Envisioning Water at the Installation of the Future

May 2, 2023, 2:30 p.m.

HOUSEKEEPING NOTES & TIPS

- ☑ Take Note of Emergency Exits
- ☑ Silence Your Mobile Devices
- ☑ Thank You to Our Sponsors!
- ☑ Questions will be addressed in the allotted time
- ☑ Presentations will be posted in the Attendee Service Center (ASC) post conference

Thank You to our Education Session Sponsors!

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Envisioning Water at the Installation of the Future

Moderator: Noah Garfinkle, Civil Engineer, US Army Engineer Research and Development Center

Speakers:

- Kate Stoughton, Technical Advisor, Pacific Northwest National Laboratory
- Kylie Burkett, Civil Engineer, US Army Engineer Research and Development Center
- Juan Gomez, Mechanical Engineer, US Army Engineer Research and Development Center

JETC Joint Engineer Training Conference & Expo

2023

JOINT ENGINEER TRAINING CONFERENCE & EXPO

MISSION SUCCESS STARTS HERE

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MAY 2-4 2023

San Antonio, TEXAS

Noah Garfinkle

Fun Facts

Infrastructure resilience researcher and chief of ERDC's WURST Research and Development Program (Water Use, Resilience, Security, and Technology)

- Kansas City sports fan (Chiefs, Royals, KU Jayhawks)
- Part-time PhD student at the University of Illinois

Kate Stoughton

Fun Facts

- Joined Pacific Northwest National Laboratory in 1993
- Works remotely since 1999
- Hobbies include gardening, hiking, and traveling

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MAY 2-4 2023

San Antonio, TEXAS

Kylie Burkett

Fun Facts

Research Civil Engineer

WURST Research and Development Program

- Bachelor's and Master's Degree in Civil Engineering from the University of Illinois at Urbana-Champaign
- Favorite sport is Rugby
- I enjoy... reading, traveling, and listening to podcasts

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MAY 2-4 2023

San Antonio, TEXAS

Juan Gomez

Fun Facts

Research Mechanical Engineer

WURST Research and Development Program

- Bachelors in Aerospace Engineering
- Hobbies: Microgreen Growing and Video Games

ENVISIONING WATER AT THE INSTALLATION OF THE FUTURE

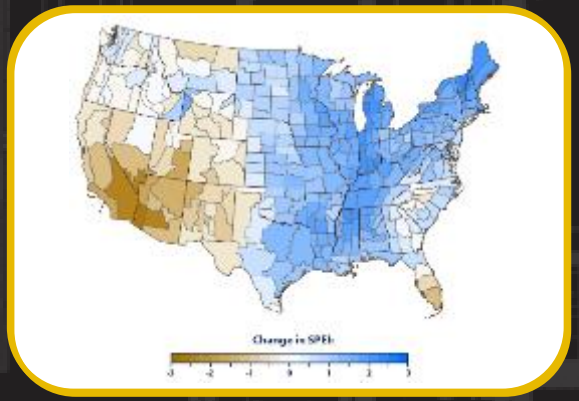
U.S. ARMY

US Army Corps of Engineers

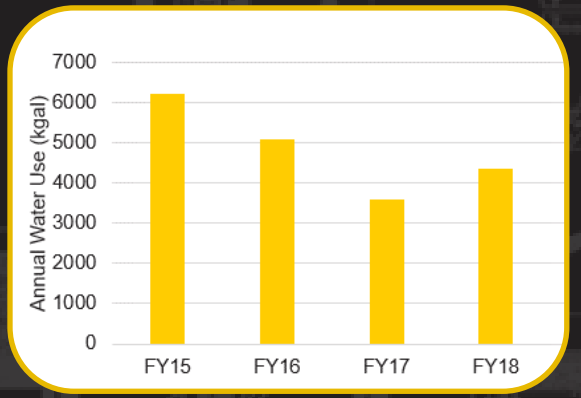
U.S. DEPARTMENT OF ENERGY

Pacific Northwest NATIONAL LABORATORY

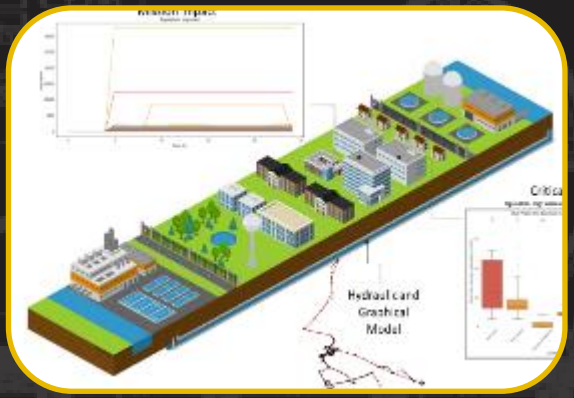
DRIVERS



WATER SOURCES



WATER USE & EFFICIENCY



FUTURE WATER SYSTEMS

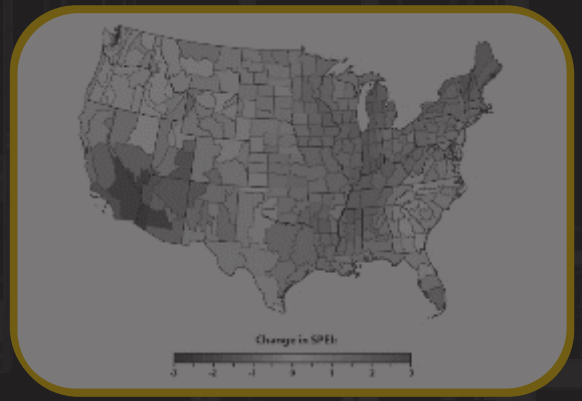
U.S. ARMY

US Army Corps of Engineers

U.S. DEPARTMENT OF ENERGY

Pacific Northwest NATIONAL LABORATORY

DRIVERS



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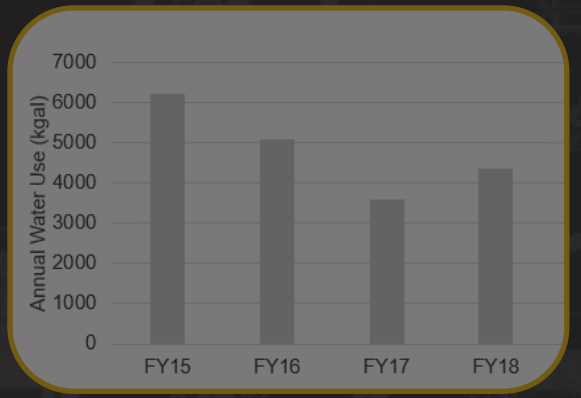

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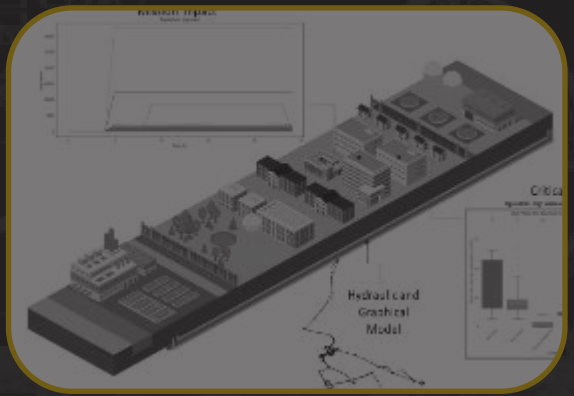


FUTURE WATER SYSTEMS

U.S. ARMY

US Army Corps of Engineers

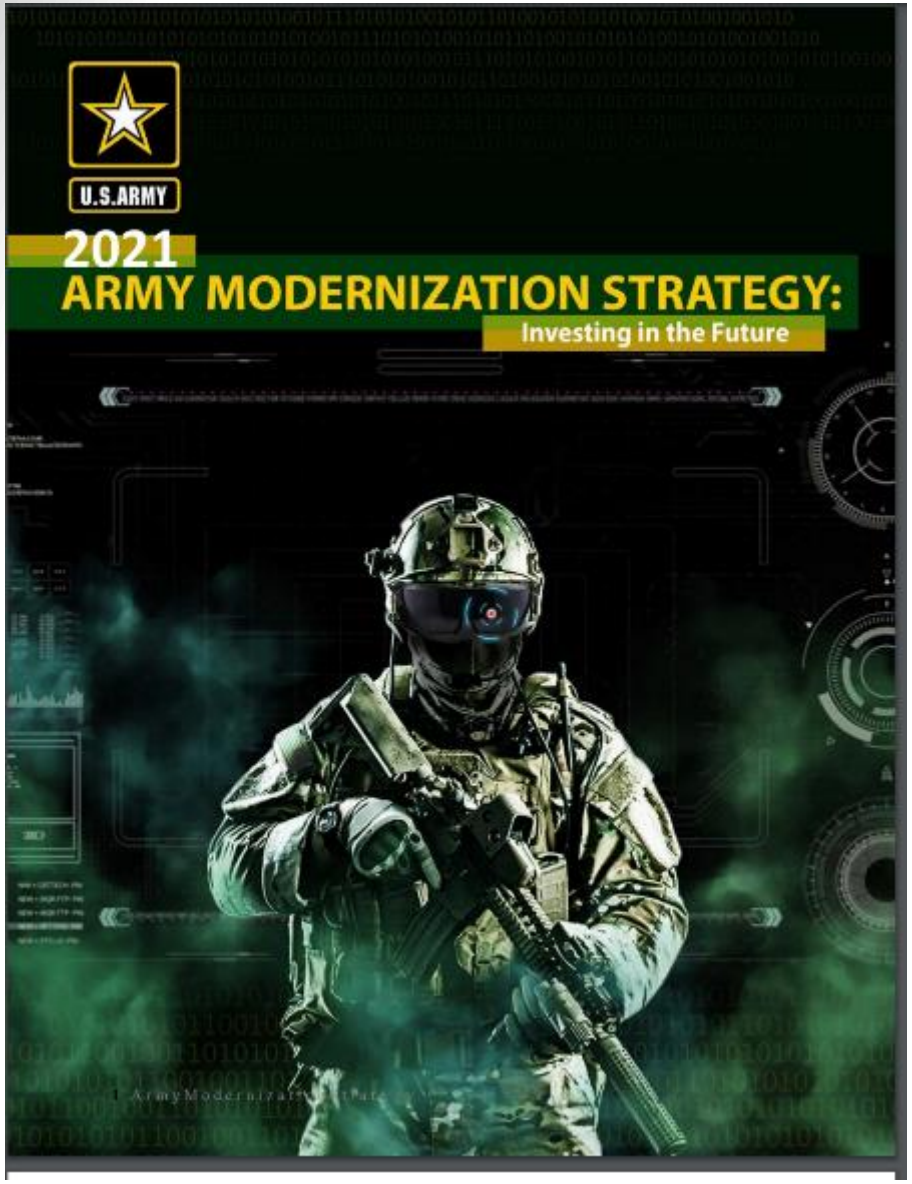
WHY SHOULD THE INSTALLATION OF THE FUTURE CARE ABOUT WATER?

Every installation mission depends on water.

Getting the right amount of water to the right place, at the right quality, takes a lot of infrastructure.

Ensuring installations have enough water does not fit neatly with existing mission assurance constructs.

WHY SHOULD THE INSTALLATION OF THE FUTURE CARE ABOUT WATER? MISSION



- How we fight
- What we fight with
- Who we are

WHY SHOULD THE INSTALLATION OF THE FUTURE CARE ABOUT WATER? OPERATING ENVIRONMENT

Infrastructure Failures

Environmental Contamination

Physical Attack

Cyber Attack

Drought

Aging Infrastructure

Energy-Water Nexus

Drinking Water Contamination

WHY SHOULD THE INSTALLATION OF THE FUTURE CARE ABOUT WATER? POLICY

FY21 NDAA Section 2827

Requirements (e) Implementation

(1) REPORT REQUIRED.—Not later than one year after the date of the enactment of this Act, the Secretary of Defense, in coordination with the other Secretaries concerned, shall submit to the Committees on Armed Services of the Senate and the House of Representatives a report on the progress made in implementing this section.
(2) REPORT ELEMENTS.—The report shall include the following:
(A) The methodology developed under subsection (b) *to conduct* water management and security *assessments*.
(B) A list of the military installations that have been assessed using such methodology and a description of the findings.
(C) A list of planned assessments for the one-year period beginning on the date of the submission of the report.
(D) An evaluation of the progress made on implementation of xeriscaping and other regionally appropriate landscaping practices at military installations.

