Remediation Site Uses Innovative Pump-and-Treat System for Real-Time Control and Data Collection

Level TROLL® 500 Instruments and Con TROLL® PRO Systems maintain hydraulic gradient at a tidally influenced site

by Tim Stone, Senior Geoscientist at Anchor QEA

Introduction

Harbors, ports, and rivers, all play a vital role for the U.S. economy. Approximately 95 percent of U.S. trade moves through over 260 coastal and inland ports throughout the United States. Cities like Houston, New Orleans, and Portland are home to some of the largest ports located on inland waterways. According to the Bureau of Transportation Statistics, the Portland Harbor in Oregon ranks nineteenth on a list of U.S. container ports. Since the turn of the nineteenth century, people have been trading near the confluence of the Willamette and Columbia Rivers.

Stone checks water levels being reported by a Level TROLL 500 Instrument deployed in a monitoring well. The Con TROLL PRO System displays and records water level and temperature from up to two Level TROLL 500 Instruments, as well as ambient barometric pressure and air temperature. The Willamette River can be seen in the background.

This case study focuses on controlling the discharge of impacted groundwater from a former industrial site to the surface water of the Willamette River. This site, one of many sites undergoing remediation, is part of the much larger Portland Harbor Superfund site. Establishing control of impacted groundwater discharge is necessary to prevent recontamination of future in-river sediment remediation.

The tidally-influenced site has a complex groundwater system that includes three primary water bearing zones (WBZs) including a fill WBZ, an upper alluvium WBZ, and a lower WBZ. These factors make this site particularly challenging for remediation specialists. Anchor QEA, an environmental science and engineering firm, is working with its client to design and implement remediation of the site. Since 2007, Anchor QEA has collected baseline hydrology data, conducted aquifer testing, and monitored river level elevations at the site using Level TROLL 500 Instruments, Con TROLL PRO Systems, and TROLL® Link Telemetry Systems.

Each pumping well is equipped with a pump that is controlled by a VFD and a Level TROLL 500 Instrument. Water level elevation data generated from pumping wells is used to monitor well efficiency over time and to trigger low-water shutdown to protect pumps when water levels fall below safe pump operation levels.

Anchor QEA is currently designing and testing an automated, real-time hydraulic containment system intended to minimize the discharge of impacted groundwater to the Willamette River. The hydraulic containment system is designed to reverse the current riverward groundwater gradient by pumping groundwater from the impacted WBZs. Once the pilot control system is implemented, water produced by the hydraulic containment system will be treated in an on-site wastewater treatment plant that will discharge to the Willamette River under a National Pollution Discharge Elimination System (NPDES) permit.

Helping Sisyphus

Contaminated groundwater at the site naturally flows down gradient into the river. The hydraulic control system is designed to prevent impacted groundwater from discharging to the Willamette River and to prevent recontamination of remediated sediments along the site shoreline.

The challenge is that we must achieve a constant shoreward gradient in a tidally-influenced river environment. The project team selected Level TROLL 500 Instruments and Con TROLL PRO Systems to interface with a programmable logic controller (PLC) in order to maximize hydraulic control and minimize the volume of groundwater requiring treatment.

To maintain a shoreward gradient, groundwater is pumped at variable flow rates from wells along the upland shoreline to lower the elevation of the shoreline and transition zone groundwater to below the Willamette River elevation. In general, higher pumping rates are required to maintain the shoreward gradient during a falling tide cycle; and lower pumping rates are required during a rising tide because the increasing head pressure of the river water naturally discourages groundwater discharge.

Monitoring gradients and automatically adjusting pumping rates in real time

The PLC processes and records data from the Level TROLL 500 and Con TROLL PRO Systems to monitor the real-time gradients and to select a pumping rate for each pumping well that will maintain the desired elevation differential between groundwater and surface water. The ability to automatically adjust pumping rates in real time as opposed to pumping at a fixed rate will reduce the volume of water requiring treatment, which ultimately reduces the cost of long-term system operation.

