CHAPTER 05

# LAND CLASSIFICATION

*The taxonomic method of describing the spatial distribution of the various forms of vegetation and occupation of the land.*

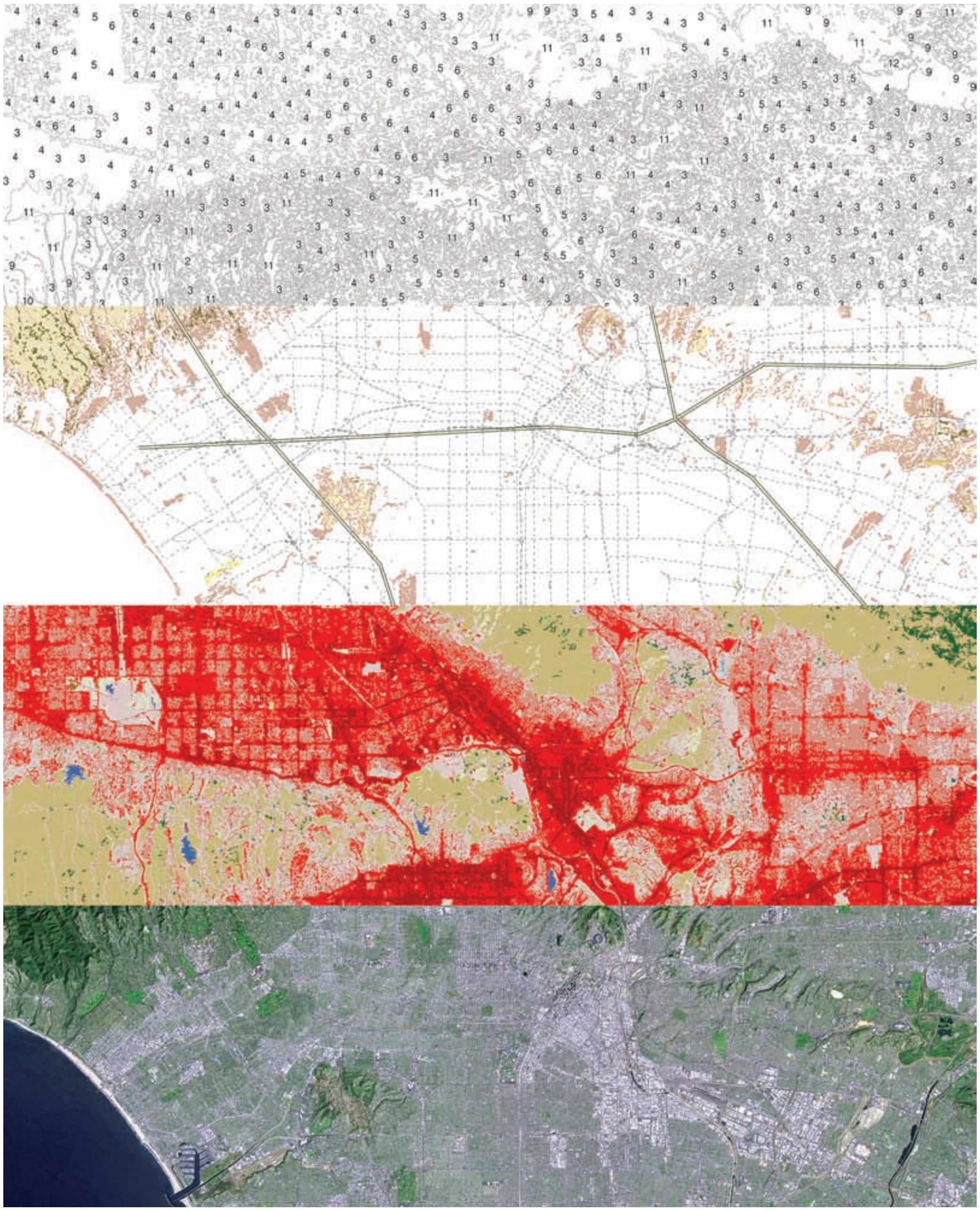
The terrestrial ground has multiple physical components: its topographic morphology, its surface material, and its occupation or use. To depict the ground is to describe all of these. Land classification departs from the representation of terrain to describe occupation of the land: cultural and agronomic land uses, vegetation and the material characteristics of the earth's surface. Land-use maps call out the actual and possible uses of land; they are explanatory and projective. Land classification is based on indices, involving the placing of a symbol, letter, color, or pattern to represent typologies of soil, vegetation, or activity. Categorization and tolerance—how to choose and where to draw the line between categories—create the visual differentiation of the ground plane, whether data is gathered on foot by the surveyor or remotely with Landsat satellites, a family of satellites that are used to collect data necessary to create images of the earth's surface. The classification is inherently reductive, requiring delineation within a naturally continuous landscape. The idea is to balance clarity and description, to find a hierarchy that translates land use into clear taxonomies. Once the categories are determined, choices must be made as to how the map will be drawn: flat or highly textured, bright or muted, true color or infrared. [FIG. 5.1]

Maps that categorize and delineate types of land cover and use require simplification and generalization. These maps are deceptively static, masking the dynamic process of occupation: land owners change, land uses change, vegetation appears and disappears continuously. They are out of date before they can be drawn—a limitation addressed previously through the physical updating of maps and currently with the issuing of revised data sets. Land classification is most prevalent at the large scale, showing regional, national, or even global extent rather than the detailed, evasive, and nuanced characteristics of the local ground. Data is generated remotely, simplified into categories and output to areas on a map. Ground truthing follows as a way to verify airborne remote sensing—data collected by aerial photography, satellite radar, or infrared images checked against field data collected by teams of scientists. In situ land use or cover of the location is compared with the remote imagery. Data and maps are then adjusted accordingly.

Until the first half of the twentieth century, natural-resource inventories were done entirely from the ground. Robert N. Colwell, a forestry professor at the University of California, Berkeley, and early adopter of aerial photogrammetry, which he employed to assess Imperial Valley cereal crops, told *Scientific American* readers in January 1968, "Geologists traveled widely in exploring for minerals; foresters and agronomists examined trees and crops at close hand in order to assess their condition; surveyors walked the countryside in the course of preparing the necessary maps. The advent of aerial photography represented a big step forward." Colwell worked with NASA to recommend specific wavelength bands for mapping resources from space, contributing to one of the first land-classification maps based on remote sensing, later deemed a classic.[1]

Contemporaneously, significant advances were being made in computer mapping at the Harvard University Graduate School of Design Laboratory for Computer Graphics and Spatial Analysis, founded by Howard Fisher in 1965. The "Lab" worked to combine georeferenced ecological, topographical, sociological, and demographic data and visualize it through digital cartographic output. Landscape architect and planner Carl Steinitz collaborated with the group and produced an influential body of maps of the Delmarva Peninsula for an academic studio. The maps reflected the technological limitations of computer output, rendering information through black-and-white dot densities (**SEE CHAPTER 01**). Jack Dangermond, a student at the school at the time, worked in the Lab, and later went on to found Esri, a leader in the creation and dissemination of GIS (Geographic Information System) technology. GIS, a software platform that facilitates the aggregation of spatial data and allows for its translation into maps, underlies much of contemporary cartography. With the advent of GIS, maps can be understood as databases that allow for the layering of data—following the traditions of landscape architects Charles Eliot and Ian McHarg and others—to facilitate comprehensive, systematic formulations of particular landscapes. The layers are superimposed and can be toggled on and off, isolating and aggregating information at the same time on the same map.

With the increase in data and the development of computer mapping, the National Land Cover Database (NCLD) emerged as a system to codify land-use data at a national scale in the United States. James R. Anderson made a plea for standardization in 1976, desiring consensus on accepted terminology, easier information transfer, and consistent categorization. He proposed nine primary land-use categories, broken down into thirty-seven secondary units.[2] Further differentiation



## 5.1

**34.0500° N, 118.2500° W,**
**Jill Desimini, *Land-Classification Techniques: Los Angeles*, 2014. After Milne [FIG. 5.3], Pietrusko and Grga Basic [FIG. 5.2], and NASA, *Los Angeles and Vicinity Seen from Space*, 2001.**

could be achieved at the local level. This system evolved into the NCLD, a data set of land-use classification, currently with twenty categories grouped into eight themes. The choice of categories drives the resulting maps, yielding a very specific understanding of occupation and distribution.

Inherent in the task of land classification is the drawing of boundaries, both literally and figuratively. The land-classification map belongs to a category of maps measuring human occupation and activities that includes administrative and jurisdictional maps, cadastral maps, and insurance maps, among others. Rather than simply depicting natural phenomena, the land-classification map alludes to colonization, commodification, and cultural control. Early property surveys include information on land use alongside boundaries, location, size, value, and ownership of property. Methods of land classification evolved from black-and-white line drawings and annotations into a practice of showing enclosures and occupation through color by the late 1500s, still used on estate and property maps.

Due to reproduction constraints, older maps relied on lines, words, alphanumeric annotations, and black-and-white patterned hatches to distinguish land use. These maps were linked to early surveys, representing the first measured drawings of a property or city. Hand coloration was also prevalent and served to pull land use out from background survey information. With the advent of color printing, color becomes the dominant system—either for textural overlays or flat fills. Contemporary designers have experimented with ways to describe land classification, or design's equivalent, the material and programmatic characteristics of a project. While color fills are still the norm, investigations with textural imagery, numerical coding and hatching, and combinations of GIS data, line work, color, and raster imagery point to the potential for dynamic rendering.

