A Drinking Water Supply Manifesto

(A Statement of Policies)

It is time to start protecting and
conserving our nation's purest water,
our drinking water

John T. O'Connor, P.E.

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Policy 1: Fix the Leaks

Missouri Rural Water Association Rate Survey - 2010

'% of water loss' from Missouri water systems ranges from 0% to 85%, averaging 12% for the larger cities and districts.

Many communities and water districts have not reported water losses.

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Policy 1: Fix the Leaks

County	Connections	% Water Loss
Greene	5154	22
Polk	4156	22
Pulaski	1699	40
Cole	4971	5
Butler	5300	5
Jefferson	1812	3

Selected high and low water loss data - Missouri Rural Water Association Rate Survey, 2010

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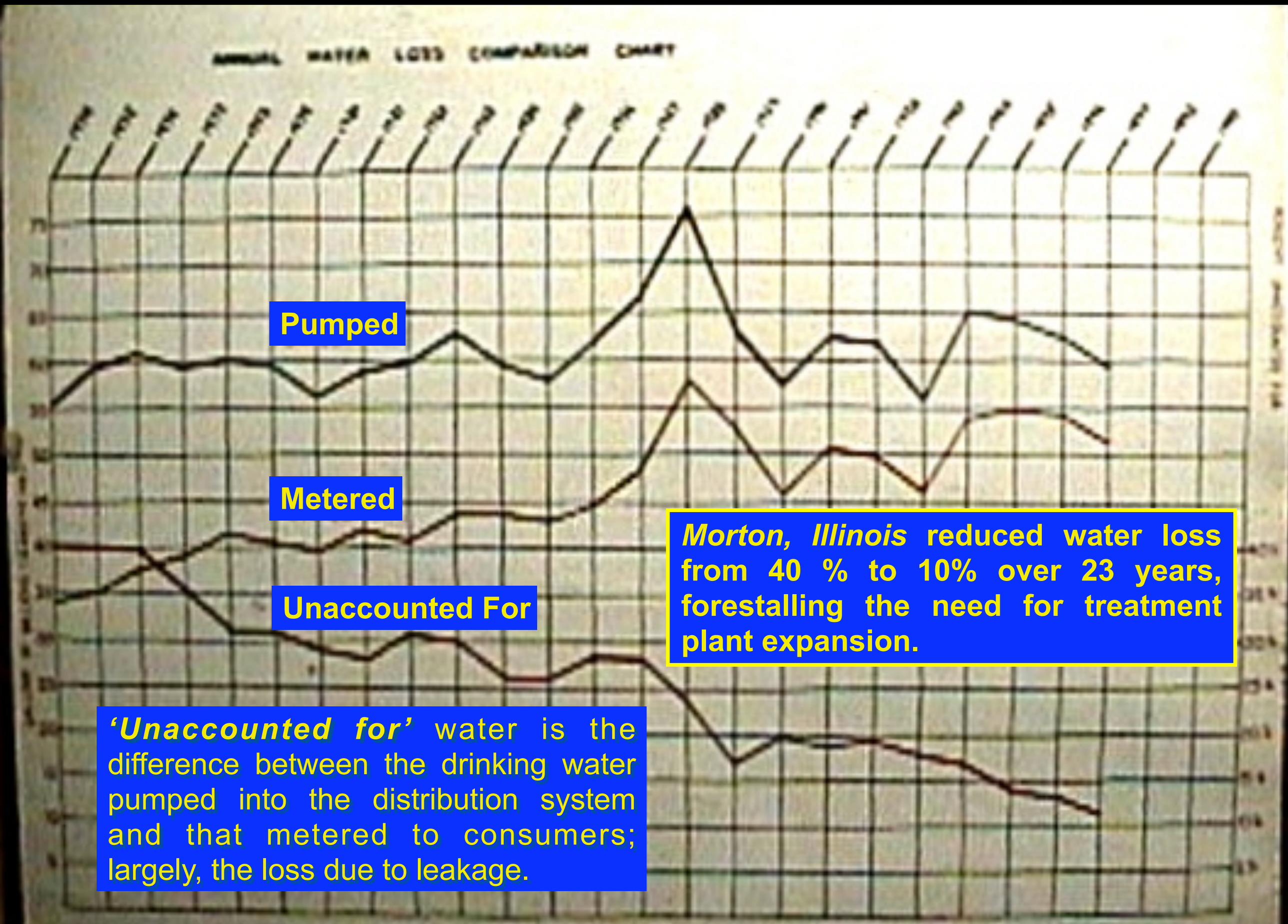
ANNUAL WATER LOSS COMPARISON CHART
Pumped
Metered
Unaccounted For
'Unaccounted for' water is the difference between the drinking water pumped into the distribution system and that metered to consumers; largely, the loss due to leakage.
Morton, Illinois reduced water loss from 40 % to 10% over 23 years, forestalling the need for treatment plant expansion.

Policy 1: Fix the Leaks

Policy Statement:

Municipal utility management shall conduct routine *water use audits* to determine water losses and make continuing, concerted leak reduction efforts to minimize those losses.

Policy 2: Reduce Peak Demand

"Columbia proposing to nearly double water supply at treatment plant"

Columbia Missourian, March 27, 2012

Yearly Average, mgd	Peak Capacity, mgd	Proposed, mgd
12	32	60

If expansion is implemented, City would have to finance **$65 million** and maintain **48 mgd** in normally idle water production capacity.

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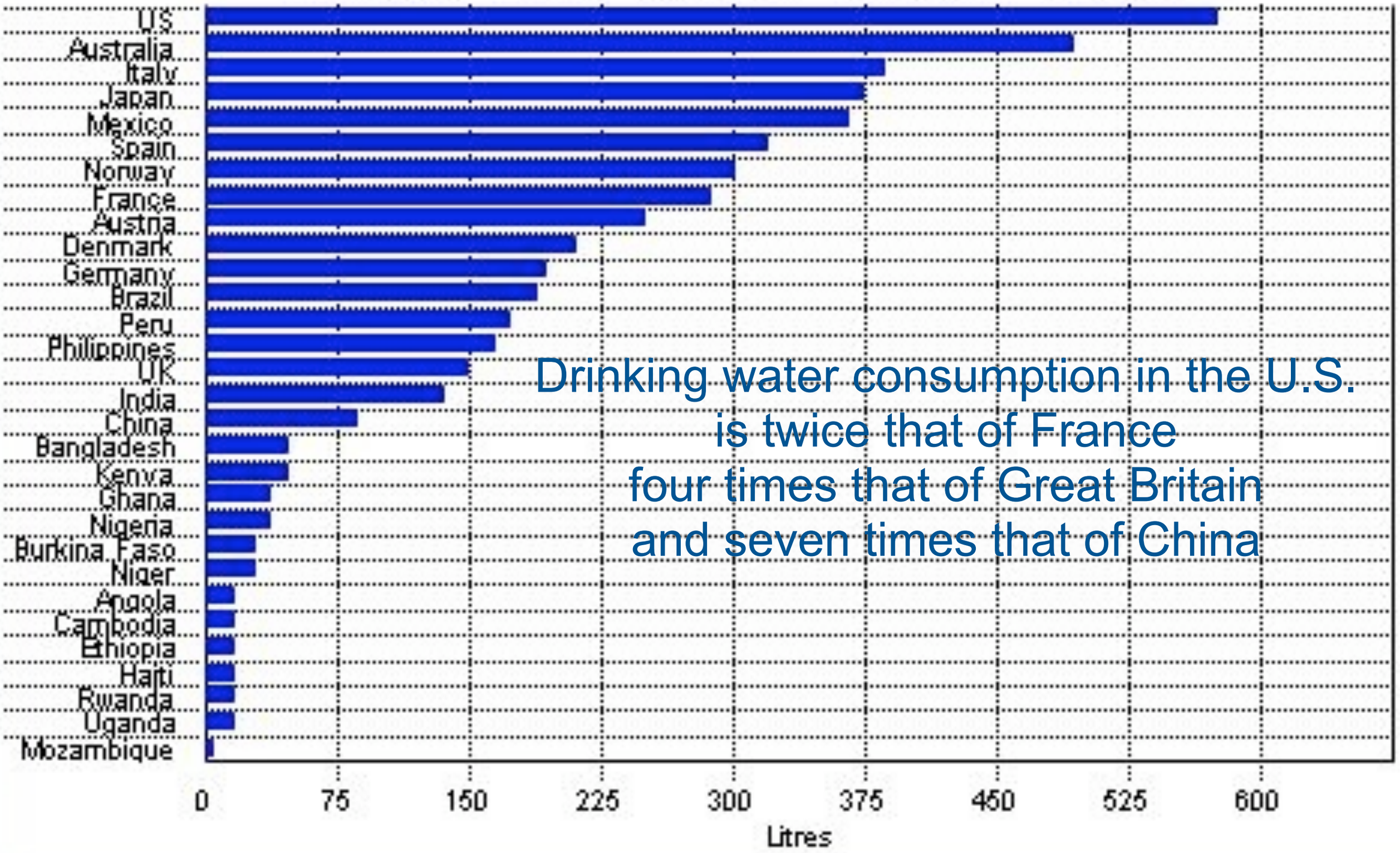
Average Water Use Per Person Per Day



Drinking water consumption in the U.S.
is twice that of France
four times that of Great Britain
and seven times that of China

United Nations Development Program - Human Development Report 2006

Water Usage: Room for Improvement?

