

SAFE and SUSTAINABLE Groundwater Supply Wells in Developing Countries

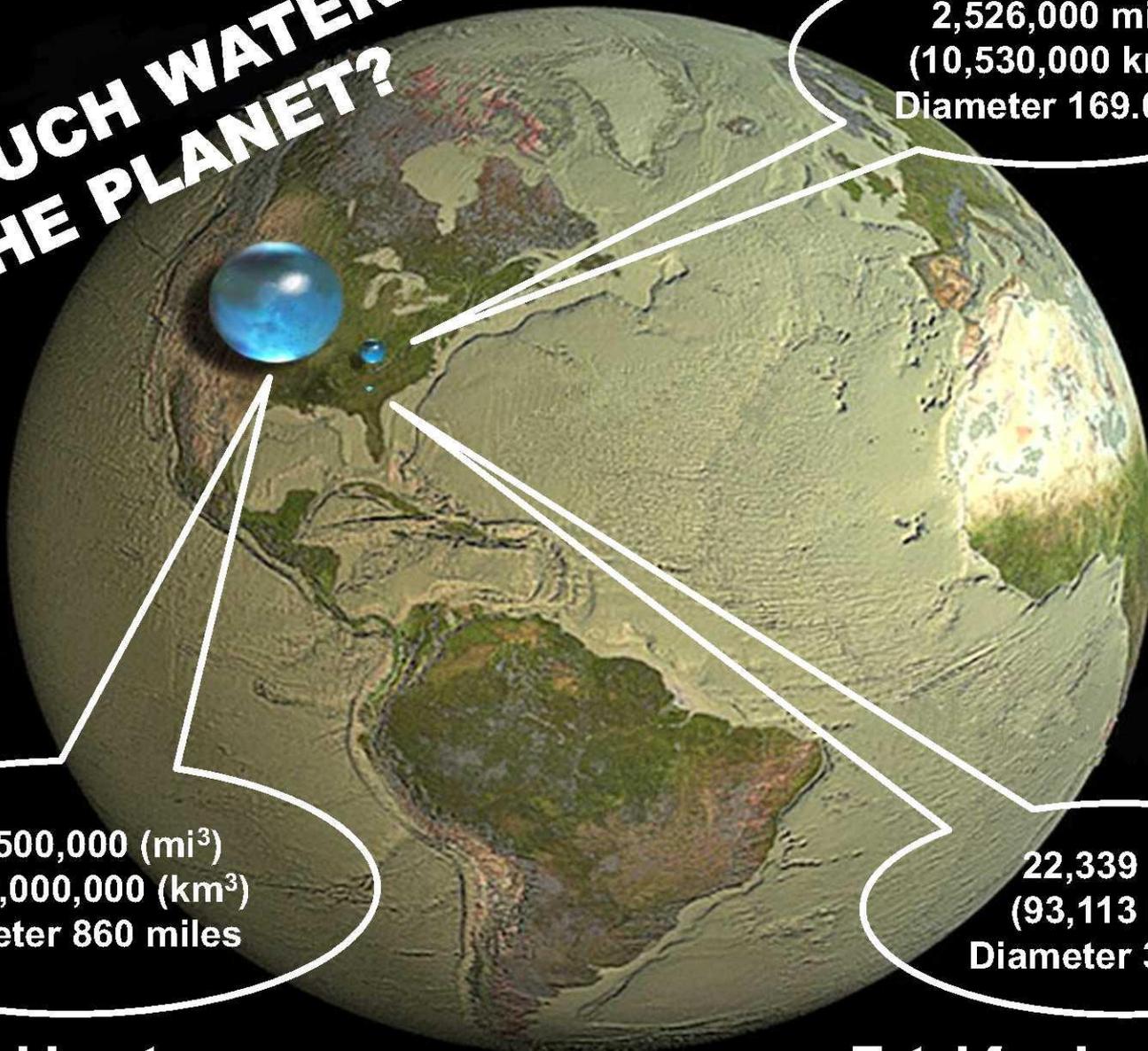
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Charitable arm of the NGWA

VP - Drilling Operations
Schneider Water Services



HOW MUCH WATER ON THE PLANET?



