

AN ILLUSTRATED GUIDE

Urban Landscape



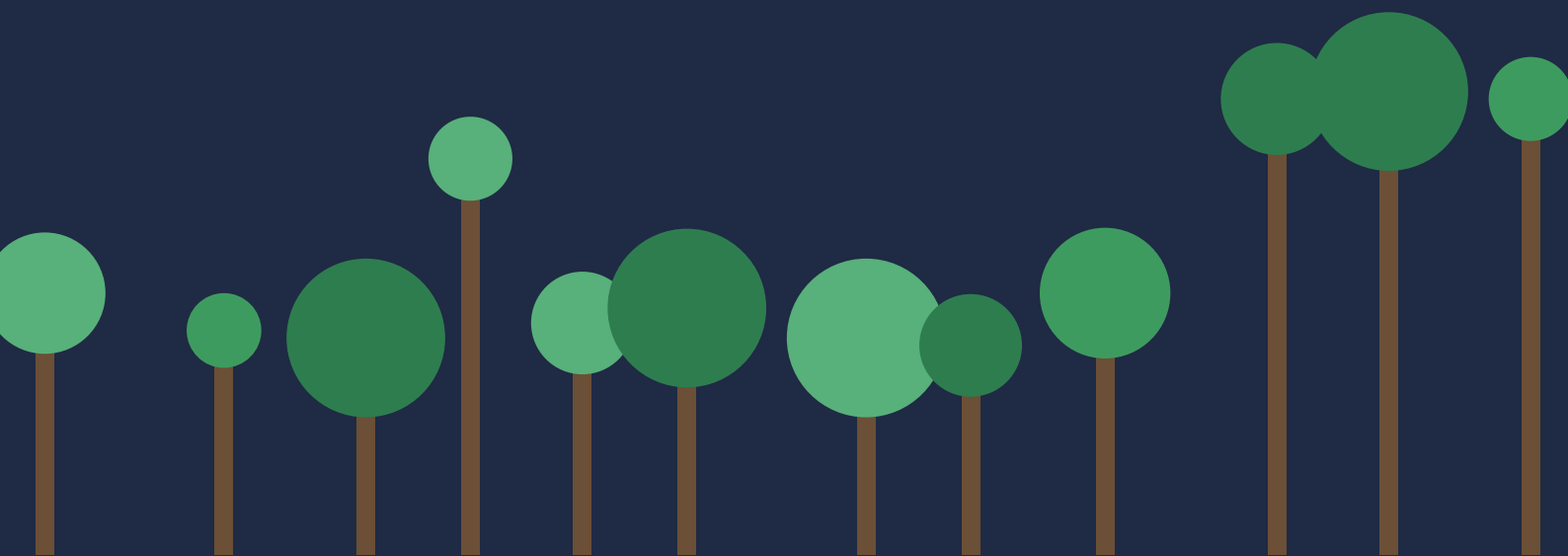
**A friendly guide to nature,
green cities and urban AI**

Plain English, worked examples and short exercises,
with a glossary and a four-week study plan.

Sixteen short chapters · Quiz · Glossary

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Welcome

This guide is for anyone who wants to understand how **nature and cities fit together**: architects, engineers, data scientists, geographers, planners and students. It is a plain-English tour of the urban landscape: parks, trees, water, wildlife, streets, and the data and AI tools now used to study them.

You do not need a background in landscape architecture or ecology. Each chapter explains the main ideas, the words people use, the numbers worth remembering, and the debates in the field. Boxes with worked examples and short exercises help the ideas stick.

REMEMBER

The goal is fluency, not memorisation: know the main ideas, know the words, and know which questions to ask.

How to read this book

This is a **fast primer**: about six hours end to end. Skim each chapter, look at the pictures, and read the coloured boxes twice. Chapter 14 summarises the classic books so you do not have to read them all, and the four-week plan at the end turns the guide into a routine.

The little boxes you will see

Box	What it means
TIP	A shortcut or a way to remember something.
WATCH OUT	A common trap. Papers fall into these all the time.
REMEMBER	If you keep only one thing from the page, keep this.
SAY IT LIKE THIS	Sentences you can use in a real conversation.
YOU CAN SKIP THIS	Extra detail. Read it on a second pass.
WORKED EXAMPLE	A small calculation with toy numbers.
TRY IT	A ten-minute exercise.

Five habits for learning a new field

- **Learn the scales.** A garden, a street, a park and a river basin need different tools and different questions.
- **Ask what is being measured.** “Greener” can mean tree canopy, grass, or a score from a photo. Always ask which.
- **Keep a list of new words.** Check them against the glossary the same night.
- **Separate evidence from slogans.** Many claims about green cities are true on average and false in a particular street.
- **Claim only what you have read or built yourself.**

WATCH OUT

Most numbers and book details here come from general knowledge and well-known studies, and are marked “about” or “roughly” where they vary. Check any figure before you quote it in a paper or a meeting.

1

What Is the Urban Landscape?

Everything in a city that is not a building, seen as a system.

The big idea

The **urban landscape** is the living and shaped ground of a city: soil, plants, water, open space, streets and the way they connect. Buildings sit in it, but it is more than the gaps between buildings. It shapes heat, floods, health, wildlife and how a place feels.

Three words that overlap

Term	What it means	Typical question
Landscape architecture	The profession that designs outdoor space: parks, plazas, streets, campuses, waterfronts.	How should this space look, work and be maintained?
Landscape ecology	The science of how patterns of land (patches, corridors, edges) affect ecological processes.	Can animals and water move through this city?
Landscape urbanism	A school of thought (1990s onward) that treats landscape, not buildings, as the main organiser of cities.	Can landscape structure the whole urban area, not just fill leftover space?

Scales

Landscape questions change with scale. The same tree is a design detail on a site, a shade element on a street, a unit of canopy in a neighbourhood and a data point in a city-wide map.

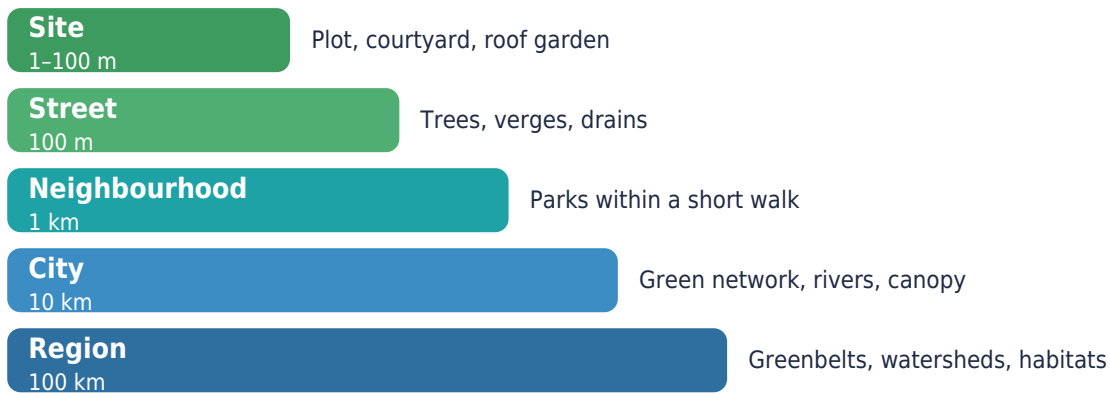


Figure 1. The landscape scale ladder: from a single site to a region.

TIP

When someone says “green”, ask “at what scale?” A park may help a neighbourhood and do nothing for the street next to a busy road.

SAY IT LIKE THIS

“Are we talking about site-scale greening, or a city-wide green network?”

TOOLS FOR THIS CHAPTER

QGIS, ArcGIS Pro: map green, blue and grey shares

i-Tree Canopy: free web tool that estimates canopy cover from aerial photos

Google Earth Engine: satellite archives for greenness maps

TRY IT (10 MINUTES)

Look at your own street on a satellite map. Mark the green (trees, grass), the blue (water) and the grey (roads and roofs). Roughly what share is each? Which scale is the biggest gap?

2

A Short History

From pleasure parks to living infrastructure.

Cities have always had gardens, but the modern story starts in the nineteenth century, when crowded industrial cities needed fresh air and open space.

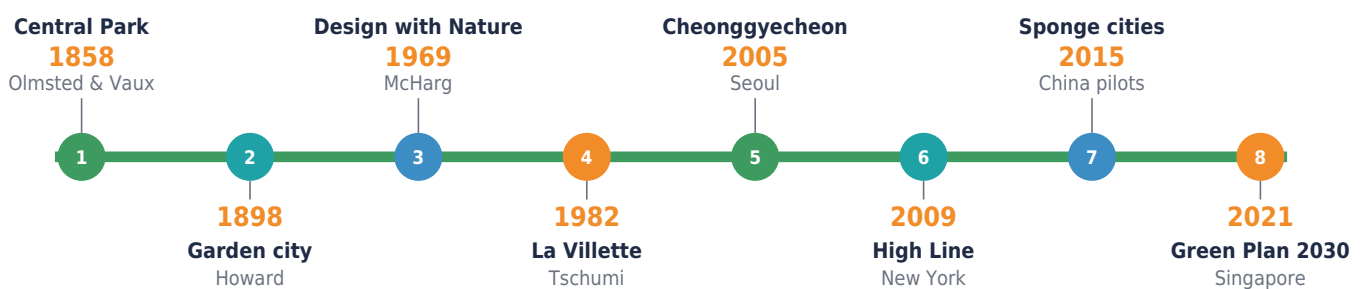


Figure 2. Eight milestones in the story of urban landscape.