(a) RISK BASED APPROACH TO INSTALLATION WATER MANAGEMENT AND SECURITY.
(1) GENERAL REQUIREMENT.—The Secretary concerned shall adopt a risk based approach to water management and security for each military installation under the jurisdiction of the Secretary.
(2) IMPLEMENTATION PRIORITIES.—The Secretary concerned shall begin implementation of paragraph (1) by prioritizing those military installations under the jurisdiction of the Secretary that the Secretary determines—
(A) are experiencing the greatest risks to sustainable water management and security; and
(B) face the most severe existing or potential adverse impacts to mission assurance as a result of such risks.
(3) DETERMINATION METHOD.—Determinations under paragraph (2) shall be made on the basis of the water management and security assessments made by the Secretary concerned under subsection (b).
(b) WATER MANAGEMENT AND SECURITY ASSESSMENTS.—
(1) ASSESSMENT METHODOLOGY.—The Secretaries concerned, acting jointly, shall develop a methodology to assess risks to sustainable water management and security and mission assurance.
(2) ELEMENTS.—Required elements of the assessment methodology shall include the following:
(A) An evaluation of the water sources and supply connections for a military installation, including water flow rate and extent of competition for the water sources.
(B) An evaluation of the age, condition, and jurisdictional control of water infrastructure serving the military installation.
(C) An evaluation of the military installation's water security risks related to drought-prone climates, impacts of defense water usage on regional water demands, water quality, and legal issues, such as water rights disputes.
(D) An evaluation of the resiliency of the military installation's water supply and the overall health of the aquifer basin of which the water supply is a part, including the robustness of the resource, redundancy, and ability to recover from disruption.
(E) An evaluation of existing water metering and consumption at the military installation considered at a minimum—
(i) by type of installation activity, such as training, maintenance, medical, housing, and grounds maintenance and landscaping; and
(ii) by fluctuations in consumption, including peak consumption by quarter.

Water Banking to Support Installation Resiliency

Water Banking to Support Installation Resiliency

The committee is concerned about the threat of drought and water insecurity, particularly for military installations in the western United States that are wholly or in part west of the Continental Divide. The committee contends that resiliency planning, particularly installation resiliency master planning, must be a key priority for the military departments to ensure that wise investments are made to ensure efficient management and storage of this resource and to model future requirements. Accordingly, the committee directs the Secretary of Defense to submit a report to the House Committee on Armed Services not later than April 1, 2022, that shall at a minimum contain the following:

(1) the results of a survey of water resources in the western United States providing water to military installations;

(2) **the amount of water purchased on behalf of military installations in the western United States by the Department** annually;

(3) a description of how **such water (total)** is stored and by what means (surface, subsurface, or by other means) by military installations;

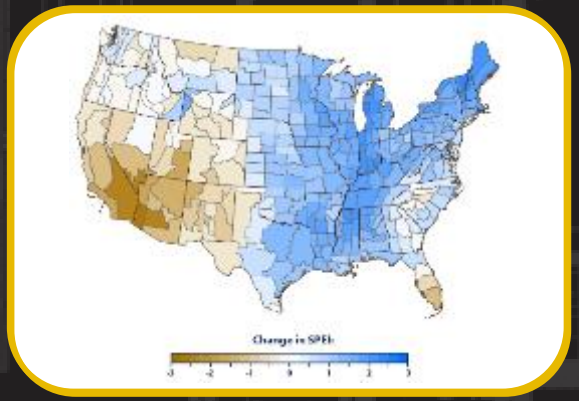
(4) the amount of such purchased water that is stored as emergency reserve for the installation;

(5) risk factors that could contribute to the loss of such purchased water resources;

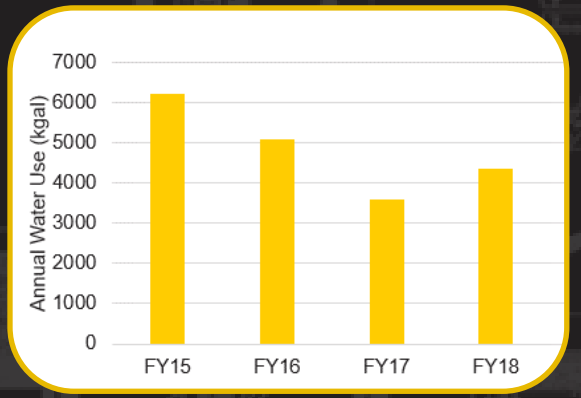
(6) a discussion of alternative storage methods that could provide additional resiliency; and

(7) the potential for regional transfers of purchased water to mitigate water insecurity or achieve resiliency.

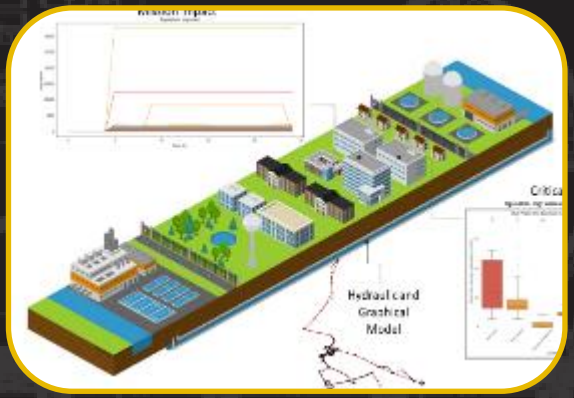
DRIVERS



WATER SOURCES



WATER USE & EFFICIENCY



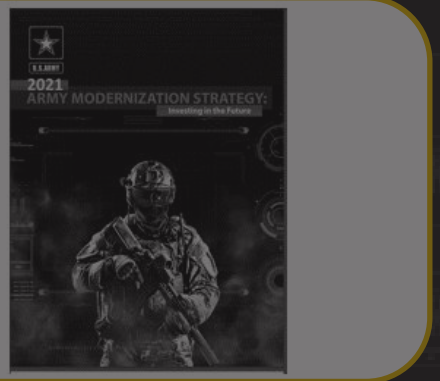
FUTURE WATER SYSTEMS

U.S. ARMY

US Army Corps of Engineers

U.S. DEPARTMENT OF ENERGY

Pacific Northwest NATIONAL LABORATORY



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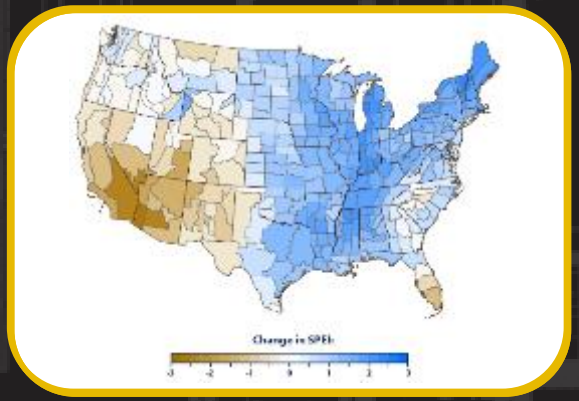

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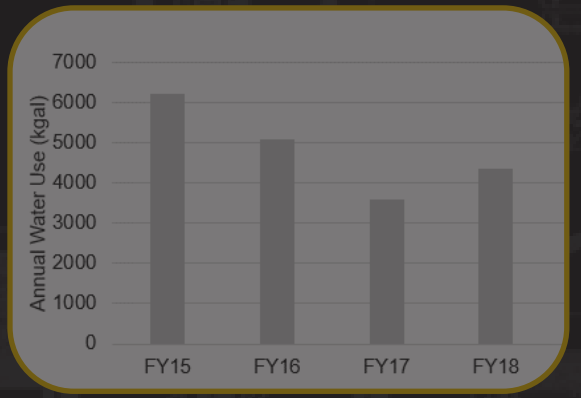

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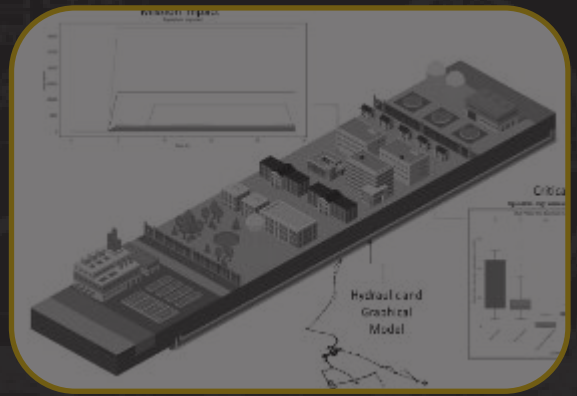


FUTURE WATER SYSTEMS

U.S. ARMY

US Army Corps of Engineers

Do you know what percent of water on earth is available for human consumption?

