

The Fifth Urban Water Revolution



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

David L. Sedlak

Department of Civil & Environmental Engineering

University of California, Berkeley

23rd Annual Clarke Prize Conference

November 4, 2016

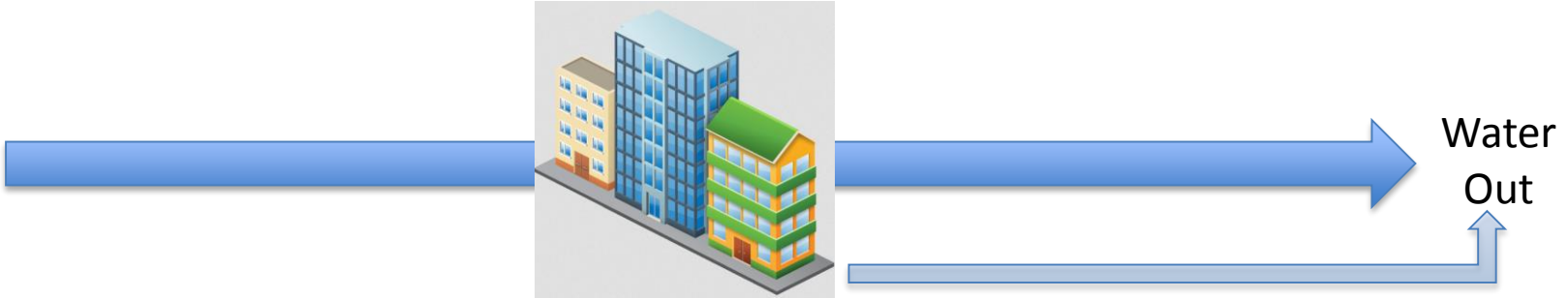


Water 1.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

Water
In



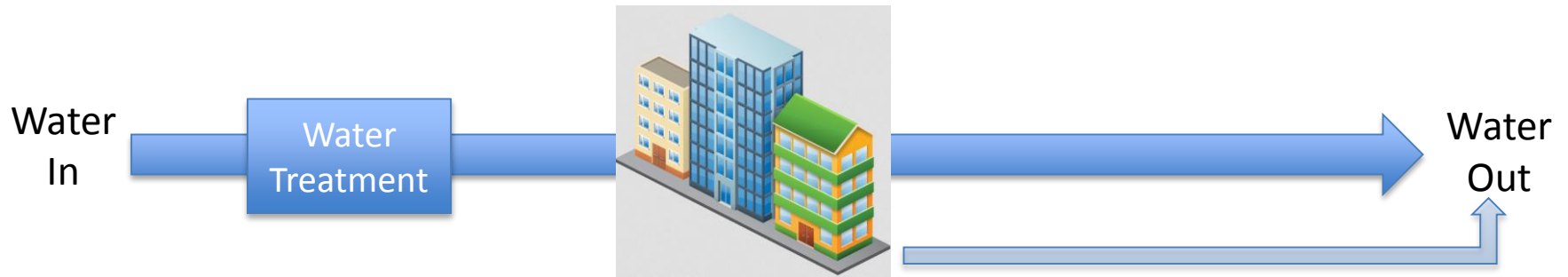
Water
Out



Water 2.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

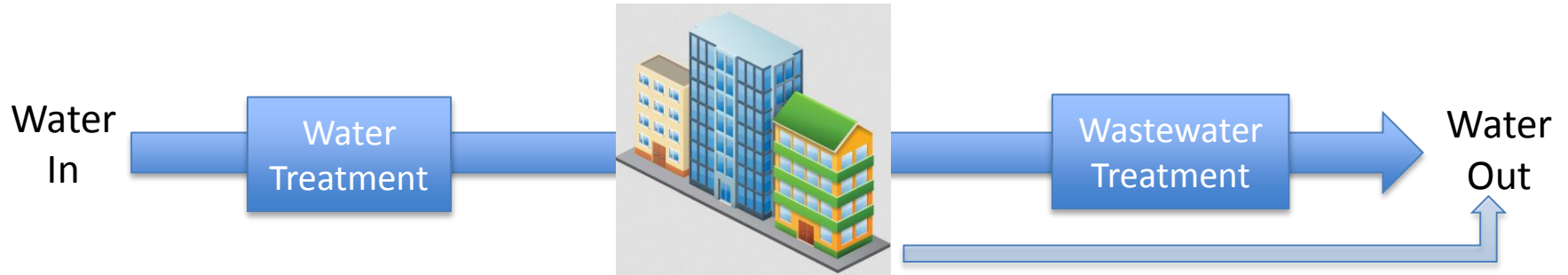




Water 3.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

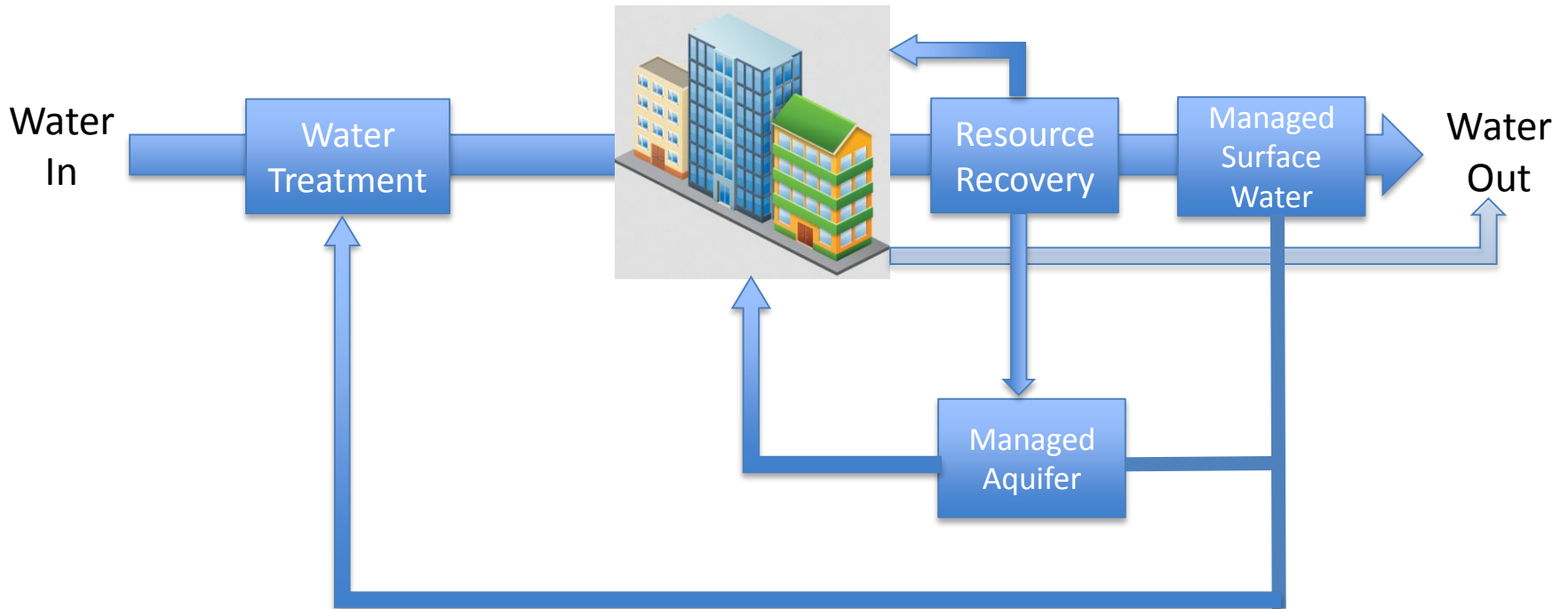




Water 4.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

