Water Efficient Installations – A New Army Guidance Document

Environment, Energy & Sustainability Symposium
Denver, CO
14-17 June 2010

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U.S. Army Corps of Engineers
Headquarters

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What Are PWTBs?

- Introducing: Water Efficient Installations
- Public Works Technical Bulletins
- Sponsored by USACE HQ
- Variety of subjects
- Available through Whole Building Design Guide
- Accessible at:
- http://www.wbdg.org/ccb/browse_cat.php?o=31&c=215
- May have to use alternate path – CCB, Army/COE, then PWTB

PWTB Contents

- Overview
- Importance of water efficiency, water conservation
- Motivation
- Expand previous CERL Tech Report and FEMP BMP information
- Installation examples/experience
- Other
  - Water audit
  - Implementation of water loss program
- Water/energy interaction
- ESPC issues and concerns
- Resources

Water is Water!

- Essential to maintain life and quality of life
- The world is not producing any more
  - Limited amount of freshwater
  - Expanding needs: population, economy
- Vital to efficiently use and reuse and recycle what we have
- Current practices and supplies are not sufficient for future needs
- Only two options
  - Encourage less use
  - Find alternative sources and supplies
- Water is a valuable natural resource and commodity
  - Cost includes cost of water, wastewater treatment and disposal, energy for treatment, heating, and disposal and often pretreatment
- Conservation/efficiency versus new infrastructure
  - Demand side ($0 to 1.0 million/mgd
  - Supply-side Surface/ground, $1 - $3 million/mgd
  - Reuse, $1 – 5 million/mgd
  - Desalination, $3 – 10+

Costs for Water Conservation & Alternative Sources

Source: Amy Vickers & Associates, Inc., Amherst, MA

Increasing Military Demands

- Sufficient high quality water is not only a global concern, but vital to the military in CONUS
- Competition with other sectors
- BRAC
- Potential stopper in mission expansion
- Concern in arid and semi-arid lands
- Installation footprint may play major role in region
- Water is essential for
  - Industrial processes
  - Military operations
  - Installation quality of life

Military Installation Water Drivers

Water Resources

- Increasing Water Quantity and Quality Concerns
- Drought
- Climate Change

Legislative and Executive Drivers

- Clean Water Act
- Energy Policy Acts
- Executive Order 13514
- EISA Section 438

Defense/Army Strategies and Policies

- Strategic Plan for Army Sustainability
- Army Strategy for the Environment
- 2010 IMCOM Campaign Plan
- Installation Sustainability Plans - Water Conservation Goals
- LEED (Leadership in Energy and Environmental Design) USGBC
- Green Building Initiative
- Federal Best Management Practices

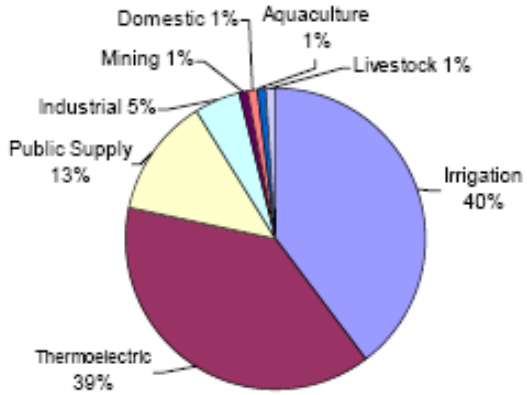
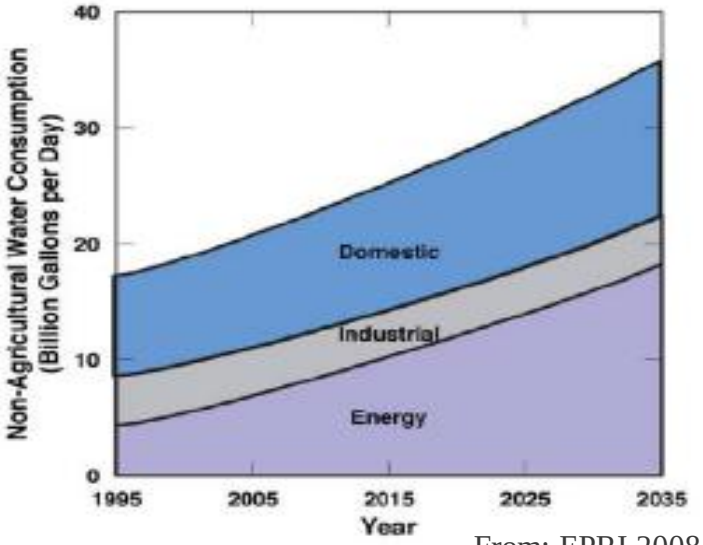
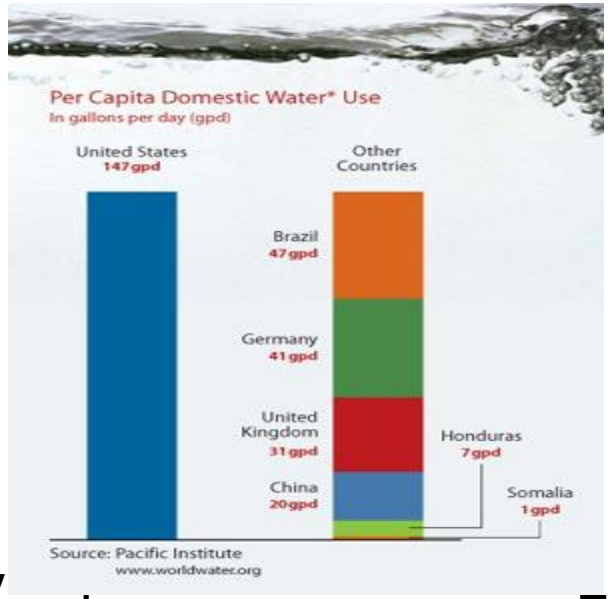


