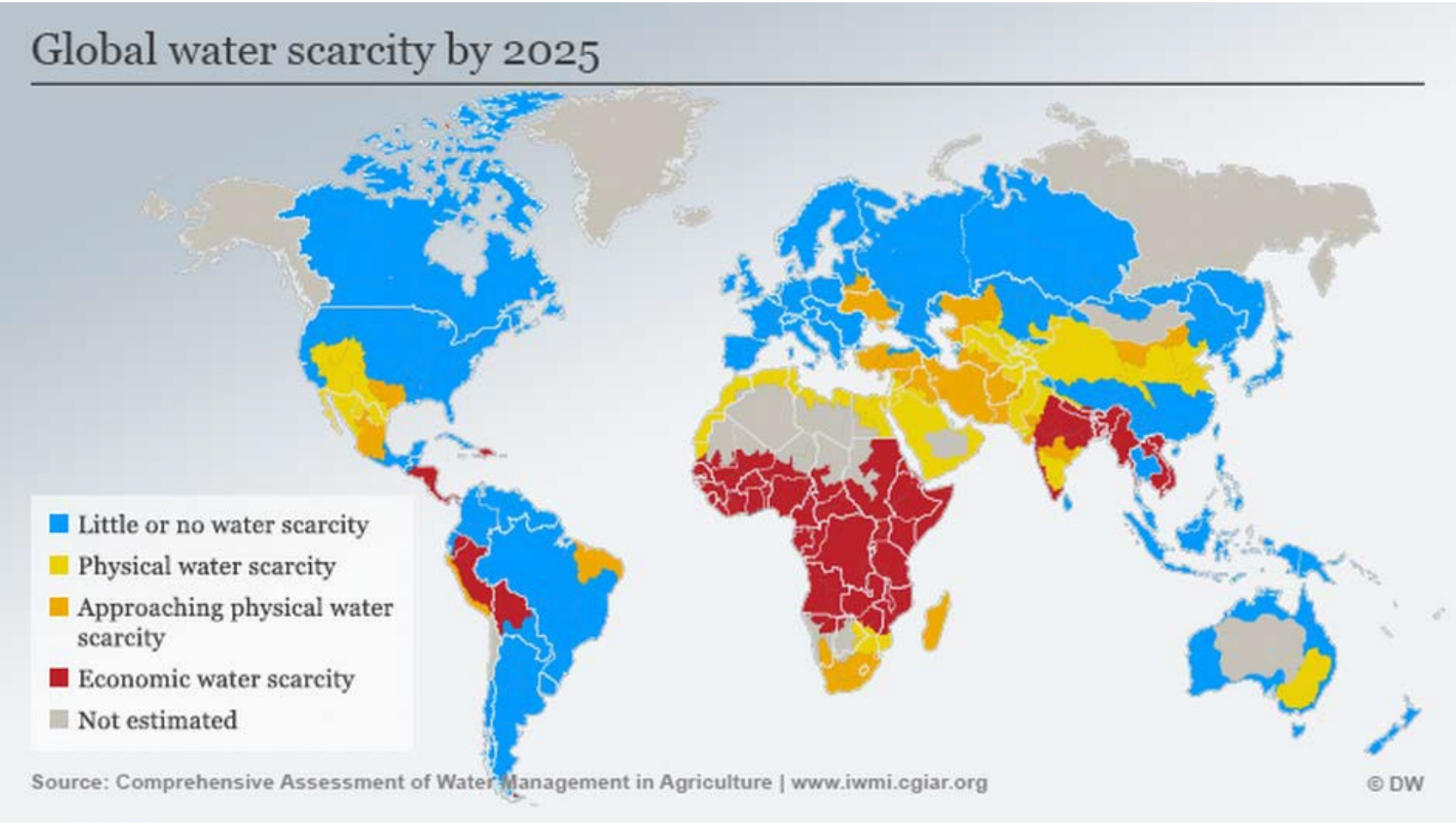
Water scarcity



Renewable vs non-renewable

- Non-renewable resources are **stock** limited
- Renewable resources are **flow** limited

- Water exhibits both characteristics:
  - renewable in general
  - Can be non-renewable in some locations

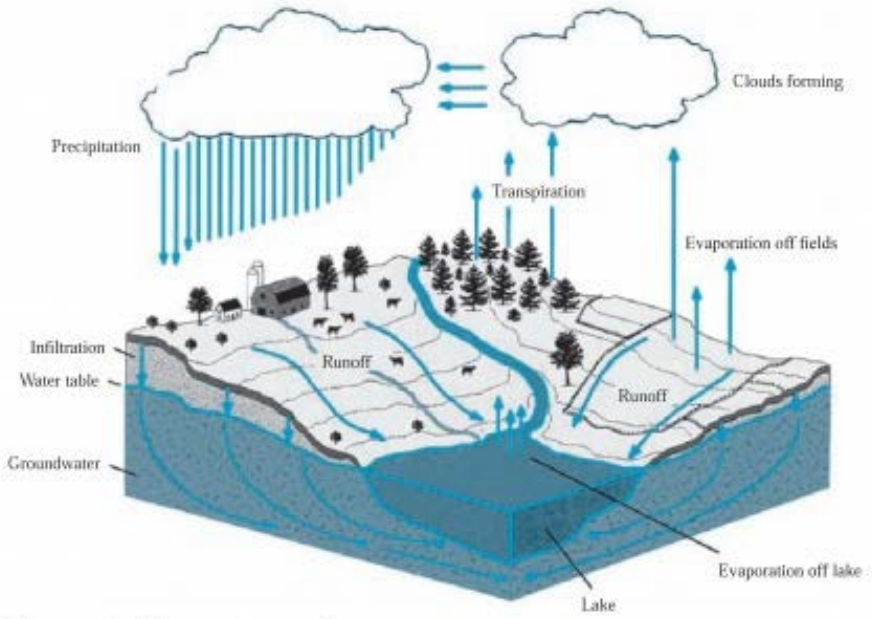
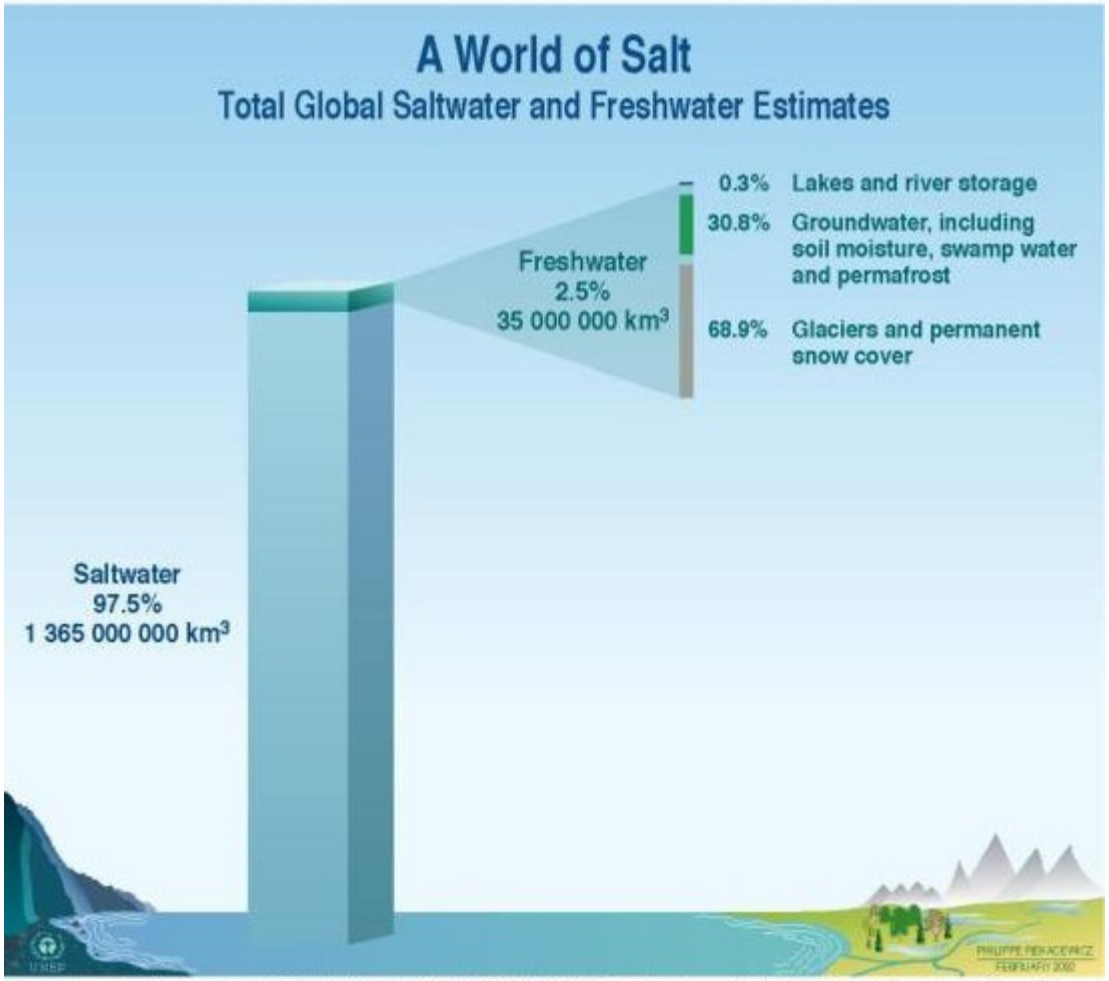


Figure 1: The water cycle.
"Understanding Groundwater."
Institute of Water Research/ Center for Remote Sensing, MSU.