When	What happened	Why it matters
1858	Frederick Law Olmsted and Calvert Vaux win the competition for New York's Central Park (the "Greensward" plan).	Public parks as a civic right and a health measure; the profession of landscape architecture takes shape.
1898	Ebenezer Howard publishes his garden-city book (retitled <i>Garden Cities of To-morrow</i> in 1902).	Towns balanced with nature and green belts; a root of new-town planning.
1969	Ian McHarg publishes <i>Design with Nature</i> .	Overlay mapping of soil, water, slope and habitat to decide where to build; a forerunner of GIS.
1982-83	International competition for Parc de la Villette in Paris, won by Bernard Tschumi.	A park as a layered urban system, an early spark for landscape urbanism.
2005	Seoul opens the restored Cheonggyecheon stream after removing a covered road.	A famous case of bringing a buried river back into the city.
2009	First section of New York's High Line opens on an old rail viaduct.	Reuse of infrastructure as a public landscape; also a lesson in green gentrification.
2010s	China launches the "sponge city" programme, with pilot cities from 2015.	Cities designed to absorb and reuse rain.
2021	Singapore launches its Green Plan 2030, building on a "garden city" vision from the 1960s.	Nature as national strategy, with targets for parks, trees and carbon.

DID YOU KNOW?

Central Park covers about 843 acres (roughly 340 hectares). Seoul's restored Cheonggyecheon stream runs for about 5.8 km, and New York's High Line is about 2.3 km long, a ribbon of park built on an old railway.

REMEMBER

The story moves from **nature as decoration** (parks as relief) to **nature as infrastructure** (landscape doing work: cooling, draining, cleaning, connecting).

YOU CAN SKIP THIS

Dates and competition details are good for conversation, but the main thing to keep is the arc of ideas above.

3

Green, Blue and Grey Infrastructure

The vocabulary of urban nature, and how the pieces work together.

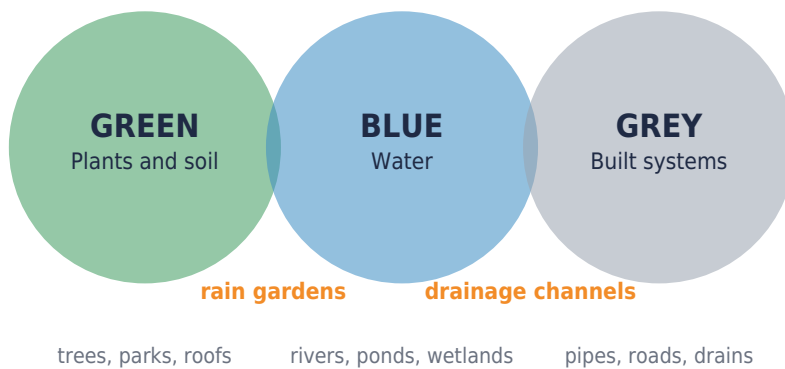


Figure 3. Green, blue and grey systems overlap. The overlaps are where most modern design happens.

The three layers

- **Green infrastructure:** trees, parks, green roofs and walls, gardens, urban forests, street verges, meadows.
- **Blue infrastructure:** rivers, canals, ponds, lakes, wetlands, coastal edges, and engineered water features.
- **Grey infrastructure:** built, hard systems: pipes, drains, culverts, roads, dams, sea walls. Often essential, but single-purpose.

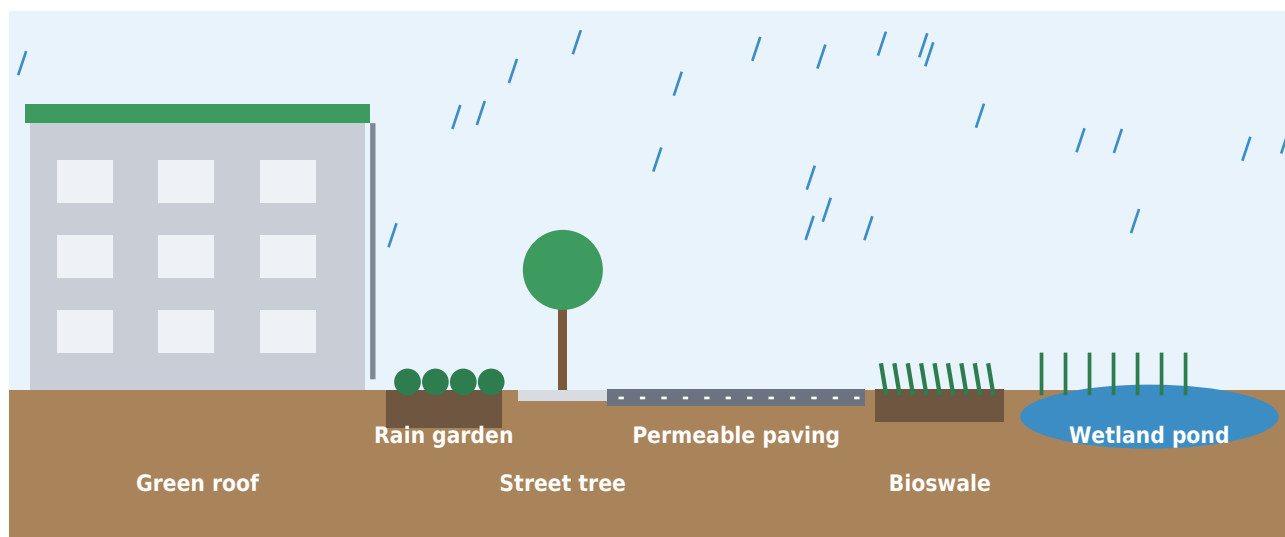


Figure 4. Where each tool sits in a city block. Rain falls on the roof, the street and the park, and each tool deals with it near where it lands.

Tools you will hear named

Tool	What it does	Where it works
Street tree	Shade, cooling, runoff interception	Sidewalks and medians
Green roof / wall	Insulation, rain retention, habitat	Buildings
Bioswale	Planted channel that slows and filters runoff	Roadsides, car parks
Rain garden	Planted hollow that soaks up roof and road water	Courtyards, street corners
Permeable paving	Lets rain pass into the ground	Parking, plazas, paths
Constructed wetland	Cleans and stores water	Park edges, large sites
Green corridor / greenway	Linked path for people and wildlife	Across districts
Urban forest	All trees in a city, public and private	City scale

Names for the same idea

Different countries use different labels for similar practice: **SuDS** (sustainable drainage systems, UK), **LID** (low impact development, US), **WSUD** (water sensitive urban design, Australia) and **sponge city** (China). **Nature-based solutions** is the broad umbrella used in policy.

WATCH OUT

“Nature-based solutions” can be a label for anything green. Ask what problem it solves (heat? flood? health?), for whom, and how it will be maintained.

SAY IT LIKE THIS

“Is this a grey solution with a green finish, or does the vegetation actually do the work?”

TOOLS FOR THIS CHAPTER

EPA SWMM: stormwater simulation, with modules for green roofs, rain gardens and permeable paving

InVEST (urban flood risk model): how much rain different land covers retain

i-Tree Hydro: effect of trees and surfaces on runoff

4

What Nature Does for Cities

Ecosystem services in plain English.

Researchers describe the benefits of nature as **ecosystem services**. A widely used grouping comes from the Millennium Ecosystem Assessment (2005).

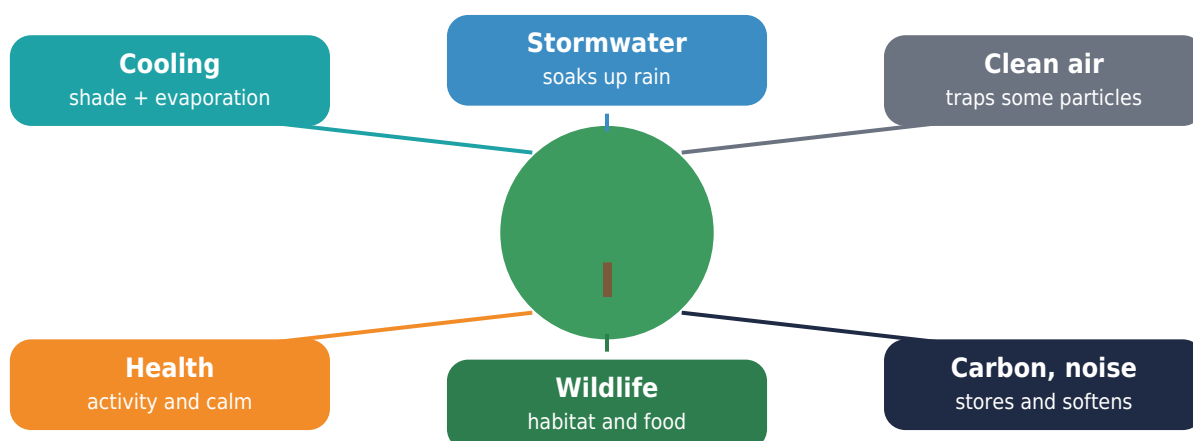


Figure 5. One tree or park delivers several services at once. That is why planners count benefits together.

