Stockholm World Water Week

Applying a Water Lens to the Circular Economy

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Jon Brigg	Innovation Manager	Yorkshire Water

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Overview

- The Water Cycle and the Circular Economy
- Governance
- Innovation and Practical Applications
- Conclusions

Water Cycle and the Circular Economy

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What is the Circular Economy?

"A circular economy is an industrial system that is restorative or regenerative by intention and design. It replaces the end-of-life concept with restoration, shifts towards the use of renewable energy, eliminates the use of toxic chemicals, which impair reuse and return to the biosphere, and aims for the elimination of waste through the superior design of materials, products, systems and business models."

World Economic Forum

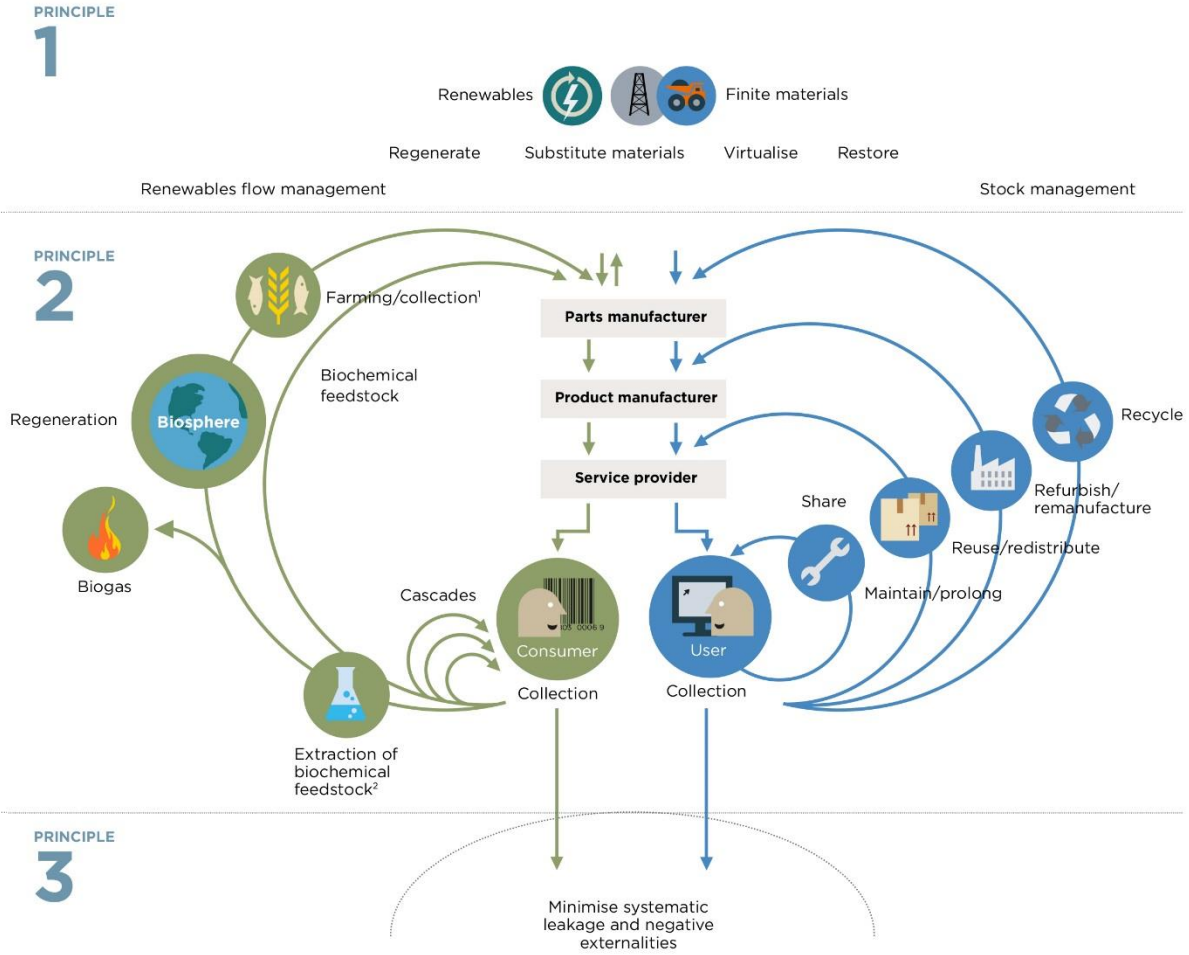
The Circular Economy Butterfly Diagram

The circular economy is built around three key principles:

Preserving and enhancing natural capital by controlling finite stocks and balancing renewable resource flows

Optimising resource yields by circulating products (use of renewables, recycling, re-use, better maintenance of products, sharing products)

Fostering system effectiveness by designing out negative externalities (waste which cannot be used).

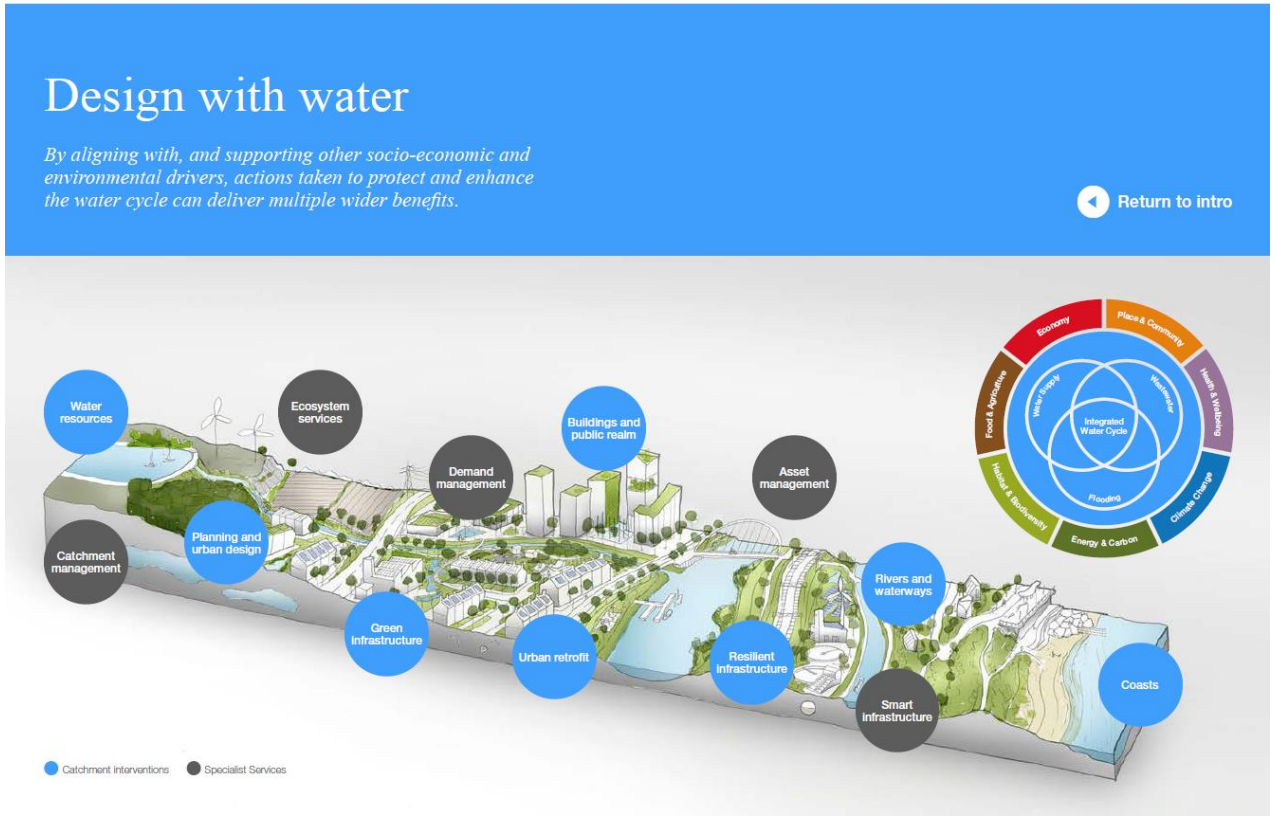


A Circular Economy characterisation
(source Ellen MacArthur Foundation 2016)

Water Cycle and Circular Economy

- The Water Cycle is a system ripe for Circular Economy thinking
- Focusing on the Water Cycle (Urban and Catchment) can enable and enhance discussions around Circular Economy at local, city and regional scales.
- Understanding the governance across the Water Cycle is important if we are going to maximise the value of Circular Economy thinking.
- How do we bring together the thinking on Water Cycle and Circular Economy concepts and frameworks?

