Global Platform for Sustainable Cities | Resource Team

Nature-based solutions in cities

February 25, 2020

gef

Global Platform for Sustainable Cities

WORLD RESOURCES INSTITUTE | ROSS CENTER

C40 CITIES

ICLEI Local Governments for Sustainability

NATURE BASED SOLUTIONS IN CITIES

Dealing with a changing climate and ongoing urbanization including loss of forest and natural land; there has been a further call for nature-based solutions in the development of urban areas. For achieving a healthy and liveable city, we need to consider a city that provides ecosystem services and a healthy natural environment, thereby offering a range of social, ecological, and economic benefits. After all, as people, we are part of the urban ecosystem or 'ecopolis'. In this webinar we will discuss:

- *The city in its natural landscape.*
- *What are nature-based solutions?*
- *Water-Sensitive Urban Design.*
- *Nature-Based Solutions for developing climate resilient pathways.*
- *Applications in practice; case of São Paulo.*

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AGENDA

- 5 mins introduction
- 30 mins presentation
- 25 Q&A

REMEMBER

- Mute yourself
- If you are joining by phone and computer, mute your computer audio
- Use the chatbox to write questions or unmute yourself during the Q&A session

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Nanco Dolman is a leading professional in water resilient cities at Royal HaskoningDHV.

Nanco has worked in various adaptation strategies for delta cities, like the 'Bangkok Adaptive City 2045' (Chao Phraya River, Thailand), the 'Rotterdam Adaptation Strategy' (New Meuse River, the Netherlands), the 'Greater New Orleans Urban Water Plan' (Mississippi River, USA), the 'Comprehensive Urban Water Strategy for Hoboken' (Hudson River, USA), 'Water as Leverage for Khulna' (Bhairab River, Bangladesh), 'Xiong'an new district ecological – sponge city masterplan' (Baiyang Lake, China) and the 'Adaptation Strategy for Zwolle' (IJssel-Vechtdelta, the Netherlands).

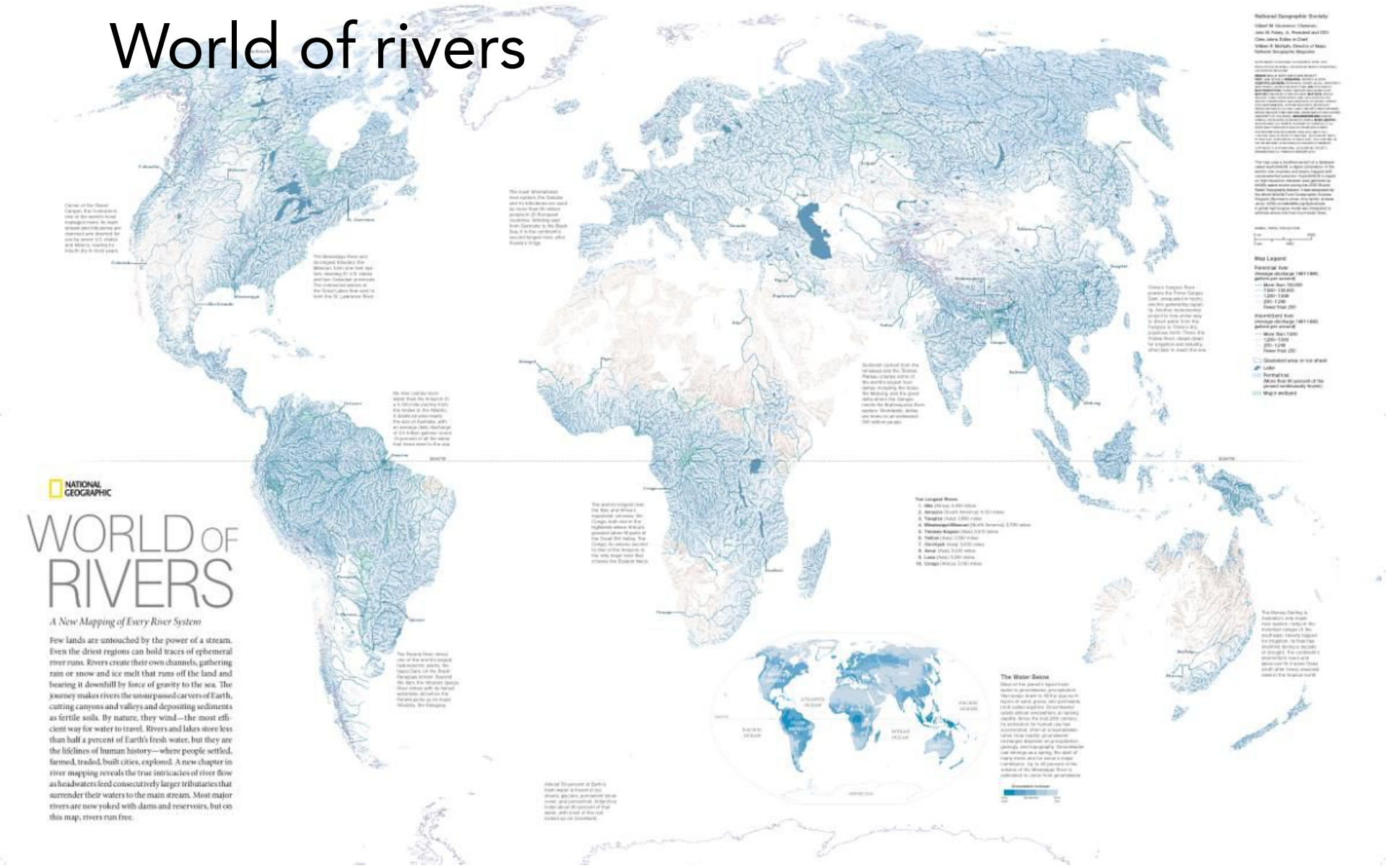
From 2011 to 2016 Nanco was part time lecturer Adaptive Urban Development at Rotterdam University of Applied Sciences.

Nanco has a MSc in Civil Engineering from Delft University of Technology (1998) and a BLA in landscape architecture from Amsterdam Academy of Architecture (2008).

