



Cities of the Future

Kala Vairavamorthy

Sustainable Water Management in Cities

17 Dec 2010 – Zaragoza, Spain

Water is Life!

..... 10,000 to 20,000 people mainly children die every day from water-related diseases.

Water is also Killer no. 1

A child dies every 15 seconds from a disease caused by lack of access to safe water, inadequate sanitation and poor hygiene.



Response - Good News and Bad News

'Open the loop' - linear supply and disposal

Good News

- Upper income countries have revolutionized public health outcomes
- Also have made major progress in mitigation of environmental damage

The Bad News

- Systems built for narrow objectives with little resilience – not suited to the challenges ahead
- Extraordinarily resource intensive
- Unaffordable to 2/3 of the planet







24-Hour Water Availability - Asia

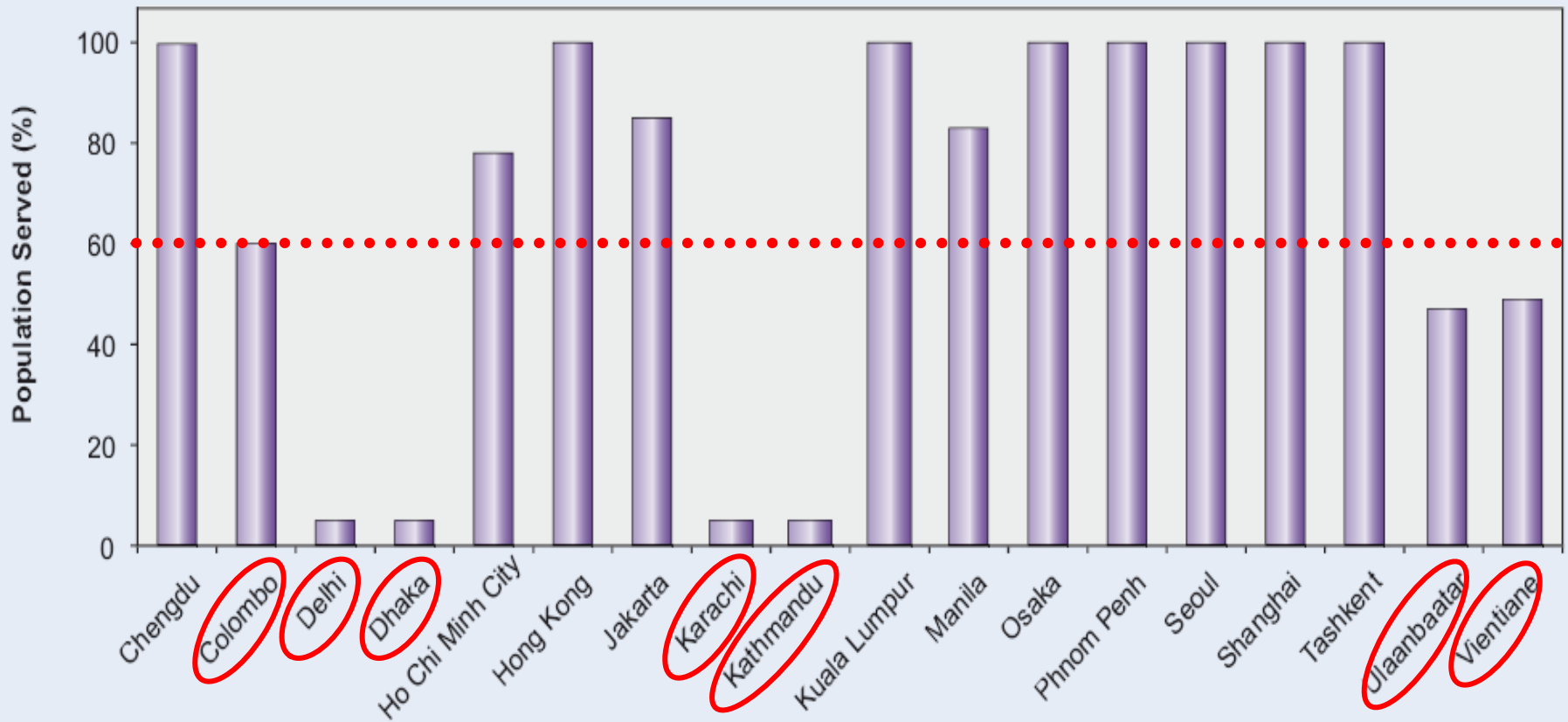
Mumbai

- 4% of the population receive water > 8 hrs/day
- 33% receive water > 4 hrs/day
- 42% receive water for just 3 hrs/day
- 21% receive water < 3 hrs/day (often only 1 hr)

Chennai

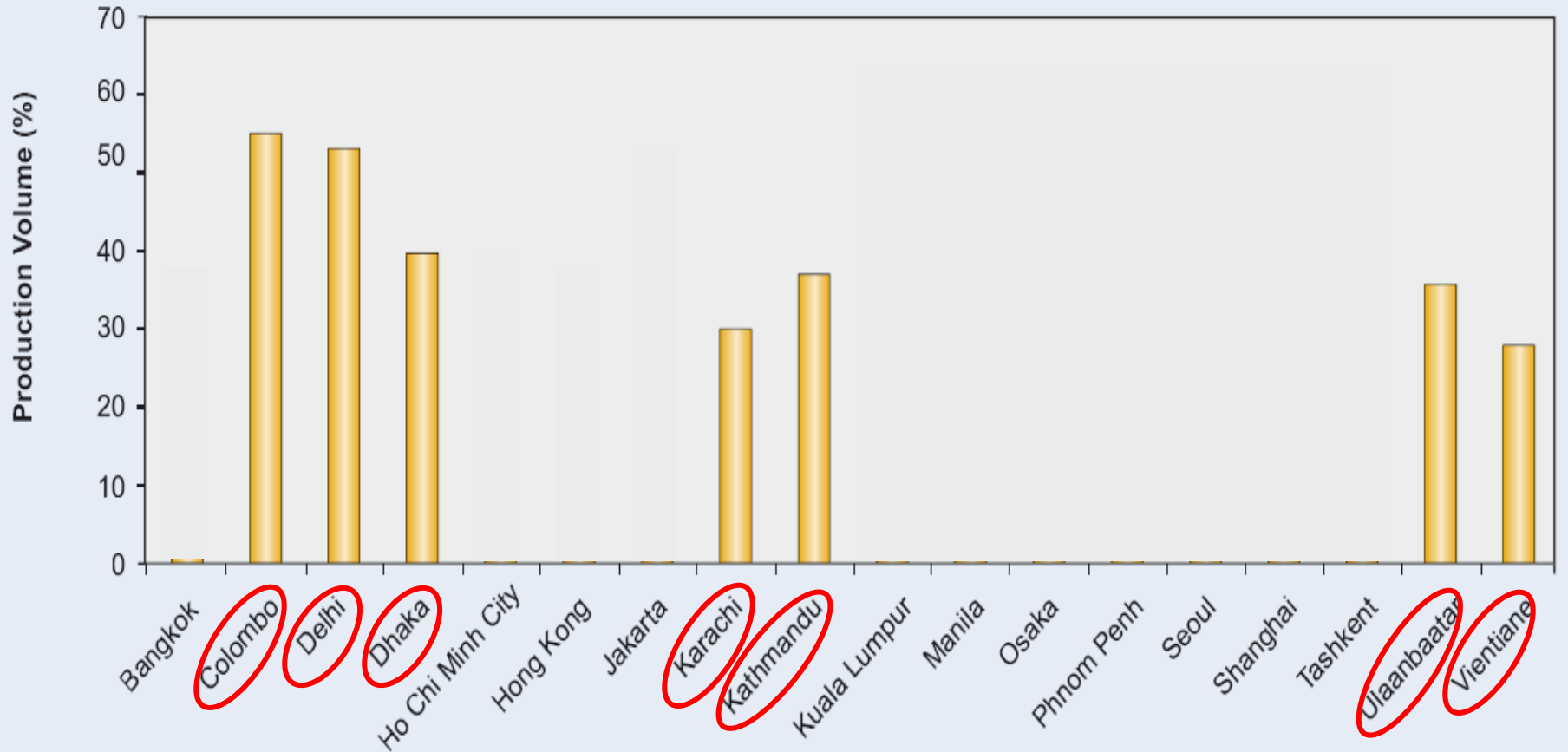
- Overall shortage of water
- Insufficient pressures (many areas had zero pressure)
- Inequitable distribution of water
- Very short duration of supply
 - 2 hours a day but irregular
 - Outskirts of Chennai - 1 hour each day

24-Hour Water Availability

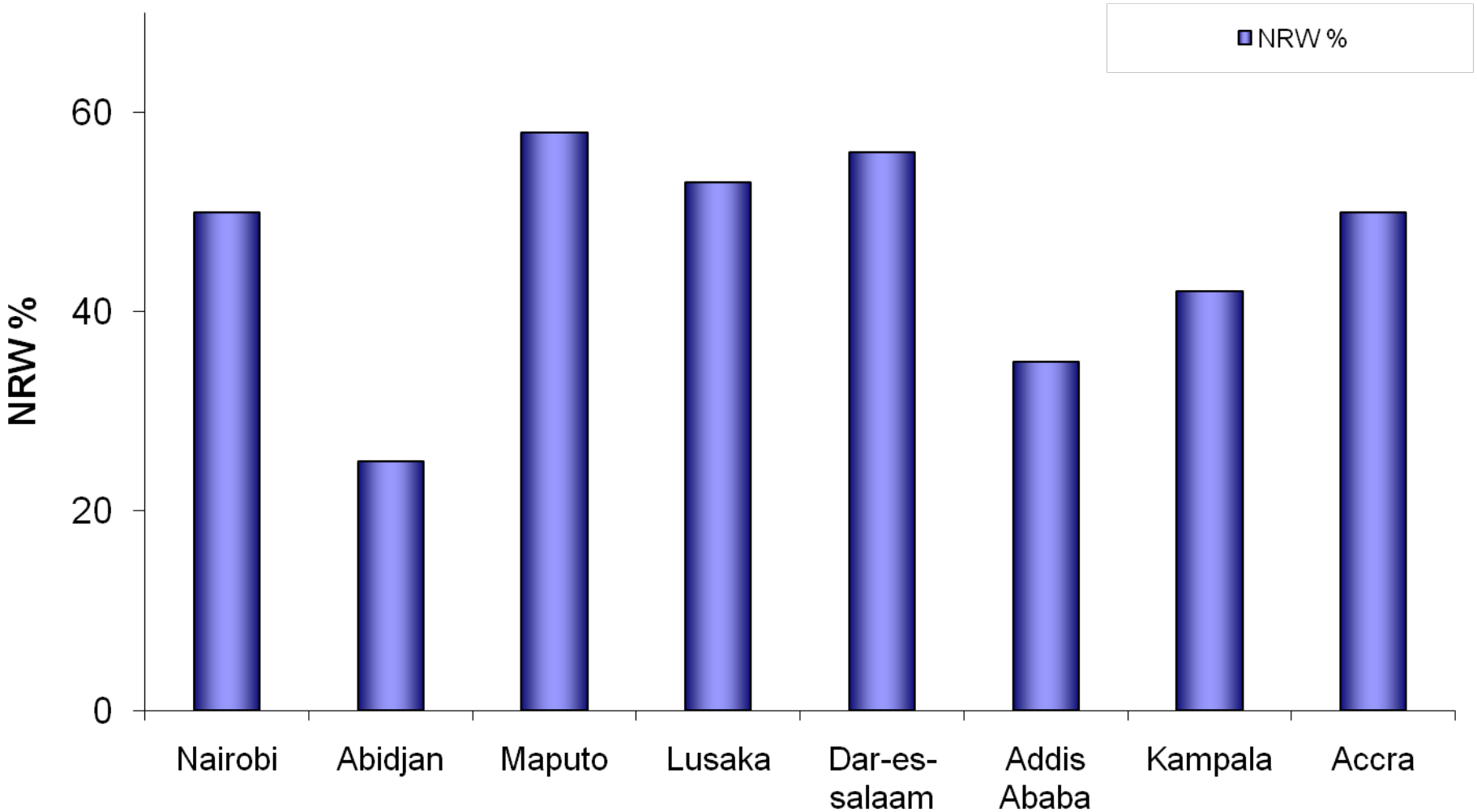


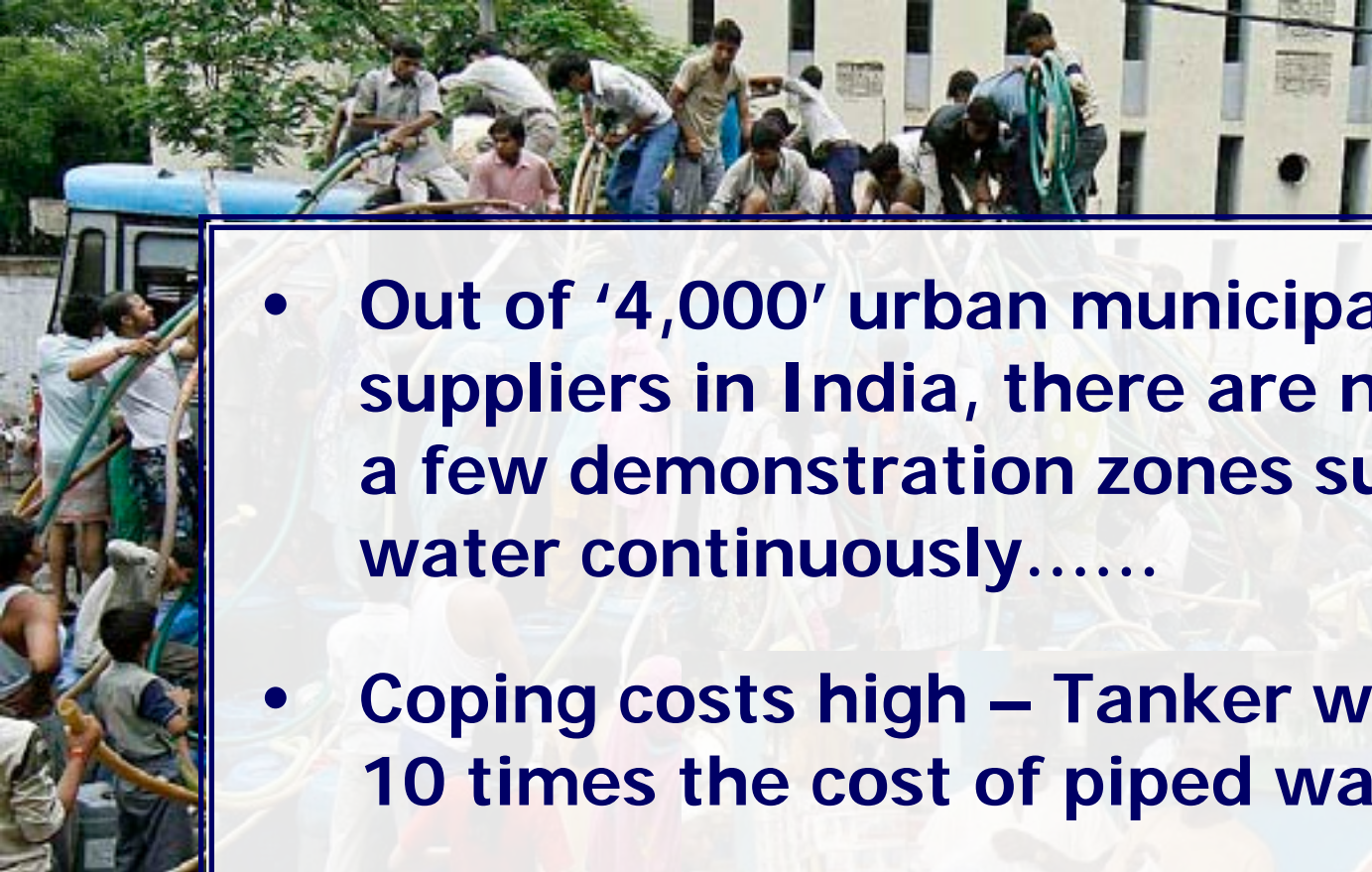
Source: McIntosh (2003)

Non-Revenue Water



Non-Revenue Water



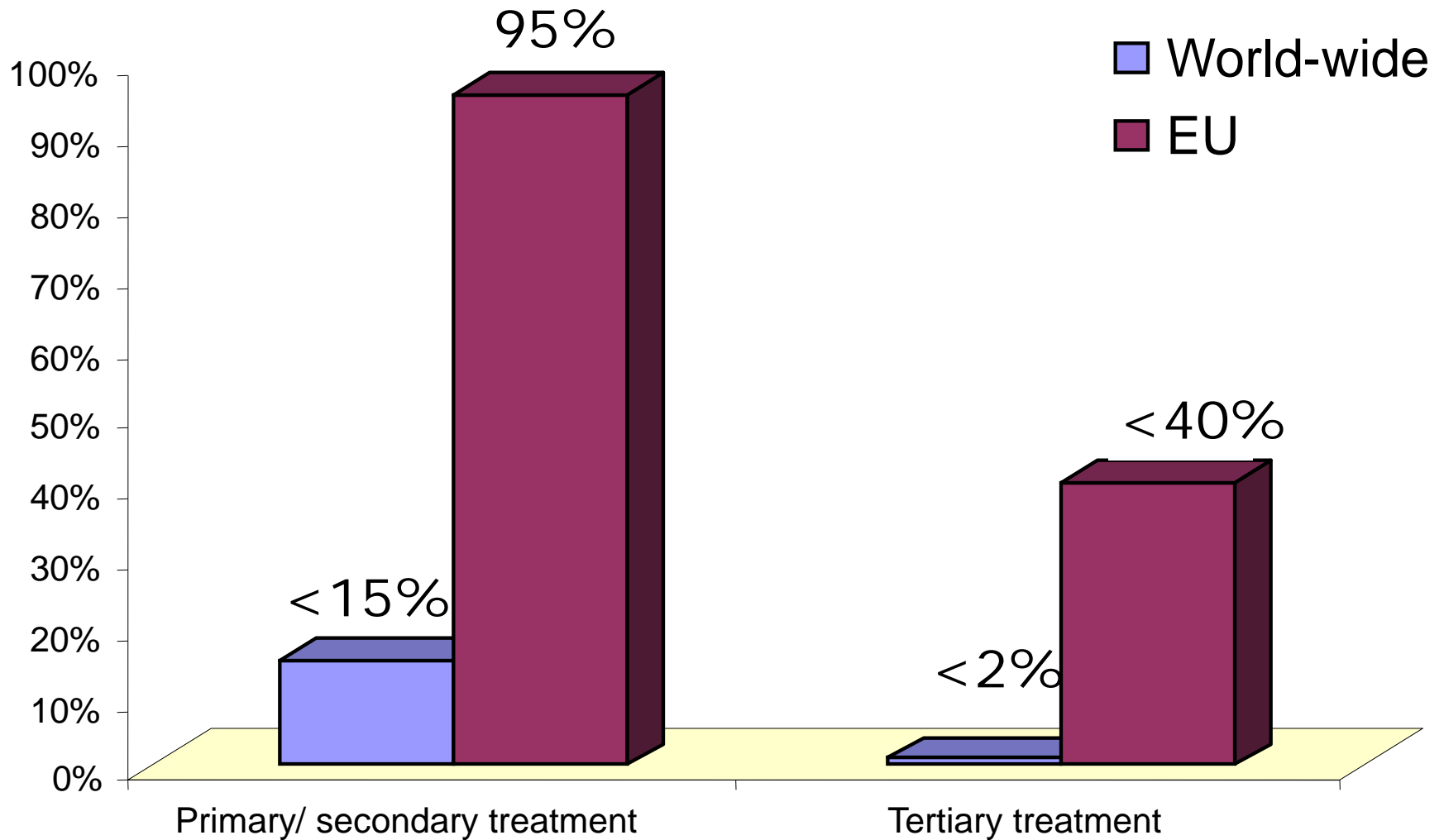


- **Out of '4,000' urban municipality suppliers in India, there are now just a few demonstration zones supplying water continuously.....**
- **Coping costs high – Tanker water is 10 times the cost of piped water**
- **Why should the poor have to buy their water in small bags??**

Franceys (2010)



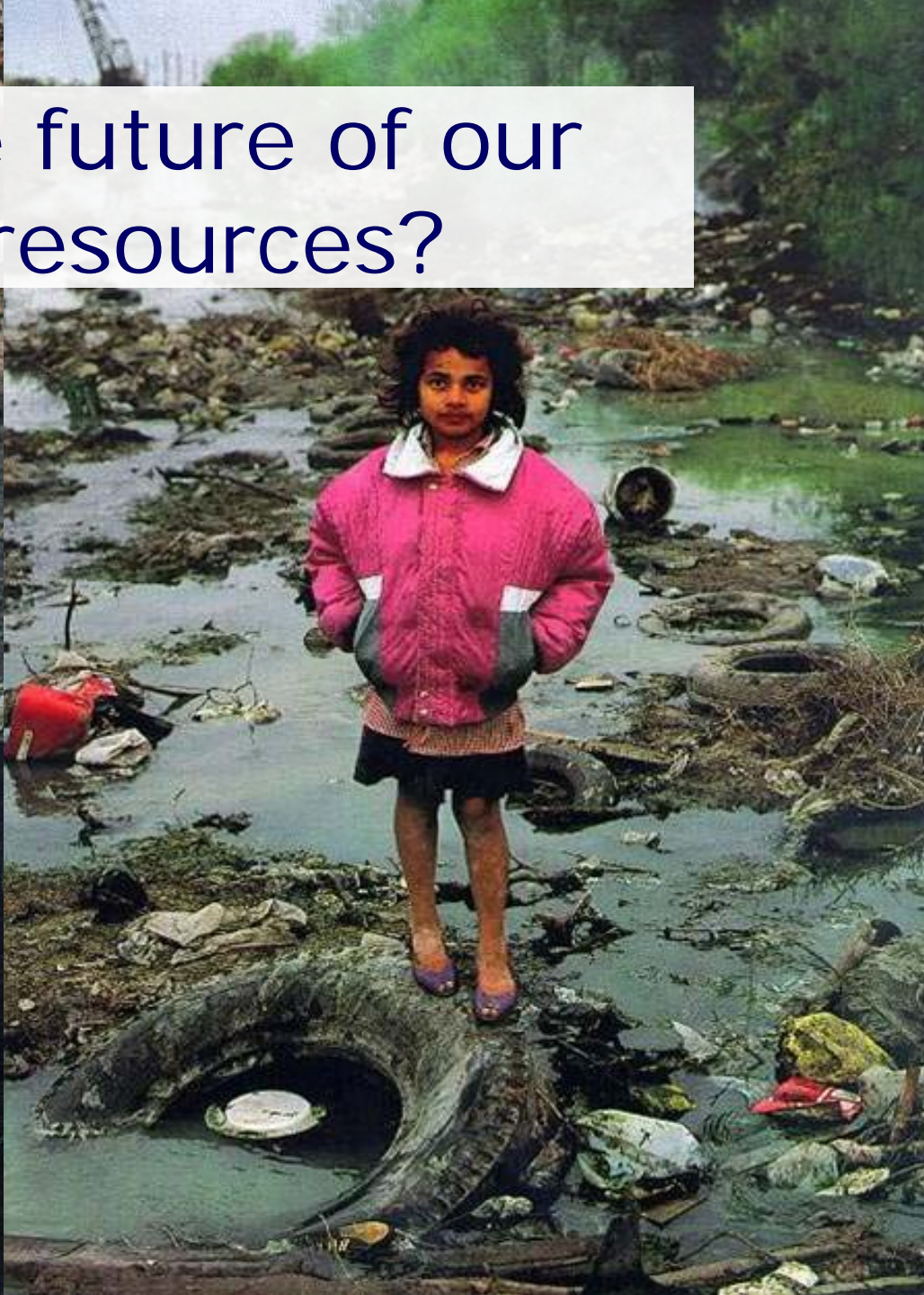
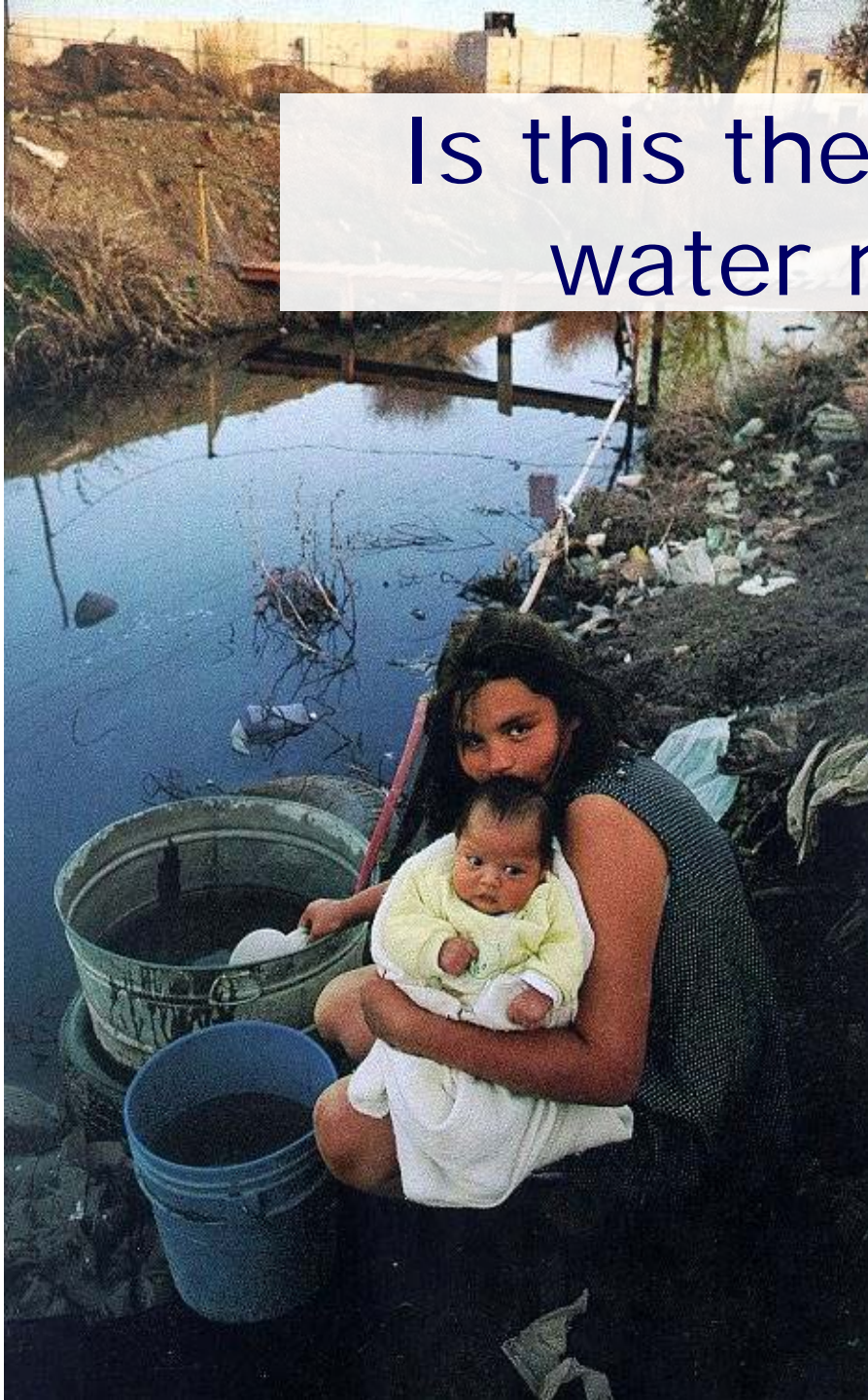
Most wastewater is not treated!