a) 50%
b) 20%
c) 1%
d) 10%
e) 80%

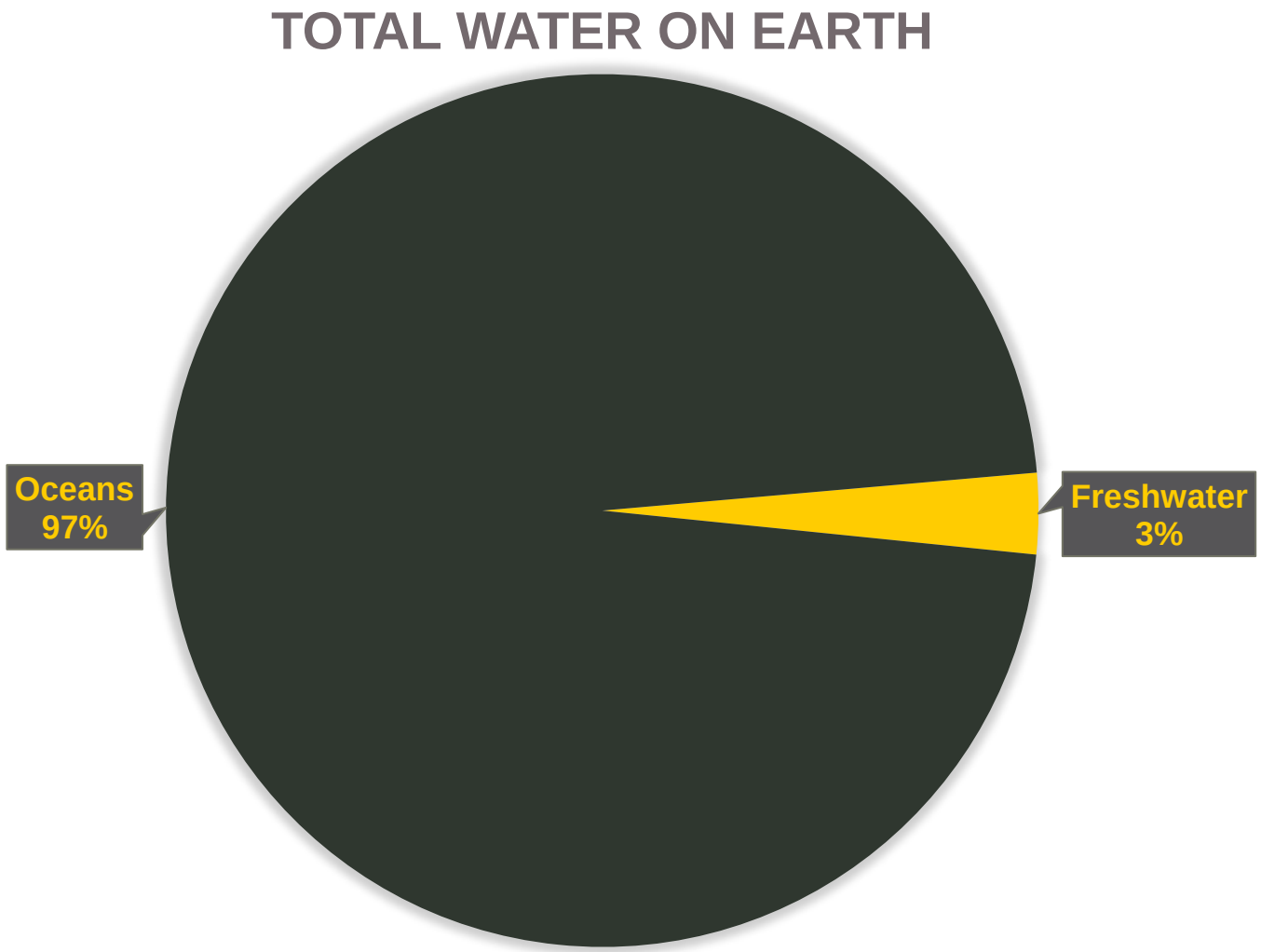
U.S. ARMY

WATER IS A SCARCE RESOURCE

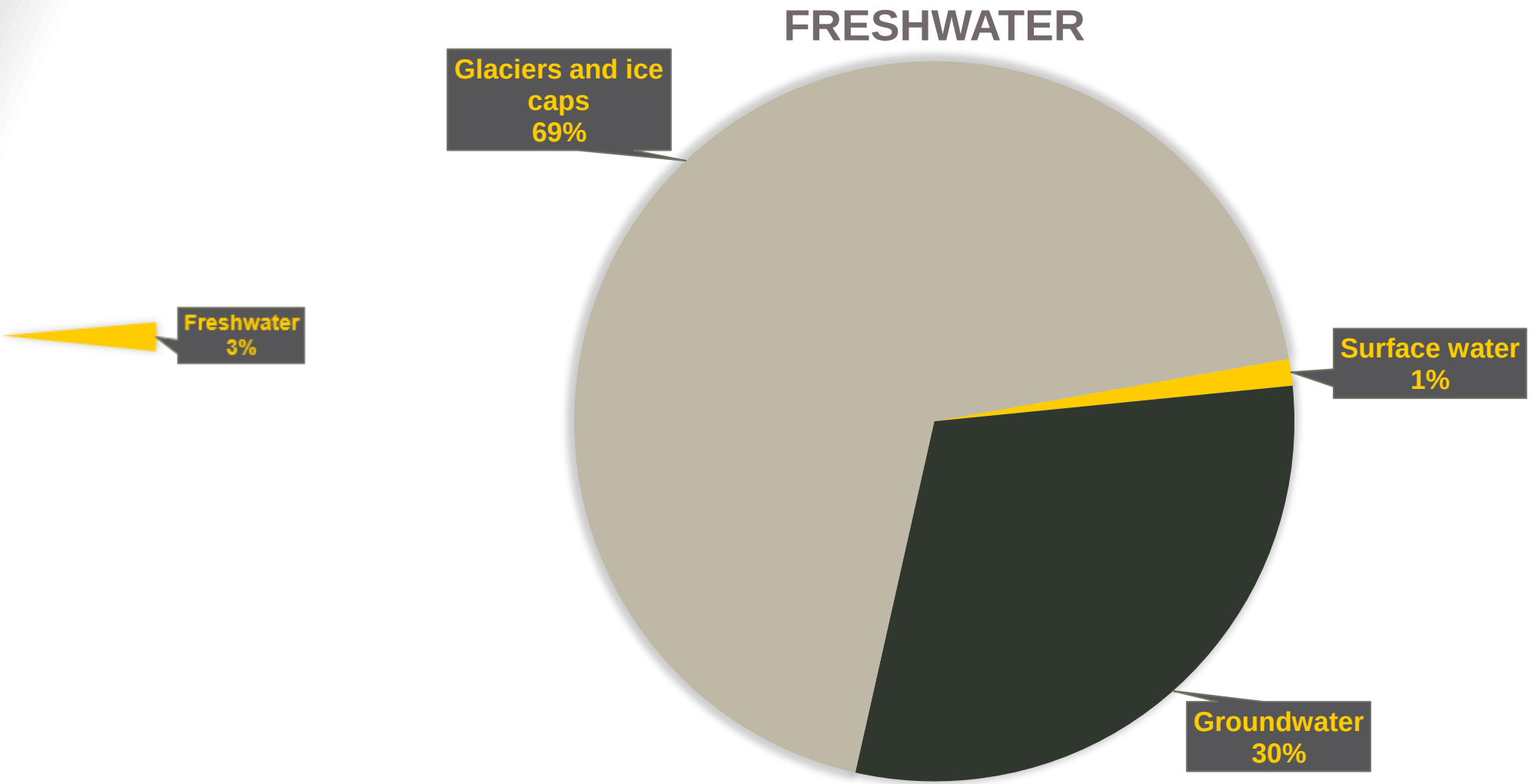
1%

OF EARTH'S WATER AVAILABLE TO US FOR OUR DAILY WATER SUPPLY NEEDS

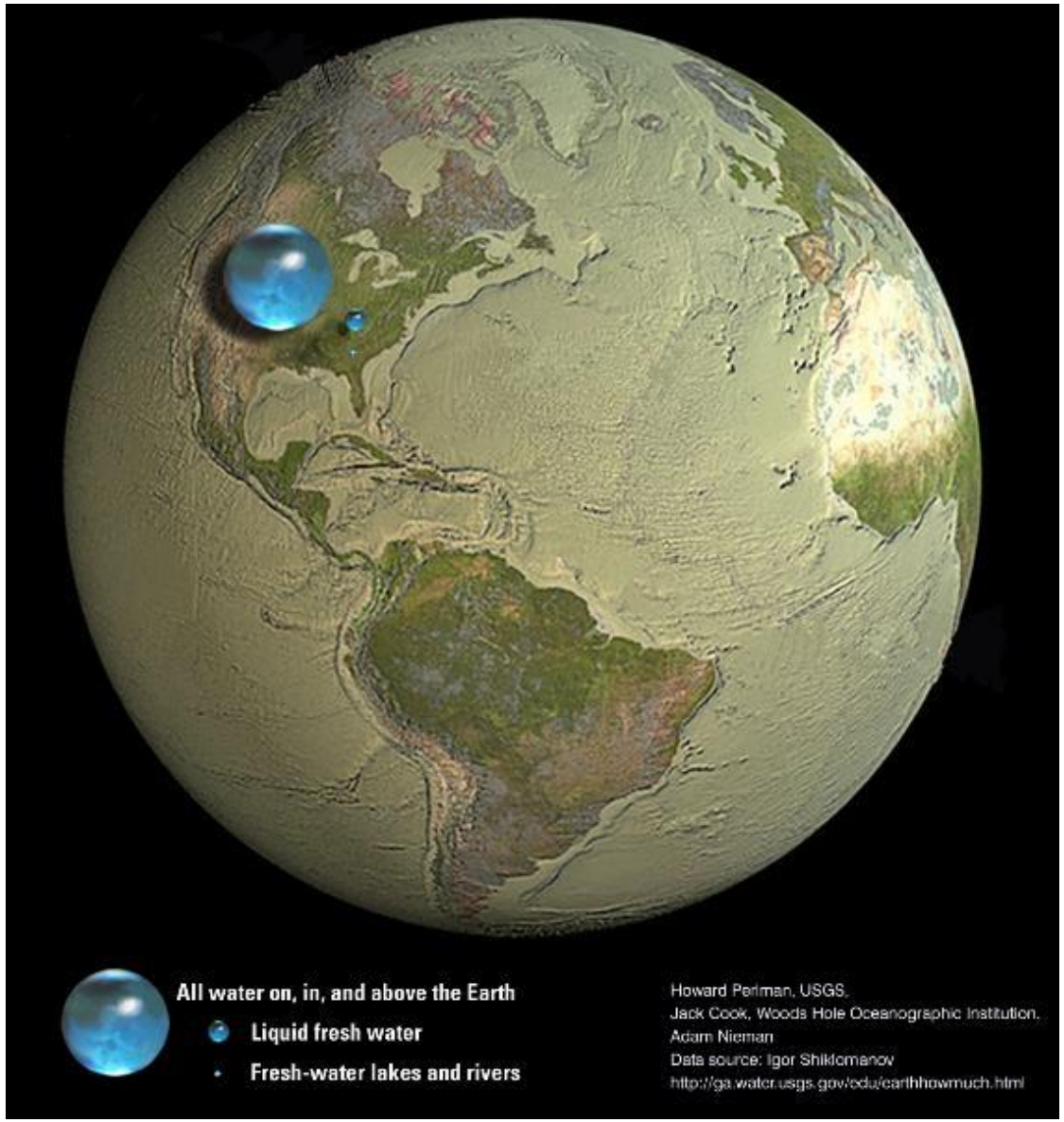
WATER COMES FROM A VARIETY OF SOURCES



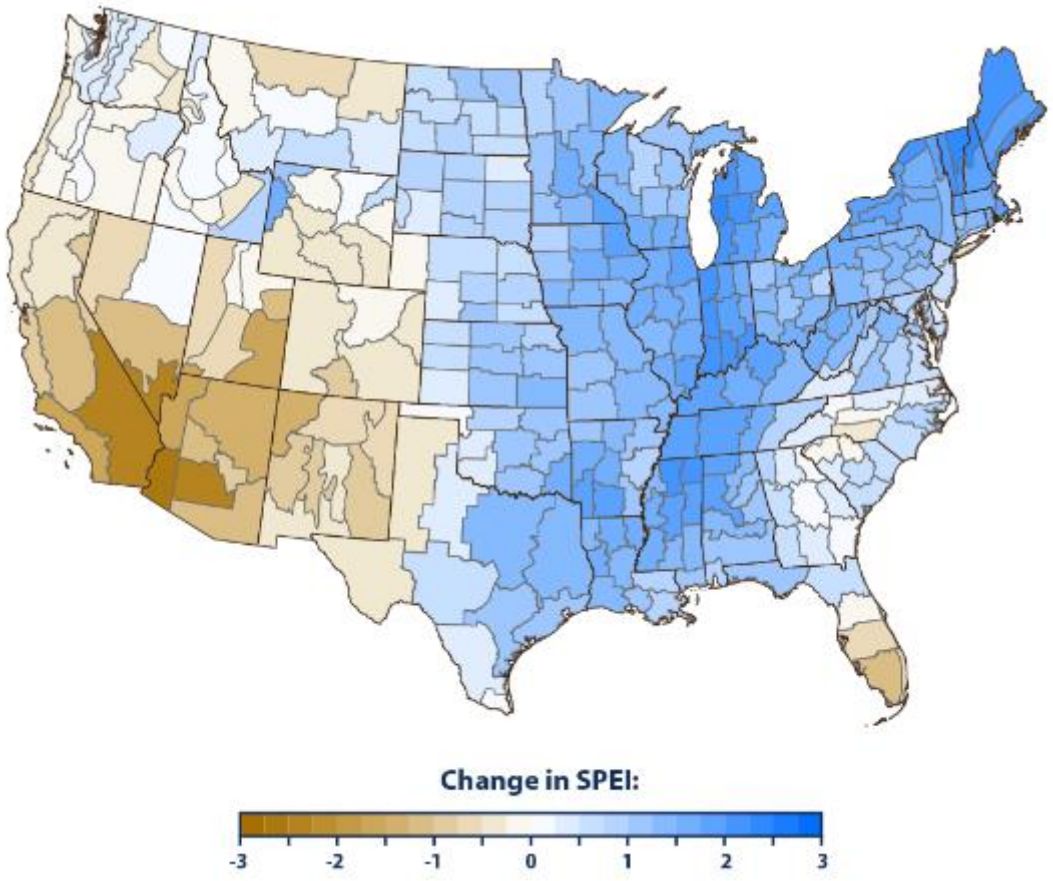
WATER COMES FROM A VARIETY OF SOURCES



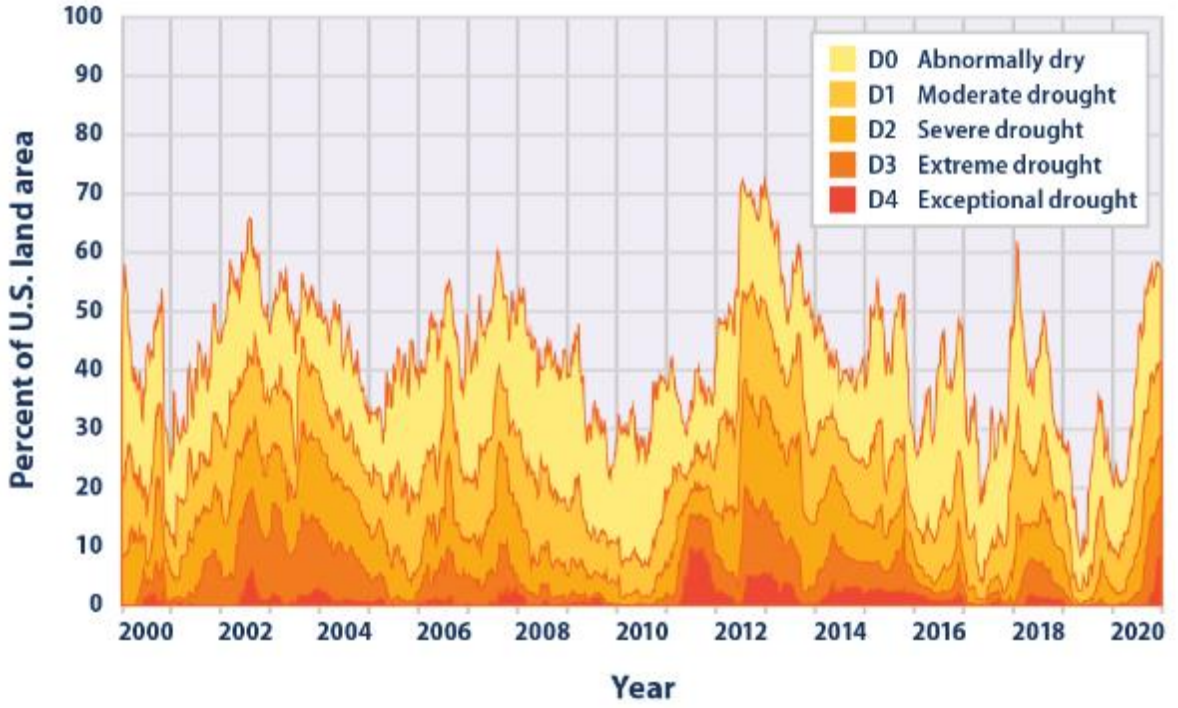
WATER IS A SCARCE RESOURCE



CLIMATE CHANGE IMPACTS WATER SOURCES AND AVAILABILITY



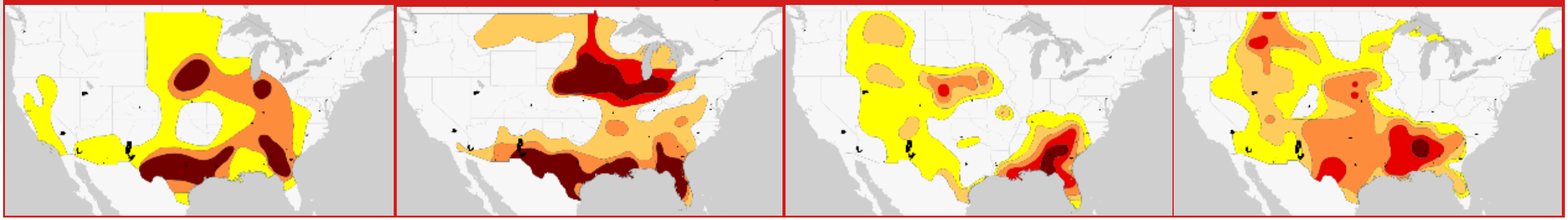
Data sources: WestWide Drought Tracker, 2021;[10] PRISM, 2021[11]
Web update: April 2021



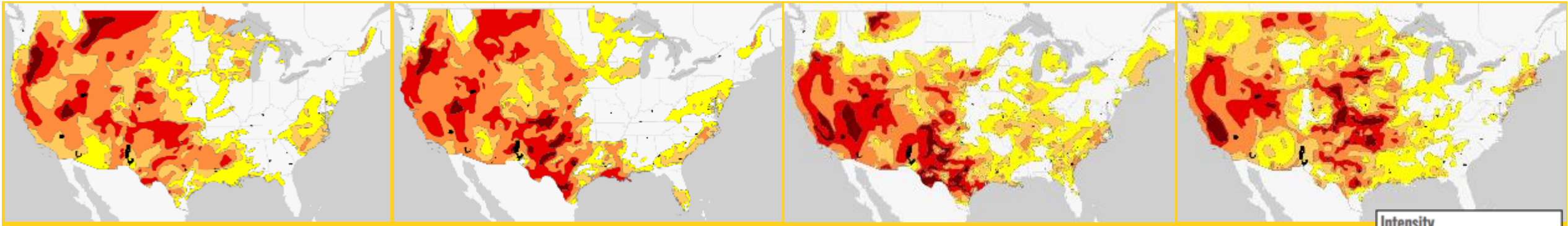
Data source: National Drought Mitigation Center, 2021[12]
Web update: April 2021

CLIMATE CHANGE IMPACTS WATER SOURCES AND AVAILABILITY

US Drought Conditions 2000



January 4 | April 5 | July 5 | October 4



US Drought Conditions 2022

Data Sources: Drought Monitor by including the National Drought Mitigation Center (NDMC)
The U.S. Department of Agriculture (USDA) and the National Oceanic and Atmospheric Administration (NOAA).

CLIMATE CHANGE IMPACTS WATER SOURCES AND AVAILABILITY

FORT BRAGG, NC, UNITED STATES
Photos by Andrea Salgado Rivera

WATER SOURCES AND AVAILABILITY IMPACT OTHER SECTORS

MITIGATION AND ADAPTATION