Figure 3-1
U.S. Freshwater Withdrawals in 2000

Source: USGS Circular 1268, *Estimated Use of Water in the United States in 2000*



From: EPRI 2008



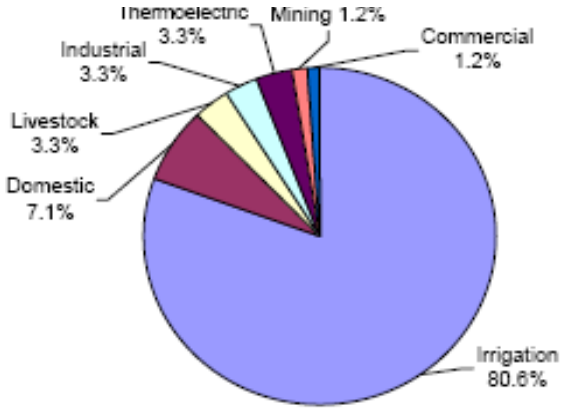


Figure 3-2
U.S. Freshwater Consumption in 1995

Source: U.S. DOE, *Energy Demands on Water Resources: Report to Congress* (2006)

FEMP Best Management Practices

1. Water Management Planning
2. Information and Education Programs
3. Distribution System Audits, Leak Detection and Repair
4. Water Efficient Landscaping
5. Water Efficient Irrigation
6. Toilets and Urinals
7. Faucets and Showerheads
8. Boiler/Steam Systems
9. Single-Pass Cooling Equipment
10. Cooling Tower Management
11. Commercial Kitchen Management
12. Laboratory/Medical equipment
13. Other Water Use
14. Alternate Water Sources

Definitions

- **Water Efficiency – minimization of water used to accomplish a task**
- **Water Conservation – elimination or minimization of water loss, waste, or use**
- **Alternative Water Source – rainwater, stormwater, condensate, graywater, others**
- **Graywater – on-site treated or untreated effluent from lavatory or clothes washing, excludes blackwater**
- **Water Reuse – on-site water that is captured and reused**
- **Reclaimed Water (also called recycled or reuse) – municipal highly treated wastewater effluent**
- **Water efficiency and water conservation are usually considered interchangeable**

Water Management Planning

- **Water management plan overview**
  - **Water use policy statement and goals**
  - **Utility information**
  - **Water use information**
  - **Metering or measurement plan**
  - **Emergency response information**
  - **Comprehensive planning**
  - **Opportunity assessment**

- **Coordinate with facility environmental management systems**

Information and Education Programs

Essential if water efficiency technologies and methods are to be successful. New operation procedures, retrofits, and replacements are most effective when employees, contractors, residents, and the public know the new technology or methods are and how to use them properly.

Positive public opinion

Internal Information and Education Options

News media, user-friendly hotline, signage, suggestion and incentive programs, training workshops

External Information and education Options

Work with local utilities and share successes, create displays, brochures, websites, work with local news media

Information and Education Programs

Distribution System Audits, Leak Detection and Repair

Program Benefits

Reduce water losses
Reduce operating costs
Increased knowledge of the distribution system
Reduce property damage
Improved justification for water management
Leak surveys – paybacks often in months
Operation and Maintenance
- **Determine whether audit is needed, conduct audit**

Retrofit and Replacement Options
- **Fix leaks or replace pipes**

Dripping faucet at 1.0 to 25 gal per hour can lose 8760 to 219,000 gal/year
Broken flush valve on toilet can lose 40 gal/hour

Water Efficient Landscaping

Design a landscape that requires minimal supplemental water.

Design, install and maintain an irrigation system that applies appropriate amount of supplemental water in an efficient manner.

Operation and Maintenance

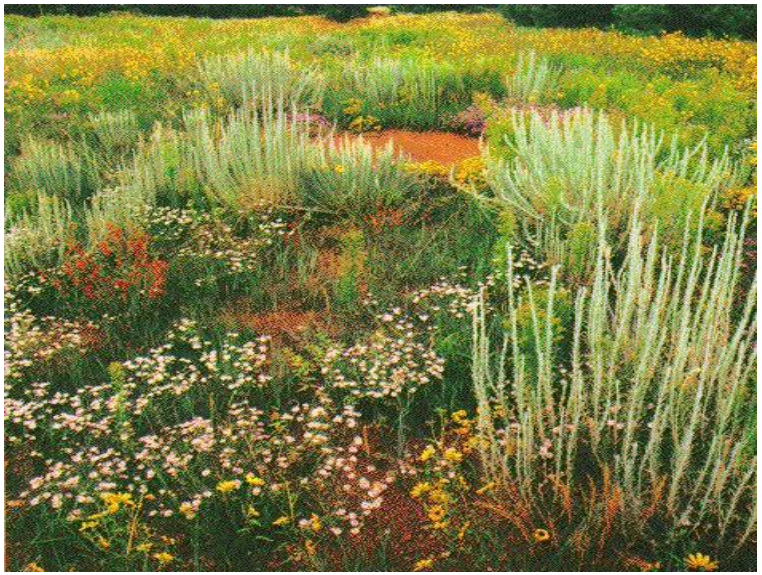
- Review service agreements
- Hire knowledgeable landscape contractors – specialty water-efficient
- Mulch
- Recirculate water in water features
- Proper mowing
- Clean without water

Retrofit and Replacement Options

- Design for water efficiency

Reduce or avoid turf

- Drought-tolerant plantings – climate-appropriate, native vegetation
- Implement LID techniques
- Hydrozoning
- Proper planting technique



