

Background Water Quality Testing in Haiti in Support of Securing a Groundwater Drilling Rig for Haiti

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International Water Resources

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During a recent medical mission headed up by the Lutheran Church of Haiti and Mission:Haiti of Fort Lauderdale, Florida (June 22 to July 3, 2010) in the Town of Leogane, Haiti, one of the principal authors of this proposal volunteered to help assist in the treatment of locals from the area surrounding the church of the L'Eglise de Dieula Terie (Lutheran Church of God from the Land). Approximately 70 to 80 percent of the patients were plagued by issues related to contaminated waters either through dermal contact and/or consumption (including elevated sodium issues). The temporary clinics set up by Mission:Haiti treated over 1,300 people that week with 17 volunteers. The observation of administering antibiotics and other pharmaceuticals for a period of two weeks does not prevent patients from getting ill again after the medicine runs out. Clean water is still the issue at hand. Based on observations of that week it was obvious that something needed to be done regarding the drinking and bathing water for the poorest people of Leogane, Haiti and the surrounding communities.

After reviewing costs to drill a well in Haiti, meeting with several Haitian drilling firms, and finding a lack of willingness of Haitian drilling companies to travel to remote areas to drill for clean water, we decided to undertake an effort to get drilling rig/service equipment into Haiti. The first step for the providing clean drinking water for the poorest of people in Haiti was to write a proposal to get a drilling rig and support services to Haiti to install wells for the poorest of people. These locations are generally located outside the urban areas and are the most rural areas of Haiti.

Since so many Haitians were affected by poor water issues, a literature review of existing water quality literature was conducted while preparing the draft drilling proposal. To our amazement, there was very little published literature on that specific issue or contamination. Much has been documented through non-governmental organizations (NGOs) but only very limited data was actually presented. Most reports lumped results by region or by departments and generally listed the number of dead or ill. There was generally no backup information or raw data. The existing reports were broken into three groups; 1) Basic ionic water quality, 2) limited water quality with bacteriological testing, and 3) small-scale aquifer performance tests and/or University dissertations. Several reports stood out and were readily available via the Internet or through contact with the principal authors (Boardman, 2001 and USACE, 1999). Most water quality data was older (1999) and of pre-Earthquake (January 12, 2009) timeframes. It was decided that if we were really going to be able to effectively discuss issues about contamination we needed actual current data from the areas that we are proposing on working in.

It was also decided that a water quality testing trip to Haiti would be necessary to address the issue of contamination and to collect actual data to that would either support our effort or not. A list of supplies and equipment purchased and donated is at the end of this article.

On February 17, 2011, Aimond Alexis, Rick Miessau, and Steve Krupa flew to Port Au Prince, Haiti, to collect samples in the general areas which we have been working in. During the travel to Haiti our checked luggage was opened and sampling strips (nitrate/nitrite and chloride) were taken from our luggage, so unfortunately we were unable to sample for these parameters. We collected the remaining samples in four areas of Haiti. The areas are Leogane, Port-Au-Prince, Verrettes and Gonaives (Figure 1). The breakdown of samples and the locations is Port au Prince (5), Verrettes (2) Gonaives (5) Leogane (2) Carrefour Dufort (5). At each location we collected general field parameters such as location in latitude and longitude by GPS, elevation by GPS, the type of sampling point (well, water supply type (residential, public etc), hand dug well), total depth of the sampling point if known or could be measured, depth to water relative to the top of casing, temperature, specific conductivity.

We sampled for the presence/absence of total coliform and E.Coli with IDEXX bottles and reagents, and in some cases we used a Hach Pathoscreen to test for the presence/absence for sulphur producing bacteria which indicates general contamination. Water quality samples were collected in the IDEXX bottles, they then were incubated by human body heat (generally over 24 hours). Following incubation and under the cover of darkness the IDEXX bottles were then tested by placing them under ultraviolet light and compared to an IDEXX control bottle. If the sample fluoresces, it indicates the presence of E. coli.

The tabulated results are presented in Table 1. Data from Table 1 was entered into an Access database and merged with other investigators' results; data was also entered into a Google Earth kmz file ⁽¹⁾ for spatial locations and uploaded to the International Water Resources ⁽²⁾ web page. The results from Table 1 are presented pictorial in Figure 2.

