SCHOOL OF BLACK-FISH STRANDED ON THE SHORE OF CAPE COD, MASS.

STRAND

Noun
A **single, thin length of something**, such as thread, wire, or hair.
An **element that forms part of a complex whole**; a component or theme.
The land bordering a sea, lake, or large river; **the shore** or beach.

Verb
To leave (someone or something) in a difficult, helpless, or **isolated position**.
To drive or run (a ship or marine animal) onto a shore; to run aground.

Timeline

114 BC

Originating in Neolithic China, silk production remained a closely guarded Chinese secret and virtual monopoly for thousands of years, even after the Silk Road opened in 114 BC.
This prized material was used for various applications beyond clothing, and the color of silk worn was a key indicator of social class. Silk is produced by carefully unwinding the single, continuous filament from the cocoons of silkworms—which are typically fed mulberry leaves—after the cocoons have been boiled to loosen the natural gum.

550 AD

The Byzantine Empire finally broke China's monopoly around 550 AD when, according to legend, monks smuggled silkworm eggs to Emperor Justinian I. This established a new, powerful European silk industry based in Constantinople, which quickly became a strict imperial monopoly. Byzantine silk, especially the fabric dyed Tyrian purple, was reserved for the emperor's court and the highest levels of the church, serving as a potent symbol of power. The state-controlled industry became a vital tool in their diplomatic relations.

1325

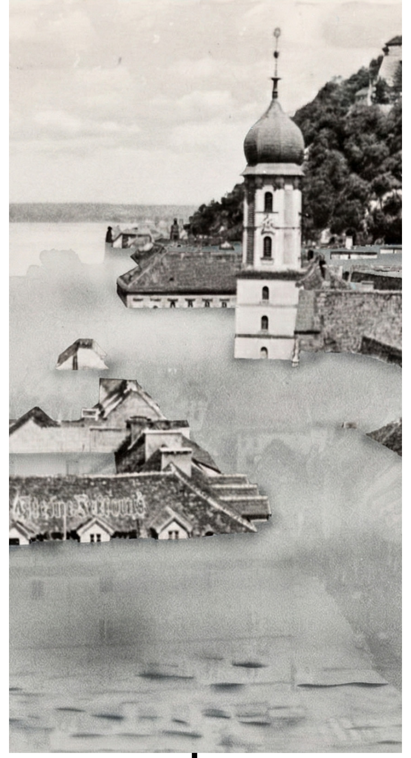
Silk production migrated to Lombardy in the 14th century as skilled artisans fled political conflict in Lucca, bringing their advanced technology to Milan. The industry truly flourished in the 15th century under Duke Ludovico Sforza, who strategically ordered the mass planting of mulberry trees across the region. This masterstroke created a fully integrated supply chain, from raising the silkworms to weaving the final luxury textile. Cities like Milan, Como, and Pavia became the undisputed new centers of European silk, bringing prestige to Milan.

NOW

The region of Pavia holds a dormant memory of entomological husbandry. For centuries, this landscape was the European epicenter of Sericulture, defined by the Bigattiera—farmhouses specifically designed to rear Bombyx mori (silkworms) on vast mulberry plantations. In 2079, as the Po Valley desiccates into an arid steppe, this heritage is not abandoned but radically adapted. The Sub-Terra project excavates this historical logic, transitioning from the production of luxury fiber to essential protein. The metabolic cycle persists: organic inputs yield high-value outputs. Yet, the delicate silkworm is replaced by the resilient cricket and mealworm. This is a survivalist evolution of local tradition. We no longer farm insects for the satin of the aristocracy, but for the sustenance of the collective. The insect returns to Pavia not as a weaver of wealth, but as the architect of caloric survival.

2026

The Giulio Natta Innovation Center in Pavia envisions a high-tech, sustainable village integrated into a re-naturalized wetland, featuring advanced irrigation canals and buildings enveloped in lush greenery. This "NBS Valley" concept, with its vibrant, nature-based solutions, symbolizes a futuristic approach to living, where sustainable infrastructure and biodiversity flourish side-by-side. The design blends cutting-edge technology, like the glowing, interconnected waterways and integrated solar panels, with a deep respect for ecological principles, creating a compelling vision of tomorrow's green communities.



2047

This vision of a high-tech Pavia "NBS Valley" clashes sharply with looming climate realities, rendering it mere science fiction. The region's wetlands face increasing droughts, yet this design relies on massive, water-intensive irrigation canals, an unsustainable fantasy. Furthermore, the low-lying structures would be catastrophically vulnerable to intensified, albeit rare, flooding events, akin to Venice's devastating acqua alta. This ambitious, seemingly green infrastructure is fundamentally incompatible with the projected environmental stresses, risking total destruction and exposing its inherent unsustainability.

Future Conditions

2079

By 2079, the Po Valley's fertile history has been erased by hyper-aridity. The Giulio Natta site, once a monument to 20th-century chemical industrialism, stands as a ruin in the new European steppe. In this hostile landscape, climate refugees do not build up; they dig down. Reclaiming the site's industrial footprint, the new settlement colonizes the subsurface, establishing a habitat 3 meters underground.

This excavation utilizes the earth's immense thermal mass to decouple the dwelling from surface temperatures of 50°C, maintaining a constant, habitable 18°C. The architecture is defined by verticality: steel Solar Chimneys pierce the crust, driving passive cooling through the stack effect and harvesting daylight for the deep-plan atrium. Survival is secured through a closed-loop metabolic system. The community practices Entomo-Agriculture (insect harvesting), converting organic waste into high-protein cricket flour. Here, the Giulio Natta site transforms from a factory of plastics into a machine for survival—a subterranean oasis enduring beneath the wasteland.

Climate Change Analysis

Time Interval: January 2024 - August 2025

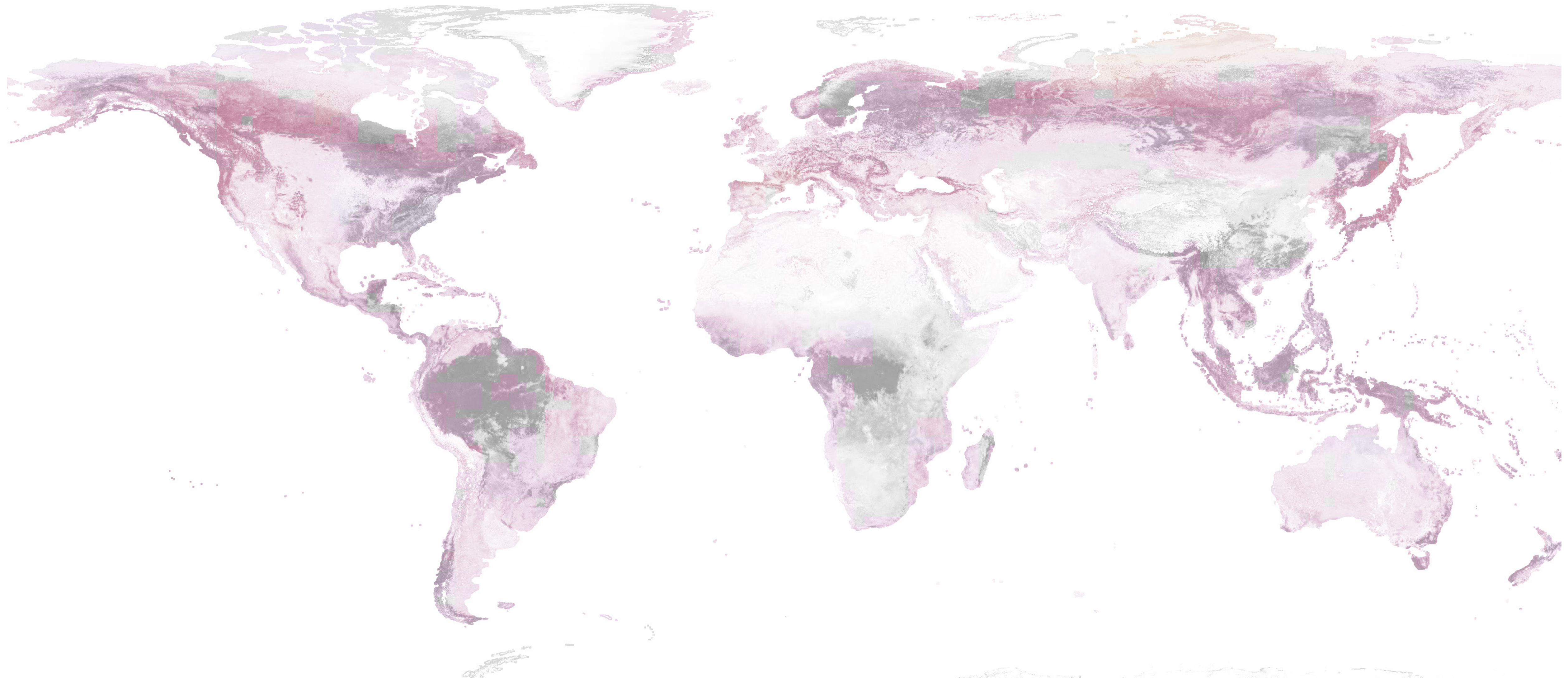
Base Period: January 1951 - December 1980

Data Provided by: GISS Surface Temperature Analysis V4

NASA, https://data.giss.nasa.gov/gistemp/maps/

0.5 - 1.0 C° 1.0 - 2.0 C° 2.0 - 4.0 C° 4.0 - 8.4 C°

The map bellow showcases an ongoing trend of our planet warming up because of human misconduct. We see that a human's activities in regards to industry and pollution are not isolated to a specific street, town or country but encapsulate a shared responsibility in the sense that the planet is shared - like it or not. It takes no more than a second to notice that the data does not look optimistic. Keep in mind the gray areas on the map record a lack of data, not an antithesis to the magenta heating index. Affected Regions include but are not limit to: Northern Russia/Siberia, US, Northern Canada and Alaska, Whole of Europe, Northern China (Vast areas of China are missing as of 14.10.2025, Mongolia, Brazil, sub-Saharan Africa, India, Australia. This reflects ongoing climate trends, with Arctic amplification evident in polar north. (478 chars) up to +8 degrees.