Global water resources

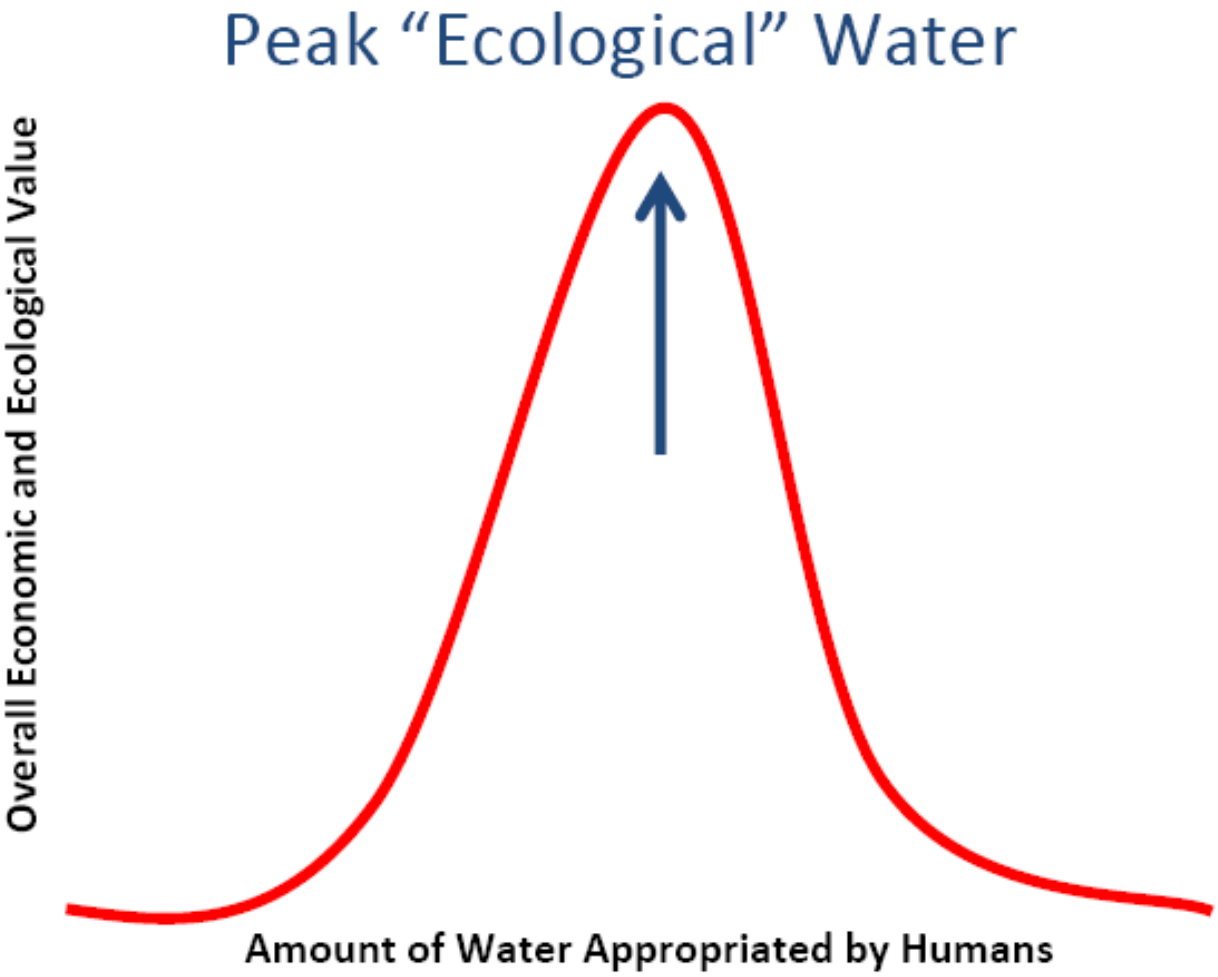


Source: Igor A. Shiklomanov, State Hydrological Institute (SHI, St. Petersburg) and United Nations Educational, Scientific and Cultural Organisation (UNESCO, Paris), 1999.

- Only 0.3% of water is renewable fresh water

- Location?
- Access?
- Quality?

Peak ecological water



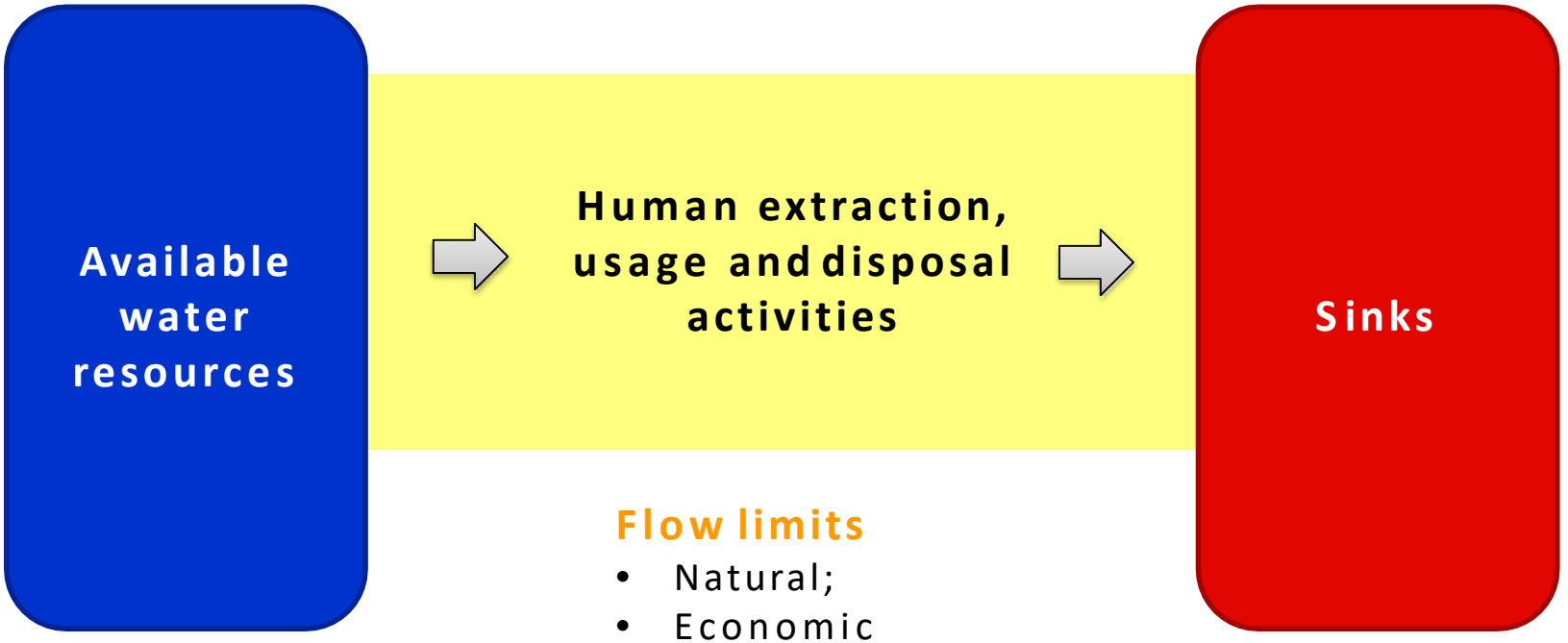
Peak water

- We will never run out of water. But...

- Where it is non-renewable, we will run into stock constraint.
- Will run up again flow limits which are a combination of natural and economical constraints
- We are increasingly hitting (exceeding) ecological limits on a localised basis

- There is no substitute for water

Peak water – A sustainability issue



Stock constraint

Flow limits

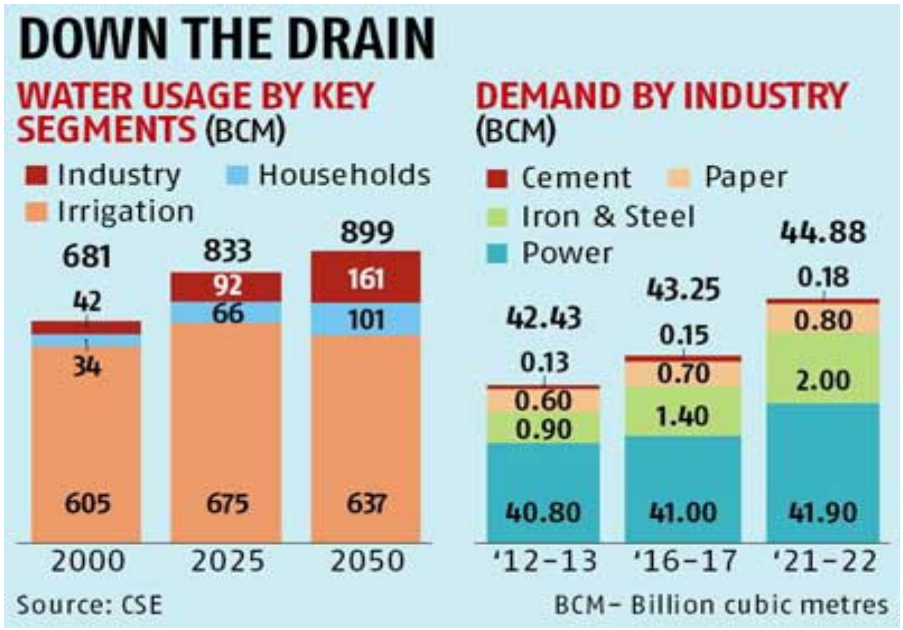
- Natural;
- Economic constraints

Ecological limits

- Capacity for sinks to absorb pollutants

Peak water – Implications

- Agriculture is water limited
- Risks to companies that depend on water are real and growing; and
- Opportunities exists in the water sector for companies, investors, and public.



Risks associated with Peek water

- Increase competition for water; concern over reliability
- New limits on access to markets/sites in water-short regions
- Increase difficulty in getting/keeping water permits
- Higher cost of treatment, quality control & distribution; new expenditure
- Regulatory uncertainty

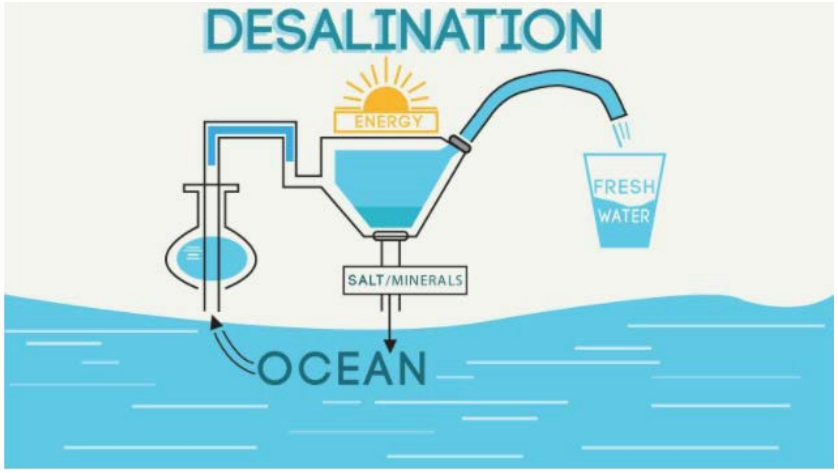
Water related opportunities

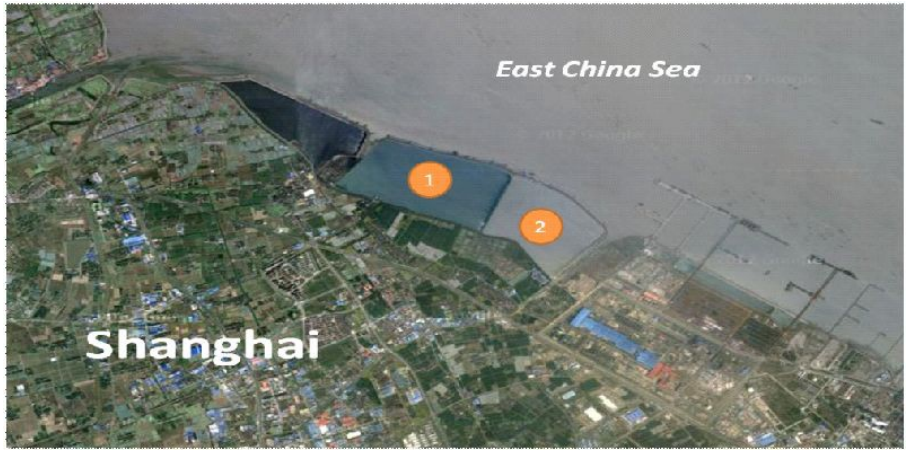
- The water sector is growing at 10-15% annually
- Significant growth in some regions
  - In Australia: all major capital cities now have seawater desalination and/or water recycling schemes
- Government incentives
- Water Accounting is essential for management