Table of content

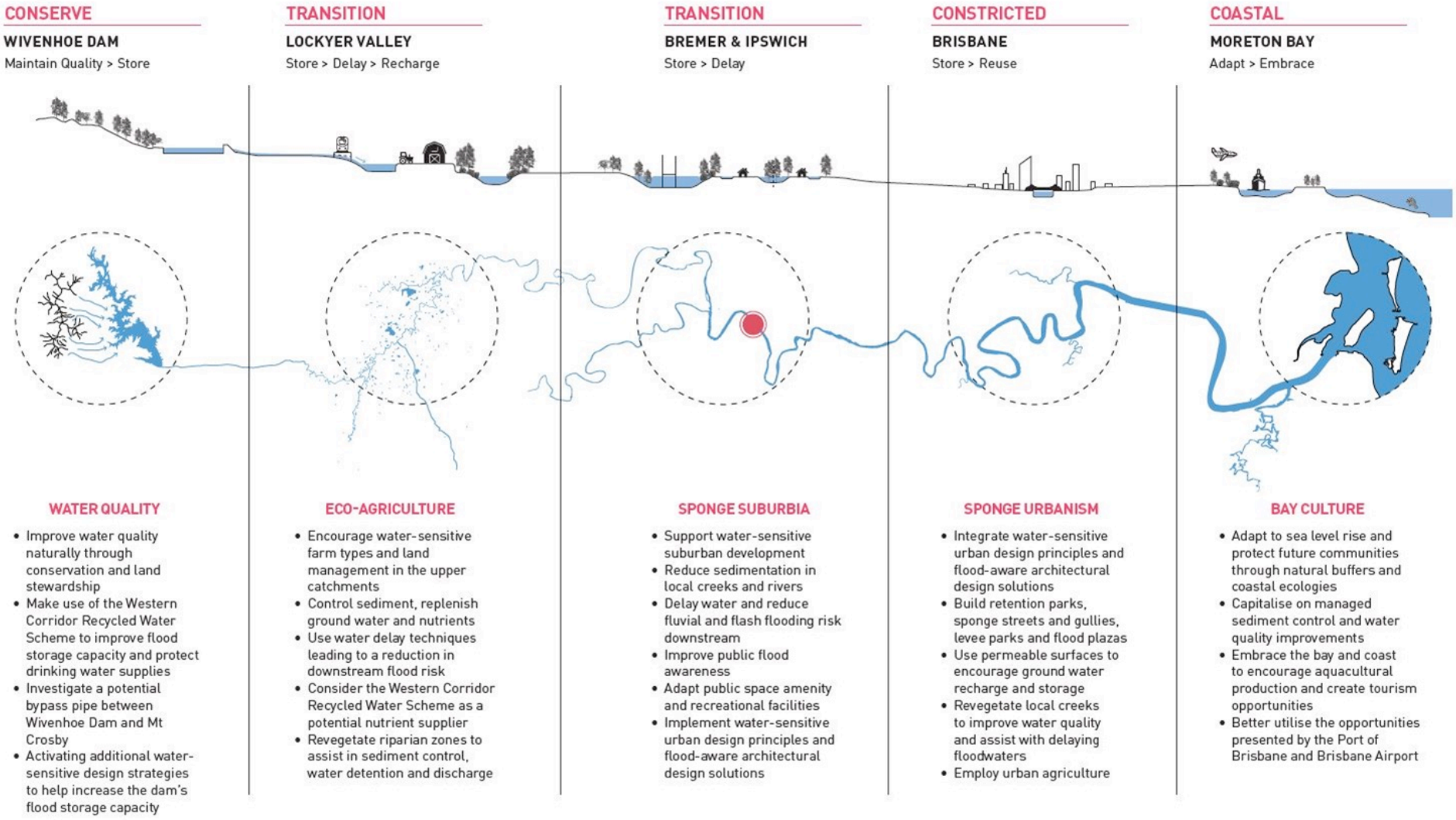
A. The city in its natural landscape

World of rivers

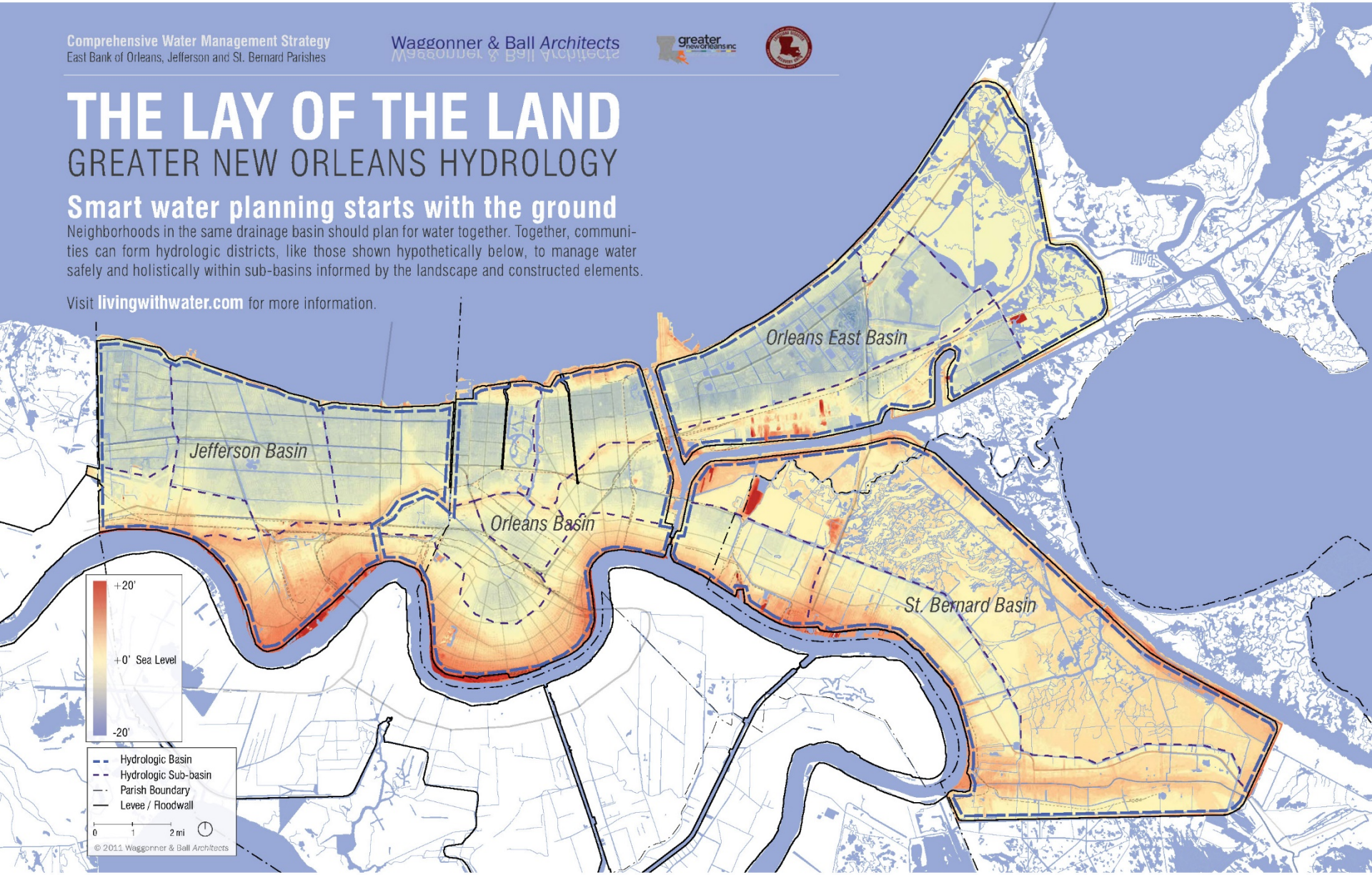


World of cities

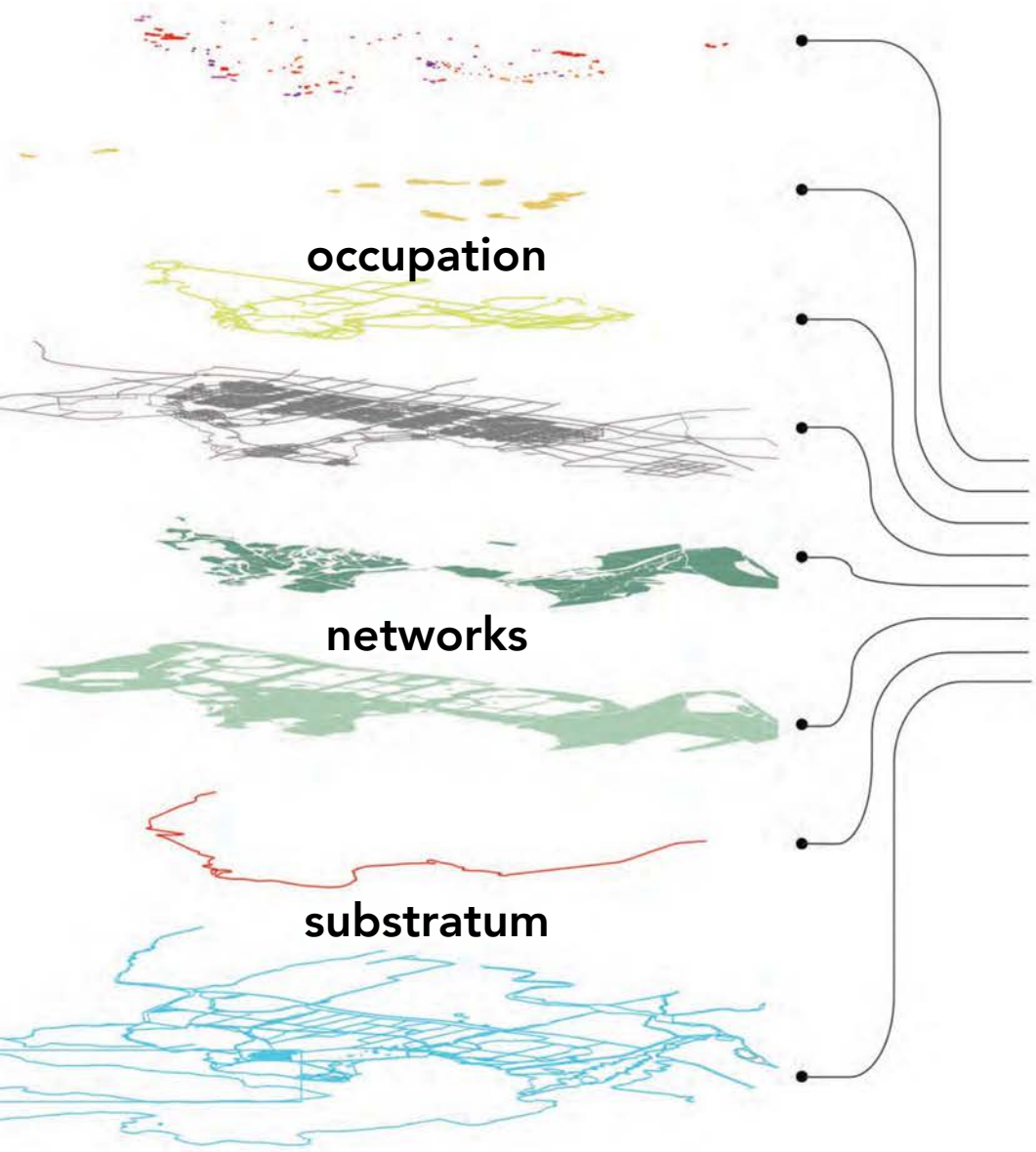
Fluvial transect – cities as water catchments



Source: Brisbane river


Comprehensive Water Management Strategy
East Bank of Orleans, Jefferson and St. Bernard Parishes
Waggonner & Ball Architects
greater new orleans inc
THE LAY OF THE LAND
GREATER NEW ORLEANS HYDROLOGY
Smart water planning starts with the ground
Neighborhoods in the same drainage basin should plan for water together. Together, communities can form hydrologic districts, like those shown hypothetically below, to manage water safely and holistically within sub-basins informed by the landscape and constructed elements.
Visit livingwithwater.com for more information.
Orleans East Basin
Jefferson Basin
Orleans Basin
St. Bernard Basin
+20'
+0' Sea Level
-20'
Hydrologic Basin
Hydrologic Sub-basin
Parish Boundary
Levee / Floodwall
0
1
2 mi
© 2011 Waggonner & Ball Architects

Layers approach to spatial planning & design

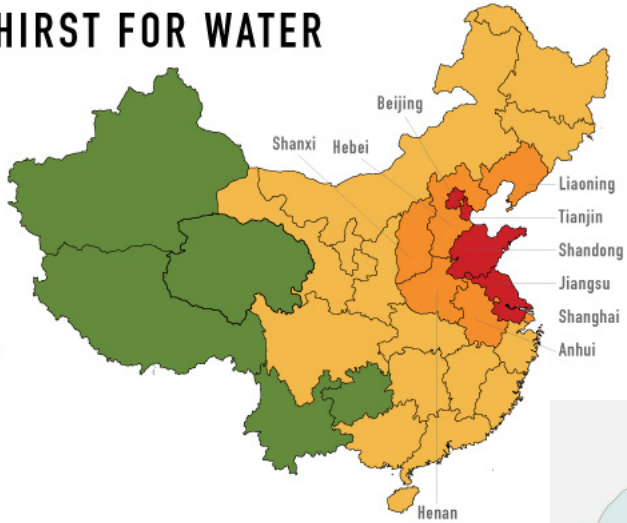


(West 8 | RHDHV, 2018)

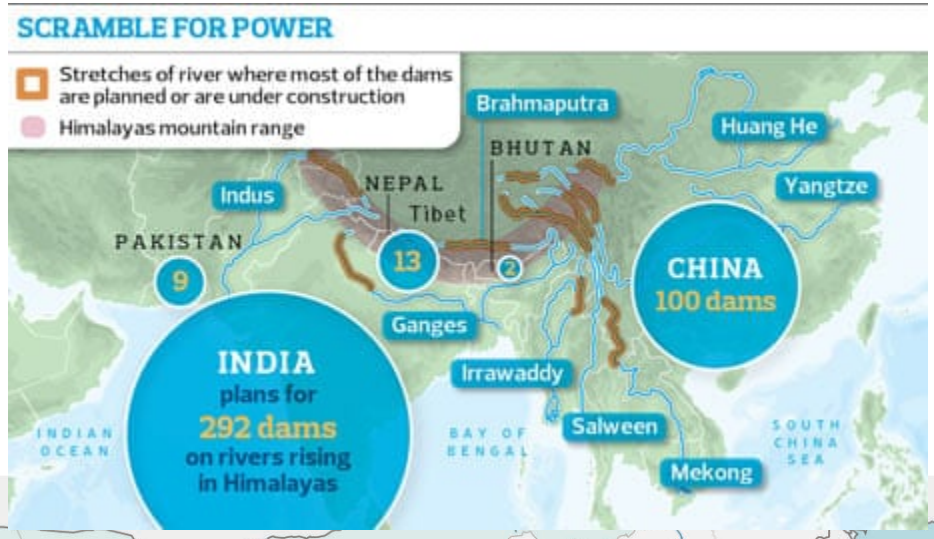
Pressure on water resources

CHINA'S THIRST FOR WATER

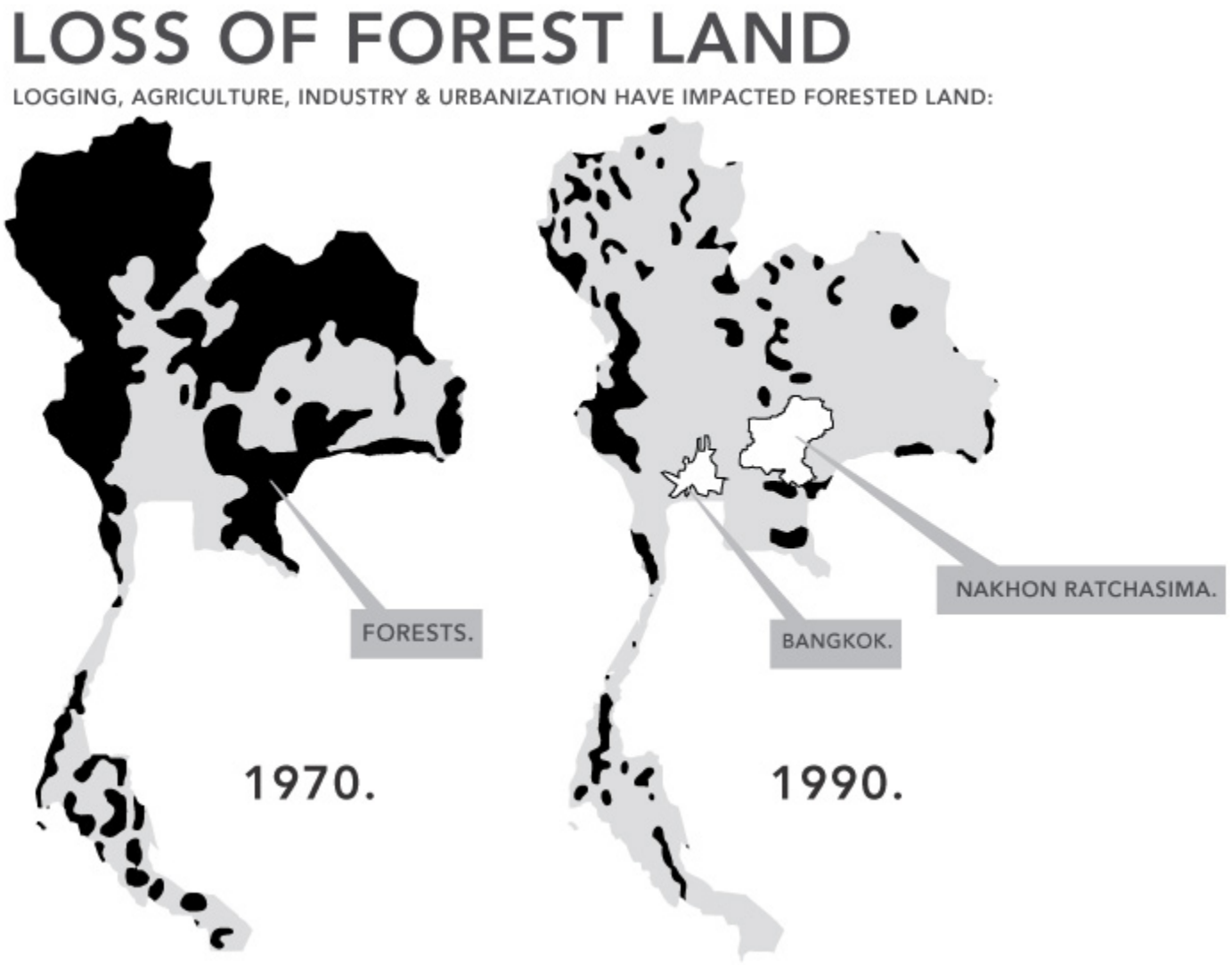
Four major Chinese provinces are at "extreme risk" of water shortages according to the China Water Stress Index from risk analysis company Maplecroft. Researchers compared the amount of renewable water supplies from rain, streams and rivers with typical usage by households, farms and factories and found that in some provinces people are simply using too much.