MITIGATION IS ABOUT

ENERGY

ADAPTATION IS ABOUT

WATER

GOOD WATER MANAGEMENT INCREASES RESILIENCE, SECURITY, AND OUR ABILITY TO ADAPT

Soldiers

Operations

Heating & Cooling

30.4

Billion Gallons

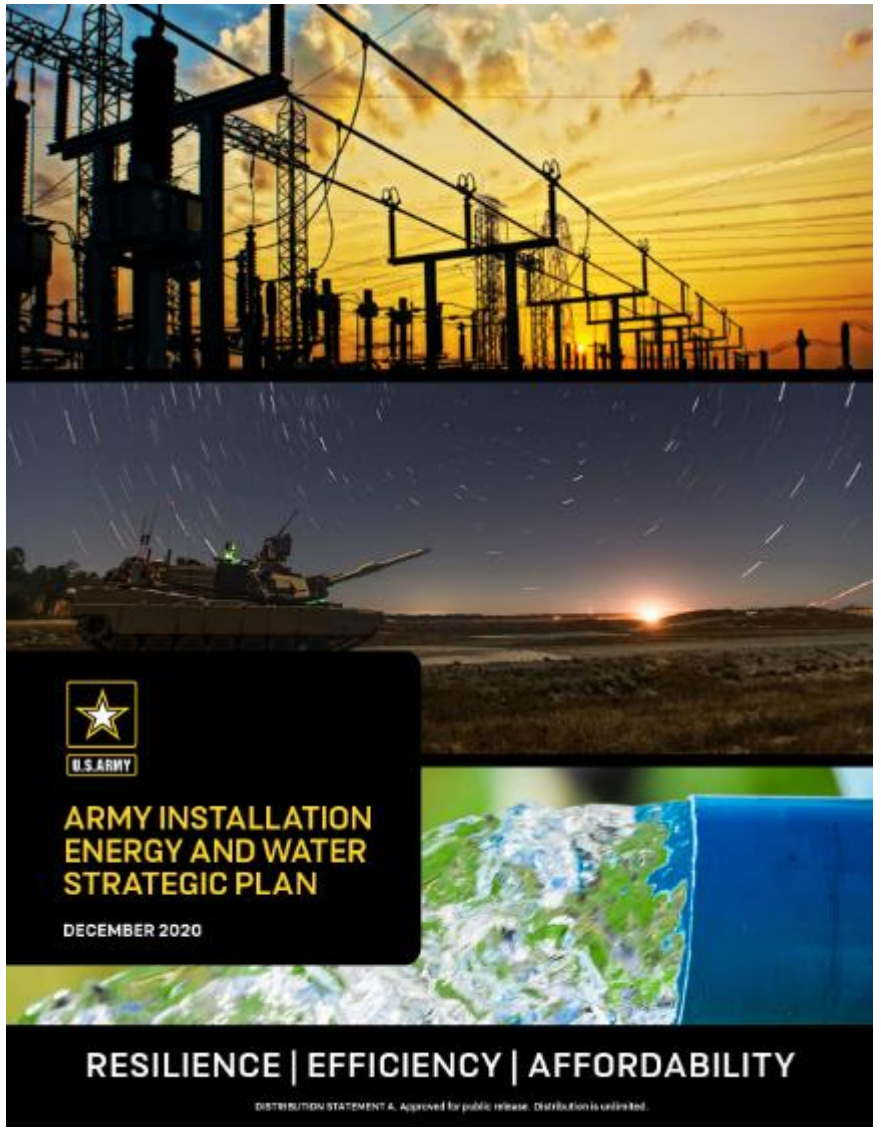
Families

Land Management

Buildings

HOW DOES THE ARMY MANAGE WATER?

Fort Greely Installation Energy and Water Plan



HOW DOES THE ARMY MANAGE WATER?

H. R. 6395—949

SEC. 2827. IMPROVING WATER MANAGEMENT AND SECURITY ON MILITARY INSTALLATIONS.

(a) RISK-BASED APPROACH TO INSTALLATION WATER MANAGEMENT AND SECURITY.—

	Installation X	Installation Y	Installation Z
Current Water Competition Indicator	Low	Low	Low
Future Water Competition Indicator	Sig.	Low	High
Water Competition Category	Mod.	Low	Sig.
Water Use Intensity Indicator	Sig.	Low	High
Water Use	Mod.	Mod.	Sig.
Fluctuations in Water Use	Low	Low	Mod.
Water Metering	Sig.	Sig.	High
Infrastructure	Mod.	Low	Mod.
Preparedness	High	Low	High
Response to Water Shortage	High	Mod.	Sig.
Water Rights Documentation	Low	Mod.	Low
Potable Water Quality	High	Low	Low
Water Quality	High	Low	Low
OVERALL RISK SCORE	Sig.	Low	Mod.

This is an example with fake indicators and installations (X, Y, Z) to portray what a water management resilience assessment based on risk factors may look like

HOW DOES THE ARMY MANAGE WATER?