Key message

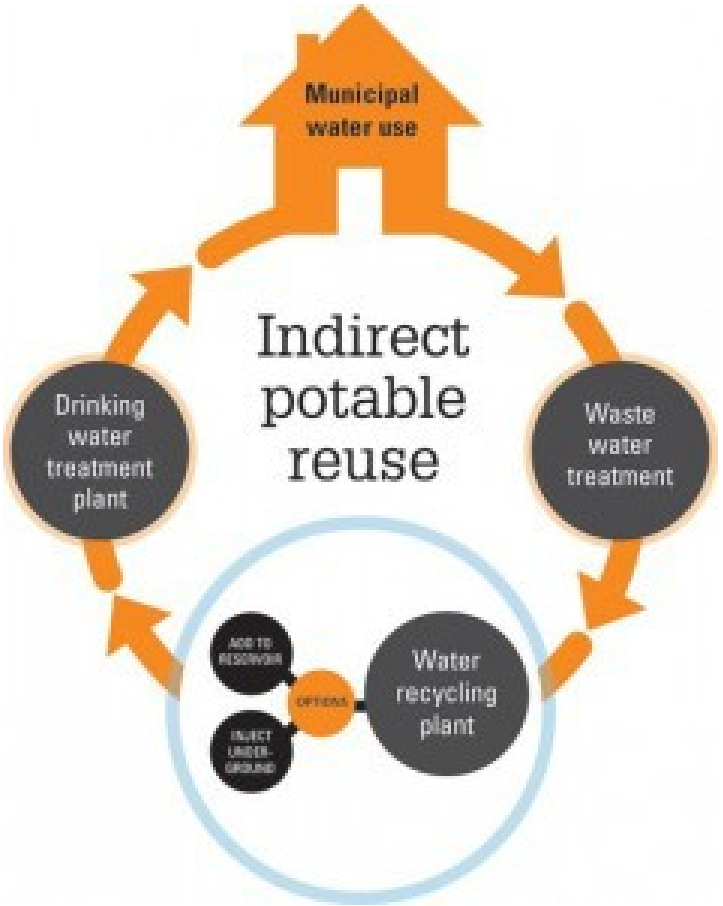
- There is a real water crisis
  - In different forms and different places
- We have gone past the point of “ecological peak water” in many regions
  - Cape Town, South Africa
  - Bangalore, India

Water resource supply solutions



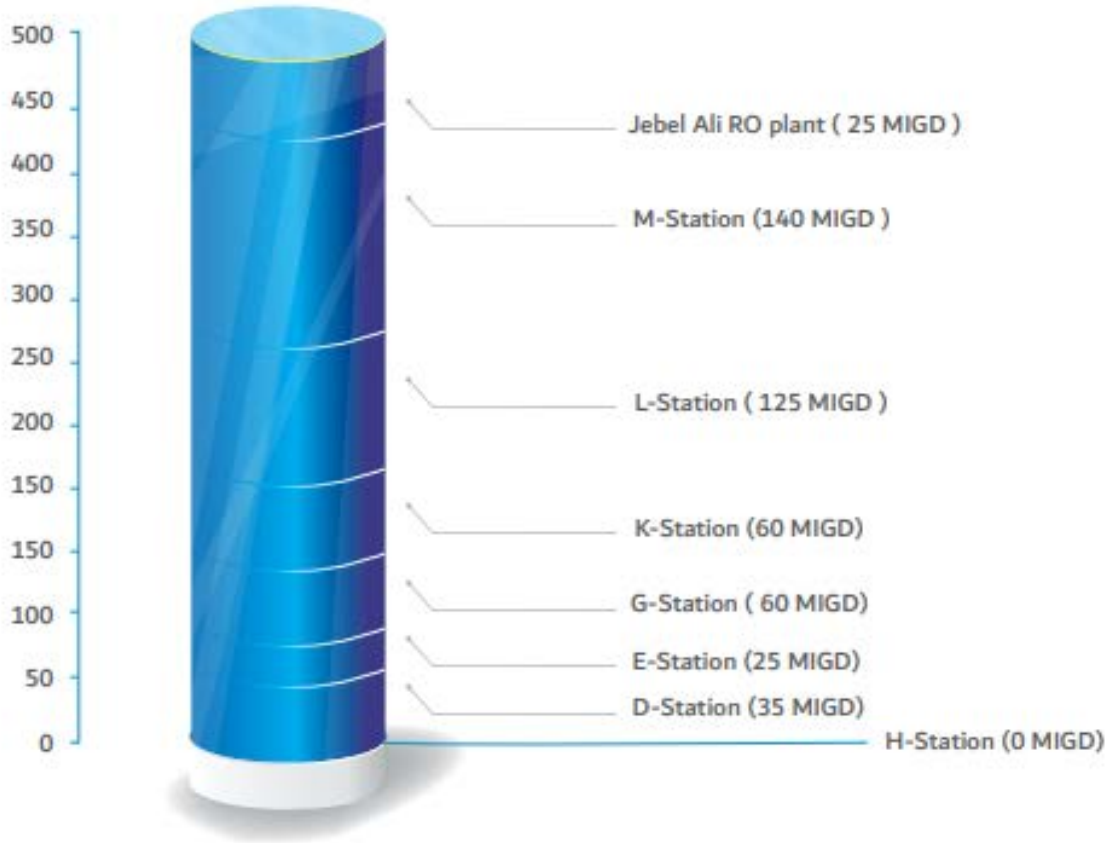


Coastal reservoir



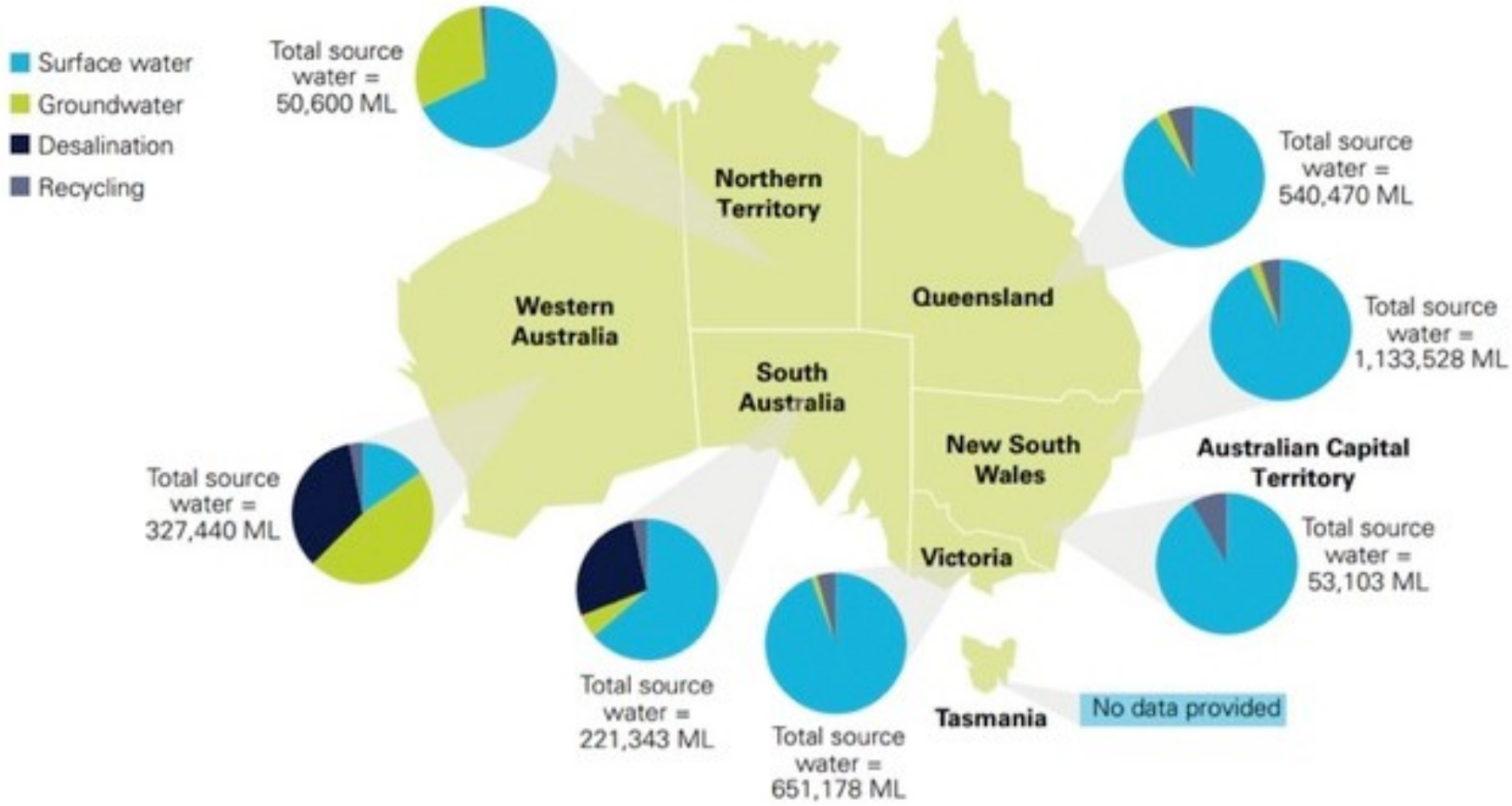
UAE Water production

Graph: Total water production capacity in 2016 (million imperial gallons per day)

