from "Stone City" to "Hidden Water Region"

visualize and value the invisible water flows in Matera



P5 Presentation Wenting Gao 5565804 2023.06.22

01 Sassi di Matera: from stone city to hidden water city

Outer form: stone city





Basilicata region

Matera Province

Municipality of Matera

UNESCO World Heritage Site in 1993

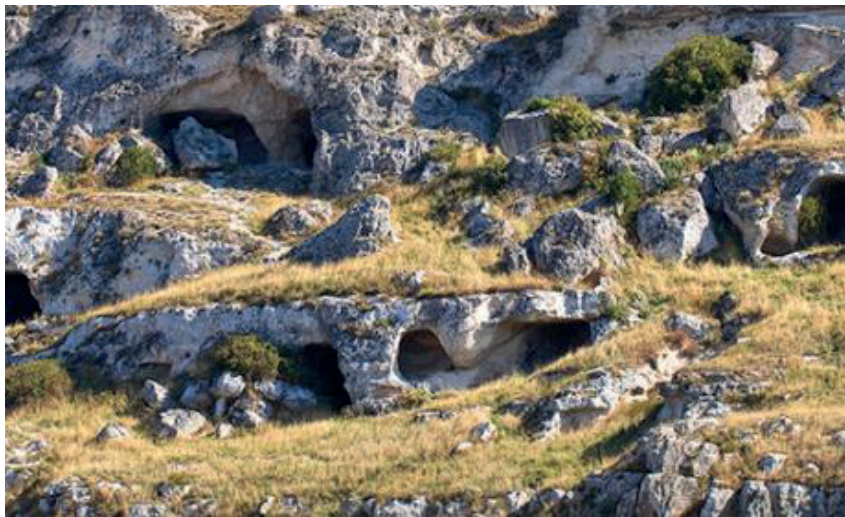
European Capital of Culture in 2019

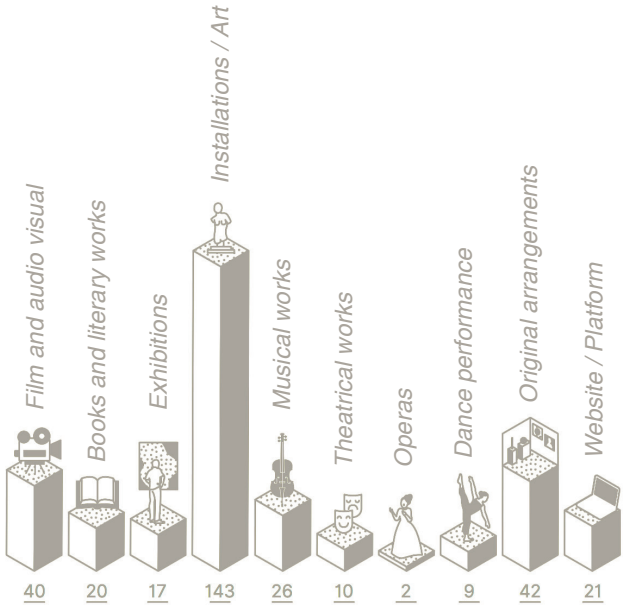






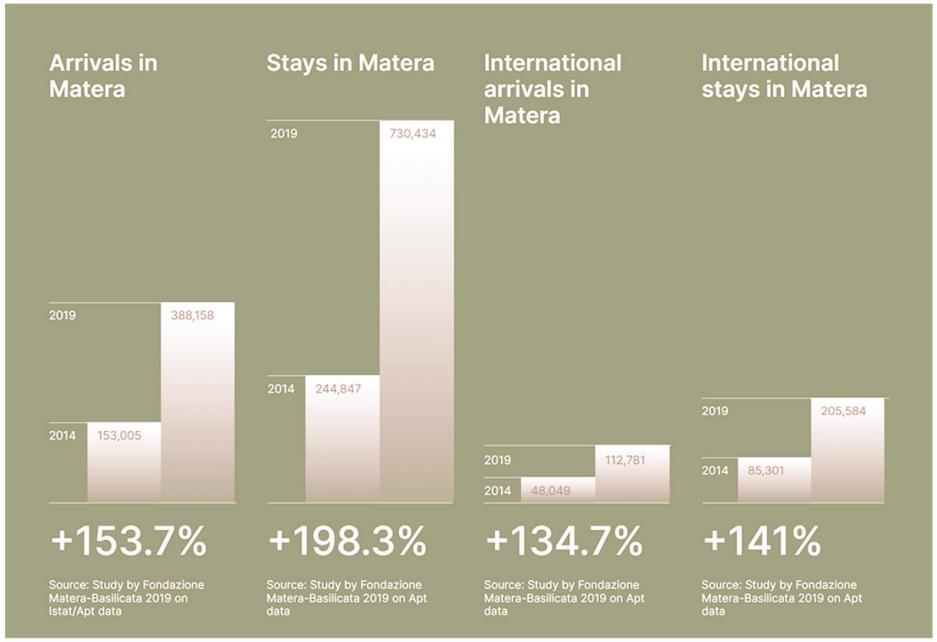


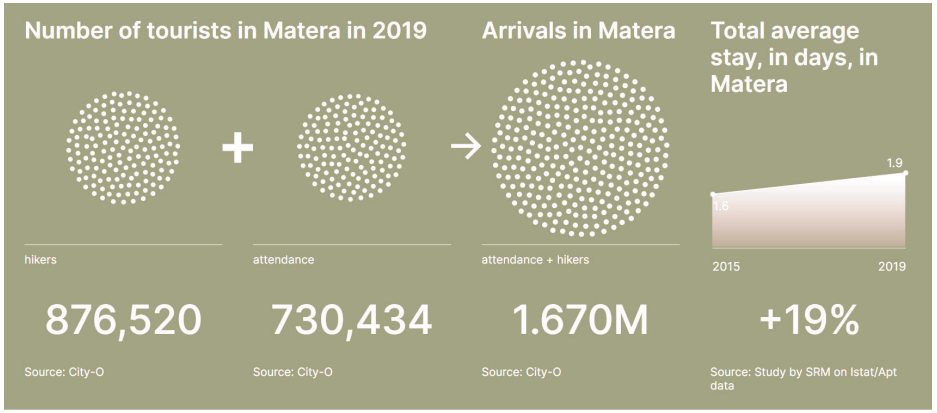






Cultural activities and works in 2019





Statistics of tourism in 2019

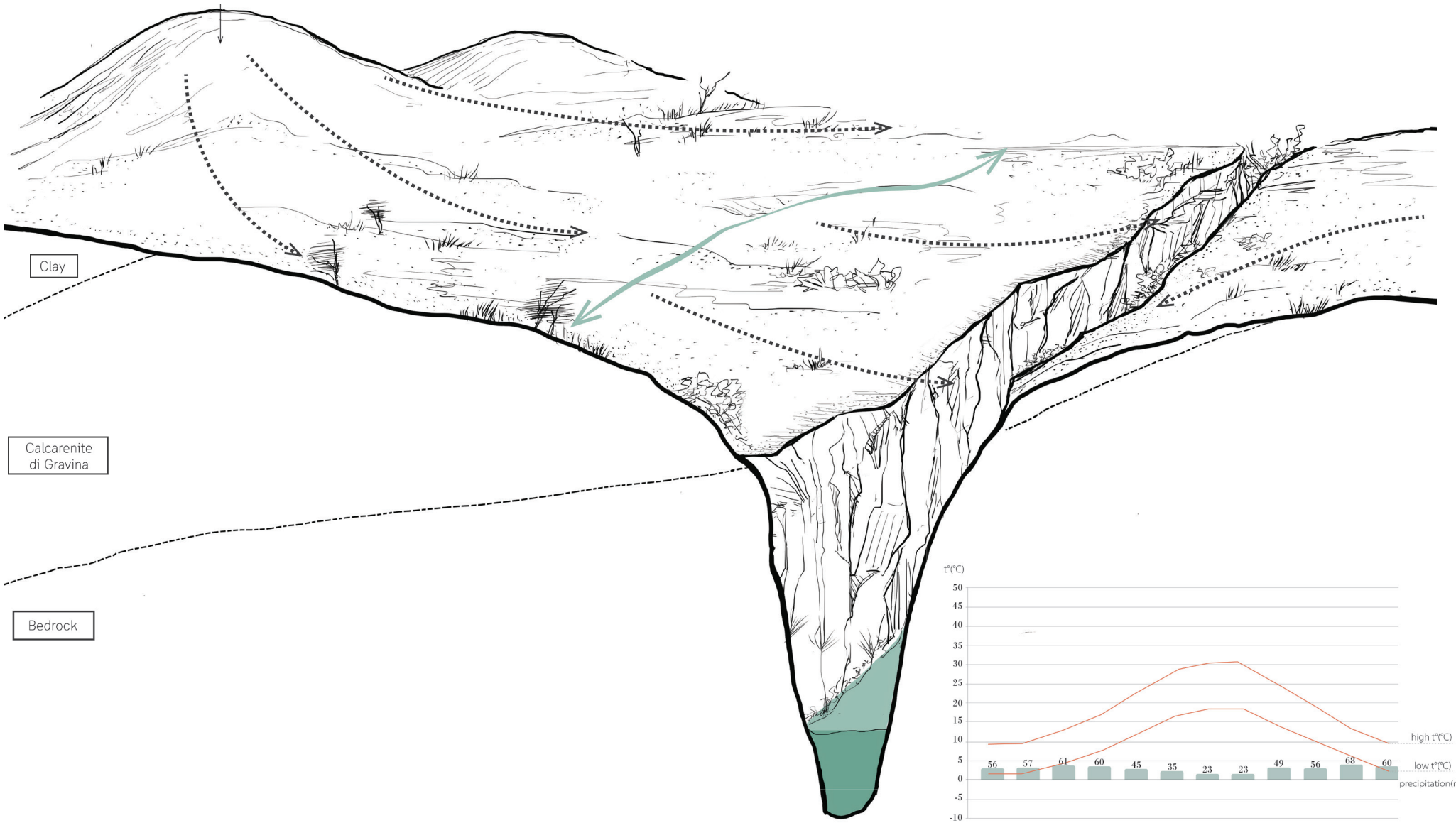






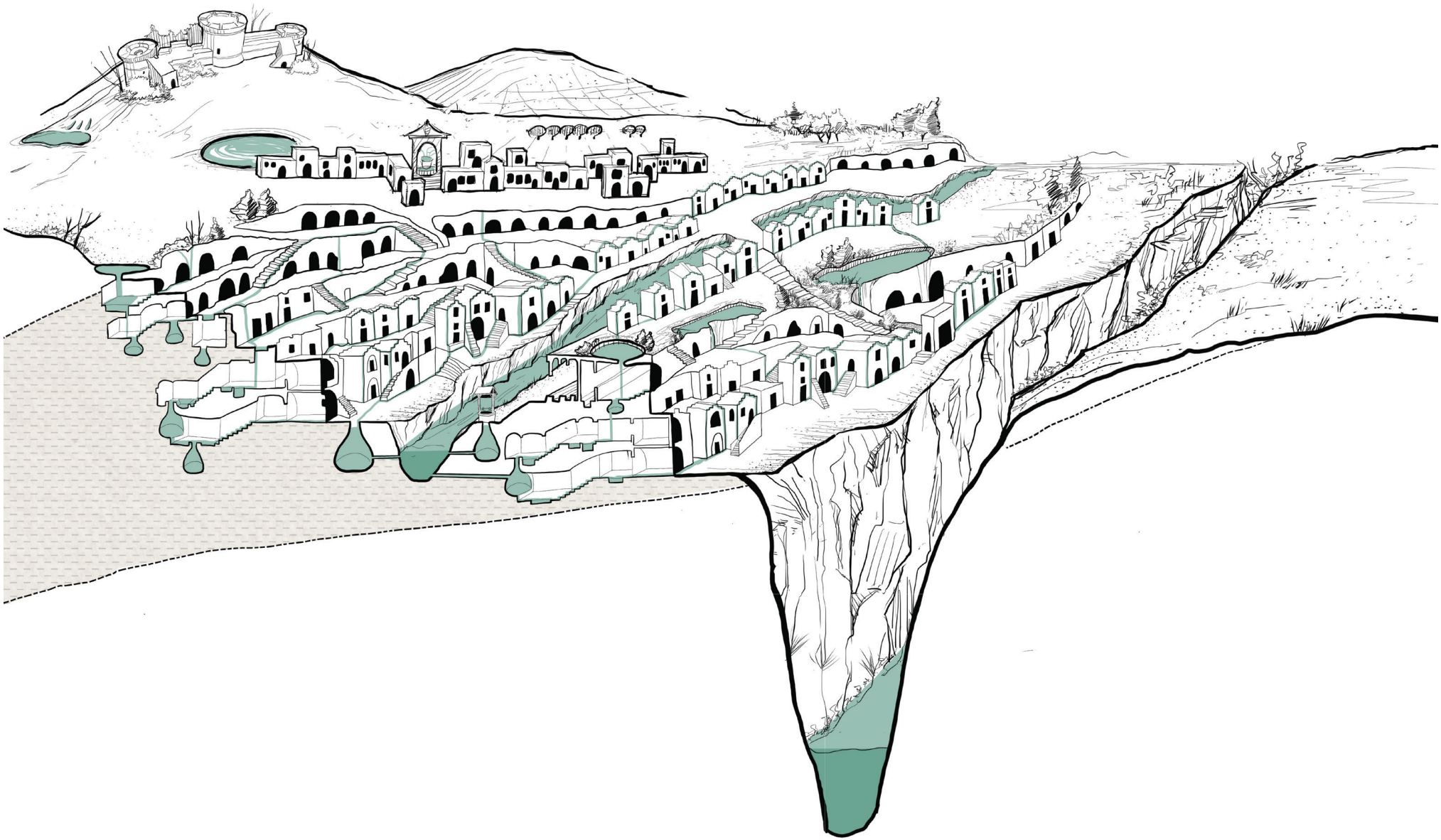


Internal mechanics: hidden water city

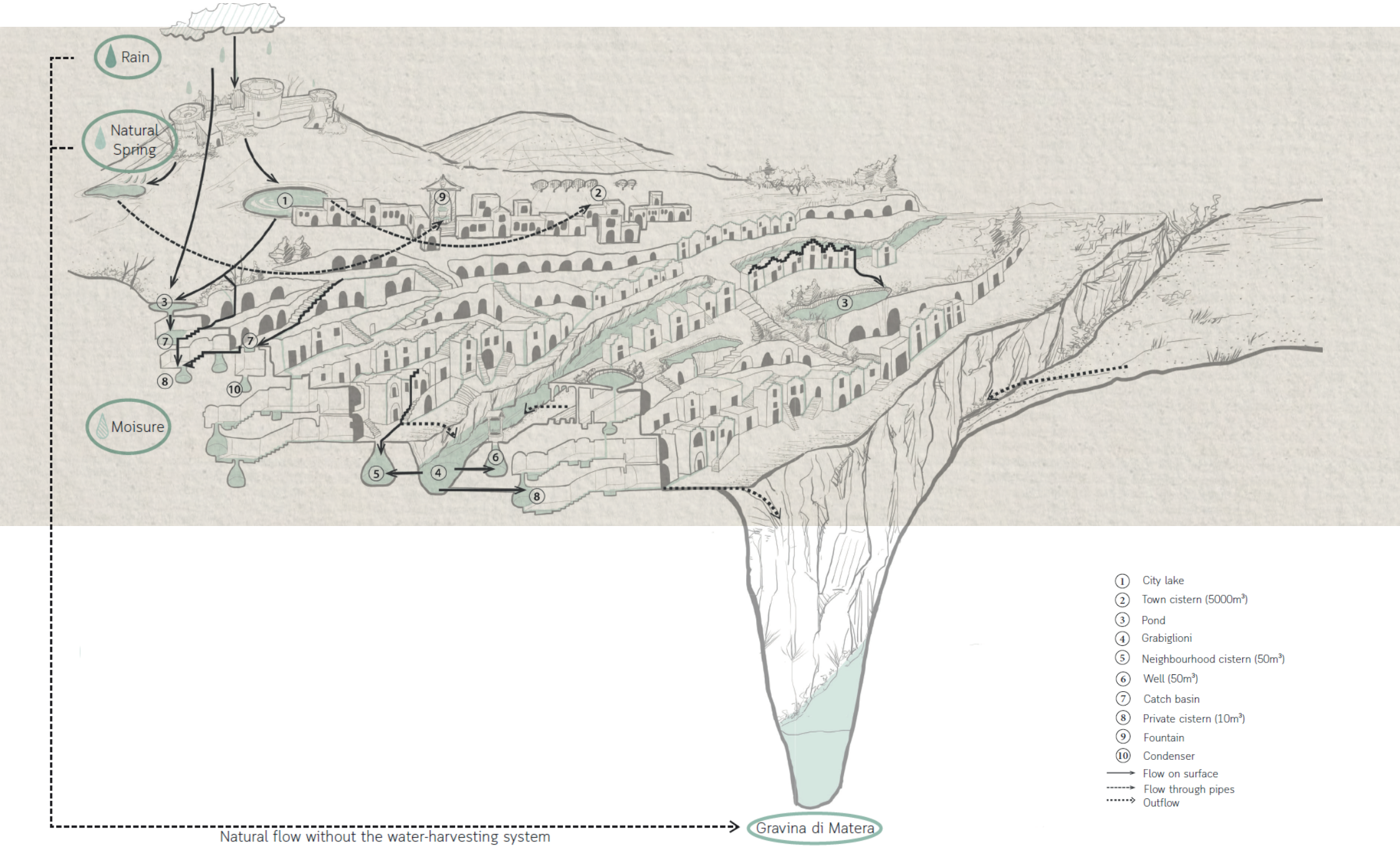


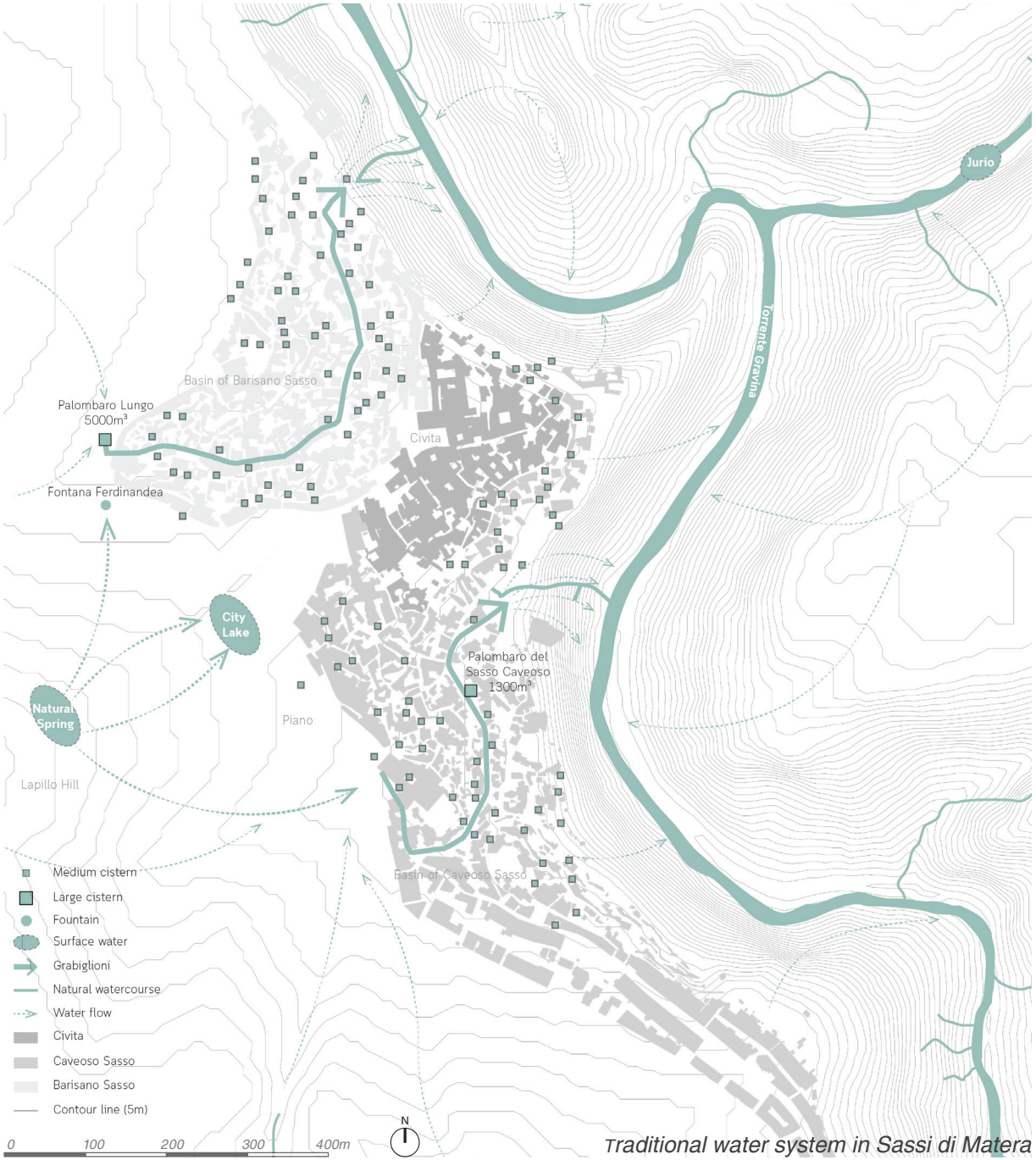
Natural base

Precipitation and temperature in Matera



Traditional water harvesting system in tuff

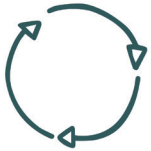

Rain
Natural Spring
Moisure
Natural flow without the water-harvesting system
Gravina di Matera
1 City lake
2 Town cistern (5000m³)
3 Pond
4 Grabiglioni
5 Neighbourhood cistern (50m³)
6 Well (50m³)
7 Catch basin
8 Private cistern (10m³)
9 Fountain
10 Condenser
Flow on surface
Flow through pipes
Outflow



Traditional water system in Sassi di Matera

"About 2211 cisterns in total
2039 private cisterns
170 neighbourhood cisterns
2 town cisterns"

What we can learn from the traditional water harvesting system in Sassi di Matera?



Cirluar System

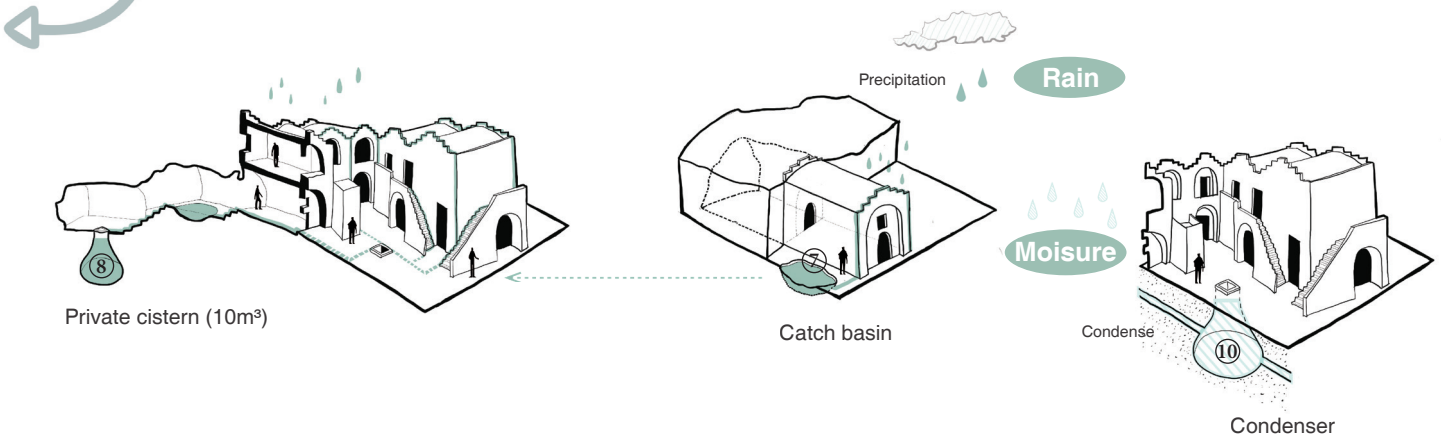


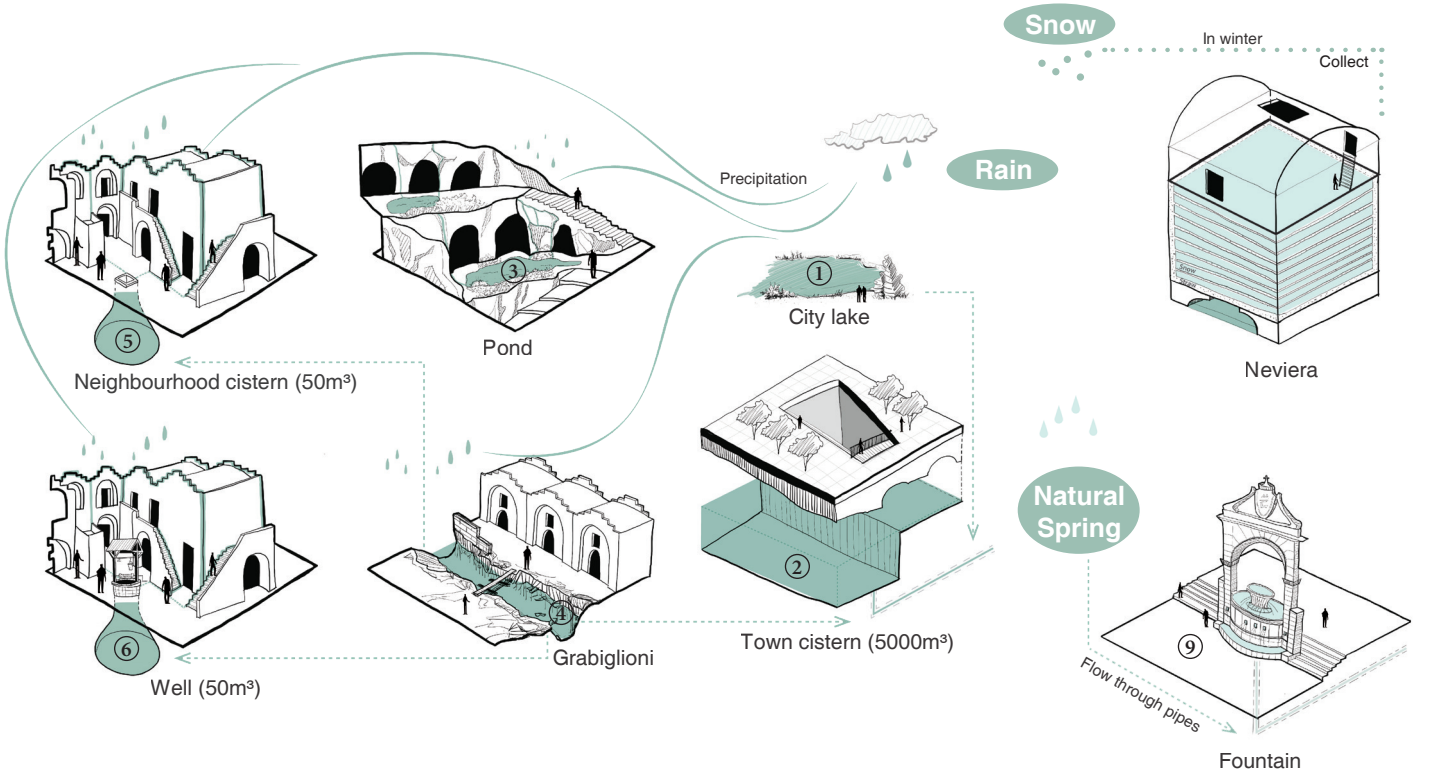
Social Network



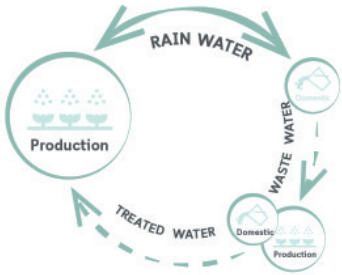
Green Space

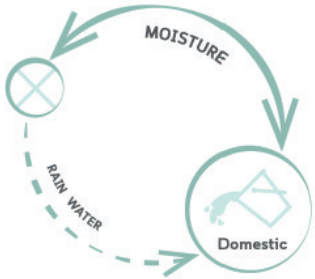
Cirluar system





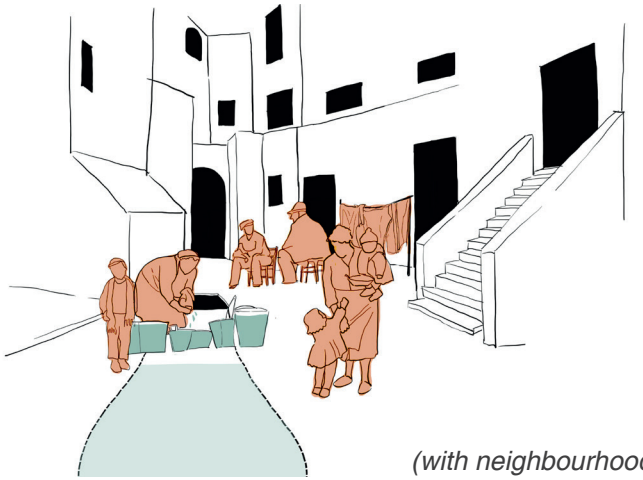
Sustainable use of water





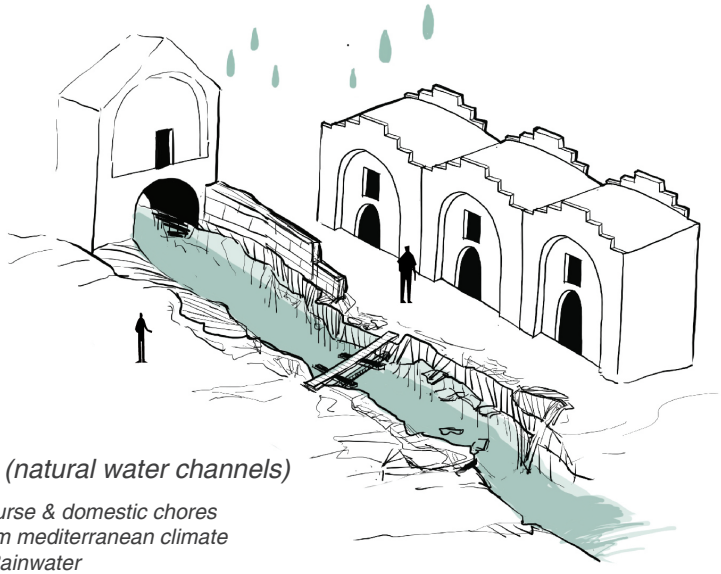


Social network



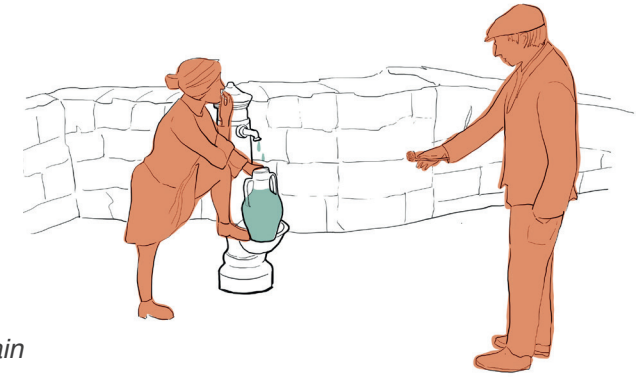
Vicinato
(with neighbourhood cistern)

social intercourse & domestic chores
Climate: Warm mediterranean climate
Water type: Rainwater
Meaning: Domestic and agricultural use



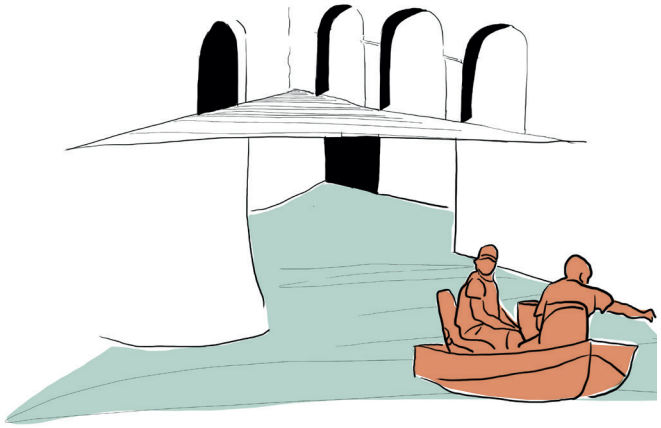
Grabiglioni (natural water channels)

social intercourse & domestic chores
Climate: Warm mediterranean climate
Water type: Rainwater
Meaning: Domestic use



