Tarahumara Children's Hospital Fund (TCHF)

Water Supply Survey Project

October 2015

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INTRODUCTION

The Tarahumara Children's Hospital Fund (TCHF) consists of four separate groups working together to support the Jesuit Tarahumara Mission in the Copper Canyon of Mexico. These groups are located in Detroit MI, New Orleans, LA and Milwaukie (Portland), OR. The Mission headquarters is in Creel, Chihuahua, Mexico, with Fr. Miguel Quintanilla, S.J. serving as Director since March of 2015.

The TCHF was first established in Detroit in 1966 as an independent, non-profit, tax deductible organization. Since that time, chapters have been created in Louisiana in 1983 and Oregon in 1998. Our purpose is to raise money and awareness in the United States to support vital services provided to the Tarahumara Indians in the Copper Canyon region of Mexico. The 60,000 Tarahumara Indians who live in the Sierra Mountains maintain lifestyles much like their ancient ancestors. Many still live in caves, without electricity or running water. Their dire poverty results in malnutrition, parasites, and many intestinal diseases, which still claim 25-40% of their children before their fifth birthday. The Mission Tarahumara, headed by a compassionate Jesuit priest, provides a range of services to the Tarahumara people. First, a medical clinic was created. Today, it has 75 beds, 2/3 for children. The mission is also responsible for digging water wells which provide safe drinking water for many people. A boarding school has been developed which teaches Indian children about their own culture, the Spanish language, and teaches them skills to make a living as farmers, craftsmen, and teachers of their people. In recent years, outdated and obsolescent oxygen and X-Ray equipment has been replaced as well as heavily used ambulances and rehabilitative playground equipment.

All of these projects are funded through the generous help of patrons from around the country and the world. The Tarahumara people do not have the means to pay for these services themselves. The Mission must rely on the support of foundations and individuals who recognize the importance of both preserving a cultural heritage and ensuring the healthy future of a tribal community. Fr. Miguel Quintanilla, S.J., the new Mission Director, continues the belief in "helping people help themselves". The Mission does not just provide charity today. It trains and uplifts the Indian people so that they can provide for themselves tomorrow.

John Brockamp, President, Tarahumara Children's Hospital Fund of Oregon (Brockamp, John, 2015)

TARAHUMARA CHILDREN'S HOSPITAL FUND (TCHF) WATER SUPPLY SURVEY

EXECUTIVE SUMMARY

Problem statement

A lack of evidence exists for TCHF members to achieve optimal management of limited water resources in served and potential expansion to unserved communities. The criteria establishing evidence includes the following water source measurements:

- accessibility
- sustainability (reliability or seasonal effects)
- quality
- quantity

Anticipated benefits and/or information expected from the project

This project will establish an electronic database of all known 'improved' Tarahumara utilized drinking water sources and a statistically relevant sampling of 'un-improved' sources. Improved sources include wells, protected springs and rainwater collection system. Specific data will be generated during this project for each source. That data will include chemical testing, yield and reliability information, all of which is needed in order to assess the safety and sustainability of each source and the general effectiveness of each type of source. Complejo Asistencial Clinical Santa Teresita A.C. (CASCTAC) staff will be enabled with electronic tools needed to manage these sources and plan for the effective utilization of TCHF/CASCTAC's limited financial resources to repair, replace and/or add to the appropriate sources.

Nature, Scope and Objectives of the Proposed Project

Brief introduction on the nature of the problem(s) to be addressed

In 1964, the mortality rate for Tarahumara children under five years of age was 75%. With the benefits of health care and cleaner water supplies, especially from reliable well water sources primarily offered in the area surrounding Creel, Mexico, the morality rate has been significantly reduced to around 20%. However, that mortality rate and the morbidity rate for the Tarahumara in the Creel area are still very significant and many times higher than one would ever find acceptable in a developed country. In addition, the aforementioned health care and cleaner water supplies are estimated to be only servicing approximately 20% of the over 60,000 Tarahumara population that live in some of the most difficult, rugged and poor areas of Mexico (Fr Pedro de Valesco Rivero, 2012). Over 45,000 Tarahumara resort to untreated surface water for their drinking, cooking and sanitation uses, which are commonly the same unprotected sources that are shared with their livestock and other animals and creatures.

Justification of the proposed work

It has been well documented that safe drinking water supplies alone will significantly reduce health care needs and costs and will markedly reduce the mortality rate of children under the age of five. 'Clean' water may appear to be safe and may be of better quality than untreated surface water; however, it still may not always be safe. Safe water must be free of harmful pathogens and also not contain any harmful compound above limits established by the World Health Organization (WHO). (Organization, 2011) Only chemical testing can establish the safety of drinking water.