Is this the future of our water resources?



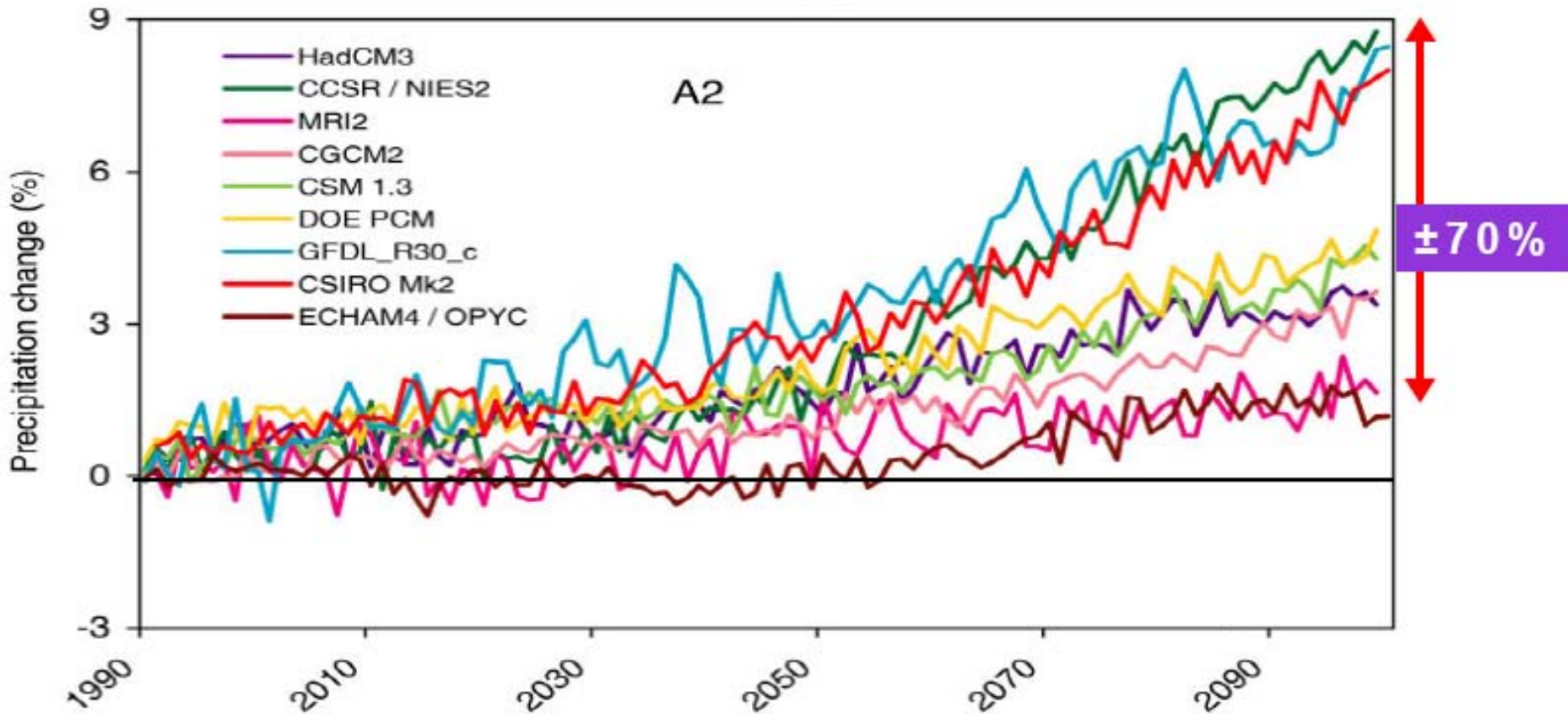
Future Pressures

Hazards - New challenges

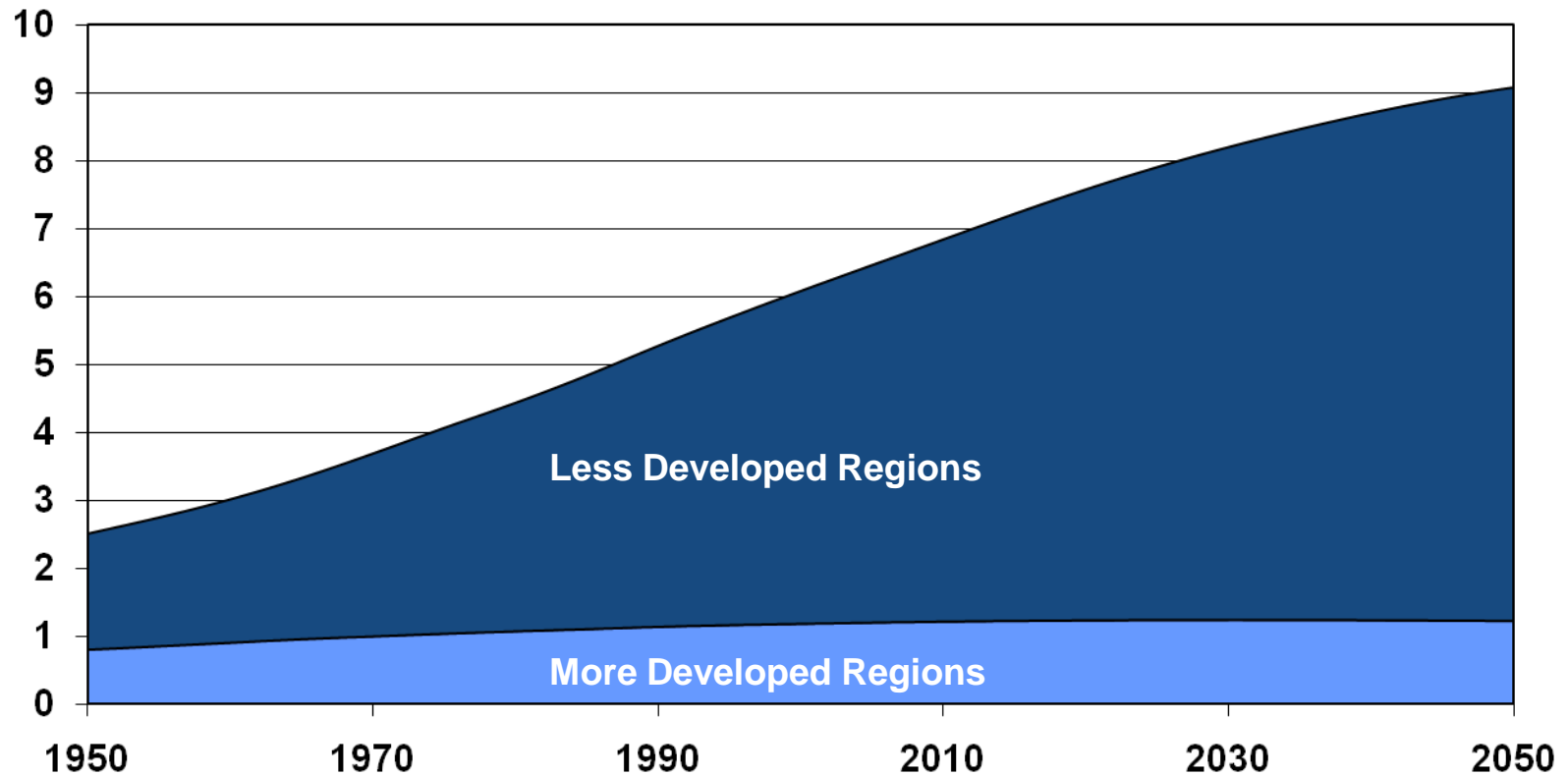
- Entire earth system is changing!



Changes - Uncertainties

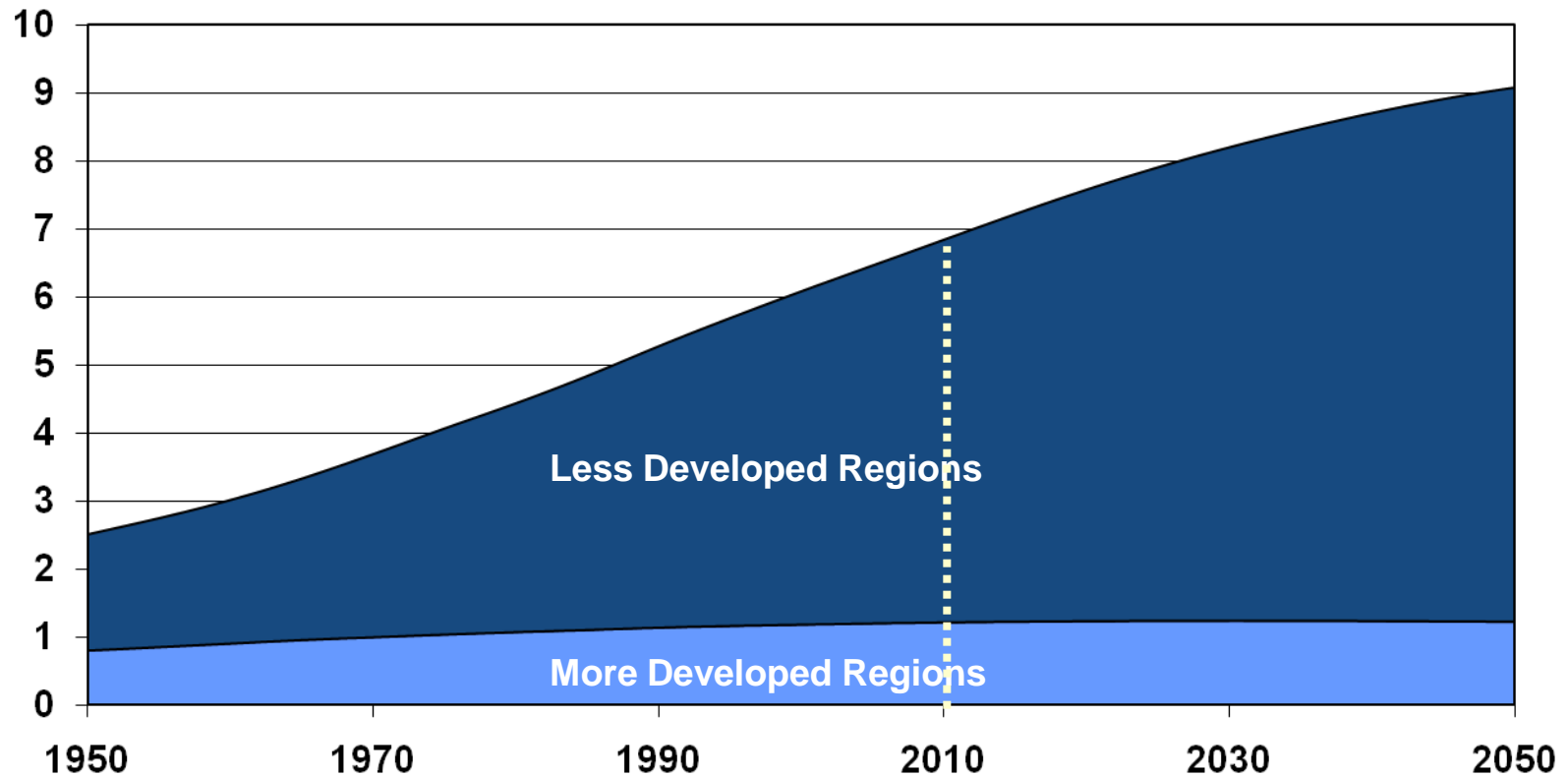


World population prospects 1950 - 2050



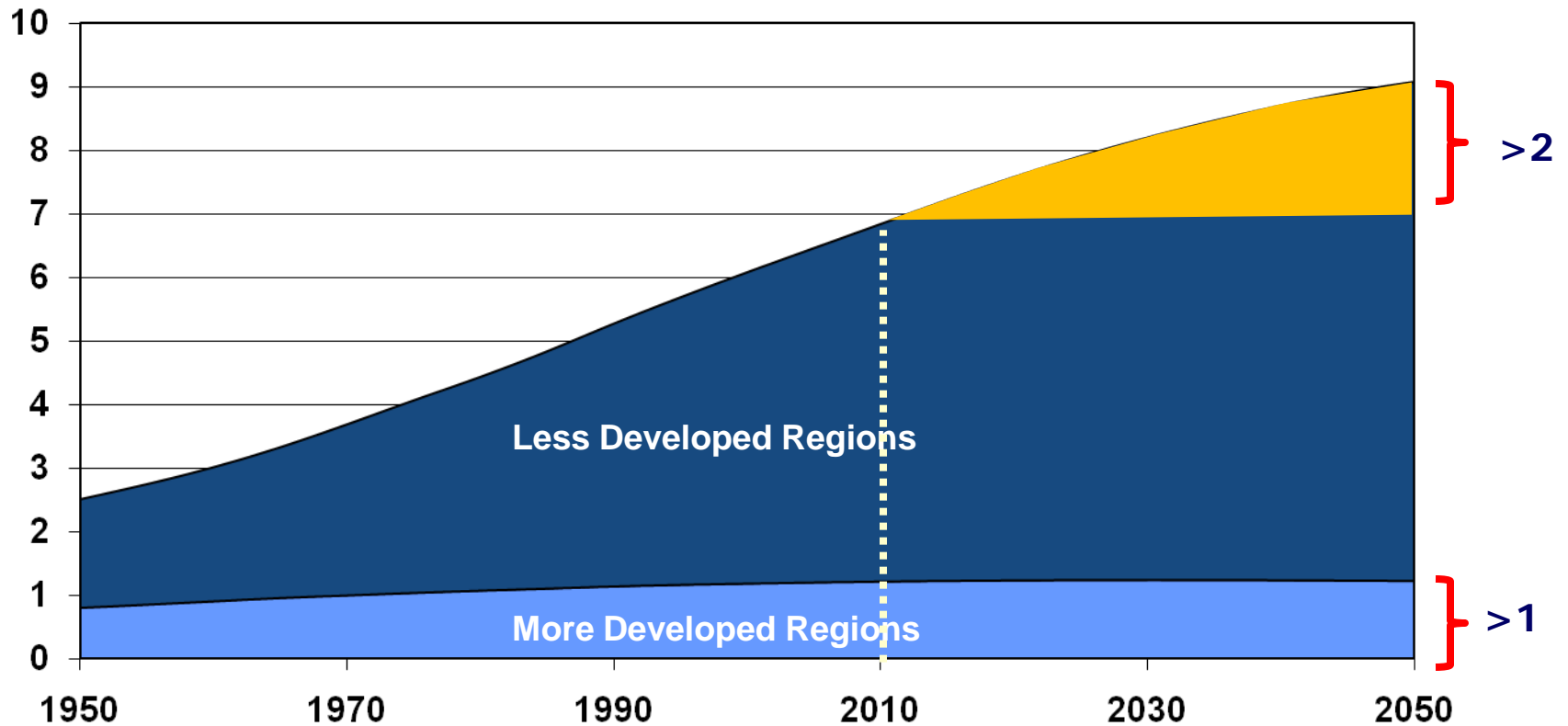
Source: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.

World population prospects 1950 - 2050



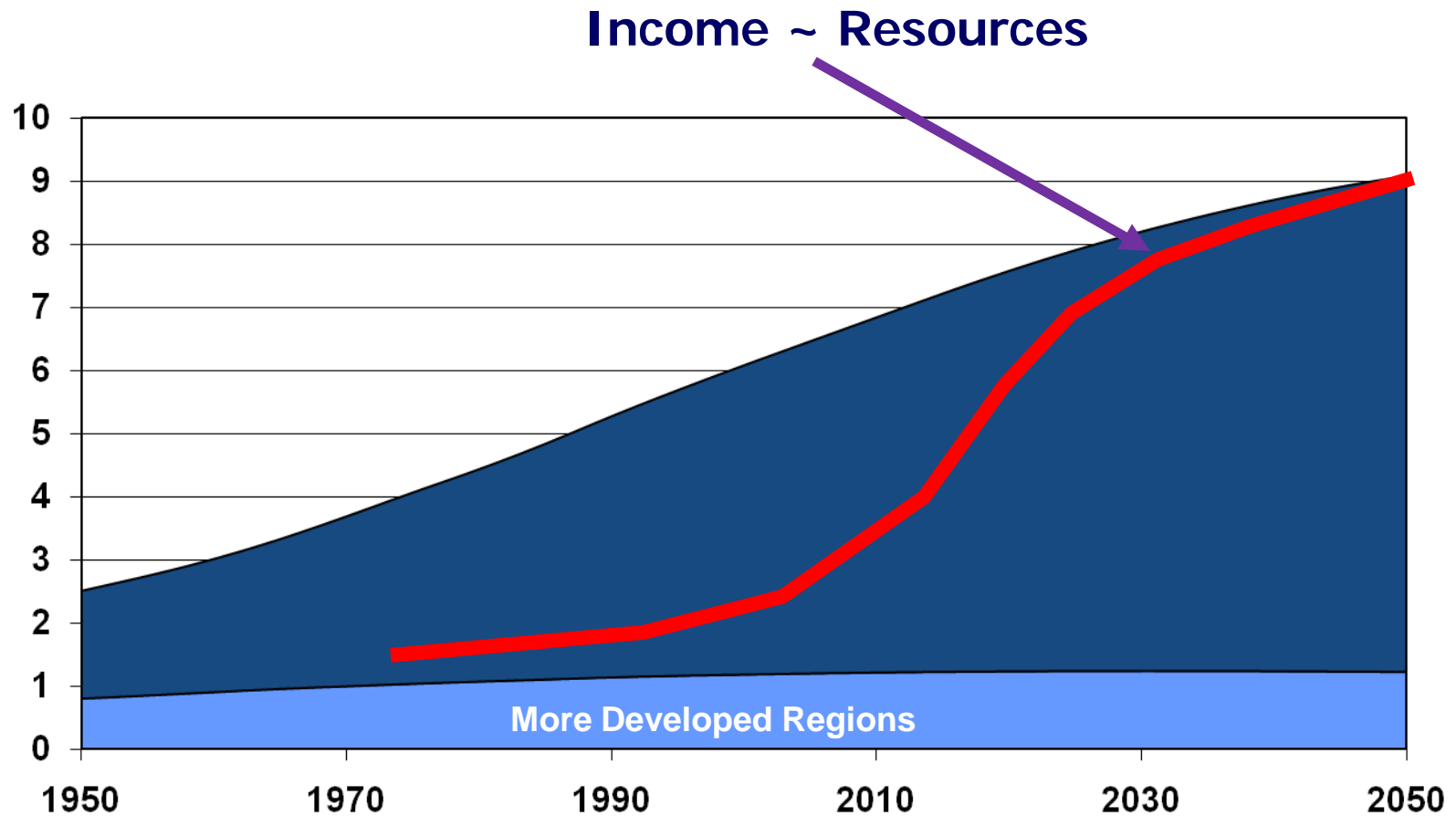
Source: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.

World population prospects 1950 - 2050



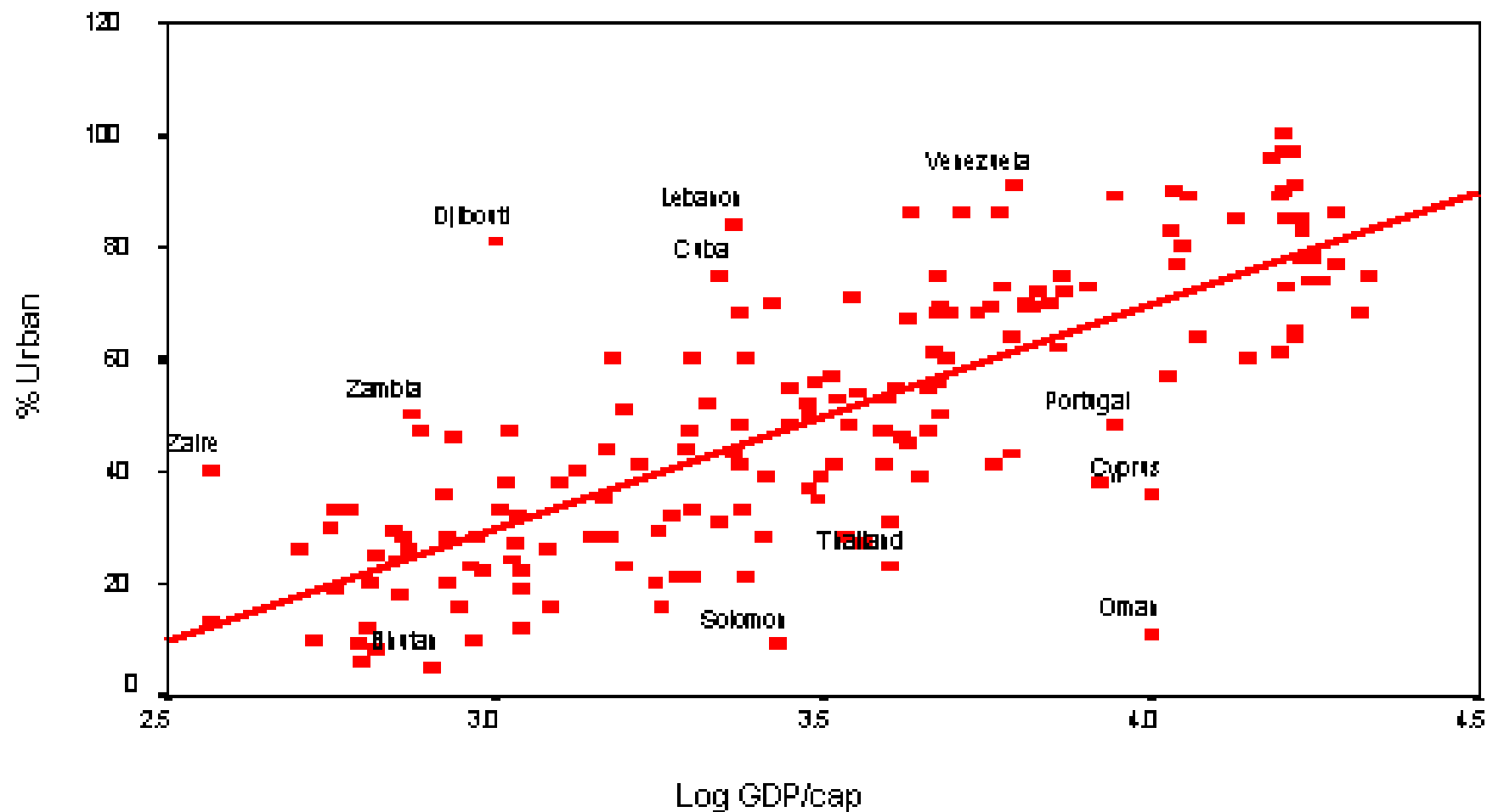
Source: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.

World population prospects 1950 - 2050

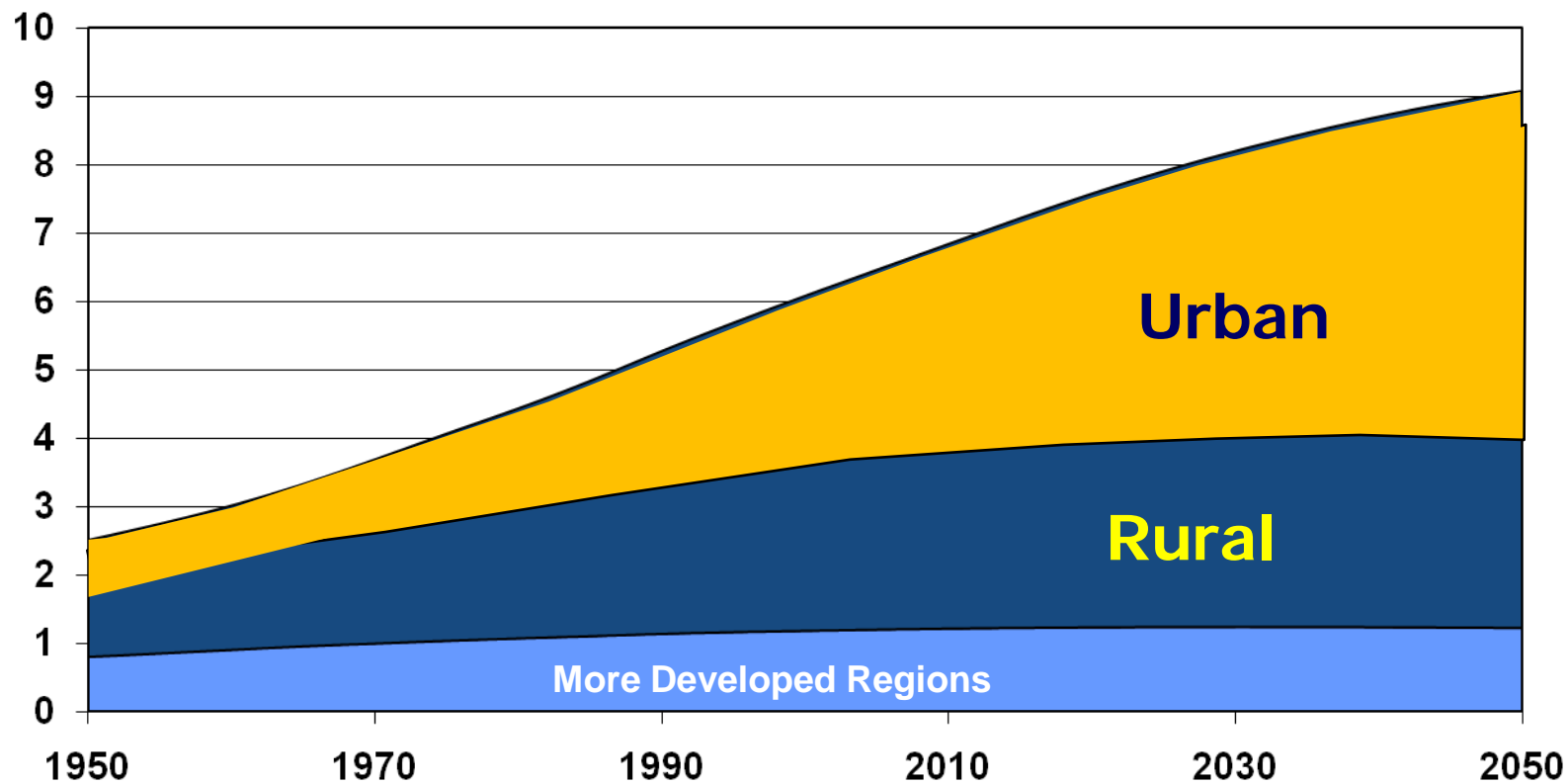


Source: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.