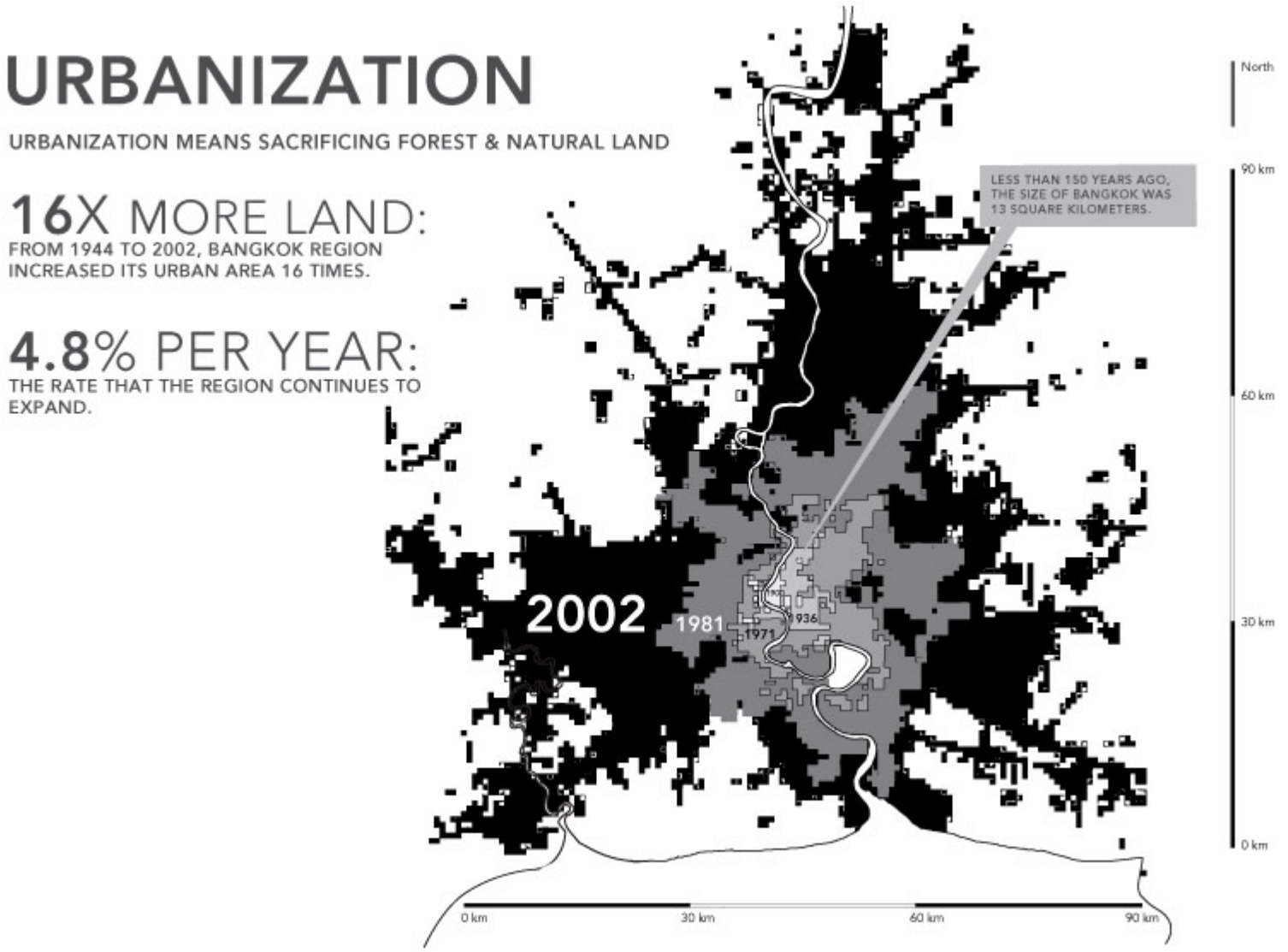
Low risk
Medium risk
High risk
Extreme risk



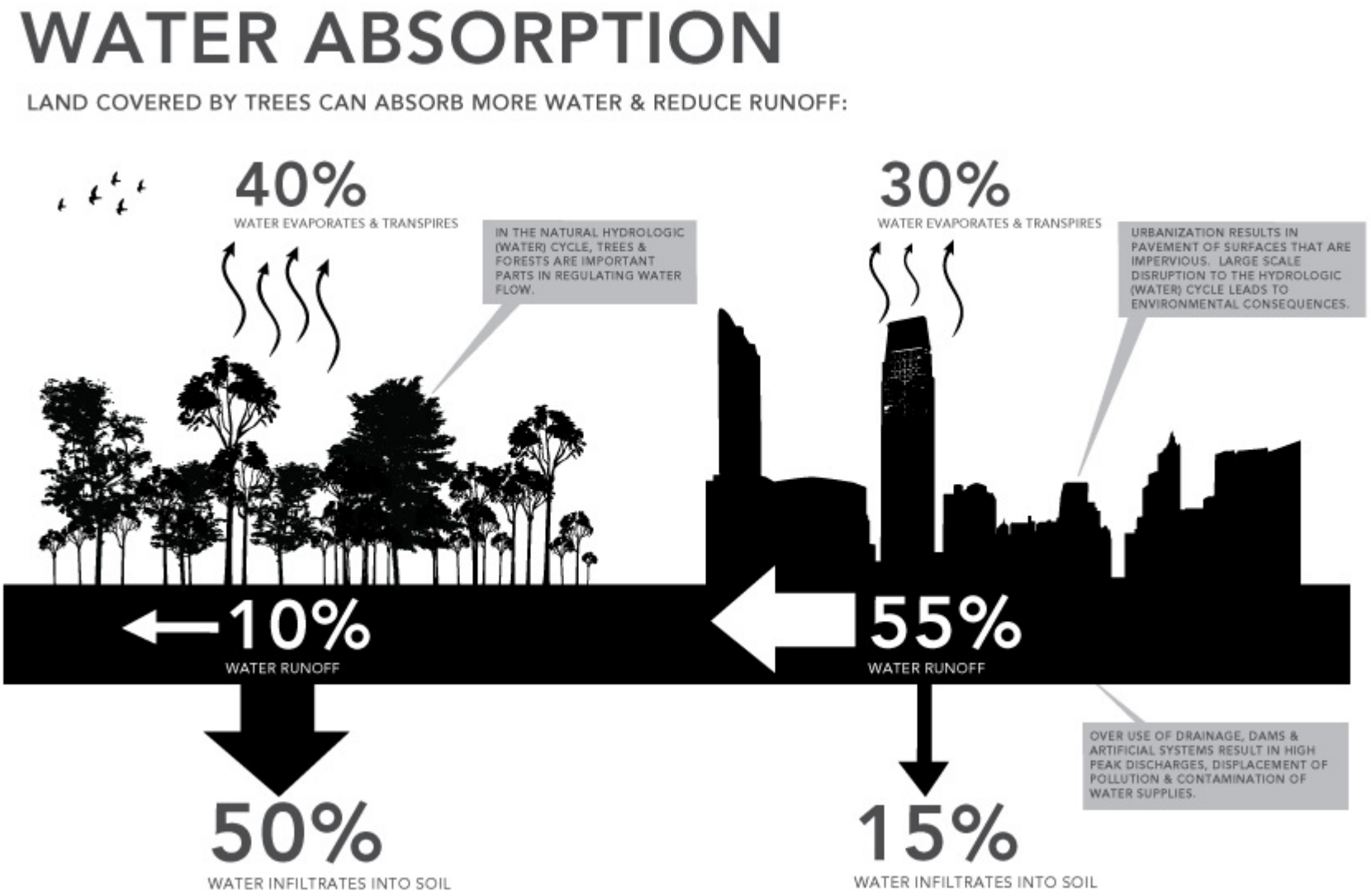
Deforestation in river catchments



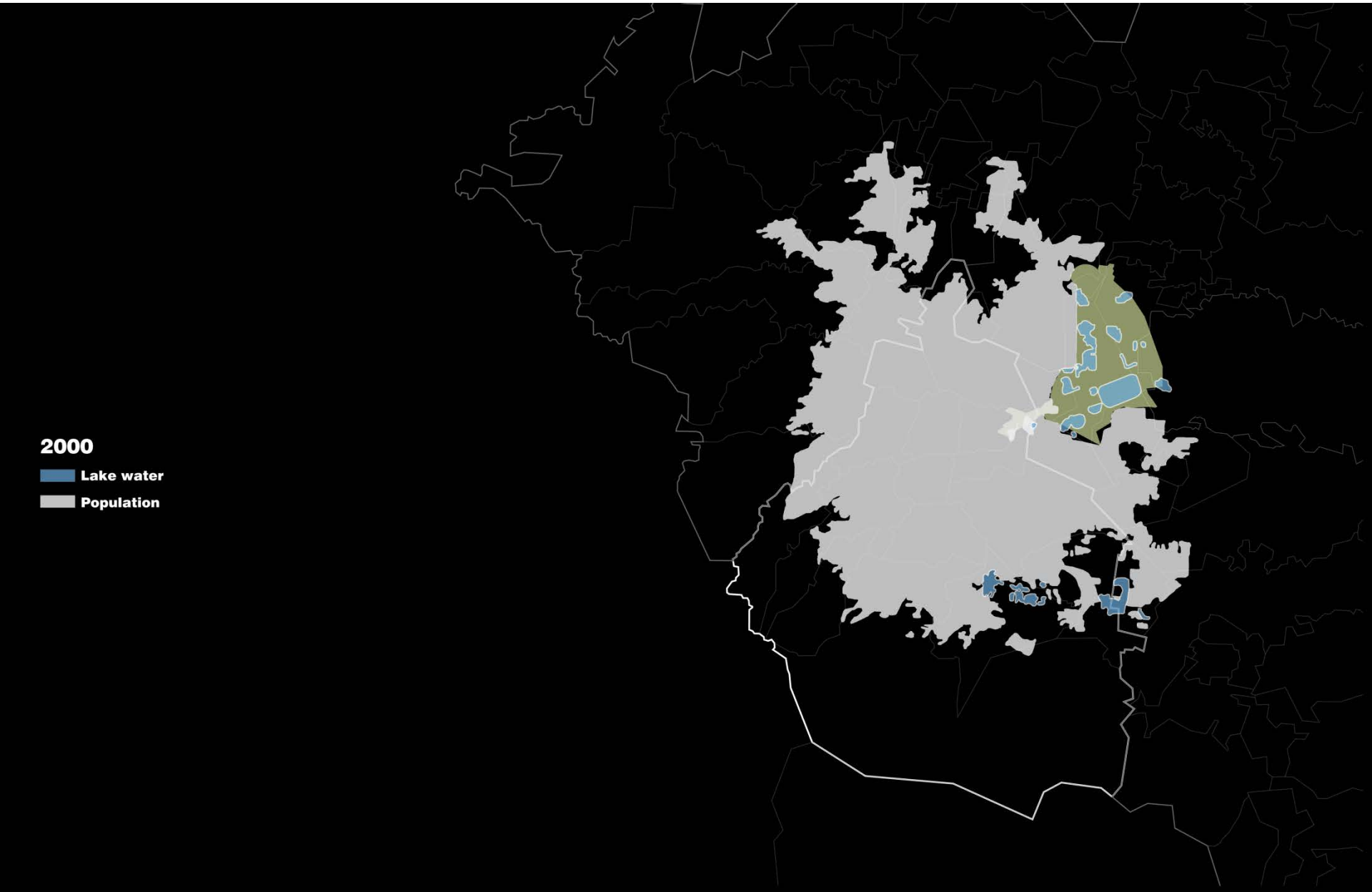
Progress of urbanization



Imbalance of natural and urban water system



Urbanization Mexico City valley



Mexico city in lake Texcoco (today)

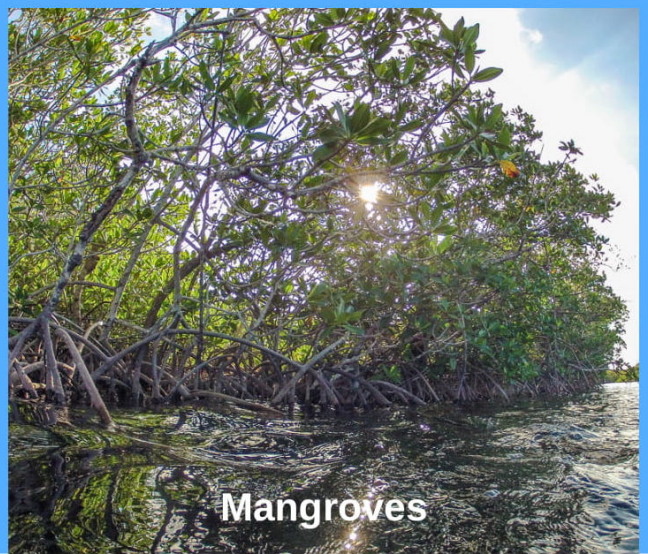
B. What are Nature Based Solutions?

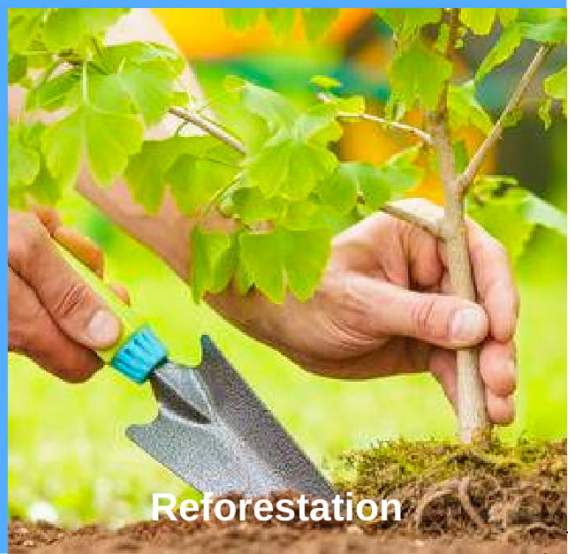
Nature-Based Solutions (NBS)

- Refers to the sustainable management and use of nature for tackling socio-environmental challenges, that include climate change, water security, water pollution, food security, human health and disaster risk management.

- Defined as actions to protect, sustainably manage, and restore natural or modified ecosystems, which address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits.

Types of Nature-based Solutions





“Existing” natural areas

City Park/ Bayou, New Orleans, USA

Constructed areas

Mirabeau Water Garden, New Orleans, USA
NB; to store 6.5 million gallons of floodwater

NBS in cities

We need to move towards a combination of
- technological solutions and
- Nature-Based Solutions.

"Nature as the inspiration for climate & multifunctional solutions."