Fountain

getting of drinking water & meet of young people
Climate: Warm mediterranean climate
Water type: Spring water
Meaning: Drinking



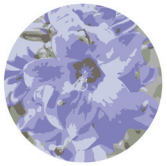
Plazza vittorio (with Palombaro lungo)

social intercourse & domestic chores
Climate: Warm mediterranean climate
Water type: Rainwater
Meaning: Domestic and agricultural use

Green space



Caper



Apulian bellf lower



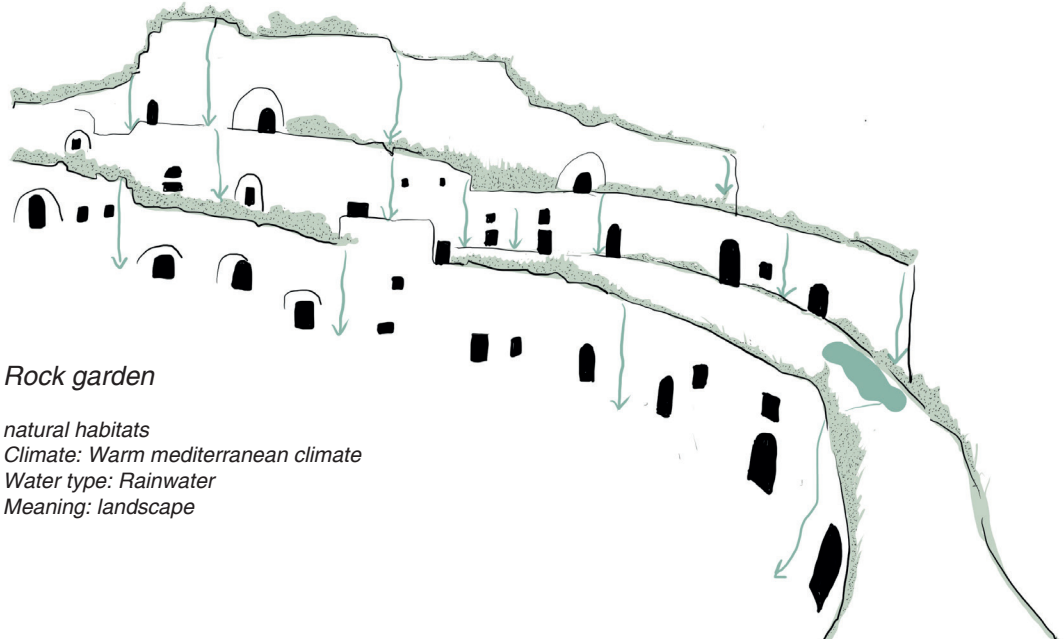
Navel of Venus



Polio camedrium



Lucania fennel



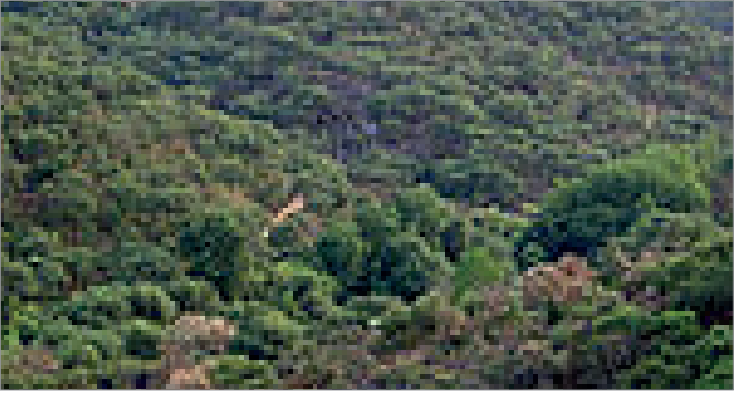
Rock garden

natural habitats
Climate: Warm mediterranean climate
Water type: Rainwater
Meaning: landscape

02 Sassi di Matera & Matera



Stone city on postcard






60,000








Challenges in Matera



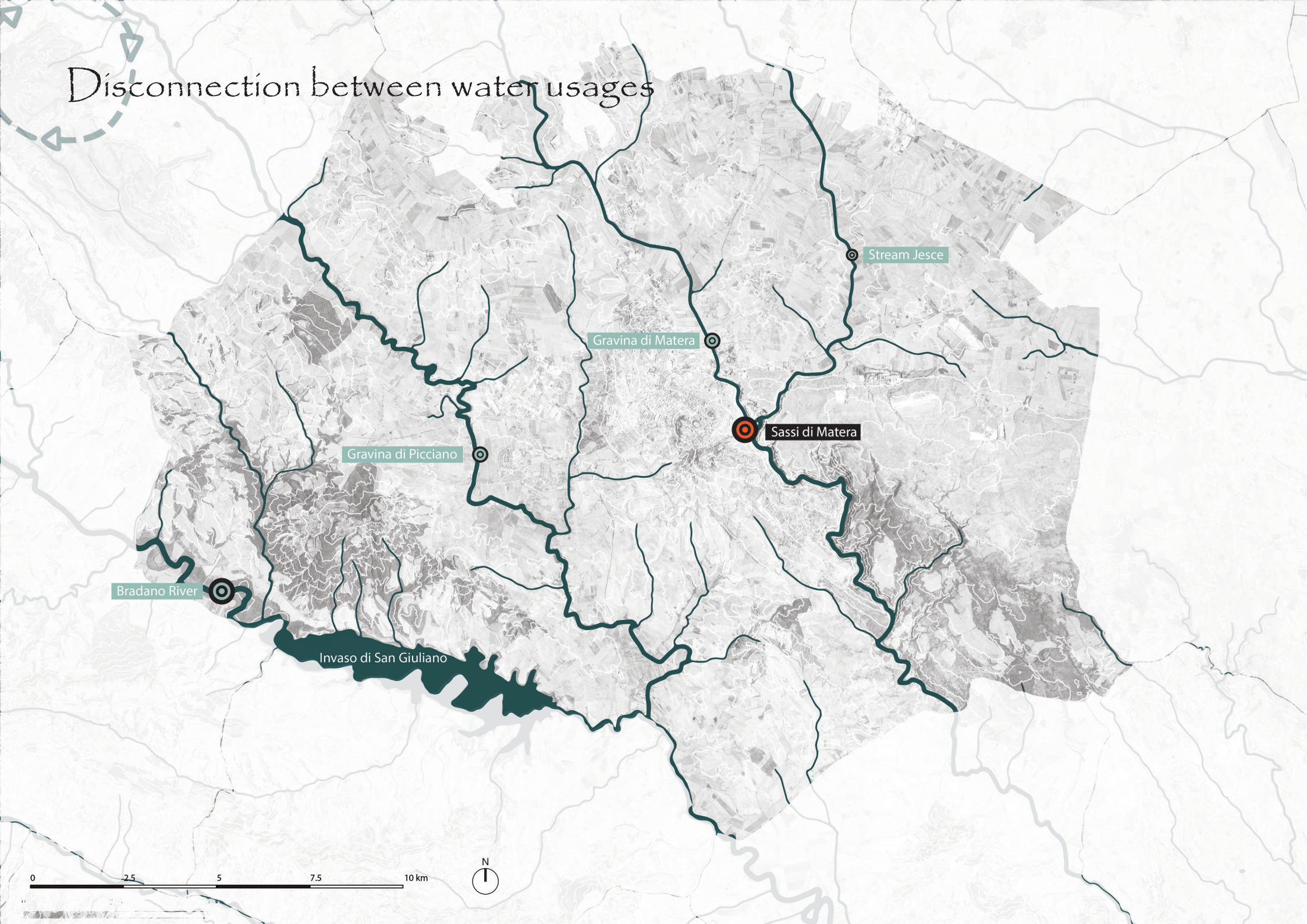
Water usages



Settlements



Natural areas


Disconnection between water usages
Stream Jesce
Gravina di Matera
Sassi di Matera
Gravina di Picciano
Bradano River
Invaso di San Giuliano
0
2.5
5
7.5
10 km
N

Disconnection between water usages

Urban flooding









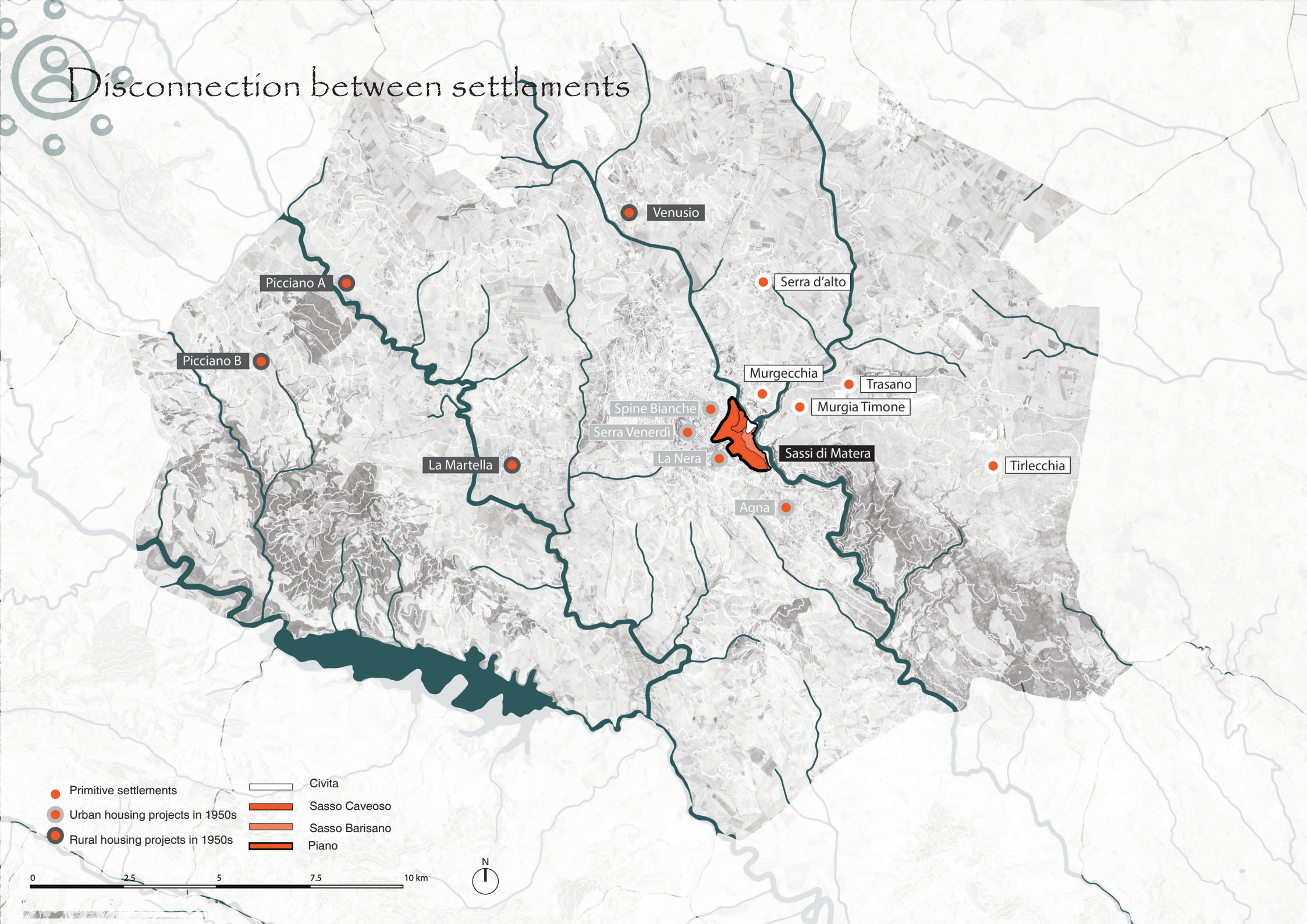
Water shortage

Wastewater pollution

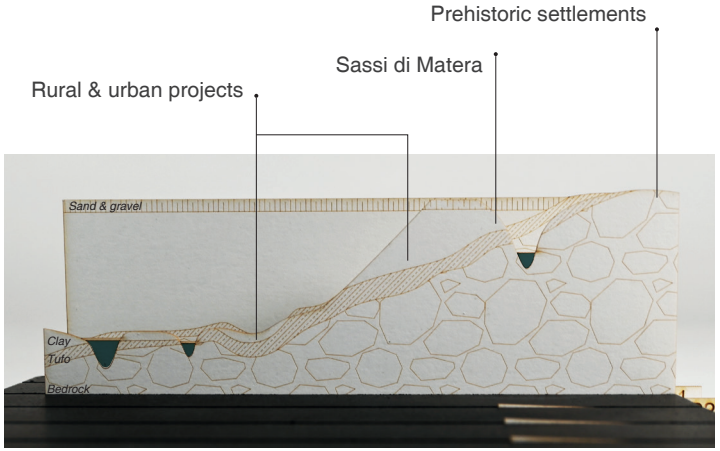


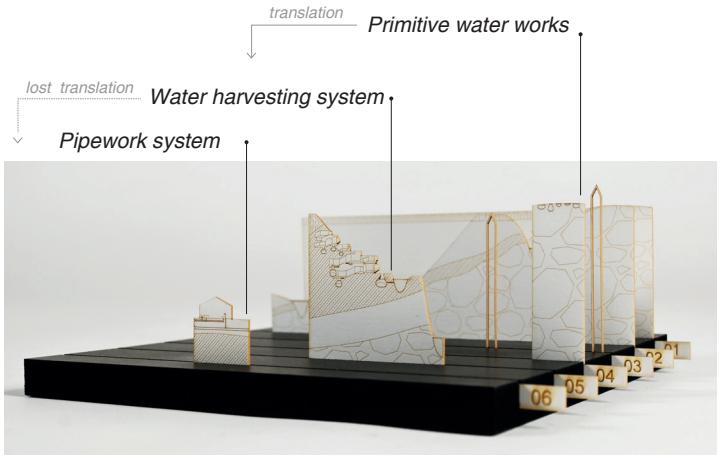


Disconnection between settlements

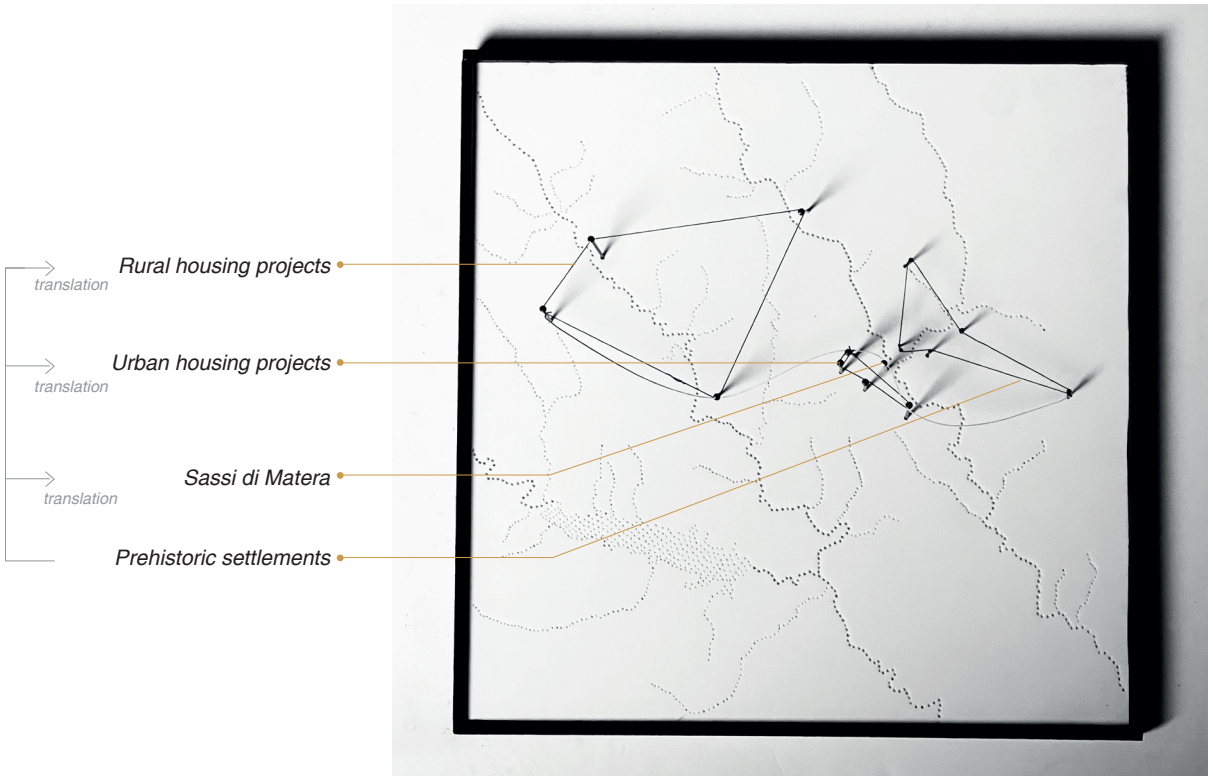


Disconnection between settlements



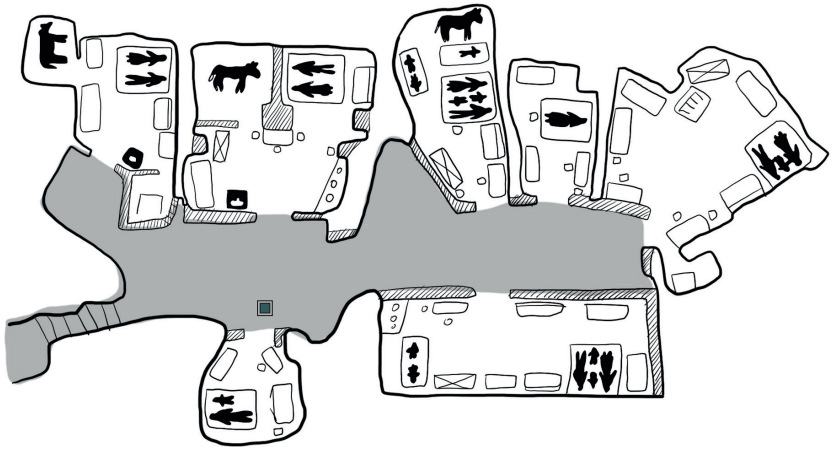


Comparison between water works



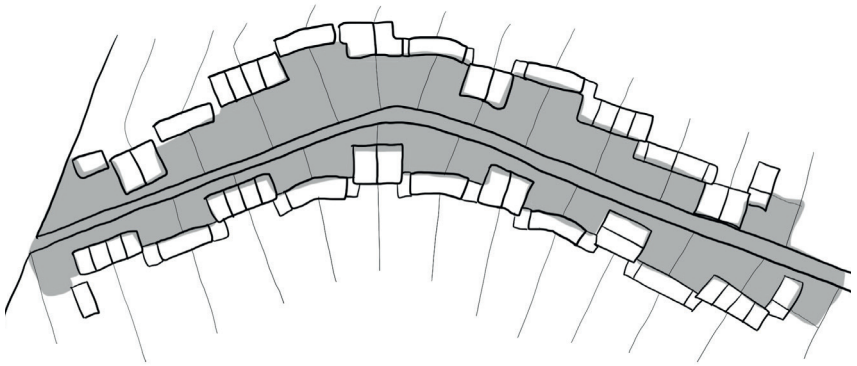
Distribution of settlements

Disconnection between settlements



20 m

With underground water cistern



120 m

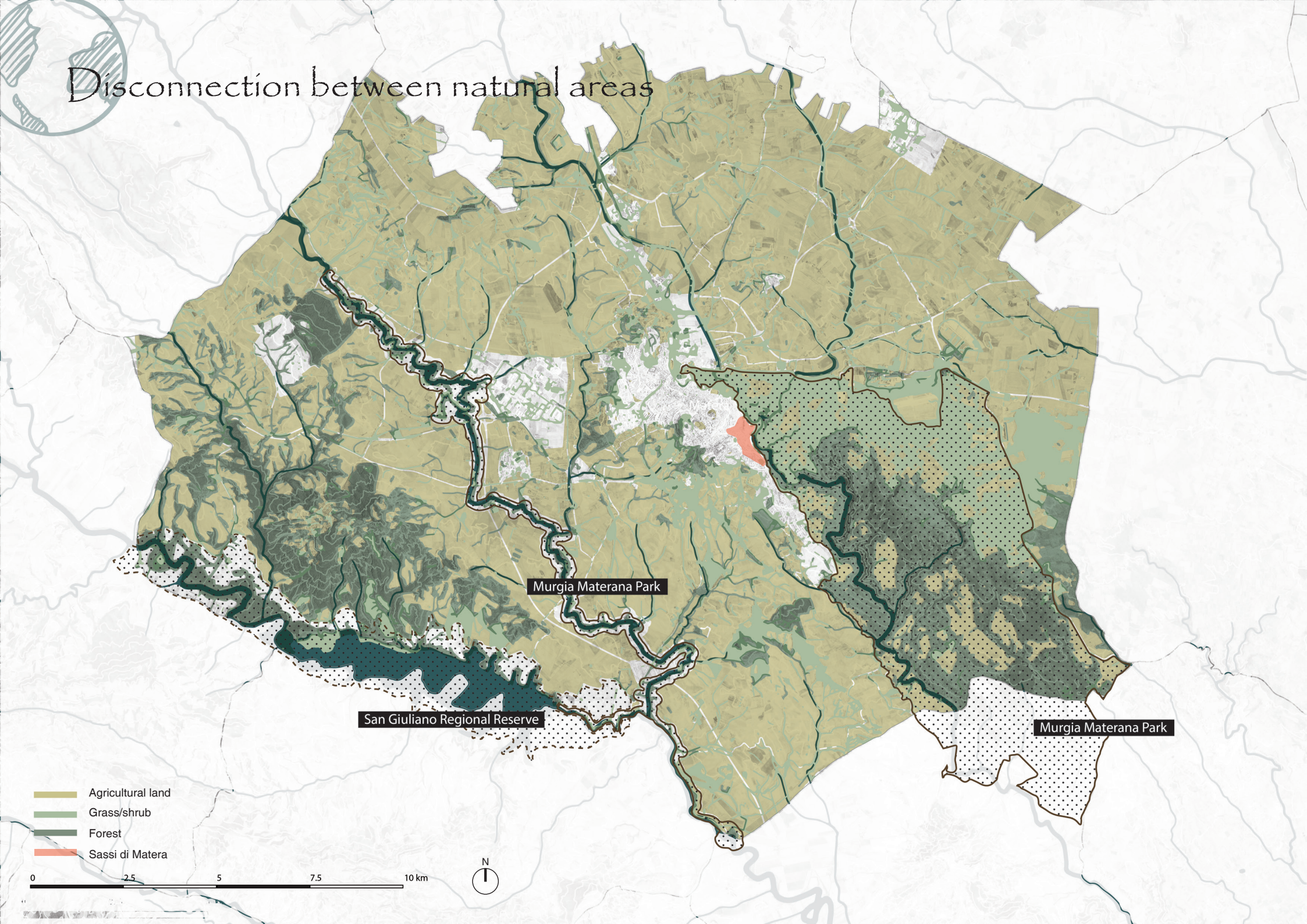
Enlarged in scale, lost of water works



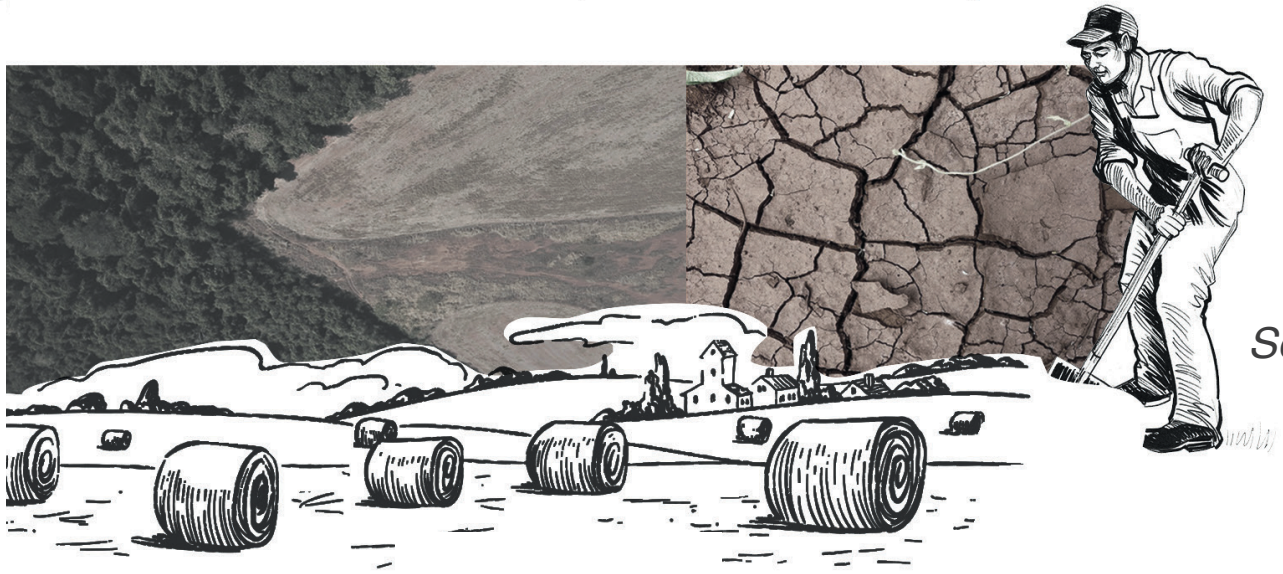


Transformation of Vicinato, La Martella as an example

Disconnection between natural areas



Disconnection between natural areas



Soil degradation & Mono agriculture

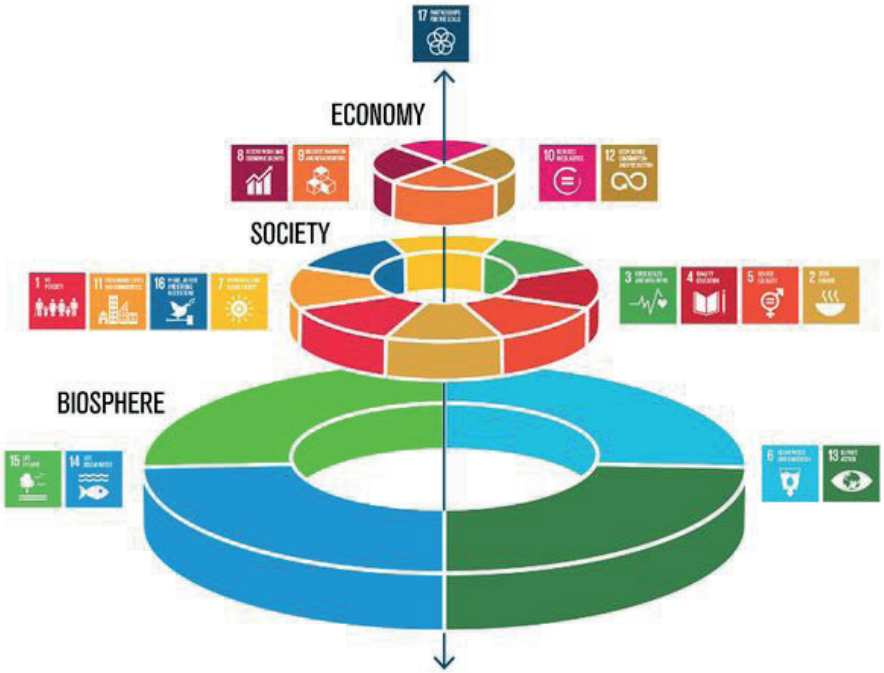


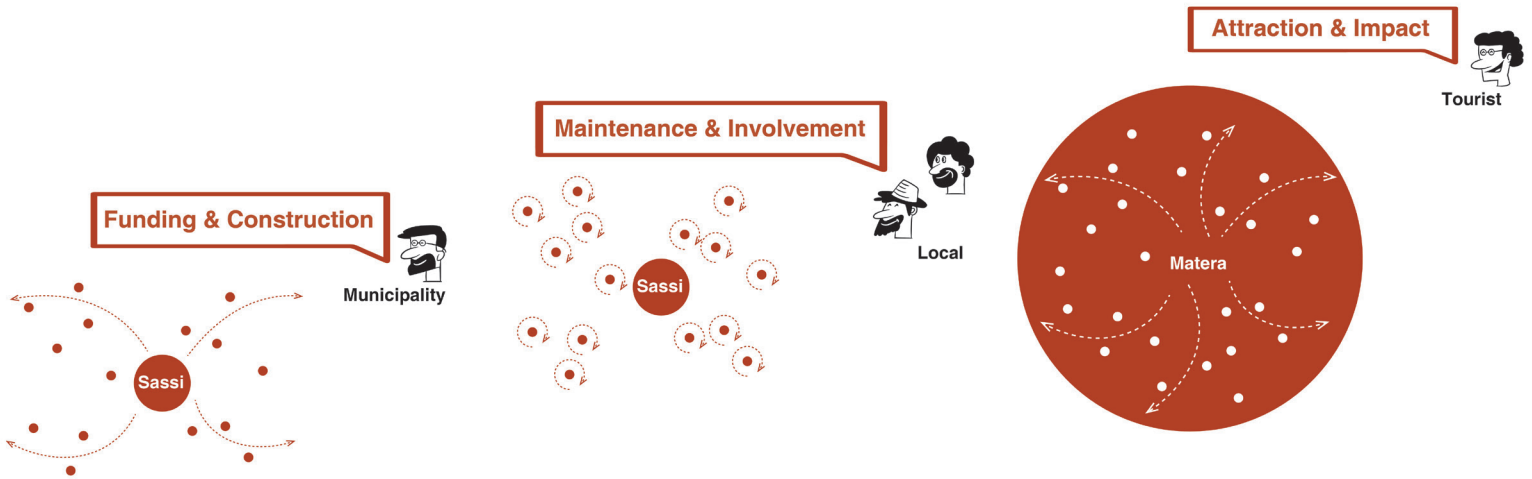
Shrinking habitats

Research Question

How can Matera learn from the circular water system of ancient Sassi di Matera, especially in terms of social and ecological values, by using the knowledge for a blue-green network that enhances the livability and resilience of the area?

03 Matera: to hidden water region





Sustainable development

Research Question

How can Matera learn from the circular water system of ancient Sassi di Matera, especially in terms of social and ecological values, by using the knowledge for a blue-green network that enhances the livability and resilience of the area?

Sub Questions

- How is water used as a local resource in the traditional system and what connection did people have with water in the past?