Early land-classification maps resulted from an additive process, beginning with a blank topographic slate and filling in occupation and land cover as surveyors gathered information to populate the maps. Now the information is extracted from a fully detailed image, a satellite capture, where land classification is deduced through the reduction of a continuous field into distinct categories. This is a process shared by cartography and design. The representational tools are indexical: simple means of assigning a mark or color to a typology. It is the juxtaposition of these indexical systems with the taxonomic classifications themselves—the categories that are mapped—that give rich contextual and subjective readings of the landscape. As a means of describing land use, the maps reflect the social conceits of their makers. This chapter covers both the technical, categorical, and cultural range evident in visualizing land occupation.

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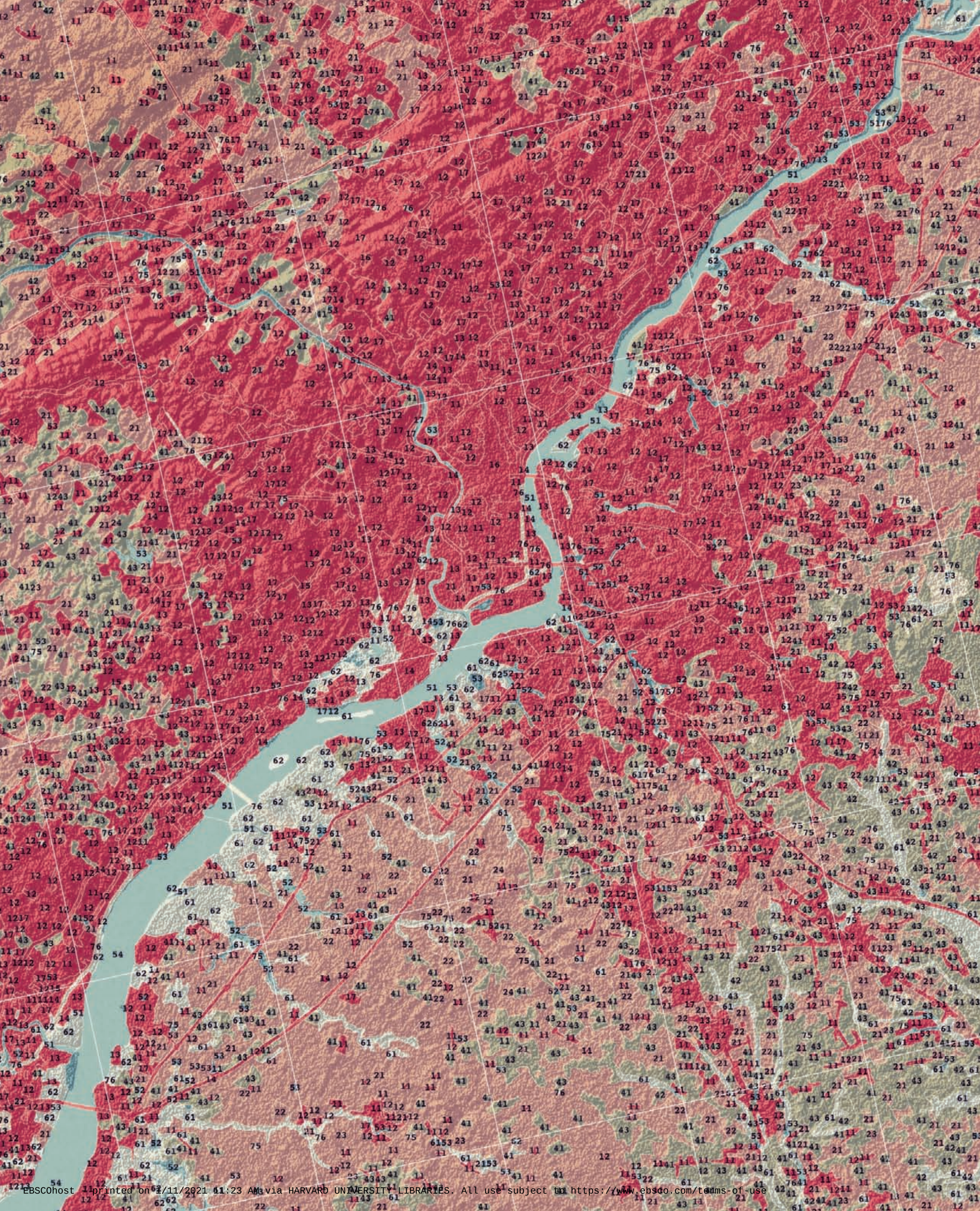
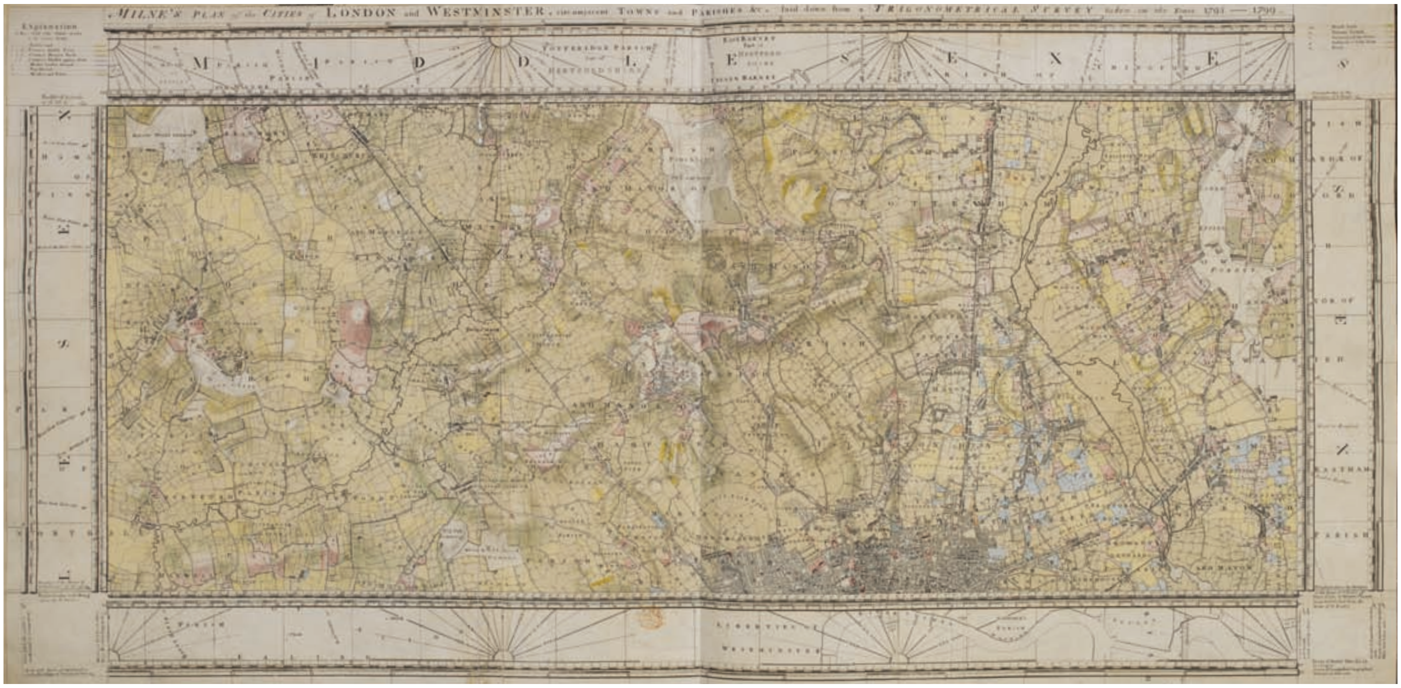
[1]John Noble Wilford, *The Mapmakers* (New York: Vintage Books, 2001), 394.
[2]James R. Anderson, Ernest E. Hardy, John T. Roach, and Richard E. Witmer, "A Land Use and Land Cover Classification System for Use with Remote Sensor Data," *Geological Survey Professional Paper 964* (Washington, DC: Government Printing Office, 1976), 1–28.