The results in Table 1 show that we took nineteen samples throughout Leogane, Port-Au-Prince, Verrettes and Gonaives. Figure 2 shows samples visually, yellow tinted water indicate that thirteen (samples 1,2,3,4,5,8,9,10,11,11A,13,14,18) had the presence of total coliform which is a secondary indicator of contamination. Visually, samples 6 and 7 have a slight tinge and would require additional sampling to be conclusive for contamination. All samples were exposed to ultraviolet light (Figure 3) and compared to an IDEXX control bottle. If the sample fluoresces it indicates the presence of E. coli. Our investigation had 5 positive hits for E.coli, samples 1, 5, 6, 9, 10; two of those (samples 1 and 6) were confirmed by the Hach Pathoscreen tests.

Overall 19 samples were taken (Figure 2) of which 13 showed signs of contamination, which translates to 68 percent of the overall samples. Of the 13 samples that showed contamination, E.coli bacteria was present in 5 of them. In summary, 26 percent of the overall samples and 38

percent of the contaminated water samples contained E.coli bacteria, indicating fecal contamination.

Web pages discussed in text:

- 1.) http://www.internationalwaterresources.com/docs/TWR_HaitiWells_20110917.kmz
- 2.) <http://www.internationalwaterresources.com/>

The following equipment were donated or purchased:

Donated Items Links:

- Yellow Springs Instrument (YSI) Foundation, Yellow Springs, Ohio (www.yxi.com) donated a Model 30 temperature and conductivity water quality probe.
<http://www.yxi.com/productsdetail.php?30-28>
- IDEXX Laboratories, Westbrook, Maine (www.idexx.com) donated Colilert Coliform/E.Coli Test Kits.
http://www.idexx.com/view/xhtml/en_us/water/colilert.jsf?conversationId=601&SSOTOKEN=0

Purchased Items:

- Garmin Company: Global Positioning System was purchased by Mission:Haiti (Fort Lauderdale, Florida)

The following items were purchased by Epiphany Lutheran Church (Lake Worth, Florida):

- Hach Company:
 - Hach Pathoscreen Test Kit <http://www.hach.com/pathoscreen-field-test-kit/product?id=7640249603&callback=qs>
 - Nitrate/Nitrite Test Strips <http://www.hach.com/nitrate-and-nitrite-test-strips/product?id=7640211606&callback=qs>
 - Chlorides Test Strips <http://www.hach.com/chloride-quantab-test-strips-30-600-mg-l/product?id=7640211602&callback=qs>

Table 1. Well Locations and Water Quality Characteristics
Aimond Alexis, Rick Miessau, and Steve Krupa
Port Au Prince, Haiti
February 17, 2011, to February 23, 2011

Haitian Well Name	Sample Number	Date	Time	Nick Name/ American Site Name	Public or Private Well	Longitude from GPS	Latitude from GPS	Known or Measured Well Depth (meters)	Depth to Water (meters)	Specific Conductivity (µS/cm)	Temperature °C	IDEXX Total Coli form/ <i>E.coli</i> Test Kit Results	Hach Test Kit Pathogen
Rio Well	1	2/17/2011	11:15	Rio's Cheri House	Private	-72.26004	18.53263	8.7	6.7	835	26.8	Light Brown Total Positive (Under UV Highly Fluorescents)	Positive (Black)
Savane Blonde1	2	2/17/2011	16:00	Public Well Near Mondy House	Public	-72.22979	18.59760	Wellhead Pump	Wellhead Pump	584	27.5	Light Brown Total Positive	Not Taken
Mondy2	3	2/17/2011	16:30	Aimon's Alexis Shallow Well	Private	-72.22952	18.59752	23.85	12.13	597	28.3	Light Brown Total Positive	Not Taken
Verrettes School	4	2/18/2011	13:15	Good Samaritan School	Public	-72.46207	19.07102	11.8	4.93	785	27.4	Light Brown Total Positive	Not Taken
Baptist Mission House	5	2/18/2011	8:15	Baptist Guest House in Verrettes	Public Water Supply (Faucet)	-72.46420	19.05499	N/A	N/A	594	N/A	Positive Total Positive (Under UV Moderate)	Not Taken
Faith Lutheran Church	6	2/18/2011	13:15	Pastor Benoit's Church	Private	-72.67771	19.44297	6.96	1.94	897	28.7	Positive Total Positive (Under UV Slight)	Light Brown
Eglise Presbyterienne LA Trinite	7	2/18/2011	14:10	Trinity Presbyterian Church	Private	-72.66629	19.46843	10.58	Didn't collect because	1731	29.7	Clear Total Positive (?)	Not Taken

