

ENV H 440/ENV H 545

Water Contaminants, cont.

1970's

1976 (NIPDWRs, 22 contaminants regulated)

- 2,4-D
- 2, 4, 5-TP (Silvex)
- Arsenic
- Barium
- Cadmium
- Chromium
- Coliform Bacteria
- Endrin
- Flouride
- Gross Alpha
- Gross Beta
- Lead
- Lindane
- Mercury
- Methoxychlor
- Nitrate
- Radium-226
- Radium-228
- Selenium
- Silver
- Toxaphene
- Turbidity

1979 (TTHMS, 23 contaminants regulated)

- Total THMs (CHCl_3 , CHBrCl_2 , CHBr_2Cl , CHBr_3)

1980s

1986 (Fluoride Rule, 23 contaminants regulated)

- *Fluoride*

1987 (Phase 1 VOCs Rule, 31 contaminants regulated)

- Benzene
- Carbon Tetrachloride
- 1,2-dichloroethane
- p-dichlorobenzene
- 1,1-dichloroethylene
- 1,1,1-trichloroethane
- Trichloroethylene
- Vinyl Chloride

1989 (TCR and SWTR, 35 contaminants regulated)

- *Total Coliforms*
- *Turbidity*
- Giardia
- HPC bacteria
- Legionella
- Viruses

1991 (Phase II and LCR, +27, 61 contaminants Regulated)

- **2, 4-D**
- **2, 4, 5-TP**
- Acrylamide
- Alachlor
- Aldicarb
- Aldicarb Sulfone
- Asbestos
- Atrazine
- **Barium**
- **Cadmium**
- Carbofuran
- Chlordane
- Chlorobenzene
- **Chromium**
- Copper
- Dibromochloropropane
- 0-dichlorobenzene
- Cis-1,2-dichloroethylene
- Trans-1,2-dichloroethylene
- 1,2-dichloropropane
- Epichlorohydrin
- Ethylbenzene
- Ethylene dibromide
- Heptachlor
- Heptachlor epoxide
- **Lead**
- **Lindane**
- **Mercury (inorganic)**
- **Methoxychlor**
- **Nitrate**
- Nitrite
- Total Nitrate/Nitrite
- PCBs
- Pentachlorophenol
- **Selenium**
- Styrene
- TetraChloroethylene
- Toluene
- **Toxaphene**
- Xylenes

1992 Phase V: SOCs & IOCs

- Adipate, di(2-ethylhexyl
- Antimony
- Beryllium
- Cyanide
- Dalpon
- Dichloromethane
- Dioxin (2,3,7,8-TCDD)
- Diquat
- Endothall
- **Endrin**
- Glyphosate
- Hexachlorobenzene
- Hexachlorocyclopentadiene
- Nickel (remanded in 1995)
- Oxamyl (vyadate)
- PAHS (benzo(a)pyrene)
- Phthalate, di(2-ethylhexyl)
- Picloram
- Simazine
- 1,2,4-trichlorobenzene
- 1,1,2-trichloroethane

+ 22 = 84 Contaminants Regulated

1998-2001

1998 (Stage 1 DBPR & IESWTR, 90 contaminants regulated)

- Bromate
- Chloramine
- Chlorine
- Chlorine dioxide
- Chlorite
- Haloacetic acids (HAA5 sum < 60 ug/L)
- *TTHMs (THM4 sum < 80 ug/L)*

2000 (Radionuclide Rules, 91 contaminants regulated)

- *Gross Alpha*
- *Gross Beta*
- *Radium-226*
- *Radium-228*
- Uranium

2001 (Arsenic Rule, 91 contaminants regulated)

- *Arsenic*

Drinking Water CCL

- List of unregulated contaminants that present potential threat to public health
- Developed with input from scientific community and stakeholders
- Used to prioritize EPA's research and data collection efforts
- SDWA directs EPA to consider 5 contaminants every 5 years
- CCL3 (released September 22, 2009) includes 104 chemical and 12 microbial contaminants

Recent changes from draft to final CCL3

- Two cancelled pesticides were removed
 - nitrofen and ethion
- One perflourinated compound was added
 - perfluorooctane sulfonic acid (PFOS)
- Ten pharmaceuticals were added:
 - One antibiotic – erythromycin
 - Nine hormones – 17 alpha-estradiol, 17 beta-estradiol, equilenin, equilin, estriol, estrone, ethinyl estradiol, mestranol, and norethindrone
- Two potential disinfection by-products were added
 - chlorate and bromochloromethane (Halon 1011)
- Two pathogens were removed
 - *Vibrio cholera* and *Entamoeba histolytica*
- Three pathogens were added
 - Adenovirus, Enterovirus, and *Mycobacterium avium*

Drinking Water CCL3 (Chemicals)

Disinfection Byproducts (DBPs)

- Chlorate
- Formaldehyde
- Halon 1011 (bromochloromethane)
- N-nitrosodiethylamine (NDEA)
- N-nitrosodimethylamine (NDMA)
- N-nitroso-di-n-propylamine (NDPA)
- N-Nitrosodiphenylamine
- N-nitrosopyrrolidine (NPYR)

Metals (natural & industrial sources)

- Cobalt
- Germanium
- Molybdenum
- Strontium
- Tellurium
- Vanadium

Algal Toxins

- Cyanotoxins (Microcystin-LR, Cylindrospermopsin, Anatoxin-a)

Pharmaceuticals and Personal Care Products

- 17-alpha-estradiol
- 2-Methoxyethanol
- 2-Propen-1-ol
- 3-Hydroxycarbofuran
- equilenin
- equilin
- Erythromycin
- Estradiol (17-beta estradiol)
- estriol
- estrone
- Ethinyl Estradiol (17-alpha ethynyl estradiol)
- Mestranol
- Norethindrone (19-Norethisterone)
- Quinoline

Drinking Water CCL3 continued:

Industrial Chemicals

- 1,1,1,2-Tetrachloroethane
- 1,1-Dichloroethane
- 1,2,3-Trichloropropane
- 1,3-Butadiene
- 1,3-Dinitrobenzene
- 1,4-Dioxane
- 1-Butanol
- 4,4'-Methylenedianiline
- Acetamide
- Aniline
- Benzyl chloride
- Butylated hydroxyanisole
- Chloromethane (Methyl chloride)
- Cumene hydroperoxide
- Ethylene glycol
- HCFC-22
- Hexane
- Hydrazine
- Methanol
- Methyl tert-butyl ether (MtBE)
- Nitrobenzene
- Nitroglycerin
- N-Methyl-2-pyrrolidone
- n-Propylbenzene
- o-Toluidine
- Oxirane, methyl-
- Perchlorate
- Perfluorooctane sulfonic acid (PFOS)
- Perfluorooctanoic acid (PFOA)
- RDX (Hexahydro-1,3,5-trinitro-1,3,5-triazine)
- sec-Butylbenzene
- Urethane

Drinking Water CCL3 continued:

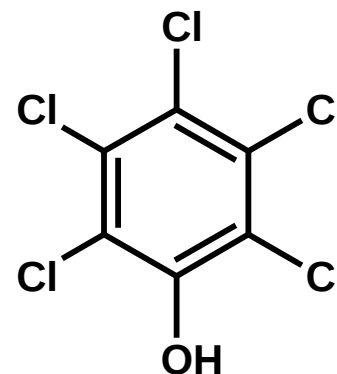
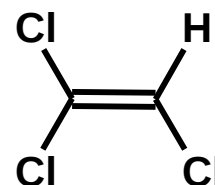
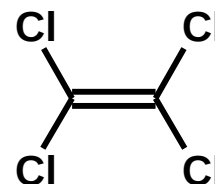
Agricultural Chemicals

- Acephate
- Acetaldehyde
- Acetochlor + products
- Acrolein
- Alachlor products
- alpha-Hexachlorocyclohexane
- Bensulide
- Captan
- Clethodim
- Dicrotophos
- Dimethipin
- Dimethoate
- Disulfoton
- Diuron
- Ethoprop
- Ethylene oxide
- Ethylene thiourea
- Fenamiphos
- Methamidophos
- Methyl bromide (Bromomethane)
- Metolachlor + products
- Molinate
- Oxydemeton-methyl
- Oxyfluorfen
- Permethrin
- Profenofos
- Tebuconazole
- Tebufenozide
- Terbufos + products
- Thiodicarb
- Thiophanate-methyl
- Toluene diisocyanate
- Tribufos
- Triethylamine
- Triphenyltin hydroxide (TPTH)
- Vinclozolin
- Ziram

Volatile Organic Compounds

Volatile Organic Compounds In Groundwater

- PCE - perchloroethylene or tetrachloroethylene
 - Common waste from dry cleaning operations
- TCE - trichloroethylene
 - Common industrial solvent, used as degreaser in metal industry
- Pentachlorophenol
 - Wood preservative, railroad tie and pole production



Volatile Organic Compounds

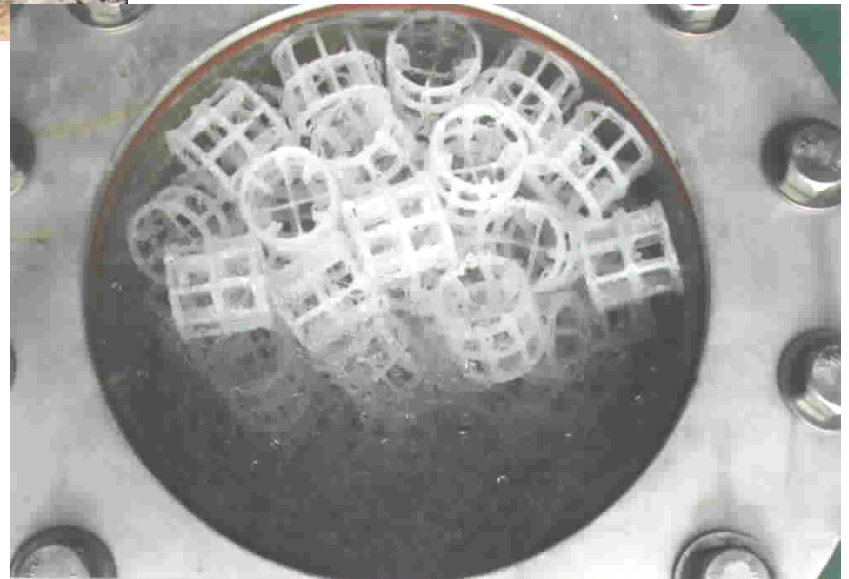
- Most are suspected carcinogens
- Epidemiological evidence linking TCE with adverse reproductive outcomes^{*}
 - Central nervous system defects
 - Neural tube defects
 - Oral cleft defects

^{*}*Bove et al., 1995. American J. Epidemiol.*



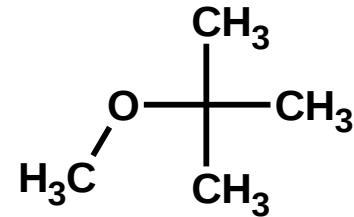
Air Stripping Towers for PCE or TCE removal from drinking water (white vessels are GAC units to remove PCE from off-gas stream)

Packing media inside towers



Hydrocarbons and Additives in Groundwater

- Sources
 - Leaking fuel storage tanks (primarily underground)
 - Gas and oil pipeline leaks/breaks
- Methyl tert-Butyl Ether (MTBE)
 - Fuel additive to reduce air pollution
 - Now present in ground waters
 - Currently listed as possible carcinogen
 - MTBE will most likely be regulated in drinking water based on organoleptic (taste/odor) threshold concentration, ~20 to 100 $\mu\text{g/L}$
 - Health risk based levels are greater, ~180 $\mu\text{g/L}$