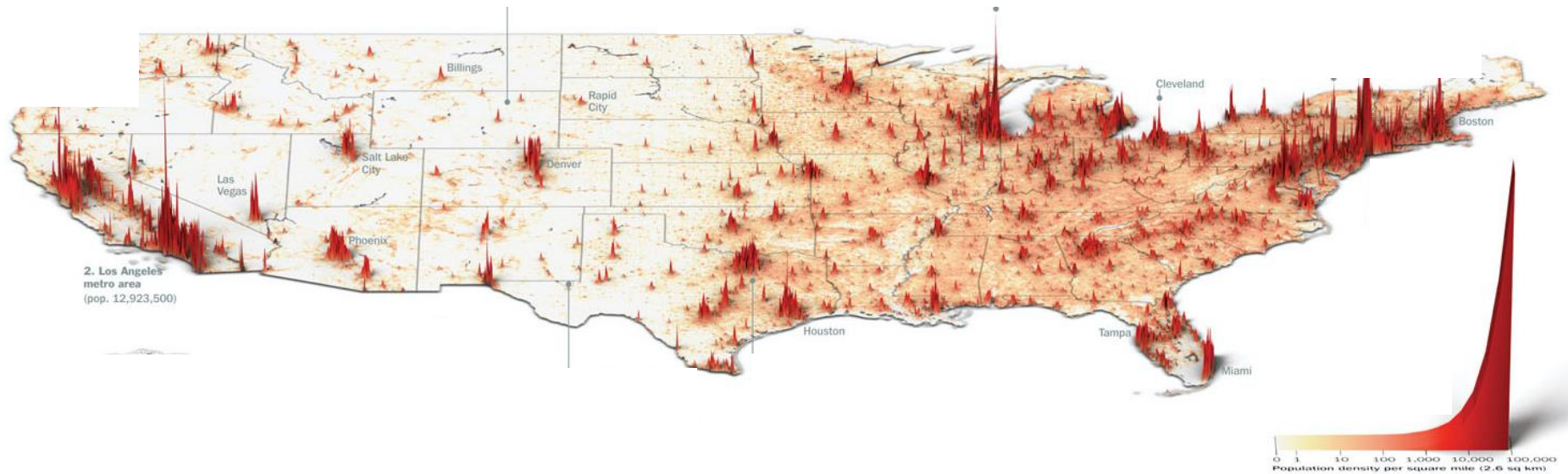




Front Lines of the Revolution



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



<http://www.thefunctionalart.com>



Front Lines of the Revolution



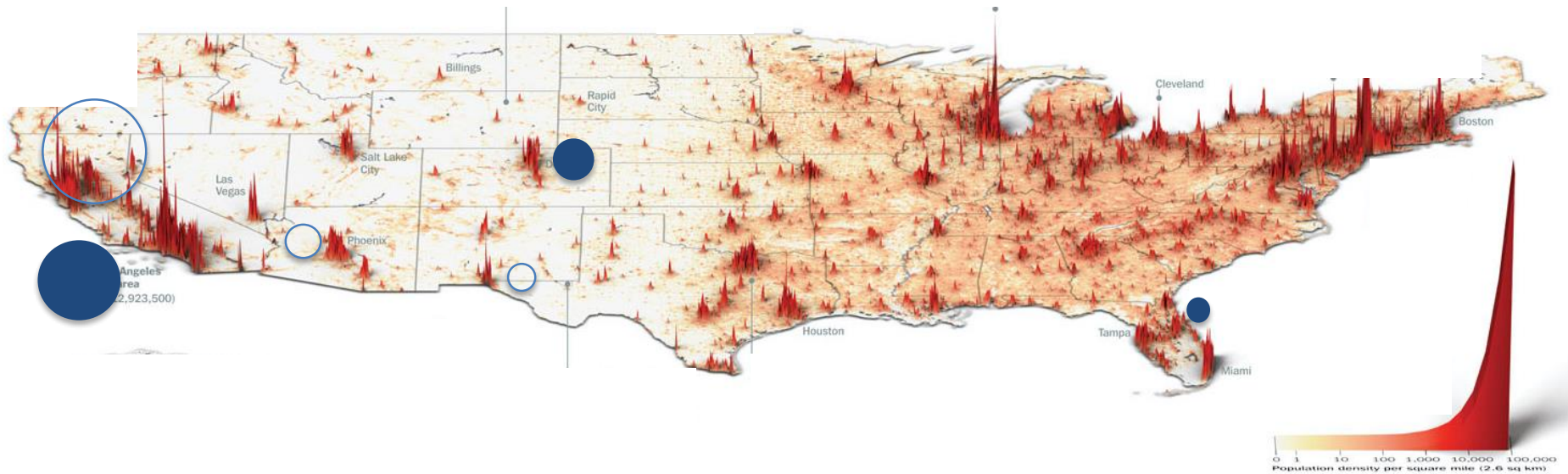
ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



Managed Aquifer Recharge



Advanced Treatment/Recharge



<http://www.thefunctionalart.com>

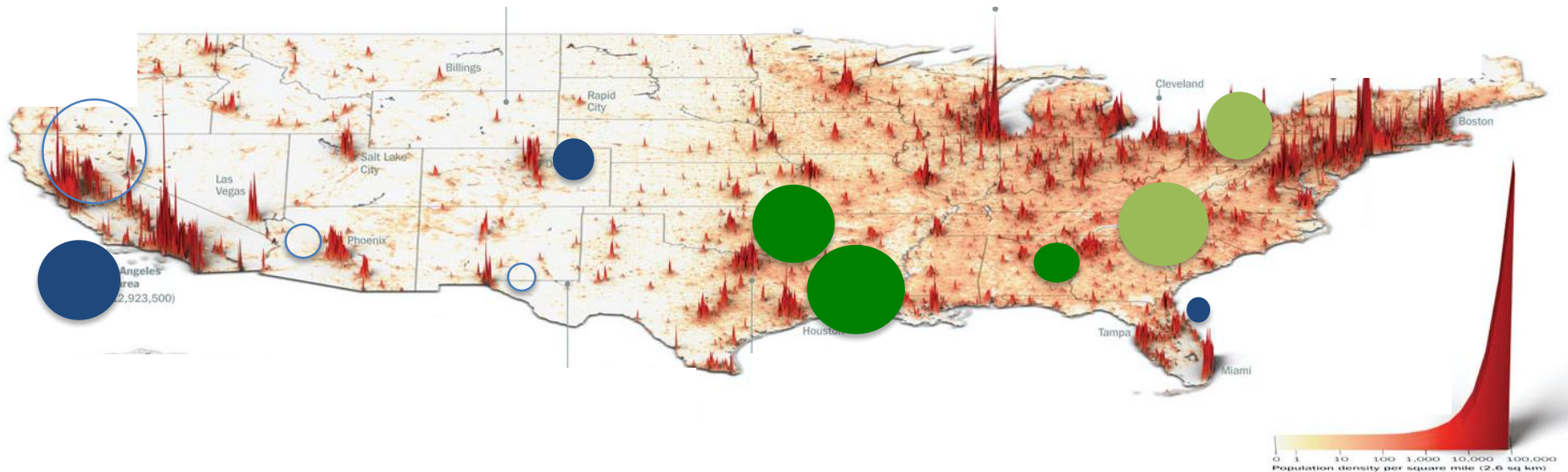


Front Lines of the Revolution



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

- Managed Surface Water
- Managed Aquifer Recharge
- Surface Water Augmentation
- Advanced Treatment/Recharge



