



**COLLEGE:**

Loma Linda University School of Public Health

**PROJECT TITLE:**

Characterization of microbial contamination in water vending machines of Eastern Coachella Valley.

**FACULTY PROJECT MANAGER:**

Ryan G. Sinclair PhD, MPH

**GRADUATE STUDENT PROJECT MANAGERS:**

Thomas Hile

**PHOTO / ILLUSTRATION:**



**PROJECT STRAND:**

LOCAL: A communications strategy project in the Coachella Valley of Riverside County.

## **SUMMARY**

The stigma of contaminated tap water motivates many to purchase bottled or vending machine drinking water when they don't have to. Many of the Coachella Valley Water District's (CVWD) customers purchase vending machine drinking water as an alternative to their home's tap water. This population lives in homes around the communities of Coachella City, Mecca, Thermal, North Shore and Oasis. Water-District connected residents are concerned about the quality of their tap water because they hear about their *unconnected* neighbors in rural mobile home who have to buy drinking water because of their naturally occurring arsenic in their well-water. This is problematic because water stores and/or vending machines are not a consistent source of clean quality drinking water. Our team's recent home assessment shows high levels of bacteria in vending machine-sourced water. Other studies have confirmed that drinking water vending machines can be contaminated. Our study will compare the microbial concentrations of water from vending machines, home stored water, and tap water within the CVWD pipes. We will determine the type of water contamination in homes and pair them to their self-reported drinking water source.

**CONTACT INFORMATION**

College	Loma Linda University
Department	Center for Community Resiliency
Make Check Payable To:	Loma Linda University School of Public Health

**3. A.**

Application Strand	
<b>LOCAL</b>	A communications strategy project in the Coachella Valley of Riverside County.

**3. B.**

PI -Faculty Project Manager	Ryan Sinclair	
Title	Assistant Professor	
Department	Center for Community Resiliency	
Campus Address	24951 N. Circle Drive, Loma Linda, CA, 92354	
Telephone / Email Address	9095584000	rsinclair@llu.edu

**3. C.**

Student Project Manager	Thomas Hile	
Graduate	PhD (c)	
Department	Earth and Biological Sciences	
Cell Phone / Email Address	9096460433	wahilefils@gmail.com

**3. D.**

Contracts Manager / Officer	Aleta Savage	
Title	Director of Financial Management	
Department	Research Affairs	
Campus Address	24887 Taylor St. Suite 202	
Telephone / Email Address	909-558-4589	rafm@llu.edu

**3. E. PROJECT MANAGEMENT TEAM**

NAME	TITLE / ORGANIZATION	ADDRESS	PHONE & EMAIL
Dr. Ryan Sinclair	Project consultant in water quality, MWD experience/ LLU SPH	24951 N. Circle Drive, Loma Linda, CA, 92354	909.558.4000 x85633 rsinclair@llu.edu
Dr. Stephen Dunbar	Project consultant in environmental conservation/LLU	11234 Anderson St, Loma Linda, CA, 92354	Ph: (909) 558-1000, 48903 Fax: (909) 558-0259 E-mail: <a href="mailto:sdunbar@llu.edu">sdunbar@llu.edu</a>
Thomas D. Hile PhD(C)	Student Co-Lead/ LLU EBS	24585 Canada street Loma Linda, CA, 92354	9096460433 WAHILEFILS@GMAIL.COM
Elvin M. Walemba PhD(C)	Student Co-Lead/ LLU EBS	11065 Campus Street Loma Linda, CA 92350	Tel: +1-909-499-5205 (W) Email: <a href="mailto:ewalemba@llu.edu">ewalemba@llu.edu</a>
Joanne Rodrigue	Student in SPH		<a href="mailto:jrodrigue@llu.edu">jrodrigue@llu.edu</a>
Catherine Martinez	Student in SPH		<a href="mailto:cemartinez@llu.edu">cemartinez@llu.edu</a>

**3. E. MEMBER AGENCY/ LOCAL WATER AGENCY**

NAME	TITLE / ORGANIZATION	ADDRESS	PHONE & EMAIL
Patty Reyes	Coachella Valley water district Water District	Coachella Valley Water District PO BOX 1058   COACHELLA, CA 92236	(760) 398-2651 <a href="mailto:preyes@cvwd.org">preyes@cvwd.org</a>

#### **4. ORGANIZATIONAL BACKGROUND**

##### **Eastern Coachella valley**

The Eastern Coachella Valley is located in the Riverside County of Southern California and is made up of several rural and unincorporated communities. These communities include Thermal, Oasis, Mecca, and North Shore (BHC, 2013). Many of the residents of the Eastern Coachella Valley's roughly 125 unpermitted mobile home parks struggle to make a 720 square feet of deteriorating metal and plywood a safe and habitable home (Leigh P., 2014).

