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**Solinst**<sup>®</sup>

## Assessing Coastal Flood Vulnerability to Sea Level Rise

Enhanced by Extreme Events in Preferential Flow Pathways



Community resilience in the face of sea level rise and extreme events is a concern for coastal regions, including coastal California. James Jacobs, a PhD candidate researcher at the University of California Santa Cruz, is investigating whether utility trenches contribute to increased vulnerability to coastal flooding in the San Francisco Bay Area.

The available sea level rise data for these communities is vague, making it difficult for planning departments to make decisions and adapt to changes at a local scale. Jacobs aims to establish baseline metrics for coastal flooding processes related

to sea level rise and extreme events by analyzing groundwater and surface water data. He seeks to understand the impact of preferential flow pathways, such as utility trenches, on exacerbating flooding.

The investigation focuses on observing groundwater response to atmospheric rivers and HAT (highest astronomical tides) events.

Vulnerable areas to sea level rise and extreme rains were identified in three study areas in the filled coastal fringe: Manzanita, Tamalpais Valley, and Atchison Village.



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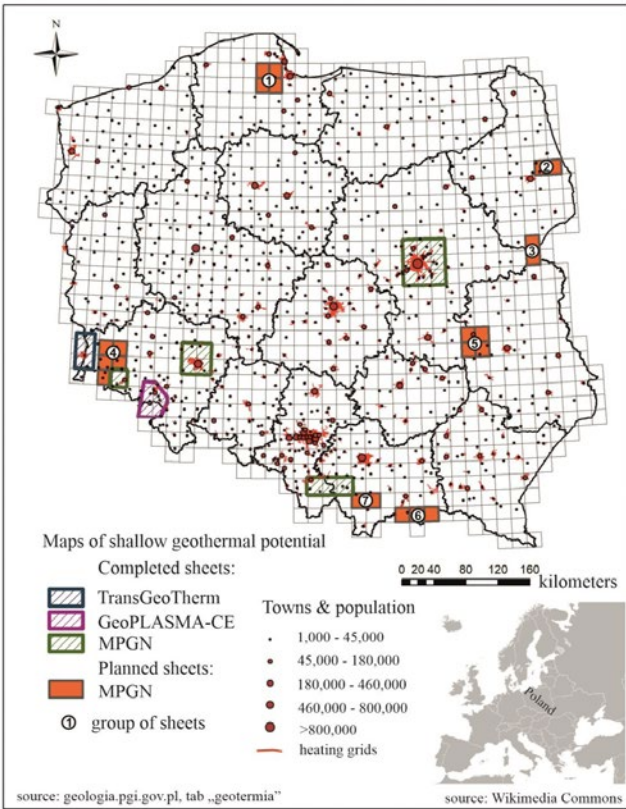
## NEW Bladder Pump & Double Valve Pump Designs

**Solinst 407 Bladder Pumps** now feature Santoprene<sup>®</sup> bladder cartridges that are quick and easy to replace in the field – no tools required. Santoprene's chemical resistance and inert properties make the bladders suitable for harsh environments and potable water applications. They are resilient and flexible, ideal for repeated, long-term use.

In addition, back by popular demand, the NEW PVC Bladder Pumps are low cost and are excellent for metals sampling and in harsh, corrosive environments. The PVC option has also been brought back for our **408 Double Valve Pumps**, which have also been revamped to feature a simplified, lighter design for increased convenience in the field.



# Assessing Low-Temperature Geothermal Potential With Temperature Logging



The main goal of the Geological Survey study is to identify the subsurface temperature regime in the context of local geology, tectonics, hydrogeology, and human influences. As such, in 2021, five boreholes were drilled in diverse locations across the country to account for different natural conditions.

Each of the boreholes was equipped with a heat exchanger with a single U-pipe. Temperature measurement, logging and thermal response tests (TRT) were performed within the boreholes.

In 2021, test temperature measurements were taken, and TRT tests were conducted. The Geological Survey took regular and quarterly temperature measurements in 2022 and 2023.