SECRETARY OF THE ARMY
WASHINGTON

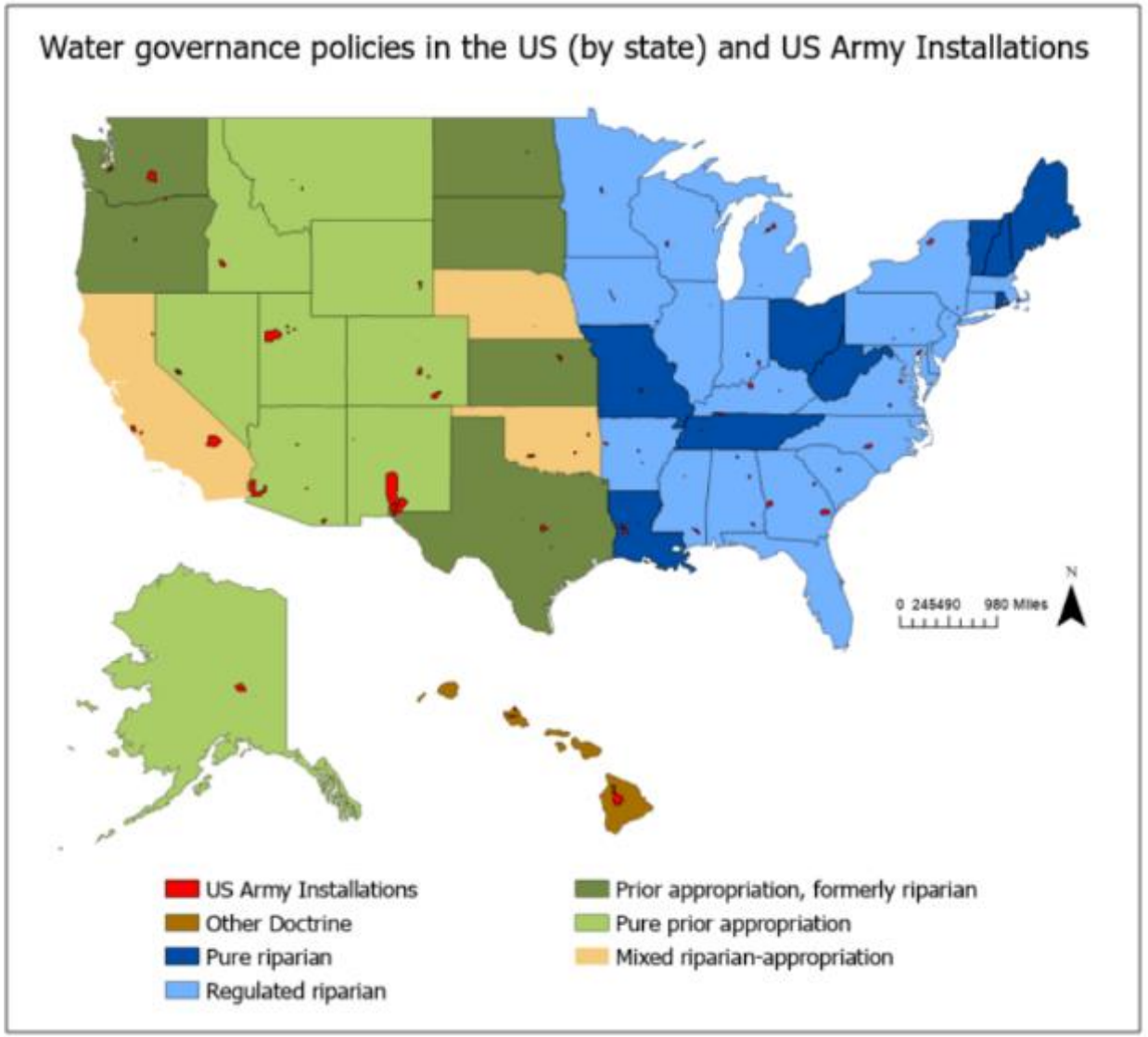
12 MAY 2014

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Army Directive 2014-08 (Water Rights Policy for Army Installations in the United States)

1. Reference Memorandum, Assistant Secretary of the Army (Installations, Logistics and Environment), 24 Nov 95, subject: Policy Guidance on Water Rights at Army Installations in the United States.

2. Purpose. The Army requires enough water to carry out its missions without significant disruptions. This directive, which supersedes the reference, sets policy and assigns responsibilities for identifying, asserting and preserving the Army's water rights.



UNDERSTANDING THE VARIOUS USES AND IMPACTS ON WATER IS VITAL FOR MANAGEMENT AND CONSERVATION

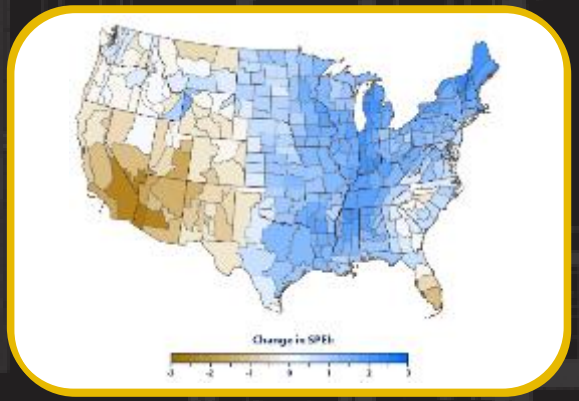
1%

OF EARTH'S TOTAL WATER AVAILABLE FOR HUMANS

30.4

BGAL OF WATER USED BY ARMY IN FY22

DRIVERS



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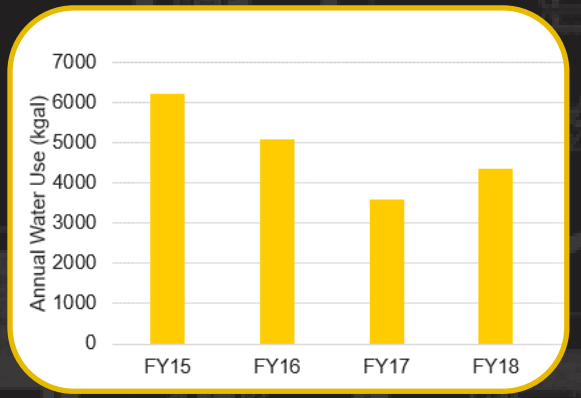
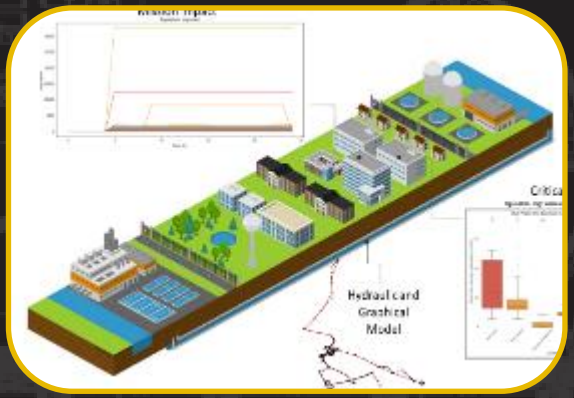


WATER USE & EFFICIENCY



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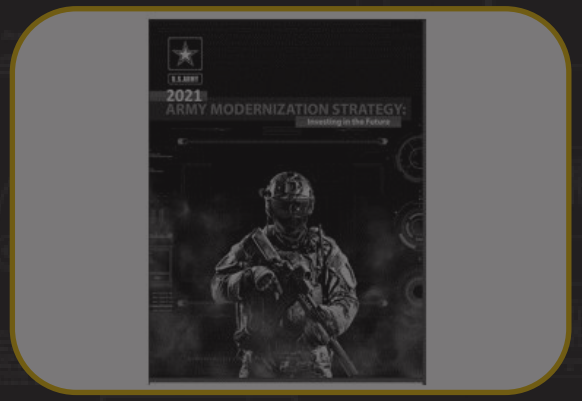

DRIVERS

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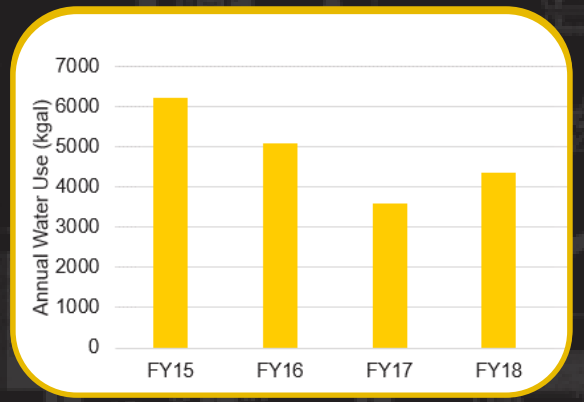

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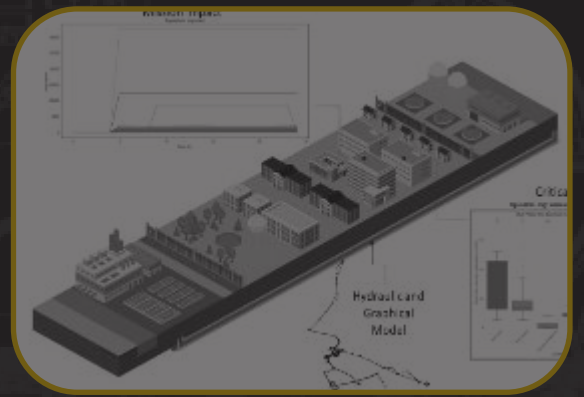


FUTURE WATER SYSTEMS

U.S. DEPARTMENT OF ENERGY

Pacific Northwest NATIONAL LABORATORY

STATUTORY DRIVERS FOR FACILITY WATER MANAGEMENT

Energy Act 2005

- Water efficient procurement
- Water efficiency measure implementation

Energy Independence & Security Act 2007

- Comprehensive Energy and Water Evaluations
- Sustainable design
- Stormwater management

Energy Act 2020

- Water metering
- Use of performance contracts
- Energy manager must manage water
- Commissioning of water equipment

EXECUTIVE ORDER 14057

Agency Water Efficiency Requirement:

- ***Potable Water Use Intensity (WUI) Target:*** Each agency shall establish an FY2030 agency-wide potable WUI target (measured in gallons per square foot per year)

Other Requirements:

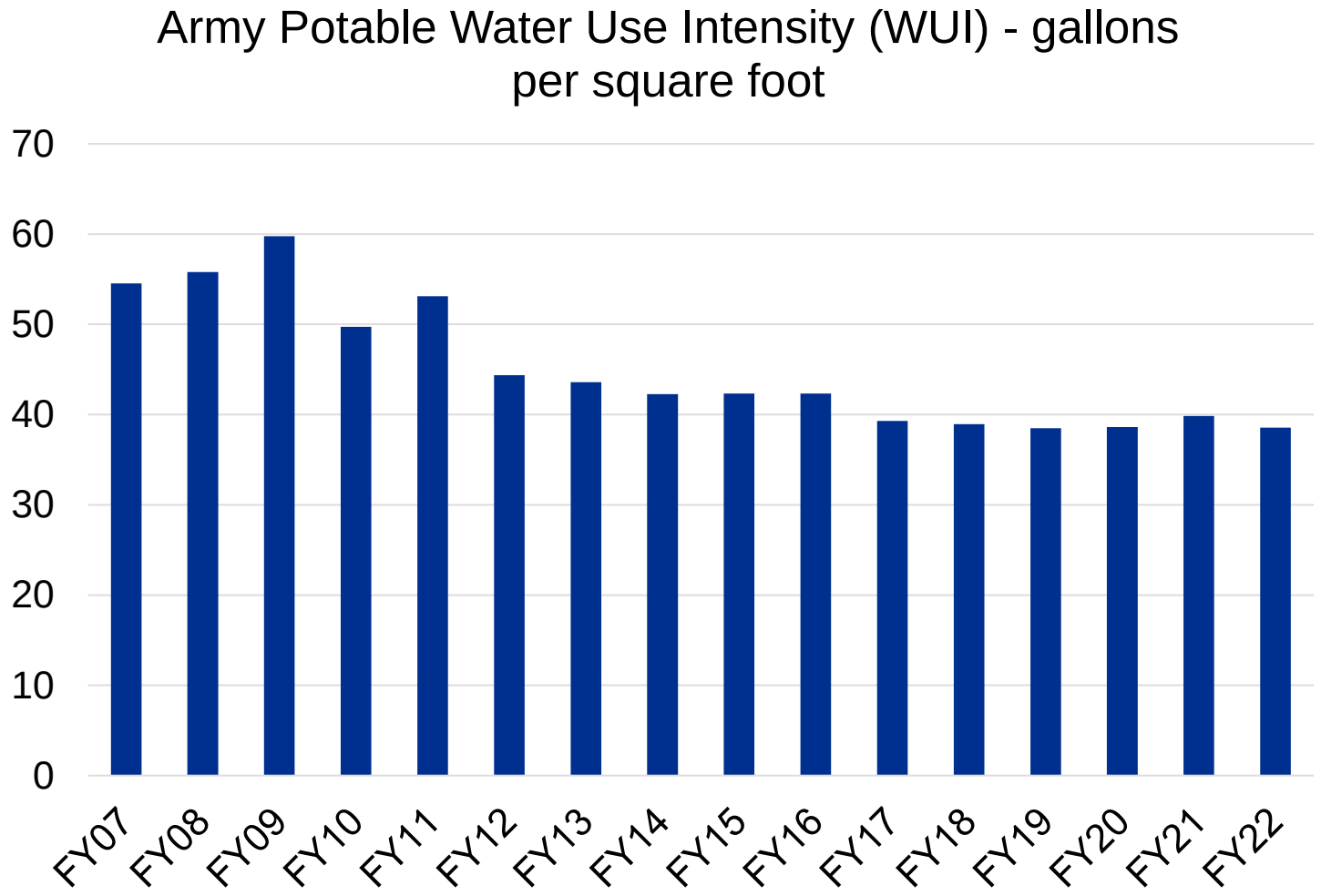
- ***Sustainable Procurement:*** Purchase sustainable products identified by the Environmental Protection Agency
- ***Net zero water:*** Agencies must ensure all new construction over 25,000 sqft are designed to meet net zero water where feasible
- ***Performance Contracting:*** Agencies are to use performance contracting to audit buildings and implement energy and water efficiency measures