##### **Loma Linda University**

Loma Linda University had its beginning in 1905 with the Loma Linda Sanitarium (R&H, 1906). Loma Linda University (LLU), is a nationally-known health sciences institution with over 3,000 students, situated in one of the fastest growing areas in the US. The University is affiliated with the Loma Linda University Medical Center (LLUMC). The LLUMC operates some of the largest clinical programs in the U.S. in areas such as neonatal care, and is recognized as the international leader in infant heart transplantation and proton treatments for cancer. LLU has Schools of Medicine, Dentistry, Public Health, Nursing, Pharmacy, Allied Health Professions, Religion and a School of Behavioral Health.

##### **School of Public Health**

The LLU School of Public Health has been in existence since 1967, and currently offers master's level degrees in biostatistics, epidemiology, environmental health, global health, health policy and leadership, nutrition, preventive care, public health practice, and business administration. Facility LLU will provide the overall support structure for the proposed training and communication activities, including the computer infrastructure, office space and administrative support. LLU is one hour from the project area and offers an optimal place for project preparation and planning. Facilities include computer labs, a water and wastewater microbiology laboratory and student computer workrooms to accommodate individual projects.

##### **Department of Earth and Biological Sciences (EBS)**

The Department of Earth and Biological Sciences in the School of medicine offers

Undergraduate degrees in Environmental Sciences and in Geology. Graduate degrees include a MS and a PhD in Biology, a MS in Geology, and a PhD in Earth Sciences and a non-Thesis master's degree in Natural sciences. The research interests of the Biology program faculty and students include: wildlife biology, ecology and conservation biology, ecological physiology, and venom expenditure, marine invertebrates, Behavioral Ecology, Herpetology, Marine Biology, Biosystematics, ornithology, and sea turtle biology.

## 5. CERTIFICATE OF PARTICIPATION



## 6. PROJECT DESCRIPTION

### INTRODUCTION – WATER RELATED ISSUE

This project addresses the public's perception of drinking water quality from the tap in their homes. Many public believe they should drink bottled water or water they filled from a vending machine. This represents an unneeded expenditure for many disadvantaged communities and wastes resources/energy from the water district. Tap water is stigmatized among the public due to rumors of harmful arsenic in the drinking water. This is true for many of the rural residents who live in mobile homes that are supplied with contaminated and untreated well water. ("Safe Drinking Water Evades the Poor" 2015). Many other homes in the Eastern Coachella Valley are supplied with tap water treated by the Coachella Valley Water District. These households do not have microbial and arsenic contamination, but many fear that they do. A recent survey of the area during an IRWM evaluation found that many households rely on vending machines (Sinclair, Ryan 2015).

The microbial quality of water vending machines is reported as poor quality in various studies. One Arizona study confirmed the scarcity of studies that evaluate the microbes coming from those vending machines and dispensers (Chaidez et al. 1999); they identify coliform bacteria in 20% pseudomonas aeruginosa in 23% and 73% of heterotrophic plate count all from 30 water vending machines. This situation is likely true of water vending machines in the Coachella Valley; while, the local water district likely provides a much higher quality drinking water.

The Coachella valley water district (CVWD), provides drinking water to nearly 108,000 homes and businesses, from wells drilled into a natural groundwater basin. The CVWD is a contemporary water district committed to providing high quality drinking water that is monitored multiple times per month throughout the distribution system. The CVWD annual water quality report that documents that the water served to all CVWD users meets state and federal drinking water quality standards (CVWD 2015). An assessment of drinking water quality from vending machines, tap water and water stores will help the public become aware of potential health risks and options for drinking water.

### **THE FINANCIAL PROBLEM**

The vended water market tripled over the past 10 years with much of the USA population drinking bottled water or vending machine water. Many Americans exclusively drink bottled water despite it being thousands of times more expensive than tap water. The social norms in regard to bottled water was built over time and now the industry annual revenue is estimated to be greater \$15 billion for the bottle water industry (Linden 2015). We are not aware of the annual revenue of water vending machines and water stores, but we realize that the same social reasons for drinking exist as for bottled water. We also realize that vending machine water can represents a large amount of time and a large percentage of a family's monthly budget.

### ***Contamination during collection and storage***

There is a growing awareness that drinking-water can become contaminated following its collection from the sources and also during storage. Increasing contamination during water collection, from the source to home storage, was found in all the studied

households using 4 different types of drinking water (Han et al. 1989). A later study proposed the need to extend protection to the point of use after a study on fecal contamination of drinking water during collection and household storage (Clasen and Bastable 2003).

### ***Chlorine residual and PH***

By measuring the chlorine residual, we will be able to determine if the water is properly treated in the home's premise plumbing and within the vending machine. When chlorine is dosed correctly, it leaves a disinfectant residual which helps to prevent recontamination in the distribution system and the home plumbing infrastructure. When chlorine cannot be detected, in distribution system, this may indicate that contamination has entered the system or that chlorine dosing is incorrect (WHO 2011).

