Drinking Water and School Buildings
Setting the Stage

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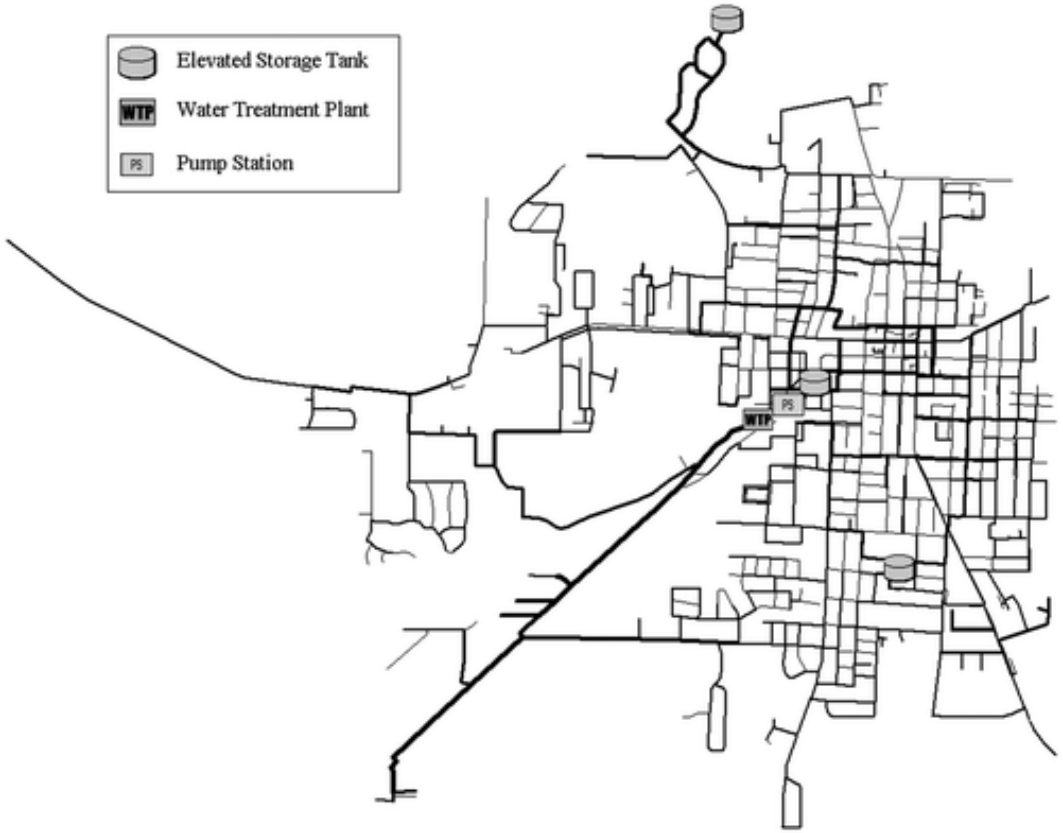
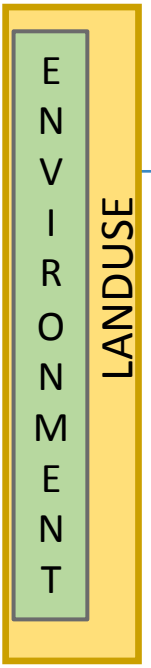
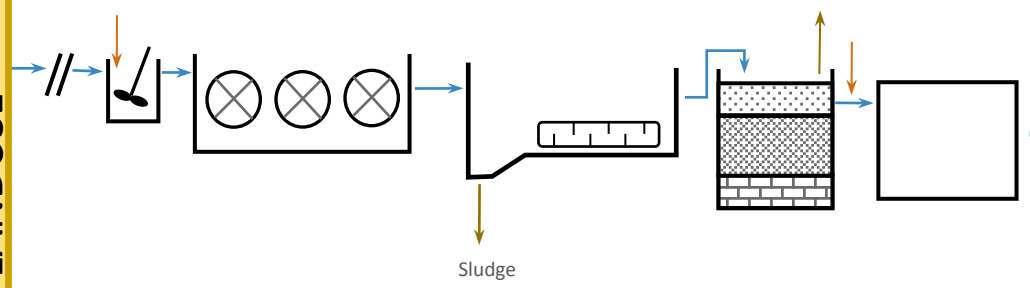
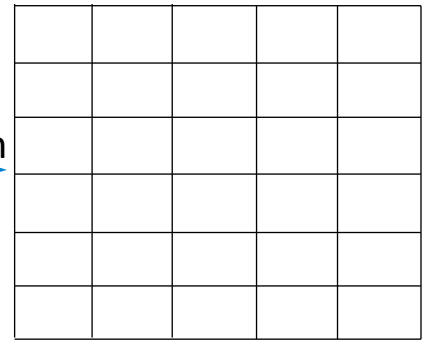


