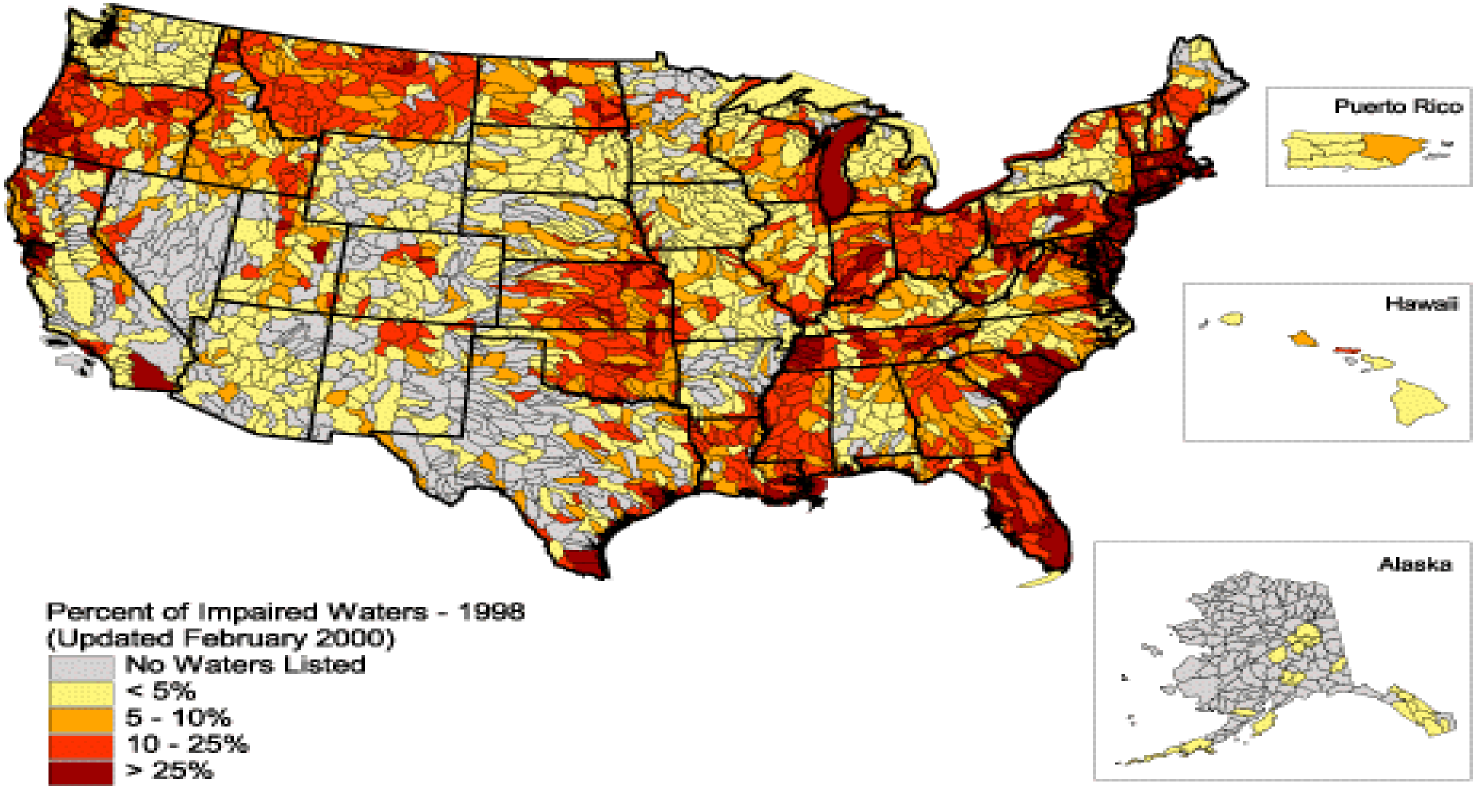


Source: USEPA, State 305(b) reports

Drinking Water

Drinking Water Problems

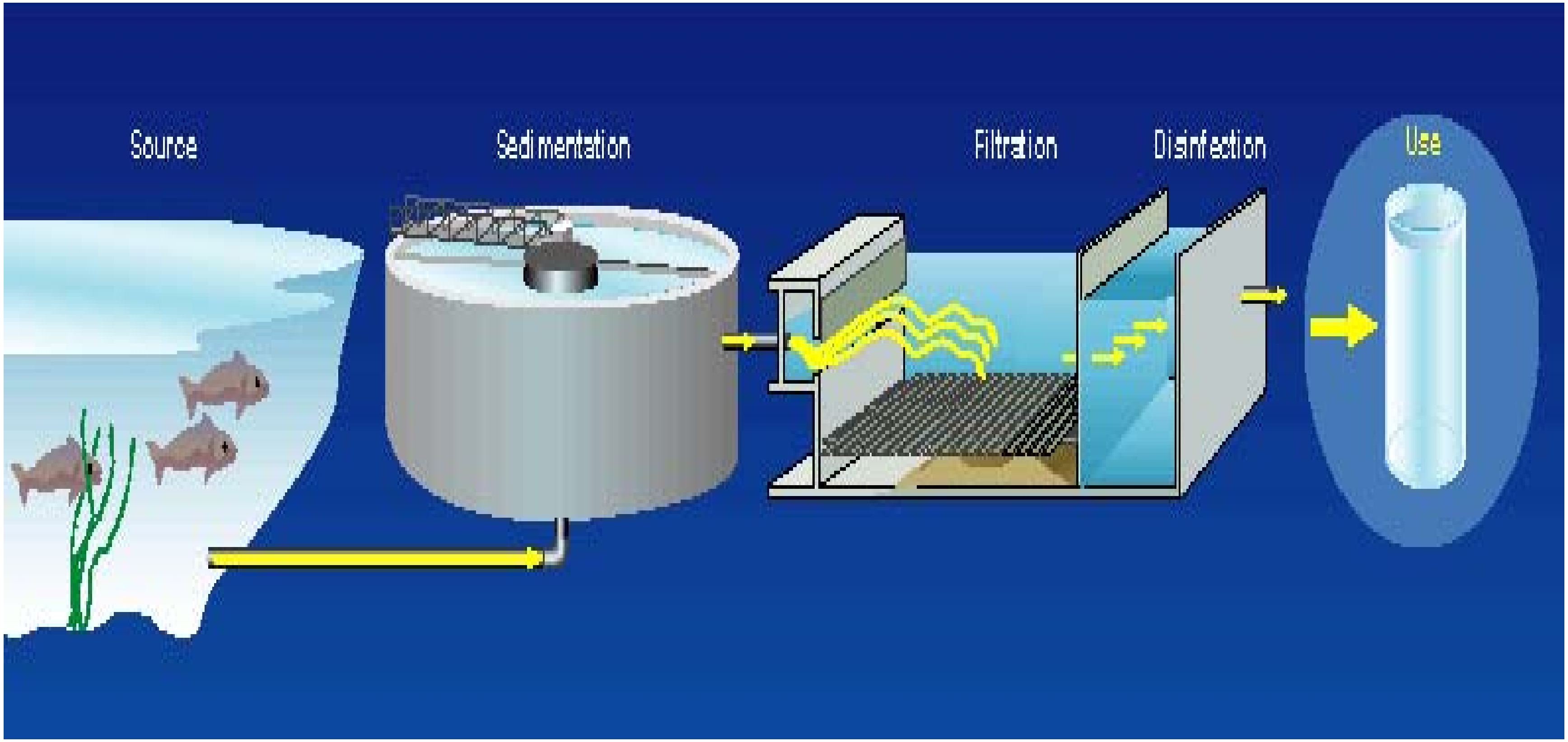
- Chronic vs. Acute
- Aesthetic
- Special populations (e.g., nitrates and “blue baby” syndrome)
- Naturally occurring vs. anthropogenic sources
- Organic/Inorganic chemicals
- Bacteria (*E. coli*)
- Viruses (*Giardia lamblia*)

Public Drinking Water Systems

- Water for human consumption with at least 15 service connections, or 25 users
- Community water systems: Serve a permanent population
- Non-transient, non-community: Public facilities, like schools; service same population for at least 6 months
- Transient, non-community: Serve transients for 60 day/year; like roadside systems

