



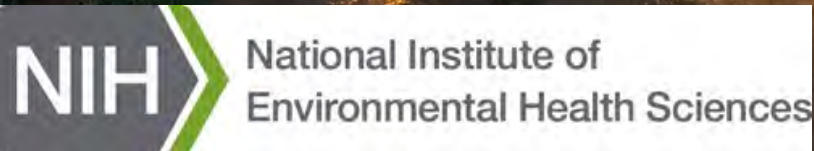
CO-DESIGNING OFF-GRID WATER SYSTEMS TO ADDRESS AMPLIFIED WATER INSECURITIES DURING A PANDEMIC



BY KARLETTA CHIEF, PROFESSOR & EXTENSION
SPECIALIST & DIRECTOR OF INDIGENOUS RESILIENCE
CENTER

CO-AUTHORS: VICKY KARANIKOLA, JOE HOOVER,
AND JANI INGRAM

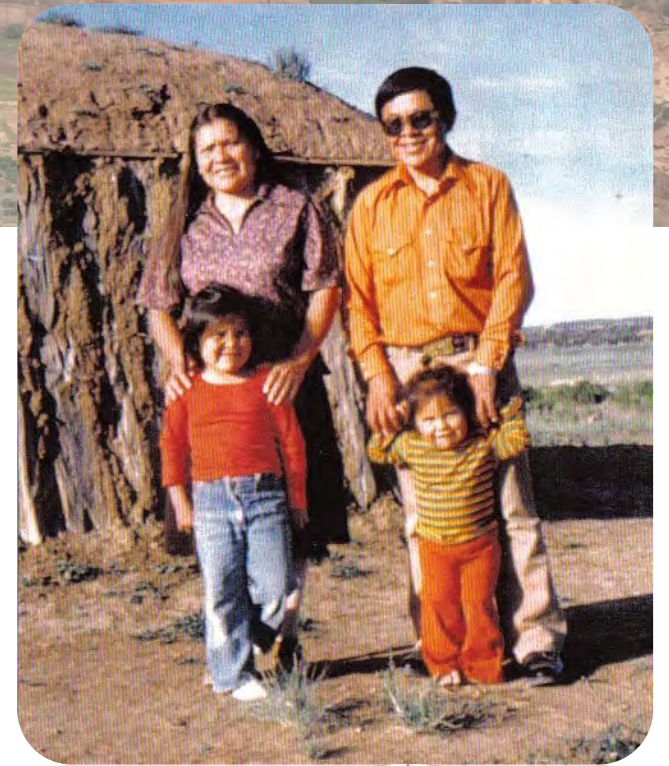
DEC 13, 2023



I AM BITTERWATER.



Near-the-
Water



Red-
house

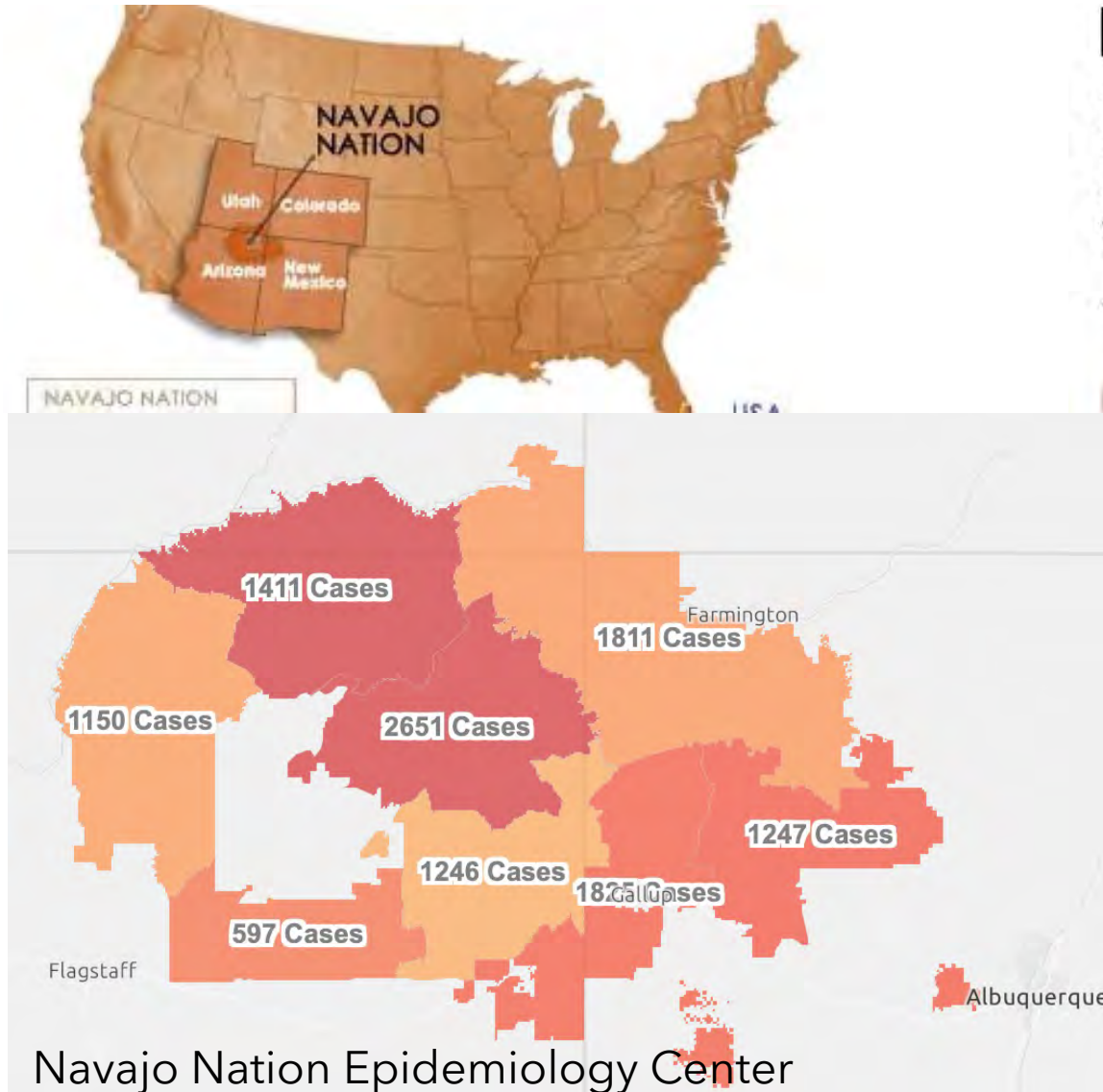


Red-
Running-
Into-The-
Water



COVID-19 RAMPANT ON NAVAJO NATION

CHALLENGE



POLITICS MAY 5, 2020

Navajo Nation Is Behind Only New York and New Jersey in Rates of COVID-19 Infection. What Happened?

"Tribes have been chronically neglected and underfunded for decades and decades."