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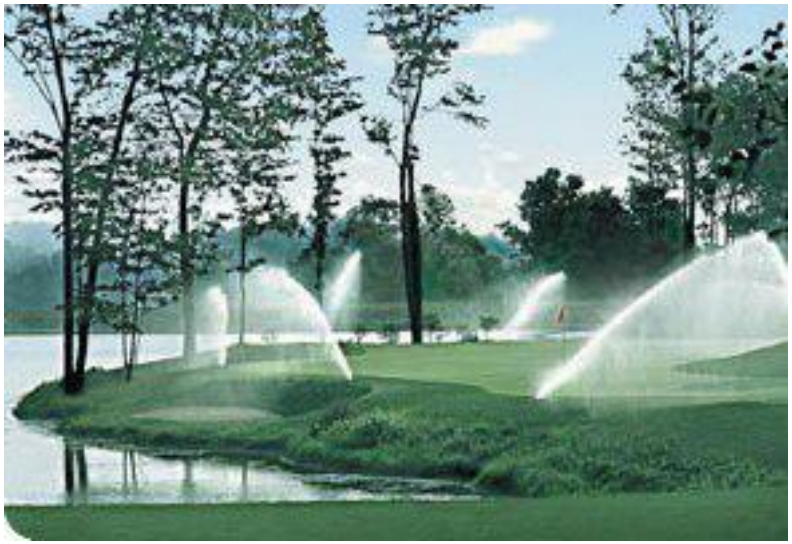
Water Efficient Irrigation

Proper training in system installation, maintenance and management

WaterSense Irrigation partner
Review service agreements to incorporate high priority for water efficiency
Immediate reporting and repair of problems
Irrigation system audit every three years
Irrigation meter
Proper scheduling of water application
Shutoff nozzles on handheld hoses
Consider weather-based irrigation controls
Soil-moisture-based irrigation controls
Central systems with demand-based controls
Micro or drip irrigation where appropriate
Proper sprinkler heads and placement
Rain-sensing technology
Freeze-sensing technology
Flow rate monitoring equipment

Water Efficient Landscaping and Irrigation



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Options for the Reduction of Outdoor Garden/Landscape Water Use

Management Options	Potential Savings (Percent)
Turf maintenance	10
Turf maintenance, irrigation system	20
Maintenance, Irrigation Scheduling	
Mulching in Ornamental Gardens	20
Soil Amendments (Compost)	20
Irrigation Scheduling	25
Irrigation/Soil maintenance	65 to 75
Lawn to go Dormant	90
Hardware Options	
Auto rain Shut Off	10
Soil Moisture Sensors; Soil Probes	10 to 30
Improve Performance	40
Drip/Bubbler Irrigation	50
Gray Water	Up to 100
Rain Barrel Catchment	Up to 100
Landscape Design Options	
Landscape Design	19 to 55
Turf Reduction	19 to 35
Choice of Plants	30 to 80

From Gleick et al.

Toilets and Urinals

ULFTs Ultra-Low Flush Toilet, also called low flow 1.28 gpf to 1.6 gpf
HETs High Efficiency Toilets 1.28 gpf or less, 50 manuf., 500+ models
Required in CA
Dual flush options also available

WaterSense program provides certification and specifications

Urinals
National standard is 1.0 gpf
High efficiency urinals: 0.5 gpf to one pint per flush

Non-water urinals, waterless urinals
Hundreds of thousands in use
Army standard, proper maintenance essential
Some plumbers recommend flushing unit at top of drainline

Toilets

Faucets and Showerheads

Federal standard 2.2 gpm or less

EPA's WaterSense program residential lavatory 1.5 gpm or less

Public use –ASME max of 0.5 gpm

Showerhead Federal standard 2.5 gpm

Showerheads WaterSense spec. 2.0 gpm max

O&M
Fix leaks
Proper pressure in system 20 to 80 psi
Reduce water heater settings
Avoid retrofitting with flow control inserts or valves

Boiler/Steam Systems

O&M

- Routine inspection, repair leaks quickly
- Annual tuneups
- Insulation
- Proper blowdown control
- Expansion tank to temper blowdown drainage rather than cold water mixing
- Meters on makeup lines

Retrofit

- Install a condensate return system
- Automatic blowdown system
- Automatic chemical feed system
- Monitoring
- Blowdown heat exchangers in large systems

Replacement

- Energy audit to reduce heating load
- Purchase life-cycle-cost-effective boilers
- Consider small summer boiler, distributed system or heat-capture system for reheat or dehumidification
- Consider alternative technologies such as heat pumps

Single-Pass Cooling Equipment

Opportunity for significant water savings.

Typical equipment: CAT scanners, degreasers, hydraulic equipment, condensers, air compressors, welding machines, vacuum pumps, ice machines, X-ray equipment and air conditioners.

Use 40 times more water than a cooling tower operated at five cycles of concentration.

Recommendation: Modify to recirculate or eliminate

Add automatic control to shut off during unused hours if fe4asible.

Use effluent, if feasible, for boiler makeup or irrigation

Cooling Tower Management

Water leaves a cooling tower from: evaporation, drift, blowdown and basin leaks or overflows

The sum of water that is lost must be replaced by make-up water

Make-up = Evaporation + Blowdown + Drift

Cycles of concentration important consideration, want to maximize but dependent on water chemistry

Consider other water sources: air handler condensate, water from once through cooling systems, high quality effluent or recycled water

Work with experts

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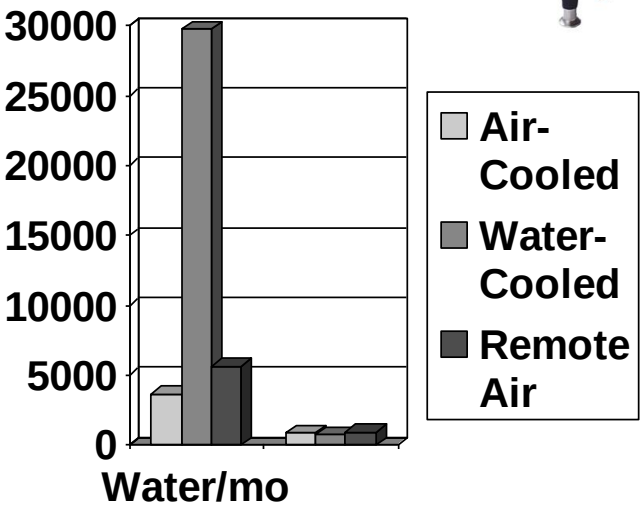
Commercial Kitchen Management