The Tarahumara Children's Hospital Fund (TCHF), a 501(c)(3), was created in the United States for the benefit of CACSTAC. TCHF/CACSTAC specific goals related to this project include (Fr Pedro de Valesco Rivero, 2012):

- "To review and study the role and performance of CASCTAC in the recent past, evaluating the effectiveness and meaningfulness of our services."
- "To improve our methods of detecting, accompanying and evaluating people's needs and urgencies, and for assessing their demands for assistance."
- "To introduce new electronic systems, programs and devices, and then train our staff in order to improve administrative procedures, making them faster and more accessible both at the hospital and the main office. Improving the flow of information and documentation through modernized systems."
- "To refurbish our well drilling equipment and older service vehicles."
- "To keep and renew the existing agreements that we have with foundations, government agencies and civic groups for the collaboration and support of our projects."

Importance of the Proposed Project

This project will establish an electronic database of all known 'improved' Tarahumara utilized drinking water sources and a statistically relevant sampling of 'un-improved' sources. Improved sources include wells, protected springs and rainwater collection systems. Specific data will be generated during this project for each source. The data will include chemical testing, yield and reliability information, and identifiable construction details. All of this information is needed in order to assess the safety and sustainability of each source and the general effectiveness of each type of source. CASCTAC's staff will thereby be enabled with a management tool, and training during the data collection, to manage these sources and plan for the effective utilization of TCHF/CASCTAC's limited financial resources to repair, replace and/or add to the appropriate sources.

Objectives for future TCHF Mission action, improvement and sustainability recommendations for groundwater:

1. Describe each water source in terms of:
    a. accessibility
    b. sustainability (reliability or seasonal effects)
    c. quality
    d. quantity
2. Compare and evaluate quality of water sources
3. Describe and contrast point of use potability issues

Scope of work

The TCHF Mission water supply survey sites shall include Clinica Santa Teresita Mission reported Tarahumara Indian Mission water sources located in and around Creel, Mexico:

- 53 original producing (groundwater) wells
- 103 rainwater collection systems
- 16 spring water supply sources
- 14 wells not drilled by TCHF Mission
- Statistically relevant evaluations of surface water sources accessed by the Tarahumara population

Methods and procedures for quantitative analysis and comparison water supply study

Groups of two to three volunteers (trained in data collection process) will collect the following data and perform the water quality tests over a period of several weeks during winter of 2015/2016 (dry season) and summer 2016 (wet season).

DATA TO BE COLLECTED (Table 4)

- GPS of source
- Photo(s) of source
- Source type
- Year source constructed
- Source operating yes or no; if no, why
- Entity / individual tasked with maintenance
- Flow rate
- Pump performance
- Water level and pumping level if source is well
- Year-round reliability (interview and person interviewed)

WATER QUALITY TESTS (Table 4)

- Coliform at source
- Coliform at point of use
- E-coli (including a count) at source if two samples fail coliform
- E-coli (including a count) at point of use if two samples fail coliform
- TDS
- Arsenic
- Fluoride
- Iron / Manganese
- Nitrate
- Turbidity
- Odor
- pH

Data Analysis

A statistical analysis will be conducted on the data elements collected and water quality test results. The analysis provides evidence through comparison and contrast of Tarahumara water supply sources. Elements of the statistical analysis can be found in Appendix A (see sheets named: 'Field Data Sheet', 'tests & data').

Output

Research reports, digital publications, surveys, electronic databases will be made available to THCF board, CASTAC staff, plus other in-kind supporters of the project. CASCTAC's staff will be able to use the data as needed to manage water sources and plan for the effective utilization of TCHF/CASCTAC's limited financial resources to repair, replace and/or add to the appropriate sources.

Schedule

Timeline, including key research project milestones and estimated completion date are outlined in Table 1.