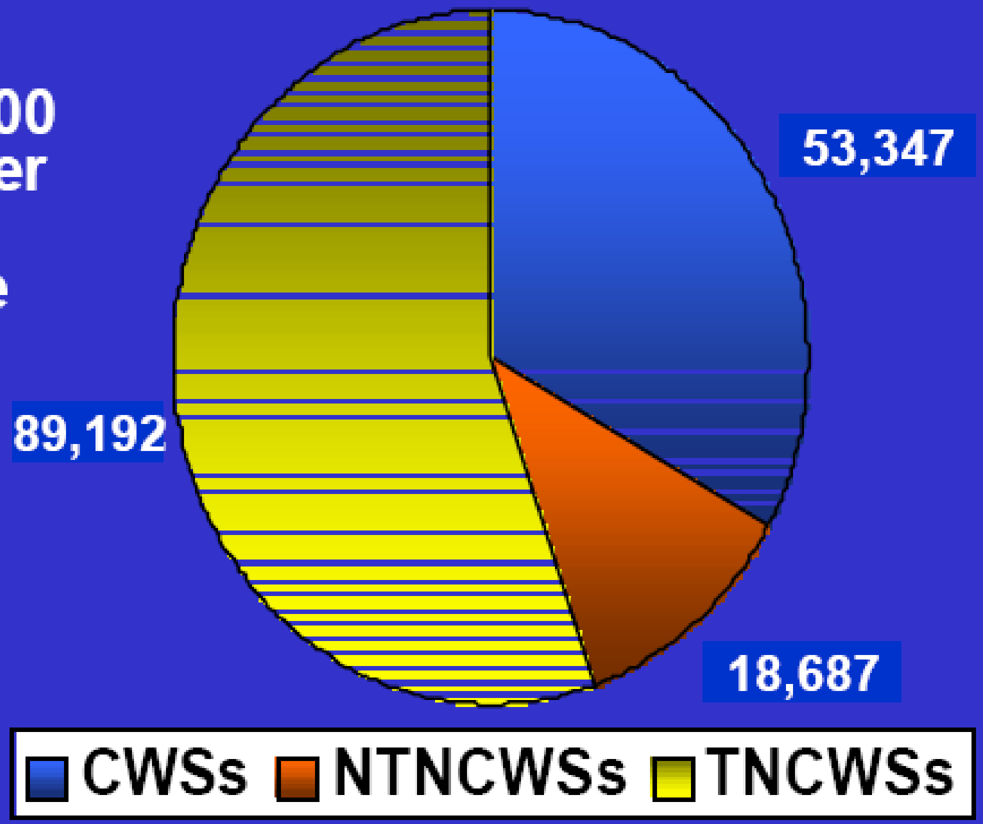
Declining Strictness ↓

Modern Drinking Water Treatment

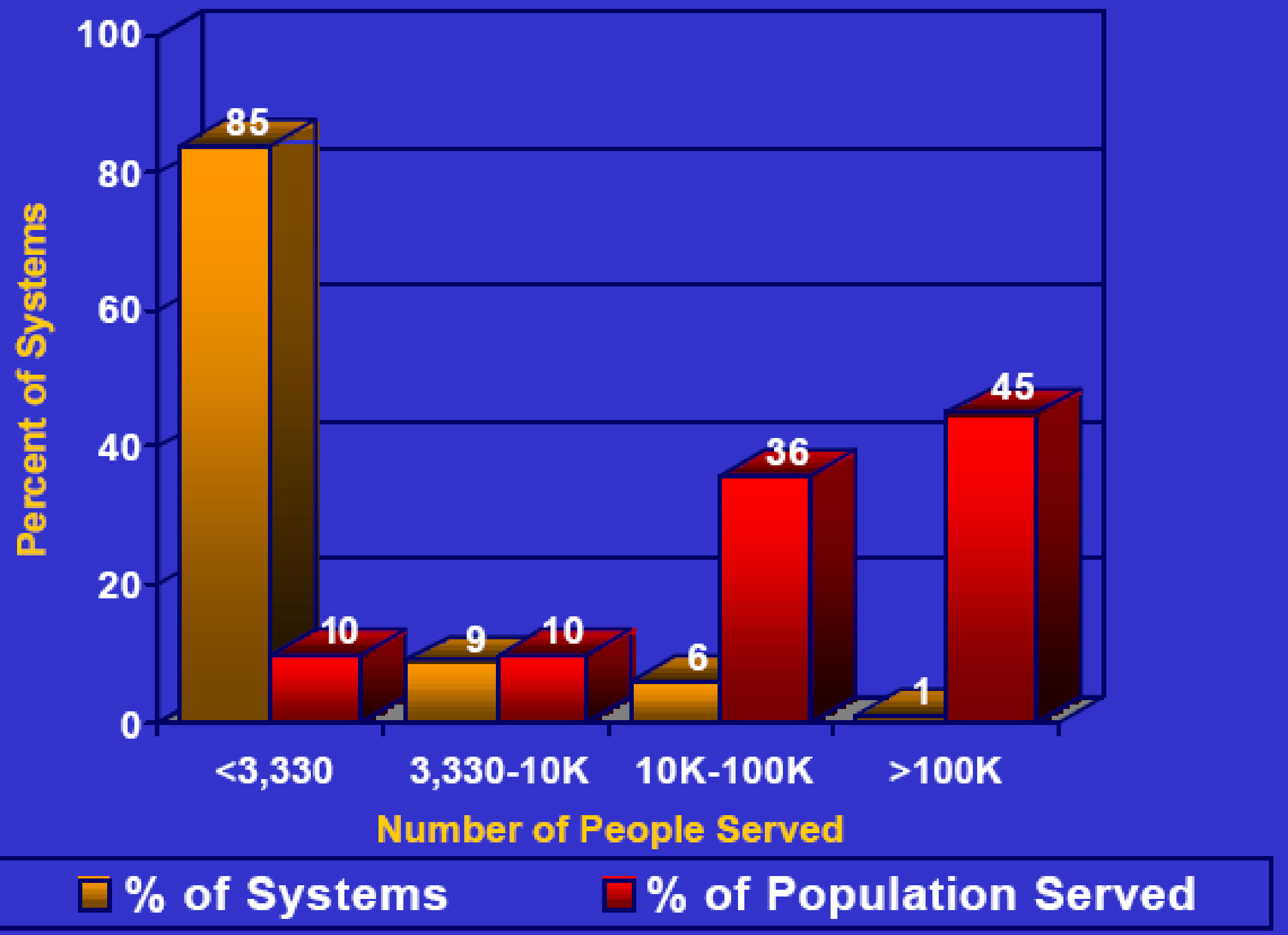