DELILAH FRIEDLER

Fellow
[Bio](#)

Navajo Nation COVID-19 Cases

11,938

...includes positive cases, not including border-town cases.

9 cases are pending locations

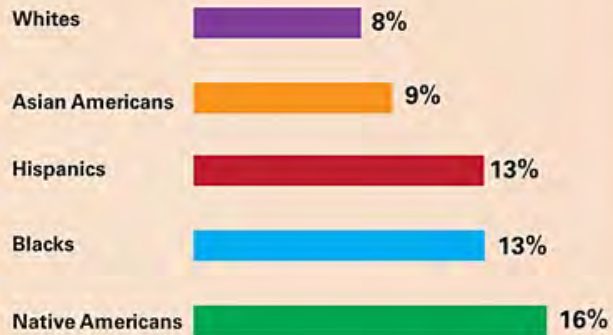
(Data presented is for November 2, 2020)

Navajo Nation Epidemiology Center

CORMORBIDITIES & ENVIRON EXPOSURE

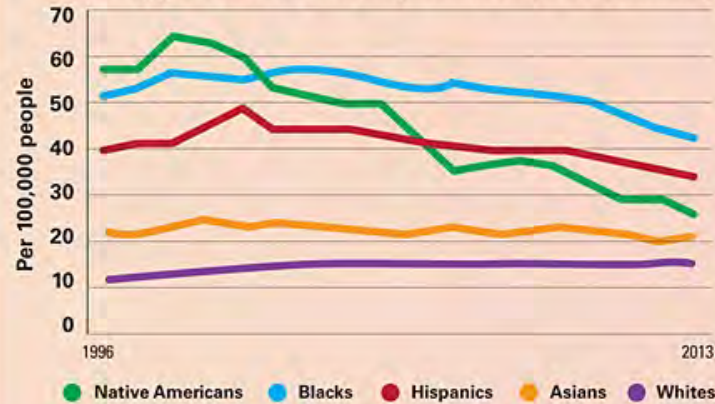
CHALLENGE

Native American adults have more diabetes than any other race or ethnicity.



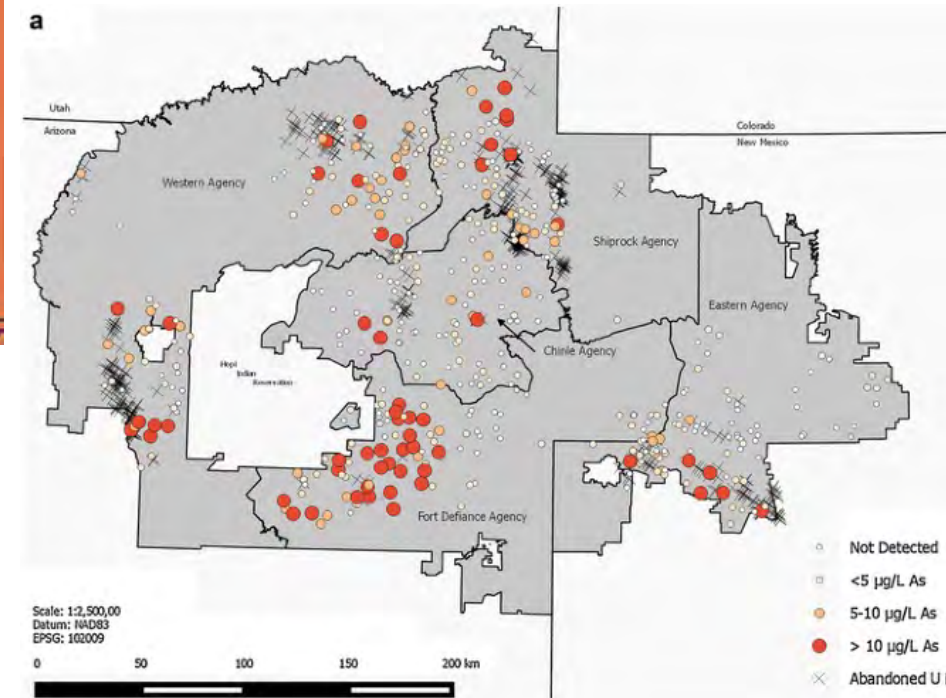
SOURCE: National Health Interview Survey and Indian Health Service, 2010-2012.

Kidney failure from diabetes in Native Americans has dropped more than any other race or ethnicity.



SOURCE: United States Renal Data System (USRDS), 1996-2013, adults 18 and older.

Arsenic in unregulated water sources on Navajo Nation



500 abandoned uranium mines



Hoover et al., 2016

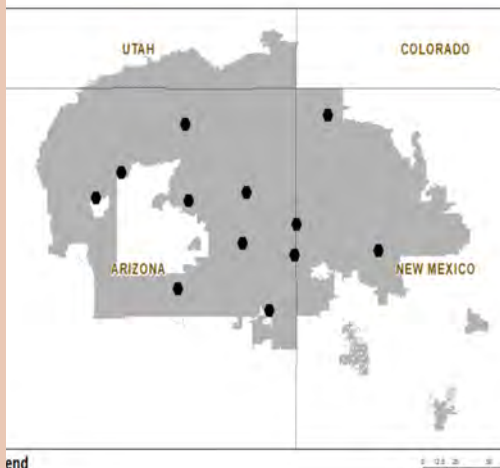
WATER INSECURITIES AMPLIFIED

INEQUITIES



Photo: ABC News

**Navajo Nation
a Food Desert.**



Hoover, 2020



Photo: Navajo Nation



**30% lack running water
40% lack electricity**



Photo: ABC News

COST OF WATER

Cost of water in Arizona: \$ 0.2-0.4/100 gal

Cost of hauling water: \$13.3/100 gal
(NNDWR, 2011)



Pressure Driven Membrane Process

Cost of water with Solar
Nanofiltration: \$0.8/ 100 gal

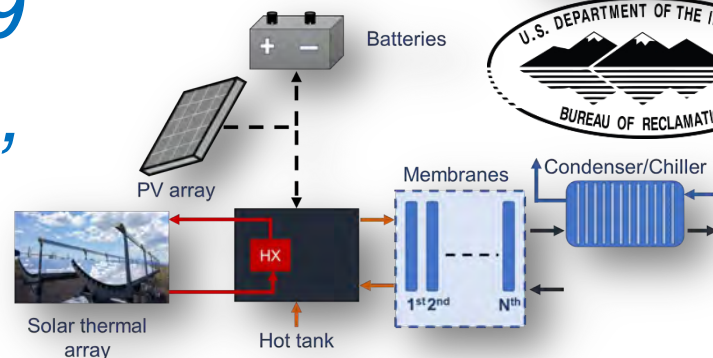
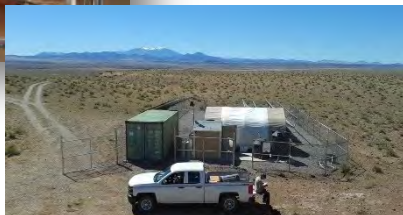


