

RESIDENTIAL CONTINUOUS TURBIDITY MONITORING

Residents complained and sued local municipality as it was unable to detect the cause of cloudy water over the course of two years.



By **Sivan Cohen, Pam Mayerfeld,
and Ariel Stern**

While water is the world's most valuable resource, it is slated to be the scarcest in the years ahead. Faced with increasing demands of a growing global population, dramatic non-revenue water (NRW) losses from aging infrastructure and threats to public health and safety via system contamination, water utilities and regulatory bodies must efficiently manage their operations.

To address these existing and impending requirements, remote water monitoring technology is being increasingly adopted worldwide to create smart water networks.

There are vast applications of smart water networks. They range from ensuring proper disinfection practice of water used for agricultural crop irrigation to gathering scientific desert flash flood data, from setting up wide networks across the entire water conveyance network of a large city to detect leads and monitor water security to figuring out supply and quality anomalies in water

delivery to individual residences. The latter of these scenarios was the incentive for two technologies to be fused together in an international R&D development project.

Founded in 2011, Ayyeka is an Israeli based technology company that develops modular, all-in-one remote water monitoring kits.

Ayyeka's integrated cross-platform solutions are comprised of the Wavelet embedded computer, the core of Ayyeka's monitoring kits, which collects and transmits monitored data. The Wavelet is pre-configured to autonomously operate and control best-of-breed sensors and samplers. Along with cloud and web-based data management, streamlined continuous information is made available to clients. www.ayyeka.com

In Sunnyvale, California, Turner Designs has specialized for over 40 years in providing sensors for environmental and industrial use.

Configurations are available for many different applications including dye tracing, wastewater and turbidity monitoring in addition to hydrocarbons. Styles are available for both freshwater and marine deployments. In 2013, Ayyeka was presented with a longstanding residential water quality problem which was the impetus for seeking out Turner Designs and integrating the technologies together. The problem poised took place in a mid-sized city in central Israel. Residents complained and then sued the local municipality because it

was unable to detect the cause of cloudy water over the course of two years. The municipality's investigation, consisting of manual sampling during daytime hours, revealed acceptable turbidity levels. Yet the water being delivered to certain homes continued to be excessively cloudy during specific and irregular time slots.

The local water municipality contracted with Ayyeka to install water quality monitoring kits in order to collect continuous data and to analyze

the problem. Ayyeka and Turner Designs worked together to synthesize the Wavelet, featuring continuous, autonomous operation and user-friendly web-based data management system, with the Cyclops-7, featuring high pressure, inline, and accurate turbidity monitoring, in order to create a customized solution for the client. Additional considerations were that Ayyeka's Wavelet platform powers sensors using an internal lithium battery utilizing low power consumption algorithms, and has ports for both digital and



Figure 1: Wavelet Water Quality Kit Installed onto Existing Pipe.



Figure 2: Cyclops-7 Submersible Sensor.

analog sensors, which allowed for the output from Turner Designs' Cyclops-7 to be converted to digital signals through a high-end 16 bit analog-to-digital converter. Once the data from the Cyclops-7 was collected, it would be encrypted and transmitted via two-way GPRS/ GSM communication, with service provided by an embedded 2G SIM card pre-installed in the Wavelet. The data would be stored on a cloud server and then re-encrypted before being conveyed to the user-interface which would permit the client to monitor their data in real-time.

These customized Wavelet-Cyclops 7 monitoring kits were installed inside the pipes leading to the affected residences, and continuous data was transmitted to the local municipality. A pattern emerged over the course of the next few weeks that there indeed was an increase in turbidity at irregular intervals during the day and in the middle of the night. From this newly collected data, the water municipality was able to further investigate and discern the source of the turbidity.

The cause of the turbidity issue was found to stem from the piecemeal development of the civil water infrastructure of this particular Israeli city, which is similar in nature to how many cities expand and add on to existing infrastructure. Israel's founding communities were primarily agriculturally based communities that drew upon groundwater and water diverted from the Sea of Galilee. Over the past several decades, many of these agricultural communities grew to the point that neighboring communities began to be combined together into small and then mid-sized cities. Initially, each community had its own water sources consisting of groundwater wells and some piping infrastructure. As the cities grew and were formalized, local water authorities were created which inherited the existing aging infrastructure and added onto or replaced with new infrastructure now built to convey water by the country's national water company, Mekorot, from the Sea of Galilee,

desalination and water treatment plants and provided to local municipalities. The old wells were for the most part abandoned and forgotten.

In this particular instance, the control system in the affected neighborhood was not working well such that there was a pressure drop several times each day. During these pressure drops, one of the old wells was triggered into action and injected water contaminated with soil and clay into the city's system. There had been an unidentified existing connection, which had not been shown on as-built drawings, from one of the old wells to the more recently laid city water infrastructure. By using turbidity monitoring systems in parallel and utilizing the Wavelet's synchronization capabilities, the municipality was able to isolate the direction of the pollution and trace the precise location of where pollutants were entering into the system.

The city then dismantled the old well, and continued to monitor the water quality delivered to the previously affected homes in order to ensure that the turbidity issue has been resolved.

Utilizing data collected by the Cyclops-7, and then transmitted and displayed by the Wavelet, the municipality was able to present evidence of problem resolution to the legal authorities involved and the lawsuit filed by the residents was dropped.

Summarily, the result of an integration of Ayyeka's Wavelet data-logging and telemetry system along with Turner Designs' Cyclops-7 turbidity sensor allowed for detection of turbidity measurement anomalies would not have been detected. Together, the technologies ultimately enabled the water company to pinpoint the problem and improve water quality to the local residents. Finally, a difficult to identify yet easy to resolve conundrum had been put to rest.

About the Authors

Pam Mayerfeld has worked for Turner Designs for over 10 years and with optical instrumentation for almost 20 years. She worked as a Design Engineer and Product Manager for semiconductor test equipment.

Sivan Cohen obtained her B.Sc. in Civil Engineering from UC Berkeley and M.Sc. in Civil Engineering from Stanford University and is a licensed Civil Engineer. She worked as a Construction Manager on large commercial and high-end custom residential projects, a researcher for production of environmentally friendly cement, and joined Ayyeka as Director of Business Development. With several years of construction management experience and a B.Sc. in Electrical Engineering from the Israel Institute of Technology (Technion),

Ariel Stern has completed multi-million dollar projects across various fields of operation.

Ayyeka was incepted in 2011. Their comprehensive, energy efficient and secure plug-and-play water quality, water supply, wastewater, hydrology and agricultural monitoring kits have been installed in more than 100 locations at water utilities, municipalities, research institutions, military bases and industry. Ayyeka's Wavelet, the core of the monitoring kit, collects and transmits monitored data.

To know more about the authors, you can write to us. Your feedback is welcome and should be sent at: mayur@ewater.com. Published letters in each issue will get a one-year complimentary subscription of EverythingAboutWater Magazine.