Implementing Instructions: https://www.sustainability.gov/pdfs/EO_14057_Implementing_Instructions.pdf

ARMY'S WATER USE – PRESENT AND FUTURE

- Army FY22 potable water use: 30.4 Bgal
- Army reduced WUI by 29% in FY22 compared to FY07
- FY30 WUI target will be released soon

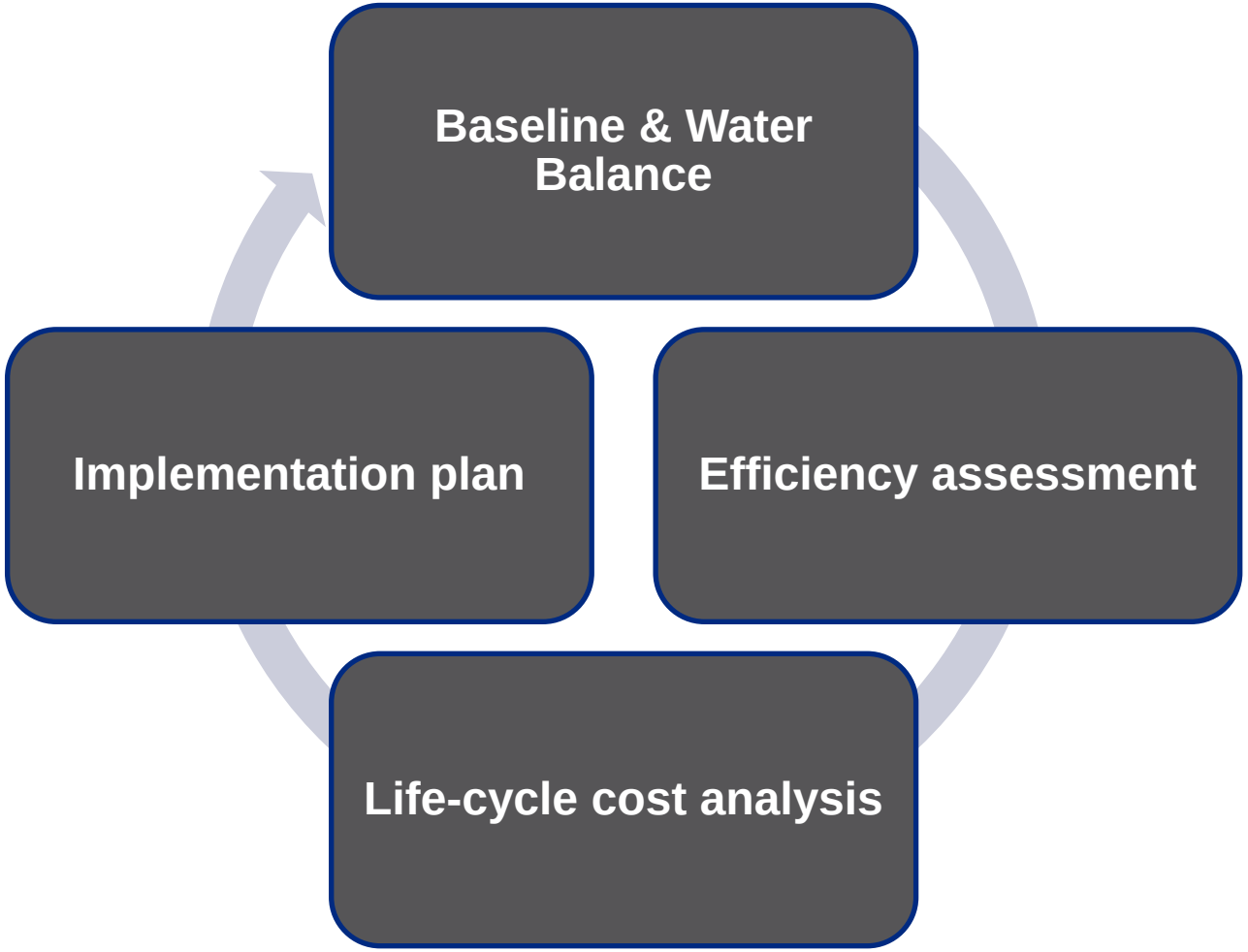
Army's WUI has flattened



HOW WILL THE ARMY MEET THE WUI TARGET?

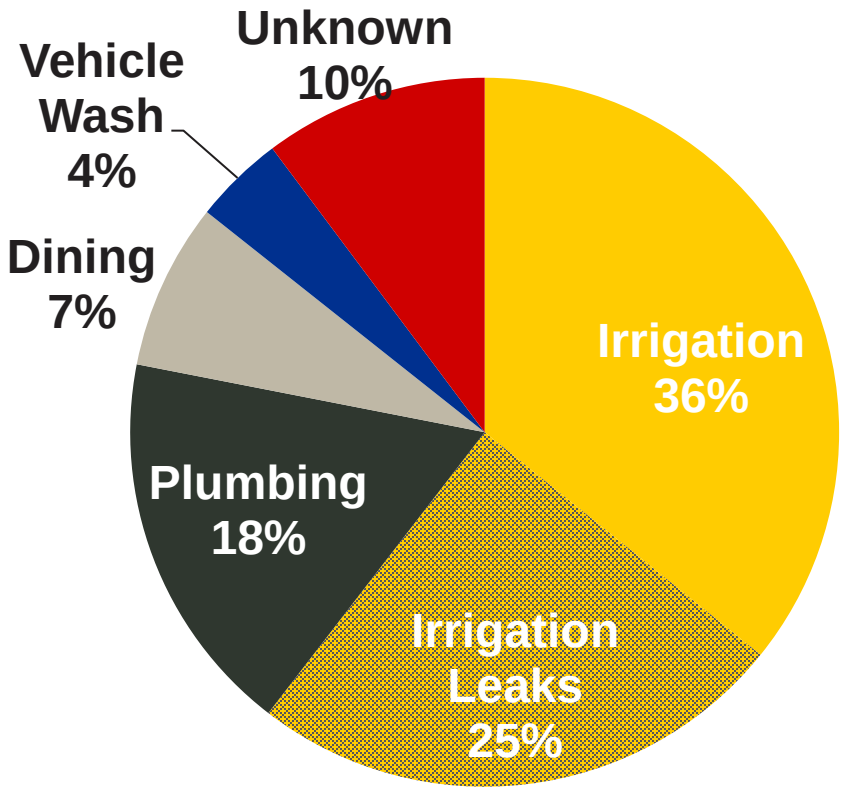
1. Meter buildings for water, prioritizing water intensive buildings
2. Assign and train energy managers to manage water
3. Conduct comprehensive water evaluations for water efficiency
4. Implement life cycle cost (LCC) effective water saving measures
5. Use performance contracts to implement water saving measures
6. Procure water-efficient equipment
7. Commission equipment and measure and verify savings
8. Construct new buildings that meet the Guiding Principles

COMPREHENSIVE WATER EVALUATIONS



WATER BALANCE EXAMPLE

- A water balance compares the total water supplied to the sum of water end-uses
- Benefits of a water balance
  - Reveals the largest water end-uses
  - Helps prioritize water efficiency improvements
  - Uncovers potential operational and maintenance issues
  - Helps to indicate losses in the system to target potential infrastructure improvement projects