Hydrocarbons in Groundwater

- Most commonly monitored compounds
 - BTEX compounds
 - Benzene
 - Toluene
 - Ethylbenzene
 - Xylenes

Inorganics/Metals

Contaminant	MCLG	MCL or TT	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
	(mg/L)	(mg/L)		
Arsenic	7	0.01 as of 01/23/06	Skin damage or problems with circulatory systems, and may have increased risk of getting cancer	Erosion of natural deposits; runoff from orchards, runoff from glass & electronics production wastes
Barium	2	2	Increase in blood pressure	Discharge of drilling wastes; discharge from metal refineries; erosion of natural deposits
Cadmium	0.005	0.005	Kidney damage	Corrosion of galvanized pipes; erosion of natural deposits; discharge from metal refineries; runoff from waste batteries and paints
Copper	1.3	TT8; Action Level=1.3	Short term exposure: Gastrointestinal distress Long term exposure: Liver or kidney damage People with Wilson's Disease should consult their personal doctor if the amount of copper in their water exceeds the action level	Corrosion of household plumbing systems; erosion of natural deposits
Mercury (inorganic)	0.002	0.002	Kidney damage	Erosion of natural deposits; discharge from refineries and factories; runoff from landfills and croplands
Thallium	0.0005	0.002	Hair loss; changes in blood; kidney, intestine, or liver problems	Leaching from ore-processing sites; discharge from electronics, glass, and drug factories

Arsenic

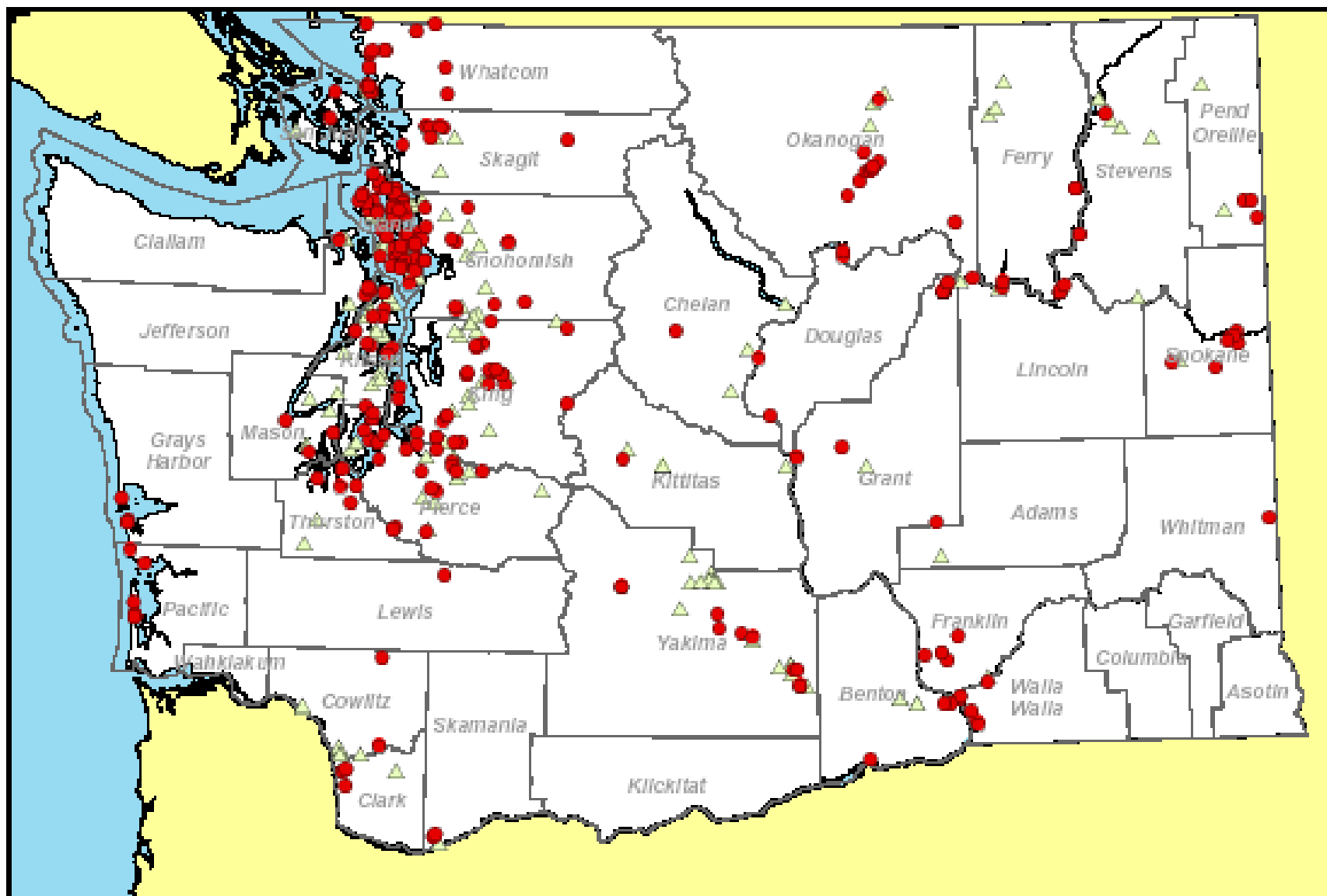
- **What is it?**
 - Naturally occurring element in earth's crust
 - In water: no smell, no taste, no color
- **Where does it come from?**
 - May be released by natural geologic processes, mining/smelting, and Orchard spraying
 - Most in water from natural rock formations
- **How does it affect Human Health?**
 - Cardio-Vascular disease, diabetes, skin changes, nervous system damage, cancer
 - Disease may depend on amount consumed and personal sensitivity

Arsenic in Washington??