Cirluar System

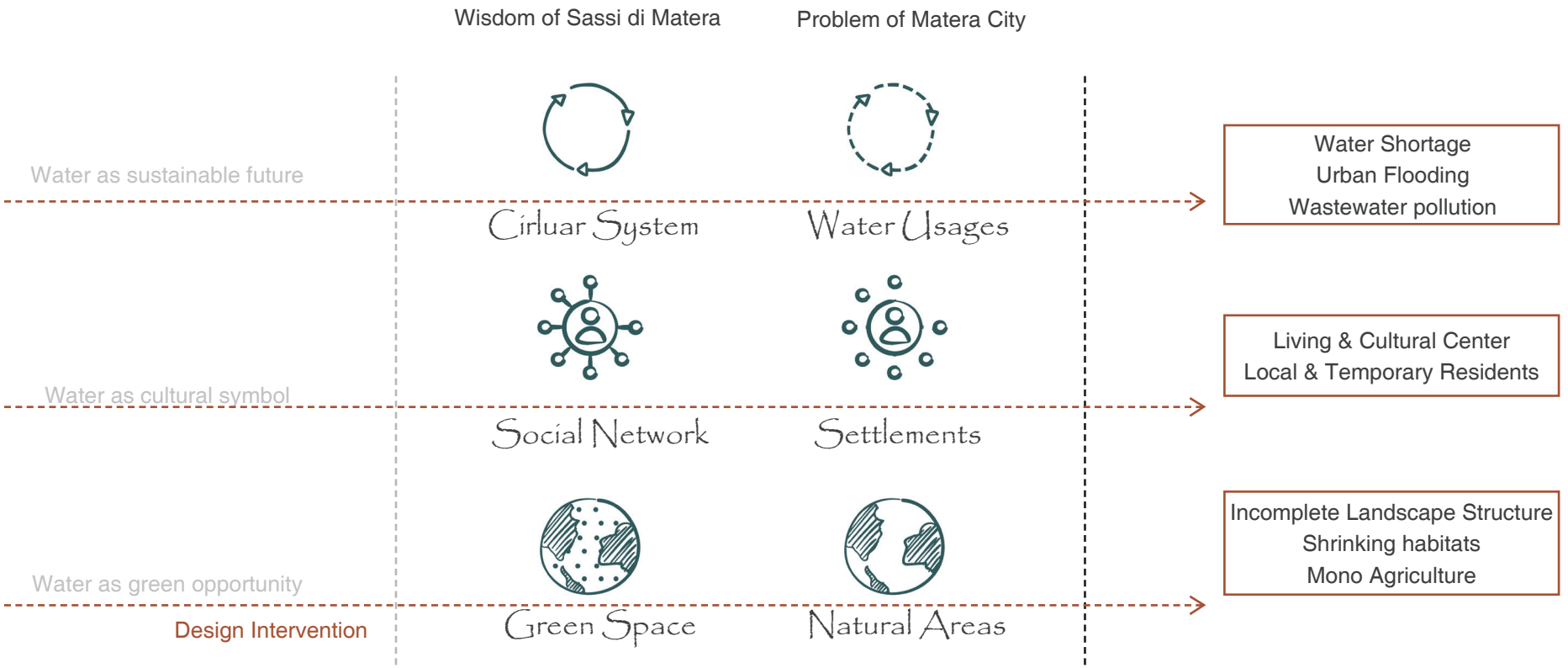


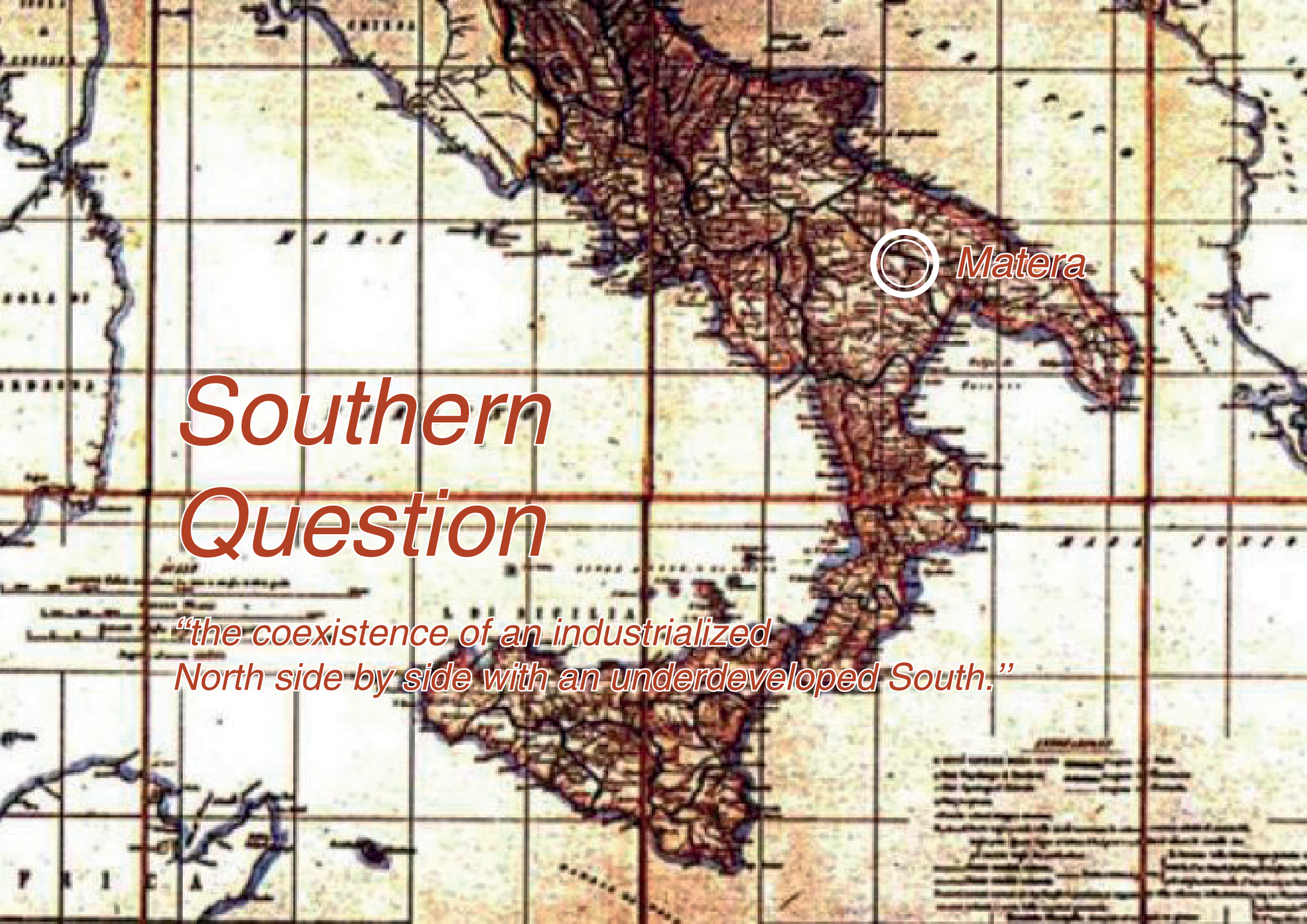
Social Network



Green Space

- How can we learn from the traditional system for today and visualize the hidden water in landscape?


Wisdom of Sassi di Matera
Problem of Matera City
Water as sustainable future
Cirluar System
Water Usages
Water Shortage
Urban Flooding
Wastewater pollution
Water as cultural symbol
Social Network
Settlements
Living & Cultural Center
Local & Temporary Residents
Water as green opportunity
Green Space
Natural Areas
Incomplete Landscape Structure
Shrinking habitats
Mono Agriculture
Design Intervention



Southern Question

“the coexistence of an industrialized North side by side with an underdeveloped South.”

Research Question

How can Matera learn from the circular water system of ancient Sassi di Matera, especially in terms of social and ecological values, by using the knowledge for a blue-green network that enhances the livability and resilience of the area?

Sub Questions

- How is water used as a local resource in the traditional system and what connection did people have with water in the past?

- How can we learn from the traditional system for today and visualize the hidden water in landscape?



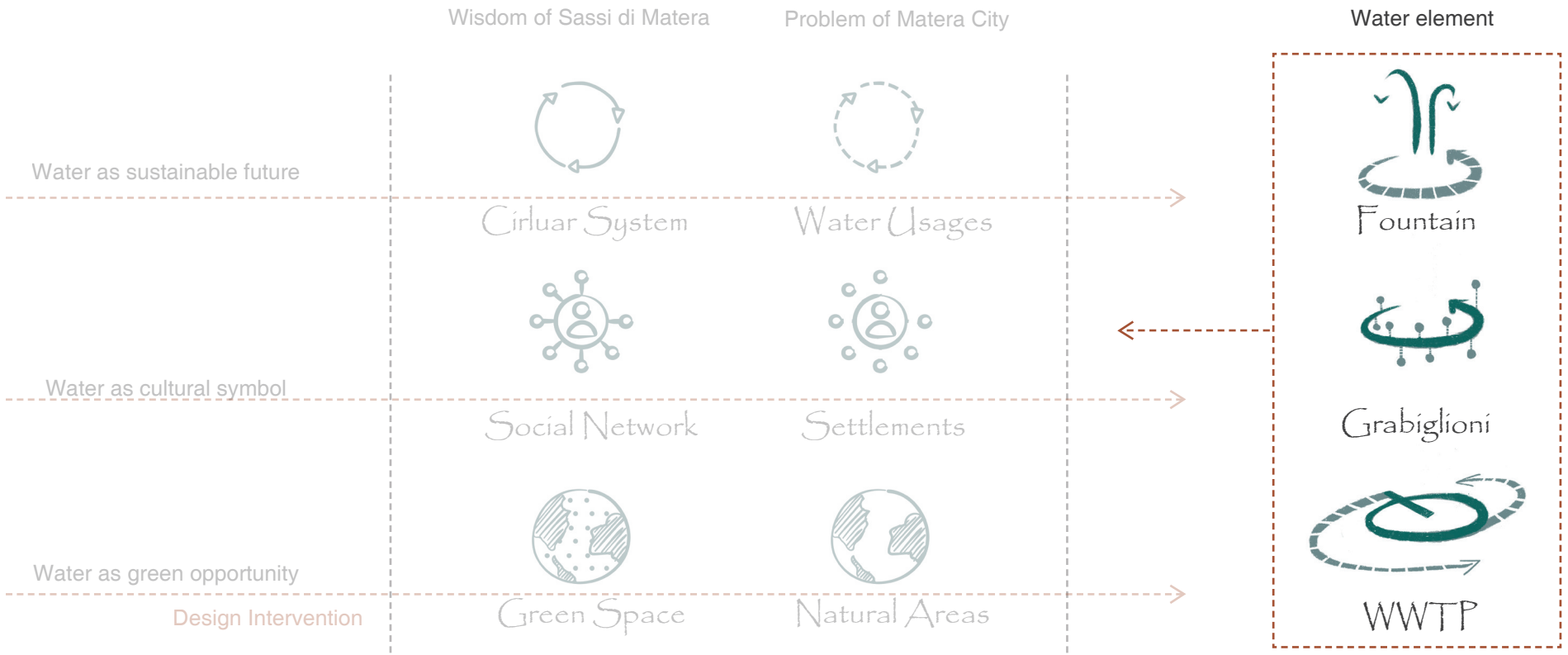
Fountain



Grabiglioni



WWTP


Wisdom of Sassi di Matera
Problem of Matera City
Water element
Water as sustainable future
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Water Usages
Fountain
Water as cultural symbol
Social Network
Settlements
Grabiglioni
Water as green opportunity
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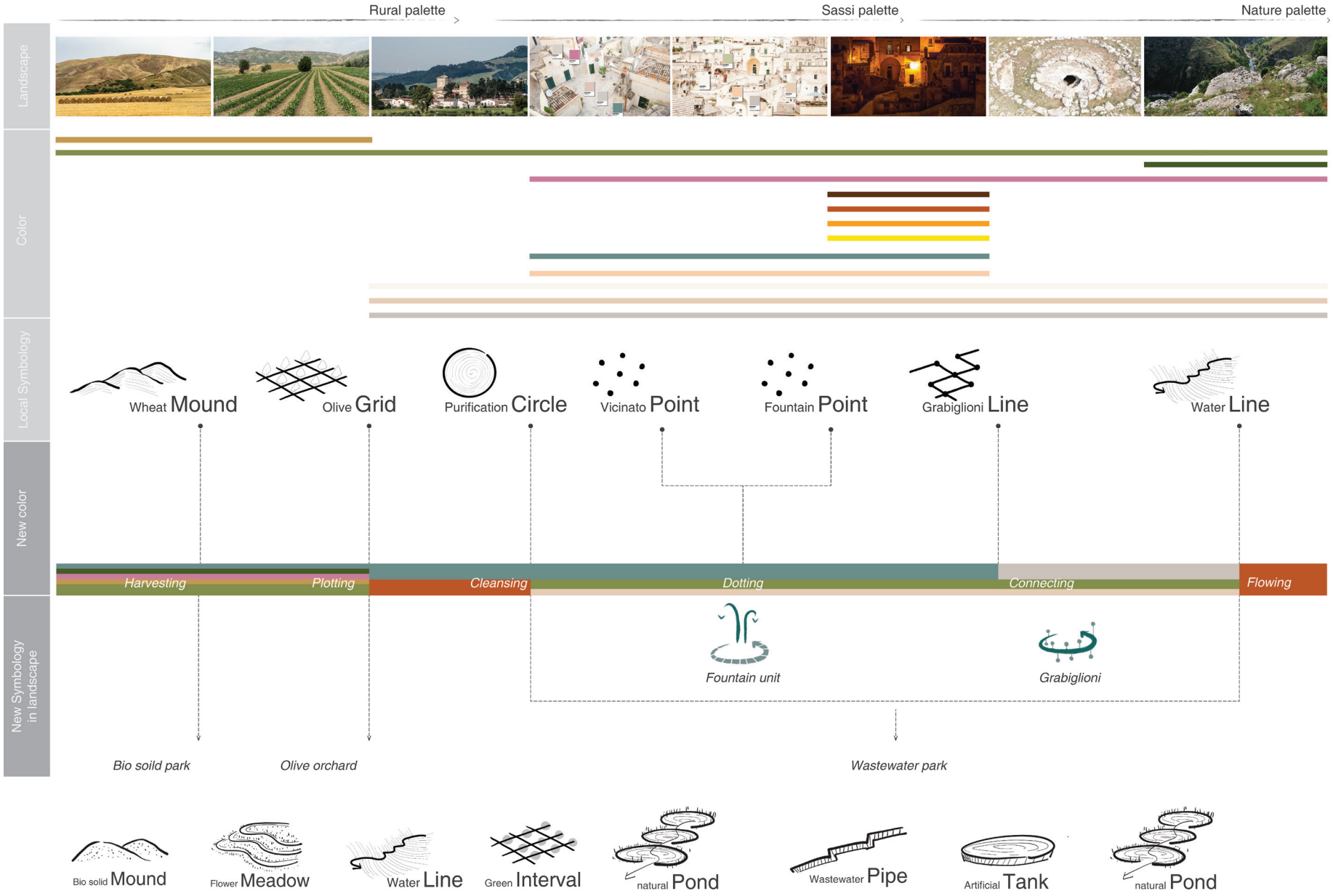
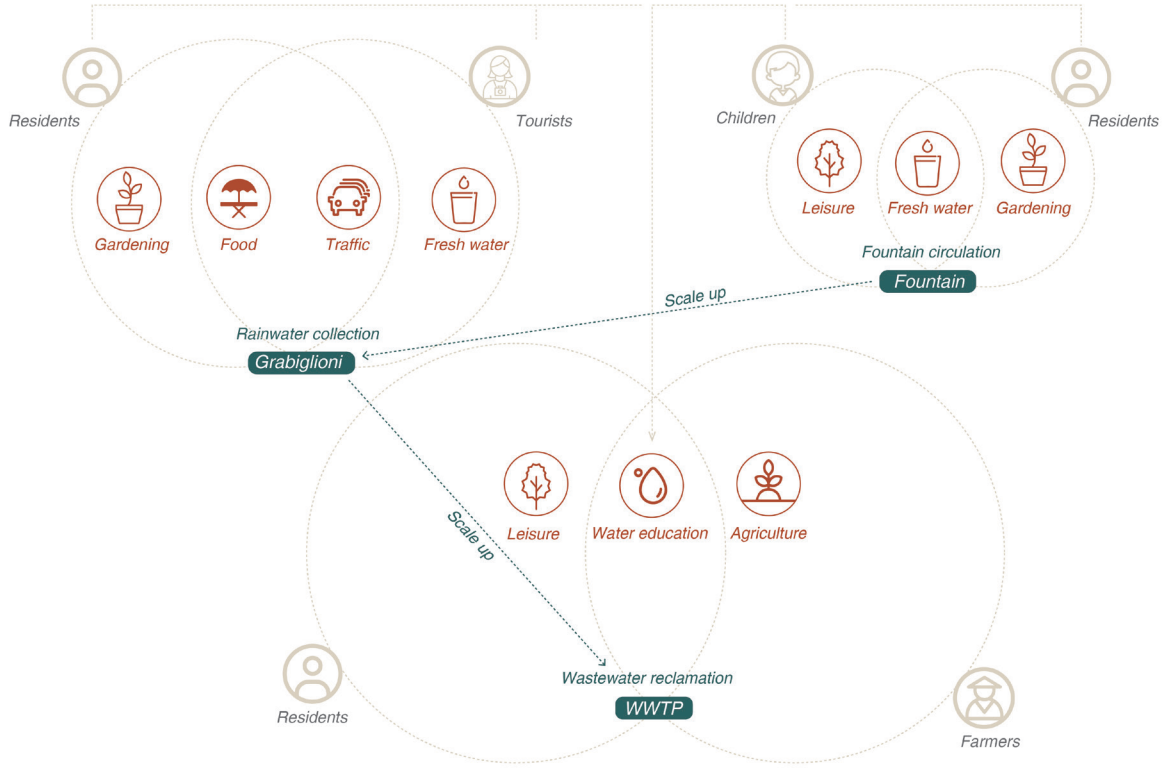
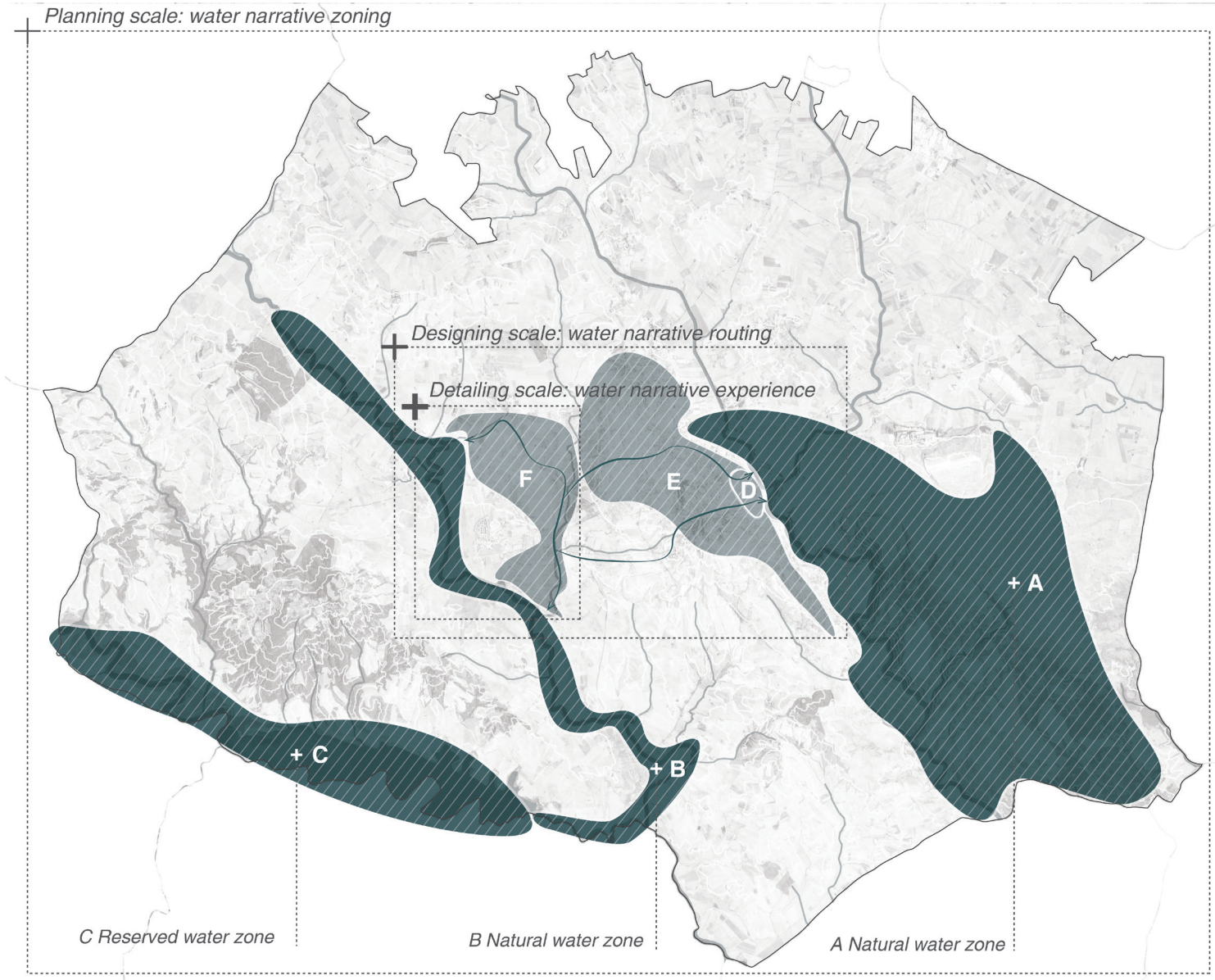


Landscape representation



water element	circular system	scale	social network	local	visitor	green space
fountain	- reveal circularity	Local scale	link between urban & Sassi			- build new green network
grabiglioni	- rainwater storage & connection to old system	Sassi scale	link between local & visitor			- cultivate green
wwtp	- wastewater purification & reclamation	Regional scale	link between rural & Sassi			- connect parks - increase wetland

Design matrix





D Sassi grabiglioni zone



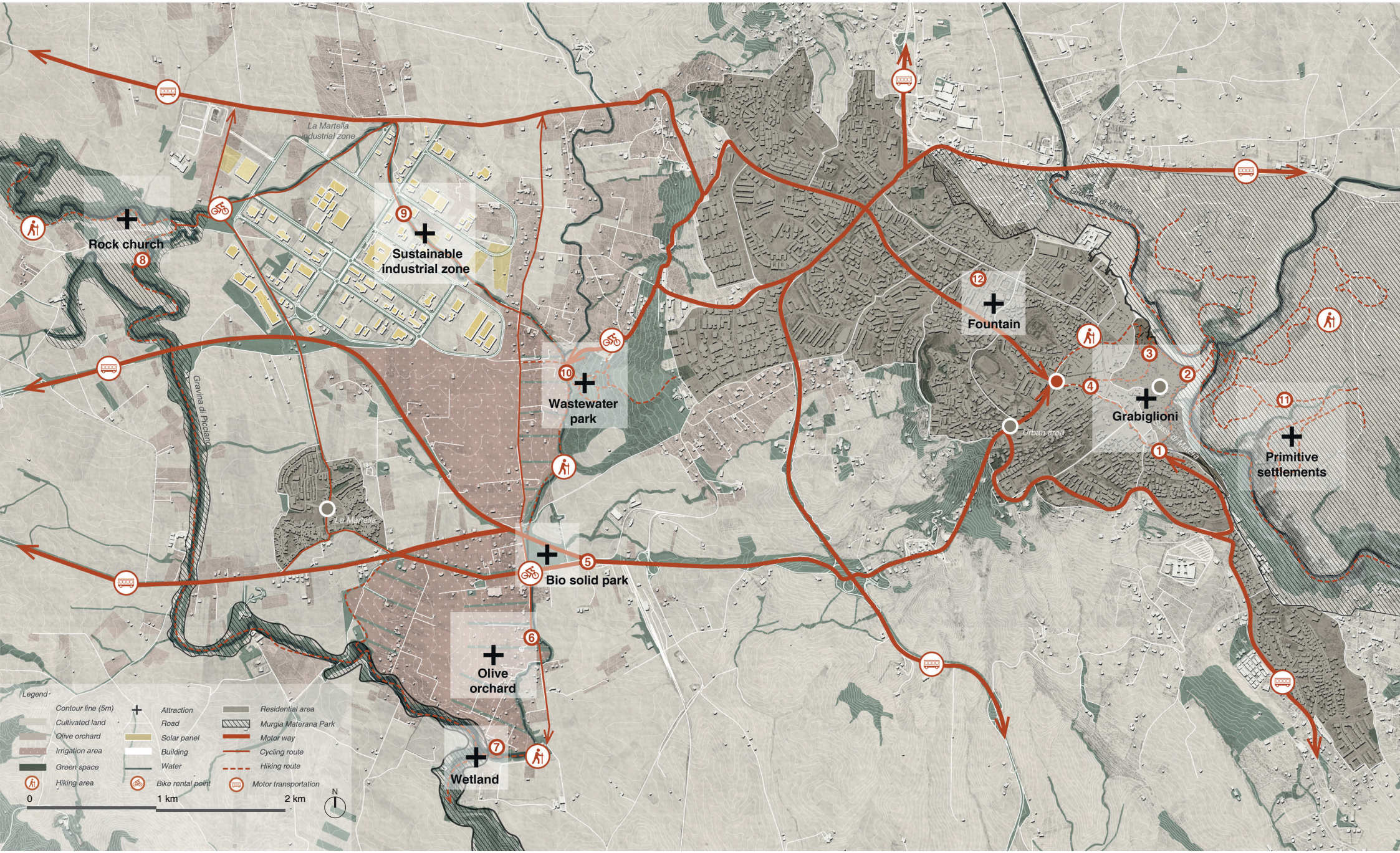
E Urban fountain zone



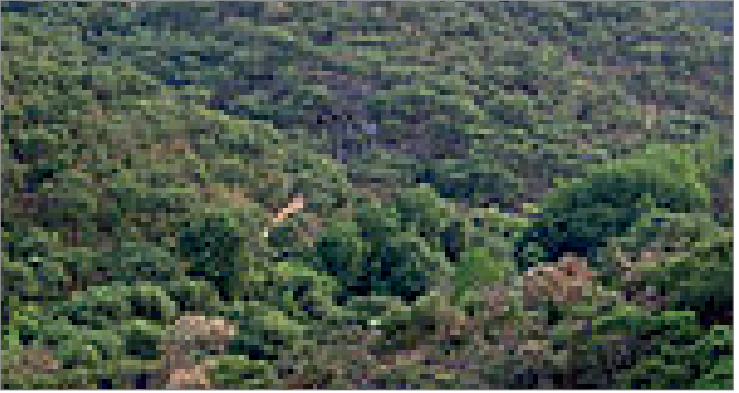
F Reclaimed water zone

0 1 4 km

N



Designing scale: water narrative routing











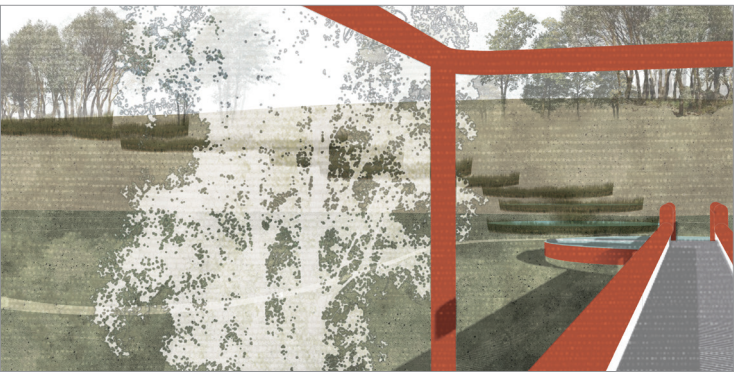


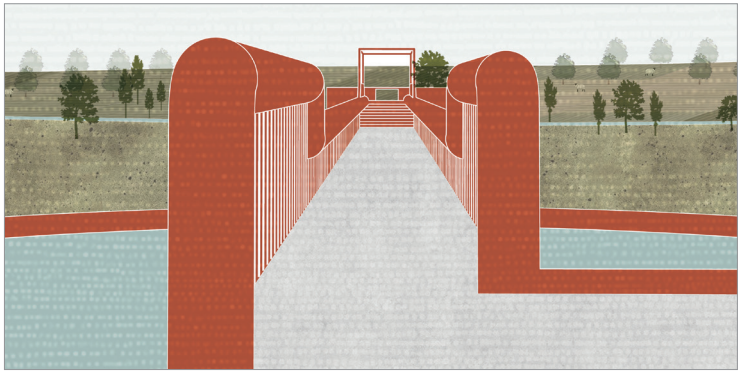


Rainwater pipe
Rain barrel
sture
Tuff
Top soil
Porous pavement
Cistern
Tuff

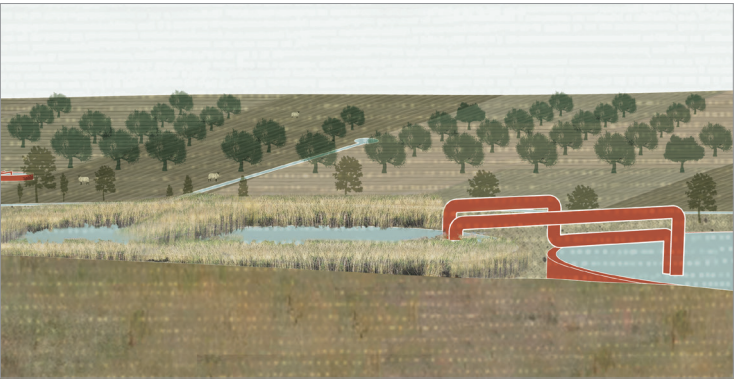

Resting area
Sunken water square
Vegetable garden
Loose pebble laye
Raised planting bed
(Local limestone & steel wire)
Clay soil