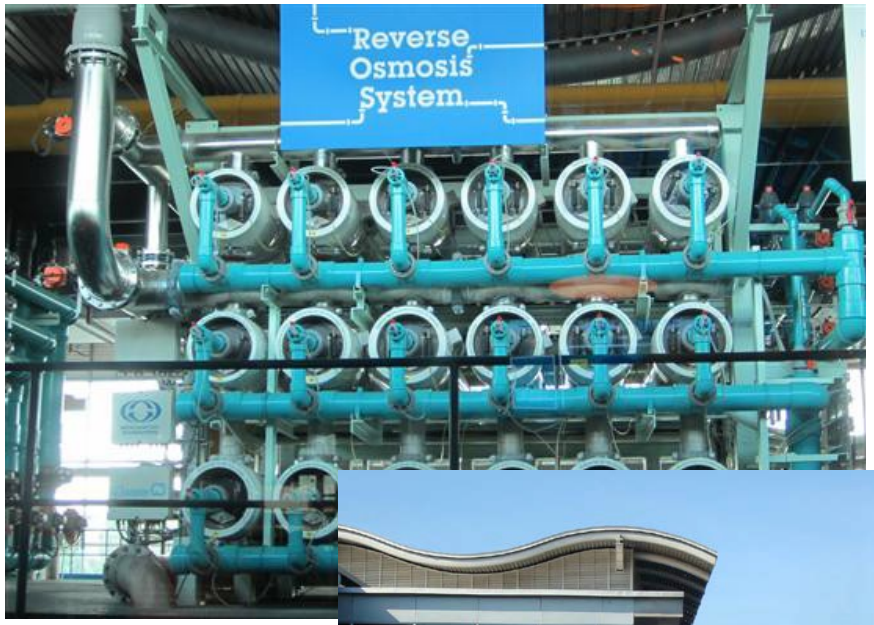


DEWA Sustainability Report 2016

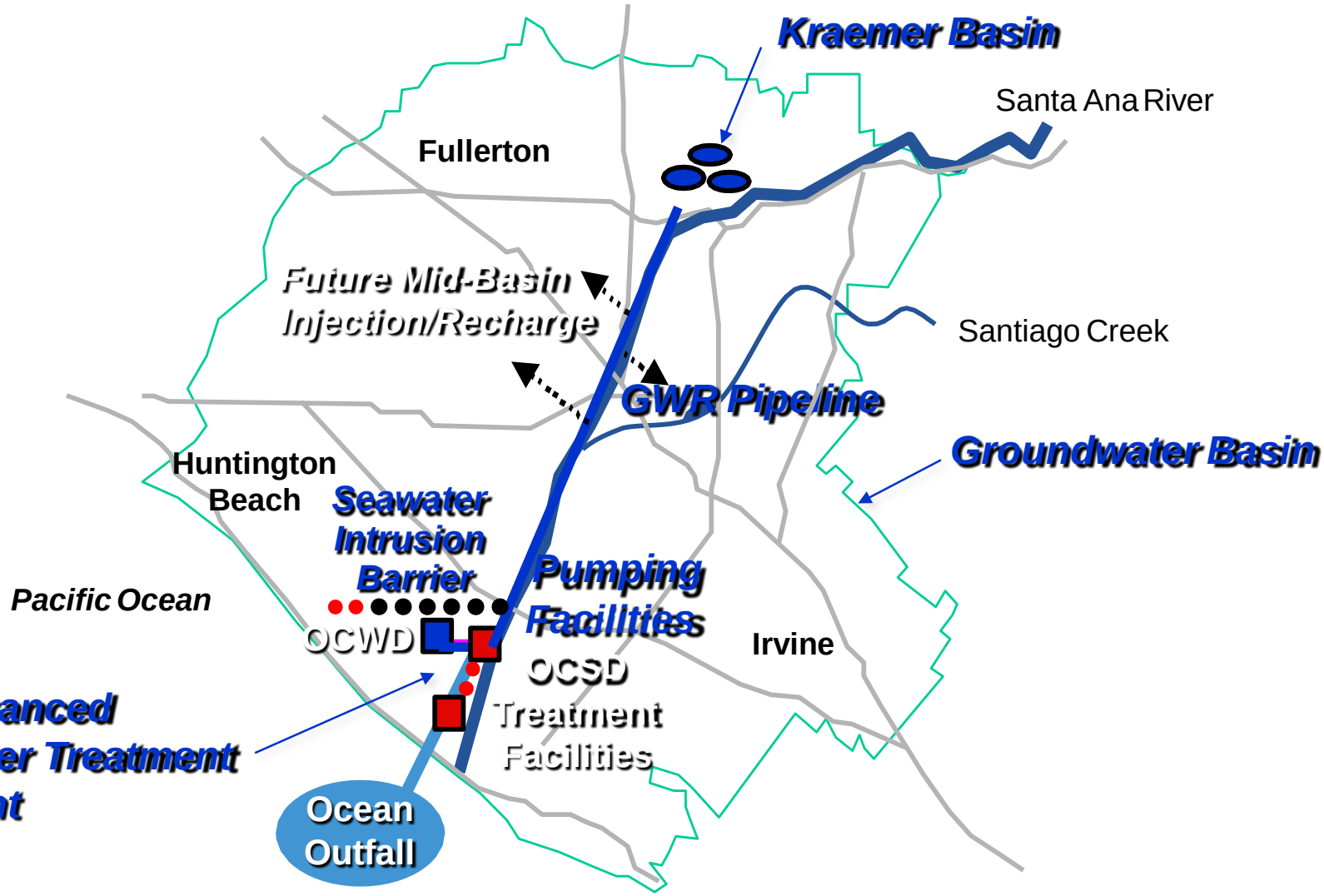
Australian water consumption



Singapore NEWater initiative



Orange County CA – Ground Water Recharge



Water footprint of a product

- Total volume of fresh water used **directly** or **indirectly** to produce the product.
- Considers water consumption and pollution in all steps of the production chain.
- Alternative terms
  - 'Virtual water content'
  - 'Embedded water'

The three water footprints

Blue water footprint

- Fresh surface orgroundwater

Green water footprint

- Precipitation on land that does not recharge groundwater
- It is stored or temporarily stays in soil or vegetation

Grey water footprint

- Indicates the degree of freshwater pollution
- Expressed in terms of the freshwater volume required to assimilate (dilute) the existing load of pollutants

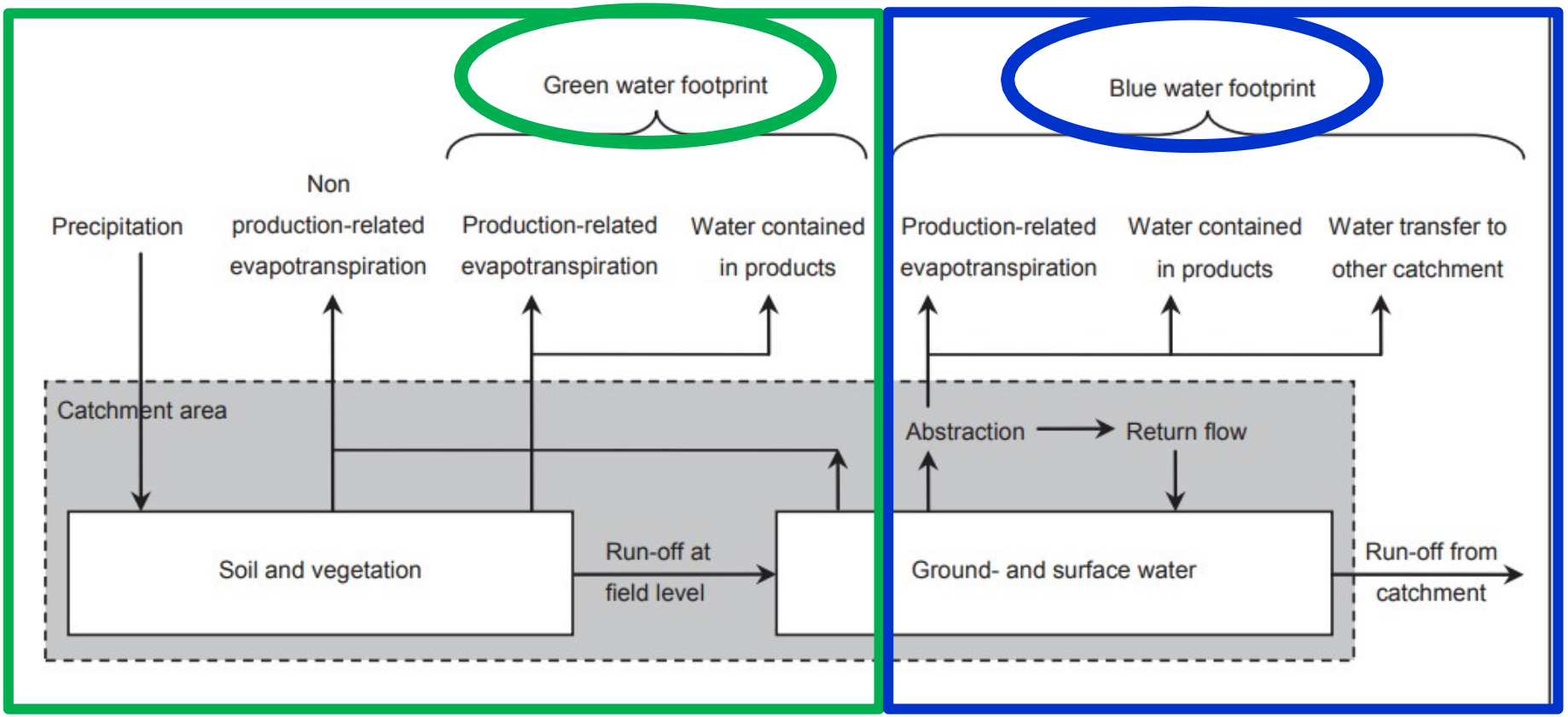
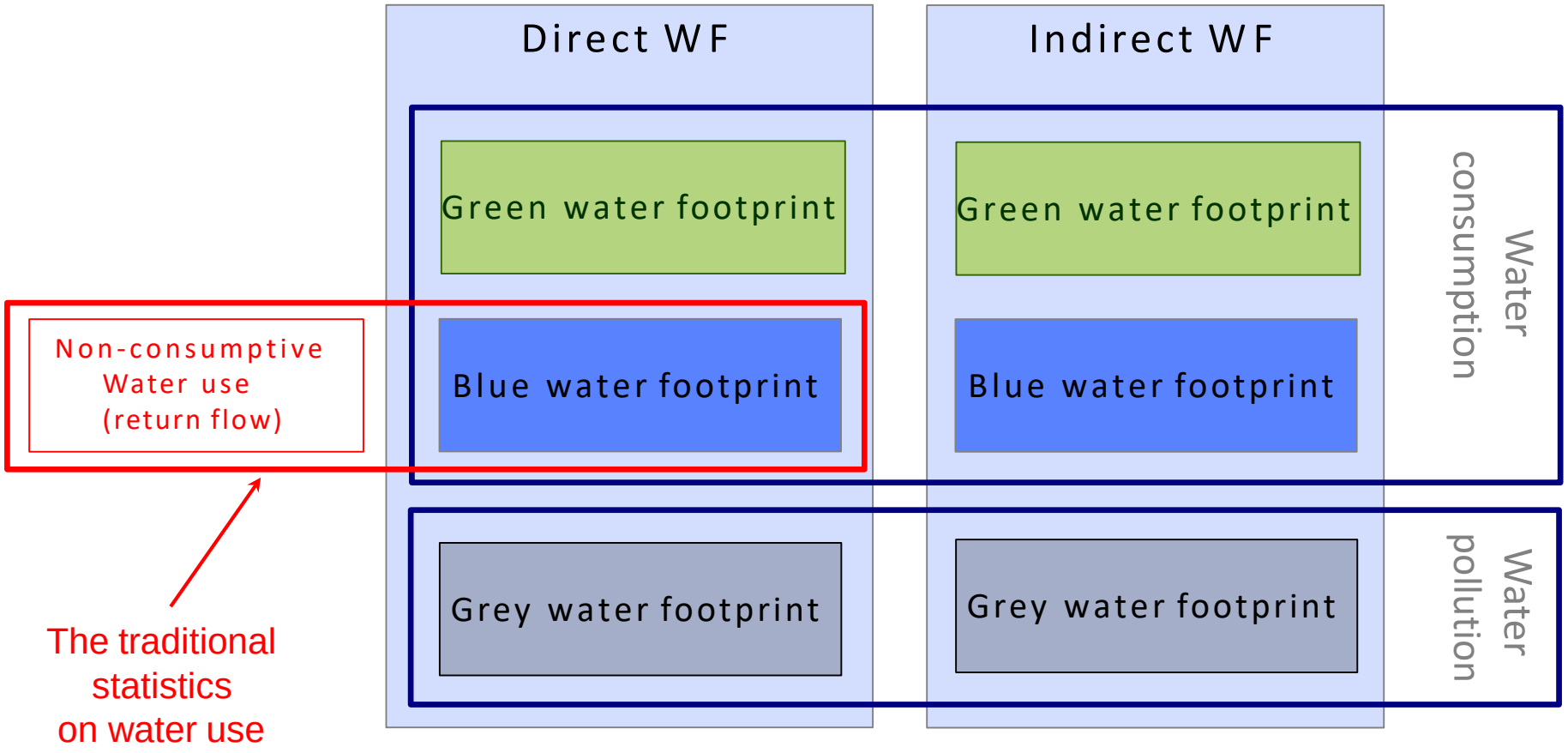


Figure 3.1 The green and blue water footprint in relation to the water balance of a catchment area

Components of water footprint



[Hoekstra, 2008]

Agricultural irrigation

Example

- Irrigation requirement =

  crop water requirement – effective rainfall
- Made up of green and blue water footprint

Grey water footprint

Reminder

- Included in footprint calculation whenever there is pollutant discharge
- "Calculated as the volume of water that is required to dilute pollutants to such an extent that the quality of the water remains above agreed water quality standards."