As Incomes Rises - Urbanization Increases

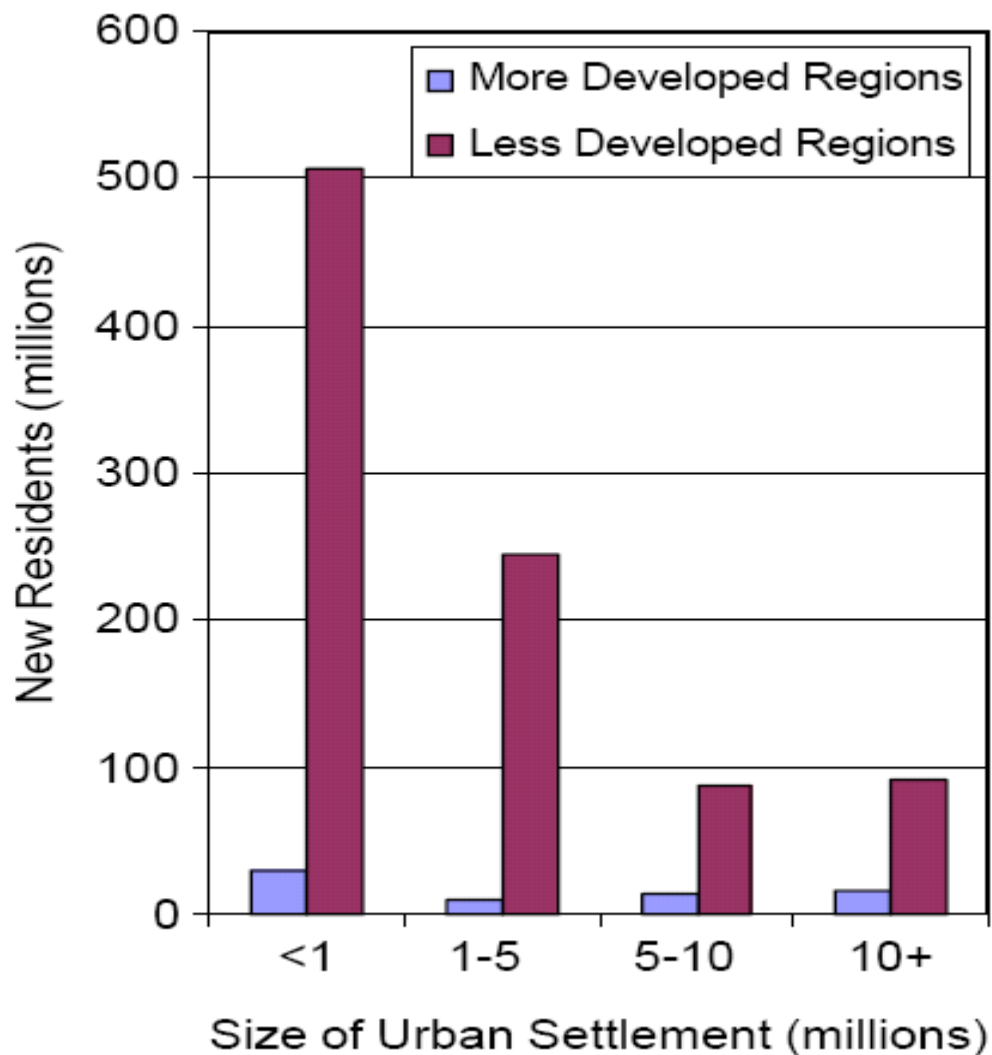


World population prospects 1950 - 2050

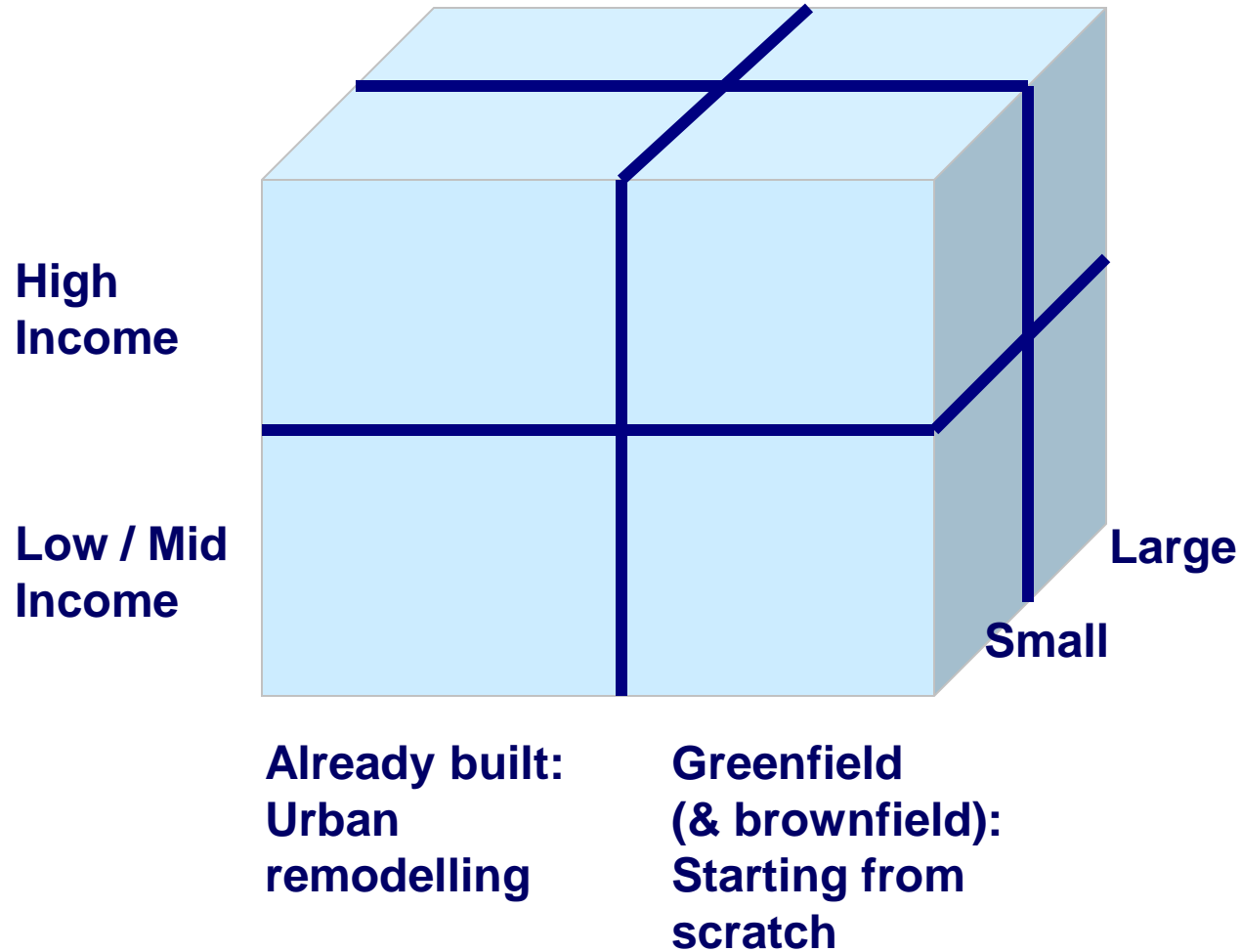


Source: United Nations, *World Population Prospects: The 2004 Revision* (medium scenario), 2005.

Number of urban residents added to the urban milieu between 2000 and 2015



The Application Space



Let's Tally Up

Population Growth + Urbanization
+ Rising Standards (Health, Environ)
+ Climate Change
= Major Change and Uncertainty

The Gap in Most Countries

What We Need

- Systems that can be incrementally designed, implemented and upgraded (adaptable systems)
- Closed loop systems that can facilitate reuse and energy recovery - *'all water good water'*
- Urban landscape that "mimics" natural systems

What We Currently Install

- Systems with fixed, centralized designs (concrete systems with little evolutionary ability)
- Systems that treat stormwater as waste and place WW treatment plants far from households (severely restricting reuse opportunities)

Imperative for Change ?

“One of the main barriers to turning knowledge into action is the tendency to treat *talking* about something as equivalent to actually *doing* something about it.”....

Knowing-doing gap (Pfeffer and Sutton)



Way Forward

Way Forward

- **Learning Alliances**
- **Greater Integration**
- **Adaptive/Flexible Approaches**

Way Forward

- **Learning Alliances**
- Greater Integration
- Adaptive/Flexible Approaches
- Security Through Diversity

Learning Alliances

Lessons Learnt

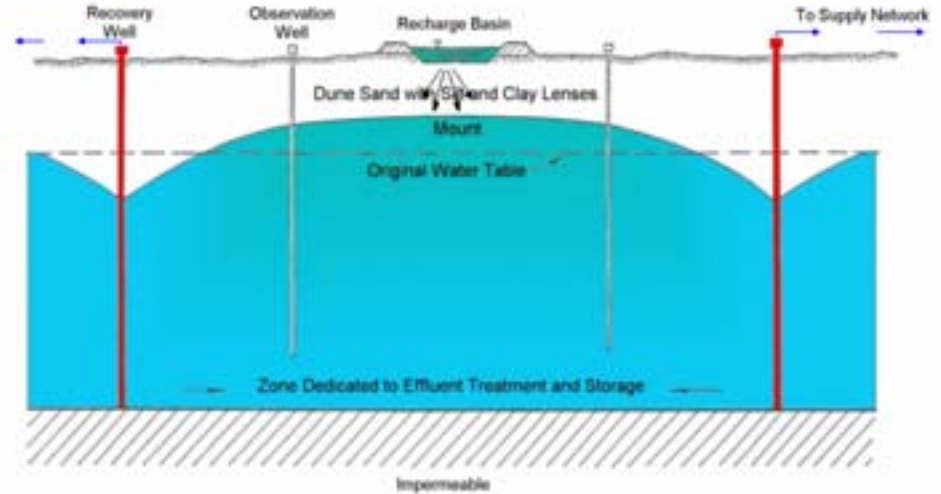
- Improved collaboration among all professionals who influence the shape of the urban space (not a question of whose “vision” wins)
- Greater focus on understanding integrated systems performance – using CityWater in Bham, Alex..
- Strategic planning is providing a useful focus in many cities – most SWITCH cities
- Demonstrations provide the strongest potential for realizing action research and need to be given more priority.



How to put water in the minds of people?

Game Changers

Natural Treatment Systems

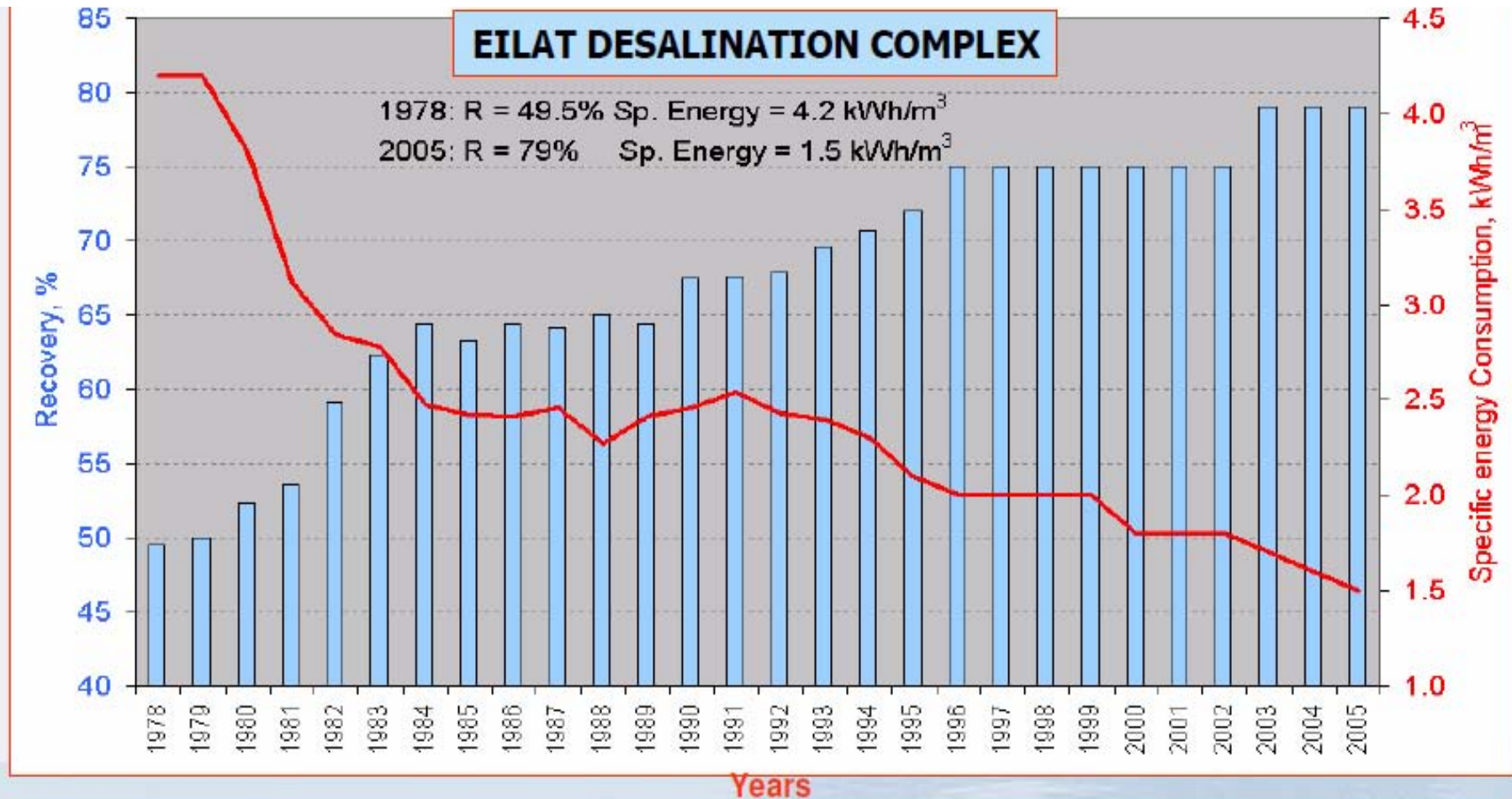


Recharge - Recovery Scheme

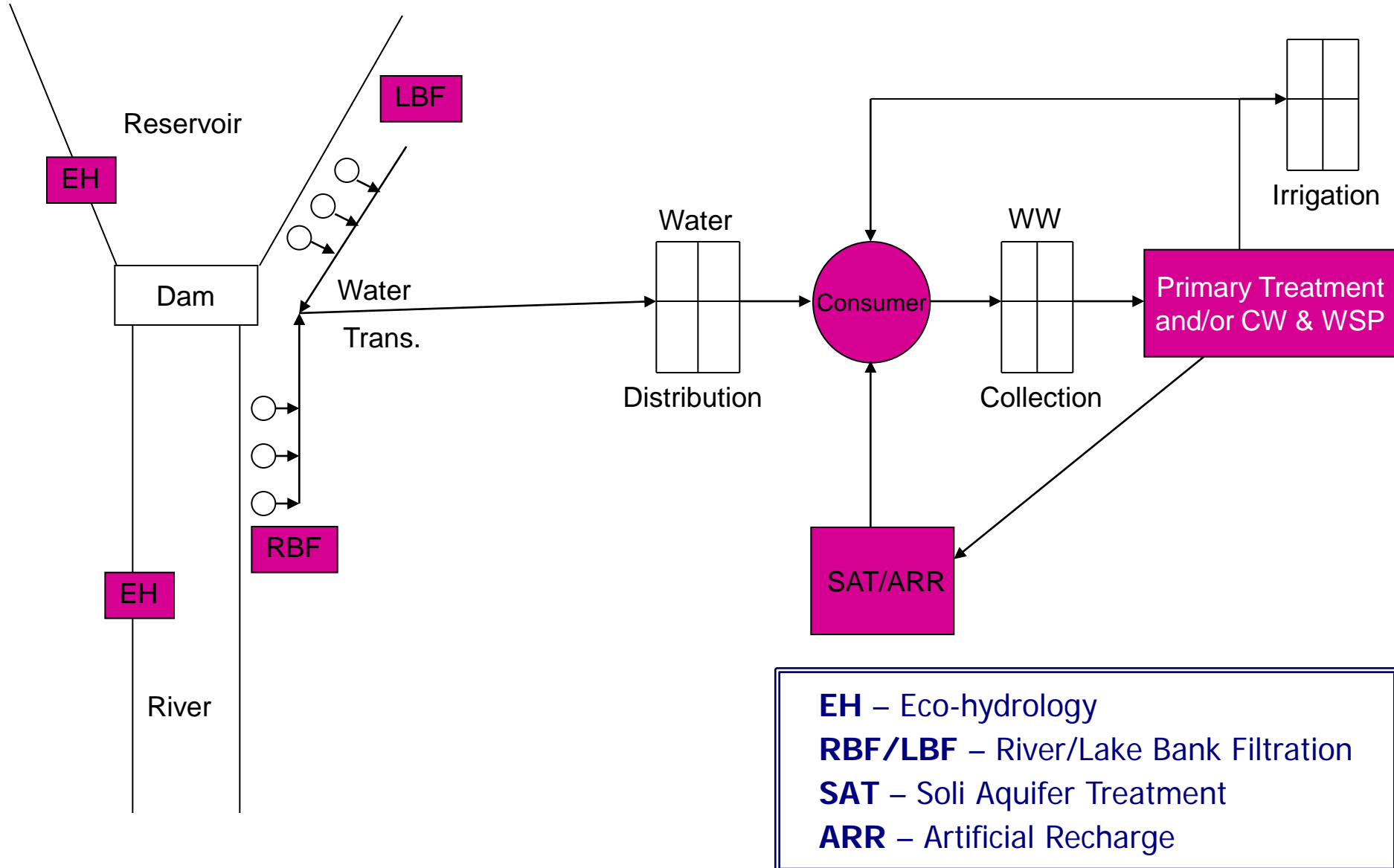
Membranes



Improvements in Technology

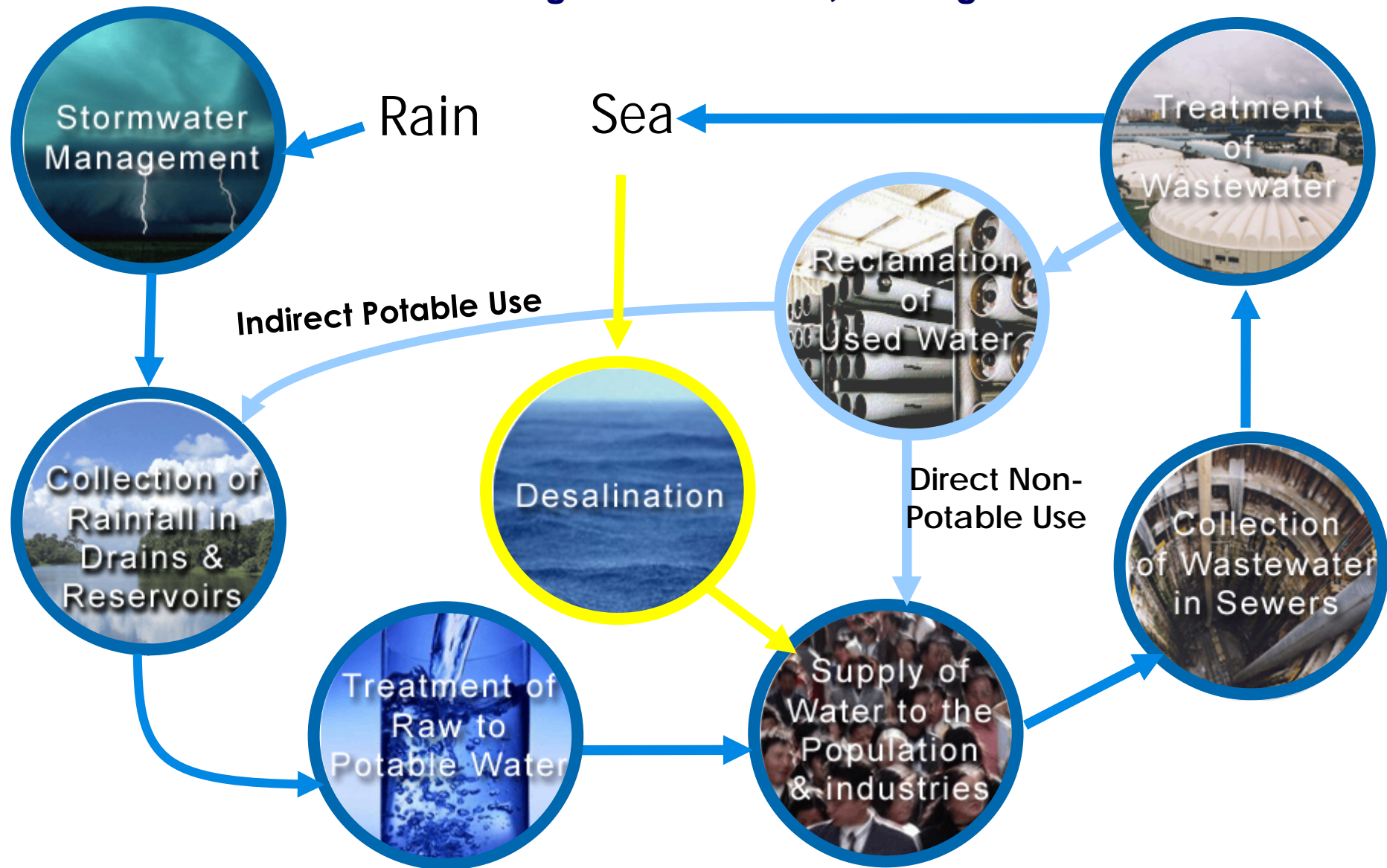


More is needed than simply improving component parts



PUB manages the complete water cycle

From sourcing, collection, purification and supply of drinking water, to treatment of used water and turning it into NEWater, drainage of storm water



FOUR NATIONAL TAPS



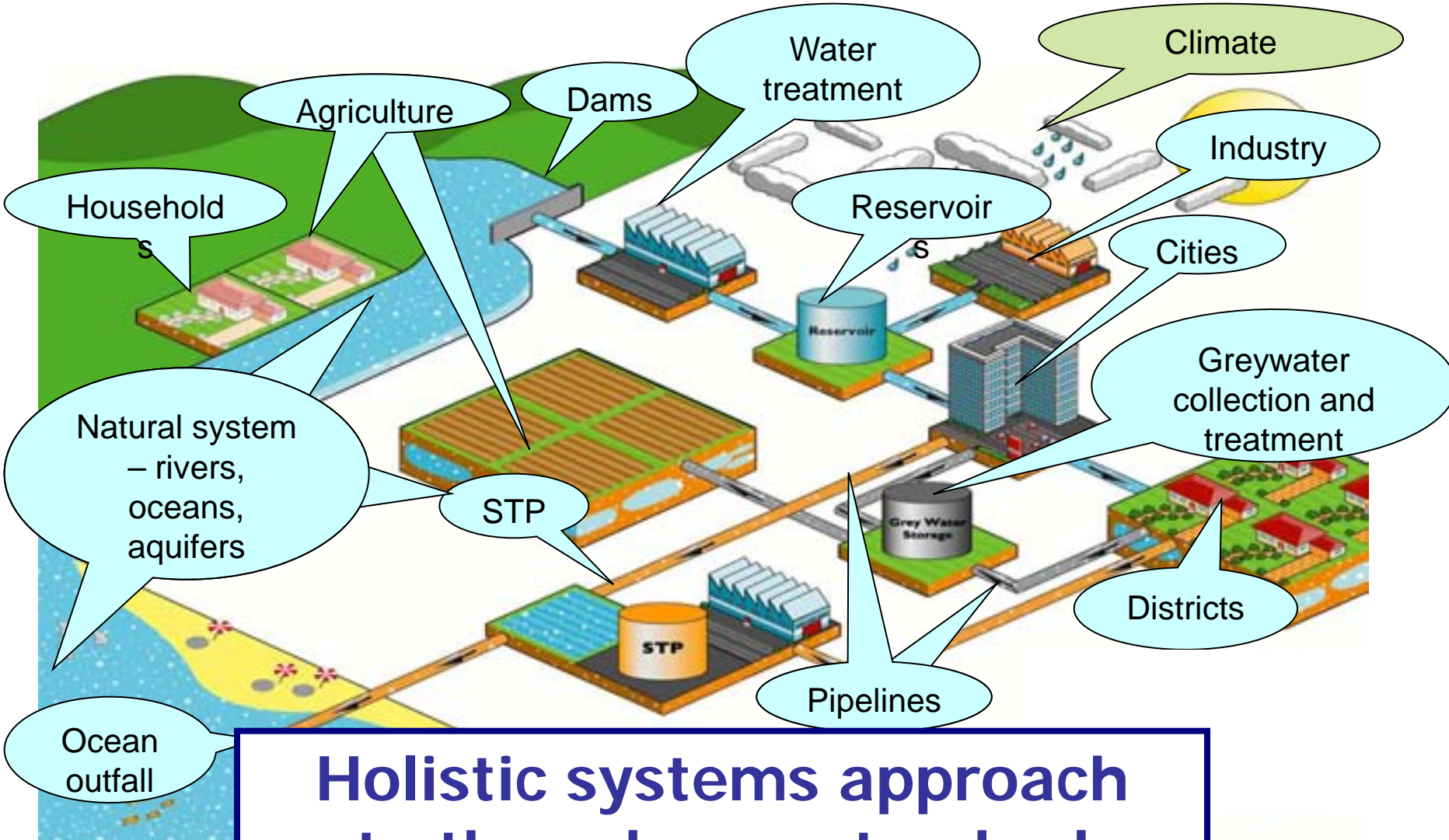
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City of the Future - Integration



Holistic systems approach to the urban watershed

SWITCH City Water

SWITCH



CITY WATER

A knowledge and information sharing platform to support global and integrated urban water planning

offering

A Combined Information System,

- Generic Database
- Geographic Viewer
- Reporting tool
- Systemic Viewer
- And more...

