Toxic Levels of Lead and Copper in Groundwater Can Be Caused by Stray Electrical Current

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Why focus on lead and copper in drinking water?

- The Flint, Michigan water-quality disaster
- Lead is toxic at low concentrations: AL = 0.015 mg/l
- Children: Delay in physical and mental development
- Adults: Kidney problems and high blood pressure
- Copper is also toxic: AL = 1.3 mg/l
- Short term: Gastrointestinal distress
- Long term: Liver or kidney damage
- Groundwater that does not contain elevated lead or copper is undrinkable (exceeds the Action Levels) at the faucets in homes and institutional buildings

The source is the piping in the building

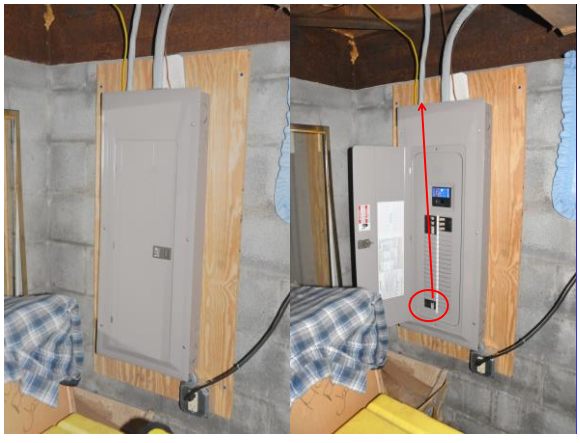
Today, the use of lead solder is prohibited. Federal Safe Drinking Water Act amendments in 1986, Pennsylvania Lead Ban Act in 1991

What is stray electrical current ?

- Not flowing through the correct wires
- May not be a shock hazard
- Not enough flow to trip a circuit breaker
- Water pipes are the stray current flow path
- The electric current dissolves some solder
- The electric current dissolves some copper
- Stray electrical current does present the danger of a fatal electrical shock

A public water supply from a limestone spring

Incoming groundwater:	Lead = 0.00214 mg/l AL = 0.015 mg/l Copper = 0.088 mg/l AL = 1.3 mg/l
Bathroom sink:	Lead = 0.00525 mg/l = 2.5 times Copper = 0.730 mg/l = 8.3 times

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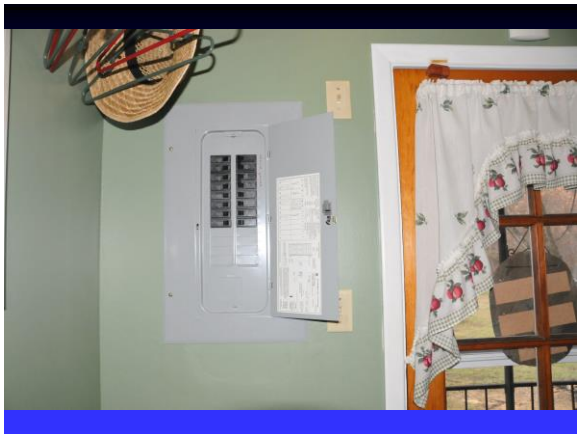
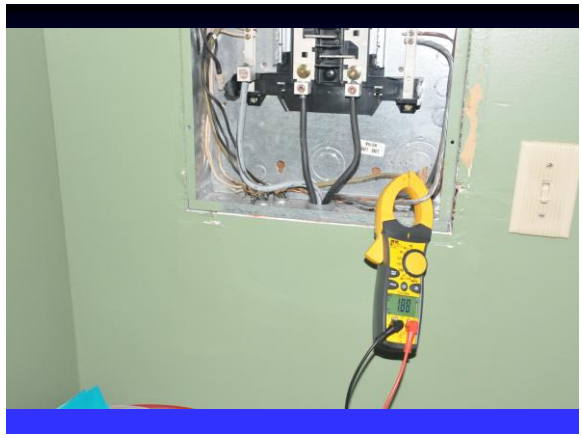
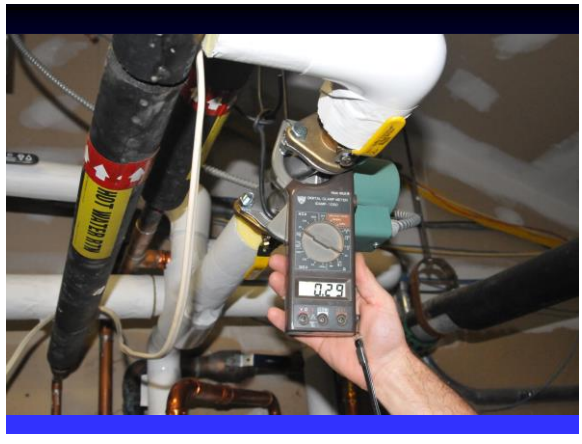




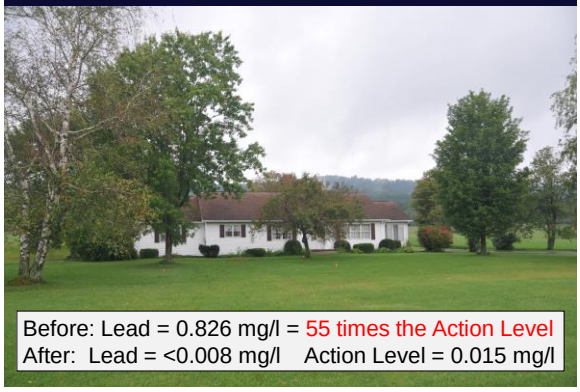
What is the impact of the stray electrical current?