Local Temperature Anomalies

Time Interval: January 2015 - August 2025

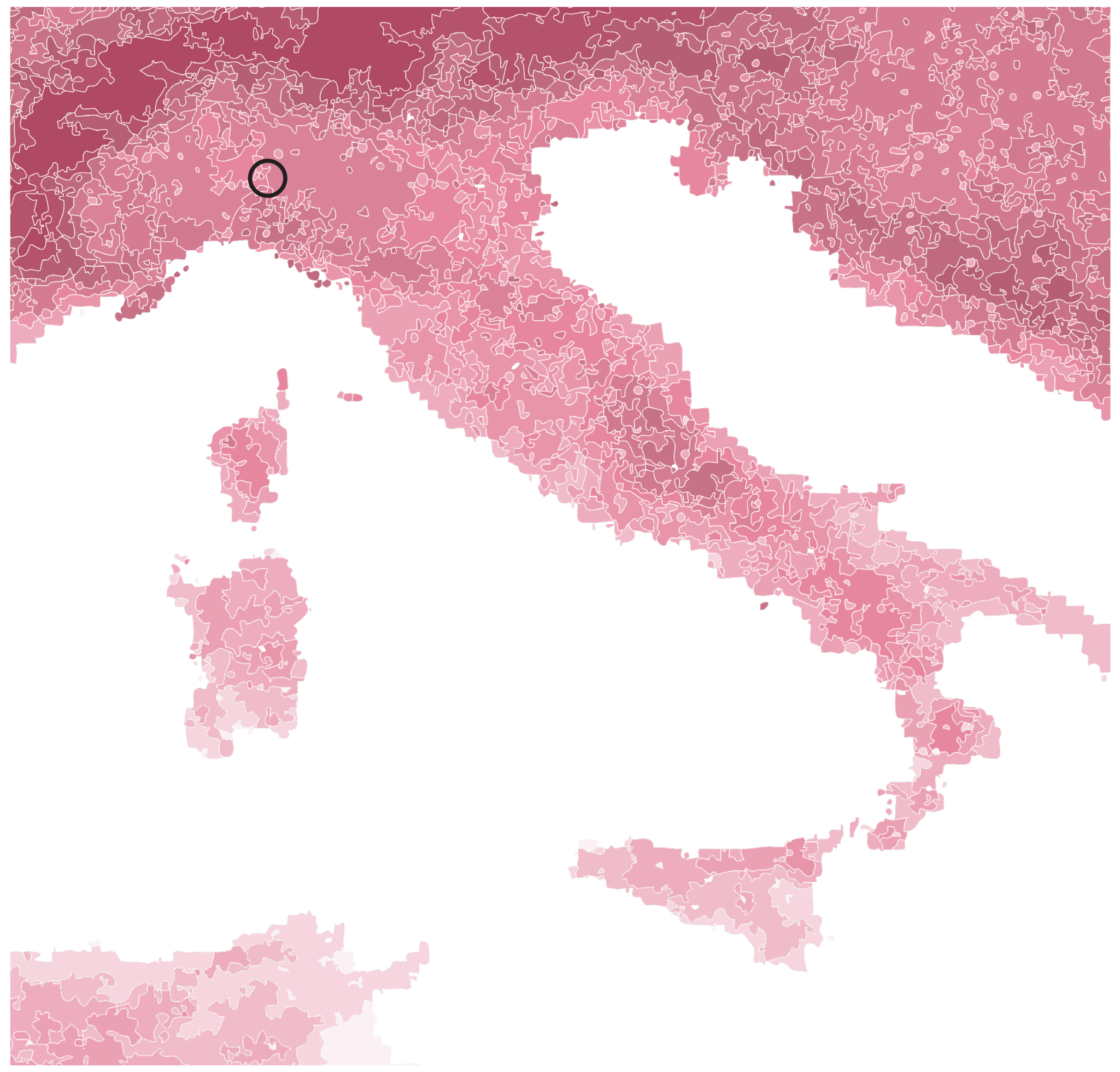
Base Period: January 1940 - December 1980

Data Provided by: Climate Data Store, ERA5 monthly averaged data, 1 degree accuracy = 9km

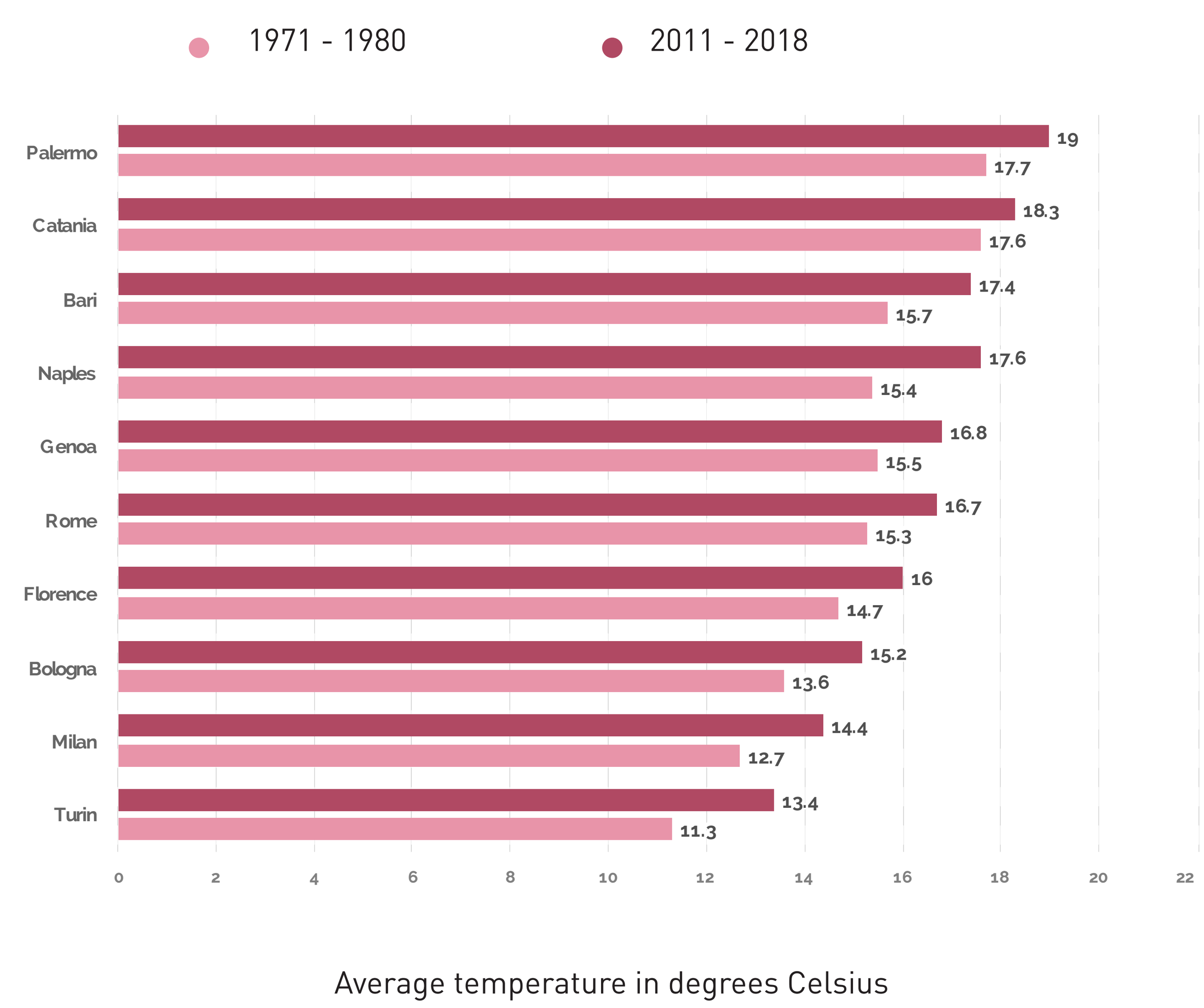
Copernicus, https://cds.climate.copernicus.eu/datasets/reanalysis-era5-single-levels-monthly-means

0.5 - 1.0 C° 1.0 - 2.0 C° 2.0 - 4.0 C° 4.0 - 8.4 C°

Italy has seen accelerated warming over the past 50 years (1975-2025), with average annual temperatures rising by about 1.5-2°C compared to mid-20th century baselines, faster than the 1°C over the last century. This is evident in cities like Rome, where averages jumped from 14.6°C in the 1970s to 16.9°C since 2000. Heating degree days (HDD) have decreased by 10-30% across regions due to milder winters, reducing heating demands, while cooling degree days (CDD) increased sharply—up to 171% in Milan from 1980-2010—signaling hotter summers and more heat waves. Northern and central Italy exhibit the strongest anomalies, with Europe-wide trends showing 2.2°C warming in the last decade vs. pre-industrial levels, exacerbating extremes. (482 chars)

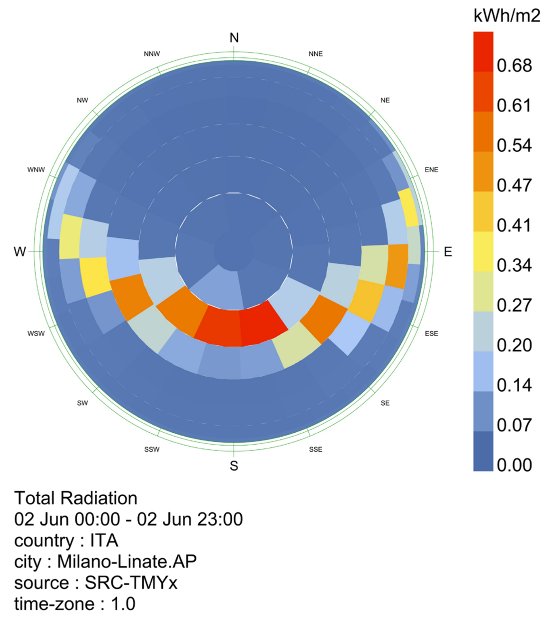


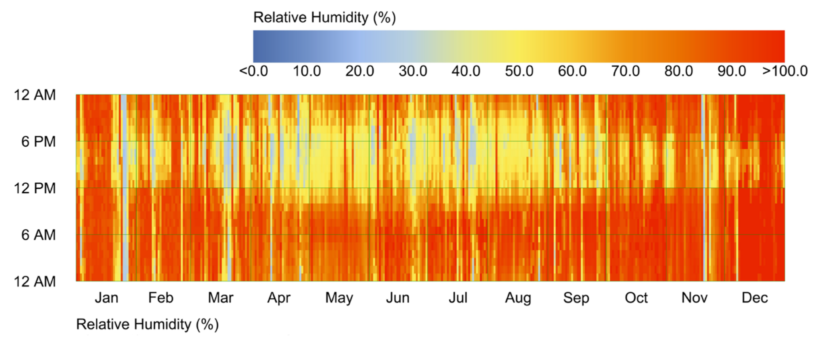
Average temperature recorded in Italy from 1971 to 1980 and 2011 to 2018, by city