2,526,000 mi³
(10,530,000 km³)
Diameter 169.0 mi

**Total
fresh
ground
water**

332,500,000 (mi³)
(1,386,000,000 (km³))
Diameter 860 miles

Total world water

22,339 mi³
(93,113 km³)
Diameter 34.9 mi

**Total fresh
surface water**

WHY SAFE & SUSTAINABLE WELLS?

“You will never solve poverty without solving water and sanitation” *Matt Damon - interview with Katie Couric*

“You will never solve sanitation without water free of harmful pathogens” *S³*

“... 1.8 billion people globally use a source of drinking water that is faecally contaminated...” *Progress on Drinking Water and Sanitation – 2014 update – WHO & UNICEF*

SAFETY & SUSTAINABILITY

- Public Safety - Safe vs clean drinking water
Goal is SAFE = ZERO E-coli (<1/100ml)
& within guidelines for other minerals/chemicals
- Safety: Those constructing (e.g. dug wells)
- Up to 80% non-functioning wells in SSA
- Groundwater resource protection –
quantity and quality (future generations)

GUIDELINES BACKGROUND

- 2008 DCIG – identified need
- 2008-2011 – drafts circulated
- 2011 – first edition presented (UO)
- 2012 – second edition
- 2013 – third edition (following Kenya)

**MWONGOZO WA KISIMA
CHA KUSAMBAZA MAJI**



**kwa matumizi katika
NCHI ZINAZOSTAWI**

**Available in 5 languages:
Second Edition – Swahili
Third Edition – all others**

**DIRECTRICES PARA
POZOS DE
ABASTECIMIENTO DE AGUA**



**para usar en
PAÍSES EN DESARROLLO**

TERCERA EDICIÓN

**WATER SUPPLY WELL
GUIDELINES**



**for use in
DEVELOPING COUNTRIES**

THIRD EDITION

**供水井
指南**



供发展中国家使用

第三版

**DIRECTIVES
POUR LES PUITES
D'ALIMENTATION EN EAU**



**destinés à être utilisés dans les
PAYS EN VOIE
DE DÉVELOPPEMENT**

TROISIÈME ÉDITION

KEY COMPONENTS

- Location, location, location

- Set backs
- Three dimensional

- Annular seal

- Mandatory
- Chip bentonite
- Commingling

- Documentation – well logs

- Facilitates O&M
- Used by drillers, hydrogeologists
 - Locate other well sites
 - Design other wells
 - Facilitate drilling plans for other wells
 - Aquifer characterization
 - Reposited & accessible



WATER SUPPLY WELL REPORT

Well ID # / Name _____ Location of ID on well _____

(1) OWNER: Land _____ User _____ Both _____
 Name _____
 Address _____

(2) TYPE OF WORK
 New Well Deepening Alteration (repair/recondition) Decommissioning

(3) DRILL METHOD:
 Rotary Air Rotary Mud Cable
 Other _____

(4) PROPOSED USE:
 Domestic Community Industrial Irrigation
 Thermal Injection Livestock Other _____

(5) BORE HOLE CONSTRUCTION:
 All Depths Are in _____ Meters _____ Feet Below Ground Surface
 Depth of Completed Well _____

HOLE		SEALS	
Diameter	From To	Material	From To

How was seal placed: _____

Backfill placed from _____ to _____ Material _____
 Filter pack placed from _____ to _____ Size of pack _____

(6) CASING/LINER:

Casing/Liner	Diameter	From To	Gauge	Material			
				Steel	Plastic	Welded	Threaded
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
				<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Drive Shoe used Inside Outside None
 Final location of shoe(s) _____

(7) PERFORATIONS/SCREENS:
 Perforations Method _____ Material _____
 Screens Type _____

