Water From Within

How to decrease inter-basin water-transfer
by enhancing Mexico City’s own potable water sources

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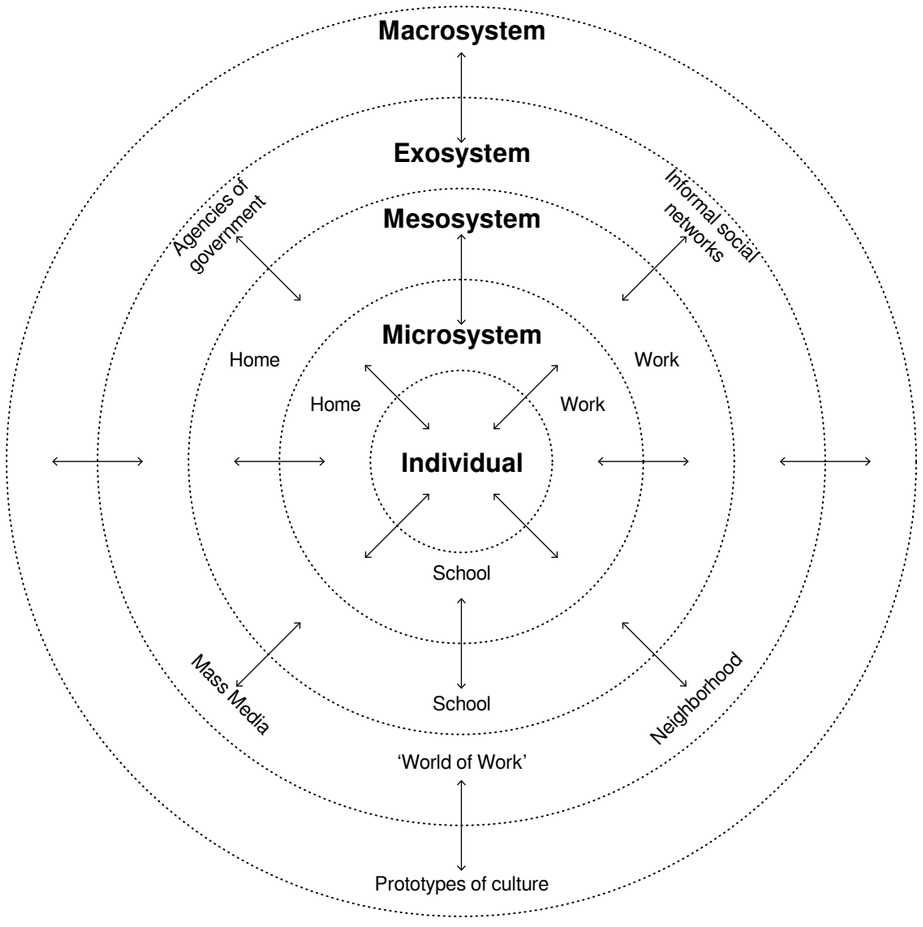
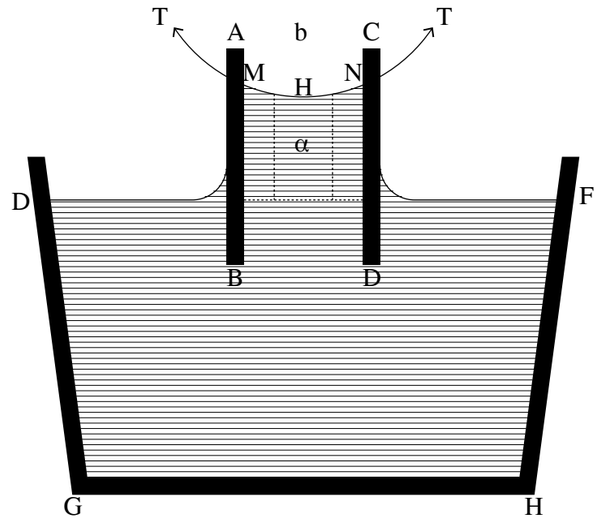


Bronfenbrenner's (1979) Social