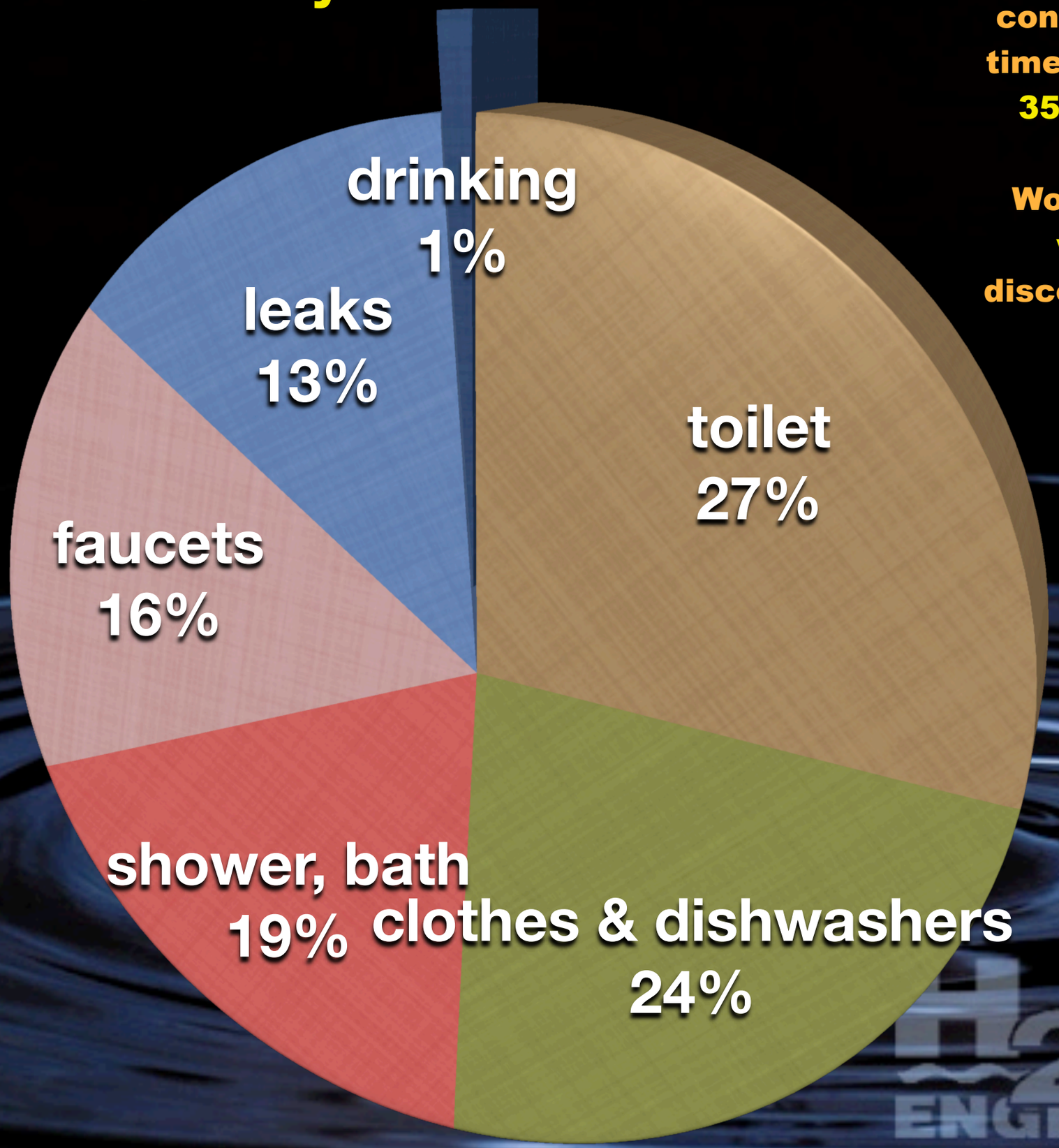
How do we use twice
the water as the French,
four times the British, &
seven times the Chinese?

U.S. suburban homeowners are ‘grass farmers’

60% of water use is outdoors; **only 40% indoors**

Water utility revenues plummet during years of above average rainfall.

% Daily Indoor Water Use



Some households consume two to five times as much as the 350 gpd average?

Would progressive water pricing discourage excessive use?

Managing Water & WW Costs

Reduce Hydraulic Loadings

Mandate efficiency of toilets, showers, faucets

Advocate Gray Water use for lawn, gardens, toilets

U.S. Suburban Household Water Use *(Family)*

Average Day: 350 gallons

Toilet flushing: 100 gallons

Gallons per flush: 3.5, 1.6, 1.28, 1.0

Federal Water Efficiency Standards (1992)

Showerheads: 2.5 gallons per minute

Faucets: 2.5 gallons per minute

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Managing Wastewater Costs

Water Conservation Programs

Offer Financial incentives to install water-efficient toilets

Pass Municipal ordinances allowing watering only on certain days

Ban ornamental fountains unless they run on re-circulated water

Require homes to have low-flow shower heads and faucet aerators

Recycle Gray Water

"If it's yellow, let it mellow; if it's brown, flush it down."

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Water Conservation - Household

EPA's WaterSense
Rainwater Harvesting
Graywater Reuse
Xeriscaping

EPA WaterSense PARTNER

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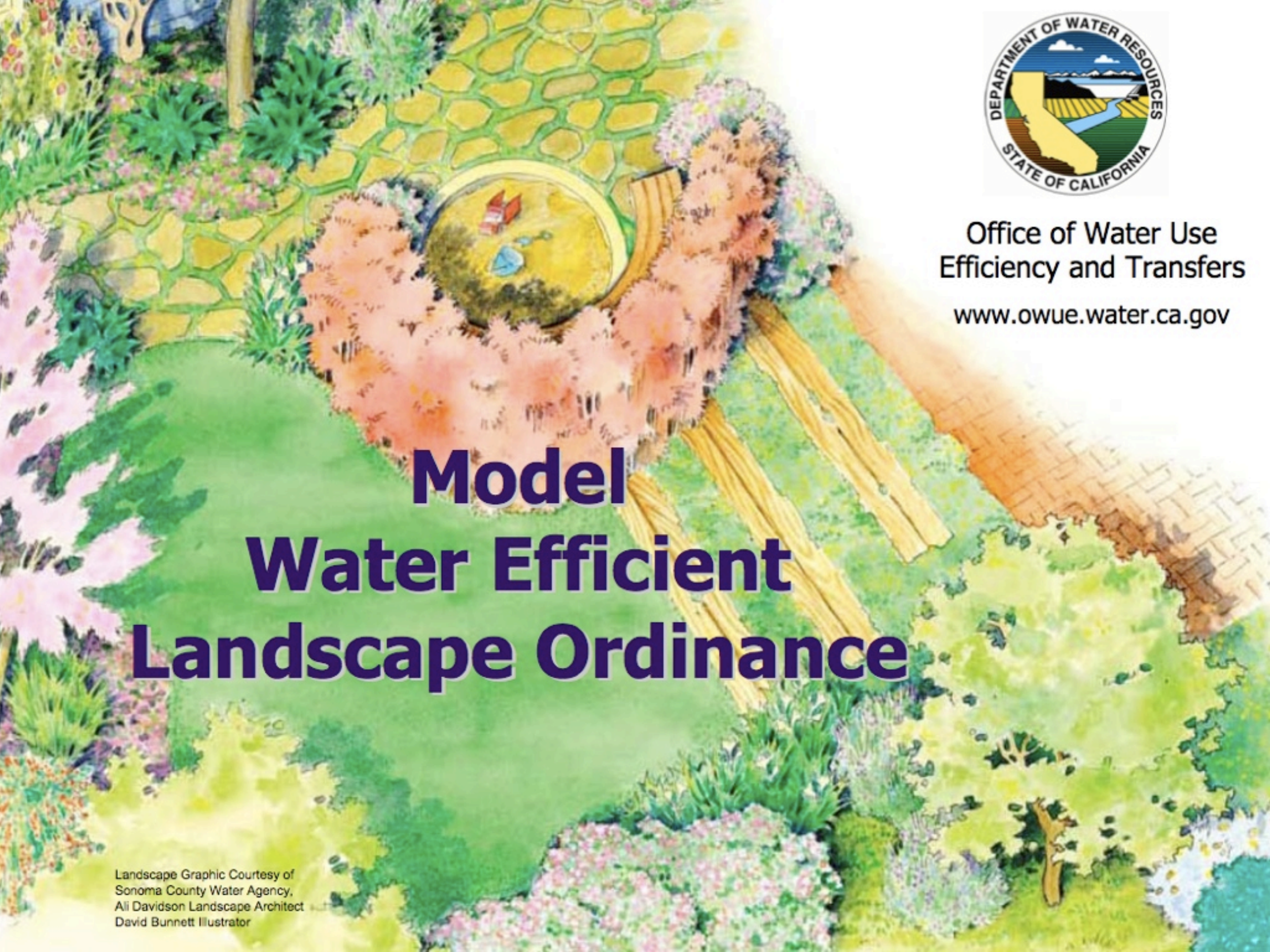

Office of Water Use
Efficiency and Transfers

www.owue.water.ca.gov

Model Water Efficient Landscape Ordinance

Landscape Graphic Courtesy of
Sonoma County Water Agency,
Ali Davidson Landscape Architect
David Bunnett Illustrator

Conservation and Efficiency

‘Virtual’ Water System Expansion:

Reduce Demand rather than Increase Supply

Take the money that you were planning to spend on capacity expansion and allocate it to conservation programs and incentives (a.k.a., *Demand Side Management*).

Examine and update rates, policies, and ordinances regarding water use.

Policy 2: Reduce Peak Demand

Policy Statement:

Water utility management shall defend the financial interests of their community in controlling peak water demand through appropriate price structures (*full cost pricing*) and the advocacy of public policy constraints on excessive water use.

Policy 3: Protect Source Water

Progressive U.S. communities, Columbia included, have established citizen ***Source Water Protection Task Forces*** to coordinate regional well and watershed protection programs with regulatory authorities.

Sources of Potential Water Contamination (ref. NRDC, *A Citizen's Handbook on Groundwater Protection*)

Industrial Impoundments: Ponds, lagoons, and pits used for disposal of wastes.
Land Disposal of Wastes: U.S. landfills; most are on-site/industrial.
Haz. Waste Injection Wells: Hazardous waste disposed of legally in the U.S., injected into deep aquifers.
Municipal Wastewater Disposal: Seepage of biologically refractory contaminants into groundwater.
Septic Systems and Tile Fields: 20 million U.S. households use septic systems or cesspools.

Accidental Spills and Leaks: Storage tanks, pipelines, trucks, holding tanks, injection wells.
Agricultural Practices: Irrigation return-flows, pesticides, fertilizers, manure, sediments, nitrates, atrazine.
Buried Storage Tanks: Leaking gasoline, fuel, hazardous chemical storage facilities.
Fracking, Petroleum, Mining: Brine disposal pits, acid drainage from abandoned mines, methane.
Salt water Intrusion: Overpumping of freshwater aquifers, road de-icing chemicals.