Includes operation
and maintenance

Thermal Driven Membrane Process

Cost of water with Solar Membrane
Distillation System: \$5.6/ 100 gal

5T-529
Leupp,



NN WATER ACCESS COORDINATION GROUP

PARTNERSHIP

The Water Access Coordination Group



THE UNIVERSITY OF ARIZONA
Agnes Nelms Haury
Program in Environment and Social Justice



COLLEGE OF AGRICULTURE
AND LIFE SCIENCES
COOPERATIVE EXTENSION

NBCS
Navajo
Birth Cohort Study



ECHO
Environmental Influences
on Child Health Outcomes
A program supported by the NIH

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in Indian Country

ASU Ira A. Fulton Schools of
Engineering
Arizona State University



JOHNS HOPKINS
CENTER FOR AMERICAN
INDIAN HEALTH



JOHNS HOPKINS
WATER INSTITUTE

MISSION:

To identify, acquire, prioritize, and use available resources to increase access to quality water for tribal homes. The WACG is using available data to identify and design interventions to guide the mission.

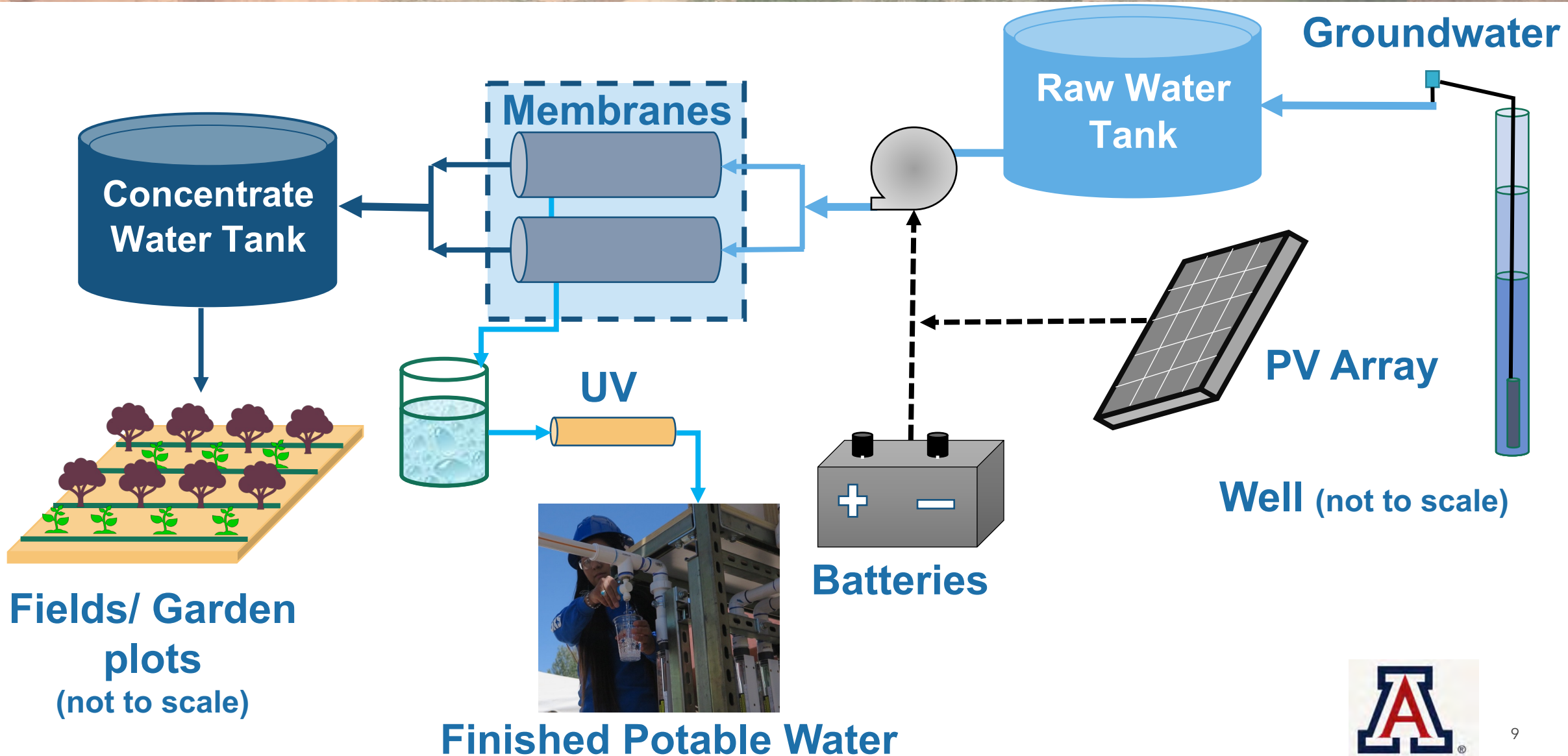


<http://navajosafewater.org>

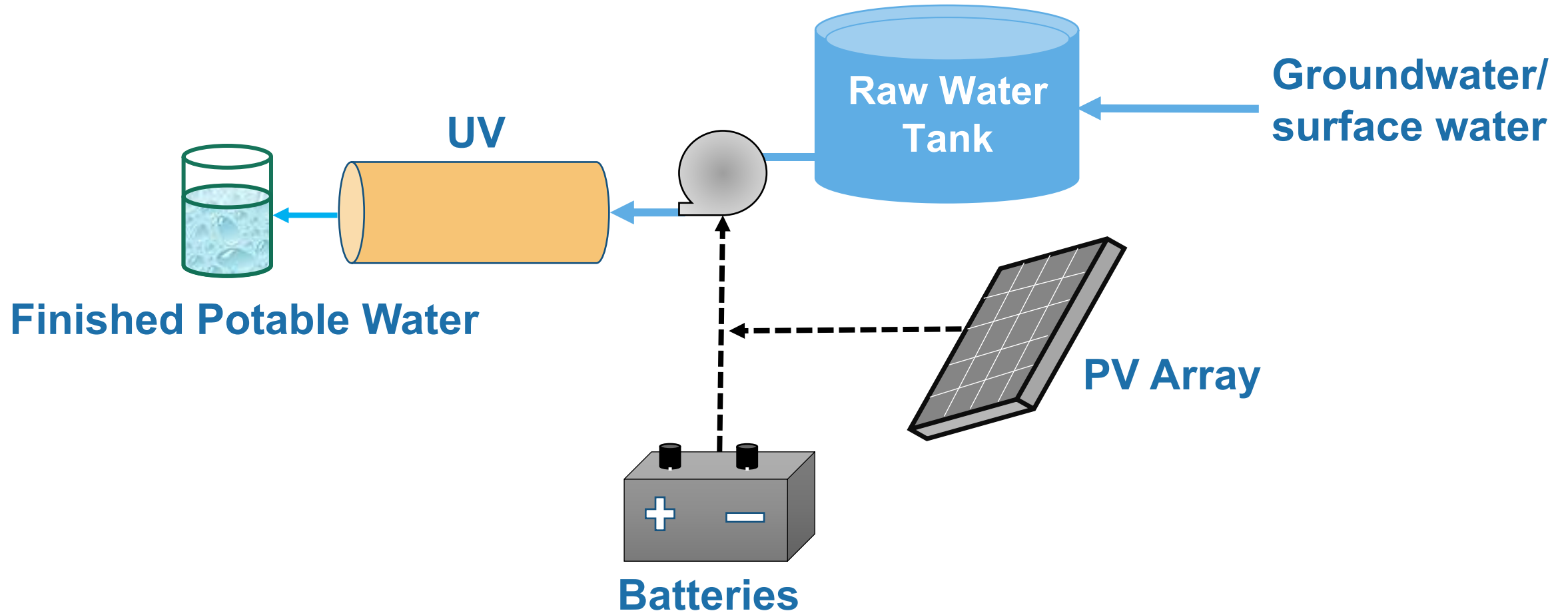
CO-DESIGN OF LARGE WATER SYSTEMS -2018



SOLAR NANO FILTRATION



SOLAR UV SYSTEM



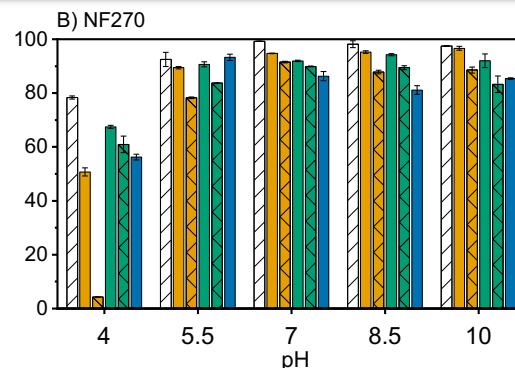
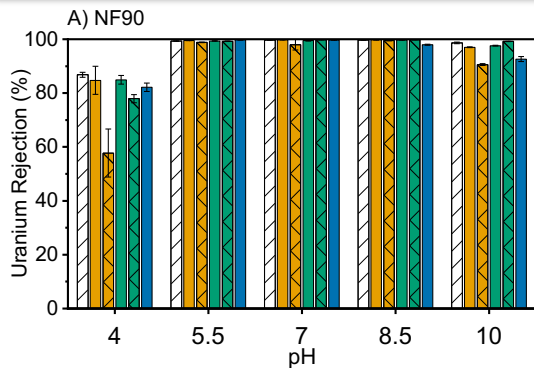
CO-DESIGN & TRAINING TO BUILD HOUSEHOLD WATER SYSTEMS - MAY 2021

IMPLEMENTATION SCI



shutterstock.com - 1654071211

50 – 100 gpd
SNF system



[U]
 [U] + 1 g/L NaCl
 [U] + 5 g/L NaCl
 [U] + 1 g/L MgCl2
 [U] + 5 g/L MgCl2
 [U] + 1 g/L CaSO4



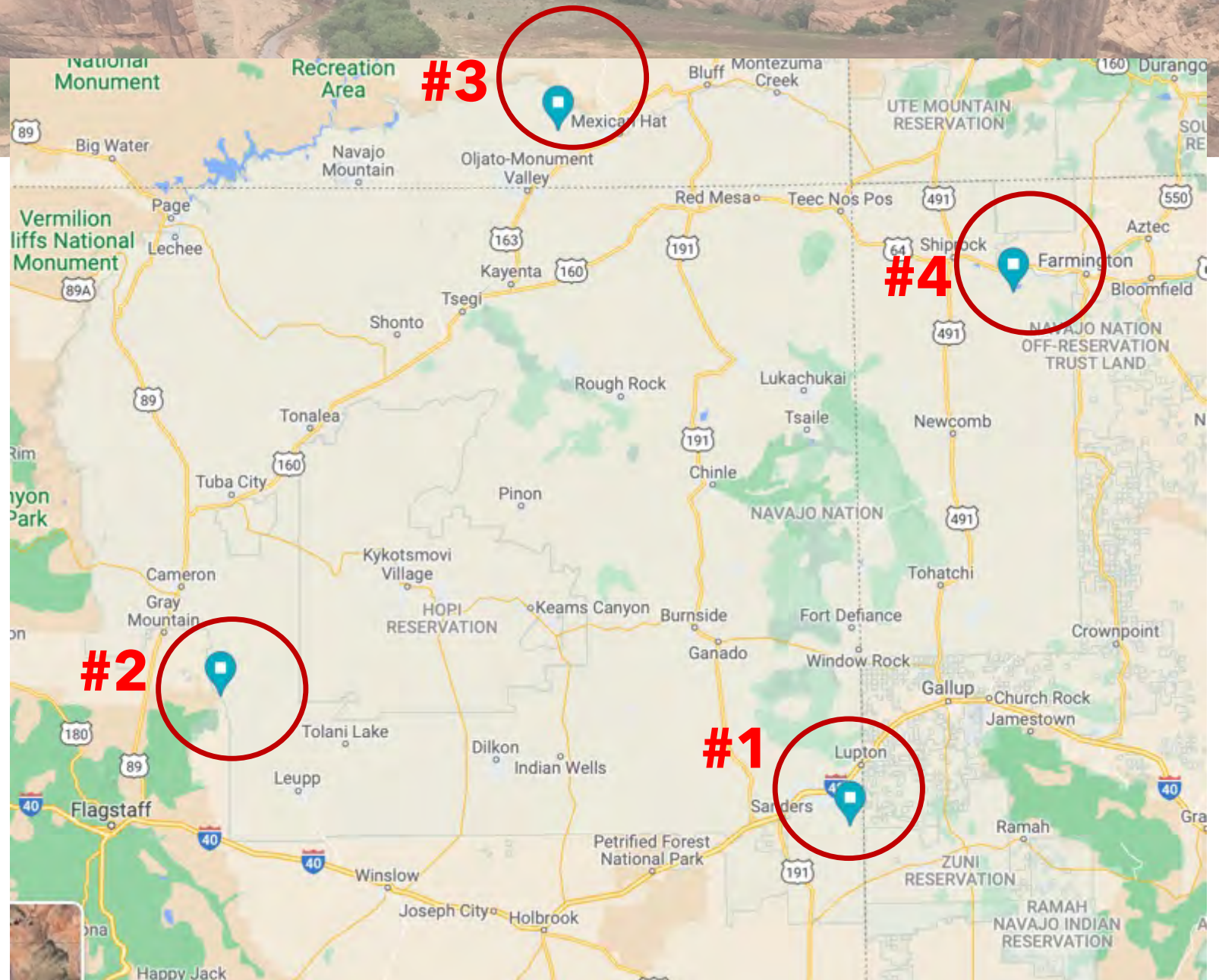
SIXTH WORLD
SOLUTIONS

PILOT SITES

1. Lupton - UV
2. Black Falls - SNF
3. Oljato - SNF
4. San Juan - UV



SIXTH  WORLD
SOLUTIONS



LUPTON

- Elder walks 1-2 miles to 18K-331 for water. Using wheel barrow she carries her gas and water.
- Livestock well
- Gas-powered pump
- Solar panel destroyed by vandalism
- Water pipes freeze in the winter & family creates a fire to thaw pipes out.



