A young boy with dark skin and short hair is smiling slightly, looking directly at the camera. He is holding a large, white, rectangular water container with both hands. The container has a red cap on the right side. The background is a blurred outdoor setting with dry earth and some wooden poles.

THE WATER MARGIN

IN 2005, 50% OF HAITI'S WELLS WERE BROKEN OR CONTAMINATED. SO HAITI OUTREACH DECIDED TO USE GEOSPATIAL TECHNOLOGY TO ENSURE EVERY HOUSEHOLD HAS ACCESS TO CLEAN DRINKING WATER.

SARAH ALBAN REPORTS



A number of non-profit organisations drill water wells to increase access to potable water in un-developed countries. But the worldwide failure rate of these wells is about half

In Haiti, the Western Hemisphere's poorest nation, more than 98% of drinking water is contaminated by E. Coli bacteria. For 30 years, Haiti Outreach has strived to increase access to clean water by drilling wells for Haitian communities called "communes".

"People in Haiti needed water, so we started digging wells all over the place," Haiti Outreach director Neil Van Dine says. "We thought that would be enough."

But a 2005 study showed at least half of all Haitian wells were broken or contaminated. According to Van Dine, a 50% success rate is on par with other non-profits performing similar work worldwide. "The next highest I have seen is in Uganda, where they have a 70% success rate," he says.

But Haiti Outreach wanted to do better. "After all, it's not about getting a well – it's about having a future where the water doesn't make you sick."

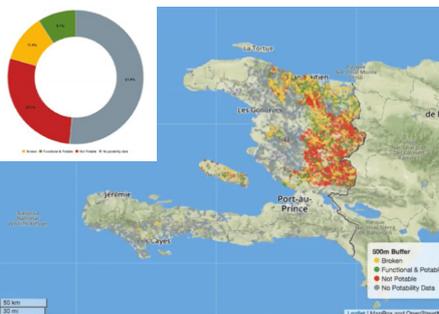
In Haiti, where decades of political and fiscal corruption have created widespread distrust, the cost of US\$0.50 per household to maintain a well was still a hard sell. However, as communes agreed to the fee, Haiti Outreach saw their success rate of so-called "managed wells" double.

"Our success rate jumped from 50% to over 90%," Van Dine says. "Today, we have about 450 managed wells."

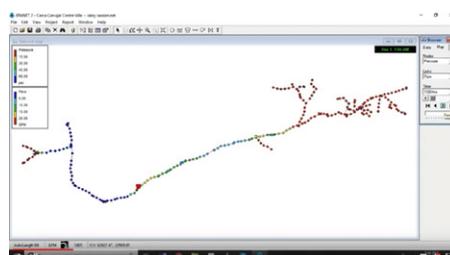
Encouraged, Haiti Outreach asked itself a new question: "How would we know if everyone in Haiti had access to clean drinking water?"

Access for everyone

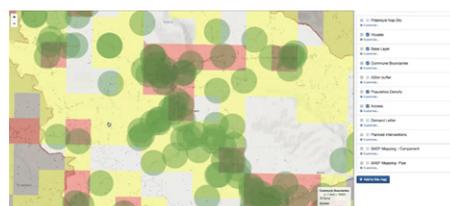
To answer this, Haiti Outreach needed to know the location of every household in relation to water sources. They also needed to know if these water sources were clean, contaminated, functioning or broken.



In Haiti more than 98% of water is contaminated with E. Coli



An EPANET simulation helps Haiti Outreach determine where water distribution systems fail. Failure (shown in red) is often caused by either poor construction or a system being tapped too many times, resulting in low pressure



A black point represents a household, school, or related institution. A circle represents an area covered within a 500m walking distance to a water source. Green circles are the best, indicating access to clean drinking water. Most households fell outside these areas in red (contaminated) or yellow (nonfunctioning) access zones

First, it purchased a government dataset of all two million Haitian households, including schools and institutions. They mapped the data in an open-access geospatial platform called mWater Portal. By sticking to open-access software, Haiti Outreach ensured it could share its data with politicians, donors, residents and anyone else.

To map water sources, Haiti Outreach sent out field crews to record each spring, well, hand pump, kiosk and other water source on foot. On average, this work cost US\$25,000 per commune. With 145 Haitian communes to pick from, Haiti Outreach decided to use its own: rural and mountainous Pignon, three hours north of Port-au-Prince.

Using mWater's mobile data-collection app, mSurveyor, on Android phones, 15 field workers collected the location and status of each water source. mSurveyor sent this data in real-time via the cloud to mWater in the office, where a trained engineer verified the quality of the data.

"Because of this tool, we can have one engineer in the office instead of many in the field, greatly reducing costs," Van Dine says.

Then, using radius buffers, Haiti Outreach identified which residents fell within a reasonable daily walking distance (500m) of an existing water source. They colour-coded the sources to indicate if access was to a clean, contaminated, functioning or broken source.

The results were startling: 70% of Pignon's water sources, serving a third of residents, were unusable. "It was like 'holy smokes!'" Van Dine says. "Where do you even start with the magnitude of this problem?"