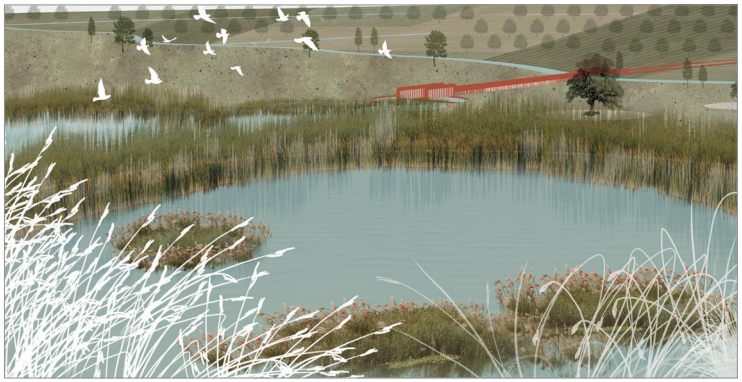

Fountain corner
Sidewalk
Outflow pipe

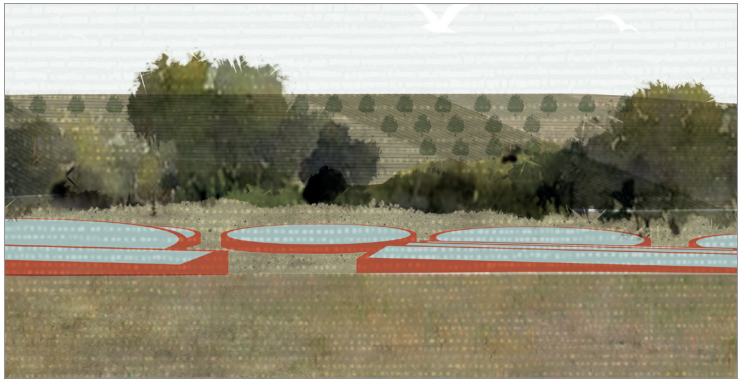










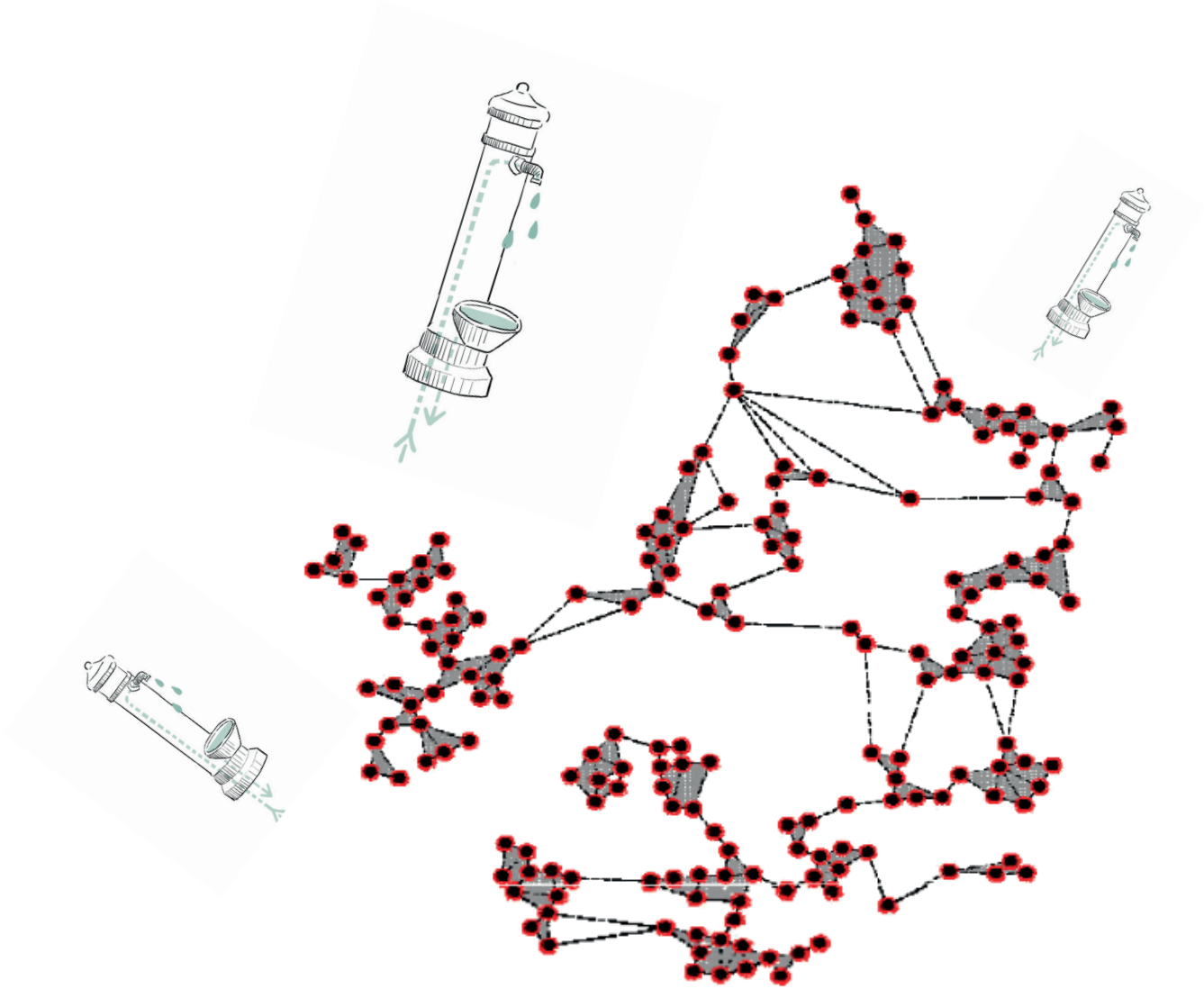








04 Water elements



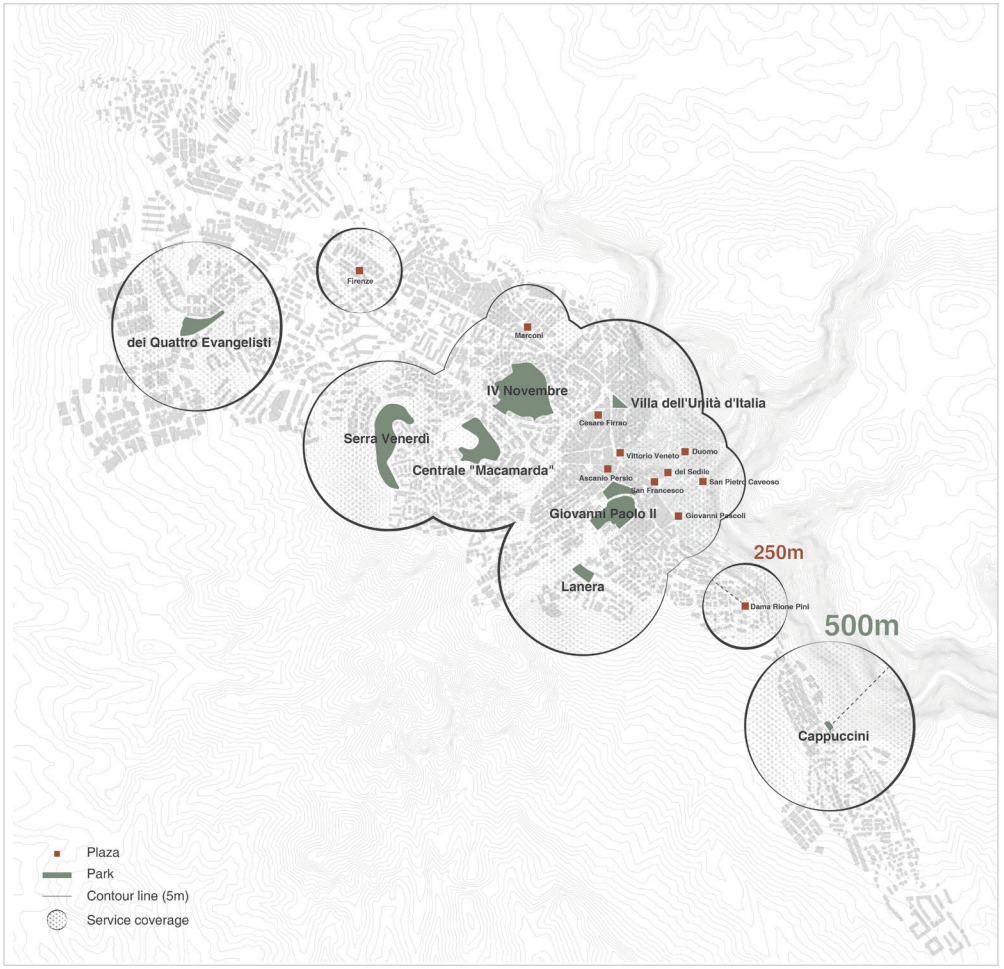
Fountain network & social network

Drinking water fountain



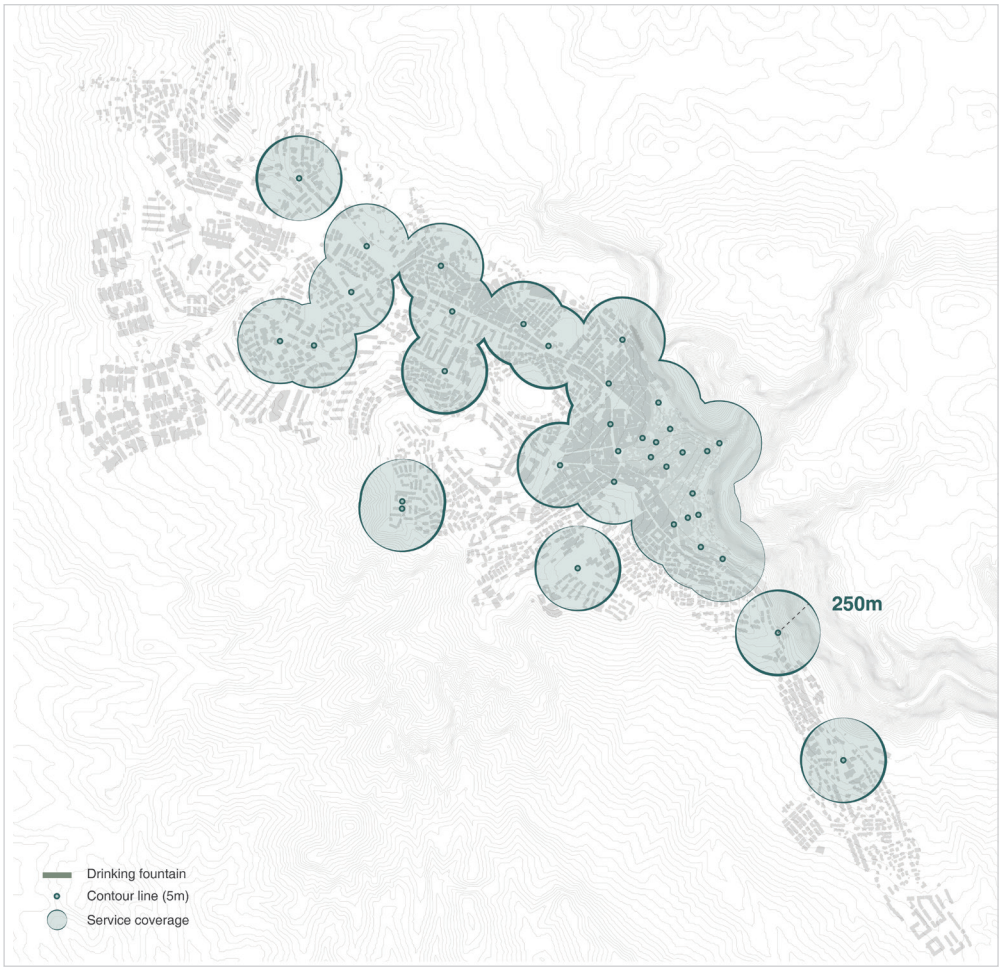


Neighbourhood and population in Matera

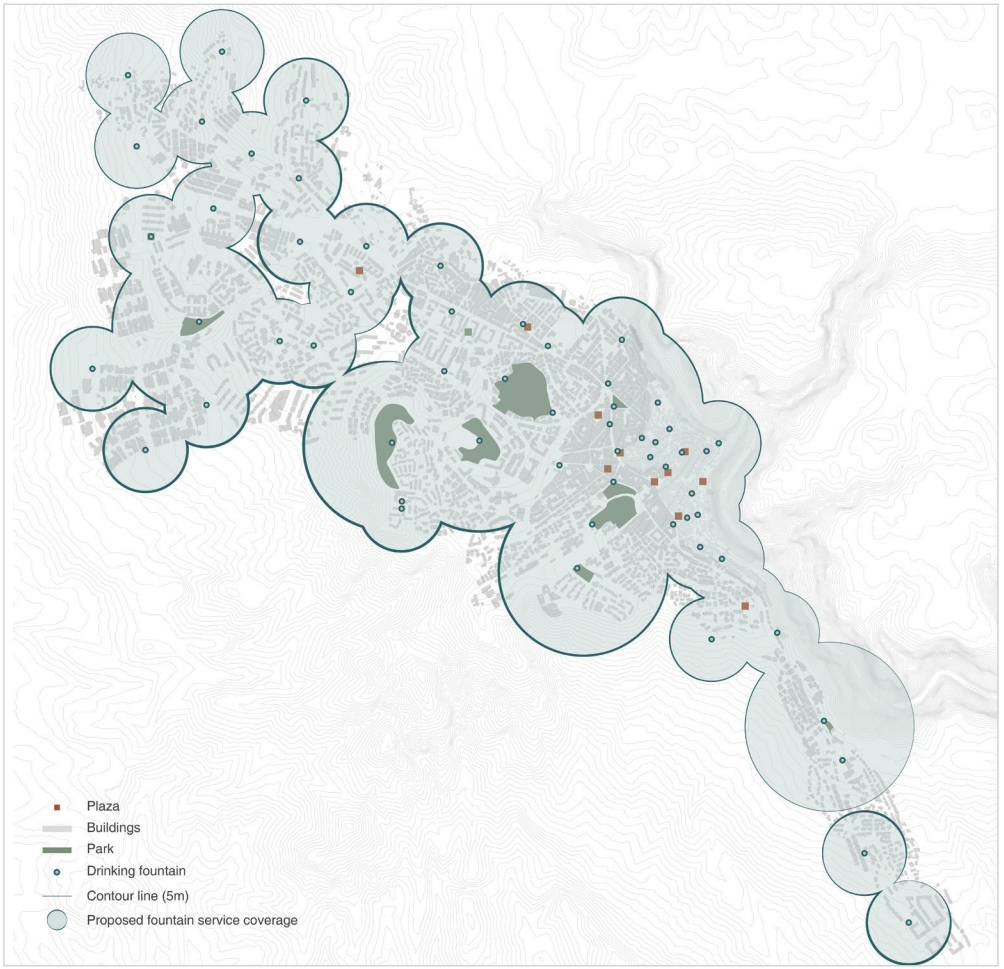


Public space and accessibility in Matera

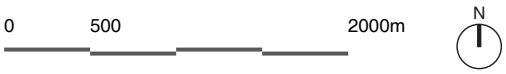
0 500 2000m N

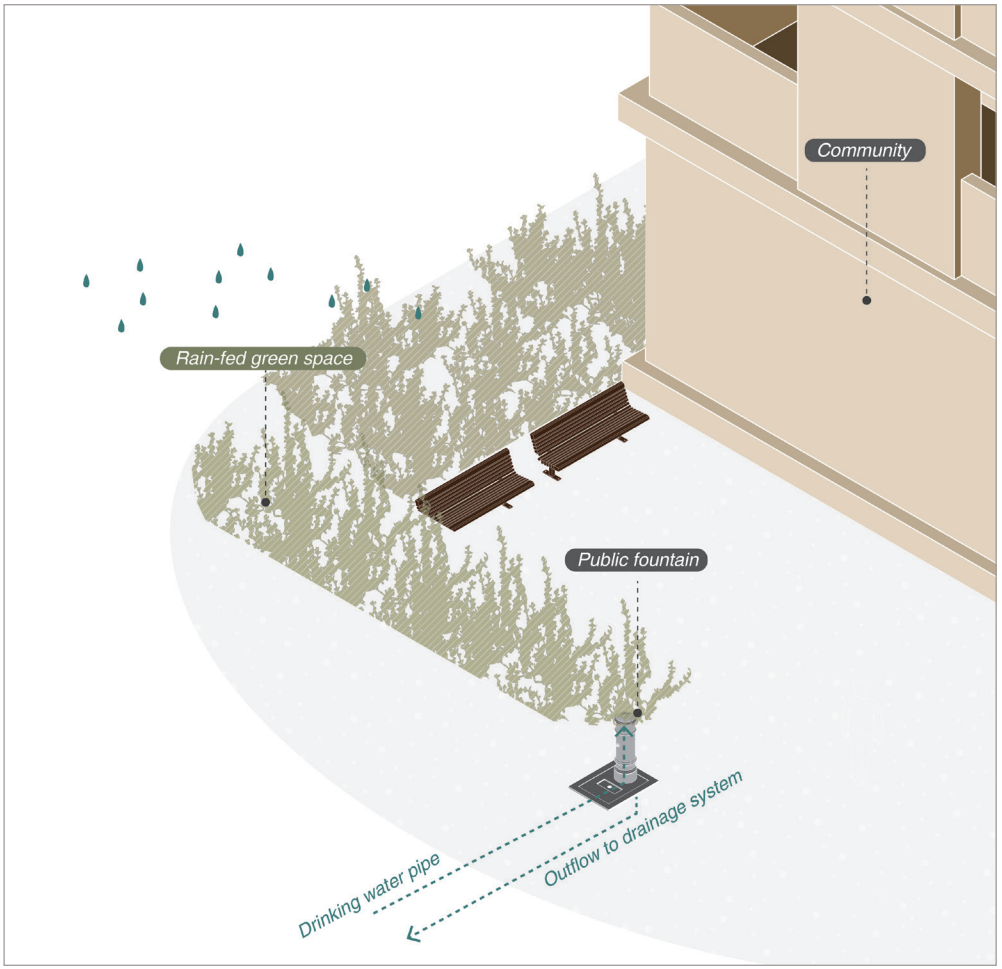


Fountain and accessibility in Matera

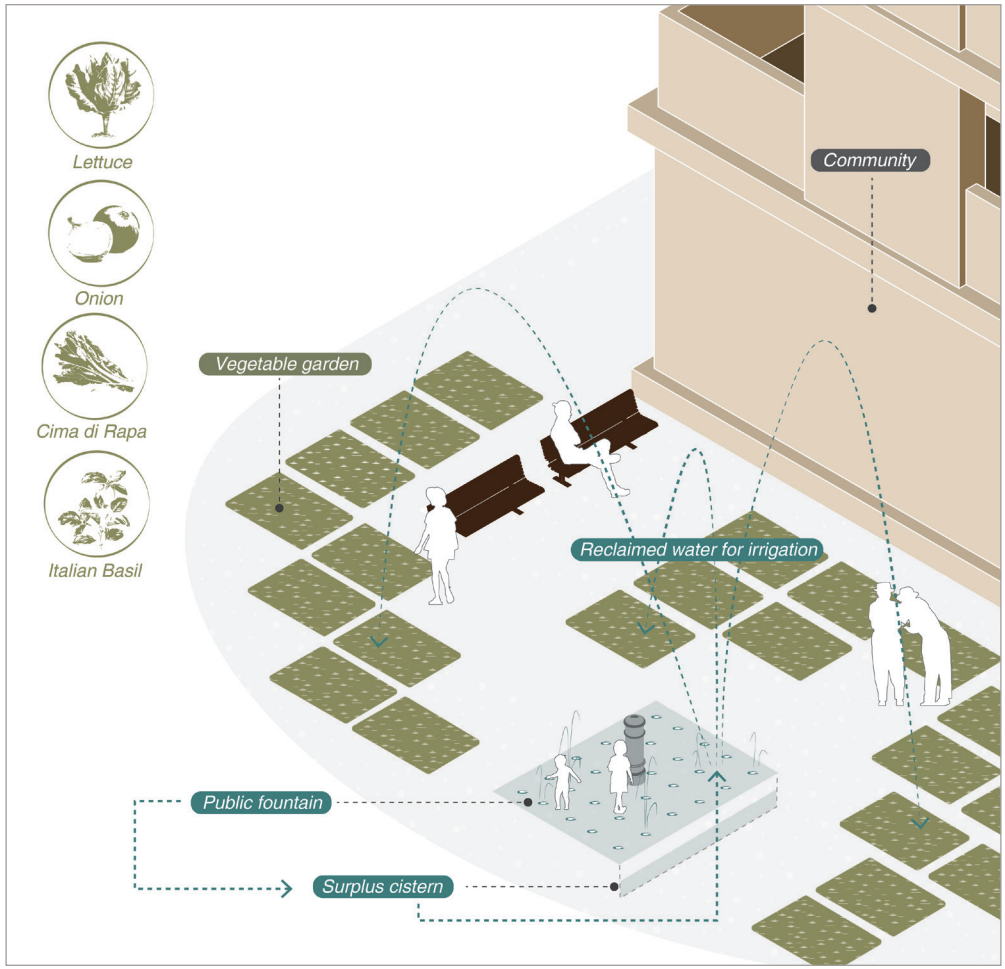


Proposed neighbourhood unit in Matera

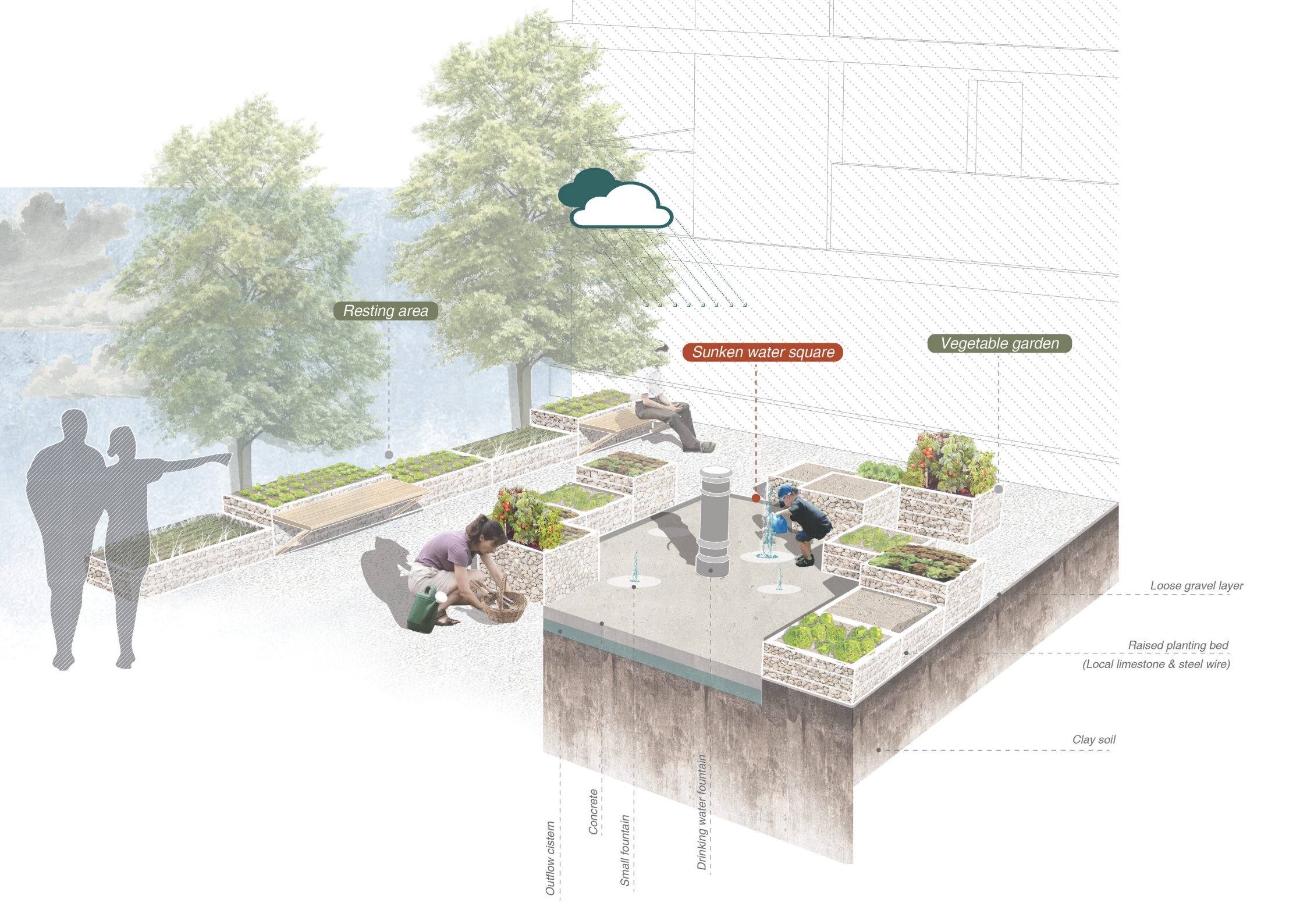




Isolated public fountain



Proposed neighbourhood unit


Resting area
Sunken water square
Vegetable garden
Loose gravel layer
Raised planting bed
(Local limestone & steel wire)
Clay soil
Outflow cistern
Concrete
Small fountain
Drinking water fountain



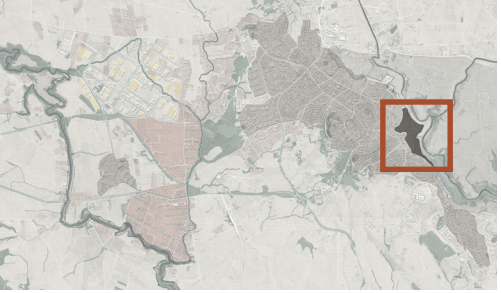
Grabiglioni in 1900



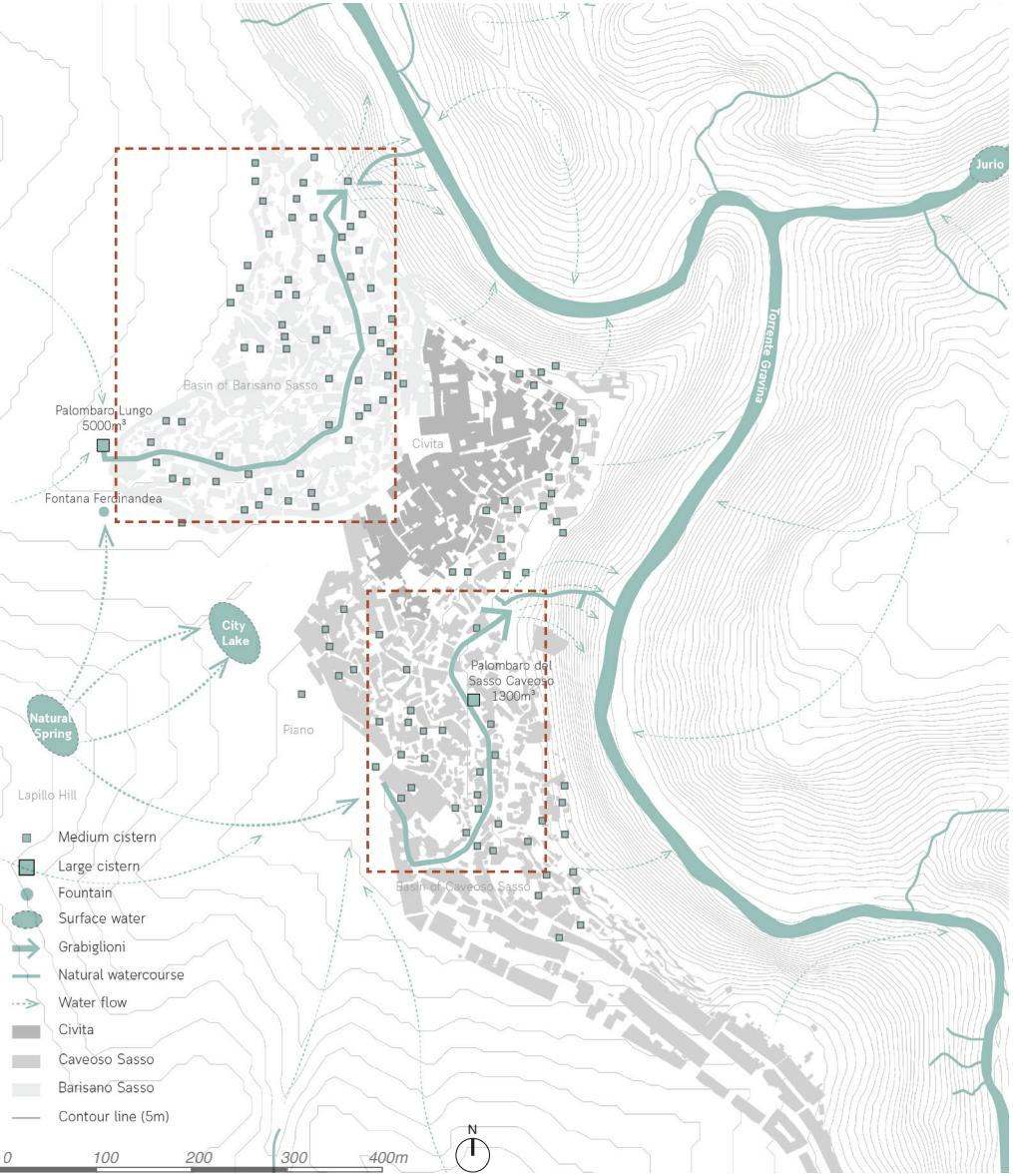
Social gathering around grabiglioni



Grabiglioni in 2004



Grabiglioni



Grabiglioni in Sassi di Matera





Sasso Caveoso & Sasso Barisano with highlighted grabiglioni

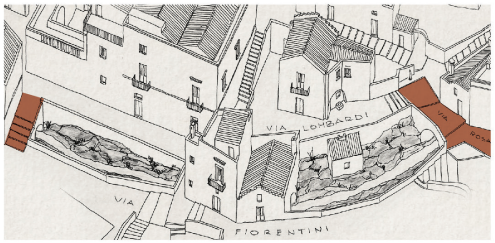
0 *Sewer*



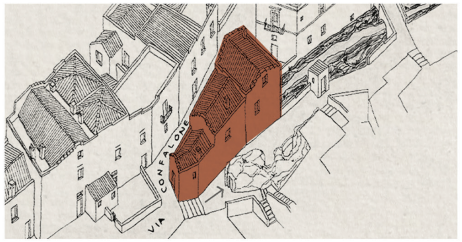
1 *Sidewalk*



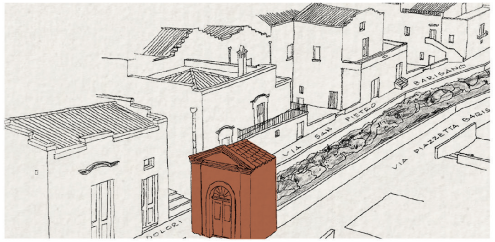
2 *Bridge*



3 *Lamione*



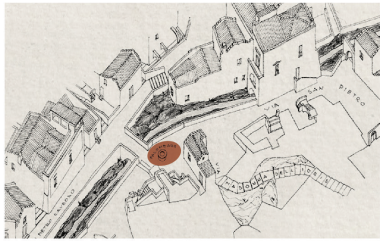
4 *Chapel*



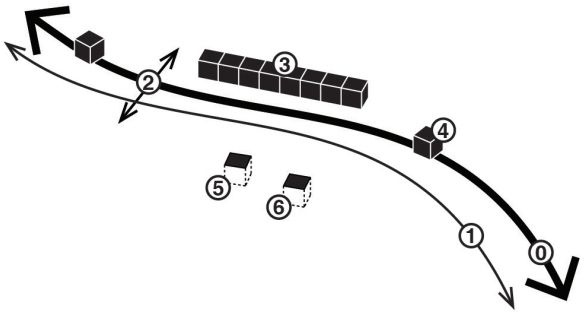
5 *Cistern*

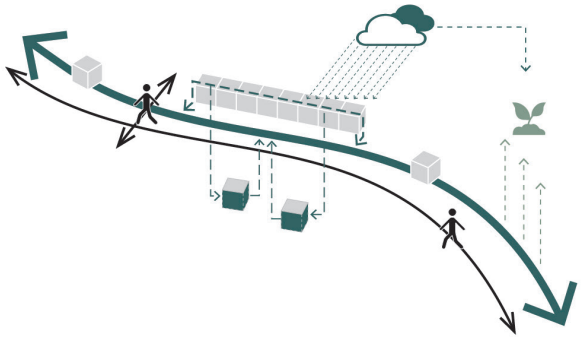


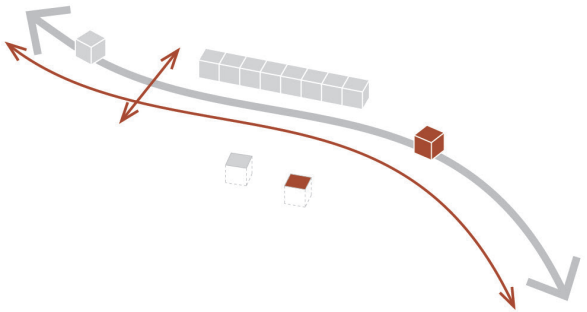
6 *Palombaro*



Grabiglioni in 1910:
Circular water & social life





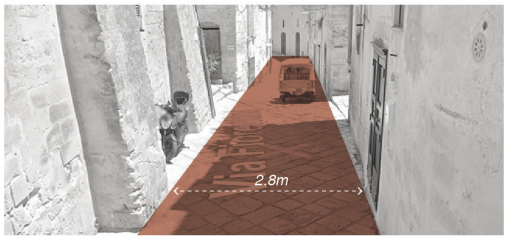


Type	Relation	Form	Circular system	Green space	Social network	User
⓪ Grabiglioni	×	Line	Drainage	Humus provider	×	Public
① Sidewalk	Along	Line	Pedestrian traffic	×	Main street	Public
② Bridge	Above	Line	Pedestrian traffic	×	Main crossing	Public
③ Lamione	Along	Line	Rainwater collection	×	×	Private
④ Chapel	Above	Block	Rainwater collection	×	Religious site	Public
⑤ Cistern	Near (below)	Block	Rainwater storage	×	×	Private
⑥ Palombaro	Near (below)	Block	Rainwater storage	×	Plaza	Public

