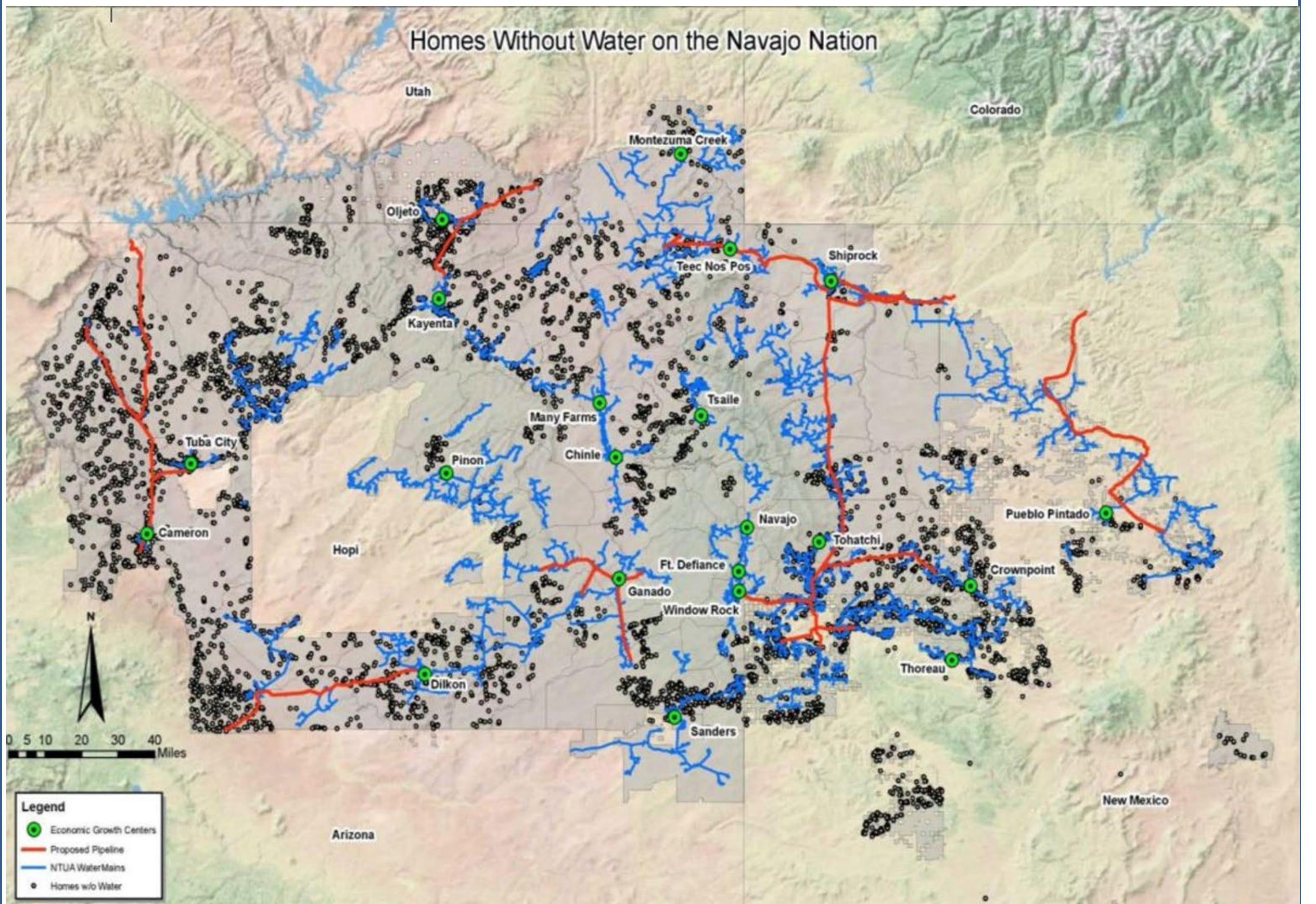


# Restóre: Addressing decade-long water issues in the Navajo Nation

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## Introduction



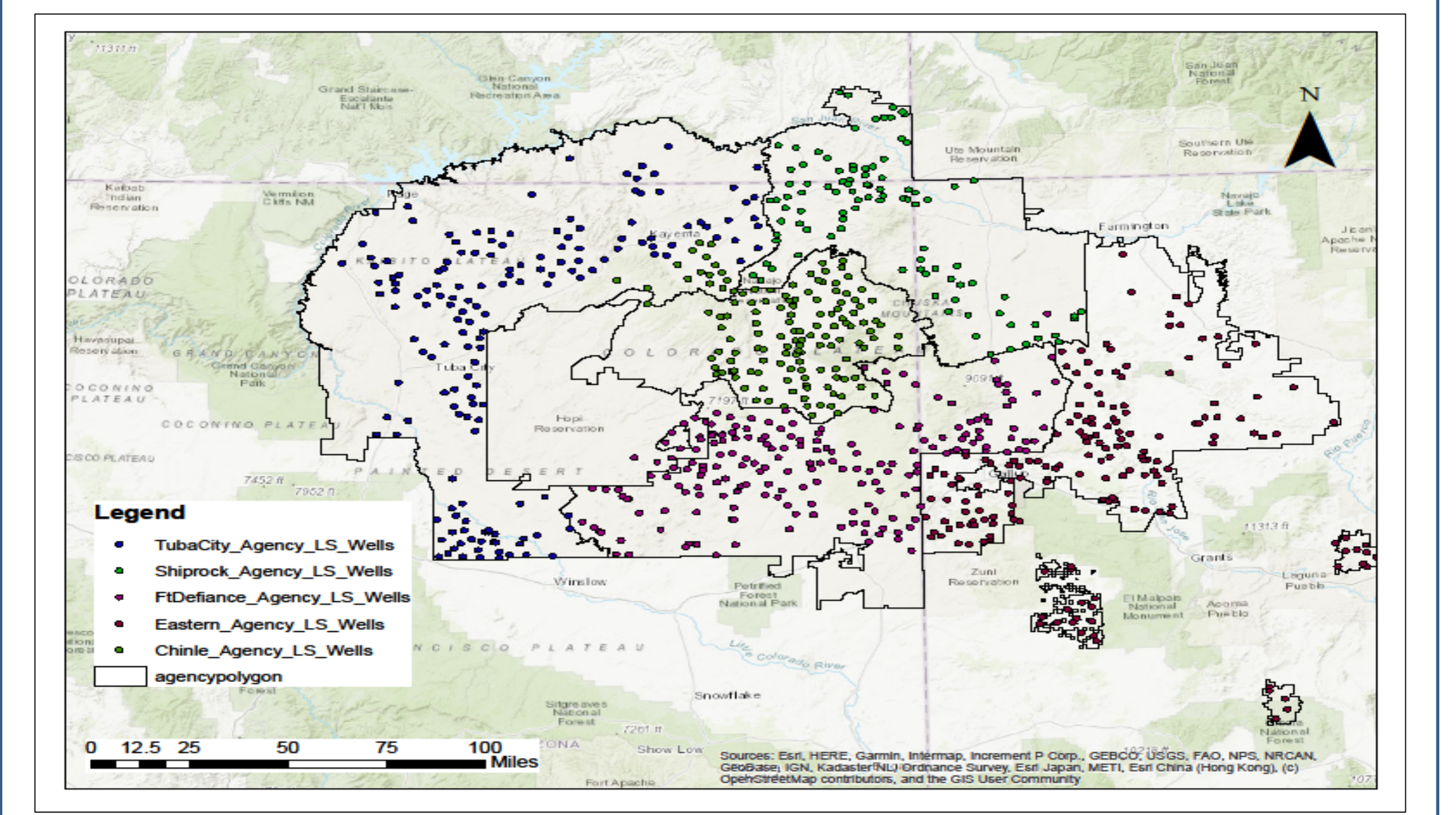
**Fig. 1. Map of homes without water on the Navajo Nation.**  
[Source: The Salt Lake Tribune, July 25, 2020]

- 30% of the homes on the Navajo Nation have no direct access to public water systems.
- Many households haul water long distances to provide water for their families.
- Navajo households are 19 times more likely than white households to be without running water.
- The groundwater contains elevated arsenic and uranium in the Navajo Nation area.
- Cost-effective desalination technologies are highly demanded for reliable water reuse.