Linked to a Set of Screening Models

- City Water Balance
- City Water Economics
- City Water Drain
- And more...

The screenshot displays the SWITCH City Water software interface. The top window shows a map of a city area with a red highlighted region. The bottom window shows a systemic diagram with nodes and arrows. The right window shows a report viewer with a title 'Month: WWTW 4210, Node' and a table of data.

Month: WWTW 4210, Node

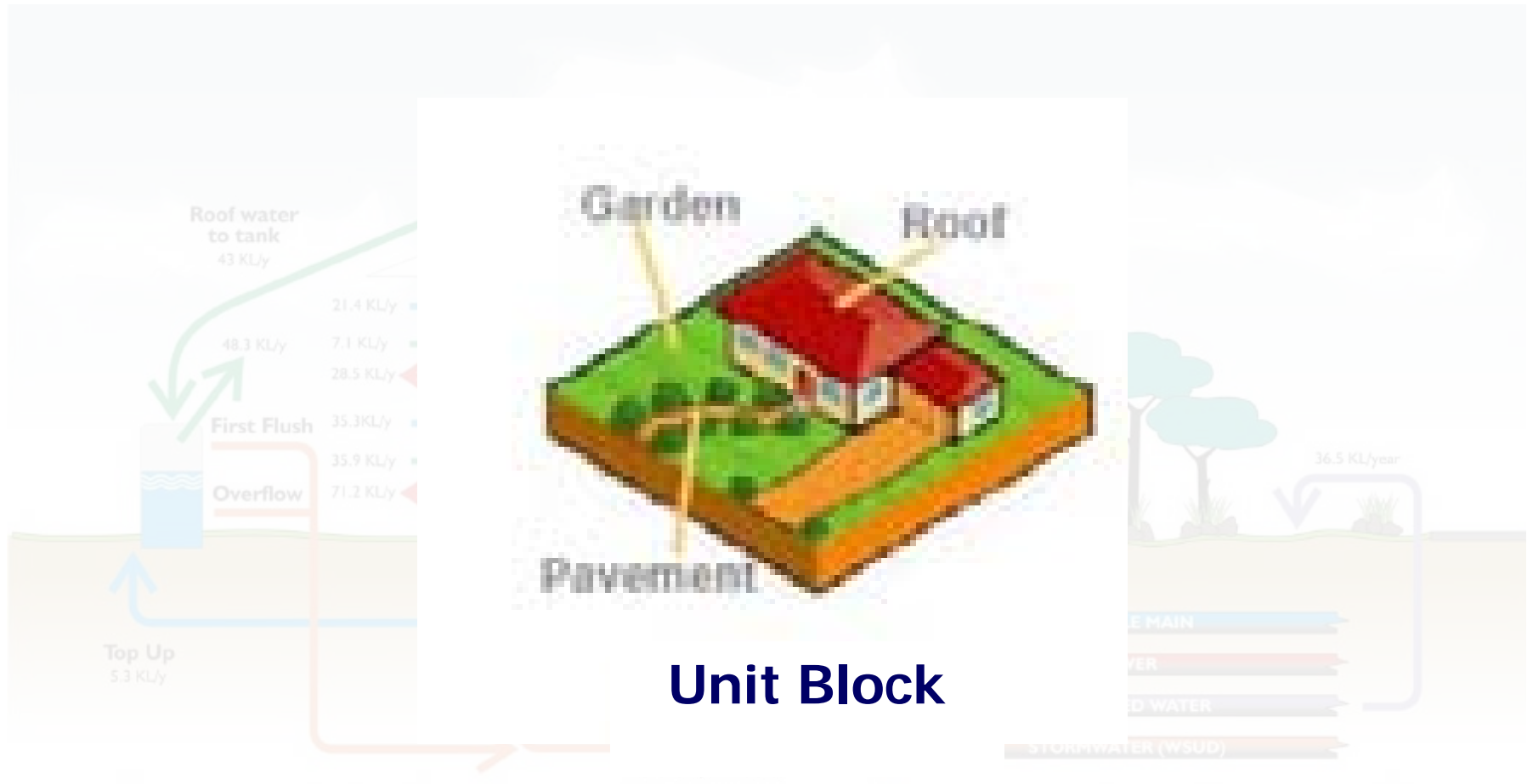
Reports

New report

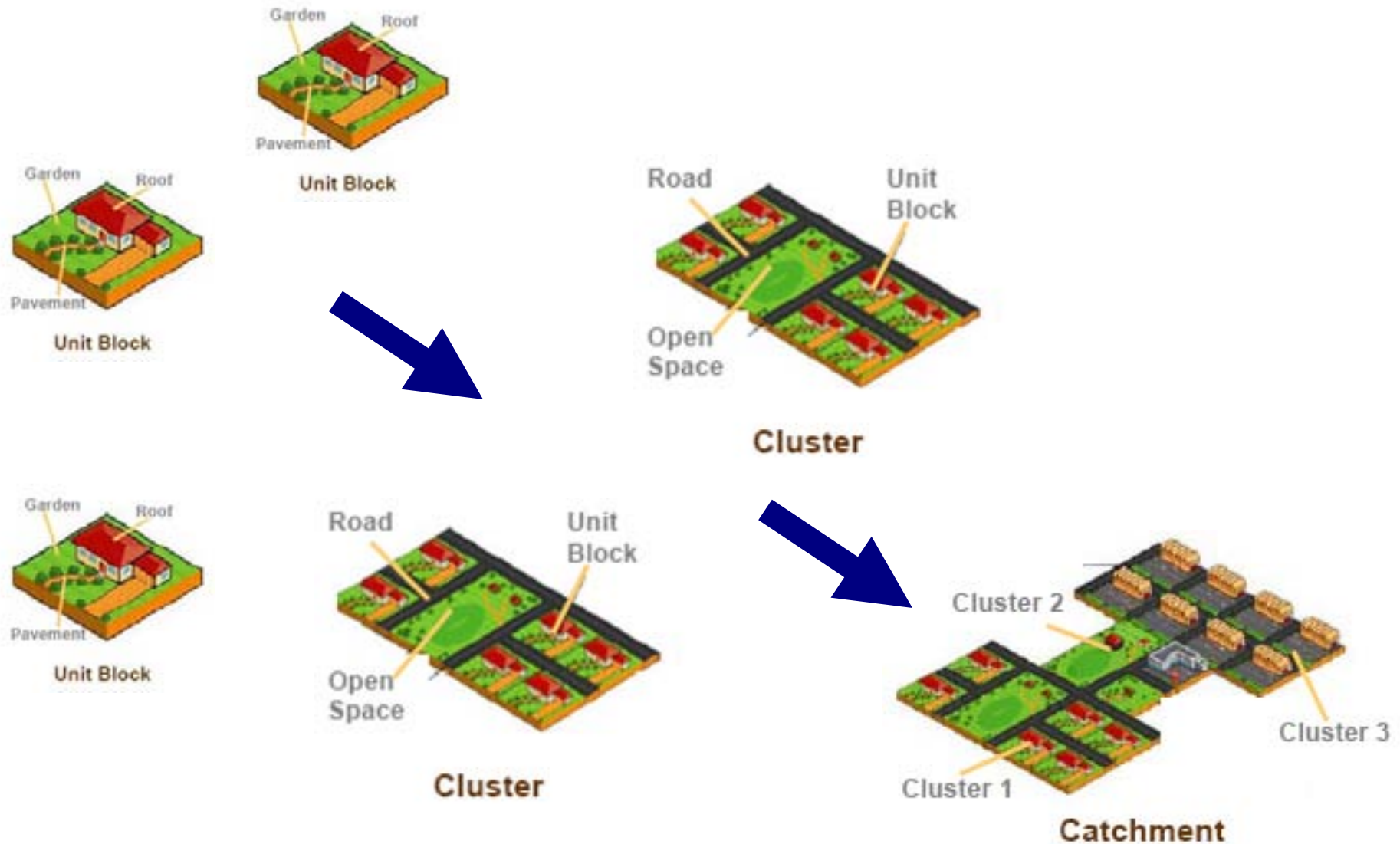
Full times that

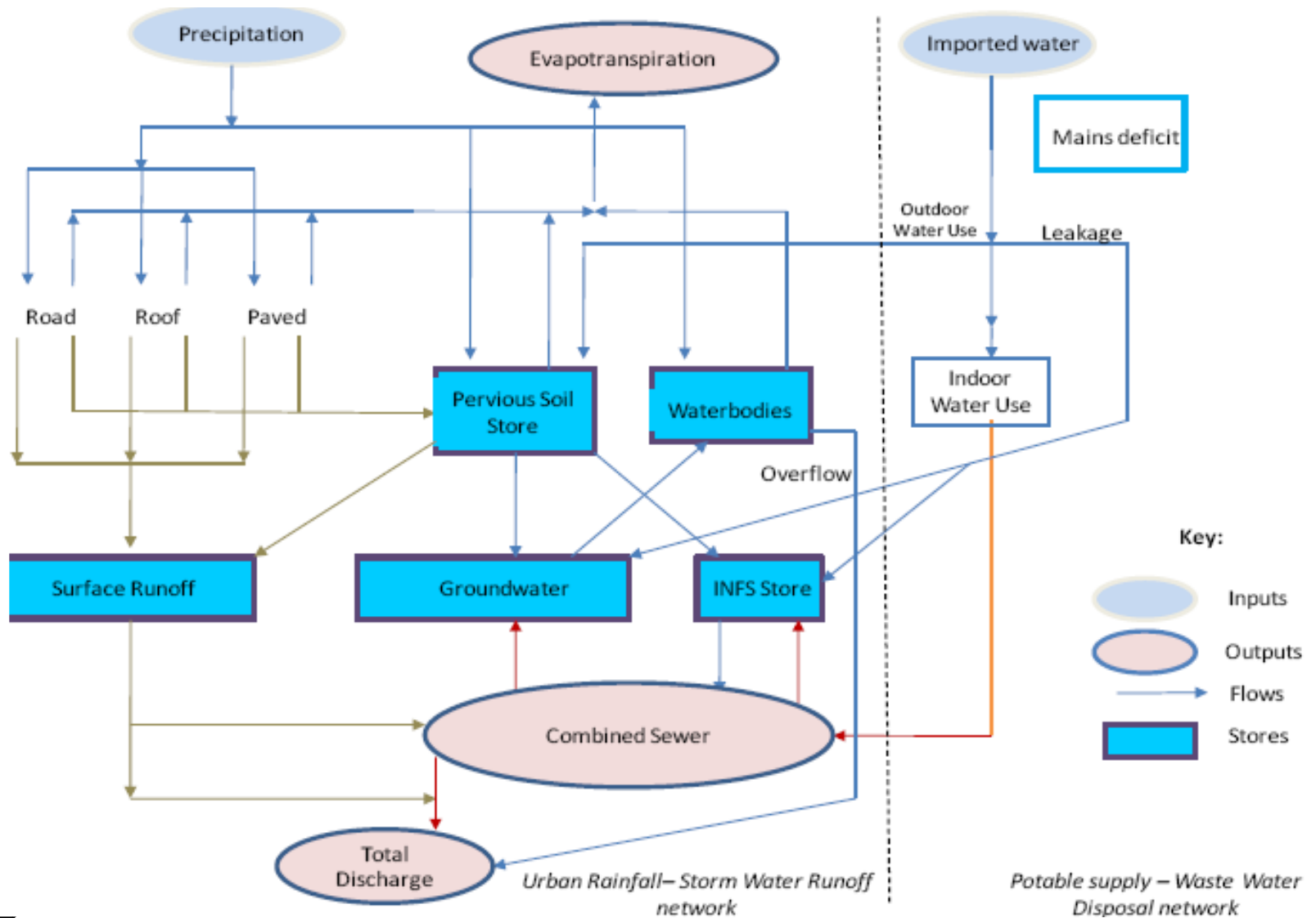
Thumbnail	Name	Extension	Start date	End date