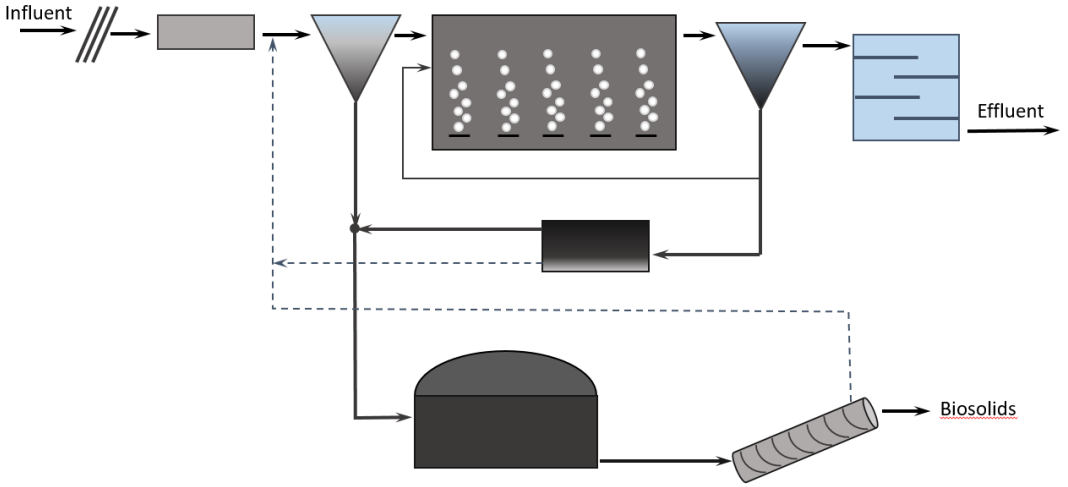




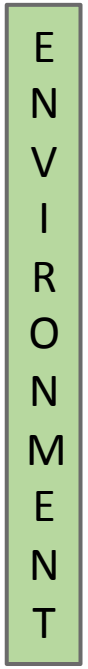
Drinking Water Treatment Plant



Collection

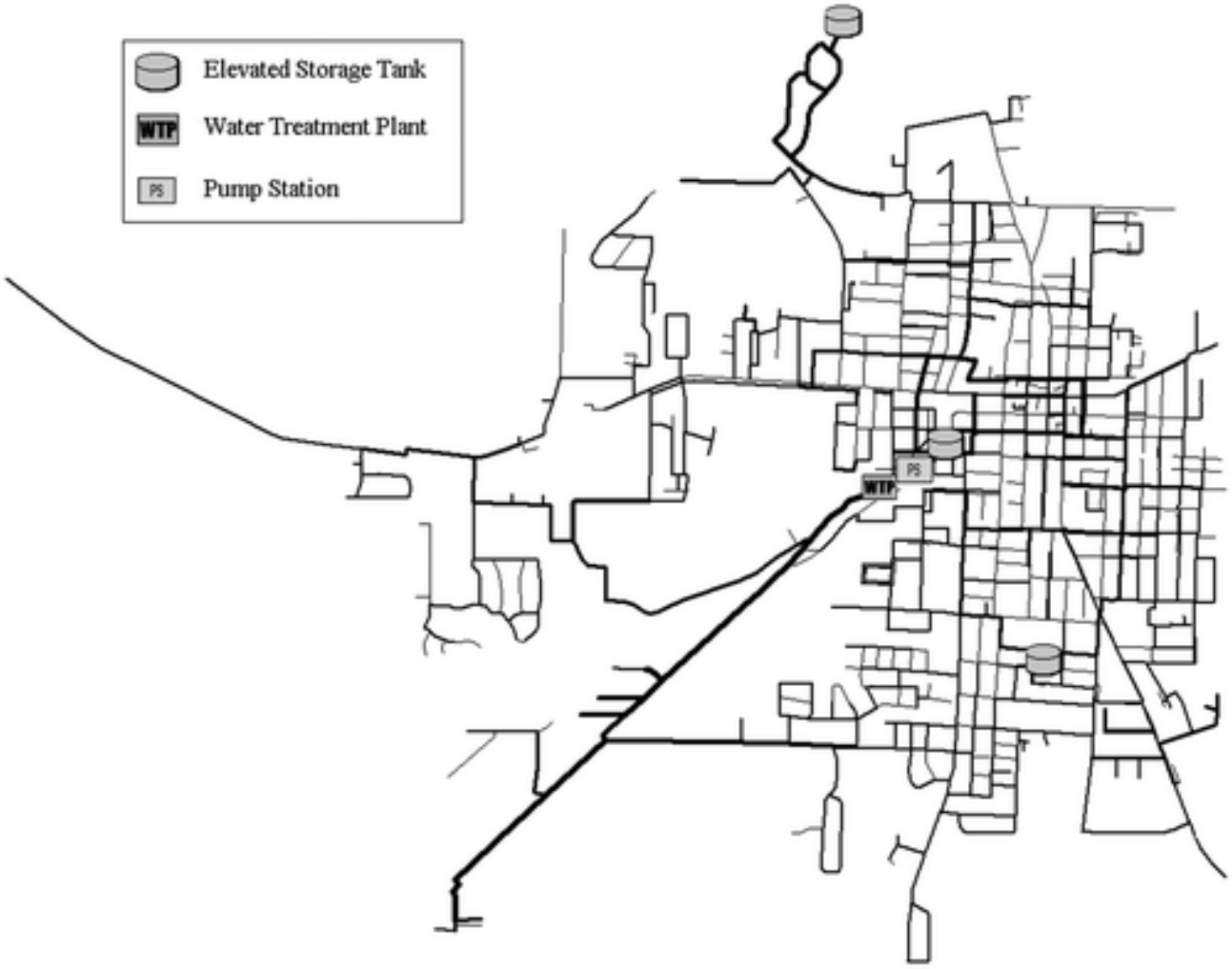


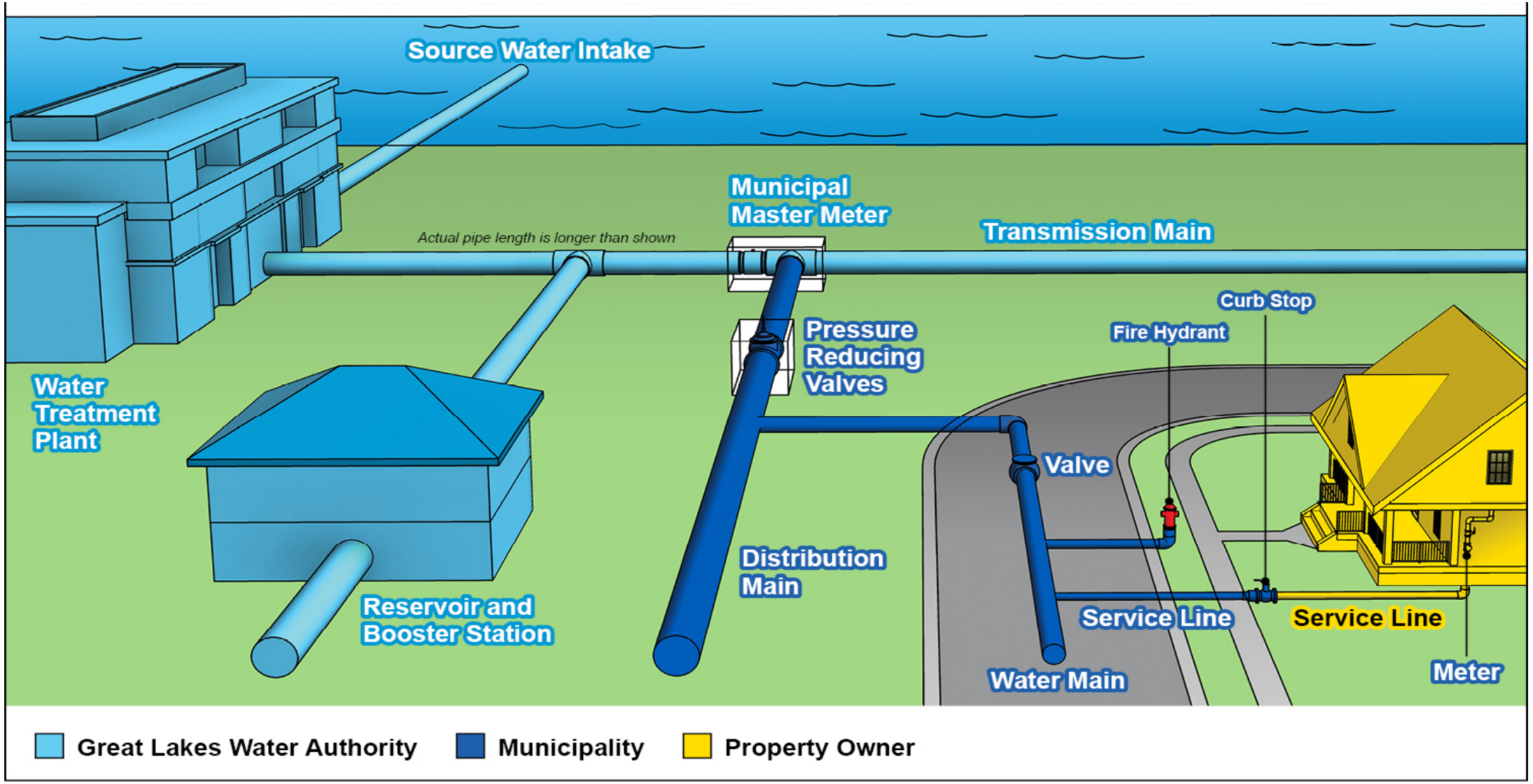
Water Resource Recovery Facility



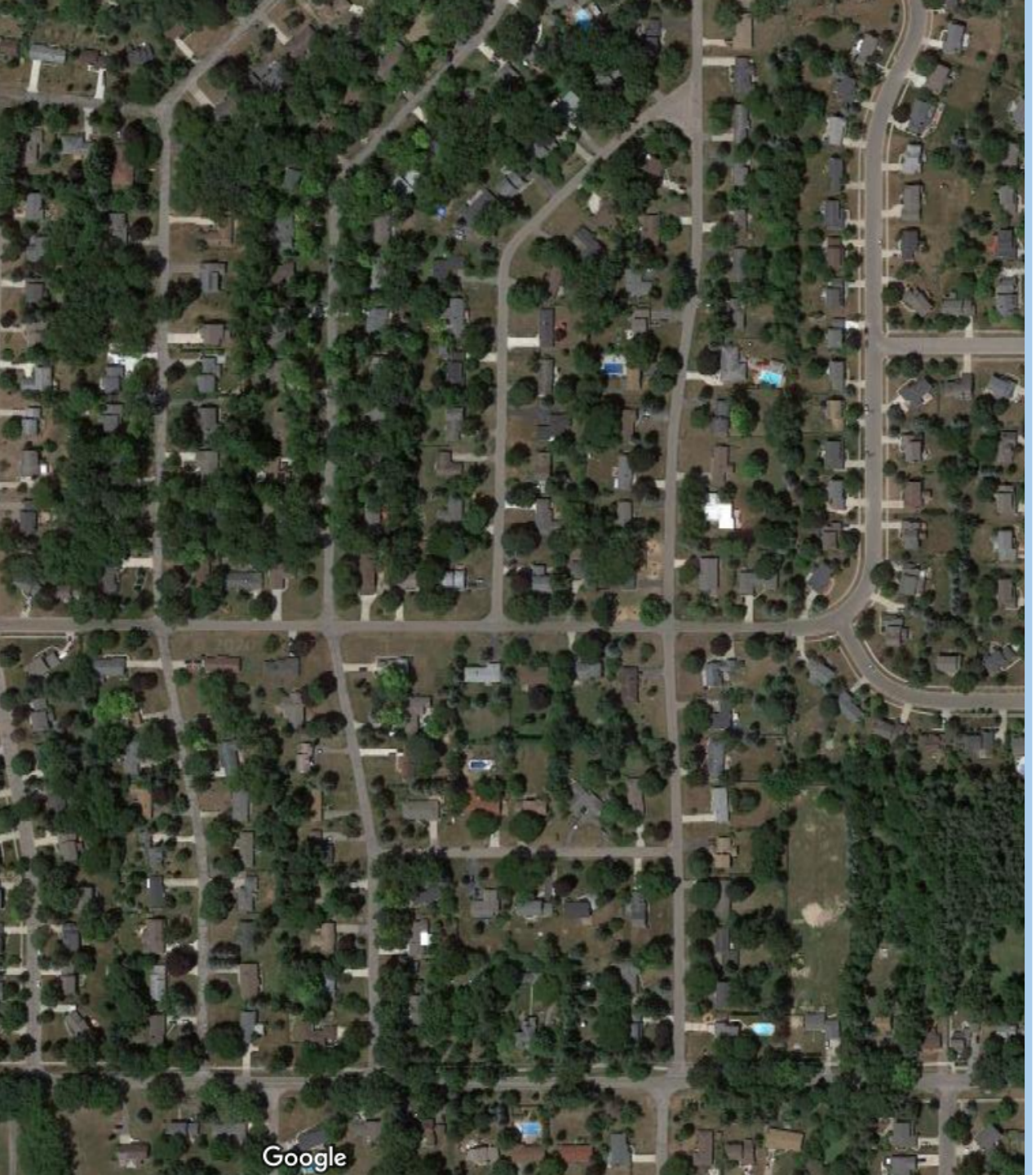
MULTIPLE BARRIER APPROACH

A typical community distribution system