Type	Meaning	Urban examples
Provisioning	Things we take	Food from urban farms, timber, fresh water
Regulating	Natural processes that moderate harm	Cooling, flood control, air filtering, noise reduction, carbon storage
Cultural	Non-material benefits	Recreation, mental health, identity, beauty, education
Supporting	Basic processes behind the others	Soil formation, pollination, habitat

What the evidence says

- **Cooling:** parks and tree canopy lower temperatures. A well-known review found parks to be about 1 °C cooler on average than their surroundings, with large variation.

- **Stormwater:** soil and plants slow and soak up rain, which cuts the peak flow that overloads drains.
- **Air quality:** trees capture some particles, but the effect on city-wide pollution is usually modest. Trees close to roads can also trap pollution in street canyons.
- **Health:** access to green space is linked with better mental health and more physical activity. Much of the evidence is correlation, and wealthier areas often have more green space.
- **Biodiversity:** gardens, parks and wetlands host many species, and some cities are surprisingly rich in wildlife.

WATCH OUT

Disservices exist. Some trees release compounds that can contribute to ozone formation, pollen causes allergies, leaves block drains, roots lift pavements, and water-hungry lawns strain supplies. Good design weighs services against disservices.

SAY IT LIKE THIS

“That is the average effect. Does it hold on this street, in this climate, for this species?”

TOOLS FOR THIS CHAPTER

InVEST: urban cooling, flood risk and nature access models

i-Tree Eco: carbon, runoff and air-pollution benefits of trees

ARIES: ecosystem-service modelling with AI

QGIS: map the results

5

Heat, Shade and Trees

Why a tree is more than a green dot on a map.

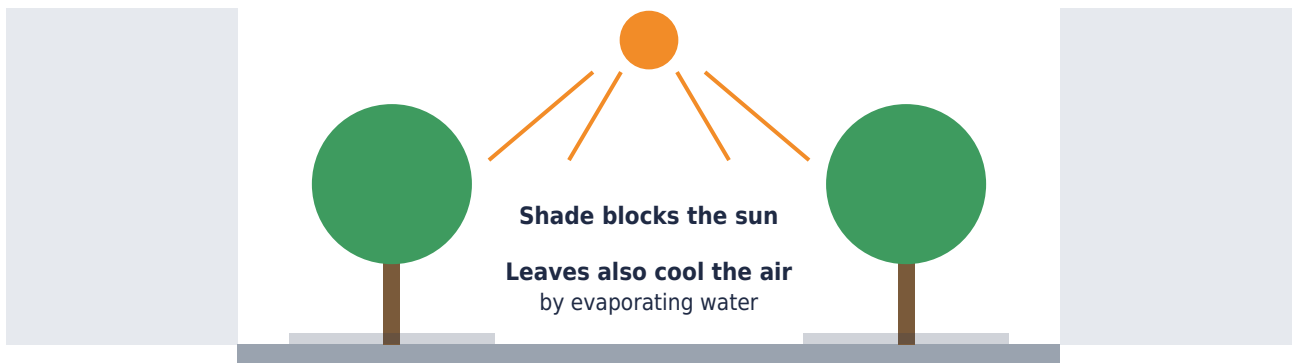


Figure 6. Trees cool in two ways: they shade surfaces and people, and they evaporate water.

How trees cool

- **Shade:** the biggest effect for people. Shade blocks direct sun, lowering the heat people feel (and the surface temperature of the ground).
- **Evapotranspiration:** plants move water from soil to air; evaporating water takes heat from the surroundings.
- **Surface properties:** cool roofs, light-coloured pavements (high albedo) and green roofs change how much heat is absorbed.

DID YOU KNOW?

A large tree can move tens to hundreds of litres of water from soil to air on a hot day. And colour matters: fresh asphalt reflects only about 5 to 10 percent of sunlight, while a white cool roof can reflect more than 60 percent.

WATCH OUT

Air temperature is not the same as how hot a person feels. Shade can lower the felt heat a lot even when the air temperature barely changes. That is why heat studies use measures such as **mean radiant temperature** and **UTCI** (the Universal Thermal Climate Index), not air temperature alone.

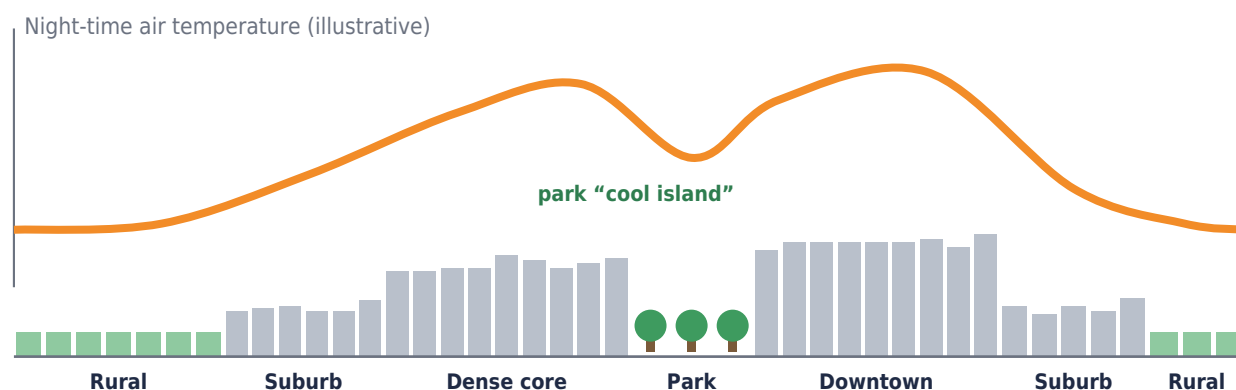


Figure 7. The urban heat island: night-time air temperature rises toward dense areas and dips over a park.

Words and numbers worth knowing

Term	Meaning
Canopy cover	Share of ground covered by tree crowns seen from above. Targets of around 30% are common, but fit depends on climate and density.
NDVI	A satellite index of how green and dense vegetation is (see Chapter 10).
Sky view factor (SVF)	How much sky is visible from a point (0 to 1). Low SVF means tall buildings or canopy; it affects daytime shade and night-time cooling.
Street canyon H/W	Height of buildings divided by street width. Deep canyons are shadier but trap heat and pollution at night.
Urban heat island (UHI)	Cities are warmer than surroundings, most clearly at night.
3-30-300 rule	Idea by Cecil Konijnendijk: see 3 trees from home, have 30% canopy in the neighbourhood, and be within 300 m of green space.

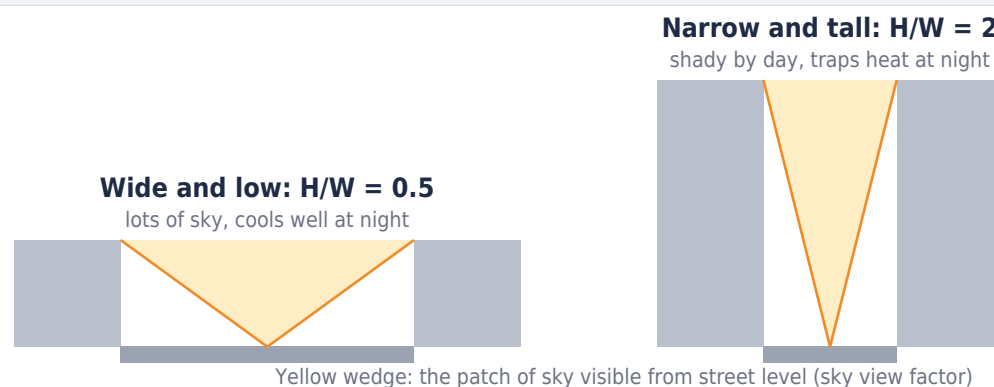


Figure 8. Street canyons: the proportion of building height to street width sets how much sky you see.

COMMON MYTH

“More trees always means a cooler street.” Not always. Dense canopy in a deep canyon can slow night-time cooling and reduce ventilation. The right tree in the right place, with enough soil and water, matters more than the count.

TRY IT (10 MINUTES)

Take a photo of a hot street at noon and mark where the shade falls. Which surfaces are sunlit? What single change (one tree, an awning, lighter paving) would help people most?

TOOLS FOR THIS CHAPTER

ENVI-met: street and neighbourhood microclimate with plants

UMEP and SOLWEIG (QGIS plugins): shade, radiation and thermal comfort

Ladybug Tools (Grasshopper): sun, shade and UTCI maps

RayMan: free model of radiation and thermal comfort

OpenFOAM: CFD for wind around buildings and trees

WUDAPT LCZ Generator: local climate zone maps for heat studies

6

Water: Floods, Drains and Sponges

How a city handles rain, and how landscape can help.

