ON THE LEVEL

Winter 2023

Planting 51 Trees Speeds Up Toluene Cleanup Efforts

High-Res Groundwater Monitoring Tracks its Success:

Over 40 years ago, a former industrial site in the City of Guelph, Ontario, was contaminated by toluene; the chemical plume has since leached into the underlying fractured bedrock aquifer. Today, the site is home to a unique research project headed by the University of Guelph Morwick G360 Groundwater Research Institute.

The study is evaluating the use of trees as a viable tool for cleaning up the contamination. The project began in 2008 with the planting of 51 hybrid poplar trees. The poplar trees tested the process of phytoextraction.

Toluene concentrations were measured in sap samples. This provided evidence that poplars were actively extracting toluene from the site. In addition, core samples from tree stems showed microorganisms in the trees had the ability to break down toluene.

To monitor the subsurface during the study, multilevel groundwater monitoring wells were installed. The multilevel wells are used to take groundwater level measurements and samples from several depths to track the contaminant concentrations. Vapour sampling is taking place using monitoring ports in the vadose zone.

Results from the subsurface measurements show that bioremediation is occurring in the groundwater and in the vadose zone, which is being enhanced by the trees.

After the poplar trees were removed in 2020, 120 willow trees were planted at the site to begin the next stage of the study. The willow trees will also test the effectiveness

of the bioremediation process called phytoremediation.

Phytoremediation occurs when trees interact with the soil to produce microorganisms that aid bioremediation. These microorganisms naturally break down the chemicals into non-harmful compounds.

Other recent additions to the study are two **Solinst Model 615ML Multilevel Drive-Point Piezometers.** The Drive-Point Piezometers will be used for multilevel soil vapour sampling.

...continued on page 4

IN THIS ISSUE

Solinst®

NEW 101 Power Winder Saves Time & Effort

The Model 101 Power Winder is designed to conveniently connect to the frame of any Solinst reel to allow effortless winding of longer lengths of tape, cable, and tubing. It is lightweight and very easy to adjust to fit small, medium, or large Solinst reels, as well as other Water Level Meter reels on the market.

The Power Winder uses a standard power drill to operate. The drill can connect directly to the Power Winder, or an optional flex drill adaptor can be used to allow more ergonomic operation. It is ideal for use with Solinst Water Level Measurement Devices but can also be used with Solinst Tag Lines or pump tubing reels, such as the Model 425 Discrete Interval Samplers.

Packer Tests Using Low Pressure Pneumatic Packers

Packer Tests & Hydrogeological Characterization

Estimating aquifer properties, such as hydraulic conductivity (K) and permeability is an essential part of site characterization and creating accurate conceptual site models during site investigations. The data gained through aquifer characterizations help to plan further monitoring programs and remediation efforts.

Packer Tests are a great way to obtain these aquifer characteristics using minimal equipment that is readily available and at a reasonable cost. They are also relatively simple to set up and perform – most requiring just one person.

Packer Tests can be performed at multiple, isolated depth discrete zones in a single borehole or monitoring well, providing data to create a hydraulic conductivity profile. Performing tests in boreholes across a whole site can help interpret the stratigraphic profile and provide additional information beneficial to understanding the entire conceptual site model.

Conducting a Falling Head K Test

Solinst Model 800 and 800M Low Pressure Pneumatic Packers are ideal for performing various types of borehole and well tests, including Falling Head K Tests.

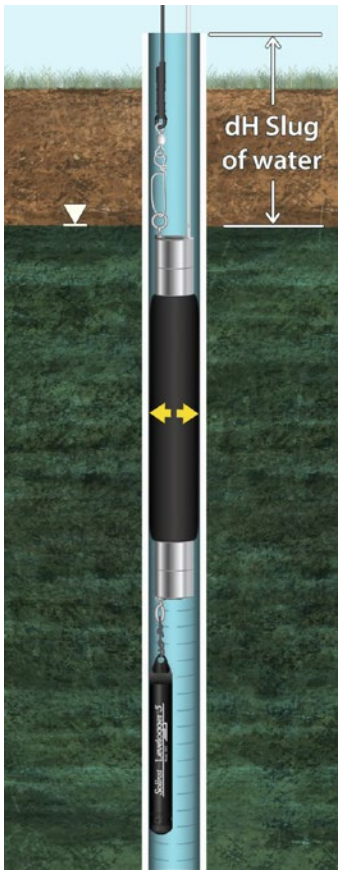
Solinst Packers have eyebolts, top and bottom, for connecting monitoring instruments such as dataloggers. A Solinst Levelogger is connected to the eyebolt on the bottom of the Packer and set to record water level readings at a high frequency. Logarithmic style sampling can also be programmed using the scheduled sampling option in Solinst Levelogger Software.

The depth to static water level is measured, and then the Packer is lowered on a suspension cable (e.g. 103 Tag Line) down the 2"(50 mm) OD monitoring well to just below the water level, and above the screen inlet. The Packer is then inflated to 40 psi (275 kPa).

