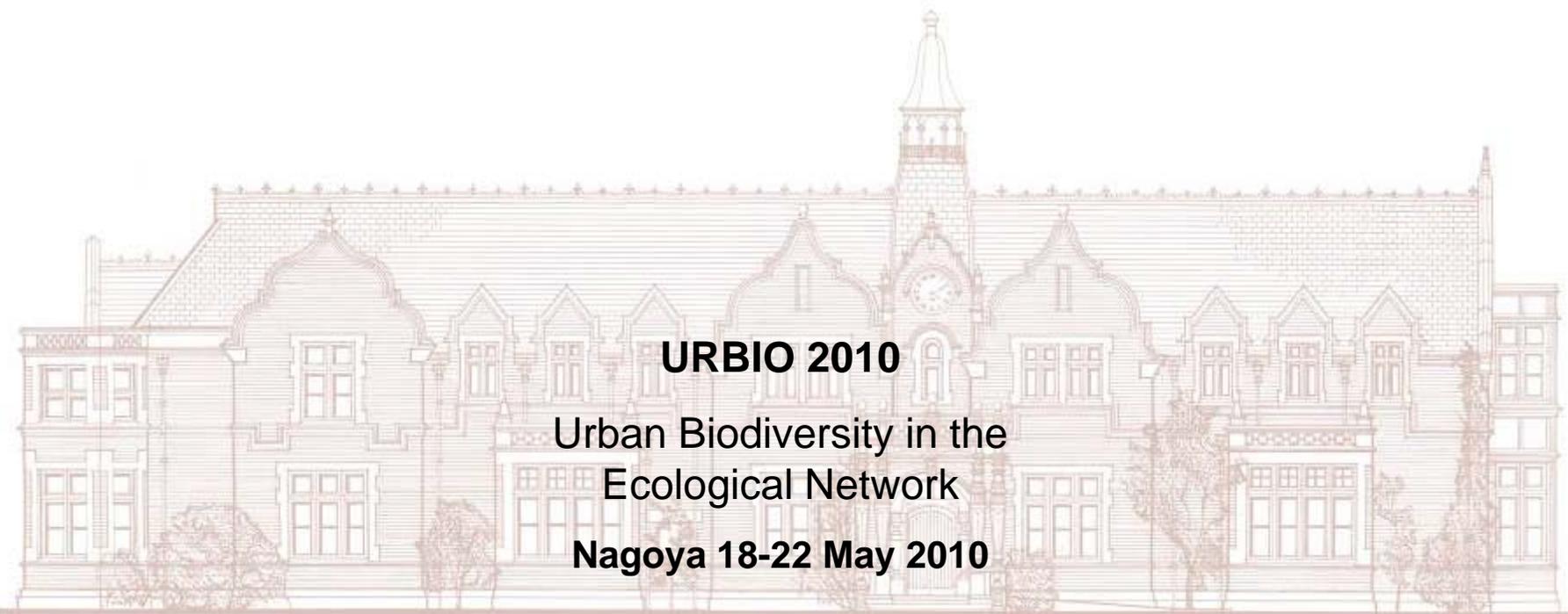


Planning and Design of Ecological Networks in Urban Areas

Dr. Maria Ignatieva

School of Landscape Architecture



URBIO 2010

Urban Biodiversity in the
Ecological Network

Nagoya 18-22 May 2010

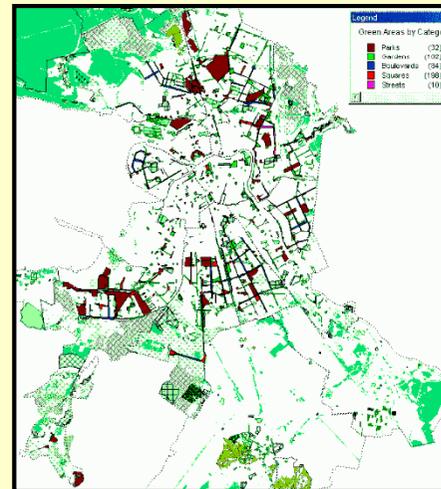
Ecological Network in Urban Areas

- **Urban ecological network** is a very complicated and dynamic phenomenon
- **Ecological network definition:** emphasis on 'pure' ecological essence as "representation of the biotic interactions in ecosystems in which nodes are connected by interaction links".
- Several **definitions** in different disciplines with similar meanings:
 - Landscape ecology perspective:** providing **landscape connectivity**, particularly in the **forms of wildlife movement corridors** and **core areas, stepping stones**; incorporating higher **quality linkages between habitat patches** (Dramstad et al 1996)
 - Urban planning and design perspective:** developing **physical and ecological connections** between built-up areas of the city and surrounding natural areas and greenspaces (Beatley, 2000)

Linearity and linkage are in common!

Green areas as an essential part of ecological network

- From the beginning **green areas** were the **essential component** of **ecological networks in cities** providing numerous **ecological, design and social services** such as
- improved visual qualities and climate,
- wildlife habitats
- hygiene
- recreation
- environmental protection
- supplying food or timber



Urban Ecological Network: historical aspects

- Mostly focussed on **designing green spaces**:
Explicit visual and intuitive ecological improvement
- Early (16th-18th centuries) the function of green areas was mostly “**beautification**” of cities and associated issues of **improving urban spaces** and **public sanitation**
- Urban planning history is rich with examples of **creating links** between different green areas within a city (public and private)

http://en.wikipedia.org/wiki/File:DSC00679_Ile_de_la_Cite.JPG



Paris: The Île de la Cité looking upstream from the West, with the Pont Neuf spanning the Seine. Result of **Henry IV campaign** in 16th century aimed at improving Paris's appearance and urban environment

Urban Ecological Network: historical aspects

Components of *early urban networks*:

Nodes:

- Royal and nobility parks and gardens
- Planted tree groves
- Trees in urban public squares

Corridors:

- Alleys of trees along main urban axes and some waterways



Paris: Tuileries Gardens



Kinkaku-ji (Golden Pavilion), Kyoto

Urban Ecological Network: historical aspects

- **Green areas as main components**
- Design of early green areas:
 1. **Limited number** of species
 2. **Simple structure** (tree layer and grass)
 3. **Remnants** of urban forests based on indigenous vegetation were common and widely used
 4. **Intuitive** understanding of **ecological values** of green areas



Bois de Boulogne in Paris

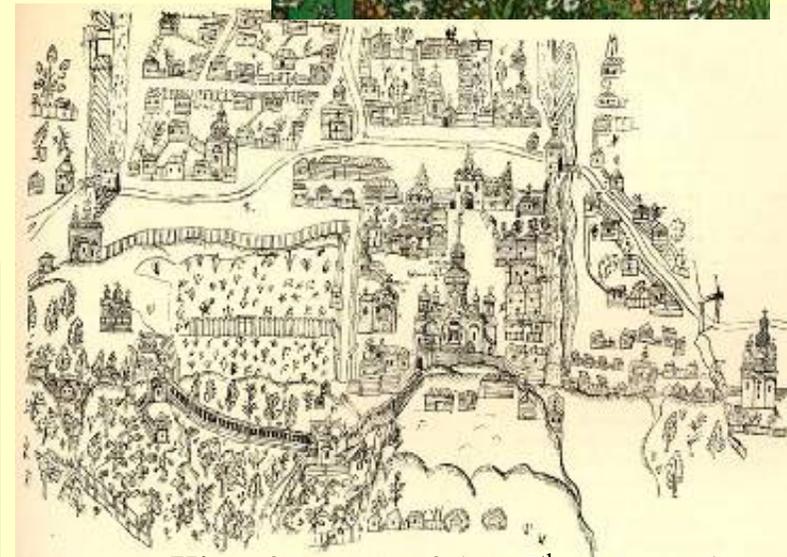
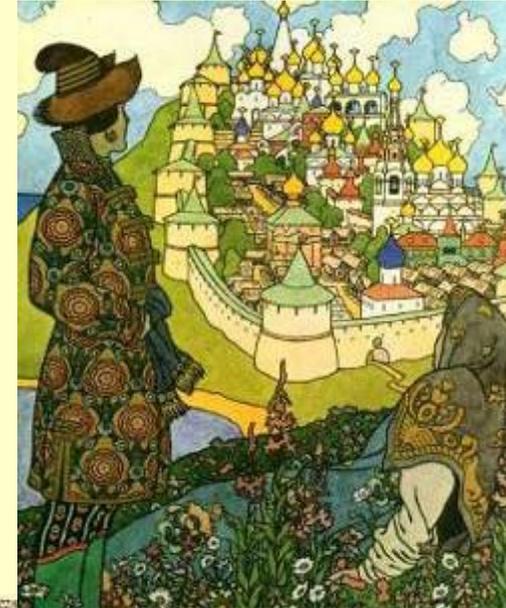