Public Water System Supervision Program

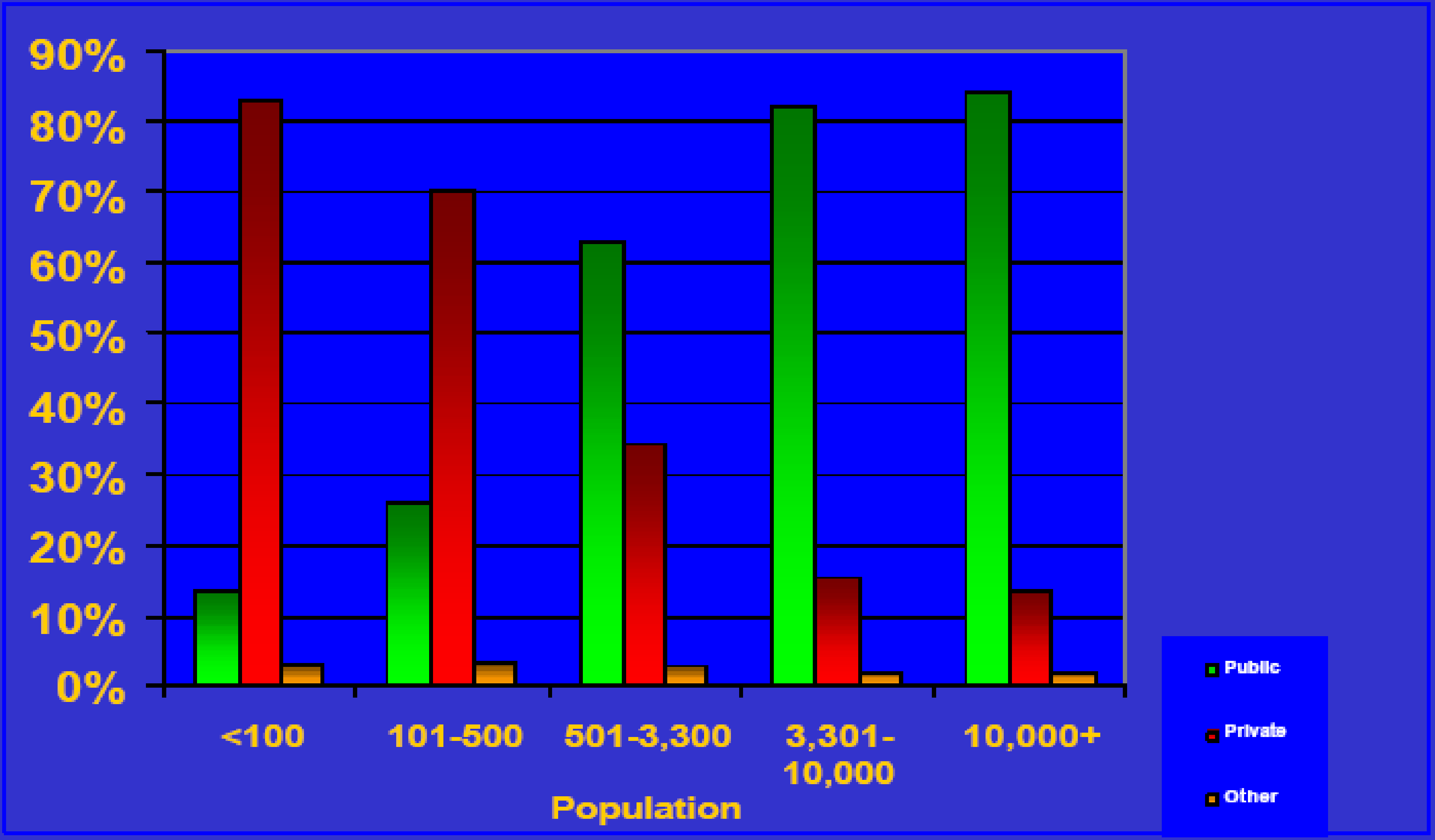
Over 161,000 Public Water Systems Nationwide



