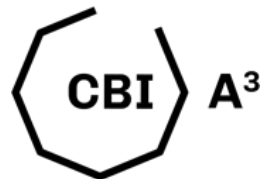# Systems Thinking & Mapping

Systems Thinking

A way to understand how different parts of a system interact and influence each other, considering the whole system rather than individual components.
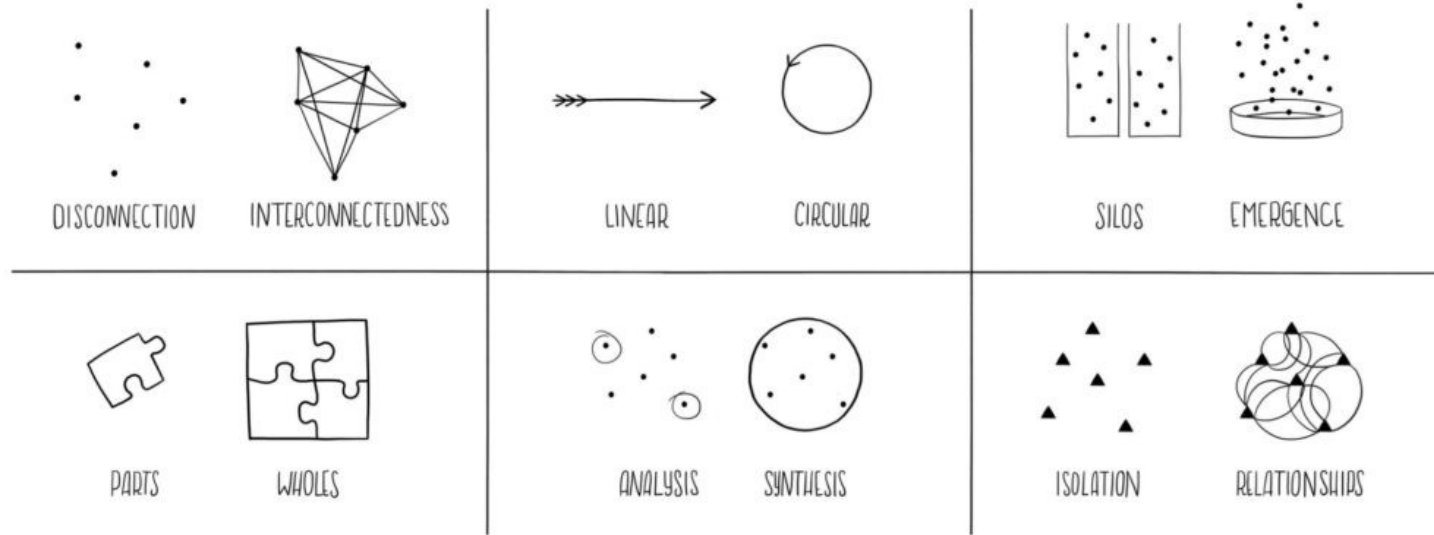
TOOLS OF A SYSTEM THINKER

DISCONNECTION — INTERCONNECTEDNESS | LINEAR — CIRCULAR | SILOS — EMERGENCE

PARTS — WHOLES | ANALYSIS — SYNTHESIS | ISOLATION — RELATIONSHIPS

DISRUPT DESIGN

Image source: https://medium.com/colab-dudley/making-sense-of-the-mess-learn-to-use-a-systems-thinking-approach-a6f2738a1e6b

Video link – bottom of page. https://www.disruptdesign.co/blog/7-systems-thinking-benefits-that-every-organization-needs

THE **ICEBERG** MODEL as learned from PETER SENGE & JOHN STERMAN

EVENTS
WHAT WE SEE

QUALITY:
REACTIVE

PATTERNS of BEHAVIOR
CHANGES OVER TIME

ADAPTIVE

STRUCTURE
HOW PARTS ORGANIZE

CREATIVE

MENTAL MODELS
THEORIES on HOW
THINGS WORK

REFLECTIVE

VISION
ESSENCE of a
DESIRED FUTURE

GENERATIVE

20150224 Kelvy Bird

http://www.kelvybird.com/iceberg/

THE ICEBERG
A Tool for Guiding Systemic Thinking

EVENTS ———————————————— **React**
What just happened?