https://outreach.glwater.org/Home/News/OCW_Safeguarding_Our_Water_1/tabid/241/Default.aspx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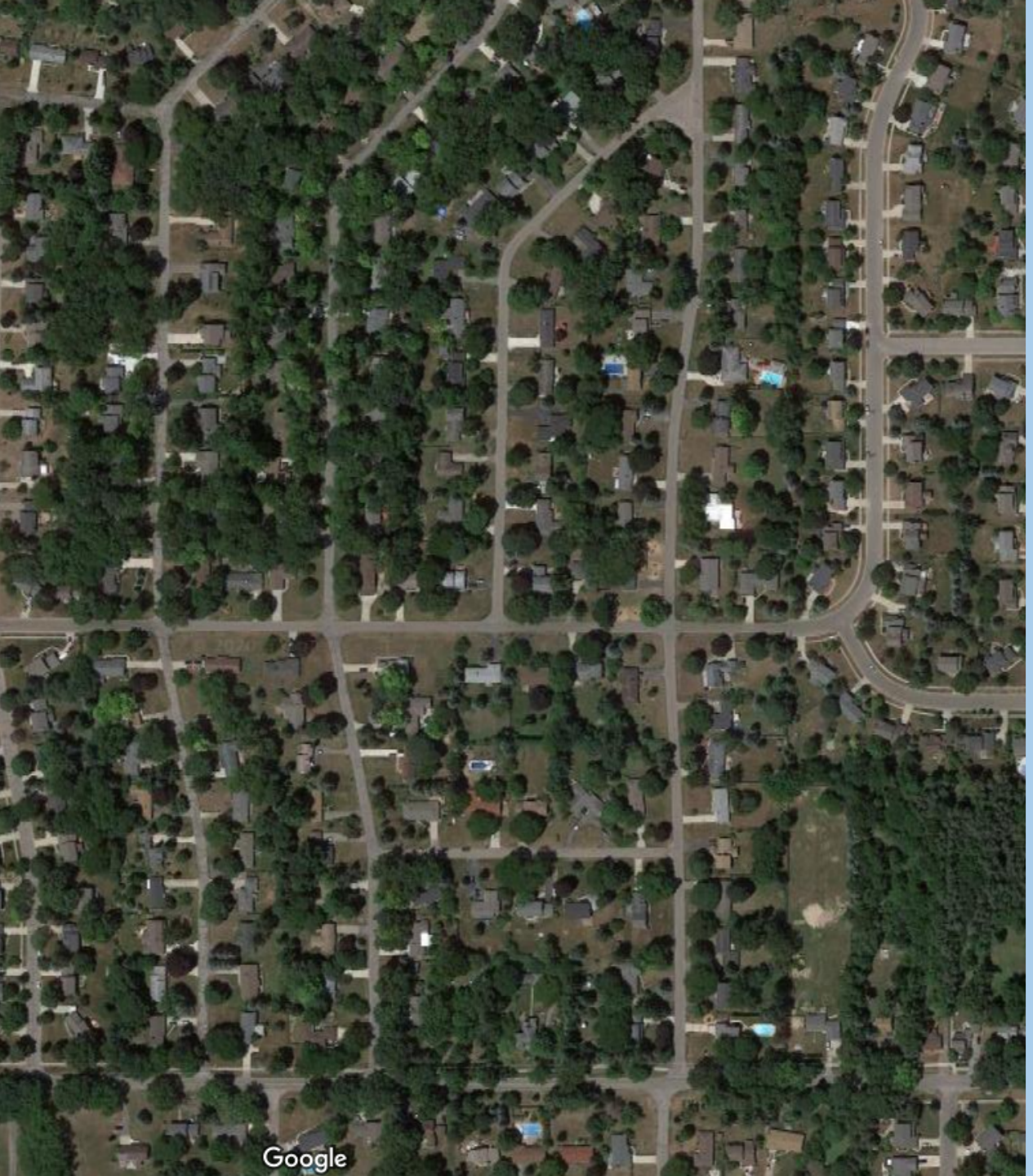
Greenwood Dr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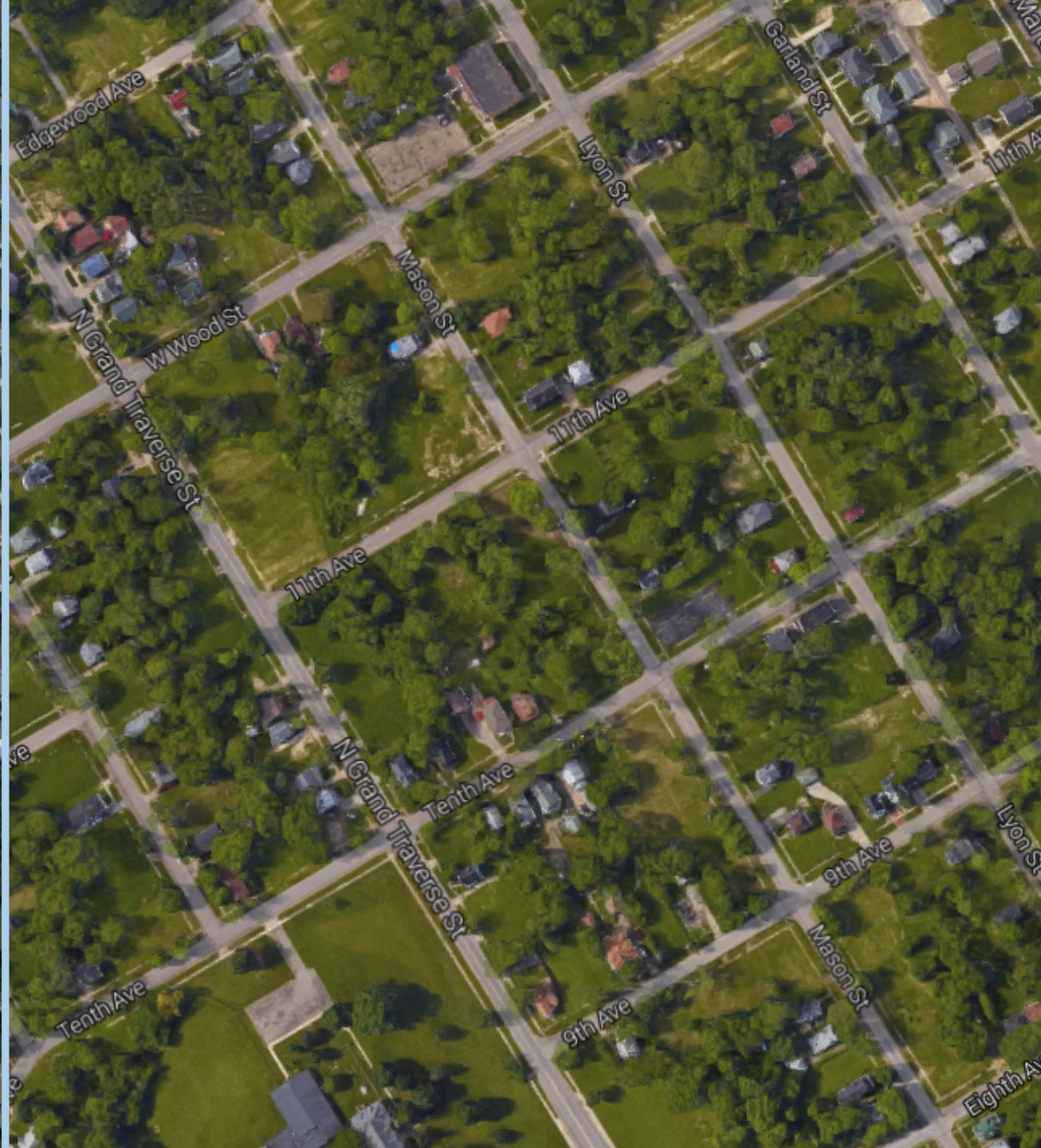
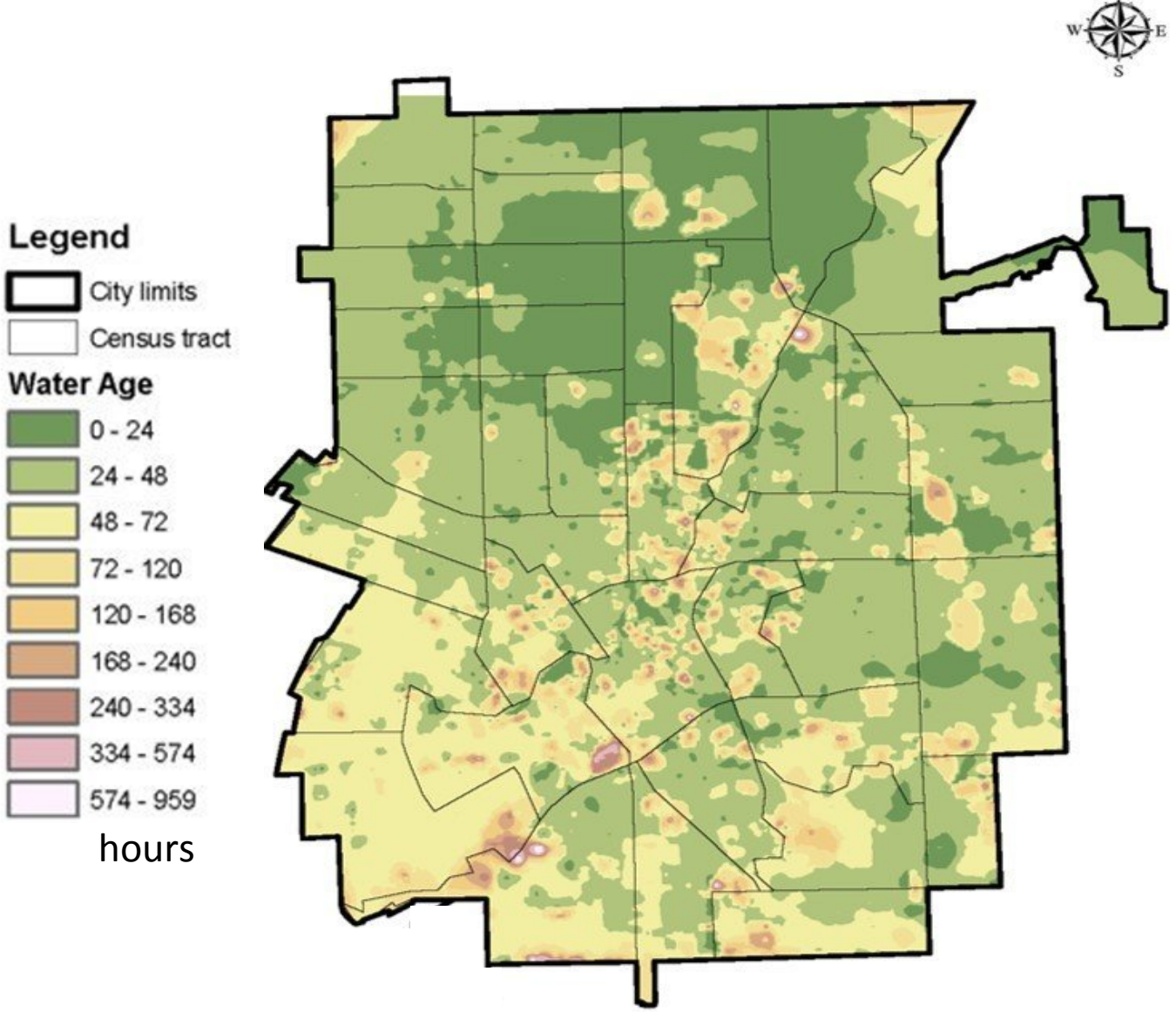