<http://www.thefunctionalart.com>

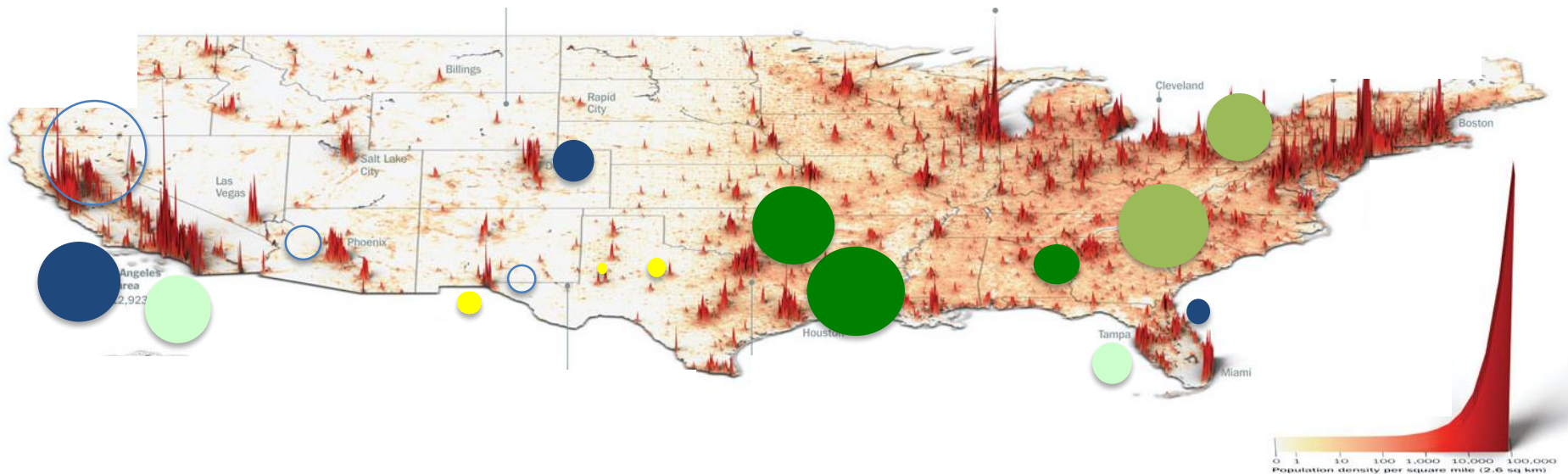


Front Lines of the Revolution



ReNUWIT
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

- Managed Surface Water
- Managed Aquifer Recharge
- Direct Potable Reuse
- Surface Water Augmentation
- Advanced Treatment/Recharge
- Seawater Desalination



<http://www.thefunctionalart.com>



Big Infrastructure: Problem of Solution?



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



Big Infrastructure: Problem of Solution?



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



Source: California Natural Resources Agency

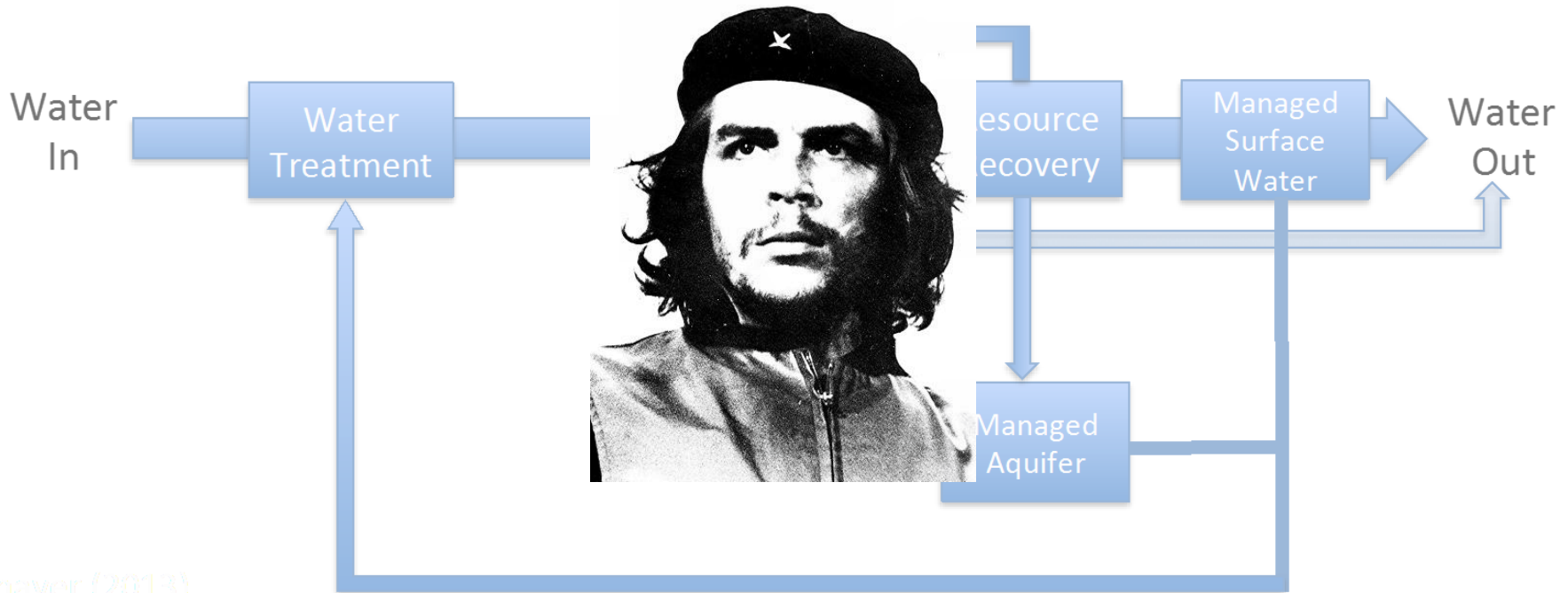
BAY AREA NEWS GROUP



Did Someone Say Revolution?



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



Hayer (2013)