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Columbia's Source Water Supply

18 Water Supply Wells
in Missouri River
Alluvial Flood Plain

Yield / well ≈ 1 mgd

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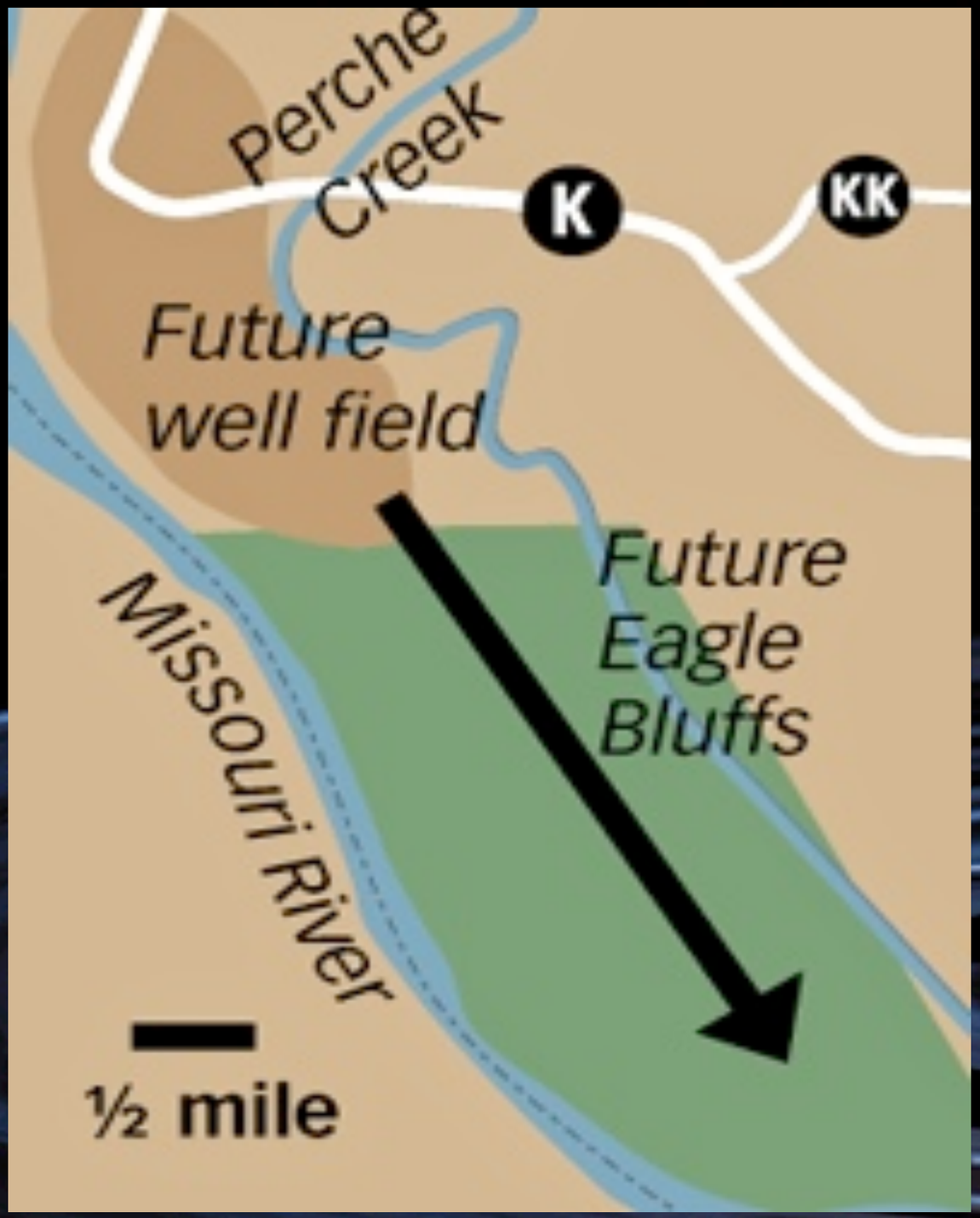
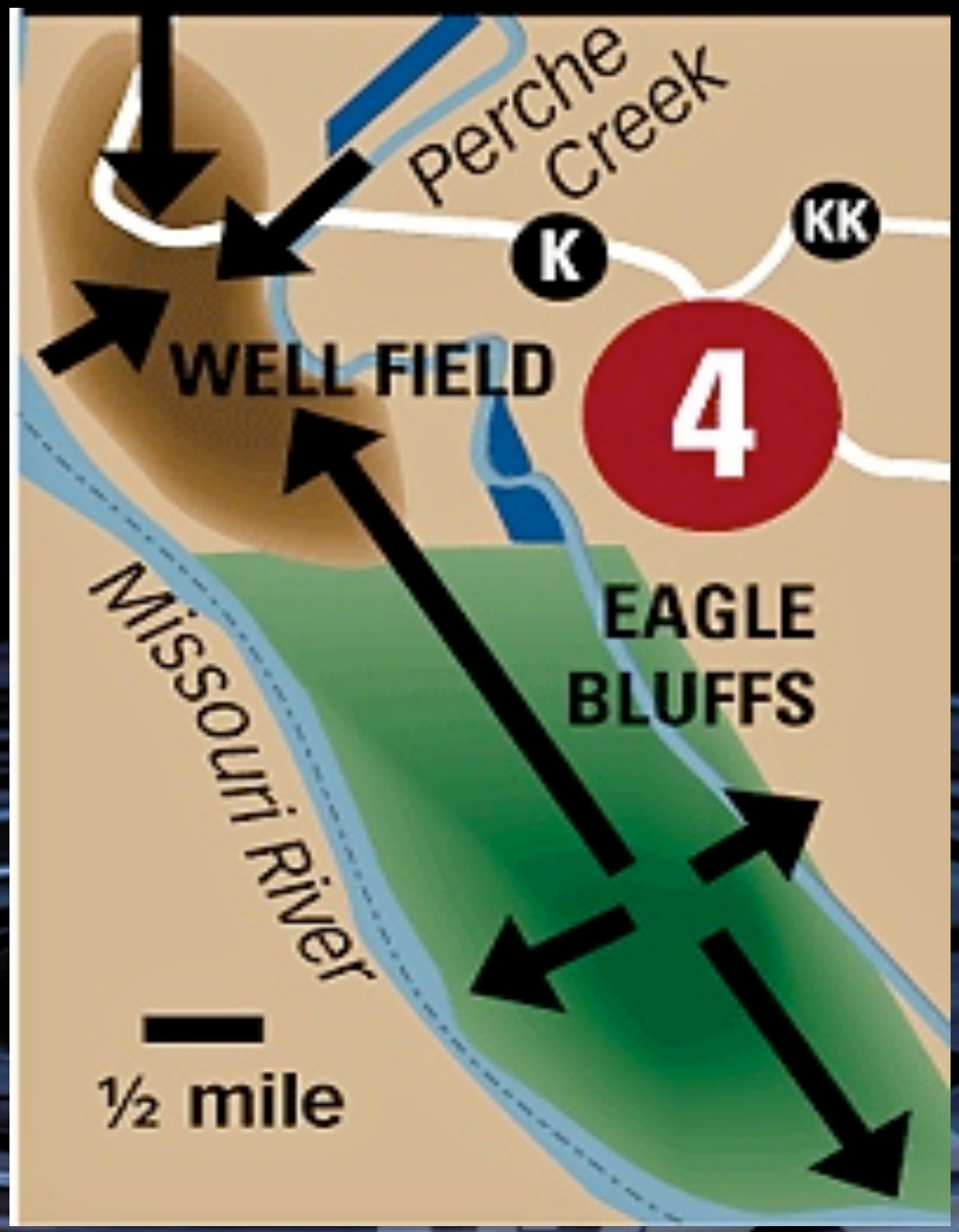
Wetlands adjacent to Columbia's Well Fields

Department of Conservation Wetlands:

1,300 acres of unlined wetlands receive effluent
from Columbia Wastewater Treatment Wetlands

Wetlands influence Groundwater Flow





Columbia Daily Tribune - August 27, 2008

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Chloride Concentrations

	milligrams per liter
Rainwater	1
Well Water	15*
Missouri River	19
Wastewater (treated)	240