### **LOCAL FOCUS AND GLOBAL PROBLEM**

The Global lack of access to quality drinking water exists locally in the Eastern Coachella Valley of Riverside County. For many residents, this is because their well water is contaminated with bacteria and arsenic. Other residents of the ECV are connected to the CVWD treated water line, but also believe that their water is contaminated. This belief and public awareness of the treated water is the local problem that we are addressing.

### ***Water as a human right***

Water is considered to be the most important resource for sustaining ecosystems, which provide life-supporting services for people, animal and plants (Gleick 1998). On 28 July 2010, through Resolution 64/292, the United Nations General Assembly explicitly recognized the human right to water and sanitation and acknowledged that clean drinking water and sanitation are essential to the realization of all human rights (UN 2015).

### ***Family financial burden***

Using drinking water that is piped to households will reduce the water expense and allow money to be used for other expenses. Secondly, the gasoline cost used for weekly travel to the vending machine will be saved.

### ***Public health improvement***

Moving water from the tap, into an infrequently monitored water filter increase the risk of contamination. Inadequate drinking water supply and quality and poor sanitation are among



the world's major causes of preventable morbidity and mortality. According to the World Health Organization, estimates, basic hygiene related diseases have a significant impact on human health. Diarrheal disease alone causes 2.2 million of the 3.4 million water-related deaths per year (WHO, 2014).

## **CONTENT STRAND**

### ***Communication as a Content Strand***

The goal of this project is to inform and educate the population of the ECV about the safety of tap water. We address the communication issue from the microbial assessment of various sources of drinking water in the region. This will tackle the safety of water from vending machines in the community, the contamination related to water transportation as well as an evaluation of tap water from CVWD. By evaluating the quality of drinking water from vending machines in comparison to tap water from CVWD, we will be able to educate the population on drinking water safety and how to manage their water. Local *promotora*, will be the means for our team to access the community through workshops hosted with regional community based organizations such as Pueblo Unido Community Development Cooperation. We will host community workshops with the *promotora* and PUCDC relay the results of our study and how it applies to available water sources.

## **DATA COLLECTION AND RESEARCH**

This project works through another project currently underway; an environmental justice project run through the California Endowment's Building Healthy Communities in Coachella Valley and LLU. This current project has collected health and survey data from over 600 households in the ECV region with a series of questions on drinking water sources. Individual households who state that they have CVWD tap water and use water vending machines or water stores will be visited. Considering this, we will collect water from 3 types of sources in the ECV:

1. Homes selected in the BHC study who have existing LLU IRB approval have previously agreed to provide environmental samples.
2. Nearby water vending machines that they report to visit
3. Tap water from accessible and representative CVWD sampling sites

Our team will collect samples from each source one time during this study. A Quality Assurance Plan Protocol will be developed for the sampling and laboratory portion of this study and will detail sample controls, sampling procedure, transport procedure and laboratory methods.

### ***Research***

The LLU Environmental Microbiology Research Laboratory will be used to process the water sample assays for *E.coli*, Coliform, Heterotrophic Plate Count, *Pseudomonas* and Adenovirus. We will use culture based methods for the E.coli, Coliform and HPC. We will use qPCR for the *Pseudomonas aeruginosa* and adenovirus.

### **ANTICIPATED OUTCOME**

Goal: To improve the quality of life of the population by reducing their drinking water expenditure and protecting their health.

#### ***Short-Term outcome objectives***

- Training promotoras on the results of our water quality evaluation and on how to communicate the findings to the selected households.
- 50% of the stakeholders will be able to effectively convey information to their representative population.

#### ***5. b. long term change***

- Community members will use tap water instead of vending machine water.
- A lowered risk of infection by enteric diseases and other illnesses from contaminated water.

### **PROJECTION BENEFITS**

This project focuses on water conservation, hygiene, and public health education to 50 residents of the ECV. This will be later expanded to the CVWD water district's customer base.

This project will be beneficial to:

- The population of ECV

The population of Coachella valley will be informed about the quality of drinking water from the water vending machine, tap water and water sampled from their homes. They will be informed of the safety of the tap water and the effort provided by the government about the public health safety. They will also be educated about water conservation and how why to keep water

containers and dispenser filters clean.

- Law makers and water regulation agencies

This study will serve as a guideline to policy makers, planners and regulators. The study can also be used by the USEPA office of water and other federal government agencies. It will allow appropriate measures to be taken for the public health of disadvantaged populations.