Design with Water



1 in 4 cities would see a positive return on investment from investing in watershed conservation

Developing language:

Reduce
Recycle
Reuse
Share
Regenerate
Refurbish
Resource (not waste)

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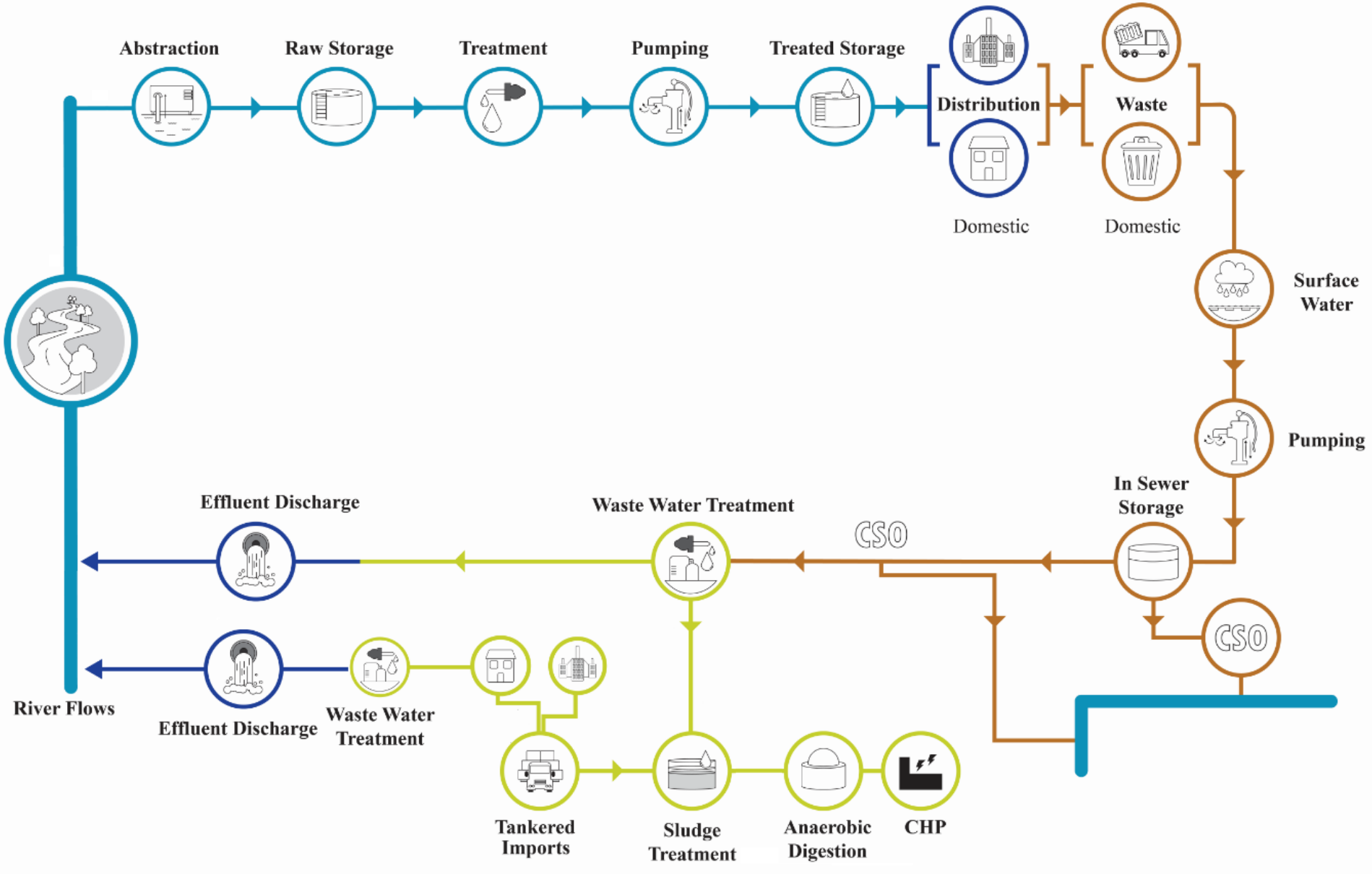
Food and agriculture

Agriculture uses around 70% of the world's freshwater supply and impacts on water quality and ecosystem health. Improved water efficiency in agricultural practice alongside new models of prodcution, such as urban agriculture, can increase food security and support water-sensitive landscape retrofit.


Abstraction
Raw Storage
Treatment
Pumping
Treated Storage
Distribution
Waste
Domestic
Domestic
Surface Water
Pumping
In Sewer Storage
CSO
CSO
Waste Water Treatment
Effluent Discharge
River Flows
Effluent Discharge
Waste Water Treatment
Tankered Imports
Sludge Treatment
Anaerobic Digestion
CHP

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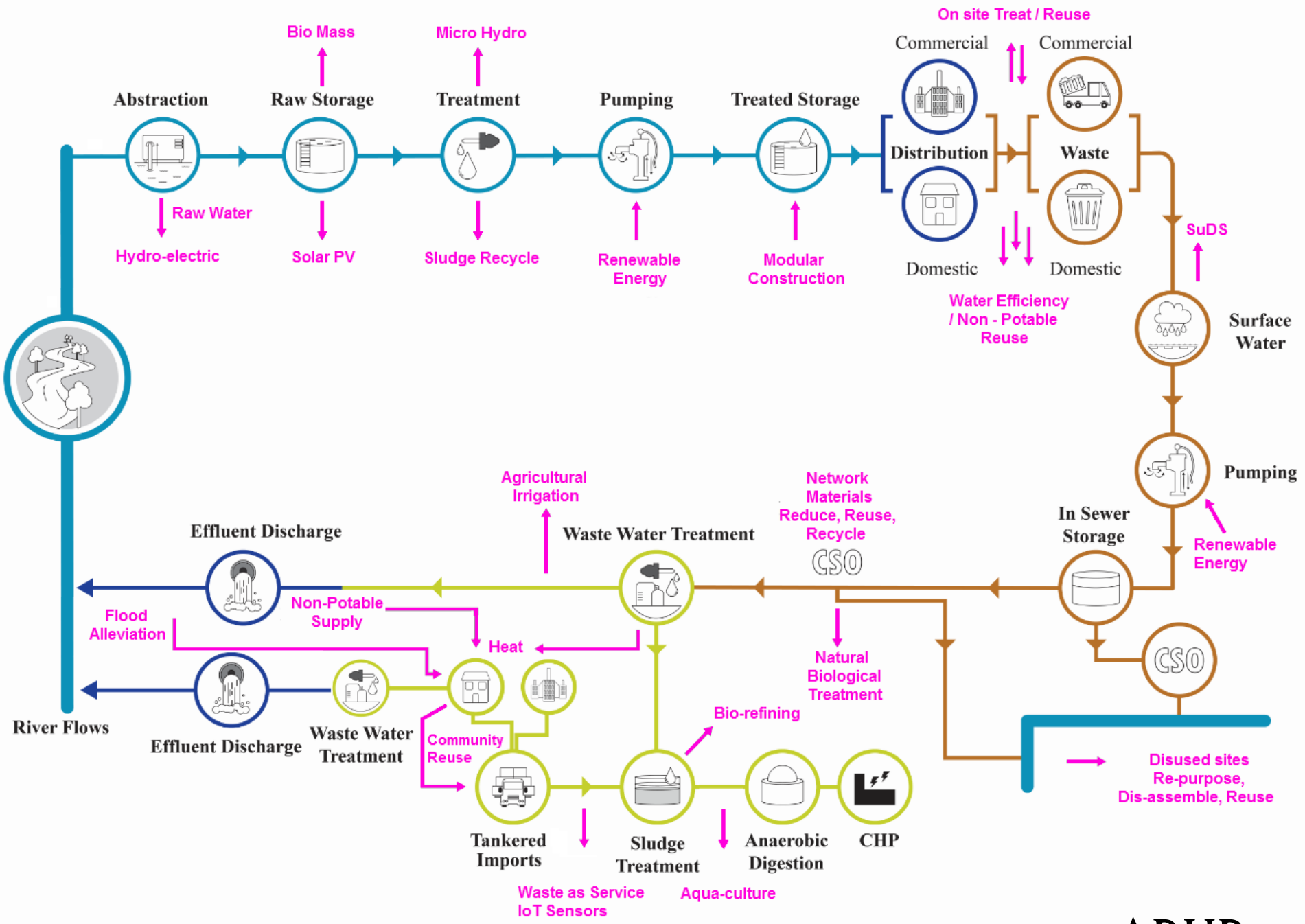
Bio Mass
Micro Hydro
On site Treat / Reuse
Commercial
Commercial
Abstraction
Raw Storage
Treatment
Pumping
Treated Storage
Distribution
Waste
Raw Water
Hydro-electric
Solar PV
Sludge Recycle
Renewable Energy
Modular Construction
Domestic
Domestic
Water Efficiency / Non - Potable Reuse
SuDS
Surface Water
Pumping
Renewable Energy
In Sewer Storage
Agricultural Irrigation
Network Materials Reduce, Reuse, Recycle
Effluent Discharge
Waste Water Treatment
CSO
Flood Alleviation
Non-Potable Supply
Heat
Natural Biological Treatment
CSO
River Flows
Effluent Discharge
Waste Water Treatment
Community Reuse
Bio-refining
Disused sites Re-purpose, Dis-assemble, Reuse
Tankered Imports
Sludge Treatment
Anaerobic Digestion
CHP
Waste as Service IoT Sensors
Aqua-culture