* prior to wetlands

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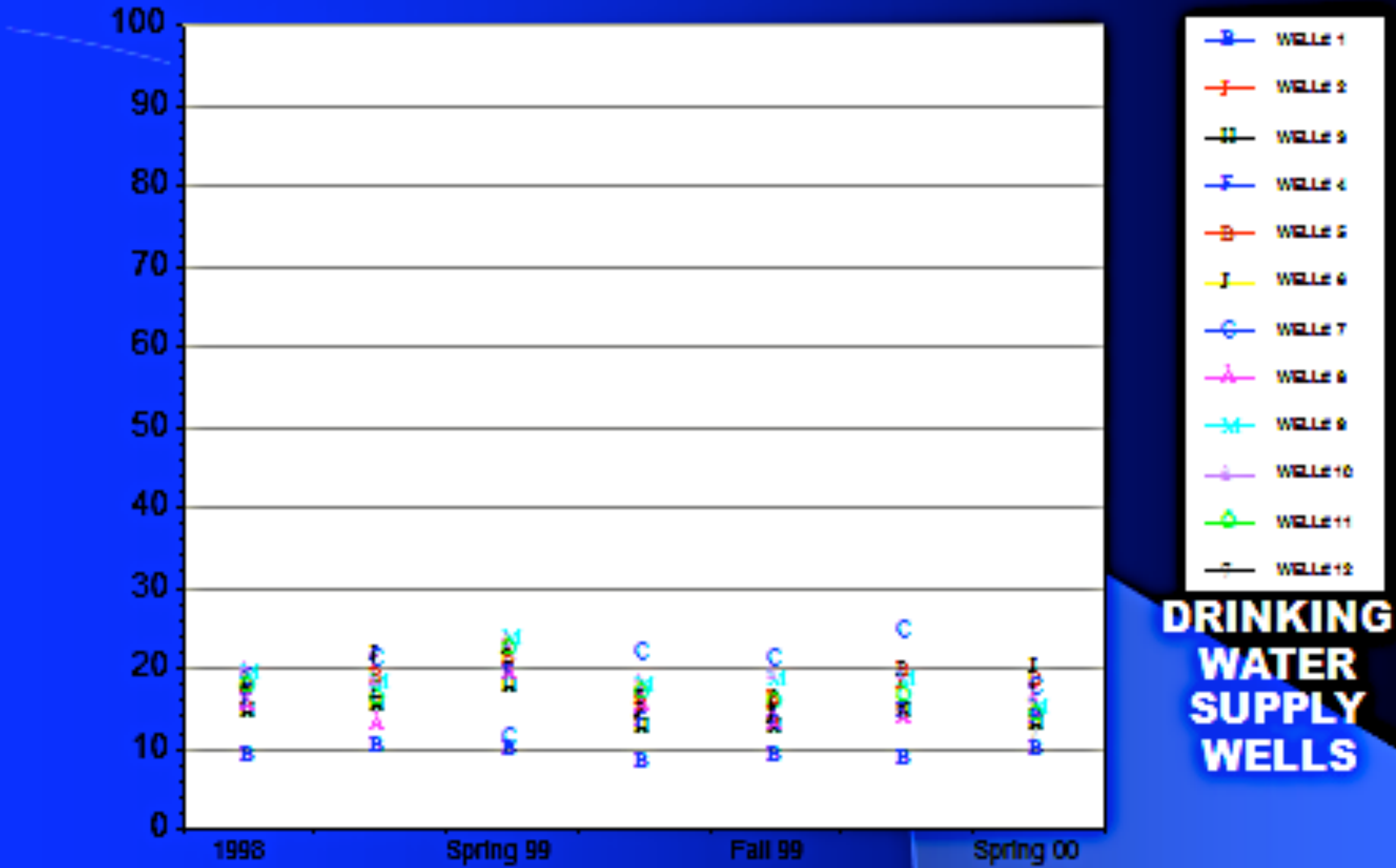
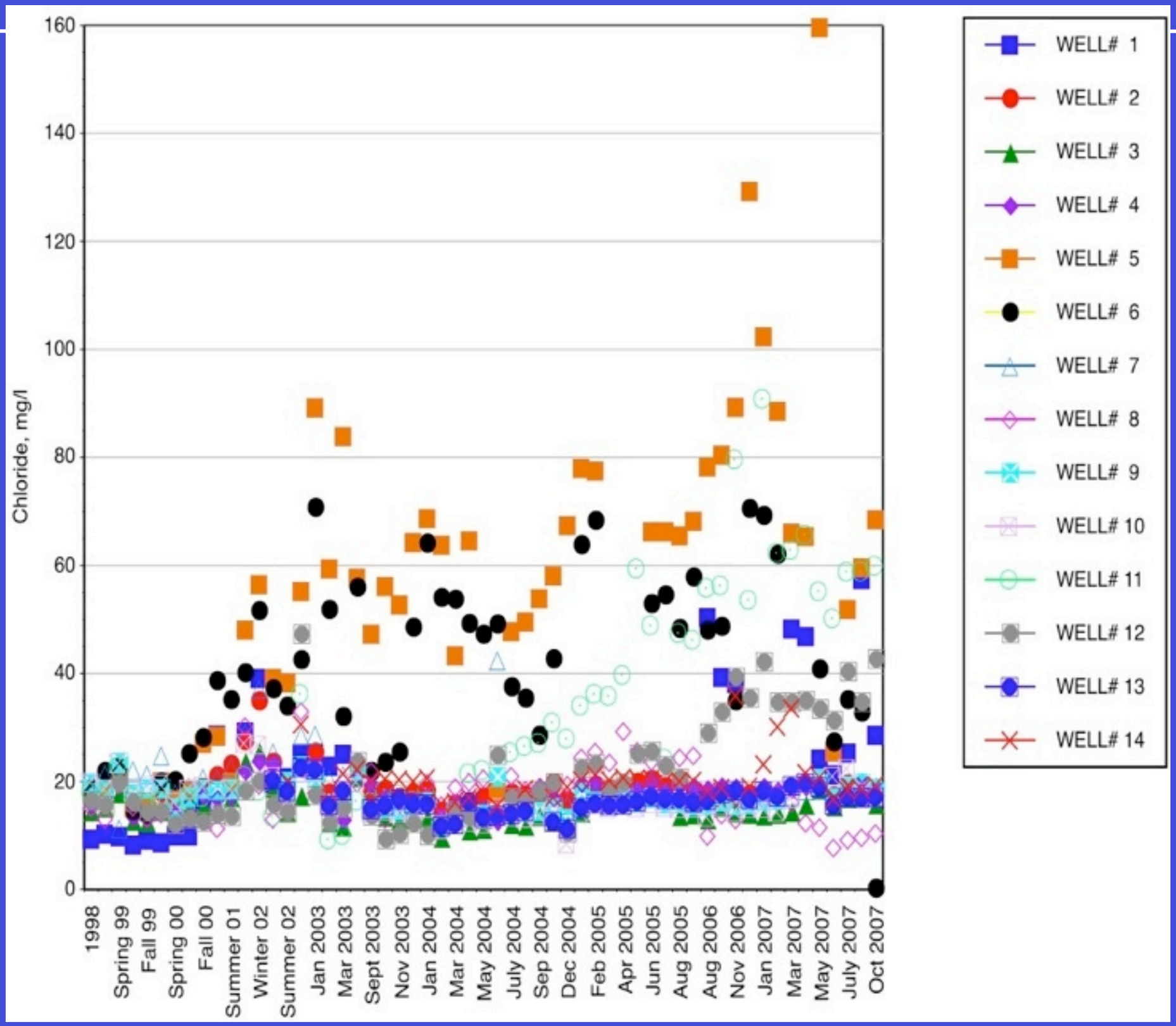
Pre-Wetlands



Chloride Levels after Wetlands



USGS Report - 2007

Monitoring wells in McBaine bottoms indicate substantial changes since 1992 in calcium, potassium, sodium, chloride, and sulfate.

Changes began at beginning of operation of the two wetland operations

17 monitoring wells located near wetland cells designated as affected by wastewater effluent

Measurable traces of pharmaceuticals, pesticides, and phenol products found in monitoring wells throughout bottoms

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Emerging Health Concerns

pharmaceuticals: N-nitrosodimethylamine (NDMA), 1,4-dioxane, bisphenol A, alkylphenol polyethoxy carboxylates (APECs), dioxin, disinfection by-products, ...

cosmetics, hormones, nanomaterials

endocrine disruptors, a class of compounds that perturb the normal functioning of endocrine systems including those that affect growth, reproduction and behavior.

Partial removal requires capital, energy-intensive processes:

(GAC adsorption; ozonation; micro-, ultra-, nano-filtration; reverse osmosis; membrane bioreactors; advanced oxidation (hydrogen peroxide - UV)

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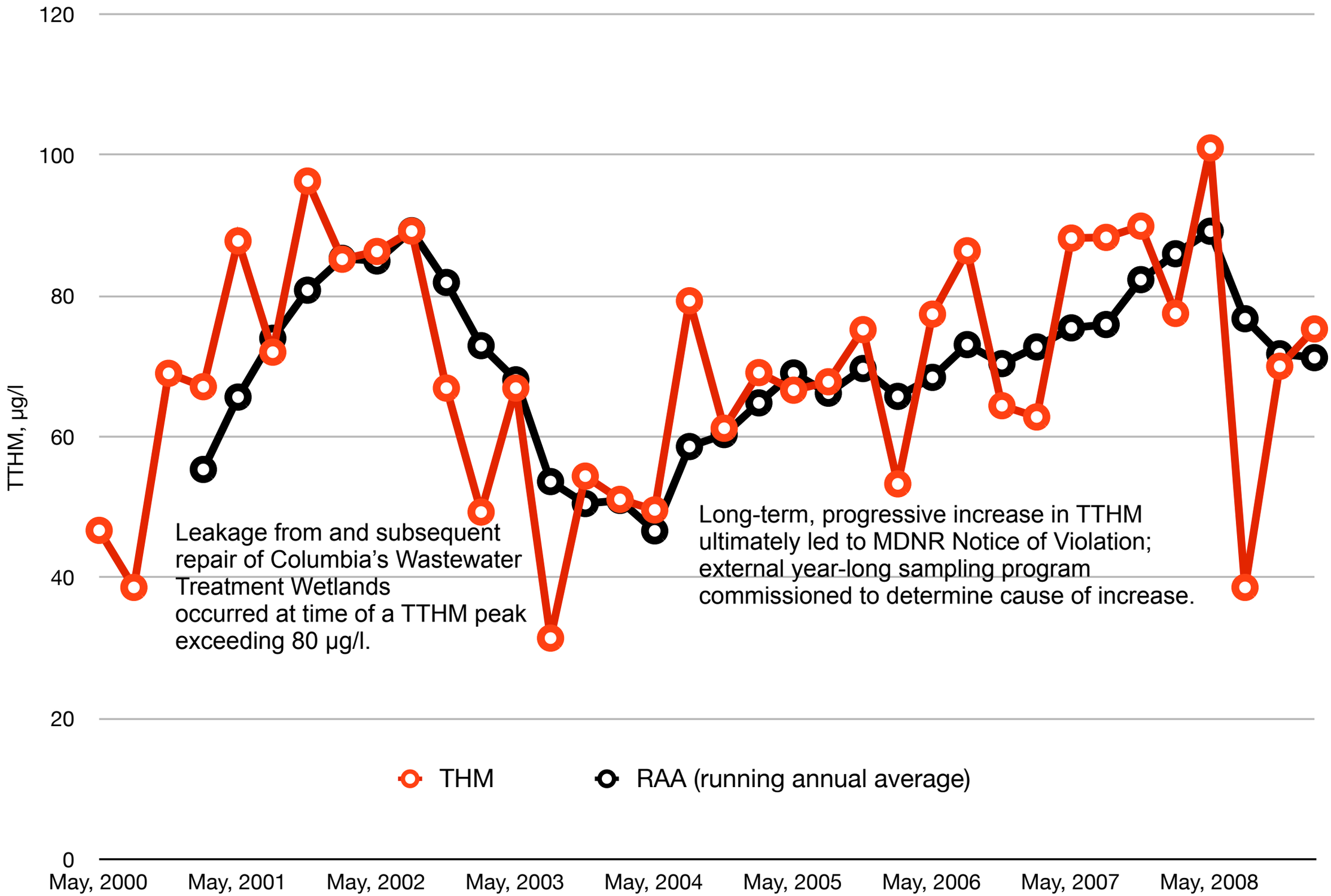
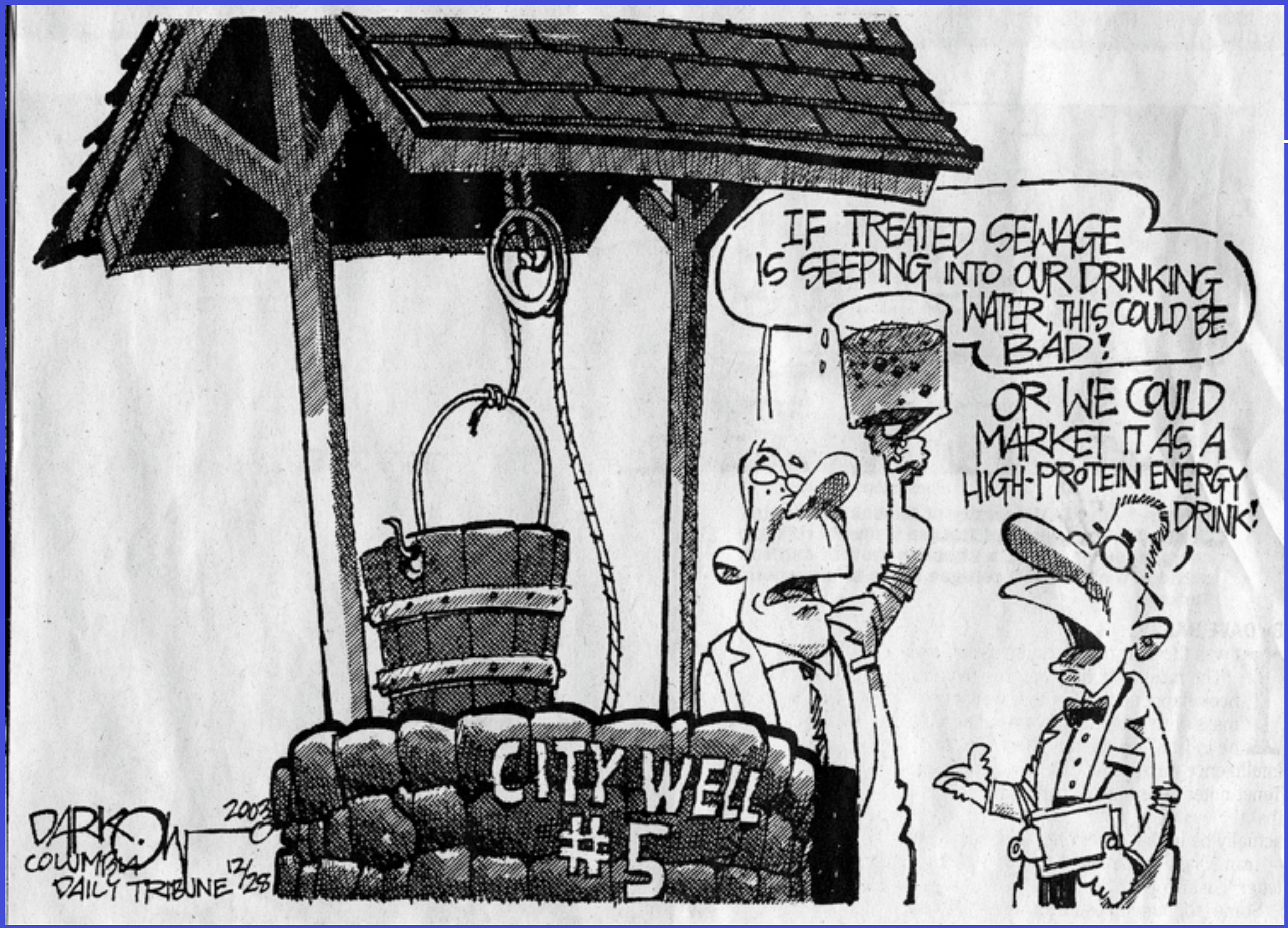
City of Columbia Total Trihalomethanes