LAND COVER 1973 PHILADELPHIA, PENNSYLVANIA
1:250,000
Level 1
Level 2
1. Urban or built-up land
11 Residential
12 Commercial and services
13 Industrial
14 Transportation,communication and utilities
15 Industrial and commercial complexes
16 Mixed urban or built-up land
17 Other urban or built-up land
2. Agricultural land
21 Cropland and pasture
22 Orchards,groves,vineyards,nurseries,etc.
23 Confined feeding operations
24 Other agricultural land
3. Rangeland
31 Herbaceous rangeland
32 Shrub and brush rangeland
33 Mixed rangeland
4. Forest land
41 Deciduous forest land
42 Evergreen forest land
43 Mixed forest land
5. Water
51 Streams and canals
52 Lakes
53 Reservoirs
54 Bays and estuaries
6. Wetland
61 Forested wetland
62 Non-forested wetland
7. Barren land
71 Dray salt flats
72 Beaches
73 Sandy areas other than beaches
74 Bare exposed rock
75 Strip mines,quarries,and gravel pits
76 Transitional areas
77 Mixed barren land
8. Tundra
81 Shrub and brush tundra
82 Herbaceous tundra
83 Bare ground tundra
84 Wet tundra
85 Mixed tundra
9. Perennial snow or ice
91 Perennial Snowfields
92 Glaciers




## 5.2 *(pp. 118–19)*

**39.9500° N, 75.1667° W,**
**Robert Gerard Pietrusko and Grga Basic, *Anderson Land Classification System*, 2014.**

## 5.3

**51.0000° N, 0.1000° W,**
**Thomas Milne, *Milne's Plan of the Cities of London and Westminster*, 1800.**

A growing interest in human influence on the environment led to new types of map products, including those focused on land use. Considered one of the first true land-utilization maps, the Milne plan distinguishes seventeen types of land use (including arable land, meadows, market gardens, hop fields, pastures, marsh lands, nurseries, orchards, paddocks, parks, and woods) by key letters. The classification system used on the map focuses on agricultural and cultural landscapes and includes faint watercolors, printed textures, and indexical letters.

## 5.4

**40.6905° N, 74.0165° W,**
**Michel Desvigne Paysagiste, *Governor's Island Summer Park*, 2007.**

Michel Desvigne Paysagiste's design for the Summer Park on Governor's Island in New York is a gridded mosaic of fields, forests, and water infrastructures. The design and its representation are deliberately layered and variegated. Taking inspiration from aerial imagery, the plan plays with the patchwork grain of the agricultural field set against the fluvial cuts and treed ribbons. There is an interaction between the land uses confined within the rectilinear structure and those that are connective and extend across and beyond the cellular boundaries.

## 5.5 *(p. 122)*

**35.6825° N, 139.7521° E,**
**Ranzan Takai, *Man'en kaisei O-Edo oezu*, 1860. Scale: approx. 1:10,000 (shown at half size).**

This Edo-period map, a hand-colored woodblock print, illustrates land use, ownership, and building occupation. The tones of pink and gray denote use, while ownership is indicated with text and symbols, including family crests for larger, private homes. The map is designed to be viewed from all sides, with no top or bottom, and therefore no singular orientation for the text. The characters respond to the form of the building, the blocks, and the city while the information reveals the social strata embedded within the urban life. Through the mapping of use and ownership, class distinctions are evident. In 2008, Google made some Edo-period historical maps available as a layer, controversially revealing past social occupations—including areas dominated by the discriminated-against *Burakumin* class—within the contemporary city. While the overlay of past and present makes change evident, the alignment of geographic and social information points to the potential of mapping as a discriminatory practice.

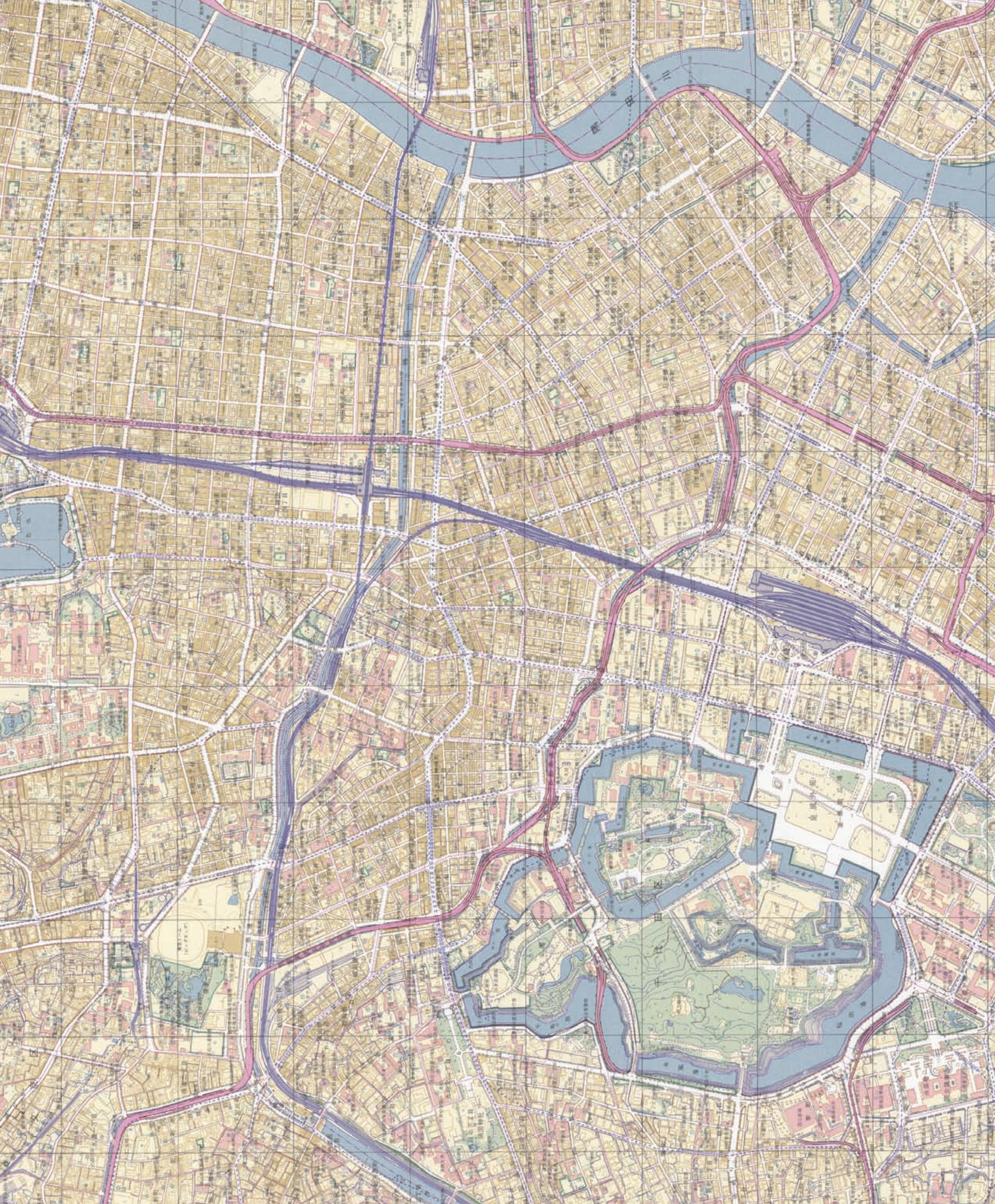
## 5.6 *(p. 123)*

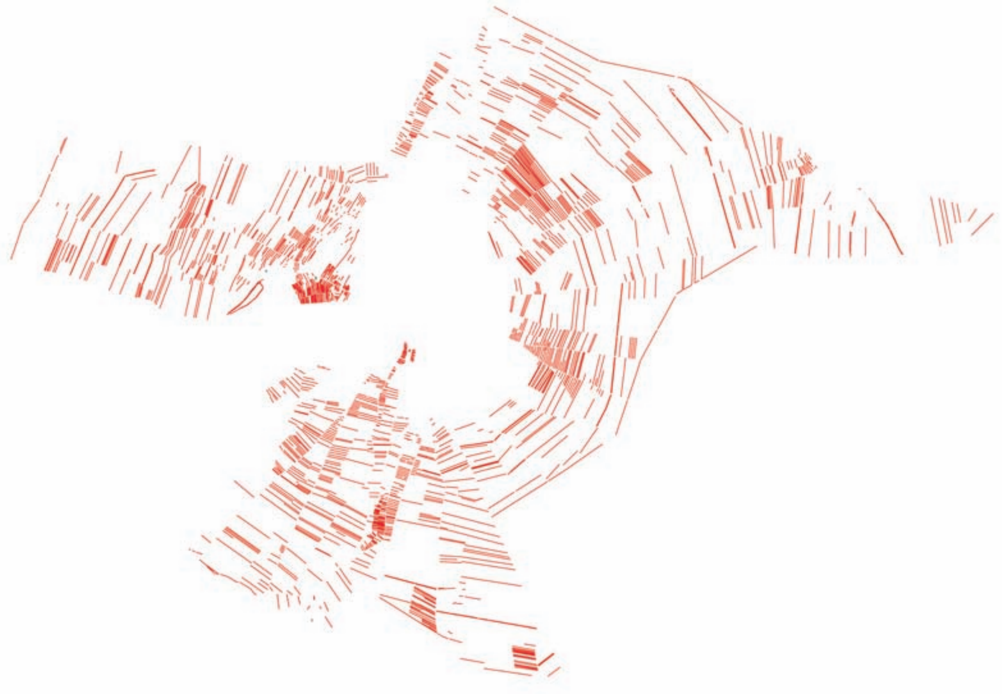
**35.6825° N, 139.7521° E,**
**Geospatial Information Authority of Japan, *Topographic Map (Tokyo)*, 1990. Scale: 1:10,000 (shown at half size).**

Building on the Edo period, when intense governmentally driven cartographic efforts attempted to describe the productive potential of property across the country, Japanese cartographers continue to produce maps with great levels of precision. Contemporary city maps are richly coded, including zoning, ownership, and material information atop the infrastructure and built forms of the city. The level of detail gives a clear grain and texture to the depiction of the city. As the complexity and population of the city has increased, the city map no longer has the capacity to show individual ownership information, but each building and parcel are still drawn and coded for material and use.