- Staff education
- Only run dishwashers when full
- Check water temperatures and flow rates to match manufacturer recommendations
- Test system pressure
- Use batch loading for steam cooking
- Eliminate or minimize use of garbage disposals by using strainers or traps

- Modify ice machines to use closed loops or use air-cooled unit
  - Capture and reuse cooling water from old units
  - New machines use can use 10 percent of water cooled units
- Purchase ENERGY STAR brand dishwashers and food service equipment
- Use high efficiency spray valves (save thousands with a $75 item)
- Manufacturers have water conserving features in their equipment
- Savings in annual and lifetime costs in both water and energy

Commercial Kitchen Management

- Pre-rinse spray valves
- SOMAT system
- Boilerless food steamers
- Air-cooled icemakers
- Water conserving dishwashers
- Eliminate garbage disposals
- Eliminate steam tables
- Steam kettles
- Adequate refrigeration
- Waterless wok



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SOMAT System
Pulper and Hydra-Extractor

Laboratory/Medical Equipment

Be aware of Labs 21 program from USEPA and DOE

Shut off units not in use

Install pressure reducing device on equipment that does not require high pressure

Set flow rates near minimums

Use efficient disinfection/sterilization equipment

Use small expansion tank instead of using water to cool steam for sewer discharge

Consider uncontaminated, non-contact steam condensate and cooling water as make-up for non-potable uses

Replace older equipment with digital x-ray and photographic equipment and computerized printing

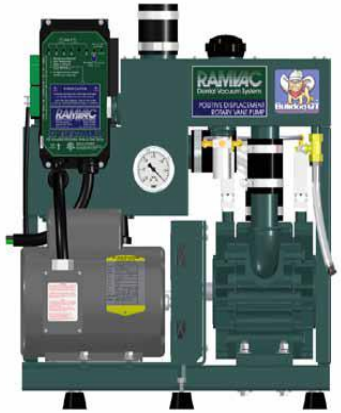
Use a laboratory vacuum system instead of faucet-based aspirators

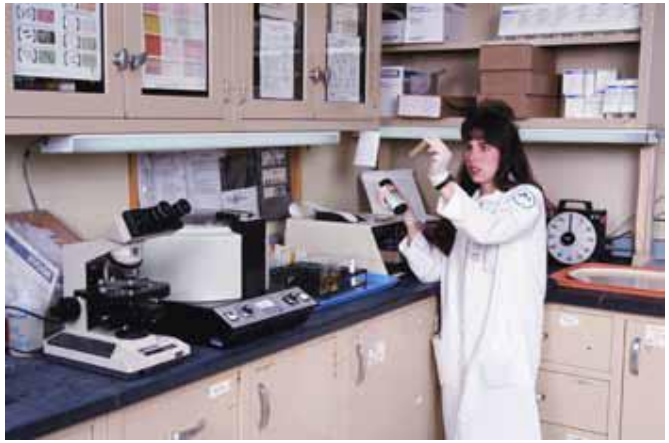
Use newer water-efficient glassware washers

In animal facilities, use counter current washers

Reuse unusable drinking water for cleaning or cooling towers

Laboratory/Medical Equipment





Other Water Use

Laundries

- **Wash full loads**
- **Replace old washers with more efficient models, tunnel washers**
- **tunnel washer units can have 60% energy recovery and paybacks of 1-5 years**