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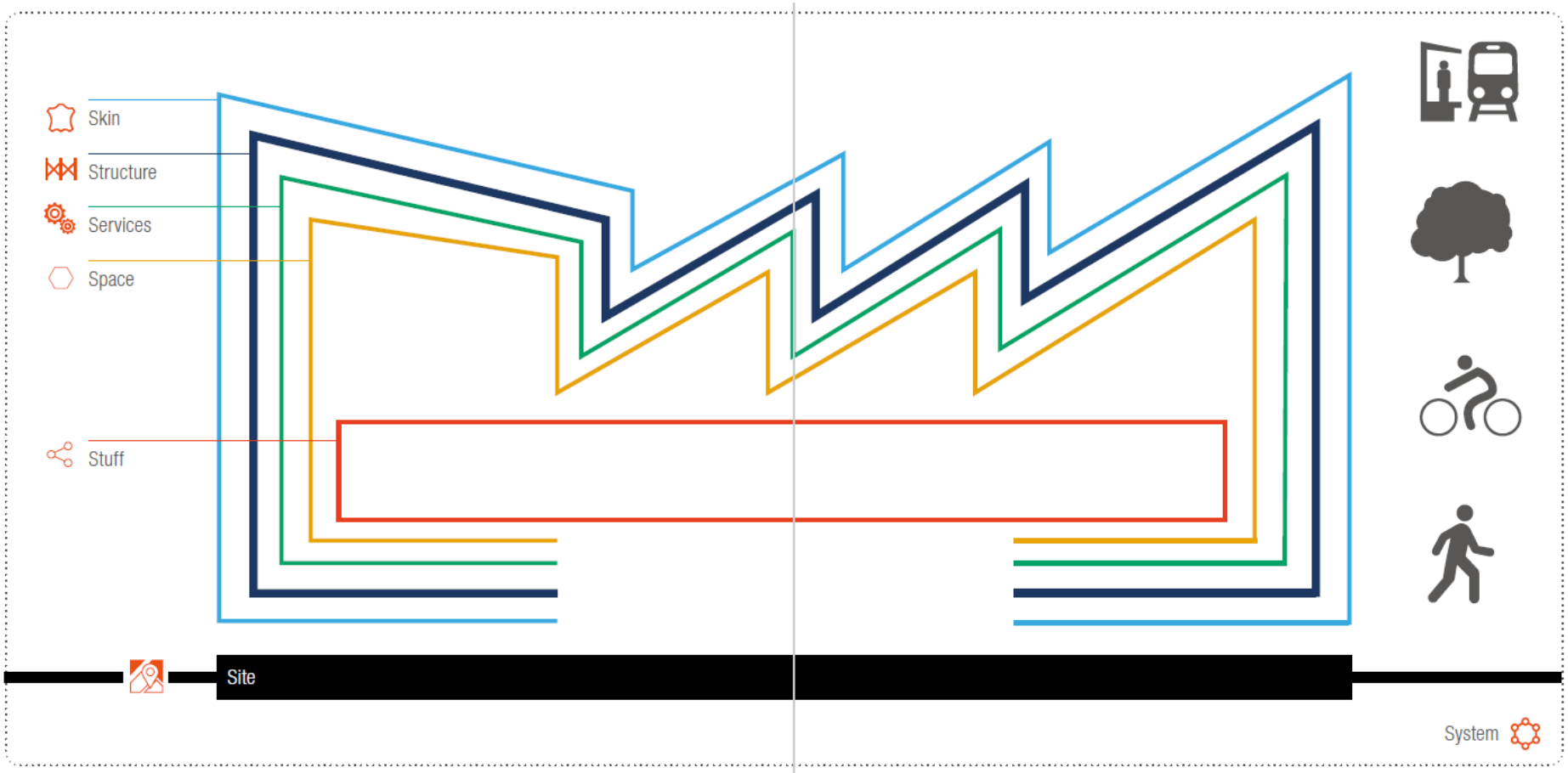
Circular Economy & Buildings - 7S Model



ReSOLVE

ReGENERATE

- Shift to renewable energy and materials
- Reclaim, retain, and restore health of ecosys- tems
- Return recovered biological resources to the biosphere

SHARE

- Share assets (e.g. cars, rooms, appliances)
- Reuse/secondhand
- Prolong life through maintenance, design for durability, upgradability, etc.

OPTIMISE

- Increase performance/efficiency of product
- Remove waste in production and supply chain
- Leverage big data, automation, remote sens- ing and steering

LOOP

- Remanufacture products or components
- Recycle materials
- Digest anaerobically
- Extract biochemicals from organic waste

VIRTUALISE

- Dematerialise directly (e.g. books, CDs, DVDs, travel)
- Dematerialise indirectly (e.g. online shop- ping)

EXCHANGE

- Replace old with advanced non-renewable materials
- Apply new technologies (e.g. 3D printing)
- Choose new product/service (e.g. multimodal transport)

Growth Within: A Circular Economy Vision for a Competitive Europe (2015) (source Ellen MacArthur Foundation, SUN and McKinsey Center for Business and Environment,. Based on S. Heck, M. Rogers, P. Carroll, Resource Revolution (2015)).

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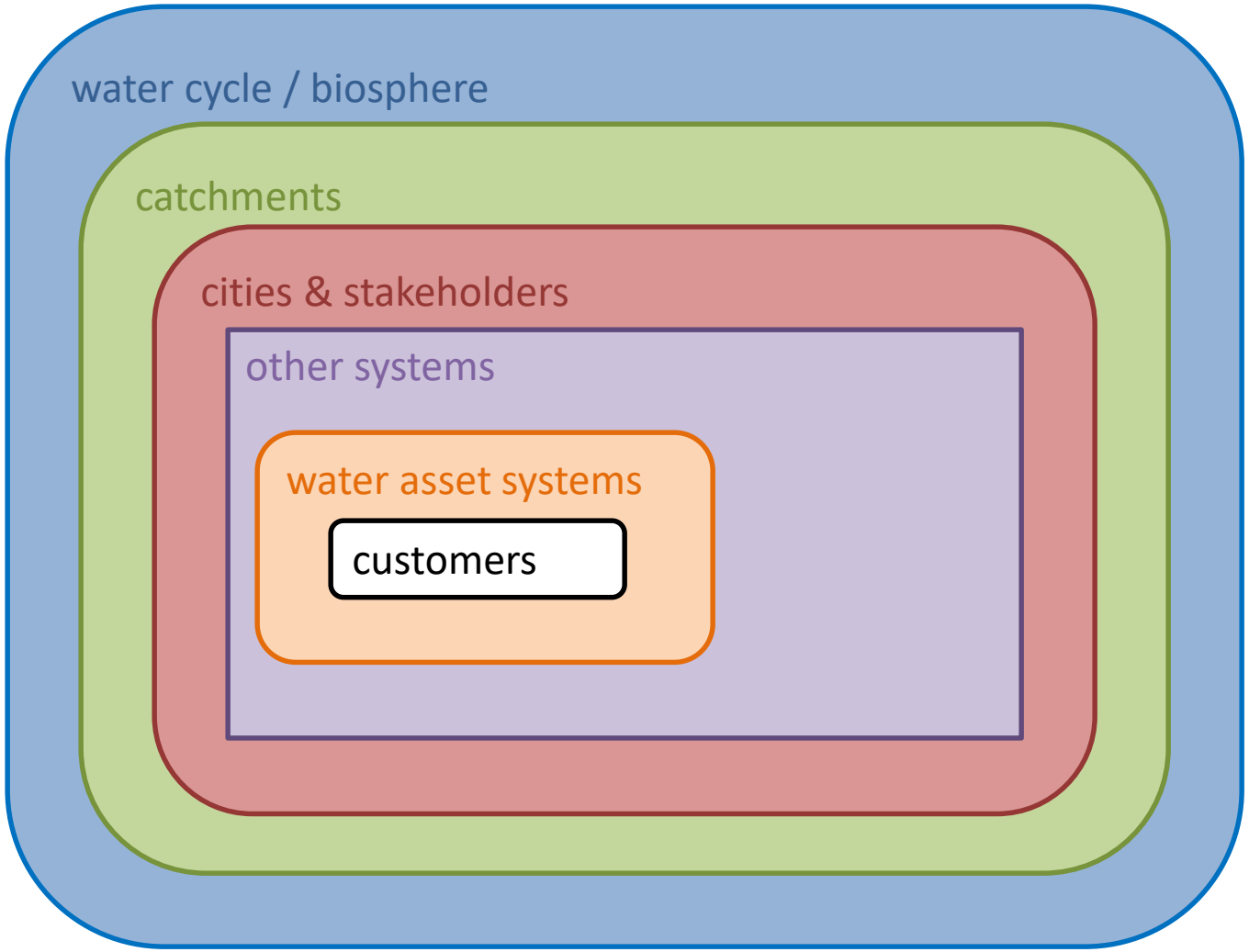
ReSOLVE Framework and 7S Model