Temperature profiling was conducted using a temperature datalogger as part of the quarterly measurements. Datalogging was completed using a **Solinst Levelogger 5**. Solinst Leveloggers are well-known for recording changes in water levels, but they also contain a temperature sensor that records accurate water temperature readings.

The Levelogger 5 was set to record temperature every 4 seconds and lowered down the U-pipe on a Kevlar rope at a slow, consistent rate. Subsurface readings were compensated by a Barologger 5 that was recording at the same interval at the surface of the borehole. The high-resolution, depth-dependant temperature measurements provided nearly continuous results, allowing for detailed temperature analysis.

The depth-dependent temperature patterns measured for the studied observation boreholes are alike to a major extent in 2022 and 2023. For each temperature profile, the depth zones associated with different subsurface temperature variability, which depend on various factors, can be identified.

Results from the shallow subsurface (up to 2-5 meters deep) show a strong correlation between temperature and climatic conditions (atmospheric air temperature, precipitation, solar radiation, etc.), creating a zone of daily and seasonal temperature changes.

Below-subsurface temperature variability gradually decreases with depth and is less dependent on external factors. Usually, at a depth of 15-25 meters, depending on location, temperature stabilizes and is close to the value of average ambient air temperature at the given location.

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## Why Use a Santoprene Bladder?

The new **Model 407 Bladder Pump Santoprene™ Replacement Cartridges** were designed to make replacement extremely simple in the field – no tools required and under 2 minutes! But, why did we choose to use Santoprene?

Here are a just few benefits that the Santoprene Cartridges provide:

- Inert properties make them suitable for harsh environments as well as potable water applications
- Resistant to various chemicals, including acids, bases, and petroleum products
- Can withstand extreme temperatures and abrasion
- Flexible and resilient, making them ideal for repeated use
- Provides better sampling rates compared to previous bladder design
- The material is recyclable



Check out our [Bladder Replacement Video](#) to see how simple it is!



## Levellogger Data Critical For Water & Leachate Management at a Queensland Landfill

After a significant rainfall event in early 2022, groundwater levels at a landfill site in southeast Queensland, Australia, had risen several metres above any previously recorded.

As such, the landfill operators contracted Anderson Consulting to assist with site planning and works. This included reviewing the existing groundwater data and requesting advice on operation planning.

The landfill's existing groundwater level data only consisted of compliance monitoring data collected every three months. This "snapshot" of data limited the assessment of the groundwater trends and site responses to continual rainfall.

Anderson Consulting proposed installing **Solinst Levellogger 5** water level dataloggers across the monitoring network, which consists of sixteen groundwater monitoring wells. HydroTerra, the exclusive distributor of Solinst products in Australia, supplied the Levelloggers and equipment.



Solinst Levellogger 5 dataloggers were selected because of their:

- Robustness (Anderson Consulting have used Levelloggers continually for over six years in a multitude of situations, environments, and conditions)
- Accuracy
- Ability to expand with Direct Read Cables and Telemetry in the future
- Long battery life
- Simple PC interface and the ability to use a Solinst DataGrabber 5 to download data rapidly

The Levelloggers have a 10-minute logging rate. Over the next few months, the collected data provided an important understanding of groundwater characteristics, particularly each of the monitoring wells' responses to rainfall.

The data allowed analysis and determination of groundwater recharge locations, aquifer



types, and groundwater decay rates. With this understanding, operations planning could be made based on known data rather than speculation or interpolation between quarterly compliance monitoring.

Because of high quality data and subsequent understanding gained from the groundwater dataloggers, the site operators requested Anderson Consulting provide information on the behaviour of surface waters (in particular, sediment basins).

Four more Solinst Levellogger 5 dataloggers were deployed at the landfill site. The water level data was used alongside a known survey (stage-storage) of the water bodies to understand volumetric changes due to rainfall events, evaporation, losses, and pumping. From this information, site-specific stage runoff factors and pumping curves were calculated.

