between the Ostara and Lystek technologies. The Lystek process requires dewatered biosolids and, in turn, releases a high concentration of phosphorus. Routing this water (centrate) to the Ostara processes increased the amount of phosphorus available for harvesting and pelletizing.



Future Value to the Engineering Profession and Public Perception

The City of St. Cloud has received significant interest from other communities interested in learning more about the successful processes implemented at St. Cloud. The innovative biosolids process that produces a liquid Class A product is well suited to communities and sanitary districts that have an established liquid program, require additional cake solids storage, or a landowner community that prefers liquid land application. A Class A liquid

program is often more cost-effective and community-acceptable than a cake program, particularly a Class B program.


Social, Economic, and Sustainable Development Considerations

For many years, the City of St. Cloud operated a successful Class B liquid biosolids program; however, since implementing biological phosphorus removal several years ago, liquid biosolids volume had increased by 50% and the plant's storage basins were no longer adequate. In addition, clean water agencies and the regulatory community are striving to reduce the quantity of phosphorus land applied to watersheds.

The ability for the City to advance their successful land application program, while reducing and controlling costs, were key project features. Existing plant infrastructure, such as liquid storage tanks, buildings, and the truck loading station were reused. The City was also able to improve efficiencies. The concentrated nature of the end product, LysteGro, has reduced biosolids volumes by over 70%, extending St. Cloud's existing storage capacity. The high solid, liquid properties of the product allow the City to maintain pumping, loading, and unloading efficiencies, while also dramatically decreasing the amount of road time and wear and tear on trucks, overtime, and the number of passes application equipment must undertake when land applying.

During its first full biosolids-recycling season with the new Lystek system and LysteGro product, the reduction in volume resulted in a significant decrease in miles driven to recycle the product, total acres applied and a reduction in staff hours. The concentrated nutrient-rich biosolids product resulted in an average application rate of 4,700 gallons per acre, compared to an average application rate of 9,200 gallons per acre in the prior year.

Land Application: Before NR2 (Class B Product)				
6.6 million gallons	11,869 miles	716 acres	1,043 regular staff hours	560 overtime staff hours

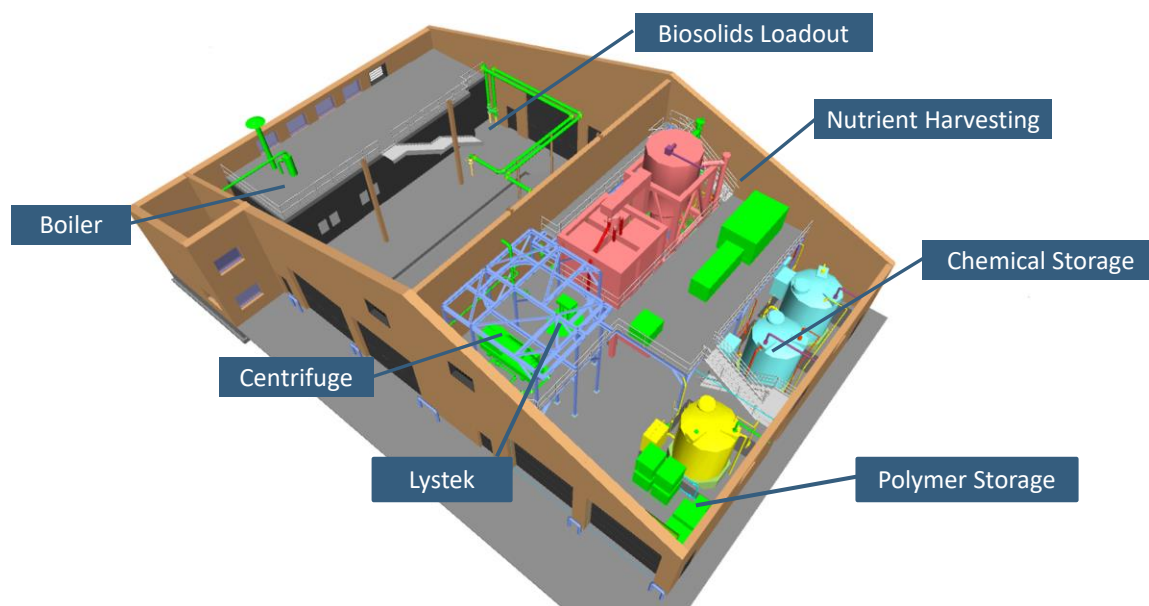


Land Application: After NR2 (Class A Product)				
2.9 million gallons	3,694 miles	619 acres	825 regular staff hours	84 overtime staff hours