Edgewood Ave
Garland St
Lyon St
Mason St
W Wood St
N Grand Traverse St
11th Ave
11th Ave
Tenth Ave
N Grand Traverse St
9th Ave
Lyon St
Tenth Ave
9th Ave
Mason St


Greenwood Dr


Flint, Michigan
Street View - Sep 2015
Tenth Ave
Lyon St
Tenth Ave



Analysis by: Shawn McElmurry, Sara Schwetschenau, Amir Kamjou, Harry Vaslo

Wayne State University

Every city should have a hydraulic map

Hydraulic maps are unique per city

Hydraulic layout defines a city's water age map

Water quality deteriorates with water age or storage

Chemical Issues
Disinfection byproduct formation
Disinfectant decay
Corrosion control effectiveness
Taste and odor

Biological Issues
Disinfection byproduct degradation
Nitrification
Microbial regrowth/recovery
Taste and odor

Physical Issues
Temperature increases
Sediment deposition
Color

Bold denotes water quality problem with direct potential public health impact

Design guidelines for water age: preferably <72 hours

After: USEPA. 2002. Effects of Water Age on Distribution System Water Quality; The Water Industry Database, AWWA and AwwaRF, 1992.

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Physical Issues

Temperature increases
Sediment deposition
Color

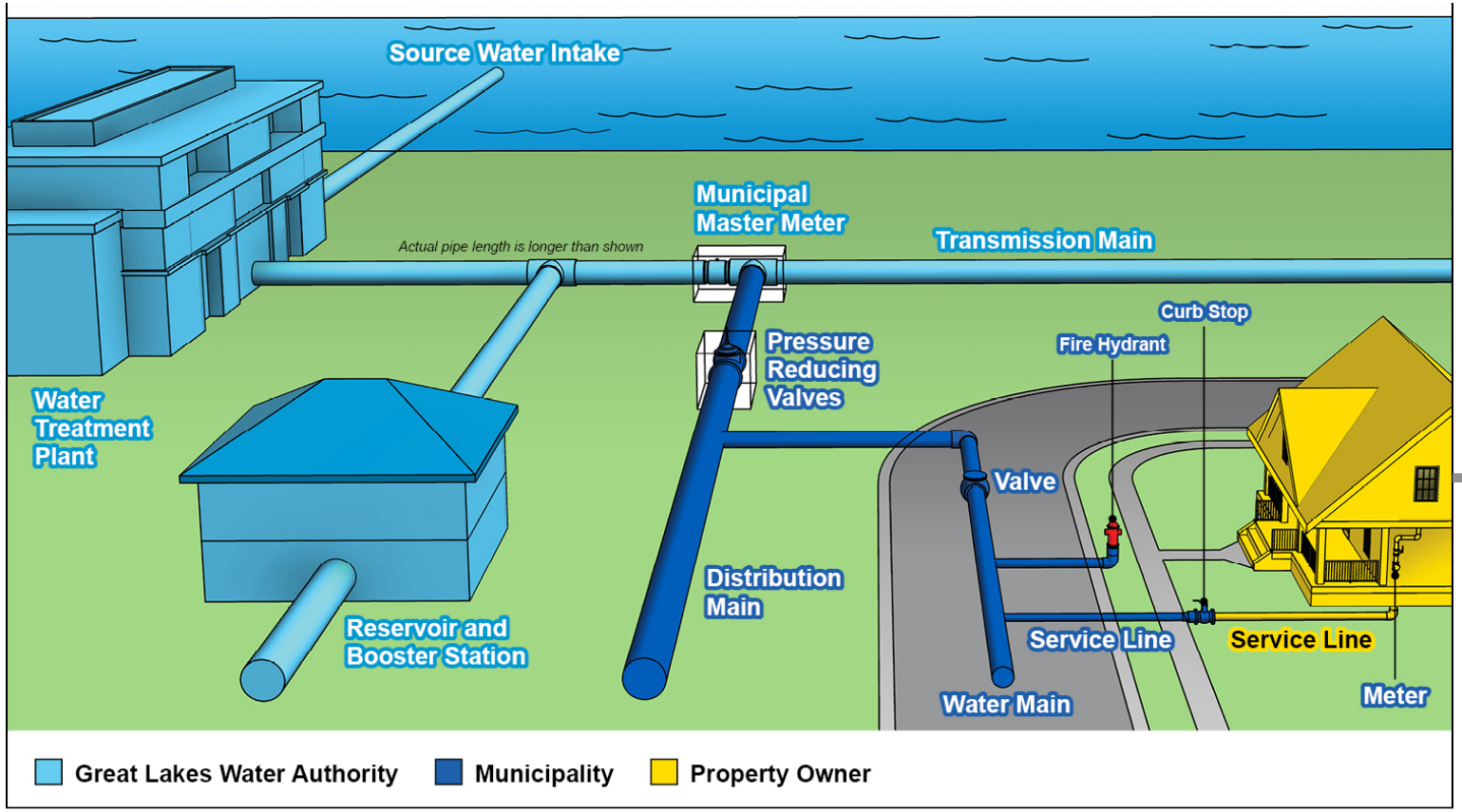
Water quality is also impacted by:

- quality and use of premise plumbing
- Is a function of where the building is in a city's hydraulic map

Bold denotes water quality problem with direct potential public health impact

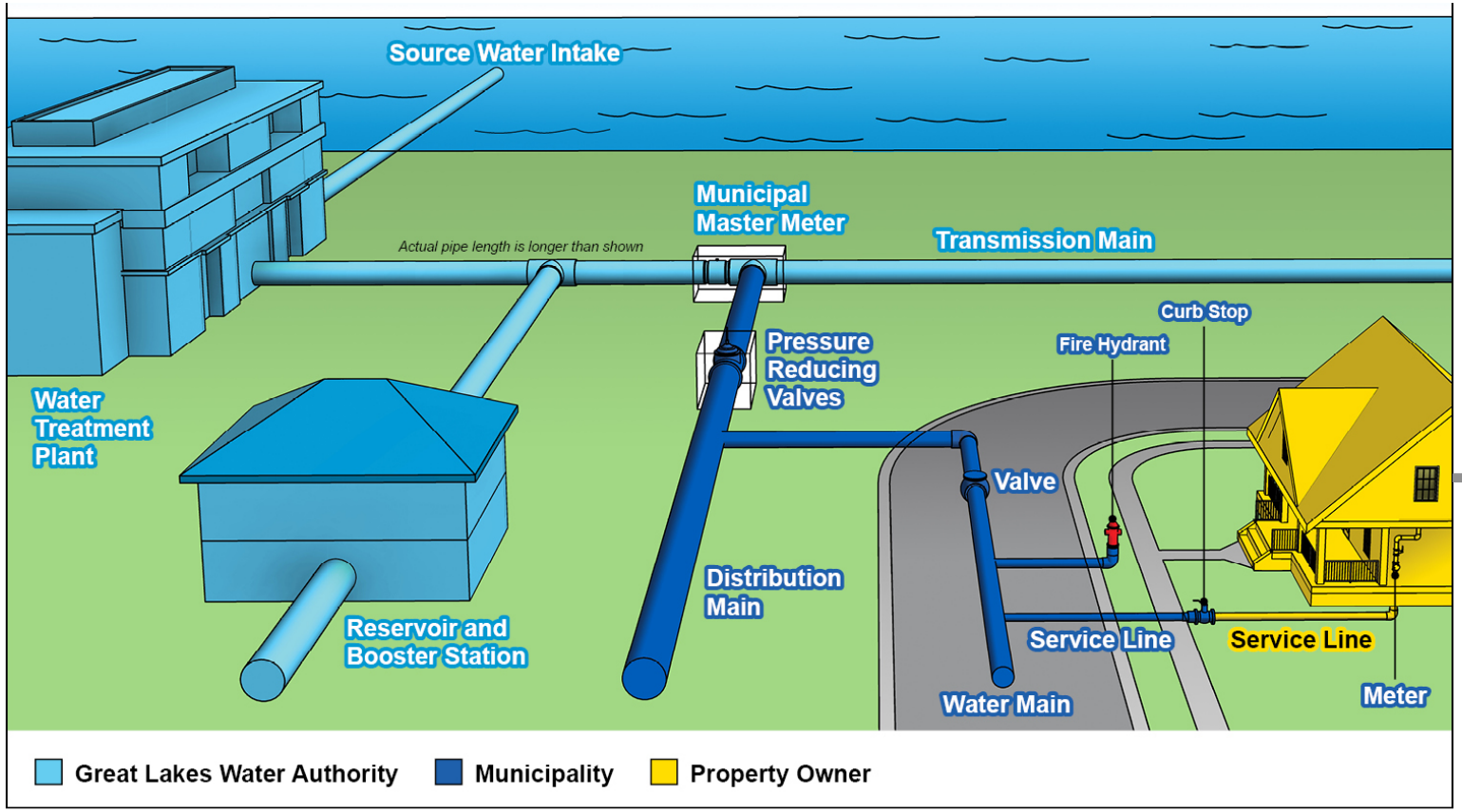
Design guidelines for water age: preferably <72 hours

After: USEPA. 2002. Effects of Water Age on Distribution System Water Quality; The Water Industry Database, AWWA and AwwaRF, 1992.



Examples:
Point-of-Use Treatment

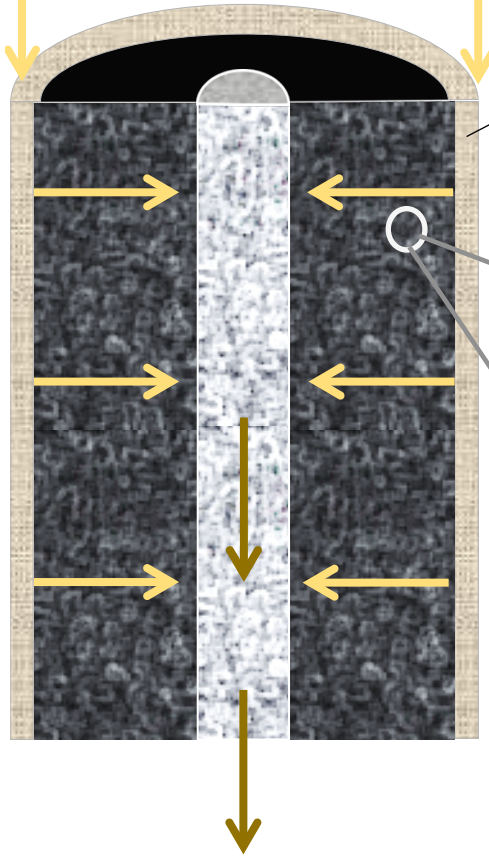
https://outreach.glwater.org/Home/News/OCW_Safeguarding_Our_Water_1/tabid/241/Default.aspx