The operators then requested dataloggers to augment the site's current leachate level monitoring system. Again, Solinst Levellogger 5 dataloggers were chosen. Three Levelloggers have been deployed, with a further five to be installed in early 2023. Overall, the introduction of Solinst Levellogger 5 dataloggers to the site has allowed for:

- More detailed monitoring and analysis of groundwater, surface water, and leachate
- A clearer picture of the workings and interactions of water (rainfall, runoff, recharge, and infiltration)
- Decision-making to be based on real-time data

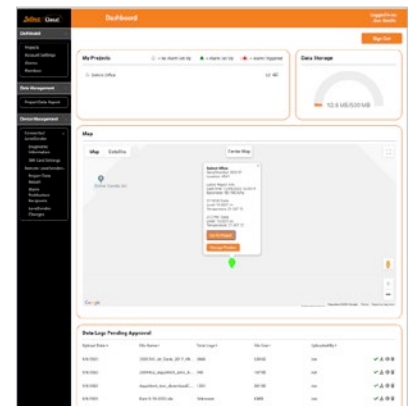
*The original article was written by Chris Anderson, Principal Engineer and Scientist with Anderson Consulting.*

## Simplify Monitoring, Expand Networks & Extend Data Management with Solinst Cloud

**Solinst Cloud** is a sophisticated cloud-based platform to simplify data management and storage. It is designed to adapt to your needs and expand as your water monitoring networks grow. Data is kept secure, allowing you to control access and extend data management to team members as needed.



Managing and organizing all your data and monitoring projects in one central location has never been easier. Solinst Cloud smartly organizes your information, putting important data at your fingertips. Navigate your way through the user-friendly Dashboard with ease, quickly reaching critical details such as alarm triggers and the latest reports. Solinst Cloud supports **LevelSender 5** network communications and seamless configuration of your telemetry systems and monitoring networks.



# Why Use Multilevel Monitoring Wells?

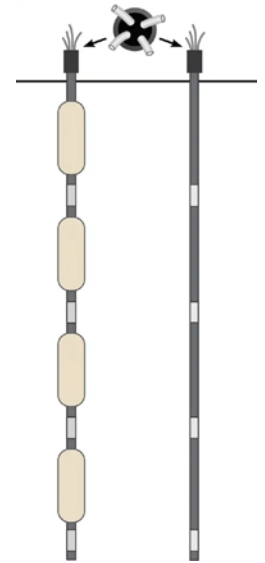
## Choosing the Right Monitoring Well

Groundwater. We all recognize it as a necessity and the need to keep watch on its quality and quantity with time. However, how do we effectively monitor something that we can't see? The short answer – choose the right monitoring wells!

As an environmental colleague working in the industry, your goal is our goal – to select a monitoring well that provides detailed information on hydraulic and transport properties and water chemistry from each geological stratigraphy so changes can be identified over time. You're looking for cost-efficient, defensible data that's easy to collect.

