Cosmogonia of Crete: Critical zones as a continuous altered nature and the transition to the future

Major and minor stories of places from the past to the future

Graduation studio Transitional Territories
First Mentor | Luisa Maria Calabrese
Second First Mentor | Taneha Kuzniecow Bacchin
Second Mentor | Elena Longhin
Delegate of the Board of Examiners | Wing Yung

Georgia Kokolaki

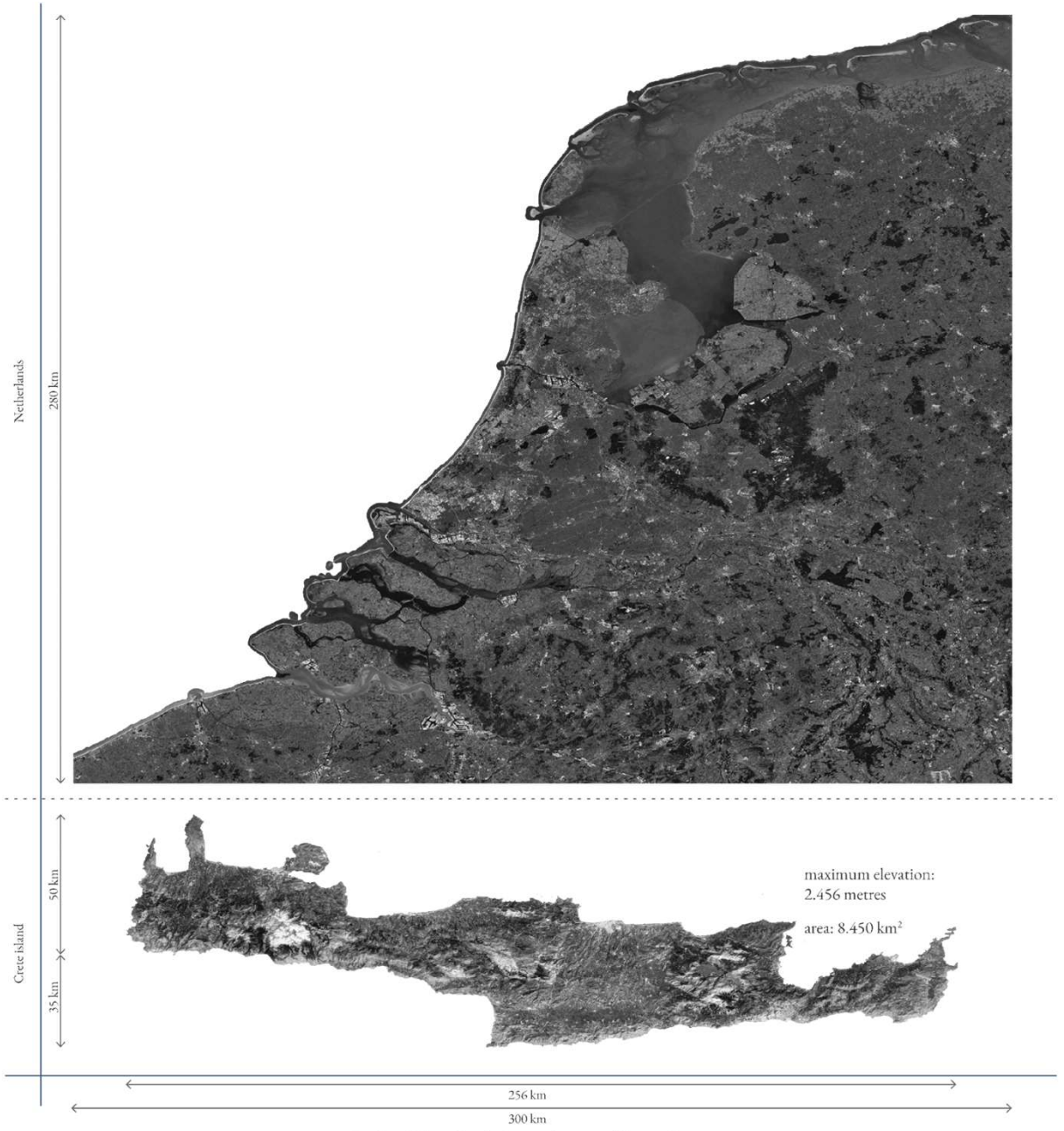
Introduction

Research Scope

The research scope involves a comprehensive exploration of the altered nature of the Cretan landscape, particularly through the lens of water scarcity and excess influenced by climate changes and human activities.

Context & Urgency

Scale



Scale of the island Crete, designed by author

Problem Statement

Extreme and **frequent climate changes have affected the island** of Crete.

Flooding and water scarcity have started **threatening existing infrastructure, coupled with the imminent threat of sea level rise.**

Finally, the **current planning and design instruments fail to incorporate these urgencies in their strategies** for the island**.**

Extremely low water level - Aposelemis dam, December 2023

Flooding events in Crete, 2020, Municipality of Hersonissos, Gouves

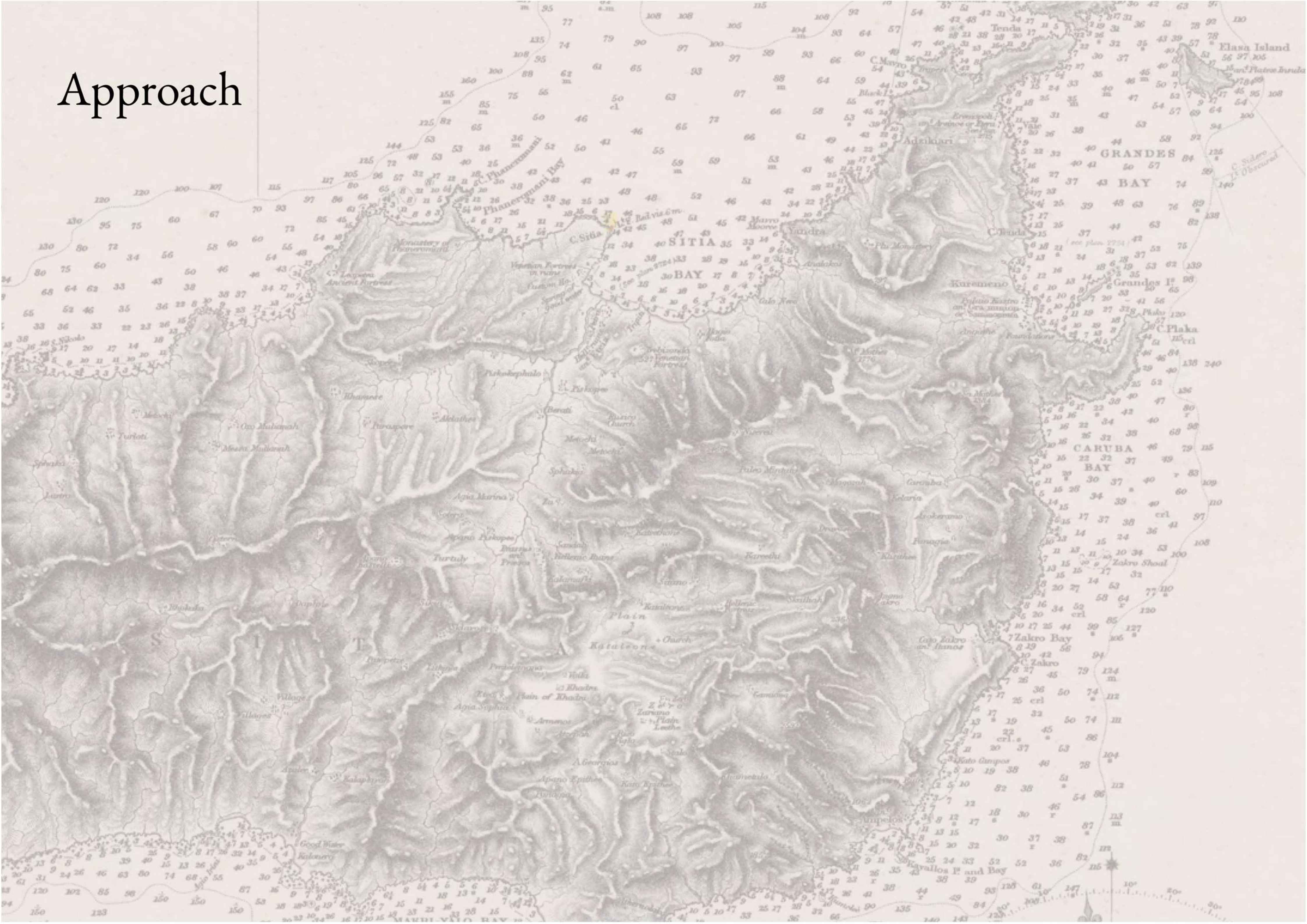
Research Question

"How can critical zones **effectively guide the island** through the complex system of environmental, cultural, and socioeconomic challenges **driven by uncertainty, climate changes and human activity** with a **focus on water scarcity and excess** ?

Extremely low water level - Aposelemis dam, December 2023

Flooding events in Crete, 2020, Municipality of Hersonissos, Gouves

Approach



Elasa Island
Tenda
C. Mavro
GRANDES BAY
C. Tenda
Grandes I.s
C. Plaka
Phaneromani Bay
C. Sitia
SITIA BAY
CARUBA BAY
Zakro Shoal
Zakro Bay
C. Zakro
Kavallos I.s and Bay

Current planning & design instruments

Current planning instruments used in Greece:

- present limitations in representing the **dynamic nature of environmental elements and processes**
- do not acknowledge **climate change impacts in space**

There is a need for a more **flexible and radical approach**

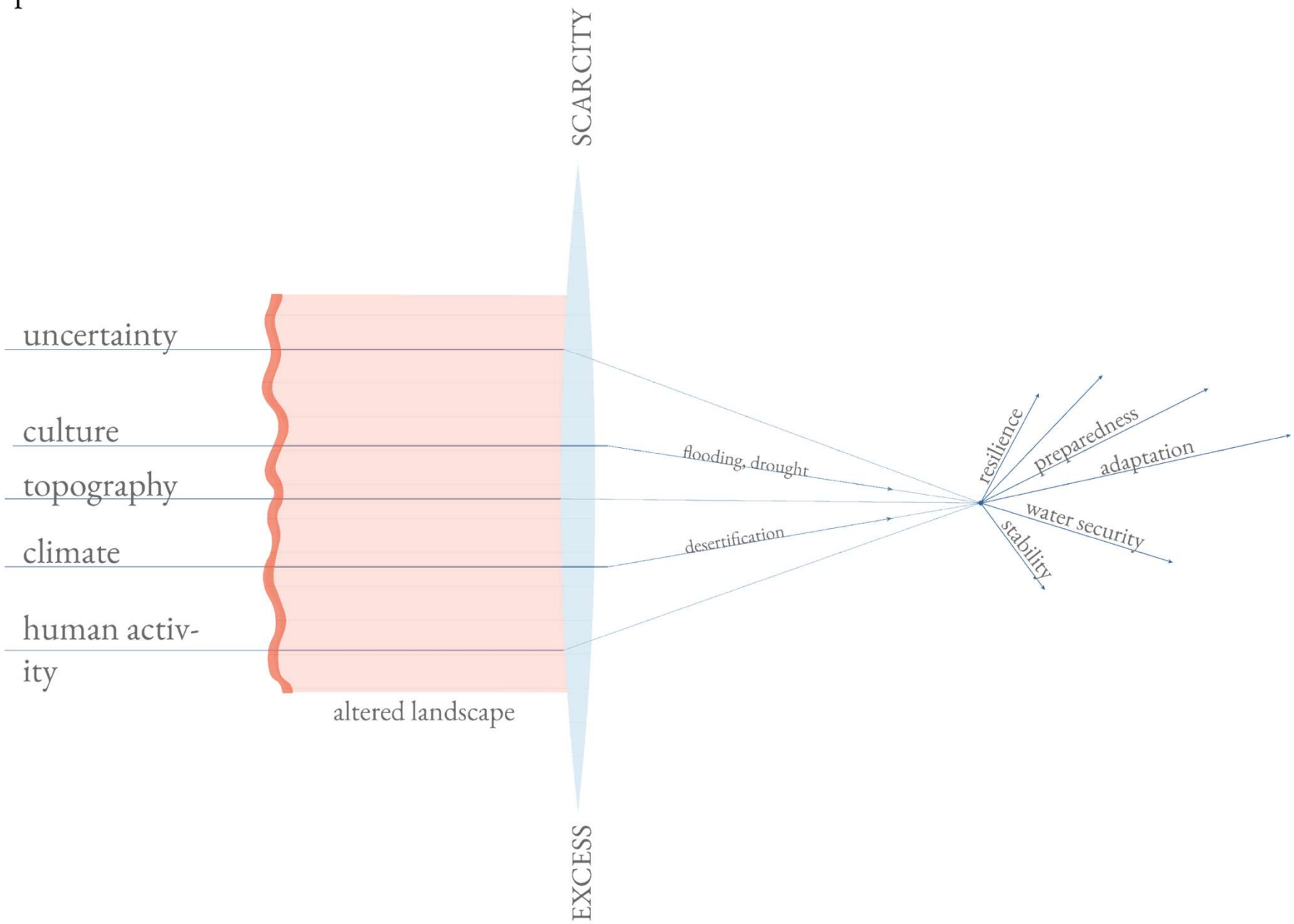
There is a need for a more **community-inclusive approach** by giving local communities more power, and responsibilities.