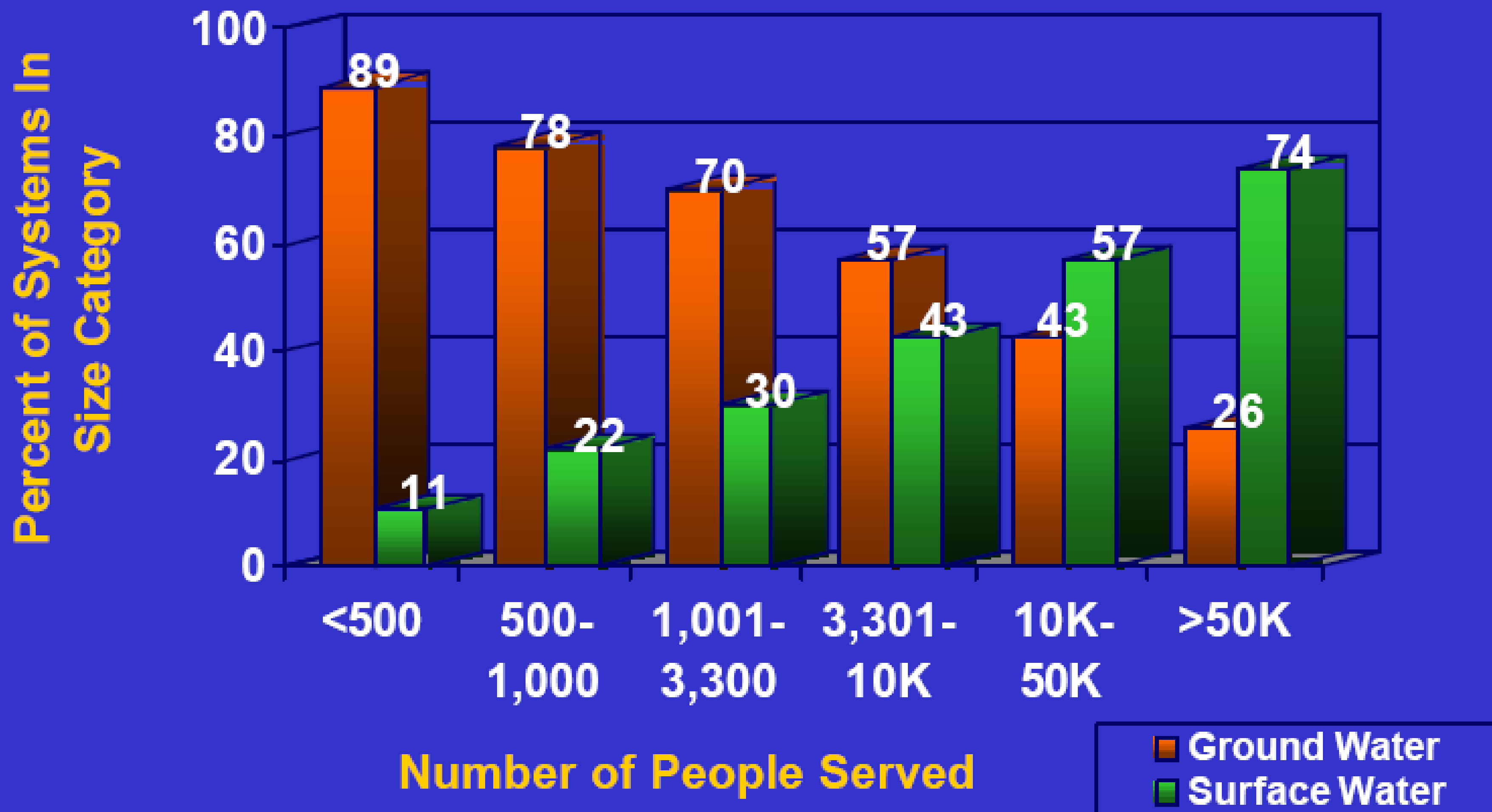
CWSs by System Size



Ownership of Public Water Systems



CWSs by Source



Policy History

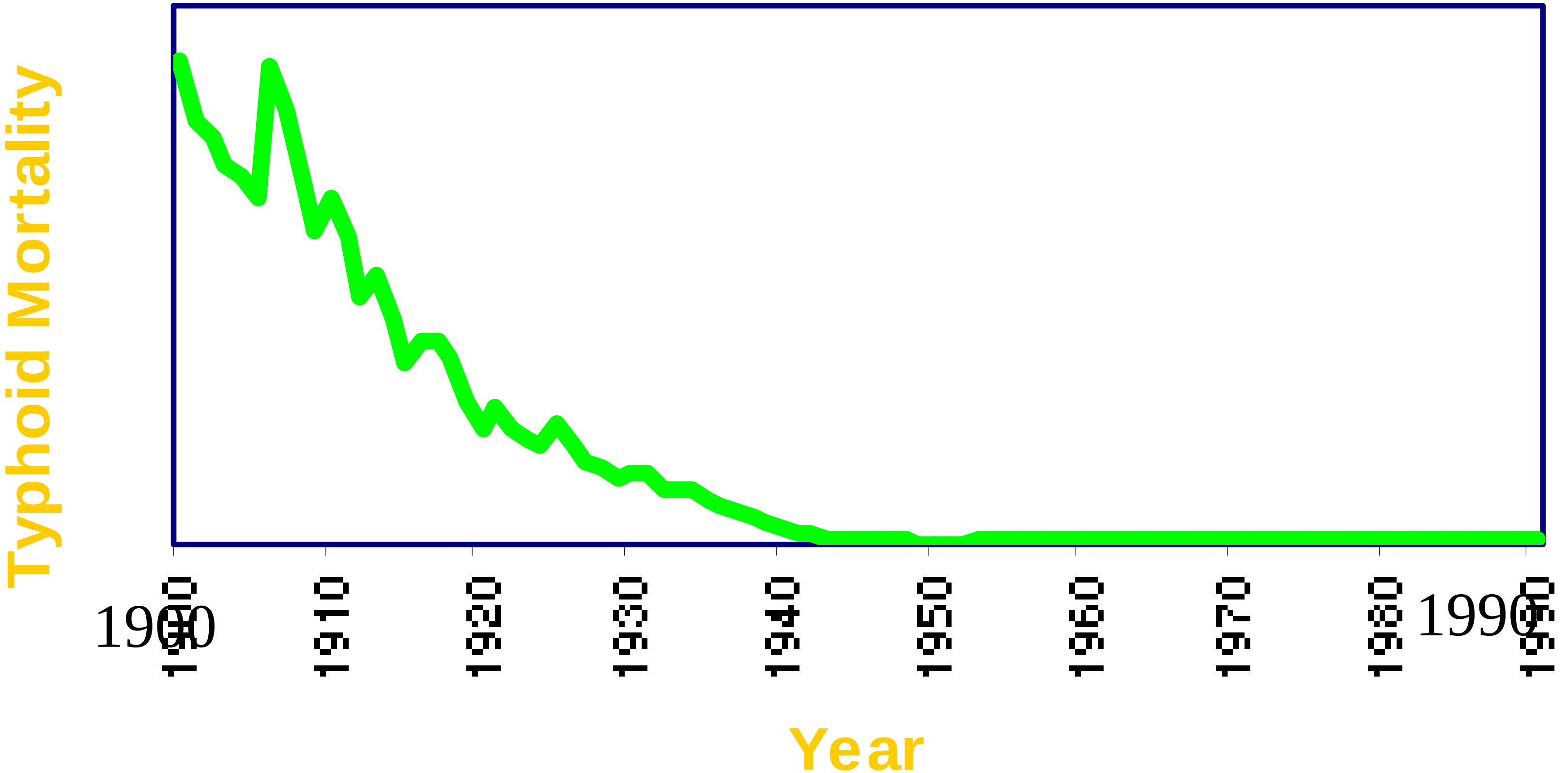
Early History

- 4^{th} Century B.C.: Hippocrates advises people to boil and strain water before drinking to prevent hoarseness
- Late 1800s/early 1900s: Disease outbreaks lead to establishment of community water systems
- Local and state governments begin developing public health programs
- States developed “multiple barrier” systems: source, treatment, and distribution system all subjected to scrutiny
- Think of public health/drinking water systems like a public good