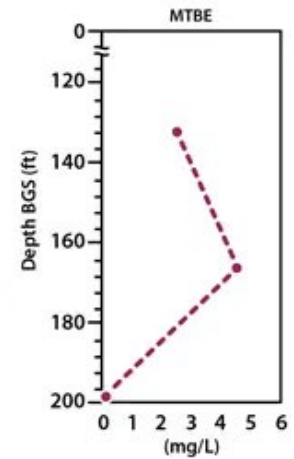
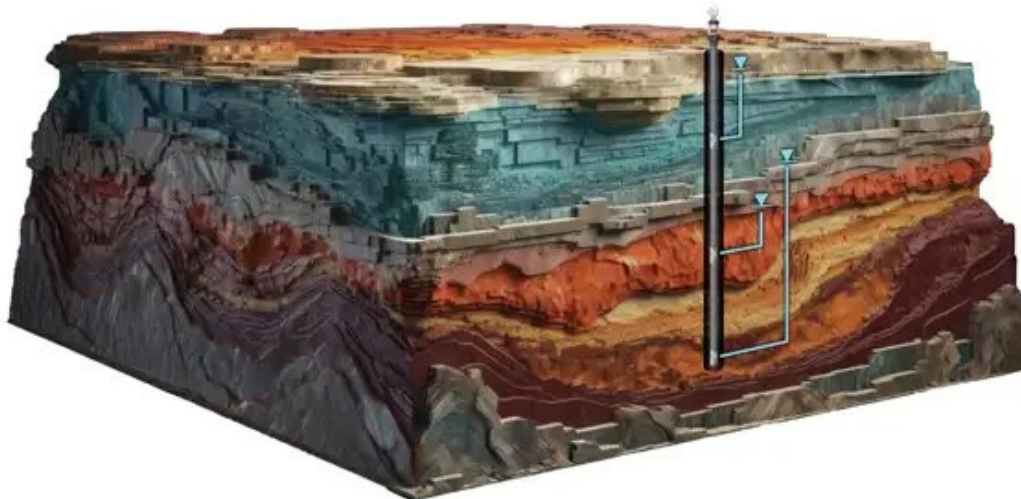
## The Multiple Level Well (aka. Multilevel) – what is it?

As pictured, Multilevel monitoring wells use a number of individually isolated short screens to 'capture' water at each specific depth in a single borehole. Each well screen is isolated using sequences of clay seals or borehole Packers so that a representative water level and water sample can be collected from multiple depths in a single borehole.



## Reasons for Using a Multiple Level Well

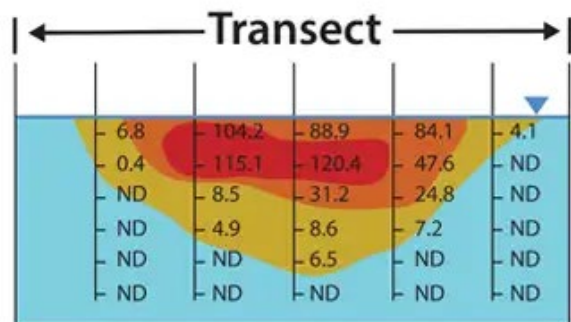
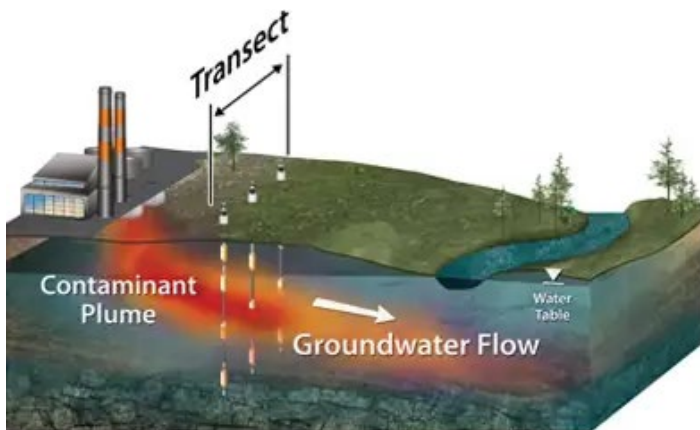
1. Geology is not always 'homogeneous'. Understanding the vertical differences in water levels and water chemistry across complex geology is key.



2. Installing well clusters can create 'short-circuit' pathways for water levels and chemistry across over-lapping sand packs.
3. Long-screen wells can 'over-estimate' a contaminate thickness and 'under-estimate' the maximum concentration.
4. Nested wells can also present biased chemistry and water levels at poorly sealed zones.

## Multiple Level Wells Provide High Resolution Data

Creating 'transects' across zones of interest provides depth discrete data that can be compared 'seasonally' through various geological strata.





## Kootenay Watershed Science Now Includes Alpine Lake Monitoring



Kootenay Watershed Science (KWS) is a community-driven project spurred into action by concerns over climate change impacts and the lack of watershed monitoring in the Kootenay region.