Interventions over urban water cycle

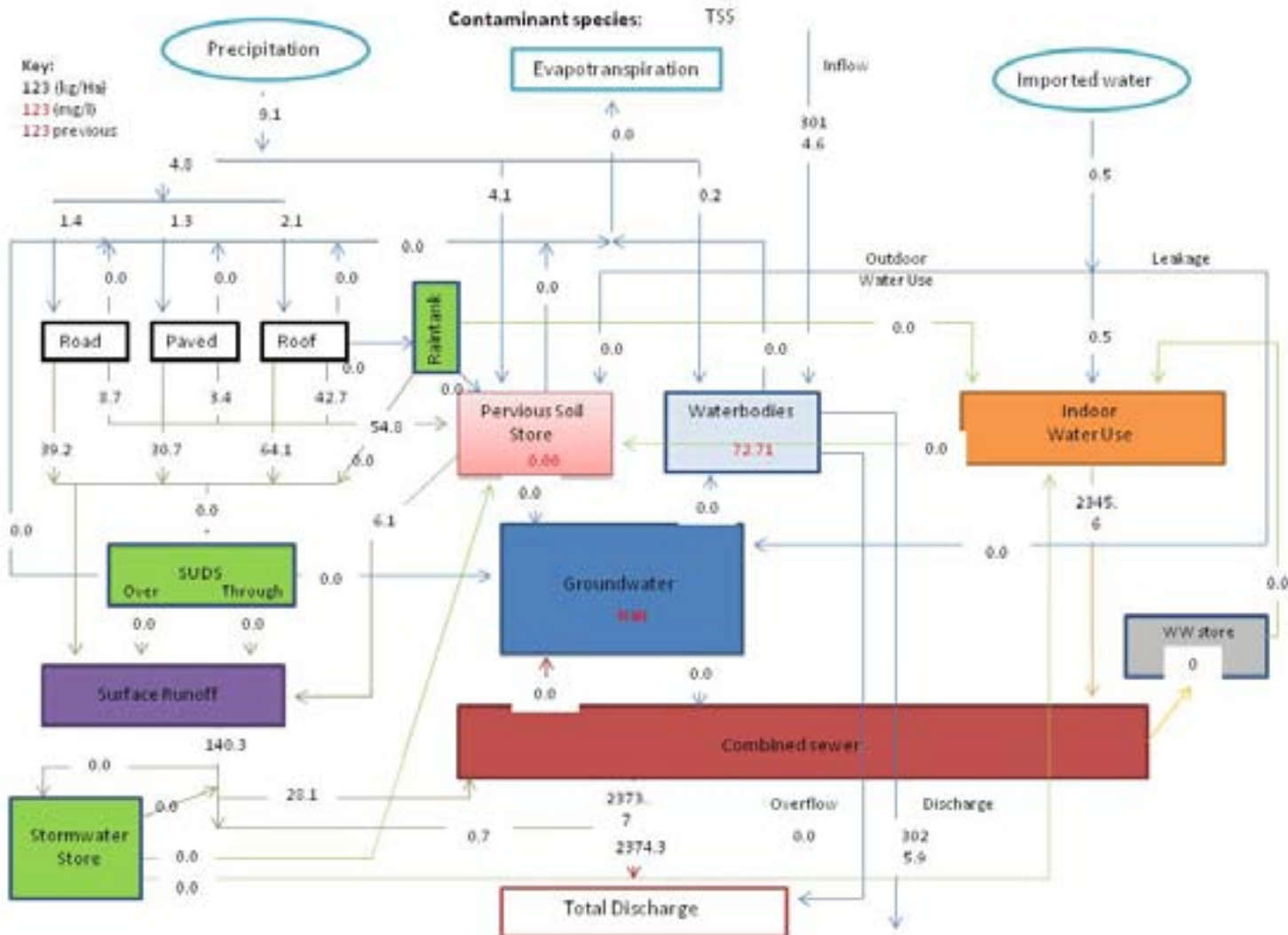


Interventions over urban water cycle

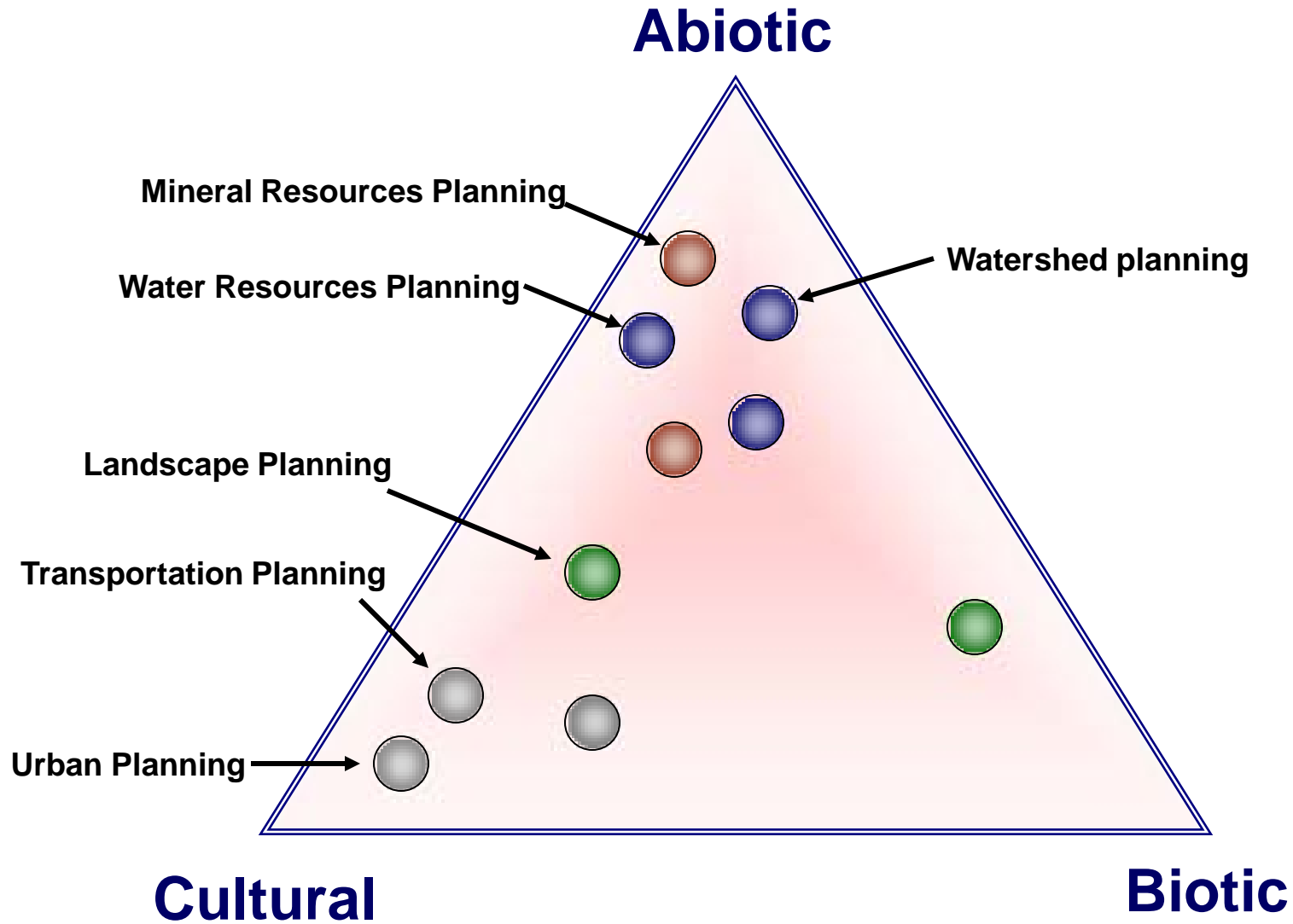




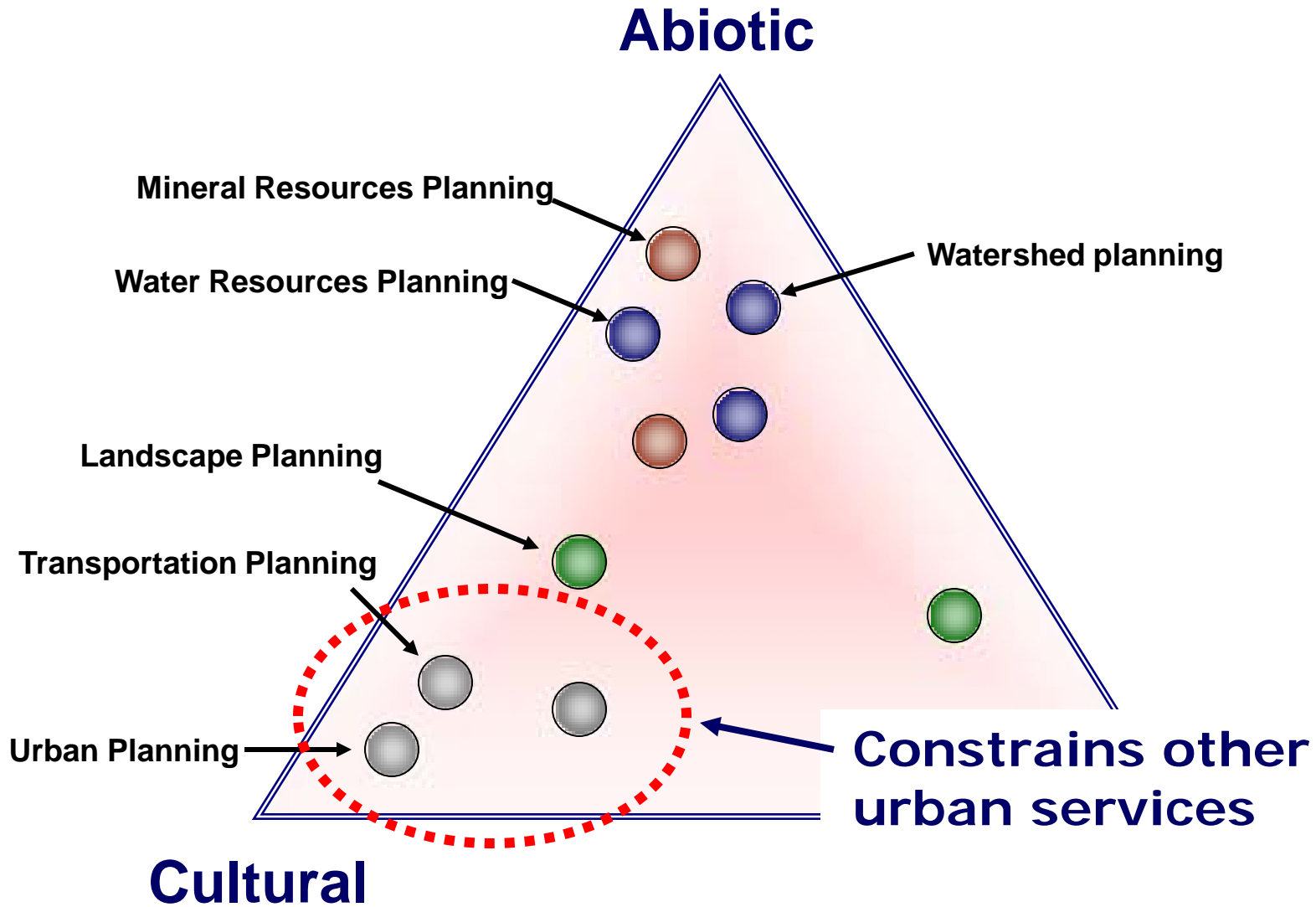
CWB Output – Flows



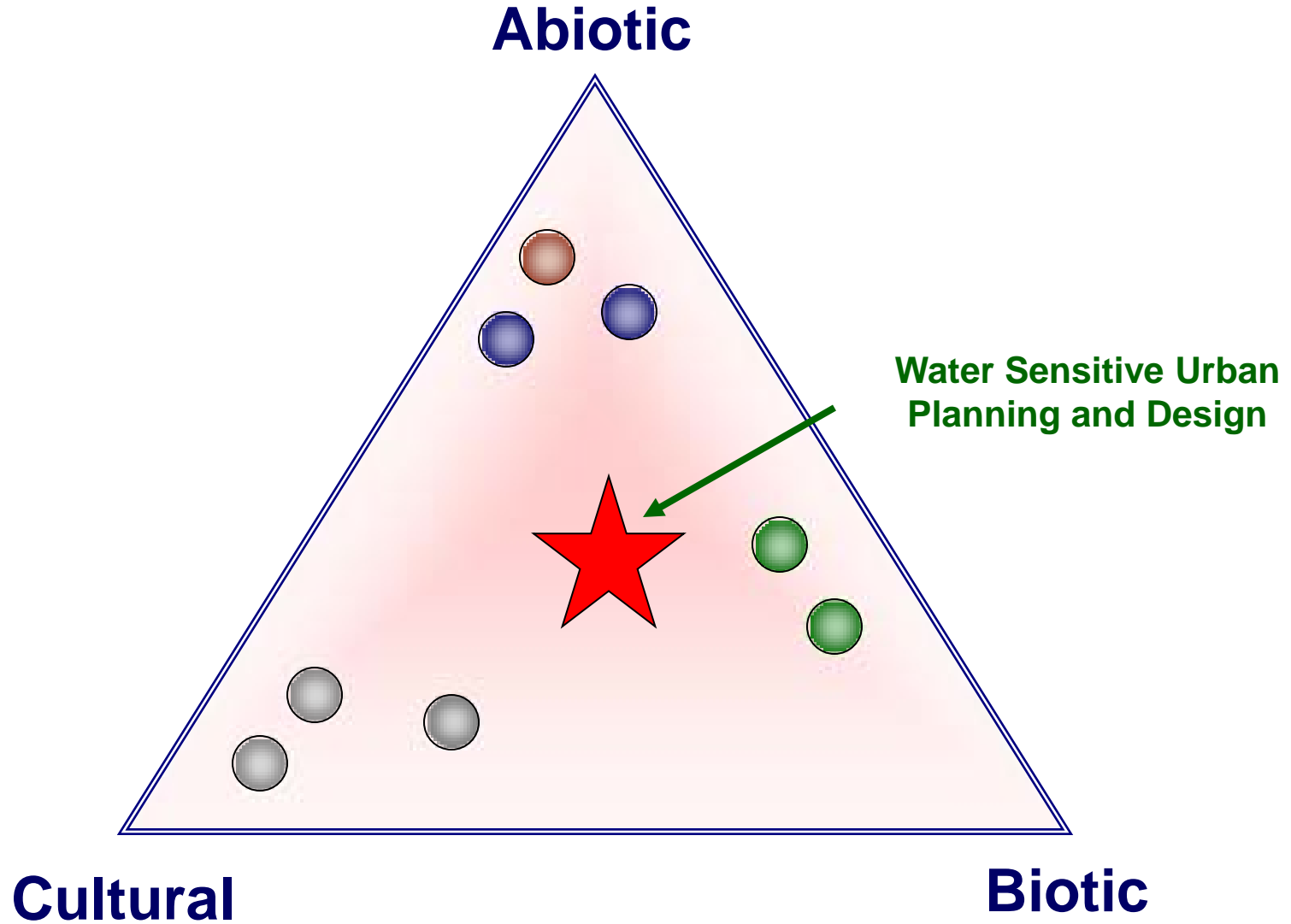
Greater Integration



Planning - Lack Integration



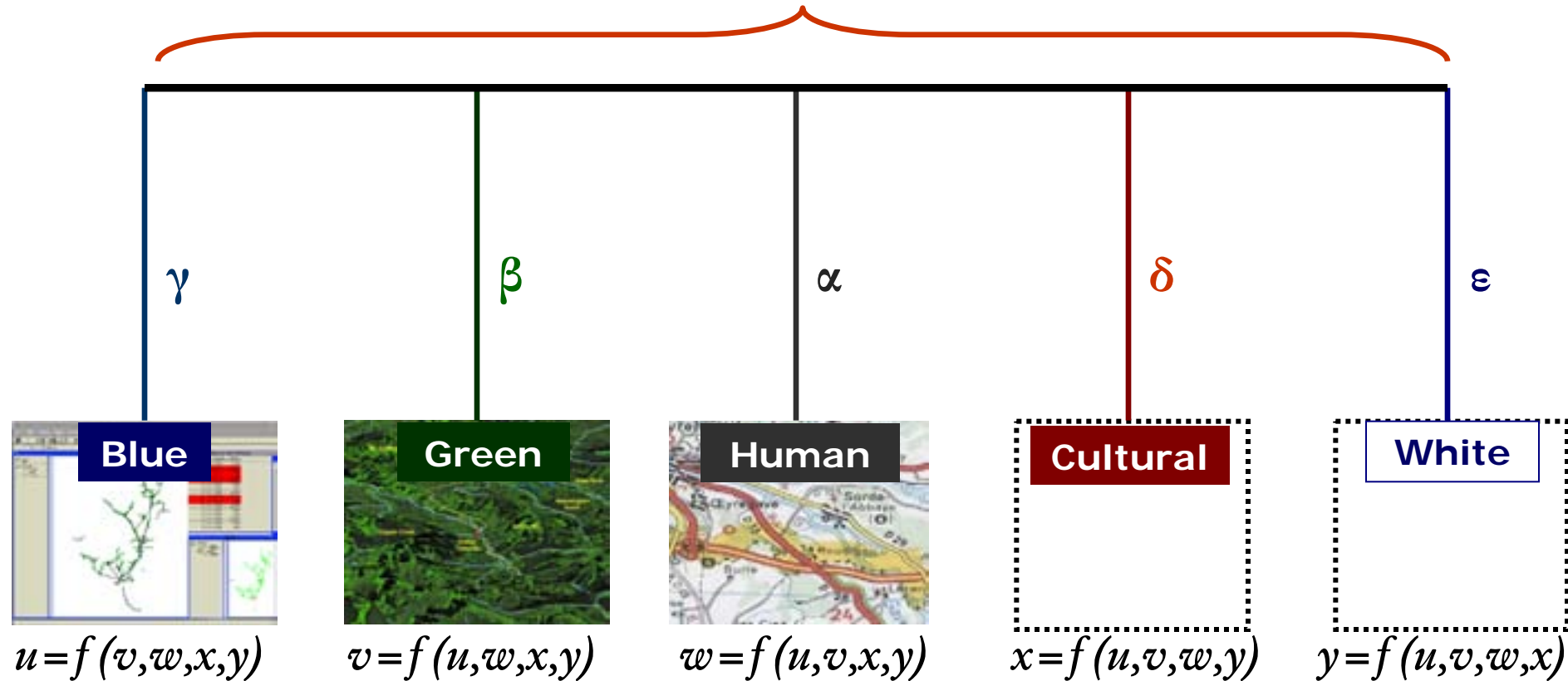
Greater Integration



New challenges – New Thinking

- Multi-objective urban planning (what should drive the urban plan?)

$$Z = (\gamma.u + \beta.v + \alpha.w + \delta.x + \varepsilon.y)$$

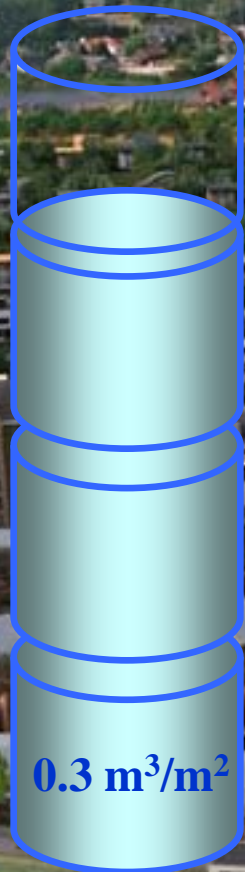




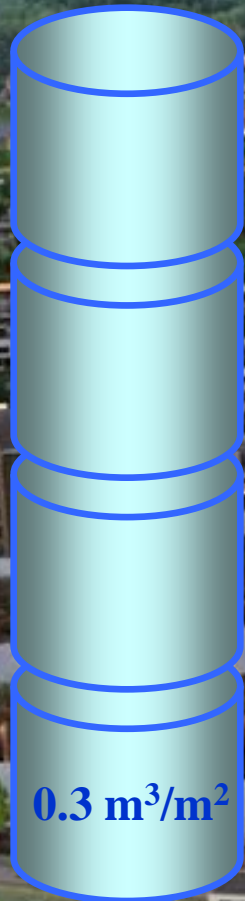
$0.3 \text{ m}^3/\text{m}^2$



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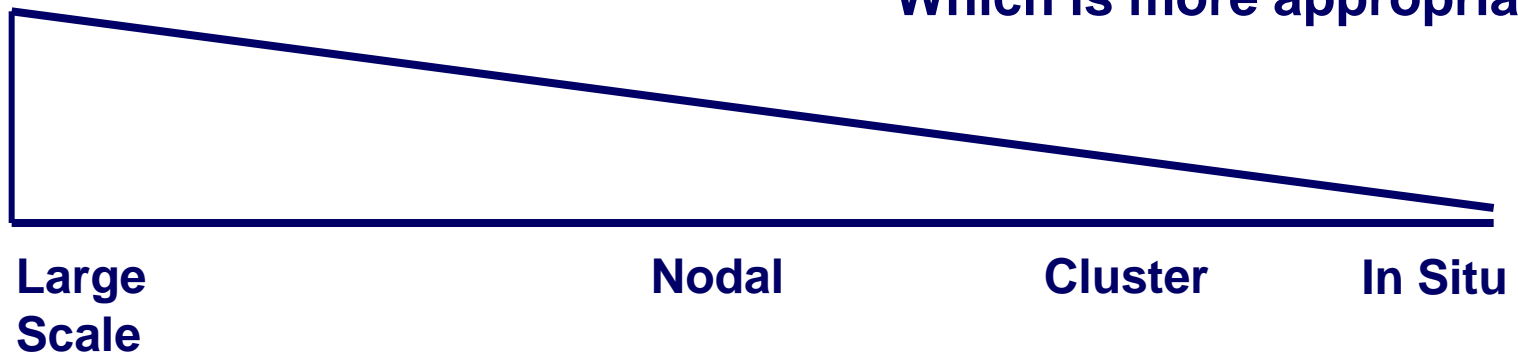
Greater Integration

Allows optimizing
within a continuum
of options

Which is more efficient?

Which is more sustainable?

Which is more appropriate?



Need for Interfaith Dialog !

Highly
Centralized

Highly
Decentralized

The water sector can't do it alone



Need to create **Utilities of the Future** that lead innovation

- Direct utility investments towards integration
- Advocate for funding, regulations and incentives

Land planners
Architects
Developers

Gov't officials
Financiers
Energy experts

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New challenges – New Thinking

- Entire earth system is changing!