PERMANENT INFRASTRUCTURE—WOODLANDS
Mature woodland
Woodland plantations dense
Woodland plantations less dense
Woodland plantations thin
Succession experimentation
PERMANENT INFRASTRUCTURE—WATER
Marine water elements
Irrigation elements
Water retention reservoirs
Water filtration
Gray water filtration


御城
西御丸

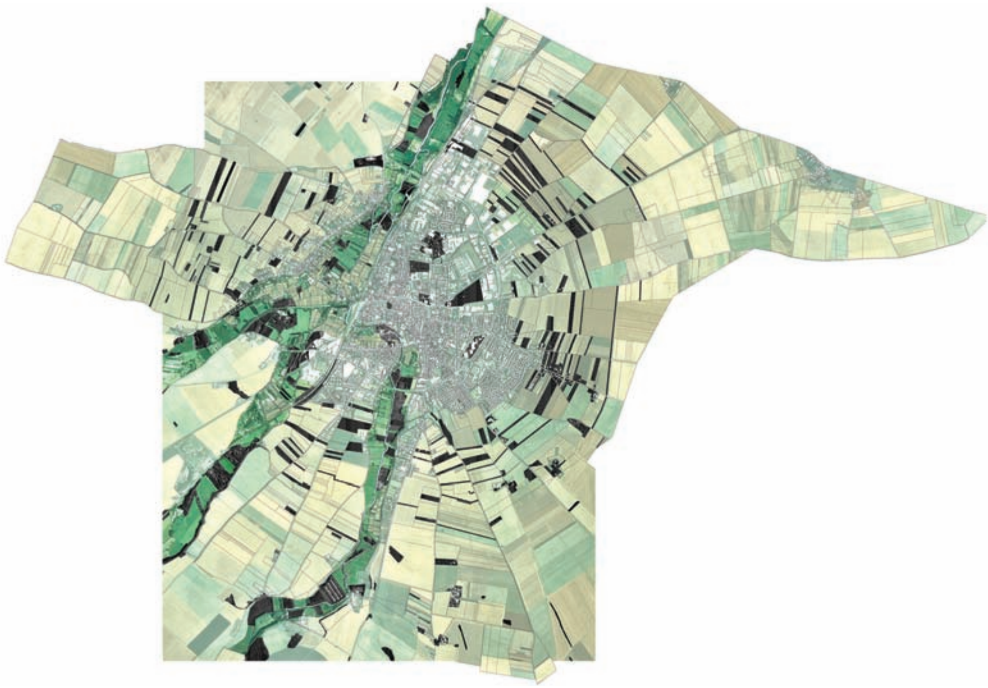




## 5.7

**46.9608° N, 1.9944° E, Michel Desvigne Paysagiste, *Issoudun District*, 2005.**

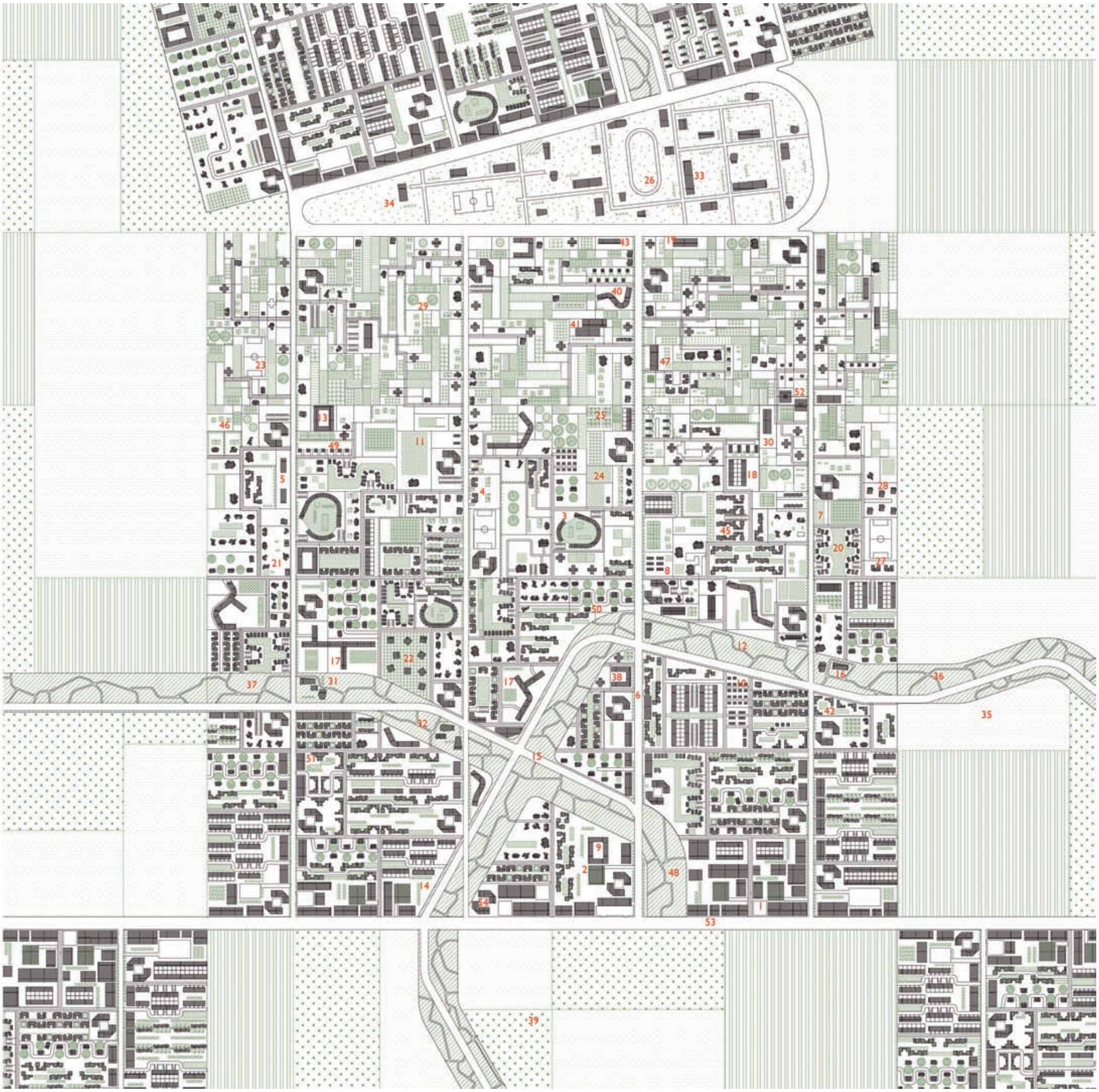
Through survey, visual analysis, isolation, and extraction, a landscape structure emerges for Issoudun, France, a set of “fragmented slabs” that form potential sites of future development. The project reorganizes the spaces on the periphery, creating a logical, deliberate, and readable transition from urban core to farmland. The pair of plans shows the radial pattern of available lands, first alone, in red to highlight these “invisible spaces,” and then as part of a continuous landscape with proposed connective corridors. Through drawing, an intrinsic, hidden structure is extracted from the perforated base condition, allowing a different peri-urban identity to surface.