- **Is Arsenic a problem in the State of Washington?**
 - Yes, some central and northern Puget Sound counties have elevated natural levels of Arsenic
 - Below detection in Cedar and Tolt water supplies, present in blended groundwater at 1-2 ppb
- **The Federal Arsenic Rule set the MCL at 10ppb for compliance by January 2006. What is Washington's rule?**
 - Class A systems: 10 ppb for community and NTNC systems; rule adoption 2004, compliance 2006
 - Class B systems: Currently collecting information regarding switch from 50 ppb to 10 ppb

CCR Reporting for Arsenic

- Consumer Confidence Report for Washington:
 - Three Levels
 - Above detection below 5ppb-must include in water quality data table in report
 - 5-10 ppb- must include statement of possible health effects caused by chronic low level exposure being balanced by costs of removal
 - Above 10 ppb- required health effects statement e.g. People who consume over MCL of Arsenic over many years may develop.....or have and increased risk of....



● Group A Systems – Water Systems that meet the federal definition of a public water system: those that regularly serve 15 or more residential connections or 25 or more persons, 60 or more days per year. WAC 246-290-020

▲ Group B Systems – Water systems usually serving 2-14 connections and less than 25 persons or more than 25 but for fewer than 60 days per year. WAC 246-291-010. Group B systems are not subject to the revised MCL for arsenic.

Disclaimer

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Contact Information

Trace Warner, Source Monitoring Coordinator
Division of Drinking Water
Washington State Department of Health
P.O. Box 47822
Olympia, WA 98504-7822
Voice: (360) 236-3067
E-mail: trace.warner@doh.wa.gov

Copper in Drinking Water

- **What is Copper?**
 - A mineral and natural component of soil
 - Essential nutrient for humans and plants
- **Where does it come from and how does it get into water?**
 - Industrial pollution, domestic and mining wastewater, weathering of copper-bearing rocks, agricultural use, Plumbing corrosion
- **What are the health effects?**
 - Acute single dose of 15mg/L may cause nausea, vomiting, diarrhea, and intestinal cramping
 - Severe exposure may result in anemia; kidney and liver problems
 - Wilson's and Menke's diseases have absorption and metabolism concerns and are at higher risk

Other Metals in Drinking Water

- Antimony
 - Industrial dust, auto exhaust, heating oil, mining/smelting
 - Short-term effects: nausea, vomiting diarrhea
 - Long-term effects: cancer
- Barium
 - Industrial and mining wastes
 - Short-term : GI distress, muscular weakness
 - Long-term: High blood pressure

Other Metals in Drinking Water

- Beryllium
 - Coal-burning power plants and other industrial discharges; generally present as insoluble compounds
 - Short-term : inflammation when inhaled, less toxic in water
 - Long-term: potentially cancer
- Cadmium
 - Industrial discharge, pipe corrosion, smelting/refining
 - Short-term : nausea, vomiting, diarrhea, muscle cramps, liver injury, convulsions, shock and renal failure
 - Long-term: damage to kidney, liver, bone and blood

Other Metals in Drinking Water

- Chromium
 - Chemical Industry and fossil fuel combustion
 - Bioaccumulates in aquatic life
 - Short-term : skin irritation, ulceration
 - Long-term: liver, kidney, circulatory, nervous tissue damage
- Mercury
 - Fossil fuel combustion , industrial discharge, refining/smelting
 - Short-term or long-term: kidney damage, “mad as a hatter”, Minamata’s disease

Minimata's Disease

- Minamata is a farming and fishing area on the west coast of the southern Island of Kyushu
- Linked to consumption of fish
- numbness of the extremities, difficulty in hand movements and in grasping things, sensory disturbance, weakness and tremor, dysarthria, ataxic gait, then disturbances of sight and impaired hearing, general paralysis, deformity, difficulty in swallowing, convulsions and even death



Other Metals in Drinking Water

- Selenium
 - Combustion of fossil fuels, smelting and refining
 - Short-term : hair and fingernail changes, damage to peripheral nervous system, fatigue, irritability
 - Long-term: hair and fingernail loss; kidney, liver, nervous and circulatory system damage
- Thallium
 - Industrial discharge, coal-burning plants, ore leaching
 - Short-term : GI irritation, nerve damage
 - Long-term: changes in blood chemistry, damage to liver, kidney, intestinal and testicular tissue; hair loss

Other Metals in Drinking Water

- Lead, MCL 5 $\mu\text{g/L}$
 - Plumbing corrosion/Solder, mining and smelting
 - Short and Long-term: interference with blood cell chemistry, delay in mental and physical development of infants and young children, deficits in attention span, hearing and learning disabilities, high blood pressure
 - Long-term effects: Stroke, kidney disease, cancer

Secondary Drinking Water Standards

Contaminant	Secondary Standard
Aluminum	0.05 to 0.2 mg/L
Chloride	250 mg/L
Color	15 (color units)
Copper	1.0 mg/L
Corrosivity	noncorrosive
Fluoride	2.0 mg/L
Foaming Agents	0.5 mg/L
Iron	0.3 mg/L
Manganese	0.05 mg/L
Odor	3 threshold odor number
pH	6.5-8.5
Silver	0.10 mg/L
Sulfate	250 mg/L
Total Dissolved Solids	500 mg/L
Zinc	5 mg/L

Radionuclides

Radionuclides

- **What is a radionuclide?**
 - Generally naturally occurring chemical that may be found in water
 - Arise from decay of uranium-238 and thorium 232
- **What are the most common types of radionuclides?**
 - Alpha emitters
 - Radium 226 and 228
 - Uranium
 - Radon
 - Beta and photon emitters (primarily man-made)

Radiation

- **What is Alpha radiation?**
 - Two protons and two neutrons
- **What is Beta radiation?**
 - Negative or positive particle with the mass of an electron
- **What is Gamma or Photon Radiation?**
 - High energy electromagnetic radiation with no mass or charge