Households can get efficient units such as horizontal axis machines

Evaporative cooling

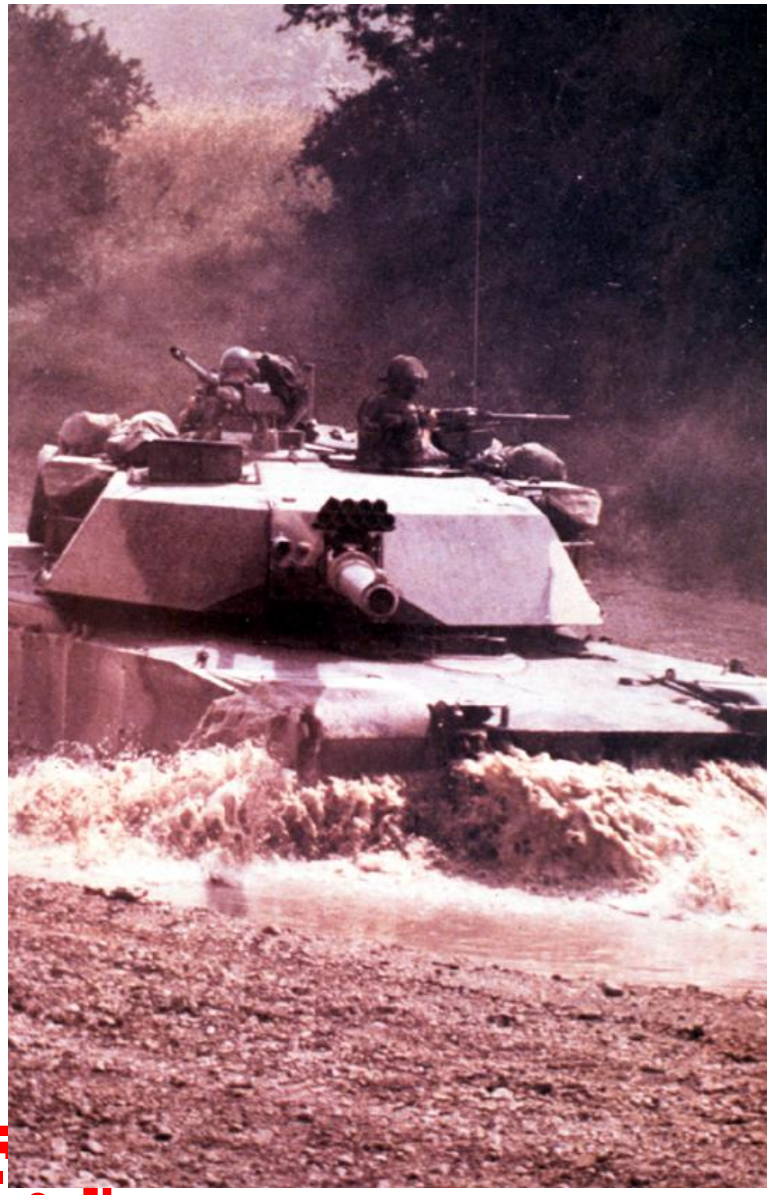
- **Keep tight rein on bleed-off**

Vehicle washing

- **Aircraft**
- **Automotive vehicle washrack**
- **Tracked vehicle washrack**

Wastewater recycling in washracks

New technology



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Central Vehicle Wash Facility

Other Water Use/Alternate Water Sources Options

- Water reuse
- Desalination
- Produced water
- Rainwater harvesting
- Graywater reuse
- Sewer mining
- Stormwater runoff
- Air conditioning condensate
- Municipal supplied reclaimed water

Water Reuse

~90% of water needs do not require potable quality

Why?

- Overcome water scarcity
- Environmental protection requirements
- Drought
- Increasing demands
- Dependable supply

Benefits

- Drought-proof
- Quantity increases with growth
- Reduce stress on aquifers and surface waters
- Improved water security
- Local control

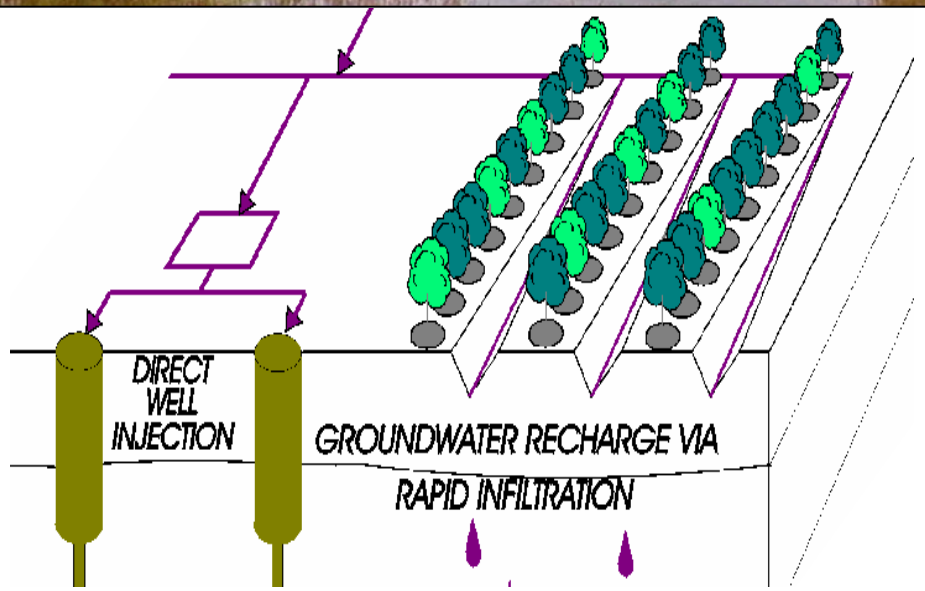
Trends

- Gaining in prominence around the globe
- On Federal radar screen
- Indirect potable reuse here

Water Reuse Categories & Typical Applications

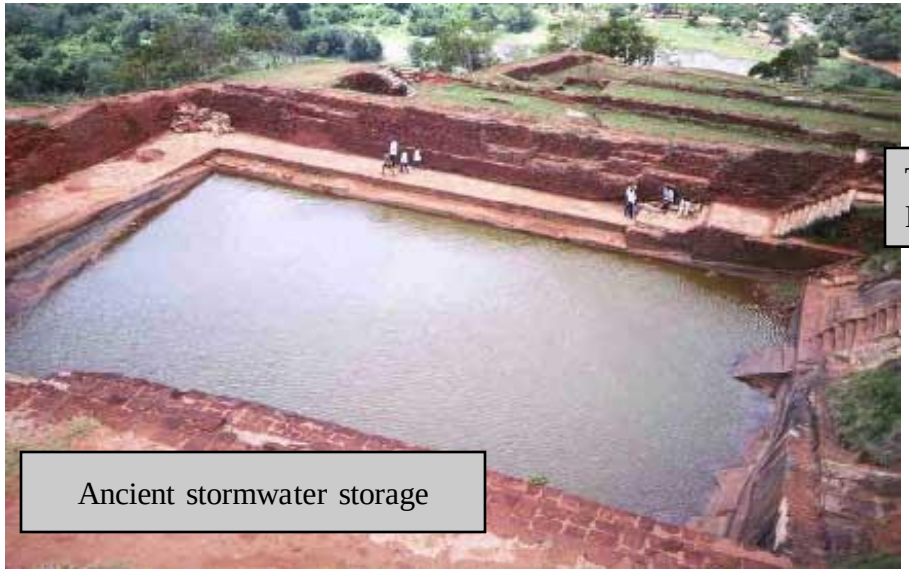
Category	Typical Application
Irrigation	Parks School yards Highway medians Golf courses Cemeteries Parade grounds Athletic fields Building landscapes Crops or vegetable gardens
Industrial recycling and reuse	Cooling water Boiler feed Process water Construction
Groundwater recharge	Groundwater recharge Saltwater intrusion control Subsidence control
Recreational/environmental uses	Lakes and ponds Marsh enhancement Streamflow augmentation Fisheries
Nonpotable urban uses	Fire protection Air conditioning Toilet flushing Water features