EFFICIENCY ASSESSMENT

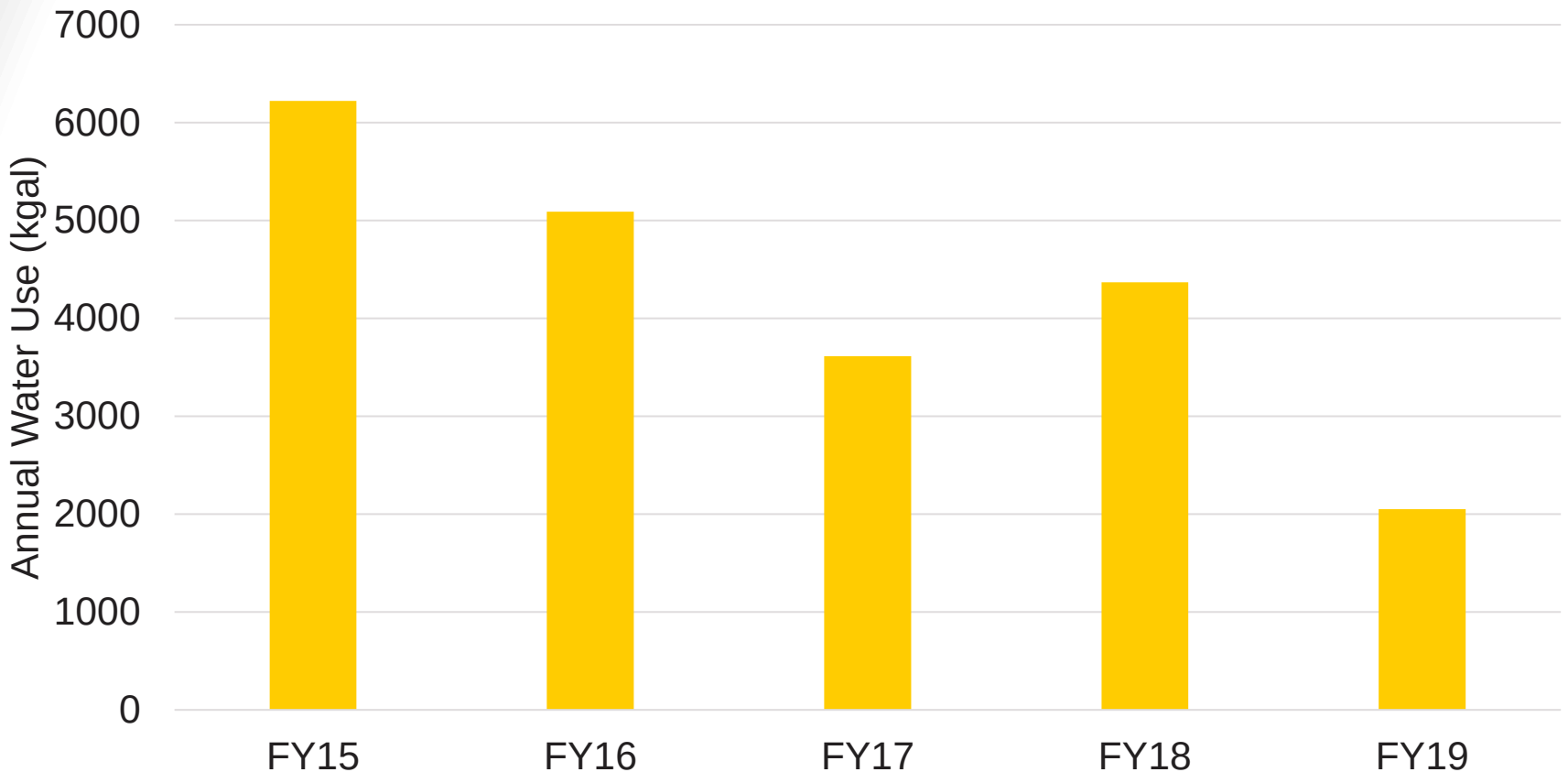
Control box full of water

Broken/ leaking sprinkler heads

Puddling

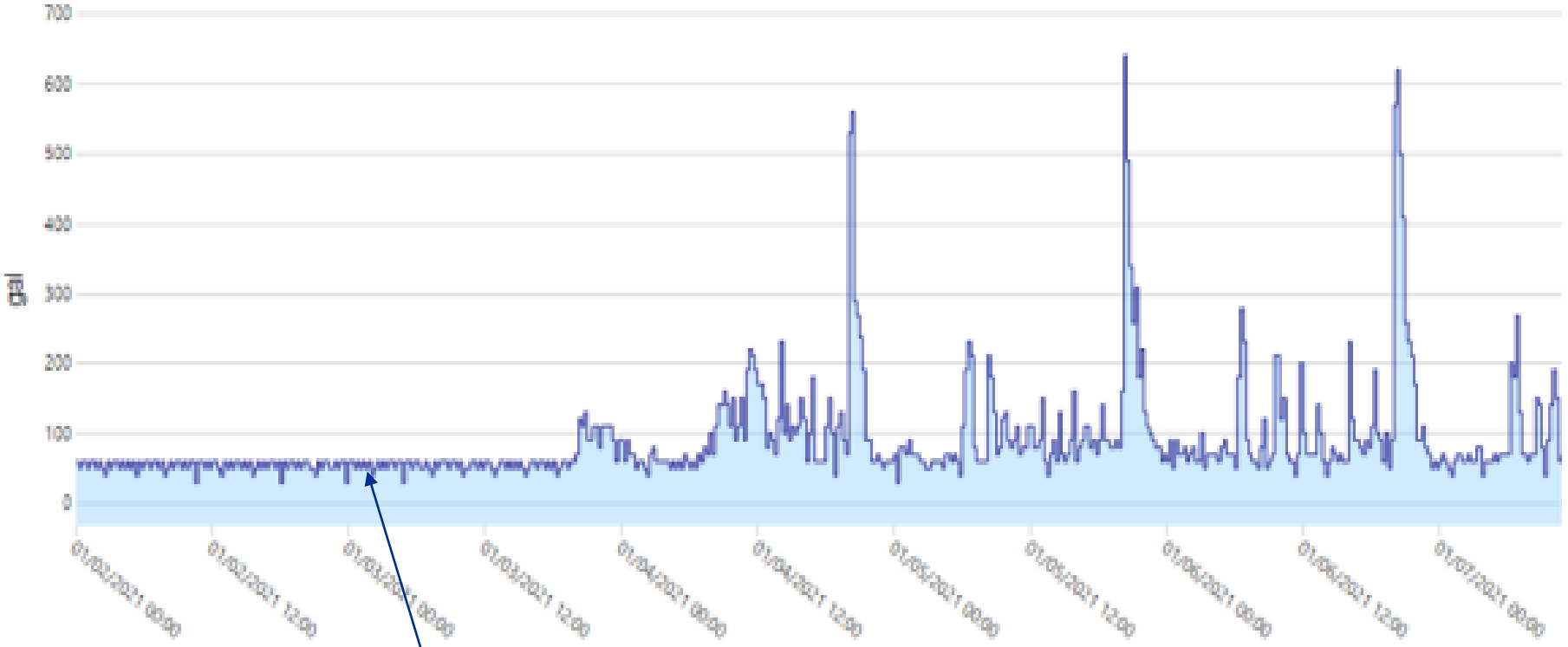
Irrigating during rain

OUTCOME OF EFFICIENCY ASSESSMENT



60% reduction in water use after leak repair and efficiency improvements

ARMY METERING DATA MANAGEMENT SYSTEM (MDMS)



Large leak detected using MDMS

What is the definition of alternative water?

a) Sources not from freshwater supply (groundwater & surface water)
b) Groundwater (i.e. well water)
c) Non-potable water
d) I don't know!

ALTERNATIVE WATER

Alternative water offsets freshwater use:

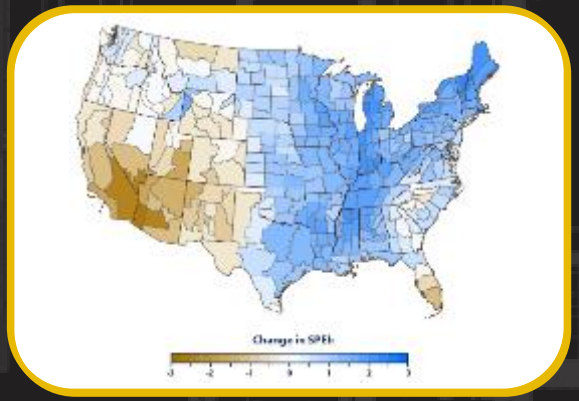
- Harvested Rainwater
- Reclaimed Wastewater
- Condensate Capture
- Process Reuse

Fort Buchanan Potable Rainwater Harvesting

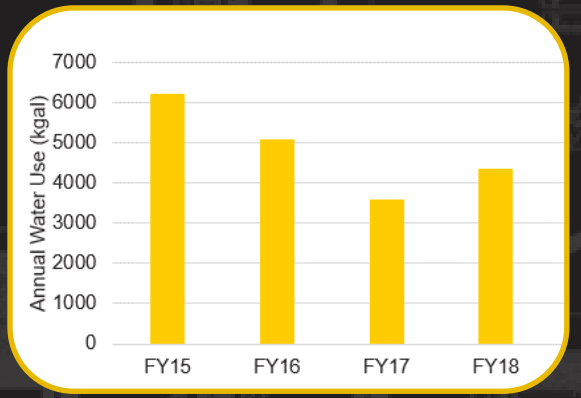
Camp Rilea Indirect Potable Reuse

Fort Carson Reclaimed Wastewater

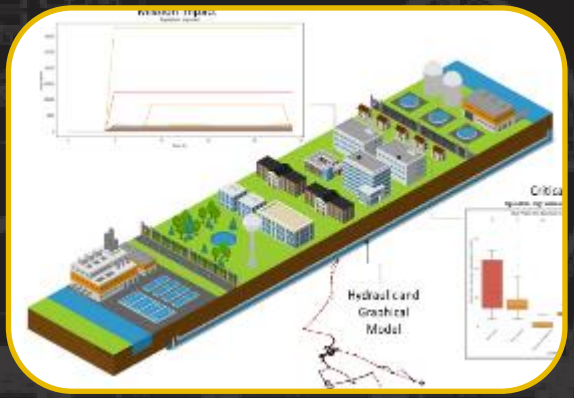
DRIVERS



WATER SOURCES



WATER USE & EFFICIENCY



FUTURE WATER SYSTEMS

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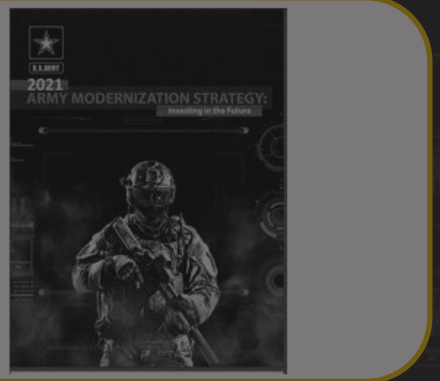
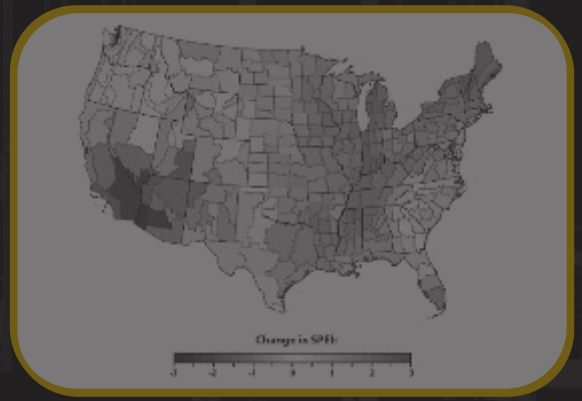
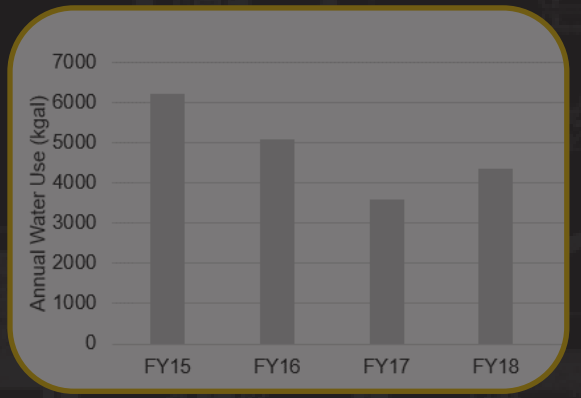
Pacific Northwest NATIONAL LABORATORY



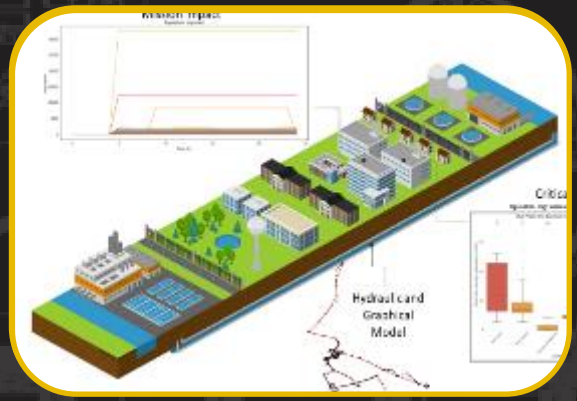
DRIVERS



WATER SOURCES



WATER USE & EFFICIENCY



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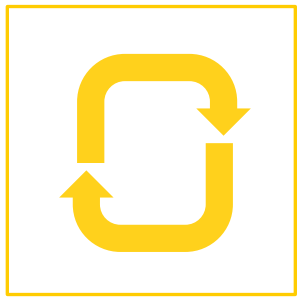
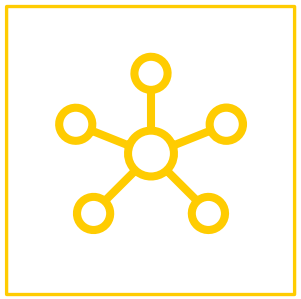
FUTURE WATER SYSTEMS

Function & Technology

Alternative Water Sources

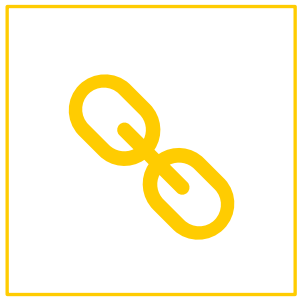


Water Micro - grids

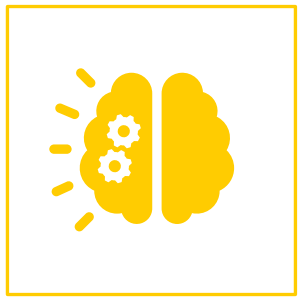


Energy – Water Nexus

Maintaining Water Quality



Coupled Modelling



Digital Twins

ALTERNATIVE WATER SOURCES

Currently Used

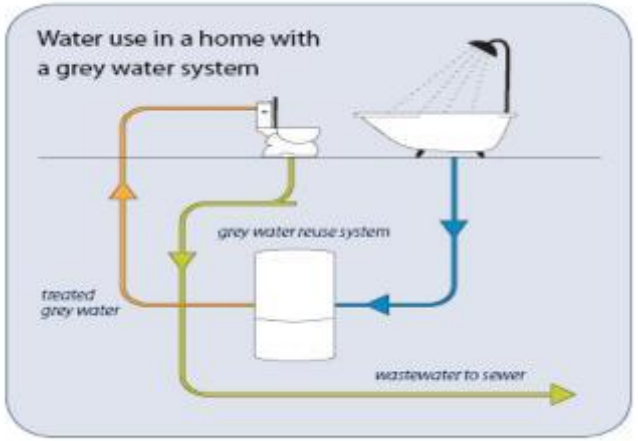
- Rainwater Harvesting
- Reclaimed Wastewater
- Greywater
- Stormwater Capture
- Captured Condensate

Researching

- Desalination
- Indirect Potable Reuse
- Direct Potable Reuse

Possible Solutions

- Atmospheric Water Generation
- Discharged Water from Purification Process
- Foundation Water
- Blowdown Water