The Class A biosolids also have additional agronomic benefits. Potassium is a highly valued nutrient in field crop production and in demand from the agricultural community. Potassium hydroxide is added as part of the Lystek process, which triples the potassium content of the biosolids.

The increased removal and recovery of phosphorus in the waste stream protects the digester and dewatering equipment from nuisance struvite formation and redirects the facility's reclaimed phosphorus from the biosolids to a commercial struvite fertilizer product, which can then be exported out of the local watershed to where there are phosphorus deficiencies.

Complexity



Equipment Layout: Due to its ideal location and quality structure, the NR2 team was tasked with converting an existing equipment storage building into the new biosolids processing facility.

The City wanted to use their existing equipment storage building for the NR2 equipment. Donohue team members carefully prepared equipment layouts to fit with the existing building footprint, taking into consideration accessibility for maintenance and operation. Due to the height of the nutrient harvesting (Ostara) equipment, the team designed modifications to the ceiling and added a penthouse-type structure to fit the facilities.



The design was further complicated by the uniqueness of these processes. St. Cloud's NEW facility is the first in North America to combine thermal hydrolysis and phosphorus recovery. The Lystek installation is the second in the United States and the seventh Ostara Pearl 2K reactor in the nation and 10th world-wide.



Since these processes are so new, the project team was tasked with adapting solutions as the project progressed. One of the challenges was lower than anticipated soluble phosphorus due to alum in the primary sludge. The solution was to install a WAS phosphorus release process to release soluble phosphorus prior to thickening.

Successful Fulfillment of Client/Owner Needs

"The NR2 Workshop went GREAT today. Both Brian and I wanted to let you know we think Jeff, Allen, Nathan and Jeremy are all absolutely fantastic. It was so great to get together and go through all the details again and being able to ask questions with everyone being in the same room. As a team, St. Cloud and Donohue have spent several hundred hours and then some working on this project thus far, and it's exciting to be at the stage of where it is at now; equipment being delivered in the next few weeks, installed and we will be operating this all very soon!

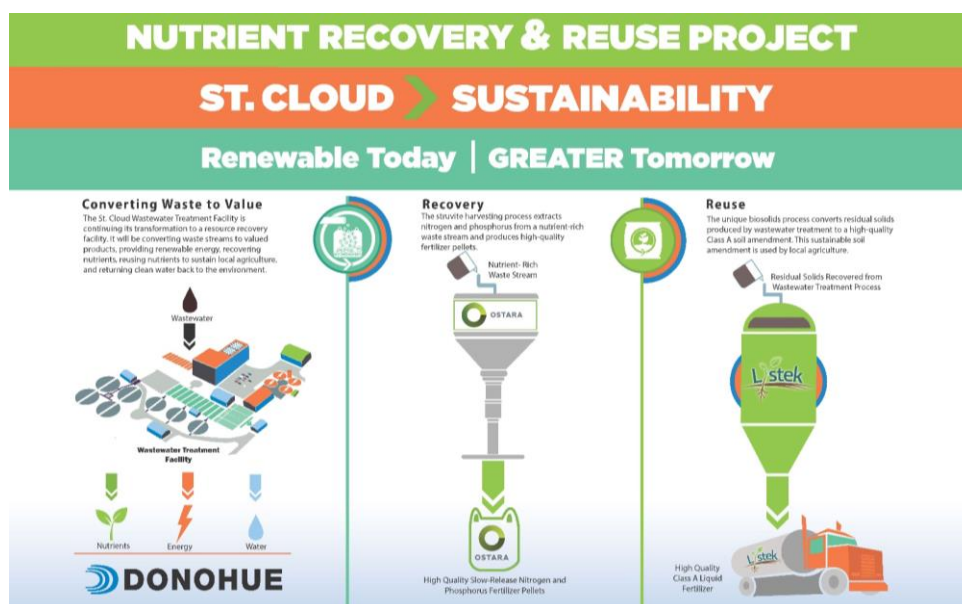
Your team is exceptionally brilliant, knowledgeable, professional and respectful. We truly enjoy working with all you freaky smart people!"