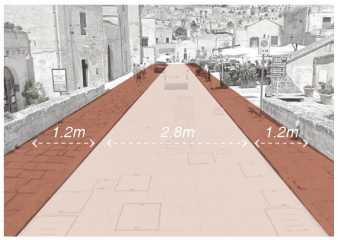
0 *Underground sewer*



1 *Car lane*



2 *Sidewalk*



3 *Lamione*



4 *Parking lot*



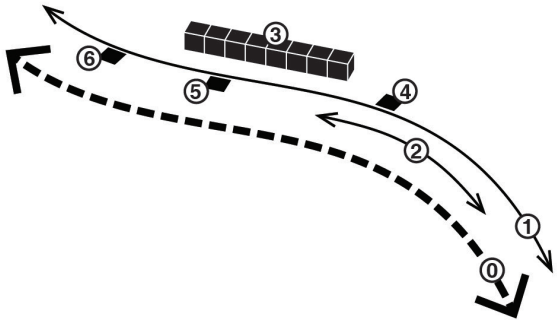
5 *Outdoor dining*

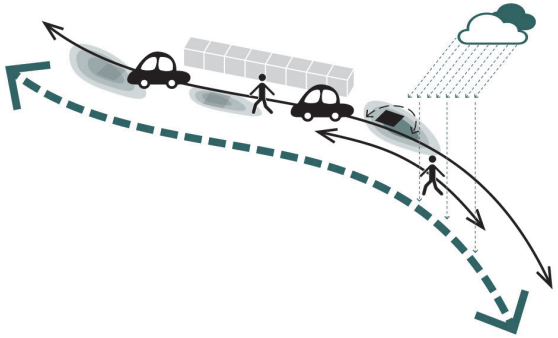


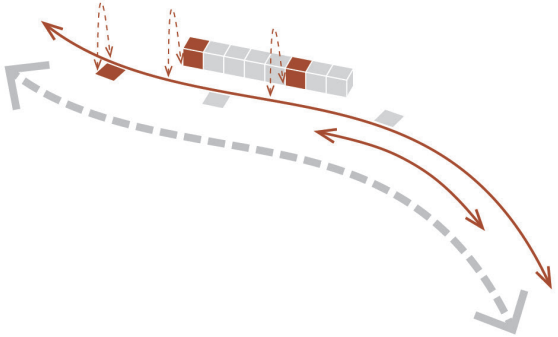
6 *Fountain*



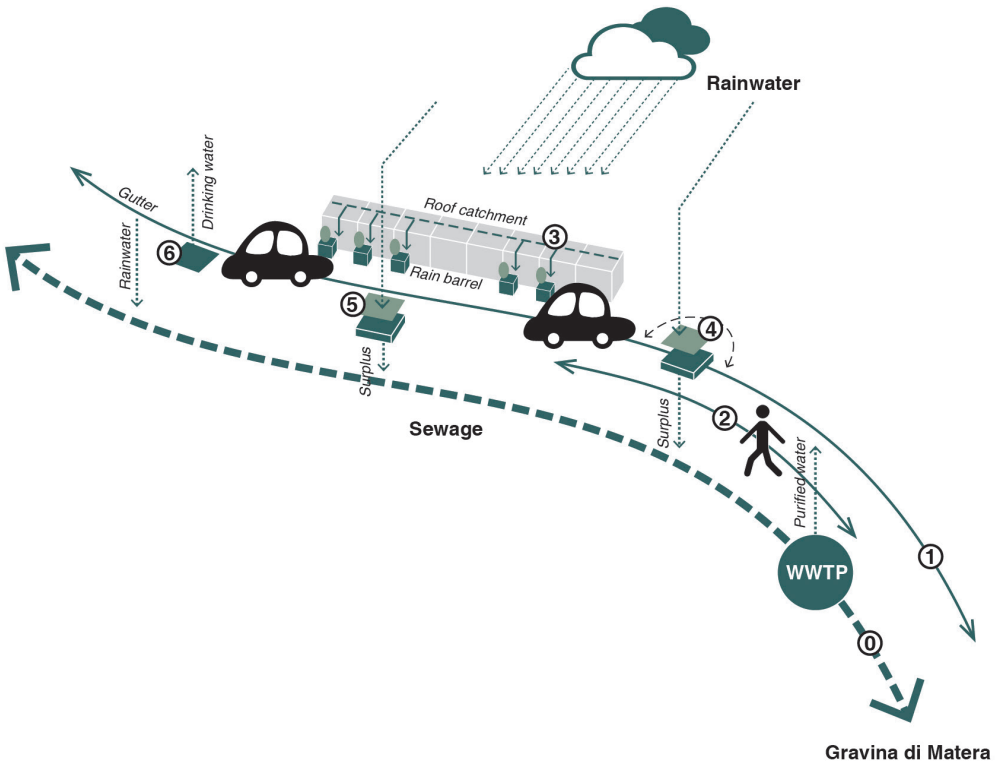
Grabiglioni in 2023:
Traffic & tourist center

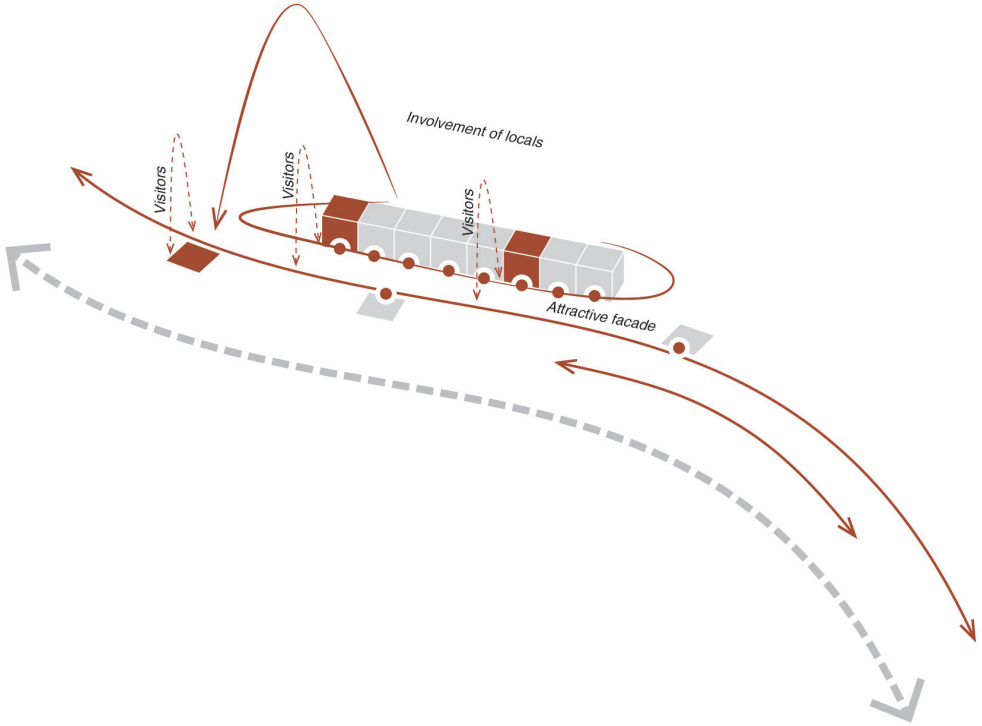






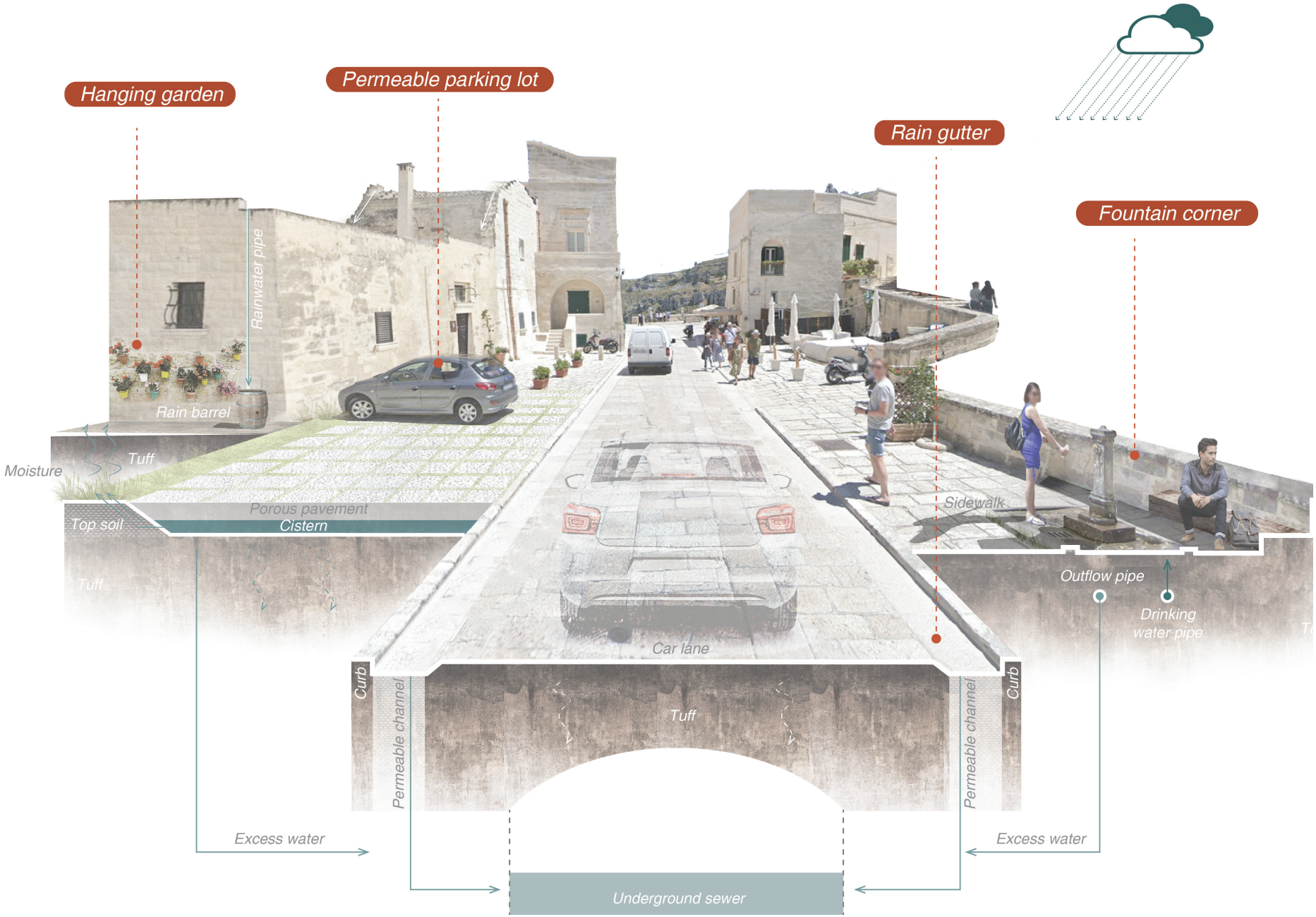
Type	Relation	Form	Circular system	Green space	Social network	User
⓪ Grabiglioni	×	Line	Hidden drainage	×	×	Public facilities
① Car lane	Along (above)	Line	Only motorway	×	Main street	Public facilities
② Sidewalk	Along (above)	Line	Pedestrian traffic	×	Main street	Public facilities
③ Lamione	Along (above)	Block	×	×	Residential or service	Locals
④ Parking lot	Near (above)	Surface	Parking space	×	×	Public facilities
⑤ Outdoor dining	Near (above)	Surface	×	×	×	Locals & visitors
⑥ Fountain corner	Near (above)	Surface	×	×	Water sharing and resting	Visitors

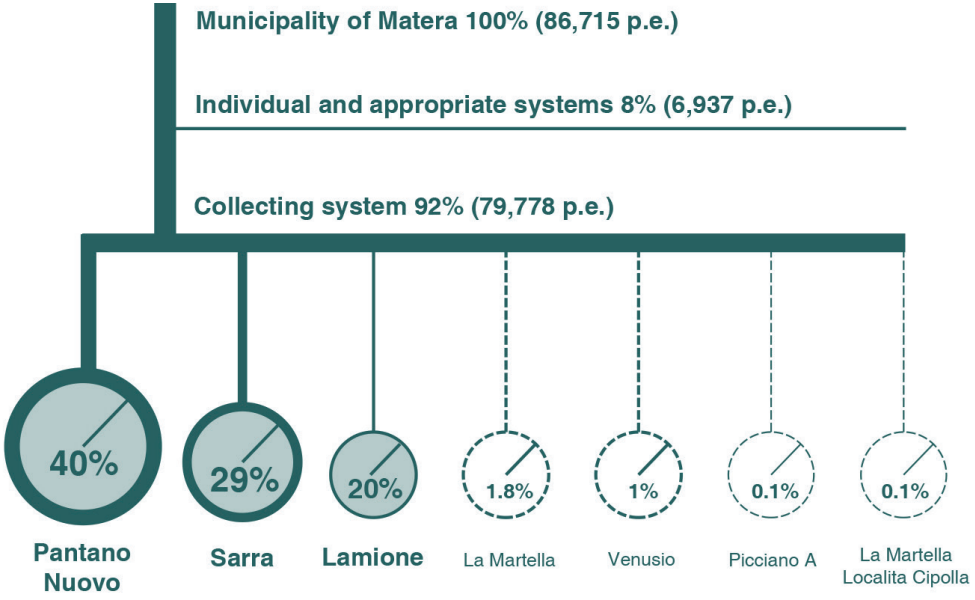


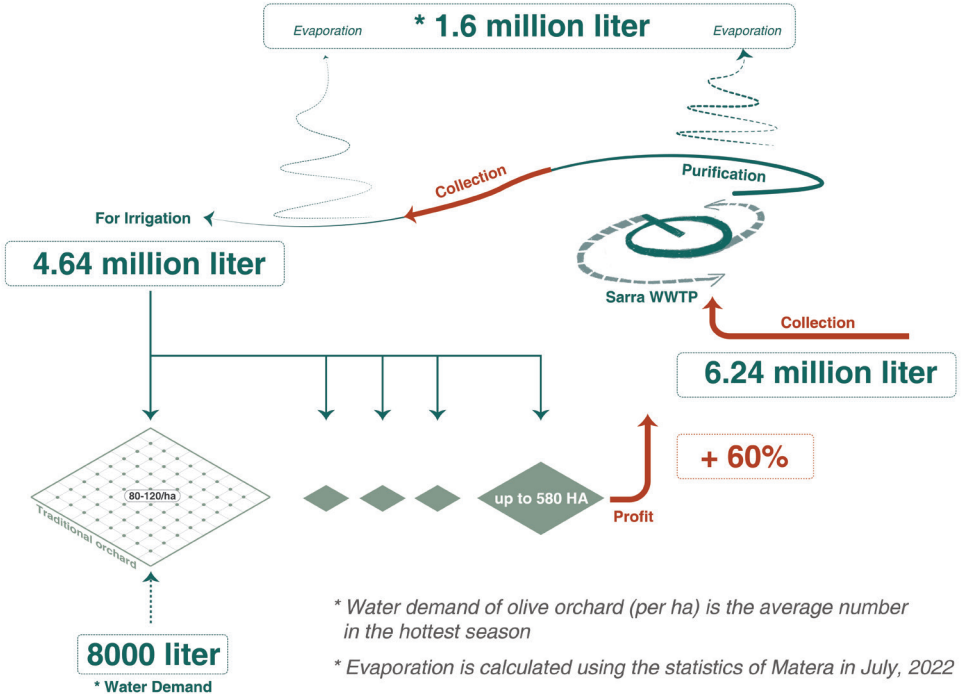


Proposed Grabiglioni:
from traffic-oriented to water-oriented

Type	Circular system	Green space	Social network	User
⓪ Grabiglioni	Hidden drainage	×	×	Public facilities
① Car lane (with gutter)	Rainwater evacuation	×	Main street	Public facilities
② Sidewalk (with gutter)	Rainwater evacuation	×	Main street	Public faciloities
③ Lamione (with mini garden)	Rainwater collection	Mini garden	Residential or service	Locals & visitors
④ Eco parking lot	Rainwater collection	Linear green space	×	Public facilities
⑤ Garden dining room	Rainwater collection	Linear green space	×	Locals & visitors
⑥ Fountain square	Small circulation	×	Water sharing and resting	Locals & visitors

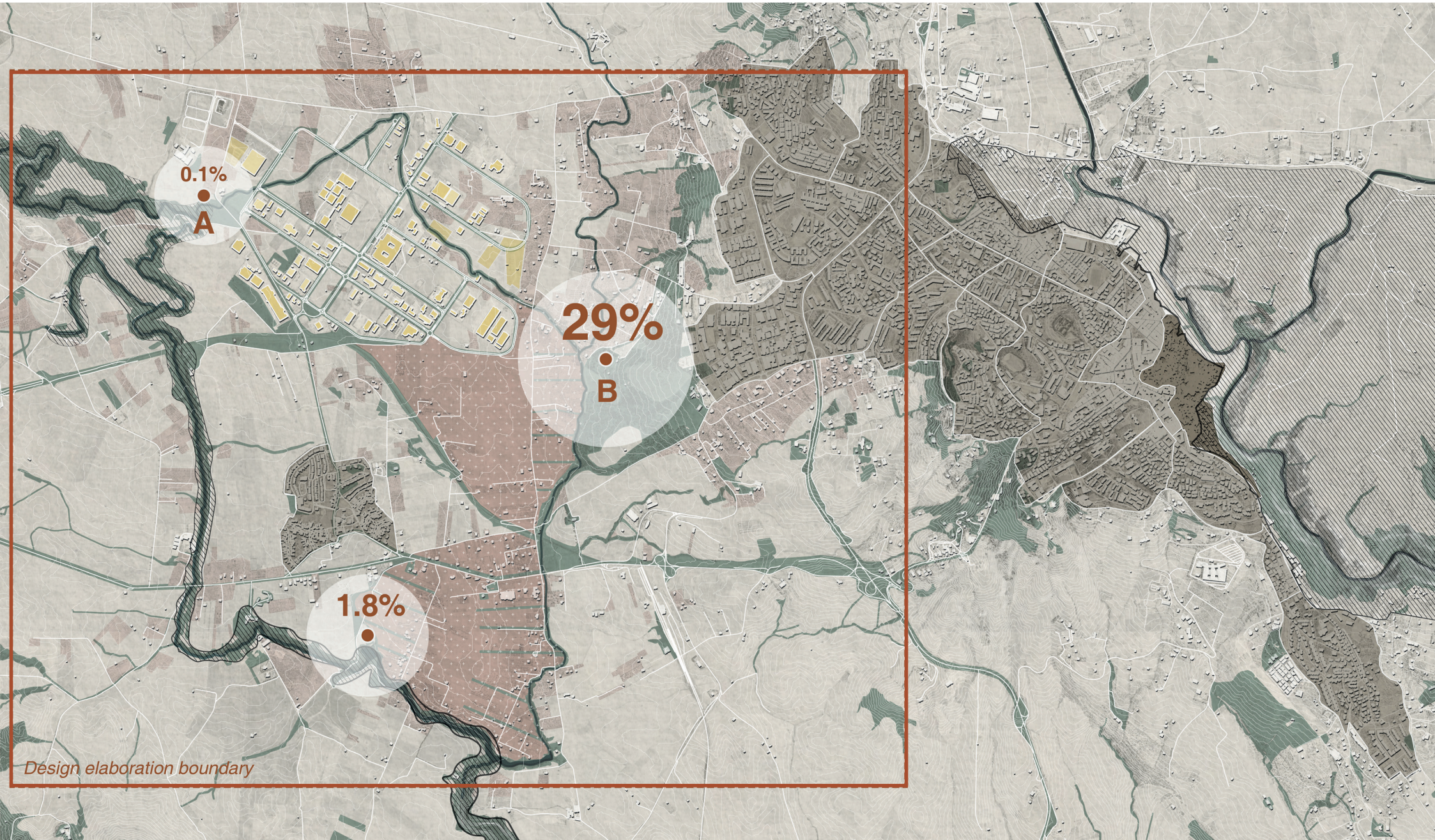

Hanging garden
Permeable parking lot
Rain gutter
Fountain corner
Rainwater pipe
Rain barrel
Moisture
Tuff
Top soil
Porous pavement
Cistern
Tuff
Car lane
Sidewalk
Outflow pipe
Drinking water pipe
Curb
Permeable channel
Tuff
Permeable channel
Curb
Excess water
Excess water
Underground sewer

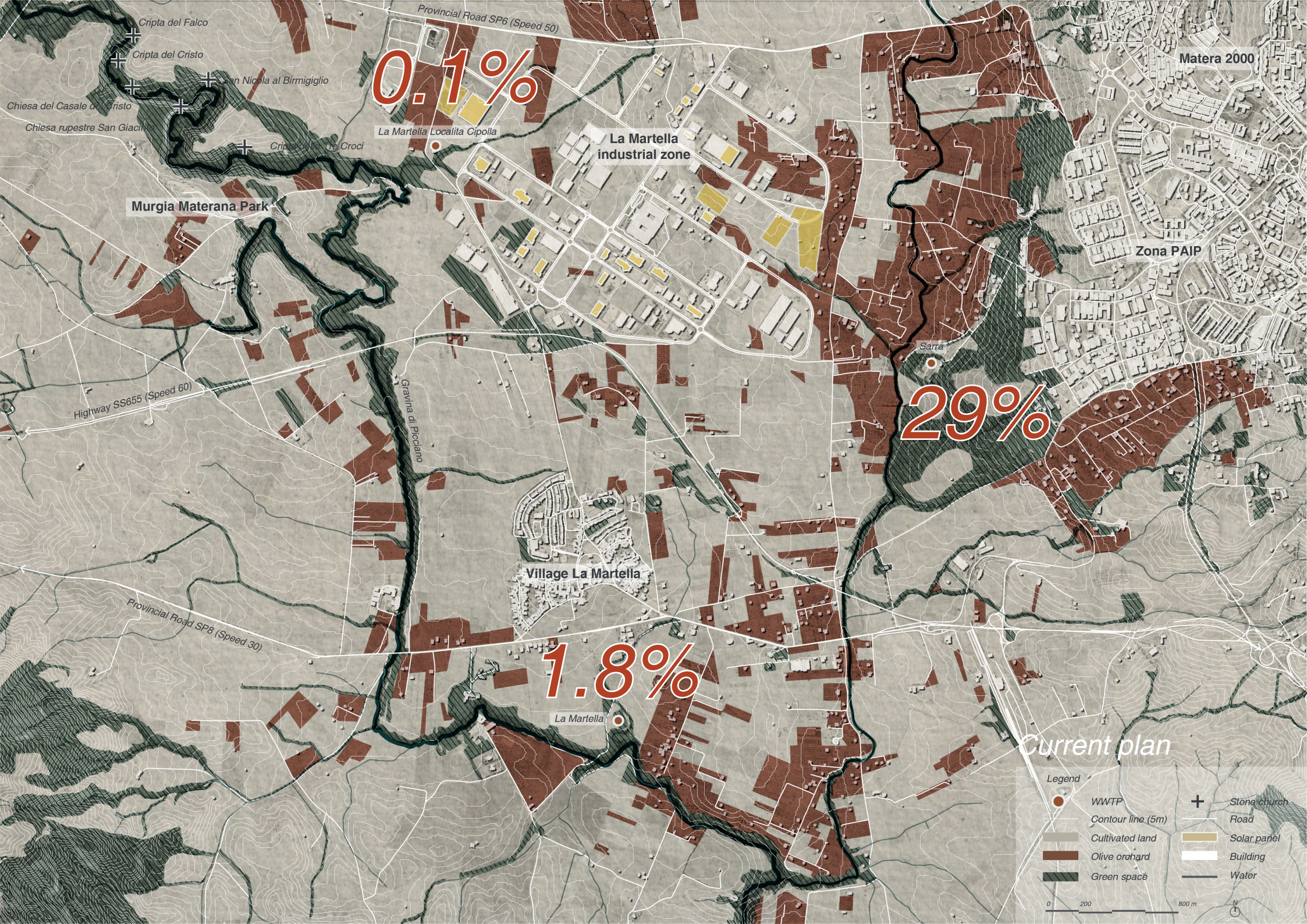


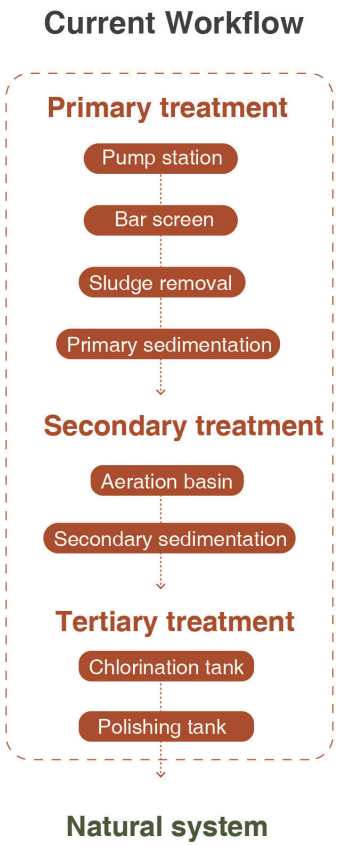


Potential of wastewater for agricultural irrigation

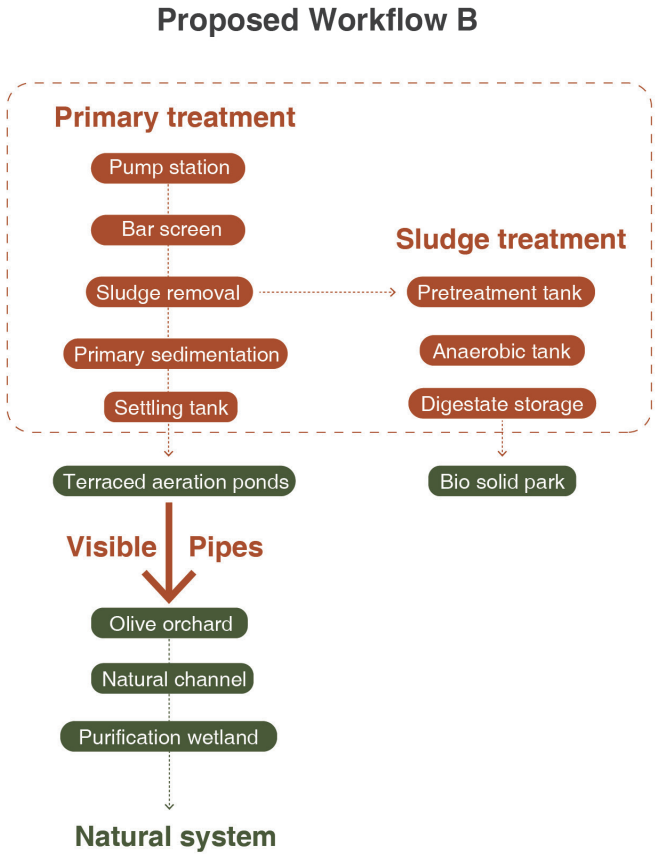
Wastewater treatment plant

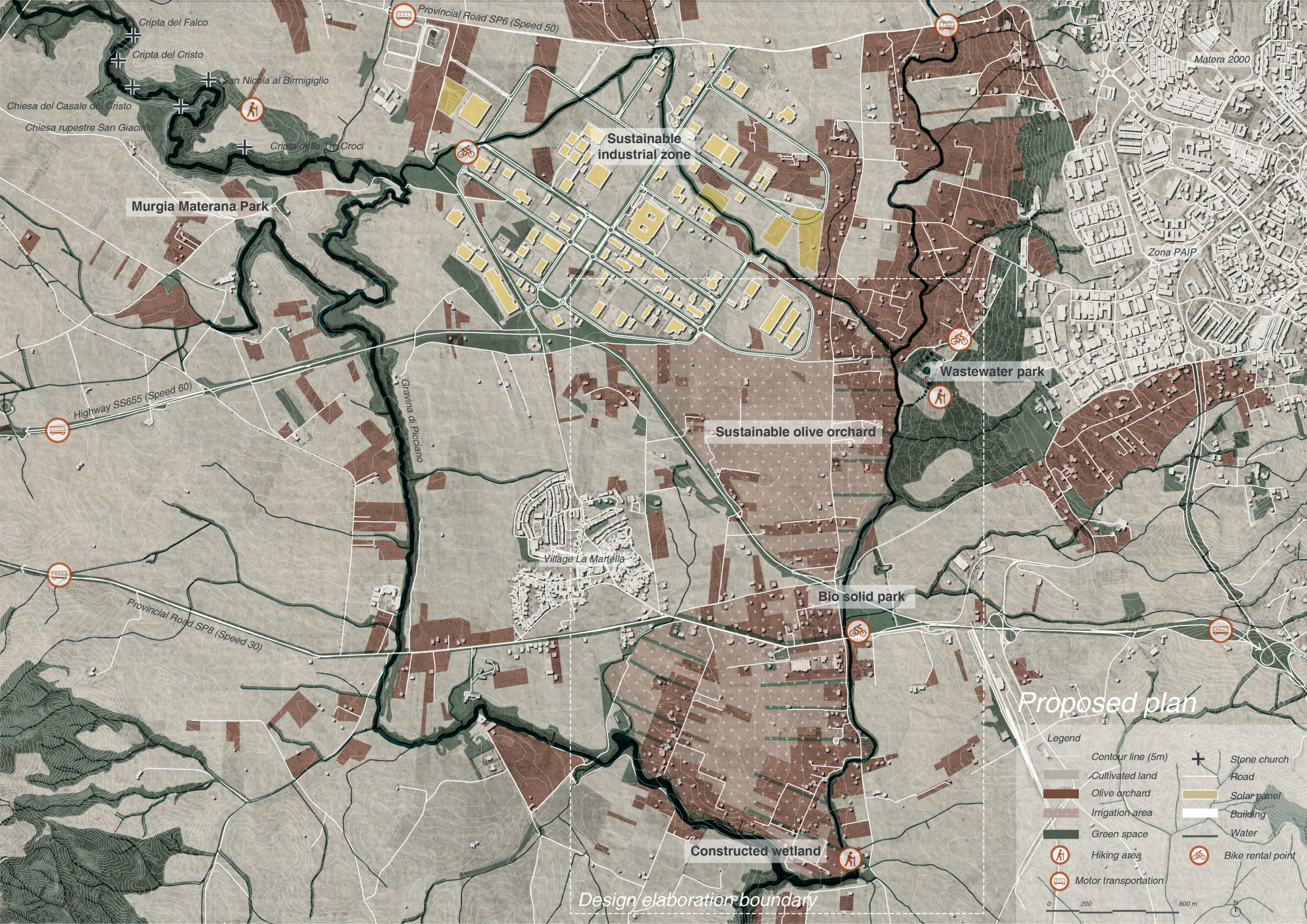



Cripta del Falco
Cripta del Cristo
San Nicola al Birmigiglio
Chiesa del Casale di Cristo
Chiesa rupestre San Giacinto
Cripta delle Croci
Provincial Road SP6 (Speed 50)
0.1%
La Martella Localita Cipolla
La Martella industrial zone
Matera 2000
Zona PAIP
Murgia Materana Park
Sarra
29%
Highway SS655 (Speed 60)
Gravina di Picciano
Village La Martella
Provincial Road SP8 (Speed 30)
1.8%
La Martella
Current plan
Legend
WWTP
Contour line (5m)
Cultivated land
Olive orchard
Green space
Stone church
Road
Solar panel
Building
Water
0
200
800 m
N

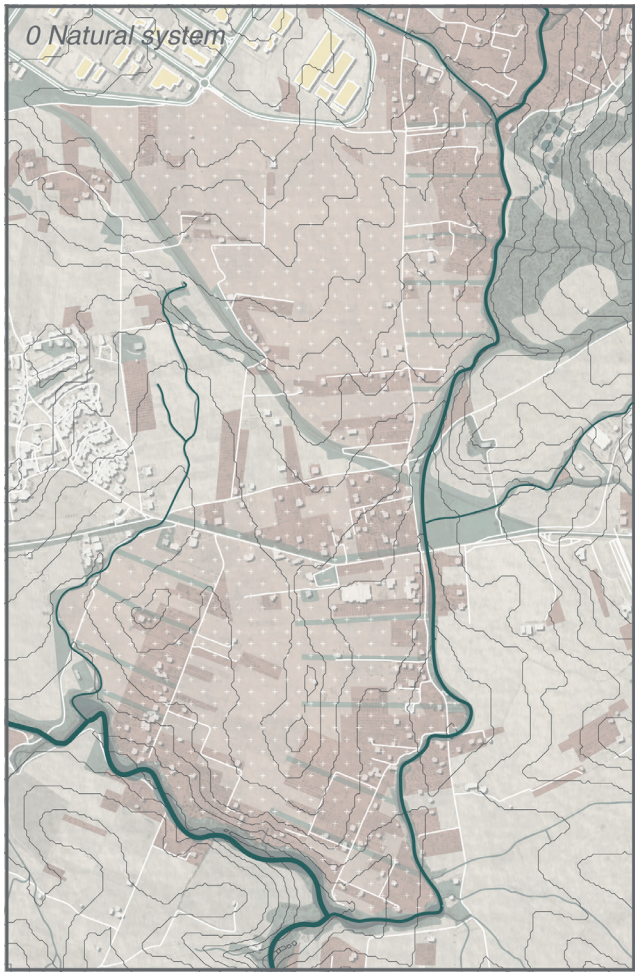

Current Workflow
Primary treatment
Pump station
Bar screen
Sludge removal
Primary sedimentation
Secondary treatment
Aeration basin
Secondary sedimentation
Tertiary treatment
Chlorination tank
Polishing tank
Natural system