ALTERNATIVE WATER SOURCES

Climate Change & High Water Demand

Drought, Extreme Weather, Source Depletion

Water Shortages

Alternative Water Source Supplementation

Fulfill Demand, Reduce Water Consumption

Increased Resilience

WATER MICROGRIDS

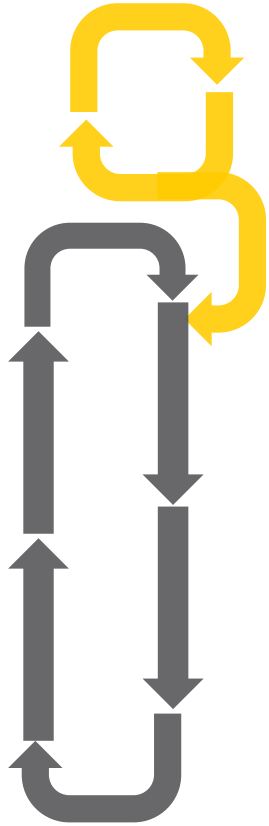
An on-site water supply providing backup storage, treatment, and distribution

Characteristics

- Backup Power
- Advanced Monitoring and Controls
- Self-sufficient
- Automated

Benefits

- Fulfill mission critical demand during emergency
- Improved water resilience for high-risk areas and installations
- Independent operation



WATER MICROGRIDS - USE CASES

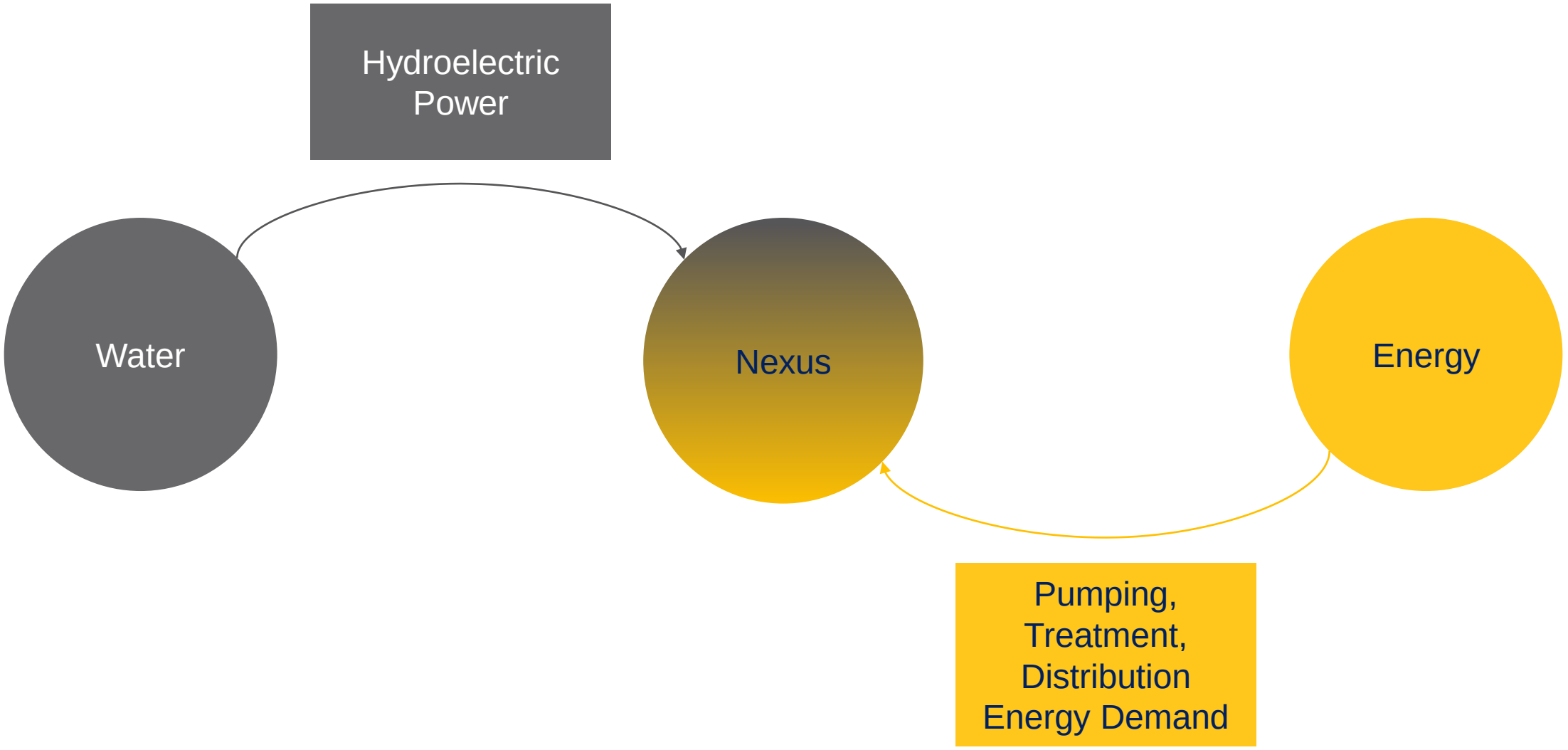
Camp Rilea

Self contained, automated water system that supplies, treats, stores and distributes all on-site

Camp Swift

Smart Water Grid Project. Prompted by Winter Storm Uri, the water system is meant to maintain operability during disruption to main water supply

ENERGY WATER NEXUS



What percentage of the nation's energy consumption is used by drinking water and wastewater systems?

a) 2%
b) 4%
c) 12%
d) 1%
e) 6%

ENERGY WATER NEXUS

Digital Twins, Network Modelling, Microgrids

Energy and water systems interdependencies, strengthening partnerships

Building resilience and redundancy by using multiple sources

Protecting against resource scarcity, infrastructure vulnerability, weather hazards

MAINTAINING WATER QUALITY

Issues

- Source Disruptions (Contamination)
- Aging Infrastructure
- Extreme Weather

→ Sensor feeds tied to Digital Twin, Rapid detection and response, Localization

Strategies

- Sensors integrated with Digital Twins
- Varied Water Treatment Strategies

→ Physical / Biological / Chemical Filtering, Desalination, Experimental Filtration Methods

NETWORK COUPLED MODELLING

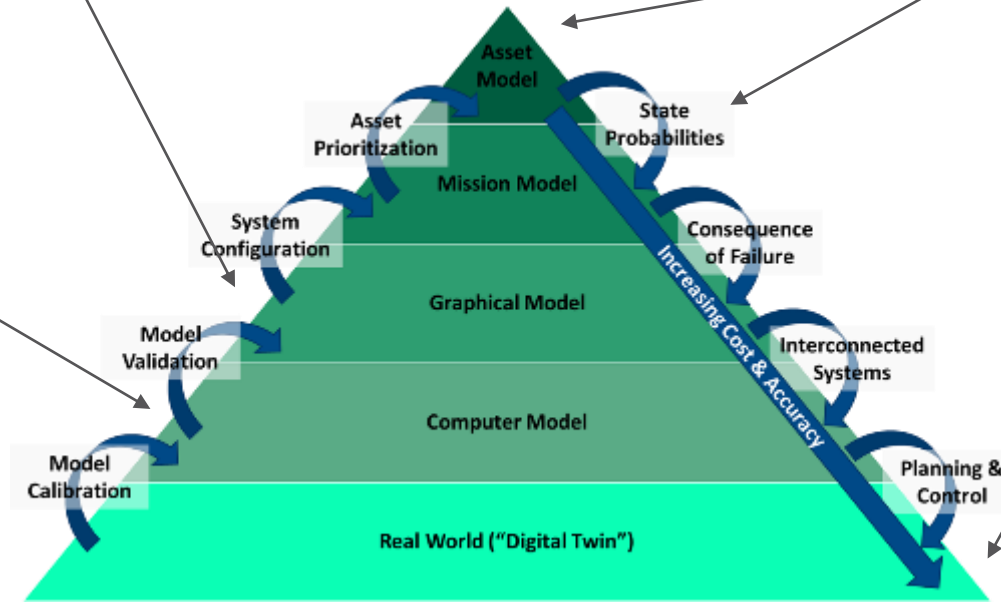
Coupled models overcome the draw backs of the different models and produce quantifiable, repeatable results

Computationally cheap and easily repeatable, not as accurate.

Scalable and support other models, may lack completeness / consistency

Highly accurate physics-based modelling, computationally expensive

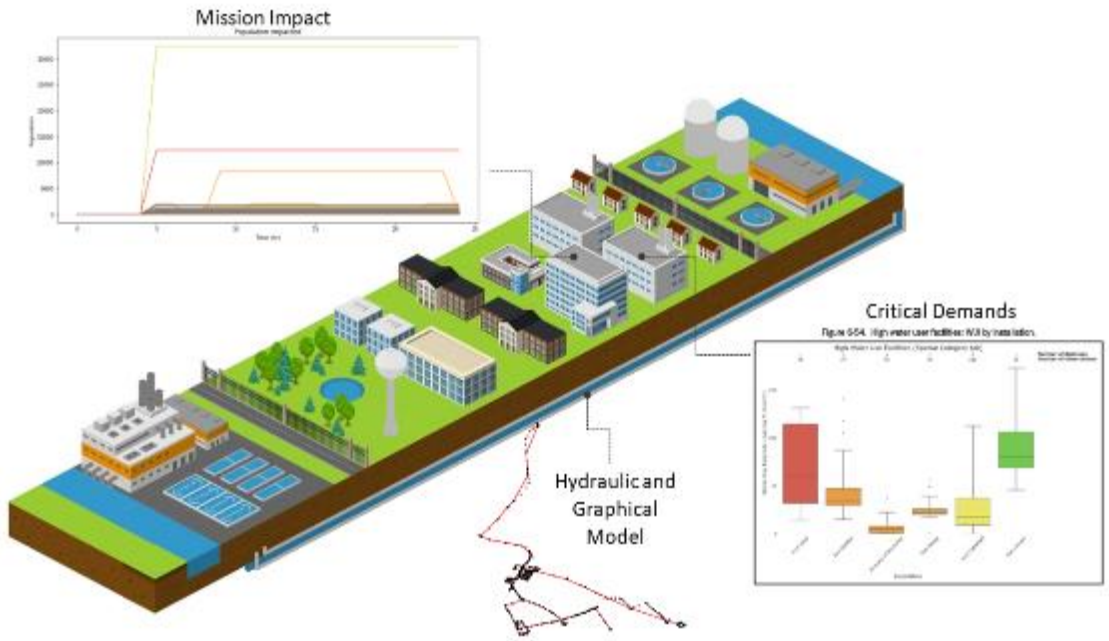
Real time data feeds and anomaly detection/localization



DIGITAL TWINS

Smart Meters, ML / AI, Network Modelling

Near Real Time Data, Anomaly detection and localization



Infrastructure condition and probability of failure

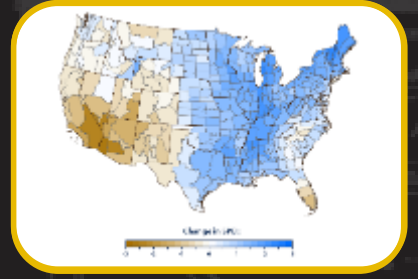
Enable rapid response to emergencies, highly accurate modelling

Q&A

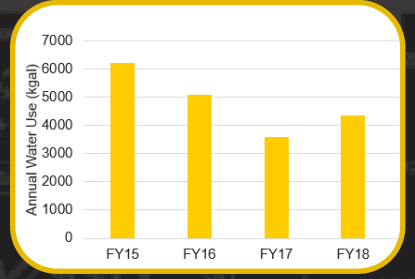
Thank you!

Noah Garfinkle, Noah.W.Garfinkle@erdc.dren.mi
Kate Stoughton, Kate.Stoughton@pnnl.gov
Kylie Burkett, Kylie.R.Burkett@erdc.dren.mil
Juan Gomez, Juan.C.Gomez@erdc.dren.mil

DRIVERS



WATER SOURCES



WATER USE & EFFICIENCY

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- Kate Stoughton,
  kate.stoughton@pnnl.gov
- Noah Garfinkle,
  noah.w.garfinkle@usace.army.mil
- Kylie Burkett,
  kylie.r.burkett@usace.army.mil
- Juan Gomez,
  juan.c.gomez@usace.army.mil

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JOINT ENGINEER TRAINING CONFERENCE & EXPO

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MAY 2-4 2023

San Antonio, TEXAS

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