Production chain
cotton

Cotton plant → Harvesting → Seed-cotton → Ginning

Ginning → 0.63/0.18 → Cotton seed → Hulling/extraction

Hulling/extraction → 0.16/0.47 → Cotton seed oil → 1.07/1.00 → Cotton seed oil, refined

Hulling/extraction → 0.51/0.33 → Cotton seed cake

Hulling/extraction → 0.10/0.20 → Cotton linters

Ginning → 0.35/0.82 → Cotton lint → 1.00/1.00 → Cotton, not carded or combed → Carding/Spinning

Carding/Spinning → 0.05/0.10 → Garnetted stock

Carding/Spinning → 0.95/0.99 → Cotton, carded or combed (yarn) → Knitting/weaving

Knitting/weaving → 0.95/0.99 → Grey fabric → Wet processing → 1.00/1.00 → Fabric → Finishing → 1.00/1.00 → Final textile

Knitting/weaving → 0.05/0.10 → Yarn waste

Legend

$\frac{0.35}{0.82}$ ← Product fraction

$\frac{0.35}{0.82}$ ← Value fraction

[Hoekstra & Chapagain, 2008]

[Hoekstra & Chapagain, 2008]

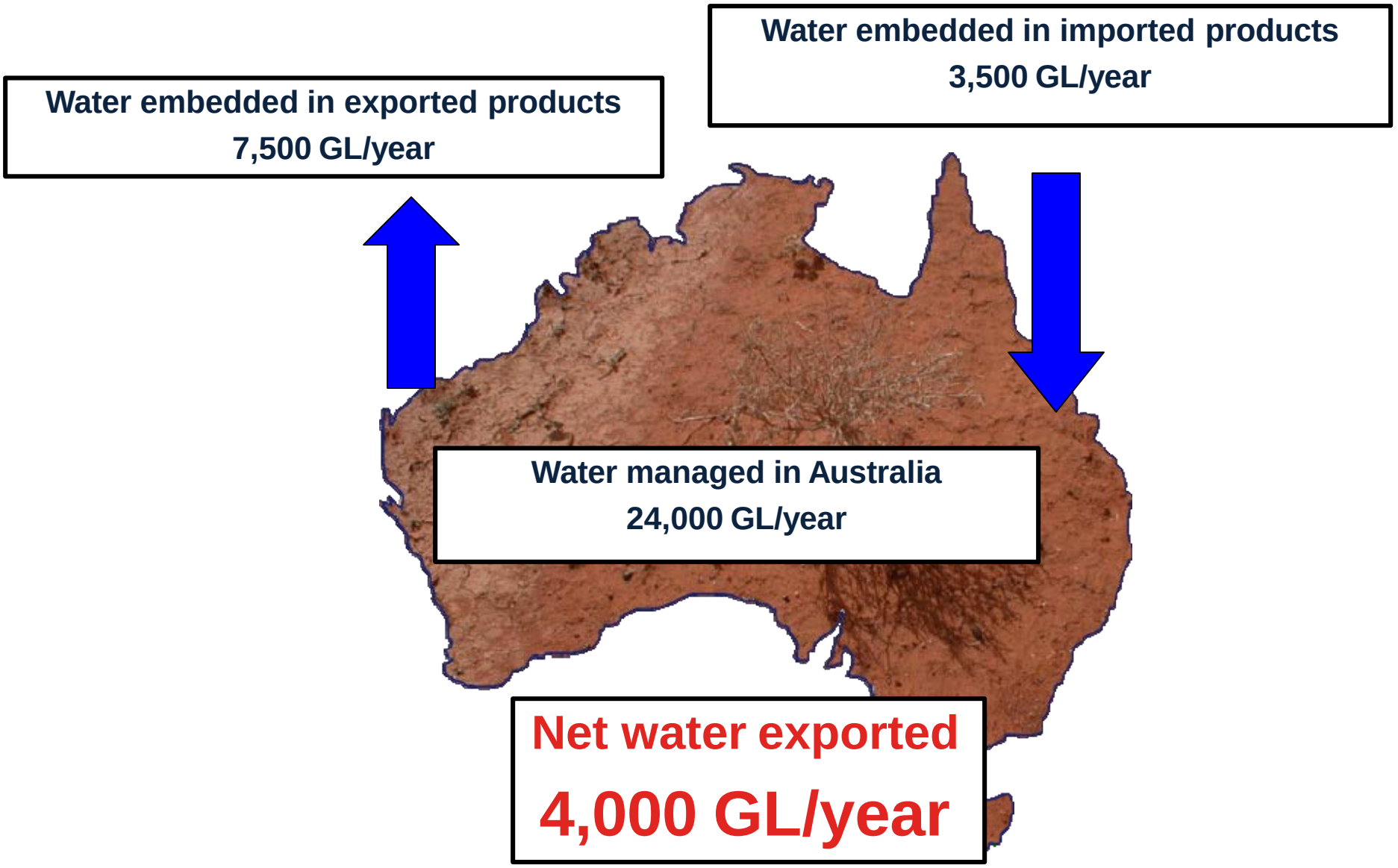
[Hoekstra & Chapagain, 2008]

[Hoekstra & Chapagain, 2008]

[Hoekstra & Chapagain, 2008]

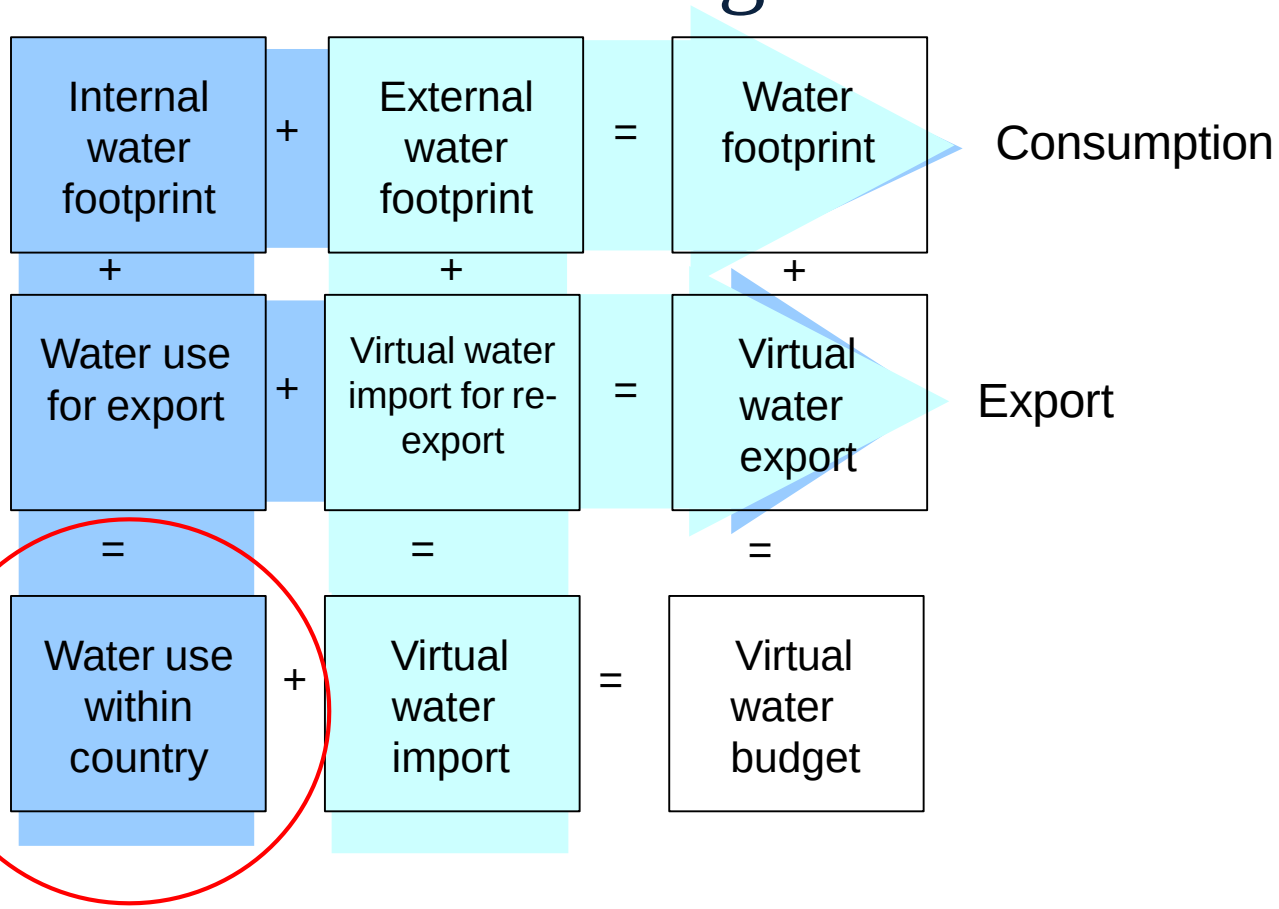
Water footprint of a nation

- Total amount of water that is used to produce the goods and services consumed by the inhabitants of the nation.
- National water footprint = National water use
  + virtual water import
  – virtual water export



Source Lenzen and Foran 2001

National water accounting framework



The traditional statistics on water use

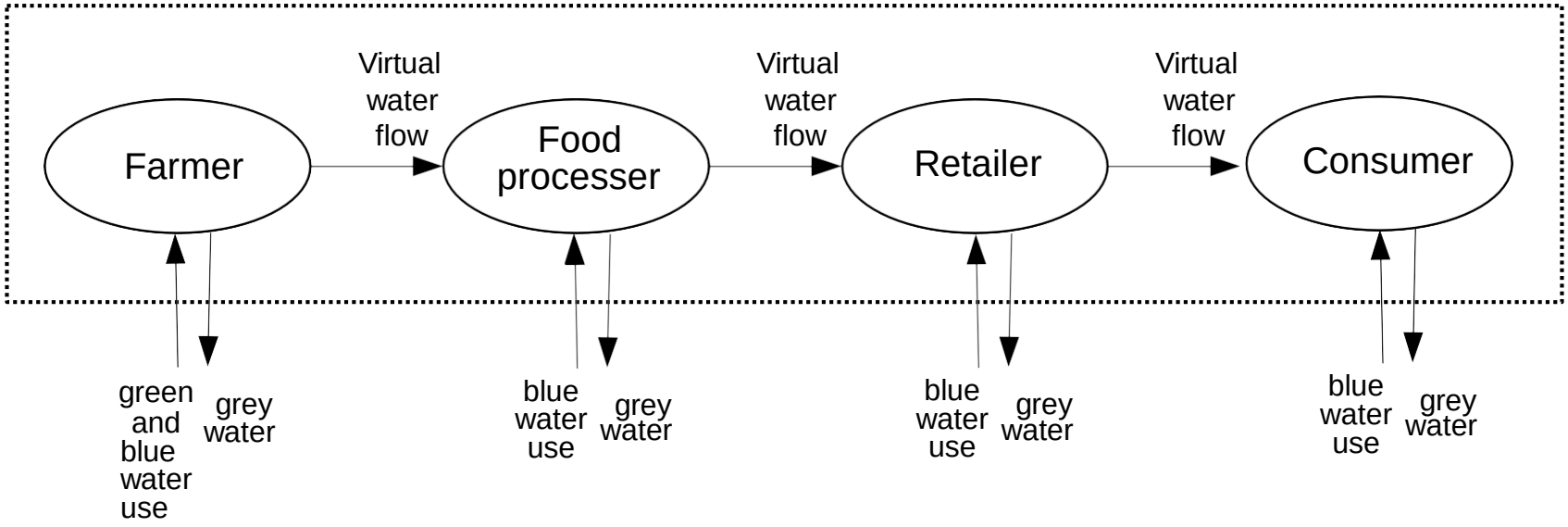
Water footprint of a business

- Operational water footprint
  - the **direct** water use by the producer – for producing, manufacturing or for supporting activities.
- Supply-chain water footprint
  - the **indirect** water use in the producer's supply chain.