Table 1

STAGES OF PROJECT	STAGE COMPLETION DATE
Proposal Development, Volunteer Recruitment and Funding Completion	September 2015
Pre-Training of Volunteer	October/November 2015
Wet Season Data Collection	November 2015— March 2016
Dry Season Data Collection	July 2016— August 2016
Report Out on Entire Project	1st Quarter 2017

Investigator's Qualifications

Steve Schneider, MGWC, Lead Investigator— (Steve) manages the drilling division at Schneider Water Services of St. Paul, OR, USA a contracting business employing approximately 25 people in water related activities including: drilling, pumps & water systems installations, water treatment and service. With a BS degree in mechanical engineering from Oregon State University, Steve worked for the US Department of Defense as a civilian engineer, which included writing/editing many technical specifications. He has drilling licenses in the states of Oregon, Washington and Idaho and pump installer licenses in Oregon and Washington. He is a National Ground Water Association (NGWA) Master Ground Water Contractor (MGWC). Steve has presented educational seminars and workshops via Webinars and in person at NGWA Expos, NGWA Groundwater Summits, Oregon Ground Water Association (OGWA) conventions, WEDC International Conference, and other events. He was the first non-government presenter of required continuing education related to well construction rules in Oregon. Steve has also served on State well construction rules and advisory committees, numerous National and State groundwater association committees including as officer/director, and is a current director and past-president of the National Ground Water Research and Educational Foundation. Steve continues to be active in NGWA's Developing Countries Interest Group and has made several trips to, and continues to work with, a mission in Mexico developing groundwater supplies for the indigenous Tarahumara Indians. He has also presented water supply well workshops in Africa.

Miriam Schneider, Co-investigator, MSN, RN—10 year nursing educator experience training acute care nurses, certified nursing assistants, and technicians with Providence Health & Services, participation in research based projects in the hospital setting; developed and delivered outcomes on Management of Difficult Behavior and Palliative Care hospital projects at national and local healthcare conferences and currently a parish nurse with Resurrection Catholic parish in Tualatin, Oregon. Curriculum Vitae available on request.

Ronnie Schneider – Co-investigator, BSAE, ME, MS—25 years engineering, analysis, and project management experience. Experience with statistical analysis, computer models, databases, and organization of data sets. Proficient at data-driven reporting.

Volunteer and Mission Staff Training

The volunteers are adult professionals (i.e., educators, nurses, contractors, environmental engineers, well drillers, lawyers, et. al.). Each will attend and successfully complete data collection and water quality test training prior to the initial site visit. Additional on-site training will be conducted upon arrival to Creel, Mexico. Each volunteer will be part of a team to complete water survey responsibilities. Training on water survey responsibilities includes overview of project, instruction on field data sheet completion for surface water and improved water sources, and instruction for completion of data sample collection of water sources.

Mission staff (assisting with this project) have been chosen by the Complejo Asistencial Clinical Santa Teresita A.C. (CASCTAC) director. The designated staff will be trained in Creel before and during initial data collection by the Lead and Co-Investigators.

The following tables provide the essential survey details for the volunteer sample collection training.

- Current number of water sources to be accessed, estimated number of people served and tests/measurements/records with the water source estimated quantity to be sampled (Tables 2 and 3).

Table 2

Water Sources	qty	# people served	total served
Functioning wells	53	60	3180
wells not drilled for TCHF	14	60	840
Springs	16	60	960
SUBTOTAL (GW Sources)	83		4980
Rainwater systems	103	15	1545
SUBTOTAL (improved sources	186		6525
Surface sources	300	150	45000
	486		51525

Table 3

	Estimated quantity to be sampled			
Tests/Measurements/Records	Wells (67)	Springs (16)	Rainwater (103)	Surface Water (>300)
SOURCE Identifyier (# or name)	all	all	all	statistical #
GPS	all	all	all	statistical #
photos	all	all	all	statistical #
e-coli	all	all	all	statistical #
coliform	all	all	all	statistical #
TDS	all	all	all	statistical #
pH	all	all	all	statistical #
hardness	all	all	all	statistical #
turbidity	all	all	all	statistical #
odor	all	all	all	statistical #
nitrate	all	all	all	statistical #
arsenic	all	all	all	statistical #
fluoride	all	all	all	statistical #
iron	all	all	all	statistical #
manganese	all	all	all	statistical #
temperature	all	all	all	statistical #
flow (gpm) or availability	all	all	all	statistical #
drawdown	all	n.a.	n.a	n.a.
SWL	all	n.a.	n.a	n.a.
pump description	all	doubtful	doubtful	doubtful
pump depth	as avail	n.a.	n.a	n.a.
pump drop pipe	as avail	n.a.	n.a	n.a.
pump rod size	as avail	n.a.	n.a	n.a.
casing size	as avail	n.a.	n.a	n.a.
pad dimensions	all	n.a.	n.a	n.a.
seal type	as avail	n.a.	n.a	n.a.
annular seal depth	as avail	n.a.	n.a	n.a.
liner size	as avail	n.a.	n.a	n.a.
liner depth	as avail	n.a.	n.a	n.a.
storage type	doubtful	all	all	n.a.
storage size	doubtful	all	all	n.a.
other field observations (e.g. pad condition, drainage, venting, leaks, livestock access, etc)				

- TCHF-Improved Water Source Field Data Sheet to be completed by the volunteer (Table 4).