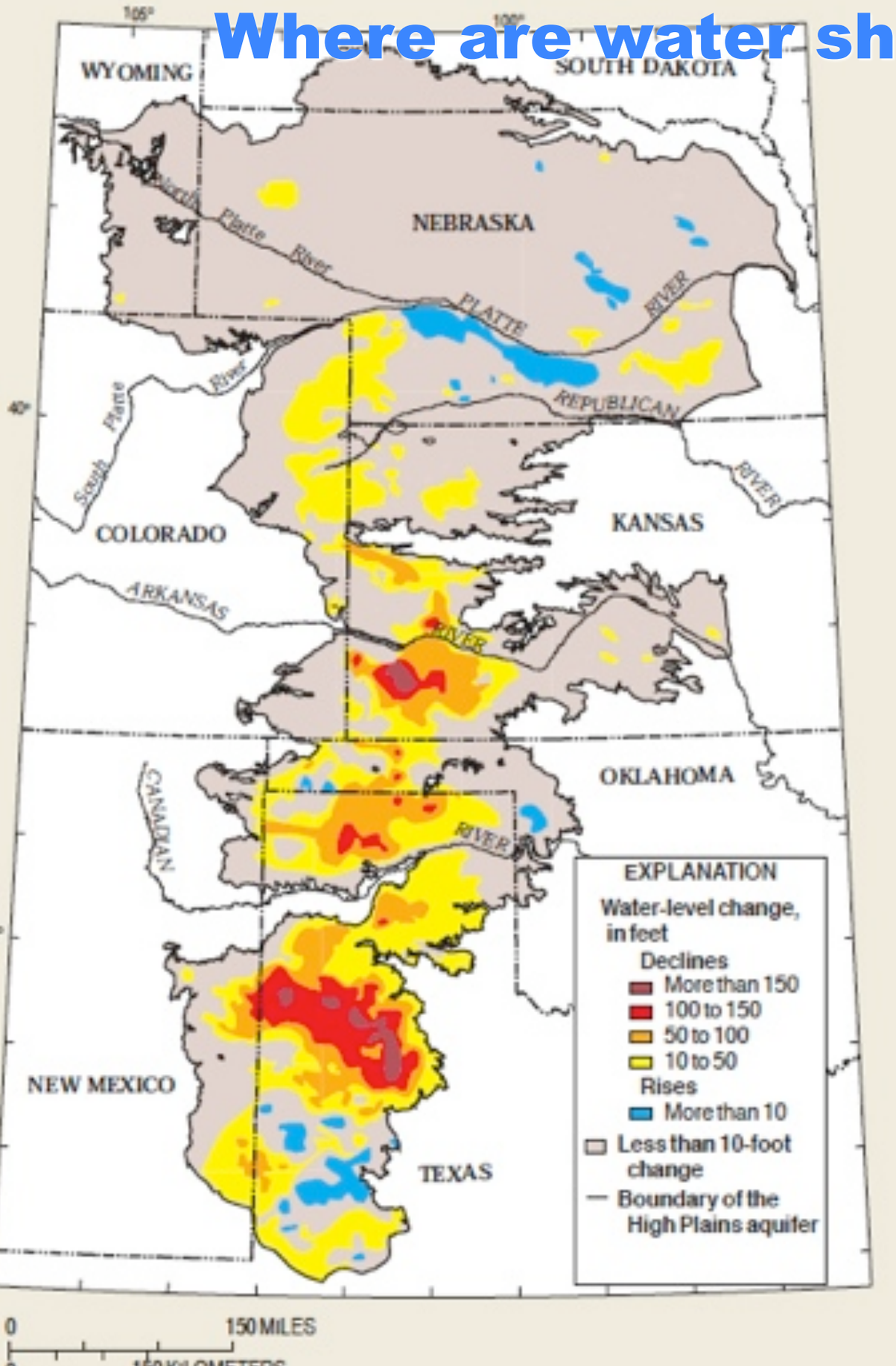


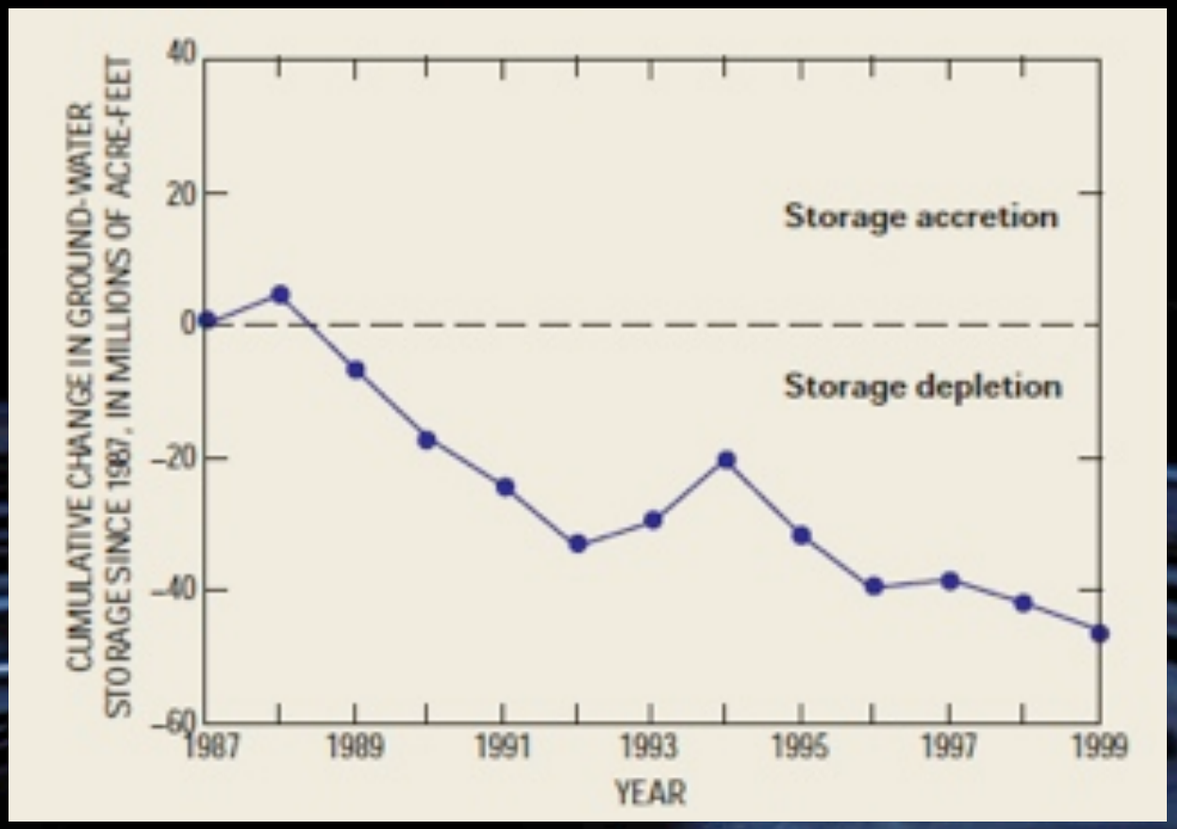

IF TREATED SEWAGE IS SEEPING INTO OUR DRINKING WATER, THIS COULD BE BAD!
OR WE COULD MARKET IT AS A HIGH-PROTEIN ENERGY DRINK!
CITY WELL #5
DARKOW 2003
COLUMBIA DAILY TRIBUNE 12/25

Where are water shortages developing?