The project:

- presents a more sensitive approach with water and soil
- embraces **climate change impacts in space** and enhances the island's preparedness
- places the island of Crete as a paradigm for islands facing similar challenges globally.

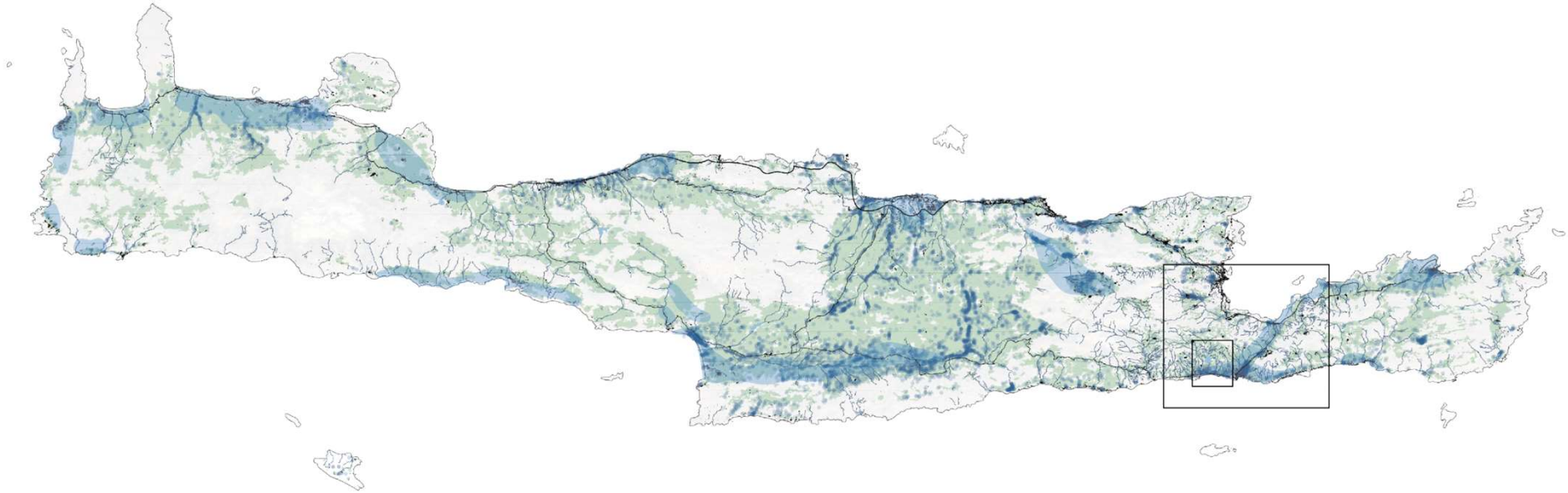
Selection of spatial planning instruments in Greece / Crete, sources: ΓΠΣ, Aquaman research project, Strategic Planning Crete

Conceptual Framework



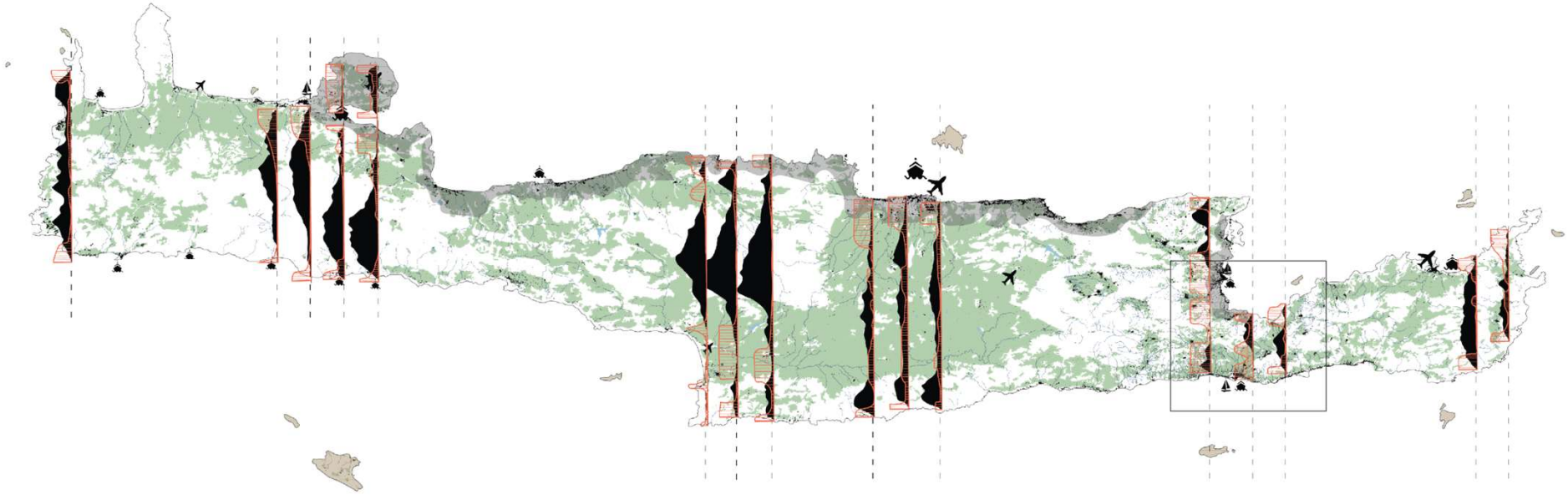
Conceptual Framework, designed by author

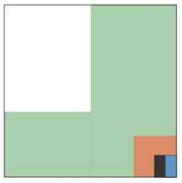
Designing method



Diagnosis

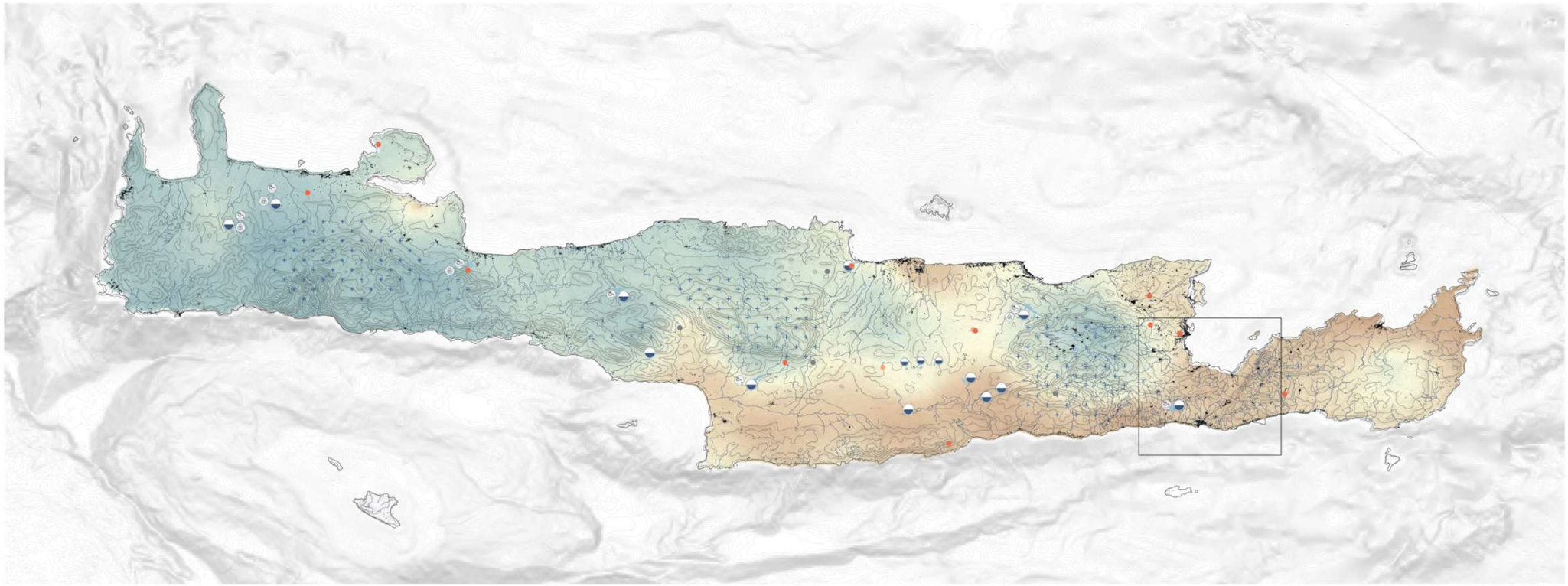
Island of Crete



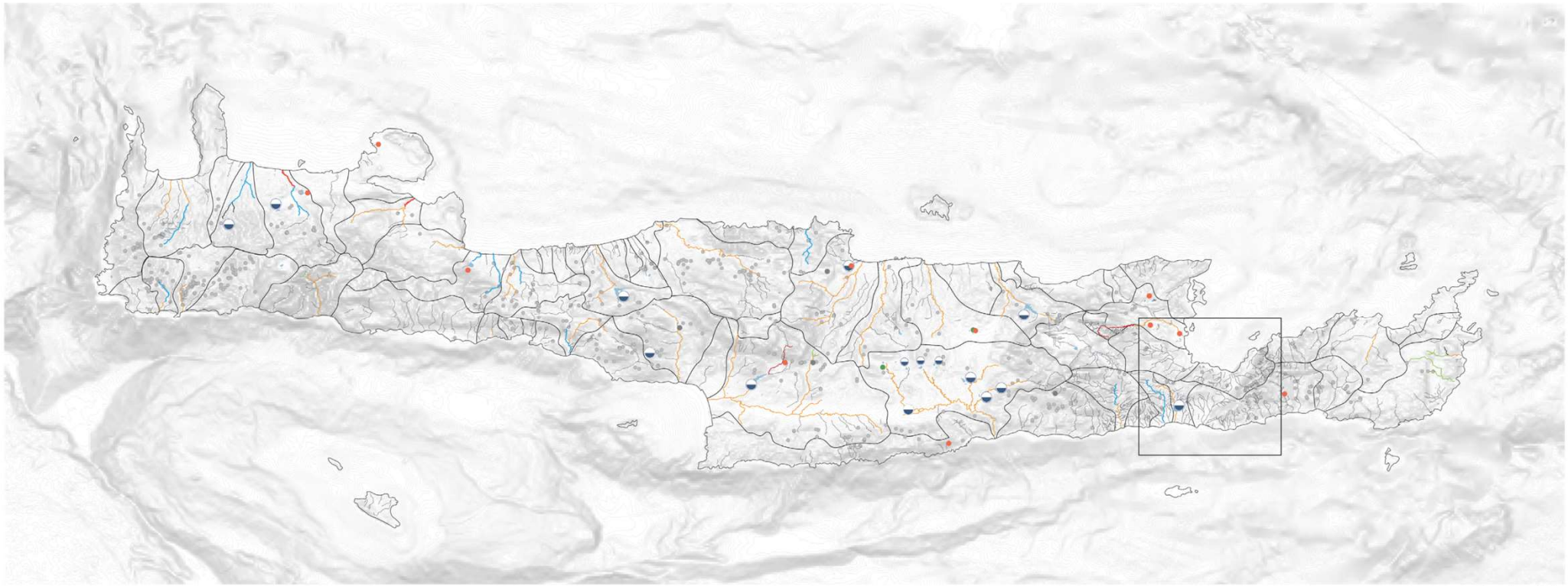


2 %	Built environment
6 %	Pastures
71 %	Agricultural areas
1 %	Water bodies
100 %	Total island area
	Highly touristic zone