Along with its parent organization, Living Lakes Canada, a water stewardship NGO whose work was founded in the Columbia Basin, this project aims to understand further how the warming atmosphere will influence their region's small and medium-sized watersheds.

In a previous article, we discussed KWS's overall goal of collecting and sharing critical data to base future decisions.

KWS has established several hydrometric stations and high-elevation snow courses to achieve these goals, collecting data on snowpack, precipitation, temperature, water quantity, and more.

KWS expanded their program by adding a monitoring site at Upper Fletcher Lake near Kaslo BC.

Alpine lake monitoring started in 2021 with a pilot project at Ben Hur Lake near Kaslo BC. The site was inaccessible in the summer of 2022 due to forest fires and road closures, but data from 2021 were collected and provided some good information.

Baseline data on water level, lake transparency, temperature, and precipitation provided an essential understanding of the behaviour of the lake throughout the summer.

Through the data, KWS determined the lake has high transparency that changes

throughout the summer months, and is a snowmelt-driven system. They also determined that lake temperature is more affected by air temperature than precipitation.

This baseline information will provide insight into how alpine lakes could change over time as the climate changes and will help guide mitigation efforts.

As mentioned previously, KWS expanded their alpine lake monitoring efforts by adding a monitoring site at Upper Fletcher Lake.

**Solinst Levelloggers** have been installed in each of the lakes to measure the changes in water levels over time. They are both small lakes, so just one Levellogger (and one Barologger for barometric compensation of the water level data) are installed at each.

The Levelloggers are installed in protective tubes and then weighted down on the bottom of the lake near the shore. A bolt is drilled into a large rock above the Levellogger, which is used to measure absolute water level. The Barologger is suspended in a shady tree in a nearby forest. Paul says, "This is quite a simple and easy way to get the loggers in, and it also makes them completely unnoticeable, which is good for safety and keeps the lake looking pristine."

Downstream from the Ben Hur Lake site on Ben Hur Creek, KWS has operated a stream discharge measuring station since 2013. "At this remote, high elevation station, we need to be completely confident in our loggers. The Solinst loggers have performed flawlessly despite the challenges of this

environment," says Paul. By comparing the data from the two sites over the coming years, they can see how the lake level correlates with the discharge rates in the creek.

Alpine lakes may play a role in moderating the flow of small creeks in the region. The creeks are important for water resource users in the community, as well as the freshwater ecosystems. Modelling suggests that as climate change continues to affect the region, there will be less flow in the creeks over the summer months. The alpine lake-fed systems may be able to help by moderating the flow over the seasons.

Overall, the monitoring program will help build an understanding of alpine lake health and function in the area. The alpine lakes in British Columbia, and Canada overall, have not been studied thoroughly, so creating a dataset that characterizes these types of lakes will significantly build upon our understanding of these important ecosystems.



Ultimately, the data collected by KWS helps evaluate how the watersheds in the area respond to different hydrological flows – especially in times of high precipitation and low water supply. The data will help predict the risk, frequency and outcome of more catastrophic events brought on by climate change. Making the data publicly available will help allow for appropriate watershed management moving forward.

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## New Versatile Submersible Water Level Transmitter

The **Solinst Model 301 Water Level Temperature Sensor** provides the option of highly accurate water level transmission using multiple protocols, including MODBUS, SDI-12 and 4-20mA.

This compact, all-in-one submersible hydrostatic level transmitter provides continuous water level and temperature readings using absolute (non-vented) or gauged (vented) pressure sensors. Accuracy is 0.05% FS with six pressure ranges (5–200 m) and communication cable assemblies available in lengths up to 300 metres.

Sensors are enclosed in a 316L stainless steel housing with double o-ring seals to prevent leaks, and a Faraday cage design to protect against power surges and lightning. A 1/4" NPTM threaded connection provides the option of attaching to pipes/conduits.