Goals:
- Enhancing sustainable urbanization
- Restoring degraded ecosystems
- Developing climate change adaptation and mitigation
- Improving risk management and resilience

Recommended actions in urban planning

- Urban regeneration through nature-based solutions
- Nature-based solutions for improving well-being in urban areas

- Establishing nature-based solutions for coastal resilience

- Multi-functional nature-based watershed management and ecosystem restoration

- Nature-based solutions for increasing the sustainable use of resources and energy
- Nature-based solutions and the insurance value of ecosystems

- Increasing carbon sequestration through nature-based solutions

C. Water-Sensitive Urban Design

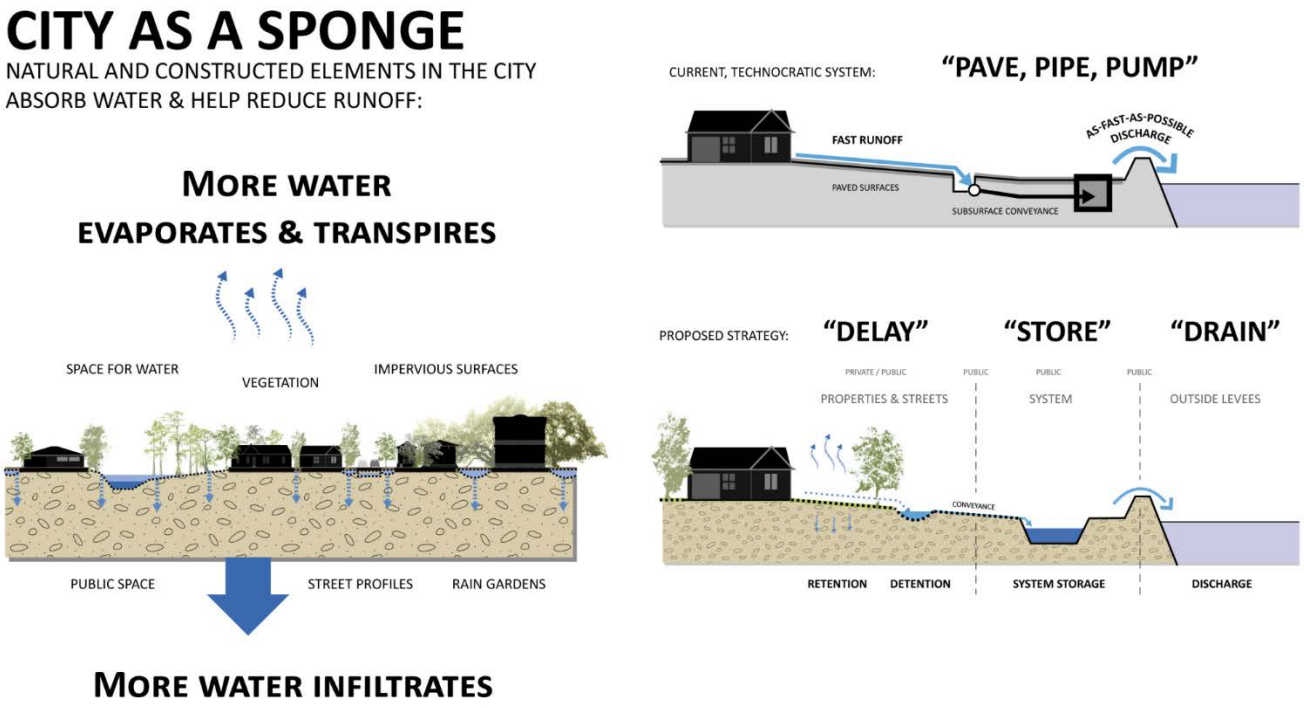
What is Water Sensitive Urban Design?

- Water Sensitive Urban Design (WSUD) is the **interdisciplinary cooperation** of water management, urban design, and landscape planning.

- WSUD develops integrative strategies for **ecological, economical, social, and cultural** sustainability.

http://www.switchtraining.eu/fileadmin/template/projects/switch_training/files/Resources/UNESCO-IHE_2008_Natural_systems_in_urban_water_management.pdf

“Living with water” principles



Source: Three-stage approach of quantitative water management, as:

- Proposed in 4th Water Management Memorandum (1998);
- Included in 21st Century Water Management report (2000).

RDSD-strategy – Rebuild by Design (2013)

A COMPREHENSIVE URBAN WATER STRATEGY

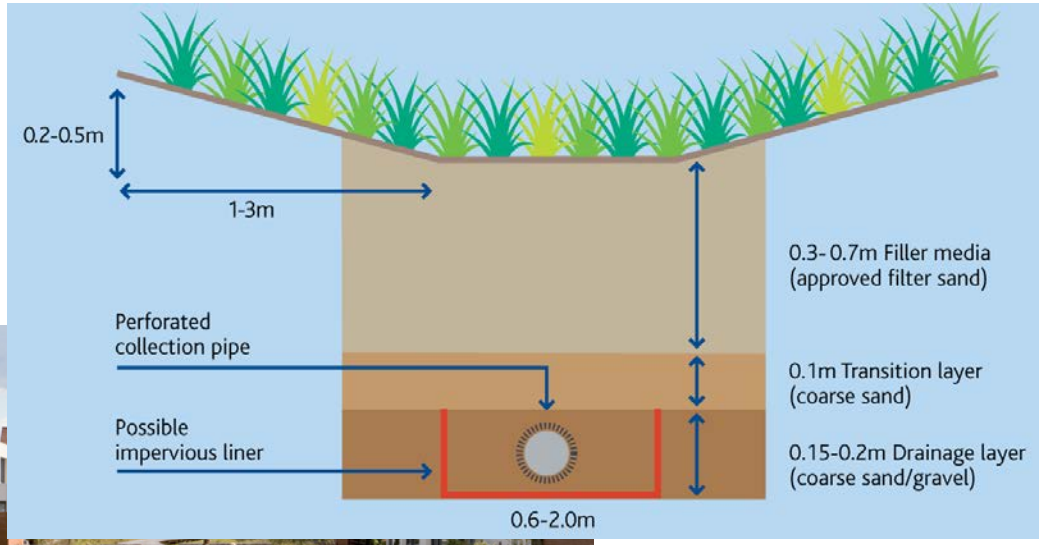
OMA AMO HR&A Royal HaskoningDHV BALMORI

Basic elements of WSUD

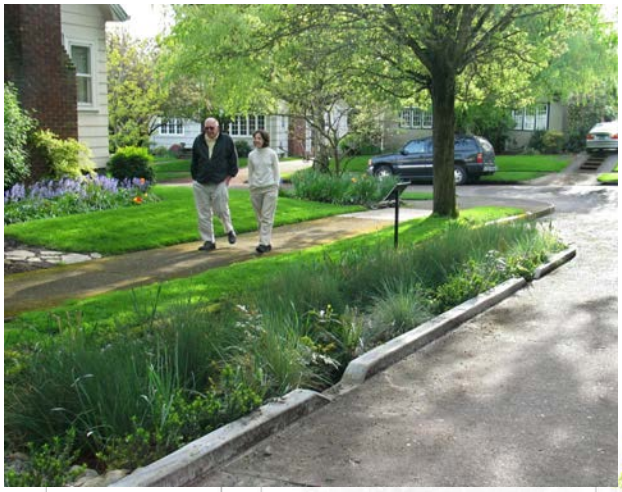
User	Fact Sheet number	Fact Sheet	Stormwater		Wastewater	Aesthetic value	Application Type			
			Quality	Retention			Small	Medium	Large	Broad
Household	1.	Water sensitive homes	–	–	–	–	•			
	2.	Household rainwater tanks	✓	✓	–	–	•			
	3.	Sizing a rainwater tank	✓	✓	–	–	•			
	4.	Porous paving	✓	✓	×	×	•	•	•	•
	5.	Site layout and landscaping	✓	✓	×	×	•			
Developers, Council planners, architects, engineers	6.	Water conservation initiatives	–	–	–	–	•	•	•	
	7.	Waterway rehabilitation	✓	×	×	✓		•	•	•
	8.	Rainwater tanks	✓	×	×	×		•	•	•
	9.	Gross pollutant trap	✓	✓	×	✓?		•	•	•
	10.	Sedimentation (settling)	✓	✓	✓?	✓	?	•	•	•
	11.	Ponds and lakes	✓	✓	–			•	•	•
	12.	Vegetated swales and buffer strips	✓	×	×	✓	•	•	•	•
	13.	Raingardens	✓	×	×	✓	•	•	•	•
	14.	Raingarden tree pit	✓	×	×	✓		•	•	•
	15.	Surface wetlands	✓	✓	✓?	✓		?	•	•
	16.	Subsurface flow wetlands	✓?	✓?	✓?	✓	•	•	•	
	17.	Suspended growth biological processes	×	×	✓	×	?	•	•	•
	18.	Fixed growth biological processes	×	×	✓	×	?	•	•	•
	19.	Recirculating media filter	×	×	✓	×	?	•	•	
	20.	Sand and depth filtration	×	×	✓	×	?	•	•	
	21.	Membrane filtration	×	×	✓	×	?	•	•	•
	22.	Disinfection	×	–	✓	×	?	•	•	•

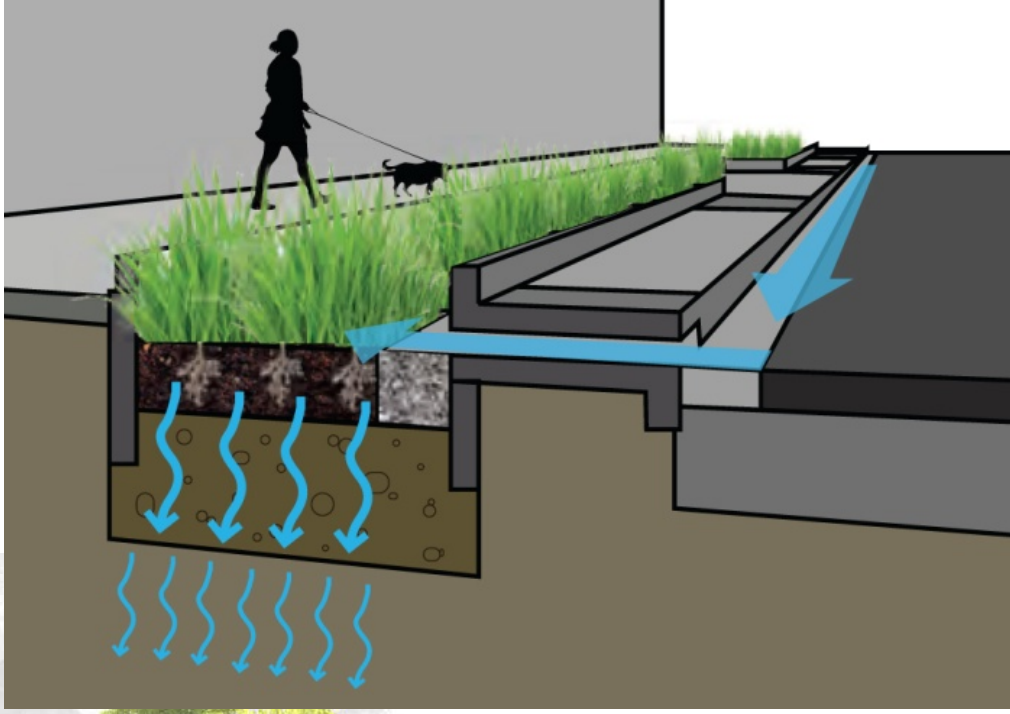
✓ = Primary purpose ✓? = Some impact but not primary purpose × = Does not contribute
– = not applicable ? = possibly applicable • = applicable