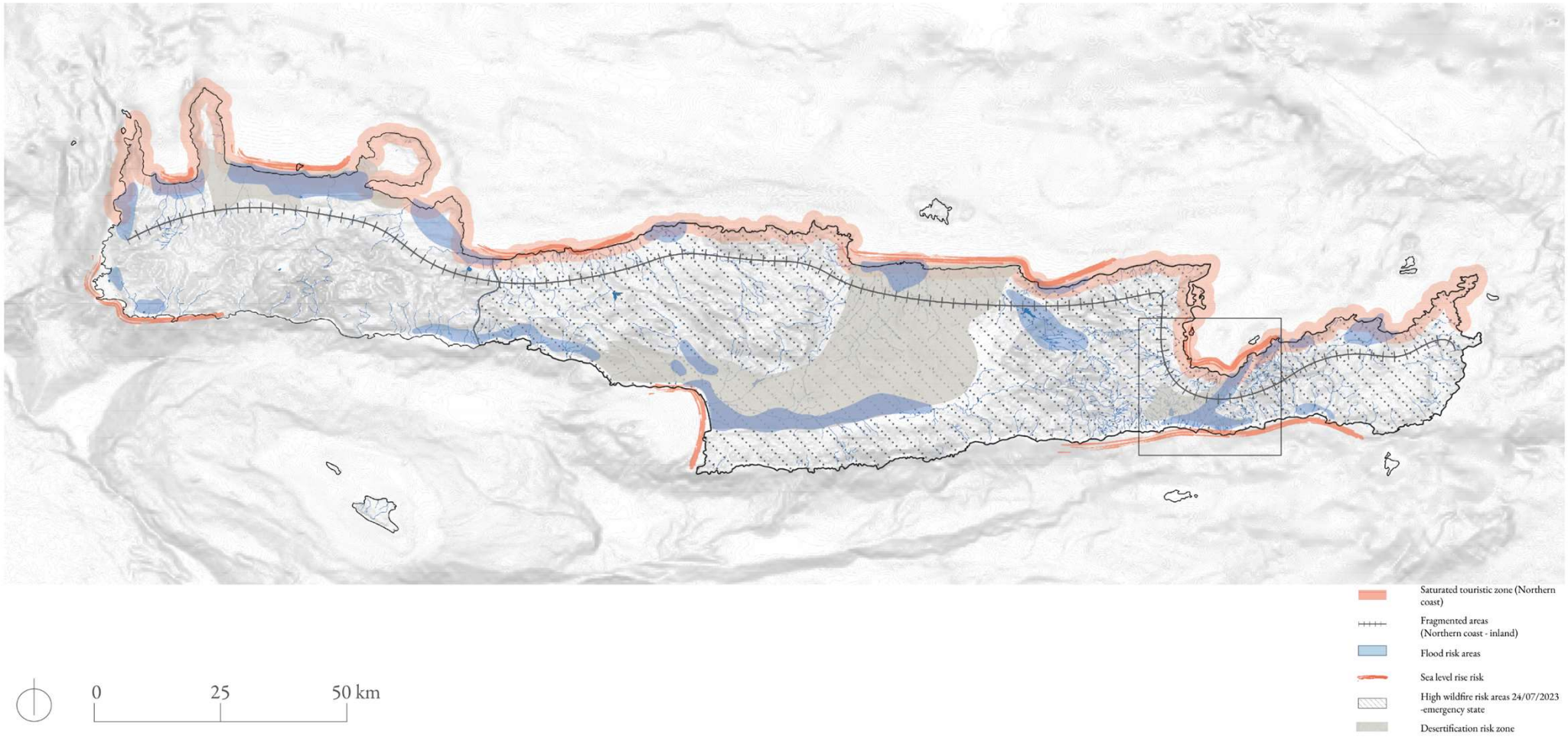
Water origins



River system (Seasonality)



Current challenges



Contemporary water collection means

Water reservoir at Ierapetra, 2023

Water reservoir at Vainia, Ierapetra, 2023

Low water levels of water reservoir at Lasithi, created to prevent from flooding and collect the water for agricultural water supply, 2023

Water collection - Dams

Bramiana dam extremely low water level, December 2023

Significantly lowered water level in the Aposelemis dam, December 2023

Timeframe

Climate Scenarios based on the very high greenhouse gas emissions scenario (SSP5-8.5+ Low Confidence). To indicate the potential impact of deeply uncertain ice sheet processes, a Low Confidence scenario under SSP5-8.5 by IPCC is chosen.

2023
Annual temperature: 0.89 °C
Current sea level: 101 (± 4.0) mm

2040
Annual temperature: 2 °C
Sea level rise change: 0.16 m

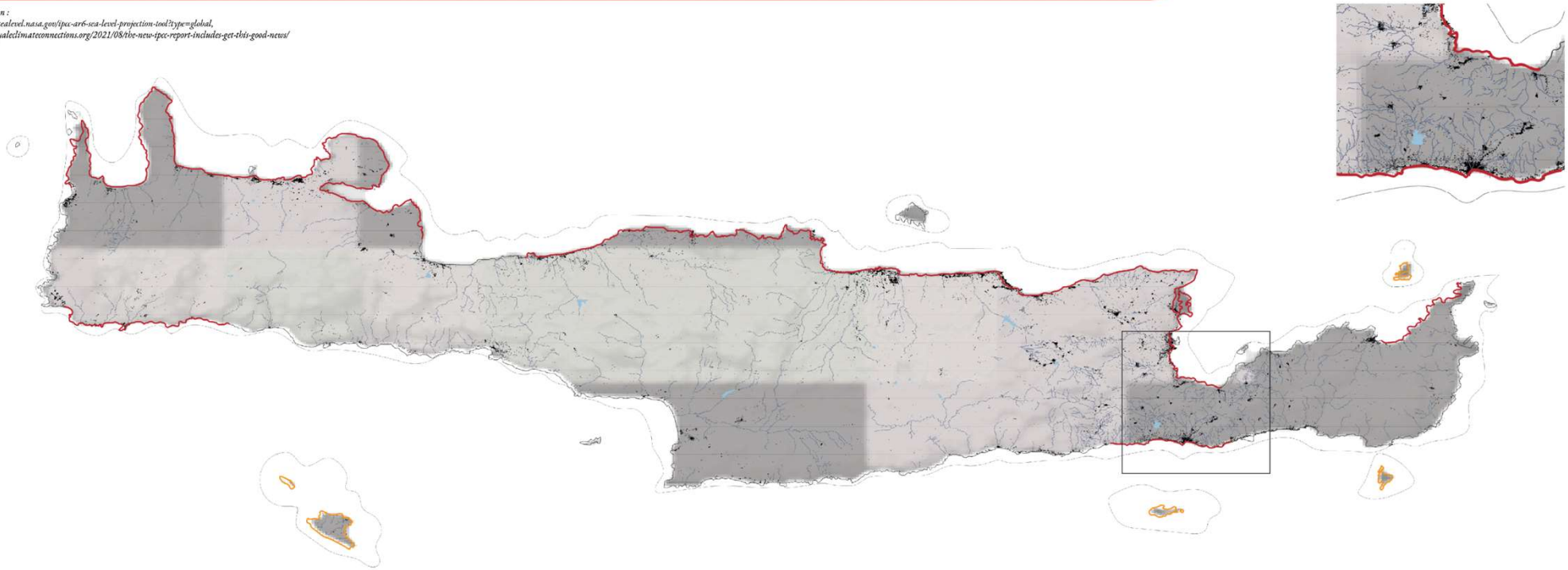
2060
Annual temperature: 2.8 °C
Sea level rise change: 0.33 m

2100
Annual temperature: 4.4 °C
Sea level rise change: 0.88 m

2150
Annual temperature: 5 °C
Sea level rise change: 1.98 m

**consider 0 during 1993*

Based on :
https://sealevel.nasa.gov/ipcc-ar6-sea-level-projection-tool?type=global,
https://yaleclimateconnections.org/2021/08/the-new-ipcc-report-includes-get-this-good-news/

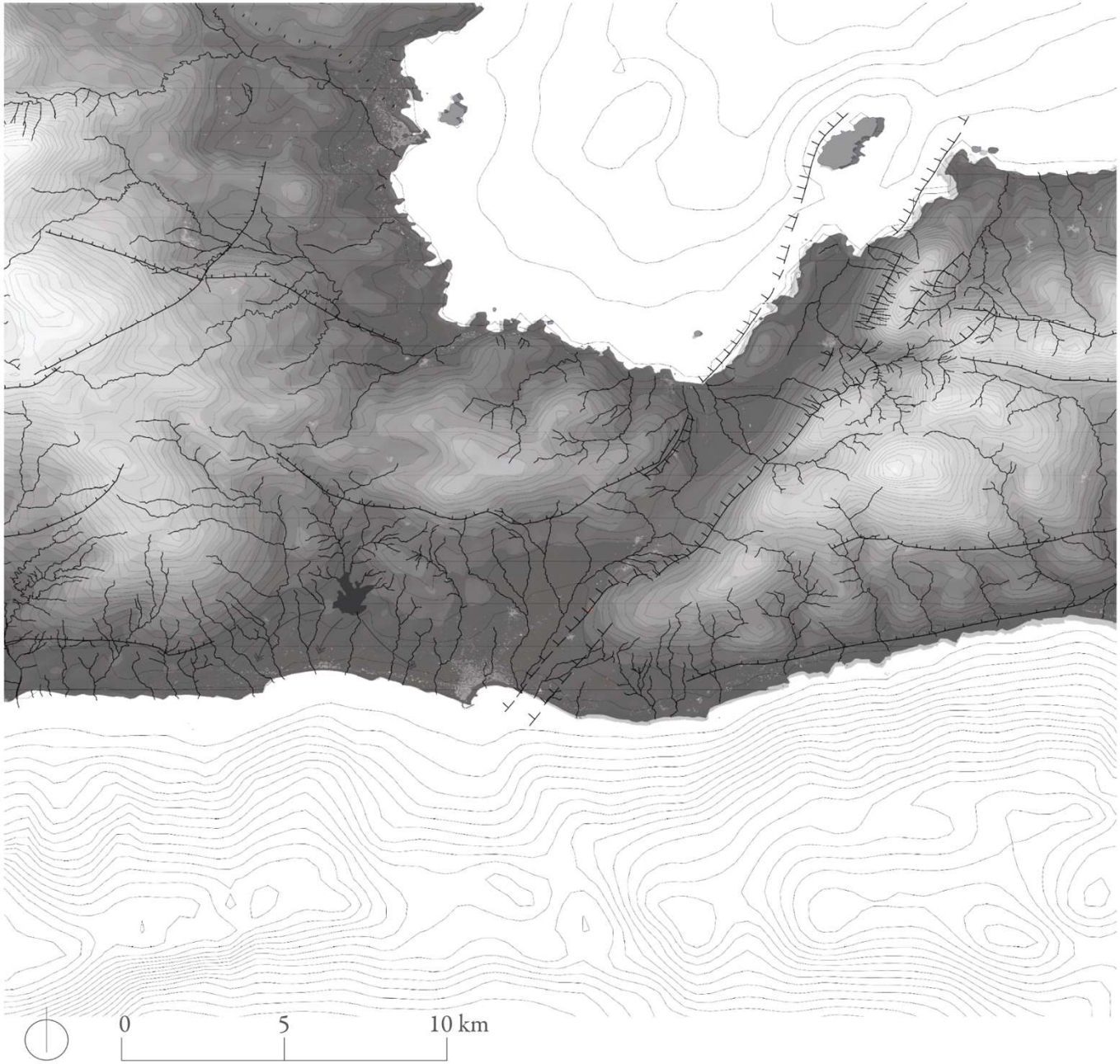


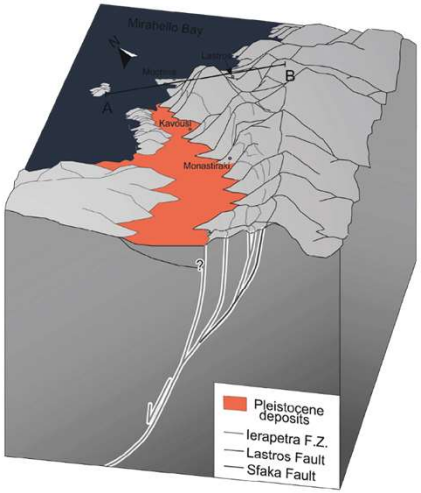
High risk of sea lever rise
Lower risk of sea lever rise
Built environment
River System
Palaioshoreline map during Last Glacial Maximum

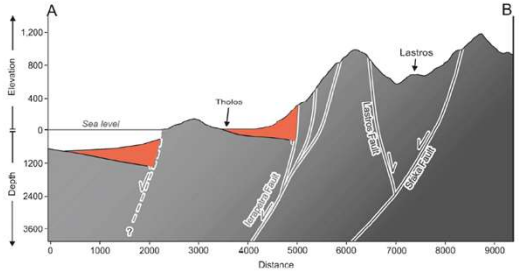
0 25 50 km

Further Research - Isthmus of Ierapetra

Topography







Elevation (low-high)