Ecclesale Woods: remnant of native forest in Sheffield

Urban Ecological Network: historical aspects

Case Study: Old Russian Cities

- Old Russian cities (10th - 17th centuries) always had numerous **green areas** within the city boundaries due to their **urban planning structure** (private houses with adjacent gardens)
- **Open areas next to churches**
- Extended areas of **common meadows.**



Kiev: fragment of the 17th century plan

Urban Ecological Network: historical aspects

Green Areas in Baroque Cityscapes

- Principles of **Baroque urban planning** in 17th & 18th century Europe saw green areas as an important part of grandeur **Baroque cityscapes**
- Main emphasis on **visual connection**



Plan for the “urban renewal” of Rome (1585-90), designed for Pope Sixtus V, by Domenico Fontana



Urban Ecological Network: historical aspects

French Formal Gardens Contribution

- Tree-lined alleys were the *major contribution* of French formal garden style of 17th century and provided a *model for street tree planting* and also “*socialisation of urban space*”
- Main emphasis on *visual connections* (urban corridors-vistas and axes) and *networks* (creating *grand unified ensembles*)



Urban Ecological Network: historical aspects

St. Petersburg Case Study: Peter the Great Green Rings

- ***St. Petersburg:***
green areas in private
gardens of the nobility
created significant
green “*rings*” along
the Fontanka and
Moika rivers



Map of St. Petersburg 1753



Perspective plan of St. Petersburg, 1764-1773

18th Century Picturesque Vision of Urban green Areas

- Creation of *the picturesque model* for parks and most urban green areas: *single trees, group of trees, groves scattered on mown grass*
- *Simplified ecological structure* (no natural regeneration or shrub layers allowed)



Kedleston Hall Park in England



Hyde Park in London

18th Century “rus in urbe” (country-in-the city)

- ***Picturesque landscapes in England***: attempt to create a *new city model*
- Parks, gardens, landscaped squares and street green promenades used as a “***softener***” of hard cityscape and created a “***greener***” city
- Attempt to create ***network of urban green areas*** - visually and physically connected by systems of ***open grazed areas, gardens and road plantings***
- New progressive vision: ***preservation of large green areas in fast growing urban centres***



Chatsworth, England



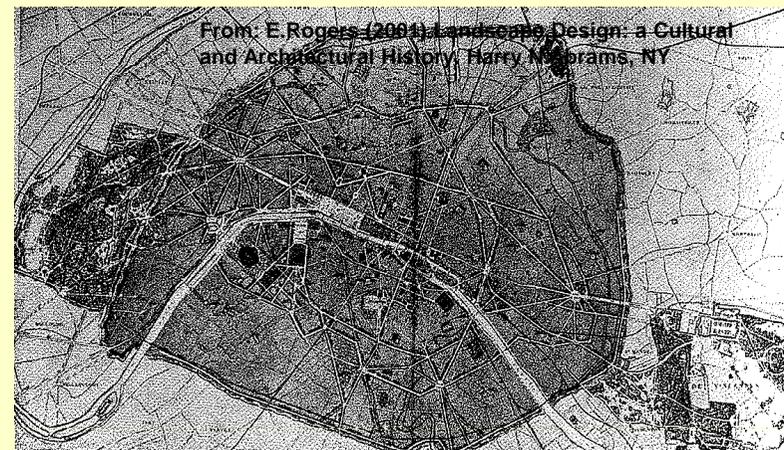
Industrial Revolution of the 19th century: birth of a modern vision of urban ecological networks

- Introduction of **certain regulations** and **urban planning codes**
- **Redesign** of old cities
- Creation of **boulevard system** and **their “openings”**, miles of planted **street trees**, connecting them to new **landscaped** public squares and **old green areas** – aimed at improving **appearance** of cities and their **ecological function**



http://www.statemaster.com/encyclopedia/Haussmann's-renaissance-Paris#The_Haussmann_system

The Boulevard de Sébastopol. Opened in 1858, the boulevard runs through the heart of Paris



Paris map (1867-73) showing Haussmann's new boulevard system

Iconic Boulevards

http://en.wikipedia.org/wiki/File:Paris_Champs_Elysees_westwards_DSC03316.JPG



The Champs Élysées in Paris, France

http://en.wikipedia.org/wiki/File:Unter_den_Linden_im_Herbst.jpg



Under the Linden in Berlin, Germany



Gogol Boulevard, Moscow

http://en.wikipedia.org/wiki/File:Gogolevsky_boulevard_shot_02.jpg



Paseo de la Reforma, Mexico City

http://en.wikipedia.org/wiki/File:Mexico_DF.Chapultepec.02.jpg

Early urban axes and boulevards

- Some modern landscape ecology authors reinterpret and appreciate the essential ***“linkage” and movement functions***
- They identify at least ***three main functions of such “grand corridors”***: ***movement, use and visual experience***



Montmartre, Paris

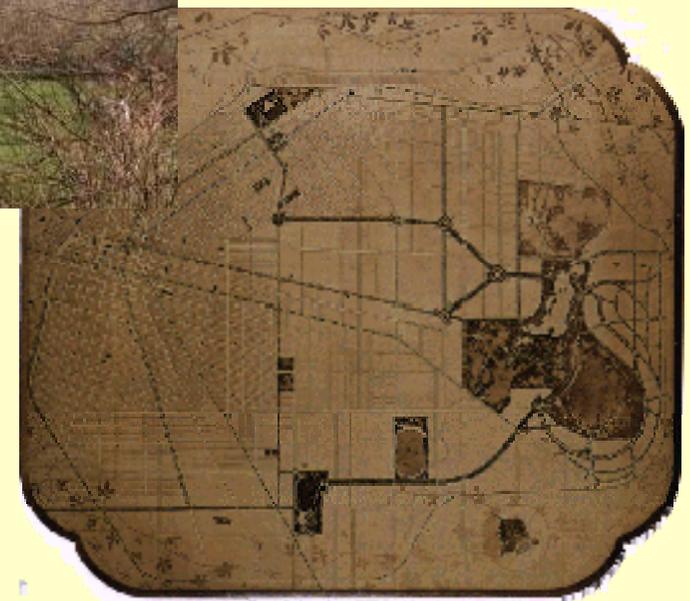
Vision of ecological network in 19th Century USA

- **Parkways movement** linking **parks and park systems** (Boston, Buffalo, Chicago etc.). **Frederick Law Olmsted** legacy
- **Interconnection of** urban landscapes with **rural scenery** (because of lost countryside landscapes during urbanisation)
- **The City Beautiful Movement** creation of *boulevards* and new *public green spaces* with heroic sculptures and noble architecture
- Emphasised the need for **united park systems** where natural landscapes played an important role
- **Prototype** of modern version of **green urban network system and urban greenways**



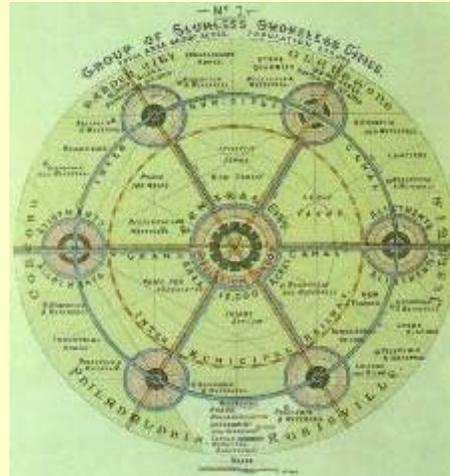
Boston: "Emerald Necklace"