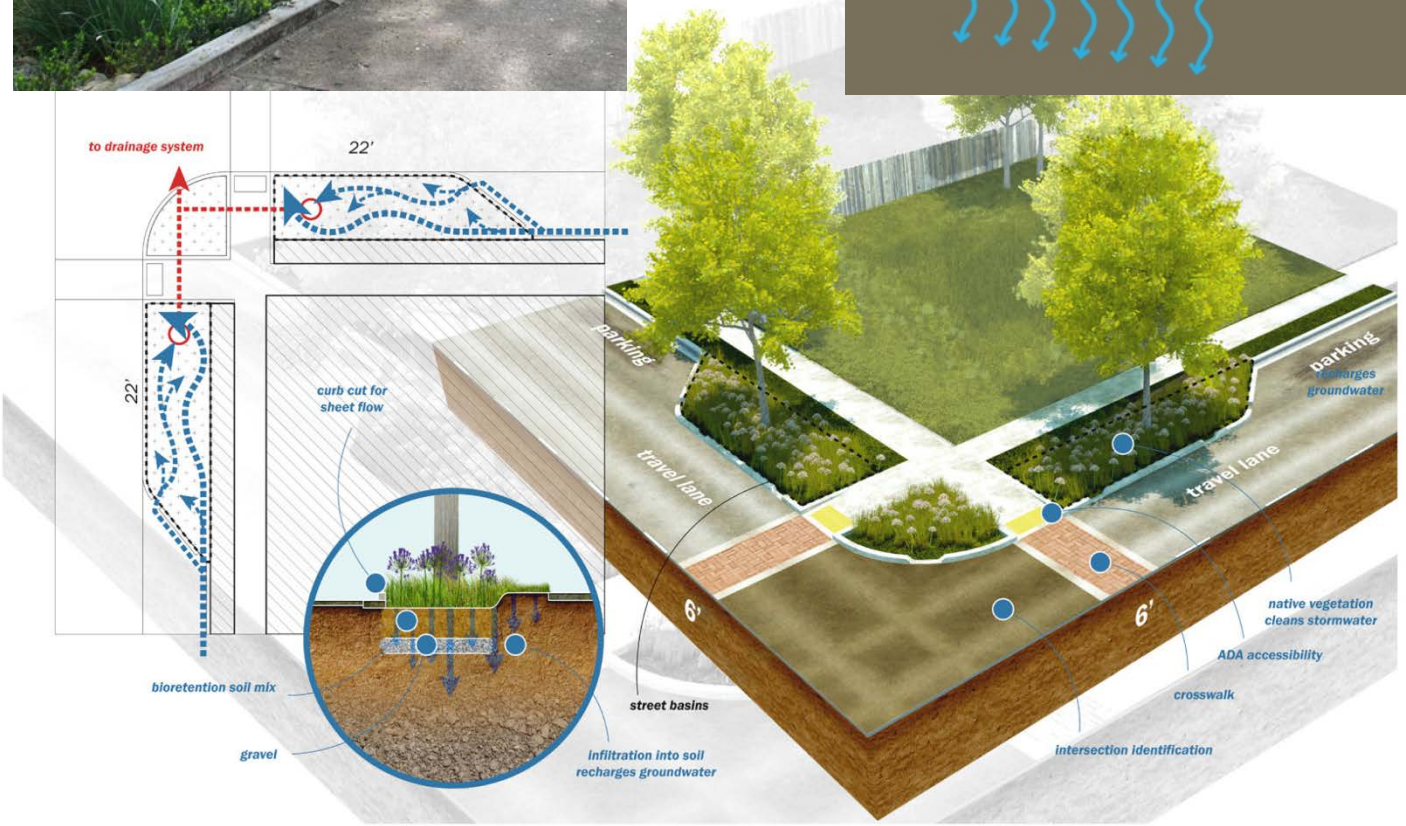
Grassed or vegetated swales



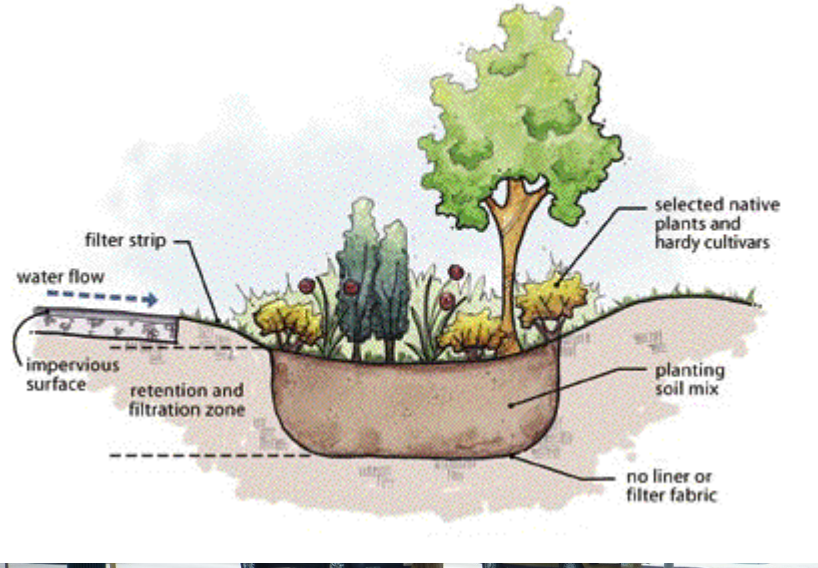
Filtration trenches

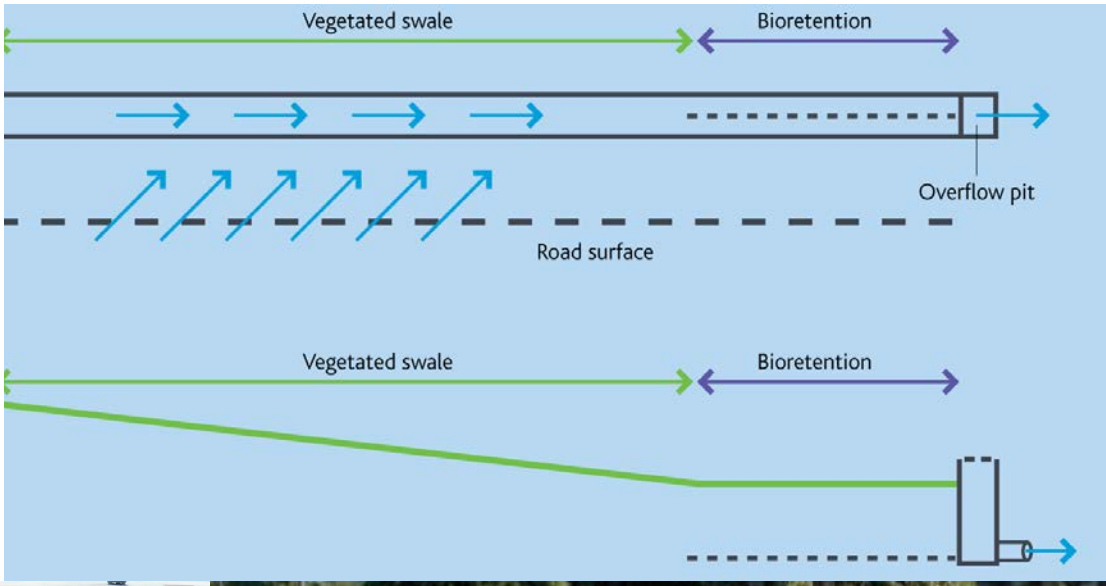




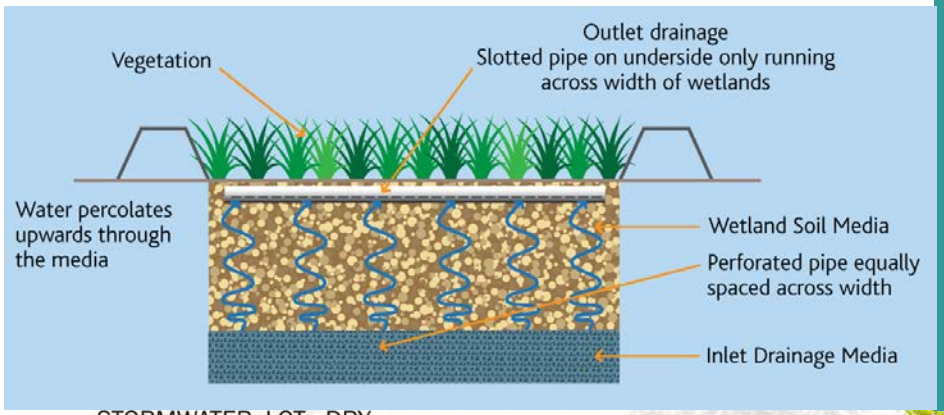


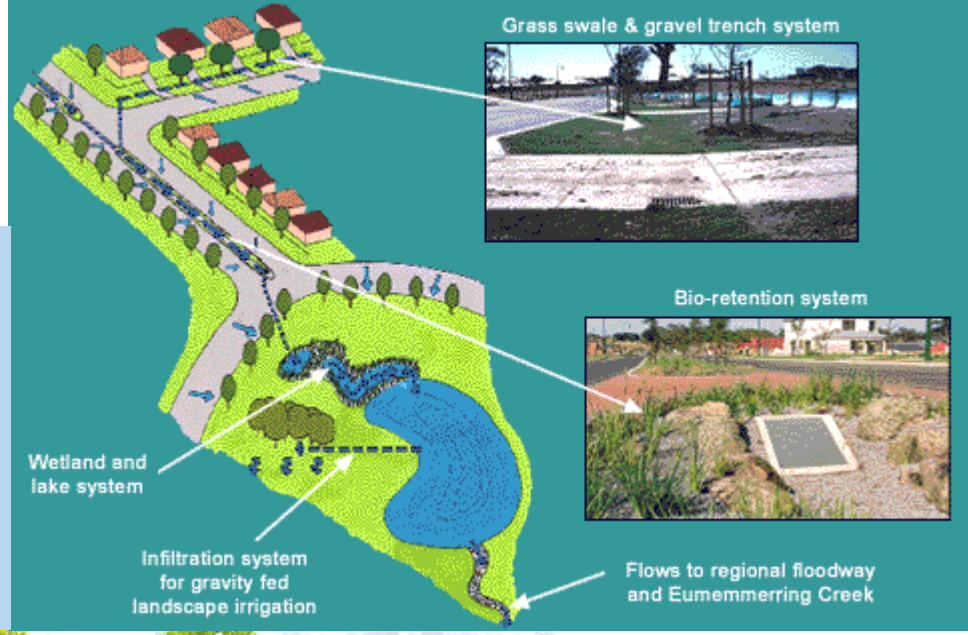
Bio-retention systems

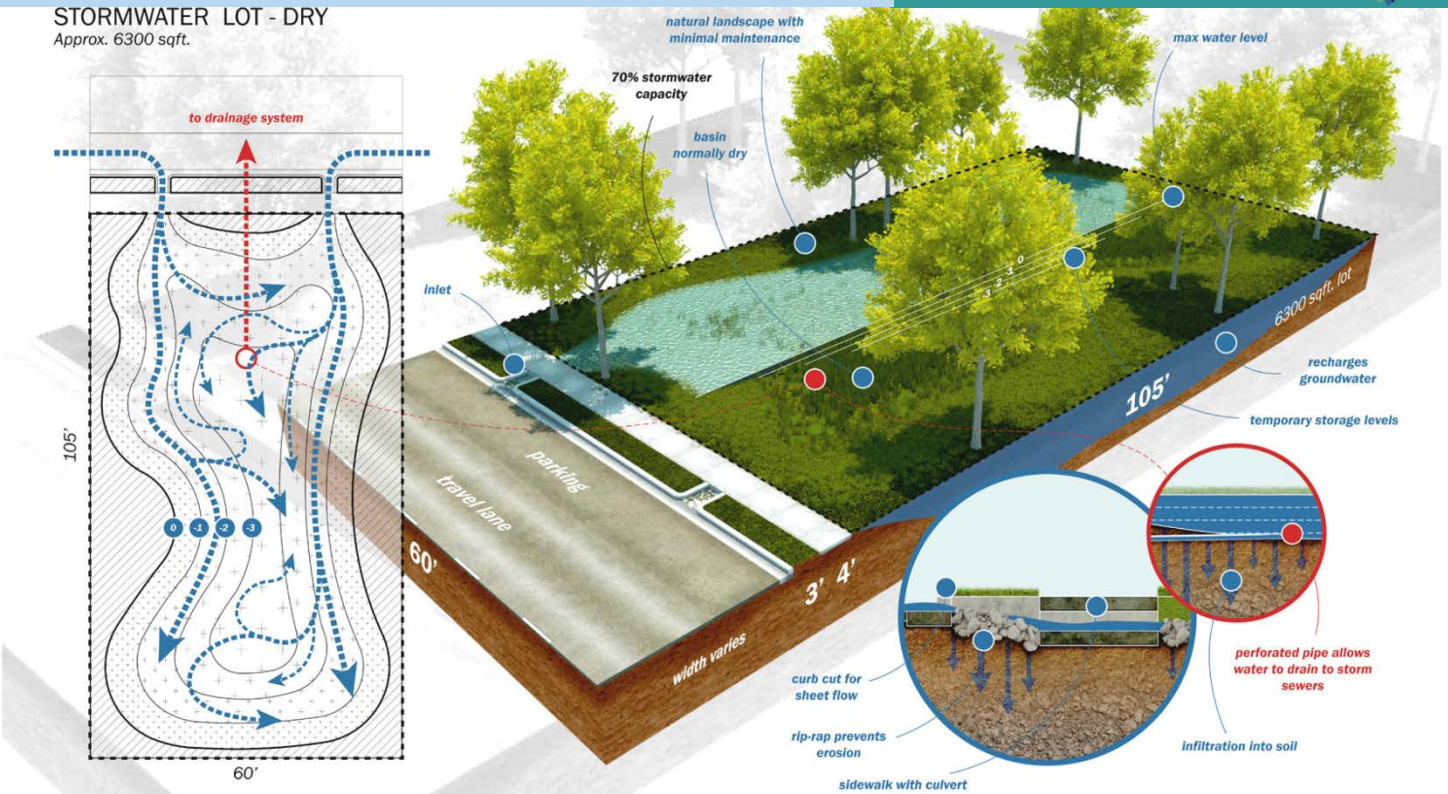




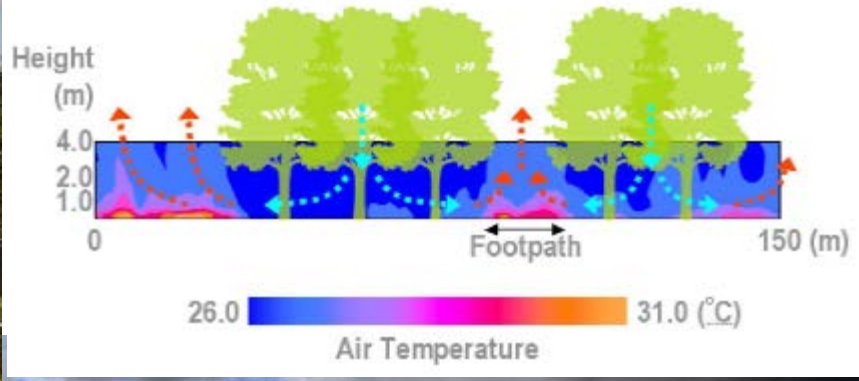
Wetlands


Vegetation
Outlet drainage
Slotted pipe on underside only running across width of wetlands
Water percolates upwards through the media
Wetland Soil Media
Perforated pipe equally spaced across width
Inlet Drainage Media