## 5.8

**Stan Allen, *The New American City*, 2013.**

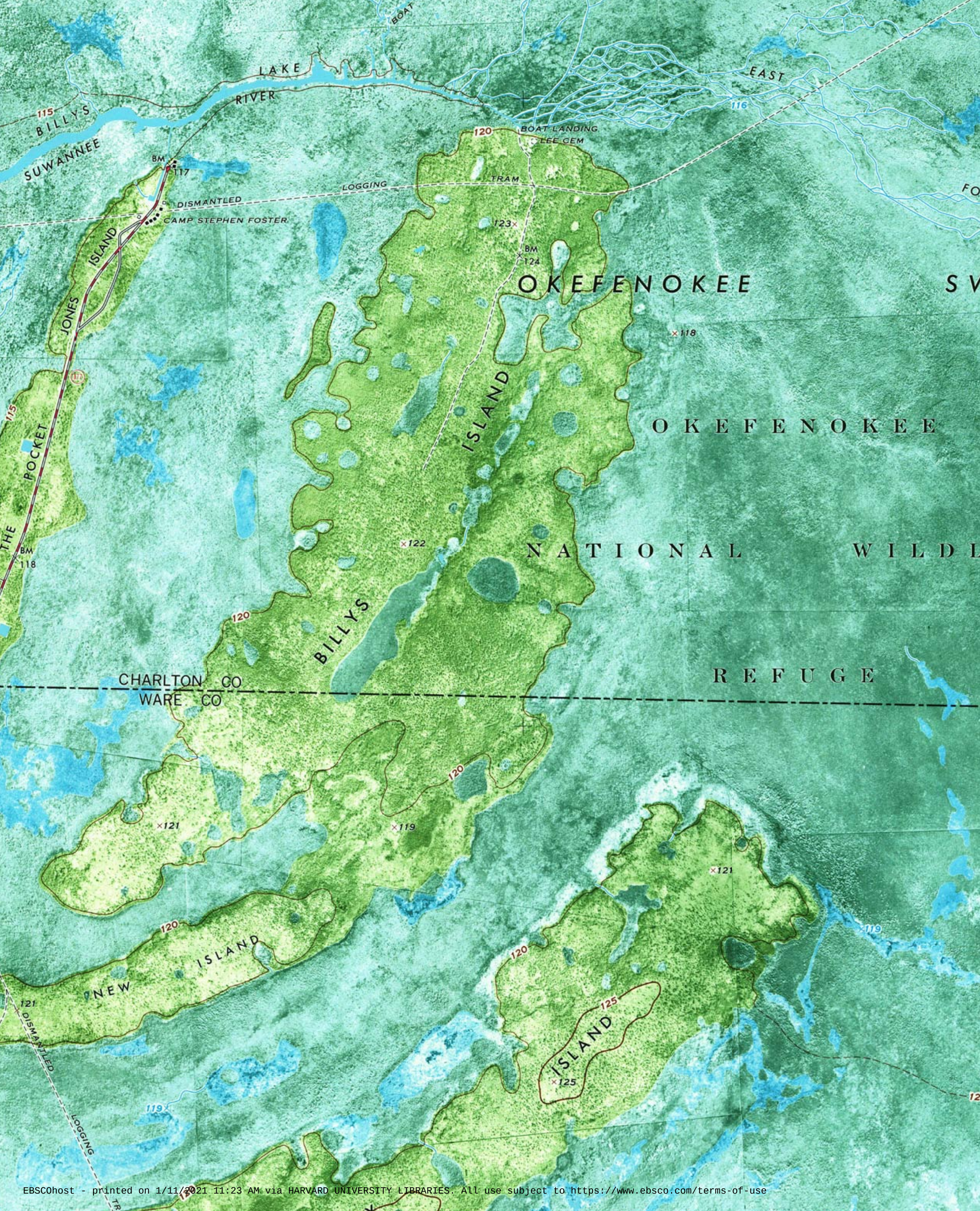
The New American City is a proposal for a dense, compact, urban settlement, which incorporates food production, minimizes ecological footprint, and operates independently within the one-mile grid. Taking Frank Lloyd Wright’s Broadacre City as its precedent and the Jeffersonian grid as its context, the New American City is prototypical, scalable, and adaptable to local geographical and topographical conditions. Terrain is implied through diagonal parkways, campus wedges, interior gardens, fields, and groves. The city has a mosaiclike quality whereby the overall structure is clear but the units have great variability.



**PLAN**

1. outdoor market
2. parking with greenhouse roof
3. cottages
4. little factories—dwellings above
5. factory assembly
6. main arterial, replacing the present railway
7. little farms
8. professionals and clinics
9. schools
10. neighborhood guest houses
11. interior park
12. music garden
13. baths and physical culture
14. farmer's market
15. parkway
16. schools
17. street-in-the air residences
18. courtyard housing
19. block-tower
20. superblock of houses
21. double-houses
22. villini
23. sports fields
24. orchards
25. allotment gardens
26. stables, paddock and track
27. athletic clubs
28. stacked villas
29. small farms
30. light manufacturing
31. cultural institutions
32. civic center/county seat
33. university campus
34. scientific and agricultural research
35. arboretum
36. botanical gardens
37. zoo
38. hotel
39. country club
40. sanitarium
41. artisan incubator
42. little clinics
43. hotel
44. little clinics
45. little apartments
46. creamery
47. school of small children
48. outdoor cinema
49. forest cabins
50. double houses
51. educational center
52. hospital
53. commercial strip
54. open-block towers, mixed-use

12,500 inhabitants per square mile
75% open space


BOAT
LAKE
RIVER
BILLYS
SUWANNEE
115
EAST
116
BOAT LANDING
LEE CEM
120
BM
117
LOGGING
TRAM
DISMANTLED
CAMP STEPHEN FOSTER
123
BM
124
OKEFENOKEE
ISLAND
JONES
118
OKEFENOKEE
POCKET
THE
BM
118
ISLAND
122
NATIONAL
WILDL
BILLYS
120
CHARLTON CO
WARE CO
REFUGE
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NEW
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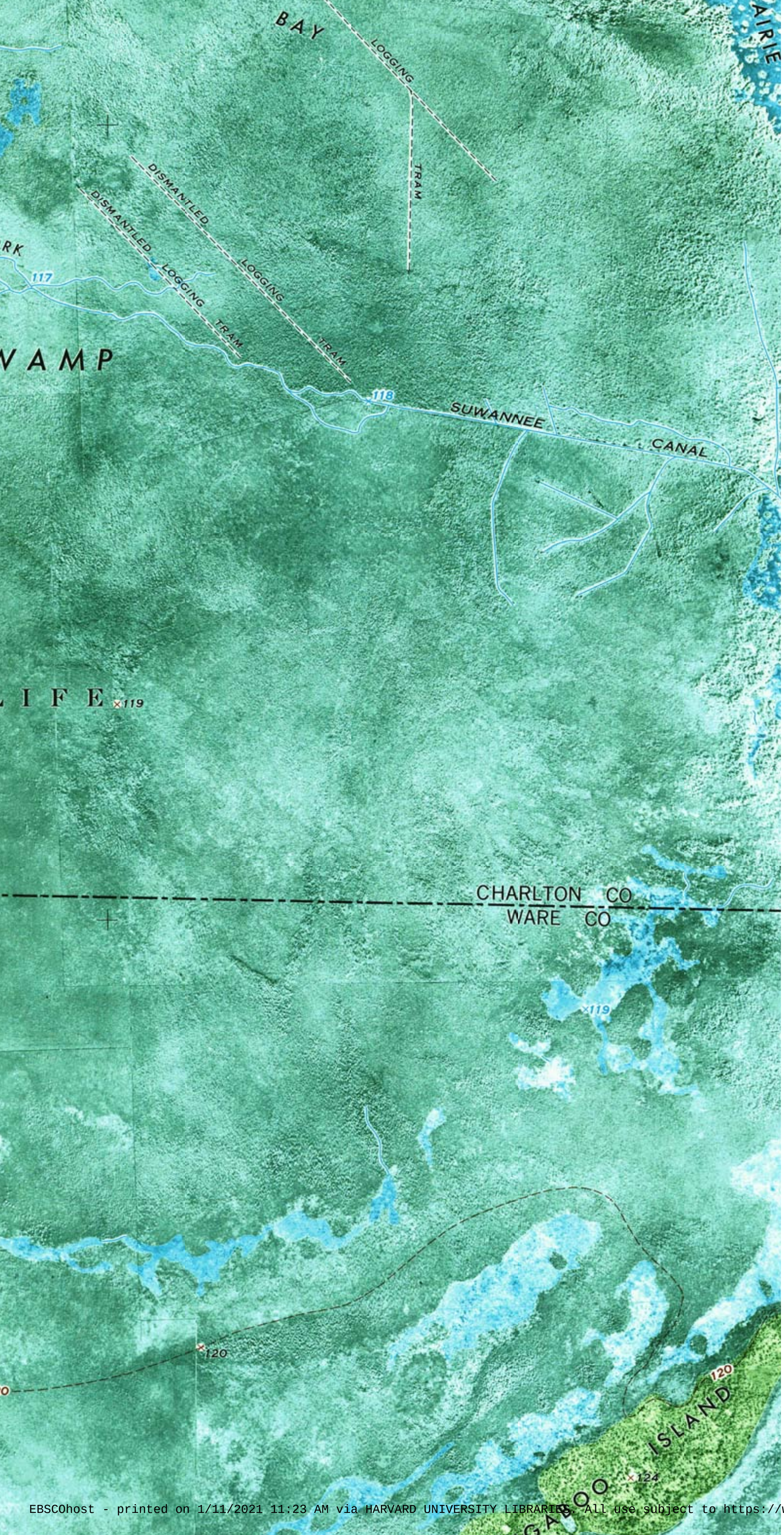
DISMANTLED
125
119
LOGGING




**5.9**

**30.6188° N, 82.3210° W, United States Geological Service (USGS), *Billys Island Quadrangle*, 1966.**

Early orthophotos, used in USGS quadrangles, allowed for the description of flat topography. These landscapes eluded description by the scale and interval of the topographic line but came to life through the photographic image. The first published images were of the Okefenokee Swamp in the 1960s, pictured here. As Rupert B. Southard, chief of the Topographic Division of the USGS, explained, the new maps were revelatory "because there are few contours, there is a low density of cultural features and the standard maps show almost nothing but the marsh symbol pattern."[1]

