Chapter 22

URBAN ENVIRONMENTS

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Case Study: Rivers, Seacoasts, and Cities

Since humans began to cluster together and build towns rivers have been important features as sources of water, transportation venues and, unfortunately, waste disposal.

We often speak of "geologic time" to refer to processes so slow that we cannot observe them, but rivers are geologic features that can change drastically in a lifetime through their normal erosion/deposition process as well as through human intervention. Cities grow to depend on rivers, but the rivers can abandon or threaten them as well.

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22.1 CITY LIFE

Cities were considered environmentally unfashionable 40 years ago. Now, about 80% of the U.S. population lives in an urban area, and there is growing interest in revitalizing U.S. cities. Globally, about 45% of the total population is urbanized and the percentage is expected to grow to 62% by 2025. Economic development leads to urbanization. About 75% of people in developed nations are urbanized compared to only 38% in developing nations. By 2015 there will be 36 **megacities** with populations exceeding 8 million; most of them will be in Asia. Because of the large numbers of people that dwell there, urban environments have become important areas of research. These areas present ecological challenges, but they also present opportunities to conserve energy and make food, water and waste processing more efficient.

Curitiba, Brazil grew from 300,000 in 1950 to 1.5 million. By 1970 the city was in trouble, but a visionary mayor turned the city around with improvements in mass transportation, provision of decent low cost housing, and green spaces. The success story of Curitiba demonstrates the importance of urban planning.

22.2 THE CITY AS A SYSTEM

Cities need to be understood as ecological systems. Cities are very complex systems of social networks and resource supply networks (food, water, energy, products). A city is not a self-sustaining system as it requires inputs from the surrounding countryside. Cities also must supply products. Thus, one could view a system as a living organism that requires energy and resources and produces outputs, including waste. Annually, the average city resident in an industrial country uses about 208,000 kg of water, 660 kg of food, and 3,146 kg of fossil fuel and produces 1,660,000 kg of sewage, 660 kg of solid waste and 200 kg of air pollutants. Cities that decline in quality are associated with declines in the surrounding area as well.

Local rural areas are often in conflict with the water, land and waste demands of nearby cities. Urban expansion sometimes threatens agricultural land and irrigation water supplies.

Two futures exist, one in which cities are managed so as to minimize negative environmental impacts and maximize social benefits, and one in which cities are allowed to become polluted and decay, sending the population on an ever expanding migration away from the core. (Cities with high emigration rates, such as Detroit and Chicago, might be interesting topics of discussion here.)

22.3 THE LOCATION OF CITIES: SITE AND SITUATION

The spatial distribution of cities is not random. They develop where they do because of special circumstances such as the availability of local resources, transportation, or for political reasons.

• The Importance of Site and Situation

Site and situation have strong impacts on the development and importance of cities. A city's **situation** is its placement with respect to other areas, resources, etc. A city's **site** is its local environment, which may not always be favorable (e.g. Venice, Italy in the chapter's opening).   **Transportation** potential has been a major driver in the development of many of the world's great cities. Cities with both good site and situation are extremely desirable.

A **fall line** occurs on a river where there is an abrupt drop in elevation, creating waterfalls or rapids. Most early cities in the U.S. developed along the fall line of major rivers for purposes of energy and access to transportation (situation). In the mid- and south-Atlantic region of the United States the fall line separates the Piedmont from a broad coastal plain. It is along the fall line that waterpower is available and where most important colonial cities developed.

City sites were/are also influenced by the location of river crossings, potential water power, trade routes, fertile land, harbors, and advantageous military positions.

• Site Modification

A city's site can be improved by technology, but it can also degrade over time, such as the silt in the harbors of Bruges, Belgium and Ravenna, Italy. Mexico City is sinking due to groundwater extraction. Expensive modifications may be needed to restore such areas.

22.4 AN ENVIRONMENTAL HISTORY OF CITIES

• The Rise of Towns

Cities developed in parallel with agriculture thousands of years ago. Agriculture provided enough food to feed a city, and also gave residents a reason to stay and defend the area. Prior to agriculture people were generally nomadic.

• The Urban Center

The population size of an urban area is limited by transportation, density, waste disposal, architecture, and water and food supplies. As improvements in agriculture and transportation were made, the population density of urban areas expanded.

• The Industrial Metropolis

Improvements in technological strategies for medicine, sanitation, and transportation allowed further expansion of cities. People could travel farther from home to work and markets, eventually leading to growth of suburbs and "urban sprawl", with shopping areas being built near highways rather than in town centers. This trend may be reversing as some cities become more attractive areas to live.

● **The Center of Civilization**

Improvements in telecommunications may further improve cities as travel to work becomes less necessary for certain occupations. The future outlook for cities will depend on efficient use of resources and the ability to remain a vibrant, clean place to live and work.

22.5 CITY PLANNING AND THE ENVIRONMENT

Cities depend on outside sources of food and water and are part of a functional ecosystem, even if they create the illusion of self-sufficiency. Natural areas within a city are necessary for maintaining health, beauty, and natural function. Internal transportation as well as ingress and egress also have a powerful influence on design.

● **City Planning for Defense and Beauty**

Many (not all) cities grew with a conscious plan, and many of those that did had two dominant themes: defense and beauty (fortress and park cities).

A Closer Look 22.2: A Brief History of City Planning

Cities such as Rome and Granada are known for their beauty. Cities such as Carcasone in France were developed as walled fortresses with streets designed for easy troop movement. Gunpowder and cannon reduced the usefulness of walls, and gardens and parks became more important.