7 S Model	Story for the lifecycle	Regenerate	Share	Optimise	Loop	Virtualise	Exchange
System	Long term stable ownership based in the third sector						
Site	Site to contribute to urban regeneration To be climate change resilient To contribute to biosphere regeneration						
Structures	Structure designed to last, facilitating flexibility and changes of use						
Skin	Skin will need to be replaced several times during building life. Replacement should be simple, safe, quick						
Services	To remain a sustainable icon, services will need to be upgraded regularly - think 'Living lab' not 'static monument.' Net-zero strategies in specification						
Space Plan	Space Plan to be as flexible (in terms of use and arrangement, in time and space) as possible, allowing maximum use through day and through life of building						
Stuff	Design for flexibility in use, maximise leasing, use of low-impact materials and ability to re-manufacture / replace items prone to wear						

Circular Economy & Water?



Governance

understand it better to make the most of Circular Economy thinking eg Yorkshire

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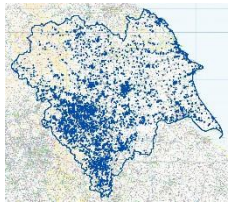
Governance across the Water Cycle eg Yorkshire



Yorkshire Water

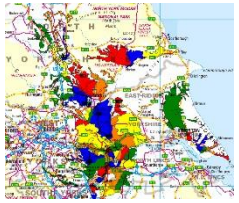
- Key assets types include: water and wastewater Treatment works, water distribution networks, sewerage, abstractions, pumping stations, outfalls and reservoirs.
- Geographical distribution of assets is fairly even across Yorkshire although there is a cluster in the Leeds-Bradford and Sheffield urban areas.

Environment Agency

- Involved in the natural components of the water cycle.
- Key assets include: flood defences, weirs, abstractions, pumping stations and reservoirs.
- Fairly even spread across Yorkshire with clusters of assets around areas liable to flood, e.g. lower Aire Valley and River Hull.

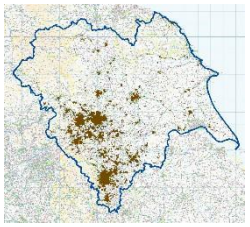
Canal & River Trust

- Key assets include: canals, locks, reservoirs and fish passes.
- Majority of the CRT assets are in the South of the county in fairly discrete corridors
- Historically distributed between trading towns in South & West Yorkshire and Lancashire.



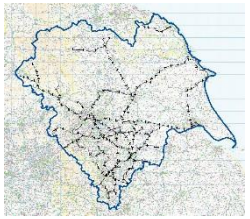
Internal Drainage Boards

- Key assets include: pumping stations (owned and/or operated).
- Map shows the area of responsibility of the Internal Drainage Boards.
- There are 42 IDBs within the Yorkshire Water area. Typically distributed through low lying areas, e.g. Vales of Mowbray, York, Pickering, and along River Hull



Local Authorities

- Key assets types include: highways drainage, pumping stations, outfalls and reservoirs.
- Majority of the assets are situated in the West and South of the Yorkshire region and in particular around the urban centres of Leeds, Bradford and Sheffield.



Network Rail

- Key assets include: railway drainage infrastructure.
- The assets are located along 1,387 km of railway lines, mainly in the West and South of the county in fairly discrete corridors.
- Network Rail (NR) core function is the management and maintenance of railways. Their influence on the water cycle is limited.

Highways Agency

- Key assets include: motorways and major trunk roads drainage infrastructure.
- The assets are located along 654 km of roads, mainly in the West and South Yorkshire in fairly discrete corridors.
- HA core function is the management and maintenance of roads. Their influence on the water cycle is limited.

Private Owners

- In addition there are a series of private owners of assets that may be of strategic interest.

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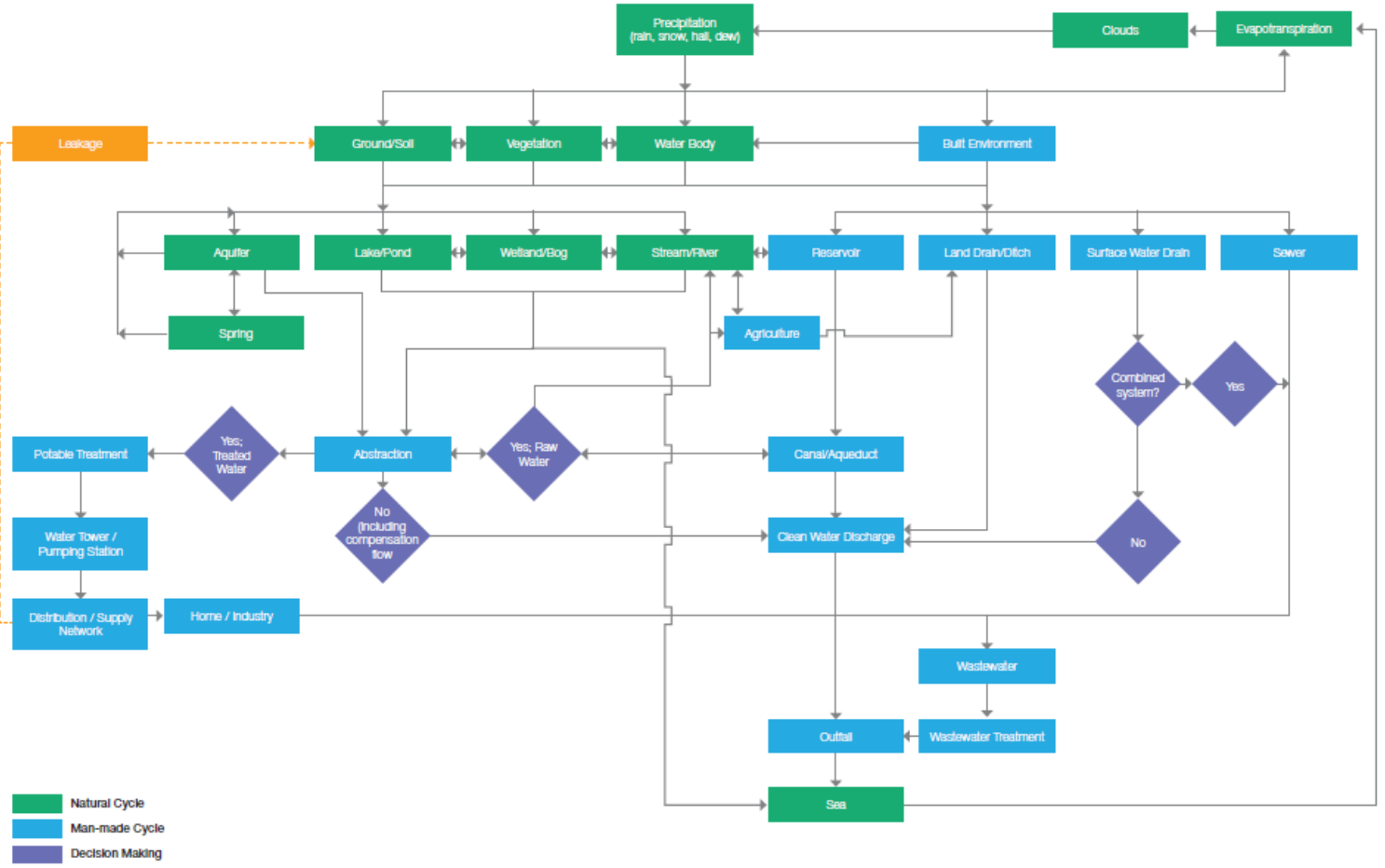
Governance: Water Cycle Flow Chart