PATTERNS/TRENDS ———————————— **Anticipate**
What trends have there been over time?

UNDERLYING STRUCTURES ——————— **Design**
What has influenced the patterns?
*What are the relationships between the parts?*

MENTAL MODELS ———————————— **Transform**
What assumptions, beliefs and values do people hold
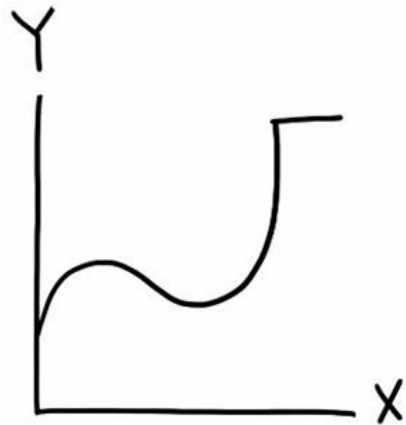*about the system? What beliefs keep the system in place?*

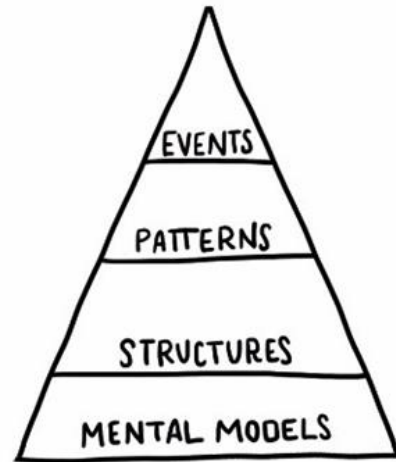https://www.nwei.org/iceberg/

Systems Mapping

A visual tool used to understand and show how different parts of a system are connected and interact, helping to see the relationships and complexities within the whole system.
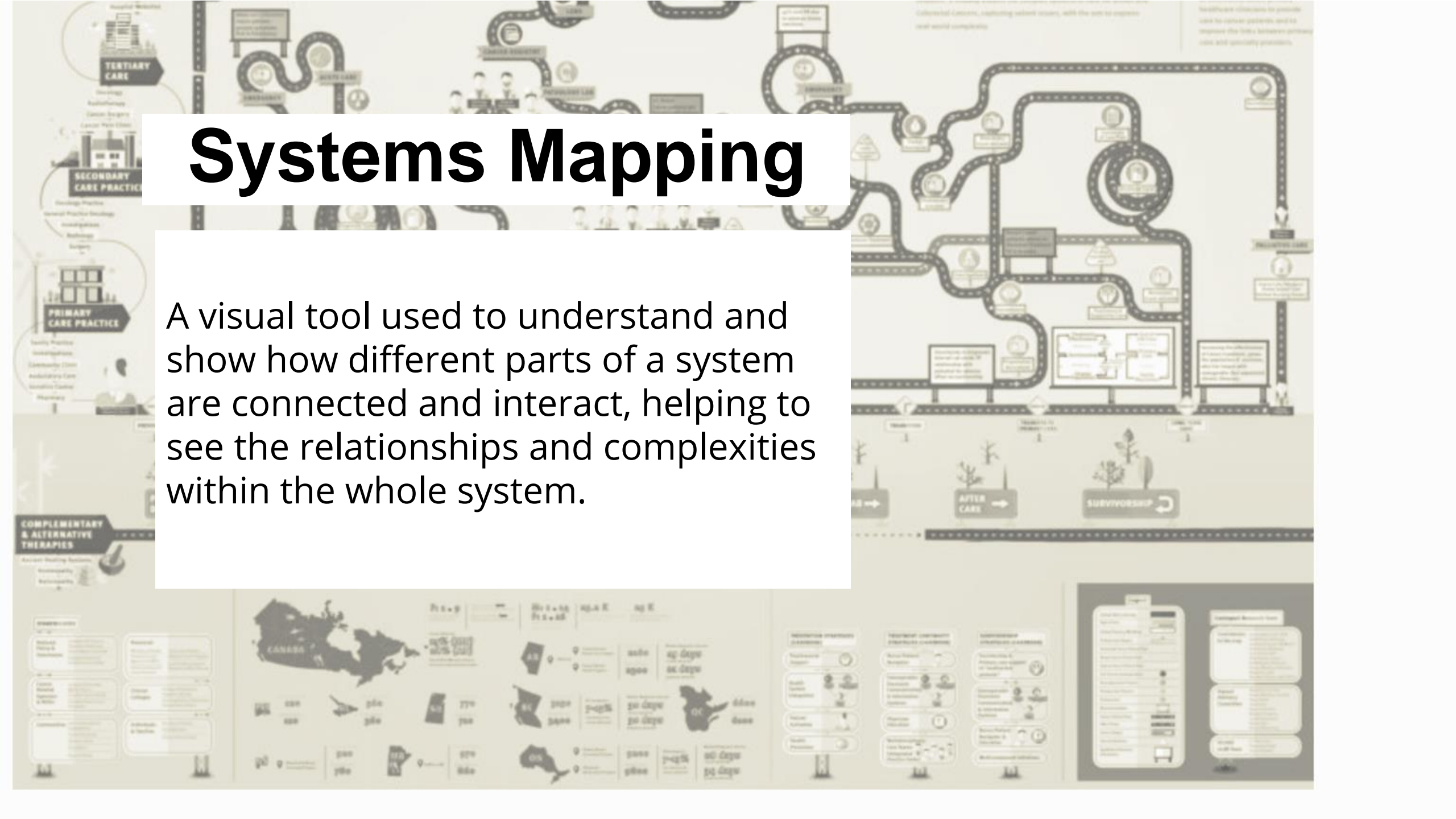
TYPES OF SYSTEM MAPPING