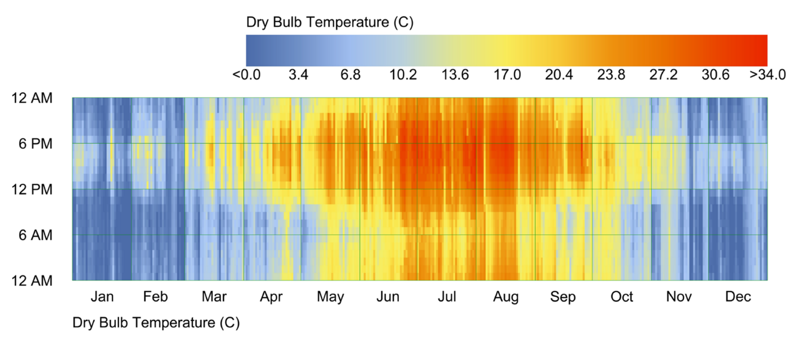


Solar and Wind

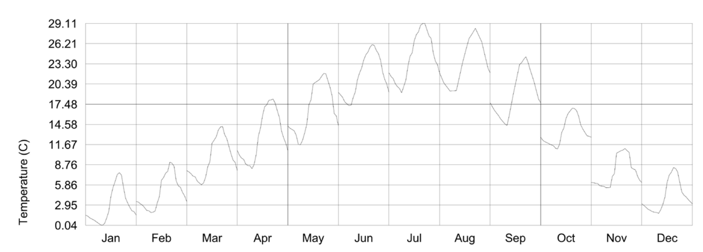
Solar Analysis



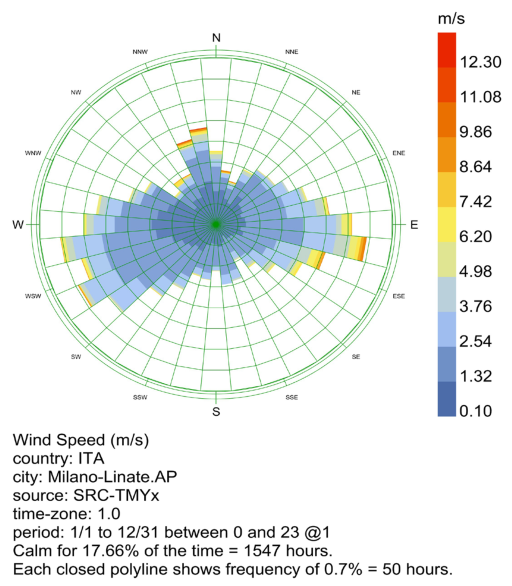


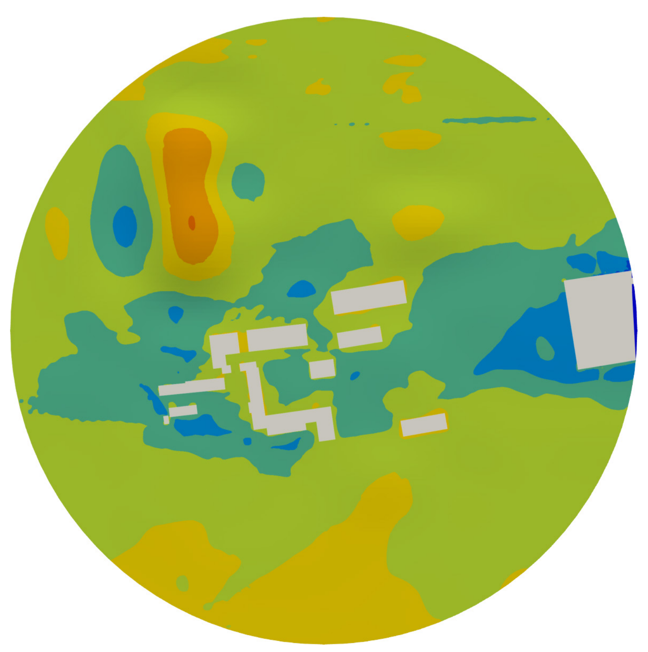


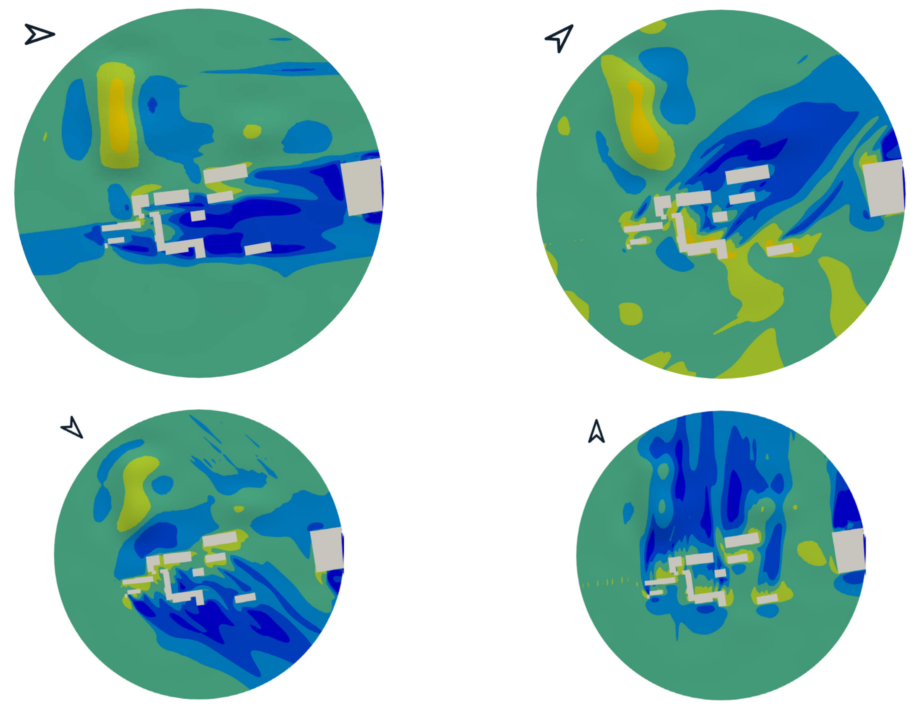
The solar analysis reveals good potential, with clear skies favoring PV output. Winter sees lower insolation due to shorter days and lower sun angles, requiring optimization for seasonal efficiency. Summer offers peak solar gain. Strategic shading/orientation is crucial for thermal comfort and energy harvesting.



Wind Analysis







Desertification Data

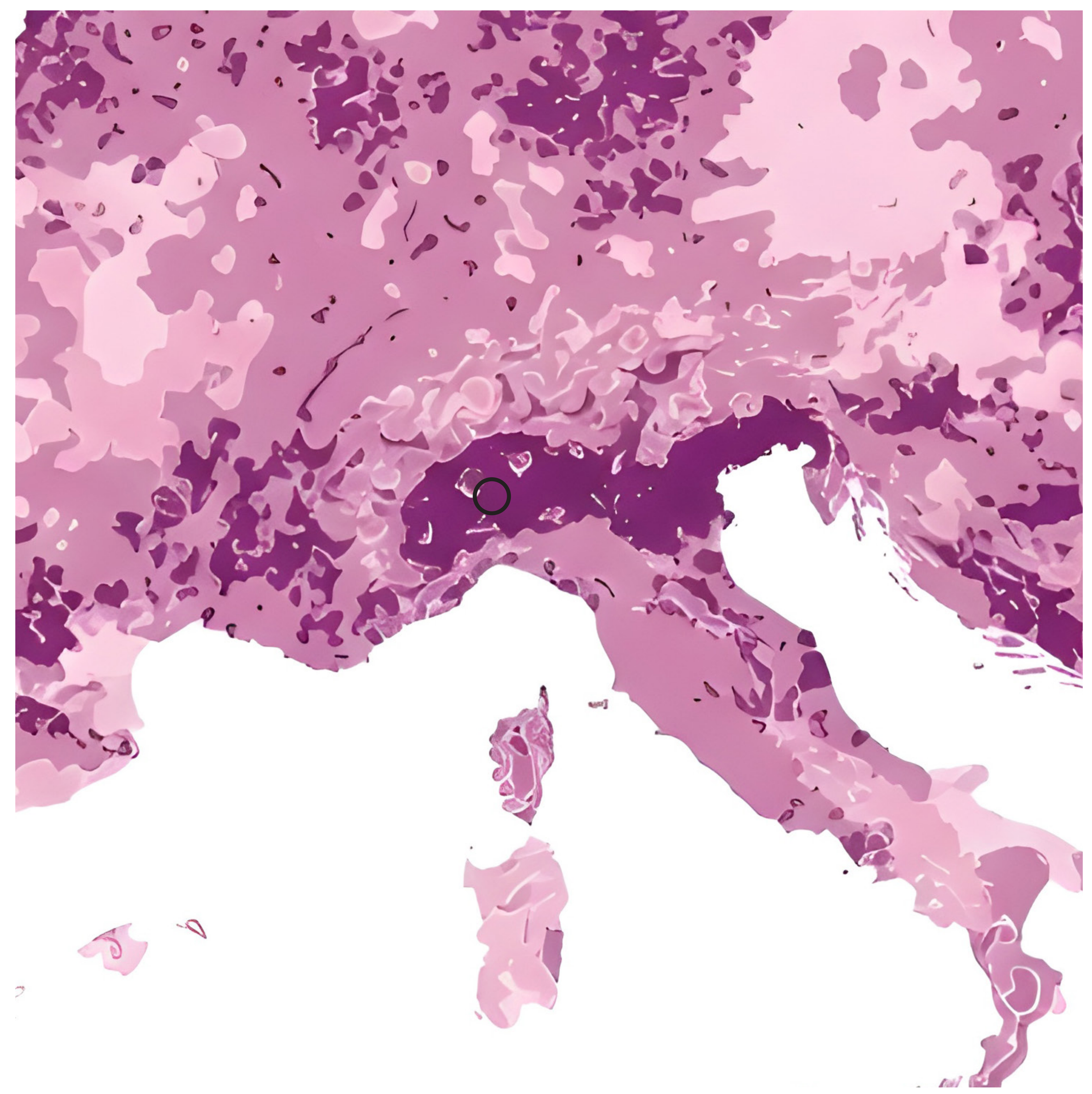
Time Interval: January 2015 - August 2025