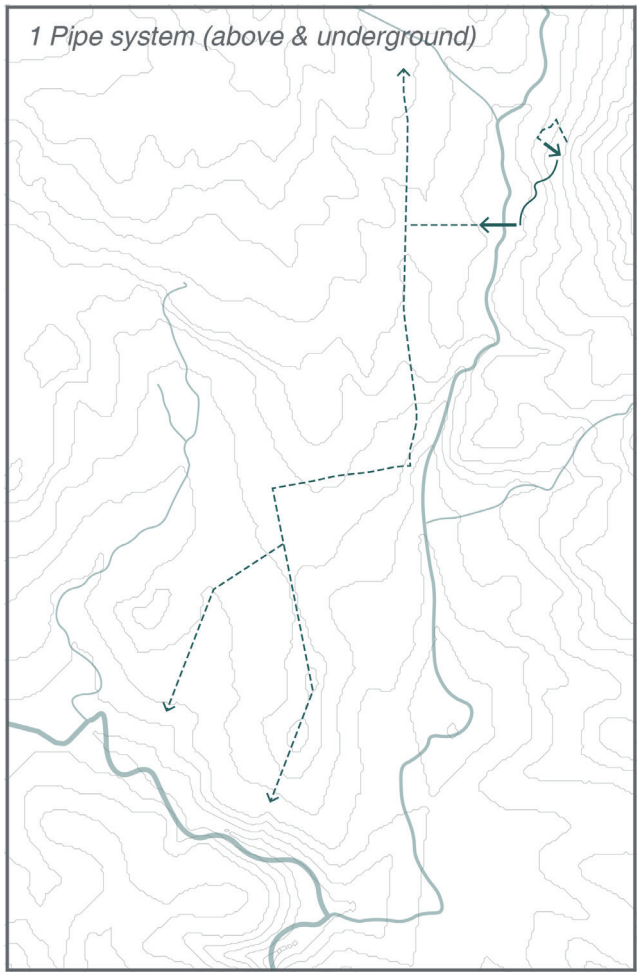

Proposed Workflow A
Grey water
Grey water tank
Septic tank
Solar roof
Public green space

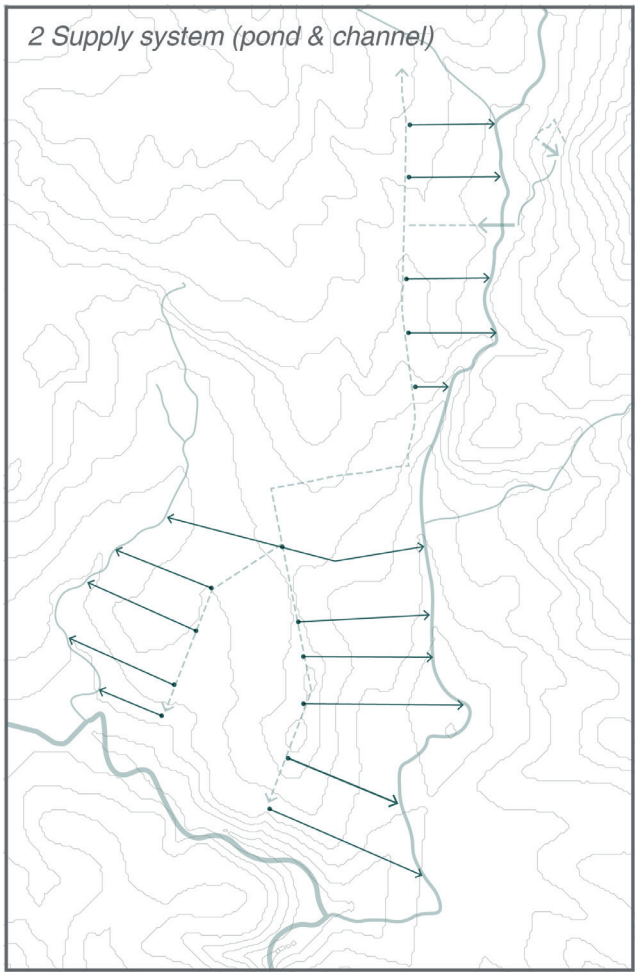

Proposed Workflow B
Primary treatment
Pump station
Bar screen
Sludge removal
Primary sedimentation
Settling tank
Sludge treatment
Pretreatment tank
Anaerobic tank
Digestate storage
Terraced aeration ponds
Bio solid park
Visible
Pipes
Olive orchard
Natural channel
Purification wetland
Natural system


Cripta del Falco
Cripta del Cristo
San Nicola al Birmigiglio
Chiesa del Casale del Cristo
Chiesa rupestre San Giacinto
Cripta delle Tre Croci
Murgia Materana Park
Provincial Road SP6 (Speed 50)
Sustainable industrial zone
Matera 2000
Zona PAIP
Wastewater park
Highway SS655 (Speed 60)
Gravina di Picciano
Sustainable olive orchard
Village La Martella
Bio solid park
Provincial Road SP8 (Speed 30)
Constructed wetland
Design elaboration boundary
Proposed plan
Legend
Contour line (5m)
Cultivated land
Olive orchard
Irrigation area
Green space
Hiking area
Motor transportation
Stone church
Road
Solar panel
Building
Water
Bike rental point
0
200
800 m
N

05 Wastewater circularity



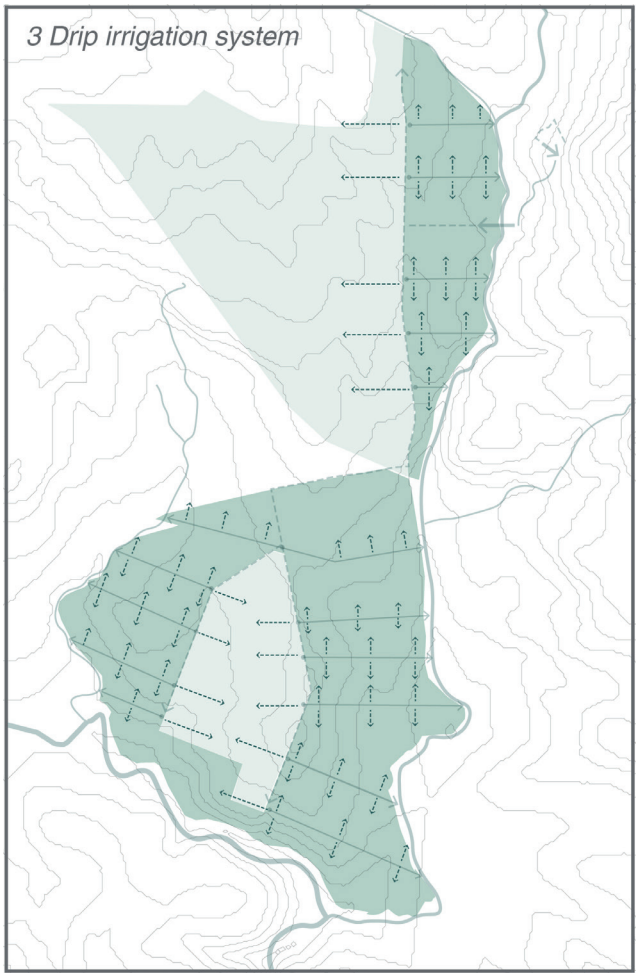


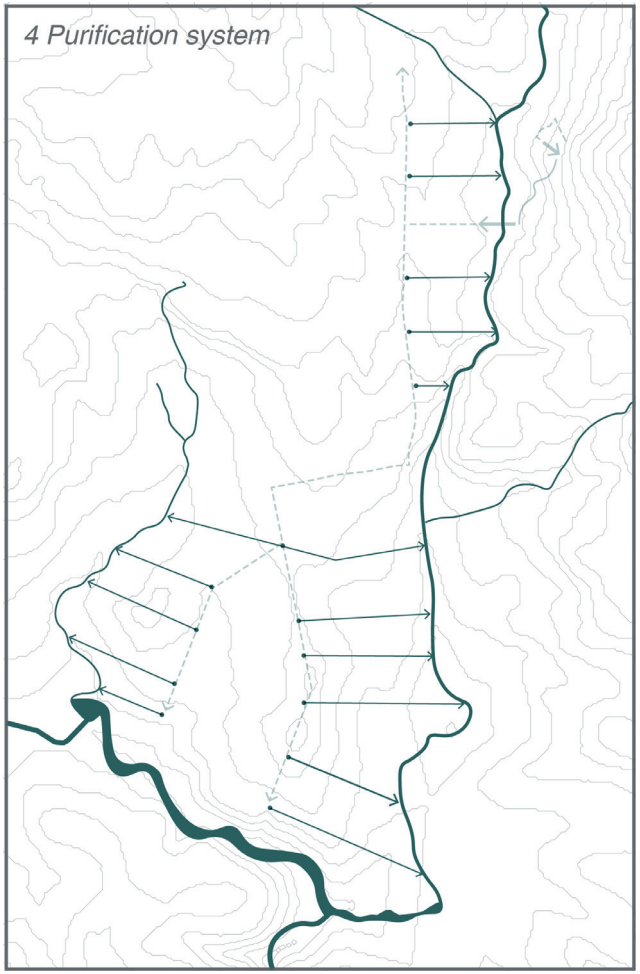


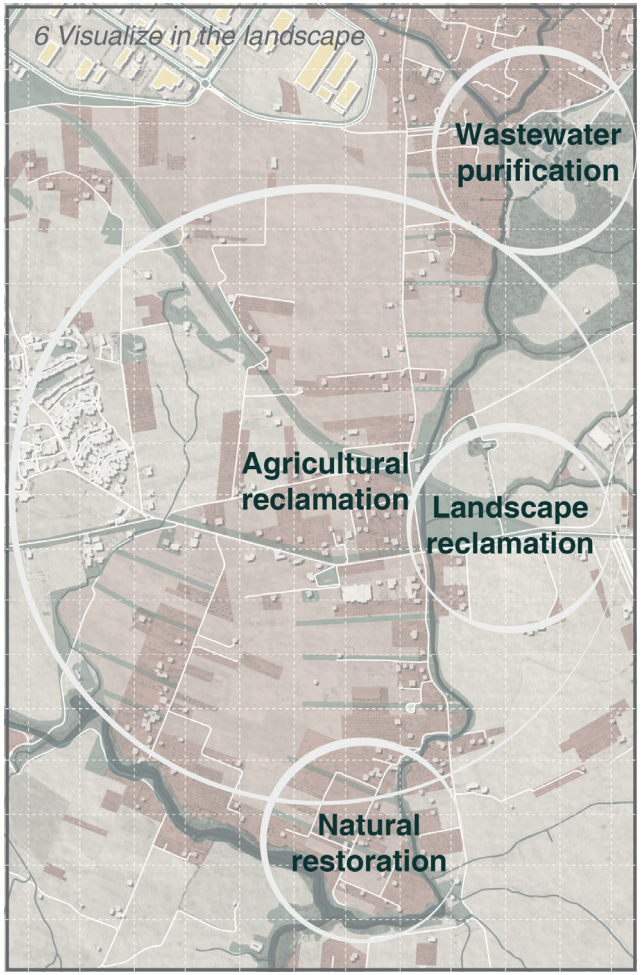
Contour line (5m)
Natural water system

Underground pipes
Visible construction
Terraced pond

Release pond
Water channel

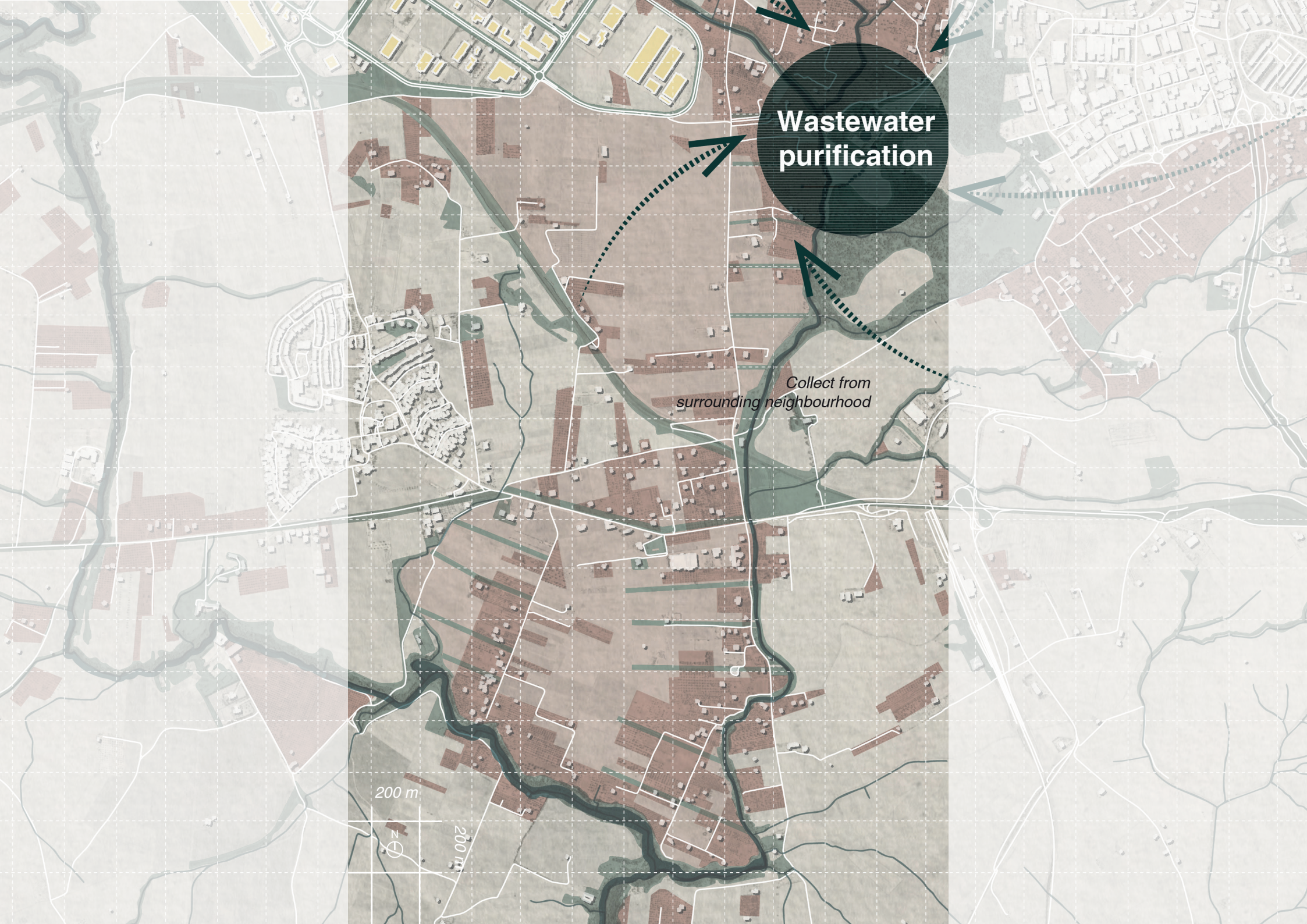




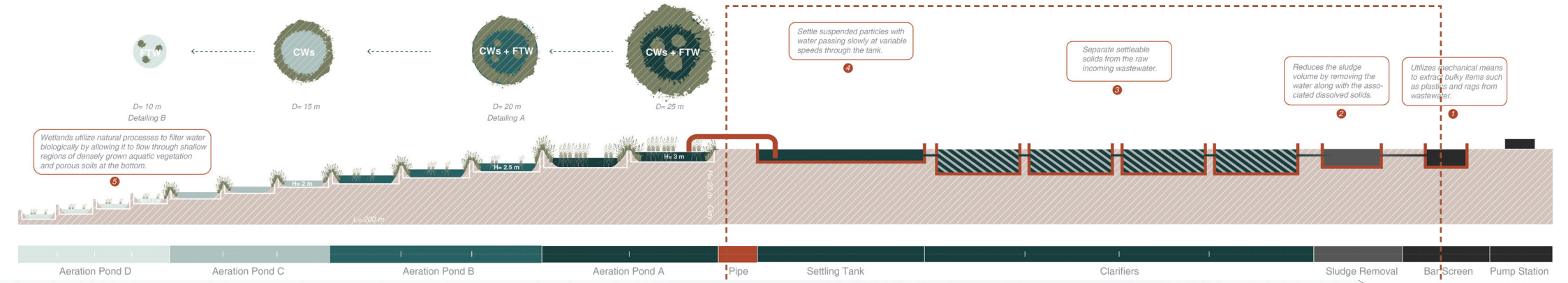


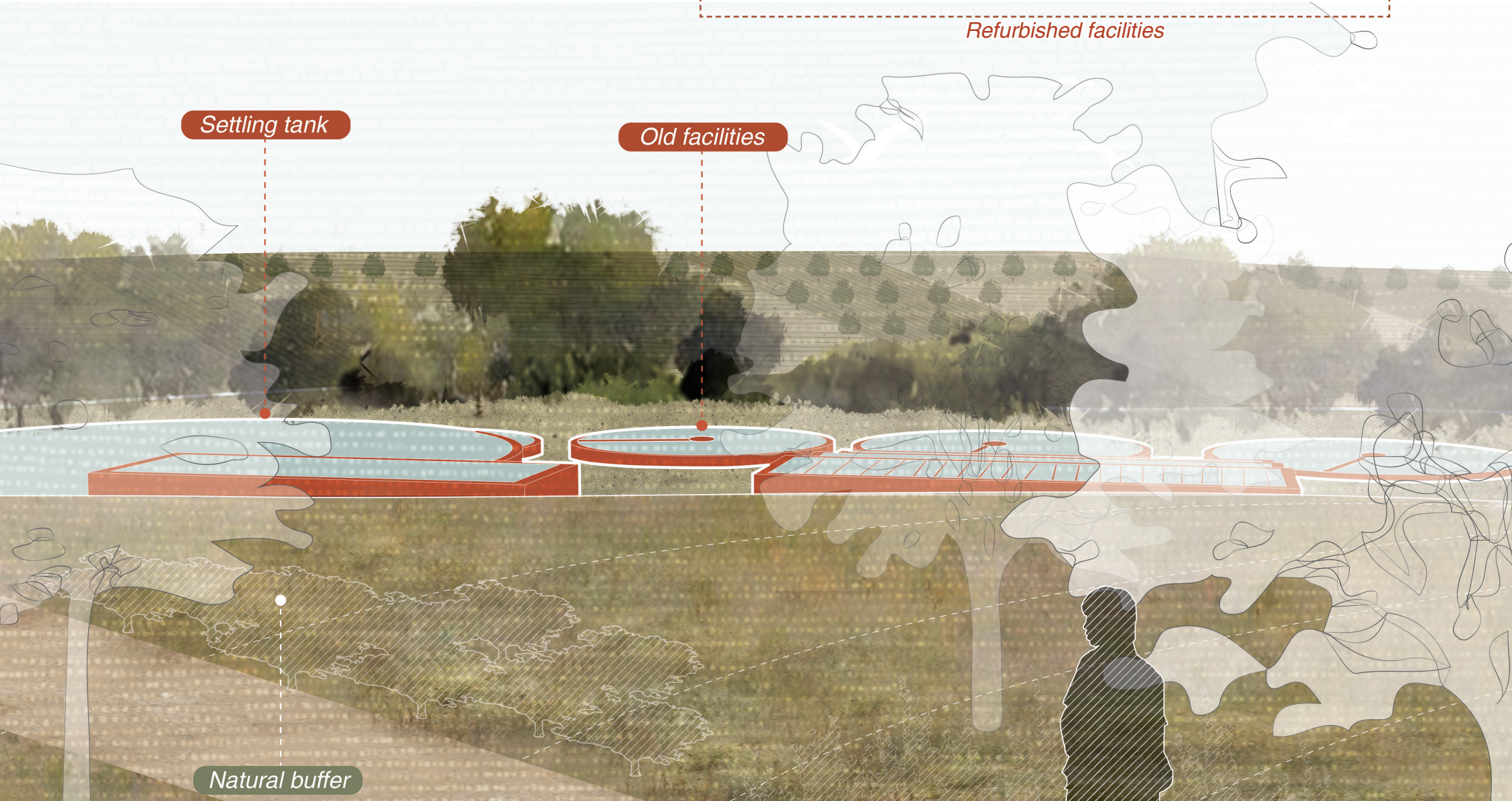
Designed area for irrigation
Possible expansion
Drip irrigation option

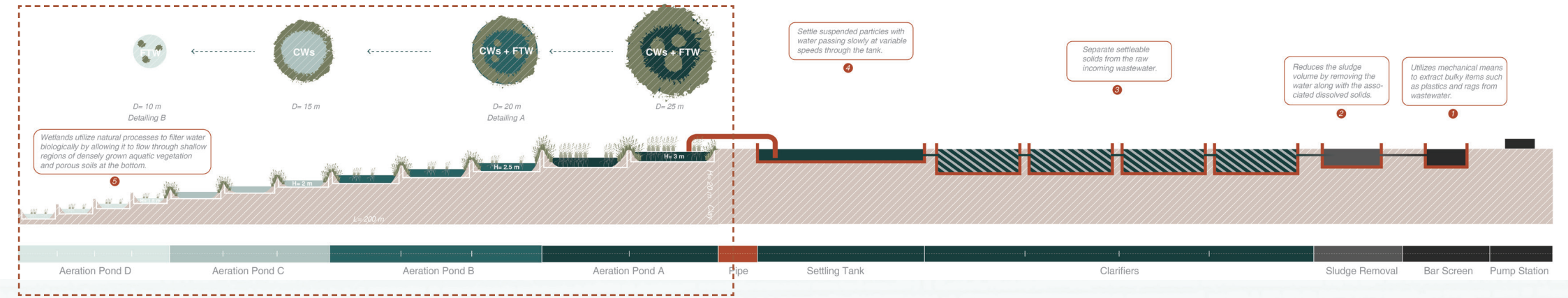
Expanded wetland


Wastewater purification
Collect from surrounding neighbourhood
200 m
200 m
N

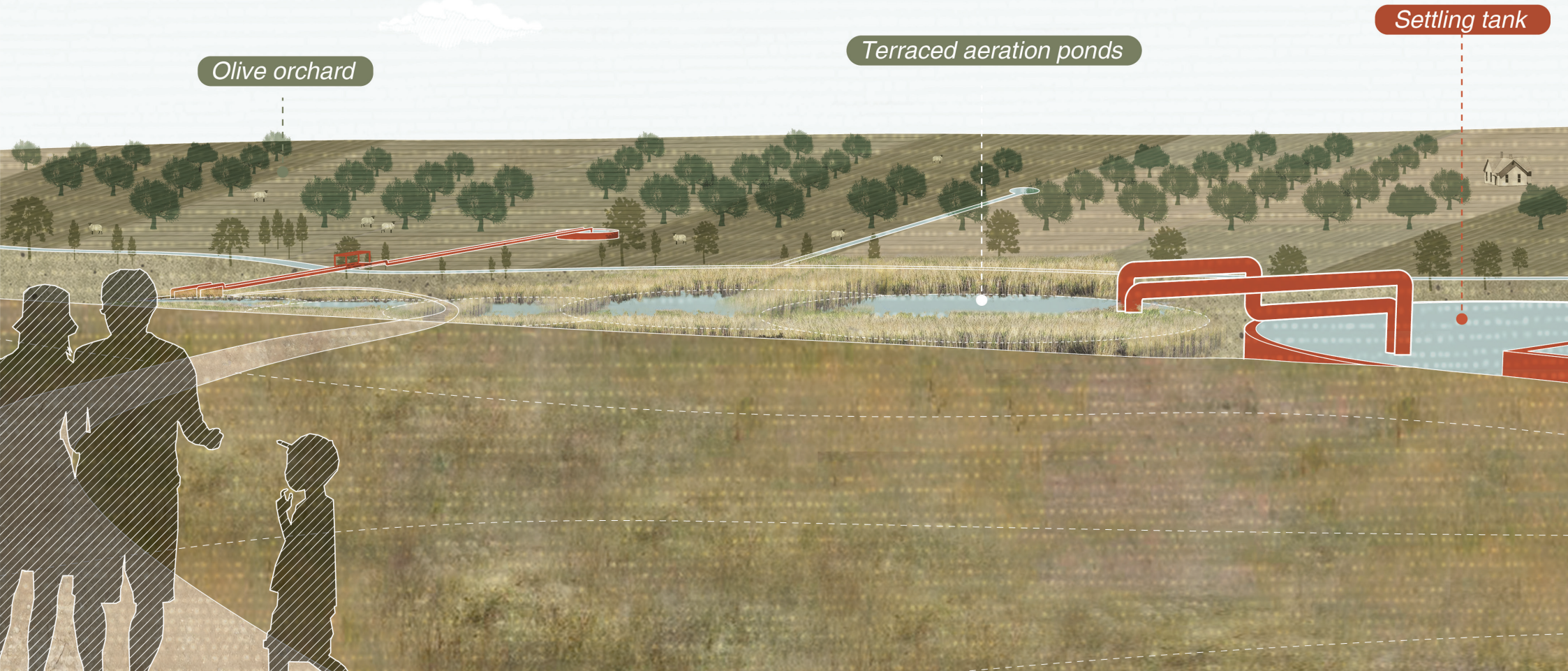

Bio solid shop
Parking lot & Bike rental
Digestate storage
Anaerobic tank
Pretreatment tank
Clarifier
Sludge removal
Bar screen
Settling tank
Terraced aeration ponds
Wastewater tank
Wastewater pipe
Viewing platform
Rainwater tank
Cycling route
Drip irrigation line
Irrigation pond
Irrigation channel
Hidden wastewater pipe
1
2
3
4
5
10 m
5 m
0 m
5 m
0 m
5 m
10 m
15 m
20 m
25 m
30 m
35 m
40 m
N
0
50
100
150 m

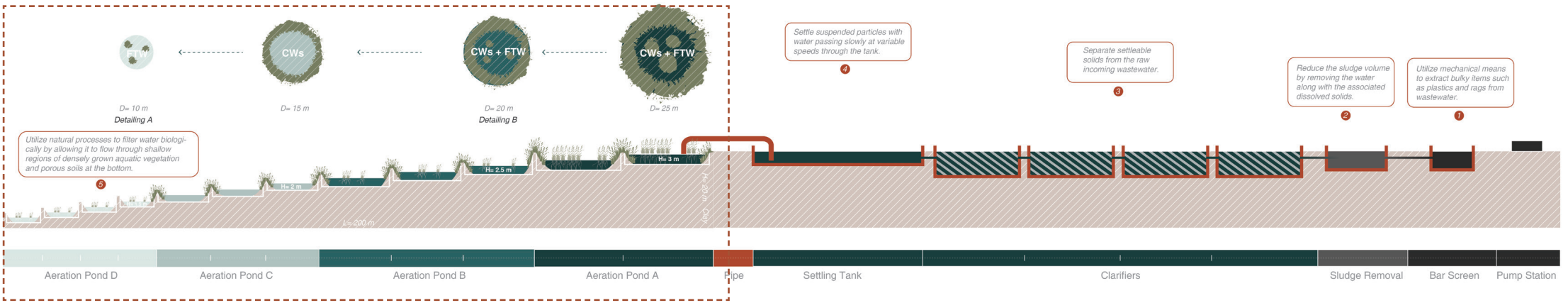

FTW
CWs
CWs + FTW
CWs + FTW
D= 10 m
Detailing B
D= 15 m
D= 20 m
Detailing A
D= 25 m
Settle suspended particles with water passing slowly at variable speeds through the tank.
4
Separate settleable solids from the raw incoming wastewater.
3
Reduces the sludge volume by removing the water along with the associated dissolved solids.
2
Utilizes mechanical means to extract bulky items such as plastics and rags from wastewater.
1
Wetlands utilize natural processes to filter water biologically by allowing it to flow through shallow regions of densely grown aquatic vegetation and porous soils at the bottom.
5
H= 2 m
H= 2.5 m
H= 3 m
k=200 m
H= 20 m
CWs
Aeration Pond D
Aeration Pond C
Aeration Pond B
Aeration Pond A
Pipe
Settling Tank
Clarifiers
Sludge Removal
Bar Screen
Pump Station
Refurbished facilities