OLJATO CHAPTER

IMPLEMENTATION SCI

Community meeting
to identify water
needs

February

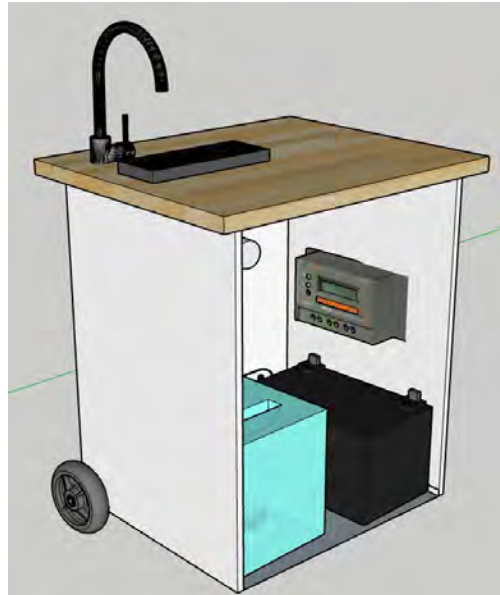
Spring water
sampling



Community calls to
identify best design
based on community
input

March/April

Draft design



Co-construction
with Diné College

April/May

Household solar UV
construction



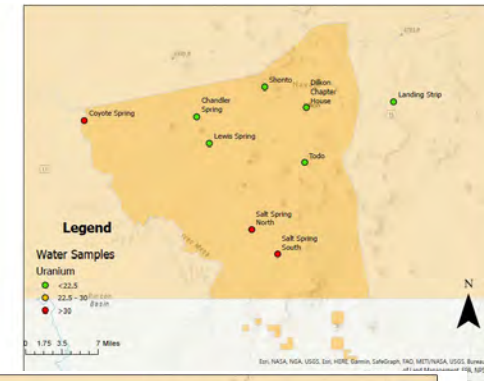
Training and
Education

May

Implementation
team- UA, Dine
College, SWS and
Navajo Nation
community members

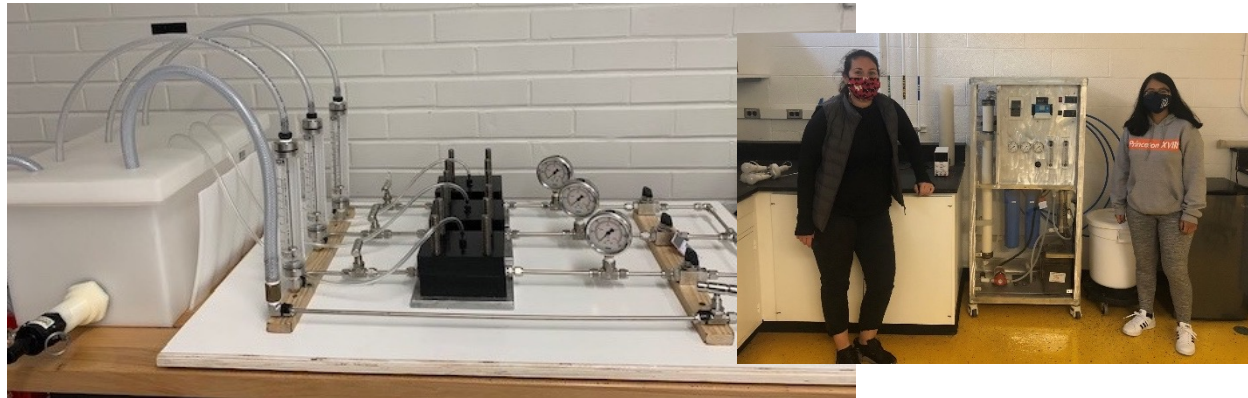


WATER QUALITY ASSESSMENT

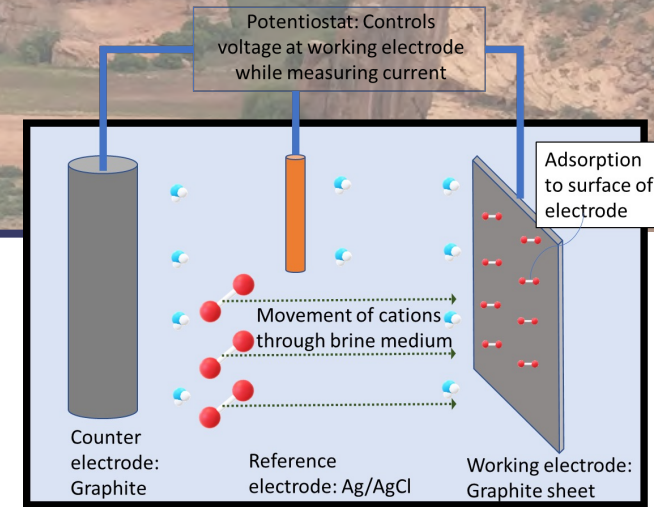


KORES LAB WORK

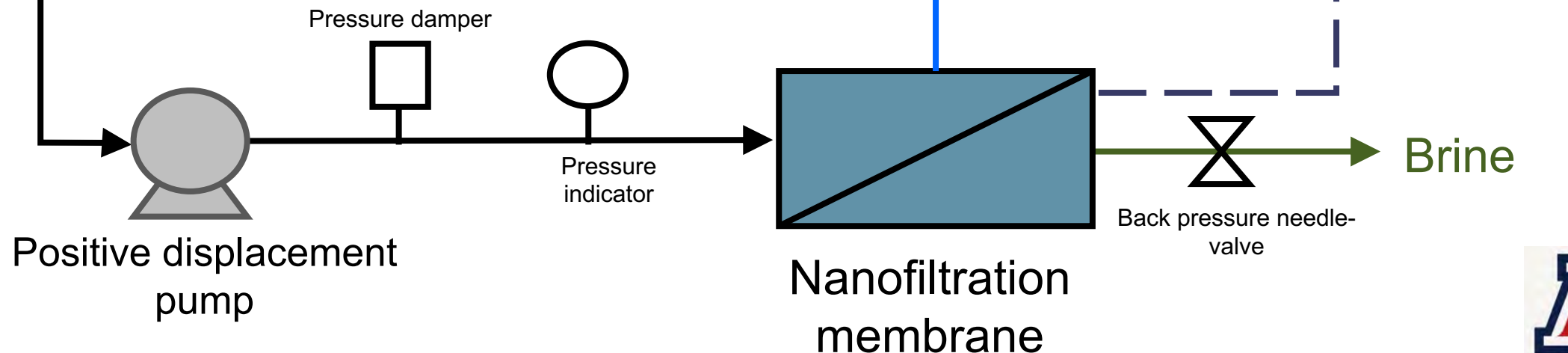
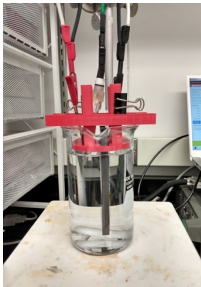
(Recycle stream for brine management)