Uncertainty in storm events



Uncertainty in carrying capacity/breakage rate



Uncertainty in runoff response

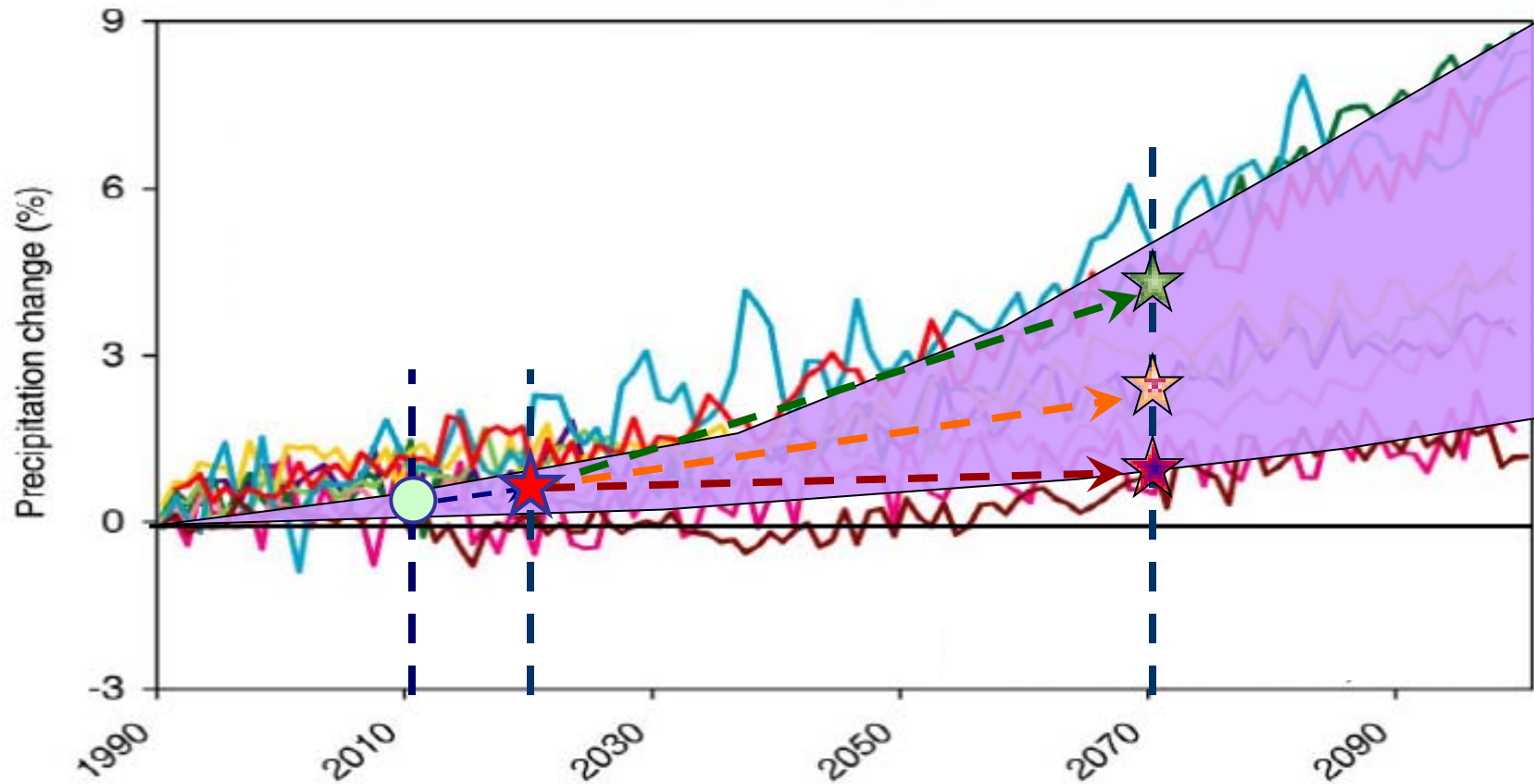


Uncertainty in demand

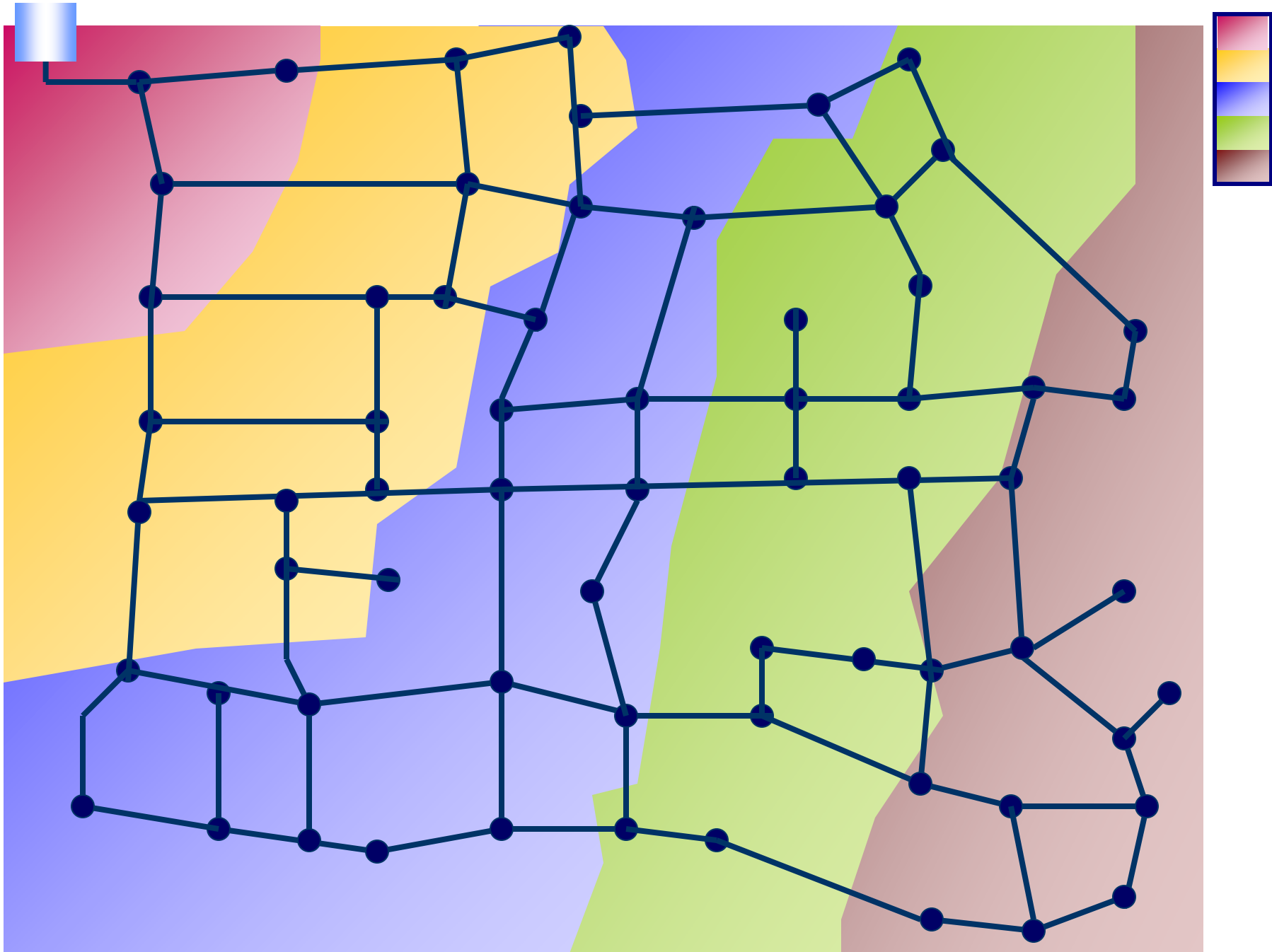


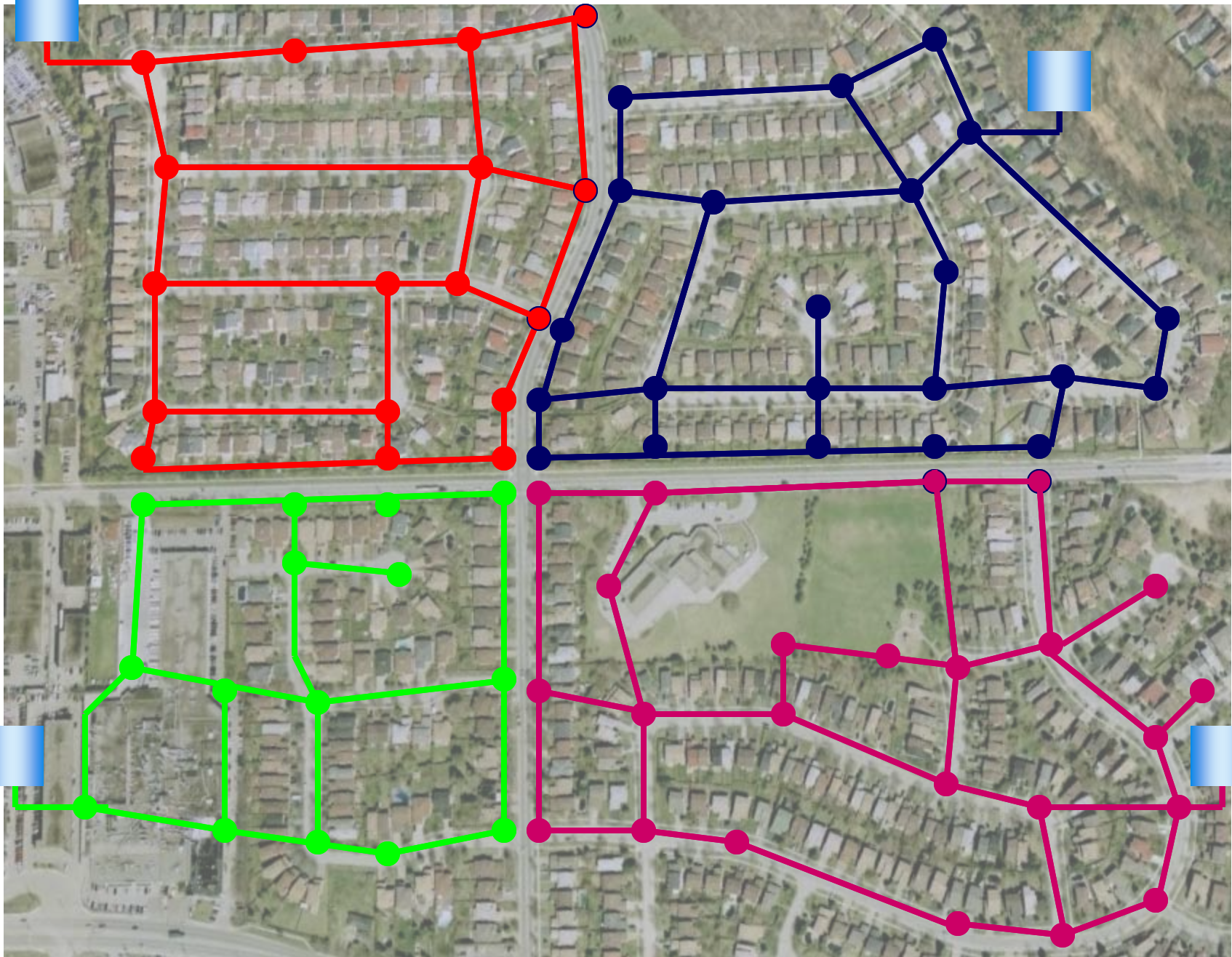
Uncertainty in quantity & quality

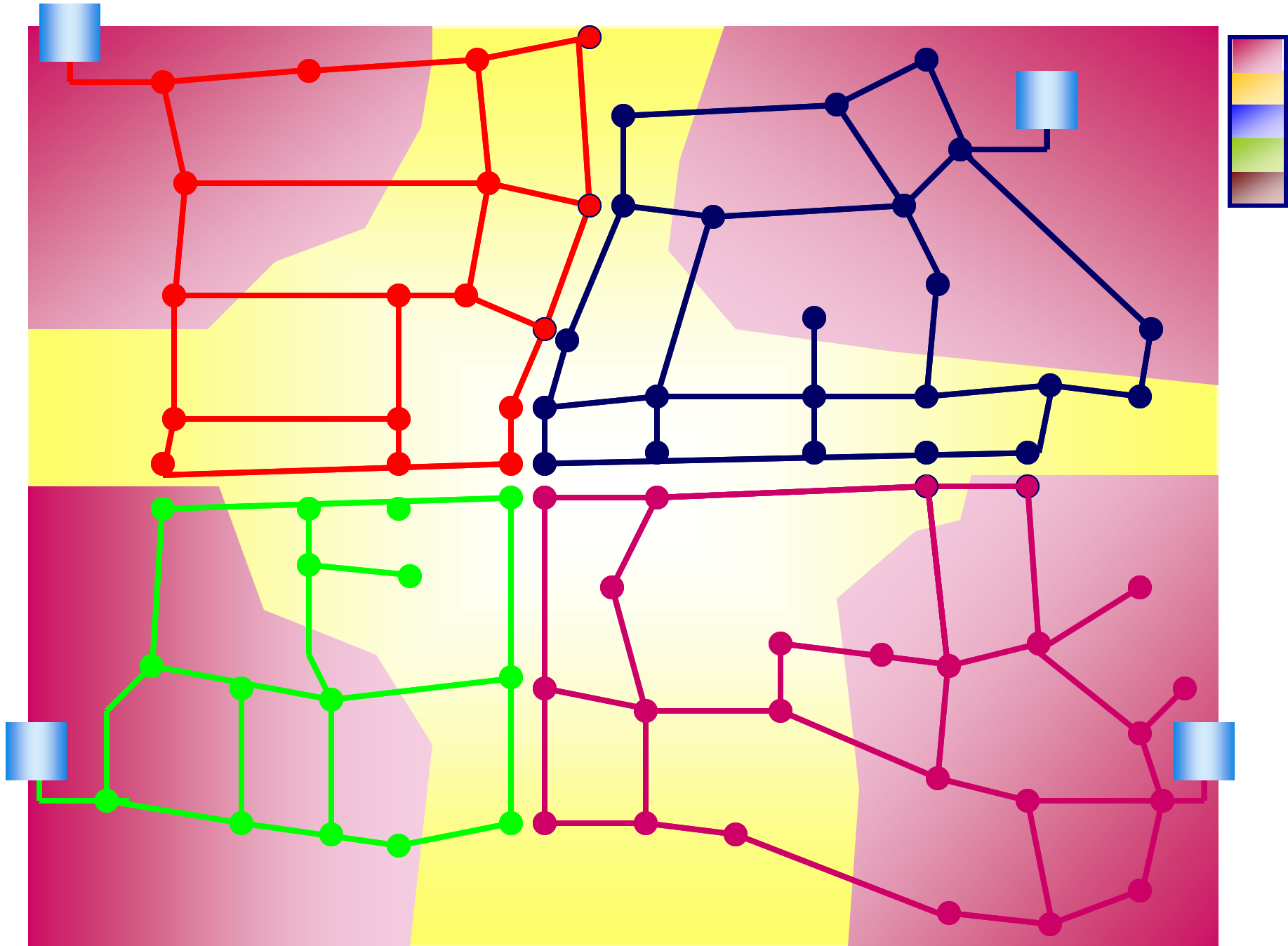
Decision Making in Uncertain World

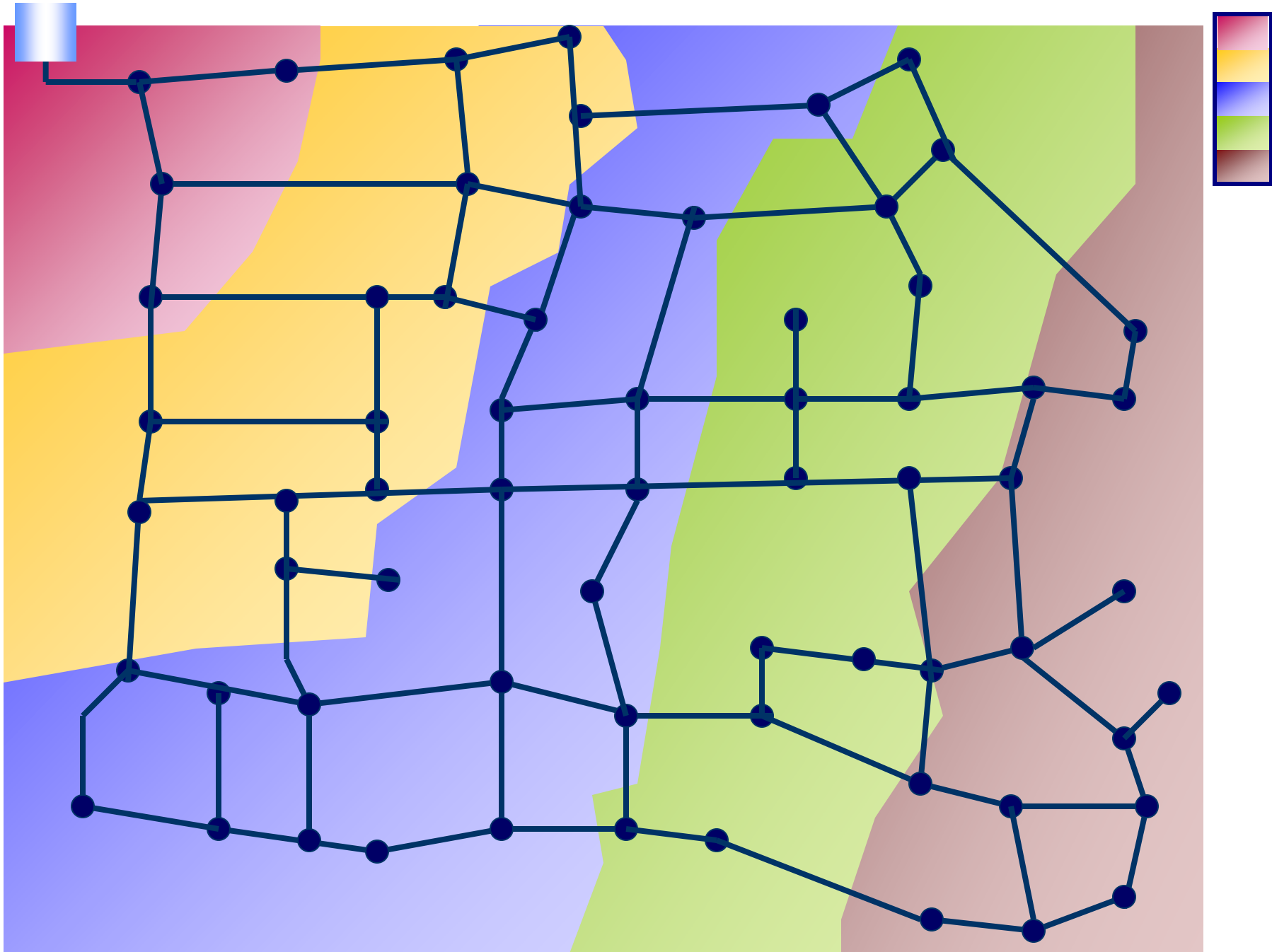


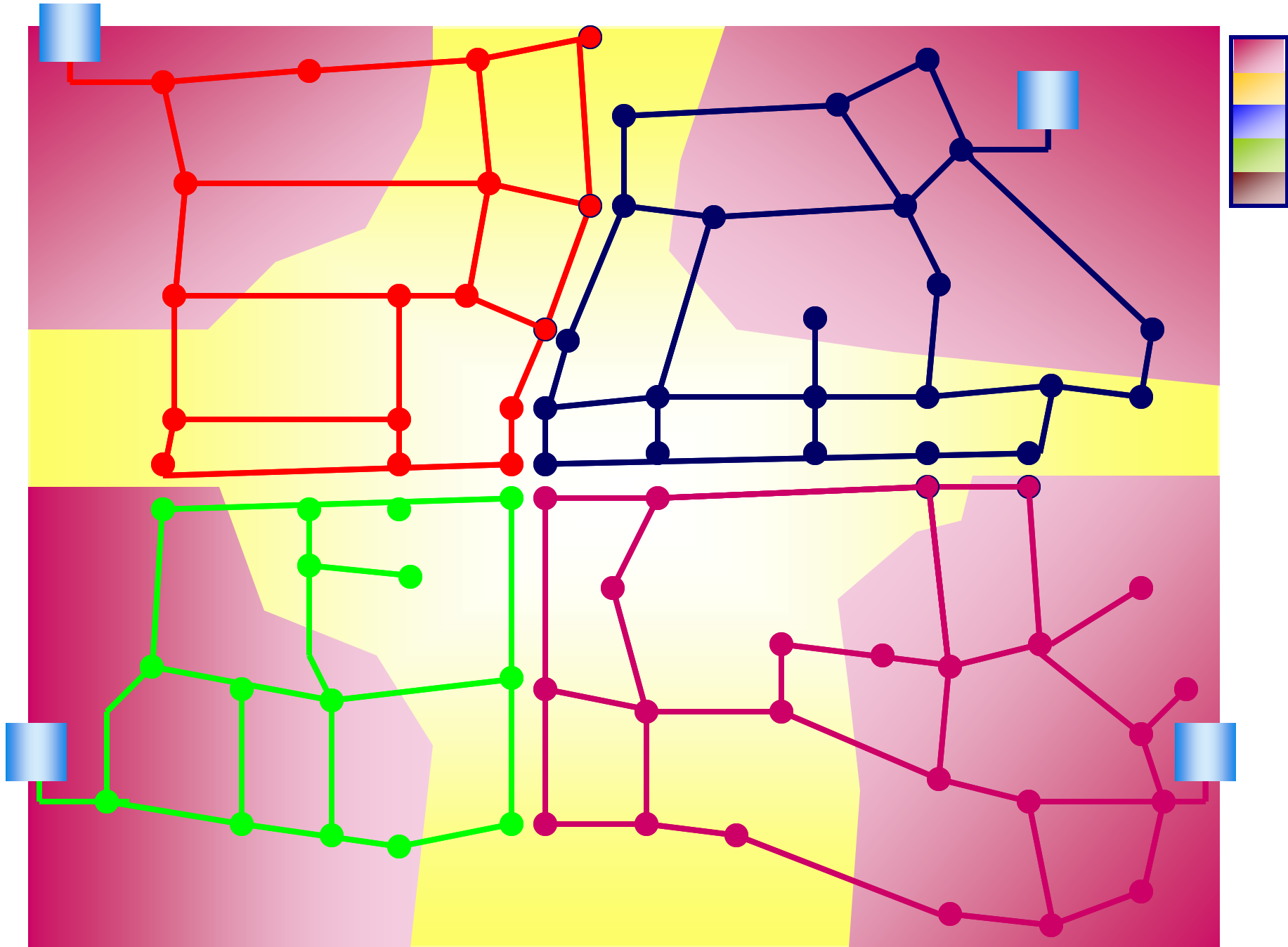


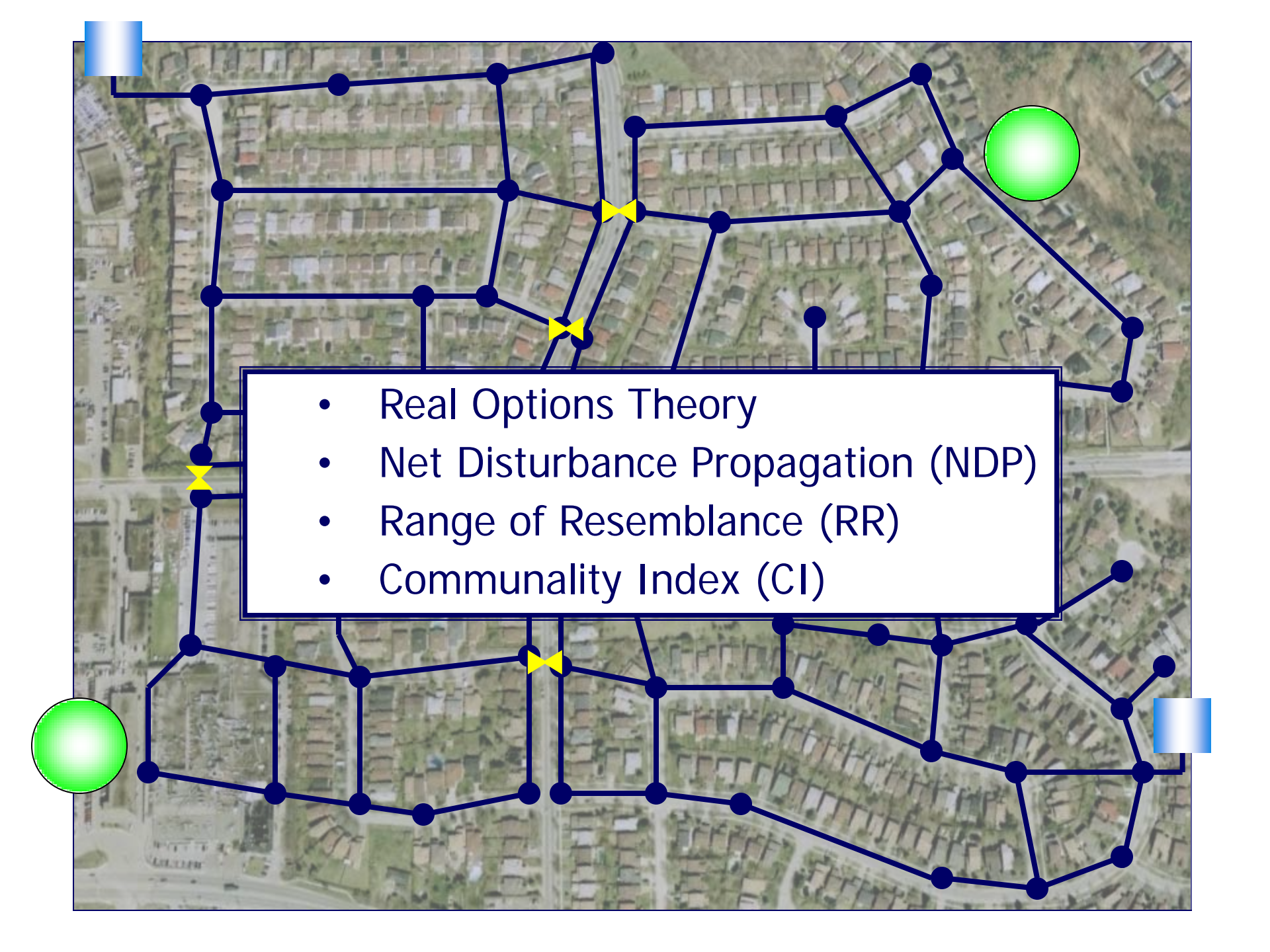










- 
- Real Options Theory
 - Net Disturbance Propagation (NDP)
 - Range of Resemblance (RR)
 - Communality Index (CI)

Sustainable Urban Drainage



ecological
treatment



green roofs



pervious
pavement



infiltration
trench



stormwater
harvesting

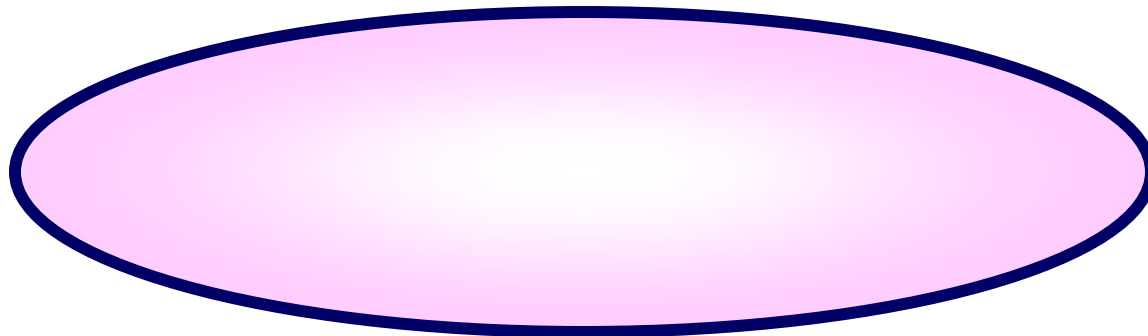
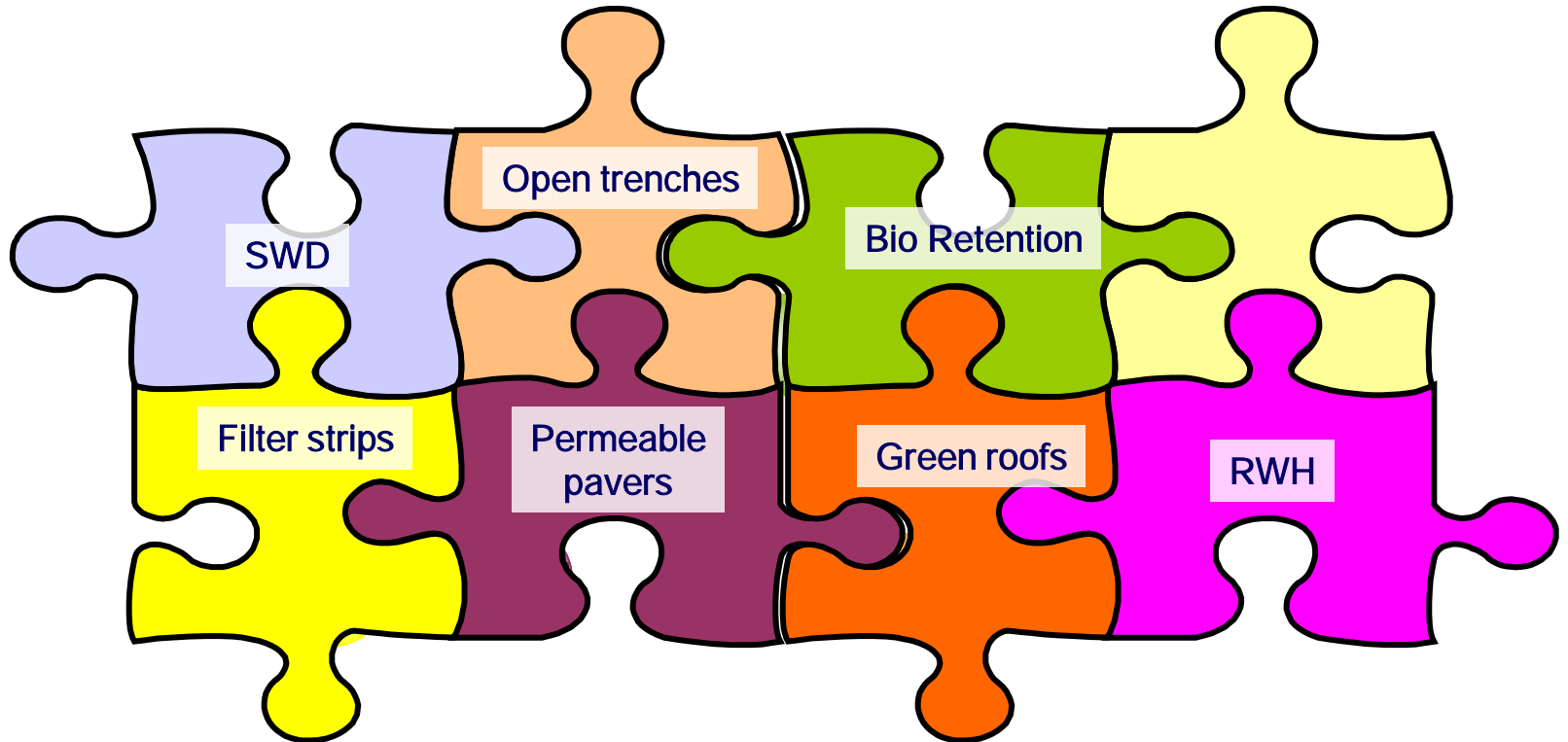


retention
pond

**SUDs provides modular diversity
that increases flexibility resulting
in a complex adaptive system**

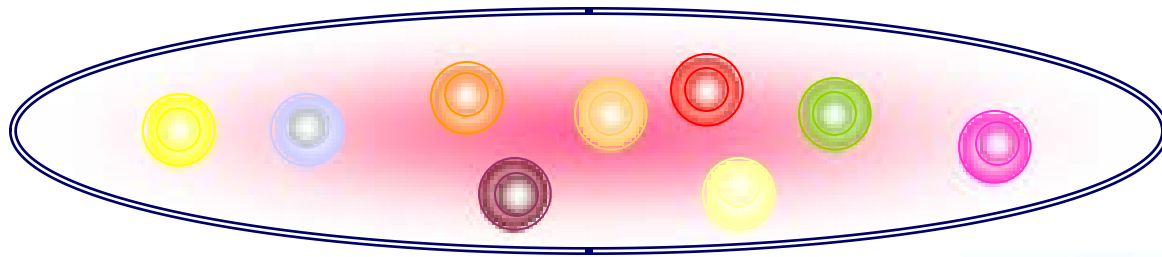
(Sieker et al., 2008, Eckart, 2008)

Examples of activities

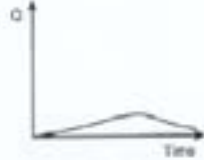


Suite of Options

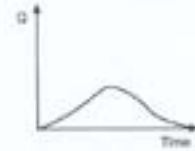
Urban Drainage Modular System



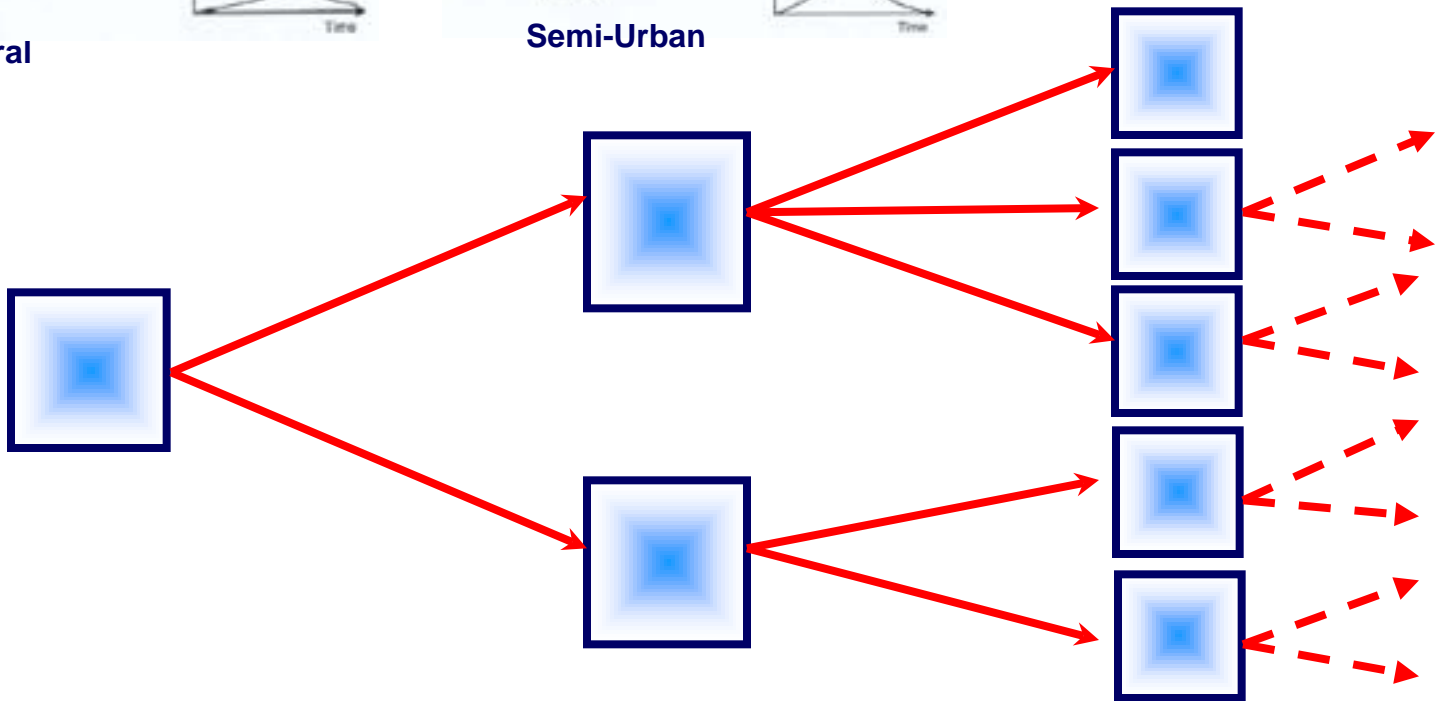
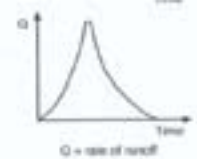
Rural



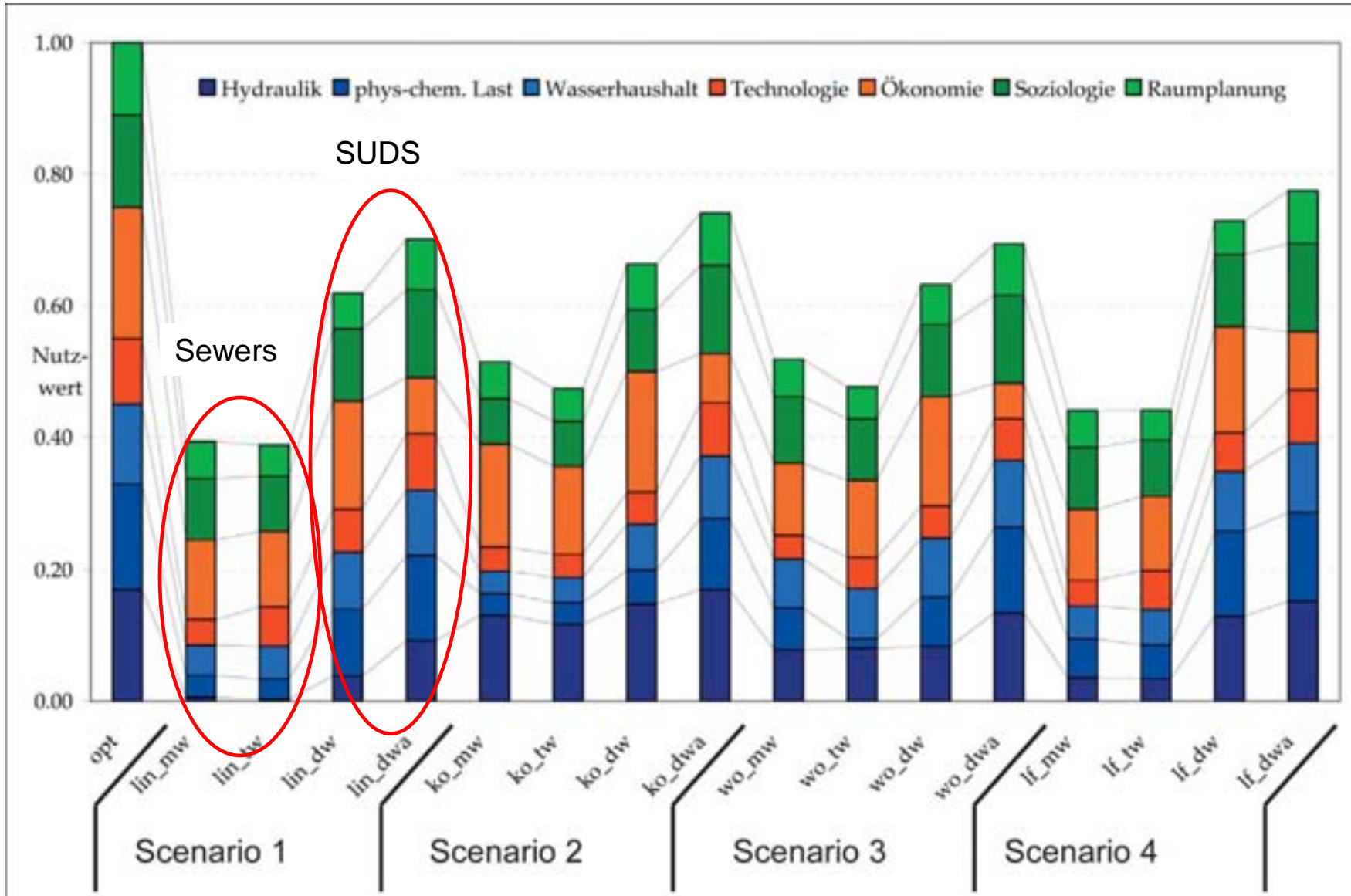
Semi-Urban



Urban



Case Study: Kupferzell Germany




Where/what to retrofit on-site???