April 25, 2018 email to Donohue
Tracy Hodel, Public Utilities Director

The St. Cloud project team decided to take a risk as part of the NR2 Project by installing two new technologies at the same time to keep rates low, enhance resource recovery opportunities, and meeting the City's sustainability goals. The end result has been a tremendous success.

Original Budget Estimate	\$20,323,000
Donohue's Portion	\$20,323,000
Final Actual Cost *	\$22,425,000
Donohue's Portion	\$22,425,000
Scheduled Completion	1/1/2019
Actual Completion	11/20/2018

**The delta between the budgeted and actual cost is primarily attributable to several major facility enhancements added after construction bidding, including an additional generator, digester mixing improvements, and high-strength waste receiving improvements.*



Nutrient Recovery and Reuse (NR2): Innovative, Cost-Effective, Sustainable St. Cloud, Minnesota





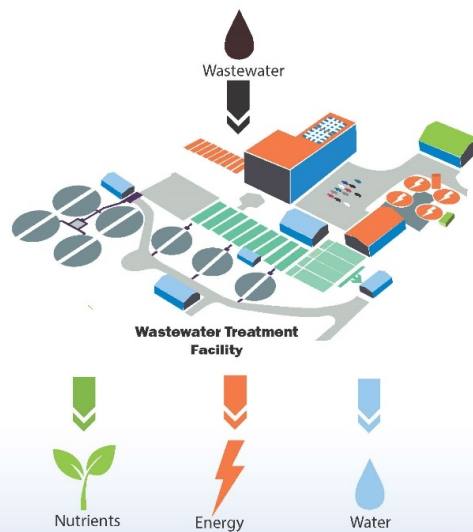
NUTRIENT RECOVERY & REUSE PROJECT

ST. CLOUD > SUSTAINABILITY

Renewable Today | GREATER Tomorrow

Converting Waste to Value

The St. Cloud Wastewater Treatment Facility is continuing its transformation to a resource recovery facility. It will be converting waste streams to valued products, providing renewable energy, recovering nutrients, reusing nutrients to sustain local agriculture, and returning clean water back to the environment.



Recovery

The struvite harvesting process extracts nitrogen and phosphorus from a nutrient-rich waste stream and produces high-quality fertilizer pellets.

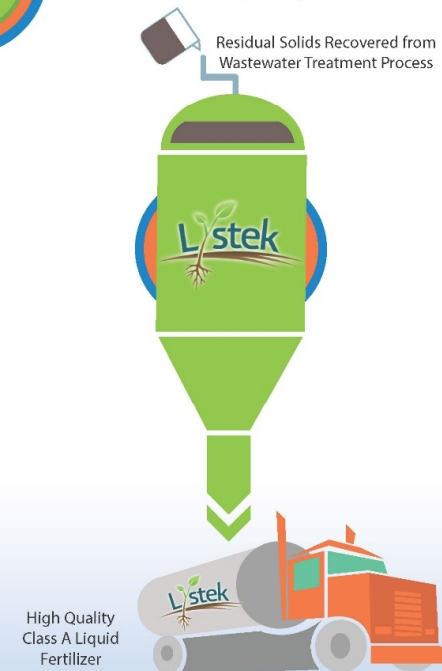


High Quality Slow-Release Nitrogen and Phosphorus Fertilizer Pellets



Reuse

The unique biosolids process converts residual solids produced by wastewater treatment to a high-quality Class A soil amendment. This sustainable soil amendment is used by local agriculture.



