Thank you Susan and ……
I used to work in India. At that time the city of Mumbai was known as Bombay. As a young man, I saw firsthand the destabilizing effects of a water-deprived region.

Freshwater scarcity is a real issue that impacts many people around the world. Today, nearly 2.8 billion people lack clean water for drinking or cooking for at least one month out of the year. There are billions more that lack access to sufficient freshwater for adequate sanitation.

In fact, freshwater scarcity is one of the 21st century's decisive, looming challenges and is driving the new political, economic and environmental realities across the globe.

- Water is our most vital resource – it supports life and life support systems.
- Over 70% of our Earth's surface is covered by water.
- 97.5% of all water on Earth is salt water, leaving only 2.5% as freshwater.
- Nearly 70% of that freshwater is frozen in the polar icecaps; the remainder is present as soil moisture, or lies in deep, inaccessible underground aquifers.
- That leaves about 1% of the world's freshwater accessible for direct human uses.
This amount will continue to decrease as the world’s population expands (7.2 billion - 2018, 9.6 billion-2050).

Additionally, current and future water supplies are being degraded by pollution from:
- domestic waste,
- solid waste,
- industrial effluent,
- agricultural drainage and
- commercial development.
What can we do to help? Well, today we'll talk about how we can help conserve water in our mechanical designs with rainwater harvesting and greywater recycling systems.
Rainwater harvesting is the process of collecting, conveying and storing rainwater for future beneficial uses.
It is the oldest method of securing water and was practiced by early civilizations over 4,000 years ago.
Today, there is a renewed interest in rainwater harvesting for:

- reducing consumption of treated water.
- reducing the flow to stormwater drains in order to reduce non-point source pollution.
When describing rainwater harvesting, sometimes the terminology can be misapplied.

**Harvested Rainwater** - Storm water that is conveyed from a building roof, stored in a cistern and filtered and disinfected before being used for non-potable uses such as toilet flushing, irrigation, cooling tower makeup water, etc.

**Reclaimed Water** - Water which, as a result of tertiary treatment of domestic waste water by a public agency, is suitable for a controlled use. The controlled use can be the supply of reclaimed water to water closets, urinals, irrigation and trap seal primers for floor drains and floor sinks.

**Grey Water** - Untreated waste water that has not come in contact with toilet waste. Grey Water includes used water from bathtubs, showers, lavatory sinks and washing machines. It does not include wastewater from kitchen sinks or dishwasher.

**Black Water** - Toilet waste.
Rainwater Harvesting Systems
Rainwater Harvesting involves:

- Collection
- Storage
- Treatment
- Delivery
Driving Forces
The use of rainwater harvesting has become more wide-spread to reduce the environmental imp...
In some areas users see tax breaks for the installation of water harvesting systems.
NO ALTERNATIVE – NO OTHER WATER SUPPLY IS AVAILABLE!

CASE HISTORY: PROVIA – SUGARCREEK, OH
PROVIA WATER CHALLENGES

- **Project Profile**
  - Water Demand: 45,000 gallons per day (domestic water)

- **Water Supply - 3-Drilled Wells**
  - 2-15 gpm
  - 1-0 gpm

- **Alternate Water Supply - 1 mile pipe run from local municipality**
  - Initial Cost of $325,000.00
  - Average Annual Cost of $300,000.00
YOU AIN'T GONNA MISS YOUR WATER UNTIL YOUR WELL RUNS DRY.