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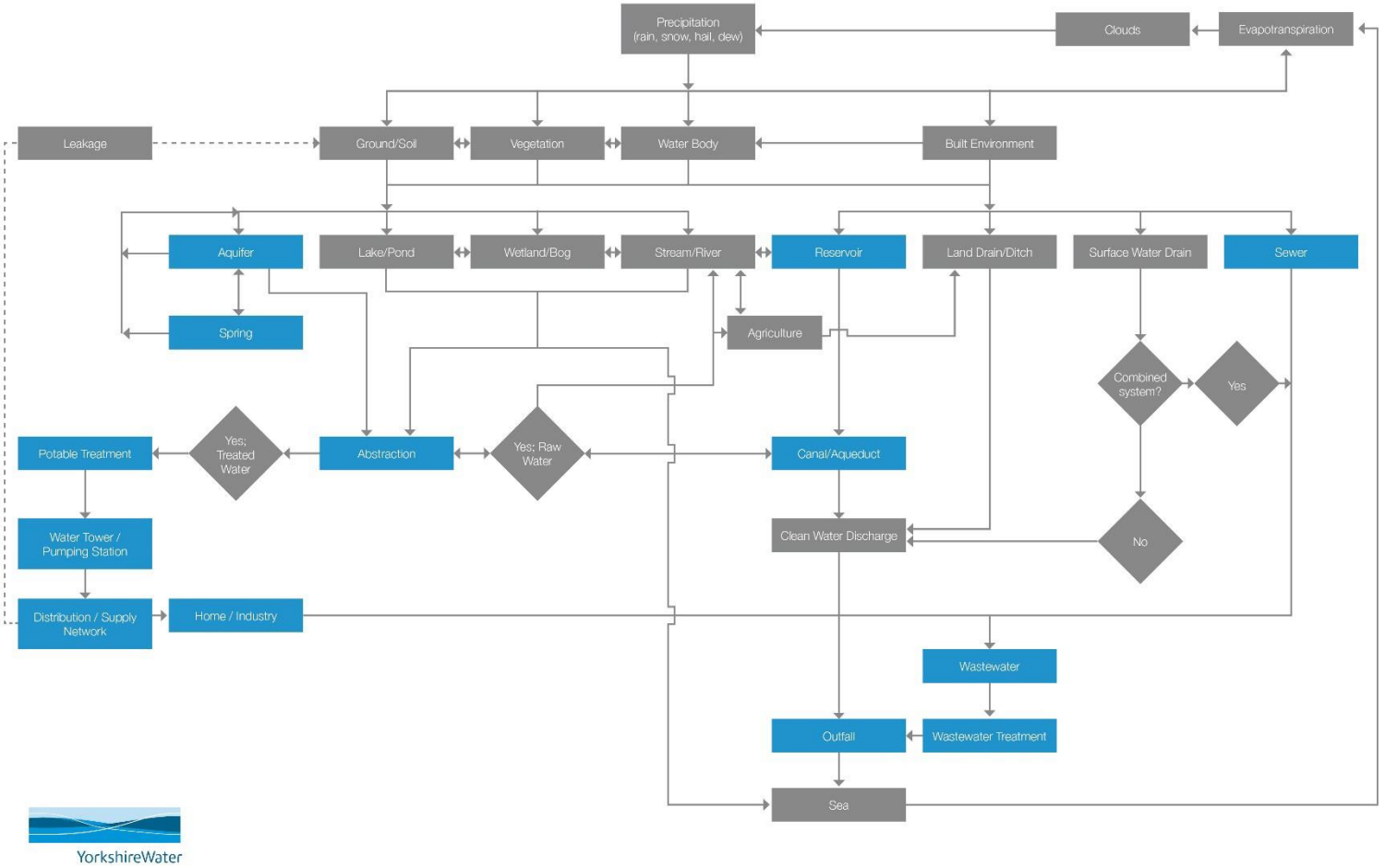
Governance: responsibility/management



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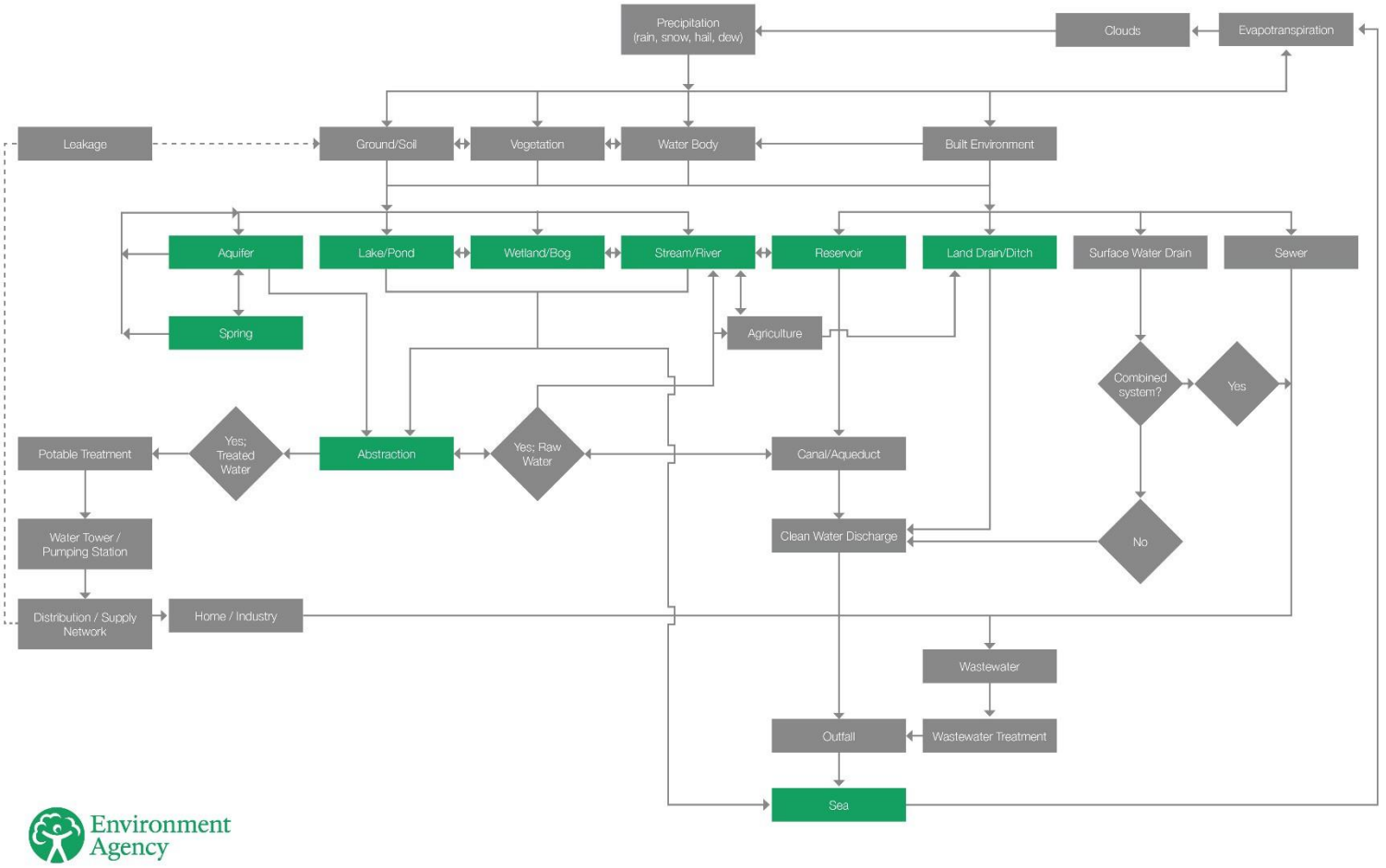