Chicago



Ecological Network Traditions of the early 20th Century

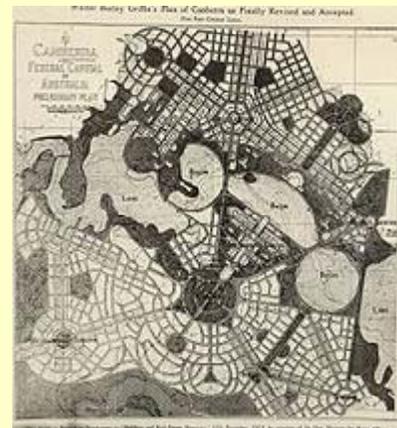
- “**Garden City**” concepts: connection to the modern social and philosophical movements
- New generation of cities where **all citizens** had **equal opportunities to access** green areas
- Idea of **planned green areas** and **greenbelts**
- Strong **connectivity message**: interconnection of urban **green areas with rural and natural landscapes**



Ebenezer Howard Garden City Concept



Letchworth, the Garden City was founded in 1903 by Ebenezer Howard. It is the world's first Garden City



Canberra, Australia (plan by Walter Burley Griffin) was accepted in 1913, inspired by the Garden City Concept



Incorporates significant green areas: the title "bush capital"

http://en.wikipedia.org/wiki/Letchworth_Garden_City

<http://en.wikipedia.org/wiki/Canberra>

Ecological Network Traditions of the 20th Century: “Garden Cities” and “Science Cities” in Soviet Union

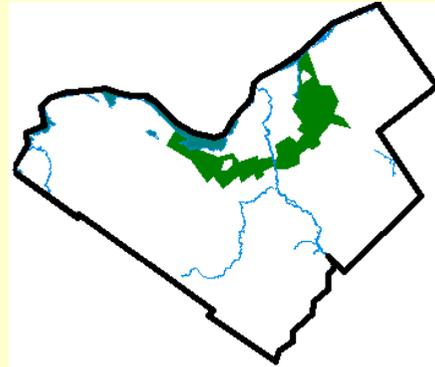
- Further development of “*garden city*” ideas in **Soviet Union**
- **Planned network system of green areas and green belts** in new cities
- Incorporating **ecological knowledge** in design process
- “**Ecopolis**” and “**Science Cities**”: concept of ecologically designed **network of green areas** connected to protected natural plant communities and **maximum protection** of existing vegetation, especially trees



Science City (Academgorodok) Novosibirsk

Ecological Network Traditions of the 20th Century: Greenbelt Concept

- **Greenbelt** is a zone of green spaces surrounding neighbouring urban areas (land use buffer)
- Greenbelt policy: **pioneered** in **the UK** in the 1930's
- Famous greenbelts: *London Metropolitan, Portland, Ottawa, St. Petersburg, Adelaide, Dunedin*
- Similar concepts: **Greenways** (USA) and **Green Wedges** (Europe)



Greenbelt, Ottawa, Canada



Greenbelt, Adelaide, Australia

http://en.wikipedia.org/wiki/Adelaide_Park_Lands

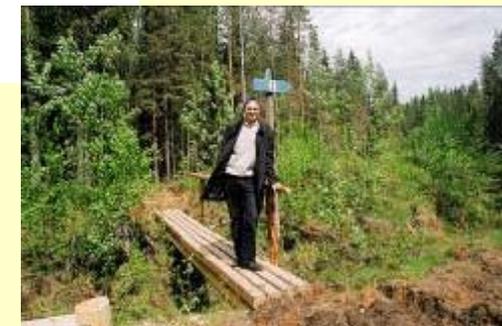
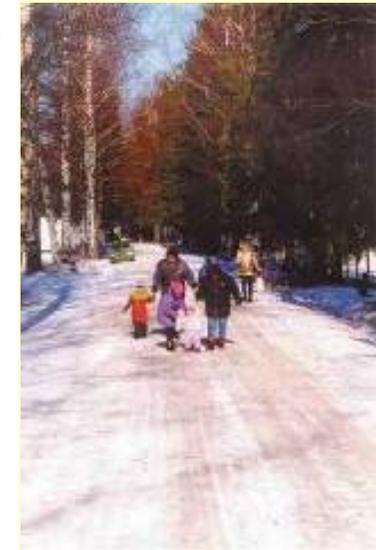
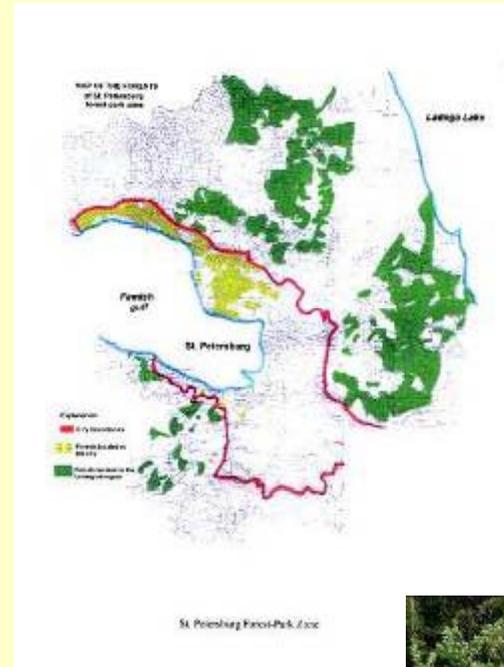


Stockholm
Green Wedges

http://upload.wikimedia.org/wikipedia/commons/4/44/Ottawa_greenbelt.PNG

Ecological Network Traditions of the 20th Century: European Greenbelts

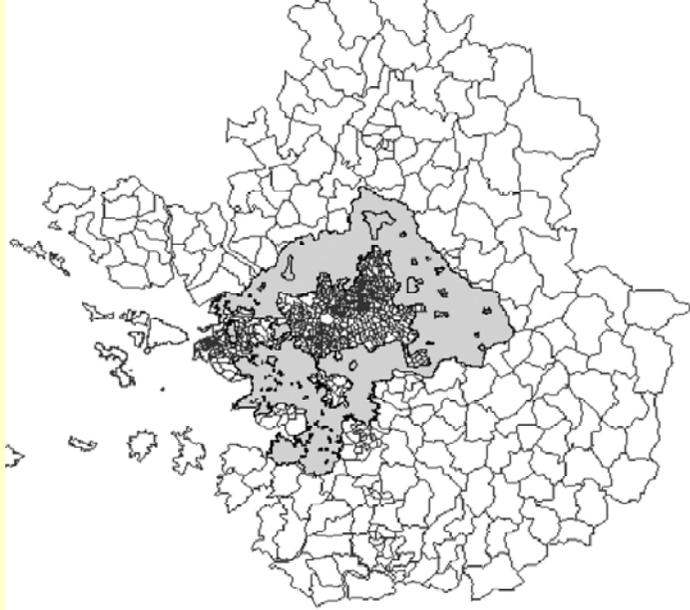
- Includes: ***natural existing woodlands*** and all other types of ***open green spaces*** (meadows, wetlands and farms, hedges, gardens, parks and boulevards)
- Parks, gardens, streams, rivers, canals and road vegetation, street plantings and hedges are seen as important ***ecological corridors*** and ***patches/stepping stones***
- Many European cities have ***full-time urban ecology*** or ***urban forestry staff*** managing these ***greenbelts***



Greenbelt of St. Petersburg, Russia

Ecological Network Traditions of the 20th Century: Greenbelt concept in other cities