Bob Marley
Jamaican singer-songwriter and musician
(1945-1981)

Song - Could You Be Loved.
Conceptual Design:
- 544,000 sq./ft. roof area
- 17 Vortex Filters
- 2-60,000 Gallon UG Cisterns
- 3-30,000 Gallon AG Day Tanks
- Transfer Pumps
- Filtration/Disinfection Skid Booster Pump
- Controls
PROVIA DOOR SUGAR CREEK, OH
(2) 60,000 GALLON UNDERGROUND CISTERN
NON-POTABLE WATER REUSES

- Lawn and landscape irrigation
- Toilet flushing
- Laundry washing
- Cooling towers
- Fire water supply
- Dust control

- Building washing-power washing
- General “household” cleaning
- Industrial processing
- Pool/pond filling
- Vehicle washing
Packaged systems typically consist of:

- First Flush Filter
- Rainwater Collection Tank (Cistern)
- Duplex Submersible Feed Pumps with Floating Suction
- Advanced Water Filtration / Disinfection System
- Day Tank
- Booster Pac with Controls
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RAINWATER HARVESTING COMPONENTS


There are six fundamental components of a rainwater harvesting system:
Rainwater Storage Tank Sizing Procedures

1” of rainfall over 1 sq. ft. of area = .623 gallons

Basically 600 gallons of water can be collected per inch of rain from 1,000 sq. ft. of roof area!
These channel water from the roof to ground level and need to be routed to a collection point on the way to the water storage tank.

Utilize gutter guards on rain gutters when possible to help minimize debris and leaf litter.
These components convey rainwater from the roof to the storage tank and remove debris, dust and dirt.

They can be either inserted into the downspouts or pre-engineered and installed in front of the water storage tank to filter the water before it gets to the storage tank.

Preliminary treatment reduces maintenance and helps protect downstream equipment.
Typical storage tank sizes range from 500 to 5,000 gal. (residential) 5,000 to 60,000 gal. (commercial, industrial, institutional).

Depending on the site suitability, storage tanks can be located below ground or above ground (horizontal or vertical).
Common Connections/Penetrations:
- Inlet
- Outlet (Pump)
- Overflow
- Vent
- Manway Access
- Pump Access
- Sensor/Gauge
JACKSONVILLE NAS, FL
20,000 GALLON RAINWATER COLLECTION TANK
(NOTE: ACCESS WAYS AND OVERFLOW)
HENRICO COUNTY, VA JUNIOR HIGH SCHOOL
50,000 GALLON RAINWATER COLLECTION TANK
(NOTE: INLET, PUMP MOUNT)
NYDOS-NEW YORK, NY
20,000 GAL. RAINWATER
COLLECTION TANK
(NOTE: INSULATION)
HBO COMMUNICATION CENTER - HAUPPAUGE, NY
25,000 GALLON RAINWATER
DETENTION/RETENTION STORAGE TANK
5. Treatment / Disinfection System: Filters and other methods of treatment include but are not limited to:

- **Treatment**
  - Screens/mesh; filters (sand, activated carbon or membrane); ultra filtration
  - manual or automatic back flush
FILTRATION SYSTEM
(NOTE: PURPLE PIPE)
RAINWATER HARVESTING

• Disinfection
  • Ultraviolet (UV)
  • Chlorination - chlorine (Cl₂) or hypochlorite.
Ultraviolet (UV) - uses electromagnetic radiation to decontaminate water to be treated…
UV damages microbes DNA.
UV WATER PURIFICATION

Pros:
• Effective against viruses, spores and cysts
• Physical process – no chemicals
• No residual affects
• Short contact time
• Small space requirement
• Recirculation
• Relatively low cost and maintenance

Cons:
• No residual disinfection
Chlorination is used to kill certain bacteria and other microbes in water as chlorine is highly toxic…it breaks chemical bonds in microbes molecules.
CHLORINATION

Pros:
• Effective against pathogens
• Well-established technology
• Cost effective
• Measurable - accurate dosing control
• Eliminates odors
• Residual disinfection

Cons:
• Chemical handling and storage
6. Distribution and System Controls: Typically systems are gravity fed and pumped to the ultimate end use.
   - Day Tank - the source of water for the Non-Potable Water Booster Pump(s) with controls.
   - System controls that monitor the water level in the day tank and switch automatically to municipal supply and/or well water intake are common for larger, more complex systems.