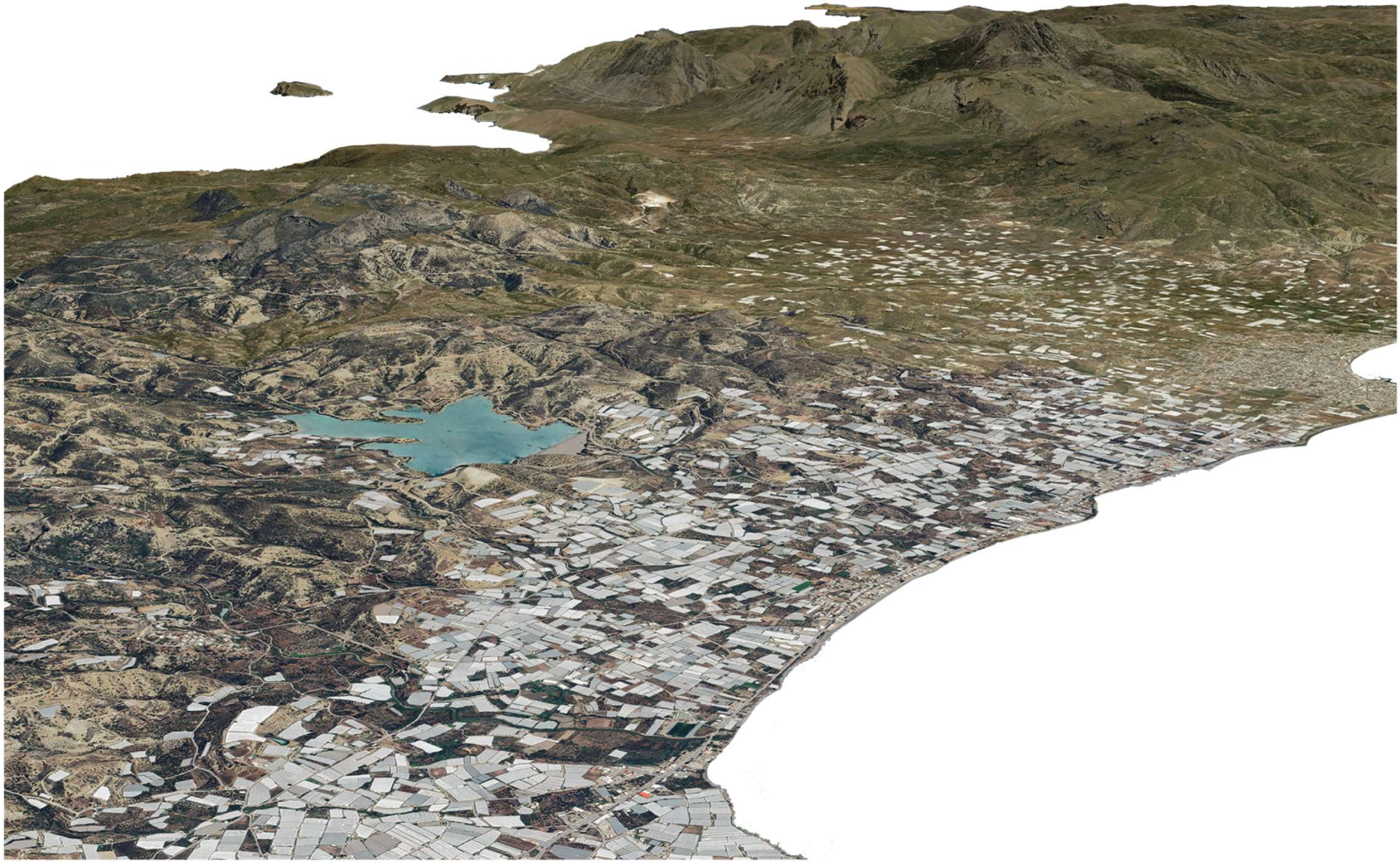
Fault zone

Dam

Built environment

Main road network

Topography

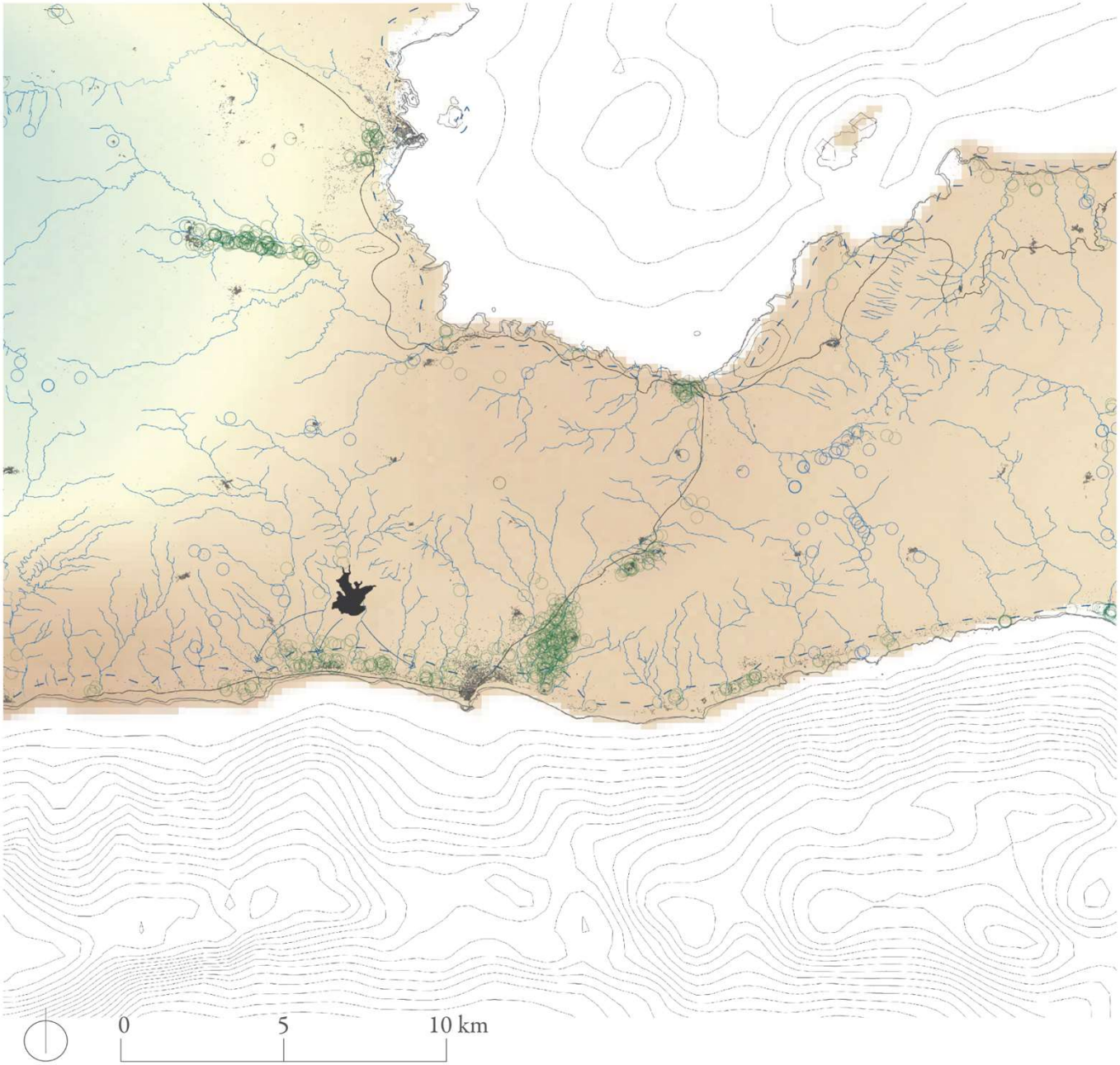


Isthmus of Ierapetra views

Southern part of Isthmus of Ierapetra, greenhouses, December 2023

Pachia Ammos, Northern part of art of Isthmus of Ierapetra, December 2023

Water systems



1900
900
500
annual precipitation mm

Wells

Springs

Dam

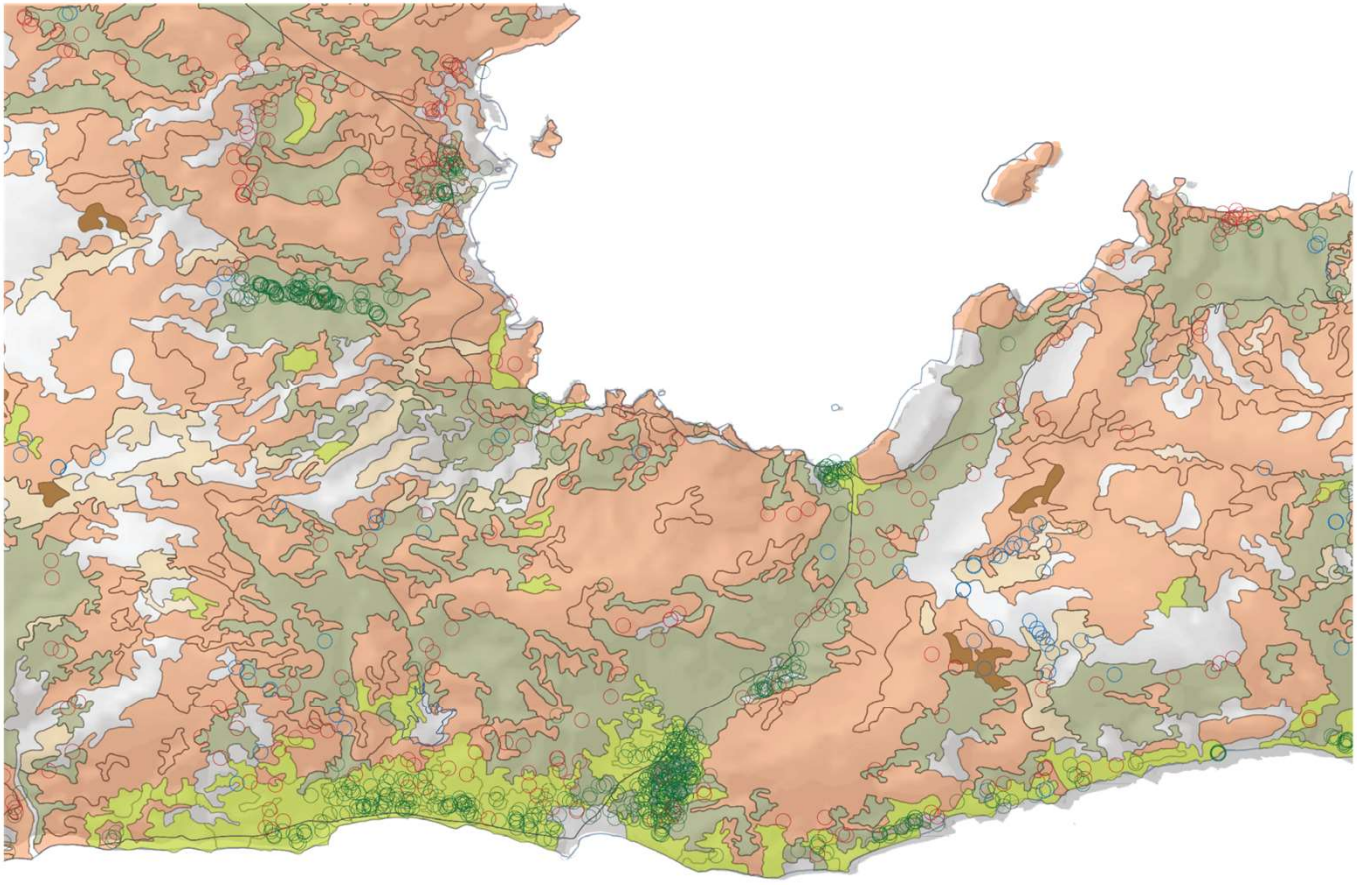
Built environment

Main road network

River system

Future coastline 2150

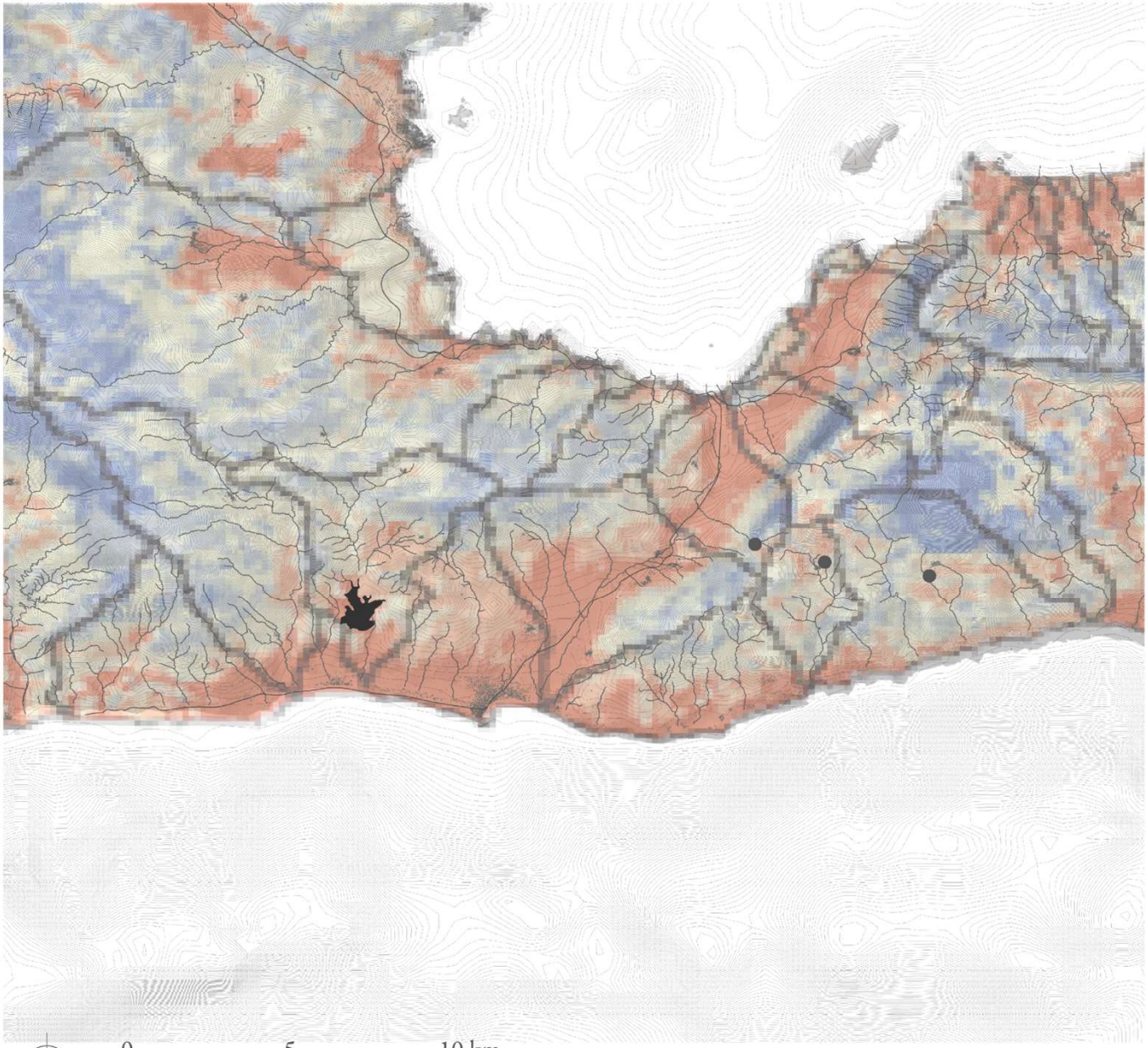
Agriculture and groundwater extraction



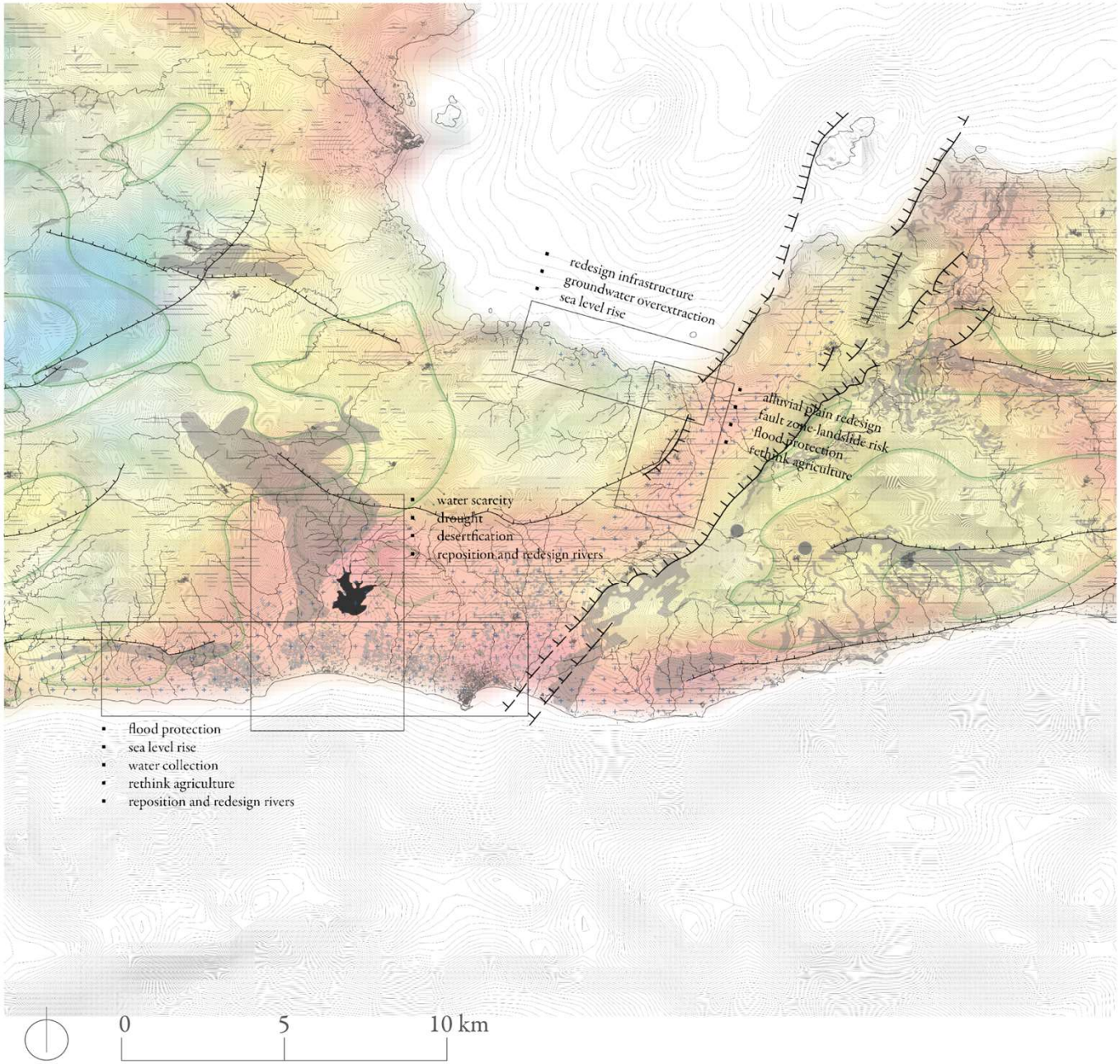
Wells
Springs
Olive groves
Vegetation, natural grasslands
Pastures
Vineyards
Lansape dominated by green-houses, irrigated land
Main road network

0 5 10 km

Flood risk


0
5
10 km
Very low flood risk
Low flood risk
Moderate flood risk
High flood risk
Very high flood risk
Dam
Built environment
Main road network
River system
Future coastline 2150
River basins
Historical floodings

Sensitivity to desertification - Vulnerable regions



Not affected
Fragile
Critical
Agriculture
Srips of the extremes
Fault zone
Dam
Built environment
High landslide risk zone
River system
Contours per 10 m
Existing forests

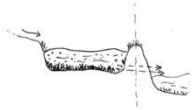
Design Proposal

Planning & Design Principles

Water risk management

1. Collect and filter water

vegetation to filter water, stabilize soil, accomodate habitats



sedimentation basins, capture-reuse sediment & improve water quality