Federal Involvement

- 1914; Public Health Service establishes drinking water standards for interstate carriers, mainly trains
- PHS integrated into Department of Health, Education, Welfare (date?)
- 1969: PHS does survey that find 60% of public water systems were contaminated; provides impetus for SDWA 1974

Early Success in Drinking Water Protection



Safe Drinking Water Act 1974

Public Water System Supervision Program

- EPA sets National Primary Drinking Water Standards
- Maximum Contaminant Level: Maximum concentrations allowed, or best available technology; takes costs into account; enforceable
- MCL Goal: Zero-risk level; non-enforceable
- Maximum residual disinfectant levels
- Primacy (All states but Wyoming have it)—CA uses two agencies (DHS, OEHHA), plus delegation to counties for some small systems

1986 Amendments

- Precipitated by EPA delays in standard setting
- Required EPA to regulate 83 contaminants in three years; 25 additional contaminants every three years after (w/ best available treatment tech.)
- Increased state-level monitoring stringency
- Created category of non-transient, non-community drinking water system
- Added Wellhead Protection Program

Safe Drinking Water Act 1996 Amendments

Overview

- Replaced ‘86 requirement of 25 per 3 years with risk-based assessment of five chemicals per five years (Contaminant candidate list)
- Forced EPA to finalize several proposed rules that were required by ’86 amendments but not completed (including arsenic)
- Cost-benefit analysis formal part of MCL standard setting
- Required states to develop Source Water Assessment Program that ranked threats to source waters(informational)
- Established Drinking Water State Revolving Funds to finance drinking water infrastructure
- Requires EPA to identify affordable technologies for small systems; if no affordable technology identified then small systems can have “variance technology”—this is in the process of happening

Setting Risk-Based Standards

Risk Assessment

- Hazard identification: Use animal studies to see if a substance is harmful
- Dose-response assessment: Identify level of harm for different doses; maybe a threshold effect
- Exposure assessment: Identify level of exposure in population; probability of different levels
- Risk characterization: Expected health risks; combine exposure and dose-response assessment

Cost-Benefit Analysis

- Benefits are monetized values of death and illnesses prevented by new regulation
- Costs are capital, operation, monitoring, paperwork

Arsenic Cost-Benefit Analysis

Arsenic µg/L	Proposed Cost in millions	Proposed Bladder benefits	Potential "What If" benefits	**Final Cost in $M**	**Final Benefits in $M**
3	$645-756	$44-104	$42-448	**$698-792**	**$214-491**
5	$379-445	$32-90	$35-384	**$415-472**	**$191-356**
10	$165-195	$18-52	$20-224	**$180-206**	**$140-198**
20	$63-77	$8-30	$9-128	**$67-76**	**$66-75**

- One of 83 contaminants required in '86 Amendments
- EPA missed several deadlines; '96 Amendments set a new deadline
- Involved a variety of National Research Council Reports
- Figures represent annual costs and benefits
- Costs asymmetrically distributed across small and large water systems; $20 per household for systems serving > 10,000 people; $145 for systems serving between 25-100 people

Economies of Scale for Meeting Drinking Water Standards

Table III-1.--Comparison of Average Costs \1\ Per Household by System Size for Three Recent Rulemakings

System size	Arsenic \2\	Radon \3\	Stage 1 DBPR \4\
25-100	$327	$270	$177
101-500	163	99	123
501-1,000	71	27	84
1,001-3,300	58	27	55
3,301-10,000	38	17	27
10,001-50,000	32	12	14
50,001-100,000	25	12	8
100,001-1 million	21	10	7
> 1 million	1	10	6

Source (notice of proposed rulemaking on arsenic affordability criteria):

[Federal Register: March 2, 2006 (Volume 71, Number 41)]
[Notices]
[Page 10671-10685]

Monitoring and Enforcement

Monitoring

- MCLs have a monitoring framework; describes schedule of monitoring
- Monitoring frequency and methodology depends on many factors, including type of contaminant and system, and past compliance
- Drinking water systems required to publish annual Consumer Confidence Report on monitoring
- States collect monitoring data in Safe Drinking Water Info. System

Compliance (2001 data; similar patterns since)