Base Period: January 1940 - December 1980

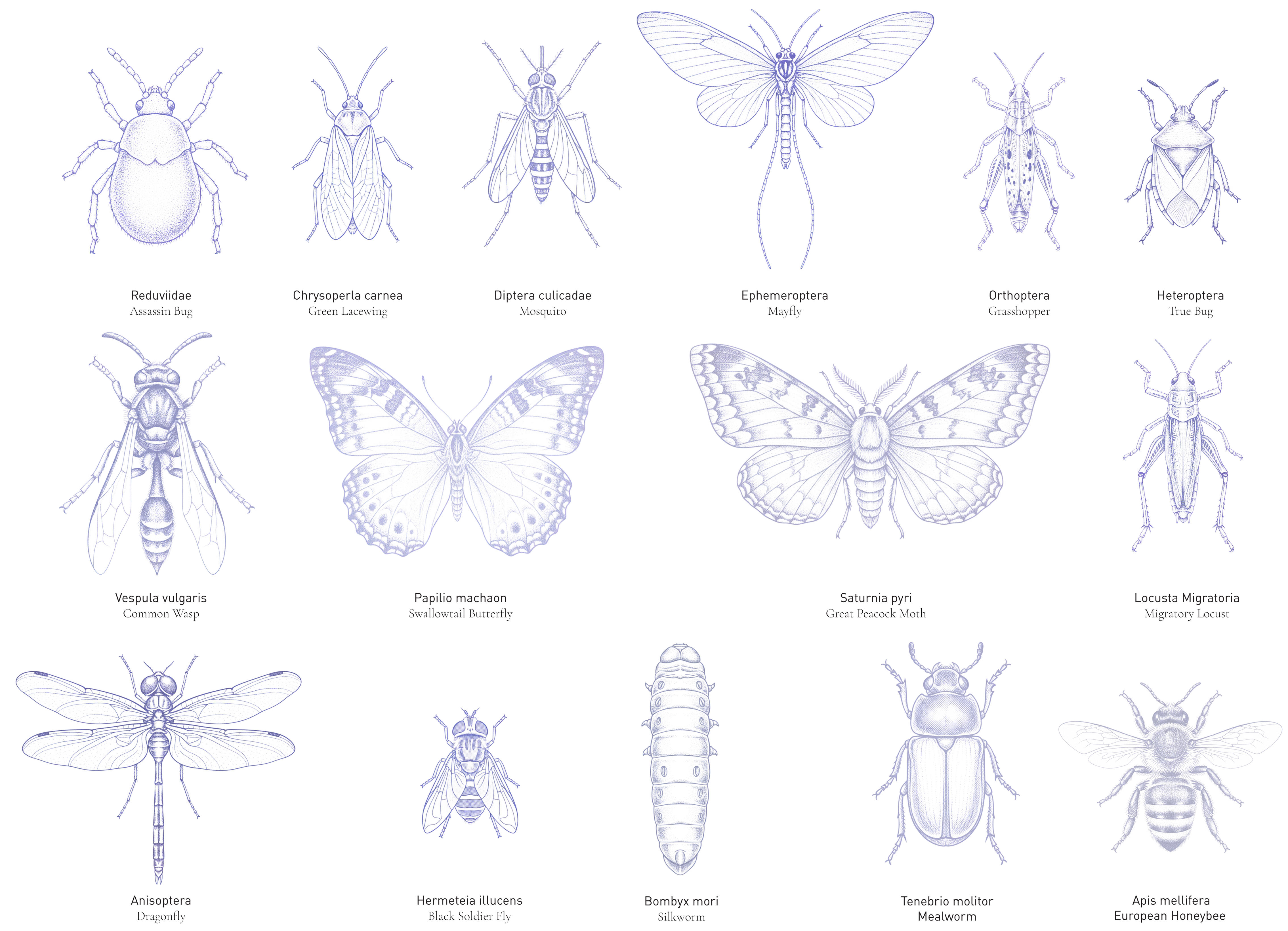
Data Provided by: Climate Data Store, ERA5 monthly averaged data, 1 degree accuracy = 9km

Copernicus, https://cds.climate.copernicus.eu/datasets/reanalysis-era5-single-levels-monthly-means

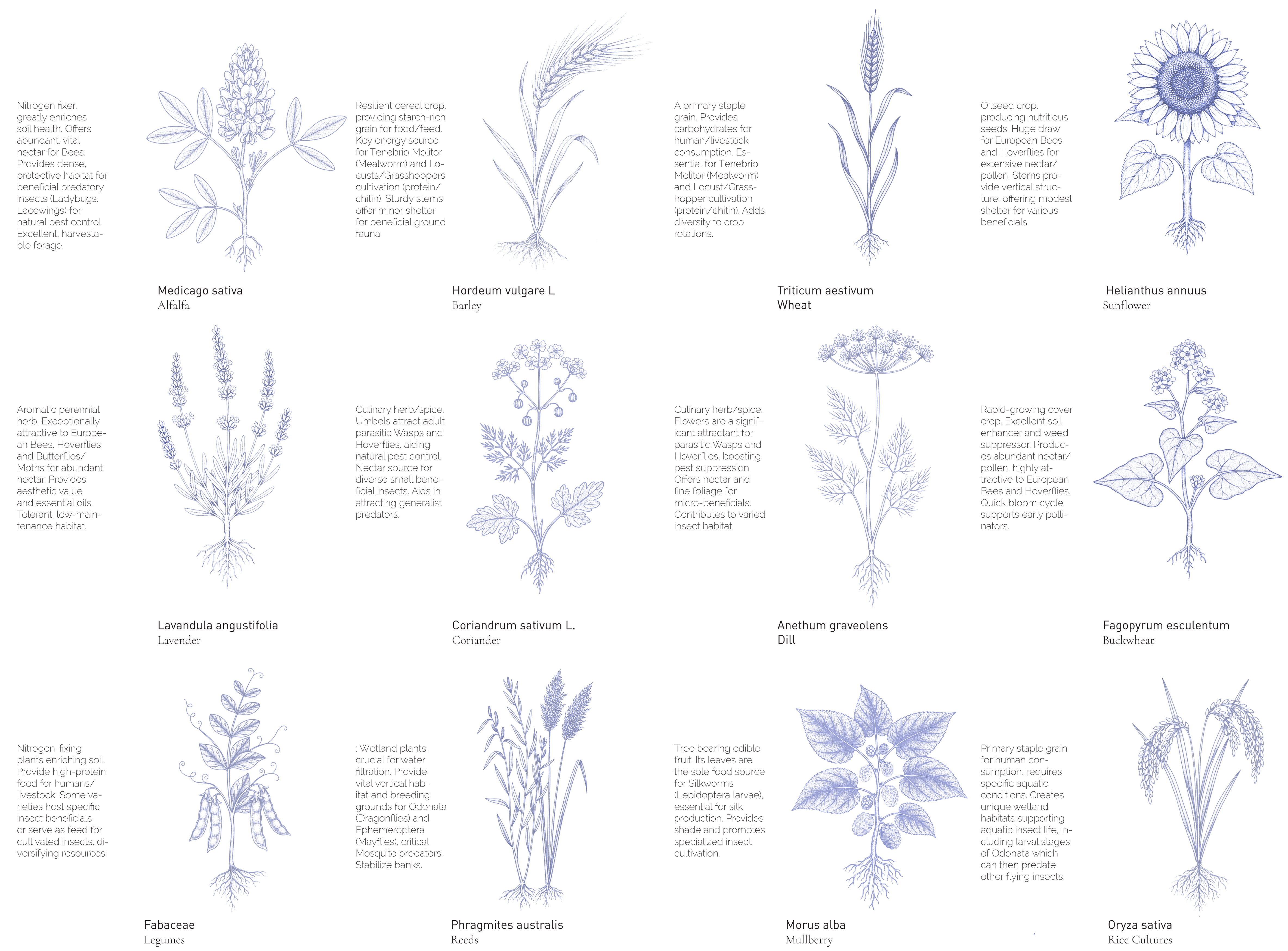
The map highlights a critical anomaly in Northern Italy. The Po Valley (Pianura Padana)—historically Europe's agricultural heartland—has transitioned from a humid subtropical zone to a semi-arid steppe. Pavia, situated in the center of this crisis, shows maximum stress levels (indicated in dark purple). By 2079, the region's aquifers have depleted, and the fertile soil, once supporting vast rice paddies, has succumbed to salinization and erosion. This total hydraulic failure renders traditional surface architecture uninhabitable, necessitating the move to the Sub-Terra settlement strategy.