From To	Slot size	Number	Diameter	Telephone size	Casing	Liner
					<input type="checkbox"/>	<input type="checkbox"/>
					<input type="checkbox"/>	<input type="checkbox"/>
					<input type="checkbox"/>	<input type="checkbox"/>

(8) WELL TESTS: Minimum testing time is 1 hour
 Pump Bailor Air Flowing Artesian
 Yield gal/min _____ Drawdown _____ Drill stem at _____ Time _____
 1 hr. _____

Temperature of water _____ Degrees C _____ F _____
 Was a water analysis done? Yes By whom _____
 Did any strata contain water not suitable for intended use? Too little
 Salty Muddy Odor Colored Other _____
 Depth of strata _____

(9) LOCATION OF WELL GPS: _____
 Latitude _____ Longitude _____
 Other (legal or locally used documentable location description): _____

(10) STATIC WATER LEVEL: _____ below land surface. Date _____
 Artesian pressure _____ PSI _____ Date _____

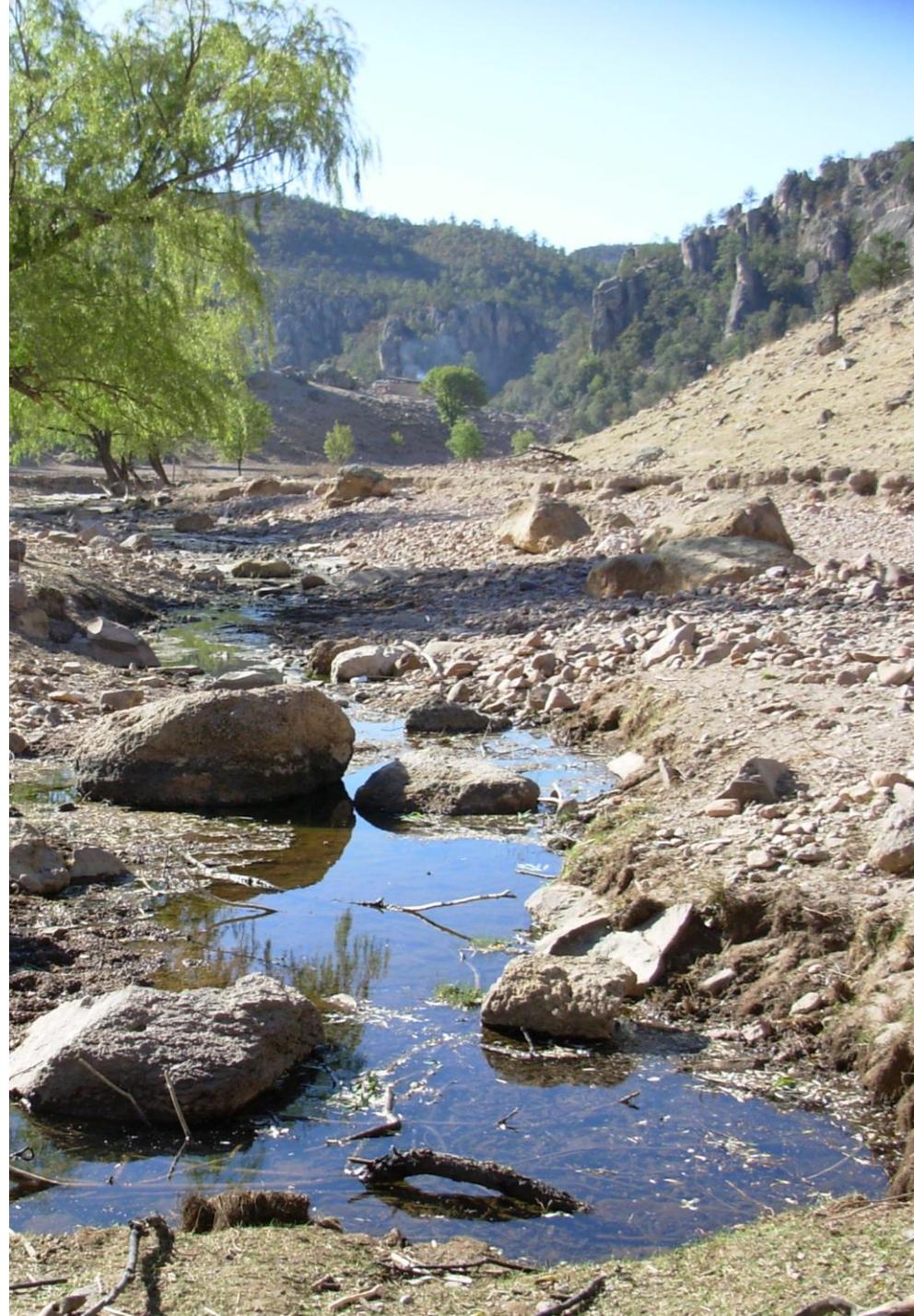
(11) WATER BEARING ZONES:
 Depth at which water was first found _____