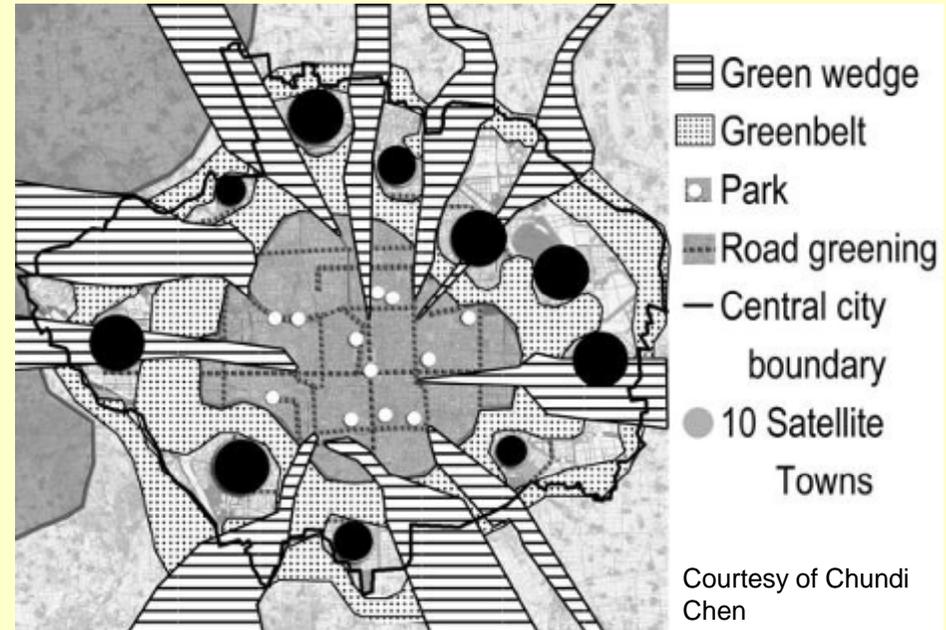
http://nrs.fs.fed.us/pubs/gtr/gtr_nc265/gtr_nc265_027.pdf



Seoul's greenbelt



<http://upload.wikimedia.org/wikipedia/commons/e/e4/Seoul-Olympic.Park-01.jpg>

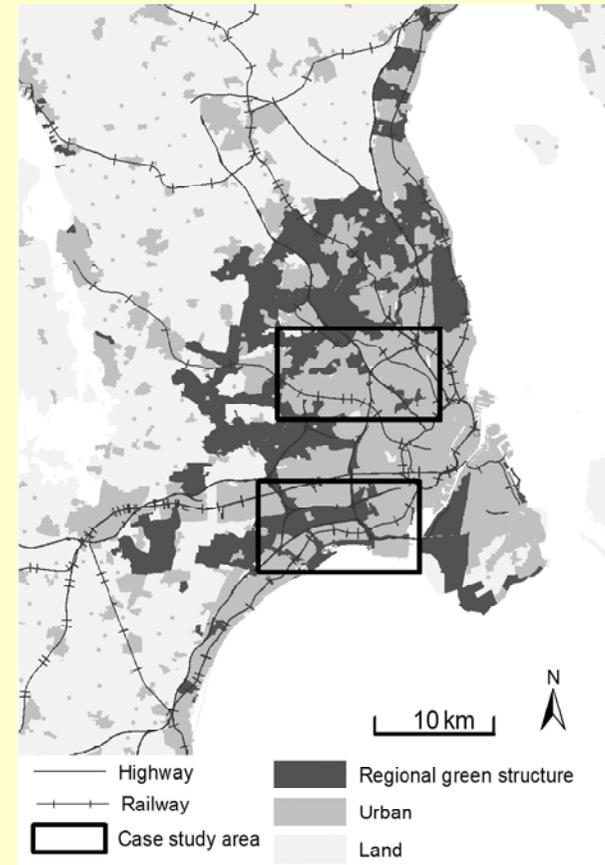


The locations of the planned first and second greenbelts of Beijing. From 1993 Beijing Master Plan.



Urban Ecological Networks at the end of 20th – beginning of 21st century: Urban green network and green structure concepts in Europe

- Urban green networks: “**protecting** or **enhancing** natural resources and systems while **linking** the urban area for recreational use” (Thompson, 2002)
- **Urban green network (UGN)**: integration of urban areas into structural network as legally recognised instrument of planning and enhancing the urban quality of life (Quintas and Curado, 2009)
- Ecological **framework** of urban space structures (Thompson, 2002)
- **Different scale**: from regional-city-neighbourhood to habitat (street, park or garden)

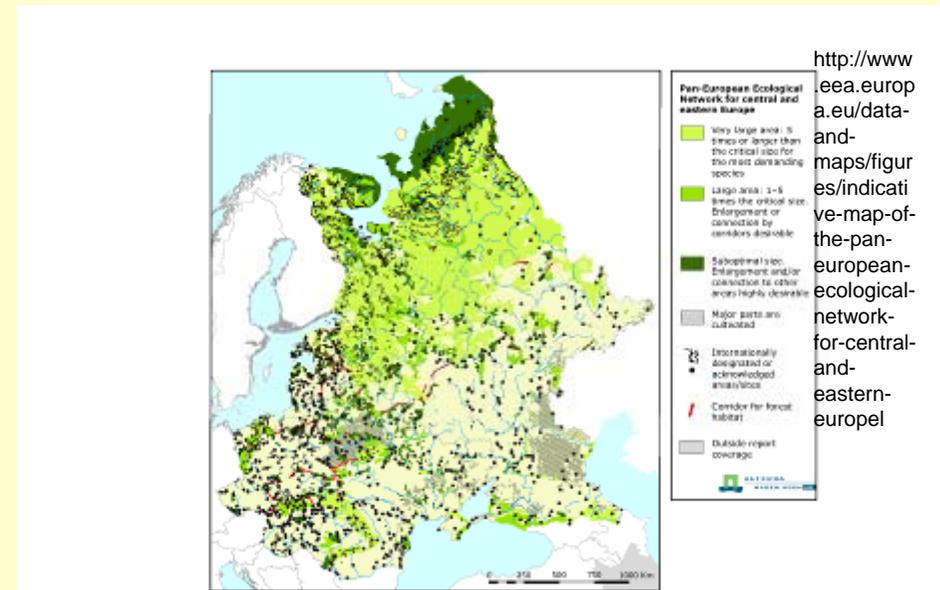


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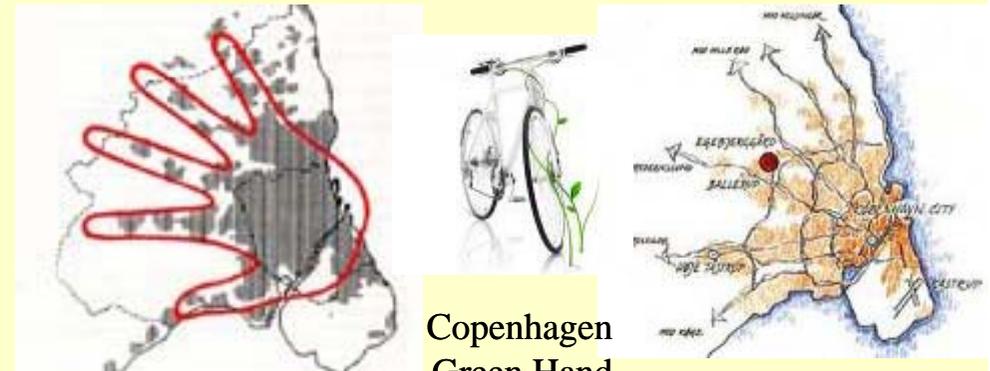
Green structure of Greater Copenhagen. The **urban fingers** include infrastructure such as highways and railways

Urban Ecological Networks at the end of 20th – beginning of 21st century: Urban green network concept in Europe

- Urban ecological networks as part of a broader ***national ecological network***
- Aim: bring ***nature into the city centres***
- **Preserving connection of people to nature**
- Develop ***physical and ecological connections*** between ***built-up urban areas*** and ***surrounding natural areas*** and ***greenspaces***
- **Elements:**
 - **Corridors** (tree-planted streets, hedgerows, roadsides, railways, waterways)
 - Recognising the importance of existing ***ecological 'core' areas*** and ***greenbelts*** as ***stepping stones***
- **Design features:** combining ***ecological*** (movement of species, biodiversity), ***recreational functions*** (bicycle and pedestrian trails) and ***aesthetics*** (beautification)