2. Store and distribute water

water retention landscapes

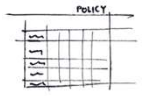
ponds and wetlands to store and manage storm water runoff

Economy shift

1. shift towards regenerative agricultural activities (climate-resilient)

2. enhance agricultural village economy

3. policy changes that support sustainable land use, water management, and agricultural practices.

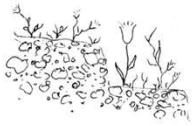


4. alternative tourism activities: eco-tourism

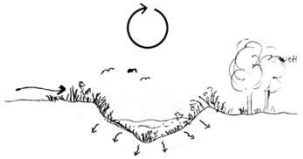
Natural ecosystem restoration

1. reforestation

2. soil regeneration



3. river restoration (riparian buffers,)

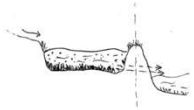


Planning & Design Principles

Water risk management

1. Collect and filter water

vegetation to filter water, stabilize soil, accomodate habitats



sedimentation basins, capture-reuse sediment & improve water quality

2. Store and distribute water

water retention landscapes

ponds and wetlands to store and manage storm water runoff

Seasonal variations, resilient, dynamic landscape

Take advantage of the topography to harvest water and use it throughout the year

Planning & Design Principles

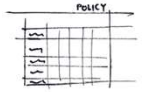
Regenerative agricultural activities (climate-resilient), temporarily flooded agricultural zone

Economy shift

1. shift towards regenerative agricultural activities (climate-resilient)

2. enhance agricultural village economy

3. policy changes that support sustainable land use, water management, and agricultural practices.