Environment Agency

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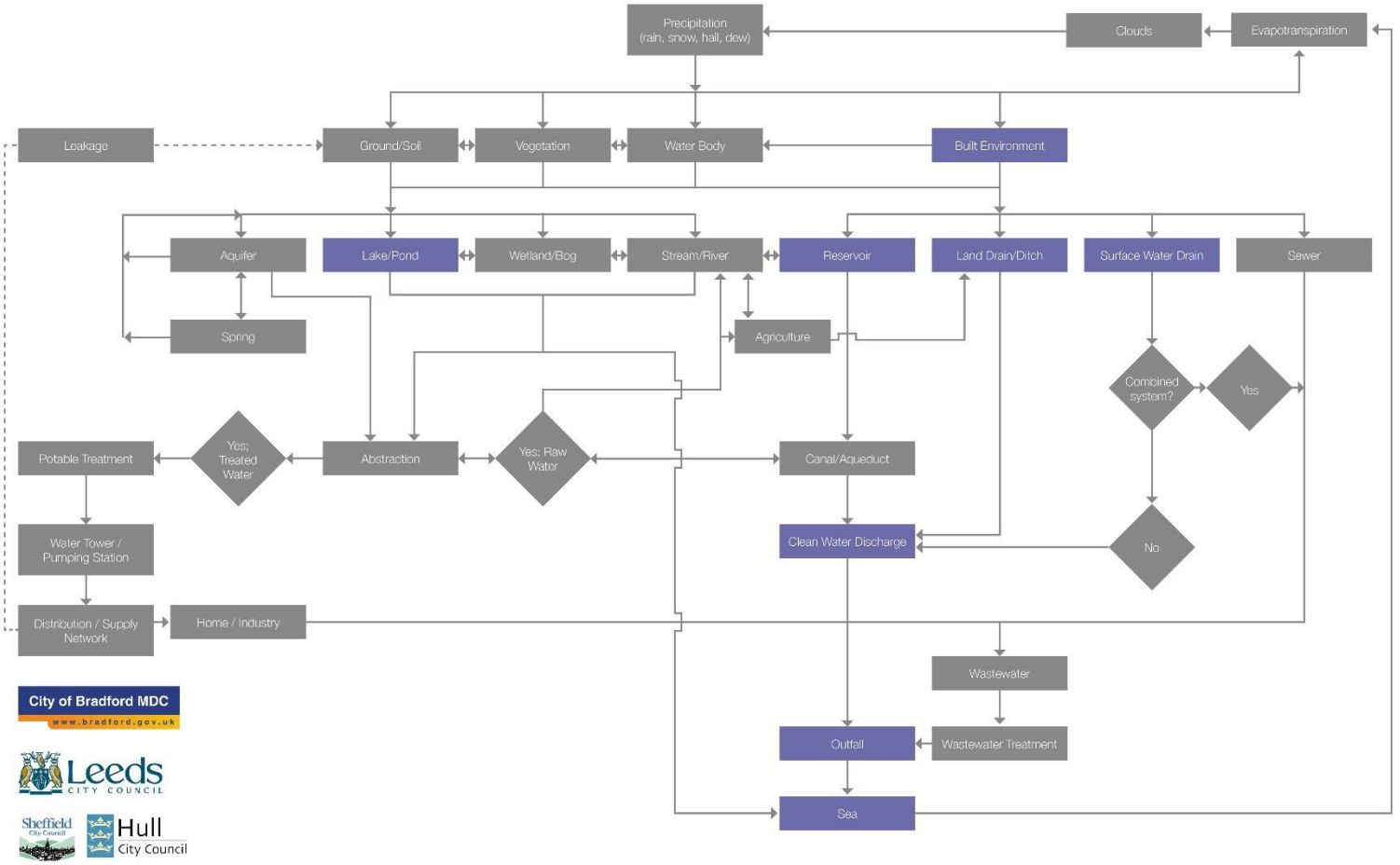
Governance: responsibility/management



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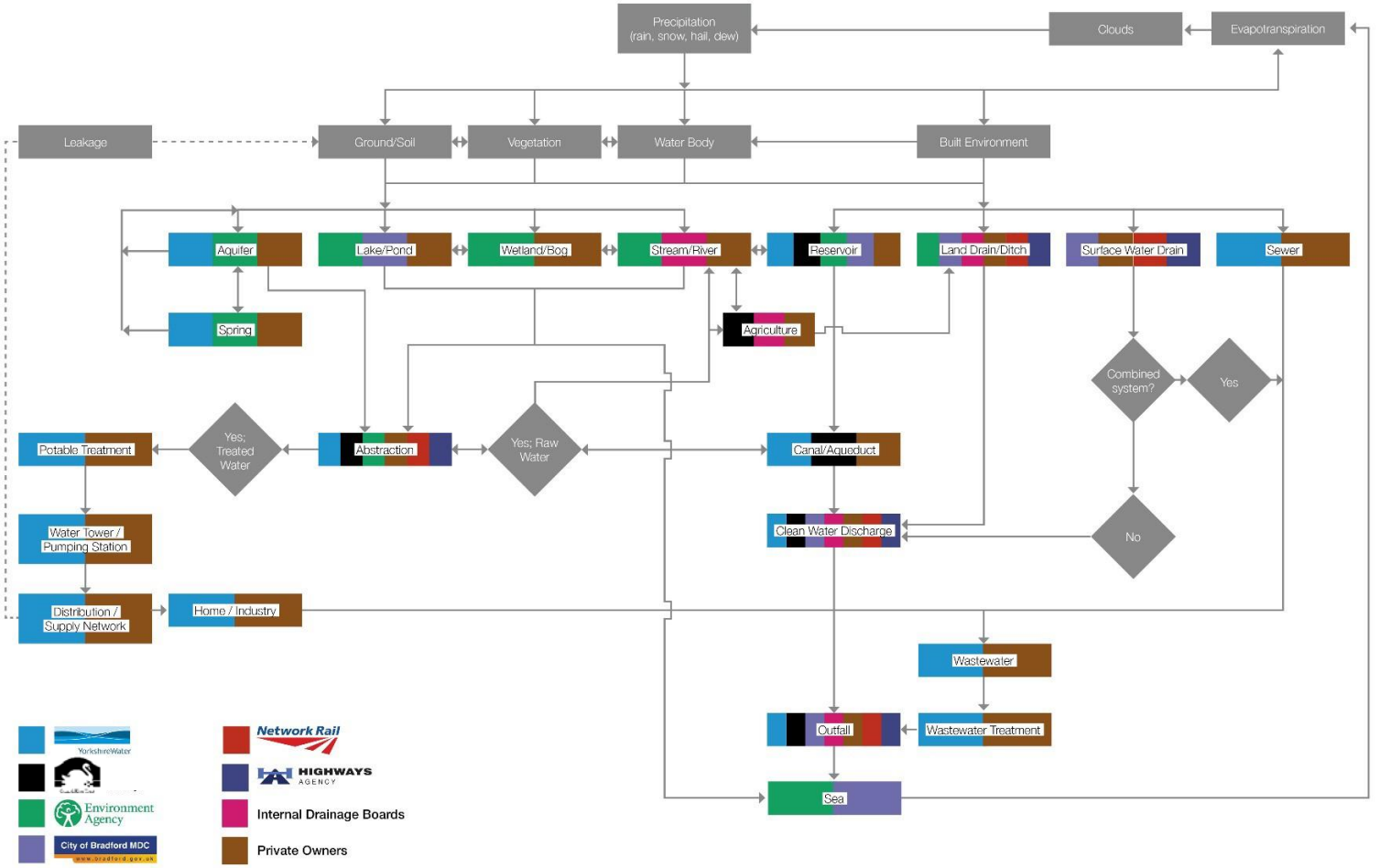
Governance: summary



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Innovation & Opportunity

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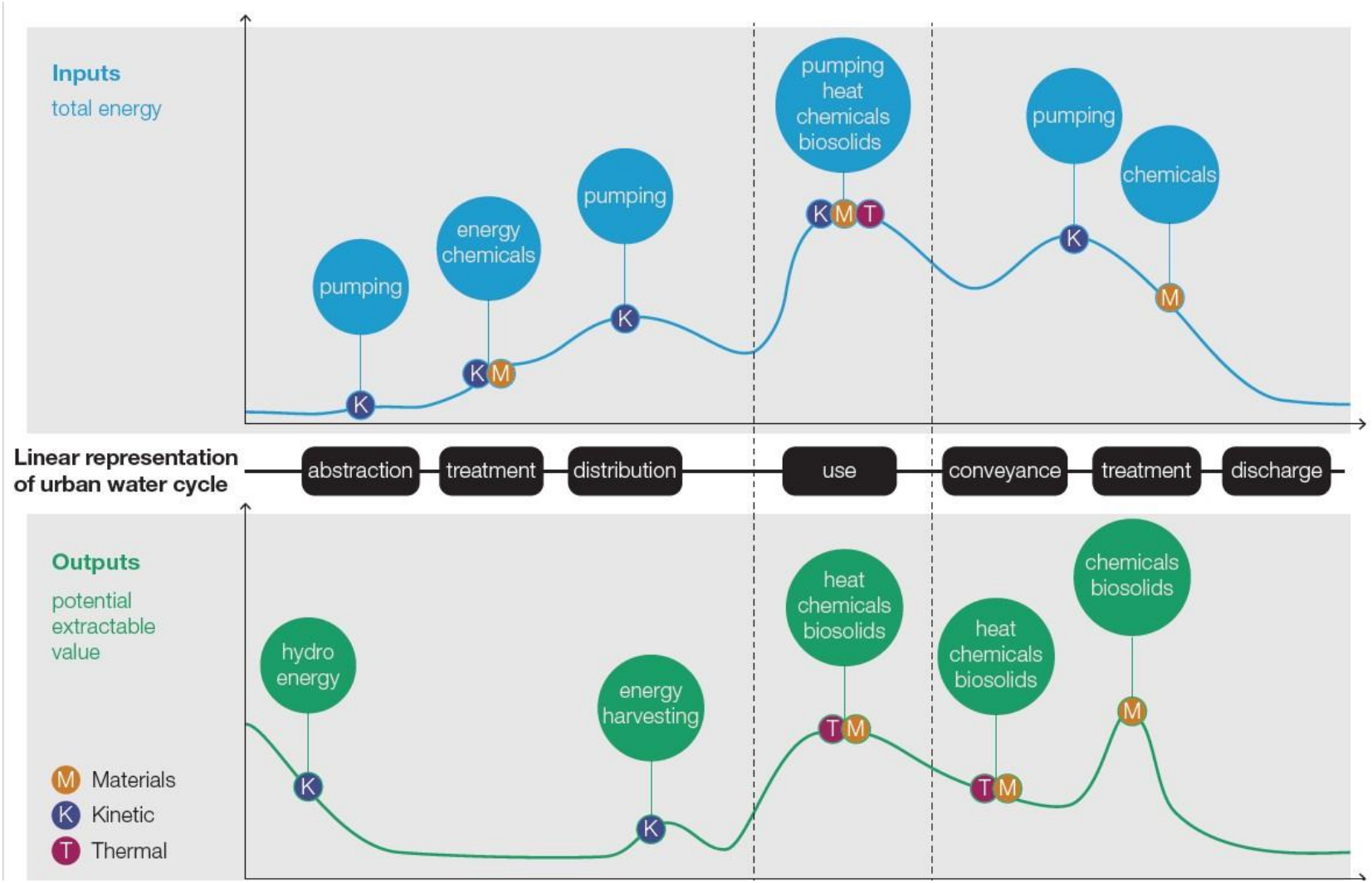
Energy + Materials in Municipal Water Cycle