Radionuclides in Water

- **Radium-** a naturally occurring element in earth's crust
 - 226 is an alpha emitter
 - 228 is a beta emitter
- **Uranium-** a naturally occurring metallic element in earth's crust
 - U234, U-235, and U-238 are alpha emitters
- **Gross Alpha-** includes all alpha emitters other than Radium and Uranium; generally naturally occurring
- **Beta and Photon Emitters-** 179 man-made; error in rule
- **picoCuries-** measure of radiation; ≈ 1 emission every 27 seconds
- **Millirem-** standardized unit; dose of absorbed energy adjusted for different radiation

Contaminant	<u>MCLG</u>	<u>MCL or TT1</u>	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
	<u>(mg/L)</u>	<u>(mg/L)</u>		
Alpha particles	<u>none</u>	15 picocuries per Liter (pCi/L)	Increased risk of cancer	Erosion of natural deposits of certain minerals that are radioactive and may emit a form of radiation known as alpha radiation
Beta particles and photon emitters	<u>none</u>	4 millirems per year	Increased risk of cancer	Decay of natural and man-made deposits of certain minerals that are radioactive and may emit forms of radiation known as photons and beta radiation
Radium 226 and Radium 228 (combined)	<u>none</u>	5 pCi/L	Increased risk of bone cancer	Erosion of natural deposits
Uranium	zero	30 ug/L	Increased risk of bone cancer, kidney toxicity	Erosion of natural deposits

Radionuclides Rule

- **Goal:** to reduce the exposure to radionuclides in drinking water, thereby reducing the risk of cancer
 - Estimated benefit: reduced uranium exposure for 620,000 persons
 - Estimated Cost: \$81 million annually; only 795 systems expected to install treatment
- **Beta/Photon emitter:** MCL = 4 mrem/yr; only vulnerable systems
- **Gross Alpha:** MCL = 15 pCi/L
- **Combined Radium 226/228:** MCL = 5 pCi/L
- **Uranium:** MCL = 30 µg/L; concerned with both toxicity as heavy metal and radionuclide

Radionuclides Rule: Monitoring

- Started December 2003; Completion by end of 2007
- **Initial monitoring-** four quarters of monitoring for combined radium, gross alpha and uranium;
- **Reduced monitoring-**
 - if average below detection then every 9 years
 - Greater than detection less than $\frac{1}{2}$ MCL then every 6 years
 - Greater than $\frac{1}{2}$ MCL but less than MCL then every 3 years
- **Increased Monitoring-** if point result over MCL, then must return to quarterly monitoring until 4 consecutive quarters below

Beta/Photon Monitoring

- **Initial monitoring-** Vulnerable systems monitor quarterly for gross beta and annually for tritium and strontium 90
- **Reduced monitoring-** every three years if running average of gross beta minus naturally occurring potassium 40 equal to 50 pCi/L
- **Increased monitoring-** speciate as required by state; maintain initial frequency

Radon

- **What is Radon?**

- Naturally occurring, colorless, odorless, water soluble gas produced by radioactive decay of radium
- Radium is a metallic radioactive element commonly found in earth's crust; fertilizer and lime may exacerbate radium in groundwater
- half life 3.8 days
- High levels in all 50 states; higher levels in areas underlain by granites, dark shale, light-colored volcanic rock, sedimentary rock with phosphate and metamorphic rock

- **What is the measurement of Radon?**

- Picocuries/liter; range <10 pCi/L to 1.5 million pCi/L
- 1 pCi/L $\approx$ decay of 2 atoms per minute in each liter
- For every 10,000 pCi/L in water about 1 pCi/L is released to indoor air
- >4pCi/L is considered high

Radon

- **What are the health effects associated with Radon?**
 - Stomach cancers from ingestion
 - 0.25 – 1% increased risk per 100,000 pCi/L water
 - Lung cancer from inhalation (greater risk)
 - Water containing 1000 pCi/L → 3-13/10,000 risk
 - Water containing 10000 pCi/L → 3-13/1000 risk
 - Water with 100,000 pCi/L → 3-12/100 risk

Radon

- **How does it get into the house?**
 - Largest risk from entering through soil underneath home; cracks in floors, walls, etc
 - Smaller risk associated with off-gassing of well-water (5% total indoor concentration) and 66-75% volatilization exposure during showering
- **What is regulated level in drinking water?**
 - No MCL for radon in drinking water
 - Proposed level of 300 pCi/L withdrawn in 1997

Pesticides

Pesticides

- Herbicides- agent used to destroy or inhibit growth of plant tissue
 - E.g. Diquat; Alachlor; Glyphosate; 2, 4-D; Dalpon; 2,4,5-TP; Picloram; Endothall; Simzine, Dinoseb, Atrazine
- Insecticide- agent used to destroy insects
 - E.g. Toxaphene; heptachlor; lindane, chlordane; endrin; methoxychlor, oxamyl
- Nematocides; fungicides; bacteriocides/stats
 - E.g. DBCP; Carbofuran; copper sulfate

Pesticides (common names)

- 2,4-D (Salvo, Scott's 4XD, Agent White)
- 2,4,5-TP (Silvex, Weed-B-gone)
- Carbofuran (Furadan 4F or 4G)
- Dinoseb (Dow Selective Weed Killer)
- Simazine (Herbex, CAT herbicide)
- Picloram (Tordon, Agent White)
- Pentachlorophenol (Ortho Triox)
- Oxamyl (Vydate k, Dupont 1410)
- Methoxychlor (Methoxy-DDT)
- Glyphosate (Roundup, Rondo)