4. alternative tourism activities: eco-tourism

Enhance agricultural village economy, sustain food production

Planning & Design Principles

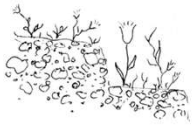
Reforestation efforts

River restoration

Natural ecosystem restoration

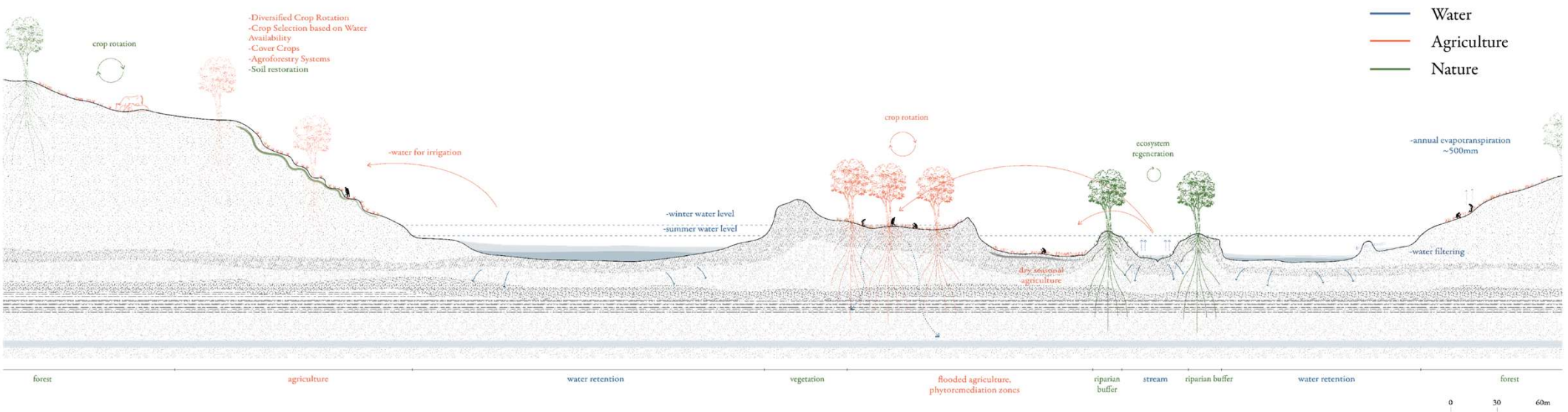
1. reforestation

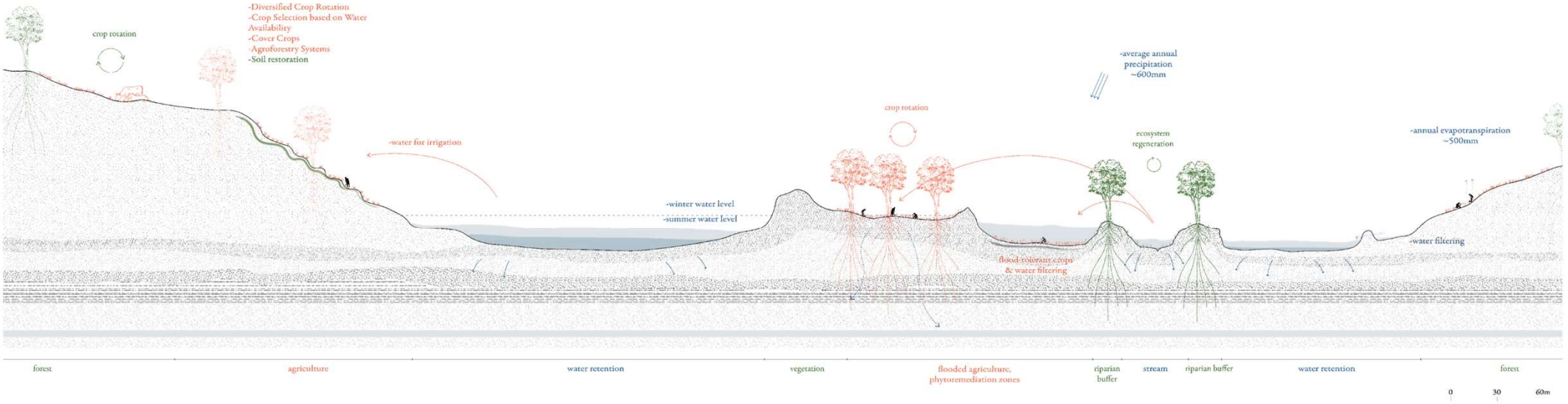
2. soil regeneration



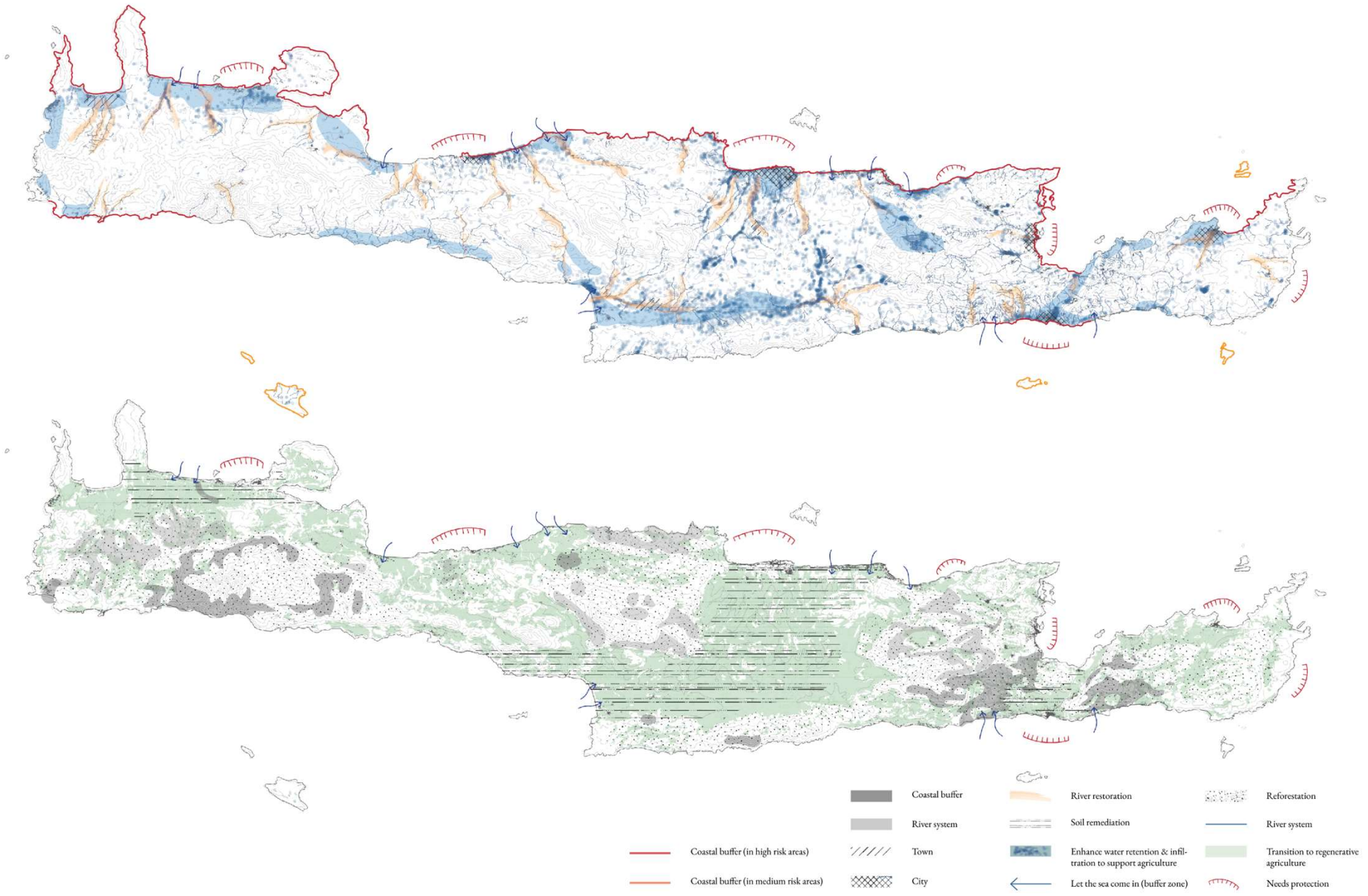
3. river restoration (riparian buffers,)

Synergies

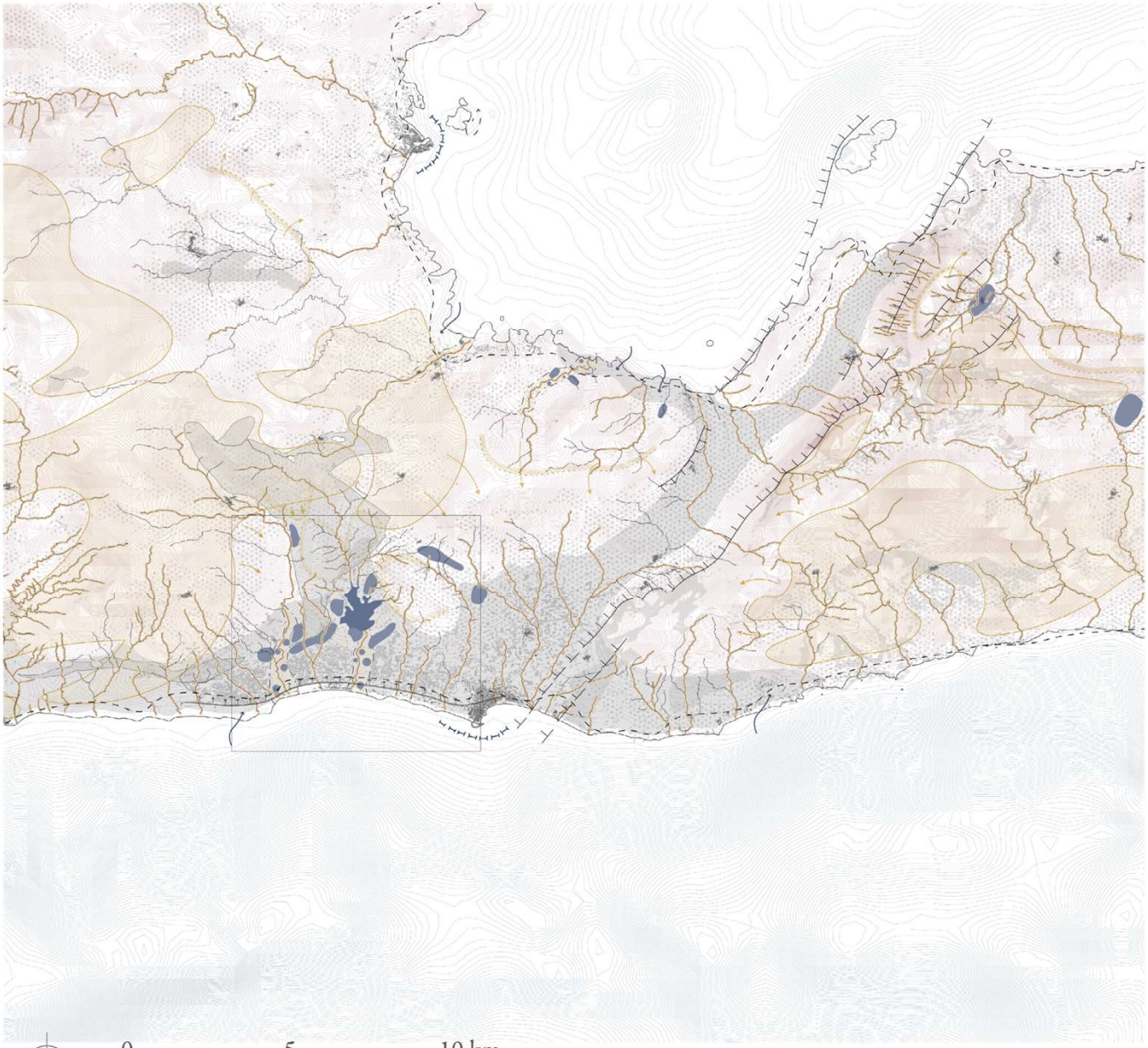

Water
Agriculture
Nature
crop rotation
-Diversified Crop Rotation
-Crop Selection based on Water Availability
-Cover Crops
-Agroforestry Systems
-Soil restoration
-water for irrigation
-winter water level
-summer water level
crop rotation
ecosystem regeneration
-annual evapotranspiration ~500mm
-water filtering
dry seasonal agriculture
forest
agriculture
water retention
vegetation
flooded agriculture, phytoremediation zones
riparian buffer
stream
riparian buffer
water retention
forest
0
30
60m


crop rotation
-Diversified Crop Rotation
-Crop Selection based on Water Availability
-Cover Crops
-Agroforestry Systems
-Soil restoration
-water for irrigation
-winter water level
-summer water level
-average annual precipitation ~600mm
crop rotation
ecosystem regeneration
-annual evapotranspiration ~500mm
-water filtering
flood-tolerant crops & water filtering
forest
agriculture
water retention
vegetation
flooded agriculture, phytoremediation zones
riparian buffer
stream
riparian buffer
water retention
forest
0
30
60m

Planning & Design Strategy



Planning & Design Transect



0 5 10 km

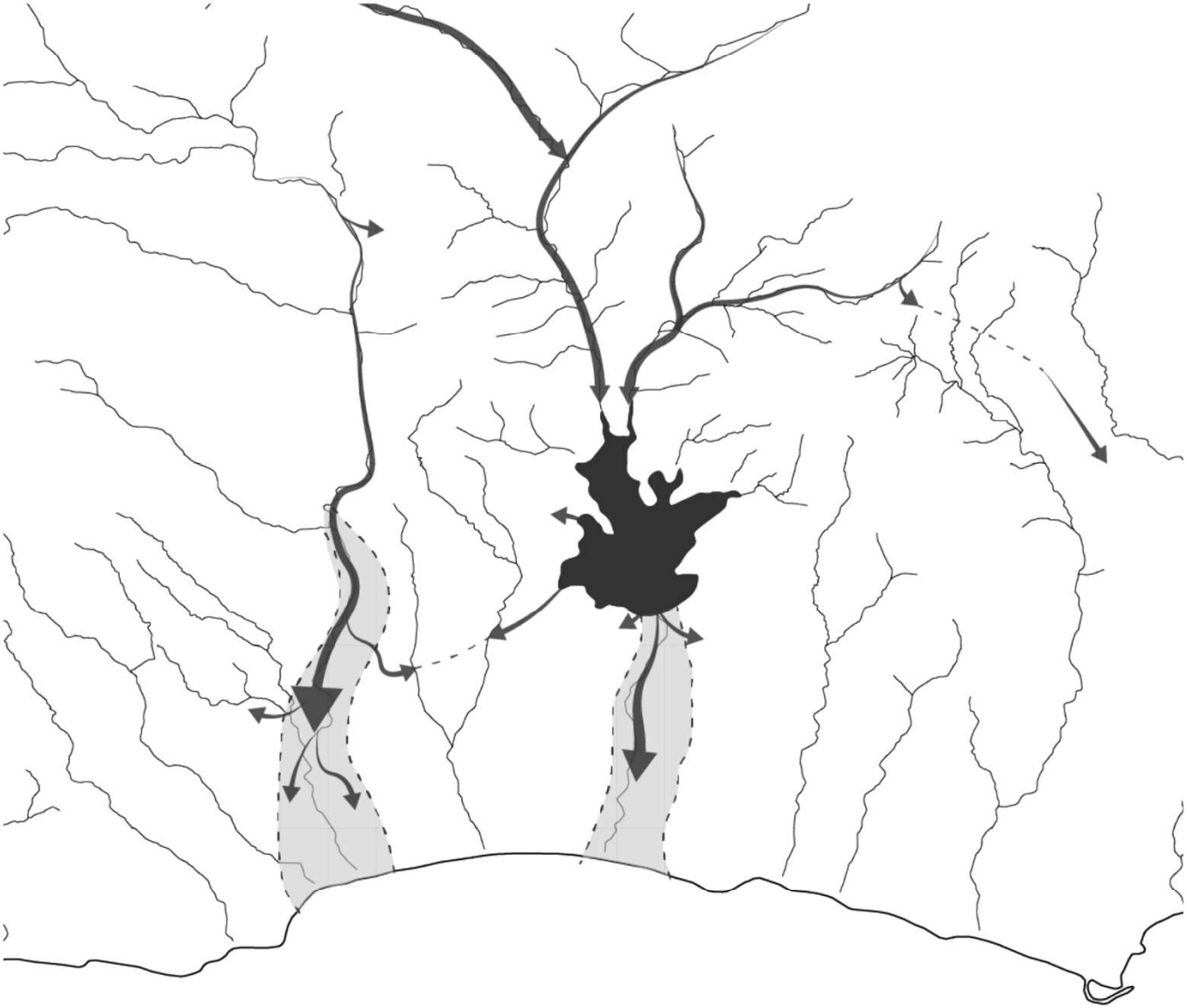
Reforestation
Existing forests
Future coastline 2150
Riparian buffer zone (main channel)
Lowest elevation zone & sensitive to desertification
Dam
River system
Greenhouses
Water retention landscape
Built environment
Alluvial river plain-water discharge
High landslide risk zone
Let sea come in (Create Buffer zone)
Fault zones
Historical floods