● **The City Park**

Parks have become important elements in cities. Frederick Law Olmsted designed Central Park in NYC as a place for psychological and physiological relief from city life, and vegetation was one of the keys. Instead of preservation, Olmsted added ponds and created a landscape pattern. Central Park is an example of 'design with nature.' Olmsted also designed much of Boston's landscape, adding holding ponds for tidal flooding, restoring a salt marsh, rerouting sewage, and added tidal gates to the Charles River. The control of water became an aesthetic design element. An extension of Olmsted's design with nature concept was Howard's 1902 **garden city** concept in which the city was surrounded by a **greenbelt** and where planning of countryside and city were integrated. Both concepts influence city planning today.

22.6 THE CITY AS AN ENVIRONMENT

● **The Energy Budget of a City**

A city has a great impact on its immediate environment. For example, a city alters the energy budget of its landscape by modifying the absorption and reflection of solar energy, the evaporation of water, the conduction of air, wind patterns, convection of surface and subsurface water, and combustion of fuel.

● **The Urban Atmosphere and Climate**

Consequently, the local climate is modified. Cities are warmer than surrounding areas (**heat island effect**), although lower elevations receive less sunlight due to shading by buildings. Heat islands are created due to less

overall albedo and the burning of fossil fuels. They are also less windy, but can channel strong winds between buildings.

• Solar Energy in Cities

Use of passive solar energy for heating was once common, but was replaced by cheap fossil fuel. It is now coming back in some places, with the addition of more active solar technologies.

• Water in the Urban Environment

Cities have a large impact on the water cycle by increasing the amount of impervious surface, and therefore runoff. Storm sewers collect runoff. This decreases infiltration and transpiration, which decreases evaporative cooling and reduces humidity. Many cities now are discouraging the spread of new impervious surfaces. This is done sometimes by setting a tax rate proportional to the amount of impervious surface area. Cities also are using artificial wetlands to hold runoff, which serves three purposes: water treatment, decreased runoff, and aesthetics. Cities also can have higher rainfall amounts, fog and cloud cover because dust particles in the air serve as condensation nuclei.

Using a common sewer system for waste and water runoff can cause the sewage treatment system to become overwhelmed during period of high rainfall.

Many cities are built on flood plains, which often require the construction of levees to protect against river flooding. The levees affect the hydrology of the entire river, and worsen the flooding along other unprotected sections of the river. An alternative is to use the floodplain for parks or for multiple uses that can tolerate periodic flooding.

Venice is a UN World Heritage site renowned for its architectural beauty, and it is slowly slipping beneath Venice lagoon. Founded more than 1000 years ago, the city is sinking because of sea level rise and pumping of ground water. Today many studies are being done about how to save Venice. Its future is uncertain.

• Soils in the City

Soils covered by impervious surface lose organic matter, become compacted and waterlogged, and are low in organic matter. Urban soils are also highly modified by toxic substances like heavy metals and oil runoff. Many urban soils are 'made land' or soils made from fill. Fill soil is unconsolidated and vulnerable to shaking from earthquakes and to subsidence.

• Pollution in the City

Everything in a city is concentrated, including pollutants. Urbanites are exposed to more kinds of toxic chemicals in higher concentrations and more noise than their rural counterparts, and the average lifespan of urbanites is shorter. Pollution sources include motor vehicles, stationary power sources, home heating, and industry. It is impossible to eliminate exposure to pollutants, but exposure can be minimized through proper urban planning.

> **A Closer Look 22.3: Design with Nature**
> Some parts of cities are unsuitable for building due to the nature of the fill used or because of periodic flooding. It can be cost prohibitive to make these lands usable for structures, but their use as parks and wildlife corridors between buildings can enhance a city's natural beauty and ecological sustainability while saving a money on drainage systems.

22.7 CITIES AND THEIR RIVERS

Making animals and plants a part of a city landscape is highly desirable but can be difficult due to space and finances. The profession of urban forestry and landscape architecture address these situations.

Riparian cities can integrate waterfront into the lives of all the citizens, since water is a natural magnet for people and has helped with the renewal of a number of cities from Austin to Providence. Unfortunately, river fronts have traditionally been dominated by transportation and industry, polluted, and were cut off to people's enjoyment by railroads and buildings.

• Vegetation in Cities

The use of trees and ground vegetation provides not only aesthetics and noise control but benefits the microclimate. However, the vegetation in cities must be carefully selected to tolerate the different kinds of stresses that an urban environment imposes, including pollution, dust, and drought/waterlogging stresses. Because cities have many disturbed areas, secondary succession plants thrive, although cities can also be a haven for endangered plants.

• Urban "Wilds": The City as Habitat for Wildlife and Endangered Species

With the exception of some birds and small mammals (e.g. squirrels), most forms of wildlife in cities are considered pests. There are species that cannot persist in urban environments and disappear, species that tolerate urban environments but do better elsewhere, species that have adapted to urban environments and may be beneficial or harmful, and species that thrive in urban environments. Species that do too well become pests, especially if they invade dwellings. Many animals adapt to urban environments and manage to find suitable habitat and alternative foods (e.g. road kill). There are species that are very beneficial, such as peregrine falcons that now nest on skyscrapers and prey on pest species. Cities can be better managed to encourage the beneficial wildlife species. One example in Florida is placement of posts for the nesting of ospreys.

Knowledge of urban ecology is paying off in the design of new cities. Woodlands, TX was designed so that the homes and roads were on ridges, and the lowlands were left as natural open space for the temporary storage of floodwater. The lowlands also provide habitat for flora and fauna, and is aesthetically pleasing.

• Animal Pests

Animals considered pests can include insects, birds, and mammals. Some can spread disease. The Bubonic plague, spread by fleas found on rodents is an example. The best was to control them is using knowledge of their urban ecology to identify and exploit their vulnerabilities.