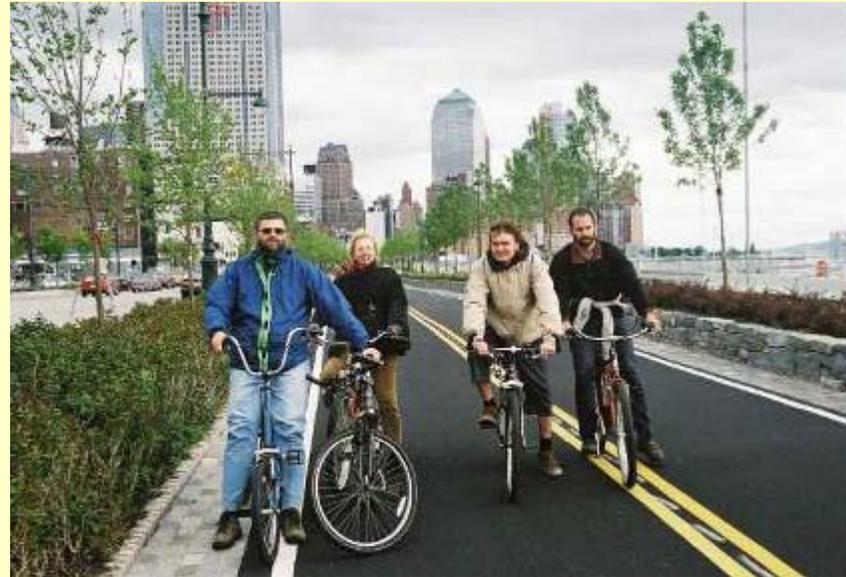


Pan-European Ecological Network for Central and Eastern Europe

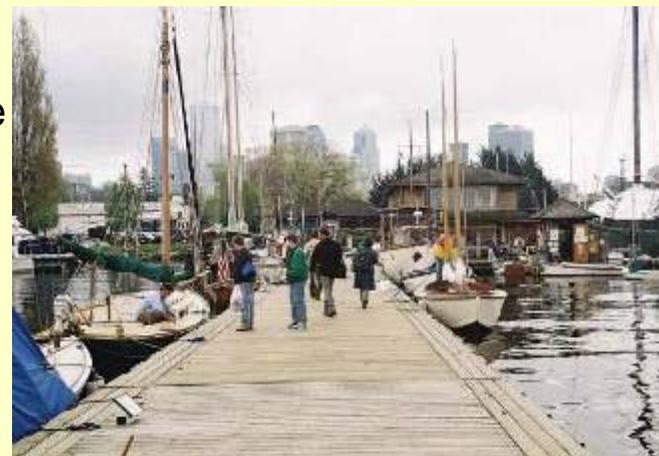


Development of Ecological Network Concepts in the USA in the late 20th century: Greenways

- **Urban “greenways”** concept: provide **access** to open space and **link** rural and urban spaces
- Connection to **“ancestral” urban greenways**: axes, boulevards and parkways
- Trails for **cyclists and pedestrians**, as an **alternative** to automobile-congested roads and highways
- Combination of **“green”** and **“blueways”**
- **Design** elements: large scale-connecting urban-suburban-natural green areas
- **Very distinctive linear character** (corridors) of various width, linked in a network
- **Multipurpose**: maintain biodiversity, wildlife migration, recreation, flood prevention and water quality
- **Compatible** with the **concept of sustainable land use**



Urban Greenway, Manhattan, NYC

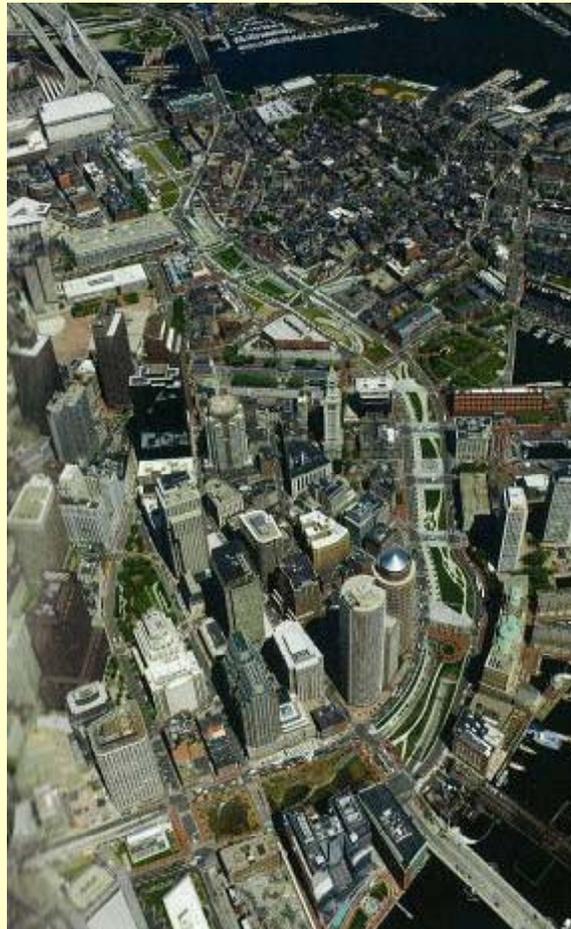


Blueways in Seattle

Rose Kennedy Urban Greenway, Boston, 2008

Modern US greenways employ:

- ***Various landscape ecology features*** (corridors, patches, matrix, and connectivity).
- ***Landscape planning concepts*** (greenways at different spatial scales)
- ***Landscape architecture principles*** (design structure, species composition, pedestrian, and bicycle circulation)
- ***Conservation biology theory***

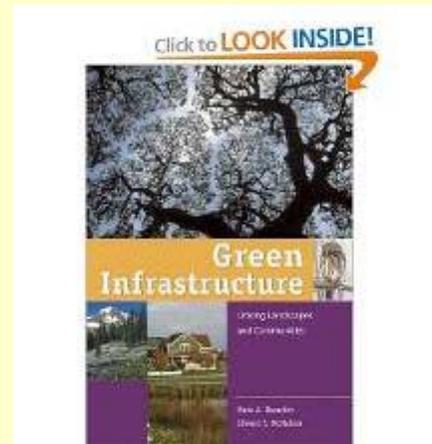


http://en.wikipedia.org/wiki/Rose_Kennedy_Greenway

2.4 km series of parks and public spaces in downtown Boston

Development of Ecological Network Concepts in the USA in the 21st century: Green Infrastructure

- **Urban green infrastructure** concept as a part of “**green infrastructure**” approach
- **Green infrastructure**: mid-1990s approach, highlighted the importance of the natural environment in land use planning decisions
- **Green Infrastructure** "...considered to comprise of all natural, seminatural and artificial networks of multi-functional ecological systems within, around and between urban areas, at all spatial scales" (Tzoulas et al., 2007)
- **Reaction** to USA urban sprawl and catastrophic loss of natural areas
- **Connected to sustainable urban practices**: *Low Impact Development, green building design and renewable energy , Integrated Catchment Management*
- A lot of **common features** with **European urban green network concept**
- **This approach is also used in some United Kingdom cities**



Development of Ecological Network Concepts in the USA in the 21st century: Green Infrastructure

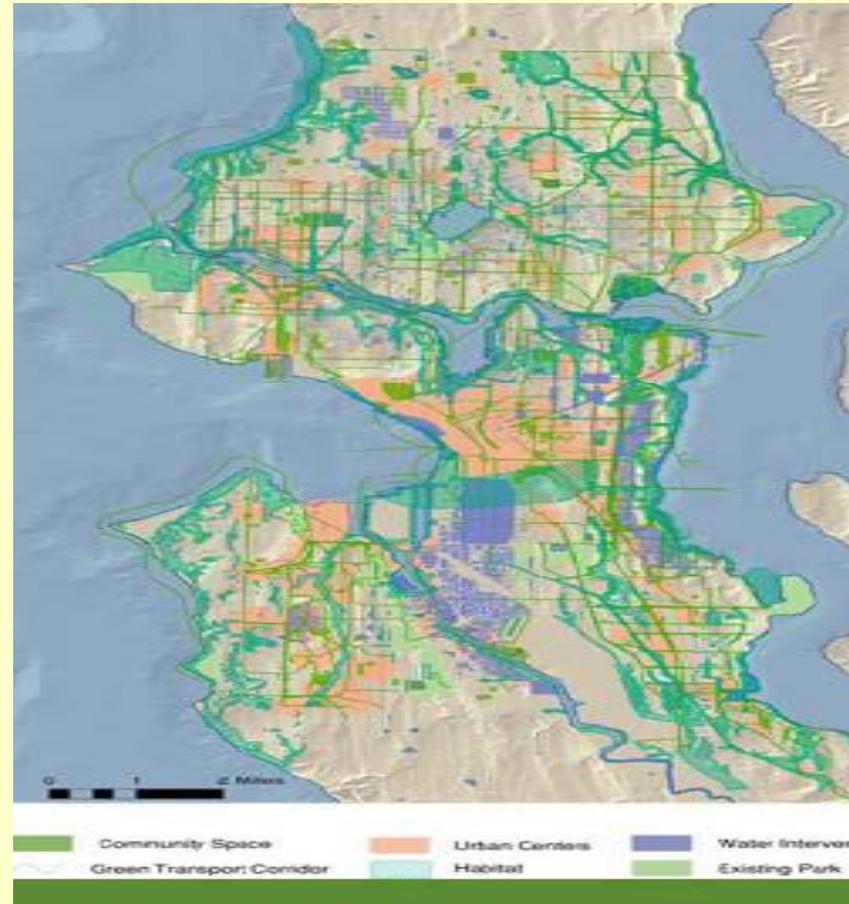
- Using **concept** of **bioretention**: swales, rain and green roof gardens, pervious services
- Design with **natural processes**
- Towards **interacting, overlapping urban green infrastructure systems** and creating an **ecological city** (N. Rottle, 2009)