Each pumping well is installed in either the upper or lower alluvium WBZ. Each pumping well will be assigned a "controlling monitoring well," which is screened vertically in the same WBZ and located approximately half of the horizontal distance to the closest pumping well in the selected WBZ. The current design includes 21 pumping wells and 21 controlling monitoring wells for hydraulic containment of the upper and lower alluvium WBZs.

Each pumping well is equipped with a pump that is controlled by a variable frequency drive (VFD) and a Level TROLL 500. Each controlling monitoring well and the Willamette River is instrumented with Level TROLL 500. The Level TROLL 500 Instruments in pumping wells, controlling monitoring wells, and the Willamette River are wired to Con TROLL PRO Systems, which

A Level TROLL 500 monitors water levels in a pumping well (foreground). The Con TROLL PRO System displays real-time water level and communicates with a PLC system. The PLC determines and directs pumping rates that will maintain the desired differential between groundwater and river elevations.

interface digital water level elevation and temperature data to the PLC.

Water level elevation data is generated by the Level TROLL 500, interfaced to the PLC, and ultimately to a PC-based human machine interface for storage and logic processing. Water level elevation data generated from pumping wells is used to monitor well efficiency over time and to trigger low-water shutdown to protect pumps when water levels fall below safe pump operation elevations. Water level elevation data generated from a controlling monitoring well is processed by proprietary logic programming which ultimately increases or decreases the pumping rate of the associated pumping well to maintain a set elevation differential between groundwater and surface water.

Each Level TROLL that is connected to a Con TROLL PRO unit sends a digital RS485 signal to the Con TROLL PRO System, which then sends a 4-20 mA signal to the PLC. The PLC converts the 4-20 mA signal to actual water level elevation by scaling the incoming 4-20 mA signal.

The trim feature of the Con TROLL PRO System provides us with the flexibility to adjust the 4-20 mA output signal from the Con TROLL PRO. These minor adjustments allow compensation for minor voltage variation associated with 4-20 mA scaling, which results

Scenic view of the Williamette River in Oregon.

in elevation outputs at the HMI that are identical to those displayed and recorded on the Level TROLL 500 and/or Con TROLL PRO System.

Complying with regulations

The Con TROLL PRO System's data logging feature provides redundant data collection, which is important for regulatory compliance. Having a local display allows us to view recent and current water elevations in the field. Maintaining a constant elevation signal to the PLC and HMI is critical to system operation. The Con TROLL PRO provides a human interface and digital connection to the Level TROLL, which allows us to calibrate reference elevation setpoints on the Level TROLL 500 without losing the elevation signal to the PLC and HMI.

The PLC and HMI record real-time flow. This allows Anchor QEA's engineers and scientists to evaluate the flow rate from each well that is required to maintain hydraulic control of the site's groundwater. When the wastewater treatment plant is operational, the data can be used to calculate treatment chemical dosage required for treatment of the combined influent contaminant concentrations.

The bottom line is that we need to maximize hydraulic containment while minimizing the total flow to the eventual onsite treatment facility. By strategically managing pumping rates based on a groundwater/surface water differential, we reduce electrical costs of operating the pumping system and the cost of treating the resulting wastewater.

Summary

Remediation of the entire Portland Harbor Superfund site will take many years. And, specialists, like Anchor QEA, are developing and implementing innovative systems for cleaning up sites and reducing upland sources of contaminants to a river that has been impacted by over a century of industrial development.

I have had the opportunity to utilize In-Situ products for nearly 15 years for a variety of applications. In my experience, In-Situ has continually updated products to increase durability, reliability, and functionality—often in response to input from end-users. Our selection of In-Situ products for the hydraulic containment project described above was primarily driven by the responsive customer service and support that has been provided to Anchor QEA by In-Situ Inc.'s knowledgeable and helpful sales and technical support staff.

References

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