BEHAVIOUR OVER TIME GRAPHS
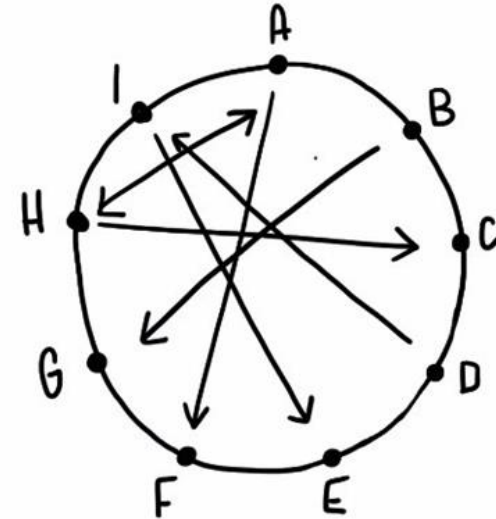
ICEBERG MODEL

- EVENTS
- PATTERNS
- STRUCTURES
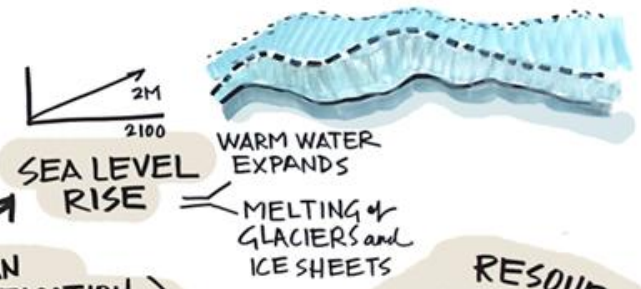- MENTAL MODELS
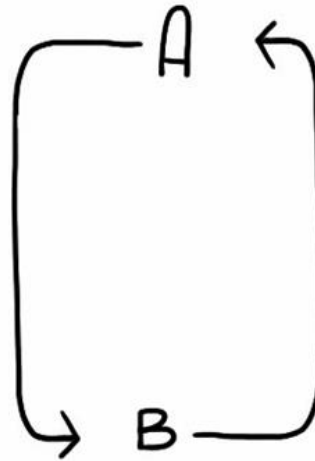
CAUSAL LOOP DIAGRAMS

CONNECTED CIRCLES

Source: https://medium.com/disruptive-design/tools-for-systems-thinkers-the-6-fundamental-concepts-of-systems-thinking-379cdac3dc6a

SYSTEMS THINKING and SUSTAINABILITY
JOHN STERMAN

TECHNICAL, SOCIAL, ECONOMIC, POLITICAL, and ALTERNATIVE RESOURCES

SOLAR WIND — AFFORDABLE NOW COST

ORGANIZATIONAL EFFORTS THAT CAN BE PROFITABLE...