The problem

Rain that falls on roofs, roads and car parks cannot soak in, so it runs off quickly into drains. The share of ground covered by hard surfaces is called **imperviousness**. The more of it, the bigger and faster the runoff, and the greater the flood risk during heavy rain.

Where does the rain go? Rough shares, after a widely reproduced US federal figure

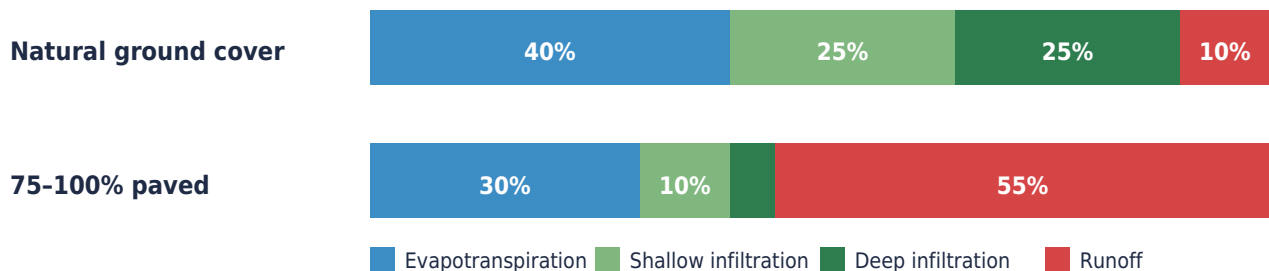


Figure 9. What happens to rain on natural ground and on a paved city. Paving flips the balance from soaking in to running off.

A simple formula: the rational method

Engineers often estimate the **peak flow** from a small catchment with $Q = C \times i \times A$. C is a runoff coefficient (0 to 1, how much rain becomes runoff), i is rain intensity and A is area. With i in mm/hour and A in hectares, Q in m³/s equals $C \times i \times A \div 360$.

WORKED EXAMPLE (TOY NUMBERS)

One hectare, heavy rain of 50 mm/hour. Roofs and pavement ($C \approx 0.9$): $Q = 0.9 \times 50 \times 1 \div 360 \approx 0.125 \text{ m}^3/\text{s}$, or about **125 L/s**.

The same hectare as lawn and garden ($C \approx 0.3$): about **42 L/s**. With a rain garden and permeable paving ($C \approx 0.15$): about **21 L/s**. The coefficients are toy values; real ones depend on soil, slope and design standards.

Roof or pavement

$C \approx 0.9$

125 L/s

Lawn or garden

$C \approx 0.3$

42 L/s

Rain garden + permeable paving

$C \approx 0.15$

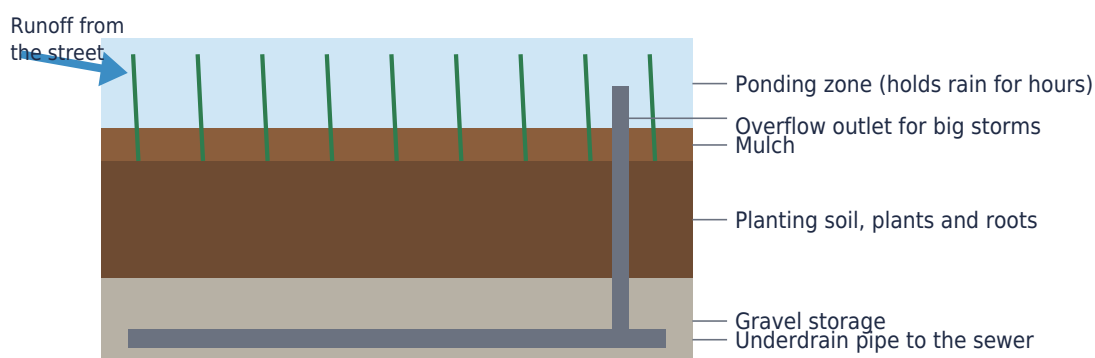
21 L/s

Peak flow from 1 hectare in 50 mm/h rain (toy numbers, rational method)

Figure 10. The same rain, three surfaces. Lower peak flow means smaller drains and fewer floods.

Landscape tools for water

- **Source control:** catch rain where it falls (green roofs, rain gardens, permeable paving, trees).
- **Conveyance:** move water slowly in swales and channels rather than fast in pipes.
- **Storage and treatment:** detention basins, ponds and wetlands that hold and clean water.
- **Space for floods:** parks and plazas designed to flood safely for a few hours in extreme storms.



Water slows, soaks, is cleaned by soil and roots, and the excess leaves safely

Figure 11. Inside a rain garden: layers that slow, store and clean runoff.

WATCH OUT

Green infrastructure works best for frequent, small to moderate storms. In extreme storms the soil is already full, so grey and blue infrastructure still matter. Maintenance (cleaning inlets, replacing clogged soil) decides whether it works in year ten.

SAY IT LIKE THIS

“What design storm is this sized for, and what happens when it is exceeded?”

TOOLS FOR THIS CHAPTER

EPA SWMM, PCSWMM: drainage and green-infrastructure simulation

HEC-RAS, TUFLOW: flood hydraulics, including 2D flooding

MIKE+, InfoWorks ICM: commercial urban drainage models

Excel or Python: the rational method by hand



Wildlife, Habitat and Connection

Landscape ecology for people who build.

Patches, corridors and matrix

Landscape ecologists describe land as a mosaic of three things, a vocabulary that goes back to Richard Forman. **Patches** are areas of habitat (a park, a wood, a pond). **Corridors** are strips that link patches (a river, a hedgerow, a railway verge). The **matrix** is what surrounds them, which in a city is mostly buildings and roads.

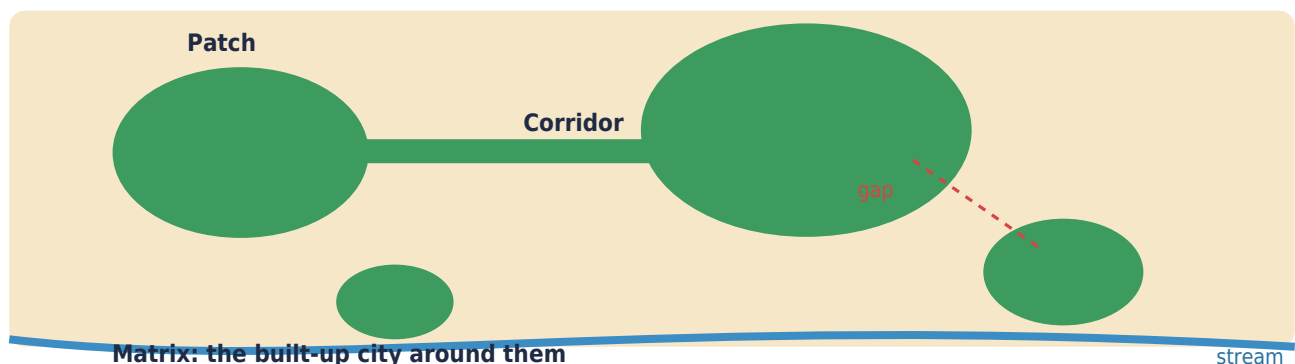


Figure 12. Connected patches support wildlife; isolated ones lose species over time.

Why it matters

- **Fragmentation:** breaking habitat into small, isolated pieces. Small patches support fewer species.
- **Connectivity:** corridors and stepping-stone patches let species move, feed and breed.
- **Edge effects:** the edges of patches are noisier, brighter and drier, so small or thin patches have little “core” habitat.
- **Species-area relationship:** larger areas hold more species. A common rule of thumb is that doubling area adds roughly 10 to 25 percent more species.

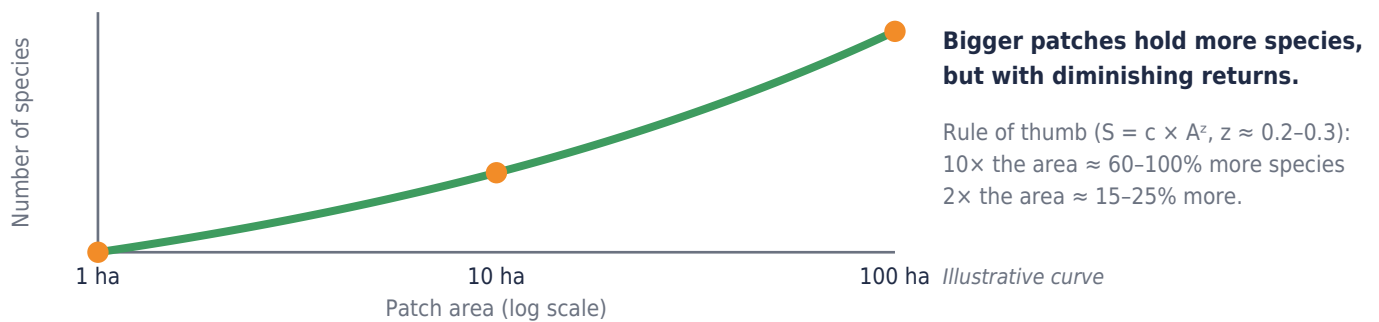


Figure 13. The species-area relationship: bigger patches hold more species, with diminishing returns.

