St. Paul Park Granular Activated Carbon Water Treatment Plant

2021 Public Works Project of the Year Award Nomination

Project Nominated: St. Paul Park Granular Activated Carbon Water Treatment Plant

Managing Agency: City of St. Paul Park

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Division: Project of $5 million, but less than $25 million

Category: Environmental

APWA American Public Works Association Minnesota Chapter

wsb

St. Paul Park Granular Activated Carbon Water Treatment Plant

The Granular Activated Carbon Water Treatment Plant was constructed to support public health by bringing cleaner drinking water to residents and businesses within the St. Paul Park community. Since 2007, the Minnesota Department of Health (MDH) has been monitoring the concentration levels of perfluoroalkyl and polyfluoroalkyl substances (PFAS) in the city's water supply. PFAS are a family of manmade chemicals that do not naturally decompose due to their heat and water-resistant structure. Studies have found that consuming drinking water with elevated levels of PFAS, overtime, can be associated with high cholesterol, reduced immune response, thyroid disease, kidney cancer and other distressing health problems. In 2018, 3M settled a PFAS-related lawsuit with the State of Minnesota for $850 million, with those dollars earmarked for investment in clean drinking water and natural resource projects in the East Metro region of the Twin Cities.

In June of 2018, the MDH notified St. Paul Park officials, stating that two of its three water wells exceeded the recommended amount of PFAS to be considered safe for public consumption. In response to this pervasive health threat, WSB partnered with the city to design a water treatment facility and remove PFAS from the community drinking water and surrounding environment. MDH and the Minnesota Pollution Control Agency (MPCA) were also key collaborators to ensure the project met all safety standards and statutory requirements. After completing a feasibility study, a Granular Activated Carbon (GAC) Water Treatment Plant was designed, bid, and constructed. The GAC Water Treatment Plant was delivered under budget and on schedule.

The implementation of the plant has improved water quality and reduced the impact of harmful contaminants on community residents. Since its opening in April of 2020, there have been no detectable traces of PFAS in the city's drinking water. To support the city's vision for providing a sustainable solution, WSB performed services for design, bidding and construction administration and observation.

A unique and innovative approach

Treatment technologies for removing PFAS from groundwater are currently limited to granular activated carbon, ion exchange, and reverse osmosis filtration. After completing a rapid column filtration pilot study during the preliminary design phase, acid-washed granular activated carbon filtration was selected as the most feasible, long term solution to treat PFAS in the city's drinking water. Steel pressure filtration vessels contain granular activated carbon filter media that facilitate the transfer of contaminants onto the media as the liquid stream passes through the vessels. When the contaminant level in the carbon bed reaches the saturation point, the carbon is removed and regenerated at an off-site facility or disposed. After the media becomes fully absorbed with PFAS, the media is removed from the vessel and refilled with high quality activated carbon.

The project utilized state-of-the-art modeling software, Matterport, to video scan the interior of the plant and provide a three-dimensional layout. This model allows city staff to provide accurate virtual tours of the plant remotely.

Matterport also serves as an asset management tool for storing critical operations and maintenance data for each piece of equipment inside the plant. For example, during a virtual tour, the user can easily click to select any piece of equipment that requires maintenance. Once selected, the operations and maintenance manual for that item will appear on the user computer screen or tablet. This innovative tool allows staff supervisors to reference and provide instructions to their teams from a remote location. Leveraging Matterport software ensures important equipment data, plant drawings and schematics can be accessed from any location with Wi-Fi or internet connection.

Innovative construction management techniques were used throughout plant planning and construction. The contractor conducted extensive pre-construction planning by investing time with project staff to develop key strategies for building. For example, the contractor developed an effective strategy for the excavation of various structures by creating a working platform that did not interfere with the neighboring park. With the project being located within a city park and in the middle of a residential neighborhood, there were little means for access and construction staging.

Without proper planning and staging of the project area, the contractor would not have had enough workspace or access to materials storage, requiring additional materials to be stored off site. Safety was also a top priority, and daily safety management was adhered to throughout construction.

The project resulted in zero recorded injuries, lost time accidents, and OSHA citations. Magney Construction Company managed over 21,000 hours on the project, with subconsultants and vendors providing more than 11,000 hours.

Community Engagement and Growing Public Awareness of PFAs in the East Metro

To bring awareness to the public on the PFAS contamination issue and proposed solutions being considered by city leaders, a community engagement plan was utilized. This strategic approach included several methods to communicate awareness and gather valuable input about the project. Tactics used for effective community engagement included public presentations, project newsletters and the development of a webpage for sharing tips and important construction updates for residents.

The new Granular Activated Carbon Water Treatment Plant was successfully implemented within Whitbred Memorial Park and provides a modern backdrop to the surrounding neighborhood with its unique brick façade, translucent windows and standing seam metal roof. The plant also serves as a model for future GAC water treatment plants to be constructed in neighboring communities within the East Metro Area showing elevated levels of PFAS in their water system.

The GAC water treatment facility was a collaborative effort to successfully treat the city's drinking water and produce non-detectable levels of PFAS. The significance of this water treatment will have a lasting impact and provide high quality drinking water for the city of St. Paul Park for generations to come. Additionally, the treatment process is cleaning the environment for nearby communities that utilize the same aquifer for drinking water and fish and other aquatic species that exist in the nearby Mississippi River, delivering significant value to those downstream from St. Paul Park.