Grass swale & gravel trench system
Bio-retention system
Wetland and lake system
Infiltration system for gravity fed landscape irrigation
Flows to regional floodway and Eumemmerring Creek


STORMWATER LOT - DRY
Approx. 6300 sqft.
to drainage system
105'
60'
natural landscape with minimal maintenance
70% stormwater capacity
basin normally dry
max water level
inlet
6300 sqft. lot
recharges groundwater
105'
temporary storage levels
parking
travel lane
60'
3'
4'
width varies
curb cut for sheet flow
rip-rap prevents erosion
sidewalk with culvert
perforated pipe allows water to drain to storm sewers
infiltration into soil

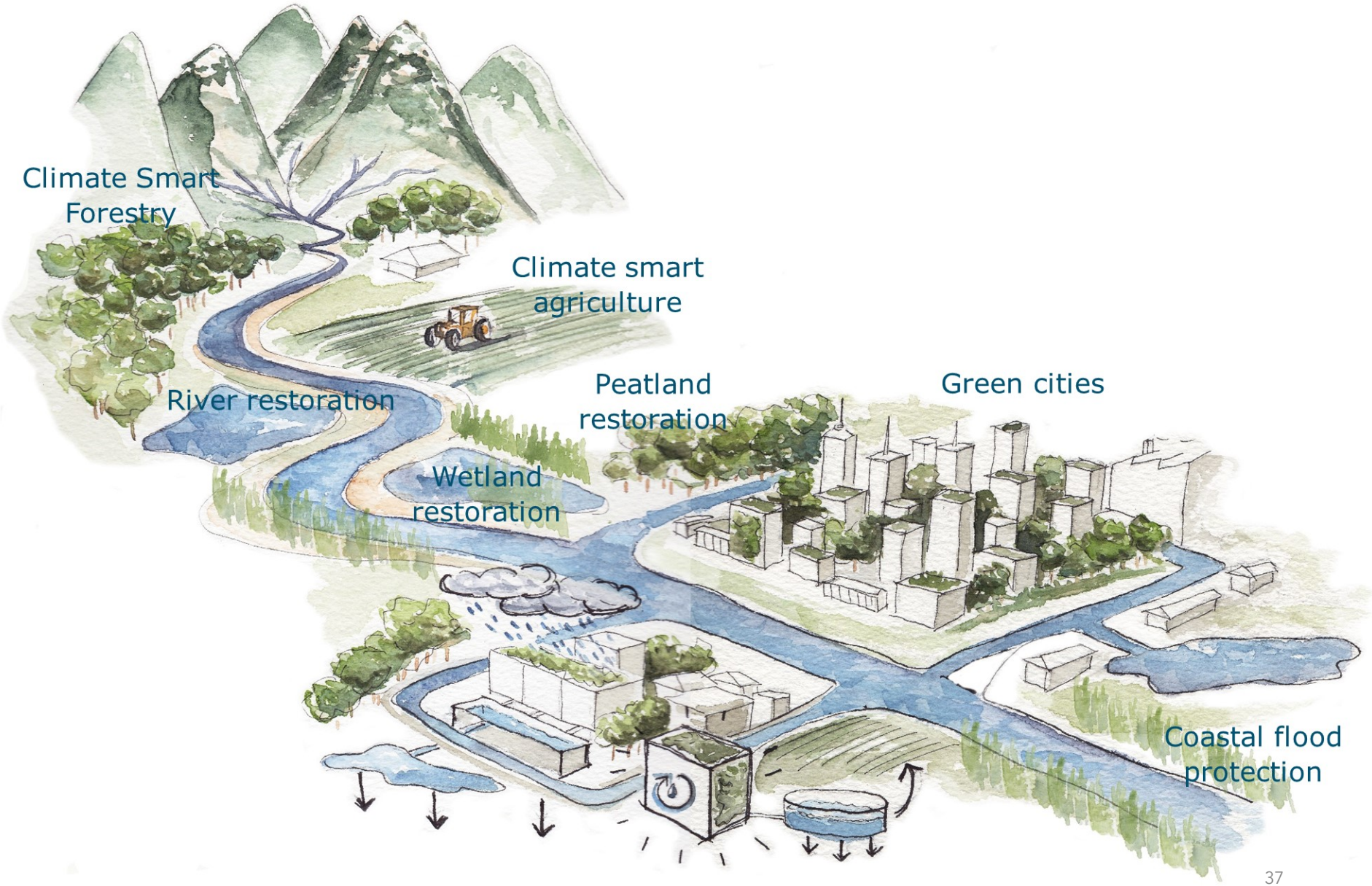
Rain gardens, roof top greening, urban forests



Combinations

D. NBS for developing climate resilient pathways

Nature Based Climate Solutions



Strategy for achieving the Water Sensitive City

Three pillars:

1. Building flexibility and adaptability in our water sources
   "Cities as Water Supply Catchments"

2. Green infrastructure
   "Cities providing Ecosystem Services"

3. Building social and institutional capital
   "A sophisticated city attuned to an Ecologically Sustainable lifestyle"

Developing countries are at an advantage!

- Lacking extensive networks of infrastructure or institutions to rebuild like those in the developed world.

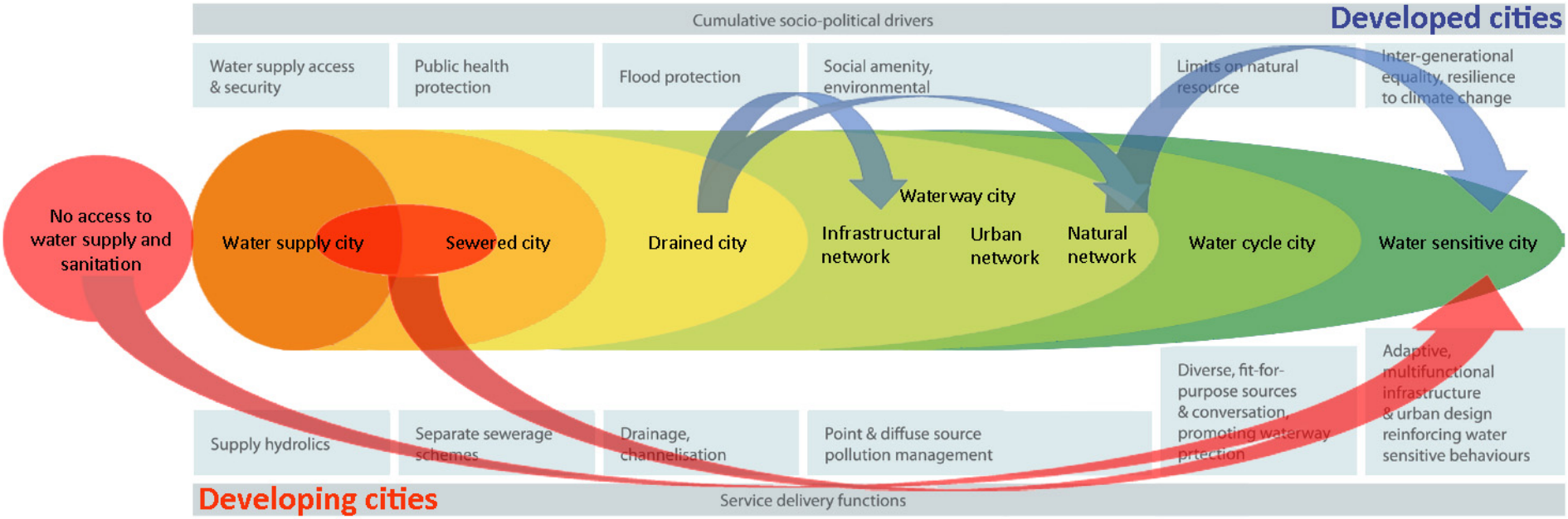
- Sustainable practices can be incorporated into their present and upcoming economic and overall growth.

- Shifting to investments in green energy, water reuse, resource recovery and nature conservation is more sustainably & viable than trying to quickly reach developed status through the traditional, degrading industrial practices.

- Moreover, governments could include Nature-based Solutions (NBS) in the sustainable policies being created for their respective countries.

Step-by-step approach and leapfrogging

a. Follows infrastructural network - *adaptive*
b. Co-organizing in urban network
c. Retro-fit natural network - *regenerative*



Adopted from the 'Urban Water Management Transitions Framework' (Brown et al, 2008)

Key elements of (spatial) adaptation

A. **Analysis** – urban system and its environment
   - Vulnerabilities (climate stress test)
   - Opportunities

B. **Ambition** – drawing up ambitions
   - Goals and challenges
   - Planning adaptation strategy

C. **Action** – implementation in planning & sensing
   - Choosing adaptation measures
   - Securing & realization in daily practice