Contaminant	MCLG1	MCL or TT1	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
	(mg/L)2	(mg/L)2		
Diquat	0.02	0.02	Cataracts	Runoff from herbicide use
Alachlor	zero	0.002	Eye, liver, kidney or spleen problems; anemia; increased risk of cancer	Runoff from herbicide used on row crops
Glyphosate	0.7	0.7	Kidney problems; reproductive difficulties	Runoff from herbicide use
2,4-D	0.07	0.07	Kidney, liver, or adrenal gland problems	Runoff from herbicide used on row crops
Toxaphene	zero	0.003	Kidney, liver, or thyroid problems; increased risk of cancer	Runoff/leaching from insecticide used on cotton and cattle
Dalapon	0.2	0.2	Minor kidney changes	Runoff from herbicide used on rights of way
Heptachlor	zero	0.0004	Liver damage; increased risk of cancer	Residue of banned termiticide
Heptachlor epoxide	zero	0.0002	Liver damage; increased risk of cancer	Breakdown of heptachlor
Lindane	0.0002	0.0002	Liver or kidney problems	Runoff/leaching from insecticide used on cattle, lumber, gardens
Pentachlorophenol	zero	0.001	Liver or kidney problems; increased cancer risk	Discharge from wood preserving factories
Chlordane	zero	0.002	Liver or nervous system problems; increased risk of cancer	Residue of banned termiticide
2,4,5-TP (Silvex)	0.05	0.05	Liver problems	Residue of banned herbicide
Endrin	0.002	0.002	Liver problems	Residue of banned insecticide
Picloram	0.5	0.5	Liver problems	Herbicide runoff

Contaminant	<u>MCLG1</u>	<u>MCL or TT1</u>	Potential Health Effects from Ingestion of Water	Sources of Contaminant in Drinking Water
	<u>(mg/L)2</u>	<u>(mg/L)2</u>		
<u>Endothall</u>	0.1	0.1	Stomach and intestinal problems	Runoff from herbicide use
<u>Simazine</u>	0.004	0.004	Problems with blood	Herbicide runoff
<u>Carbofuran</u>	0.04	0.04	Problems with blood, nervous system, or reproductive system	Leaching of soil fumigant used on rice and alfalfa
<u>Atrazine</u>	0.003	0.003	Cardiovascular system or reproductive problems	Runoff from herbicide used on row crops
<u>Dinoseb</u>	0.007	0.007	Reproductive difficulties	Runoff from herbicide used on soybeans and vegetables
<u>Methoxychlor</u>	0.04	0.04	Reproductive difficulties	Runoff/leaching from insecticide used on fruits, vegetables, alfalfa, livestock
<u>1,2-Dibromo-3-chloropropane (DBCP)</u>	zero	0.0002	Reproductive difficulties; increased risk of cancer	Runoff/leaching from soil fumigant used on soybeans, cotton, pineapples, and orchards
<u>Oxamyl (Vydate)</u>	0.2	0.2	Slight nervous system effects	Runoff/leaching from insecticide used on apples, potatoes, and tomatoes

By-products & Metabolites

- **Dioxin (2,3,7,8 TCDD)**
 - By-product of production of various herbicides
 - Present in high concentrations in Agent Orange
 - Short-term health effects- liver damage, weight loss, wasting of immune system glands
 - Long-term health effects- reproductive effects, cancer
- **DDE**
 - Primary metabolite of DDT
 - Nervous system effects, risk of pre-term pregnancy, cancer
- **Heptachlor epoxide**
 - Environmental by-product
 - Short-term health effects- liver and nervous system damage
 - Long-term health effects- liver damage, cancer

Pesticides in Washington Water

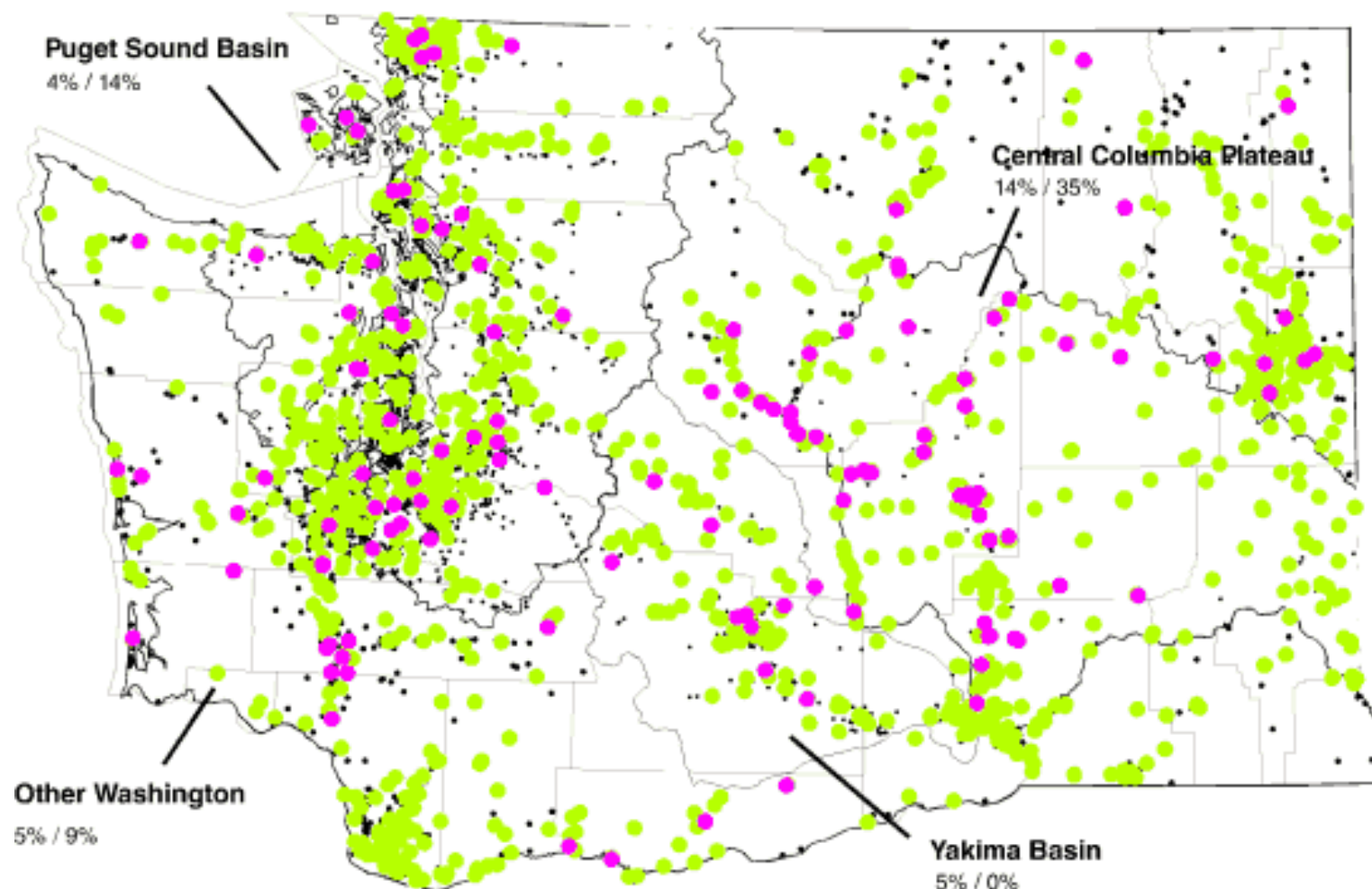
- Pesticides detected in 6% of 1103 randomly selected public water supply wells
- 21 of 27 analyzed pesticides were detected
- Atrazine; Simazine; Dicamba; 2,4,5-TP; 2, 4-DB; picloram; and metribuzin were detected in more than three wells
- 10% wells had more than one pesticide detected
- Pentachlorophenol exceeded MCL in one well
- Dieldrin and endrin exceeded health advisory levels in one well each
- No EPA standards established for 11% of pesticides detected

