

## Potable Rainwater Harvesting System

### Introduction

Located in San Juan, Puerto Rico, the U.S. Army Garrison Fort Buchanan was first established in the 20th century, with its name designated by 1940. Since 2006, Fort Buchanan has been under the direction of Installation Management Command and is the headquarters of the U.S. Army Reserve, 1st Mission Support Command and the Puerto Rico National Guard. Fort Buchanan's primary mission is to *"deliver base support and services to enable holistic readiness for the total force"*.<sup>1</sup> This mission includes approximately 130,000 people working together across three municipalities (San Juan, Guaynabo, and Bayamón), while also serving surrounding communities. The municipal water supplier to Fort Buchanan is the Puerto Rico Aqueduct and Sewer Authority (PRASA).<sup>2</sup> Additionally, Fort Buchanan produces water from an on-site well.

Fort Buchanan faces water system challenges including aging infrastructure, natural hazards, and long-term drought. For example, after Hurricane Maria devastated the entire island of Puerto Rico in 2017, Fort Buchanan had to rely on reverse osmosis water purification units to meet

### Defined Terms

**Potable water** is water that is permitted and treated to levels safe for human consumption.

**Non-potable water** is untreated water that is not safe for human consumption but can be used for other purposes, such as toilet flushing and fire suppression.

**Alternative water** is water sourced from sustainable supplies, serving to mitigate the reliance on fresh surface water and groundwater.



Figure 1. Fort Buchanan welcome gate

potable water needs. A key lesson learned from this disruption was Fort Buchanan's susceptibility to water disruptions that impact the installation's ability to perform its mission.

To help address these challenges, Fort Buchanan has worked to implement water resilience projects including replacing its water distribution system's main pipelines and installing high efficiency water consuming fixtures and equipment. Additionally, Fort Buchanan has installed potable rainwater harvesting systems, an alternative water source and method of resilience, to offset the use of PRASA supplied potable water.

### Rainwater System Pilot Demonstration

In 2018, Fort Buchanan was awarded funding from the Army's Integrated Technology Transition Program (ITTP) to demonstrate a potable rainwater harvesting system. Through the ITTP project, a private contractor was tasked with building, installing, and maintaining the pilot rainwater harvesting system. The installations first fully off-grid potable rainwater harvesting system was installed at the Fort Buchanan Welcome Center. The solar panels and batteries allow the treatment and pumping components to remain functional in the event of a long-term power loss. The intention behind the initial pilot was to demonstrate the effectiveness of the system and determine whether such shipping container mounted systems would be suitable for other buildings at Fort Buchanan. As such, the initial pilot provided an opportunity to create methods for installation, maintenance, and operation of a potable rainwater harvesting system for future successful expansion.

### What is Rainwater Harvesting?

Rainwater harvesting collects precipitation from above ground hard surfaces (e.g. building roofs and parking canopies) for later use. This water can be stored as non-potable and used for approved applications such as landscaping, toilet flushing, and emergency fire response. At Fort Buchanan, additional filtration and disinfection treats the raw rainwater to potable levels. This potable water is then pressurized and piped into adjacent buildings for all water demands, including toilet flushing, faucets, lavatories, showers, hand washing and water fountains.

### Pilot Equipment Description

The main components of the rainwater harvesting system are represented in Figure 2 and indicated by the below numbering:

1. First Flush Diverter: screens for large debris, such as leaves or sticks
2. Raw Water Storage Tank: collects rainwater prior to treatment
3. Overflow: allows for water to drain from the raw water storage tank when it reaches capacity
4. Meters: measures flow rate and consumption
5. Filtration system: filters particulates through carbon and micron filters

<sup>1</sup> Information was obtained from U.S. Army Fort Buchanan website: <https://home.army.mil/buchanan/about/mission>

<sup>2</sup> Information was obtained by Pacific Northwest National Laboratory (PNNL) for ITTP proposal in 2018

<sup>3</sup> Photos taken by PNNL February 2024

6. Treated water and hydropneumatics bladder tank: adds chemicals for disinfection to potable water standards and pressurizes water to distribute to the building
7. Solar power batteries: stores energy from solar panels to power the system
8. Solar panels and communication network: generates electricity as an off-grid energy source and communicates data using a cellular-based network for system data logging

### Pilot Results and Lessons Learned

Overall, the pilot rainwater harvesting system is considered a success. In the first year of operation, the system collected over 22,000 gallons of water and met the potable water demand of the Welcome Center.<sup>4</sup> Some key lessons learned from the demonstration project include:

**Consistent maintenance is vital:** The contractor initially provided all the operations and maintenance of the system. After the first year, the system operation was turned over to the installation. With staffing constraints, the solar batteries were not maintained properly, and the system went offline but became operational after the maintenance contract was re-issued. Although the system treatment components were fully functional, loss of power led to system degradation.

**Ample room for accessing equipment is important:** The pilot system was skid mounted, for ease of shipping; however, that system configuration left little space for accessing or modifying the equipment. The newer treatment systems are housed in a standard shipping container.



**Figure 2.** The main components of the pilot potable rainwater harvesting system

### Rainwater System Expansion

With the lessons learned from the Welcome Center pilot, Fort Buchanan moved forward with establishing additional systems onsite. As of December 2023, Fort Buchanan has 20 potable water harvesting units in use, serving a variety of building types: health clinic, data center, bowling alley, and administration.<sup>5</sup> These systems are currently operated and maintained by a contractor, ensuring proper water treatment and system function.

### Larger Scale Applicability for Future Systems

The solar powered potable rainwater harvesting systems at Fort Buchanan can largely be considered a success story and an example for a variety of buildings and

campuses seeking ways to attain resilient water infrastructures. If your agency is interested in implementing rainwater harvesting, the Federal Energy Management Program ([FEMP Rainwater Harvesting Tool](#)) is a way to assess the viability across the United States. This tool allows users to determine the potential of harvesting rainwater at their installation. Following this, installation managers can work with private contractors to determine what rainwater harvesting system would satisfy their water resiliency needs.

### For More Information

[FEMP alternative water sources](#)

[FEMP best management practices for water efficiency](#)

[Fort Buchanan website](#)



**Figure 3.** Newest model of rainwater system

<sup>4</sup> System water storage was obtained by PNNL from metered data collected in 2019

<sup>5</sup> Number and type of rainwater harvesting units in use obtained during PNNL February 2024 site visit



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