High Plains Aquifer:

- water-level declines > 150 ft.
- 220 million acre feet removed





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Policy 3: Protect Source Water

Policy Statement:

Waterworks professionals shall identify and confront all threats to the integrity of a community's drinking water sources. They shall actively defend the public's health and financial interests in avoiding source water contamination & depletion.

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Policy 4: Work toward Sustainability

"*Sustainable development*
is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Brundtland Report, United Nations. 1983.

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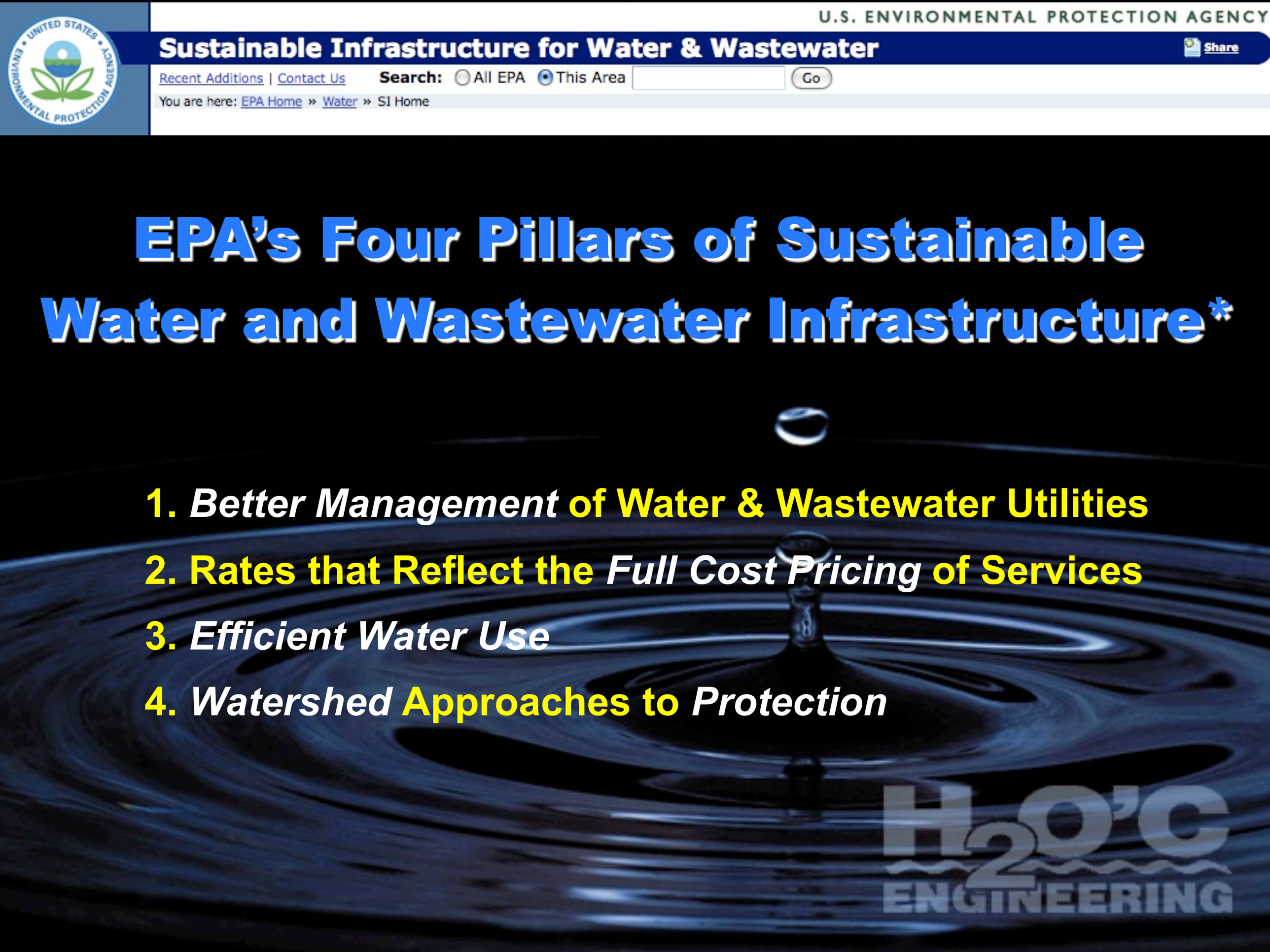
U.S. ENVIRONMENTAL PROTECTION AGENCY
Sustainable Infrastructure for Water & Wastewater
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EPA's Four Pillars of Sustainable Water and Wastewater Infrastructure*
1. Better Management of Water & Wastewater Utilities
2. Rates that Reflect the Full Cost Pricing of Services
3. Efficient Water Use
4. Watershed Approaches to Protection
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AWWA Sustainablity Policy

"AWWA advocates sustainability of drinking water utilities through the provision of adequate and reliable water supply of desired quality -- now and for future generations -- in a manner that integrates economic growth, environmental protection and social development."

Statement of Policy on Public Water Supply Matters,
Adopted by the Board of Directors, Jan. 23, 2011.

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Environmental Sustainability

"Improving the quality of human life while living within the carrying capacity of supporting ecosystems."

IUCN, UNEP, WWF (1991): Caring for the Earth. A Strategy for Sustainable Living.

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Implications of Sustainability

Ultimately, by Definition:

All Energy Must be Renewable

Which Means:

No Dependency on Fossil Fuels

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Policy 4: Work toward Sustainability

Policy Statement:

Waterworks professionals shall embrace, measure, and routinely report progress in reducing reliance on non-renewable fuels, chemicals, and materials.

Impediments to Sustainability

Modern Water Supply is Energy-Intensive

direct energy use (pumping)

indirect, embedded energy
(concrete, chemicals, pipe materials)

source water depletion/degradation

Water and Wastewater Energy

Water & wastewater utilities use an estimated 75 billion kWh/year.

U.S. water & wastewater systems spend about $4 billion/year on energy.

Energy costs for water & wastewater can be 1/3 of a municipality's total.

Savings from even a modest 5-10% improvement can be substantial.

Water System Energy Requirements
Rule o' Thumb

1.4 - 1.9 kWh / 1,000 gallons

Not very much, really.

A typical US household uses about
30 kWh of electricity per day.

The 350 gallons of water used daily by
a typical household represents about
0.6 kWh.

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Water System Electrical Usage

at a 3-4 mgd Lime Softening Plant

	kWh / month
Well Pumps	64,228
Water Treatment	106,177
Distribution Pumps	4,927
Linden Water Tower	75
Antioch Water Tower	281
TOTAL ELECTRICAL	175,688

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Carbon Emissions:

Chemical and Electrical Use

at a 3-4 mgd Lime Softening Plant

	Tons of CO_2 / month
Electricity	155
Gasoline	0.3
Lime Softening	95
Recarbonation	0
Chlorination	0.1
Aeration	3
TOTAL	253.4

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Energy Audit

1) Establish a Baseline Energy Use

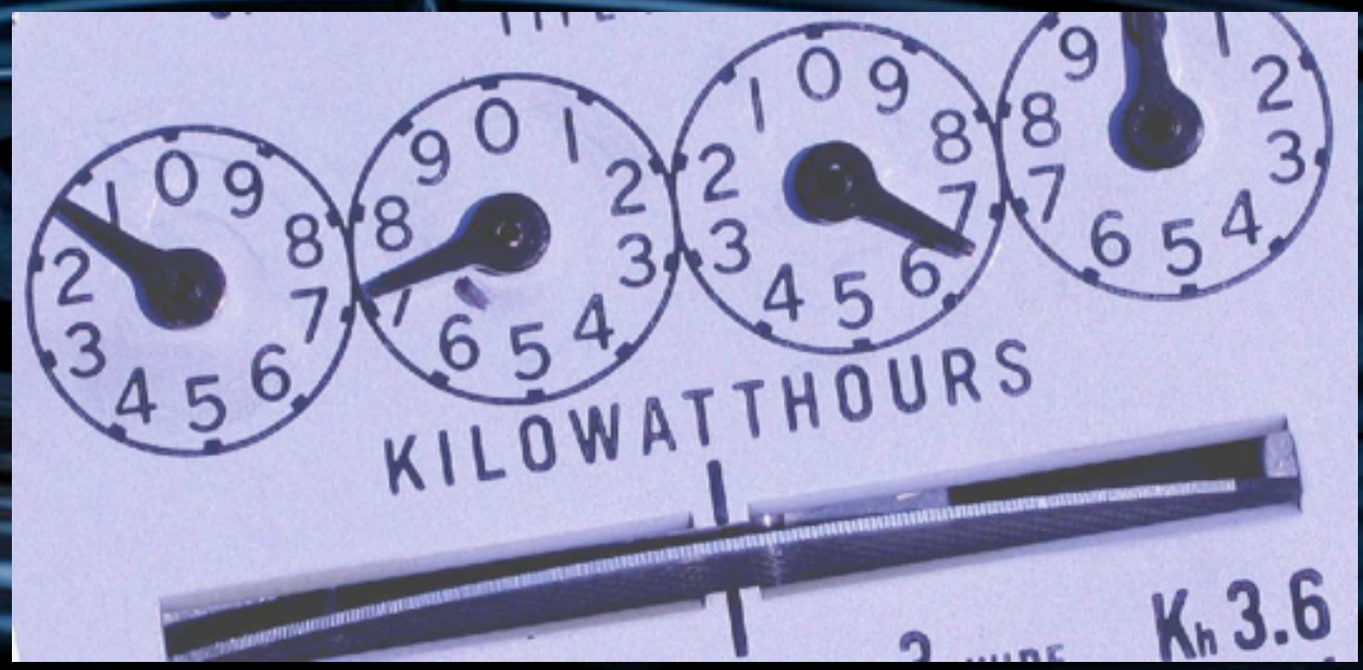
2) Estimate Energy Use for Major Systems