NB: (spatial) adaptation is always tailored

Strategy to implementation

Analysis

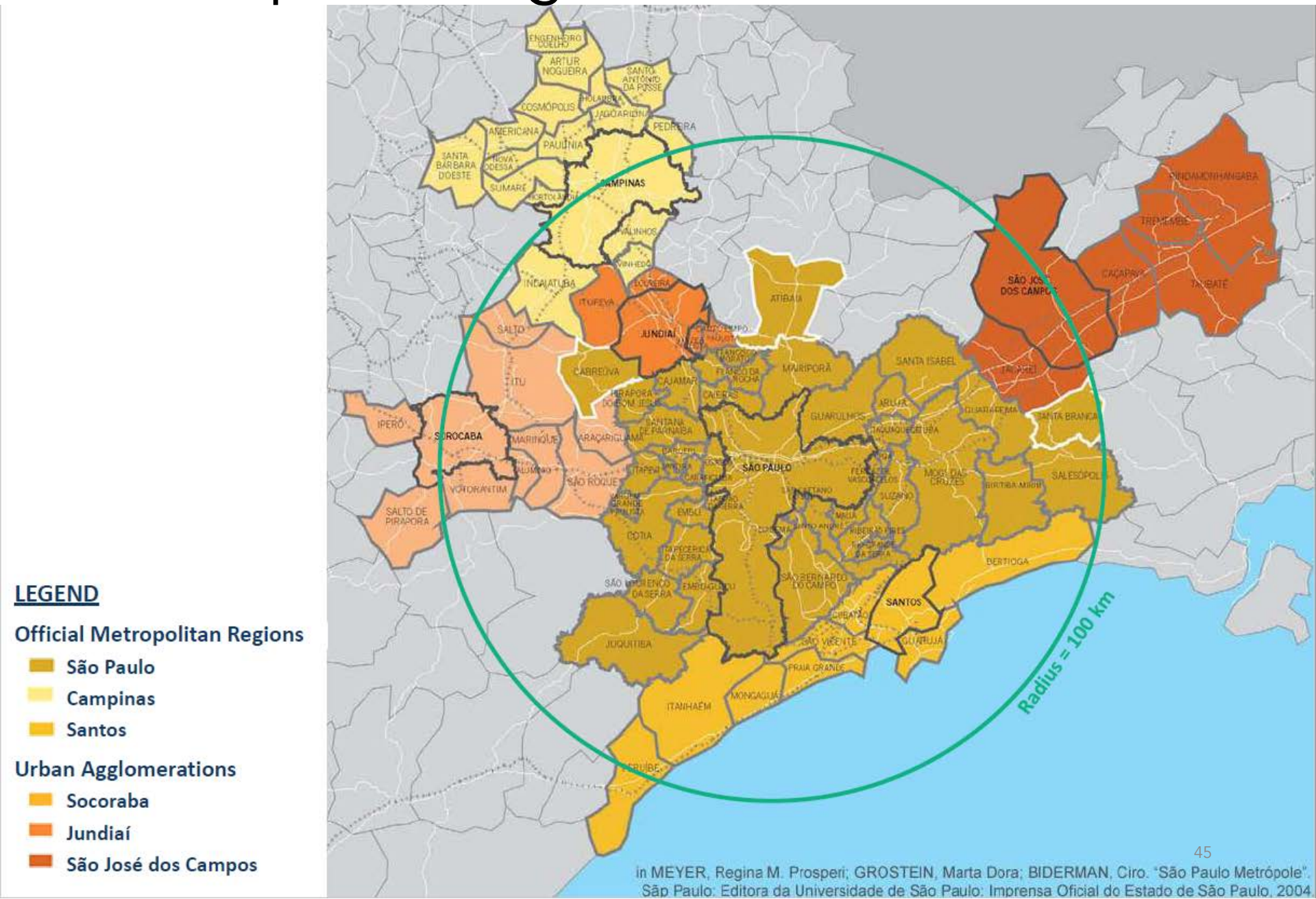
Ambitio
n

Action

E. Case of São Paulo

System of rivers

Metropolitan region of São Paulo



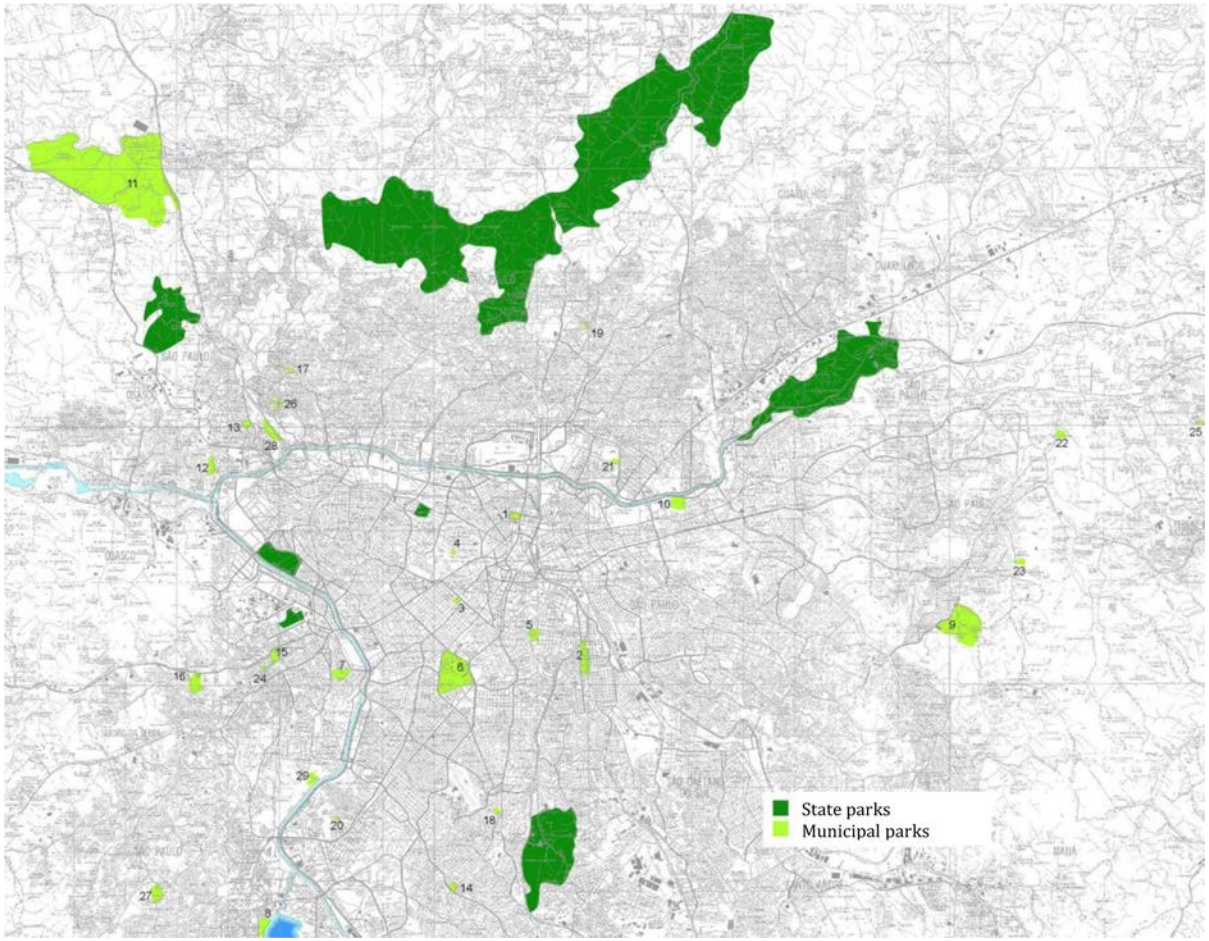
in MEYER, Regina M. Prosperi; GROSTEIN, Marta Dora; BIDERMAN, Ciro. "São Paulo Metrópole". São Paulo: Editora da Universidade de São Paulo; Imprensa Oficial do Estado de São Paulo, 2004.

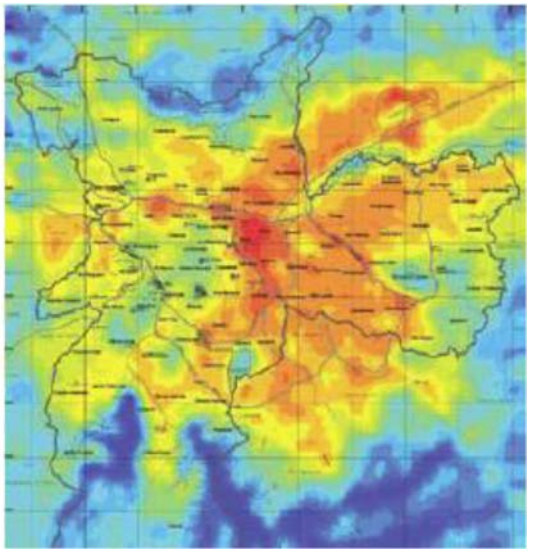
São Paulo city

Clean city

- Air quality
- Preserving and expanding green areas
- Water
- Landscape
- Eco-economics

State and municipal parks in São Paulo (1998)



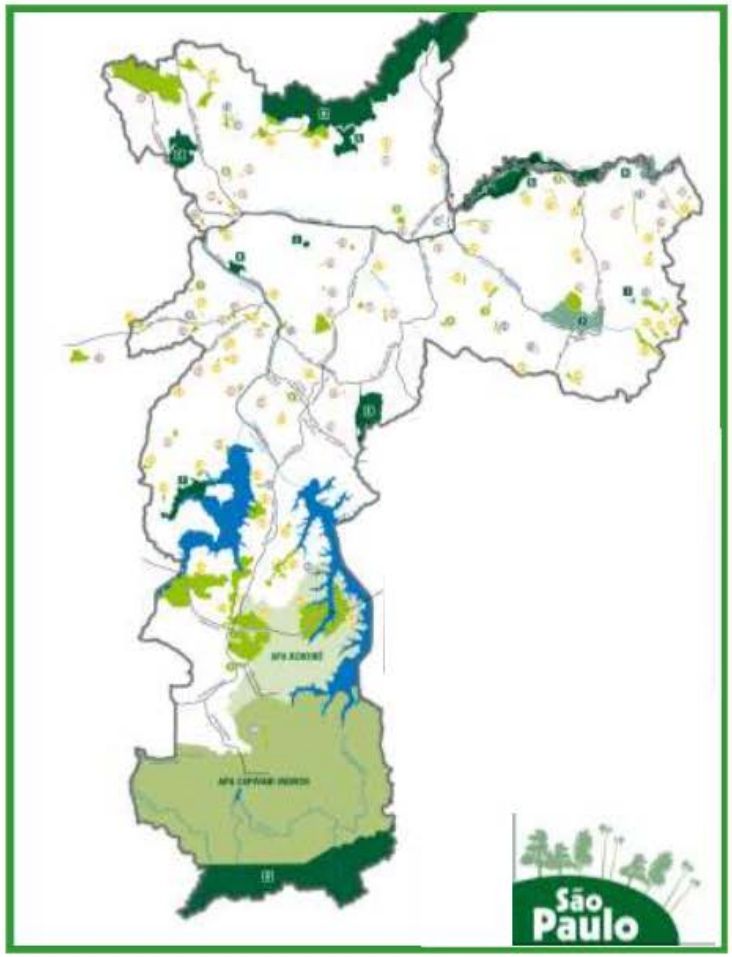


Implementation and expansion of "100 municipal parks" (from 2008)

Present	Until 2012	Until 2025
Approx. 16 Mi m²	Approx. 49 Mi m²	Approx. 60 Mi m²

* Only municipal green areas

Qty	Status	Area (m^2)	Part.	Acréscimo
33	EXISTING	15.561.363	31,8%	
10	IMPLEMENTED	398.717	0,8%	3%
26	IN PROGRESS	2.654.188	5,4%	17%
31	PROJECT	30.268.548	61,9%	195%
100	TOTAL	48.882.816	100,0%	

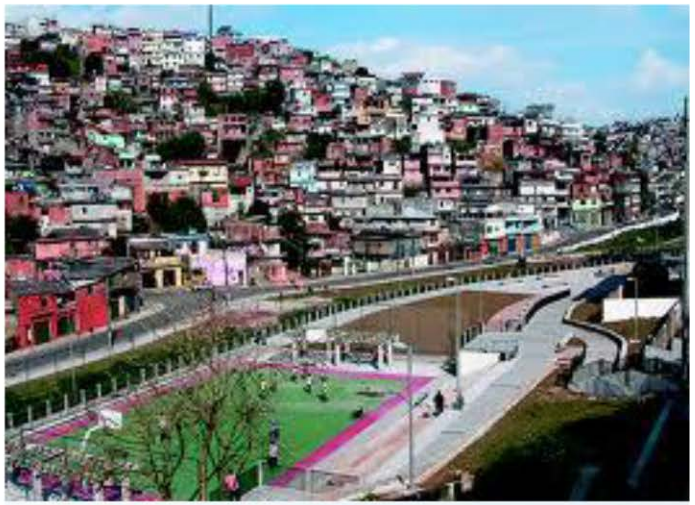


Implementation of linear parks (1/2)