Sampling Results* for 1,326 Public Supply Wells

* Contract lab results reported by WDOH, Spring 1995

- Sampled well, no detections
- Sampled well, pesticide(s) detected
- Public supply well, not sampled

4% / 14% Percentage of sampled public supply wells with pesticide(s) detected:
Random group / High-risk group



Pesticides in Washington Water

- **Factors correlated with pesticide detection**
 - Land use predominately agricultural or urban
 - Well depth <125 feet
 - Nitrate concentration >2.7 mg/L
- **On basis of sampling and risk assessment**
 - 74% of wells designated low risk
 - 20% of wells designated moderate risk
 - 6% of wells designated high risk

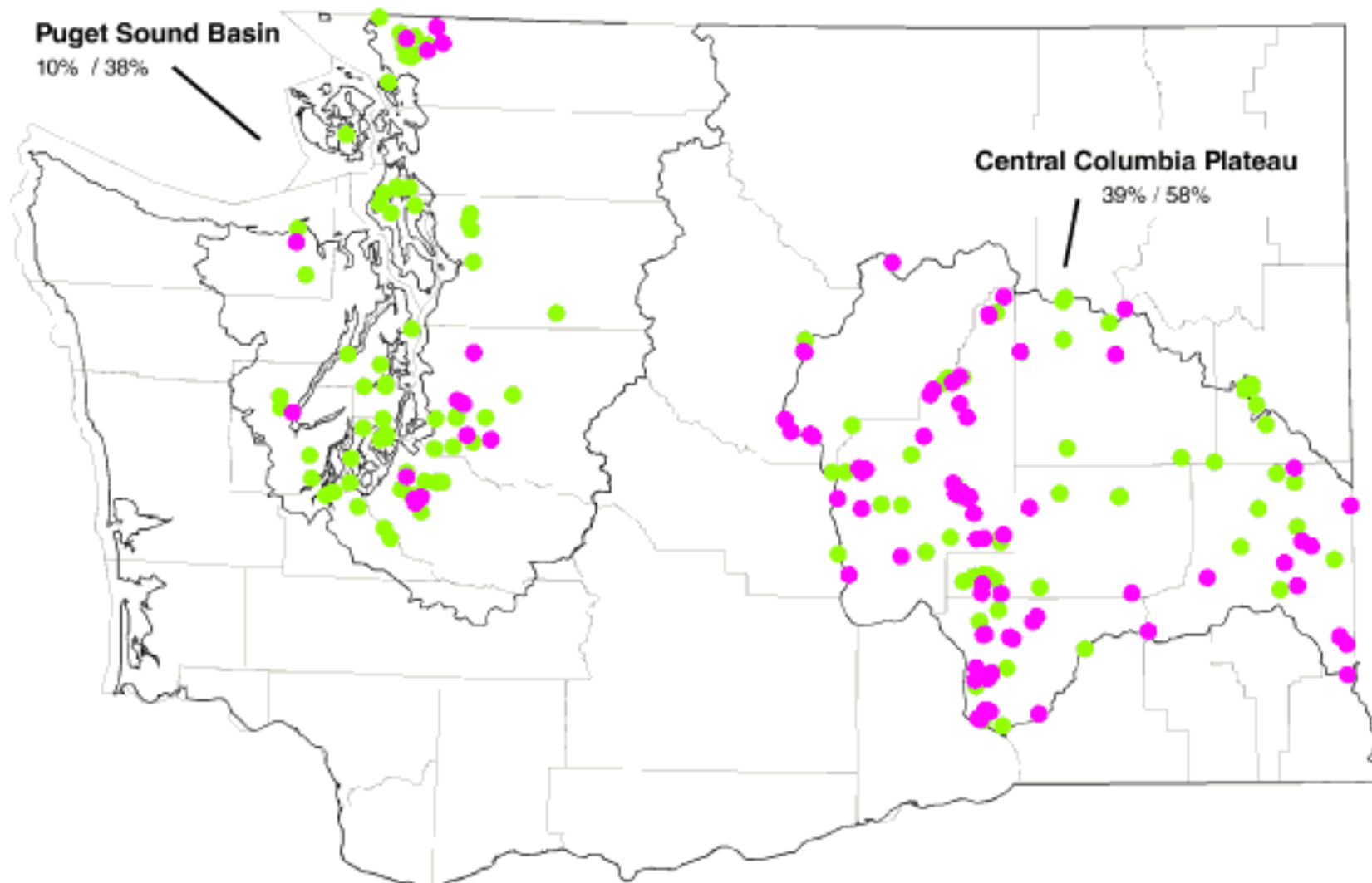
USGS Sampling Results

- Pesticides detected in 30% of 159 randomly selected duplicates from Puget Sound Basin and Central Columbia Plateau
- 13 of 48 analyzed pesticides detected
- Pesticides in 3 or more wells:
 - Atrazine, desethyl atrazine, simazine, prometon, p,p'-DDE; tebuthiuron; metribuzin