CLIMATE CHANGE IS JUST a SYMPTOM

A MODEL for CLIMATE: C-ROADS (SIMULATION)
150 / 0
GLOBAL CO₂ EMISSIONS
2000 2040 2080

2M 2100

SEA LEVEL RISE
WARM WATER EXPANDS
MELTING of GLACIERS and ICE SHEETS

CLIMATE
BIODIVERSITY LOSS
PHOSPH.
NITROGEN
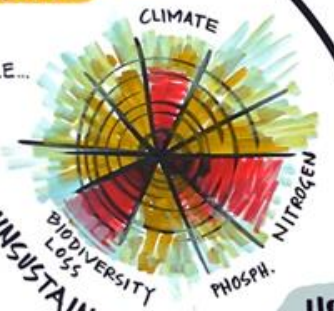
UNSUSTAINABLE SUSTAINABLE

HOW HUMANS CURRENTLY INHABIT OUR PLANET

REGENERATE ① RENEWABLE RESOURCES — DEGRADATION +

② BREAKDOWN and RECYCLING POLLUTION WASTE GENERATION + HUMAN ACTIVITY

③ NON-RENEWABLES EXTRACTION +

TEMPERATURE
5 / 2.5 — GOAL / 0
2000 2080

OCEAN ACIDIFICATION
ORGANISMS CANNOT form SHELLS
BASE of FOOD CHAIN HARMED

WEATHER
+ DROUGHT ← → + DAMAGING RAINS
+ STORM SURGES
+/- 4M SEA RISE

CORN - RISE - WHEAT - SOY AGRICULTURE

RESOURCE STRETCH — WHERE DO HUMANS GO?!

1 EARTH but OUR FOOTPRINT on AVERAGE is 1.5

1. STOP SUBSIDIES for HARMFUL EXTRACTION & FOSSIL FUELS
2. CHANGE BEHAVIORS

WE HAVE DONE IT BEFORE!

THERE IS NO BAILOUT AVAILABLE!

YES... MAKE HARD CHOICES   NO...

STOCKS

HUMAN MIGRATION

TURMOIL and CHAOS

The Cool Conservatories and Supertrees, as an integrated system, showcases the application of sustainable energy solutions.