Why businesses are interested

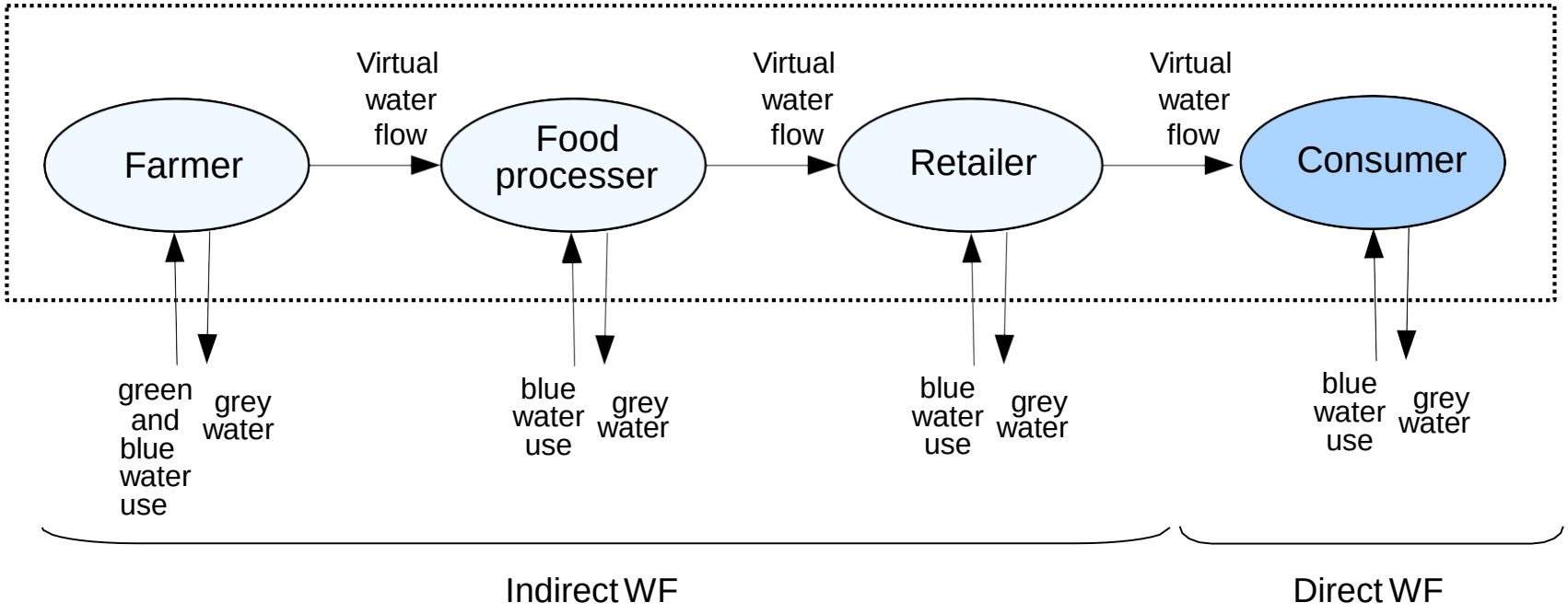
- Corporate social responsibility
- Corporate image/marketing perspective
- Business risks related to
  - Freshwater shortage for own operations
  - Freshwater shortage in supply chain anticipate regulatory control

The virtual water chain

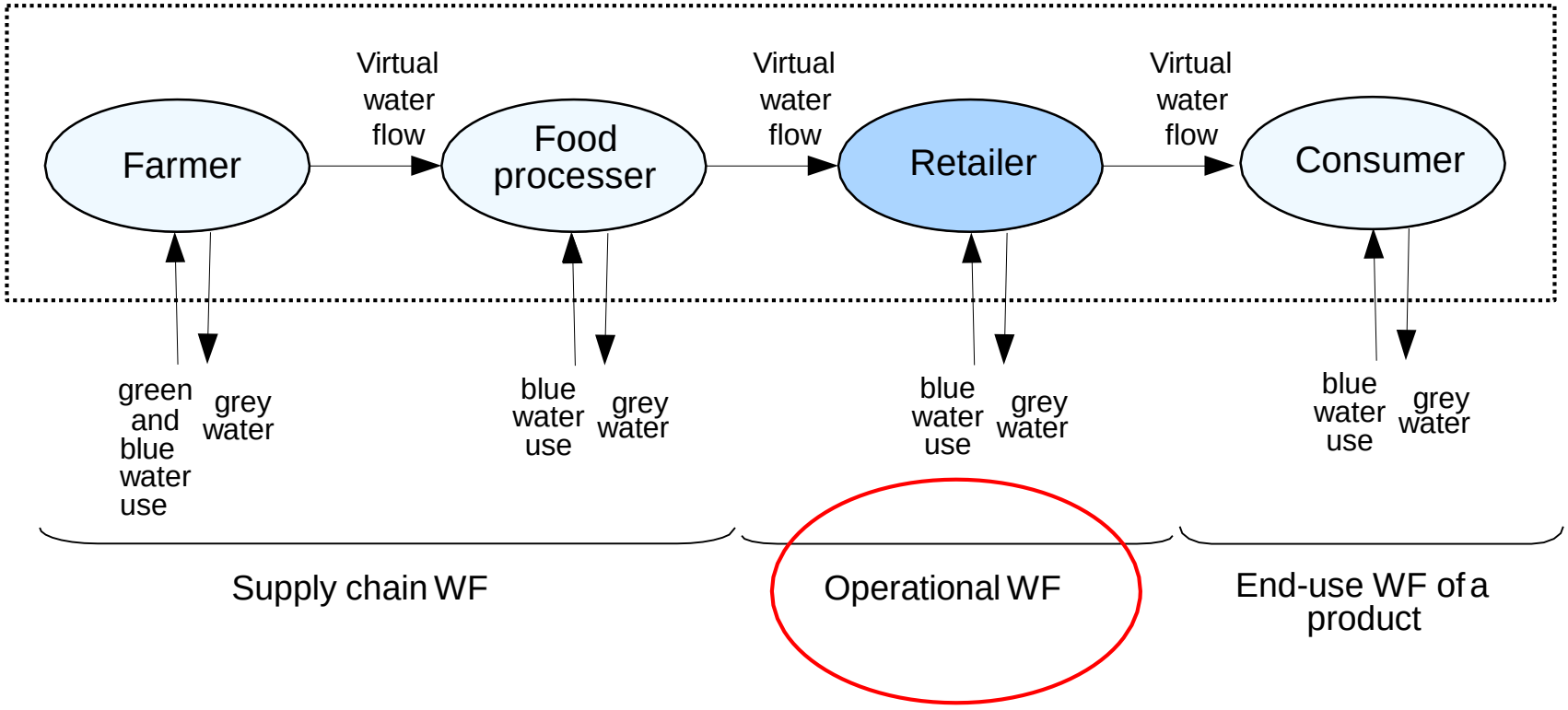


[Hoekstra, 2008]

The virtual water chain

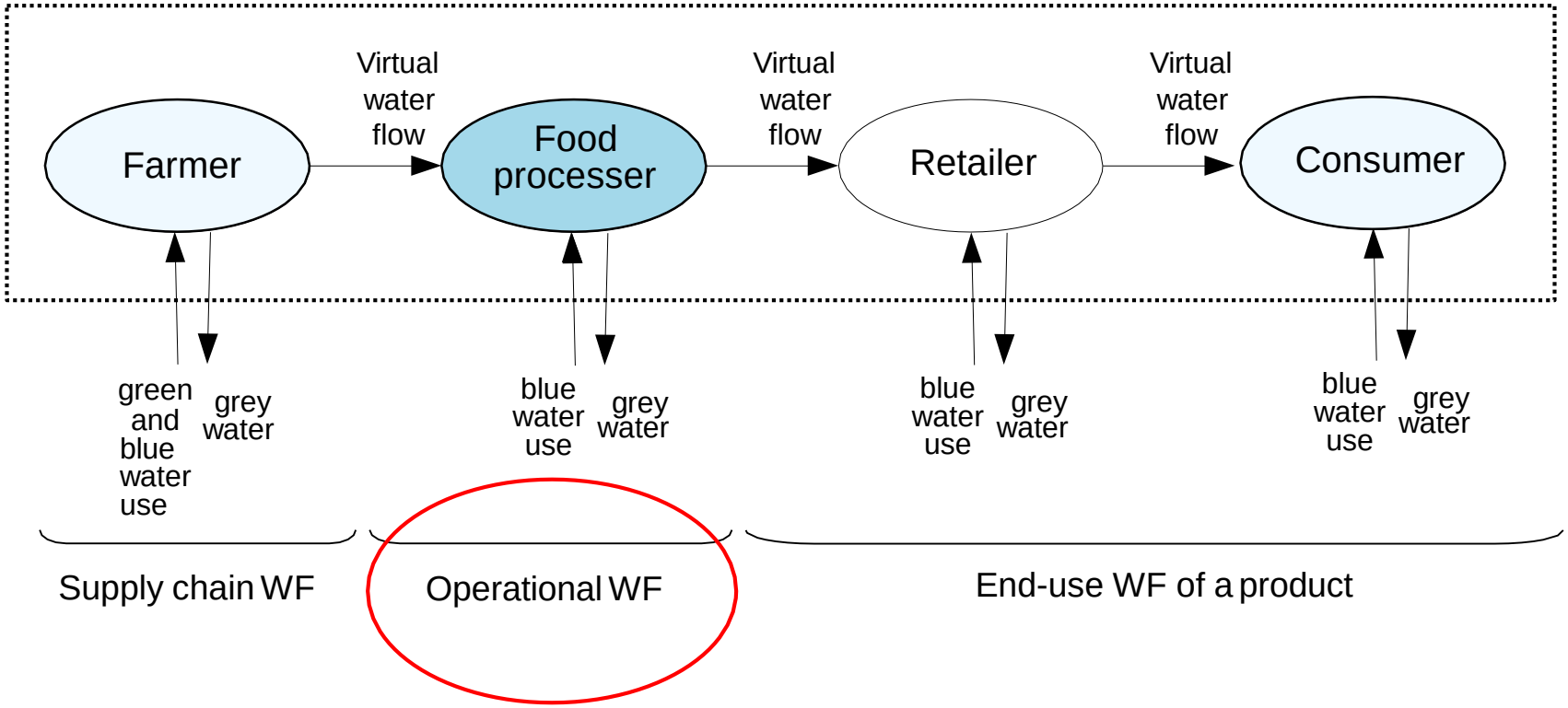


The virtual water chain



The traditional statistics on corporate water use

The virtual water chain



The traditional statistics on corporate water use

Reducing water footprint

- **Blue water footprint**
  - Water recycling and reuse
- **Grey water footprint reduces:**
  - Wastewater treatment

Water vs Carbon Footprint

Water Footprint

- spatial and temporal dimension
- actual, locally specific values
- always referring to full supply-chain
- focus on reducing own water footprint (water use units are not interchangeable)