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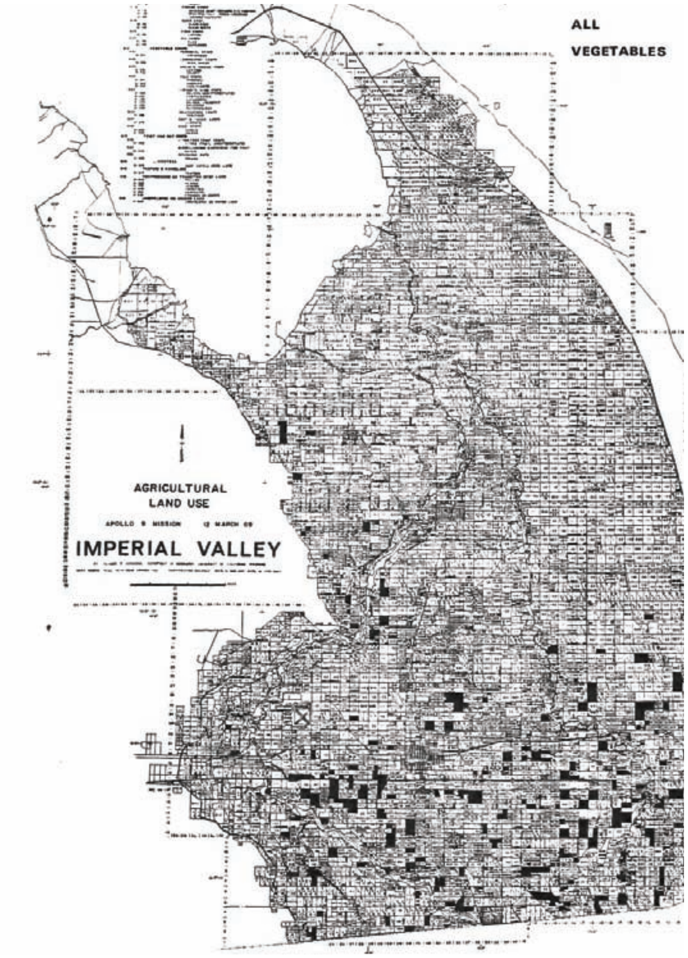
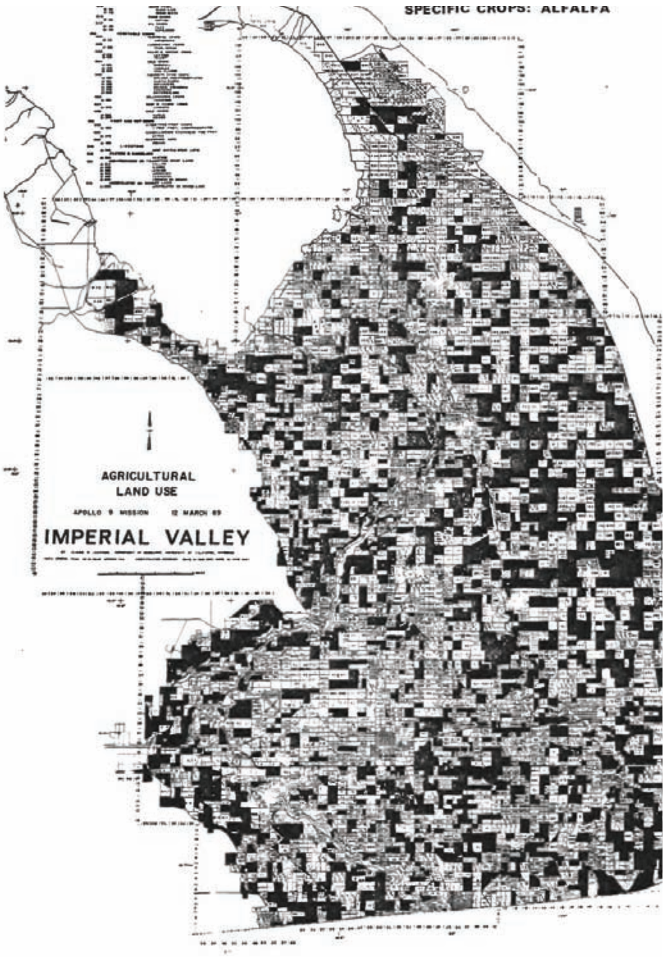
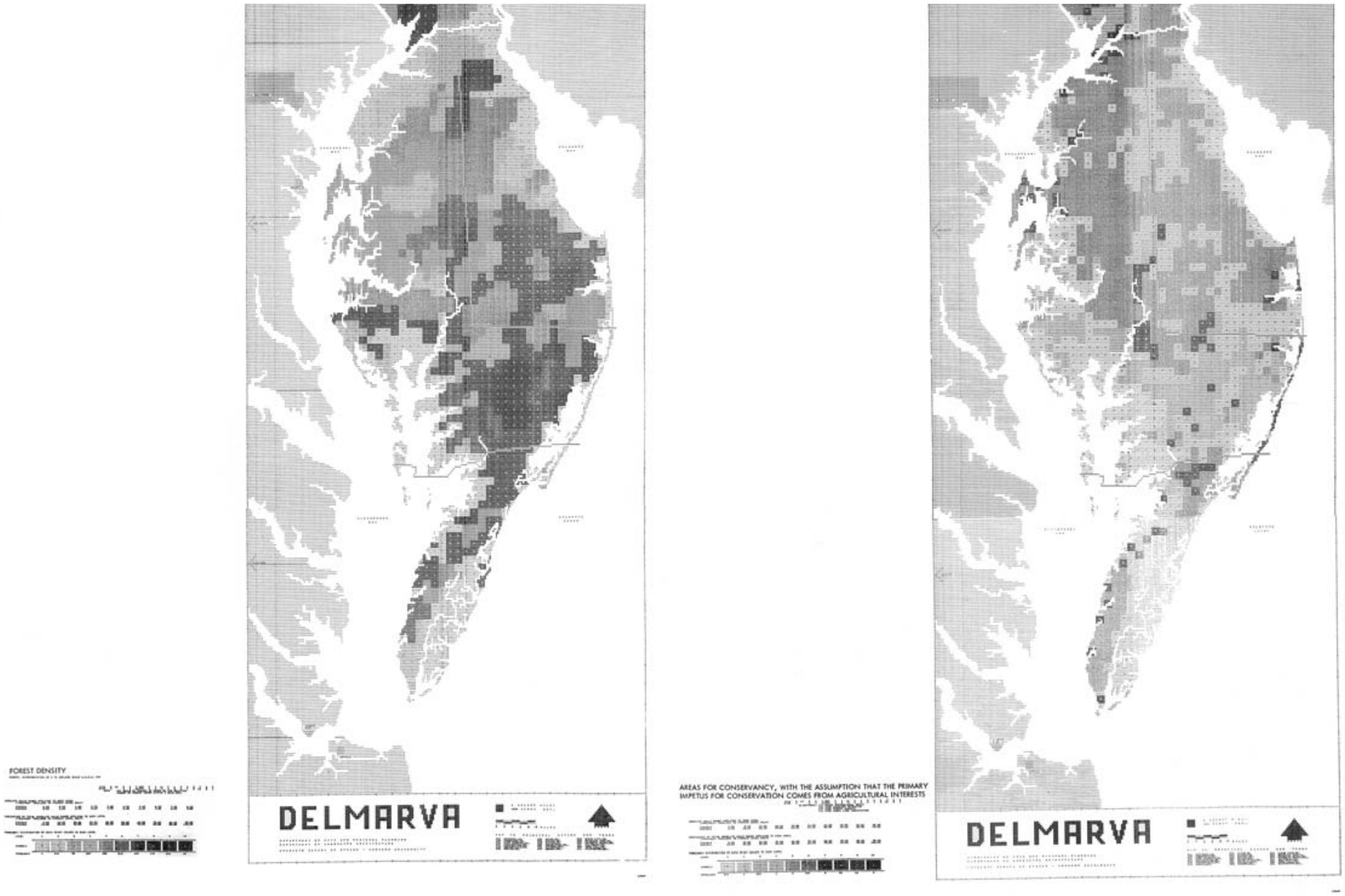
[1]John Noble Wilford, *The Mapmakers* (New York: Vintage Books, 2001), 279.




