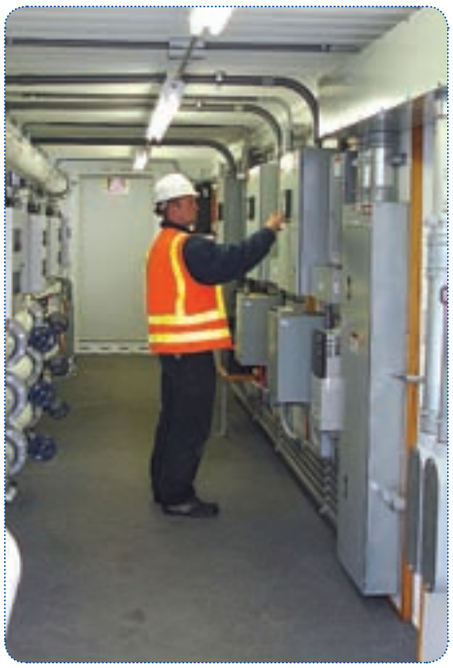


Storm water turbidity, pH and flow are monitored before and after treatment.

Working through the wet Northwest winters posed many erosion control challenges. Because the runway had to be built up to meet the grade of the other runways, steep banks more than 130 ft high were created and needed to be stabilized. Several conventional erosion control best management practices (BMPs) such as wattles, blankets, plantings, soil stabilizers and a silt fence were applied to the site to minimize the impact on receiving waters. Despite the best attempts, the conventional methods were not adequate in reducing the turbidity level to the required discharge limit.

The Port realized that the pressure was on to comply with the project storm water permit because failures could result in heavy fines, legal action or delays. It implemented an integrated approach to erosion and sediment control and storm water management, focusing on the following critical elements:

Erosion/sediment control training. The Port required contractors to receive independent erosion/sediment control training through a state-accredited training program.

Aggressive implementation of conventional BMPs. Port engineers worked with design engineers and project contractors to ensure that conventional BMPs were implemented during all phases of construction.

Independent erosion/sediment control inspections. The Port conducted independent erosion/sediment control inspections to ensure that contractors were properly installing, monitoring and maintaining BMPs.

Implementation of chemical storm water treatment BMPs. The Port recognized that implementation of conventional BMPs alone would not be sufficient to meet state water quality standards, so staff required the use of chemical storm water treatment BMPs.