## **TEAM EXPERIENCE AND TECHNICAL CAPABILITIES**

### ***Experience***

- Thomas: Medical Parasitology
- Elvin Walemba : Medical Microbiology
- Catherine Martinez: Public Health Epidemiology
- Joanne Rodrigue: Public Health Epidemiology

### ***Roles and responsibilities***

#### **Student team:**

- Sampling strategy and study design
- Marketing and interaction with water district and community
- Laboratory expertise and public health impact

#### **Faculty team:**

- Dr. Ryan Sinclair – Environmental Microbiology laboratory assessment lead and community relations catalyst.
- Dr. Stephen Dunbar- Laboratory methodology consultant.

**MILESTONES, DELIVERABLES and MEASURABLE OUTCOMES**

<b>Milestone</b>	<b>Deliverable</b>	<b>Measurable Outcome</b>
Ground truthing of drinking water sources to be sampled in ECV	A map that details locations of water stores, vending machines and other “public” POU’s	A list of water vending machines with pictures
Control household sample locations in ECV	Mapping of household in correlation to visited vending machines or water store	A list of households to compare with vending machines
Sampling strategy	Flow chart template describing the different steps that will be undertaken	Detail steps of the sampling strategy
laboratory consumables ordered	all laboratory consumables will be ordered online and kept secured in the laboratory, ready to be used	all the necessary laboratory consumables including office consumables bought and stock in the laboratory, ready to be used
evaluation and control	calibration of instruments used along with reagent	all measurable instruments tested to determine the accuracy and validity of instruments and reagents
data collection in the research area	collection of water samples in households and water vending machines	data collected and transported to the laboratory for analysis
Laboratory analysis	Molecular and cultivable lab methods testing and preparation.	An evaluation of the molecular primers and cultivable methods will be tested and calibrated of accuracy during the study
Data interpretation	computerized data analyzed and interpreted using SPSS software	data will be analyzed and interpreted toward recommendation
Community workshop and report to Coachella valley water district	recommendation and community training	The results will be reported to the community and procedural methods will be given to prevent water contamination
Final report	final document sent to MWD	document containing data analysis and recommendation send to MWD
Publication		Published paper

**QUANTITATIVE BENEFIT PROJECTIONS:**


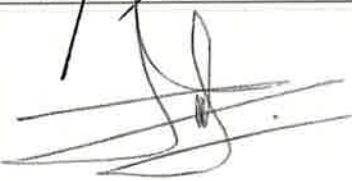
This project intends to inform 100 households on public health education. We will select and train 20 promotora who will visit homes, report the results of the research and educate the people about the study findings.

**FINANCIAL CRITERIA**

**BUDGET OVERVIEW**

DESCRIPTION	AMOUNT	NOTES
GRANT FUNDS REQUESTED	9,882	N/A
ADDITIONAL SOURCE OF FUNDS	3,300	Institutional Costs
PROJECT TOTAL	13,182	Total direct and institutional costs

**SIGNATURE BLOCK**

	NAME / TITLE	SIGNATURE	DATE
FACULTY PROJECT MANAGER	Ryan Sinclair		12/21/2015
STUDENT PROJECT MANAGER	Thomas Hile		12/21/2015

**BUDGET BREAKDOWN:**

<b>Direct Costs</b>	<b>COMPUTATION</b>					
<b>BUDGET ITEM DESCRIPTION</b>	<b>Price/ Rate</b>	<b>Unit</b>	<b>Qty</b>	<b>MWD/ WWF</b>	<b>LLU Match</b>	<b>Total Costs</b>
<b>SALARIES AND WAGES</b>						
To support student time in lab, field and for work in laboratory.	\$14.0	per hour	195	\$2,727	-	\$2,727
<b>SUPPLIES / MATERIALS</b>						
\$4000 is requested to purchase lab supplies and other consumables and LLU will match up to \$1,000 worth of glassware and lab consumables.				\$4,000	\$1,000	\$5,000
\$1,500 is matched from LLU's qPCR use fee.					\$1,500	\$1,500
<b>LOCAL TRAVEL</b>						
\$1,456 is requested for 20 round trips to the Eastern Coachella Valley using a privately owned vehicle and the LLU mileage reimbursement calculation.	\$0.45	Per mile	3236 miles	\$1,456	-	\$1,456
<b>PUBLICATIONS</b>						
\$300 is requested to publish in an open access journal and \$300 of this will be matched from one of the PI's research funds.				\$300	\$300	\$600
<b>CONFERENCE PRESENTATION</b>						
\$500 for conference registration of students to present results at the 2017 IWA Health-Related Water Microbiology conference.				\$500	\$500	\$1,000
<b>Subtotal</b>				\$ 8,984		
<b>INDIRECT COSTS</b>						
A 10% overhead fee applied to Modified Total Direct Costs.				\$898	-	\$898
<b>TOTAL</b>				<b>\$ 9,882</b>	<b>\$3,300</b>	<b>\$13,182</b>

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