From	To	Estimated Flow Rate	SWL

(12) WELL LOG:
 Ground Elevation _____

Material	From	To	SWL

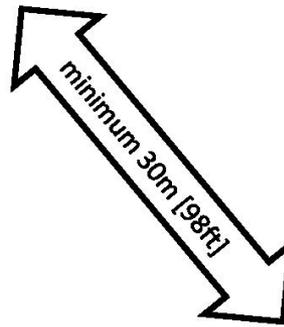
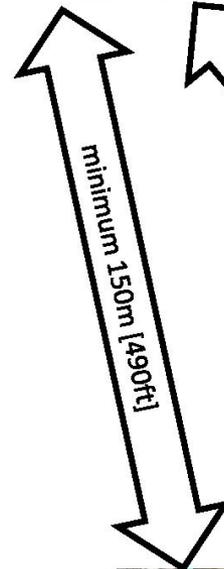
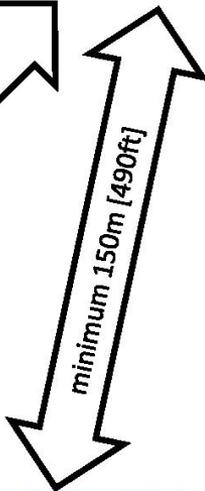
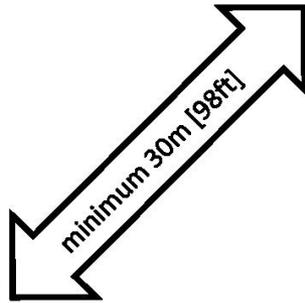
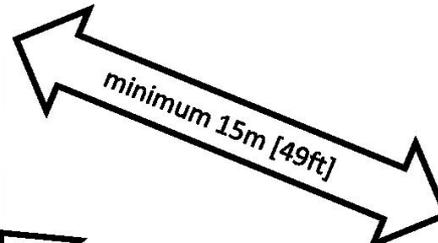
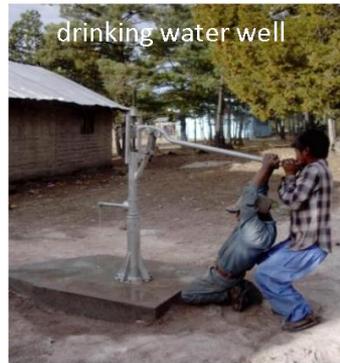
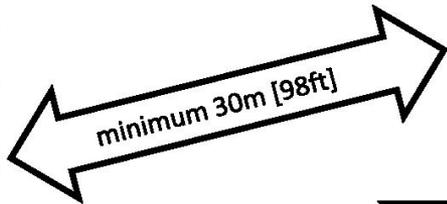
Date started _____ Completed _____
 Person or Organization responsible for well's construction:
 Name: _____
 Address _____
 Phone # _____ E-mail _____



WELL LOCATION

FIGURE 1

WELL SETBACKS



ANNULAR SEAL

- MANDATORY – 1 of 2 (zero e-coli is other)
- Most important component physically incorporated into a well's construction
- Well construction - NOT FOR AMATEURS
- Installation can be very challenging
 - Deep seals (e.g. through shoes)
 - Flowing conditions (whether at surface or not)
 - Removing temporary casing(s)