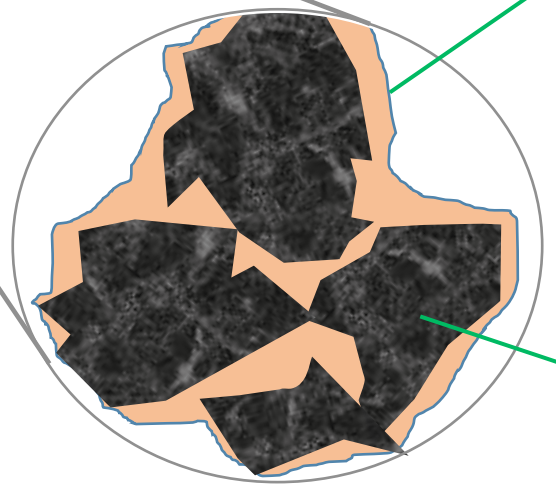


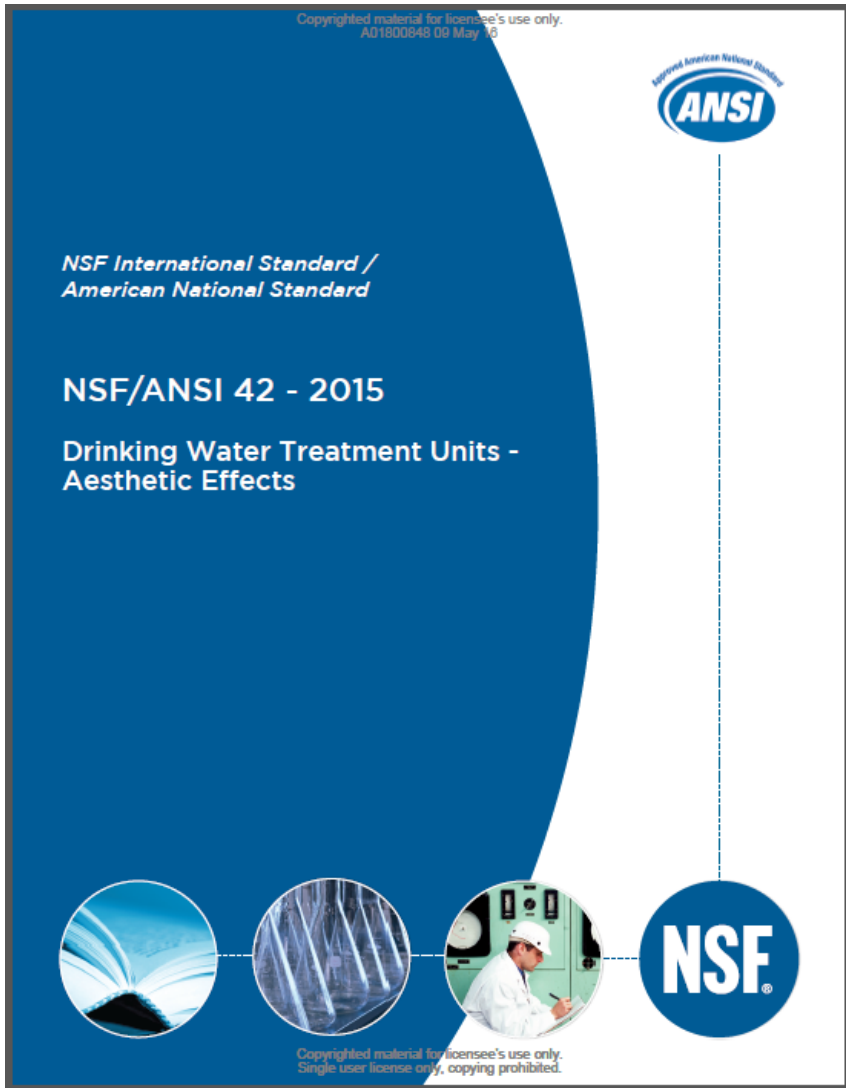
Examples:
Point-of-Use Treatment

https://outreach.glwater.org/Home/News/OCW_Safeguarding_Our_Water_1/tabid/241/Default.aspx

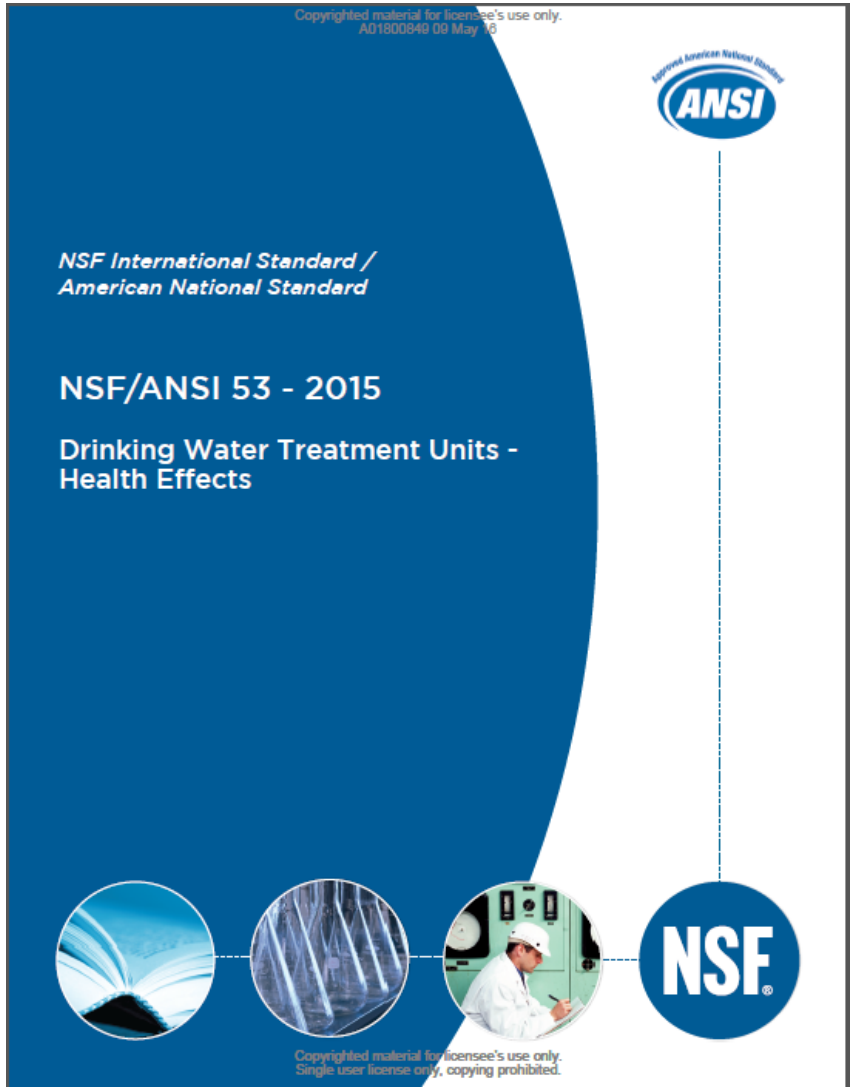
The anatomy of a point-of-use filter





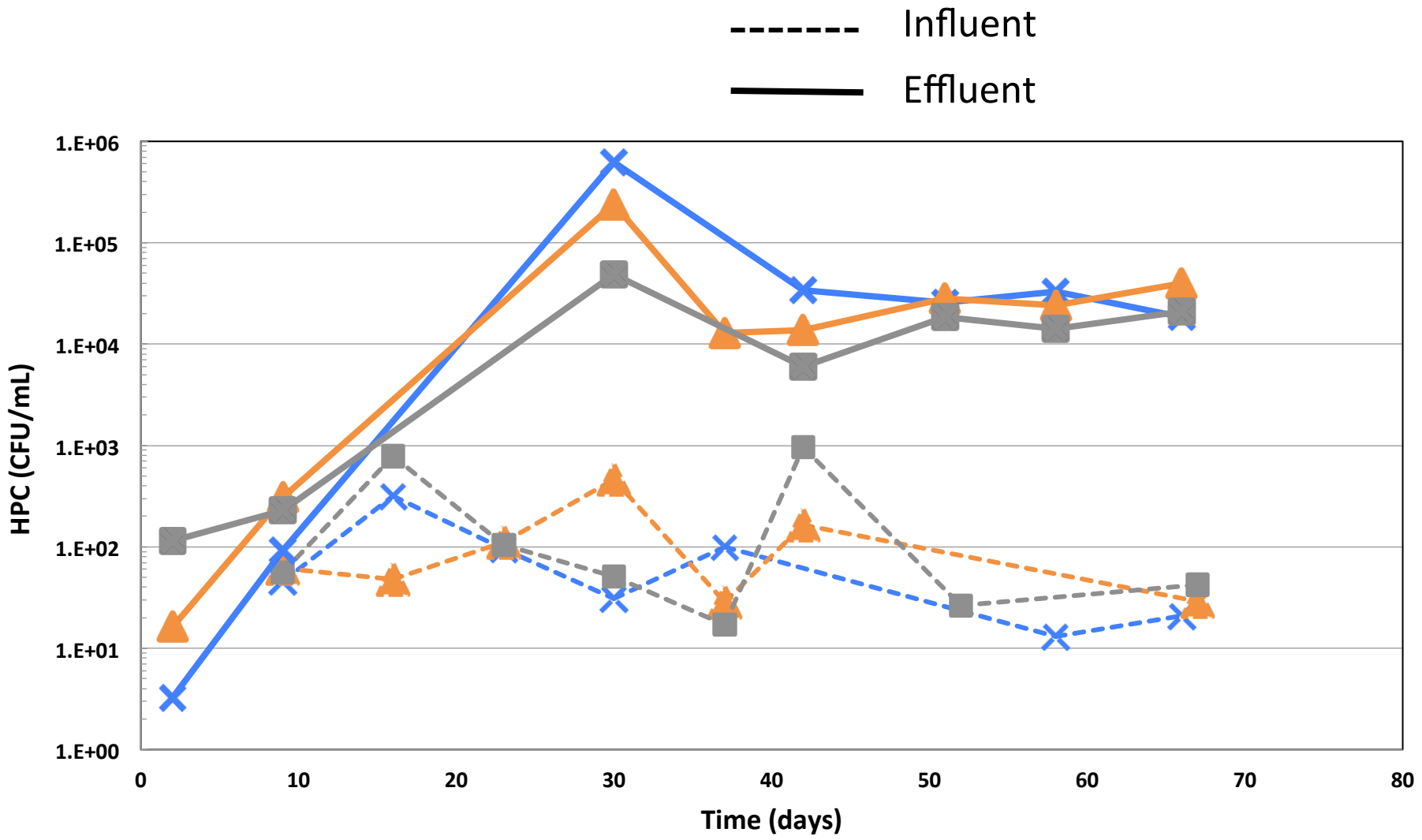


Common claims of filter reduction: **chlorine** (taste and odor), **chloramines**, **iron**, **manganese**, **hydrogen sulfide**, **pH neutralization** and **zinc**.