Table 4

TCHF - WATER SOURCE FIELD DATA SHEET	
Water Source ID (#) & Measurement Number	&
Source Type (circle one)	Surface Improved
Water Type (circle one)	well spring rainwater
Source Identifier (name)	
GPS #1 (make & model of device)	
GPS #1 Coordinates	° ' " N ° ' " W
GPS #2 (make & model of device)	
GPS #2 Coordinates	° ' " N ° ' " W
Photos Taken: camera or phone identity & by	& by:
Water Samples Taken: date & dime & by	/ / & : am pm &
Bacteria Counts: E-coli & Coliform	# E-coli & # Coliform
Bacteria Counts Read: date & time & by	/ / & : am pm &
TDS (ppm)	
pH (0-14, preferred to one decimal point)	
Hardness (ppm)	
Turbidity (NTU)	
Odor Description	
Odor Described By: identify 2 or more individuals	&
Nitrate (ppm)*	
Arsenic (ppb)*	
Fluoride (ppm)*	
Iron (ppm)*	
Manganese (ppm)*	
Temperature	°F or °C
Flow Available (gallons per minute)	
Duration of Flow Test, if pumped (minutes)	
Well Static Water Level (meters)	
Well Pumping Level (meters)	
Well Pump Description (circle one) & Mfg/Model (N/A if none)	none hand solar electric (Mfg/Model:)
Well Pump Depth (meters)	
Well Pump Drop Pipe Type & Size (inches diameter)	Galv PVC SS other & inch diameter
Well Pump Rod Size (inches)	
Well Casing Size (inches)	
Well Pad Dimensions (length, width (feet) & height (inches)	none or: ' L x ' W x " H
Well Annular Seal Material (circle one)	cement bentonite none unknown
Well Annular Seal Depth (meters)	
Well Liner Size (inches)	
Well Liner Depth (meters)	
Cistern/Storage Type (circle one, or specify other)	poly concrete other:
Cistern/Storage Size (circle one & provide depth/height & length/width or radius, inches)	square round & " high/deep x " x "
Approximate Distance to End Users (feet)	
Method of Water Transfer to Home(s) (circle all that apply)	Piped Bucket Drum Burrow Women Children Men Unknown
Other field observations (e.g. pad condition, drainage, venting, leaks, security from animals, leaks, treatment beyond source, etc.)	

N/A if not a well

* Separate water sample to be taken to laboratory for testing

- Table 5 lists itemized costs with quantity, unit $ and total $ specified for the meter or instrument to be used. The meter or instrument method and the World Health Organization (WHO) mcl parameters are indicated for the volunteer completing the sample collection in the last two columns.

Table 5

Unit	Quantity	Unit $	Total $	Method	WHO mcl
N.A.	N.A.	N.A.		TBD	N.A.
each	1	$ 200.00	$ 200.00	per meter mfr	N.A.
each	2	provided		TBD	N.A.
box-50	50	$ 90.00	$ 4,500.00	per 3M	<1/100ml
incl	incl	incl		per 3M	no limit est. (0 in USA)
each	2	$ 20.00	$ 40.00	per mft	no limit established
50 /container	10	$ 18.00	$ 180.00	per mfr	no limit established
50 /container	incl w/pH	N.A.		per mfr	no limit established
each	1	$ 375.00	$ 375.00	per mfr	
individual	2	$ -	$ -	sniff by at least two people	N.A.
25 /container	20	$ 21.00	$ 420.00	per mfr	50 ppm (10 in USA)
100/kit	4	$ 162.00	$ 648.00	per mfr	.01 ppm (10ppb)
meter+reagant	1	$ 700.00	$ 700.00	per mfr	1.5 ppm
25/tube	20	$ 23.00	$ 460.00	per mfr	no limit established
24/pkg	20	$ 32.00	$ 640.00	per mfr	no limit established
incl	incl w/TDS	N.A.		per mfr	no limit established
each	2	provided		Volume (gals) / time (min)	N.A.
each	1	$ 1,000.00	$ 1,000.00	per mfr	N.A.
N.A.	incl w/DD	incl w/DD		per mfr	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
each	2	$ 20.00	$ 40.00	per mfr	N.A.
N.A./incl	N.A./incl	N.A./incl		read tape measure	N.A.
2	each	N.A.		read tape measure	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
N.A.	N.A.	N.A.		N.A.	N.A.
2	each	$ 15.00	$ 30.00	read tape measure	N.A.
2	each	$ 150.00	$ 300.00		
1	lump sum	$ 500.00	$ 500.00		
		TOTAL	$ 10,033.00		