Settling tank
Old facilities
Natural buffer

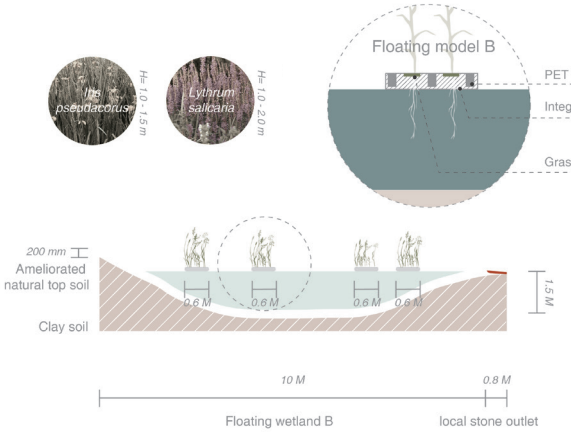


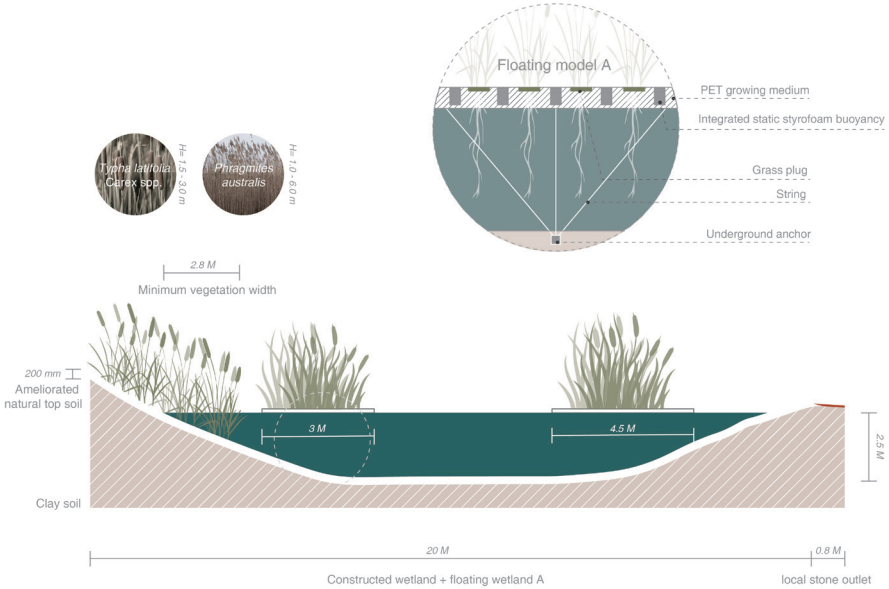
Natural purification



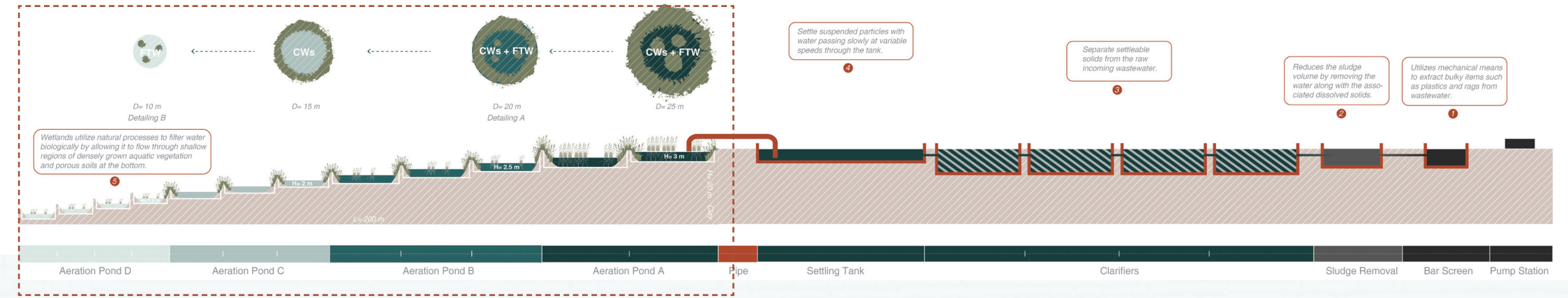


Natural purification

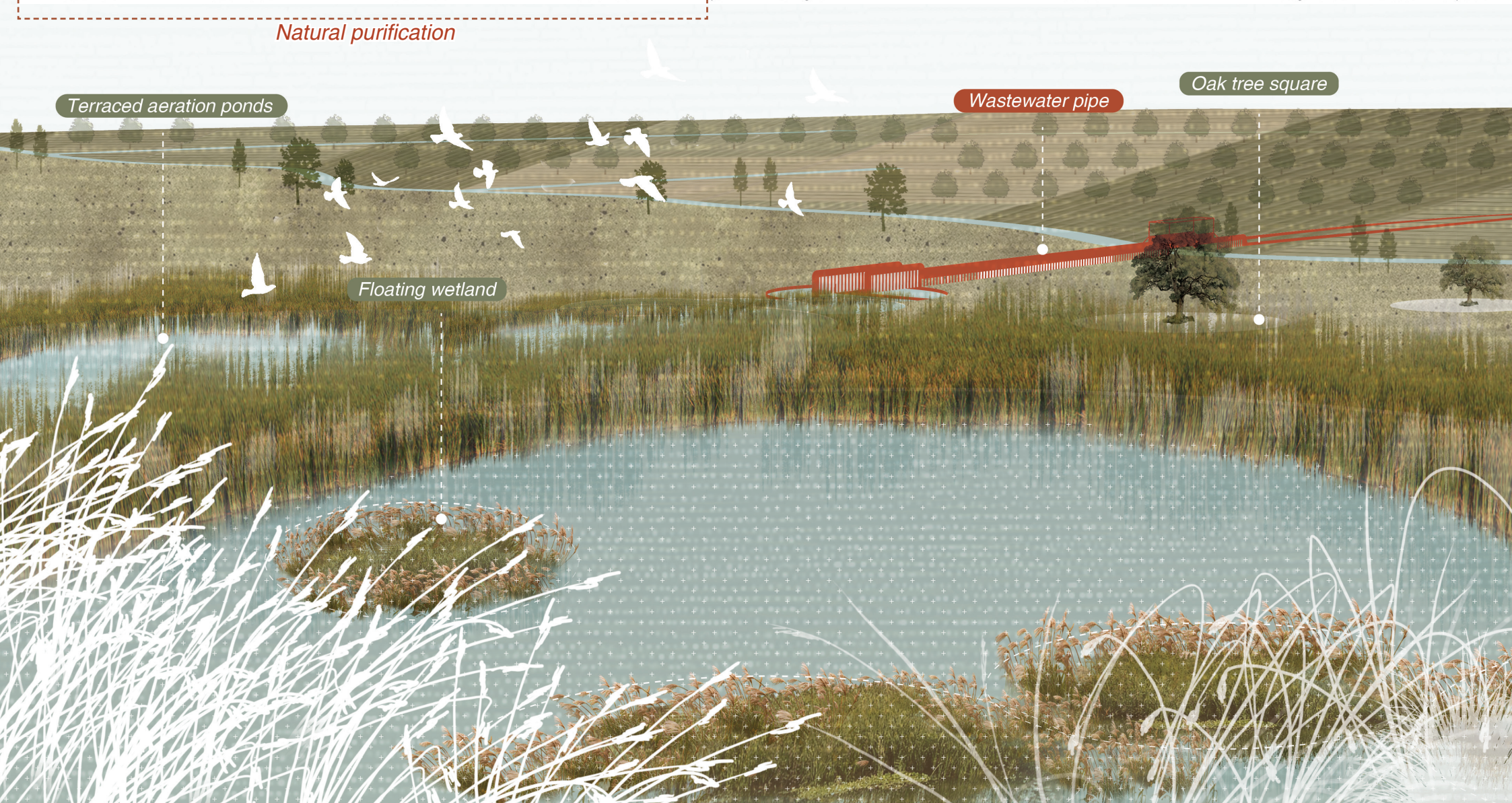


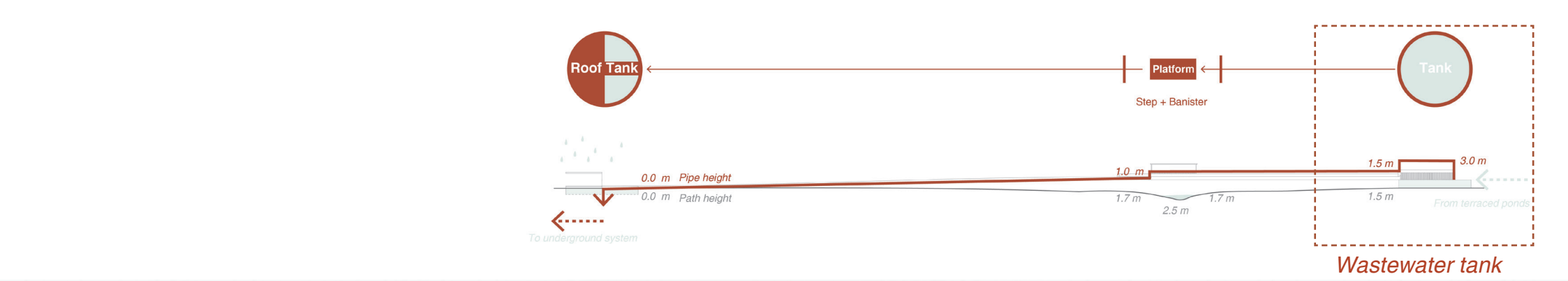


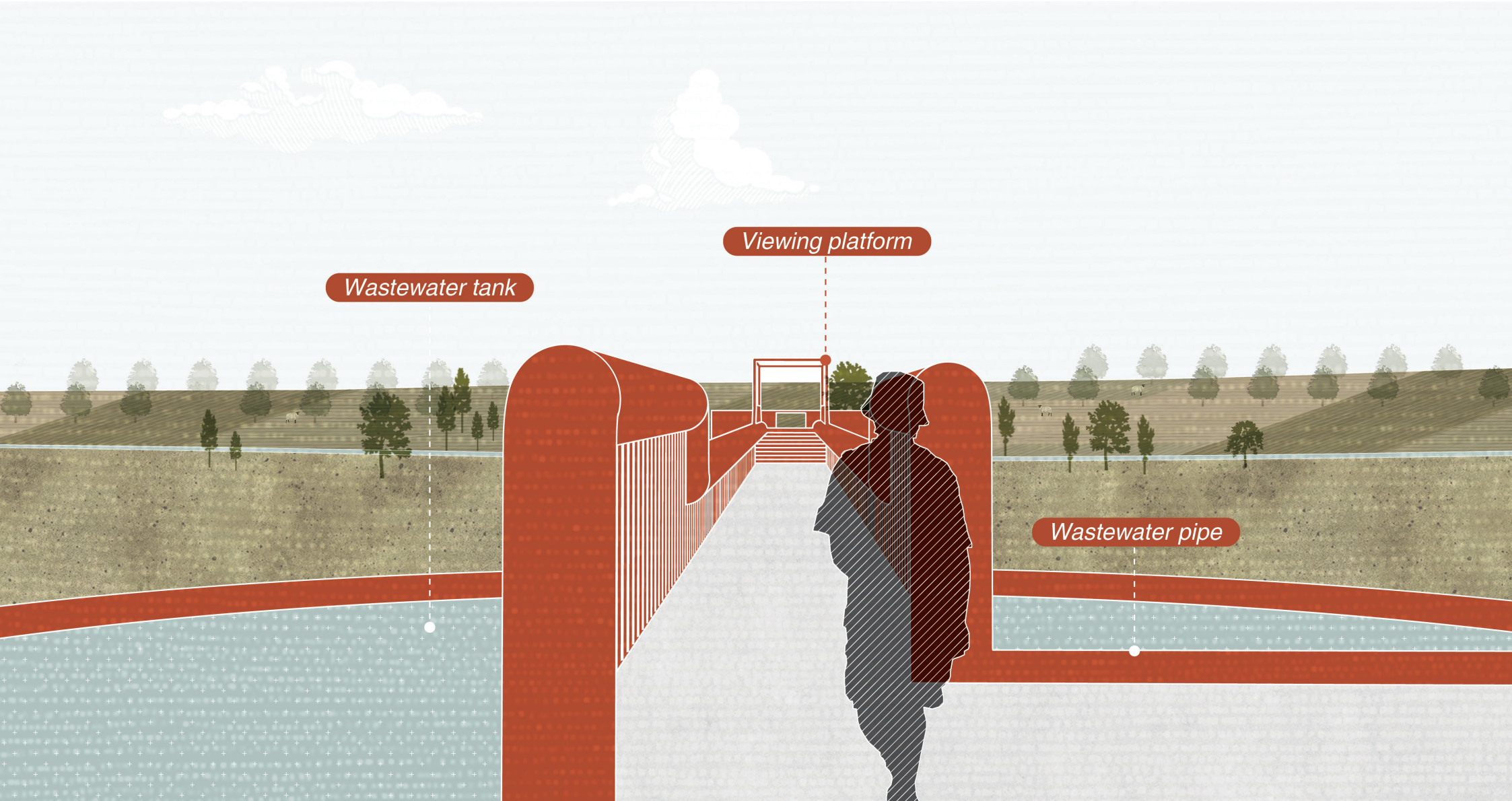


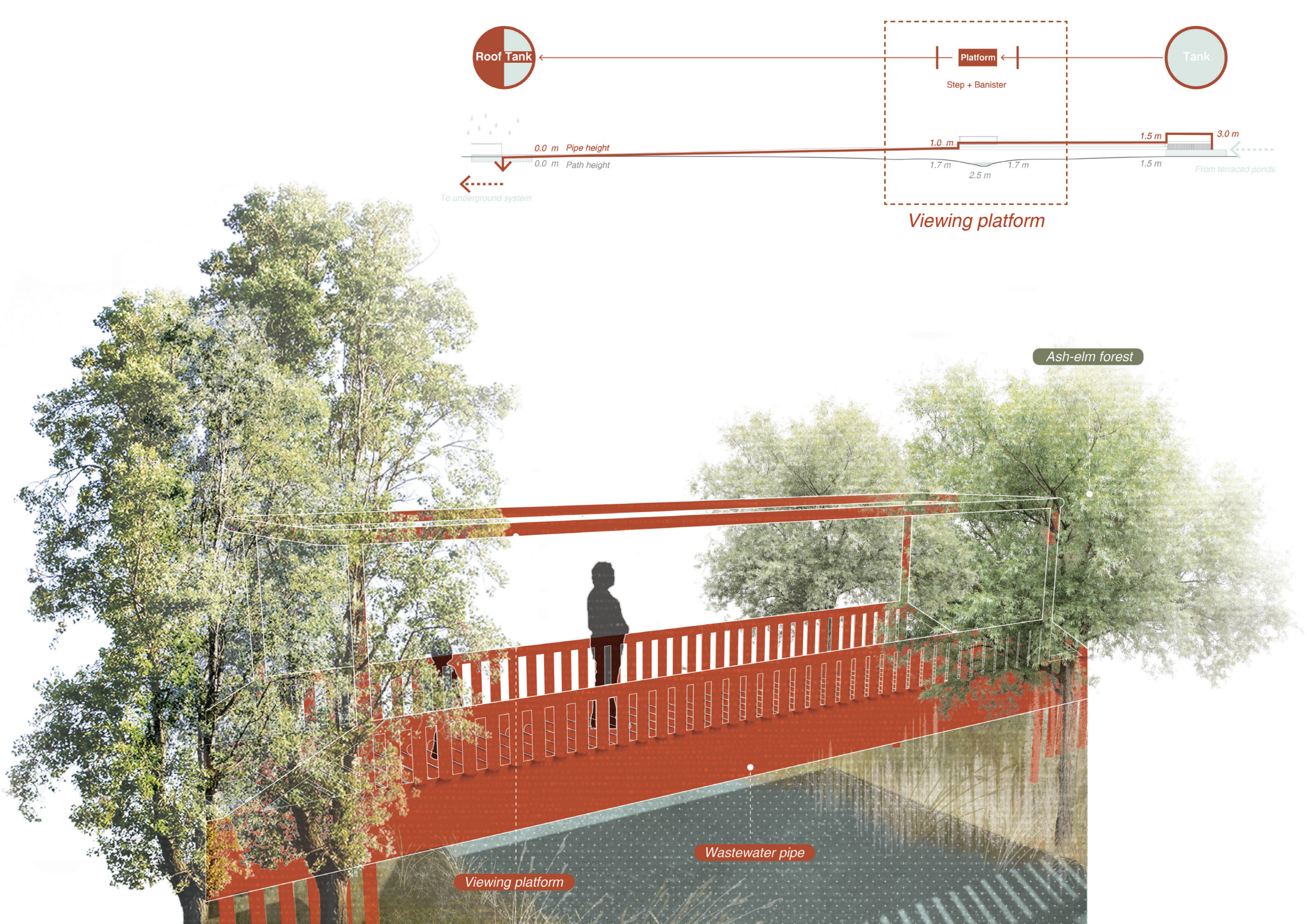


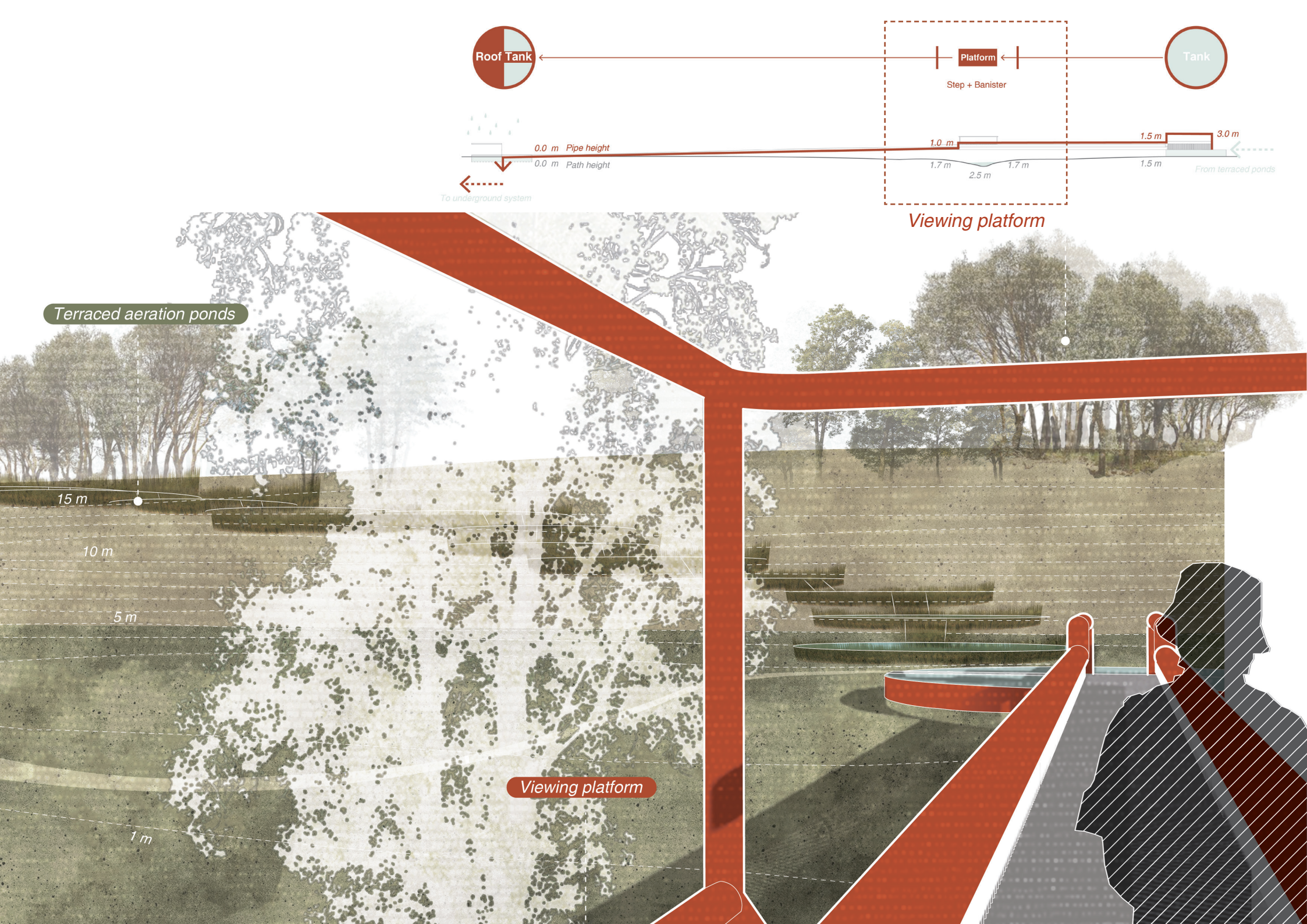
Natural purification

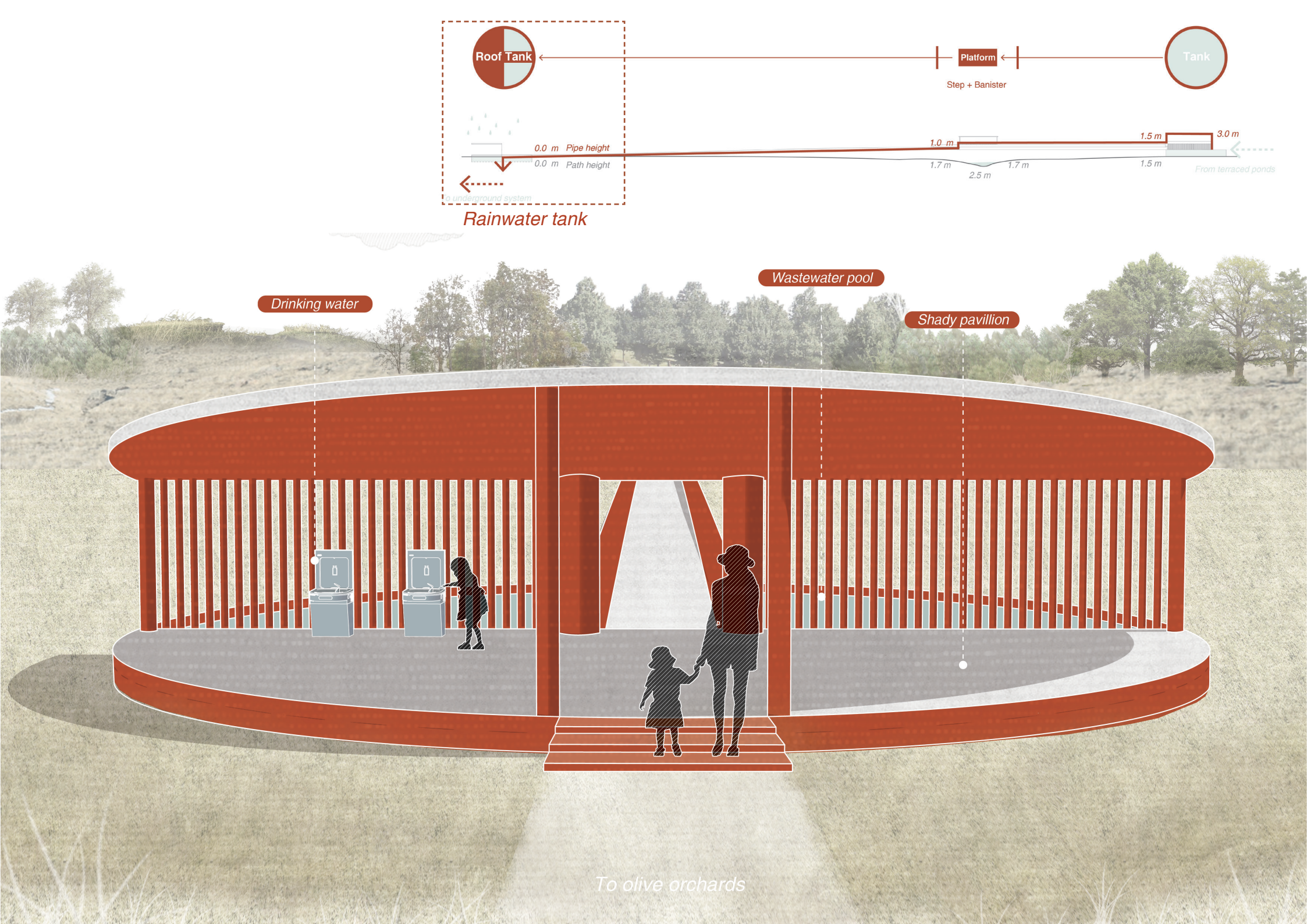


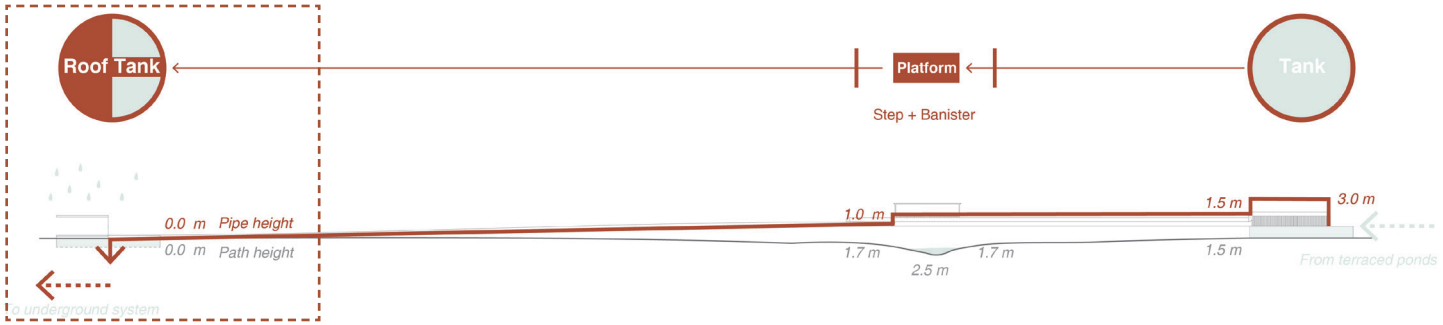

Roof Tank
Platform
Step + Banister
Tank
0.0 m Pipe height
0.0 m Path height
1.0 m
1.7 m
2.5 m
1.7 m
1.5 m
3.0 m
1.5 m
From terraced pond
To underground system
Wastewater tank


Viewing platform
Wastewater tank
Wastewater pipe

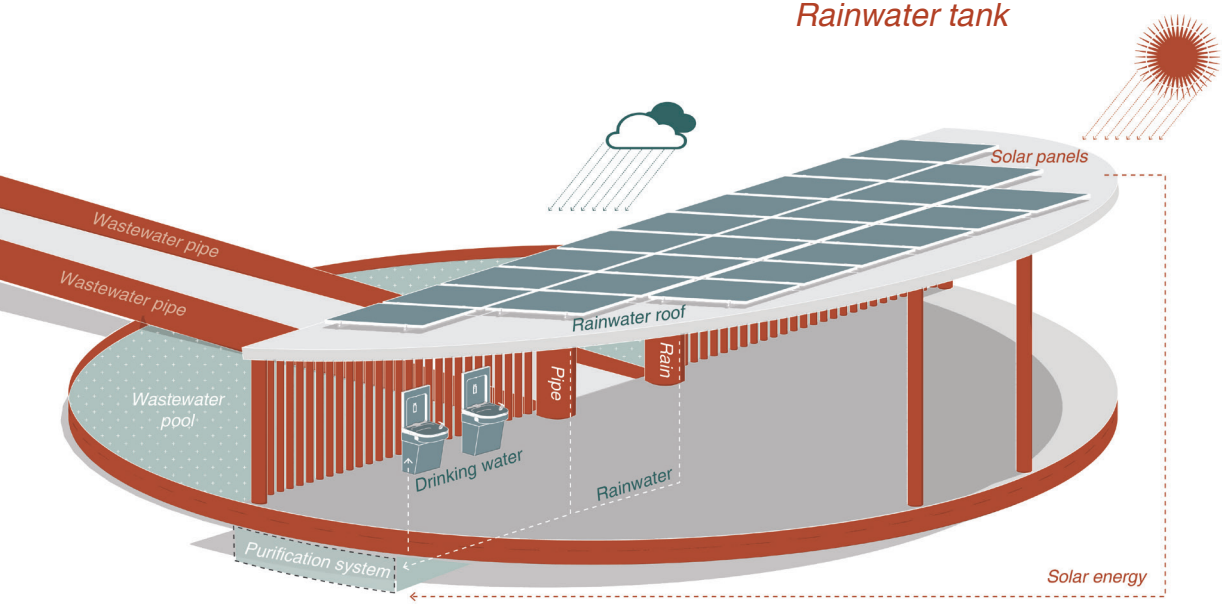

Roof Tank
Platform
Step + Banister
Tank
0.0 m Pipe height
0.0 m Path height
1.0 m
1.5 m
3.0 m
1.7 m
2.5 m
1.7 m
1.5 m
To underground system
From terraced ponds
Viewing platform
Ash-elm forest
Wastewater pipe
Viewing platform

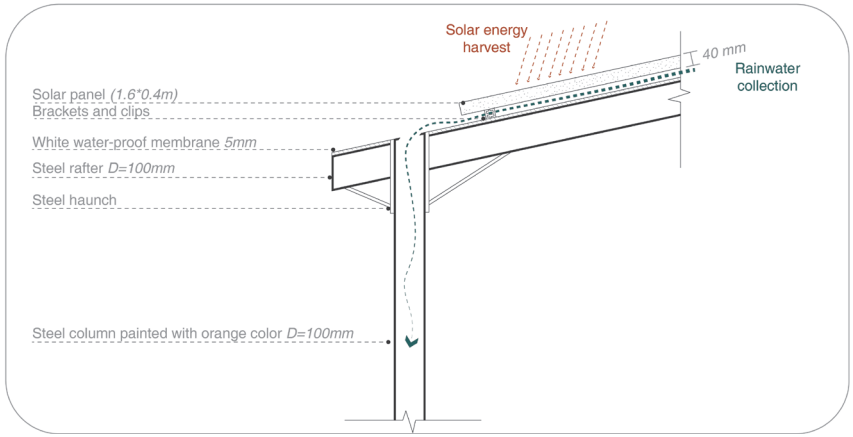

Roof Tank
Platform
Step + Banister
Tank
0.0 m Pipe height
0.0 m Path height
1.0 m
1.5 m
3.0 m
1.7 m
2.5 m
1.7 m
1.5 m
To underground system
From terraced ponds
Viewing platform
Terraced aeration ponds
15 m
10 m
5 m
1 m
Viewing platform


Roof Tank
Platform
Step + Banister
Tank
0.0 m Pipe height
0.0 m Path height
1.0 m
1.5 m
3.0 m
1.7 m
2.5 m
1.7 m
1.5 m
From terraced ponds
Rainwater tank
Drinking water
Wastewater pool
Shady pavillion
To olive orchards