Urban threats and fixes

Threat	Example fix
Light pollution	Shielded, warm and dimmable lighting; lights off at critical hours
Bird collisions with glass	Patterned or fritted glass; fewer reflective facades
Barriers (roads, walls)	Wildlife crossings, culverts, gaps in fences
Invasive species, monoculture	Diverse native or well-adapted planting
Lawn everywhere	Meadows, layered planting, deadwood, ponds

TIP

Dense native mini-forests (often called Miyawaki forests, after Akira Miyawaki) are popular. They can be effective in small spaces, but results depend on soil, species choice and care, so treat claims of very fast growth with caution.

SAY IT LIKE THIS

“Is that a patch, or a connected network? Who can actually move through it?”

TOOLS FOR THIS CHAPTER

FRAGSTATS, R landscapemetrics: patch size, edge and fragmentation metrics

Circuitscape, Linkage Mapper, Graphab: habitat connectivity and corridors

InVEST (habitat quality): habitat quality maps

MaxEnt: species distribution modelling

8

Parks and Public Space

Who gets nature, how much, and how far away.

Types of urban green space

Type	What it is	Notes
Pocket park	Very small park on a leftover lot	Good where land is scarce
Neighbourhood park	Daily-use park with play and seating	Core of the 10-minute-walk idea
Linear park / greenway	Long strip along a river, rail or street	Links places; supports walking and cycling
Plaza / civic space	Hard-surfaced gathering space	Often needs trees and shade to be used in summer
Large urban park / forest	Hundreds of hectares or more	Ecology and regional recreation
Reused infrastructure	Old rail, overpass or port made into parkland	High Line (New York), Seoulo 7017 (Seoul)

How access is measured

- **Per-person area:** square metres of green space per resident. A figure of 9 m² per person is often quoted in connection with the World Health Organization, though its origin is debated, so cite it carefully.
- **Distance:** proportion of people within a set distance of a park. Many standards use 300 m or a 10-minute walk.
- **Quality:** size, shade, safety, facilities, maintenance. A park nobody feels safe in does not provide access.

WORKED EXAMPLE (TOY NUMBERS)

A 10-minute walk at about 4.8 km/h covers roughly **800 m**. A 300 m standard is much stricter: it means a park within about a 4-minute walk. Same park, two very different verdicts on “access”.

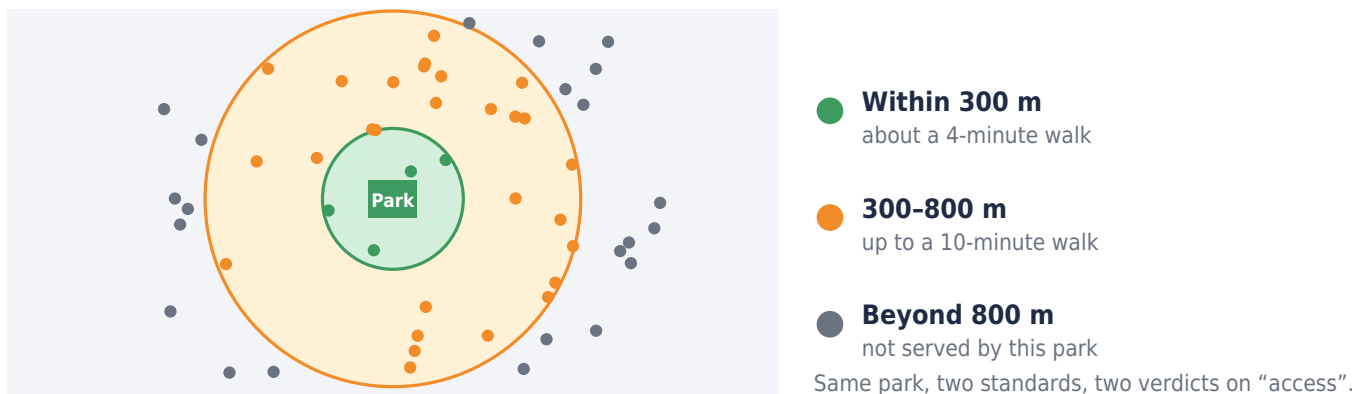


Figure 14. The same park judged by a 300 m rule and an 800 m (10-minute) rule.

Equity

Green space and tree canopy are often unevenly spread. Studies in US cities found that neighbourhoods once marked as “redlined” tend to have less canopy and higher heat today. Tools like the **Tree Equity Score** (American Forests) combine canopy with income, race and heat to find where planting matters most.

WATCH OUT

Green gentrification: new parks and greening can raise nearby prices and push out residents they were meant to help. Planners now pair greening with housing protection. The High Line is often cited in this debate.

SAY IT LIKE THIS

“Access to what? A map dot, or a park people actually use and feel safe in?”

TOOLS FOR THIS CHAPTER

QGIS, ArcGIS Network Analyst: walking-distance service areas

r5r, OpenRouteService, OSMnx: isochrones and travel times on street networks

ParkServe (Trust for Public Land): ready-made 10-minute-walk data for US cities

9

Streets and Planting Design

Where most city landscape actually lives.

Streets are the largest public space in most cities, so street landscape is where many people meet nature every day.

Design questions

- **Right tree, right place:** species chosen for climate, soil, pests, mature size and street width. Roots and crown need room.
- **Soil volume:** street trees often fail because their roots have a small, compacted pit. Engineered soil cells, continuous trenches and shared pits help.
- **Water:** directing street runoff into tree pits and swales waters trees and cuts drain loads.
- **Underground conflicts:** pipes and cables compete with roots. Map utilities early.
- **Shade for people:** plan canopy along walking routes, bus stops and playgrounds first.
- **Diversity:** a mix of species reduces the risk of losing many trees to one pest.
- **Maintenance:** pruning, watering and replacement budgets decide whether the design matures.

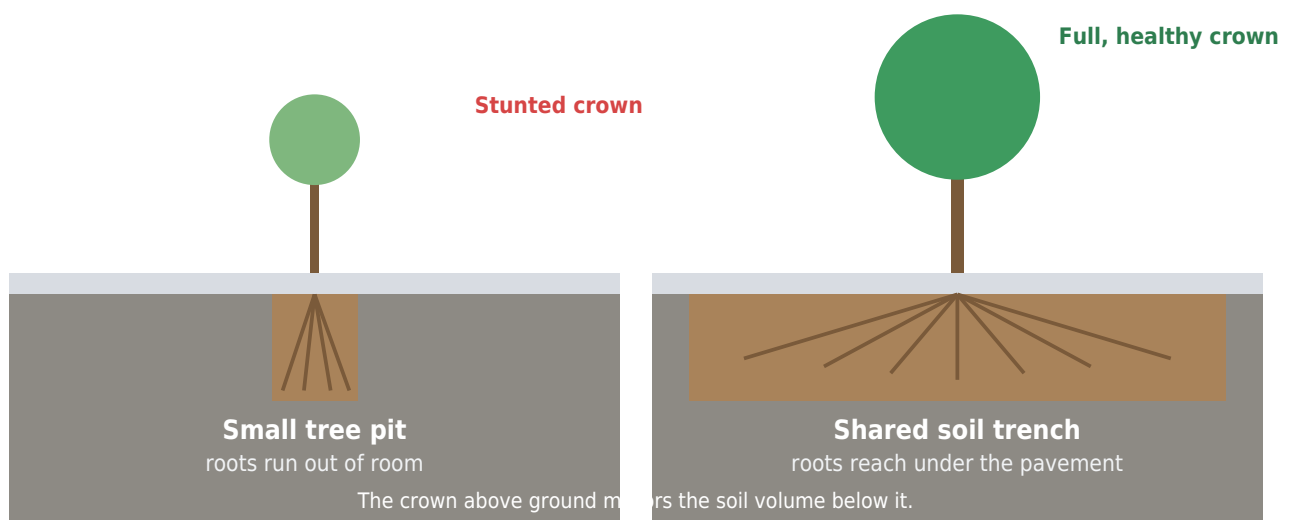


Figure 15. Why street trees fail: the crown can only be as big as the soil allows.

Surface and material choices

Choice	Effect
Light-coloured or cool pavements	Reflect more sun, but can raise glare and radiation toward pedestrians
Permeable paving	Lets rain soak in; needs cleaning to avoid clogging
Green walls and facades	Insulate and shade; need irrigation and upkeep
Shade structures and awnings	Fast shade without waiting for trees to grow

REMEMBER

A planting plan is a promise of future shade. If the roots have no space and nobody waters the tree, the promise is not kept.

TRY IT (10 MINUTES)

Pick a street you know. Count the trees on one block. How many look healthy and full? How many have a tiny pit or a stunted crown? What would you change first?

TOOLS FOR THIS CHAPTER

i-Tree Eco: benefits of a street-tree inventory

Ladybug Tools, SketchUp, Rhino: sun and shade studies for a street

ENVI-met: effect of planting on street microclimate

Streetmix: quick street cross-section sketches (visual, not computed)

10

Measuring Green: Data and Indicators

How researchers turn landscape into numbers.