3) Identify Best Practice Opportunities

4) Quantify Benefits and Project Costs of Best Practice Opportunities

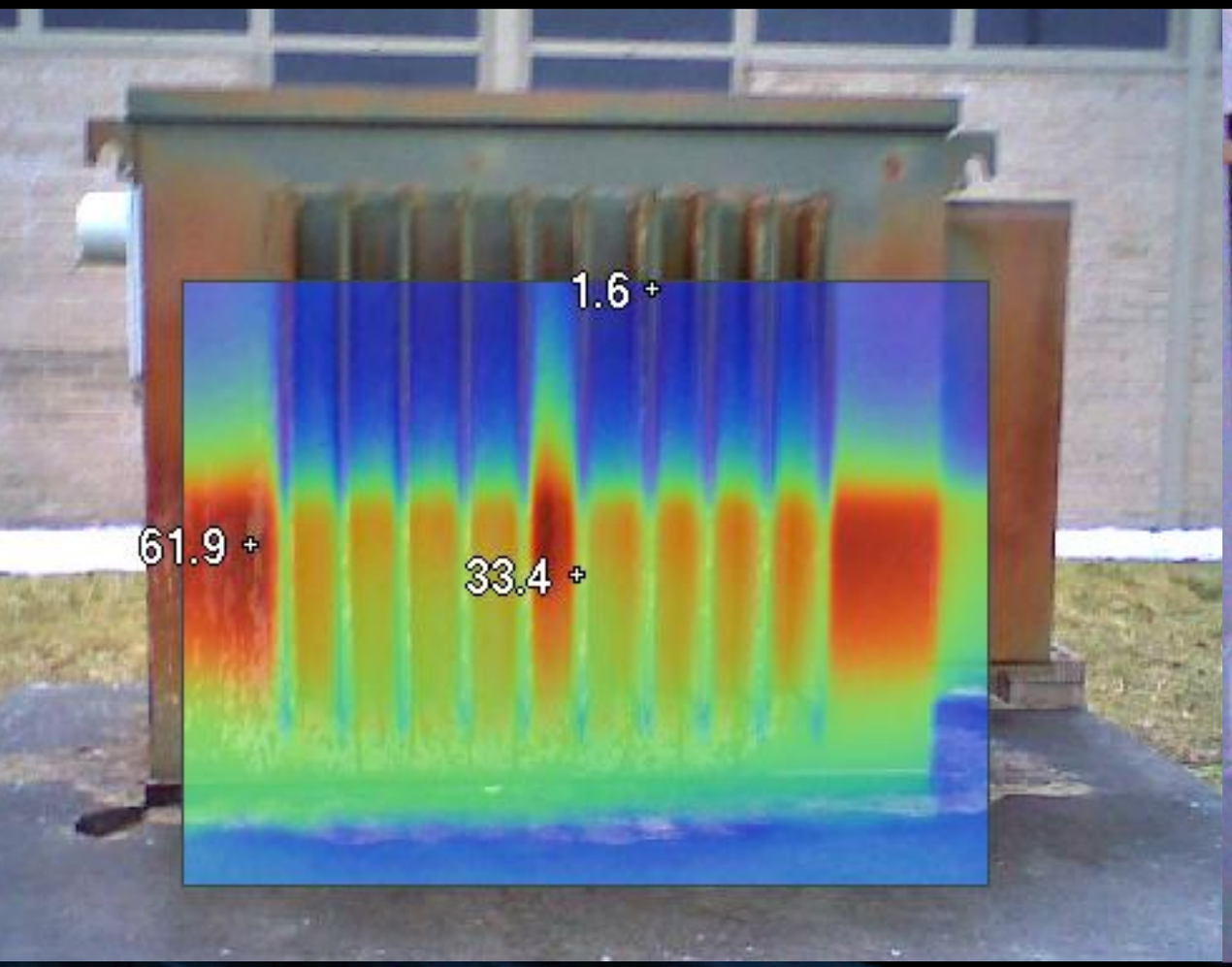
5) Prioritize Projects

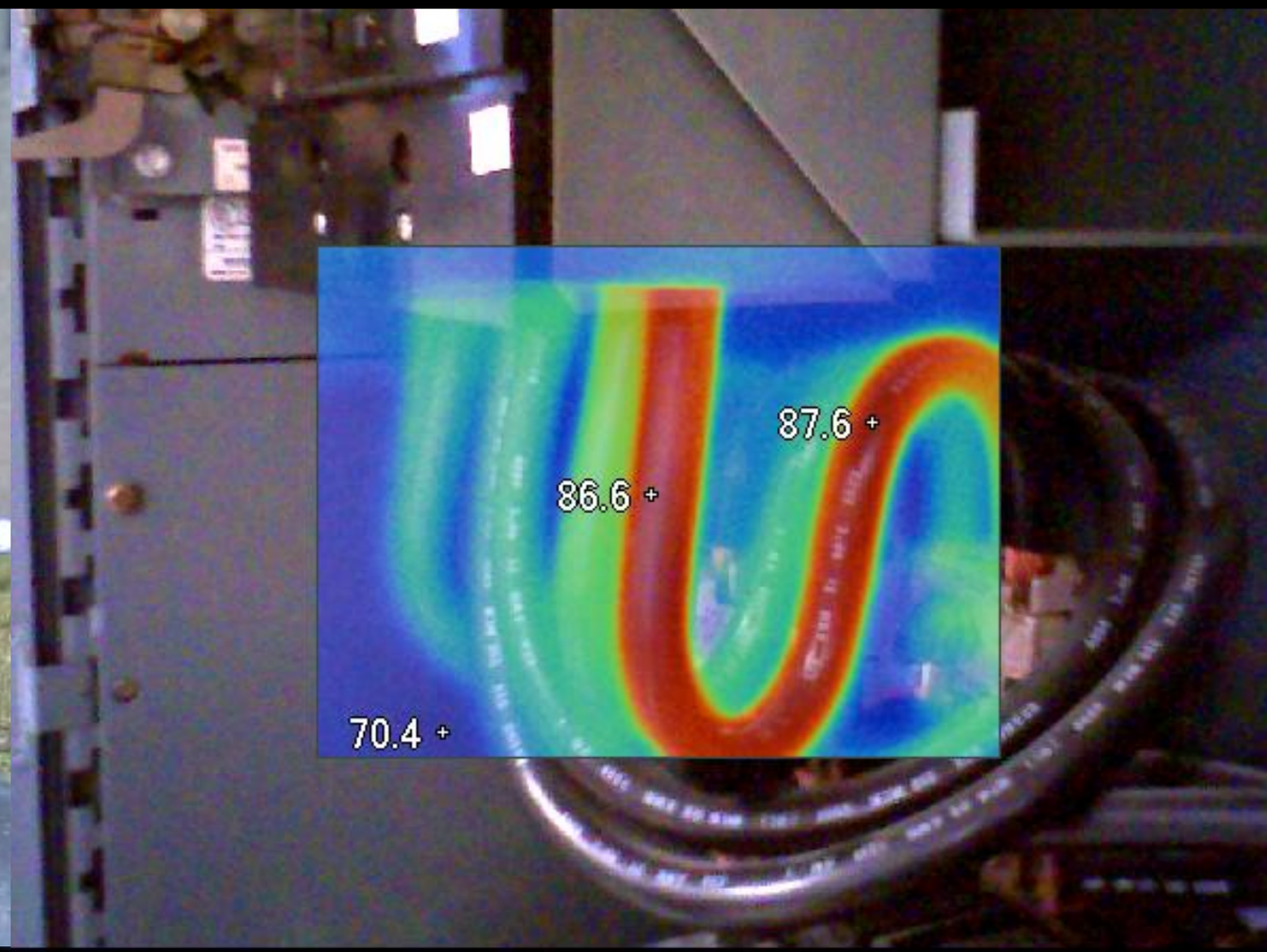
6) Project Management



Thermal Imaging

for locating energy losses





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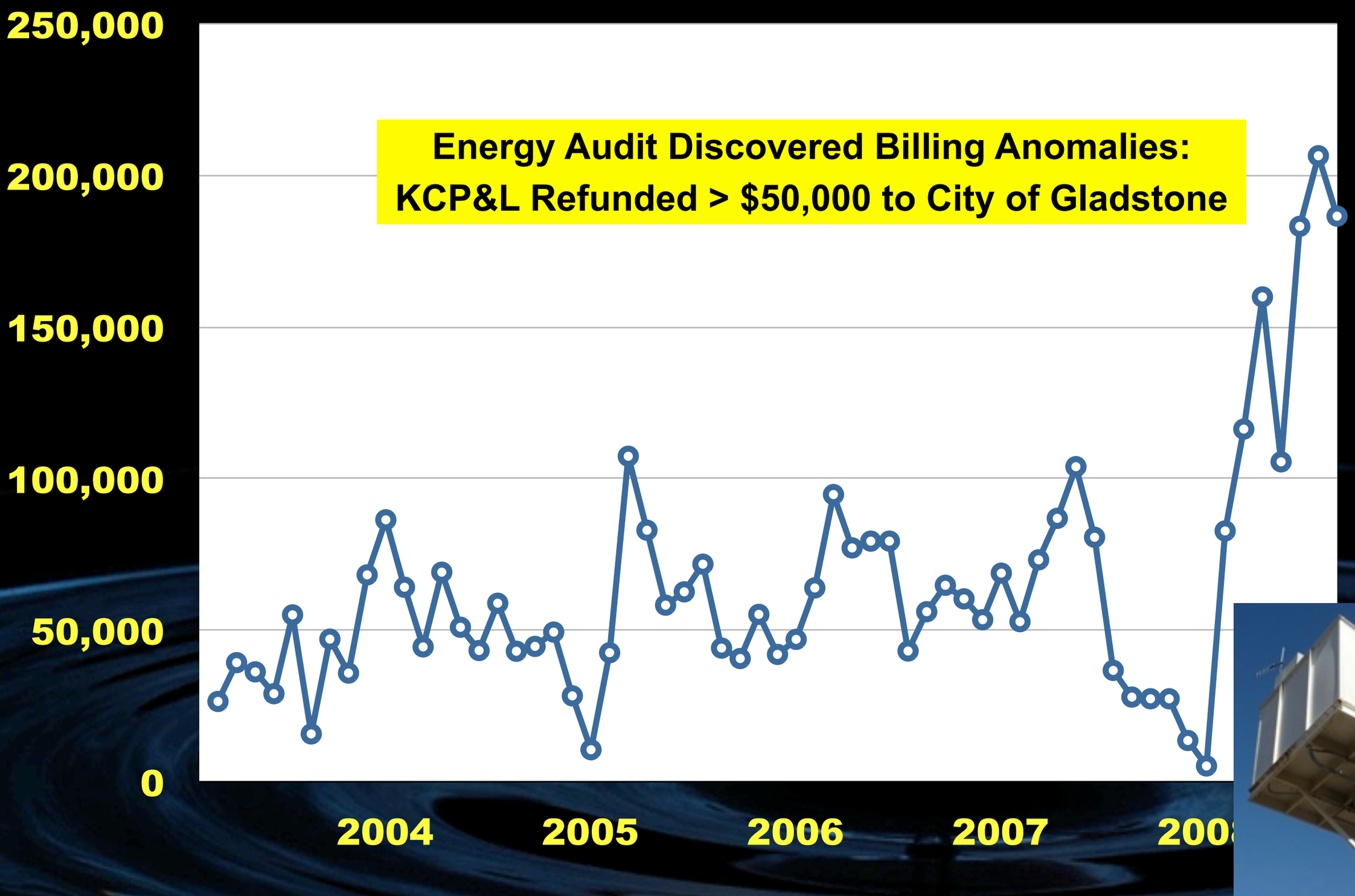
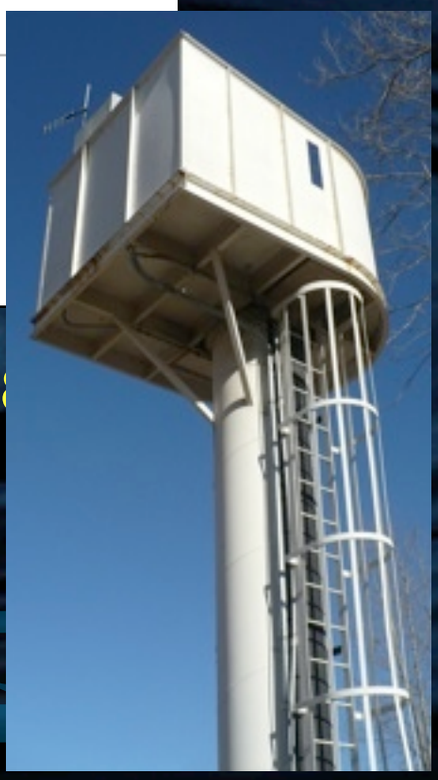
Electrical Usage at Wells (kWh/month)



Average electrical usage for the wellfield:

64,228 kWh/month (2,141 kWh/day)



Water Supply Energy Best Practices

1) Automate to Monitor and Control
2) Integrate System & Power Demands
3) Construct Distribution System Model
4) Water Audit/Leak Detection & Repair
5) Install Variable Frequency Drives
6) Manage Well Production & Drawdown
7) Sequence Well Operation
8) **Promote Water Conservation**
9) **Sprinkling Reduction Program**
10) Manage High Volume Users

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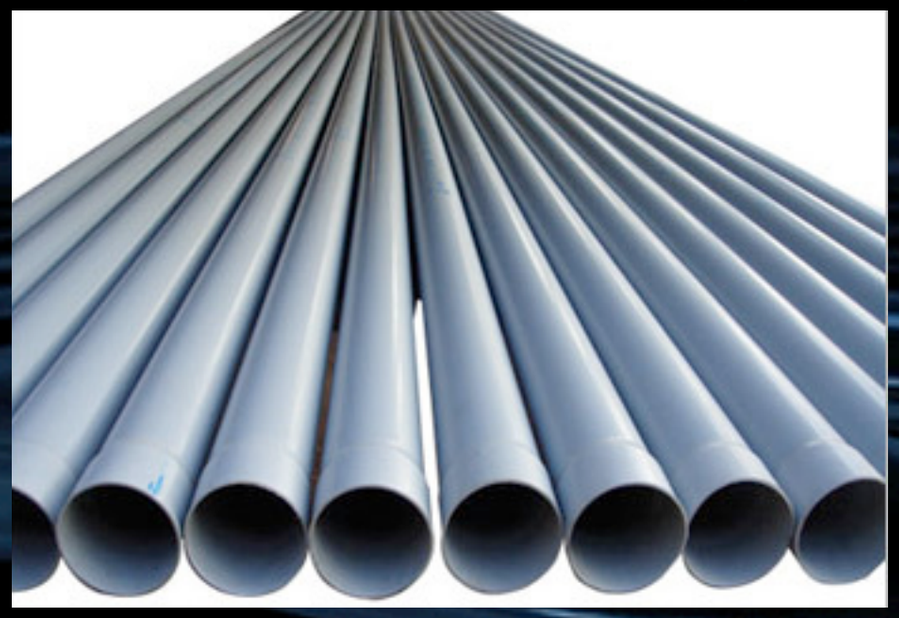
What are the Most Sustainable Options for Pipe Materials commonly used in Water Systems?



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Pipe Sustainability Fight!

"HDPE pipe is the best product for developing a truly sustainable infrastructure. From its low energy cost to produce, ship and install... there is no other material that approaches the performance and versatility of HDPE pipe."

- HDPE pipe trade association guy