Sustainable design solutions

PFAS are a family of manmade chemicals that do not breakdown in the environment and resist heat, oil, stains, grease and water. They are considered by the Environmental Protection Agency to be an emerging contaminant. The city's new GAC Water Treatment Plant physically removes PFAS from both drinking water and the environment. While the plant removes PFAS from the city's drinking water system, it also removes PFAS that exist in the environment, so that residents living downstream of any water wells have limited exposure. Researchers have found that consuming drinking water with elevated levels of PFAS is associated with higher cholesterol, changes to liver function, reduced immune response, thyroid disease and increased risk of kidney cancer. Removing PFAS from the city's water reduces the likelihood of contaminant exposure to residents.

During planning, economic considerations were discussed before getting started. WSB studied alternative water supply and treatment options such as purchasing water from a nearby public water system. A life cycle analysis was completed for a 20-year period in which capital and operations and maintenance costs were taken into consideration to determine the most economical long-term solution to provide clean water to the city. Ultimately, the approach to purchase water from a nearby public water source was found to be impractical and expensive. The city would still need to charge its customers to maintain its own water system, in addition to charging an extra fee to purchase treated water from the nearby drinking water system.

The used or spent media at the treatment plant is transported to a reactivation facility where the contaminants are incinerated and removed from the filter media to allow the media to be reused for additional treatment. This media exchange program is a simple and cost-effective way to treat PFAS in the drinking water while keeping contaminants out of the environment.

the environment and provide a sustainable facility. The plant produces almost no emissions that affect the environment other than space heating during the winter months. Nearly no wastewater will be emitted from the plant in the long term other than discharging backwash wastewater into the sanitary sewer system about once every two to three years when the filter media is exchanged for new media. On site, a large oak tree situated about 20 feet from the plant was preserved during construction. Since the plant was constructed in a city park, all areas that were affected by construction were restored with landscaping and grass that creates a natural flow to the surrounding athletic fields.

Overcoming challenges

Constructing individual water treatment plants at each of the city's water wells to remove PFAS was determined non-feasible as it would have required the city's small utility operations department to operate and maintain multiple water treatment plants, in addition to completing their other daily tasks.

In response to the operational challenges, a single, centralized water treatment structure was designed by WSB with enough treatment capacity to treat Wells 2, 3 and 4, with Well 2 being treated when levels exceed the recommended health index for PFAS in that well. A single water treatment plant required separate raw water transmission mains to be constructed between Wells 3 and 4.

The raw water is pumped from the wells through the transmission mains before entering the plant through a common header main. From there, the PFAS are absorbed by GAC filter media, installed inside eight pressure filters with a combined treatment capacity of 2,200 gallons per minute. Each of the vertical pressure filters is 10 feet in diameter and holds 20,000 pounds of filter media.

The MDH requires public drinking water systems with GAC filtration to disinfect its water in the distribution system, as microbial matter can possibly grow inside filter media. Prior to placing this plant into service, the city had never chlorinated its water system. Fluoride was injected into the raw water at each of the well houses. WSB designed the plant to include a new residual paced chlorination system that feeds only the minimum chlorine dosage required. As chlorine oxidizes natural iron in the water that can stain plumbing fixtures and even clothing, the plant includes a polyphosphate chemical feed system that sequesters the iron to keep it in a dissolved state to avoid staining. This polyphosphate feed system is programmed to operate only when the city's highest iron producing well is operated in order to use the lowest amount of polyphosphate possible.

The city's Supervisory Control and Data Acquisition (SCADA) system was redesigned to control and monitor the entire water system. The new system now operates the water treatment plant in addition to water wells and elevated water storage tanks.

Building What's Next – Delivering Value to the Public and a Safer Environment

Since the plant was placed into service, no PFAS contaminants have been detected in the effluent water that is distributed to city customers. The quality of the drinking water has been excellent and exceeds all drinking water and health standards.

In addition, the plant's new SCADA control system has greatly simplified the overall operation of the entire water system while providing continuous monitoring and security of the facility.

The construction of the plant resulted in no change orders, and the original bid price of $5,207,400 was the final contract price.

Only a minor punch list was needed after a thorough inspection of the plant was completed by the engineers and architect to demonstrate the quality of construction work. The city's cost for engineering, legal, administration and full-time construction observation was $823,000. The project was completed with a scheduled and actual completion date of April 30, 2020.

Although the Granular Activated Carbon Water Treatment Plant was constructed as a temporary treatment system until the State of Minnesota could study and recommend permanent long term solutions for each of the impacted communities in the East Metro Area, the plant was designed to provide a permanent solution for the city's water challenges. At this time, the state's drafted Conceptual Drinking Water Supply Plan has recommended granular activated carbon filtration as the most feasible solution for affected communities. This will ultimately save the state money and free-up settlement funds for other communities that require additional funding to implement their water treatment solutions. In sum, this project has served as example for other East Metro Area communities to address PFAS in their drinking water. MPCA and the MDH have toured the plant and used it as a model to estimate the costs for other proposed GAC water treatments that will be funded by the 3M settlement. In addition, another nearby community and their engineering consultant followed key design features of this plant for the design of their own GAC water treatment plants, further demonstrating how this project served as a model to other communities to address PFAS in their drinking water.