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Heat Recovery from Sewers

- The Celsius City project - aimed at harvesting energy
- Funded with £20 million from the EU
- Will build heat exchangers to extract heat from water flushed down the drain.
- Demonstrating the technology using a series of heat exchangers in the sewer system in Cologne, Germany
- Harvest the heat for use in schools and gyms.
- The first plant - 1.2 million kilowatt hours in a year – enough to heat 70 family homes.

Cologne:
CELSIUS CITY

http://celsiuscity.eu/celsius-city/

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Veolia: A new way to make plastics

Bio-refining : Using wastewater as a feed stock to make plastics

In wastewater treatment plants in **Belgium, the Netherlands**, and **Denmark**, Anoxkaldnes, a subsidiary of Veolia, is running pilot prototyping for the production and recovery of **Polyhydroxyalkanoates (PHA)** – an intermediate material used to produce bioplastics.

Bioplastic derived from wastewater. Photo credit: Alkistis Kokorikou

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Del Monte: circular thinking for pineapples

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Yorkshire Water Innovation

'Circular Economy thinking makes good business sense'

Jon Brigg, Innovation Manager, Yorkshire Water

It's part of our Blueprint for Yorkshire

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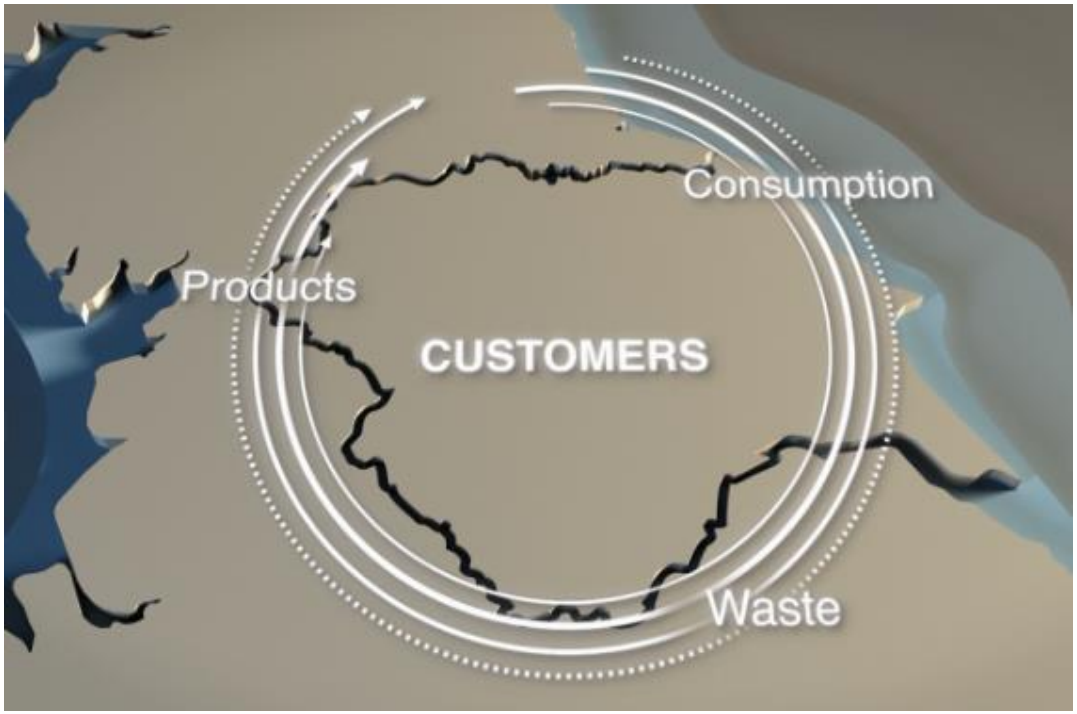
Esholt site for Circular Economy application



Yorkshire Water serve 5 million customers

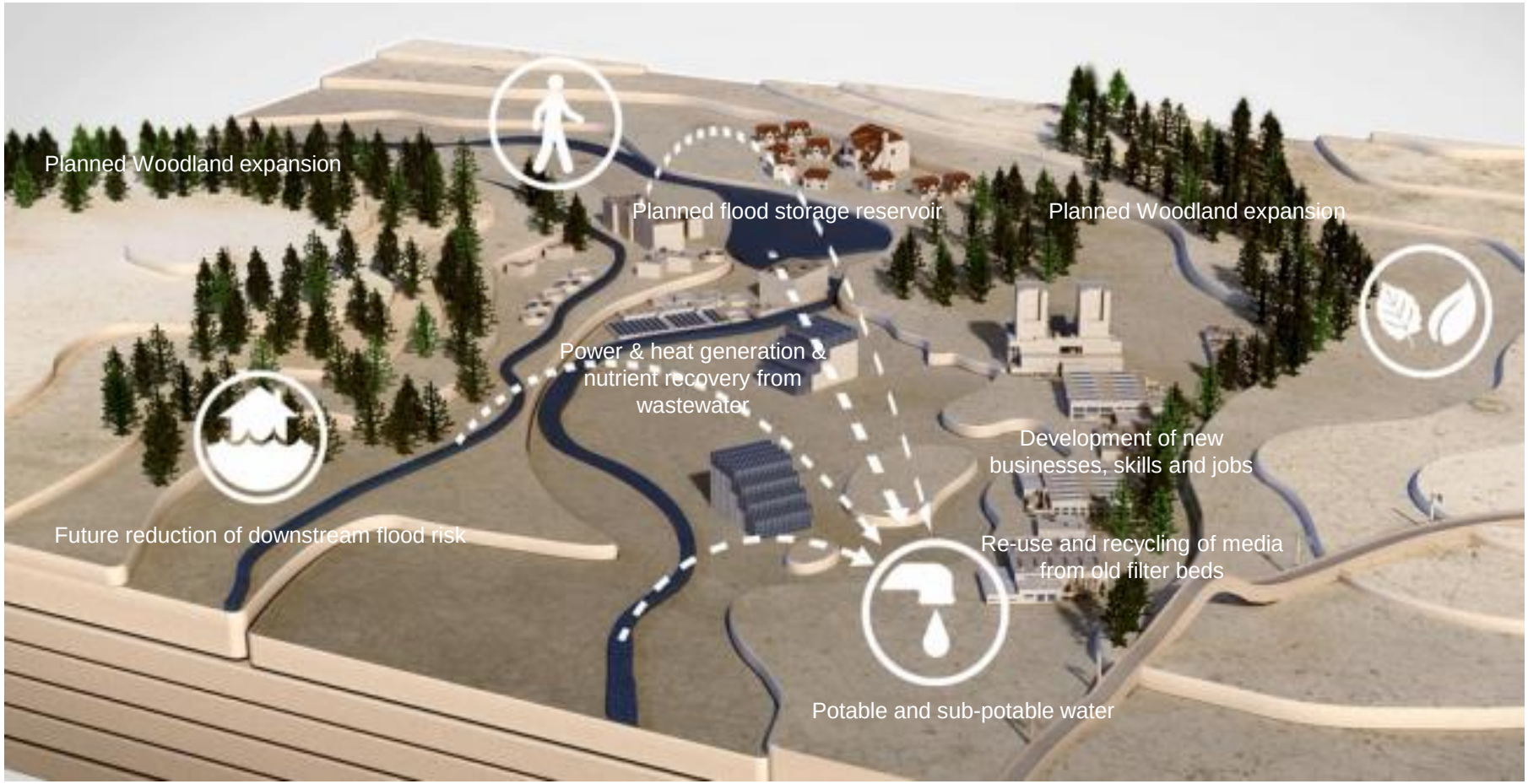
Esholt WwTW serves Bradford

Esholt site provides an opportunity to pilot ideas

Exploration of how circular economy thinking can provide benefit to customers, business and communities