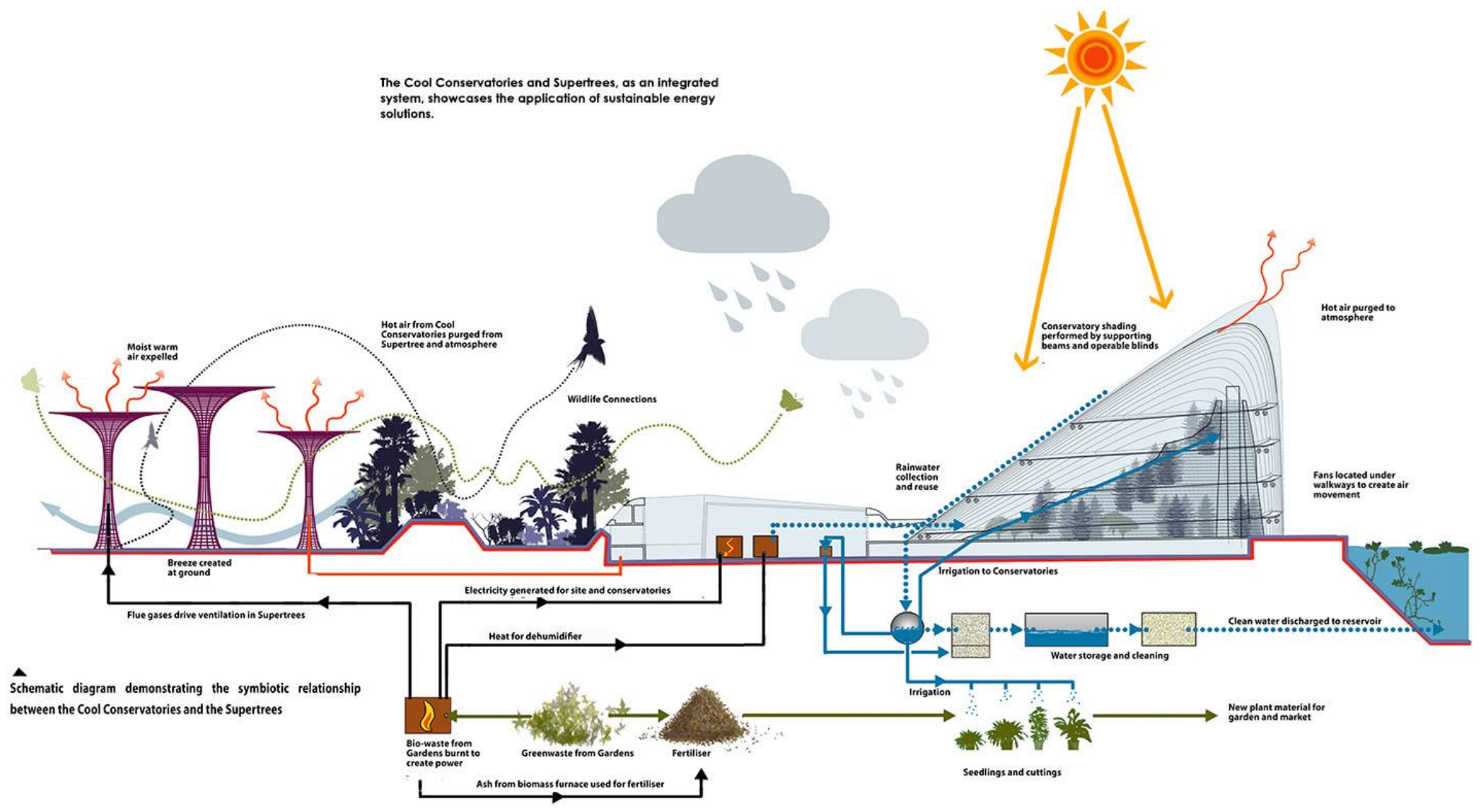Moist warm air expelled

Hot air from Cool Conservatories purged from Supertree and atmosphere

Wildlife Connections

Conservatory shading performed by supporting beams and operable blinds

Hot air purged to atmosphere

Rainwater collection and reuse

Fans located under walkways to create air movement

Breeze created at ground

Irrigation to Conservatories

Electricity generated for site and conservatories

Flue gases drive ventilation in Supertrees

Heat for dehumidifier

Clean water discharged to reservoir

Water storage and cleaning

Irrigation

Schematic diagram demonstrating the symbiotic relationship between the Cool Conservatories and the Supertrees