2000-2003 the Seattle Street Edge Alternatives-SEA Streets project-Seattle Public Utilities Department

Development of Ecological Network Concepts in the USA in the 21st century: Seattle Green Infrastructure Case Study

- Open Space and Seattle 2100 *programme*
- Envisioning Seattle's Green Future
- ***Designing Integrated and connected*** green infrastructure

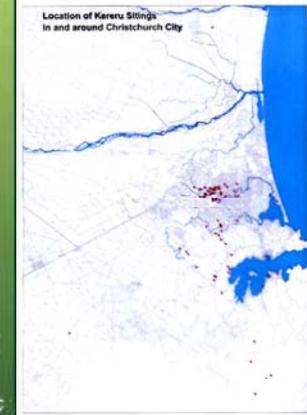
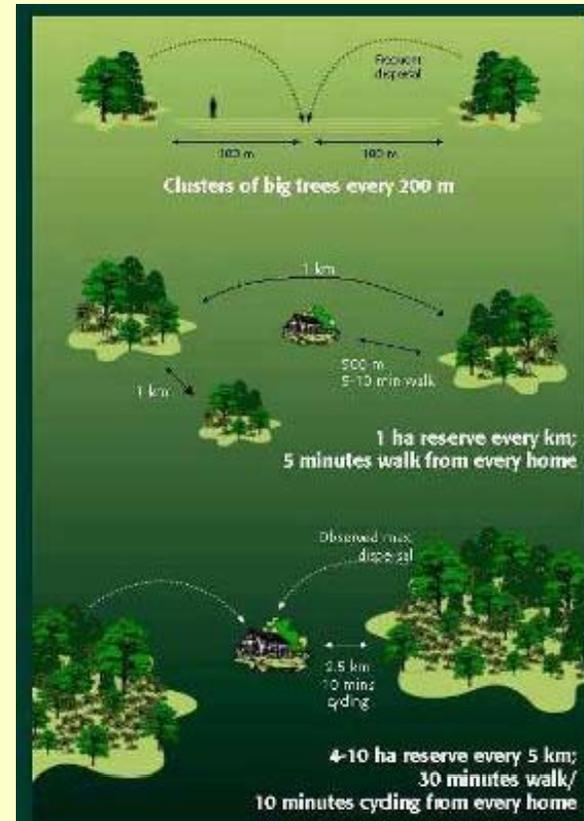


Plans for Seattle's Green Infrastructure

2025

Urban ecological network concept in New Zealand

- Unique feature of New Zealand: catastrophic **loss of indigenous biodiversity**
- What role **networks and corridors** might play
- Debate about the **functionality** of green ‘corridors’
- **Dawson (1994)**: main role of corridors - the habitat (albeit edge) in their own right and **visual continuity**, rather than in actually **connecting nodal habitats**
- **Virtual corridors** are seen as linear series of habitat stepping stones containing indigenous or even benign exotic vegetation
- Both **exotic species and dispersal process simulations** for indigenous woody plants could be applied to greenspace planning (Meurk and Hall 2006)



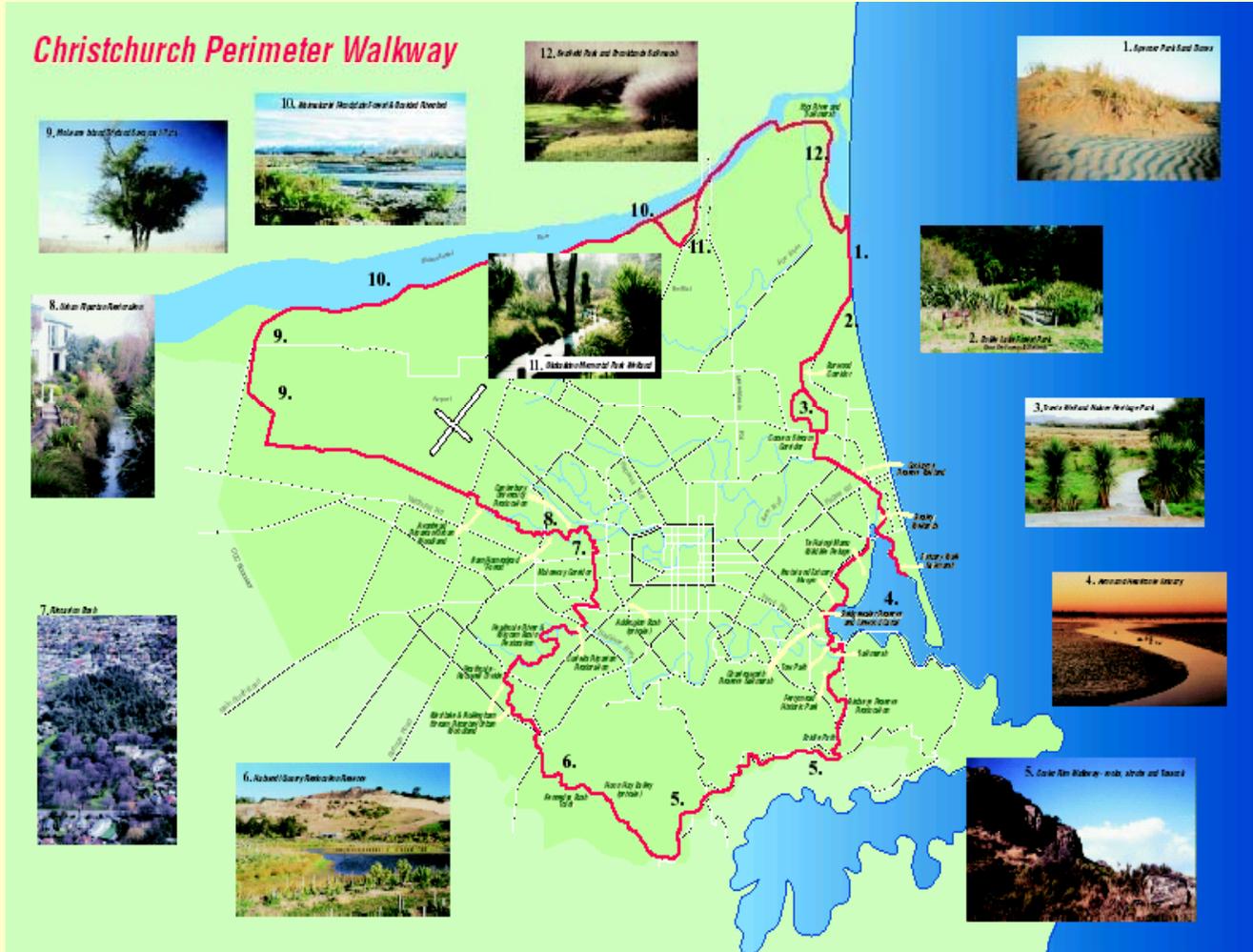
Courtesy of C. Meurk

New Zealand vision of urban green corridors

- Corridors continue to perform important riparian functions – plus reinforced by **swale drains** and **treatment wetlands as part of the LIUDD movement**
- **To most people:** main function is as **visually pleasing green fingers** through the built urban greyness
- **The health importance** of these **green spaces and networks**
- **Contrast to** the view of **earlier public health engineers:** providing initially open, and later piped, sewage and stormwater disposal systems and providing transport conduits