Eastside_WL
 Rectifyeastside455m.tif
 StormwaterBMP_location_WL2

Parameters Potential Areas SitebySite ADDStormwaterBMP Project properties Symbology

Storm Water BMP

- Retention basin
- Settlement tank
- Green roof
- Filter strip
- Swale





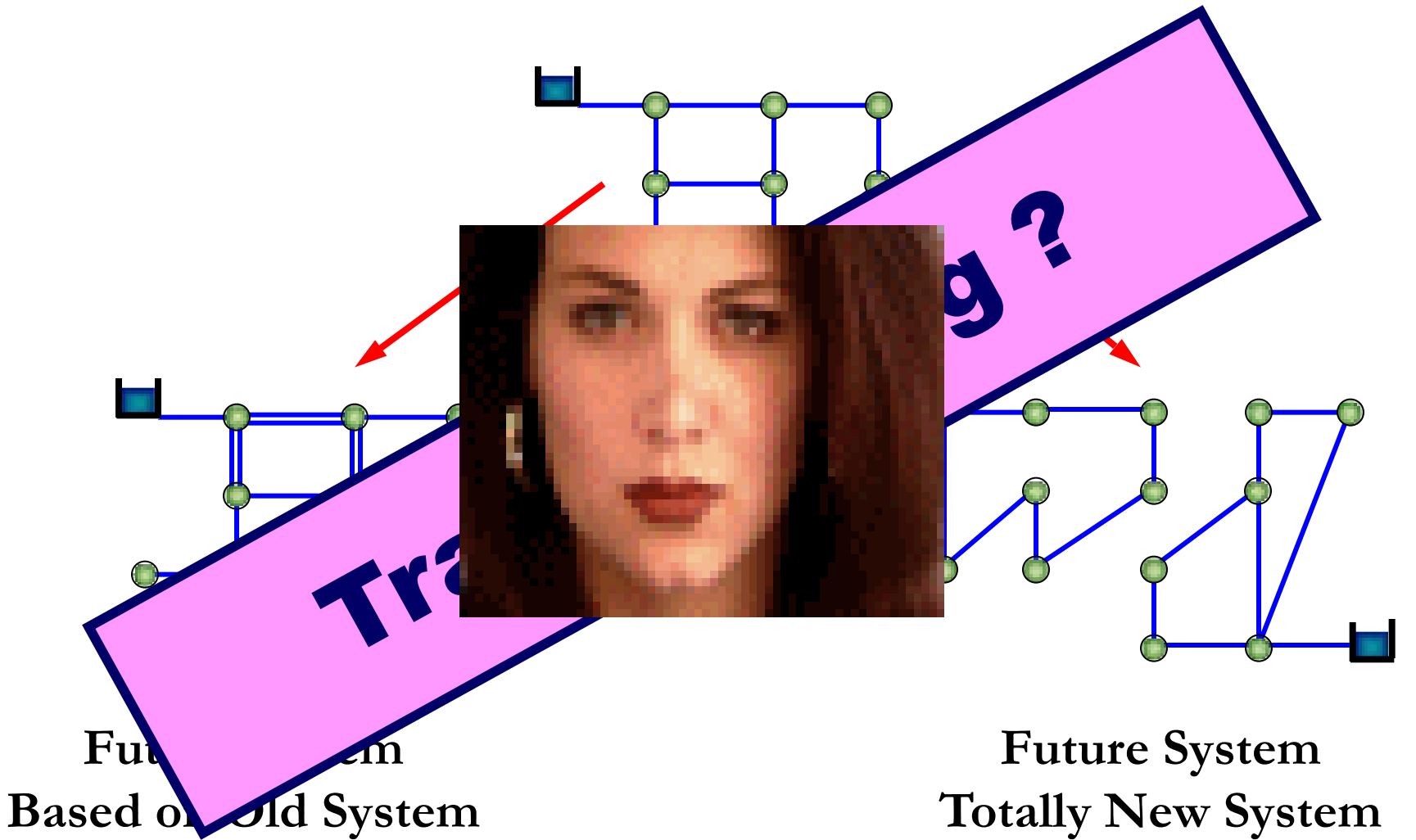
Source: Day Water <http://www.daywater.cz/>

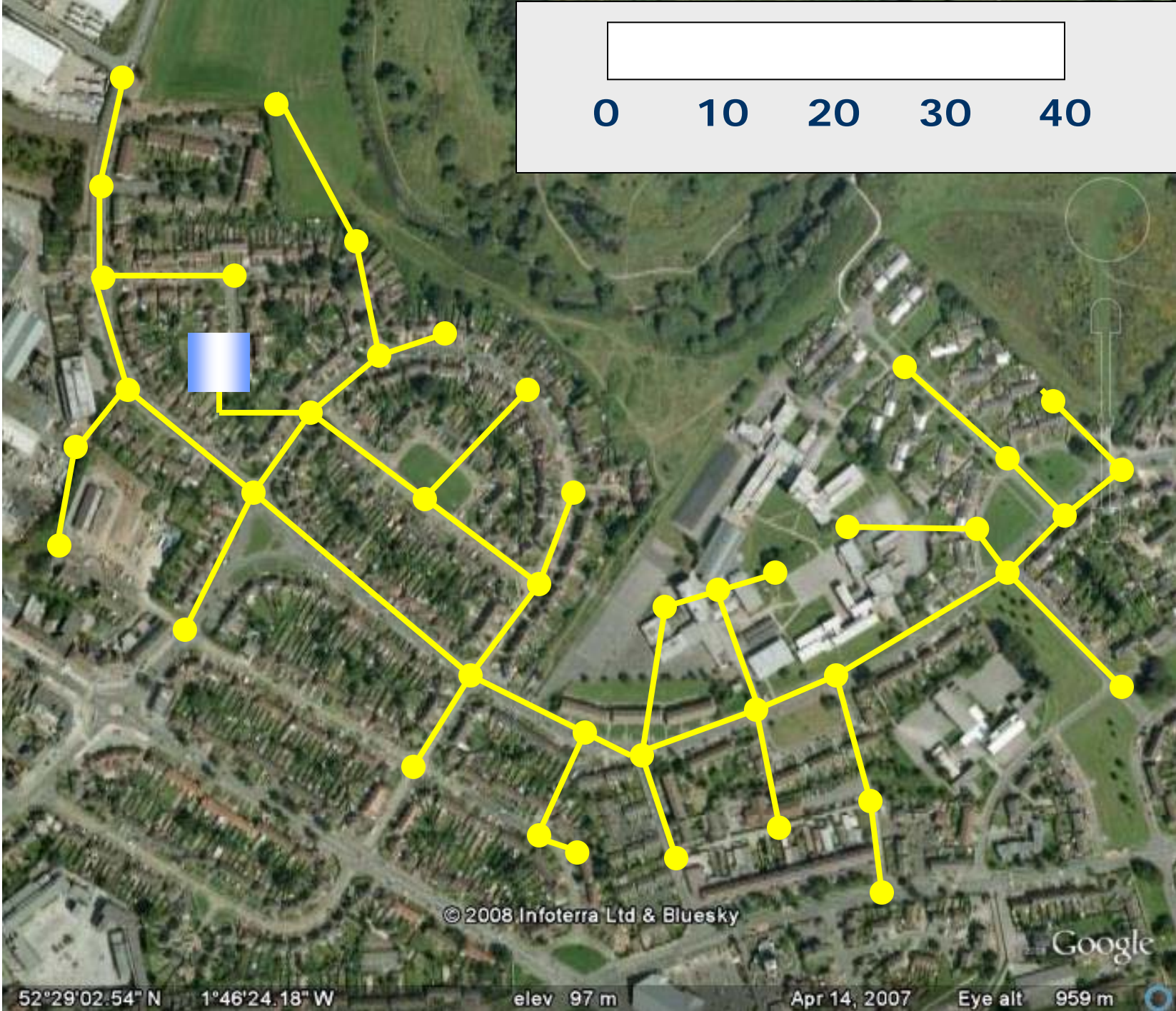
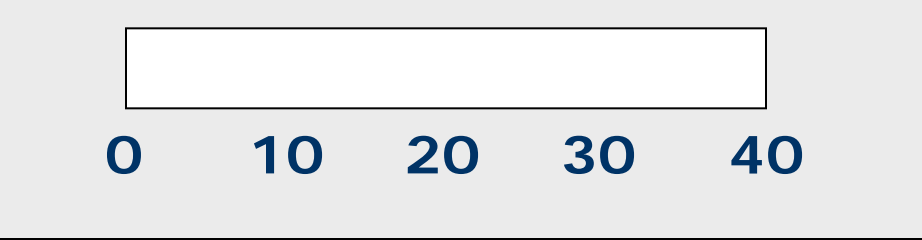
Criteria	subcriteria	Green roof
Landuse	Railway	FALSE
Landuse	Openspace	FALSE
Landuse	Carpark	FALSE
Landuse	Building	TRUE
Landuse	Pavements	FALSE
Landuse	Road	FALSE
Landuse	Impermeable	FALSE
Landuse	Verges	FALSE
Landuse	Waterbody	FALSE
Catchment	DrainageArea	999
Catchment	DrainageArea	999
DEM	SlopeMin	999
DEM	SlopeMax	999

Sites Numbre 257

Total Surface 177

Transitioning





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Google

52°29'02.54" N

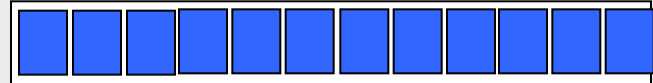
1°46'24.18" W

elev 97 m

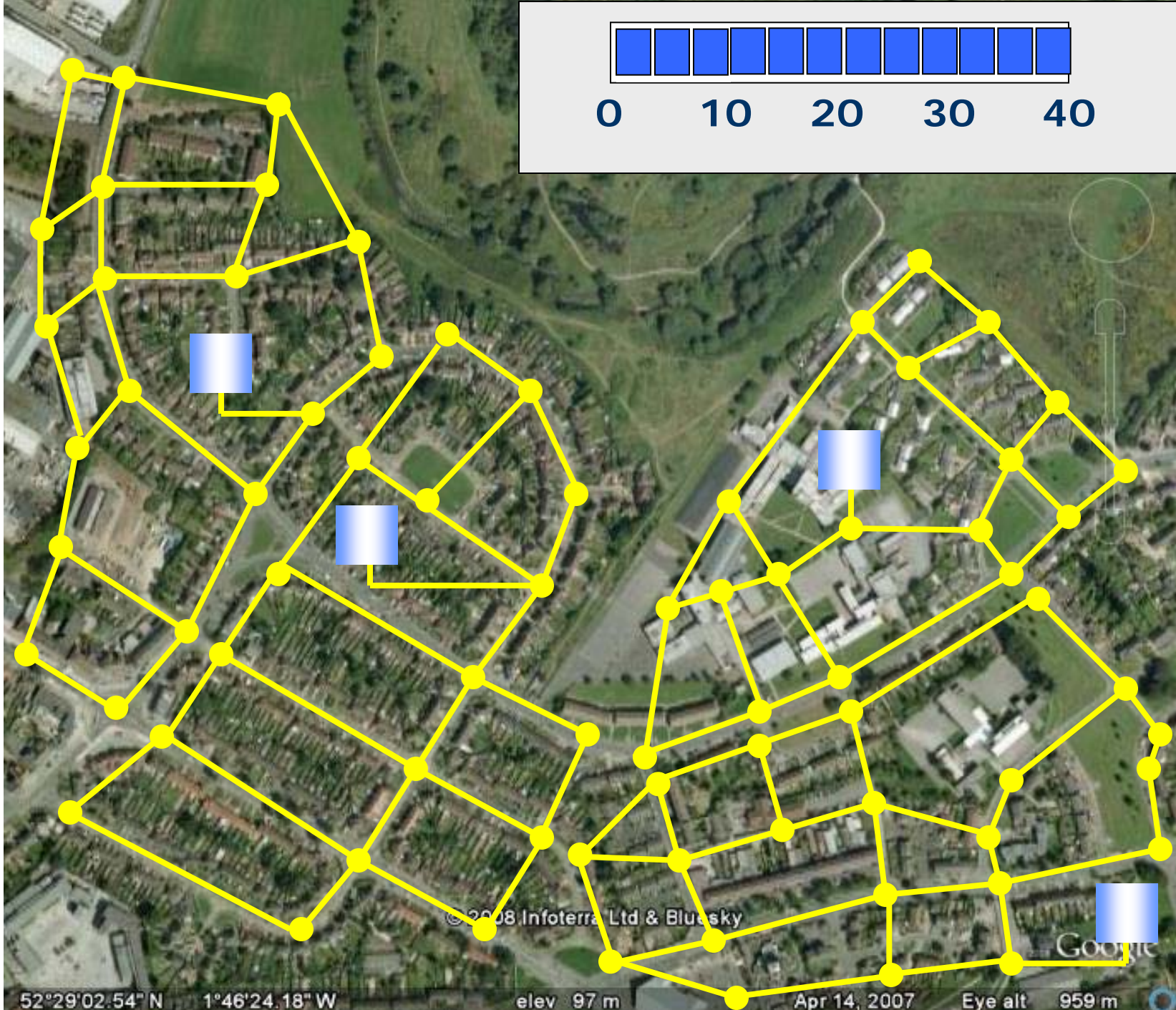
Apr 14, 2007

Eye alt 959 m

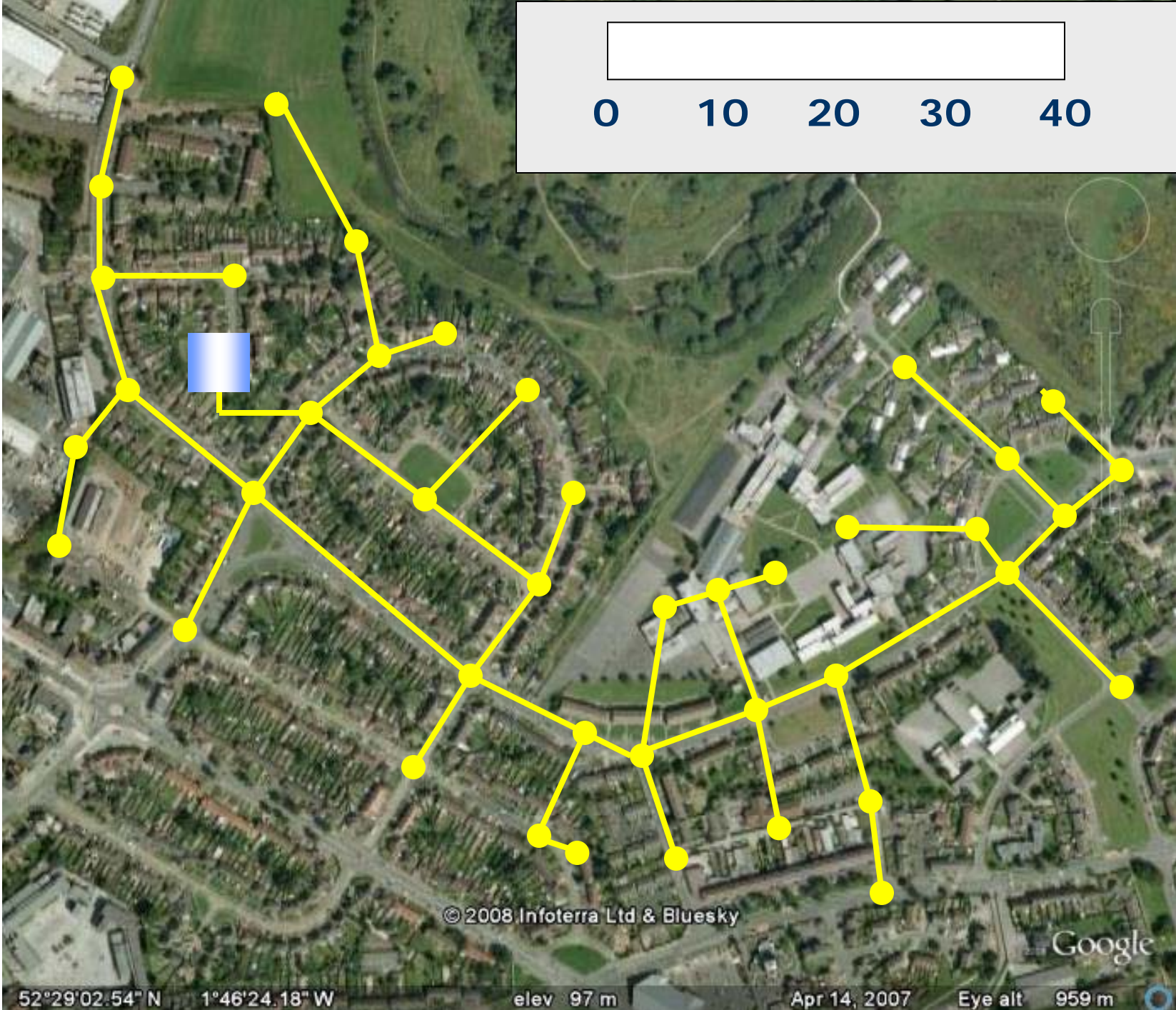
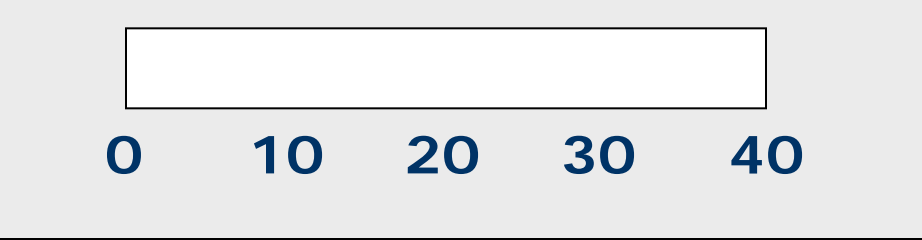




0 10 20 30 40



52°29'02.54" N 1°46'24.18" W elev 97 m Apr 14, 2007 Eye alt 959 m



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Google

52°29'02.54" N

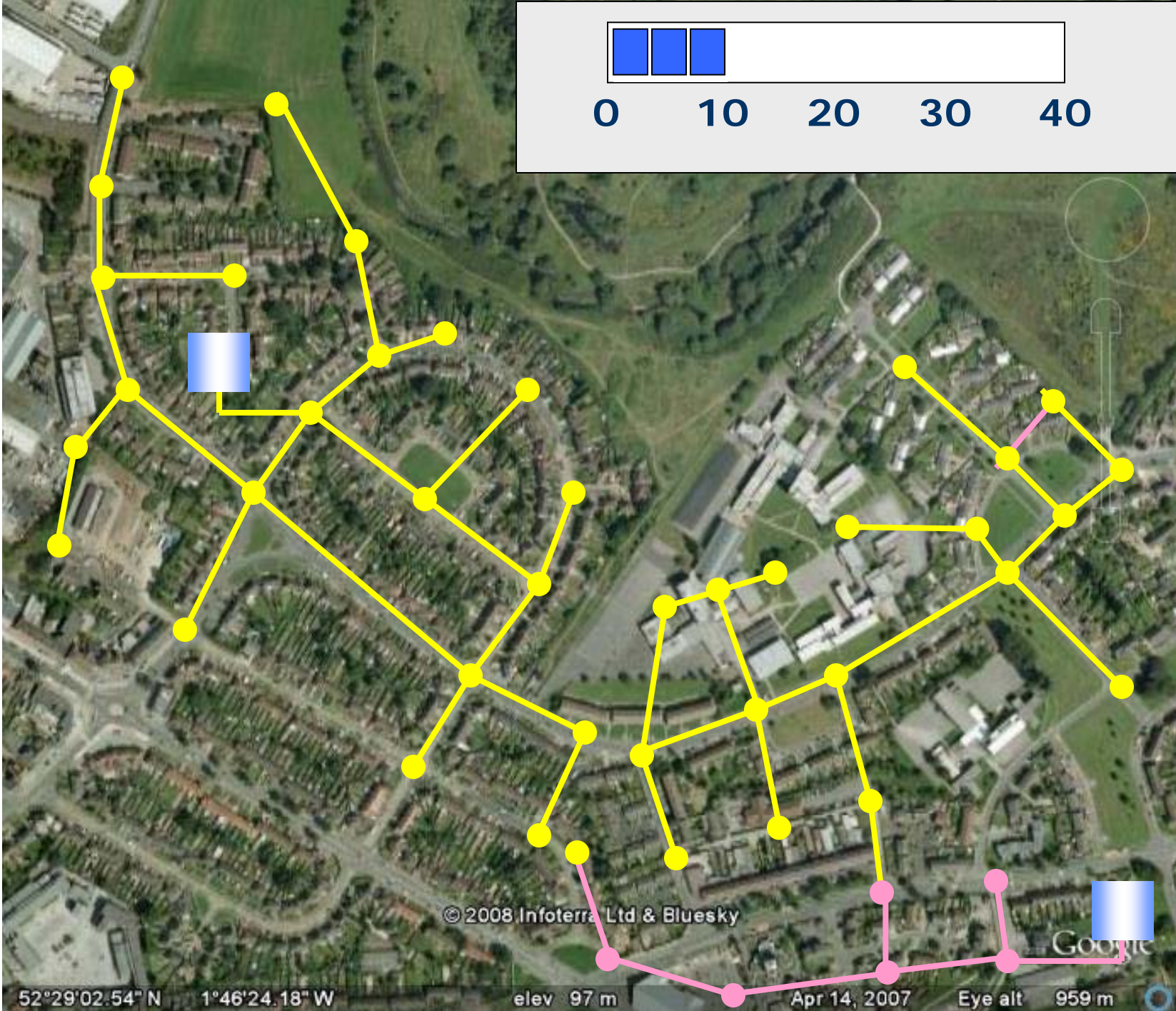
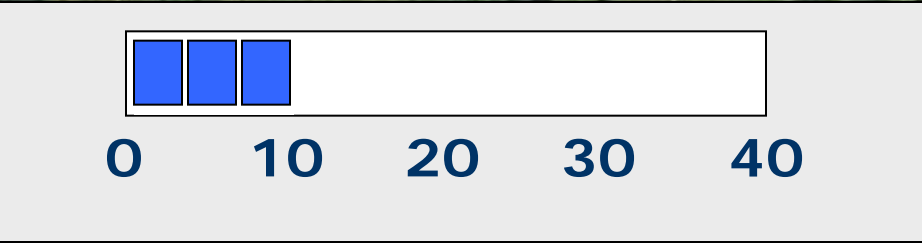
1°46'24.18" W

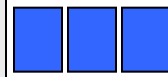
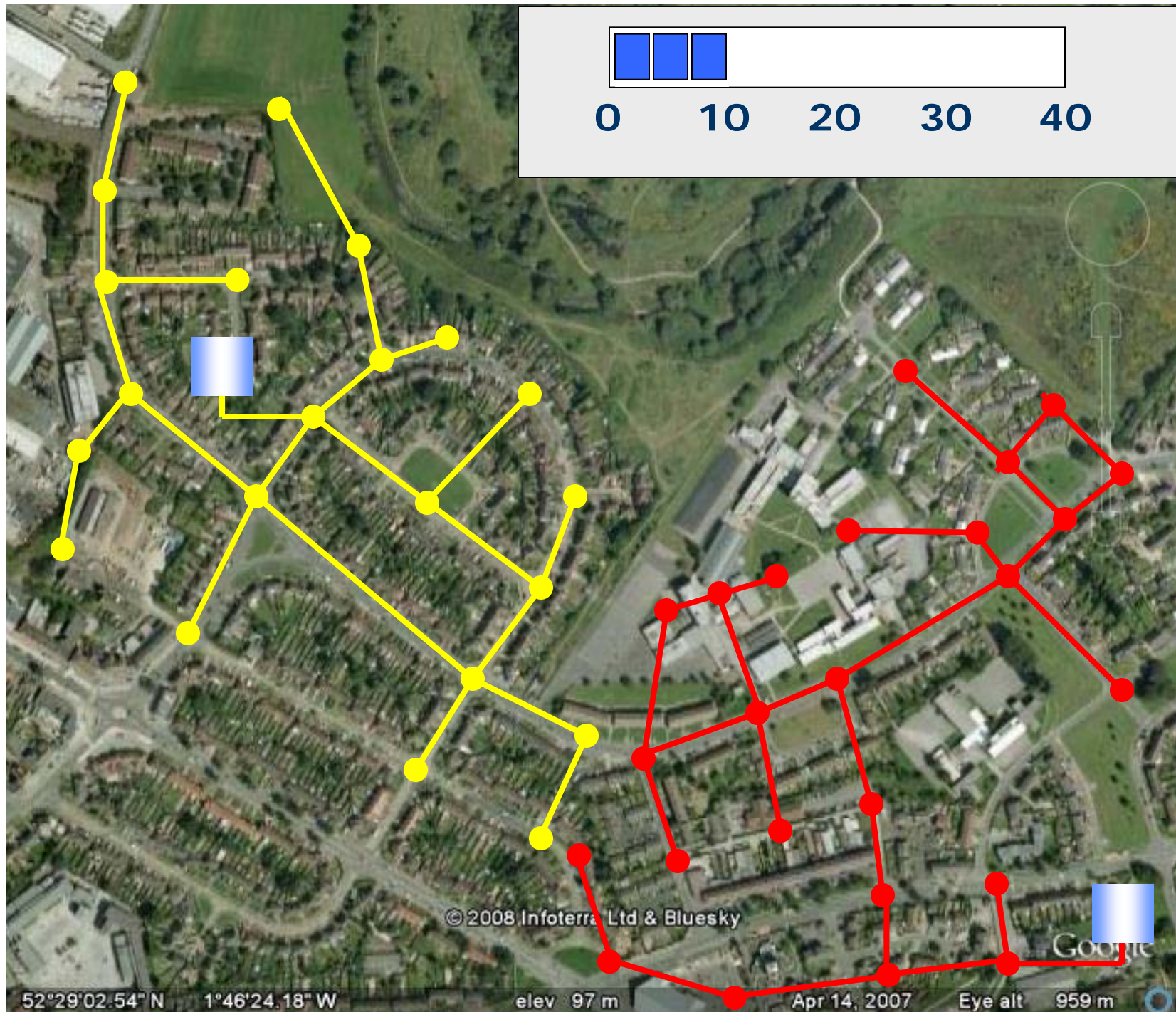
elev 97 m