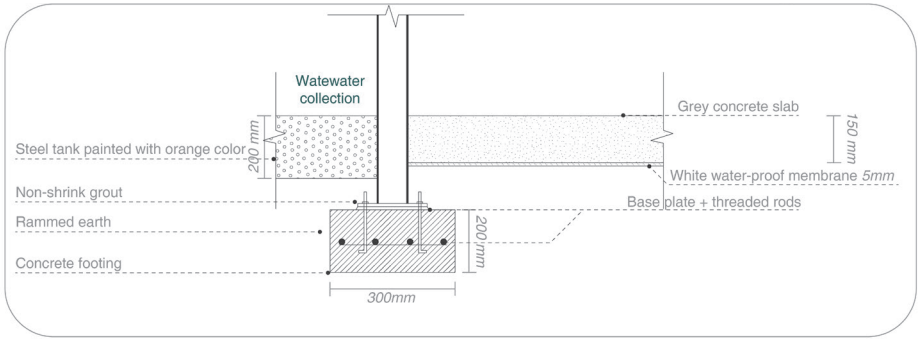


Rainwater tank



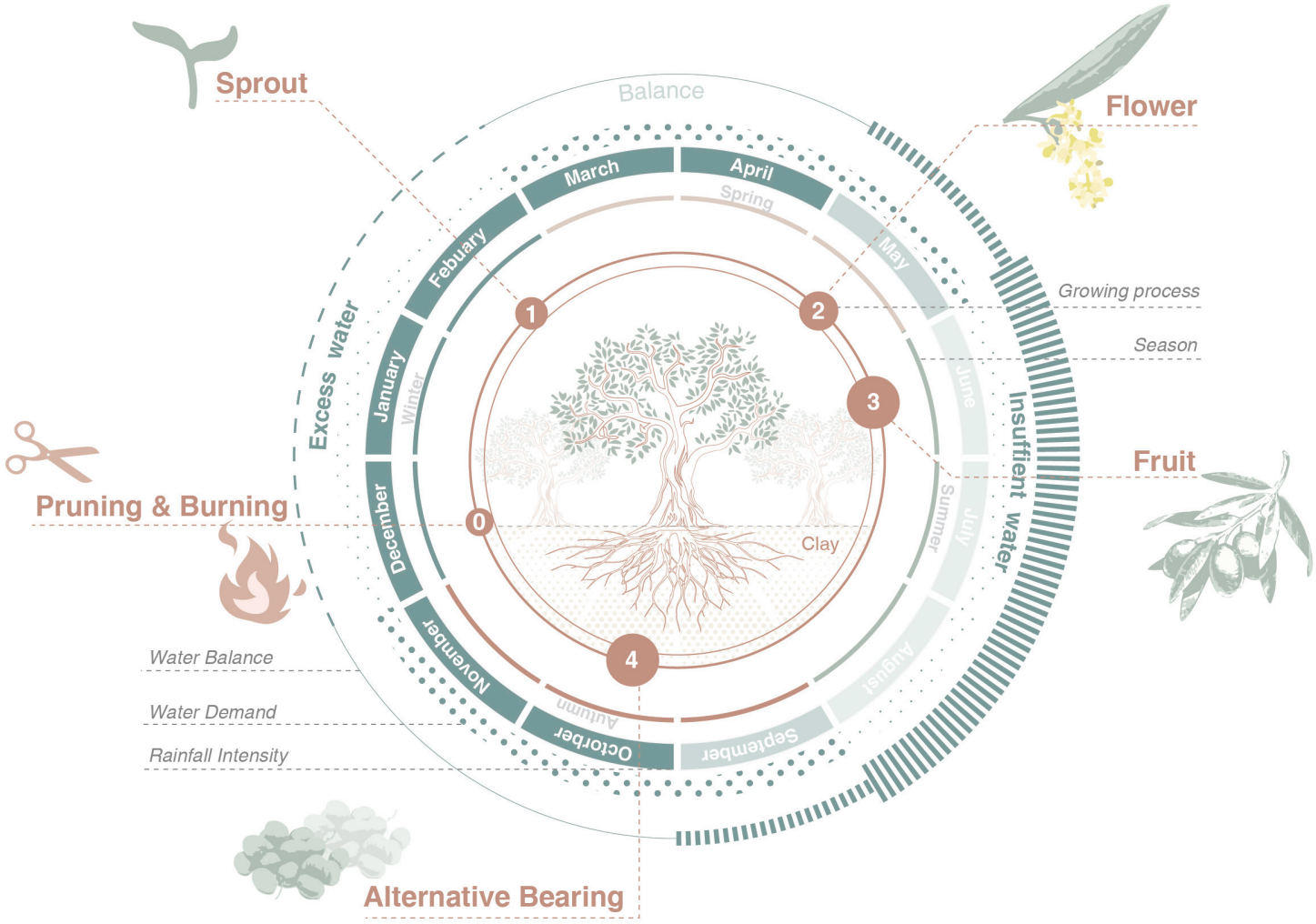


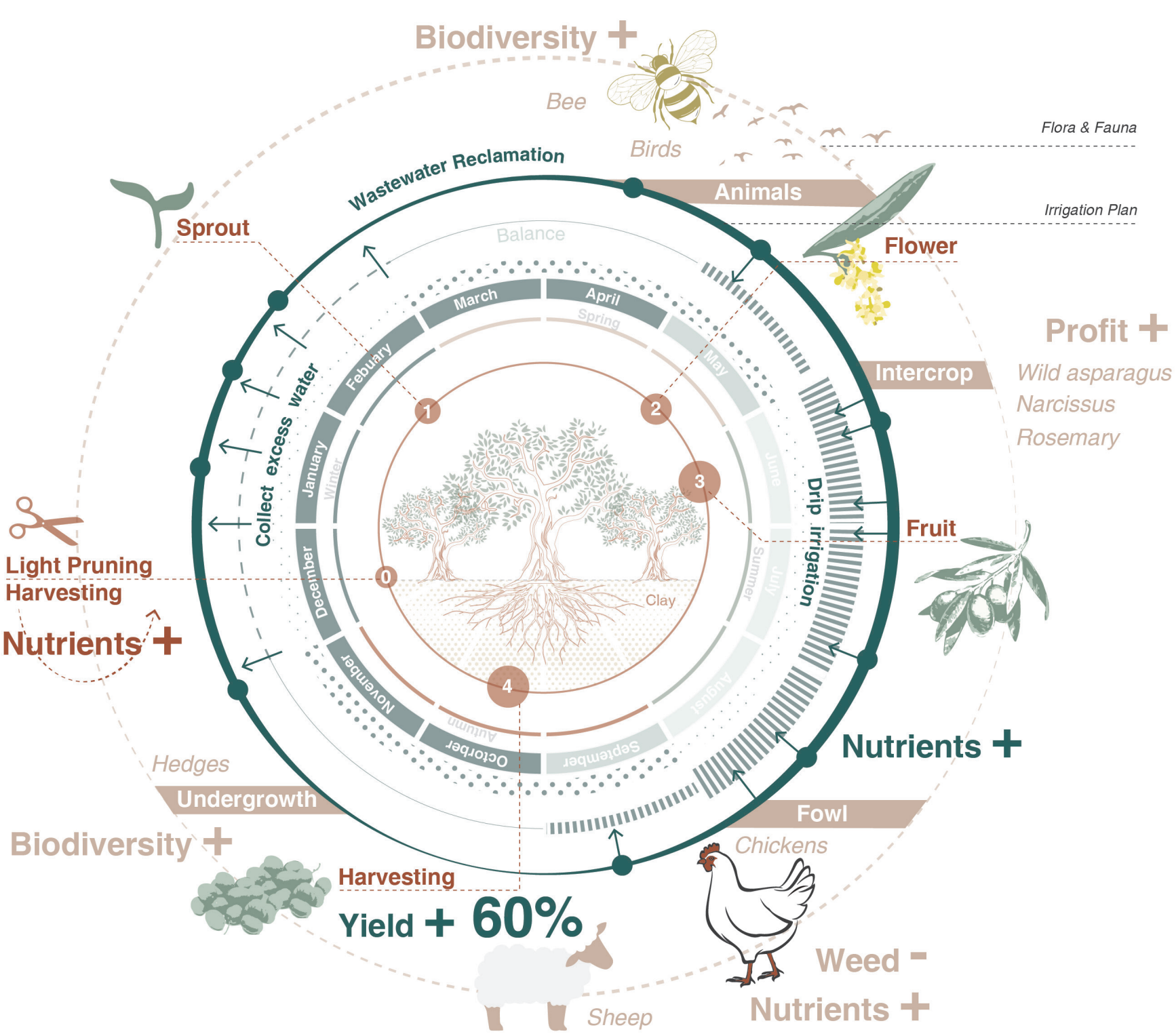


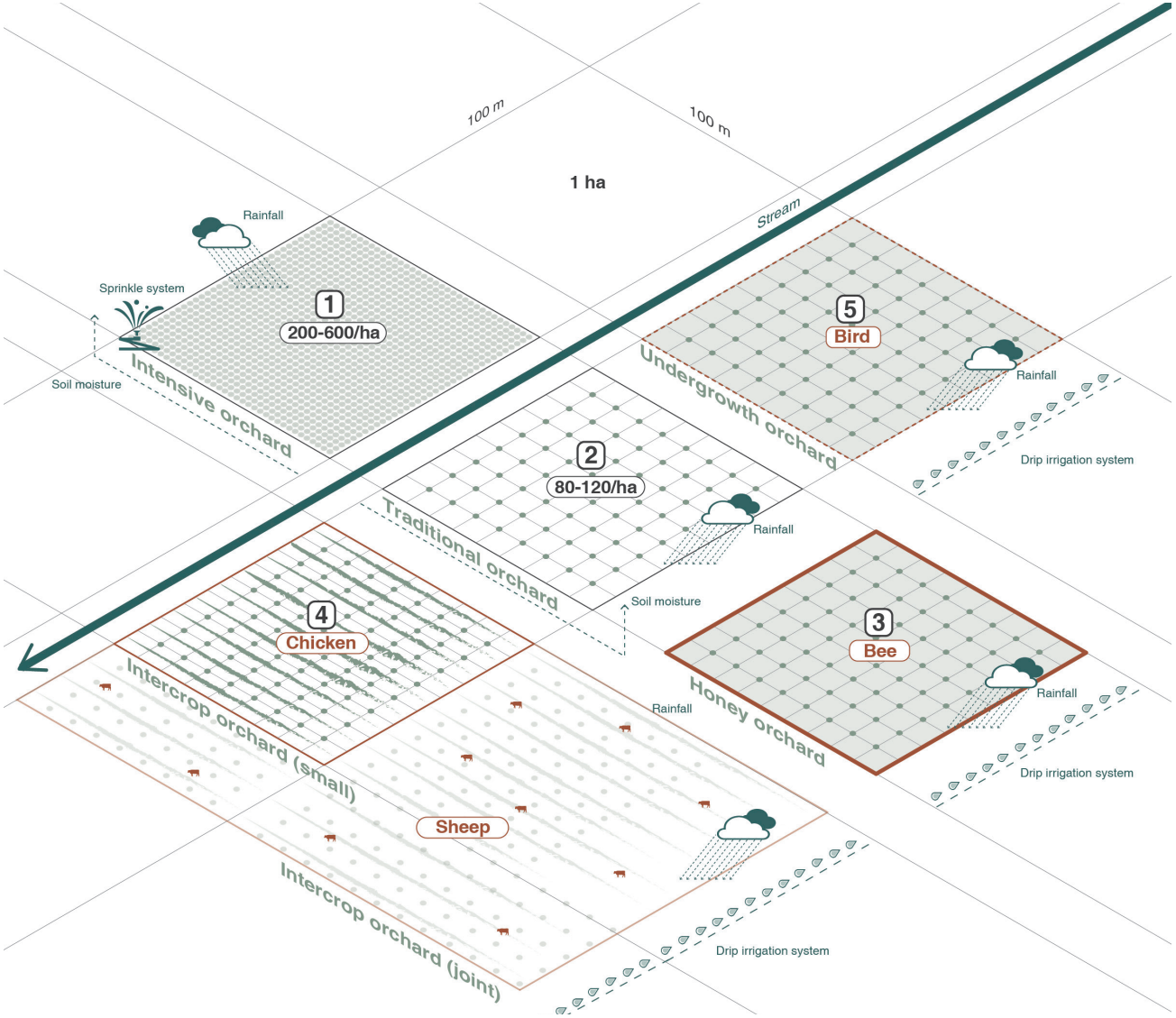


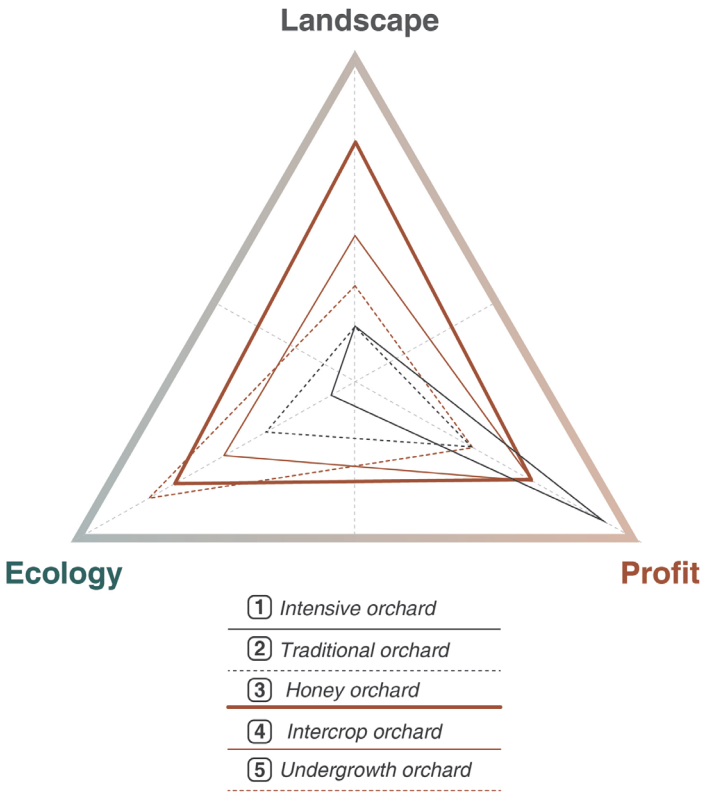

Collect pre-treated wastewater
for agricultural irrigation
Wastewater
purification
Agricultural
reclamation
200 m
200 m
N


≈180/ha
Intensive olive orchard
≈100/ha
Rainfed traditional olive orchard
200 m
200 m
N

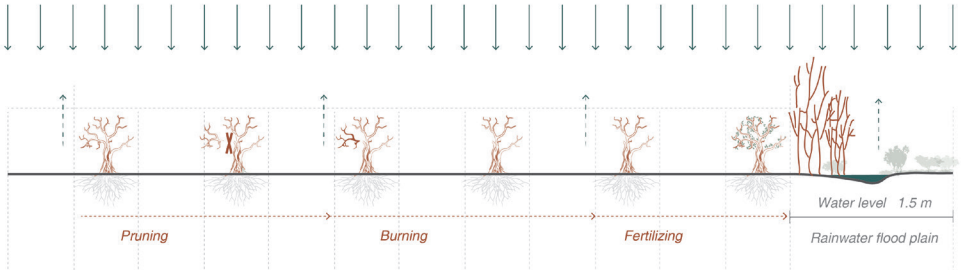

Sprout
Flower
Balance
March
April
Spring
Febuary
May
Growing process
Season
1
2
3
January
Winter
June
Excess water
Insuffient water
Fruit
Pruning & Burning
December
0
Clay
Summer
July
August
Water Balance
Water Demand
Rainfall Intensity
4
November
Autumn
October
September
Alternative Bearing


Biodiversity +
Bee
Birds
Flora & Fauna
Irrigation Plan
Wastewater Reclamation
Animals
Sprout
Balance
Flower
Profit +
Intercrop
Wild asparagus
Narcissus
Rosemary
March
April
Spring
Febuary
May
Collect excess water
January
Winter
June
Drip irrigation
Fruit
December
Summer
July
Light Pruning
Harvesting
Nutrients +
Clay
November
August
Autumn
October
September
Nutrients +
Hedges
Undergrowth
Fowl
Biodiversity +
Chickens
Harvesting
Yield + 60%
Weed -
Nutrients +
Sheep

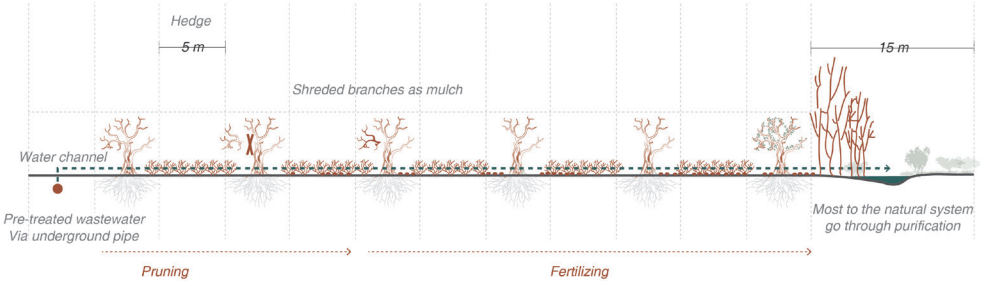

100 m
100 m
1 ha
Stream
Rainfall
Sprinkle system
1
200-600/ha
Soil moisture
Intensive orchard
2
80-120/ha
Traditional orchard
Rainfall
Soil moisture
5
Bird
Undergrowth orchard
Rainfall
Drip irrigation system
4
Chicken
Intercrop orchard (small)
Sheep
Intercrop orchard (joint)
3
Bee
Honey orchard
Rainfall
Rainfall
Drip irrigation system
Drip irrigation system


Landscape
Ecology
Profit
1 Intensive orchard
2 Traditional orchard
3 Honey orchard
4 Intercrop orchard
5 Undergrowth orchard

Wet season: December-February

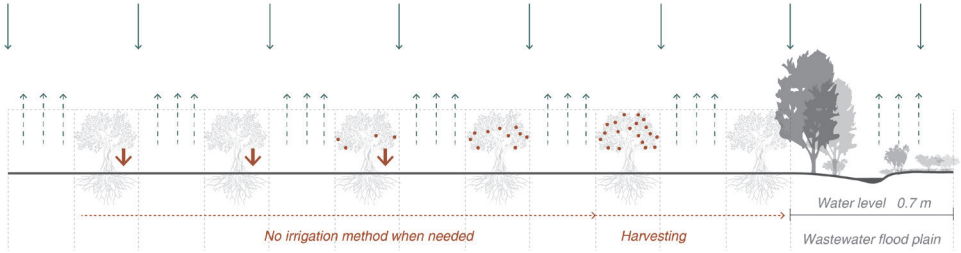


Proposed undergrowth orchard

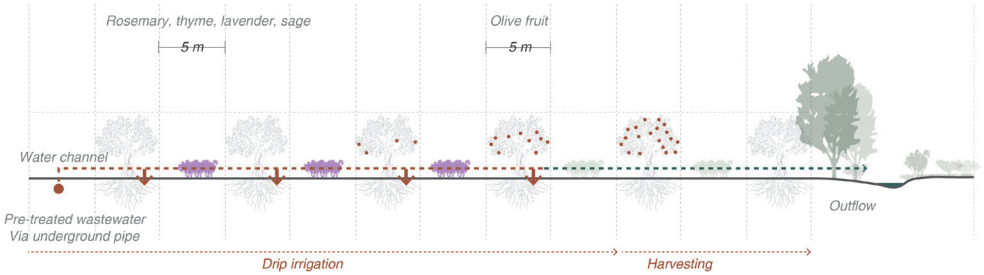




Dry season: May-September

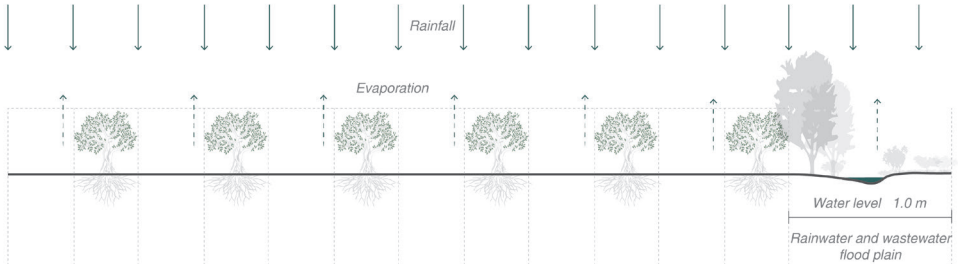


Proposed honey orchard

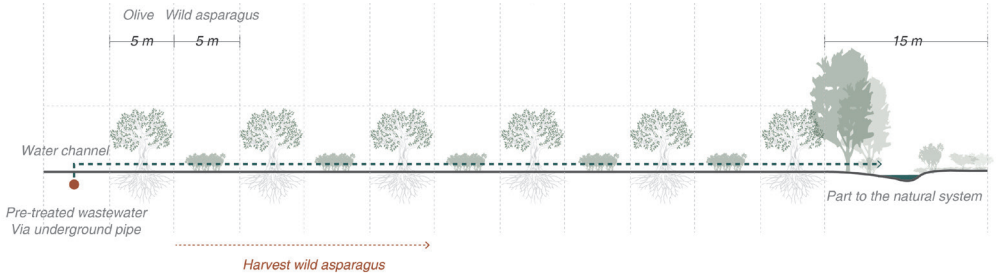




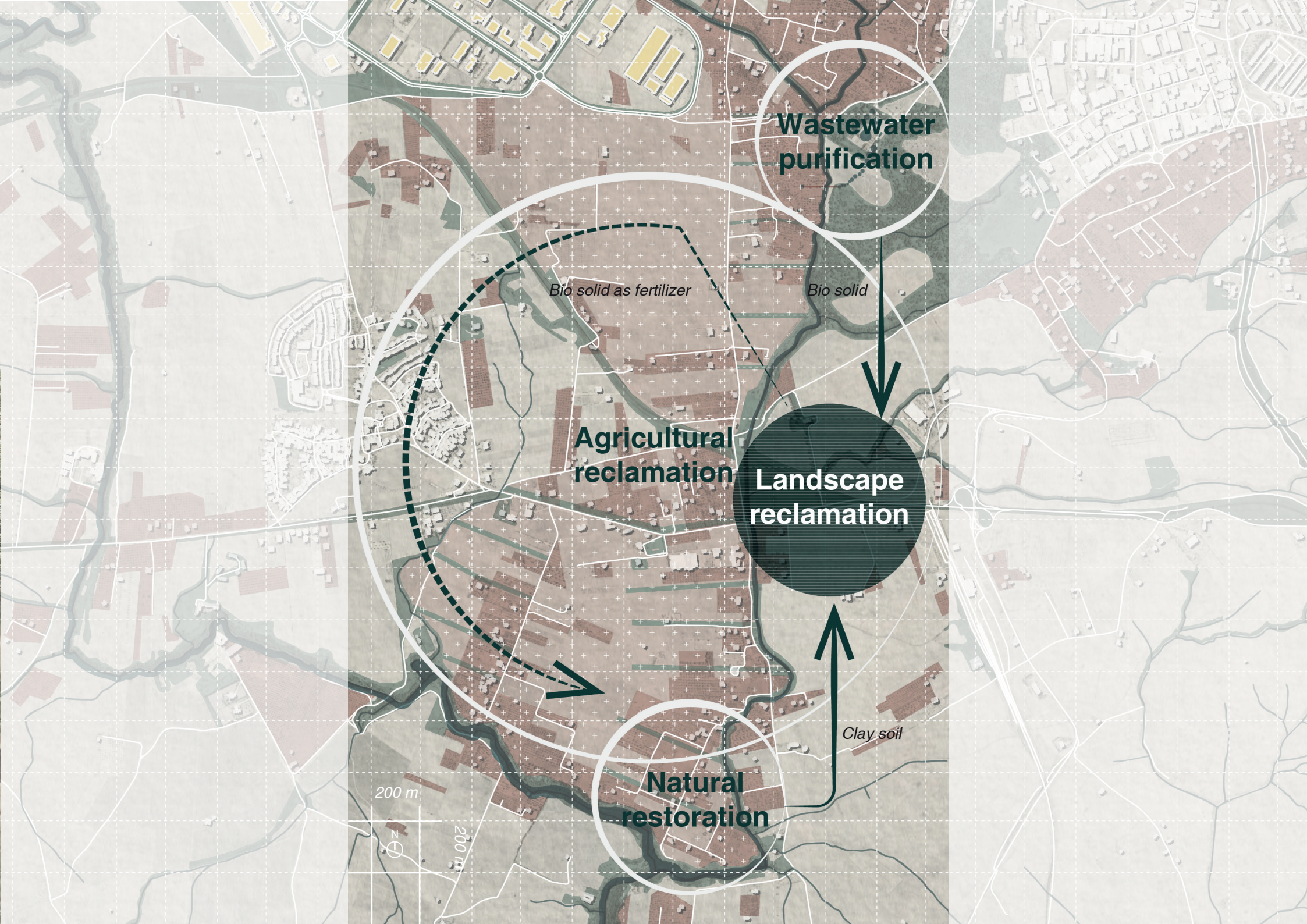
Balanced season: March-April, October-November



Proposed intercrop orchard

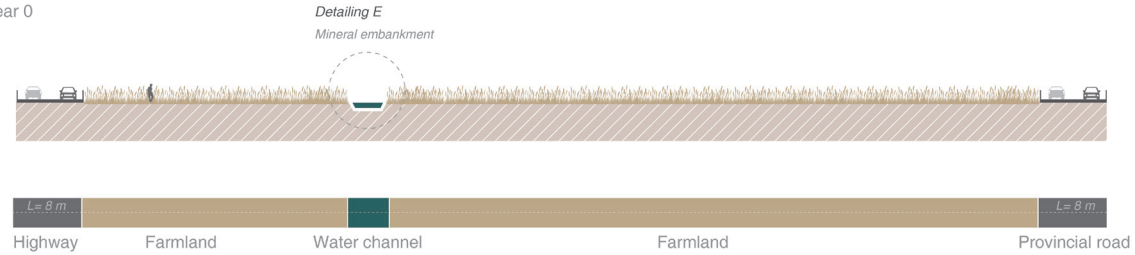




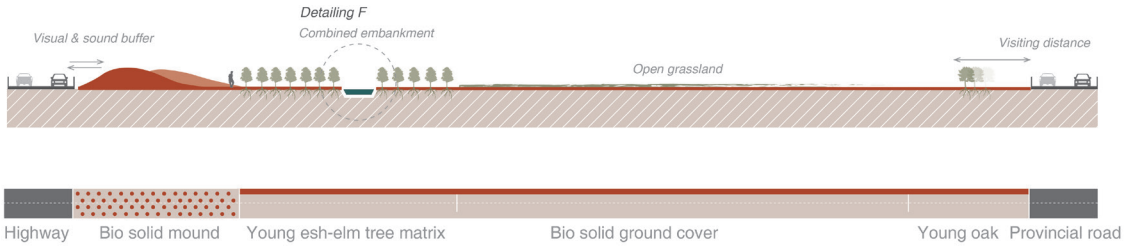

Wastewater purification
Bio solid as fertilizer
Bio solid
Agricultural reclamation
Landscape reclamation
Clay soil
Natural restoration
200 m
200 m
N

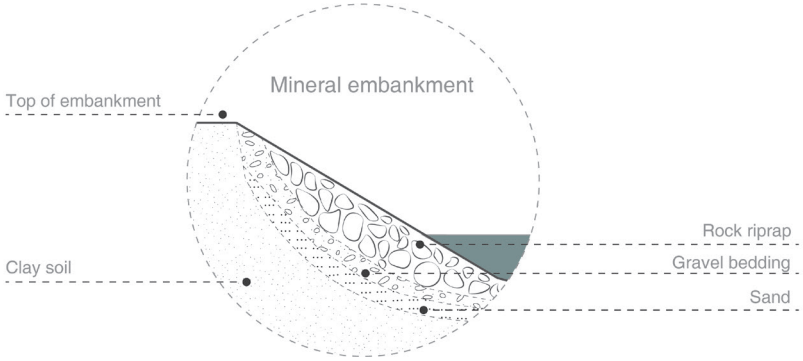

Olive orchard
Bio soild mound
Elm-ash forest
Solitary oak tree
Parking lot & Bike rental
Recovered meadows
Bio solid shop
Motor traffic entrance
Pedestrian entrance
Highway SS655 (Speed 60km/h)
Motor traffic entrance
Provincial Road SP8 (Speed 30km/h)
6
N
0
50
100
150 m

Year 0

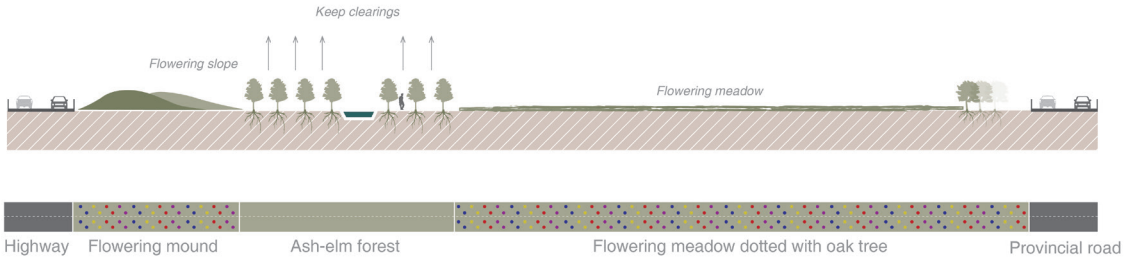


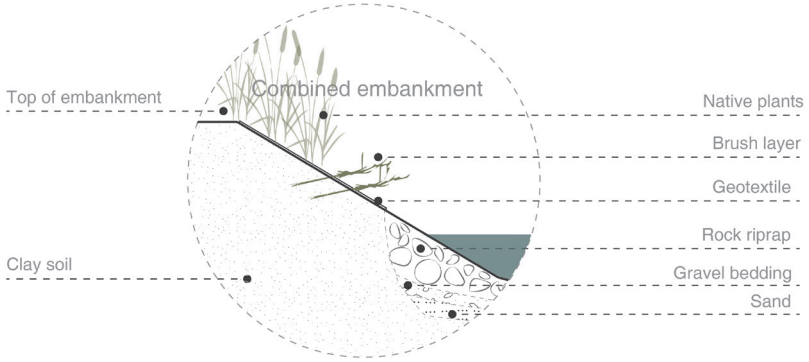
Year 1



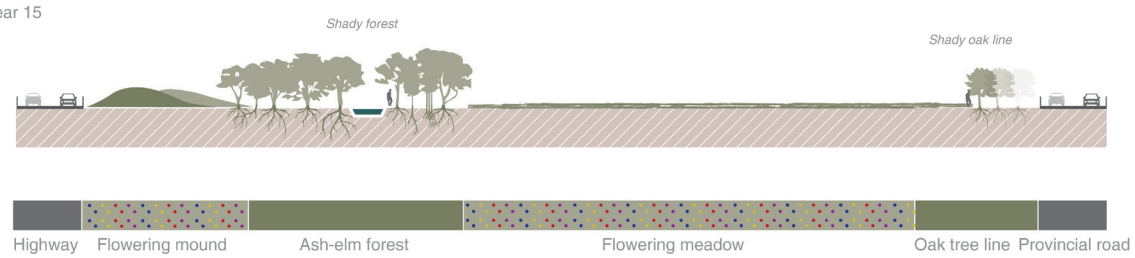


Year 5



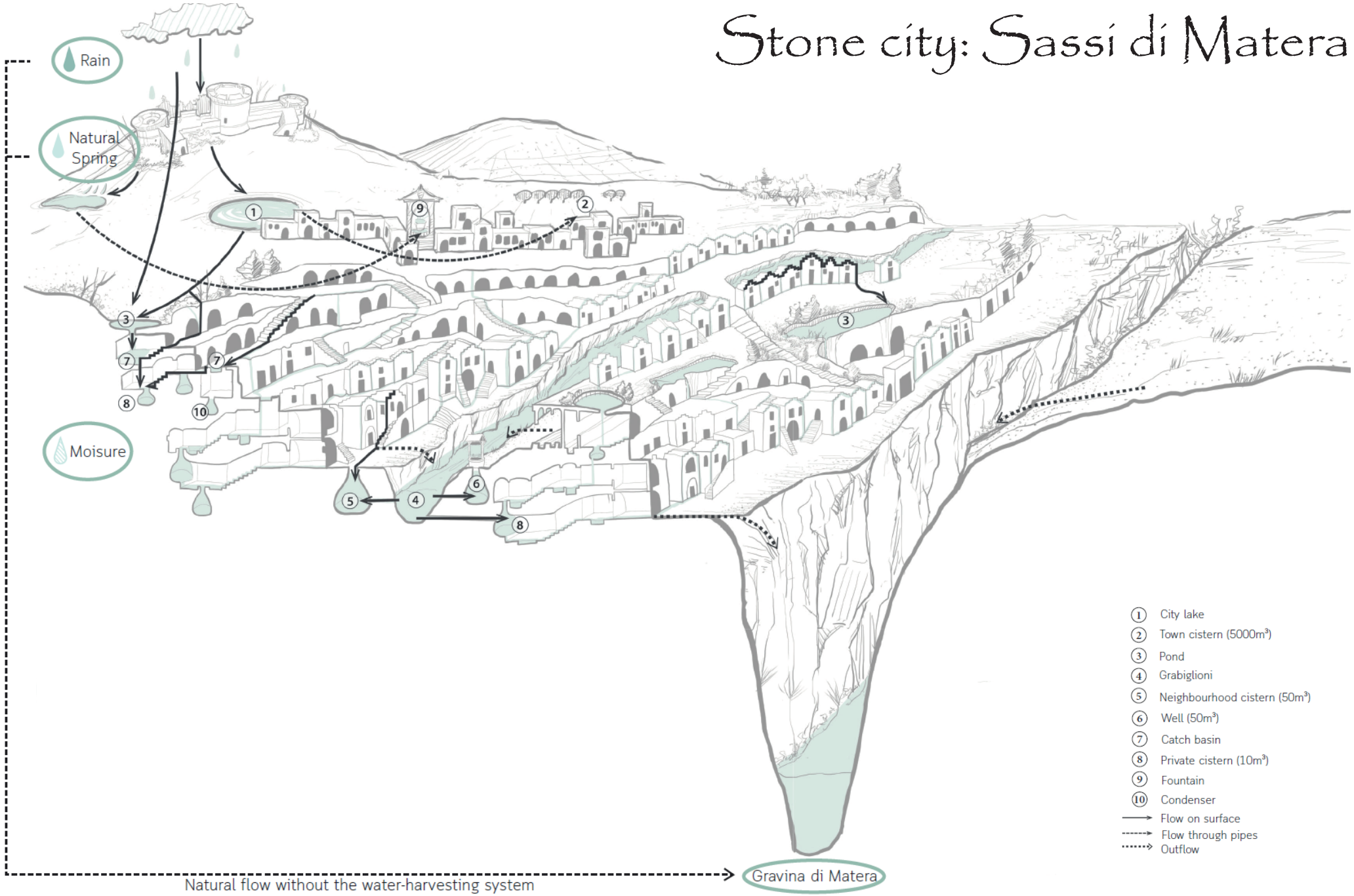


Year 15

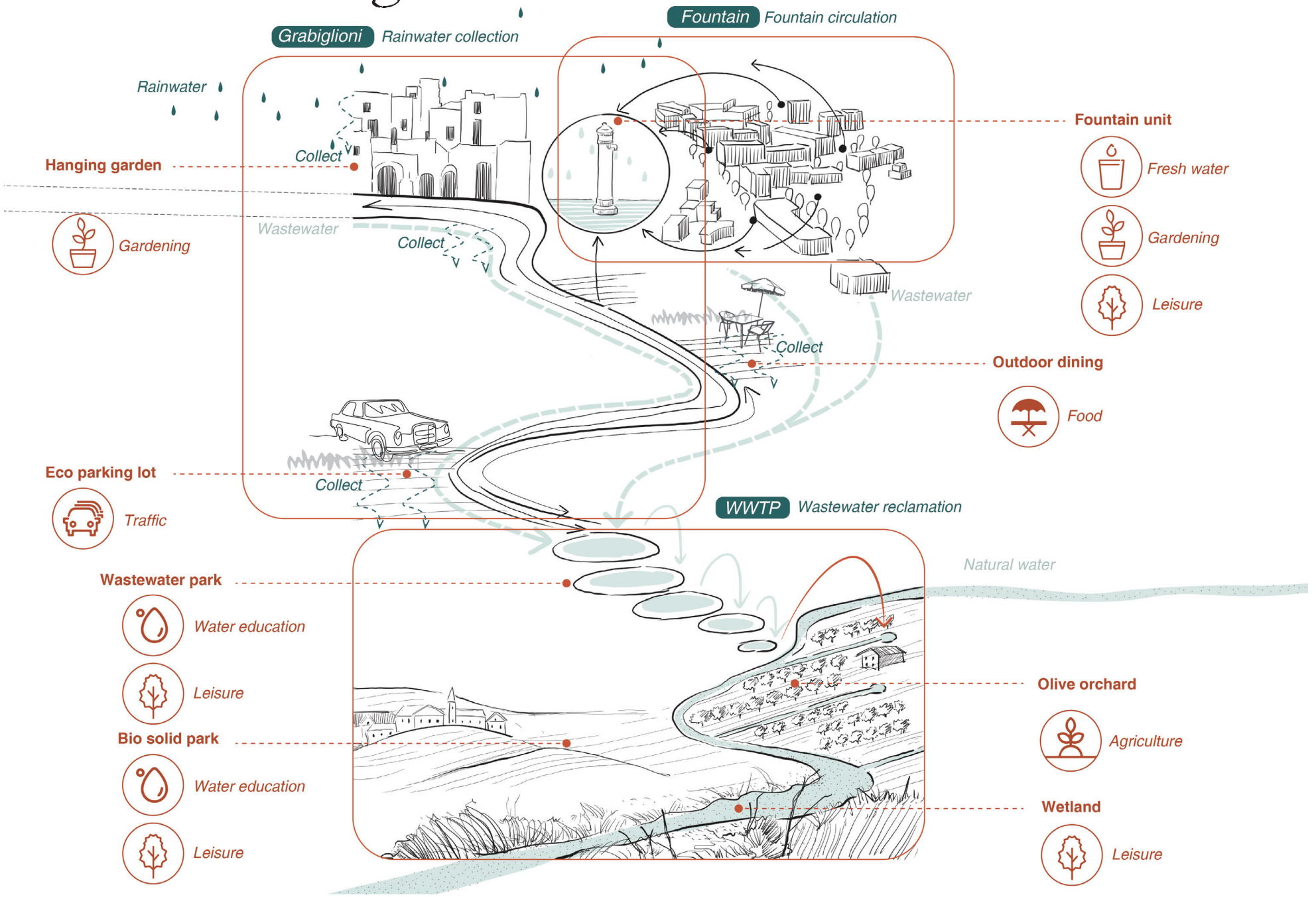



Mowing plan
Week 1
Week 2
Week 3
Oak tree line
Trail
With management
1.5 m
0.5 m
J F M A M J J A S O N D
Common poppy
Meadow thistle
60 cm
40 cm
120 cm
Alkanna tinctoria
Asphodeline lutea
Papaver rhoeas
Cirsium dissectum

Stone city: Sassi di Matera



Hidden water region: Matera



from "Stone City" to "Hidden Water Region"

visualize and value the invisible water flows in Matera