Reuse Opportunities

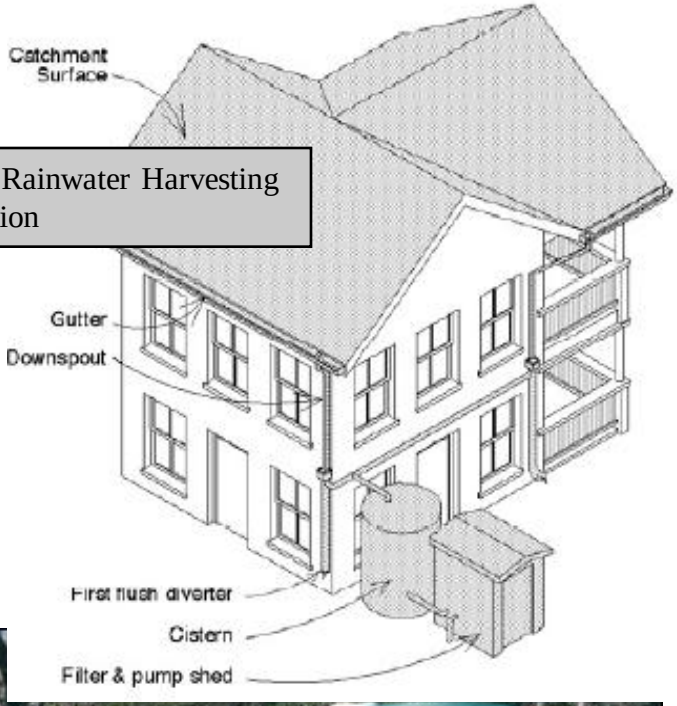


Using Rainwater

- **Advantages**
  - Saves water
  - Less discharge
  - Less energy and chemical use
  - Reduction of hydraulic load to existing systems
- **Disadvantages**
  - May be more costly
  - May decrease flow to wastewater plant



Ancient stormwater storage



Typical Rainwater Harvesting Installation

Rainwater Storage

RWH Systems for Livestock and Wildlife

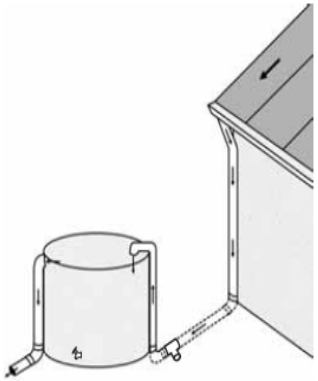


Figure 1. A typical rainwater harvesting system uses a roof, gutters, downspout and pipes underground, and backup into the top of the collection tank. This prevents livestock from damaging the pipes and allows the tank to be much further away from the shed. Unless there is a drain along the lower pipe, the standing pipes will contain water that is susceptible to freezing.

From: Texas Cooperative Extension TAMU

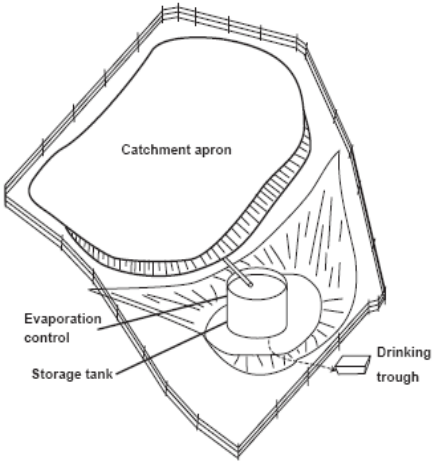


Figure 2. This rainwater harvesting system uses a prepared surface of concrete, rock or a sealing material to shed the rainfall. The rainwater is then diverted into the top of the collection tank.