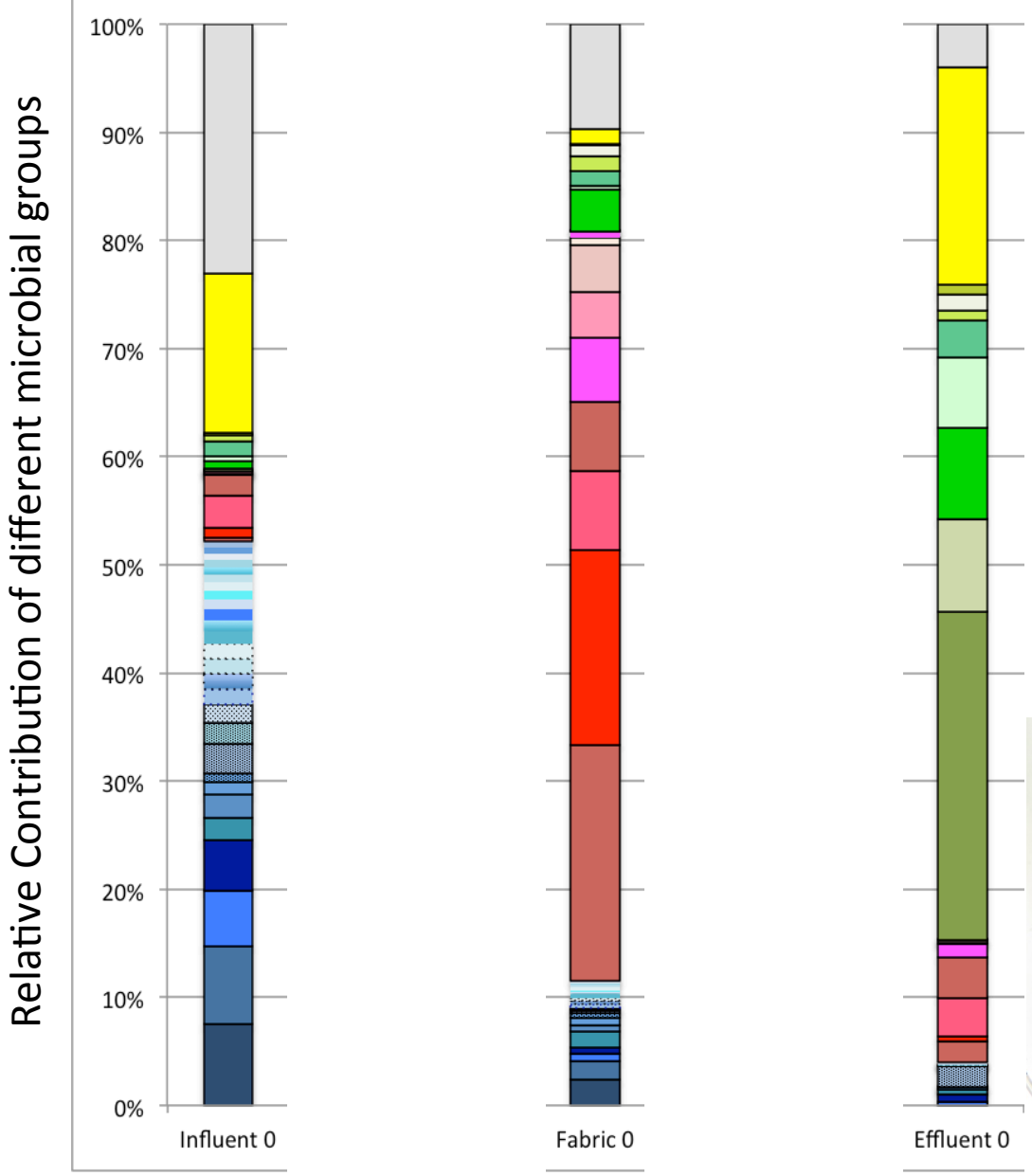


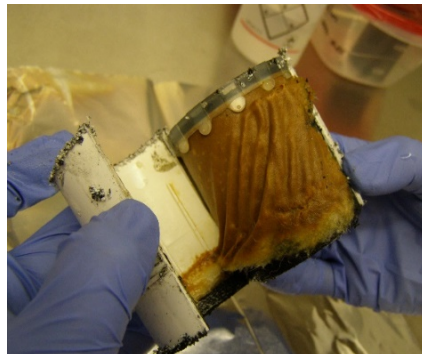
Common claims of filter reduction: **heavy metals** (arsenic, cadmium, chromium, copper, lead, mercury and selenium), **inorganics** (fluoride, nitrate, nitrite) and **VOCs** including DBPs.

Ann Arbor Study: Heterotrophic plate counts show enhanced growth in the effluent within one month of operation.



Wu, C.-C., S. Ghosh, K. J. Martin, A. J. Pinto, V. J. Denef, T. M. Olson, N. G. Love*. 2017. The microbial colonization of activated carbon block point-of-use (PoU) filters with and without chlorinated phenol disinfection byproducts. *Environmental Science: Water Research & Technology*, 2017, DOI: 10.1039/C7EW00134G



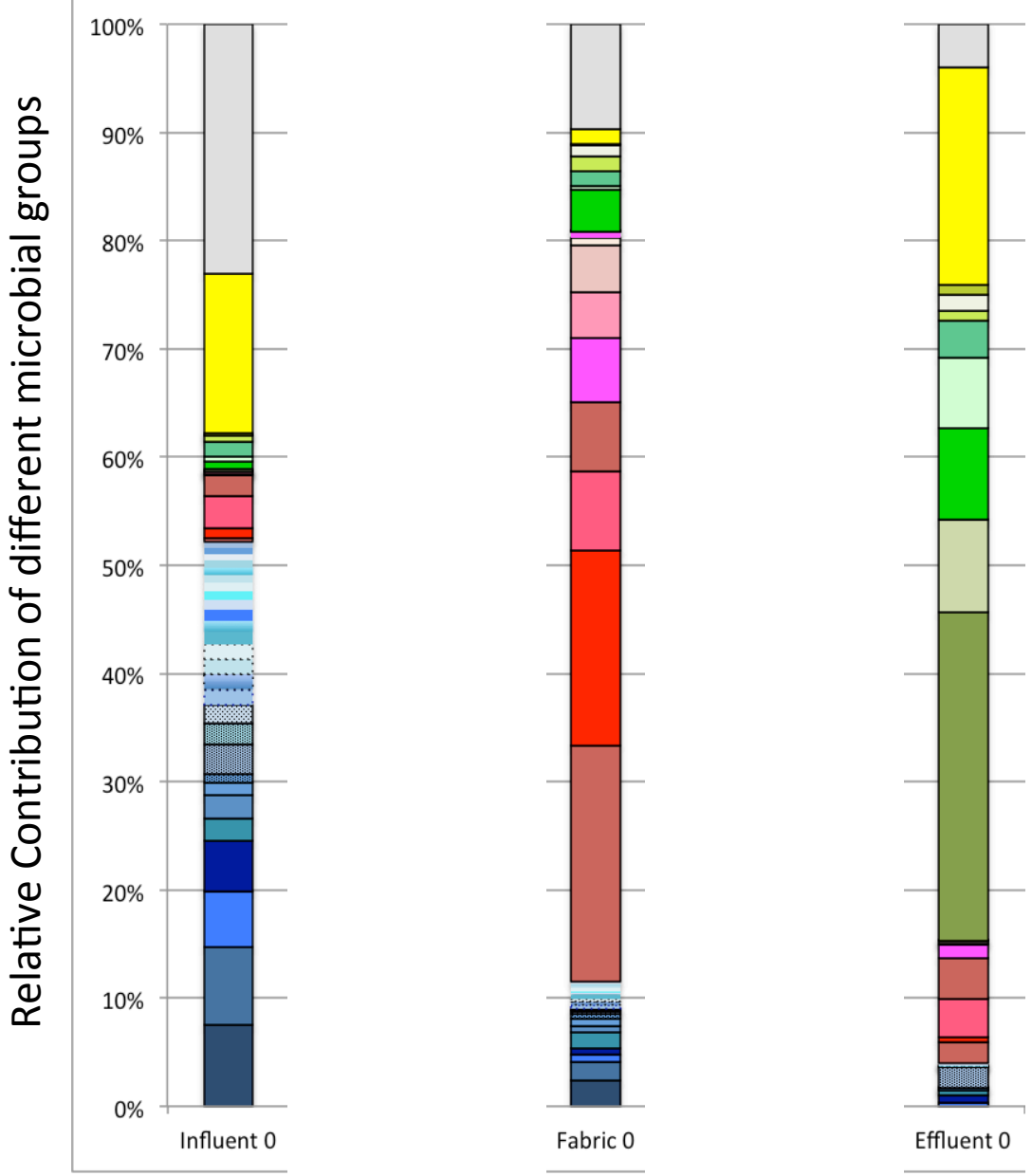


Filtered OTUs **Attached OTUs** **Unfiltered OTUs**

Dominant OTUs with relative abundance >1%

Wu, C.-C., S. Ghosh, K. J. Martin, A. J. Pinto, V. J. Denef, T. M. Olson, N. G. Love*. 2017. The microbial colonization of activated carbon block point-of-use (PoU) filters with and without chlorinated phenol disinfection byproducts. *Environmental Science: Water Research & Technology*, 2017, DOI: 10.1039/C7EW00134G

16S rRNA gene Illumina sequence analysis



Point-of-use filters change the composition and abundance of microorganisms consumers are exposed to.