Apr 14, 2007

Eye alt 959 m







0

10

20

30

40

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Google

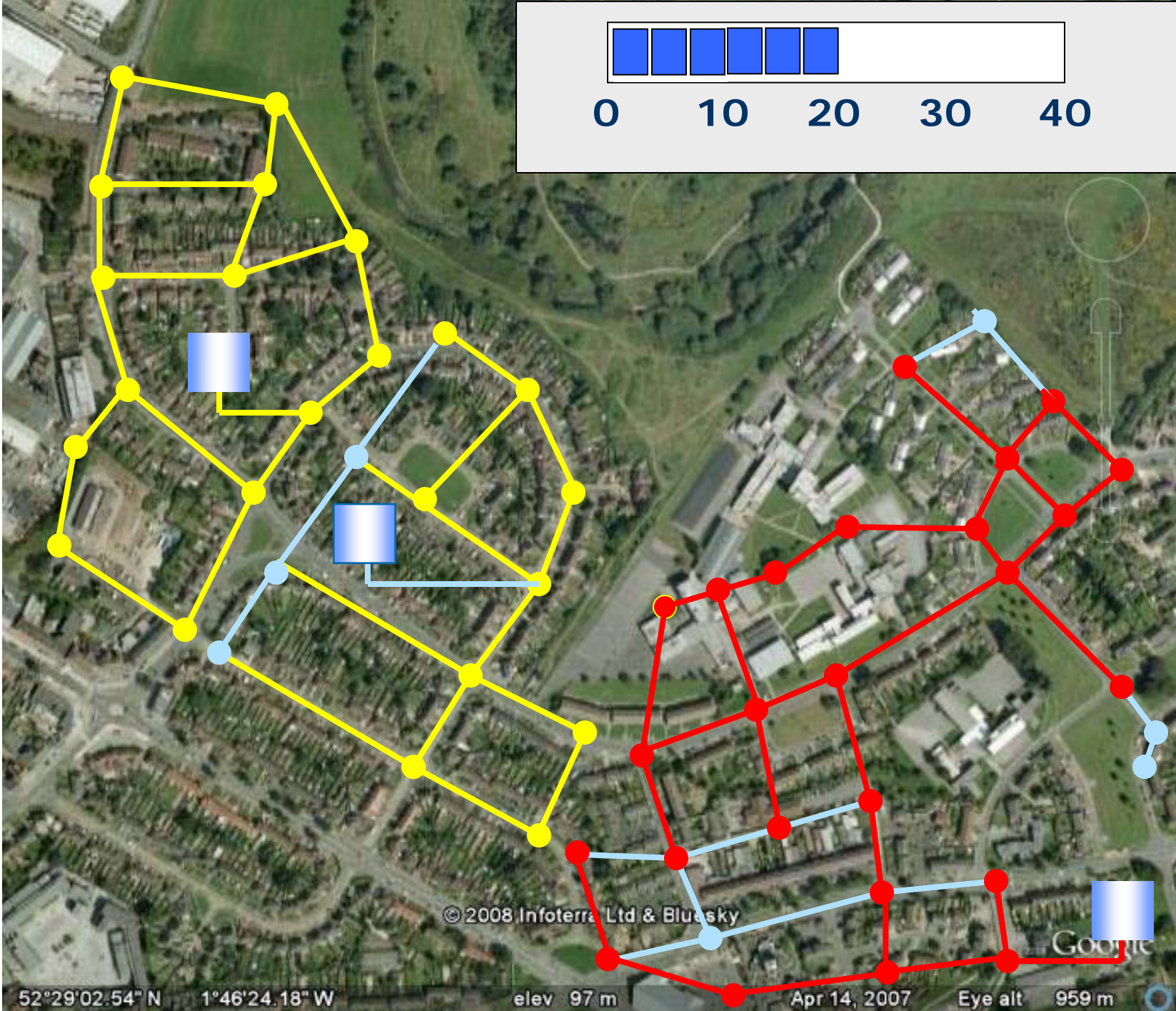
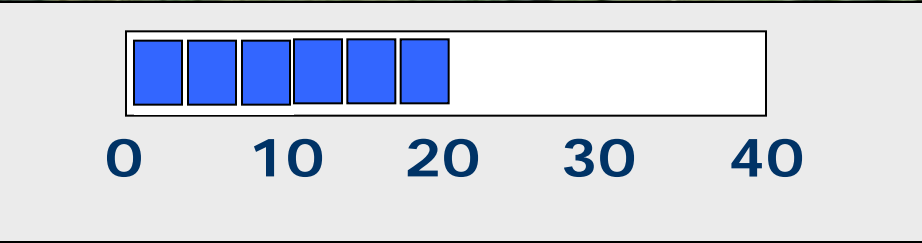
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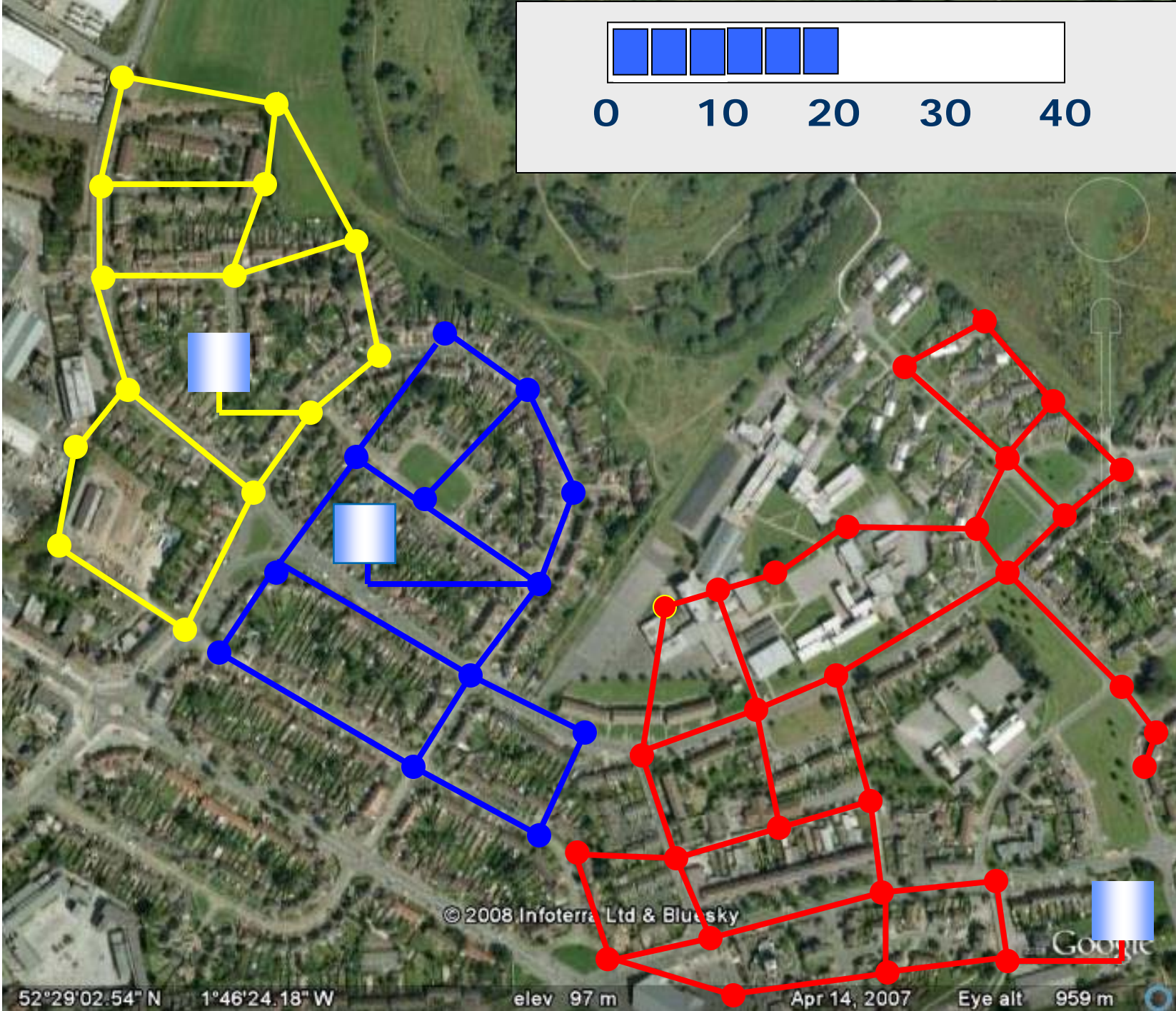
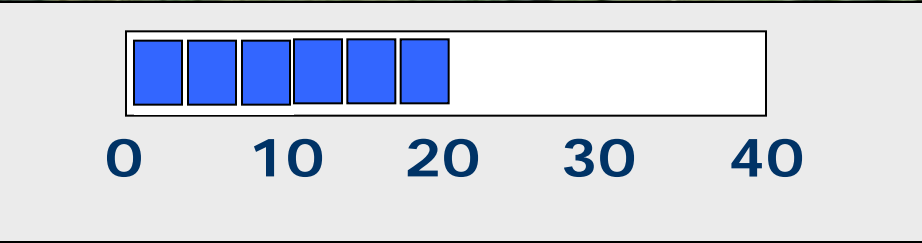
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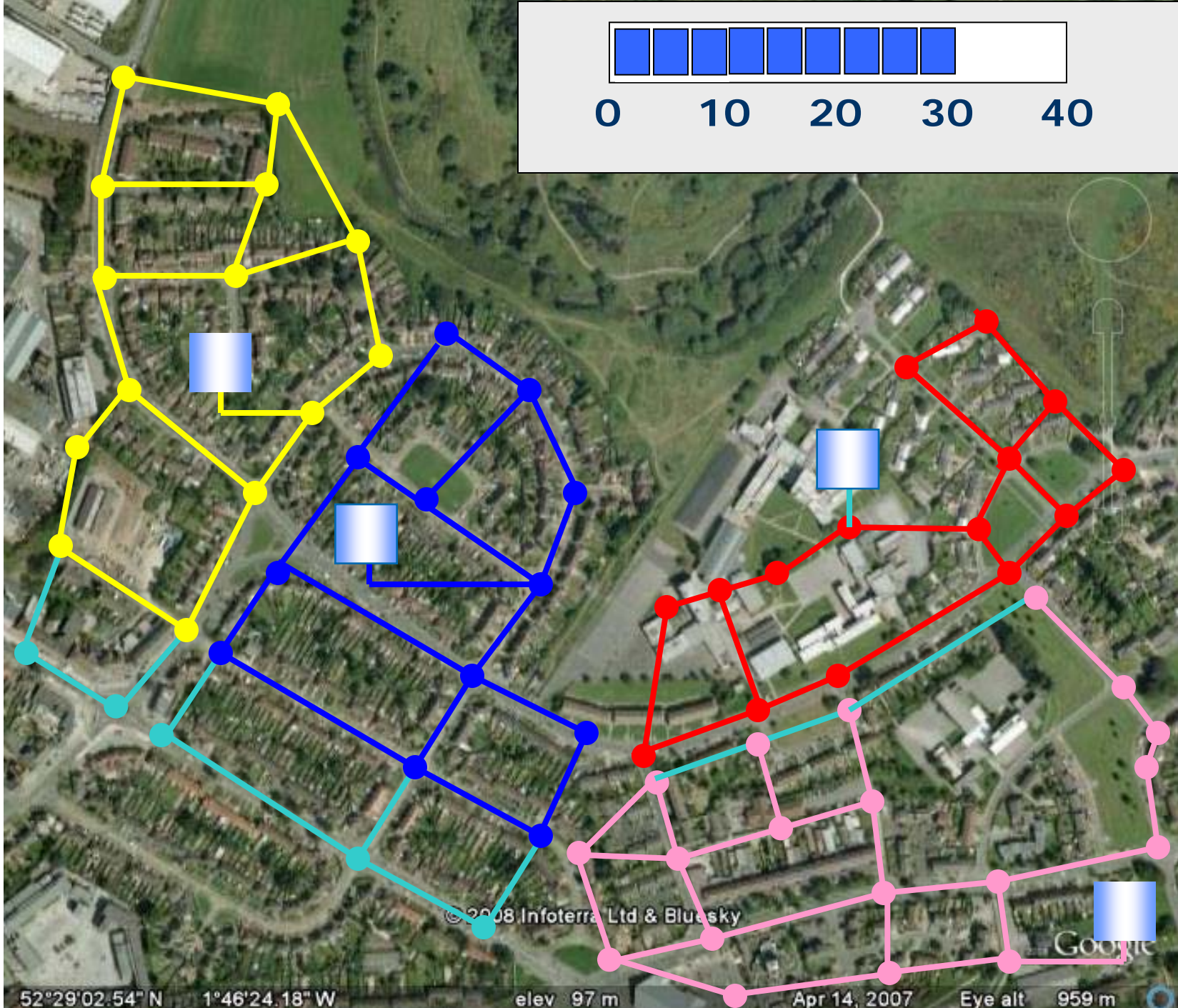
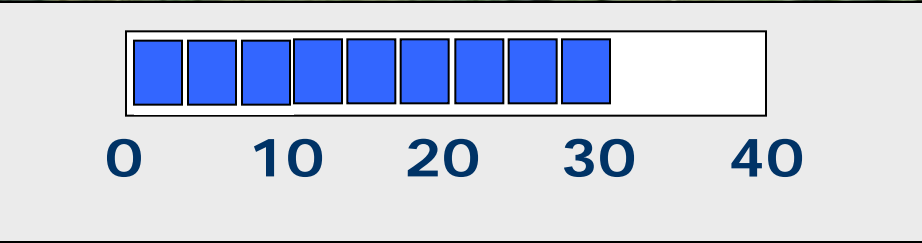
elev 97 m

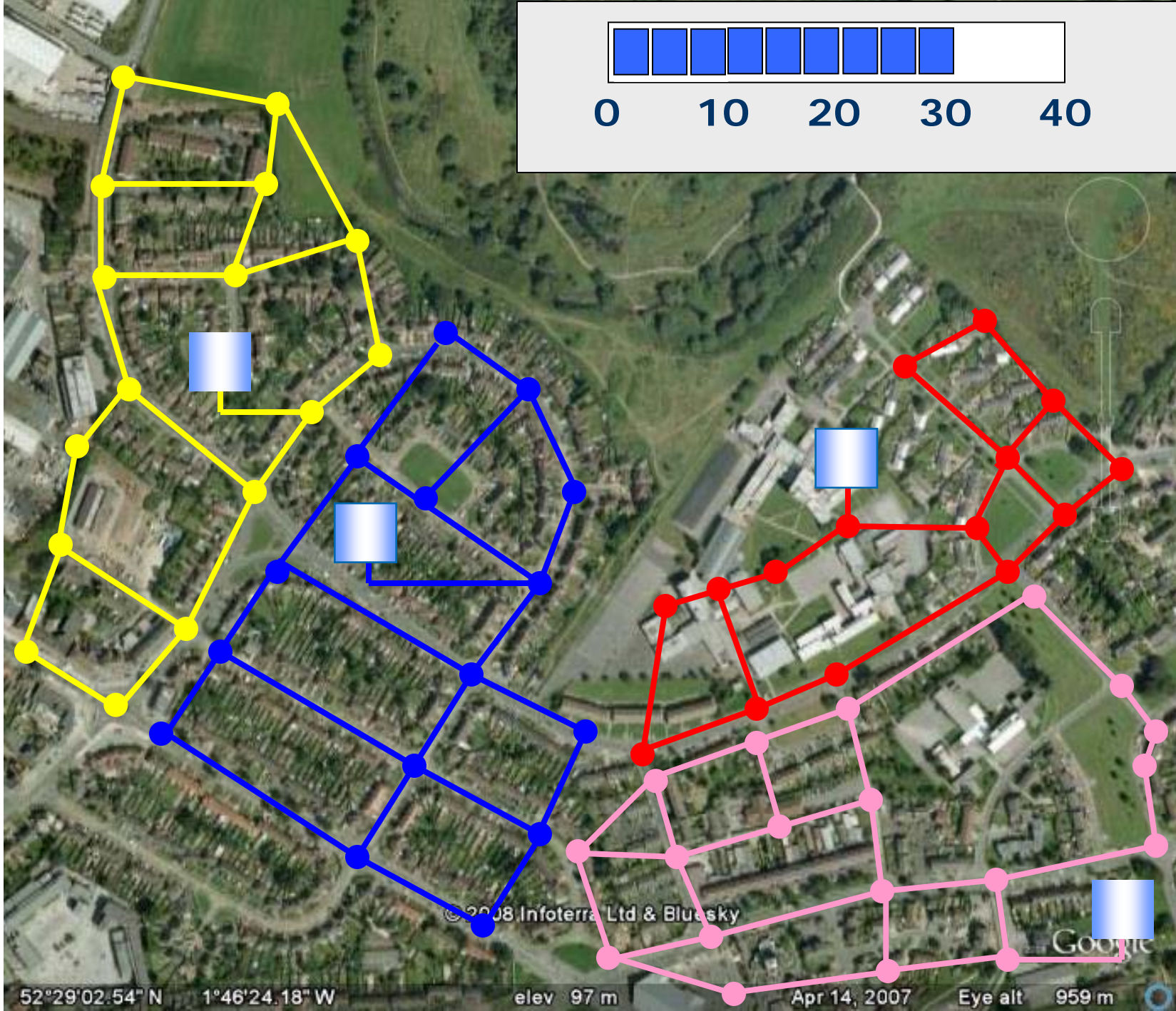
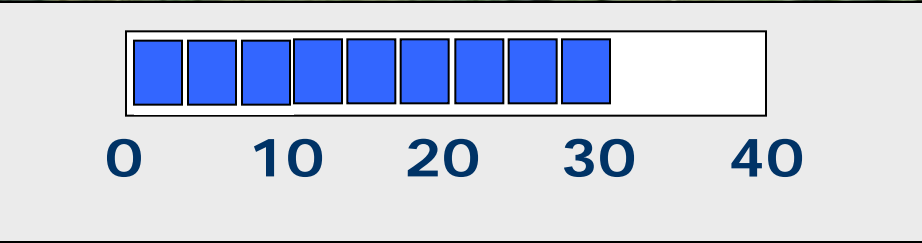
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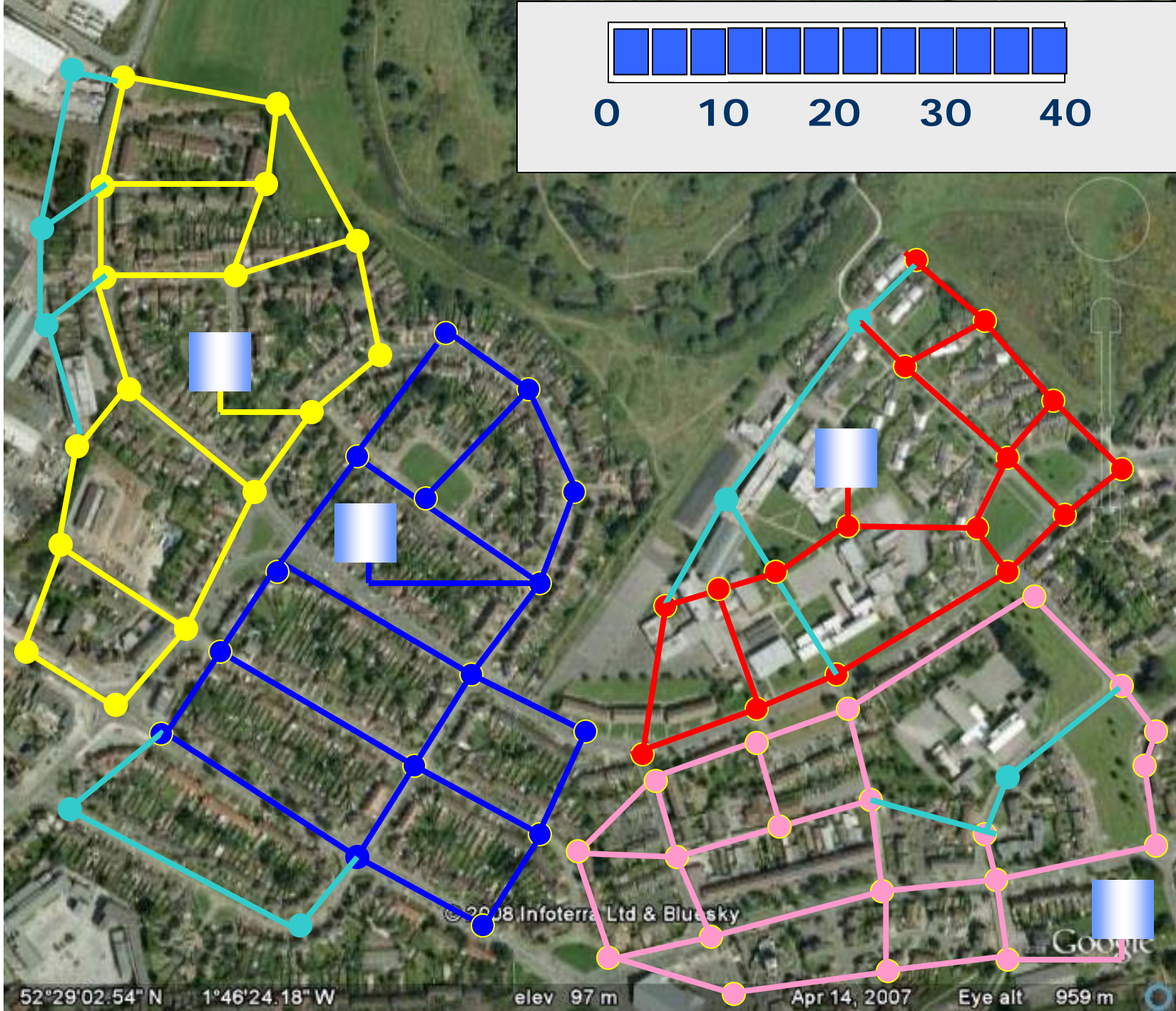
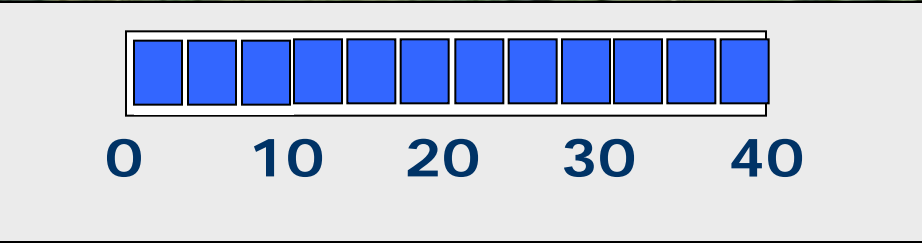


52°29'02.54" N 1°46'24.18" W elev 97 m Apr 14, 2007 Eye alt 959 m

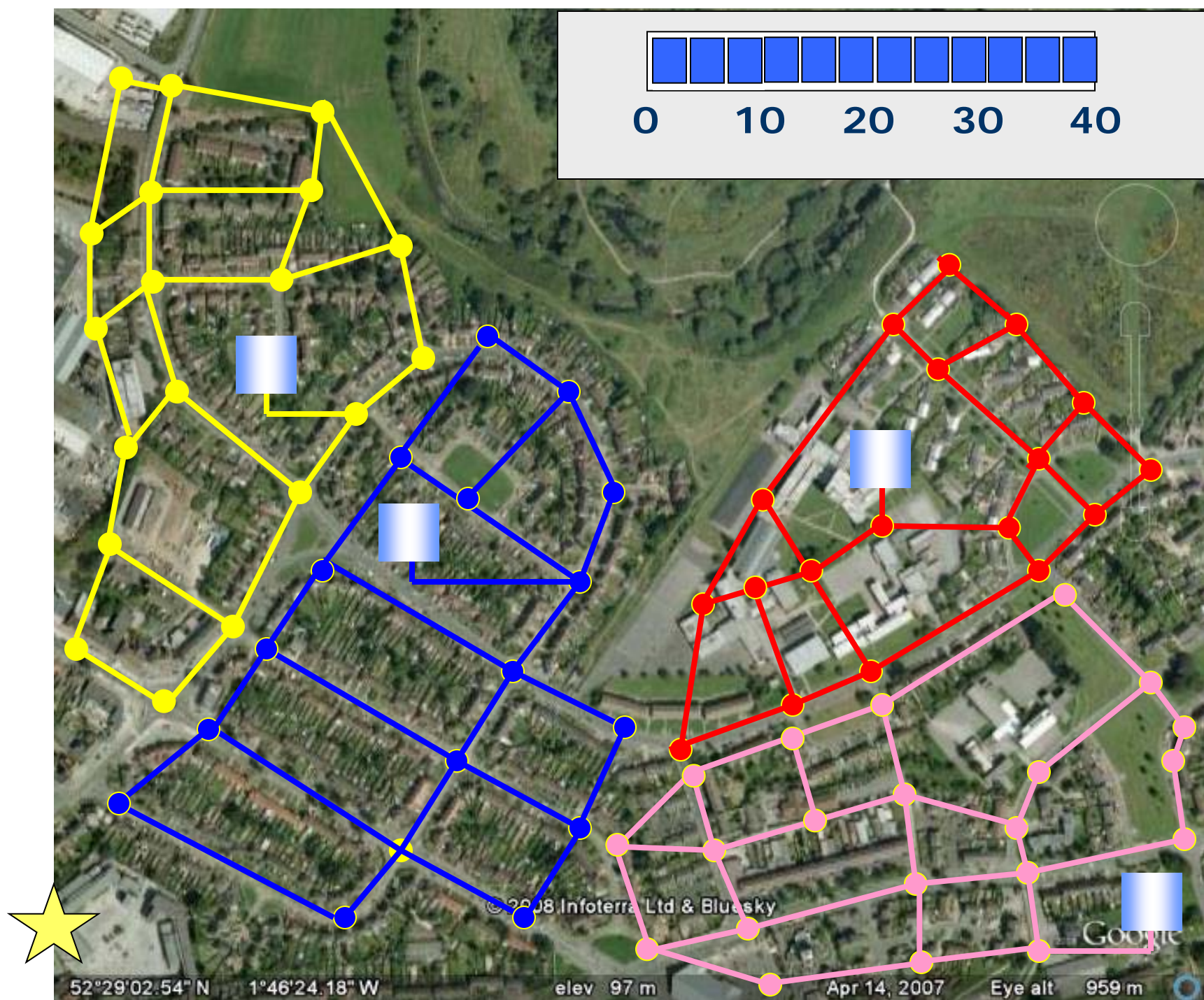




52°29'02.54" N 1°46'24.18" W elev 97 m Apr 14, 2007 Eye alt 959 m



52°29'02.54" N 1°46'24.18" W elev 97 m Apr 14, 2007 Eye alt 959 m



Summary

Summary

- We need to face the new challenges arising from the unprecedented changes taking place.
- Harmonization of approaches will require a different approach to planning and development (integrated, flexible, demand driven....)
- Sustainable and equitable solutions require locally-driven, incremental changes within a radical, wider shared vision
- Technology can make old solutions more efficient and durable – technologies combined we can achieve new system solutions

Choices Before Us

Stay in Lane -
Business as
Usual

Try Harder,
Spend More for
Traditional Sys

Truly Different
Approach



SWITCH Paris Conference

24- 26 January

Themes

- Decisions Support Systems
- Natural System and Treatment
- Sustainable Urban Drainage Systems
- Water Resource Recovery and Reuse



The poster for the SWITCH Paris Conference features a vibrant, colorful illustration of a futuristic city with advanced infrastructure, green spaces, and water management systems. The city is depicted with various buildings, roads, and water bodies, all rendered in a stylized, almost cartoonish manner. The illustration is set against a light blue sky with a few birds flying.

SWITCH

THE FUTURE OF URBAN WATER: SOLUTIONS FOR LIVABLE AND RESILIENT CITIES

24-26 January 2011 • UNESCO, Paris

OBJECTIVES

The aim of this conference is to share knowledge on recent advances in urban water management, and to catalyse change towards more livable and resilient cities – The "City of the Future".

Increasing global change pressures, escalating costs and other risks inherent to conventional urban water management are causing cities to face ever increasing difficulties in efficiently managing scarce and less reliable water resources. In order to meet these challenges there is a need for a paradigm shift in water management. Over the past 5 years major international initiatives such as the SWITCH project, UNESCO-IHP's Urban Water Programme and IHP's Cities of the Future Programme, have brought together a global consortium from the fields of academic, urban planning, water utility and consulting interests.

This conference will provide a platform for academics, public and private sector practitioners from both developed and developing countries to generate and exchange knowledge and understanding of the concepts, strategies, policies and technologies that contribute to sustainable urban water management. In addition the conference will support society, urban water actors, and policy makers with independent and scientifically based expert advice.

THEMES

Decision Support Tools: The latest developments in decision support that will assist professionals and stakeholders to scope future options for integrated urban water management will be presented.

Natural Systems for Treatment: The focus will be on the great potential natural treatment systems hold for the city of the future. It will highlight soil/aquifer-based and vegetation-based systems that are low-cost, sustainable and robust solutions to reduce stresses on water resources.

Sustainable Urban Drainage Systems: The focus will be on the innovative aspects of SUDS and will include assessment impacts of flooding in the urban environment and integration in the urban water cycle. Resilient and flexible SUDS technologies to plan for an uncertain future will also be addressed.

Water Resource Recovery and Reuse: Presentations will focus on the potential to minimize impacts and maximize reuse and recovery of resources from wastewater within the city of the future. These technologies will help avoid environmental pollution by enabling the nutrient recovery and preserving water for other uses.

For more information about the event visit:
www.switchurbanwater.eu



Thank You

Kalanithy Vairavamoorthy

Scientific Director of SWITCH-IP (EU-FP6)

vairavk@grad.usf.edu