Sources of data

Source	What it gives	Notes
Landsat	Satellite imagery, 30 m resolution, decades of history	Good for long-term change
Sentinel-2	Satellite imagery, 10 m for key bands, frequent revisits	Good for vegetation and city-scale maps
Land cover maps	For example ESA WorldCover (10 m) and Dynamic World	Global, but coarse for single trees
LiDAR	3D point clouds; tree height and canopy structure	Excellent but patchy and costly
Aerial / drone imagery	Very high resolution (centimetres)	Individual trees, but limited coverage
Street-level imagery	Photos from the street, used for “green view”	What people actually see
OpenStreetMap	Parks, trees, water, paths as map data	Quality varies by place

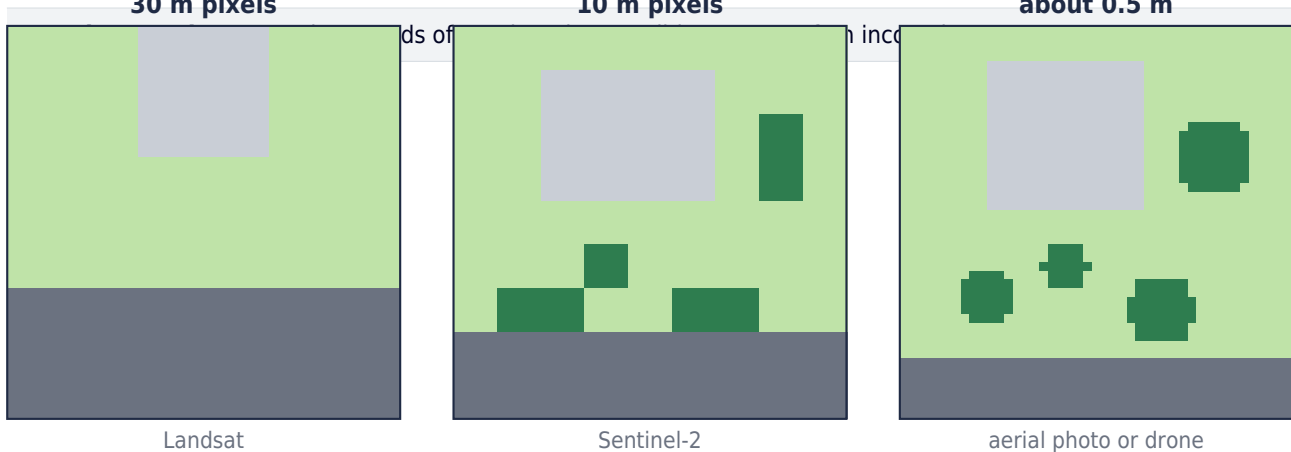


Figure 16. The same 90 m by 90 m scene at three resolutions. A 10 m pixel is larger than most street trees.

Common indicators

- **NDVI** (normalised difference vegetation index) = $(\text{NIR} - \text{Red}) \div (\text{NIR} + \text{Red})$, where NIR is near-infrared light. Healthy plants reflect a lot of NIR and absorb red, so NDVI is high.
- **Canopy cover**: percent of area under tree crowns.

- **Green view index (GVI):** share of green pixels in street-level images, popularised by MIT's Treepedia project.
- **Park access:** share of residents within a set distance of a park.
- **Land surface temperature (LST):** surface heat from thermal satellite bands. It is not the same as air temperature.

WORKED EXAMPLE (TOY NUMBERS)

A leafy surface reflects 0.50 NIR and 0.10 red: $NDVI = (0.50 - 0.10) \div (0.50 + 0.10) \approx \mathbf{0.67}$. A pavement reflects 0.25 NIR and 0.20 red: $NDVI = 0.05 \div 0.45 \approx \mathbf{0.11}$. Values near 0 mean bare or built surfaces; high values mean dense vegetation.

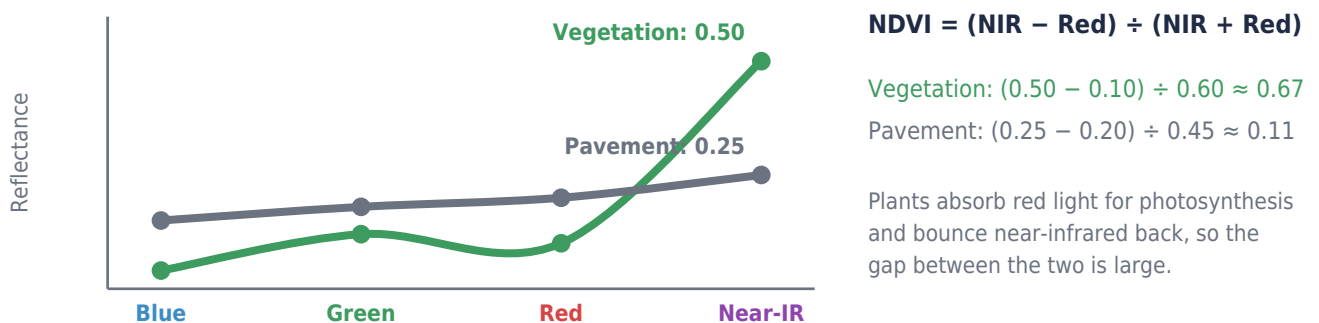


Figure 17. Why NDVI works: plants and pavement look alike in red light but very different in near-infrared.

DID YOU KNOW?

The two Sentinel-2 satellites together image the same spot on land about every five days, free of charge. That is a lot of free landscape data.

Tools and models

- **i-Tree** (US Forest Service): estimates the benefits of trees such as carbon and runoff.
- **InVEST** (Natural Capital Project): maps and values ecosystem services.
- **ENVI-met**: microclimate simulation for streets and neighbourhoods.
- **GIS and Python**: QGIS, GeoPandas, rasterio and Google Earth Engine are workhorses.

WATCH OUT

Greenness is not quality. NDVI cannot tell a shady tree from a grass field, a healthy tree from a stressed one, or a public park from a private yard. Canopy seen from above also differs from green seen by a walker.

SAY IT LIKE THIS

“Which view of green is this: from above (canopy) or from the ground (what people see)?”

TOOLS FOR THIS CHAPTER

Google Earth Engine, ESA SNAP: NDVI and land-cover from satellites

lidR (R), PDAL, CloudCompare: canopy height from LiDAR

Python (rasterio, xarray): raster processing

ZenSVI, Mapillary: green view index from street imagery

11

AI and the Urban Landscape

What machine learning is used for, and where it breaks.

What AI is used for

Task	How	Typical data
Map trees and green	Image segmentation and object detection	Aerial photos, satellite images, LiDAR
Green view from the street	Segmenting “vegetation” pixels in photos	Street-level images
Identify species and health	Classification from leaves, crowns and spectra	Close-up photos, hyperspectral imagery
Detect change	Comparing images over time	Satellite time series
Fast microclimate and flood maps	Surrogate models that mimic slow simulations	Outputs of physics models
Support design choices	Generative tools and optimisation for planting and layout	Site data, constraints, goals
Explain and query	Language models that answer questions about maps and data	Maps, reports, sensor data

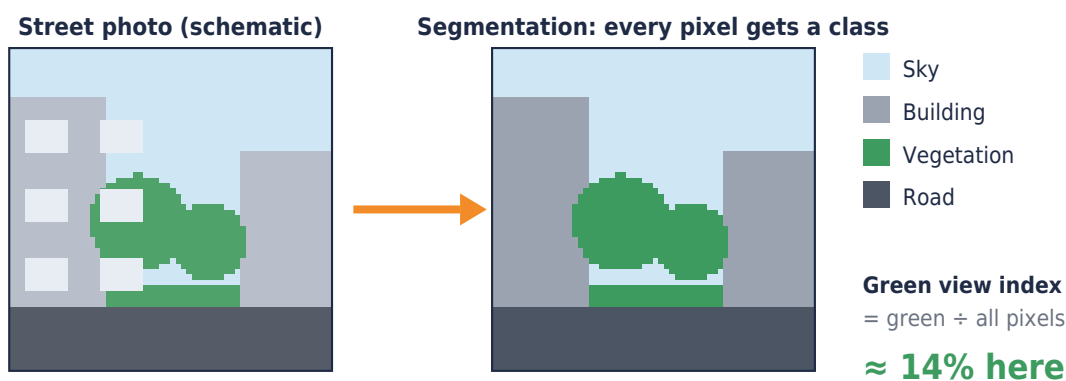
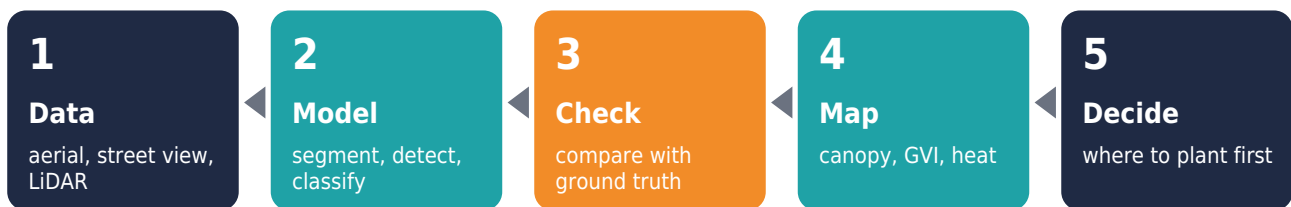


Figure 18. From photo to number: segmentation labels each pixel, and the green view index counts the green ones.