Haitian Well Name	Sample Number	Date	Time	Nick Name/ American Site Name	Public or Private Well	Longitude from GPS	Latitude from GPS	Known or Measured Well Depth (meters)	Depth to Water (meters)	Specific Conductivity ($\mu\text{S}/\text{cm}$)	Temperature $^{\circ}\text{C}$	IDEXX Total Coli form/ <i>E.coli</i> Test Kit Results	Hach Test Kit Pathogen
									of pipes			Not Completely Colorless	
Lutheran Church Guest House	8	2/19/2011	7:40	Lutheran Guest House in Gonaives	Private	-72.66698	19.45865	13.55	1.37	1024	27.8	Light Brown Total Positive	Not Taken
Star Orphanage	9	2/19/2011	10:00	Lutheran Church Orphanage	Private	-72.67657	19.43865	4.14	0.81	1138	30.1	Pale Yellow Total Positive (Under UV Slight)	Not Taken
Well Outside Star Orphanage	10	2/19/2011	11:25	Well Outside Star Orphanage	Public	-72.66629	19.464843	9.2	4.42	1760.5	27.3	Light Yellow Total Positive (Under UV Slight, flocculated, white sheety stuff)	Not Taken
New Life Orphanage	11	2/20/2011	15:00	Miriam's Orphanage	Private	-72.28992	18.58389	20.89	4.76	998	31.1	Light Brown Total Positive	Not Taken
New Life Orphanage Fish Pond	11A	2/20/2011	15:00	Miriam's Orphanage	Private	-72.28992	18.58389	N/A	N/A	1028	27	Light Brown Total Positive	Not Taken
Irvine Alexis House	12	2/20/2011	15:00	House	Public Water Supply (Faucet)	-72.26110	18.57056	Port-au-Prince City Water	Port-au-Prince City Water	624	26.1	Colorless	Not Taken
Pastor Wilson Church Well	13	2/21/2011	14:15	Well in Front of Church	Public	-72.6279	18.45584	7.45	5.40	1173	27.6	Light Brown Total Positive	Not Taken
Pastor Wilson Orphanage	14	2/21/2011	14:50	Lutheran Orphanage	Private	-72.63091	18.45024	8.88	6.06	584	27.8	Light Brown Total Positive	Not Taken

Haitian Well Name	Sample Number	Date	Time	Nick Name/ American Site Name	Public or Private Well	Longitude from GPS	Latitude from GPS	Known or Measured Well Depth (meters)	Depth to Water (meters)	Specific Conductivity (µS/cm)	Temperature °C	IDEXX Total Coli form/ <i>E.coli</i> Test Kit Results	Hach Test Kit Pathogen
Well Near Old Field Medical Camp	15	2/21/2011	15:25	Near Old Camp	Public	-72.62891	18.45161	Wellhead Pump	Wellhead Pump	650	28.2	Colorless	Not Taken
English Well	16	2/21/2011	15:35	Well at Intersection near Church	Public	-72.62873	18.45569	Wellhead Pump	Wellhead Pump	858	28.1	Colorless	Not Taken
Four Sisters Well	17	2/2/2011	15:50	Well Near Corner (Gave maps to Pastor Wilson)	Public	-72.62388	-18.45864	Wellhead Pump	Wellhead Pump	757	27.5	Colorless	Not Taken
Vincent Bridge Bladder	18	2/21/2011	16:35	International Red Cross	Public	-72.63178	18.50177	Water Bladder	Water Bladder	521	27.7	Pale Yellow Total Positive	Not Taken
Well Near Taciana Hotel	19	2/21/2011	17:50	Boston Girl	Public	-72.52017	18.51462	Wellhead Pump	Wellhead Pump	466.4	26.9	Colorless	Not Taken

○ IDEXX Test Kit http://www.idexx.com/view/xhtml/en_us/water/colilert.jsf

○ Hach Pathoscreen Test Kit

<http://www.hach.com/hc/search.product.details.invoker/PackagingCode=2859100/NewLinkLabel=PathoScreen+Field+Kit/SESSIONID%7CCE56ZzBNRFUxTIRNbVozVmxjM1JXVWtoSVVnPT1CVEV5T1RnMg==%7C>

N/A = Not Measured or Taken

Wellhead Pump = Means there was a pump on the well; well depths and water levels could not be obtained



Figure 1. Generalized site map of groundwater samples collected between February 17 and 24, 2011 in Haiti.