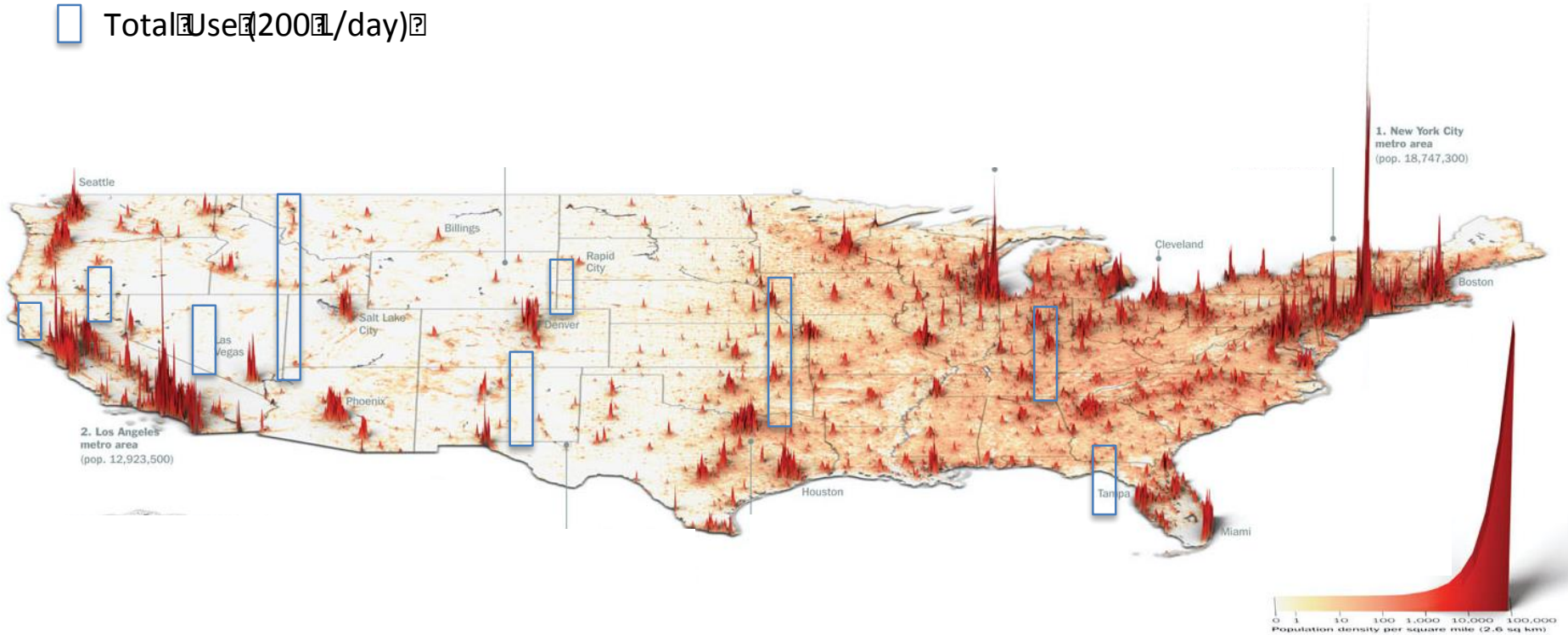


Per Capita Water Use



ReNUWIt
Re-inventing the Nation's

□ Total Use (2001/day) □



<http://www.thefunctionalart.com>



Houston



ReNUWit
Re-inventing the Nation's



NYTimes



San Francisco



ReNUWit
Re-inventing the Nation's





The Un-Lawn



ReNUWit
Re-inventing the Nation's



Photo: Steve & Michelle Gerdes



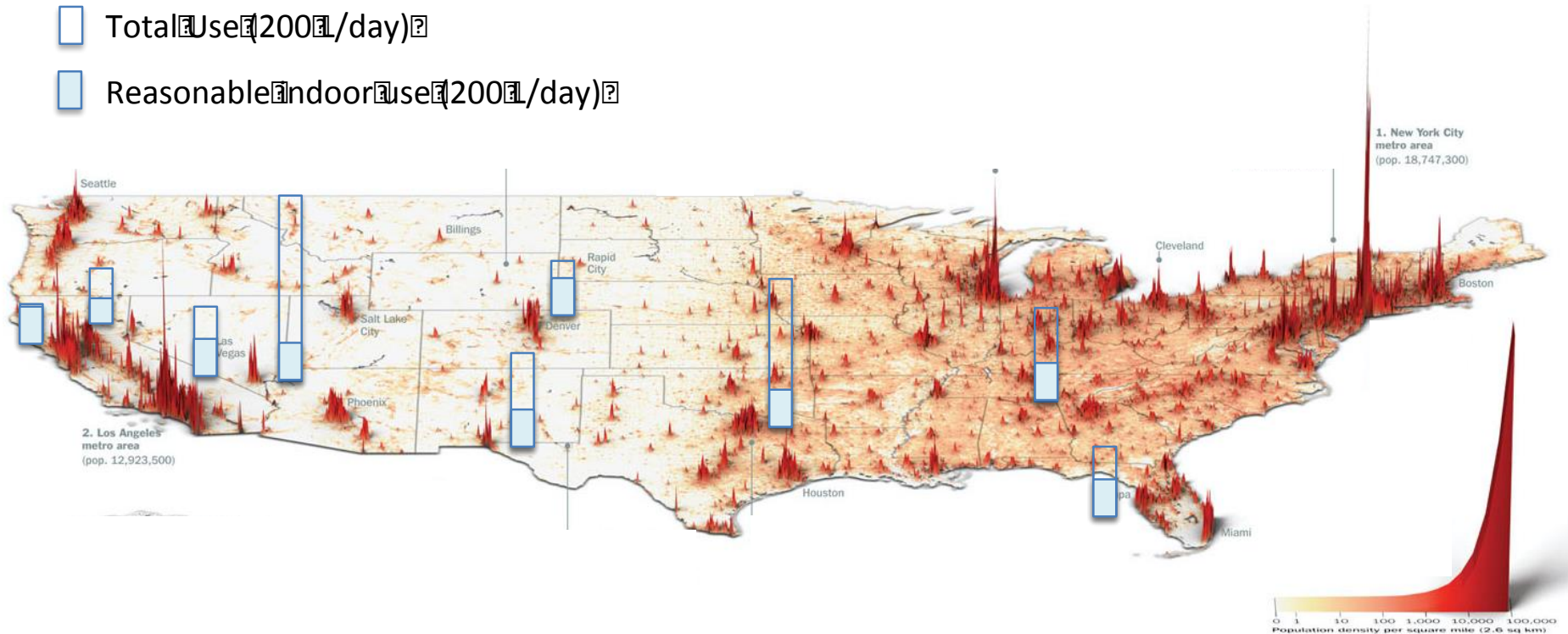
Per Capita Water Use



ReNUWIt
Re-inventing the Nation's

☐ Total Use (2001/day)

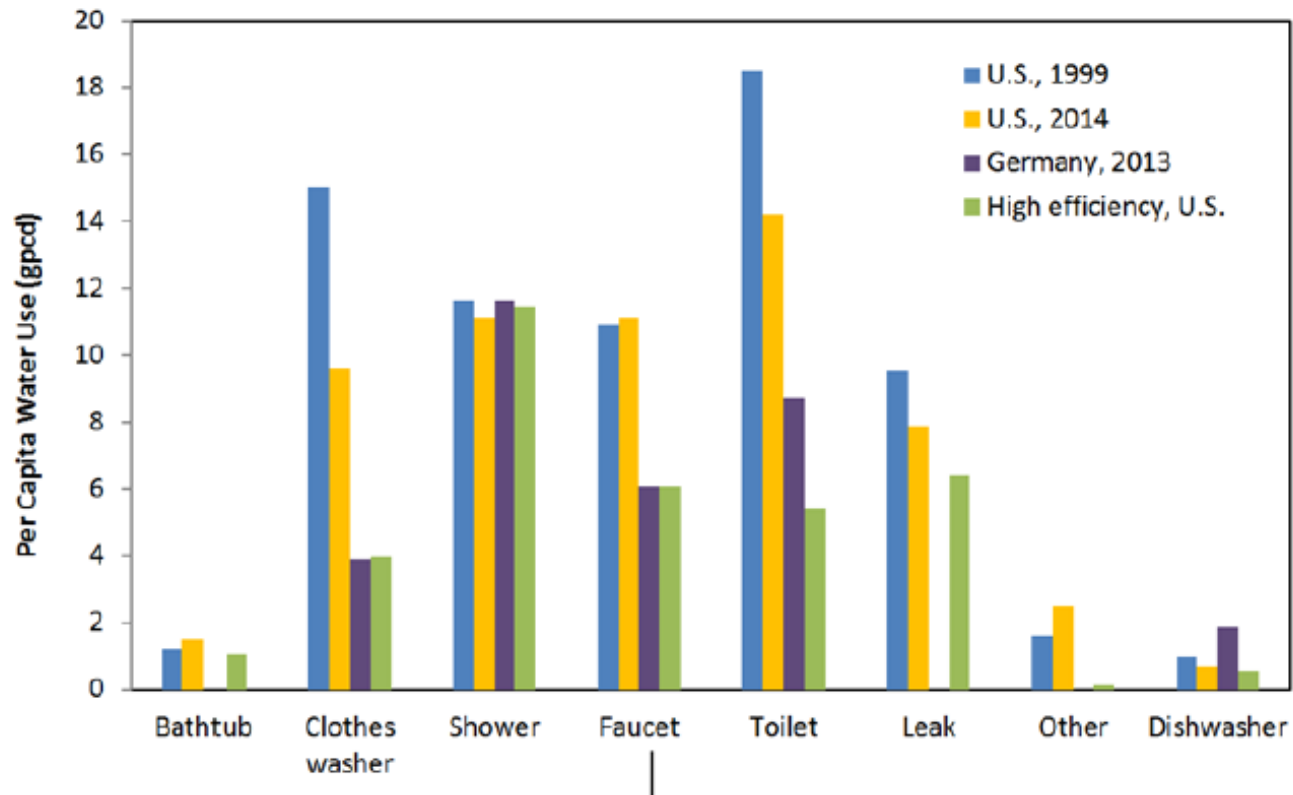
☐ Reasonable Indoor Use (2001/day)