Nature of change varies from building to building and is very much influenced by:

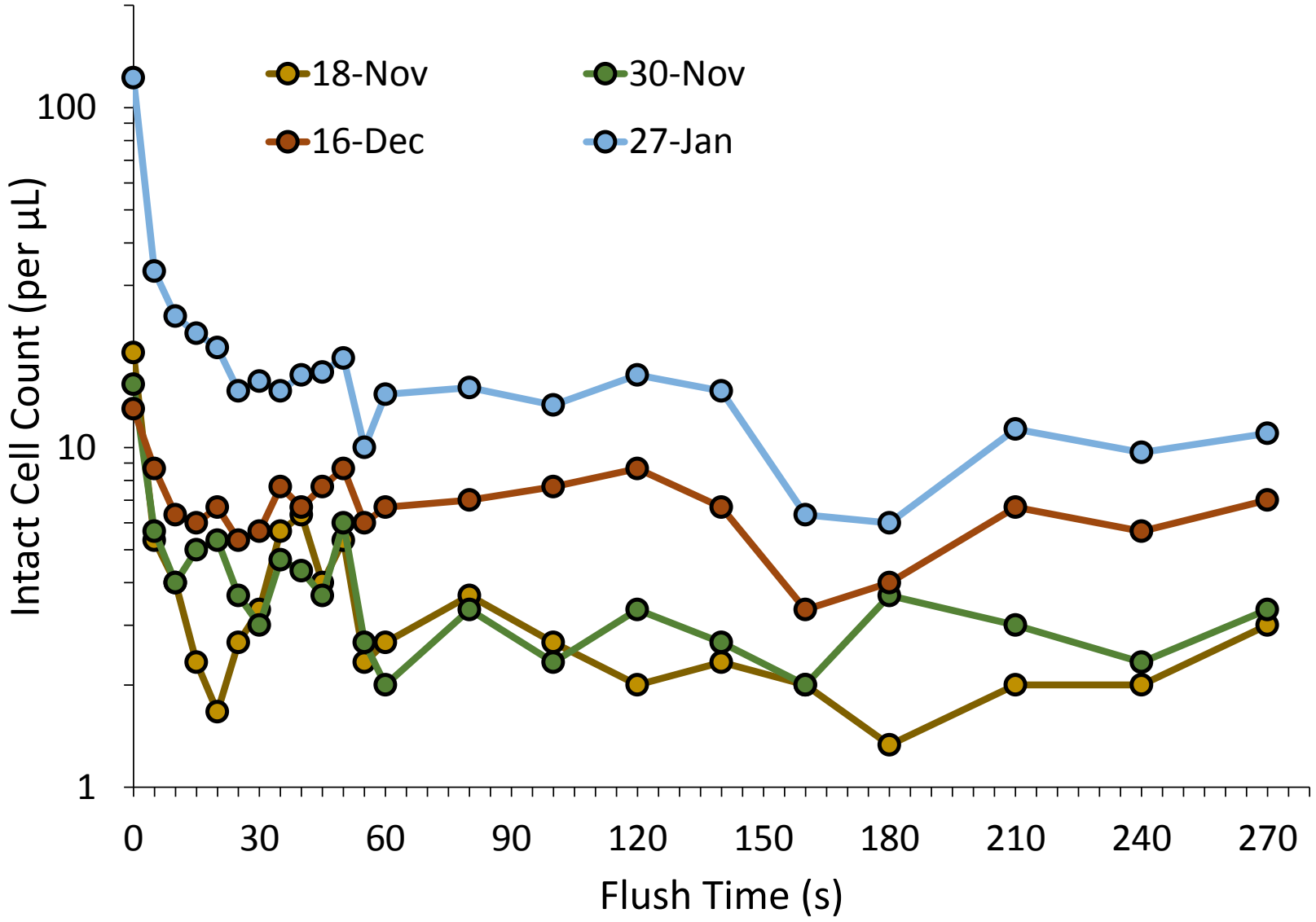
- **how water is managed in buildings**
- **where the building is in the water distribution system**

Filtered OTUs **Attached OTUs** **Unfiltered OTUs**

Dominant OTUs with relative abundance >1%

Wu, C.-C., S. Ghosh, K. J. Martin, A. J. Pinto, V. J. Denef, T. M. Olson, N. G. Love*. 2017. The microbial colonization of activated carbon block point-of-use (PoU) filters with and without chlorinated phenol disinfection byproducts. *Environmental Science: Water Research & Technology*, 2017, DOI: 10.1039/C7EW00134G

Flushing education is important for PoU filter deployments



Recommendations to use Point-of-Use filters must consider the overall status of the drinking water system supplying water to the filter.

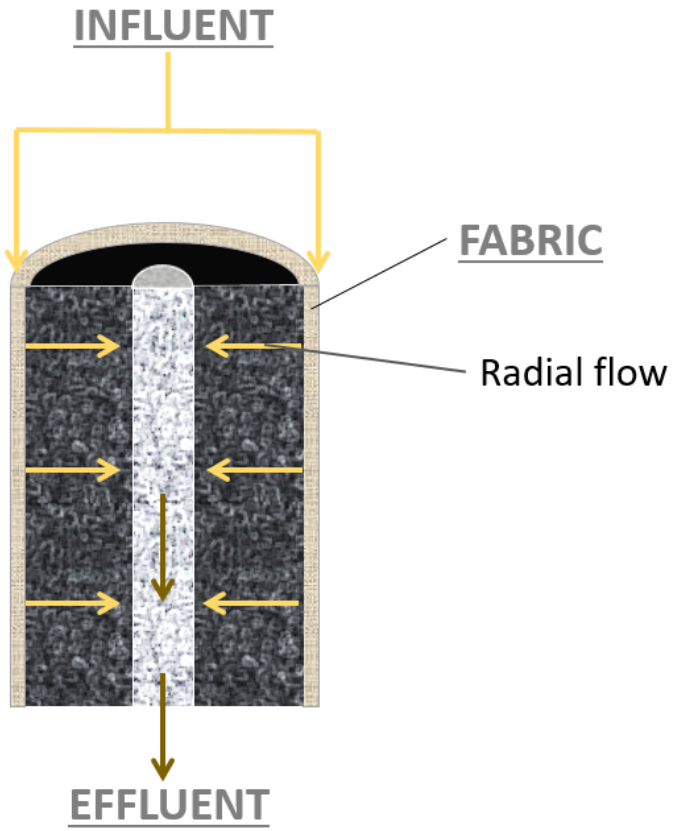
This includes being aware of the system's *water age*.

Higher water age = higher water storage in the system and the potential for reduced disinfectant residual.

There is uncertainty around point-of-use filters, and this deserves more attention:

- We do not know how point-of-use filter performance in field trials changes with increasing water age and across different systems (different treatment processes, different infrastructure conditions).
- We do not know the relationship between microbial stability, chemical water quality, point-of-use filters, and opportunistic pathogens in field trials.
- We do not know the relationship between emerging opportunistic pathogens and point-of-use filters based on field trials.
- Coordinated water quality + epidemiological studies around point-of-use filters are quite limited.
- We do not know how point-of-use filters in school buildings will perform absent maintenance and complete filter replacement after gaps in use

Observations about Water Quality Coming from Activated Carbon Block (ACB) Point-of-Use (PoU) "Lead Filters": An Emphasis on Bacterial Colonization



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