First Draw water sample results:

Building Name	Lead mg/l	Times Increase	Copper mg/l	Times Increase
Dormitory 1	**0.016**	>3.2	0.580	7.4
Dormitory 2	0.007	>1.4	0.746	9.6
Classroom 1	**0.015**	>3.0	0.595	7.6
Classroom 2	**0.053**	>10.6	0.986	12.6
Administration	**0.397**	>79.4	0.630	8.1
Incoming Groundwater	<0.005		0.078	
Action Level	**0.015**	3.0	**1.3**	16.7



The spring water source is at the base of the ridge

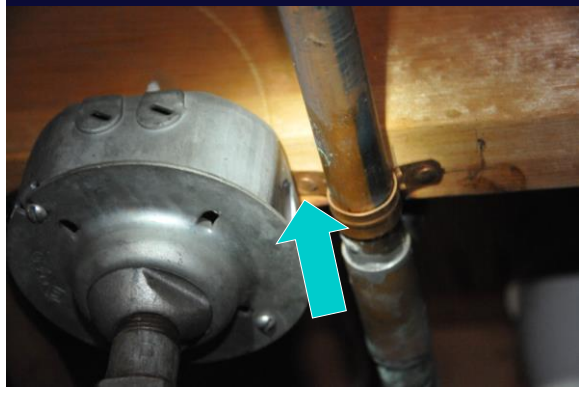


Before: Lead = 0.826 mg/l = 55 times the Action Level
After: Lead = <0.008 mg/l Action Level = 0.015 mg/l

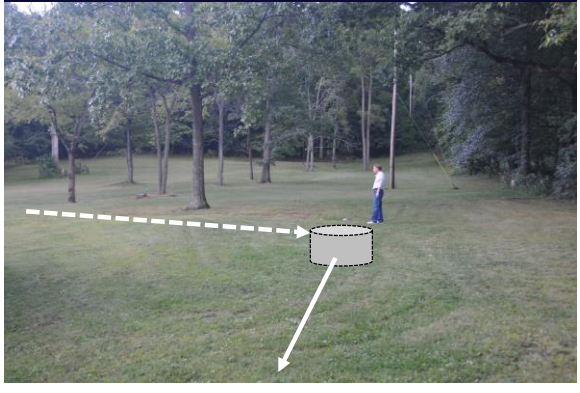
The fluorescent light fixture is in contact with the pipes

The junction box is close to the water pipe

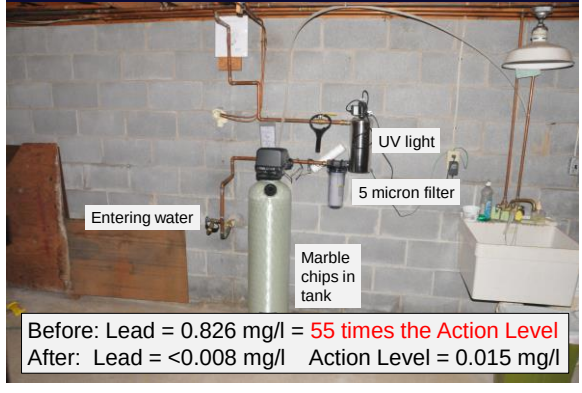
The pipe bracket is contacting the junction box



The spring infiltration gallery is beneath the lawn



The marble chips treat the aggressive spring water



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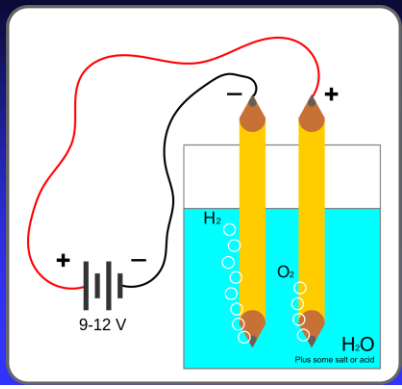
What are some symptoms of stray electrical current?

- Blue-green staining from a dripping faucet
- Black stains on clothes after washing
- Greenish grit caught in the faucet aerator
- Pinhole leaks in the copper piping
- Clothes washer hose ends corroded and leaking water
- No physical symptoms and neurological health impacts
- Elevated lead and copper levels in groundwater from a limestone or dolomite aquifer (hard, non-agressive water)

Only direct current causes electrolysis



A summary of elevated lead and copper in groundwater at the faucet:

- The lead and copper is not in the source groundwater
- Aggressive (corrosive) groundwater dissolves the pipes and the solder
- Stray electrical current dissolves the pipes and solder
- The elevated levels are from the plumbing
- Stray electrical current is an almost unknown cause of elevated lead and copper
- Stray electrical current is very poorly understood (if at all) by most apprentice, journeyman, and master electricians
- Today, “Science is just another opinion.”