**Fig. 2. Livestock well with warning signs.**

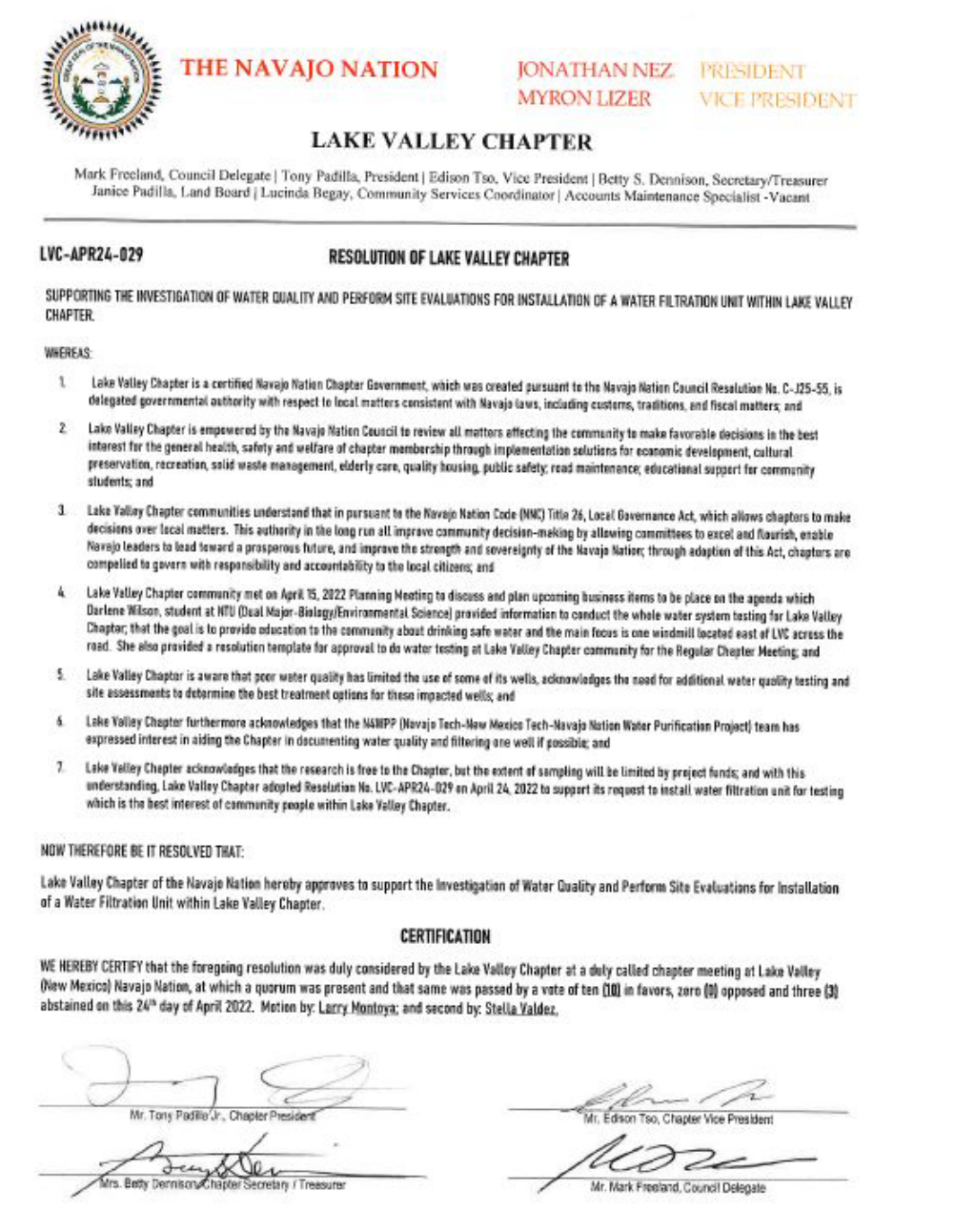
- There are over 700 livestock wells within the Navajo Nation and quality of water is not suitable for human consumption.