New plant material for garden and market

Bio-waste from Gardens burnt to create power

Greenwaste from Gardens

Fertiliser

Seedlings and cuttings

Ash from biomass furnace used for fertiliser

System Map
water infrastructure - Level 1

FIGURE 1 | DSRP map of urban water infrastructure in an SES context. Dots indicate the number of distinctions made for system parts. Parts are expanded in subsequent maps. Map originated with Plectica.
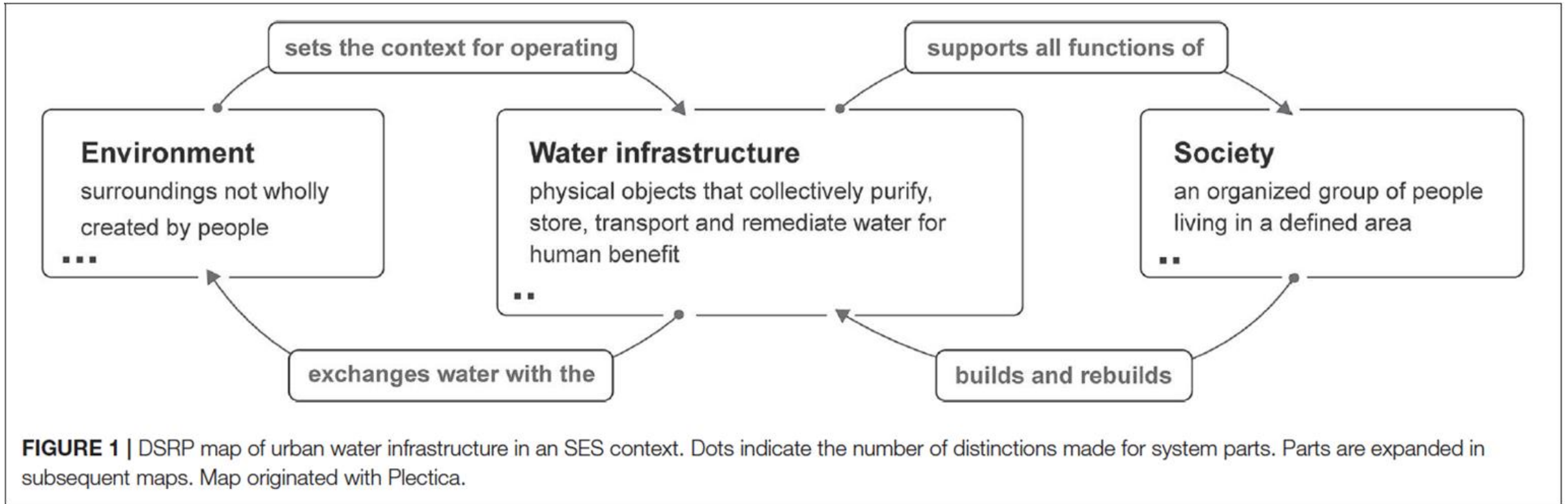
System Map