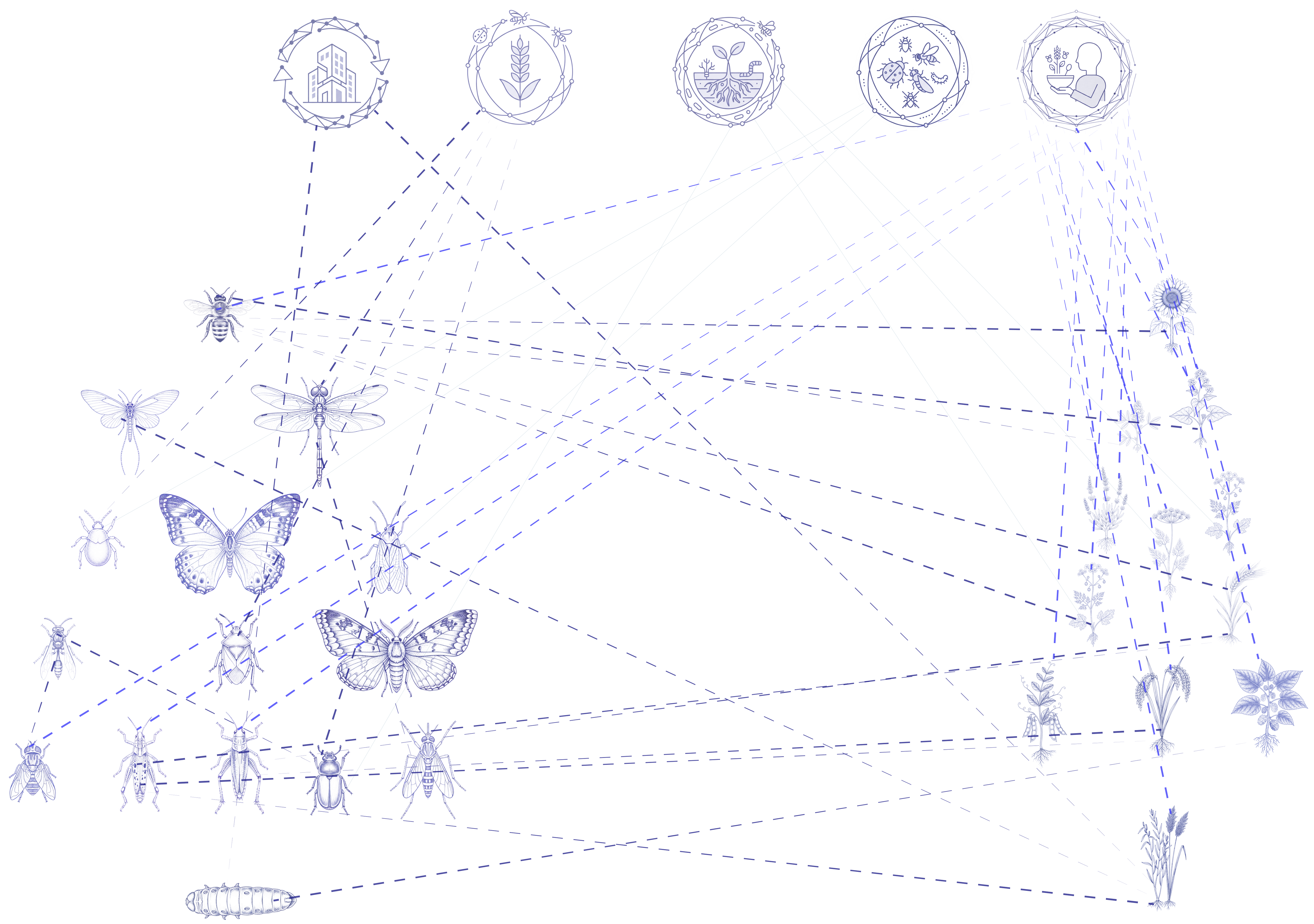
Insect Catalogue



Production Diagram

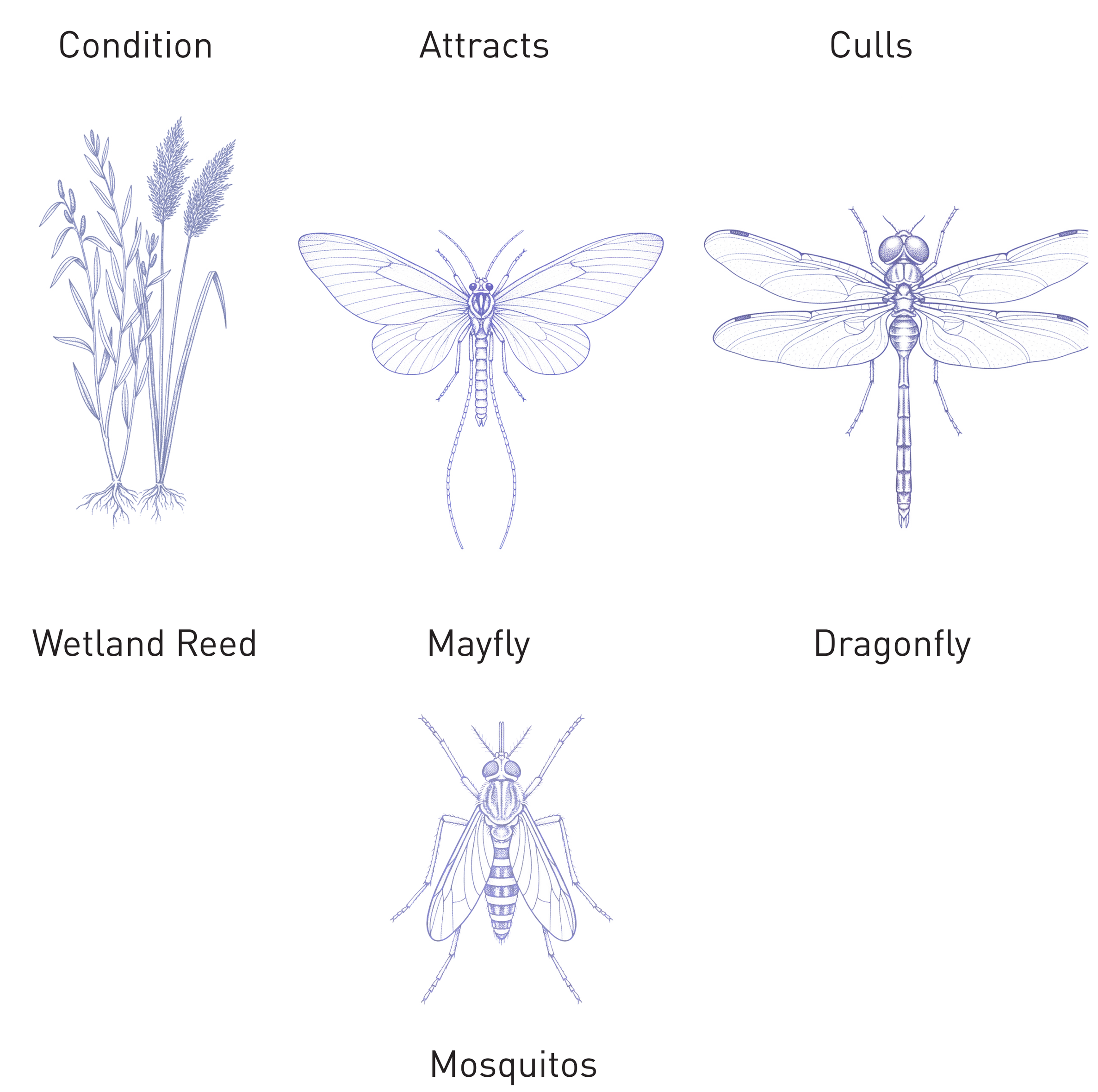


Production Diagram



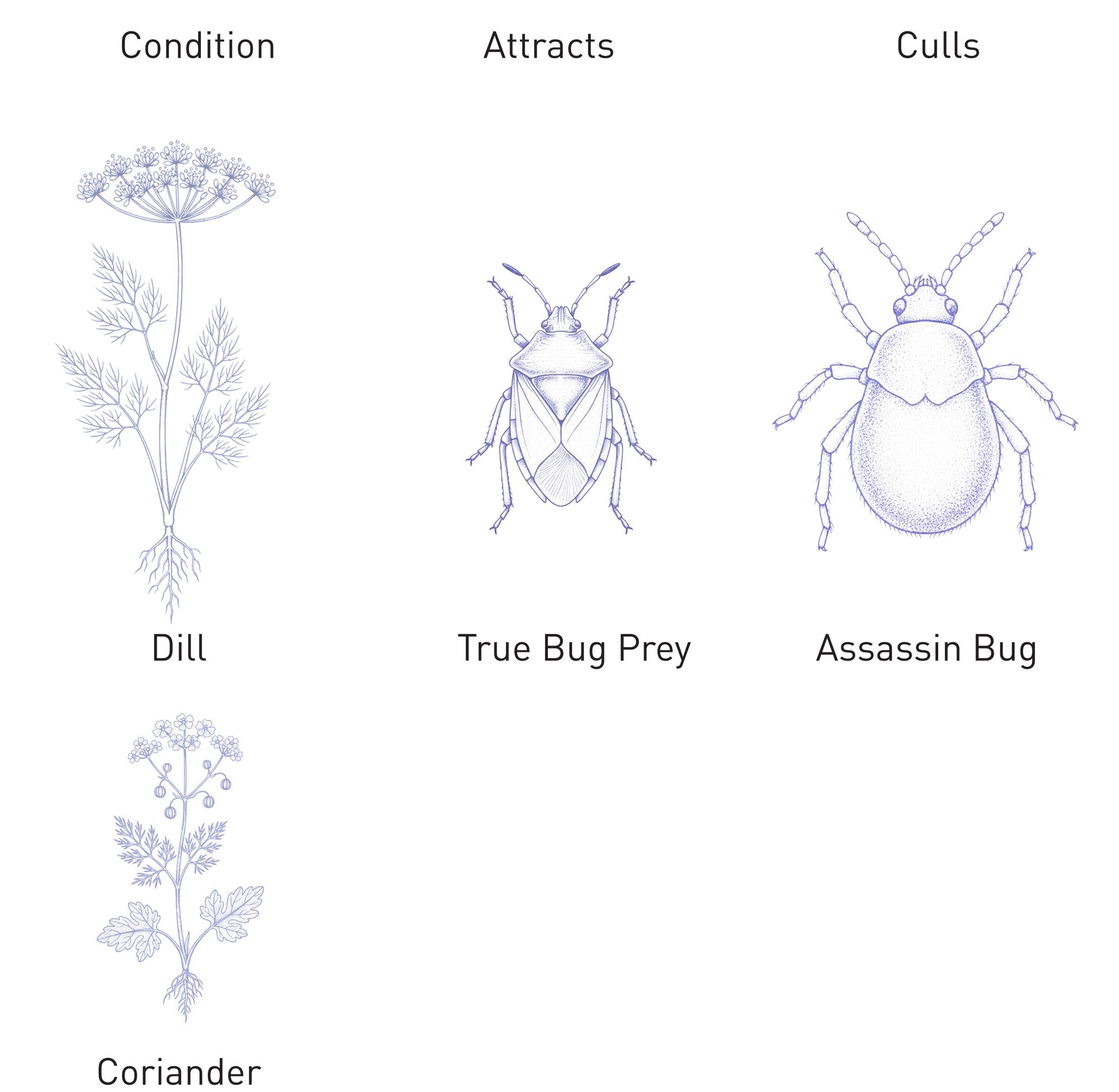
Example Systems

Example A. Aquatic Ecosystem Loop



The Reed Bed provides the crucial aquatic environment. Mayfly larvae live there and serve as food for juvenile Dragonflies. The adult Dragonfly emerges as an aerial Predator that targets Mosquitoes, providing essential pest control for the human settlement.

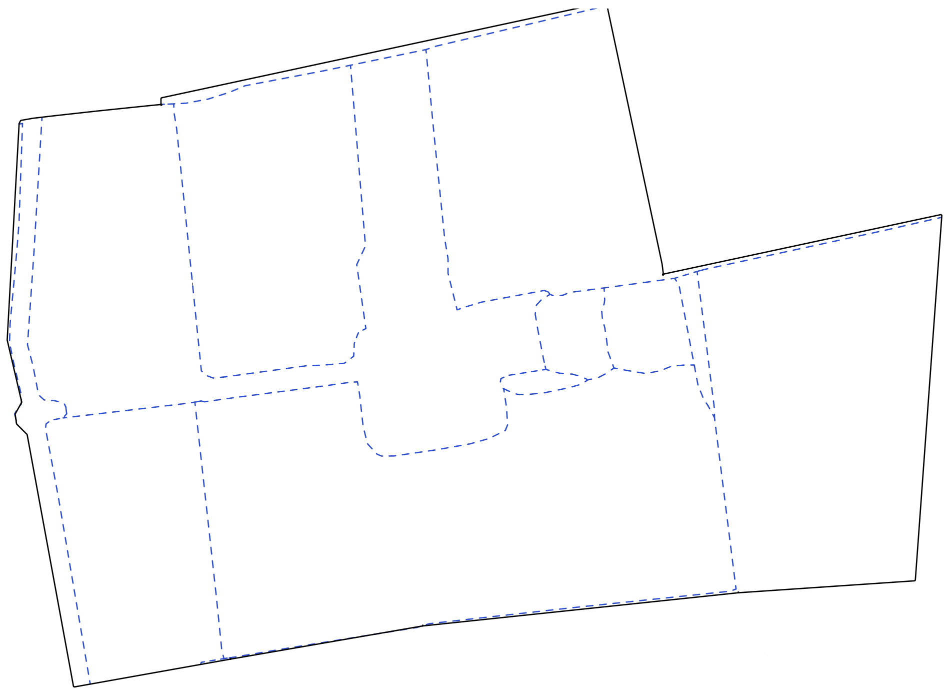
Example B. Pest Control Cascade



Dill/Coriander flowers attract adult Hoverflies, which lay eggs. The resulting larvae (Predator) consume Aphids and other soft-bodied pests (Prey), protecting crops and ensuring a better harvest for the Settlement Inhabitant.