<http://www.thefunctionalart.com>



Indoor Water Use



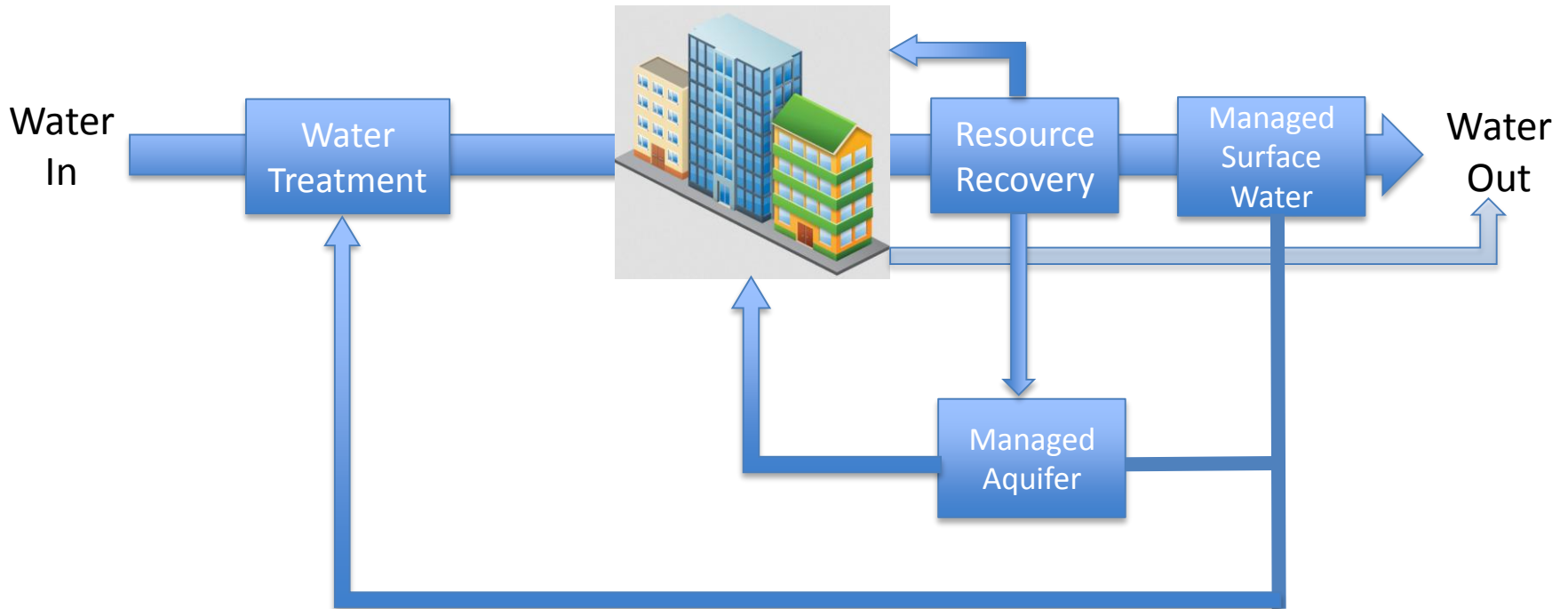
NRC (2016)