DOCUMENTATION SUBMISSION

- Logs (reports) must be a requirement
 - By whoever is funding the project
 - Final payment (retainage) pending submission and approval of completeness and acceptable accuracy.
 - By rule of law
 - Enforced by civil penalty and/or license revocation or suspension - \$ rules
- Storage and retrieval for all, especially:
 - Drillers
 - Hydrogeologists, geologists, scientists & engineers

BENEFITS (Prompted by BIG Q)

- ❖ **Shouldn't a well be constructed asap, even if resources aren't available to properly build it, in order to get some immediate result - e.g. lives saved?**

or...

- ❖ **Won't more lives be compromised as a result of inferior construction? *Safety & Sustainability will be compromised.***

- Adds to 1.8B with fecal contaminated source.
- Safety incident on your watch; how will you cope?

ADD'L RISKS / THOUGHTS re: BIG Q

- Inferior wells require decommissioning or repair at some time in future:
 - \$\$\$ to properly decommission / repair
 - Safety (open boreholes)
- Contamination from GW creates negative perception of the GW resource
 - One chance to make first impression
- Long term aquifer damage
 - GW becomes a problem, not a solution
- Short term solutions are available
 - e.g. ceramic pots, bio-sand filters, etc.

COST – BENEFIT ANALYSIS (CBA)

- June 2012 – OSU
- Jaynie Whinnery, BSME - EWB
- October 2012 – published & presented @ EWB regional, Cal Poly
- PDF on web – also spreadsheet

CBA Revelations

- Almost 40x more benefit than cost
 - If a well is properly constructed, operated, maintained
- ~5X increase in net value with O&M
- Unacceptable: Building wells that will likely produce localized poor water quality – negative NPV (B:C ratio < 1)
- 3x-infinity more NPV: Proper well v Inferior well

CBA Presumption (not specifically analyzed)

UNACCEPTABLE: Well that results in GW contamination or aquifer damage:

- Surface water leaking in
- Commingling
- Uncontrolled artesian

NEGATIVE IMPACTS:

- Reduced large-scale benefits
- Added cost of remediation / mitigation

Such impacts will certainly result in a negative NPV

CBA – Customizable Spreadsheet

- Number of wells
- Number of users per well
- Construction costs
- Discount rate
- Percent of income used for water
- Local GNI-PPP
- Morbidity values
- Mortality values

MAKING A DIFFERENCE

GW Safety & Sustainability

- Influence pathogen safe construction - 1 well for 250
- Influence well sustainability – well should last at least 2 generations
- Teach others to properly construct wells
 - Local driller – 500 wells or more likely over career
 - Each add'l driller
 - EWB chapters, students, other professionals
 - NGO's, Funding agencies, Governments
- Resource protection – many generations