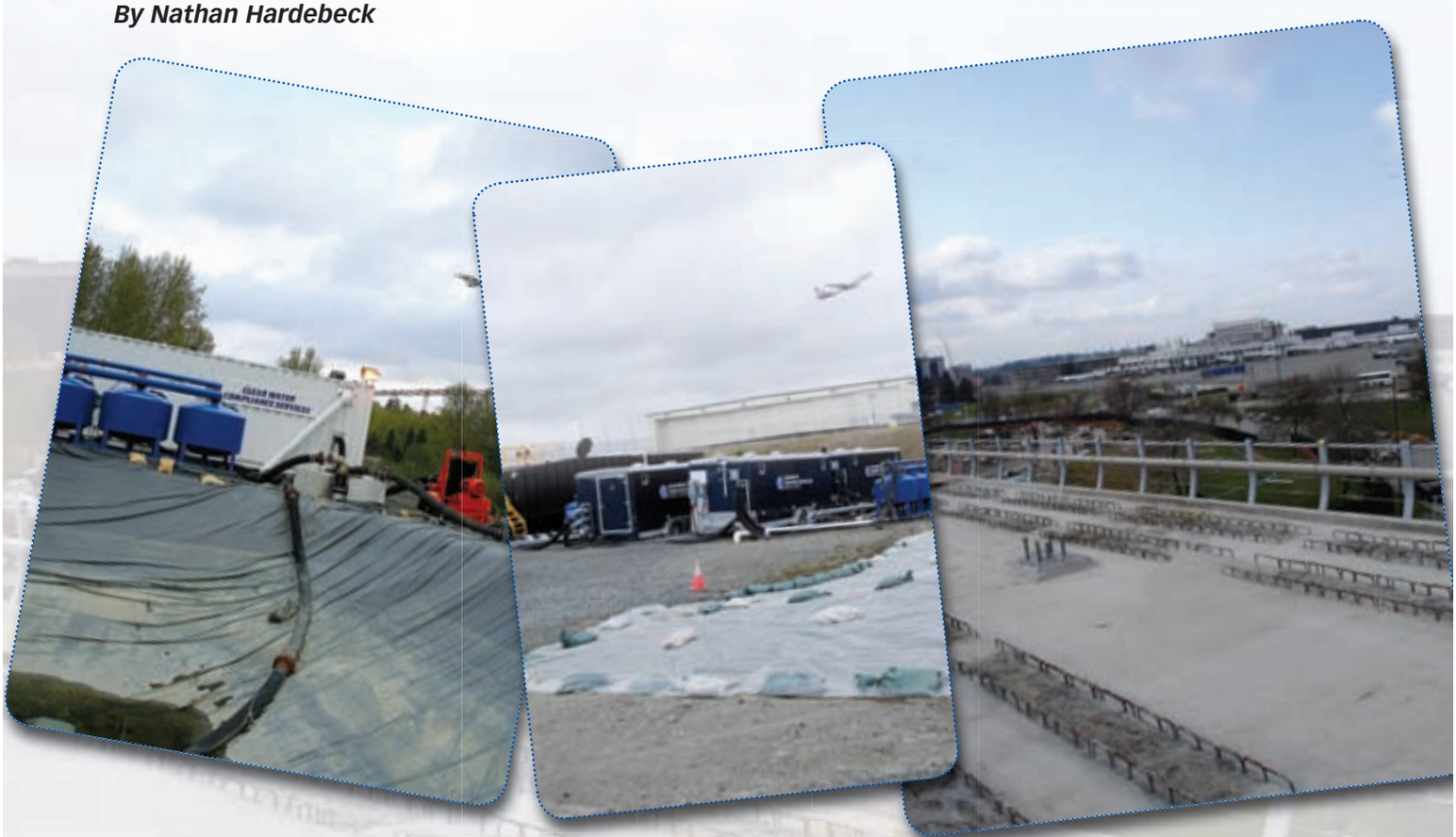
A New Solution

The Port evaluated numerous approaches to managing onsite storm

Chitosan FOR CLEANER CONSTRUCTION

The Port of Seattle implements an emerging sand filtration process to protect local water bodies during airport expansion

By Nathan Hardebeck



The construction of the third runway at Seattle-Tacoma International Airport (SeaTac) started in 2004. Capacity issues forced the Port and the Federal Aviation Administration to evaluate options to relieve airport traffic, specifically that related to poor-weather landing conditions. This $1.2-million project covers 375 acres, making it one of the largest airport projects in the country.

The project is surrounded by sensitive receiving waters identified as spawning habitats for protected salmonids. Surface water quality monitoring data showed that the typical turbidity levels within the two primary receiving waters, Miller and Des Moines creeks, were typically less than 10 ntu.

The project took more than a decade to permit. Many of the project delays were focused on environmental concerns raised by various citizen groups, regulatory agencies and environmentalists. Storm water management and the protection of water quality within nearby streams and wetlands became a project priority. Due to the environmental sensitivity, the Port implemented a 5 ntu discharge limit.

water before deciding to implement an emerging BMP called chitosan-enhanced sand filtration (CESF). CESF is a flow-through chemical water treatment technology that combines the use of polymers/flocculants (chitosan) with pressurized sand filtration. The Port selected CESF because it was the only technology available that could meet its specifications of treating 6,000 gal per minute (gpm) with a continuous effluent turbidity of less than 5 ntu.

The process relies on a unique biopolymer called chitosan, a derivative of chitin. Chitosan is made from recycled crustacean shells. When added to storm water at dose rates of up to 1 part per million, chitosan agglomerates submicron suspended sediment and acts as a filter aid when the treated storm water is processed through a sand filtration unit.