This feature allows the water level in the day tank to be maintained regardless of the amount of rain collected and can monitor the flow of total water used (harvested water versus replenishment water).
A day tank is typically sized to provide a day's worth of water usage. This configuration requires a backflow preventer or an air gap to ensure communication does not occur between the harvested rainwater and the water mains.
Booster Pump(s) pump the water to the ultimate end use.

- Controls – operation; monitoring; tied into building management system
- Power Supply – 120/240/480v; 1-phase, 3-phase
- Enclosure – NEMA rated for Indoor / Outdoor usage
A separate piping system must be provided for harvested rainwater distribution. The pipe should be labeled and color coded to indicate non-potable water (purple pipe).
Explain difference
Rainwater Harvesting System $84,943.80
15,000 Gal. Vert RCT $77,499.00.

The corporation wanted more than just being seen to be green, they wanted control over volume and quality of water for their agri-research.
To help the engineers and customers calculate the return on investment of a rainwater harvesting system, there are Interactive Rainwater Payback Calculators available. Once the correct data has been inputted, the calculator will compute the total gallons of water saved over the life of the system as well as the dollar savings and payback period.
Greywater Recycling Systems
Grey water recycling system includes process of:

- collecting grey water
- removing the large suspended particles / debris
- aeration or freshening
- filtration and disinfection
- delivery
TYPICAL GREYWATER RECYCLING SYSTEM

Surface Irrigation → Hand Basin → Clothes Washer → Shower Bath → Toilets

Overflow to Sewer

Treated Water Storage

Chlorine contact → Ultraviolet → Ultraviolet → Biological Treatment → Scavenge

Backwash

To Sewer
GREYWATER RECYCLING

- This configuration produces water for cooling towers, irrigation and fixture flushing (toilet/urinal flushing requires disinfection).
- Enough storage for 1 or 2 days demand.
- Tank water should turn at least every 3 - 7 days (code dependent).
Air Conditioning Condensate can be included with a greywater harvesting system.

Advantage of condensate capture is that its maximum production occurs during the hottest months, when the need is the greatest.
Case History: Air Operation Center, Qatar
Condensate Recovery System

• Scope of Equipment
  • Rectangular Day Tank
  • Filtration Skid
  • Multi-Media Filter
  • Activated Carbon Filter
  • UV Disinfection
  • Chlorine Injection w/ ORP
  • Dye Injection
  • Aeration System
  • Recirculation Pump
  • Control Panel
  • Booster Pump
    • Duplex
On a hot, humid day, the amount of condensate produced equals about 10 gallons per minute. Even if this system runs hard for just three summer months, it will produce 1,314,000 gallons of water!
ORP (also referred to as redox) is a measurement of the electromotive force (EMF) generated when an oxidant is present in an aqueous solution. Measurable in millivolts (mV), the strength of this force is directly proportional to the oxidative strength of the treated system. The higher the concentration of the oxidant, the higher the voltage. Conversely, the higher the concentration of the reductant (i.e. E-Coli, organic material, etc.), the lower the voltage. A redox sensing instrument, which detects this voltage, can be used to monitor the chlorine demand.
FIU Sump and Pumps
We see opportunities for this type of systems throughout the United States. In many buildings, HVAC condensate is discarded and simply sent down the sewer. However, at FIU the condensate is captured and pumped back for reuse on campus, primarily as makeup water for the central plant’s cooling towers. That means that instead of buying thousands of gallons of treated, potable water from the city to replenish its cooling towers, FIU saves a considerable amount of money as well as a precious resource.

To conclude...Learning how to manage our crowded planet's freshwater resources in both an economically viable and environmentally sustainable manner is the 21st century’s ultimate challenge. Those societies that find the most innovative responses are most likely to come out as winners, while others will fall behind.

I want to thank you all for your time and the opportunity to speak here today.
Questions?

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