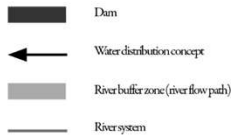
Alteration by humans

Built environment
Main road network
Secondary road network
Dam
Greenhouses

0 2 4 km

Water Distribution Concept





Initial Interventions

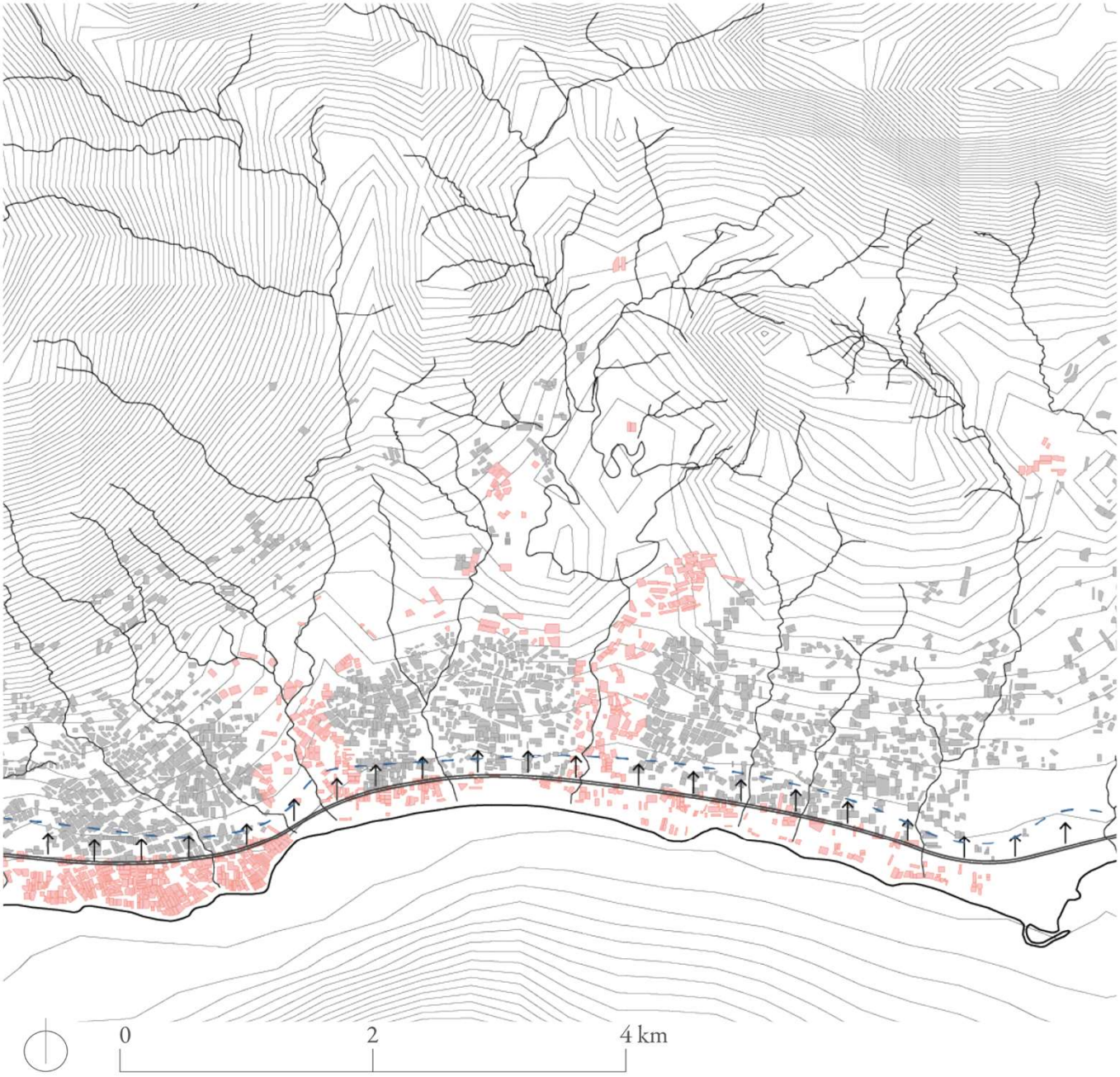
Dam

Greenhouses

Waterr retention & infiltration landscapes

River restoration zone

Coastal buffer & move greenhouses



Dam

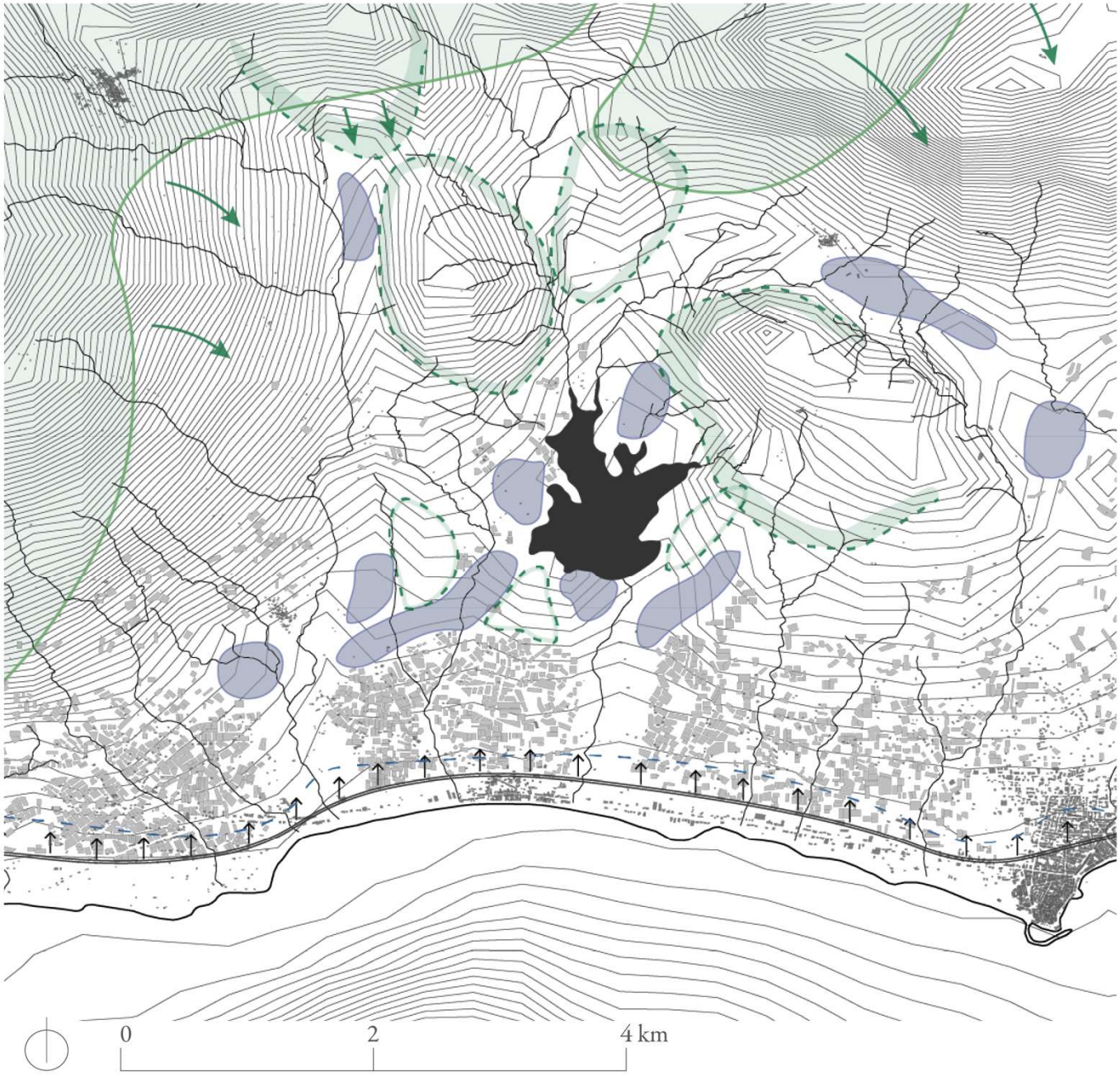
Greenhouses that need to be removed

Greenhouses

Coastline gradual movement

Future coastline 2150

Water retention & Forest expansion



Dam

Water retention basins

Vulnerable zone to flooding / desertification

Future coastline 2150

New forests

Forest expansion

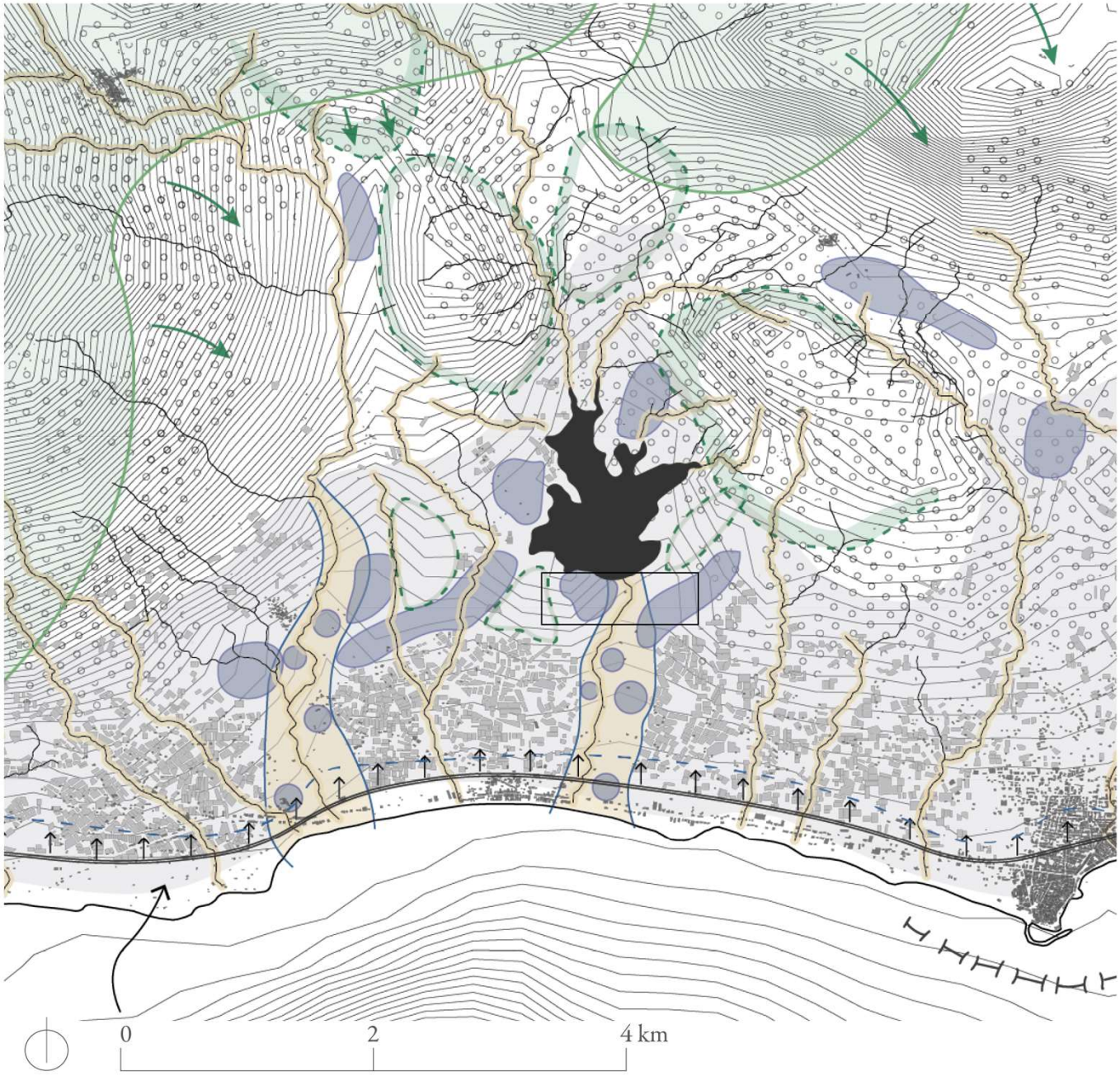
Greenhouses

Built environment

Existing forests

Coastline movement

Overall Design Strategy



Dam

Water retention basins

Vulnerable zone to flooding / desertification

Water retention basins with recreation

New forests

River buffer zone