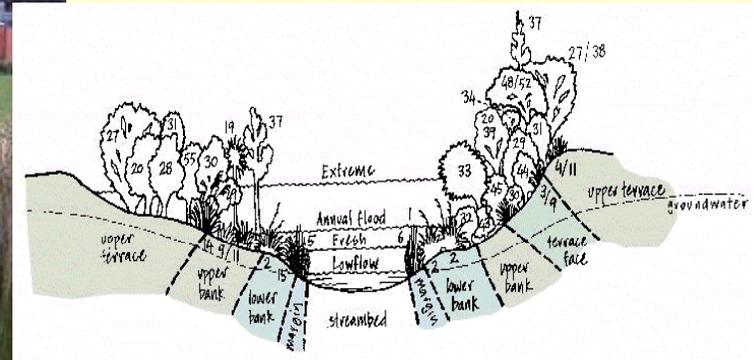
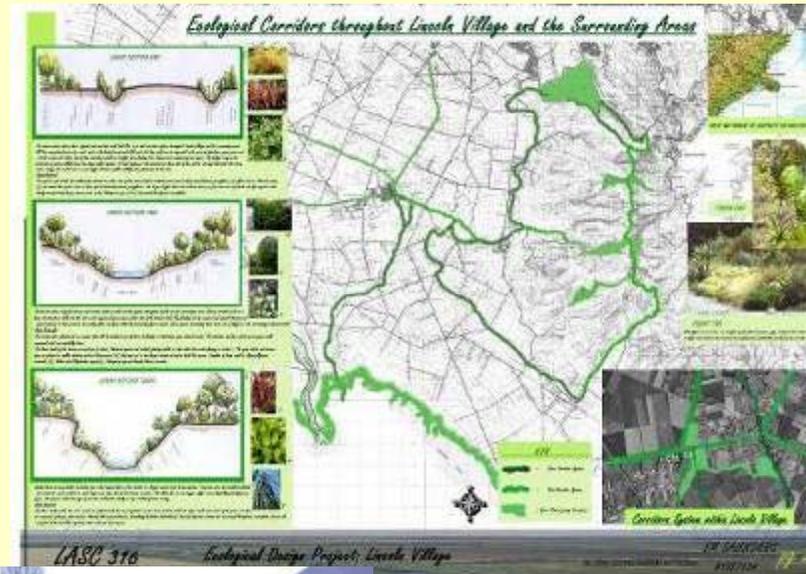
New Zealand Perimeter Urban Greenway Concept



Courtesy of C. Meurk

Design vision of urban ecological networks in New Zealand at a range of scales

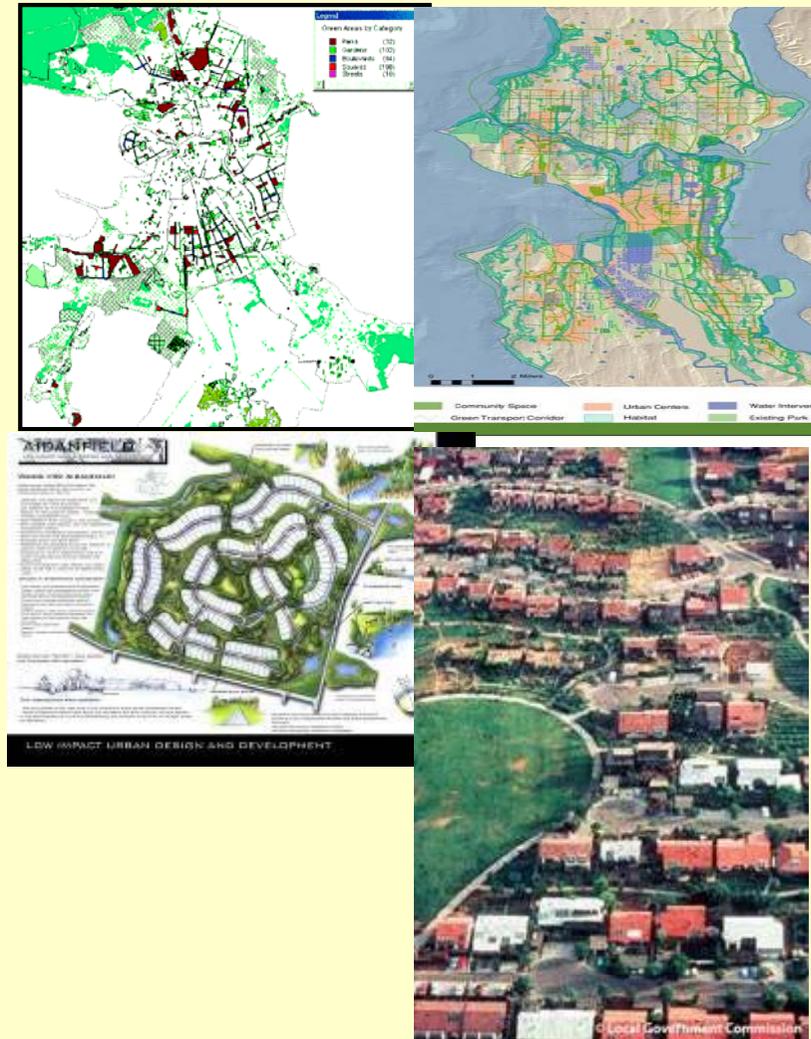
- Restoration of '**blueways**' as **ecological networks** in New Zealand cities can be seen as a significant achievement for **biodiversity and recreational goals**
- Pushing **reinforcement of indigenous biodiversity** approach at range of urban scales: from **private garden** to **urban**, to **neighbourhood** to **metropolitan** and **regional scales**



Reinforcing indigenous biodiversity through design of complex multifunctional corridors

Urban Ecological Network Concepts : summary

- All these international concepts use both ***ecological and urban planning /landscape design vocabulary***
- A lot of ***overlapping*** and ***similar principles*** in definition and design
- ***Using different scales:***
national-regional-
metropolitan-
neighbourhood



Urban Ecological Network Concepts: summary

Use potentials of *all types* of existing open space types for creating *one ecological network* (“*core*” patches, “*stepping stones*” and *corridors*):

- *original natural vegetation*: always prioritised in this networking as a unique source of native biodiversity and local identity
- *parks, private and public gardens*
- *wastelands, brownfields*
- *railway lines, roads, highways*
- *golf courses*
- *cemeteries*
- *waterways*
- *wetlands*



New types of green spaces as valuable elements in ecological networking

Growing interest in novel design solutions for sustainable cities:

- “Living Street”
- Green roofs
- “Living walls”
- Pervious pavements
- Provide **healthy environments** and **additional habitats** for urban wildlife
- Make **ecological processes visible - design with nature**
- **Improvement** of urban ecological network visibility



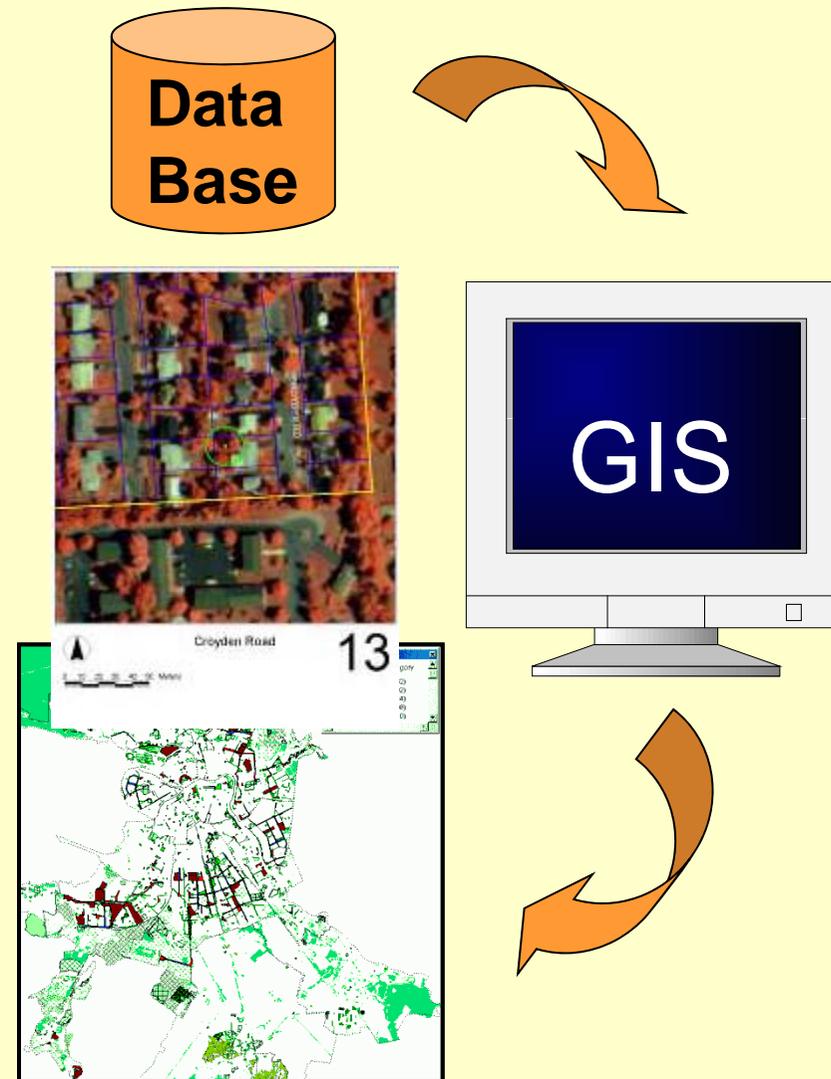
New Tendencies in Urban Ecological Networks: fine scale