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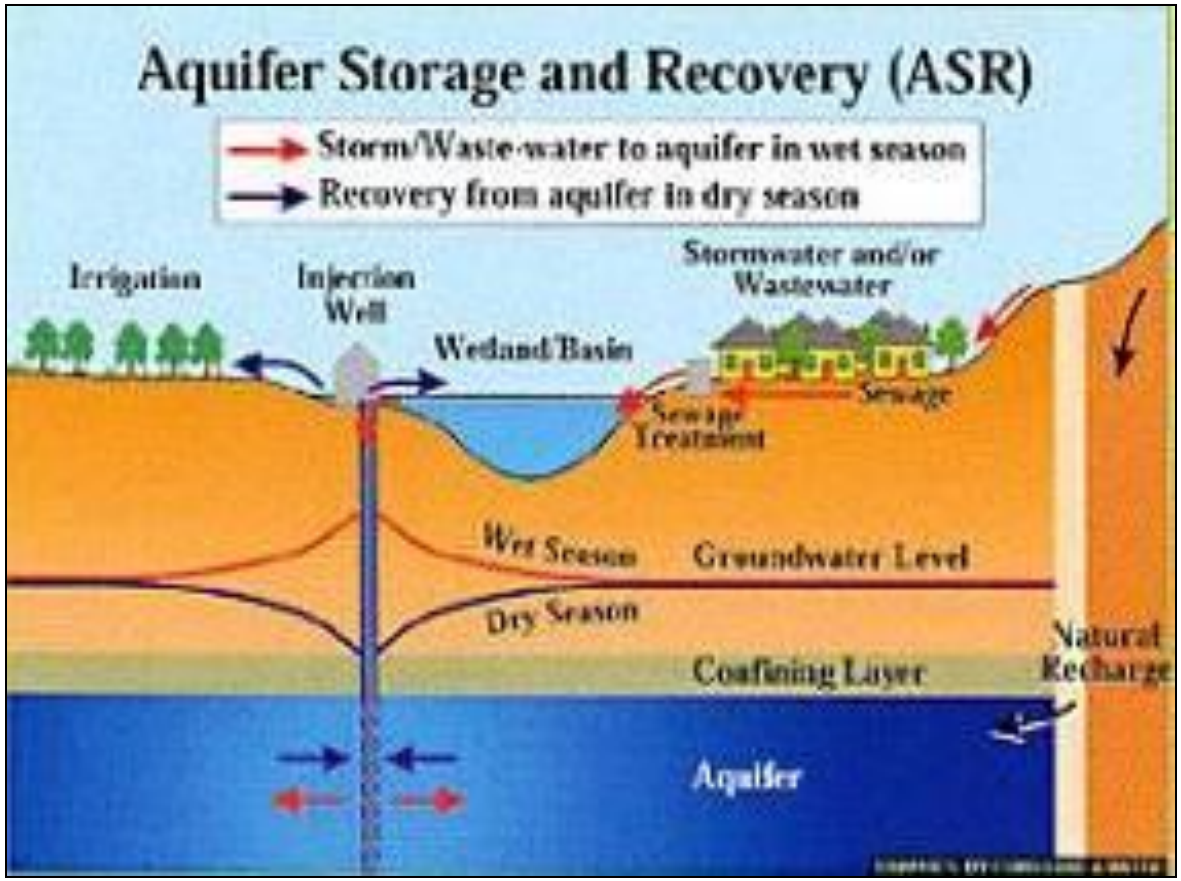
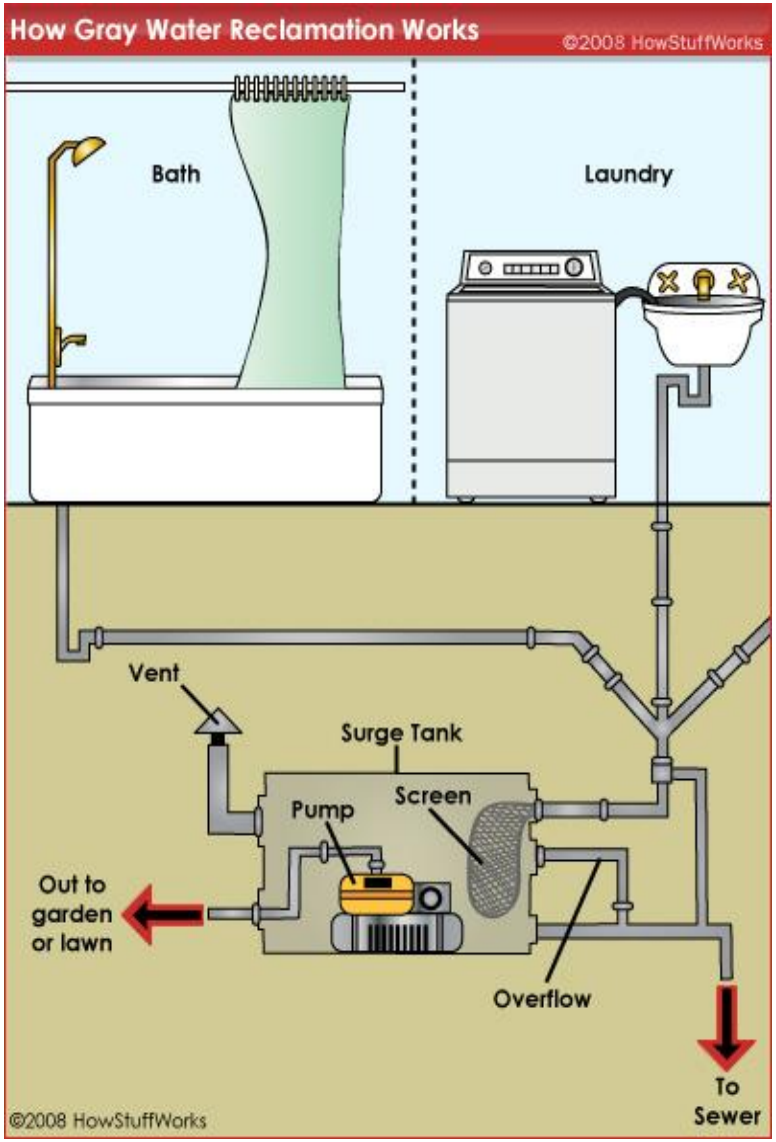
Aquifer Storage and Recovery

During a high rainfall period, excess stormwater is filtered and cleaned and then pumped into the aquifer. The water can be recovered and used for irrigation or other purposes.



Graywater Treatment



Where to Make an Impact

Irrigation – Large Water Consumer

- parade grounds
- parks and recreation areas
- athletic fields
- golf courses
- cemeteries
- landscaped grounds

Buildings

- institutional
- industrial
- barracks

Fort Huachuca Examples

WELCOME

Rainwater Harvesting

Ideal for large barracks, industrial or commercial/institutional buildings

Also applicable to expansive parking lots

Water stored in tanks or ponds – reducing runoff

Stored water can be used indoors – filtered and treated – fixture flushing, laundry, cooling tower, boiler makeup

Outdoors – irrigation, water features

Result – reduces overall demand for municipal water

Resources

Many Websites and organizations such as

Alliance for Water Efficiency

American Refrigeration Institute

American Water Works Association

California Urban Water Conservation Council

Consortium for Energy Efficiency

East Bay Municipal Utility District

Federal Energy Management Program

Food Technology Service Center

USACE –ERDC – CERL

USEPA WaterSense Program

Whole Building Design Guide

Individual States

Contact Author for additional sources

Summary

- Water is an essential resource vital to maintain quality of life and support mission
- Military demands only one of many sectors needing water
- Numerous drivers promote water efficiency
- Water has become increasingly in demand
- Current practices and supplies are insufficient for the future.
- Must use less or find new sources or supplies
- Variety of options exist for water efficiency
- New/emerging technologies should be demonstrated/adopted
- Match water quality with needs

Questions, Comments?