**Fig. 3. Over 700 Livestock wells exist on the Navajo Nation with poor water quality.**

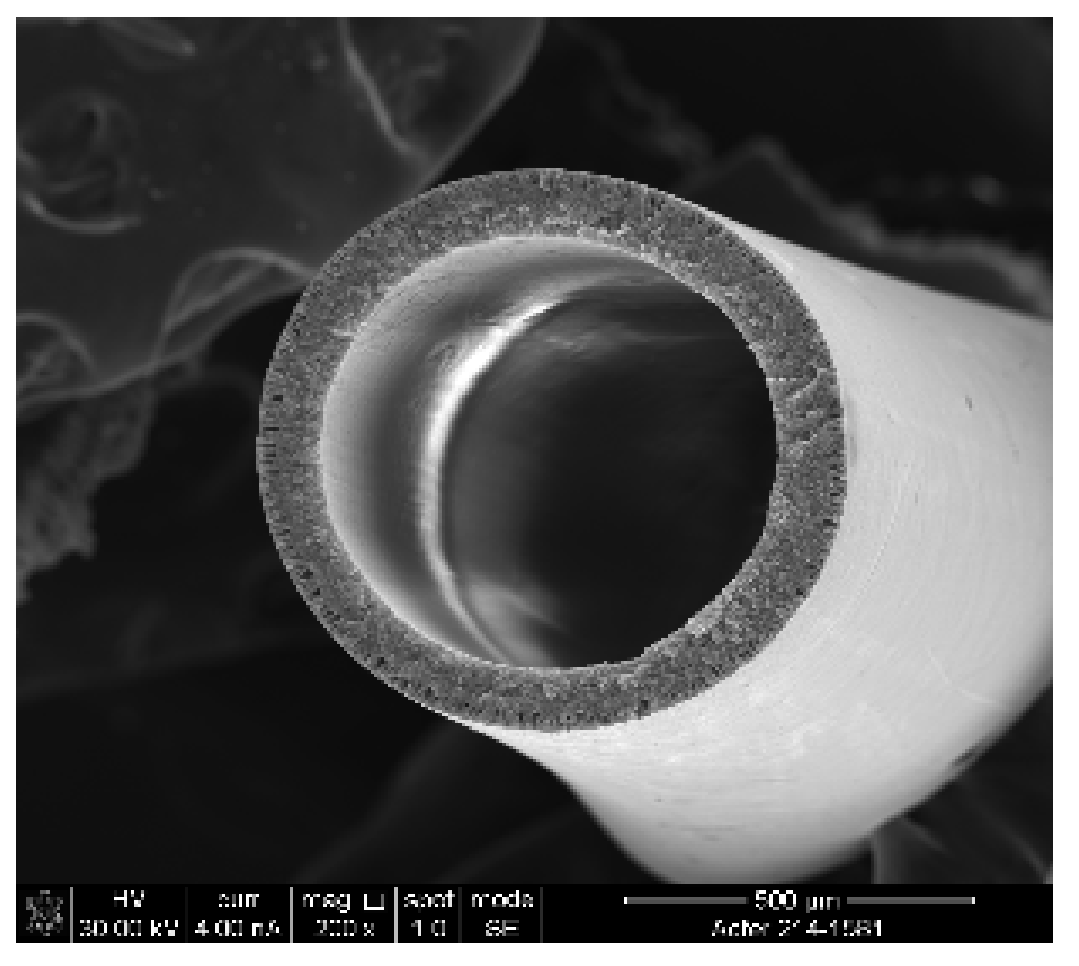
## Methods

- Site selection by testing well water.
- Getting approval from the community.
- We are proposing to install 10 filtration units across the Navajo Nation.



**Fig. 4. Chapter Resolution from Lake Valley chapter.**

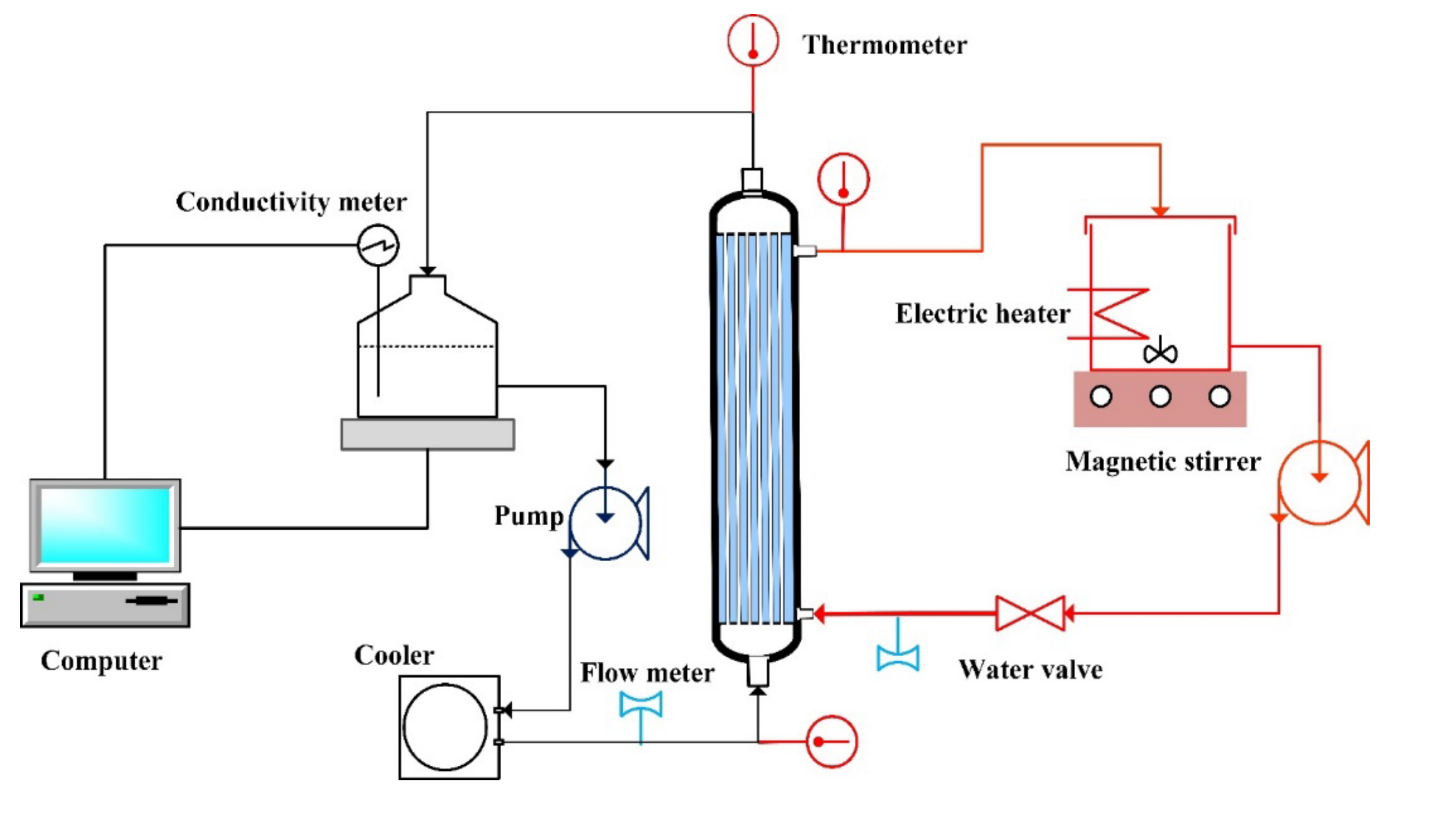
- The technology to be used is direct-contact membrane distillation (DCMD).
- involves the use of a novel hollow-fiber membrane developed by research scientists at the Petroleum Recovery Research Center (PRRC) at New Mexico Tech (NMT).
- Unusable water is channeled through the bundles of hollow-fiber membrane to recover clean water with ultra-high purity.
- Previous studies showed the efficiency of this process for desalination.