It's part of our
Blueprint for Yorkshire

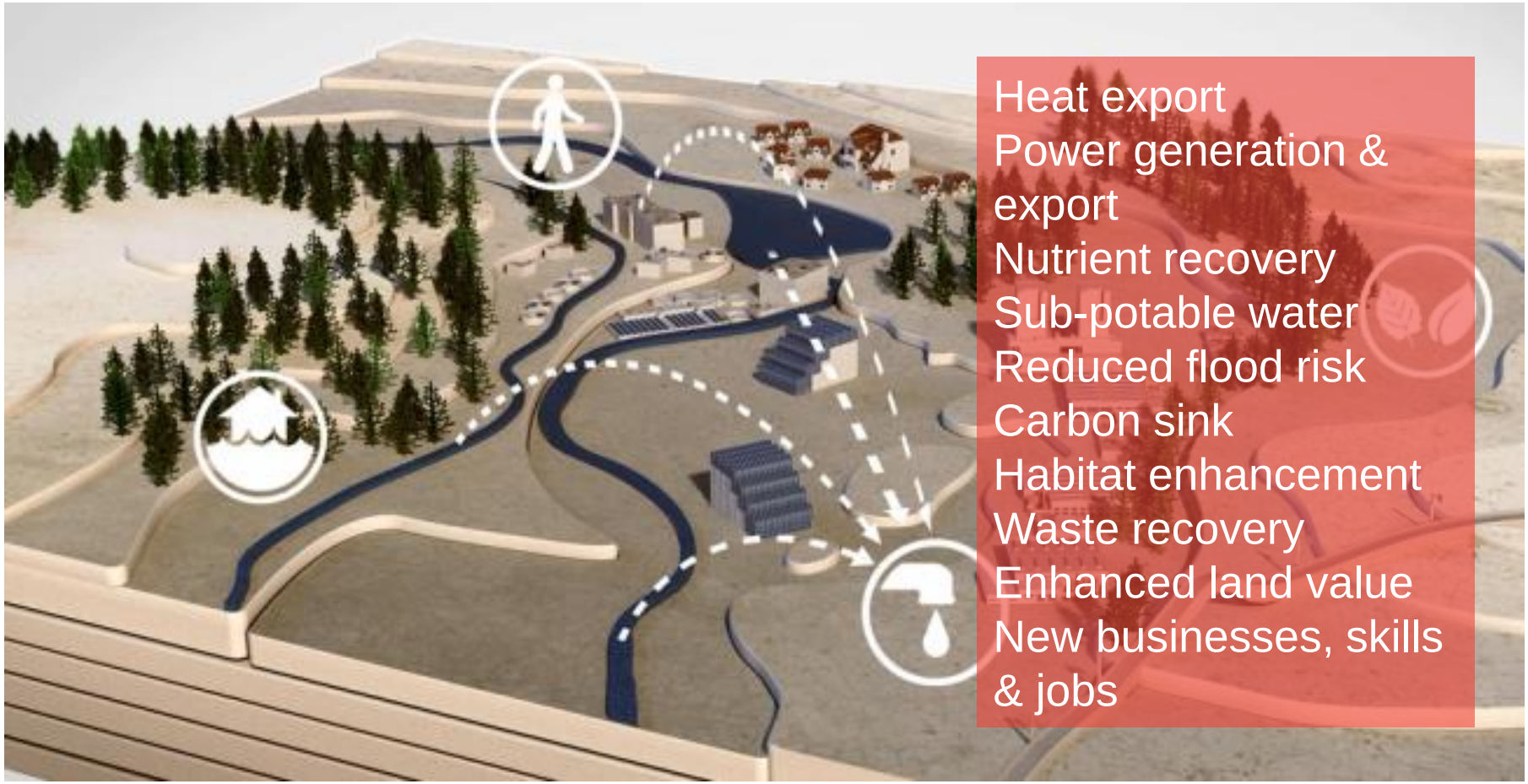
Esholt site for Circular Economy applications



It's part of our Blueprint for Yorkshire

Esholt site for Circular Economy applications

Current & Planned



It's part of our
Blueprint for Yorkshire

Esholt site for Circular Economy applications
Future

It's part of our
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Conclusions

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Conclusions

A. Think about applying circular economy thinking across the whole water cycle

B. Start using consistent language: Reduce, Reuse, Recycle, Share, Regenerate, Refurbish and Resource

C. Share more examples of what has worked – and what hasn't

D. Look across other applications of circular economy thinking in other sectors for insight and learning

E. Bring all the players across the water cycle on-board with the thinking and stimulate innovation through pilot/trial initiatives

F. Show the relevance of circular economy thinking to other emerging concepts eg Water-Wise Cities (IWA)

Relevance of Circular Economy to the IWA Principles for Water-Wise Cities

17 Principles

Replenish Waterbodies and Their Ecosystems	Reduce the Amount of Water and Energy Used	Reuse, Recover, Recycle
Use a Systemic Approach Integrated with Other Services	Increase The Modularity of Systems and Ensure Multiple Options	Enable Regenerative Water Services
Design Urban Spaces to Reduce Flood Risks	Enhance Liveability With Visible Water	Modify and Adapt Urban Materials to Minimise Environmental Impact
Plan to Secure Water Resources and Mitigate Drought	Protect the Quality of Water Resources	Prepare for Extreme Events
Empowered Citizens	Professionals Aware of Water Co-Benefits	Transdisciplinary Planning Teams
Policy Makers Enabling Water Wise Action	Leaders that Engage and Engender Trust	

4 Levels of Action

- Regenerative water services
- Water Sensitive Urban Design
- Basin Connected Cities
- Water-Wise Communities

Acknowledgments

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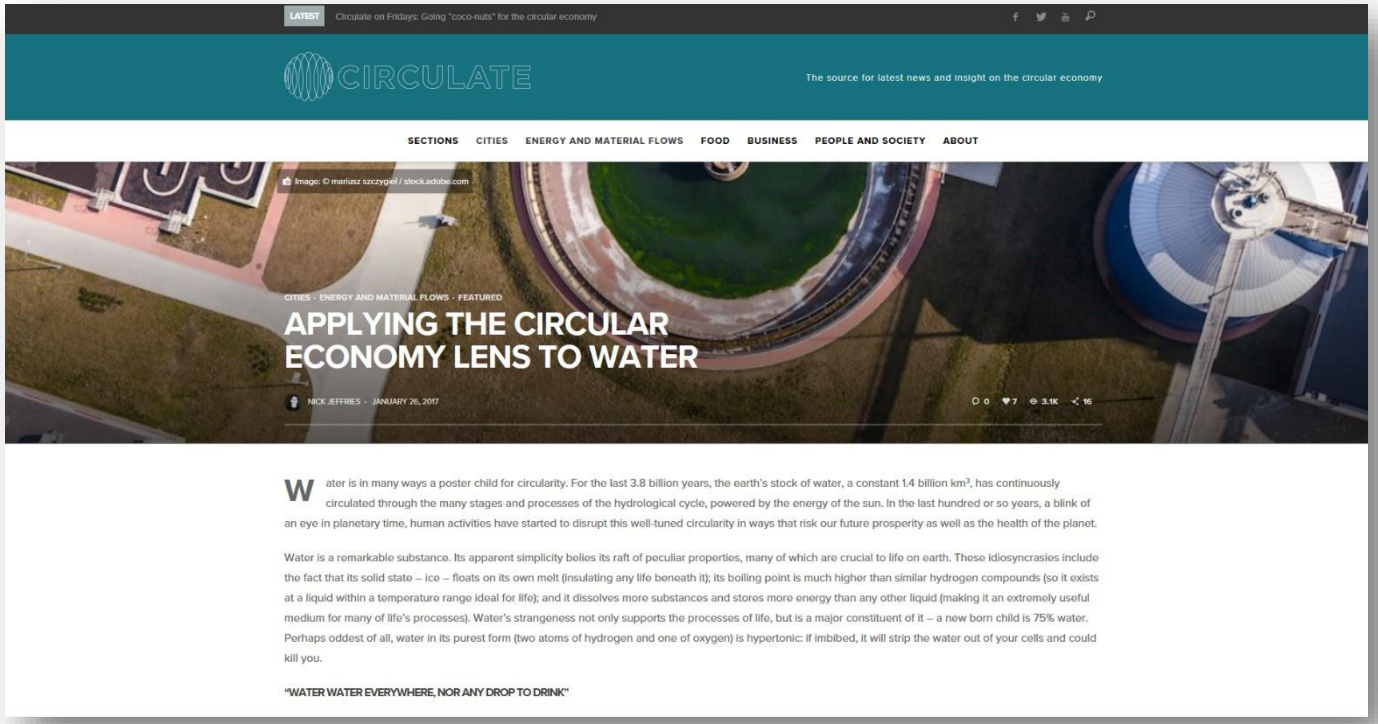
Article by EMF January 2017



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