- No MCL violation; health advisory exceedance for dieldrin in 1 well; 23% pesticides analyzed have no standards established
- 68% of positive wells had more than 1 pesticide detected

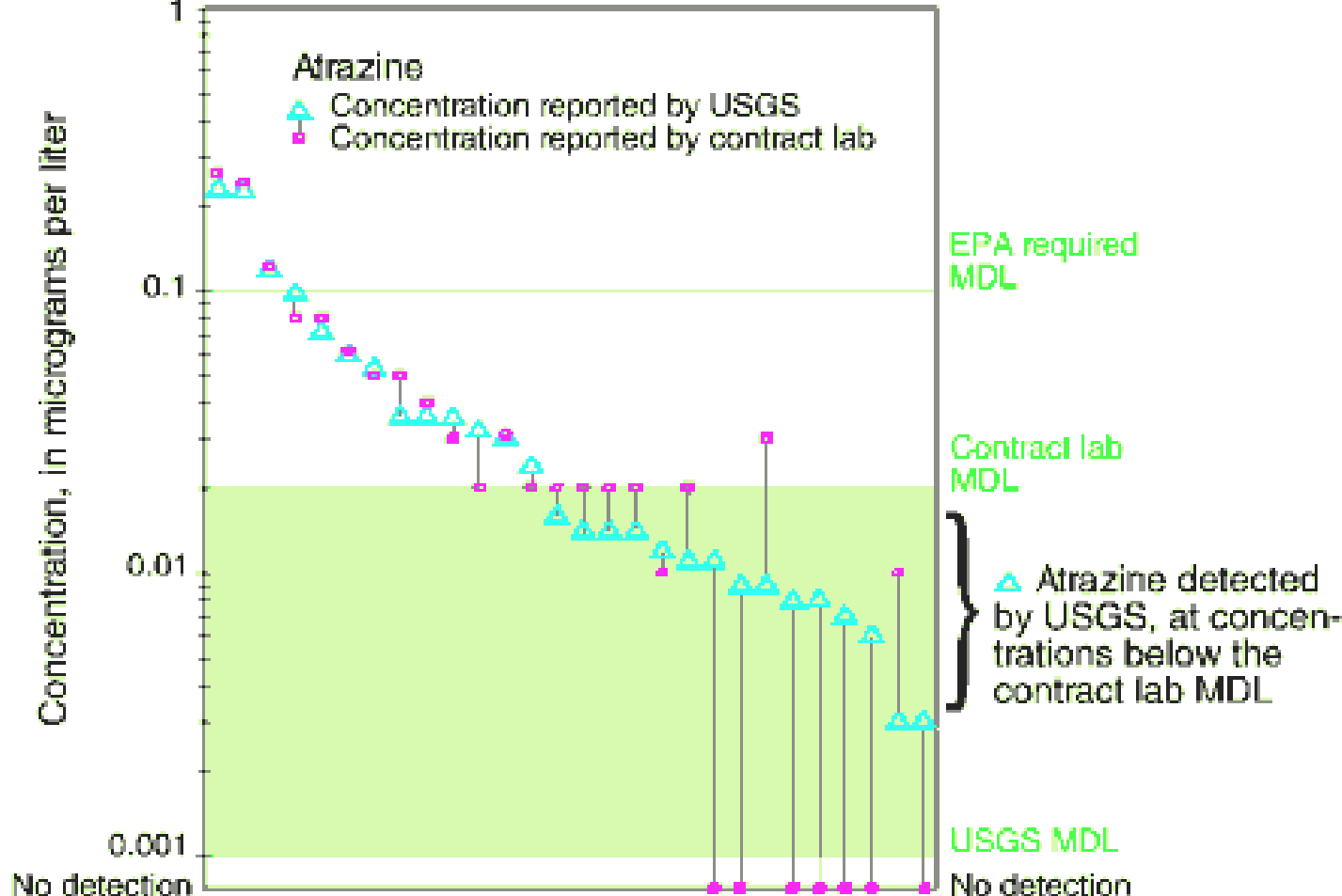
USGS results for 220 duplicate samples

- Sampled well, no pesticides detected
- Sampled well, pesticide(s) detected

10% / 38% Percentage of sampled public supply wells with pesticide(s) detected:
Random group / High-risk group



- **Why did USGS detect more Pesticides than State Sampling Program?**
 - Differences in MDLs
 - Method Detection Limits are the lowest concentration of a compound that can be reliably detected; in many cases USGS MDLs are ten times lower than contract labs used by the state



Duplicate samples analyzed for atrazine
by both USGS and a contract lab

(Cindy O'Toole, Edge Analytical, written commun., 1995)

USGS Fact Sheet 122-96

Pesticides in Public Supply Wells of Washington State

<http://www.dwtcm.wr.usgs.gov/ccpt/pubs/fs-122-96.html>