**Fig. 5. Microscopic view of the hollow fiber membrane.**

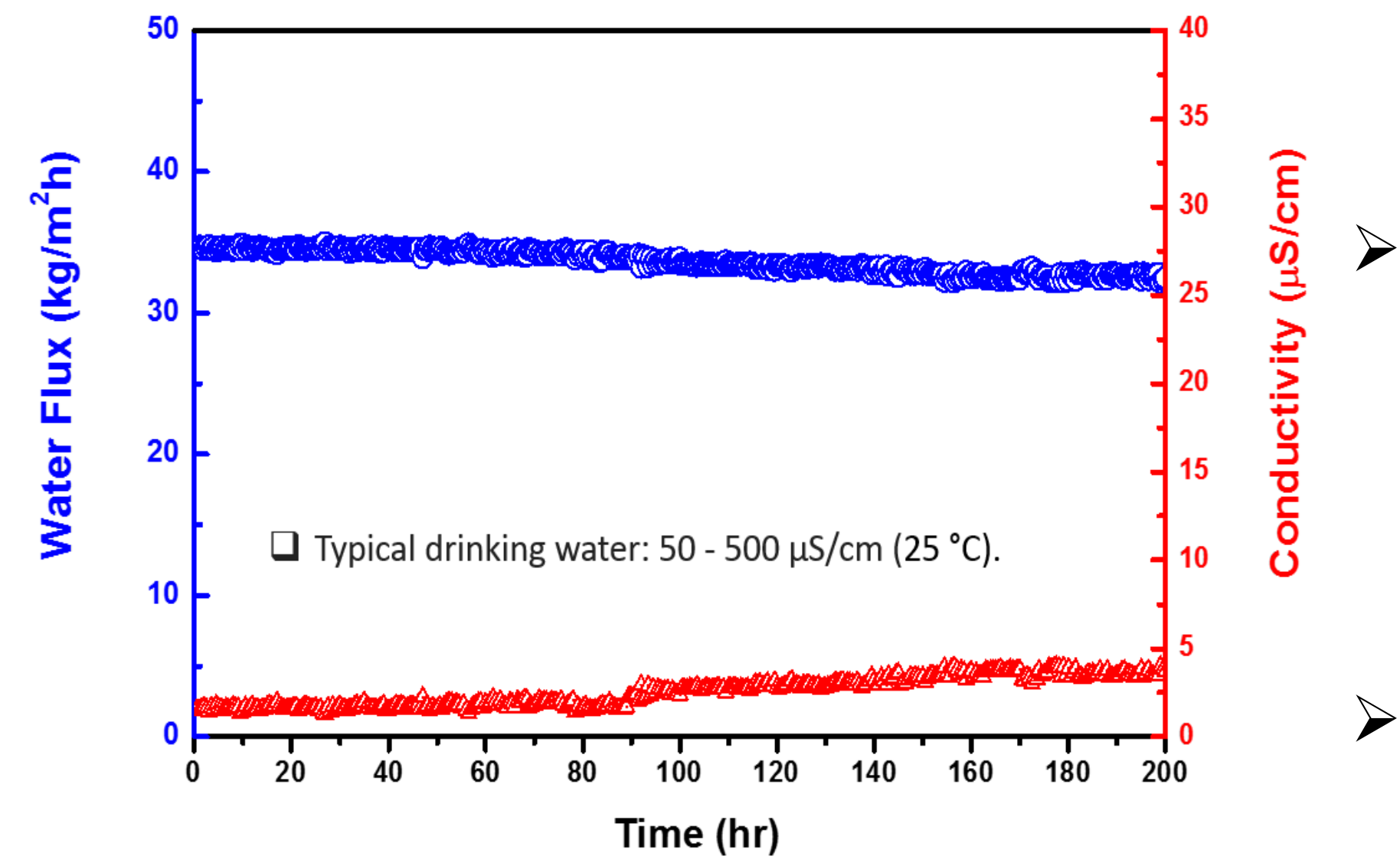


**Fig. 6. Hollow fiber membrane**



**Fig. 7 Schematic diagram of the direct contact membrane distillation process.**

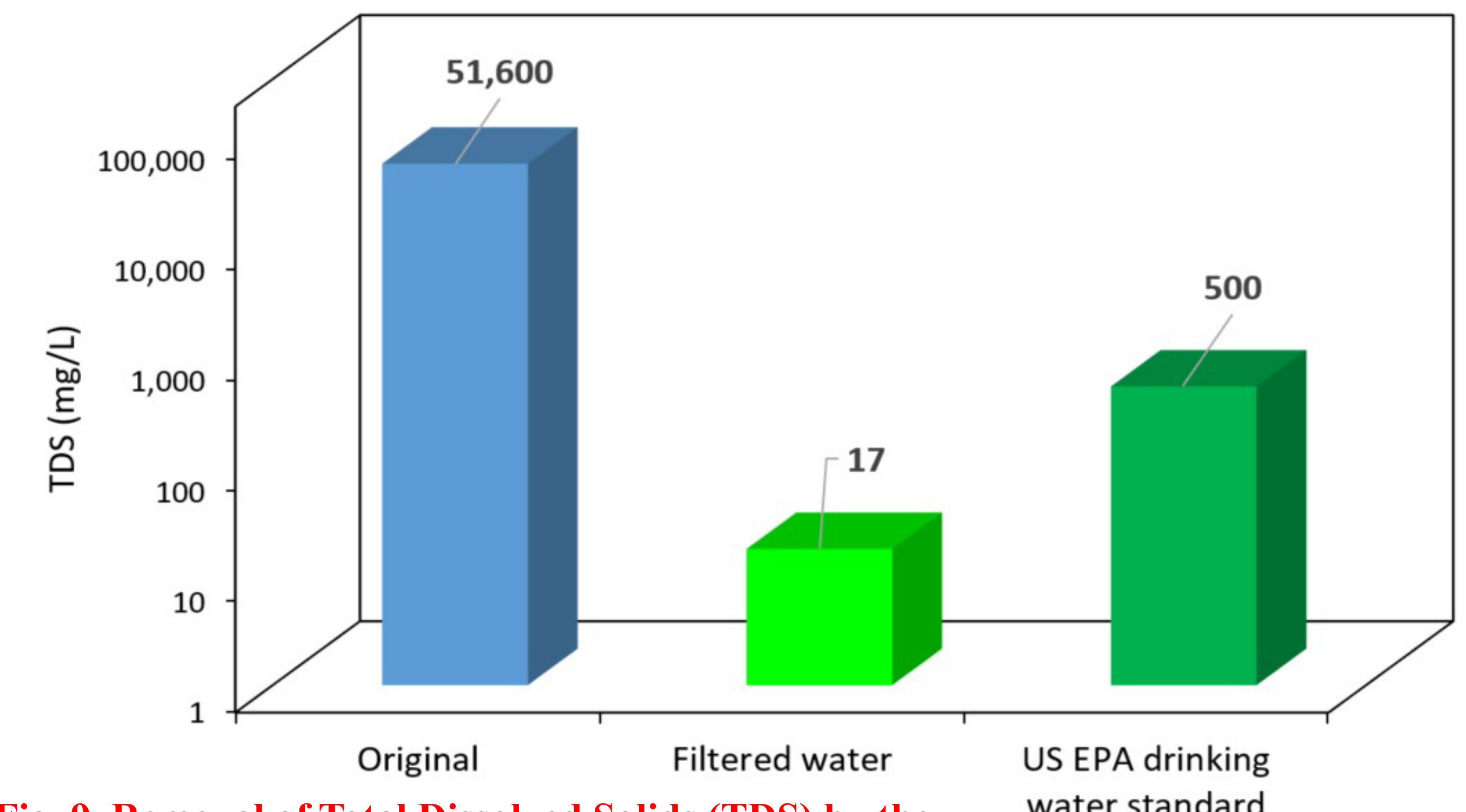
## Results



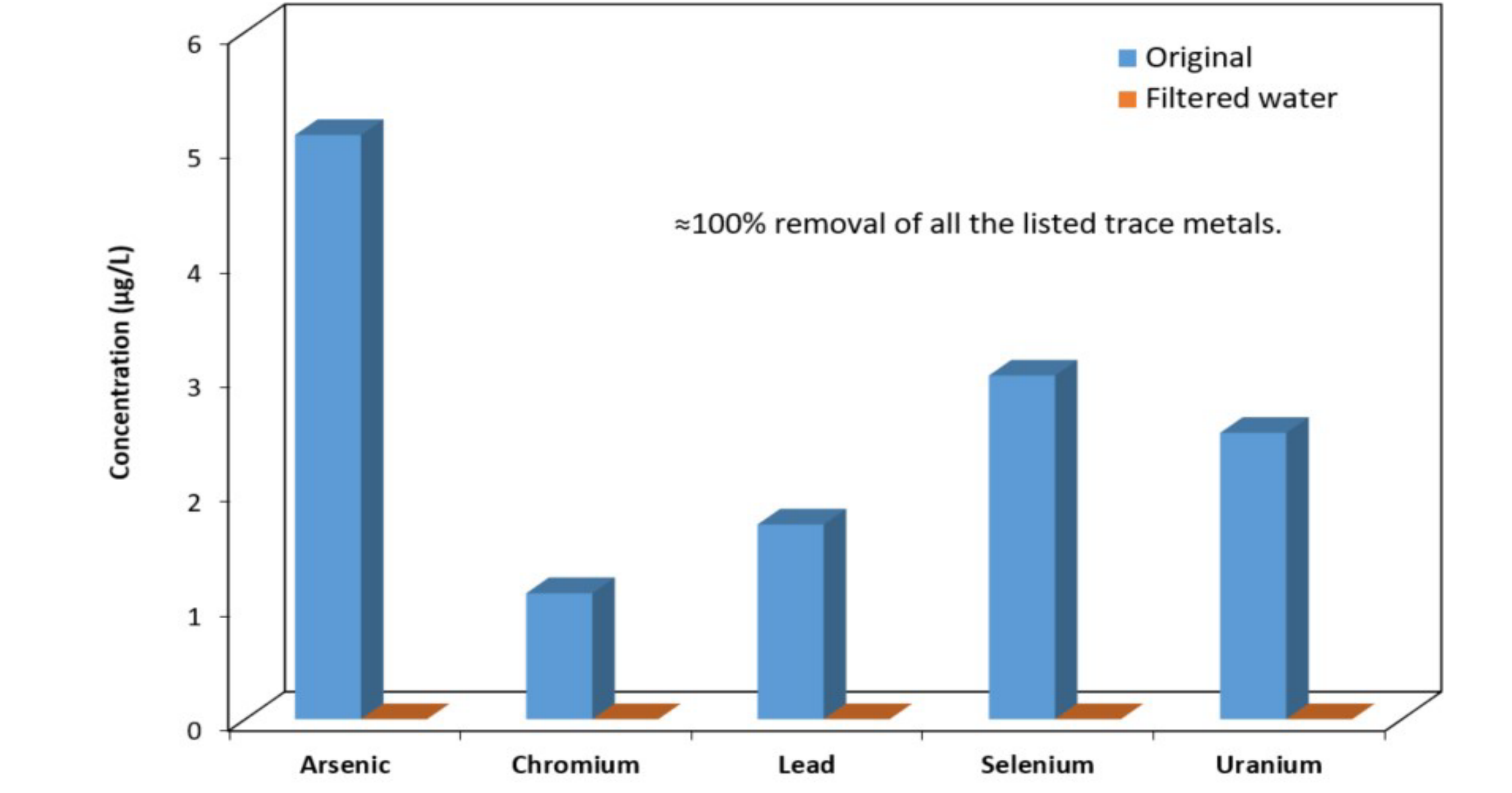
**Fig. 8. Water flux and permeate conductivity during 200 h of continuous desalination operation with a 3.5 wt% NaCl feed solution.**

- **Operating conditions:**  
T-feed: 60°C;  
T-permeate: 20°C;  
Feed velocity: 0.8 m/s  
Permeate velocity: 0.6 m/s
- No significant scaling and wetting during a continuous 200 hours of DCMD operation.