Examination of NF membrane effectiveness under different water quality scenarios

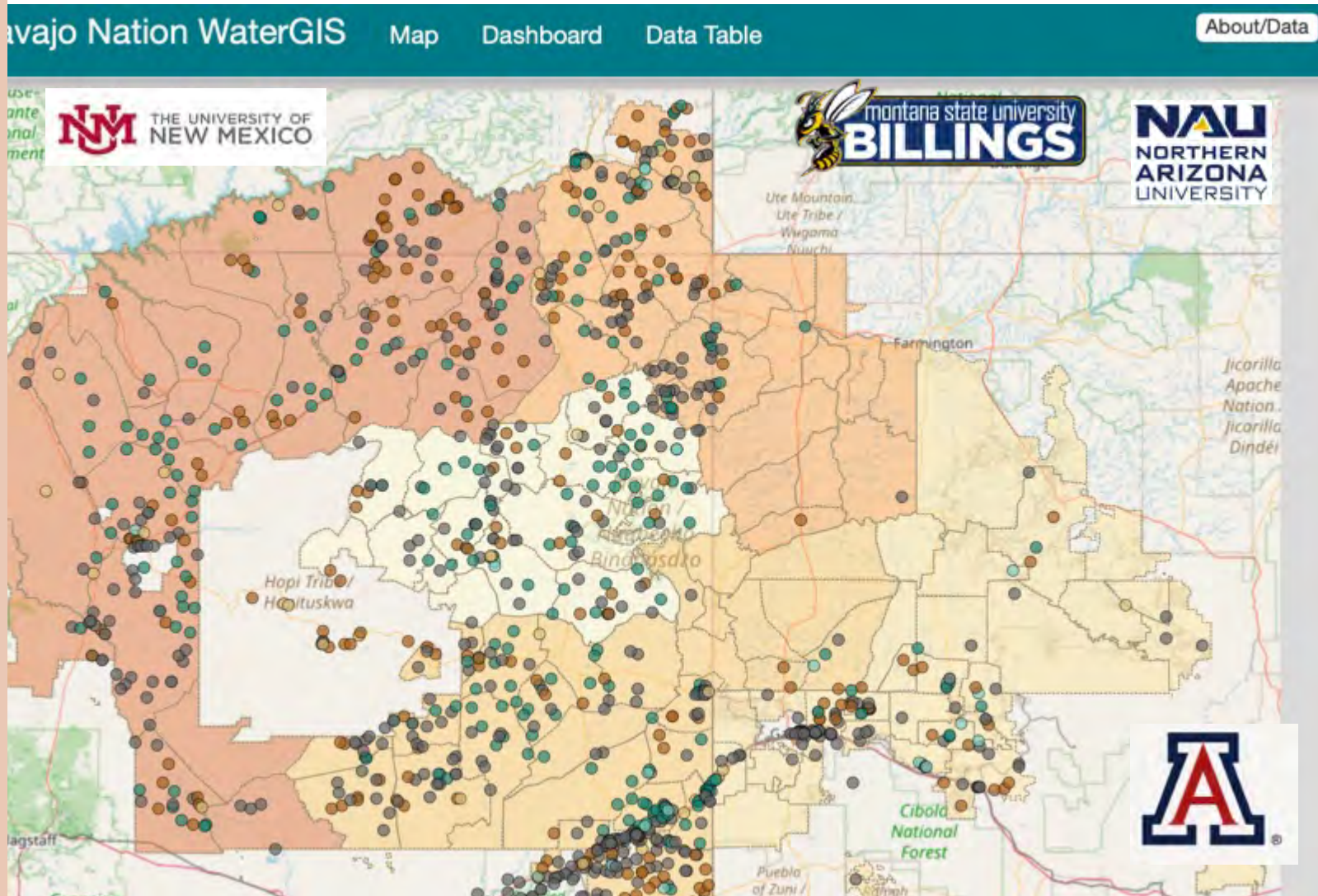


Electrochemical absorption of uranium on graphene oxide



NAVAJO NATION WATERGIS PORTAL

DATA SOVEREIGNTY



FEATURE

It Takes a Team: Tackling Water Quality Challenges and COVID-19 in the Navajo Nation

Joseph H. Hoover, Daniel Beene, and Karletta Chief



65 Water-Safe Spring, an unregulated water source on the Navajo Nation, water is collected and funneled to watering troughs downhill of a spring. Source: Joseph H. Hoover.

IN 2020 SCHOLARS FOUND THAT A LACK OF INDOOR plumbing was associated with a higher rate of COVID-19 cases in Indigenous communities in the United States. Among the affected populations is the Navajo Nation, whose territory spans northeastern Arizona, northwestern New Mexico, and a small portion of Utah. To learn more about the role of water access in the spread and transmission of COVID-19, the Navajo Nation invited water experts from multiple academic institutions to join the nation's Water Access

Coordination Group (WACG).

In collaboration with the Navajo Nation, researchers applied a team science approach to the issue, bringing together a group of researchers and students from a wide range of fields. Together, they not only answered important questions about water access and COVID-19 risk but also developed a valuable tool for assessing water quality more broadly—critical in a region dotted with thousands of unregulated groundwater sources.

January/February 2022

VOLUME 24 • NUMBER 1 • 5

Hoover, J., D. Beene, and K. Chief. 2022. It takes a team: Tackling water quality challenges and COVID-19 in the Navajo Nation. In Roehm, C. and M.E. Campana (ed.) Water Risk in a Rapidly Changing World: Part 2. Water Resources IMPACT Magazine 24(1):5-8.