Water 4.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

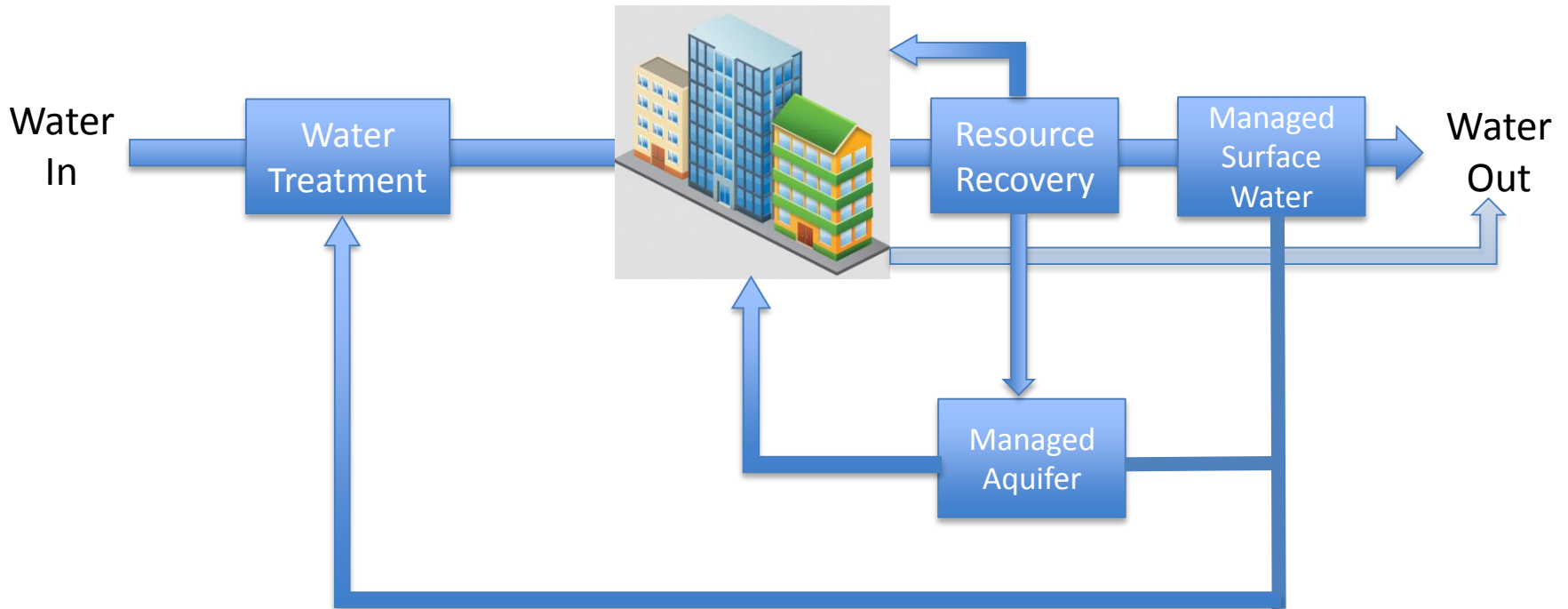




Water 5.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

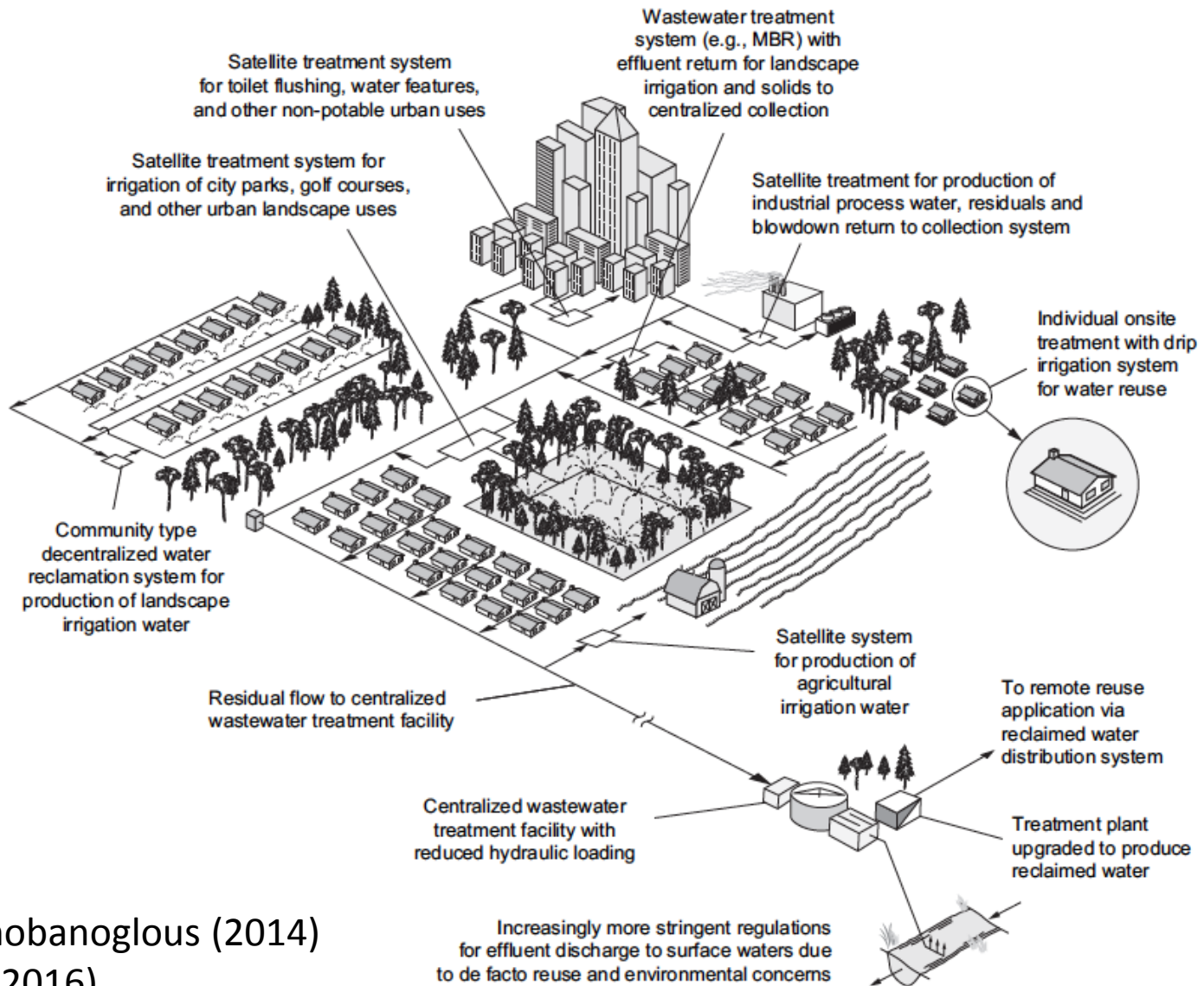




Distributed Water Reuse



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



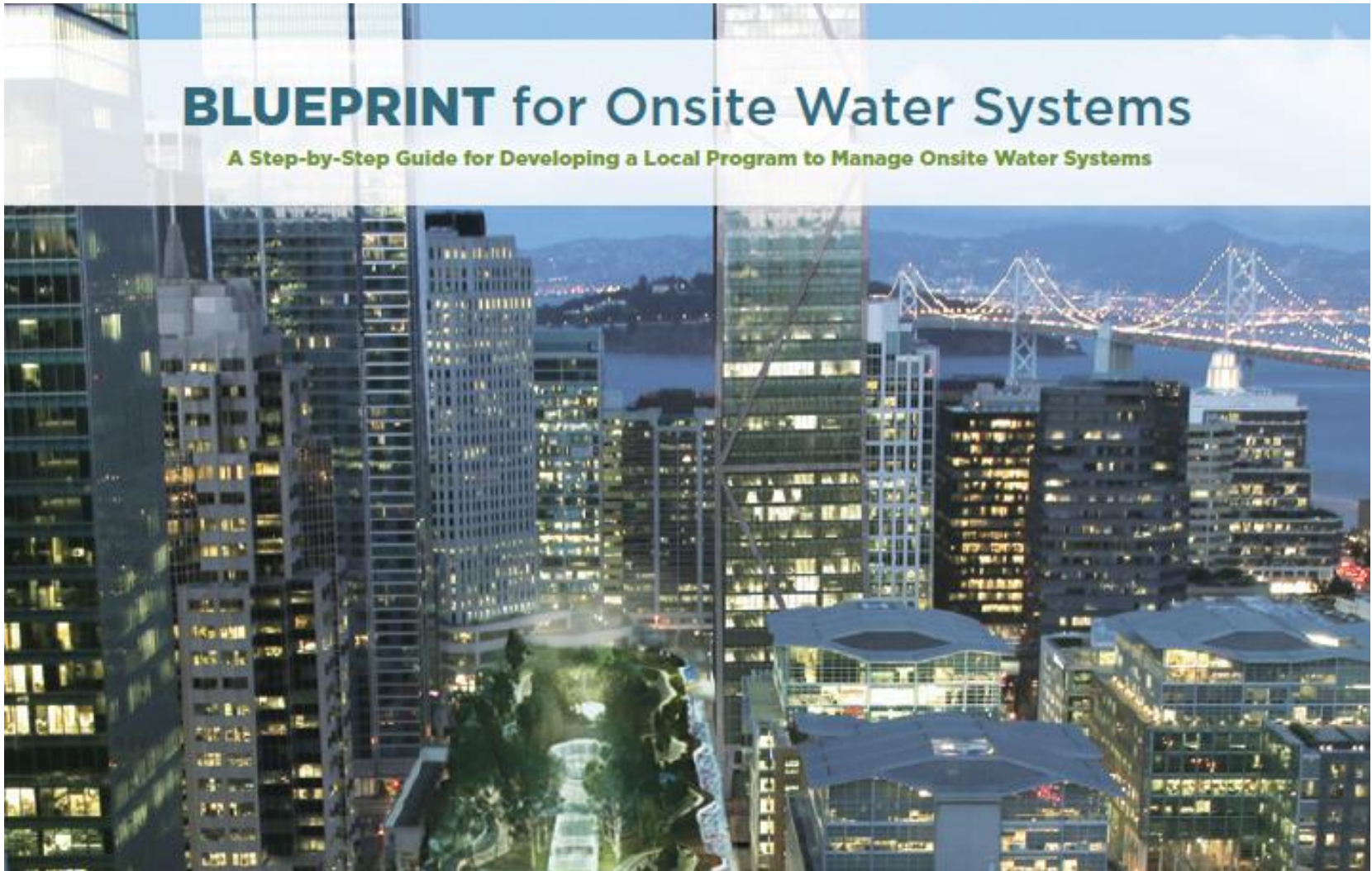
Gikas and Tchobanoglous (2014)
Larsen et al. (2016)