A known volume of potable water is added to the top of the well. This height of water represents the change in head (dH) waiting to be released. Then the Packer is instantaneously vented, supplying a known volume, or slug, of water to the monitored zone. The Levelogger records the changes in water level as the well recovers back to static level.

This type of test can also be performed using a Straddle Packer setup, and in larger boreholes using the Solinst 3.9" (99 mm) OD Low Pressure Pneumatic Packers.

For more details, read the full post in our ON THE LEVEL Blog.



Bladder Pump Helps Monitor Groundwater Contamination Near a Busy Port

Saldanha in the Western Cape of South Africa is a small port town on the northern shore of Saldanha Bay. The bay is a naturally sheltered harbour, making it ideal for exporting iron ore on massive ships. It serves the region's base metal mines and a heavy minerals smelter, and is also the location of a large crude oil storage facility.

In addition, the town is home to over 20,000 residents who follow their trade based on the economic drivers in the area, including shipping companies, industrial production plants and the railway line.

...continued on page 4

NEW! 12V Submersible Pump and Mini Pneumatic Packer

The Solinst Model 415 12V Submersible Pump provides an efficient means of purging and obtaining groundwater samples from 2" OD monitoring wells. The short (nominal 6"), compact pump can sample from depths of 36.5 m (120 ft) below ground surface. It is very easy to adjust the continuous flow rates, up to 13.5 L/min (3.6 US gpm) in shallow applications, using the 12V Pump Controller's single dial.

Save time and reduce sampling costs by connecting a **Model 800M Mini Packer** to the 12V Submersible Pump. This will isolate your sampling zone and minimize purge volumes. The 800M is 1 ft in length and is designed to fit nominal 2" OD monitoring wells to temporarily isolate discrete zones – single and straddle setups available.

Reclaiming and Remediating Abandoned Mine Drainage for Clean Water Use

Coal mining began in Pennsylvania over 250 years ago, and today it still supplies 60 per cent of the fuel for the state's electric power generation—the fourth largest coal-producing state in the U.S.

Despite efforts such as the Surface Mining Control and Reclamation Act (SMCRA, 1977), over 5000 miles of Pennsylvania's streams remain polluted by abandoned mine drainage.

In 1996, the Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR) was established to facilitate the reclamation and remediation of land and water polluted by past mining practices.

In general, EPCAMR aims to encourage land redevelopment by lessening health and safety hazards, reducing erosion, improving water quality, and returning land to a usable state, as such improving the economy in the region.

In 2018, EPCAMR began a new water monitoring project in Mocanaqua, Pennsylvania, at the lower tip of the Northern Anthracite Coal Field in the Pinchot State Forest. The monitoring site is an abandoned underground and surface coal mine operation called the West End Colliery.

An on-site stream flows underground into the former coal mines and comes out as polluted mine drainage discharge. The acidic water carries a concentration of 4 milligrams per litre of each heavy metal, iron and aluminium, which flows into the Susquehanna River.

The polluted stream discharge gained interest from the Susquehanna River Basin Commission (SRBC). The SRBC regulates withdrawals on the river for consumptive use. Consumptive use (CU)

is water that is used in a way that it cannot be returned to the environment without some form of degradation to its quality or quantity. For example, the SRBC looks to mitigate water consumed by cooling towers at power plants or used to frack gas wells.

Projects or industries that cannot achieve their own mitigation or remediation of consumed water can pay a fee to provide make-up solutions on their behalf. That's where SRBC's interest in mine drainage comes into play.

The SRBC investigates options that may offer mitigation or make-up water for consumptive users in the river basin. This includes evaluating flooded underground mine pools for potential water storage and treatment before it gets discharged.

Controlling the amount of water being discharged from the mine pools, allows treatment, and then release when water levels are low. This provides clean water to the river basin that would have previously been left untreated.

The water monitoring program stemmed from EPCAMRs 3D mine pooling mapping initiative. EPCAMR develops 3D mine pool models to help estimate water storage volumes. Furthering this initiative, EPCAMR teamed up with SRBC for a field investigation. The water monitoring project was funded by a Consumptive Use Mitigation Grant that EPCAMR received from SRBC.

Ten **Leveloggers** and a **Barologger** (used to compensate Leveloggers for barometric pressure) are deployed at the Mocanaqua abandoned mine land area.

Leveloggers were selected as they allow simultaneous measurement of surface water levels and water levels in the mine pool boreholes (similar groundwater wells). The water level measurements help provide an understanding of water movement through the site and indications of where surface water losses occur.

Two Leveloggers are deployed to measure the water levels on the stream. Three Leveloggers measure water levels in mine strip pits that were believed to be tied to the mine pool. Four Leveloggers are installed in boreholes drilled into the mine pool. The last Levelogger measures water levels at the Mocanaqua collapsed mine tunnel discharge.