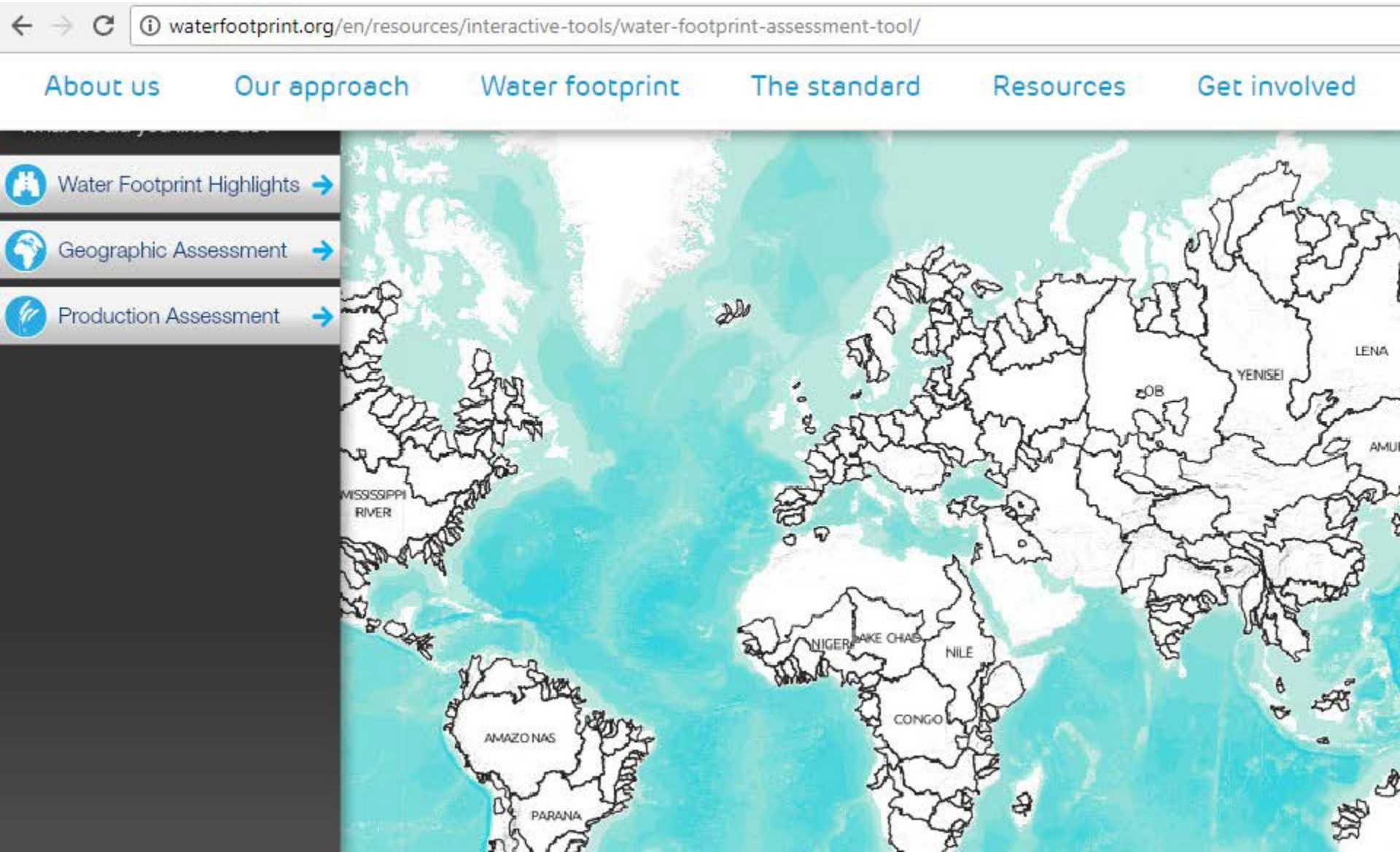
Carbon Footprint

- no spatial / temporal dimension
- global average values
- supply-chain included only in 'scope 3 carbon accounting'
- many efforts focused on offsetting (units are interchangeable)

Water footprint and carbon footprint are complementary tools.

http://waterfootprint.org/en/

water footprint network



WHAT IS WSUD?

- WSUD has evolved from its early association with stormwater management to provide a broader framework for sustainable urban water management.
- WATER SENSITIVE
  - Sustainable solutions for managing water resources
  - Protecting aquatic ecosystems
- URBAN DESIGN
  - Integrating total urban water cycle management into the urban design and built form
  - Enhancing the landscape/recreation/habitat
  - Creating an Urban Ecology

https://www.sa.gov.au/__data/assets/pdf_file/0007/9448/WSUD_summary_1_2_3.pdf

Urban water cycle

Natural water balance

Urban water balance

WSUD water balance

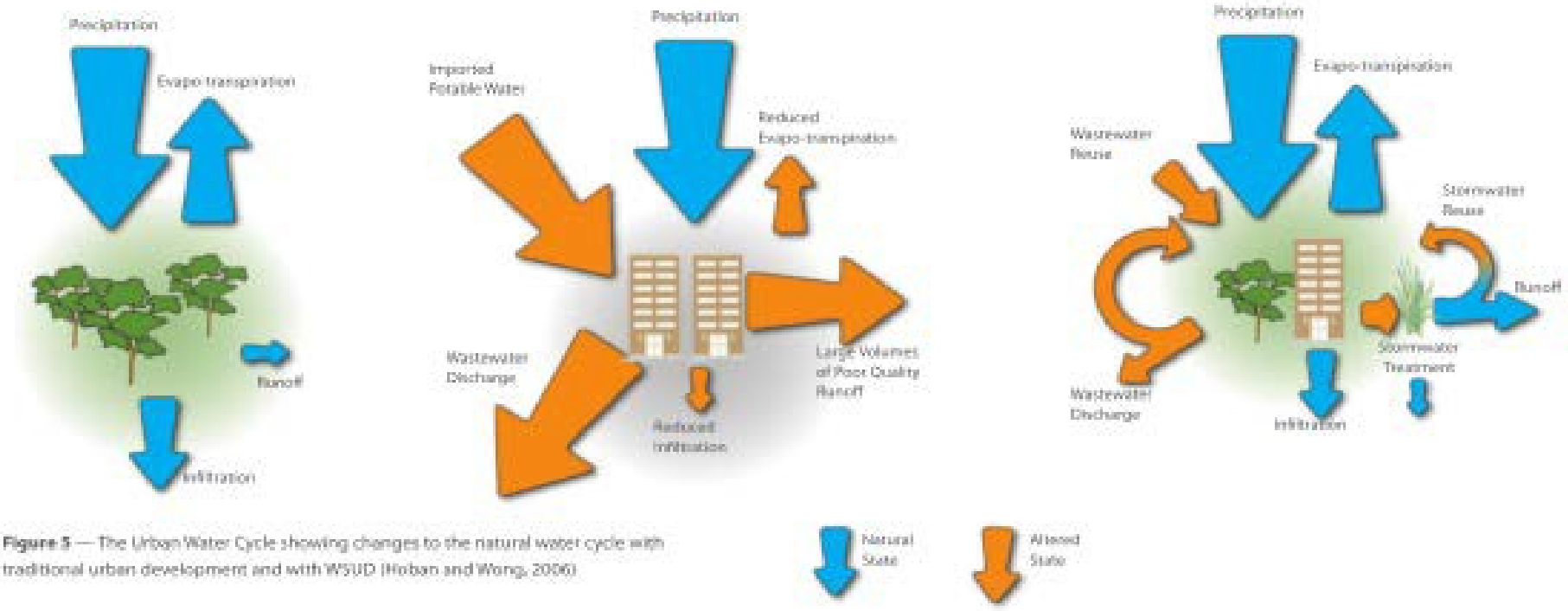
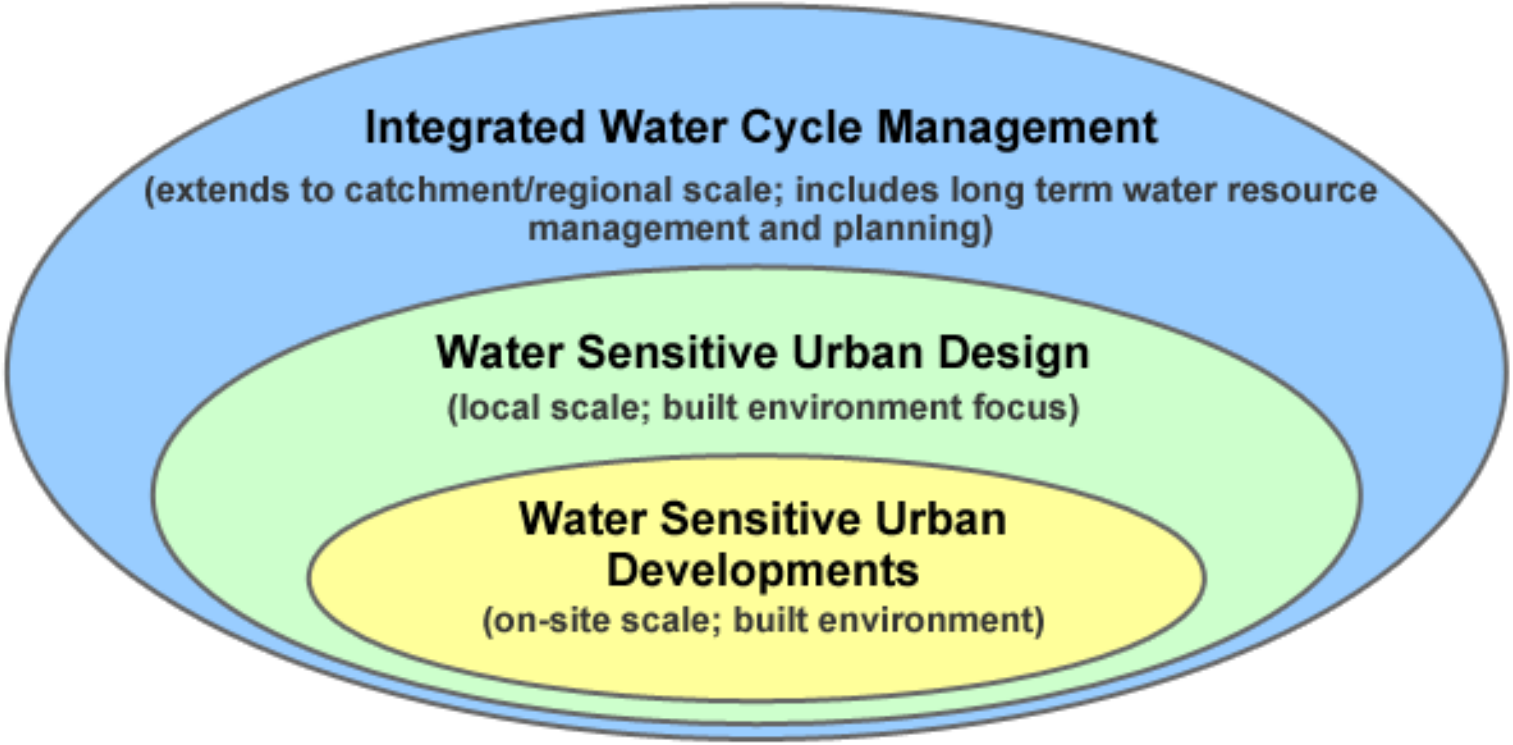


Figure 5 — The Urban Water Cycle showing changes to the natural water cycle with traditional urban development and with WSUD (Hoban and Wong, 2006)