Greenhouses

Built environment

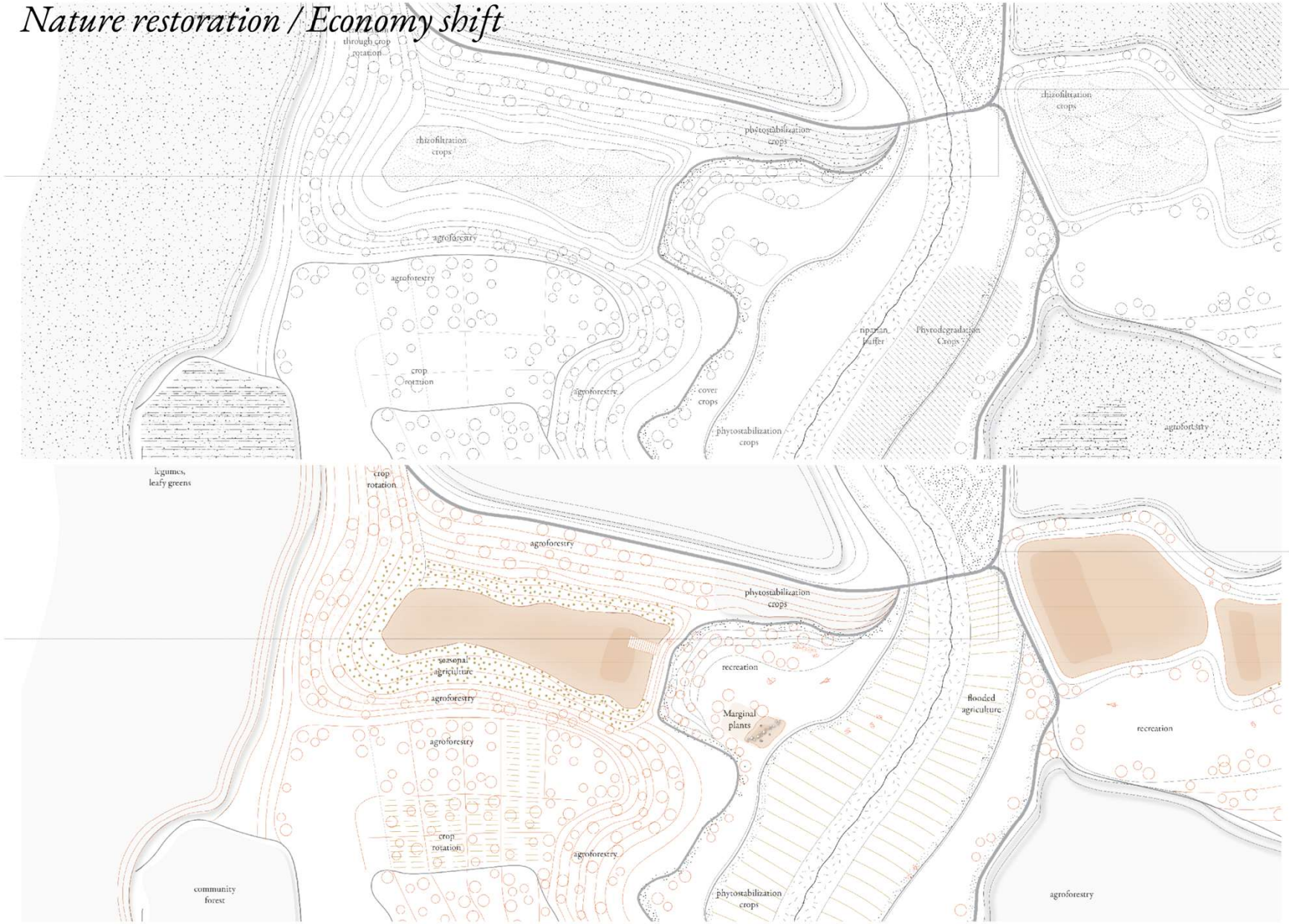
Existing forests

Coastline movement

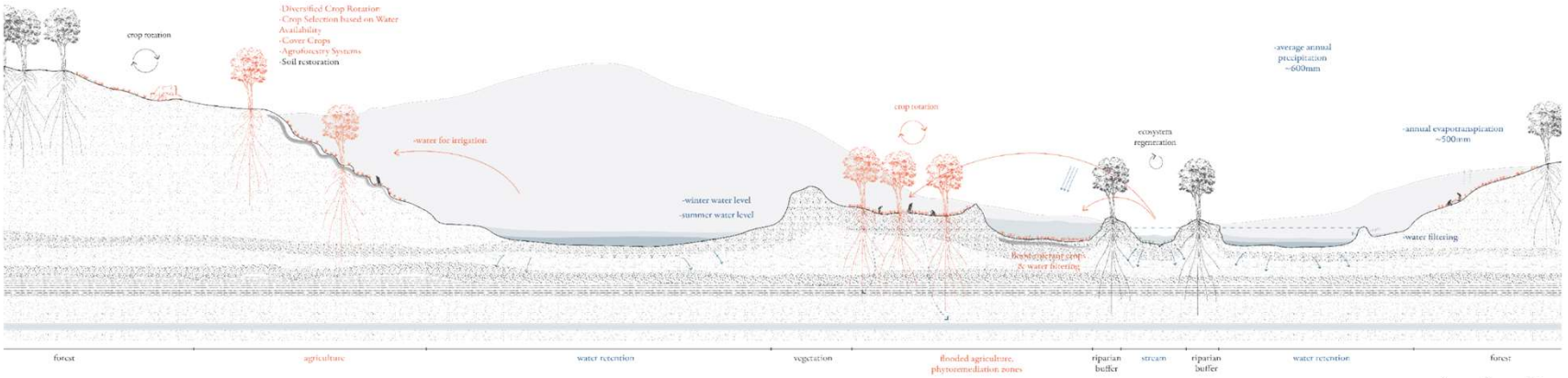
Regenerative agriculture

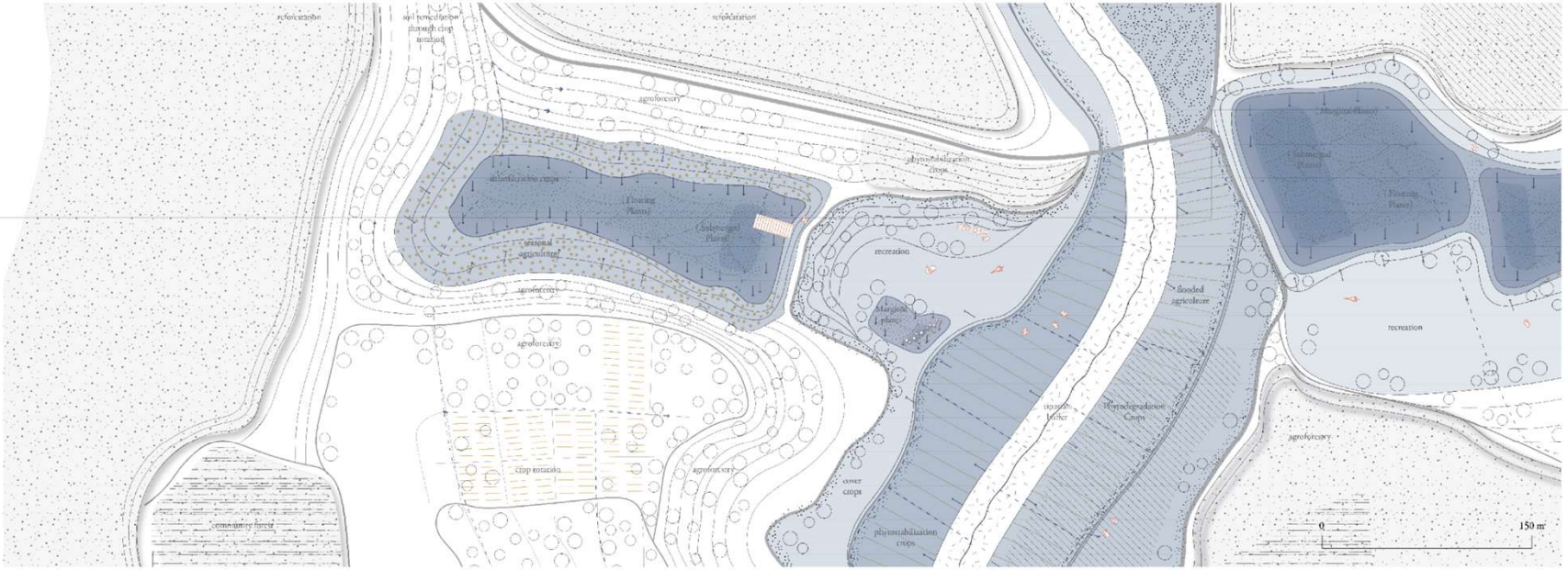
Design Synthesis

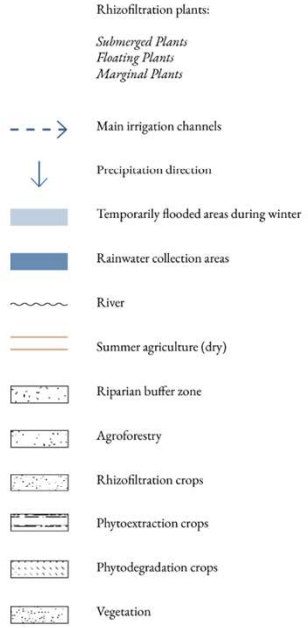
Nature restoration / Economy shift



Design Synthesis
Terraforming



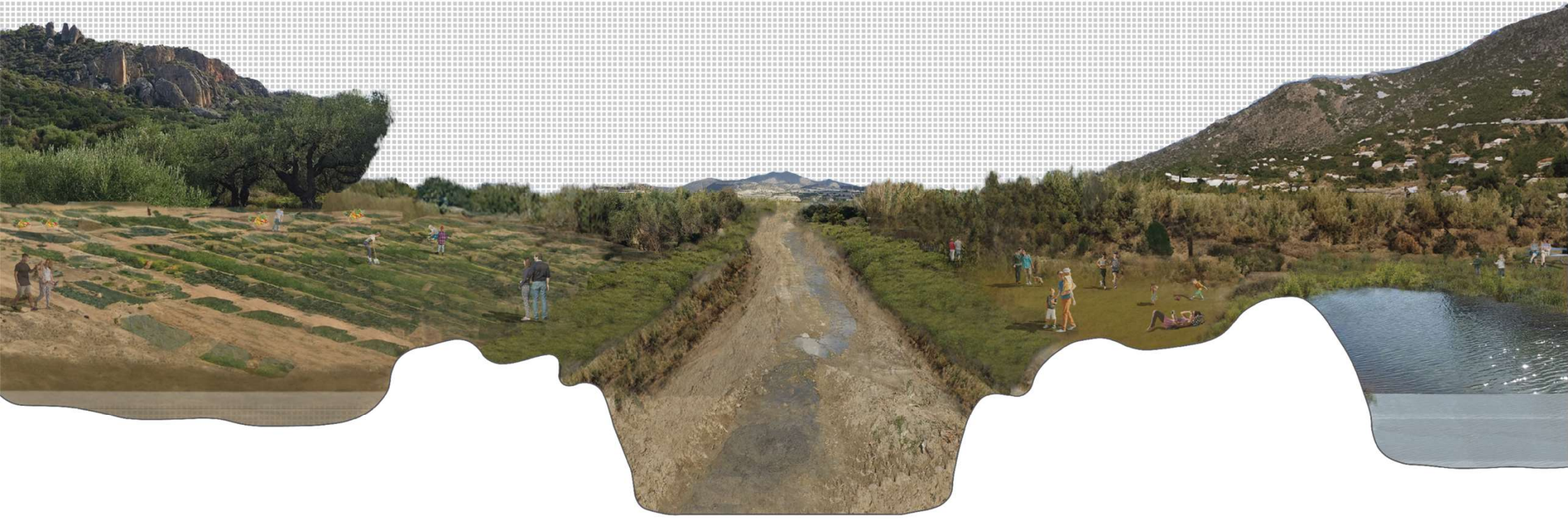




Community involvement

Regenerative agriculture

Ecosystem restoration



Conclusions

Lessons Learned

Rethink and redesign the rivers and their alluvial plains together with water retention landscapes.

Rethink the current agricultural practices and embrace regenerative and climate-resilient ones.

Advocate for flexible and sensitive approach that embraces uncertainty and adaptability.

Interconnected nature of environmental, social, and economic factors

Climate-resilient future, that becomes a paradigm not only for Crete

Thank you for your attention!

Georgia Kokolaki