The Water Level Temperature Sensor is easy to integrate into existing monitoring systems, e.g., SCADA or PLC. Measure hydrostatic liquid levels long-term in both industrial and environmental applications.



## Polish Mining Institute Finds Levelogger Data Ideal For Precise Hydrogeological Monitoring

Researchers at the Institute of Open Cast Mining in Poland (Poltegor-Institut) performed several studies to determine the suitability of **Solinst Levelogger** water Level dataloggers for hydrogeological monitoring of their mining operations.



Through pumping tests and other studies, they showed that continuous, high-frequency water level data is critical to accurately track the effects of mining operations on groundwater resources and surface water-groundwater interactions.

You can view the full article (translated and edited) about their findings that appeared in *Discovery Mining* in our [ON THE LEVEL Blog](#).

*Solinst Thanks Michal Oleksiewicz of AquaTerra.pl, Solinst Exclusive Distributor in Poland, for providing the original article.*

## Why Use a PVC Pump?

Both **Solinst Bladder Pumps** and **Double Valve Pumps** have a PVC pump option again, but why would you want to use a PVC pump over a stainless steel one? Stainless steel pumps are excellent in most standard groundwater sampling applications, but PVC is well suited for specific environments. Here are some reasons to choose a PVC pump:

### Chemical Resistance

PVC is resistant to a wide range of chemicals, making it suitable for sampling in various groundwater conditions without reacting with contaminants. PVC's non-reactive nature helps prevent contaminants from adsorbing or desorbing, providing reliable sampling results.

### Cost-Effectiveness

PVC is relatively inexpensive compared to other materials, making it a cost-effective option for groundwater sampling, especially in large-scale projects.

### Lightweight

PVC pumps are lightweight, which makes them easier to transport and install, especially in remote locations.

### Corrosion Resistance

PVC does not corrode like metals, ensuring long-term usability and reducing maintenance needs.





## KWS Expands Alpine Lake Monitoring

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Our climate is changing, and it is anticipated that there will be significant change in stream flow in the near future. The need for adequate data to better plan, prepare and respond to changing climate impacts is recognized in communities and across all sectors. The long-term streamflow, climate, snow, and alpine lake health datasets collected by KWS and powered by Solinst equipment will provide the data needed to plan for climate change mitigation efforts in the Kootenay region.

For more details, read the full post in our [ON THE LEVEL Blog](#).

Solinst thanks Paul Saso, Hydrologist with Kootenay Watershed Science and Nicole Trigg, Communications Director with Living Lakes Canada, for providing the details of this project.

## Assessing Low-Temperature Geothermal Potential

(continued from page 2)



This subsurface temperature zone, the zone of neutral or transient temperatures, can persist to about 50-60 meters of depth or even more. However, it shows some small variability, i.e. it may slightly increase or decrease. The thickness of that zone is very different and varies very much between the individual observation boreholes.

Deeper down, the subsurface temperature starts to increase according to the value of the geothermal gradient, however, this effect is not observed clearly for all the studied boreholes.

In the coming years, plans are to drill another five boreholes in various regions of the country, including Lower Silesia, Pomerania, Podlasie, and the Lublin region.

Overall, the research results provided data for developing low-temperature geothermal potential maps for the studied areas in Poland.

For more details, read the full post in our [ON THE LEVEL Blog](#).

Solinst Thanks Igor Kubicki of AquaTerra.pl, Solinst Exclusive Distributor in Poland, for providing the original article, which was presented at 49th Workshop on Geothermal Reservoir Engineering at Stanford University, Stanford, California, February 12-14, 2024, SGP-TR-227.



**SolSat 5**  
Satellite Telemetry



## Discover Anywhere Monitoring with SolSat 5 Satellite Telemetry

**SolSat 5** is an advanced telemetry system that leverages Iridium satellite technology to provide global connectivity for your remote water monitoring projects.