Lives impacted – INCALCULABLE

MZUZU, MALAWI

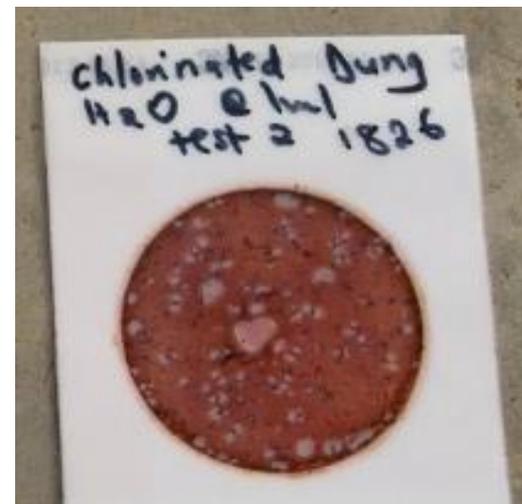
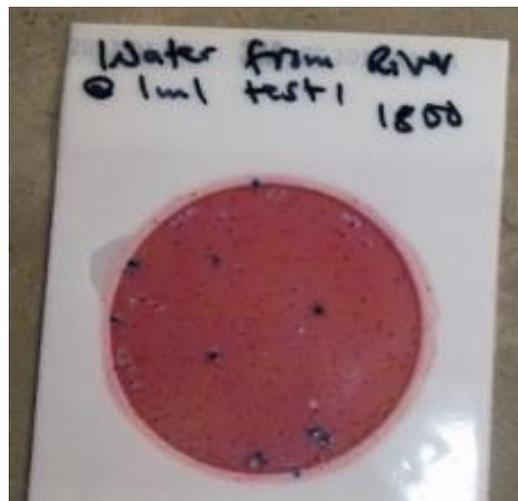
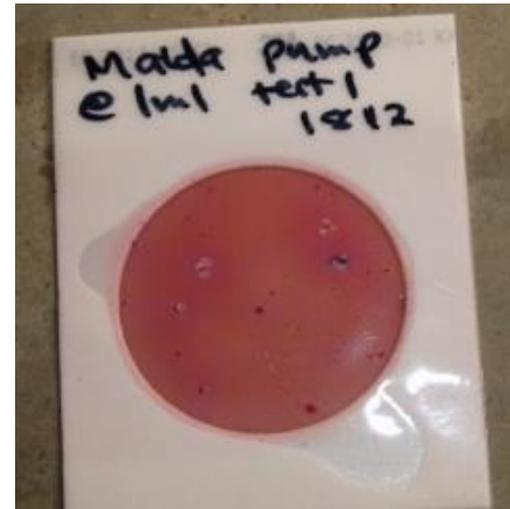
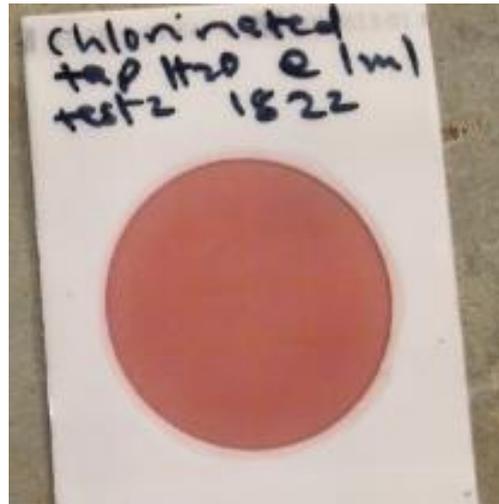
- NGWREF's first DN E&T grant
- Two courses over a week
 - 3 day – Drillers (incl. interpreter)
 - 2 day – NGO's, Government & Students
- Partner – SMART Centre, Mzuzu U
- Malawi Minister of Water – opening/closing remarks

CUSTOMIZED PROGRAM

- **Diversified Format**
 - Course Txt – WATER SUPPLY WELL GUIDELINES...
 - PPTX, Whiteboard - w/discussions
 - Classroom demos (drill fluid, chips, sampling, sand tank)
 - Field demonstration
- **Diversified Presenters**
 - MU Water Dept professionals
 - Drillers (field demos)
 - NGWREF RG
 - NGWREF MGWC



VISUAL LEARNING - Petrifilm



CUSTOMIZED CONTENT

- Components
- CBA
- Groundwater Flow
- Safety
- Ethics
- Contracts
- Opportunities (distributors)
- Regulations



RESPONSE from Malawi



‘Just a note to thank you for a wonderful program here in Mzuzu last week. Both the ...programs exceeded our expectations, and have challenged us to do a better job for safe and sustainable well construction. But, also to not just accept the status quo.’ *R Holm, PhD*

IMPACT – Estimates (since 2011)

Individuals incorporating all/part of proper well construction, or teaching it to others >100

Wells impacted >10,000

Individuals impacted (initially) >2,500,000

Add'l individuals impacted >5,000,000

MAKE AN IMPACT!

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www.schneiderwater.com

click on 'Hydrophilanthropy'

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