Contact information or for additional information or resources

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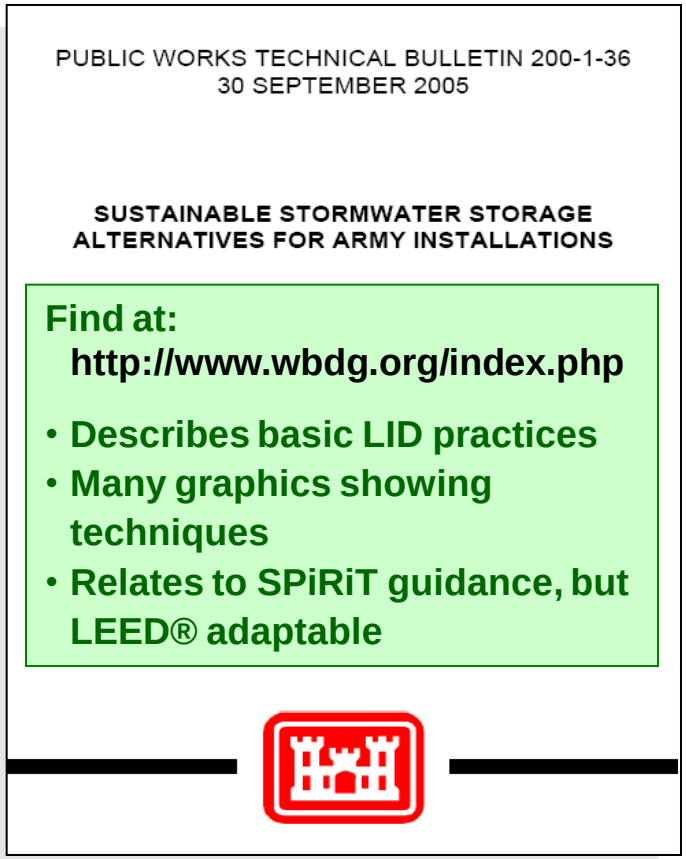
217-398-5590

Low Impact Development (LID)

Energy Independence and Security Act of 2007



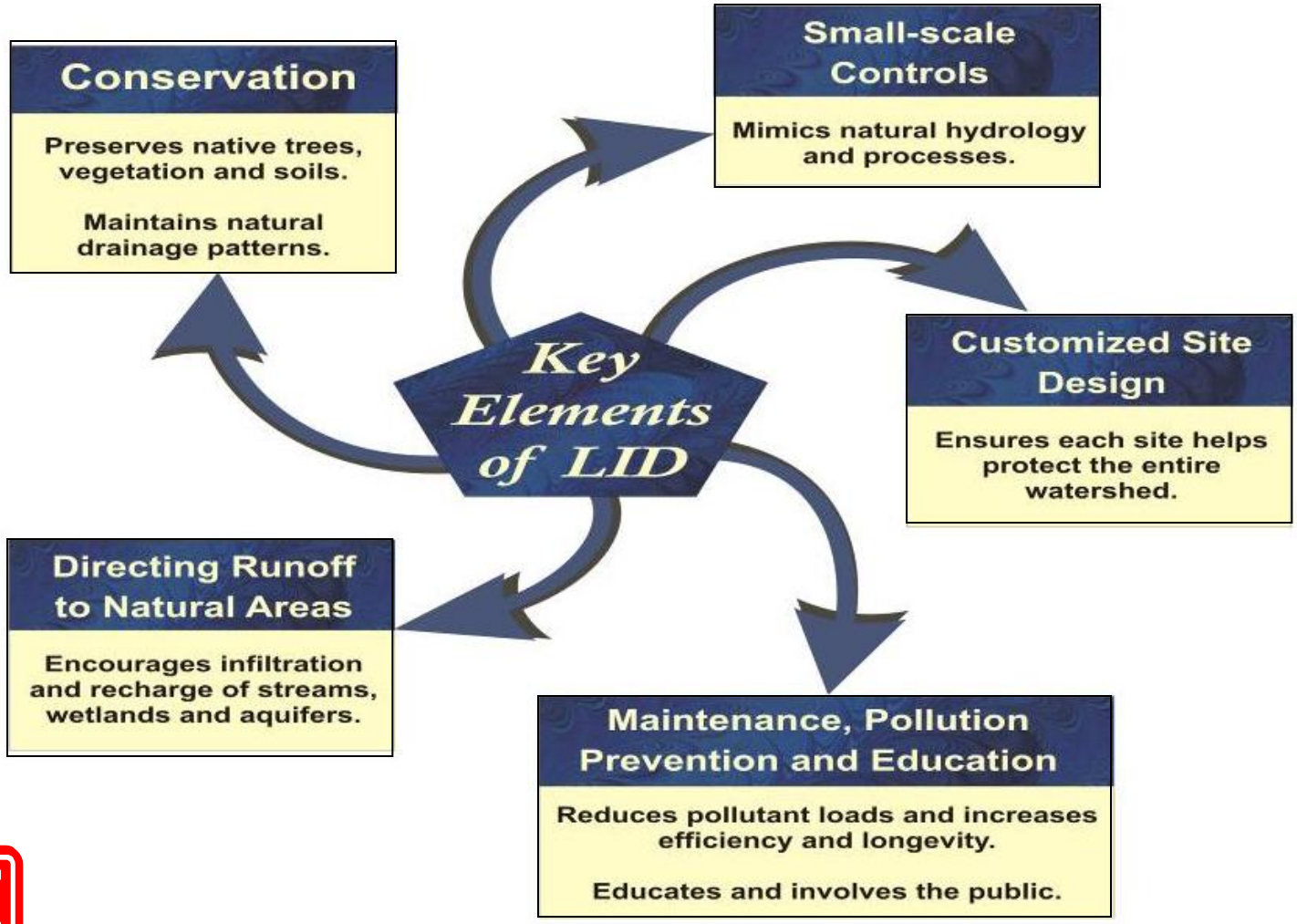
SEC. 438

STORM WATER RUNOFF REQUIREMENTS FOR FEDERAL DEVELOPMENT PROJECTS

"The sponsor of any development or redevelopment project involving a Federal facility with a footprint that exceeds 5,000 square feet shall use site planning, design, construction, and maintenance strategies for the property to maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

Low Impact Development (LID)

principals in a nutshell



LID Examples

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