- From “*tidy*” to “*messy*” ecosystem approach in design of green areas (J. Nassauer, USA)
- From *monolayer* and *monoculture* to *multilayered* and *biodiverse* composition based on knowledge of *ecological processes and design* requirements sensitive to *public requests/interaction*



21th Century new vision of planning and design of ecological networks

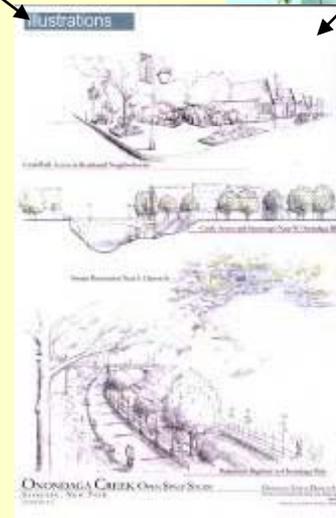
- Using ***multidisciplinary teams***
- Using new technology (***GIS, modelling, remote sensing***) in planning and design process
- Sustainable practices (LIUDD, LID)



Urban Ecological Network: 21st Century Vision

More *integration* between ecologists, landscape architects, urban planners and politicians on *planning and structure of networks*

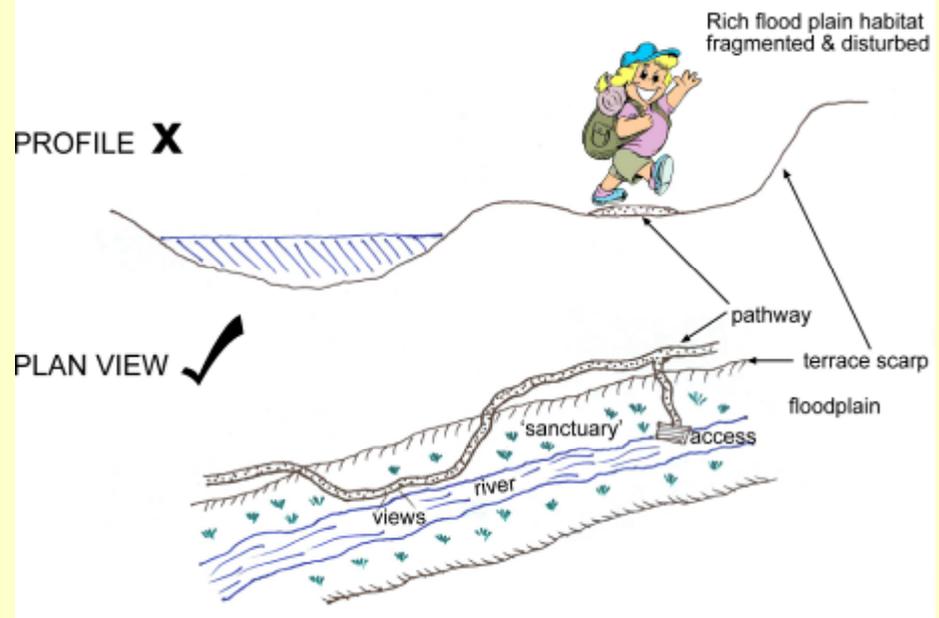
- **Politicians:** creating healthy and sustainable urban landscapes
- **Landscape Ecologists:** increase connectivity-from 'scattered patch landscape' to 'network landscape'
- **Urban Planners:** designing integrated and connected as well as safe, harmonious and cultural diverse green infrastructure
- **Landscape Architects:** designing sustainable landscapes for living, working and recreation
- **Urban Ecologists and Wildlife scientists:** protecting and enhancing urban biodiversity, introducing 'nature' in the city (presence of flora and fauna in different urban areas; providing connectivity between inner-city and peri-urban habitat)
- **Social scientist and educators:** access to nature in each part of the urban environment



Integration between ecologists, landscape architects, urban planners and politicians on **planning and structure of networks**

- **Rationalising** the **impacts of human access** on habitat and wildlife on the one hand and **visual aesthetics** and perceptions of safety on the other.
- By creating a **meandering pathway** and **providing explicit viewing** and **water access points**, representative ecological values across the riparian gradient are **preserved in sanctuary segments** (lower graphic).

Controlling impacts of access and aesthetics



Concept for **integrating social and ecological** needs in narrow corridors for New Zealand cities (by Colin Meurk)

21st Century vision on planning and design of ecological networks

- ***Integration*** of all ***positive international experience*** and its ***adjustment to local climatic and cultural conditions***
- ***Integration*** at ***all levels*** (from metropolitan to fine level of street design)



21st Century vision of planning and design of ecological networks

Wide use of *modern technology* at different scales to *model* different *stages* in the *development of the ecological network* and demonstrate its very *dynamic character*



Envisioning Seattle's Green Future, 2006



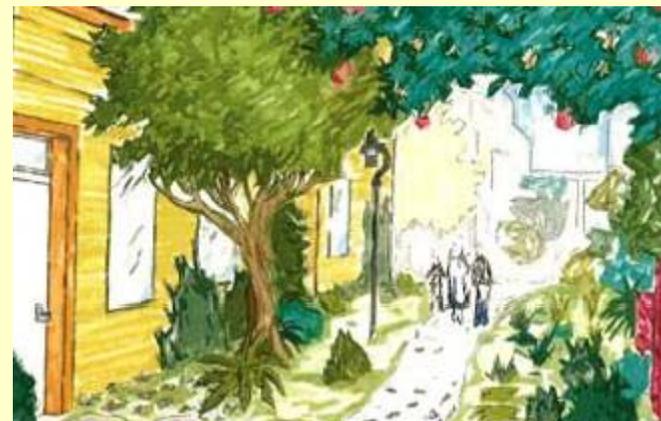
Demonstration Garden in Christchurch Botanic Garden in 2008 and 2009

21st Century vision of planning and design of ecological networks

- Contemporary cities need to **allow connectivity** within the urban structures and with **surrounding natural, semi natural and rural environments**.
- **New models of urban ecological networks should:**
 - Be based on **local unique identity** (nationhood/cityhood /neighbourhood)
 - **Urbanised, indigenous peoples** have a particular role in sensitively designing ecological networks in cities that provide for both spiritual needs and in some cases cultural harvest
 - Include **social and cultural biodiversity**
 - Have a **holistic ecological and design framework**
 - Be an important framework for **creating sustainable cities**



Wellington, New Zealand



Envisioning
Seattle's
Green
Future,
2006

21st Century vision of planning and design of urban ecological networks



http://www.google.co.nz/search?hl=en&q=future+green+roof+city+images&btnG=Search&meta=&aq=f&aqi=&aql=&oq=&gs_rfai=



<http://www.google.co.nz/imgres?imgurl=http://www.grenerfields.com/wp-content/uploads/2008/>



Acknowledgment

- Dr. Colin Meurk
- Dr. Glenn Stewart

Thank you!