The CESF process utilizes pumps, tanks, chitosan, a sand media filter and a computerized monitoring and data collection system to continuously

Runoff is collected and stored in four ponds featuring CESF equipment.

reduce turbidity in construction storm water. Storm water is first pumped from its retention pond to the control system, where an initial dose of chitosan is added as a pretreatment measure. The storm water is then routed to settling ponds for bulk solids removal. From the ponds, pretreated storm water is pumped through the control system, where turbidity, pH and flow are measured. As the water passes through the control system, another dose of chitosan is added prior to sand filtration.

The effluent from the sand filter is routed to the control unit, where turbidity, pH and flow are measured again to ensure compliance with National Pollutant Discharge Elimination System (NPDES) permit requirements and water quality discharge standards. In the unlikely event that the effluent does not meet requirements, the control system automatically recirculates the water to the point of origin to be treated again.

The CESF system has a unique programmable logic controller (PLC) which is utilized to monitor influent and effluent water quality parameters. The PLC also monitors external factors such as pond level and rainfall data. System pumps, the chemical metering system and sand filtration unit are all controlled using a touch screen on the PLC. The control system is equipped with remote telemetry capable of transmitting operational data to a secure website or initiating operational alarm text messages to system technicians.

Data Analysis

The Port began implementation of CESF on the third runway project in Fall 2004 and contracted with Clear Water Compliance Services Inc. to take over the work in Fall 2005. The first step in the management and treatment of construction storm water is to collect and convey runoff to storage ponds. Storm water runoff is collected and stored at four separate locations at the project, each of which has CESF equipment.

The Port's engineers provided target discharge rates for each pond location and equipment sized accordingly. The total discharge flow requirement for the project is 6,000 gpm, or 13.4 cu ft per second.

Storm water quality and compliance with the NPDES permit became challenging aspects of the project. Clear Water has selected a data analysis period from November 2006 through September 2007 to demonstrate NPDES permit compliance:

- During its period of operations (Fall 2005 to March 2008 at the time of report), more than 425 million gal of construction storm water has been treated and discharged from the site.
- On some wetter days, more than 4 million gal per day was treated and discharged. This is equivalent to the volume of more than 40 high school swimming pools.
- Thousands of hours of operations and maintenance have been completed.

- To date, the cost is approximately $0.019 per treated gal. This price includes all equipment costs, labor, administration and chemistry.
- Computerized monitoring equipment logged millions of data points associated with system performance and water quality data, verifying compliance with water quality standards.

Record rainfall was experienced during November and December 2006; more than 20 in. of rainfall occurred, and many of the CESF systems required around-the-clock operations for weeks straight. The CESF systems are robust and capable of consistently reducing turbidities from well over 1,000 ntu to less than 5 ntu without interruption of continuous discharge.

"It [chitosan] is very effective in removing suspended solids and turbidity from runoff and has been demonstrated to cause no harm to aquatic life in the receiving streams," according to the Sea-Tac Airport Comprehensive Development Plan Environmental Review. "The Port would continue to use this and/or other advanced construction storm water treatment for Comprehensive Development Plan projects where necessary and appropriate. Several large-scale polymer systems have been successfully operated to treat runoff from the third runway construction."

Returning Solution

Due to the success of the third runway project, the Port asked that CESF technology be implemented on the reconstruction of the entrance to the Port—the 160th Loop project. The Port is redesigning the access roads and on-ramps to the airport terminal to minimize delays and ease congestion for the public.

This is a logistically challenging project because there are two major construction projects happening in the same footprint, requiring a tremendous amount of communication and coordination. Clear Water was again chosen as the CESF service provider, and to date has treated 5 million gal.

The teamwork and dedication from all third runway project parties has resulted in ongoing environmental compliance. Its success has demonstrated how new technologies such as CESF can be utilized by engineers, developers and contractors to overcome extreme project challenges, including performing wet-weather work without impacting streams and wetlands. SWS

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