Distributed Water Reuse



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



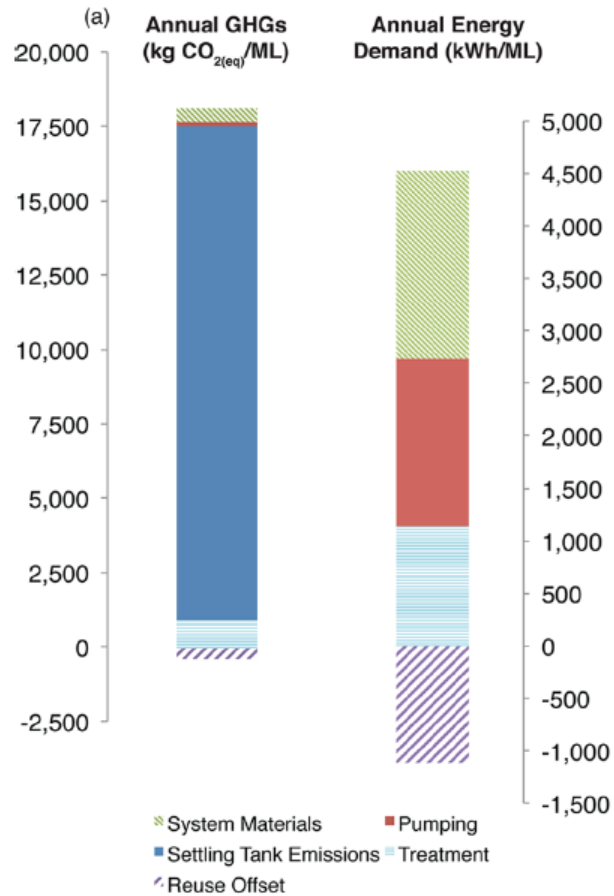
SFPUC (2014)



GHG Emissions & Energy



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



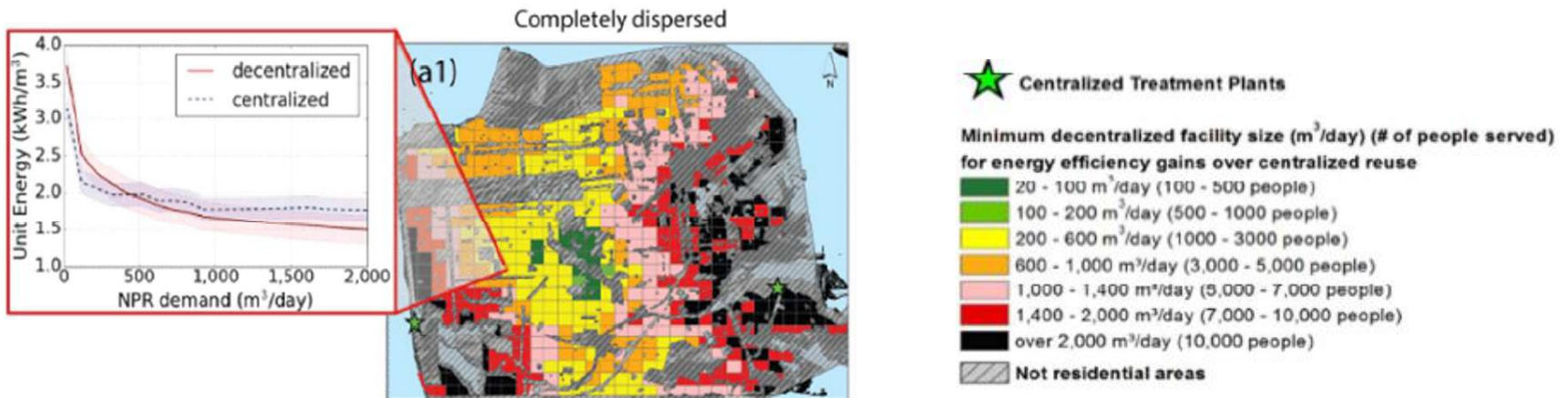
Hendrickson et al. (2015)



Spatial Analysis



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

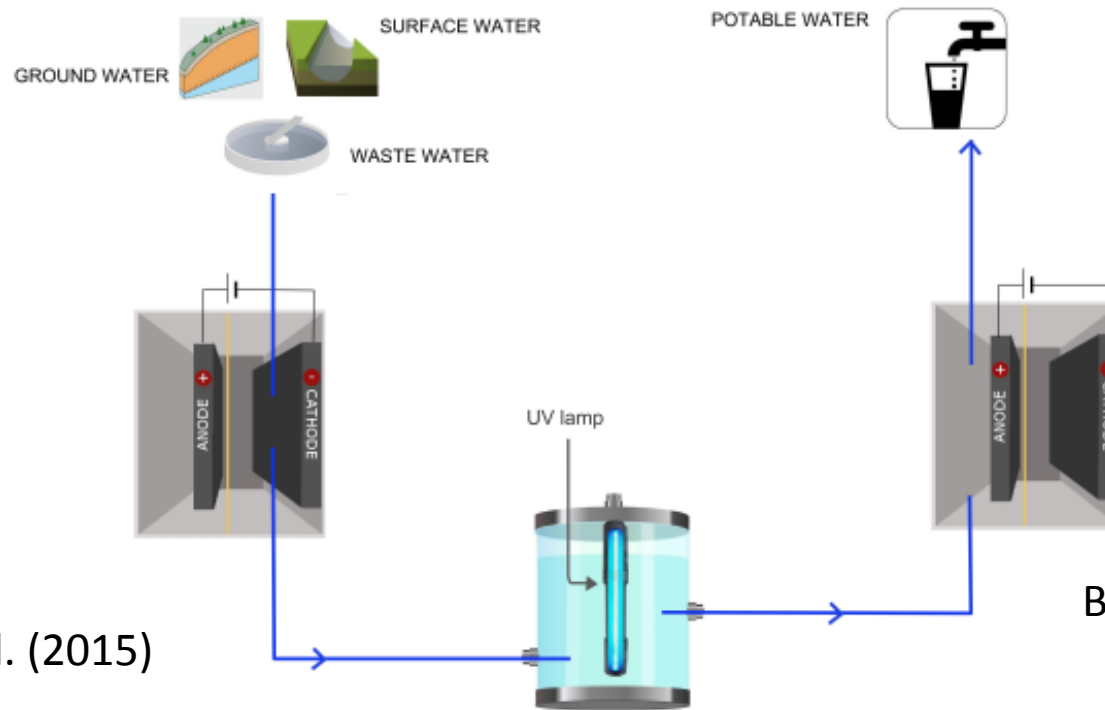




Better POE/POU Treatment



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE



Barazesh et al. (2015)