<https://unmcop.unm.edu/metals/>

SNF FIELD DEMONSTRATION



FACULTY DEMO'ING SNF



COMMUNITY TRAINING

COMMUNITY ENGAGEMENT & IRB APPROVAL

RESEARCH APPROVAL



kpcc.org



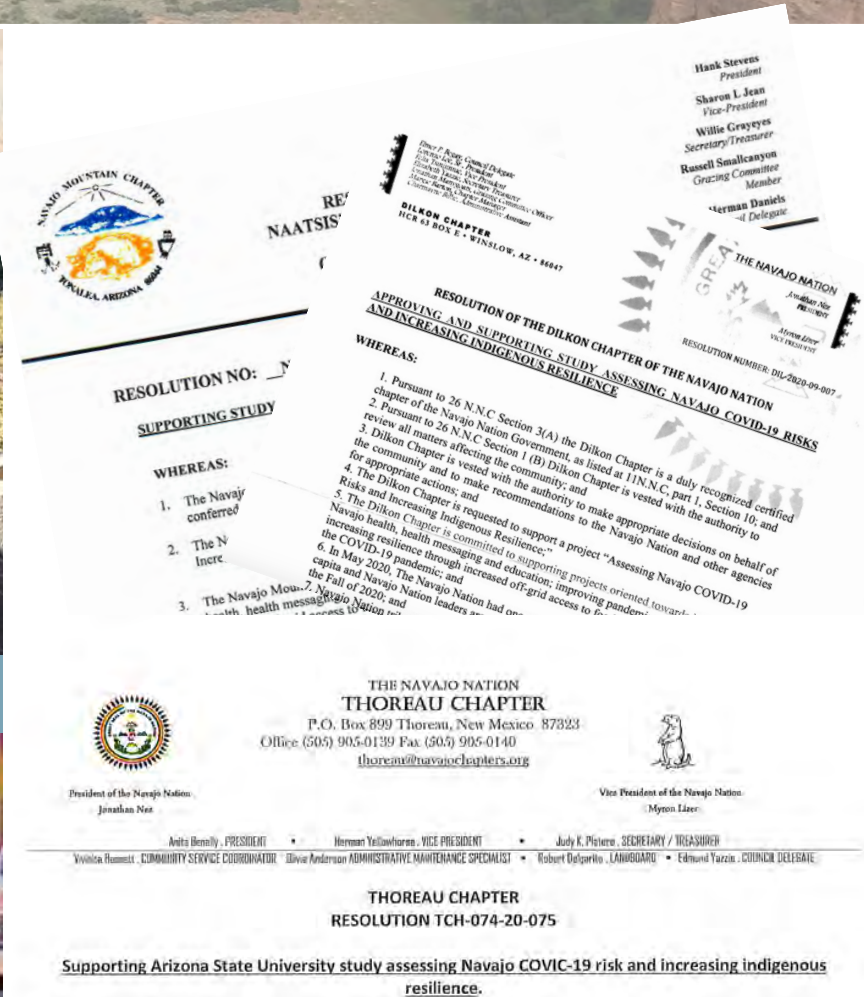
Photo by Kern Collymore on 10/4/21



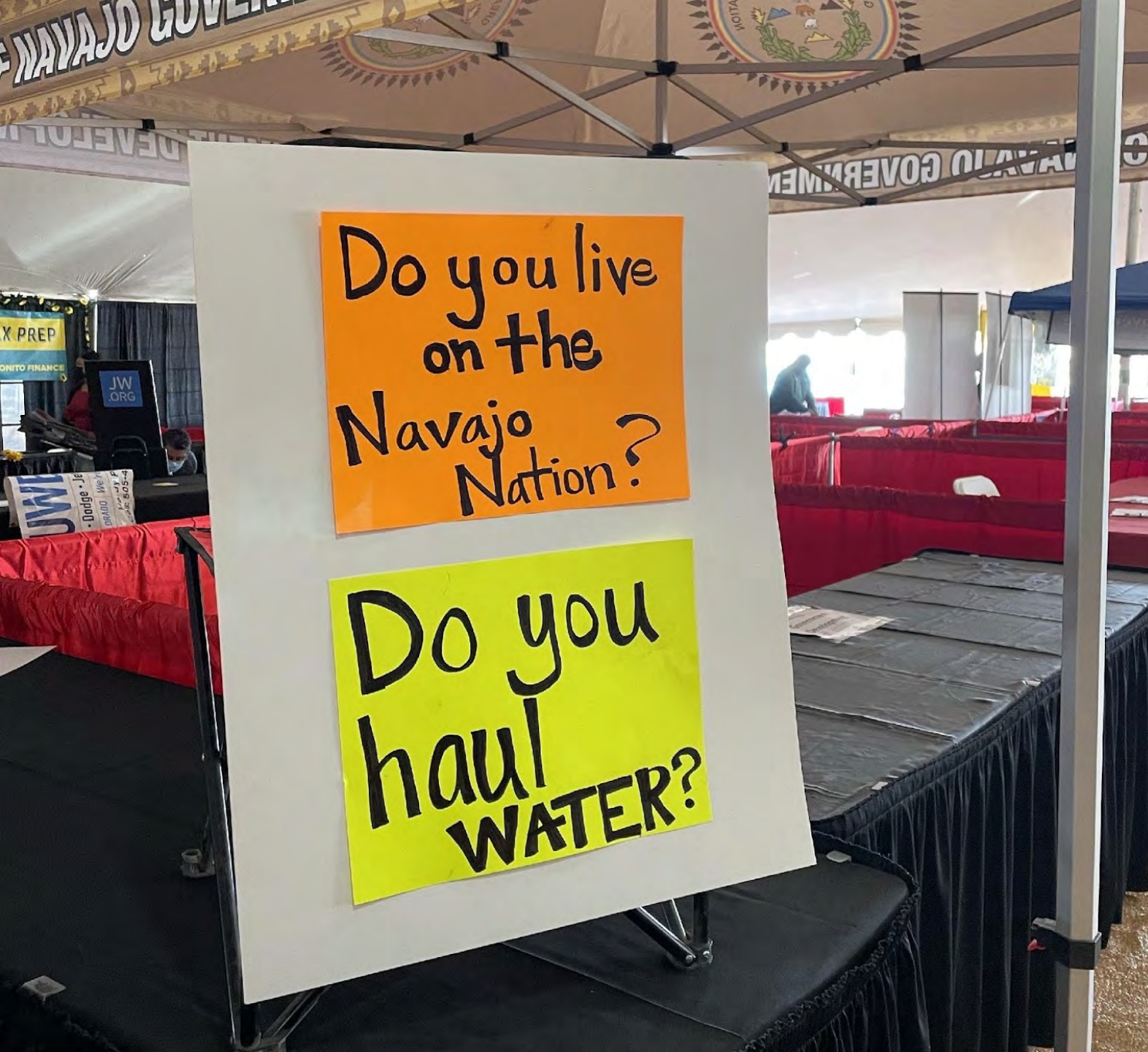
Photo by JWalker on 10/4/21



Photo by Tammy Back on 9/17/21



Approved by the Navajo IRB April 2021 (after 1 yr)