## 5.10

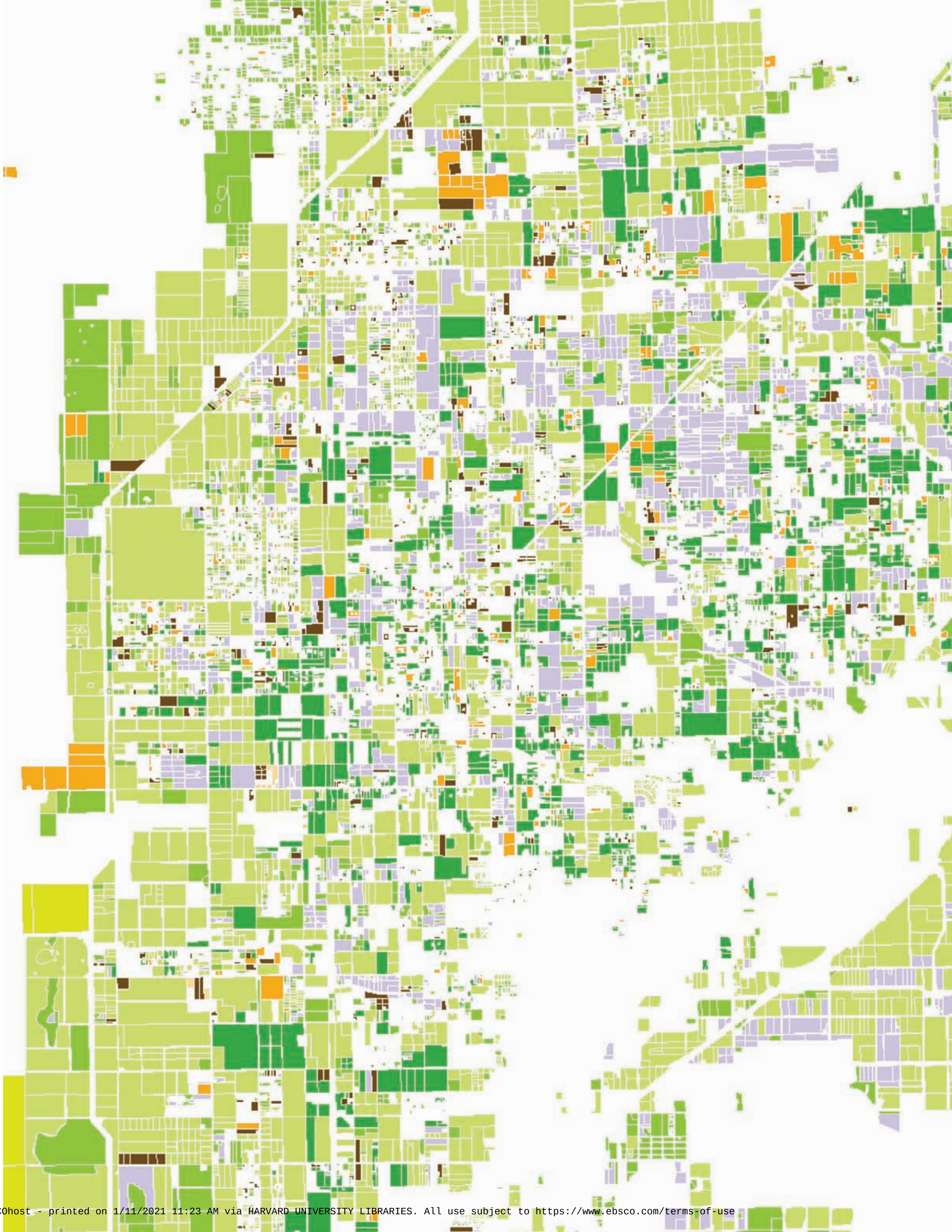
**32.9631° N, 115.4876° W, Claude Johnson, Leonard Bowden, and Robert Pease, *Agricultural Land Use, Imperial Valley All Vegetables* and *Specific Crops: Alfalfa*, 1969.**
Remote-sensing data liberated the surveyor from the ground while making the holistic view of the landscape readily accessible. The image from above—and its translation into map form—continues to fascinate. Now quotidian, the ability to document a landscape by interpreting aerial-photographs was revolutionary for the University of California agronomists studying crops and crop disease in the Imperial Valley.




## 5.11

**38.5000° N, 75.6667° W, Carl Steinitz, *Computer Mapping and the Regional Landscape, A Forest Density; B Areas for Conservancy*, 1967.**

Led by landscape architect Carl Steinitz, the mapping of Delmarva Peninsula was a joint effort of landscape architecture and planning students at the Harvard University Graduate School of Design. Using the tools and processes developed by the Laboratory for Computer Graphics, the students produced a set of maps designed to determine locations suitable for development. The deterministic and positivistic exercise was facilitated by the availability of geographical data and the ability to code this information with predetermined values. Two maps are shown here. The first, of forest density, is descriptive, produced simply from aerial imagery as a base layer to project where possible. The second is an aggregation of multiple types of data mapped with different weighted values—high soil quality (+3), high wildlife potential (+1), high forest density (+1), and high shoreline indentation (+1)—to yield optimum areas for conservation. The maps use a combination of symbols to create different monochromatic tones that mark the range of data values.



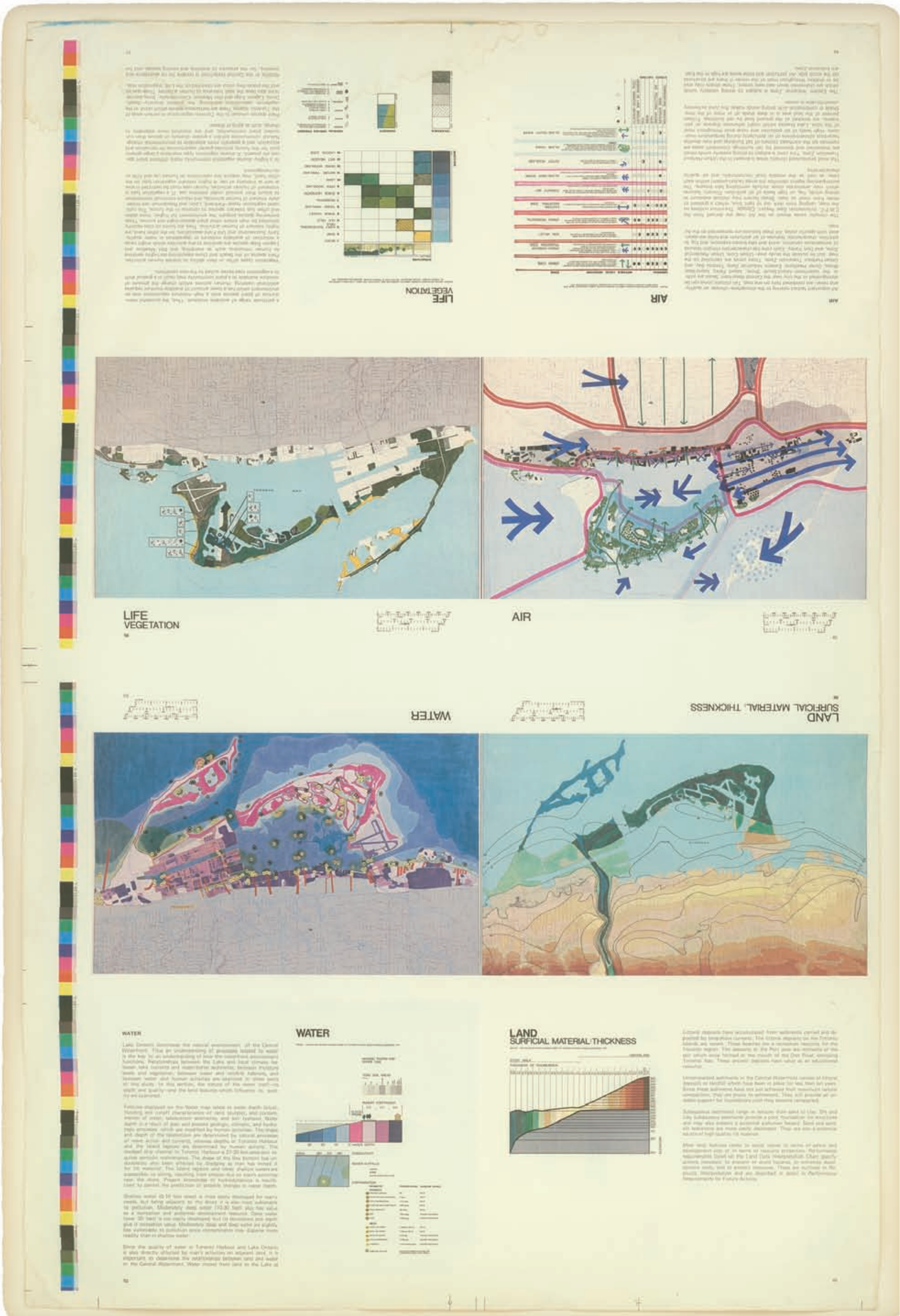
## 5.12

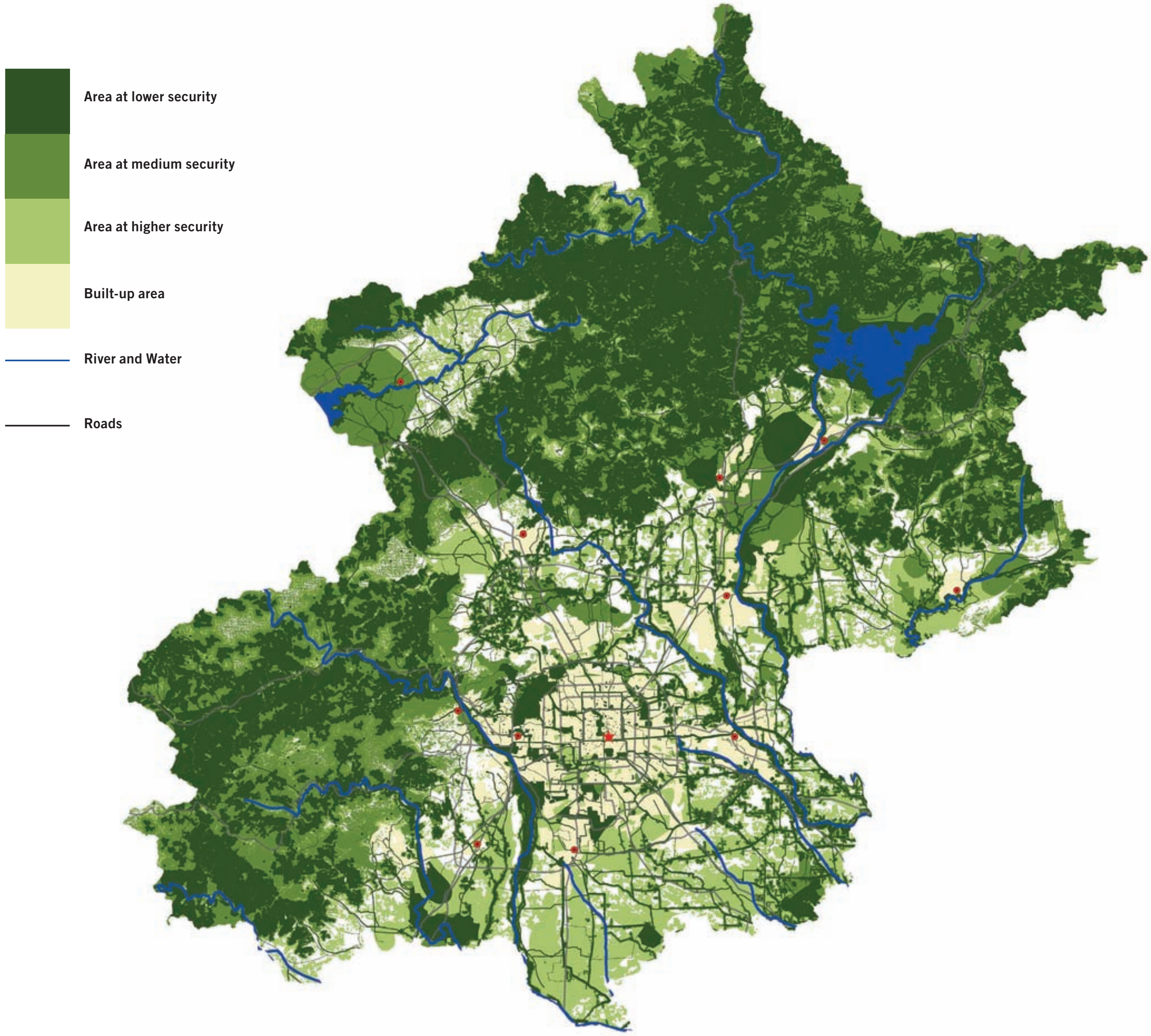
**25.7216° N, 80.2793° W,**
**Valerie Imbruce, *Agricultural Biodiversity Study*, Florida, 2004.**