Figure 2. Visual comparison of IDEXX water quality samples collected in Haiti. Samples taken February 17, 2011 to February 23, 2011. Sample numbers correspond to Table 1 identifiers.



Figure 3. Close-up of samples 1 (left most sample), 2, 3 and partially of sample 4 showing the visual results. Sample 1 was the most contaminated sample from the entire investigation. The black vial represents Hach Pathoscreen with positive results for Sample 1.

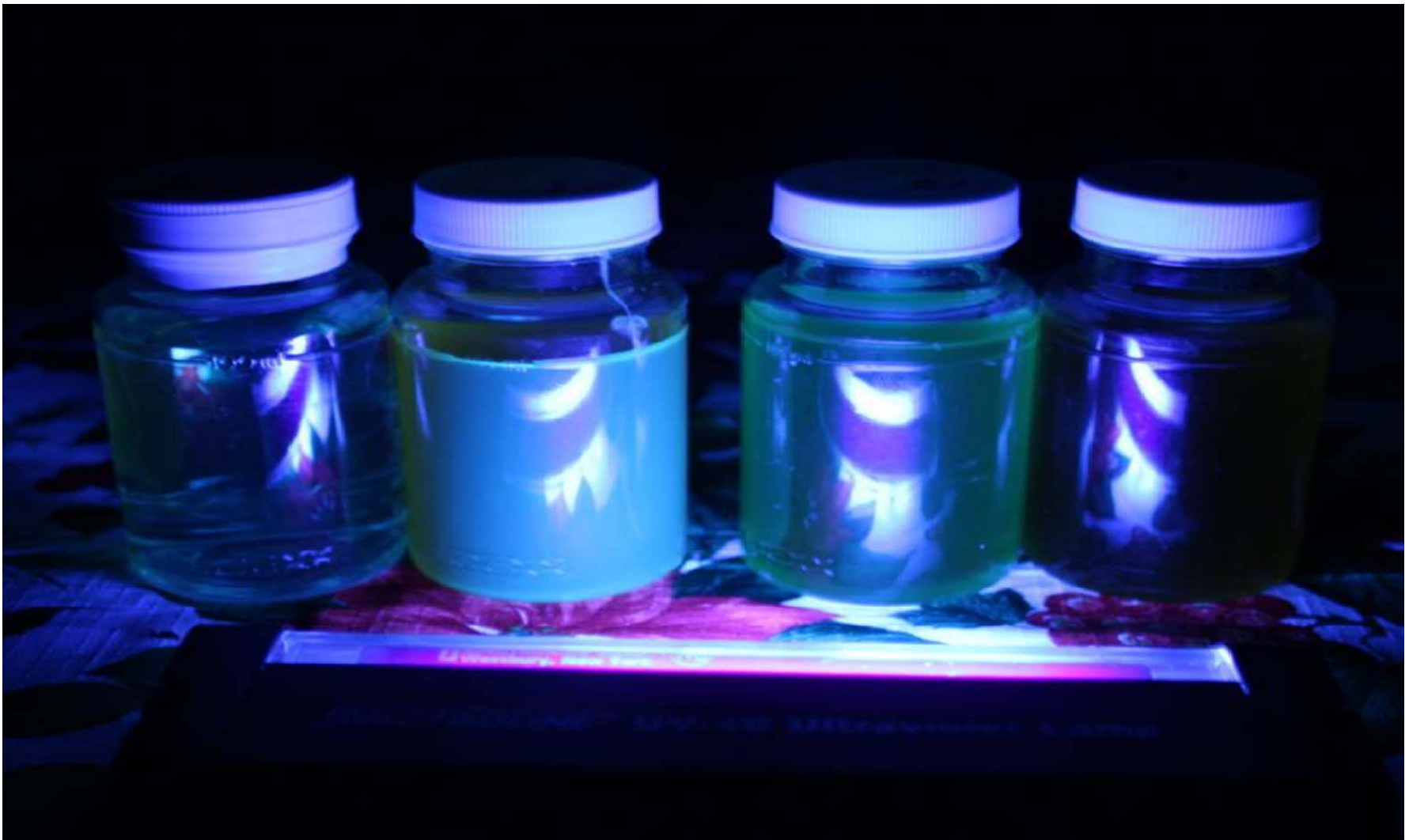


Figure 3. Close up of selected IDEXX Colilert results under ultraviolet light. Left bottle is the control; 2nd in from left is Sample 1 (Note Fluorescence Indicating Contamination), 3rd from left is Sample 2 starting to show contamination, 4th sample from left is too dark to judge results.