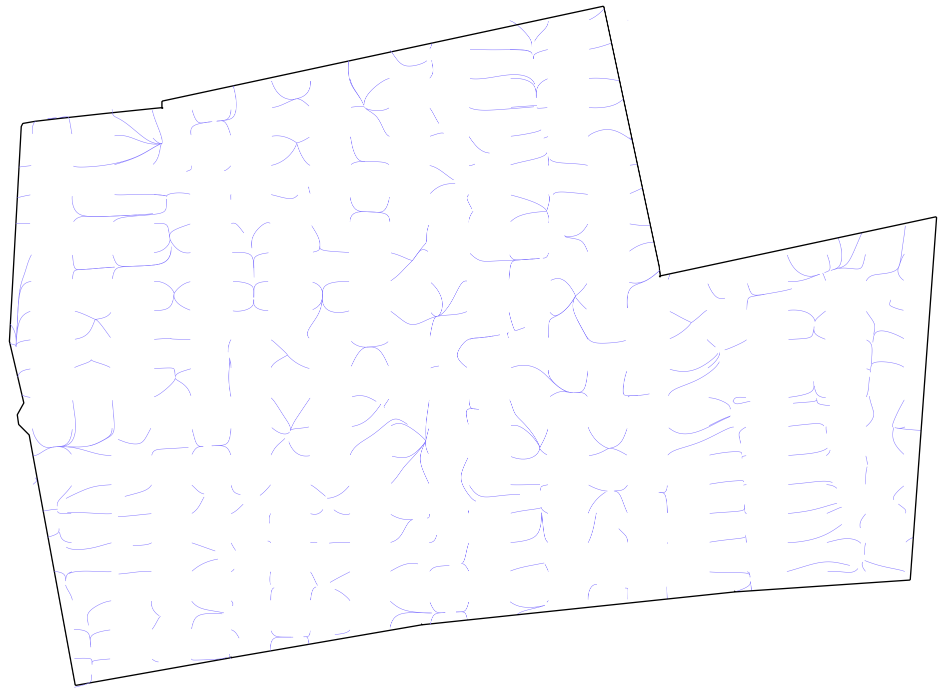
Site Conditions

The site is described as an agricultural center. Thus a nearly all of it's surface is separated into crop-like zonings with existing canals and ditches providing the irrigation for the green fields in a typical rectangular grid.



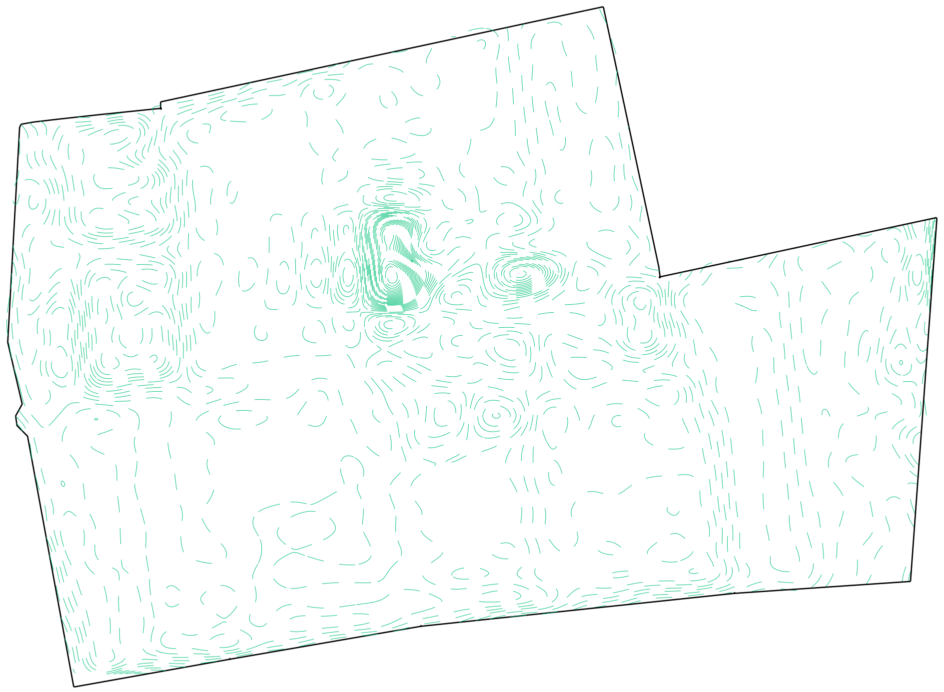
Existing Ditch System

When looking at the water run-off analysis we can subscribe values to the lowerst points on the terrain.With this information we can plot a strategy to optimize water collection and protect future built structures from flooding. The run-off analysis pinpoints and follows the ditch system.



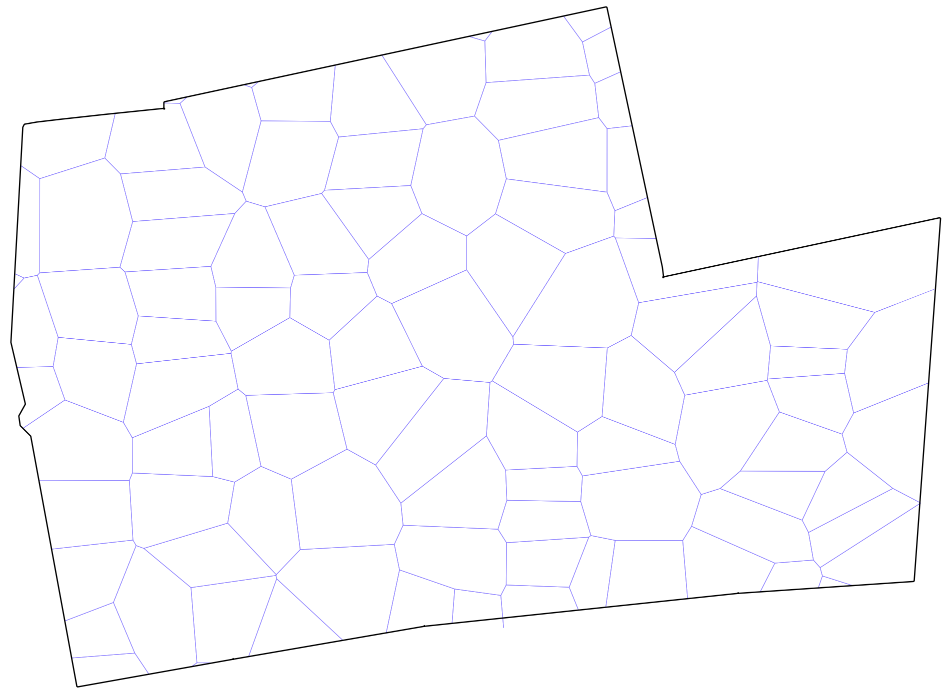
Water Runoff Analysis

Looking at the contour line it again follows the agricultural planning of the site, only having slight fluctuations around the center of the site. For the drawing a overexposed contour line of 30 centimeters was chosen to highlight the regularity of the surface.



Existing Ditch System

Based on the previous Water Runoff Analysis - all points aggregates with a minimum length of 5 meters have been chosen. Using a voronoi algorithm we can optimize the waterflow to capture water and move it around the site using the minimum required surface area for our ditches.



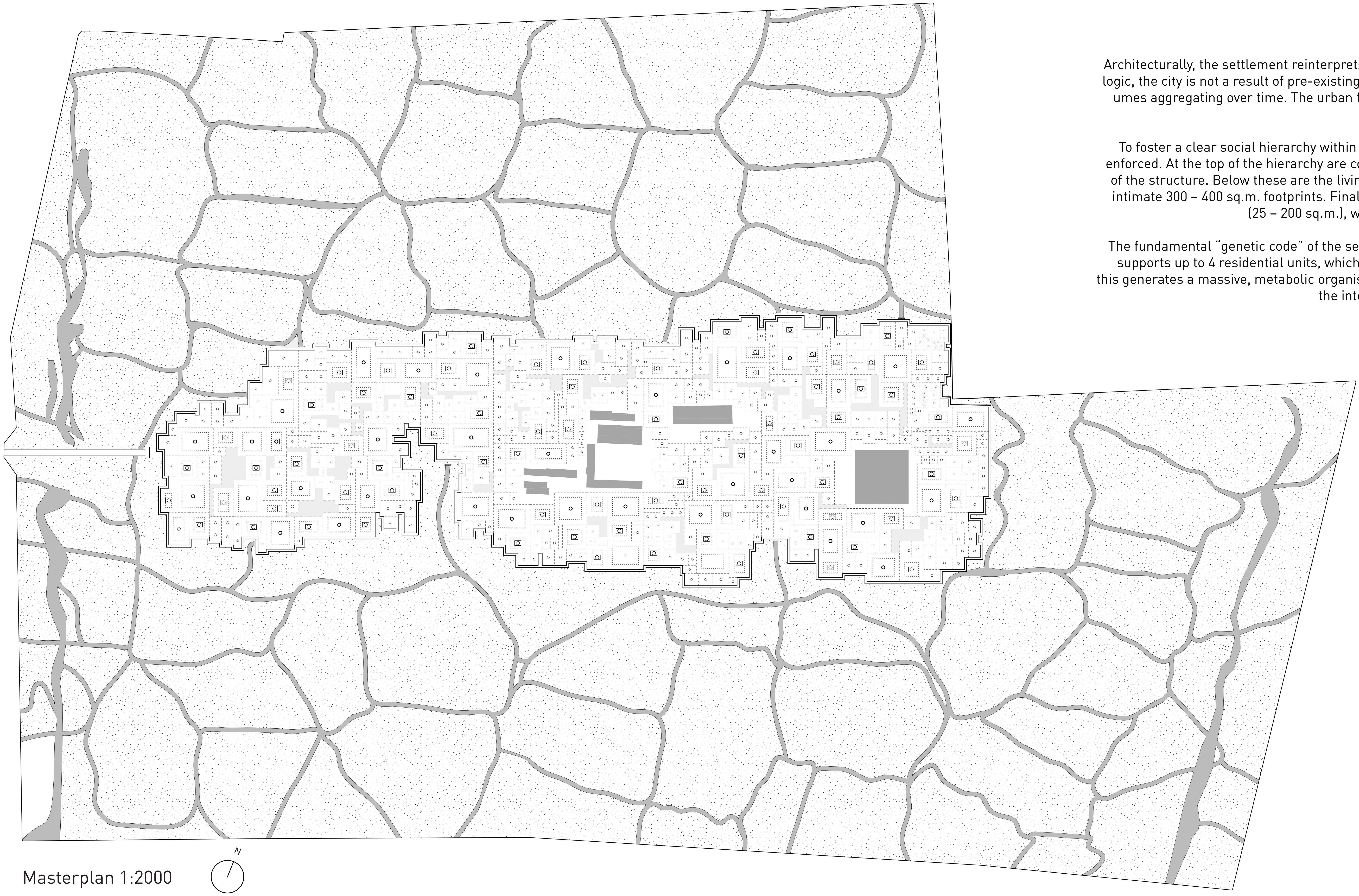
Voronoi Translation of Water Run-off

Settlement Composition

Architecturally, the settlement reinterprets the morphological density of the traditional Arabic Kasbah. In this logic, the city is not a result of pre-existing streets or grids, but rather the consequence of distinct spatial volumes aggregating over time. The urban fabric is defined strictly by the accumulation of buildings, where the interstitial spaces between units act as the circulation network.