The Leveloggers (and Barologger) are set to record at 15-minute intervals. The data was downloaded monthly while the project was evaluating

water quality and flow. The time closest to the 15-minute interval was used, so flow could be related to the water height.

Data were downloaded using a Levelogger App Interface and the Solinst Levelogger App, as well as a Field Reader cable and a laptop.

By interpreting the water level data, different levels of the mine pool below ground were found. Water level data were mapped to show how water moves across the site, down into the underground mines, and out of the tunnel.

The findings provided insight into the ability to manipulate the flows to allow storage of the water during high flow and release it during low flow (like a dam).

Overall, EPCAMR has been pleased with the use of Solinst Leveloggers. EPCAMR find Leveloggers to be more cost-effective compared to other similar instruments on the market. Michael A. Hewitt, Program Manager at EPCAMR says "we have grown to like their reliability and function over the years."

He continues, "one I call "trusty rusty" in a stilling well at the polluted water discharge at the Mocanaqua Tunnel has functioned well and

...continued on page 4

Bladder Pump Helps Monitor Groundwater Contamination Near a Busy Port

(continued from page 2)

As such, it is important that the water resources in the area, including groundwater, be monitored and protected from contamination

Groundwater consulting company GEOSS, has taken the lead in an ongoing project to monitor the potential impacts of the aboveground activities on the region's groundwater resources.

GEOSS needed equipment that could handle sampling for potential VOCs (volatile organic compounds) VPHs (volatile petroleum hydrocarbons) and general chemistry at potentially contaminated locations. They also required a sampling solution that could be used in narrow diameter boreholes.

Based on their criteria, GEOSS selected a Solinst 1" diameter **Model 407 Bladder Pump**. Solinst Bladder Pumps allow low flow purging and sampling – ideal when monitoring for VOCs.

Currently, GEOSS use a 1" diameter Solinst Bladder Pump that they transport from site to site to sample groundwater. Between each sampling event, the Bladder Pump is decontaminated to prevent cross-

contamination between wells. There are often over 30 samples to be collected each week, so efficient and proper decontamination is a crucial element to all sampling campaigns.

They are using a portable setup that includes the **Solinst Model 464 Electronic Pump Control Unit** to regulate the vent/drive cycles, and a nitrogen cylinder for the gas source.

A Solinst Model 122 Interface Meter is also used in the project to measure water level and to detect any free phase in the groundwater.

Michael Holloway, of GEOSS, said, "The equipment is used for the sampling and low flow purging of narrow diameter sampling boreholes. As hydrogeologists, we purge the borehole first before collecting a representative sample of the groundwater and not particularly water that has been standing stagnant inside the borehole."

The purpose of the groundwater-sampling program is to detect any contamination in the region's aquifers, as well as to track the movement and spatial distribution of any contaminant plumes that are found.

Michael noted, "The Bladder Pump is versatile and can be used across a few sites within the project where a vehicle can't get to… it's easy enough to carry the entire Bladder Pump setup and then continue the fieldwork without wasting too much time."

Overall, Michael mentioned many advantages to using a Solinst Bladder Pump.

For more details, read the full post in our **ON THE LEVEL Blog.**

Solinst thanks Michael Holloway, head of the GEOSS Monitoring Business Unit, for providing the details of this project.

Trees Speed Up Toluene Cleanup

(continued from page 1)

Steven Chapman, Senior Research Engineer/Hydrogeologist with the G360 Team, oversaw the installation of the Multilevel Piezometers. He noted that the "installations went smoothly". The Drive-Points consist of 3 sampling ports each and are installed to depths of ~2.2 to 2.5 meters.

The Drive-Points were installed in overburden with the aid of a manual slide hammer. The site was previously excavated and backfilled with clean sand fill, so the conditions were right for a shallow drive-point installation. The Multilevel Drive-Points haven't been used for sampling yet, but Steven says, "I'm confident we'll get good data."

In the meantime, the G360 Team have been taking water level measurements and samples, as well as soil vapour samples from the uppermost ports of some of the CMT Multilevel Systems that are above the water table. Over the next few years, the study team will continue using the multilevel wells and drive-points to monitor the plant-assisted toluene attenuation process.

For more details, read the full post in our ON THE LEVEL Blog.

Remediating Abandoned Mine Drainage

(continued from page 3)

still produces data to this day since it was deployed in 2018 (4+ years in harsh conditions)". Michael notes that they do clean off the accumulated metals periodically but "that is a testament to its quality and longevity."

Combined with their 3D modelling efforts, the field monitoring project and water level data provide a better picture of water flow through the abandoned mine site, its water storage capacity, and its potential to be treated and discharged as a clean water option for consumptive use mitigation.

For more details, read the full post in our **ON THE LEVEL Blog.**

Solinst thanks Michael A. Hewitt, EPCAMR Program Manager, and Robert E. Hughes, EPCAMR Executive Director, for providing the details of this project.