- The permeate water flux is measured by recording the mass of water received at the permeate side, indicating the clean water production rate during the desalination process.
- Conductivity at the permeate side indicates the product water quality, indicating salt rejection of the desalination process.
- Fig. 8 shows that the hollow fiber membranes developed by the New Mexico Tech shows a high-water flux and higher than 99.9% salt rejection in long-term desalination operation. Fig 9 and 10 shows the efficiency of the filtration unit for removal of TDS and trace metals.



**Fig. 9. Removal of Total Dissolved Solids (TDS) by the filtration unit.**

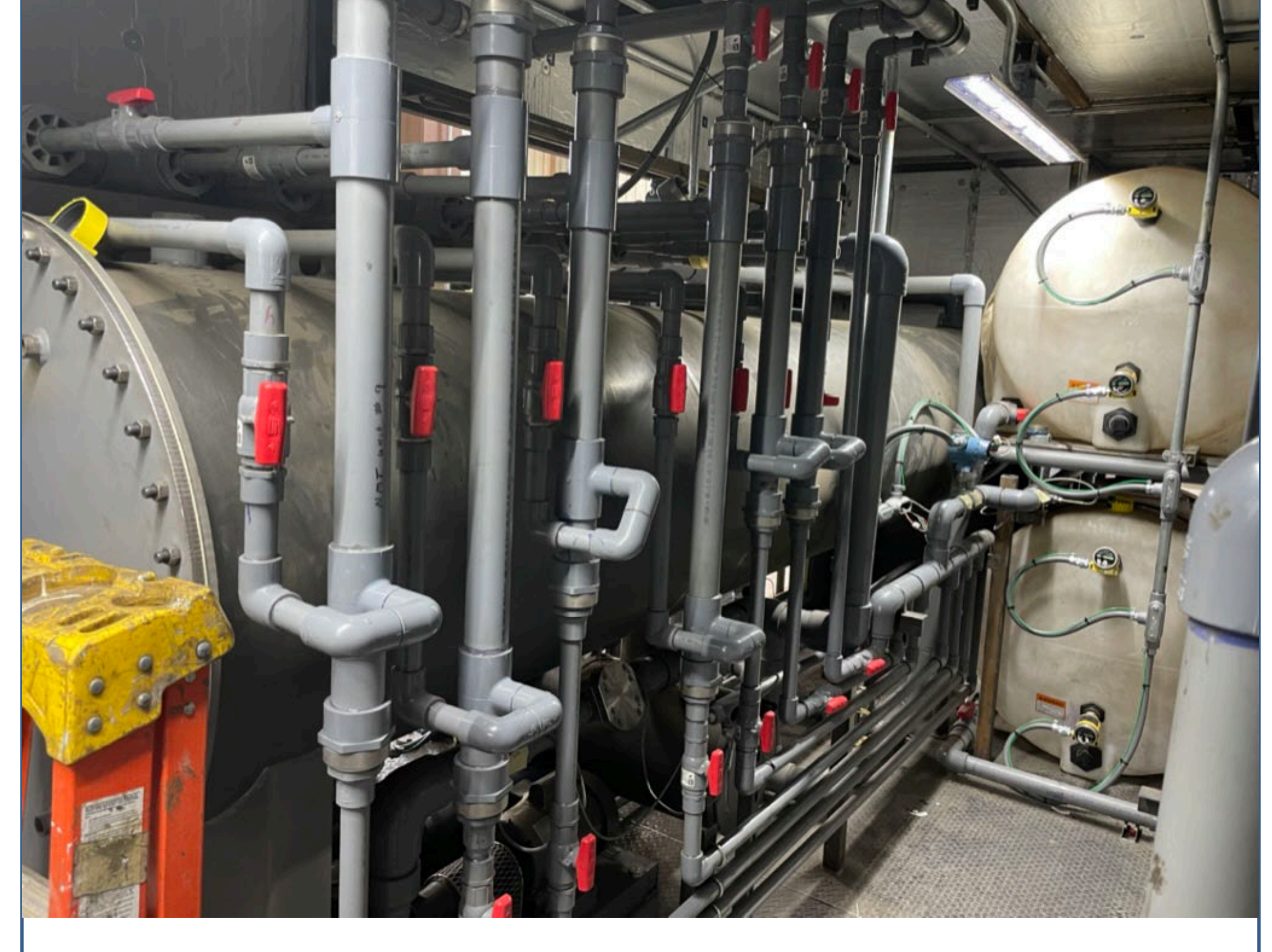


**Fig. 10. Removal of trace metals by the filtration unit.**

## Water Filtration Unit



**Fig. 11. Field deployable filtration unit.**



**Fig. 12. Inside view of the field deployable filtration unit.**

## Acknowledgments

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