To foster a clear social hierarchy within this dense mat-building typology, three specific scalar distincts are enforced. At the top of the hierarchy are communal anchors (500 – 800 sq.m.), which serve as the civic hearts of the structure. Below these are the living quarters, designed to house collective groups of 16 people within intimate 300 – 400 sq.m. footprints. Finally, the fabric is stitched together by highly variable production units (25 – 200 sq.m.), which adapt physically to their specific manufacturing requirements.

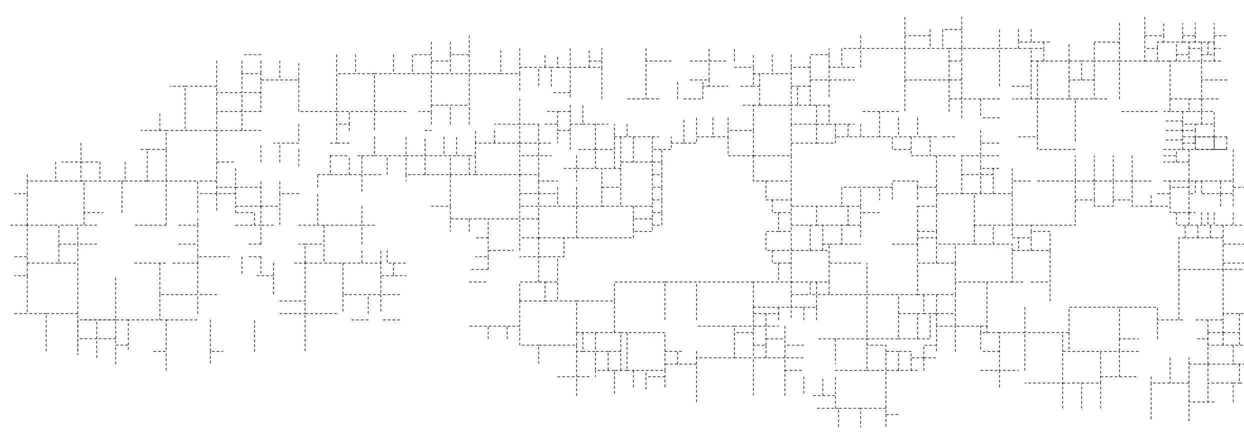
The fundamental "genetic code" of the settlement dictates a strict clustering ratio: 1 shared gathering space supports up to 4 residential units, which are in turn sustained by 15 units of production. At the macro scale, this generates a massive, metabolic organism of 5,000 inhabitants, where domestic life is inextricably linked to the intense production required to sustain a settlement of this magnitude.



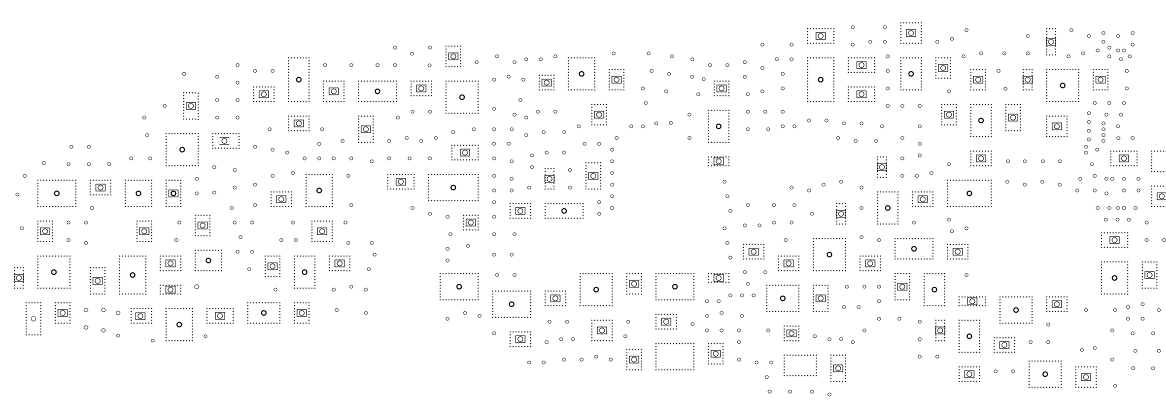
Masterplan 1:2000

Pseudocode Snippet

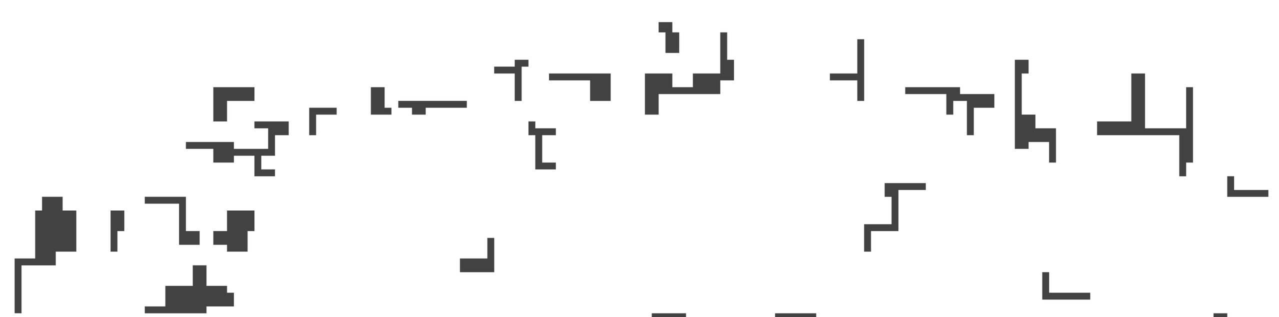
```
// 1. GLOBAL CONFIGURATION & CONSTRAINTS
   SET Grid_Module       = 3.75 meters
   SET Max_Site_Density  = 90% of total boundary area
   SET Lighting_Grid     = 1.875 meters (Half-module) / 3.75

   DEFINE CLUSTER_COMPOSITION:
      1x  Gathering Hub (Anchor)
      3-5x Living Units (Attached to Hub)
      ~15x Production Units (Loose aggregation)

// 2. INITIALIZATION PHASE
   CALCULATE total site area from Boundary_Curve
   DEFINE Target_Fill_Area
    INSTANTIATE 'Seed Block' (Type: Gathering Hub) at BoundingBox
Center
   ADD Seed Block to Placed_List
   INITIALIZE empty Build_Queue

// 3. GENERATIVE LOOP
   WHILE Current_Area < Target_Fill_Area:

      // A. QUEUE MANAGEMENT
      IF Build_Queue is Empty:
         Generate new sequence: [Gather] -> [Living...] -> [Prod...]
         Reset Current_Cluster_Hub to NULL

      POP Next_Unit_Type from Build_Queue
      CALCULATE Unit_Dimensions (Randomized Aspect Ratio)

      // B. PARENT SELECTION LOGIC
      IF Next_Unit_Type is 'Living':
         Target_Parent = Current_Cluster_Hub
         (Constraint: Housing must attach directly to GATHER)
      ELSE:
         Target_Parent = Random selection from Placed_List
         (Production/Gather units can branch off anywhere)

      // C. SPATIAL SEARCH (Max 25 attempts)
      FOR i in 0 to 25:
       SELECT Random_Side of Target_Parent (North, South, East, West)
         CALCULATE Candidate_Position based on Side & Dimensions

         // D. VALIDATION CHECKS
         CHECK 1: Does Candidate overlap existing blocks?
         CHECK 2: Is Candidate outside the Site Boundary?

         IF Checks Pass:
            INSTANTIATE New_Block
            UPDATE Current_Area

// 4. POST-PROCESSING (Lighting)
   FOR EACH Block in Placed_List:
      IF Block_Type is 'Living' or 'Gather':
         GENERATE internal grid points (Spacing: 1.875m)
         FILTER points to isolate "Ring 2" (Inset 3.75m from edge)
         INSTANTIATE Circular Light Fixtures at valid points

   RETURN Final_Geometry
```