Foundation models for Earth data

Large models pretrained on satellite data (for example IBM and NASA’s Prithvi) aim to serve many tasks, such as land-cover mapping or flood detection, with little extra training. In cities, they are still limited by resolution: a 10 m pixel is bigger than most street trees.



Step 3 is the one people skip. A human check keeps the pipeline honest.

Figure 19. A typical landscape-AI pipeline, with a human check in the middle.

WATCH OUT

Common failure modes.

Season and light: a model trained on summer images mislabels winter trees.

Shadow and occlusion: canopy hides pavement; tall buildings hide trees.

Domain shift: a model trained in one city or climate may fail in another.

Biased coverage: street-level imagery is richer in some areas than others, so scores can reflect where cameras went.

Proxy problem: “more green pixels” is not the same as “better for people”.

SAY IT LIKE THIS

“How was this validated, in which city, in which season, and against what ground truth?”

TRY IT (10 MINUTES)

Take three street photos. Estimate the green share by eye. Then try an image segmentation tool or a vision model on them. Where does it agree with you and where not?

TOOLS FOR THIS CHAPTER

PyTorch, TorchGeo: deep learning for geospatial data

DeepForest: tree crown detection in aerial images

Segment Anything: promptable image segmentation

Prithvi (IBM and NASA): geospatial foundation model

ZenSVI: segmentation of street-level images

12

Policy, Planning and Money

How cities make greening happen, and keep it alive.

Planning tools

Tool	Idea	Examples
Green factor / area factor	New development earns points for vegetation, water and permeable surface; developers must reach a target	Berlin, Seattle and Malmö use versions of this idea
Canopy targets	City-wide goals for tree cover, often by neighbourhood	Many cities set about 30%, with local variation
Greenbelts	Land around a city kept undeveloped	London; Korea's development restriction zones (from 1971)
Open-space standards	Minimum space or distance per resident	Per-person and walking-distance rules
Stormwater fees and credits	Charge by impervious area, discount for on-site control	Used in many US and European cities
Nature-based plans	National and city strategies with targets	Singapore Green Plan 2030; sponge city pilots in China

Paying for it

- **Capital and maintenance:** parks cost most to keep, not to build. Plan operating budgets from day one.
- **Value capture:** using higher property values near parks to help pay for them.
- **Developer contributions:** requirements or fees tied to new building.
- **Green bonds and grants:** funds earmarked for environmental projects.
- **Community stewardship:** volunteers and local groups for planting and care.

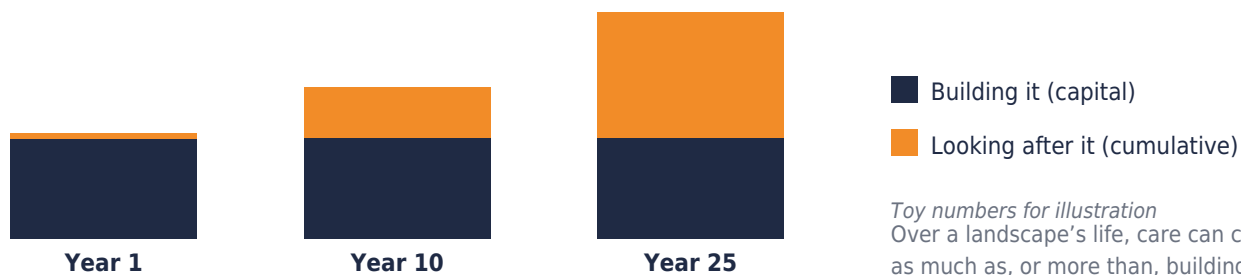


Figure 20. Maintenance is the long tail of landscape cost.

DID YOU KNOW?

Toronto's 2009 green roof bylaw was the first in North America to require green roofs on new large buildings.

REMEMBER

Policy often fails at the maintenance stage, not the planting stage. A good plan names who waters, prunes and replaces the tree after the ribbon is cut.

SAY IT LIKE THIS

"What is the maintenance budget, and who is responsible after year three?"

TOOLS FOR THIS CHAPTER

QGIS, ArcGIS: map canopy and park access by neighbourhood

Tree Equity Score tool: where planting matters most (US)

i-Tree, InVEST: benefit estimates for business cases

Excel: green factor scorecards and cost models

13

Modern Ideas and Trends

What is new in landscape thinking, and what is hype.

Landscape thinking has moved quickly in the last decade. These are the ideas you will hear in meetings and papers today, with a sober view of each.

Established	Growing fast	Emerging
Green infrastructure	Nature-based solutions	Landscape digital twins
Sustainable drainage	Tree equity	AI canopy and species maps
Green roofs	Biodiversity net gain	Nature-positive cities
Park-access metrics	Urban rewilding	Natural capital accounts
Street trees programmes	Heat-resilient planting	Sensor-led irrigation
	Daylighting rivers	Geospatial foundation models
	Superblocks, green streets	

Figure 21. A rough, subjective map of maturity. Use it as a conversation starter, not a ranking.

Ideas worth knowing

Idea	What it means	Example	Watch for
Nature-positive, nature-based	Leave nature better, not just less harmed	Singapore's "City in Nature" vision	Targets without upkeep
Biodiversity net gain	New development must leave habitat measurably better	England requires at least 10% for most new developments since 2024	Offsets can be gamed; metrics are proxies
Urban rewilding, meadows	Less mowing, native planting, ponds, deadwood	Many cities now mow verges less often	Needs public explanation; can look untidy
Heat-resilient planting	Shade targets and species picked for the future climate	Heat action plans with tree and shade programmes	Water use; choosing species for 2050
Daylighting rivers	Uncover buried streams	Cheonggyecheon, Seoul	Cost and green gentrification
Superblocks and green streets	Take space from cars for trees and people	Barcelona superblocks; school streets	Traffic displacement; fairness
Schoolyards as green space	Cool and green the places children use daily	Paris's Oasis schoolyards programme	Upkeep funding
Green roof mandates	Laws that require roofs or facades to be green	Toronto (2009)	Irrigation and maintenance
Vertical forests	Trees on tall buildings	Bosco Verticale, Milan	Structure's carbon cost; care burden
Citizen science	Residents report trees, birds and plants	iNaturalist, eBird	Bias toward easy-to-reach places
Health-focused greening	Parks and gardens as part of care	"Green prescriptions"	Evidence is mixed

Where digital and AI meet landscape

- **Living digital twins of nature:** every tree becomes an object with species, age, health and water need, inside a 3D model of the city.
- **Sensors:** soil moisture, air temperature and tree sensors feed the twin, and irrigation can follow the data.
- **Simulation and surrogates:** microclimate and flood models, speeded up by machine learning, let planners test "what if we plant here?".
- **AI mapping:** canopy, species and change detection from aerial, street and satellite imagery at city scale.
- **Assistants and agents:** language models that answer questions about the data or propose planting and irrigation options, with a human checking the result.
- **Open and citizen data:** OpenStreetMap, tree inventories and community reports fill gaps public data cannot.

WATCH OUT

Hype check. Three questions cut through most green slogans: what exactly is measured, over what time, and who maintains it afterwards? "Greenwashing" is easiest where those answers are vague.

SAY IT LIKE THIS

“That sounds like a nature-based solution on paper. What does the monitoring say five years on?”

TRY IT (10 MINUTES)

Choose one trend from the table. Find a real project that used it and read what happened ten years later. Did it deliver what was promised? Who paid for the upkeep?

TOOLS FOR THIS CHAPTER

Cesium, Unreal Engine, Unity: 3D and digital-twin visualisation

CityGML or CityJSON with 3DCityDB: city models with trees

Google Earth Engine and OpenStreetMap: open data feeds for twins

14

The Classics in Ten Minutes Each

No time to read the books? Here is what is in them.

Short retellings in plain words, written from general knowledge. Read the originals when you have time.

Design with Nature

Ian McHarg · 1969

Let the land's natural systems decide where to build and where not to.

The big idea

McHarg argued that planning should start by reading the land: soils, slopes, water, vegetation and wildlife. Layering these maps shows which places are suited to building and which should be protected.

Ideas to borrow

- **Layer-cake analysis:** overlay maps to find suitability. This is a direct ancestor of GIS overlay.
- **Fit between form and place:** design follows the site's processes (water, wind, soil).
- **Ecological planning:** avoid building on floodplains and steep slopes.

Criticism and limits

Critics say it can be deterministic and overlooks social, economic and cultural values. Modern work adds people and cost back into the layers.

SAY IT LIKE THIS

“That is basically McHarg's overlay logic, now done in GIS and machine learning.”