befor
e

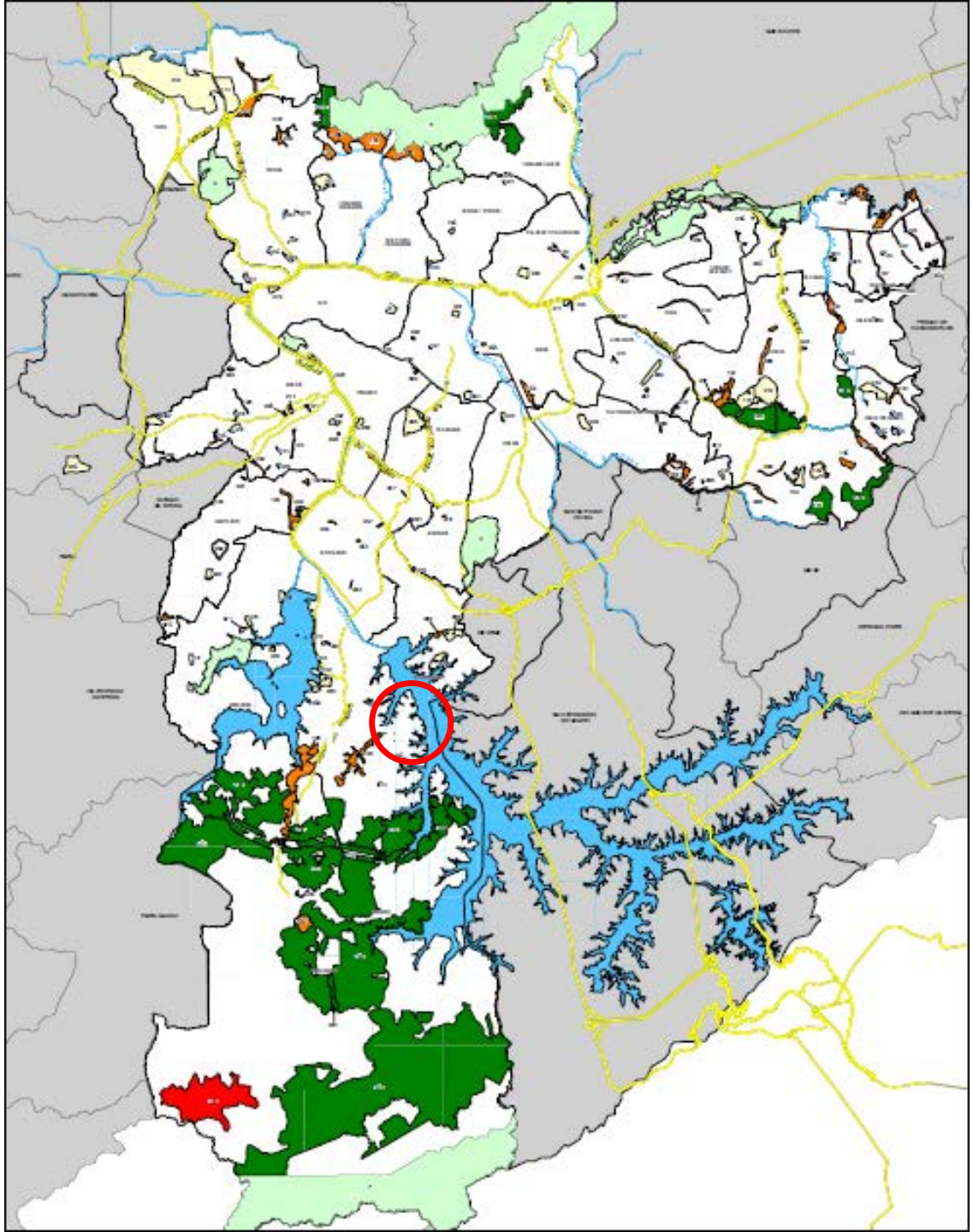
after

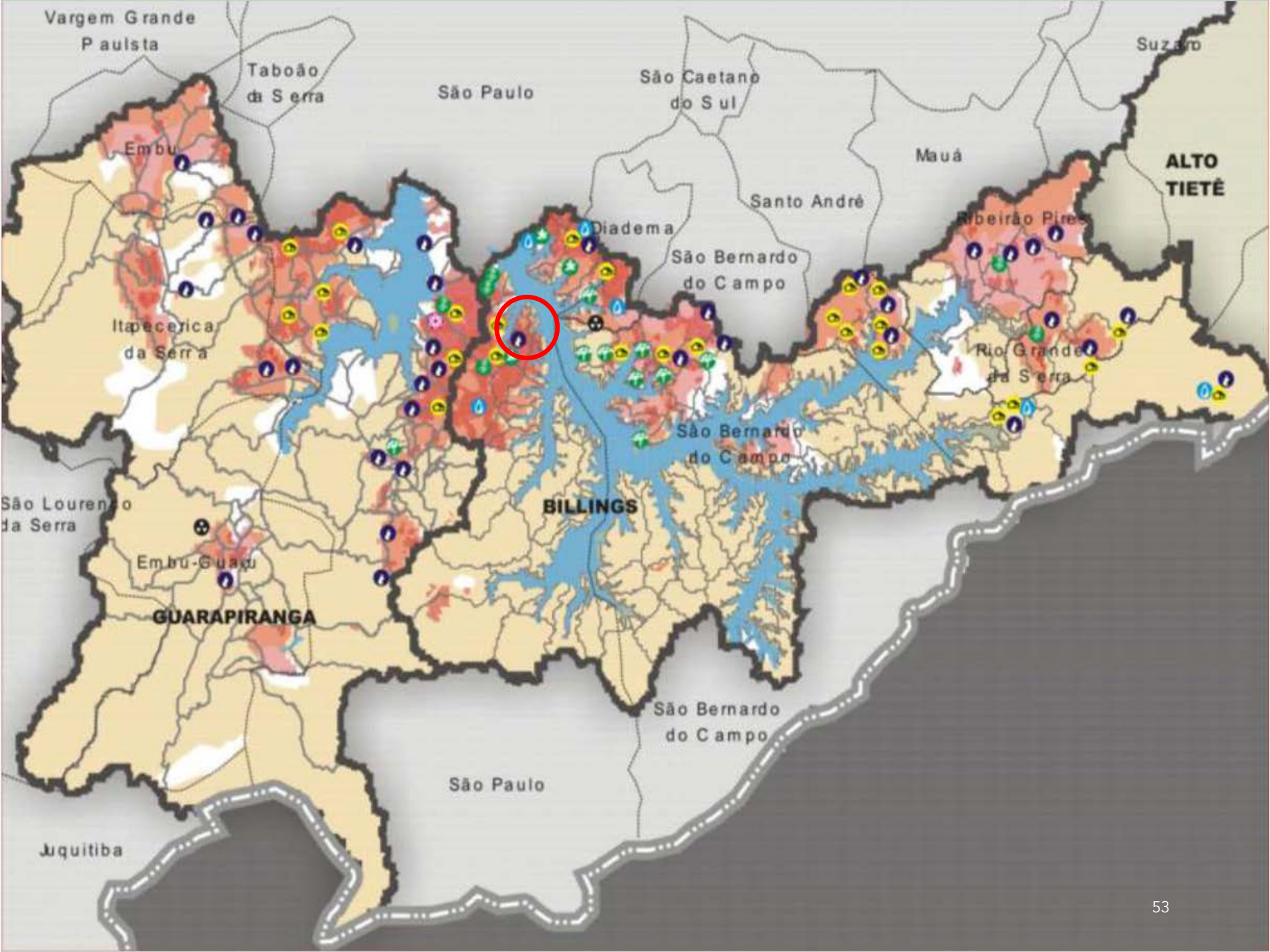
Implementation of linear parks (2/2)



Slum urbanization programme – Cantinho do Céu

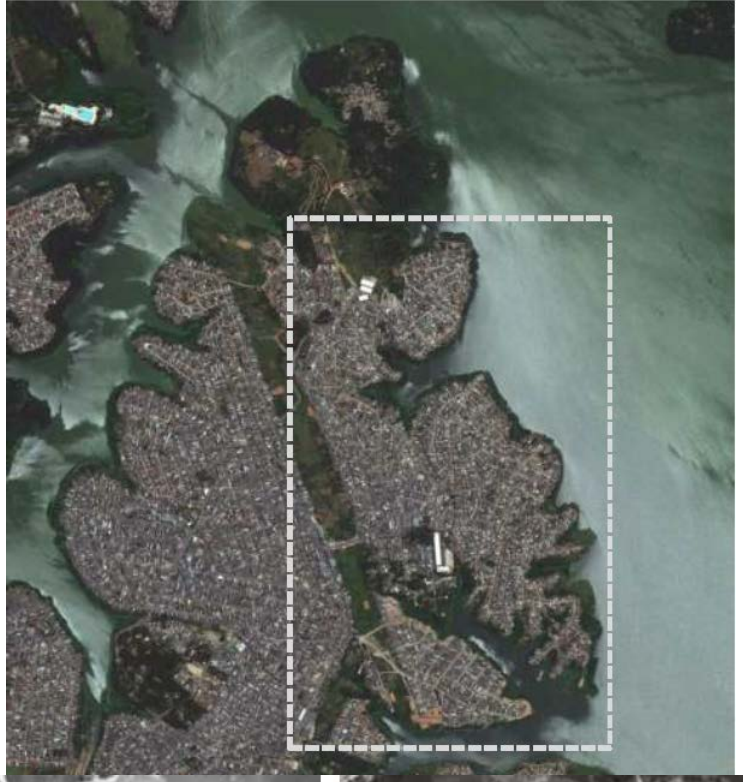
- 2008-2010 (phase 1)
- 200 hectares
- 9,800 families
- 30 hectares park

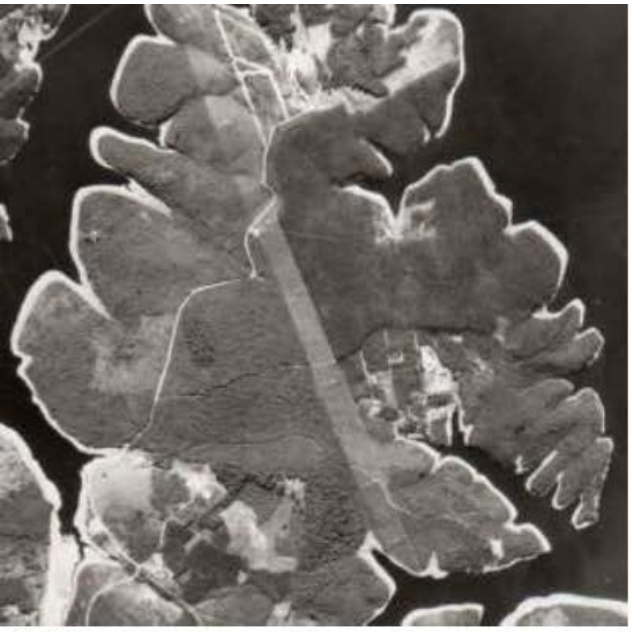



Vargem Grande Paulista
Taboão da Serra
São Paulo
São Caetano do Sul
Suzano
Embu
Mauá
ALTO TIETÊ
Santo André
Diadema
Ribeirão Pires
São Bernardo do Campo
Itapecerica da Serra
Rio Grande da Serra
São Bernardo do Campo
BILLINGS
São Lourenço da Serra
Embu-Guaçu
GUARAPIRANGA
São Bernardo do Campo
São Paulo
Juquitiba

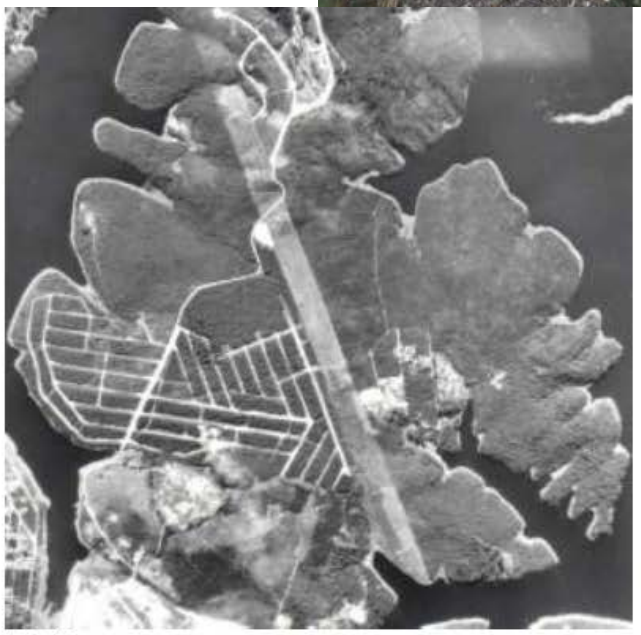
Cantinho do Céu

Cantinho do Céu





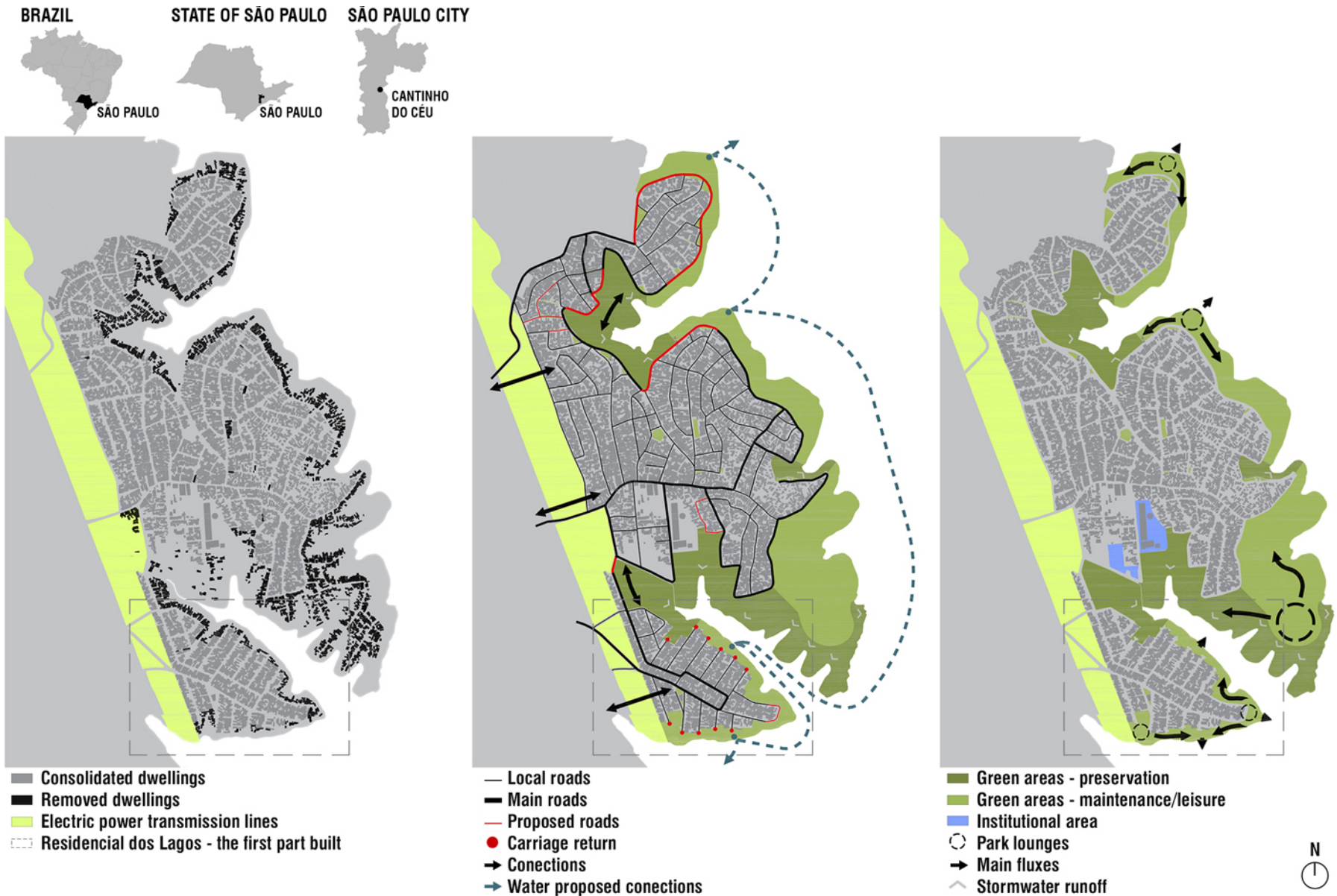
1962



1972

1994

Conceptual schemes



Conceptual schemes

Fonte: Boldarini Arquitetura e Urbanismo

Fonte: Boldarini Arquitetura e Urbanismo

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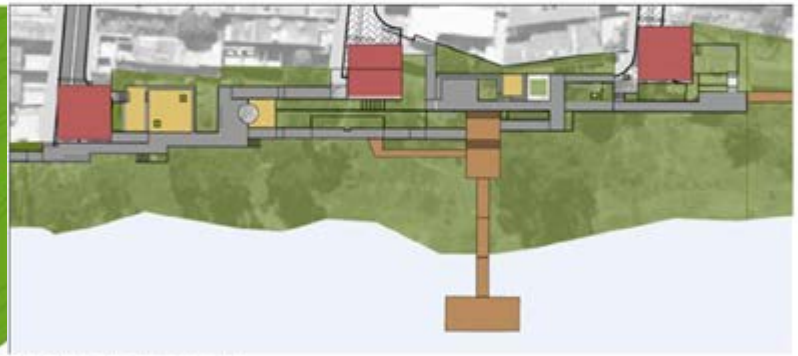

Fonte: Boldarini Arquitetura e Urbanismo

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--> Drenagem

Atividades de lazer e contemplação

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Thank you!

Any questions?

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