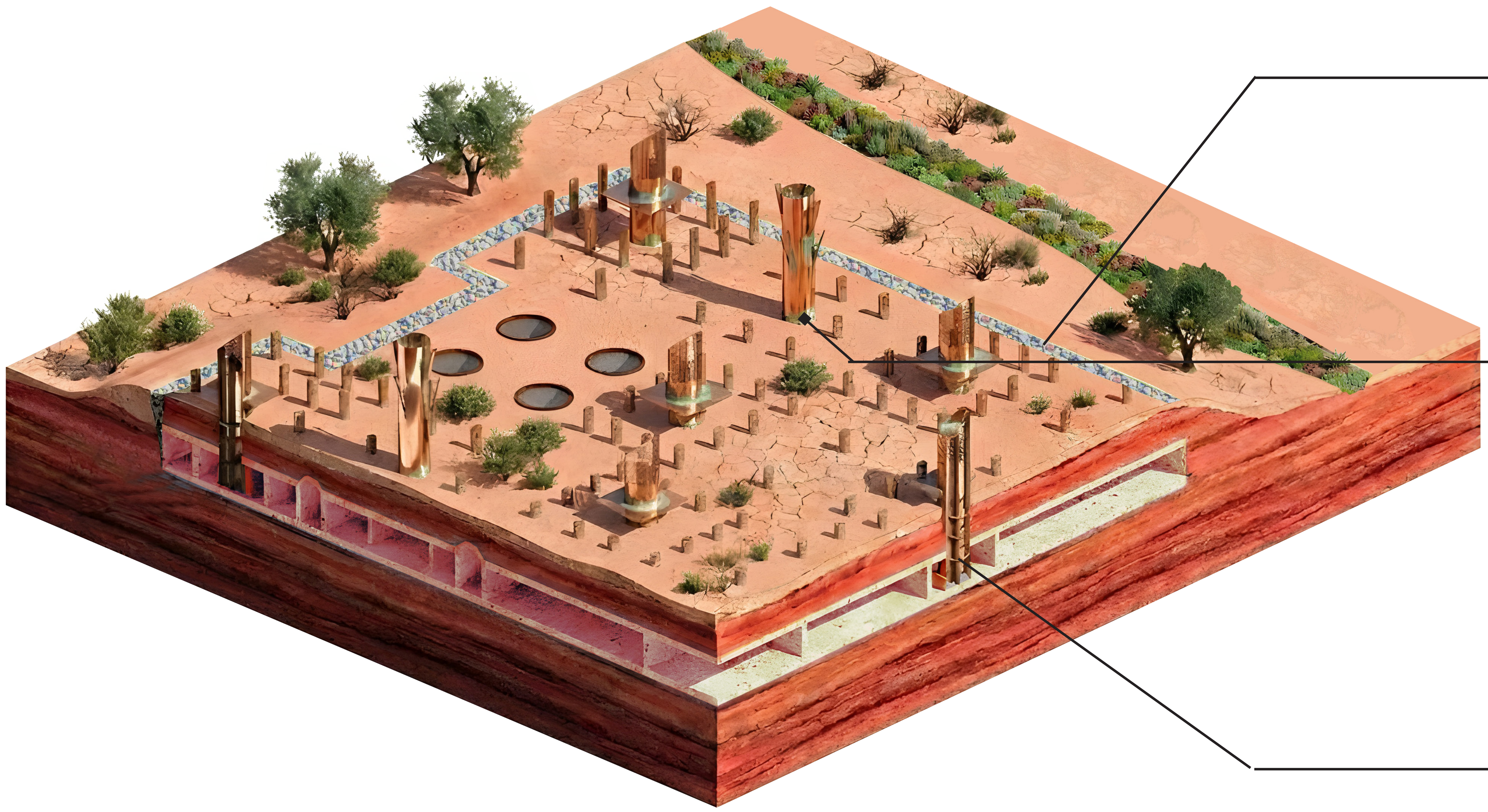
Cluster Divisions

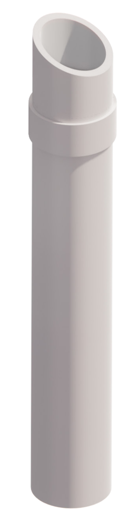


Surface Protrusions



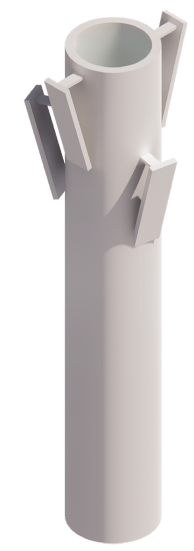
Pockets of Tunnels





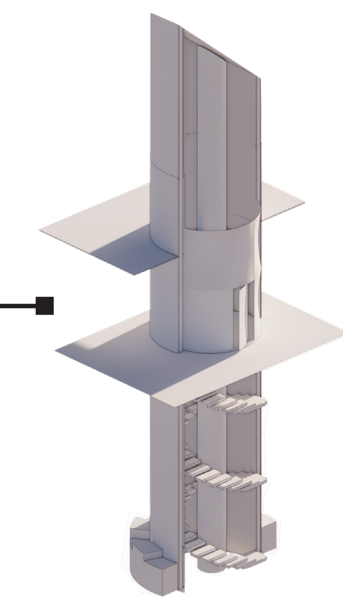
01. Lightcore

The Lightcore is the primary daylighting strategy for the deep-plan underground structure. Externally clad in 3mm weathered carbon steel armor to withstand surface conditions, its interior shaft is lined with 1.5mm mirror-polished stainless steel panels. This highly reflective internal surface maximizes light transmission, funneling natural sunlight over 3 meters deep into the central subterranean atrium and reducing reliance on artificial energy.



02. Solar Chimney

The Solar Chimney drives the project's net-zero ventilation strategy. Due to thermal buoyancy, this hot air rises rapidly, creating a powerful passive updraft (stack effect) that continuously extracts stale, warm air from the underground living quarters without mechanical fans.



03. Circulation

Circulation is tightly integrated with the environmental infrastructure to minimize the structural footprint. A functional steel spiral staircase wraps around the central Lightcore and Solar Chimney shafts. This provides the vital vertical link for residents between the protected, temperature-stable subterranean habitat and the hostile surface landscape above.

Settlement Tile = 1 ha

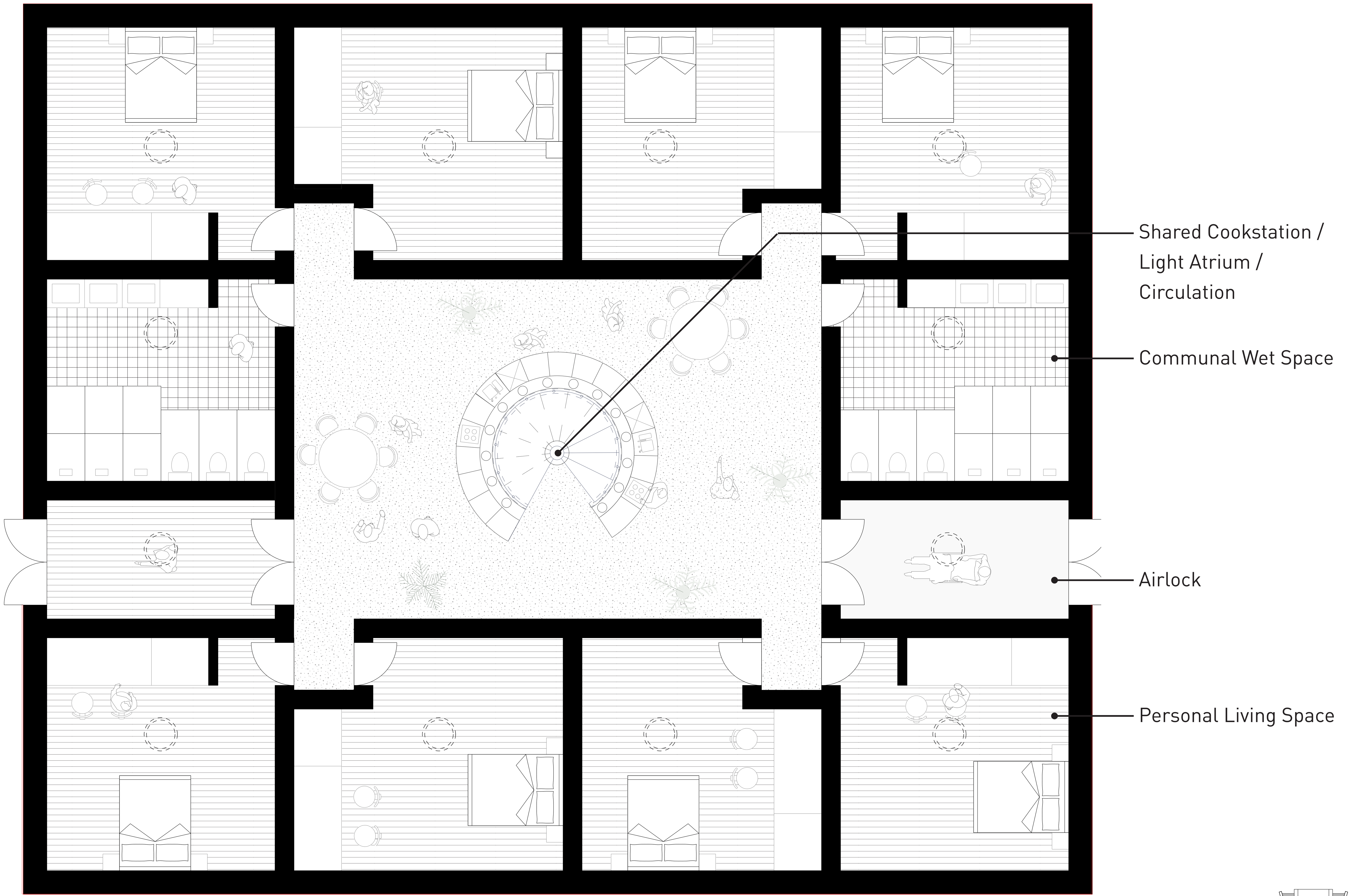
Surface Conditions

Living happens at night

Perspective Section 1:50

This 1:50 perspective section illustrates the vital relationship between the harsh surface and the protected subterranean dwelling. The central Solar Chimney anchors the home, piercing the 3-meter soil overburden to function simultaneously as a light scoop, ventilation stack, and circulation core. Below, the Lehm (earthen) living quarters utilize the soil's thermal mass to maintain a constant comfortable indoor temperature, while the peripheral gravel trench (left) safeguards the structure from moisture.

Floorplan 1:200



Living Quarter 1:50

Shared Housing Paradigm

The living quarters of the settlement are meant to house upwards of 16 people creating a space centered around light. The main point of meeting is the centralized atrium which houses the shared kitchenette, shared dining tables and the main attraction of the light core with integrated spiral stairs for connecting the settlers to the outside at night when temperatures fall to comfortable leves.

Sectional Strategy: Thermal & Passive

The project's primary environmental strategy is founded on the principle of decoupling the living habitat from the extreme climatic fluctuations of the surface world. By situating the residential cluster three meters below grade, the architecture leverages the immense thermal mass of the surrounding earth. This deep subterranean placement effectively dampens temperature swings that can range from -5°C in winter to 50°C in summer, maintaining a naturally stable interior environment at approximately 18°C year-round without the need for energy-intensive mechanical heating or cooling systems.

A sophisticated passive ventilation system, drives fresh air through the complex. The prominent vertical towers function as Solar Chimneys. Their dark-clad steel exterior absorbs solar radiation, heating the air inside the shaft and creating a powerful upward thermal draft. This stack effect continuously extracts stale, warm air from the central atrium. Simultaneously, cooler, fresh air is drawn in through strategically located ground-level scoops. This intake air passes over a subterranean gravel labyrinth, pre-cooling it before it is distributed into the living spaces, ensuring a constant supply of tempered air.

Section 1:200

Detail 1:20


Ground Level
80 mm Cellular Glass Insulation
70 cm Prefab Rammed Earth Blocks
Steel Support Frame
20 - 40 mm Recycled Concrete Aggregate
Drain Pipe phi = 16 cm
Concrete Strip Footing h = 500 mm
300 mm Sand Blinding
2-ply Damp Layer
160 mm Cellular Glass Insulation
300 mm R.C. Raft
100 mm Lehm Floor System
Bioluminescent Algae Chamber
Glass Reflectors
Steel Panel Light Chimney
Ceiling Artificial Lighting
350 mm R.C. Slab
160 mm Cellular Glass Insulation
160 mm Cellular Glass Insulation
120 mmHigh-Compressive Strength Geocomposite Drainage Mat
1 mm Geotextile
3000 mm min. Compacted Backfill
Growth Substrate
Vegetation