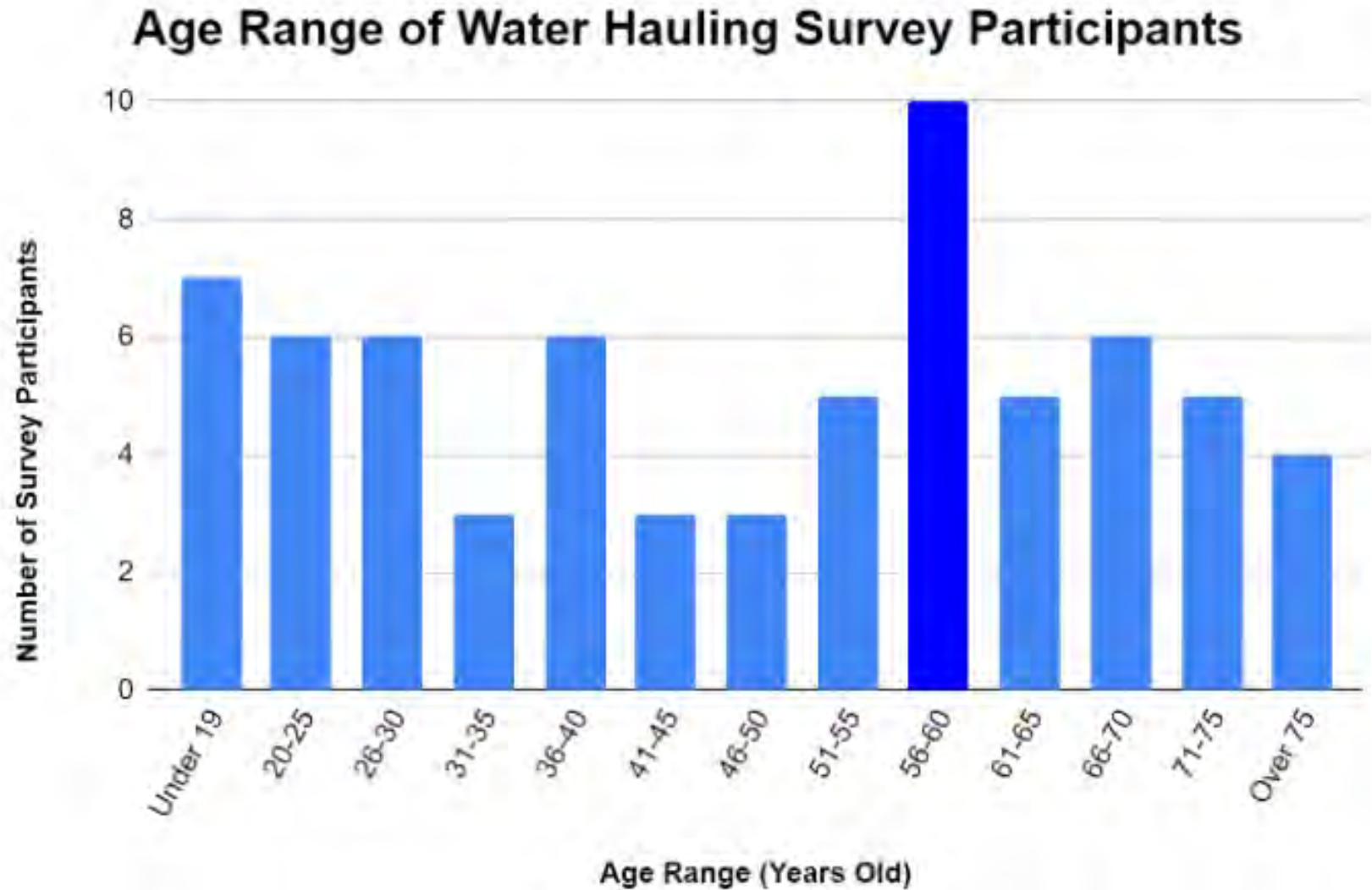


WATER HAULING SURVEY

- 69 Survey Participants
- 152 Surveys Completed
- 33 Communities Represented

AGE OF WATER HAULER

- 56-60 years of age



WATER HAULERS

- 68% hauling water 10 years +
- 51% travel 5-10 miles
- 53% haul water 2-3 times a week
- >70% haul water for cooking, cleaning, and livestock



WATER HAULING SURVEY

“I can’t ever move or don’t want to ever move closer to a central water line. This is home this has always been my home. And I’m not leaving no where.”
-Water Hauler



A word cloud featuring various place names in the San Juan region, including Naa'tsis'aan, Oljato, Chinle, San Juan, Dikona, and Crystal. Other names like St. Michaels, Shiprock, Canyon Diablo, Thoreau, Prewitt, Teesto, Sawmill, Kinlichee, Lake Valley, Lukachukai, White Rock, Nenahnezad, Tsaile, Wide Ruins, Klagetoh, Chilchinbito, Nenahnezad, Farmington, Oak Springs, Ganado, Indian Wells, Fort Defiance, and White Cone are also included.

- 70% would not move closer to a central waterline.
- 79% primary source of drinking water is bottled water
- 95% feel their water usage has increased because of COVID-19 hand washing guidelines

PERCEPTION OF WATER TECHNOLOGIES

COMMUNITY INPUT

Example Questions:

- What are your day-to-day challenges getting access to food-energy and water?
- What concerns do you have about the quality of food, energy and water?
- Do you think off-grid technologies would be helpful to increase access to food, energy and water during the COVID-19 pandemic?

EMPOWERING COMMUNITIES FOR
SUSTAINABLE FUTURES



**Lupton Stockwell
Oct 2021**



Oljato Spring Oct 2021



WATER TECH & INFRASTRUCTURE PERCEPTIONS

- 54% very likely to accept changing their current water hauling practices with new technology
- 49% willing to pay for operation & maintenance
- 58% prefer in-person training to learn about new technology



CONCLUSIONS



- COVID-19 pandemic amplified and spotlighted existing water disparities on the Navajo Nation
- 30% of Navajos Residents lack running water & many live remotely and not near a central water infrastructure
- Need innovative off-grid user friendly water solutions to address water insecurity in real time
- Off-grid rural tribal water users have different needs and perceptions than other water users (cultural, ceremonial, livelihood water needs)
- Potential to upscale effort but need more R&D and community champions
- Opportunity for capacity building, tribal college educational support, & involvement of Native American professionals, technicians & students

ACKNOWLEDGEMENTS

- All IndigeFEWSS faculty
- Cara Duncan
- Torran Anderson
- All students in the travel teams
- SWS
- Dilkon Chapter
- Monument Valley Park Community
- Effie Yazzie
- Dr. Tommy Rock
- Navajo Nation Families

Agnese Nelms Haury
Program in Environment and Social Justice

- Nikki Tulley
- Yaser Mehdipour
- Chris Yazzie
- Hua Jiang
- Ailyn Brizo
- Mackenzie Bonny
- Arianna Tariqi
- Hunter Gudenkauf
- Bob Seaman
- Bob Arnold
- Lynn Carrol

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Society

SIXTH * WORLD
S O L U T I O N S



The
Transformation
Network
Hosted by the UNM
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FUNDING



National Institute of
Environmental Health Sciences



Superfund Research Program
The University of Arizona



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Ahé'hee! Gracias! Arigatōgozaimashita