Water Sensitive Urban Design (WSUD)

- Integration of water cycle management into urban planning and design
- Combining storm water management (reuse, flood mitigation, quality control), landscaping & other economical/environmental aspects
- Essential tool for sustainable urban development

WSUD scale

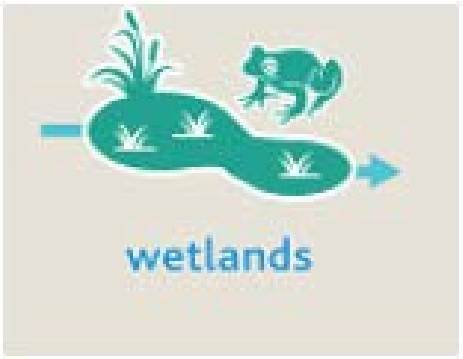

Integrated Water Cycle Management
(extends to catchment/regional scale; includes long term water resource management and planning)
Water Sensitive Urban Design
(local scale; built environment focus)
Water Sensitive Urban Developments
(on-site scale; built environment)

WSUD principles / strategies

1. Sustainable water supply options
   - Water conservation / demand management
   - Alternative water sources, e.g. rainwater / stormwater harvesting
   - Aquifer storage
2. Wastewater minimisation
   - Protect water quality
   - Use of treated wastewater / recycled water
3. Stormwater management
   - Reduce runoff and peak flows
   - Enhancement of amenity and biodiversity

‘Mimic the natural water cycle as closely as possible’

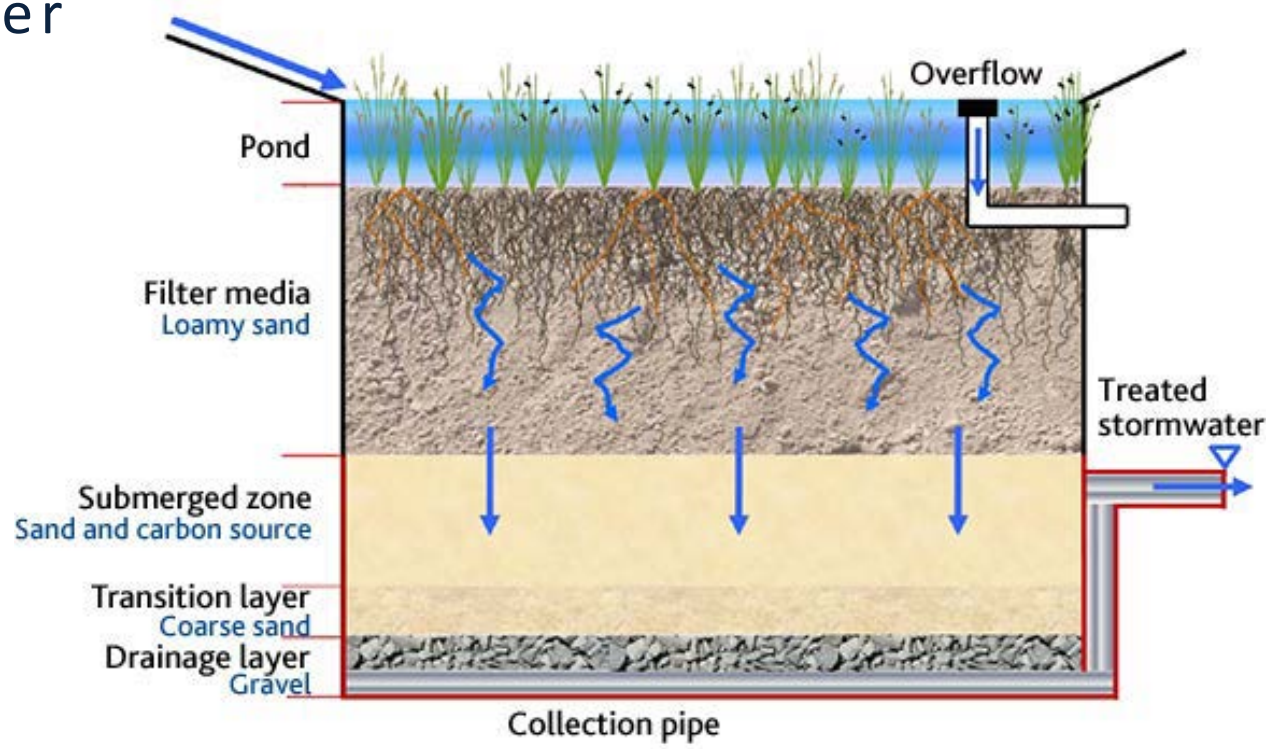
WSUD Design Options



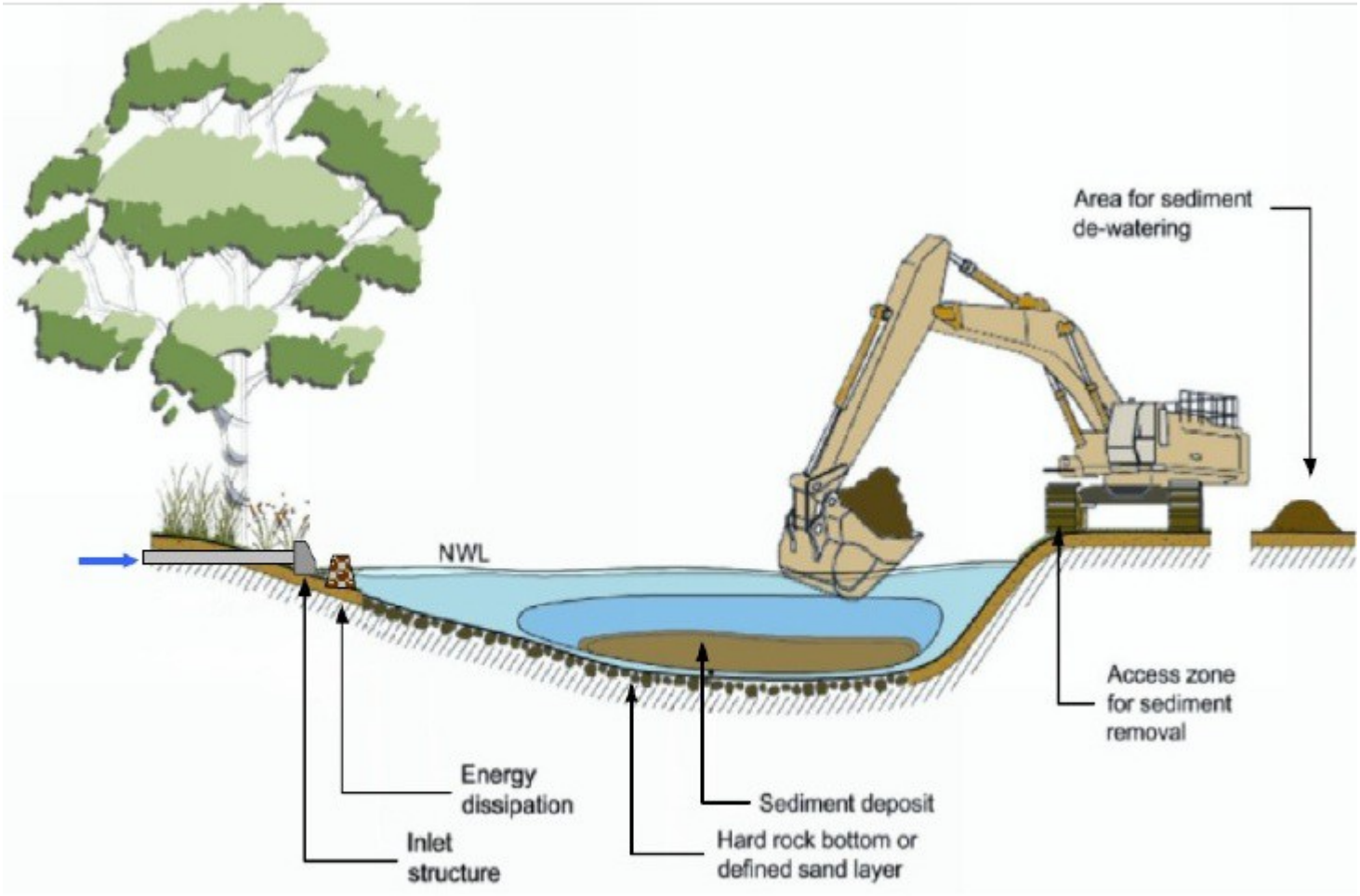
WSUD – Rainwater tanks

WSUD – Rain gardens

- Also called ‘bioretention systems’
- Use soil, plants and microbes to biologically treat stormwater



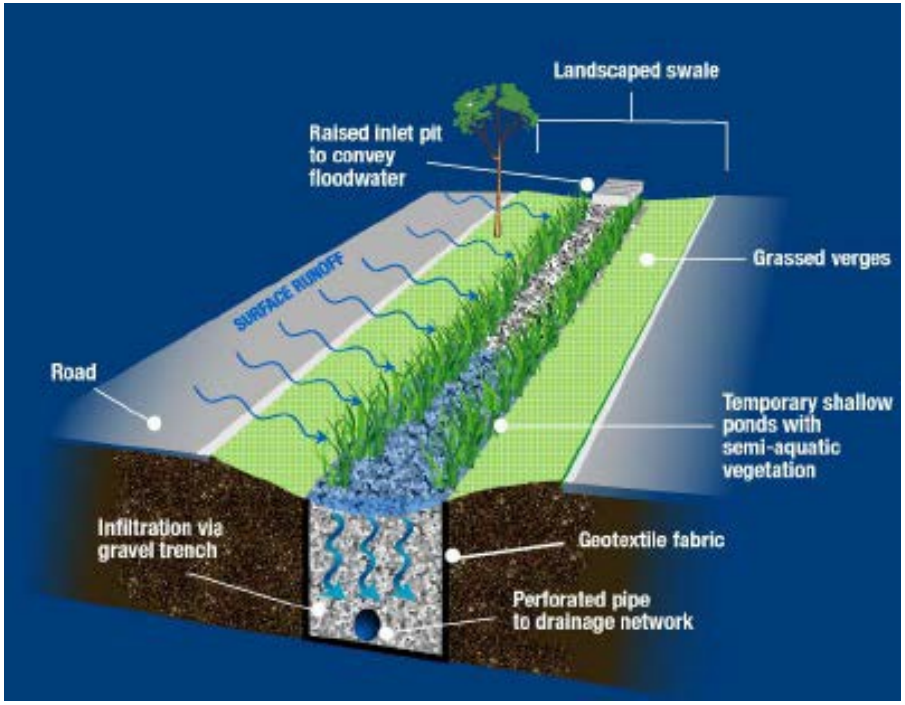
WSUD – Sediment ponds



TRADITIONAL SEDIMENTATION BASIN – CONCEPT LAYOUT

WSUD – Constructed wetlands

WSUD - Swales


Landscaped swale
Raised inlet pit to convey floodwater
SURFACE RUNOFF
Grassed verges
Road
Temporary shallow ponds with semi-aquatic vegetation
Infiltration via gravel trench
Geotextile fabric
Perforated pipe to drainage network

WSUD – Porous paving

- Porous paving + high void aggregate base
  - Allow temporary storage
  - Infiltration of stormwater into the surrounding soil
  - Parking lots, low traffic areas, parking lanes

- More info visit: https://www.melbournewater.com.au/planning-and-building/stormwater-management/introduction-wsud

Melbourne Water