The Granite Garden

Anne Whiston Spirn · 1984

The city is part of nature, and ignoring its air, water, soil and life causes harm.

The big idea

Spirn treats the city as an ecosystem. Chapters on air, water, earth, vegetation and wildlife show how design that fights natural processes (paving streams, ignoring wind, covering soil) creates floods, heat and pollution.

Ideas to borrow

- **City as ecosystem:** natural processes continue inside cities.
- **Design with processes:** work with water, wind and sun.
- **Urban nature is for everyone:** an early voice for environmental equity in cities.

SAY IT LIKE THIS

“Spirn’s point is that the city is not outside nature, so the question is how well it is designed with it.”

City Form and Natural Process

Michael Hough · 1984

Make everyday urban landscapes work with natural processes, not against them.

The big idea

Hough looks at ordinary city landscapes (streets, yards, industrial sites, waterways) and argues for designs that reduce energy and maintenance by using natural processes: native plants, natural drainage, and landscapes that change over time.

Ideas to borrow

- **Everyday landscapes matter,** not just famous parks.
- **Low-maintenance, process-based design** saves resources.

The Landscape Urbanism Reader

Charles Waldheim (ed.) · 2006

Landscape, not buildings, can organise the contemporary city.

The big idea

A collection of essays that gave a name to landscape urbanism. It argues that for sprawling, post-industrial cities, landscape is a better framework than architecture for shaping infrastructure, ecology and public life.

Ideas to borrow

- **Landscape as infrastructure** and as an organising system.
- **Process over finished image:** design for change, growth and flooding.
- **Large, post-industrial sites** as opportunities.

Criticism and limits

Critics note that it can be abstract, hard to define, and sometimes weaker on social needs and maintenance than on big ideas.

Ecological Urbanism

Mohsen Mostafavi and Gareth Doherty (eds.) · 2010

Urban design should take ecology, culture and politics together.

The big idea

A large edited volume from Harvard that treats ecological thinking as a way of seeing cities as combined social, cultural and environmental systems, with many short essays and design projects.

YOU CAN SKIP THIS

It is more of a browsing book than a single argument. Dip in by topic.

15

Field Map and Live Debates

Who works on what, where they publish, and what they argue about.

Schools of thought

Approach	Core idea
Landscape architecture	Design of outdoor space
Landscape urbanism	Landscape as the organising system of the city
Landscape ecology	Patterns of land and ecological processes
Green infrastructure planning	Networks of natural and designed green and blue assets
Nature-based solutions	Using ecosystems to address societal problems
Biophilic design	Designing for human connection with nature (after E. O. Wilson's biophilia idea)
Urban ecology	Ecology of cities, their species and processes

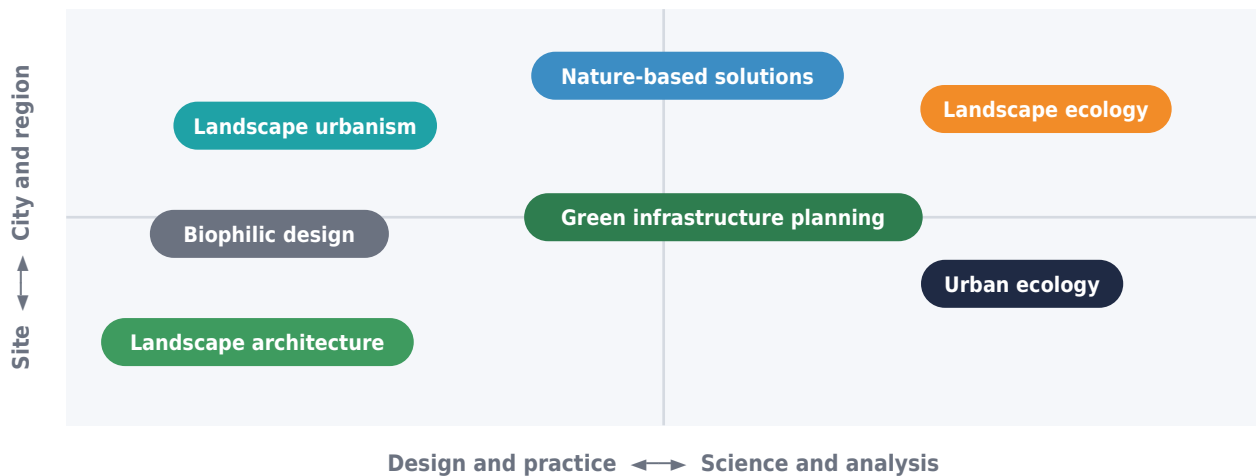


Figure 22. A rough map of the field. Positions are a guide, not a rule: most work sits between the labels.

Where papers appear

- *Landscape and Urban Planning*
- *Urban Forestry & Urban Greening*
- *Landscape Ecology*
- *Building and Environment* and *Sustainable Cities and Society* (heat, energy, design)
- *Remote Sensing of Environment* (data and mapping)
- Conferences of landscape architecture and urban planning bodies, and geospatial AI venues

Live debates

- **Green vs compact:** do we protect parks or build dense? Density saves land and transport energy but squeezes green space.
- **Cooling effectiveness:** how much do trees and parks really cool, at what scale, and at what water cost?
- **Green gentrification:** how to green without displacing people.
- **Native vs adapted species:** what to plant under a changing climate.
- **Measuring benefits:** can ecosystem-service accounting capture what nature is worth?
- **Water use:** how to keep urban vegetation alive in droughts.
- **AI-based greenness metrics:** do they match what people experience?

SAY IT LIKE THIS

"I see the point for cooling at neighbourhood scale. What about water use and equity at city scale?"

Quick Quiz

Eight questions. Answers are below the line.

1. Which term means breaking habitat into small isolated pieces?

a) Matrix b) Fragmentation c) Albedo

2. On an NDVI map, what does a value near 0.7 usually mean?

a) Bare pavement b) Water c) Dense vegetation

3. Under the rational method, which change lowers peak runoff?

a) Raising C b) Lowering C c) Raising A

4. Which is blue infrastructure?

a) Street trees b) A constructed wetland c) A bus lane

5. The 3-30-300 rule includes which target?

a) 30% canopy b) 30 parks c) 300 trees per street

6. A planner measures access with a 300 m rule instead of a 10-minute walk. The 300 m rule is...

a) Less strict b) The same c) Stricter

7. Which dataset gives about 10 m satellite imagery of the whole planet every few days?

a) Landsat b) Sentinel-2 c) LiDAR

8. “Green gentrification” means...

a) Trees raising prices and pushing residents out b) Painting roofs green c) Growing food

Answers: 1-b, 2-c, 3-b, 4-b, 5-a, 6-c, 7-b, 8-a.

16

A Four-Week Study Plan

About 30 minutes a day, five days a week.

Week	Read	Do
1. Foundations	Chapters 1-3	Map the green, blue and grey of one street.
2. Benefits and heat	Chapters 4-6	Redo the runoff example with your own numbers.
3. Ecology, parks, streets	Chapters 7-9	Audit the trees of one block; check park access by two rules.
4. Data, AI, trends and the field	Chapters 10-15	Compute NDVI for one place; pick one trend and find a real project.

One chapter a day is plenty. Keep the glossary open and update your own word list.

Glossary

Term	Meaning
Albedo	Share of sunlight a surface reflects.
Bioswale	Planted channel that slows and filters runoff.
Canopy cover	Share of ground covered by tree crowns.
Corridor	Strip of habitat linking patches.
Ecosystem services	Benefits people get from nature.
Evapotranspiration	Water moved from soil and plants to air; it cools.
Fragmentation	Habitat broken into isolated pieces.
Green infrastructure	Planned network of plants, soil and green features that provide services.
Green view index	Share of green pixels in street-level images.
Imperviousness	Share of ground covered by hard surfaces.
Landscape urbanism	School of thought that organises cities through landscape.
Matrix	The background land cover surrounding habitat patches.
Nature-based solutions	Using ecosystems to tackle problems like heat and floods.
NDVI	Satellite index of vegetation greenness.
Patch	Area of habitat distinct from its surroundings.
Permeable paving	Paving that lets water soak through.
Rain garden	Planted hollow that soaks up runoff.
Sky view factor	Fraction of sky visible from a point.
Sponge city	Chinese programme for cities that absorb and reuse rain.
SuDS / LID / WSUD	Regional names for sustainable stormwater design.
Surface runoff	Rain that flows over the ground rather than soaking in.
Urban heat island	City warmer than its surroundings, most at night.
UTCI	Universal Thermal Climate Index: felt heat for people.

REMEMBER

Language is the first hurdle in any field. When you can use these terms without thinking, you can read papers and join meetings.

About this book

Credit	Details
Prompted and directed by	Mahmoud A. (Ouf), who set the topic, the audience and the style.
Written, illustrated and typeset by	Claude, an AI assistant made by Anthropic (model identifier: claude-sonnet-5-5).
Edition	First edition, October 2026.
Please note	An AI-prepared primer based on general knowledge and well-known studies. It is not peer-reviewed. Check any figure before quoting it, and consult the original sources. Corrections are welcome.
Use	Free to download, read and print for learning.