- Table 6 provides additional comments for the meter or instrument to be used. (Schneider, 2015)

Table 6

Meter / Instrument	Comments
database	
handheld Garmin, Magellan or equal	Mission has 1; need at least one add'l
camera or phone w/camera	provided by Mission or volunteers
3M petrifilm *	each sample needs 3 petrifilm and each well sampled 3x/visit; non-wells 1x/visit
3M petrifilm	
dip meter (Mudder dual w/backlight or equal)	<600 ppm considered palatable
Hach test strip or equivalent	6.5-8.5 range is generally okay. Corrosion is concern.
Hach test strip or equivalent	>300 ppm may affect taste or indicator of other aesthetic/functional issues
Lutron turbidity meter or equivalent	<1 NTU if possible, otherwise <5 NTU. Aesthetic but also bacteria may adsorb
nose	
Hach test strip or equivalent	
Hach low range kit or equivalent	
Extech, Hanna or equivalent	
Hach test strip or equivalent	>.3 ppm stains clothes; may affect taste or indicator of other aesthetci/functional issues
SenSafe test strip or equivalent	>.1 ppm may affect taste or indicator of other aesthetic/functional issues
Mudder dual w/backlight	higher temperature is less palatable and enhances growth of organisms
bucket and phone w/stopwatch	
Powers or equiv./ Eno Scientific or equiv.	Mission has Powers or equal; need sonic meter
Powers or equiv./ Eno Scientific or equiv.	Mission has Powers or equal; need sonic meter
field observed & recorded data	
existing data as available	
existing data as available	
caliper	
existing data / field meas. (tape measure)	
tape measure	
existing data as available	
existing data as available	WSWGDC recommends minimum of 5 meters
existing data as available	
existing data as available	
existing data as available / field observation	
tape measure - calculated volume	
Incubator & DC adaptor	
Misc (sample bags, gloves, glasses, etc)	

- Project Budget (Table 7).

Table 7

TCHF Water Source Research Project - budget	Quantity	Unit	Amount	
RT airline tickets	20	$ 700.00	$ 14,000.00	
Mileage to/fm PDX (50m avg RT)	1000	$ 0.575	$ 575.00	might be individually donated
Parking at PDX (weeks)	14	$ 60.00	$ 831.43	
Chihuahua - Creel mileage (260km each way - 10 RTs)	3120	$ 0.575	$ 1,794.00	in-kind contribution by TCHF
Travel from base to water sources - mileage	1000	$ 0.575	$ 575.00	in-kind contribution by TCHF
Transfer in Chihuhua (taxi)	10	$ 40.00	$ 400.00	
Lodging in Chihuahua	20	$ 100.00	$ 2,000.00	
Lodging in Creel and surrounding area - days	194	$ 65.00	$ 12,610.00	in-kind contribution by TCHF
Per diem (Meals/beverages)	214	$ 15.00	$ 3,210.00	
Test equipment and lab supplies	1	$ 10,033.00	$ 10,033.00	
Laptops	2	$ 2,000.00	$ 4,000.00	in-kind contribution by volunteers and others
Contingency & incidentals	1	$ 2,000.00	$ 2,000.00	
Mission staff support (driver, translator, security) - da	200	$ 100.00	$ 20,000.00	in-kind contribution by TCHF
Admin & planning - days	20	$ 100.00	$ 2,000.00	in-kind contribution by TCHF & volunteers
USA volunteers time - days	200	$ 100.00	$ 20,000.00	in-kind contribution by volunteers
			$ 94,028.43	
cells this color indicated items anticipated to be provided / contributed			$ 35,979.00	contributed by Mission
cells this color indicated items anticipated to be provided / contributed			$ 25,575.00	contributed by Volunteers & Others
	Total funding required		$ 32,474.43	
	NGWREF funding requested		$ 15,000.00	
	Funding balance needed from other sources		$ 17,474.43	
	per day	**# sample pts**	**days**	
avg # sources per day first visit (first visit - more data)	4	236	59.00	
avg # sources per day second visit	8	236	29.50	
days team are sampling in Creel or surrounding area			88.50	
extra days getting oriented and breaks			8.50	
	Total team days		97.00	
	# volunteers per team		2.00	
	Total volunteer days		194.00	
	average days per trip		10	
	# volunteer trips		19.40	

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