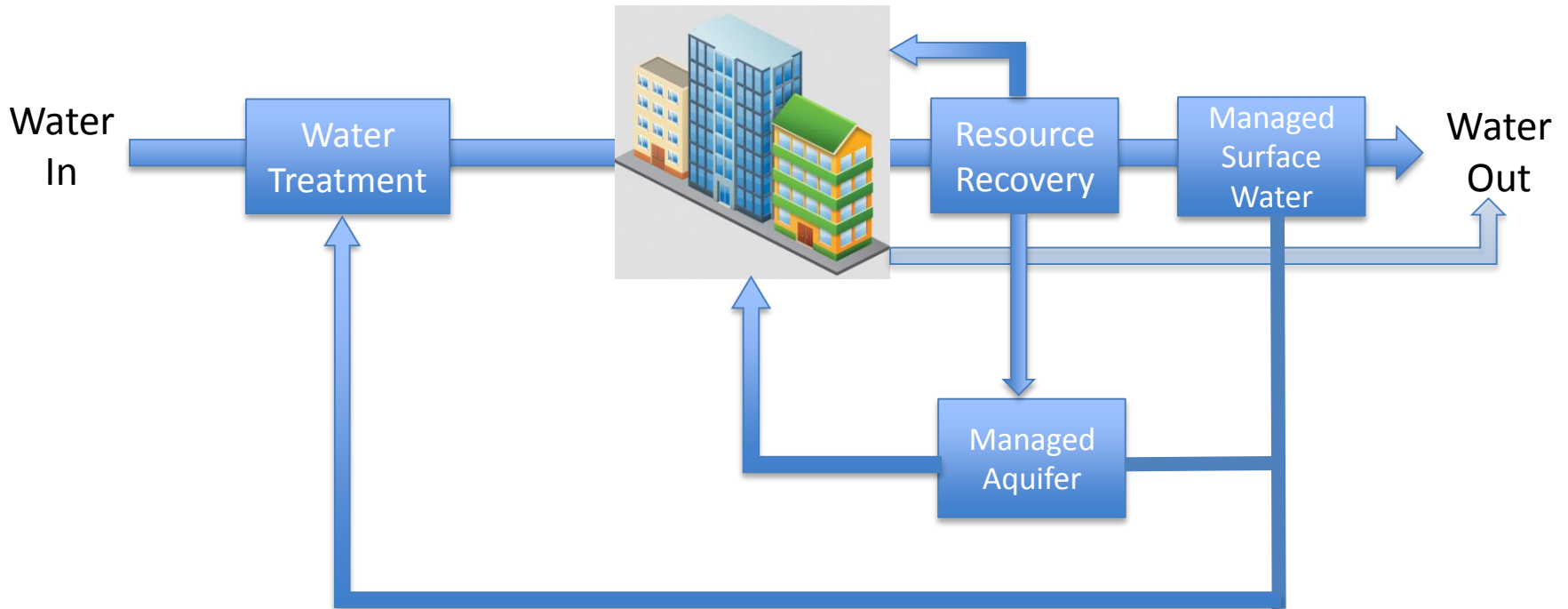
Barazesh et al. (2016)



Water 5.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE

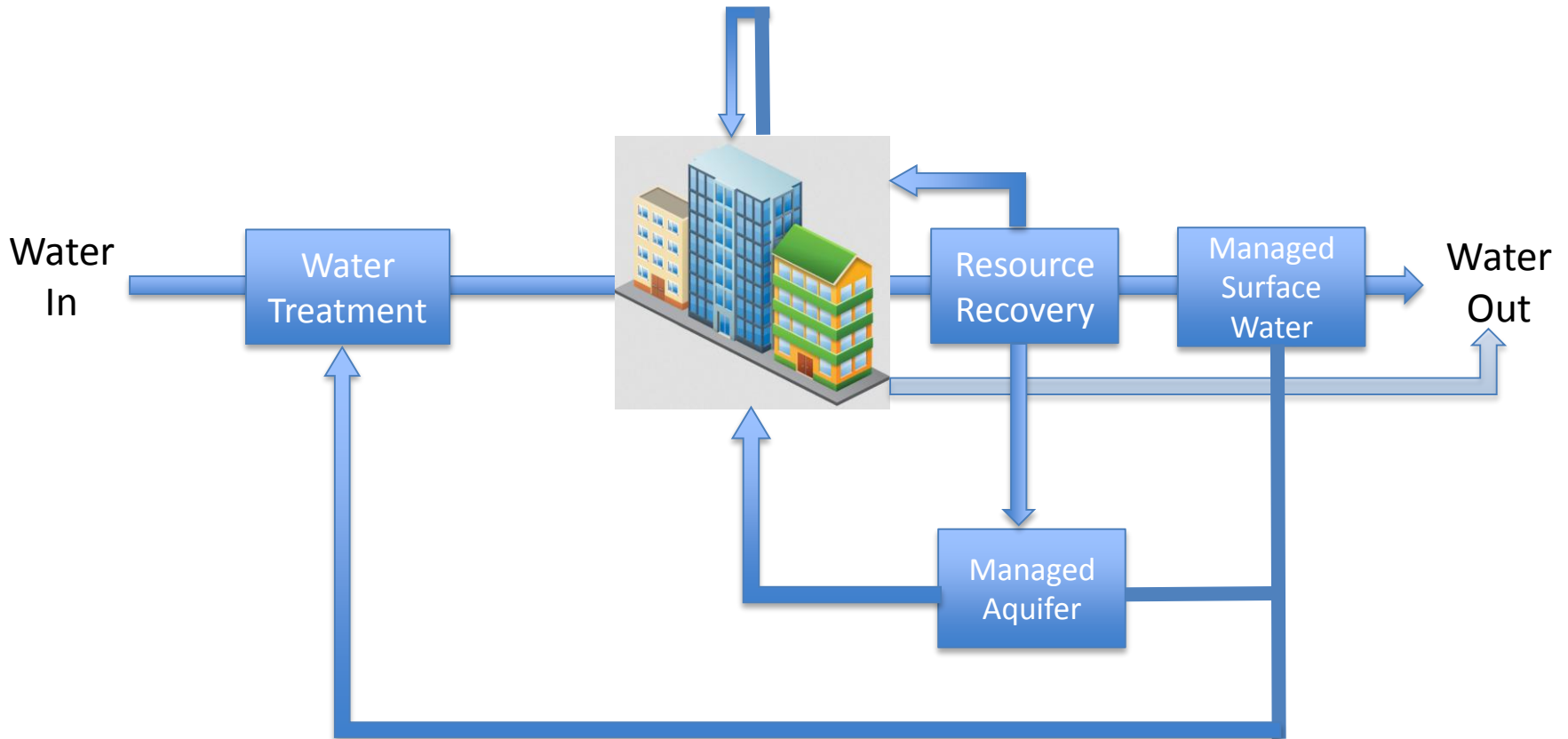




Water 5.0



ReNUWIt
Re-inventing the Nation's
URBAN WATER
INFRASTRUCTURE





Final Thoughts

Water 4.0 is Underway in Thirsty Cities

- Regional Differences
- Research Opportunities
- Centralized Infrastructure Risks



ReNUWIt

Re-inventing the Nation's
**URBAN WATER
INFRASTRUCTURE**

www.renuwit.org



Final Thoughts



ReNUWIt

Re-inventing the Nation's

**URBAN WATER
INFRASTRUCTURE**

www.renuwit.org

Water 4.0 is Underway in Thirsty Cities

- Regional Differences
- Research Opportunities
- Centralized Infrastructure Risks

Water 5.0 is a Work in Progress

- Outdoor Water Conservation
- Indoor Water Efficiency
- Onsite Reuse: Where and How?