Agricultural ecologist Valerie Imbruce—using data from the University of Florida—maps the distribution of species in small-scale productive plots in the Miami area. The array of tropical fruits, vegetables, and ornamental plants points to the diversity of agricultural practice on the urban periphery. The colorful coding highlights the exuberant nature of the mapped species, while the contrasting hues highlight the new pattern of spatially heterogeneous urban agriculture.

**LEGEND**

- Vegetables
- Nurseries
- Anonna
- Avocado
- Banana
- Carambola
- Citrus
- Guava
- Jack Fruit
- Lime
- Longan
- Lychee
- Marney Sapote
- Mango
- Mixed Grove
- Papaya
- Passion Fruit
- Sapodilla


LIFE
VEGETATION
AIR
WATER
LAND
SURFICIAL MATERIAL THICKNESS

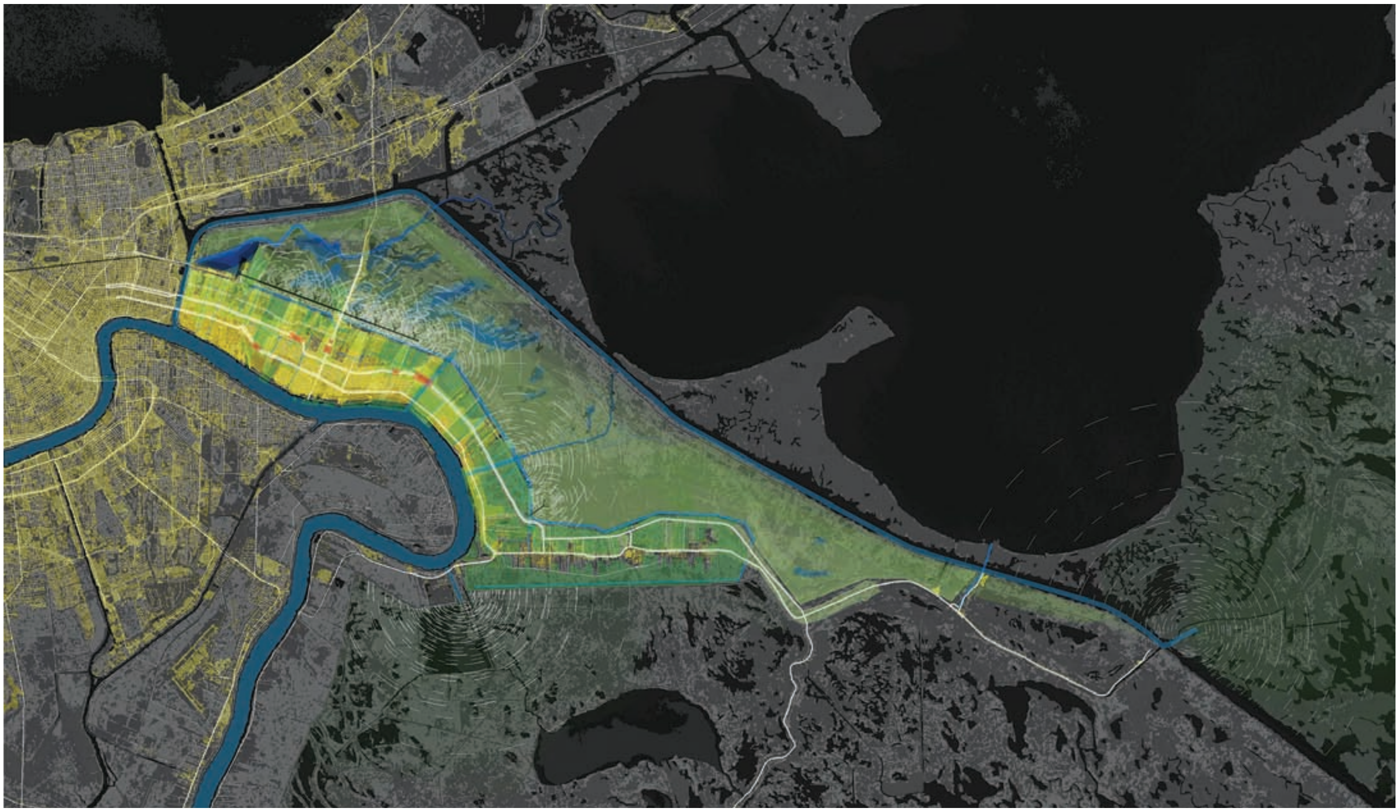



## 5.13

**43.6396° N, 79.3800° W, Wallace McHarg Roberts & Todd (WMRT), *Environmental Resources of the Toronto Central Waterfront*, 1976.** After the issuance of the seminal 1964 Plan for the Valleys, WMRT became known for their environmental planning expertise. WMRT, under the direction of landscape architect Narendra Juneja, prepared an extensive environmental synthesis study of the Toronto Central Waterfront in 1976 to guide the city's future development efforts along the waterfront. The team collected extensive data on the environmental context relating to climate, air quality, noise, geology, physiography, hydrology, sediment, vegetation, wildlife, and land use. This data was weighted based on its effects—direct and indirect—on the quality of urban life. This resulted in an extensive matrix equating environmental resource with social objectives. The matrix was translated into a series of maps describing the air, land, water, and life of the city.

## 5.14

**39.9100° N, 116.4000° E, Turenscape, *Let Landscape Lead Urbanism—Growth Planning for Beijing*, 2008.** Chinese landscape architect Kongjian Yu, through his firm Turenscape and his teachings at Peking University and the Harvard Graduate School of Design, has advanced ecological planning methods to develop ecological security plans and guides to development both in the Beijing area and across China. Geospatial data is layered to reveal underlying spatial relationships between the built, impermeable, and landscape spaces within the city. Land uses are evaluated and classified into low-, medium-, and high-security areas based on their performance related to long-term water management, resilience against geological disaster, biodiversity, cultural heritage, and recreation potential.



## 5.15

**37.6374° N, 122.3601° W,**
**Stamen Design, *Map Stacks*, 2013.**
Stamen Design is dedicated to increasing the quality of cartographic representation in digital maps, maps that are designed to be interactive, multiscalar with multiple zoom levels, user manipulated, and seen on-screen. Stamen uses OpenStreetMap data to create maps and offer a simple, user-friendly, free, readily available mapmaking Web interface. The company offers maps with three representational styles: the Toner (a high-contrast black-and-white map), the Terrain (featuring shaded relief and natural land-classification colors), and the Watercolor (a map with raster-effect area washes, organic edges, and paper texture). The MapStack interface allows for variation within a controlled representational environment, catering to the desires of the amateur cartographer.

## 5.16

**37.6374° N, 122.3601° W,**
**LSU Coastal Sustainability Studio,**
***Bayou Bienvenue*, 2010.**
This image layers a number of restoration and protection strategies proposed for the eastern portions of greater New Orleans, with a primary focus on the St. Bernard Parish Central Wetland Unit, indicated in green. The drawing codes the strategies—as projected land uses—including sediment-diversion tactics in blue, wastewater treatment and resulting cypress forest regeneration in radiating dashed white lines, and relocated and densified neighborhood development away from the marshlands in yellow. Corridor developments are shown with solid white lines. The drawing combines data with color-coded line work, fills, and raster imagery to render a complex and dynamic marsh environment.