Community action plan

Haiti Outreach used the findings to develop a community action plan (CAP). The CAP prioritised cleaning contaminated sources, because this was the least expensive action, and then ranked contaminated sources by the highest number of people who would benefit from a decontamination. This resulted in a plan of action "phase one" approach to making the best use of donations available.

The next cost-effective action was to repair broken water sources. Haiti Outreach again ranked broken water sources in terms of the highest number of people who would benefit from a repair.

After cleaning and repairing, the team had two options left to reach those without water access: they could either build new sources (dig a well) or extend access from existing sources (expand a distribution network).

By running population-density overlays in mWater, it was possible to identify where there were more than 25 households – enough to create a revenue stream to support a new well. With 100 households, the revenue could support a new in-home water-distribution network, known in Haiti as a "SAEP".

"Everyone wants a sink and a toilet in their house, rather than a bucket of water

EMERGENCY MANAGEMENT



Getting water is often a daily task in Haiti, the Western Hemisphere's poorest nation.

on their head and a latrine," Van Dine says. "So last year, we started to think about how could we do this reasonably cheaply."

EPANET and Eos Arrow Gold

Most Haitian SAEPs are not efficient, because of poor design or being tapped too many times, thereby reducing pressure and flow. Haiti Outreach decided to use the open-source hydraulic-modelling software EPANET, from the US government and hired mWater to build an integration.

"We wanted a tool that didn't require a highly trained GIS person," Van Dine says. "We can simply export from mWater to EPANET and use it to tell us whether the water will flow or not."

To run the flow models, Haiti Outreach needed topographic data of the SAEPs. So once again, they sent field workers, who this time collected a point every 50m along a SAEP, wherever they encountered a system component or wherever they encountered a visibly steep change of slope.

To get elevation that was accurate to within EPANET's sub-30cm tolerance, the crews used two external Arrow Gold GNSS receivers with their Android devices. The Arrow Golds provided decimetre accuracy by using an Atlas satellite-based differential correction service. Under dense canopy, the field workers used an Abney level to manually measure elevation.

"The Android phones got about 10m of accuracy on their own," Haiti Outreach fieldwork coordinator Micki Johns says. "But the Arrow Gold got us within that decimetre range."

Data collected in mWater went into EPANET via the integration, to simulate

water pressure and flow. Red results indicated pressure in that part of the SAEP was too low for the water to flow.

"You could tell that the only way households at the end of one SAEP could get water was if they used it at night," Van Dine says. "But if you engineered the system a little better, you could do better."

Through its relationship with Rotary International, Haiti Outreach secured a pledge of US\$340,000 to execute the Pignon CAP. The key stipulations were not only that the CAP was technologically strategic, but also that the community-funded revenue stream was secured, in order to keep the donated investment sustainable. To ensure this, Haiti Outreach worked diligently with local elected officials and the national water directorate (DINEPA) to secure transparent management of the funds.

Today, Haiti Outreach has developed numerous CAPs, and in addition to its educational outreach, it presents each CAP to the relevant mayors, administrative officials, and other politicians.

"Haiti Outreach provided the framework and the method, the government offered support, and Rotary International provided the funding," Van Dine says.

The last mile problem

After cleaning, repairing and building new water infrastructure, Haiti Outreach can finally find a solution to its massive question: how to ensure nearly everyone in Haiti has access to clean drinking water. Beyond that, Van Dine says, it faces the 'last mile' problem – the most expensive course of action, benefitting the fewest people. Haiti's last mile represents about 4% of its total population. However,

TIMELINE

1997: Haiti Outreach established, focuses on drilling water wells in Haiti

2004: Study shows most of Haiti's wells are broken or contaminated

2005: Haiti Outreach pivots from wells to wellness, focusing on educating communes about infrastructure management

2007: New data shows success of 'managed wells' has reached nearly 90%

2013: With eight years of data showing a 90% success rate for managed wells, Haiti Outreach asks the question: "How would we know when everyone has access to potable water?"

2014: Haiti Outreach uses national data and field data collection to start mapping the extent of the national water-access challenge

2015: Haiti Outreach deploys first commune action plans (CAPs) in Pignon and Trou du Nord

2018: Haiti Outreach nears completion of CAP in Trou du Nord, raising access to potable water from 45% to 88% in three years

2019: To date, Haiti Outreach has created 23 CAPs and is working on seven of them. Rotary International is working on four additional ones following their model

as Van Dine points out, "If we had 96% of people with access to clean water in Haiti, we would not be talking about Haiti as a poor country." Van Dine says the last mile could be solved with in-home water purifiers.

According to Van Dine, Rotary International intends to take their CAP model worldwide.

"We're talking about Haiti, but you start to see the possibilities of this technology," he says.

Van Dine, who has lived in Haiti for nearly three decades, says the most powerful stories come from parents who report fewer children are dying thanks to clean drinking water. He says this type of evolution, into serving a community with a shared resource to tackle some of the most basic challenges, is not a challenge isolated to Haiti, but rather a global one.

"It's a challenge for any society to deal with this stuff," he says. "Everyone has to work together to maintain a national commodity. Moreover, on a global scale, we need to work together to create an Earth that works for everyone."

Sarah Alban is director of marketing at Eos Positioning Systems (www.eos-gnss.com)