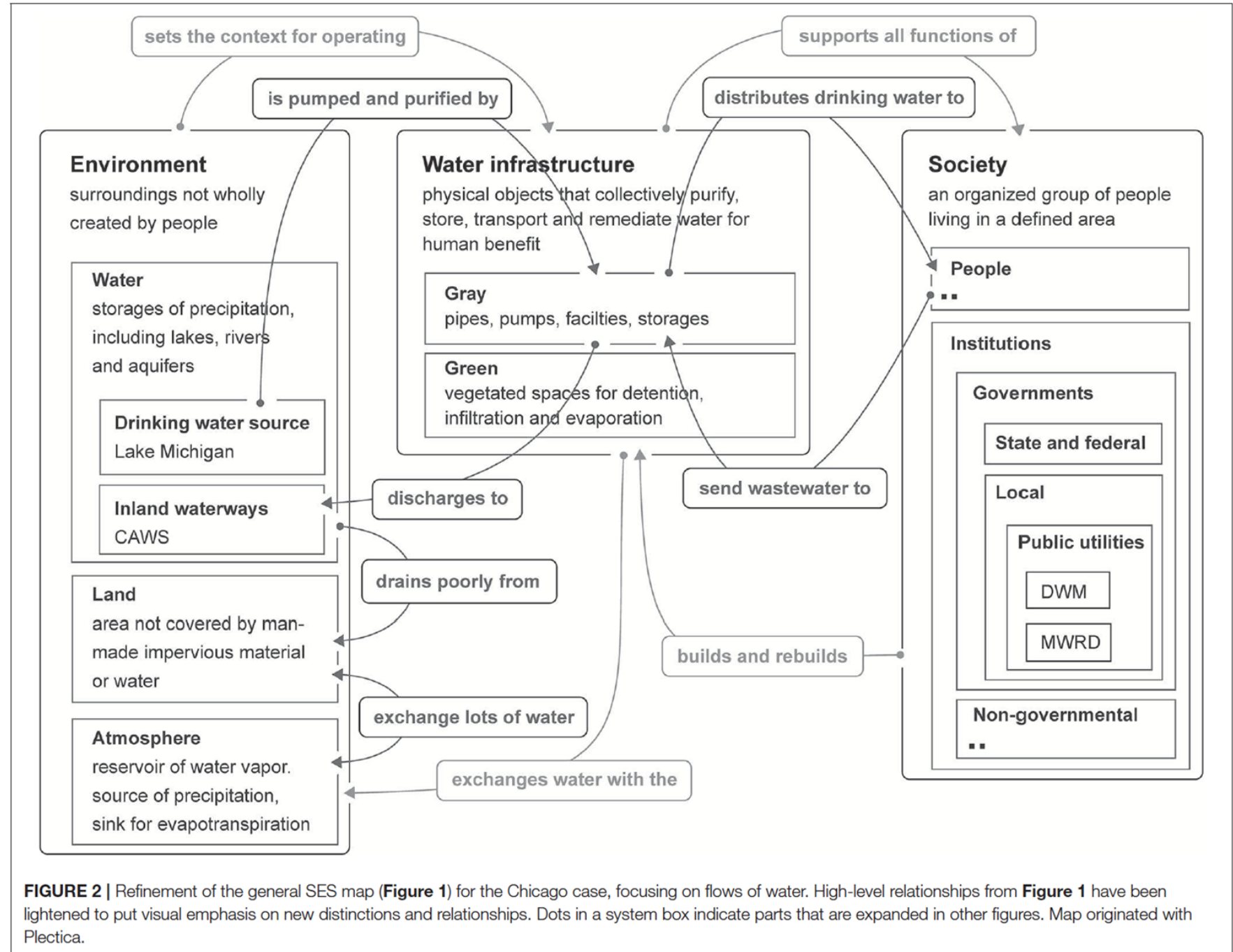# water infrastructure

Level 2

FIGURE 2 | Refinement of the general SES map (**Figure 1**) for the Chicago case, focusing on flows of water. High-level relationships from **Figure 1** have been lightened to put visual emphasis on new distinctions and relationships. Dots in a system box indicate parts that are expanded in other figures. Map originated with Plectica.