The SolSat 5 uses TextAnywhere two-way global satellite messaging to send data from Solinst dataloggers in the field to a secure web portal where you have complete control of your data. Select a low-cost data plan of your choice through Solinst.

The SolSat 5 is compact, lightweight, and features a robust weatherproof enclosure. It is installed anywhere with very little site preparation. A built-in solar panel extends the battery life, while a barometric sensor allows for automatically compensated water level data to be reported.

The SolSat 5 is simple to set up using an integral, secure Wi-Fi App on your smartphone or laptop. The app allows viewing, scheduling, and configuration wirelessly from your browser.

## Assessing Coastal Flood Vulnerability

(continued from page 1)



A total of 16 groundwater monitoring wells were installed across these locations, along with surface water sampling locations. For comparison, he selected well locations in known preferential pathways (utility trenches) and outside.

Jacobs used **Solinst Leveloggers**, donated by various sources, including Solinst and Enviro-Tech, to collect data at surveyed locations. A total of 20 permanent sensors have been collecting data since 2022. The Leveloggers are set to record data every 15 minutes, with additional Barologgers for barometric compensation. Data is downloaded every three months. Jacobs is open to sharing the data with interested parties, including modelers.

Discrete water sampling events were planned during six of the highest astronomical tide events and two low tide events. Most of the sampling events were conducted during the rainy season; however, one was completed during the dry season.

During the investigation period for Water Year 2023, there were historically intense rains and high tides in northern California. Groundwater responses to extreme rains and high tides were observed, indicating increased community vulnerability to sea level rise and extreme events, especially in areas with preferential pathways.

Jacobs recommends that all coastal communities start compiling available data to help build a picture of preferential pathways in the area and install sensors like Leveloggers to identify current conditions and rates of change. Simple, low-cost flood prevention solutions such as regular maintenance of storm drain systems are recommended.

This ongoing research underscores the need for a comprehensive, long-term data collection effort to better predict and mitigate coastal flood risks at a community level.

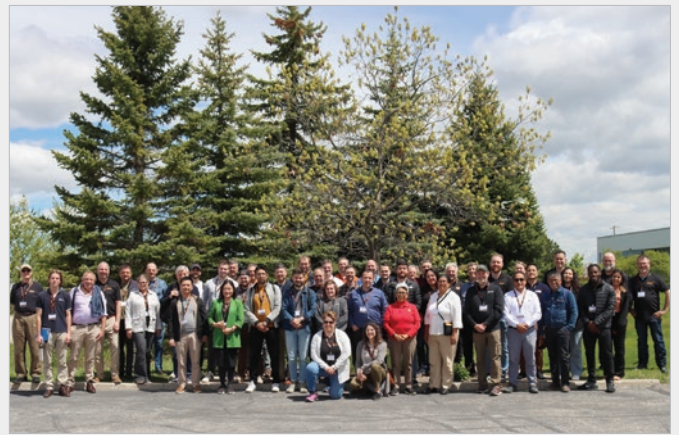
For more details, read the full post in our [ON THE LEVEL Blog](#).

Solinst thanks Jim Jacobs for providing the information about his work.

## SDC-24 Was a Huge Success with Record Attendance!

At Solinst, our distributors are integral to our commitment to providing exceptional customer service to our clients worldwide. As such, we are delighted with the Solinst Distributor Conference 2024 turnout!

We brought together over 40 distributors from around the world, including Australia, China, Vietnam, Philippines, Pakistan, South Africa, Poland, Netherlands, Estonia, Czech Republic, Lithuania, France, Brazil, Peru, and Mexico, as well as our connections in the US and here in Canada. It was great to see everyone come together to learn and have fun during our 3-day event.



SDC-24 included informative presentations and more hands-on practical sessions than ever!

We also had the pleasure of having Murray Einarson, Principal at Haley and Aldrich, give an informative talk on the importance of high-resolution monitoring and multilevel systems.

We want to thank all the participants and our employees for their commitment to making this event a success. We couldn't have done it without you!