"All municipalities want sustainable, long-lasting and cost-effective piping technologies. Ductile iron pipelines offer such sustainable features. Its raw material is scrap iron... recycle heat and process waters..."

- Iron pipe trade association guy

"PVC pipe combines the ageless durability that comes with a corrosion-free material with the overall strength... PVC is arguably the most sustainable and cost-effective of all pipe materials."

- PVC pipe trade association guy

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Can we get a Referee?

Difficult to find objective, accurate, up-to-date, research-based, scientific information

Embodied carbon comparison

Material	Embodied carbon* kg CO^2/kg	Weight of 4" pipe (lbs/lf)	Weight of 4" pipe (kg/lf)	Embodied carbon kg CO^2/kg for 4" pipe per lf
HDPE (DR-11)	1.60	2.30 typ.	1.04	1.66
PVC Sch. 40	2.50	2.10 typ.	0.95	2.38
Iron	1.91	13 typ.	5.90	11.27

*Data taken from "Inventory of Carbon and Energy (ICE)", published by the Sustainable Energy Research Team (SERT), University of Bath.

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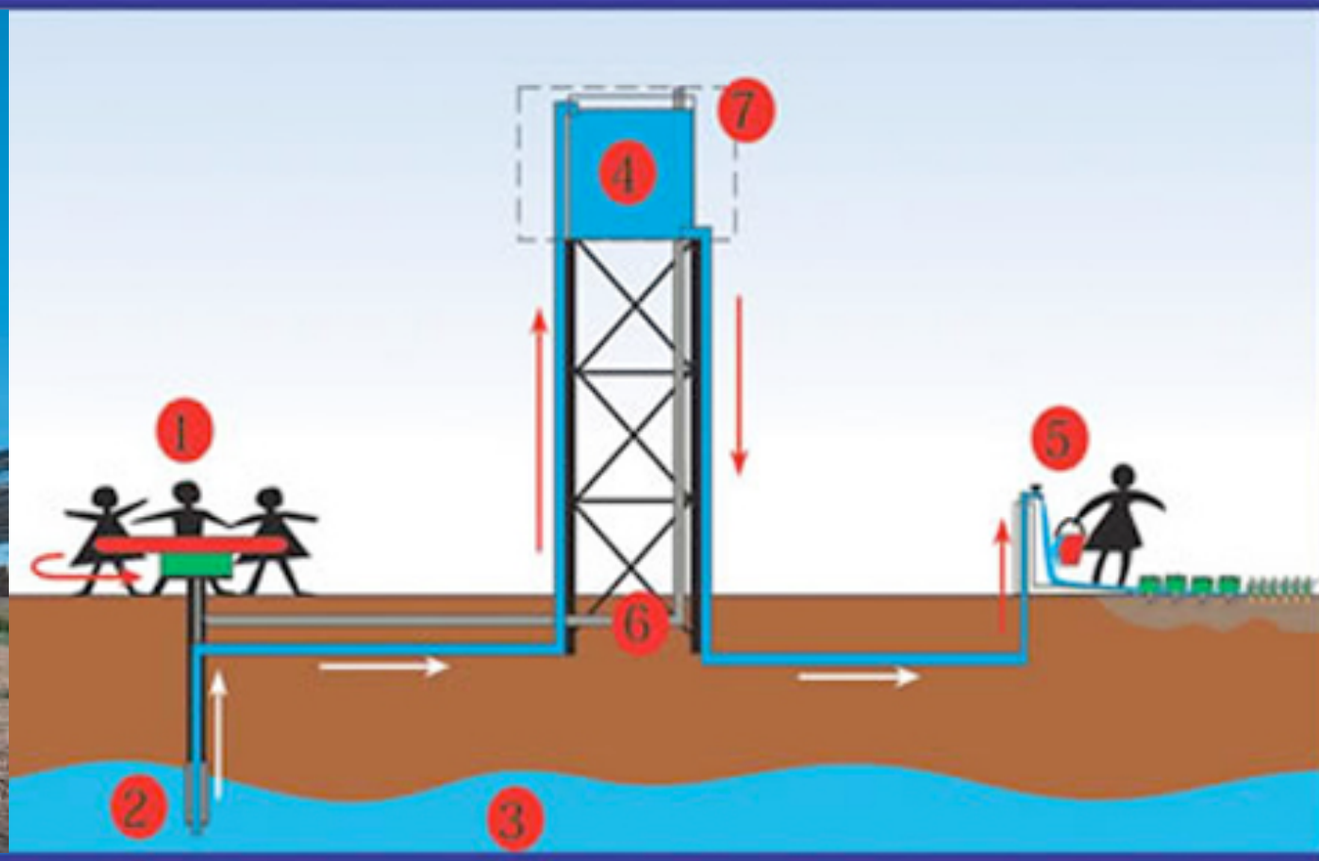
Sustainable Water Systems

Sustainable Water Systems

The Play Pump



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The Drinking Water Supply Manifesto

- Fix the Leaks
- Reduce Peak Demands
- Protect Source Waters
- Work toward Sustainability

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