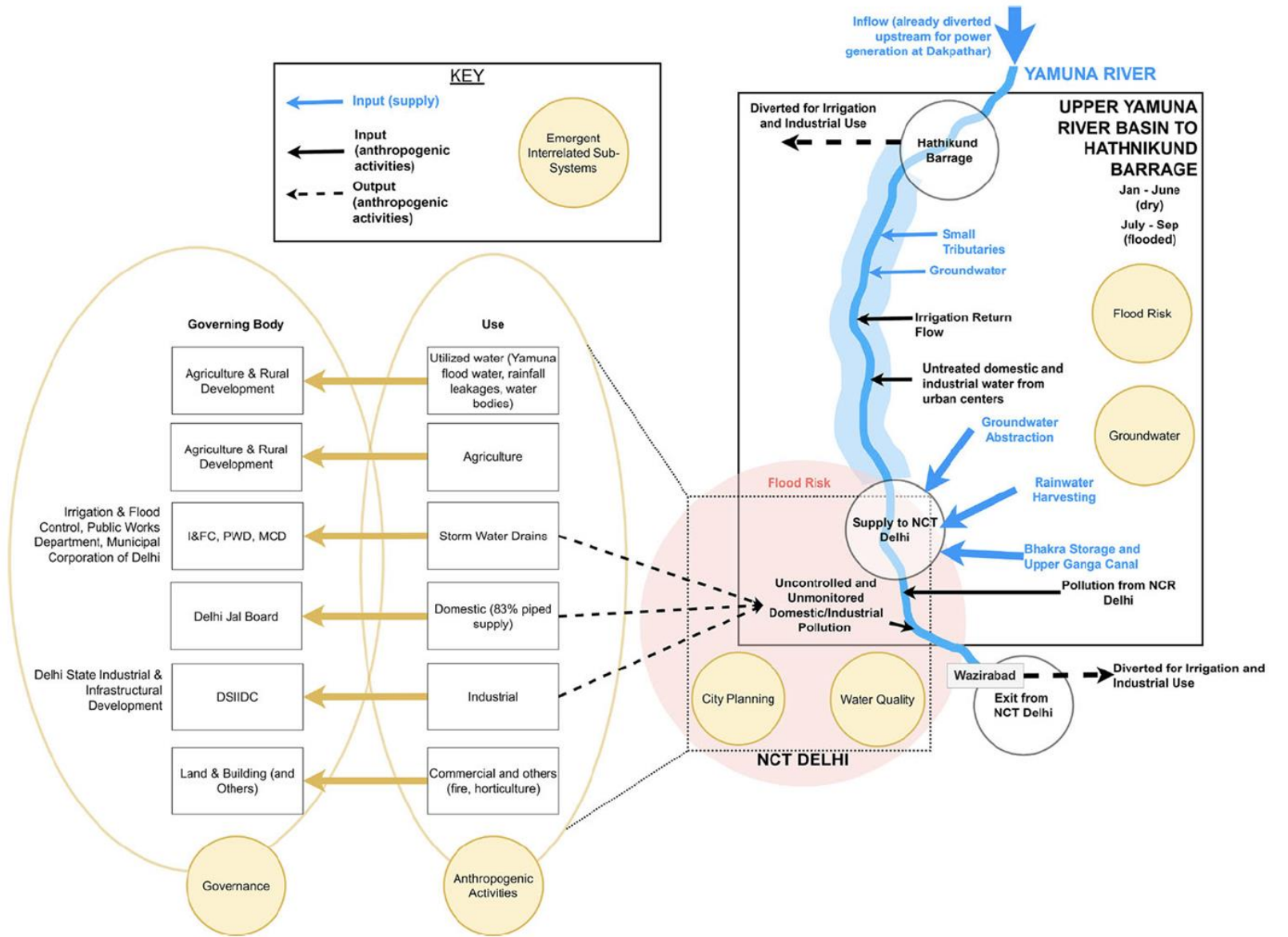# System Map water security data system

Figure 2. Upper Yamuna River Basin (UYRB) Water Security Data System from National Capital Territory (NCT) Delhi to Hathnikund Barrage.

Polaine et al. (2022)
https://doi.org/10.1080/10286608.2022.2108806

Social Ecosystem Map

Peter Jones & Kristel Van Ael (2022)

BIO-ECOSYSTEM
Bioregions, Watersheds, Ecotones

MACROSYSTEM
Culture, Government, Nationality

EXOSYSTEM
Companies, Institutions, Organisations

MESOSYSTEM
Workplaces, Schools, Religious centres

MICROSYSTEM
Local community

INTERPERSONAL
Person, Family, Friends

e.g. spirituality

e.g. religion

e.g. religious institutions

e.g. peer/family interactions

e.g. family dynamics

e.g. family

e.g. peer/family interactions

e.g. peers

e.g. P2P interaction

e.g. political parties

e.g. national identity

e.g. territory

Social Ecosystem Map

Peter Jones & Kristel Van Ael (2022)

Interpersonal: Individual actors;

Microsystem: everyday social context in the geography and society - e.g. workplaces, neighborhoods;

Mesosystem: structured community and organizational settings - e.g. company structure, schools, the local community in a city;

Exosystem: companies, industry, healthcare institutions, municipal or regional government;

Macrosystem: national culture, political context, economy, factors influencing quality of life - e.g. information and media sources, population demographics;

Bio-ecosystem: natural environment - e.g. watersheds, health of flora and fauna, biodiversity, pollution effects;

'force lines' indicate relational dynamics within and across levels

BIO-ECOSYSTEM
Bioregions, Watersheds, Ecotones

MACROSYSTEM
Culture, Government, Nationality

EXOSYSTEM
Companies, Institutions, Organisations

MESOSYSTEM
Workplaces, Schools, Religious centres

MICROSYSTEM
Local community

INTERPERSONAL
Person, Family, Friends

e.g. peer/family interactions

e.g.spirituality

e.g.religion

e.g. religious institutions

e.g. family dynamics

e.g. family

e.g. peers

e.g. peer/family interactions

e.g. political parties

e.g. P2P interaction

e.g. national identity

e.g. territory

Peter Jones & Kristel Van Ael (2022)

Mapping Exercise

Let's dive deeper and explore how we can map out systems in different ways.

1. Choose an opportunity card as a team (10 mins)

2. Share and review the information on the opportunity card (10 mins)

3. Map the systems related to the opportunity card using the Social Ecosystem Map structure (30 mins)