High Quality Class A Liquid Fertilizer









Jury Statement

(Image 1) The St. Cloud Nutrient, Energy & Water (NEW) Recovery Facility serves a population of more than 120,000 people across six communities in the St. Cloud area. In the last decade, the facility has undergone various improvements to accommodate a growing population, satisfy more stringent regulatory requirements, improve cost effectiveness, and realize ambitious sustainability goals for energy efficiency, renewable energy production, and resource recovery.

(Image 2) The NEW Recovery Facility has become one of the most sustainable resource recovery facilities in the nation and a world-class example of how well-conceived sustainability initiatives can improve cost effectiveness. These tremendous accomplishments, due in large part to its recent Nutrient Recovery and Reuse (NR2) project, are improving the health of the planet and the financial wellbeing of the people and businesses within the NEW Recovery Facility service area

(Image 3) The NR2 Project included two innovative processes: nutrient harvesting (the Ostara process) and thermal hydrolysis of biosolids (the Lystek process). This is the first time these two processes have been employed together at a resource recovery facility in North America. The Ostara process extracts phosphorus and produces a nutrient-rich fertilizer pellet. The Lystek thermal hydrolysis process produces a safe and nutrient-rich soil amendment.

(Image 4) The balance of the NR2 project included biofuel storage, biosolids dewatering, a phosphorus-release reactor, and hauled-in waste receiving and processing improvements. The hauled-in waste improvements have dramatically improved biofuel and renewable energy production, allowing the facility to regularly generate more electricity than it consumes.

(Image 5) Donohue & Associates, in close collaboration with the City, led NR2 planning, design, construction, and commissioning phase services. HTPO provided survey services and Chosen Valley Testing provided geotechnical services.

(Image 6) The St. Cloud project team decided to take a calculated risk as part of the NR2 Project by installing two new technologies at the same time to keep user rates low, enhance resource recovery, and meet the City's sustainability goals. The end result has been a tremendous success.



November 25, 2020

ACEC Minnesota
10201 Wayzata Blvd, Suite 240
Minnetonka, MN 55305

Re: 2021 Engineering Excellence
Nutrient Recovery and Reuse (NR2): Innovative, Cost Effective, Sustainable

Dear Engineering Excellence Judges:

I am pleased to provide this letter of reference for Donohue & Associates regarding their performance on the Nutrient Recovery and Reuse (NR2) Project at our Nutrient, Energy and Water (NEW) Recovery Facility.

The NR2 project is a culmination of deliberate planning and improvements that have transformed our wastewater facility from an energy consumer to an energy and resources producer. Our collaborative journey began six years ago when the City and Donohue prepared a Resource Recovery and Energy Efficiency Evaluation.

The NR2 project included biofuel storage, biosolids reuse, and nutrient recovery. The Donohue design team had to successfully combine two innovative resource-recovery processes: Lystek THP and Ostara Pearl. The design was complicated by the City's preference to fit the new equipment within existing infrastructure. I am excited that we are the first municipal water resource recovery facility in North America to employ these sustainable technologies.

We enjoyed working with Donohue during the design workshops. Their team of engineers are highly knowledgeable, professional, and respectful. During construction and startup, Donohue personnel worked closely with our team to optimize the new processes and served as a valuable resource during the first months of operation.

The end result has been a tremendous success. The Lystek THP process is producing a valuable, nutrient-rich soil amendment for area landowners and farmers. The Ostara Pearl process is producing a nutrient-rich, environmentally-friendly, fertilizer pellet and protecting our local water resources by preventing excess phosphorous from entering area waterways leading to the Mississippi River. And as a result of the biofuel recovery components of the project, the facility will be a net zero energy facility in 2021.

With the successful NR2 Project, the St. Cloud NEW Recovery Facility has become one of the most diversified and sustainable resource recovery facilities in the nation. And Donohue has helped us in so many ways to achieve that distinction. I strongly recommend them for an Engineering Excellence award.

Sincerely,

Tracy E. Hodel
Public Services Director