- 26% of PWS report violations, 23% of population served by non-compliant system
- 91% of violating systems served fewer than 3,300 users
- 87% of violations were monitoring/reporting; 13% health based; 94% of systems had no health violations
- Most frequently violated monitoring requirements and MCL is the total coliform—human waste

Native American Water Systems, 2004

- 818 systems, ~680,000 users
- 95% of systems are small; <3,300 users
- 89% reported no health violations
- 89% of violations were monitoring/reporting

Davis California

Annual Water Quality Report

Water testing performed in 2004

PRIMARY DRINKING WATER STANDARD (Regulated in order to protect against possible adverse health effects.)							
SUBSTANCE (UNITS)	YEAR SAMPLED	MCL	PHG (MCLG)	WEIGHTED AVERAGE	RANGE LOW–HIGH	VIOLATION	TYPICAL SOURCE
Arsenic (ppb)	2004	50	NA	4.6	ND-11	No	Erosion of natural deposits; runoff from orchards; glass and electronics production wastes
Barium (ppm)	2004	1	2	ND	ND-0.22	No	Discharge of oil drilling wastes and from metal refineries; erosion of natural deposits
Chromium (ppb)	2004	50	(100)	17	2-50	No	Discharge from steel and pulp mills and chrome plating; erosion of natural deposits
Fluoride (ppm)	2004	2	1	0.20	ND-0.4	No	Erosion of natural deposits; water additive which promotes strong teeth; discharge from fertilizer and aluminum factories
Gross Alpha particle Activity (pCi/L)	2002	15	NA	2.9	0.49-7.08	No	Erosion of natural deposits
Gross Beta particle Activity (pCi/L)	2002	50	NA	1.8	ND-4.15	No	Decay of natural and man-made deposits
Nickel (ppb)	2004	100	12	ND	ND-10	No	Erosion of natural deposits; discharge from metal factories
Nitrate (as nitrate, NO_3)[1] (ppm)	2004	45	45	14	2-54	No	Runoff and leaching from fertilizer use; leaching from septic tanks, sewage; erosion of natural deposits
Selenium (ppb)	2004	50	(50)	8.6	ND-36	No	Discharge from petroleum, glass and metal refineries; erosion of natural deposits; discharge from mines and chemical manufacturers; runoff from livestock lots (feed additive)
Total Coliforms (% positive samples)	2004	5% positive samples	(0)	1.3	NA	No	Naturally present in the environment
Trichloroethylene [TCE] (ppb)	2004	5	0.8	<0.50	ND-0.64	No	Discharge from metal degreasing sites and other factories
TTHMs [Total Trihalomethanes] (ppb)	2004	80	NA	<4.1	ND-4.1	No	By-product of drinking water chlorination

Perchlorate

- Limits uptake of "iodide" into thyroid gland; possible affects on human growth with pregnant women and children as vulnerable pop.
- Found in mainly in groundwater (348 sources identified in CA with more than 4 ppb); by-product of solid rocket fuel manufacturing
- There is no MCL set for perchlorate; it is on the Contaminate Candidate List and is subject to the Unregulated Contaminant Monitoring Rule
- Big fights over appropriate risk assessment (rat study); NRC report
- 2004: Forced by state legislation, CA Office of Environmental Health Hazard Assessment sets a "public health goal" of 6 parts per billion—this is the CA state version of the MCL goal
- "Notification level" of 6 ppb requires a public health warning and DHS recommendation to stop using source
- CA and EPA in process of developing MCL

Other Programs

Underground Injection

- Underground injection wells generally inject wastes from agriculture or energy production into aquifers
- More than 400,000 injection wells in US
- EPA regulates five “classes” of UIW
- UIWs must have permits or comply with general rules, which specify conditions for underground injection
- Primacy here too; CA has joint state/federal program

Source Water Protection

- Sole Source Aquifer Program (‘74): EPA must review federal projects to insure SSA is not contaminated; SSAs are petitioned into program; 70 nationwide
- Wellhead Protection Program (’86): Delineate and identify
- Source Water Assessment Program (’96): Delineate source water boundaries, identify contaminant sources,

Problems

A Laundry List

- Delays and conflict in setting MCL
- Concern about adequacy of scientific analysis in risk-based standard setting
- Resource constraints at EPA and State level; EPA estimate annual funding shortfall of $10-20 million dollars for meeting analysis requirements
- Funding gap between estimated costs of infrastructure upgrades and available government grants
- Association of Metropolitan Water Agencies insists on good science…why?
- Severe problems with small water systems (compliance capacity and motivation)
- Lack of public awareness
- End-of-pipe versus source water protection