Ecology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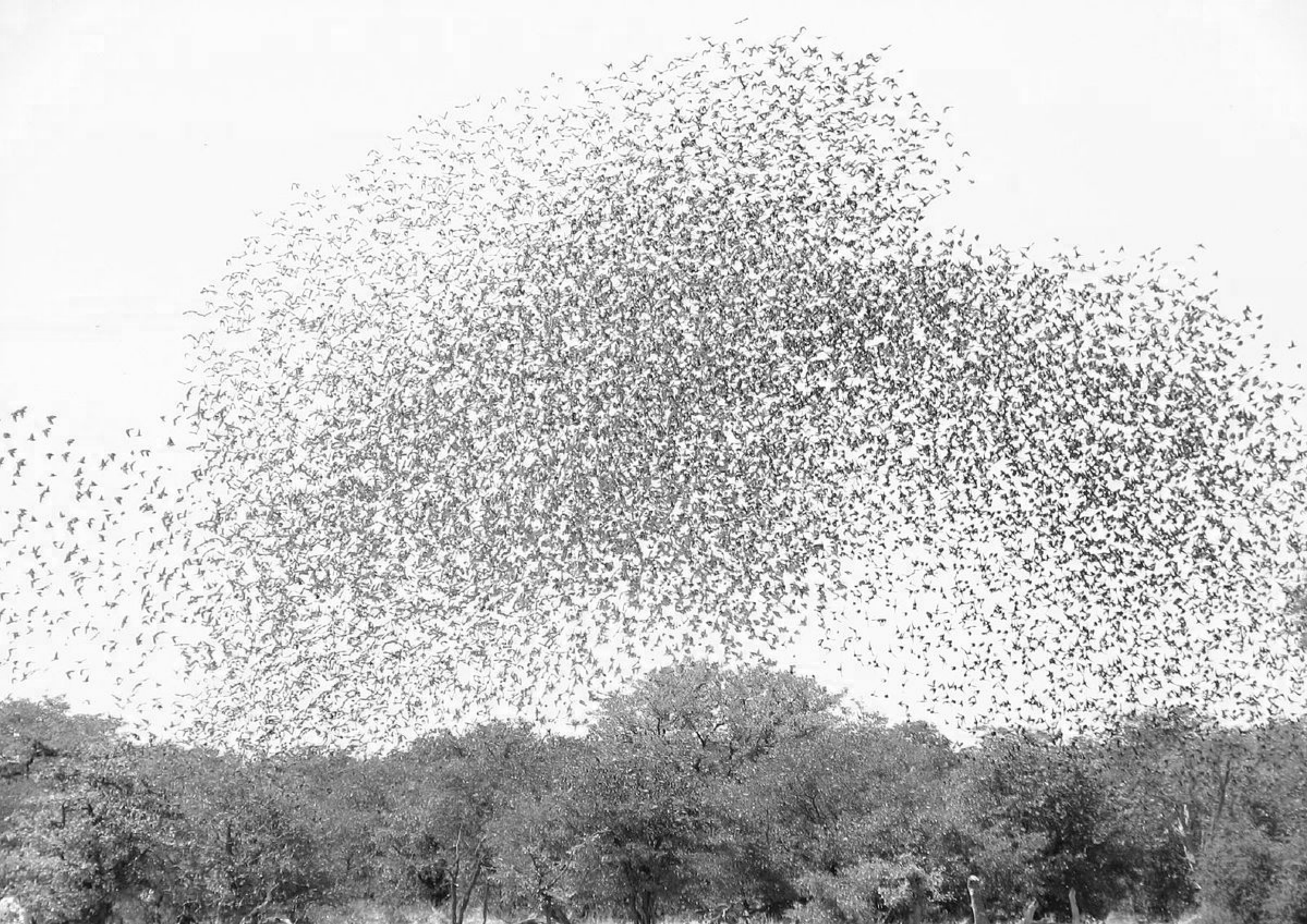
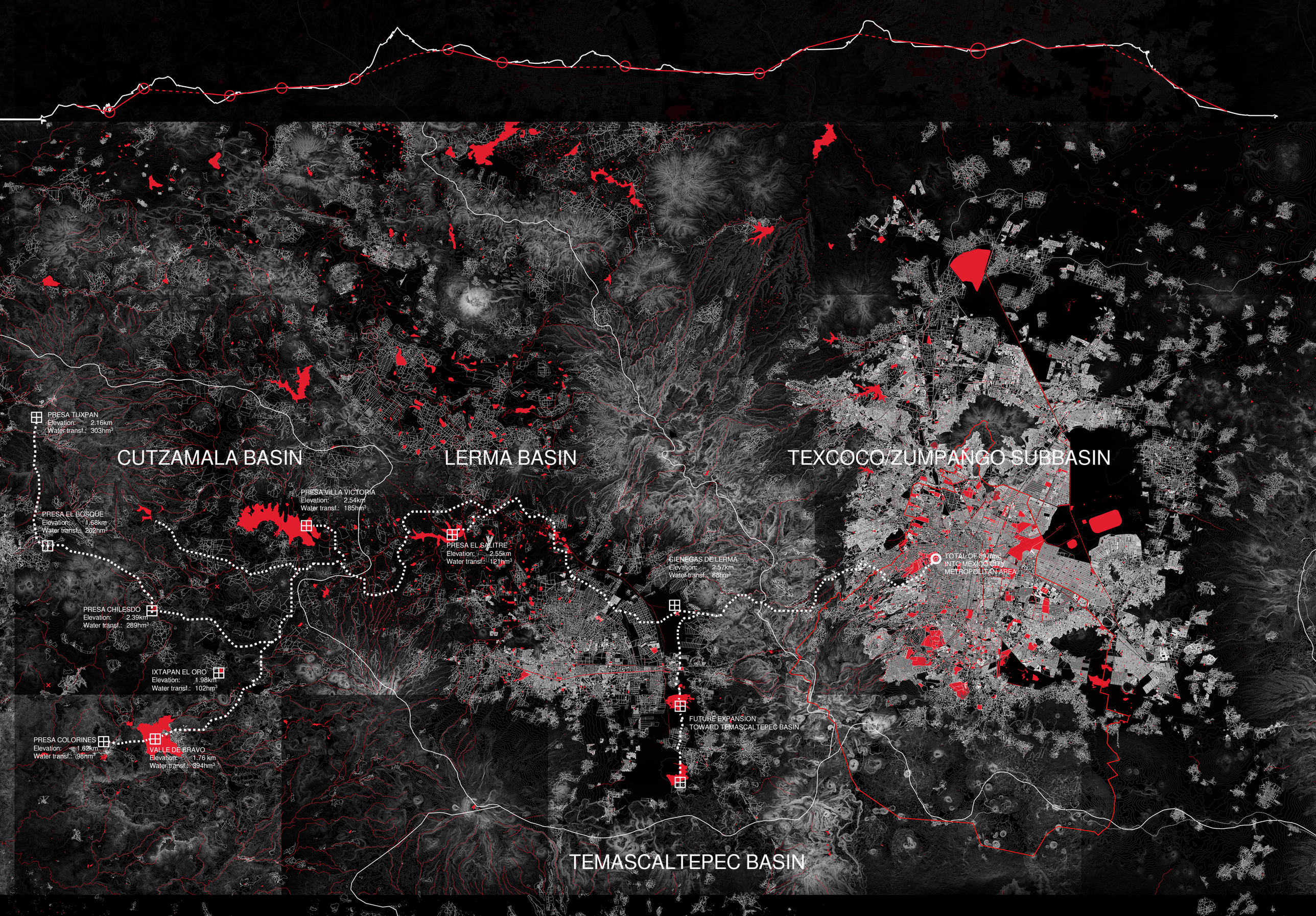
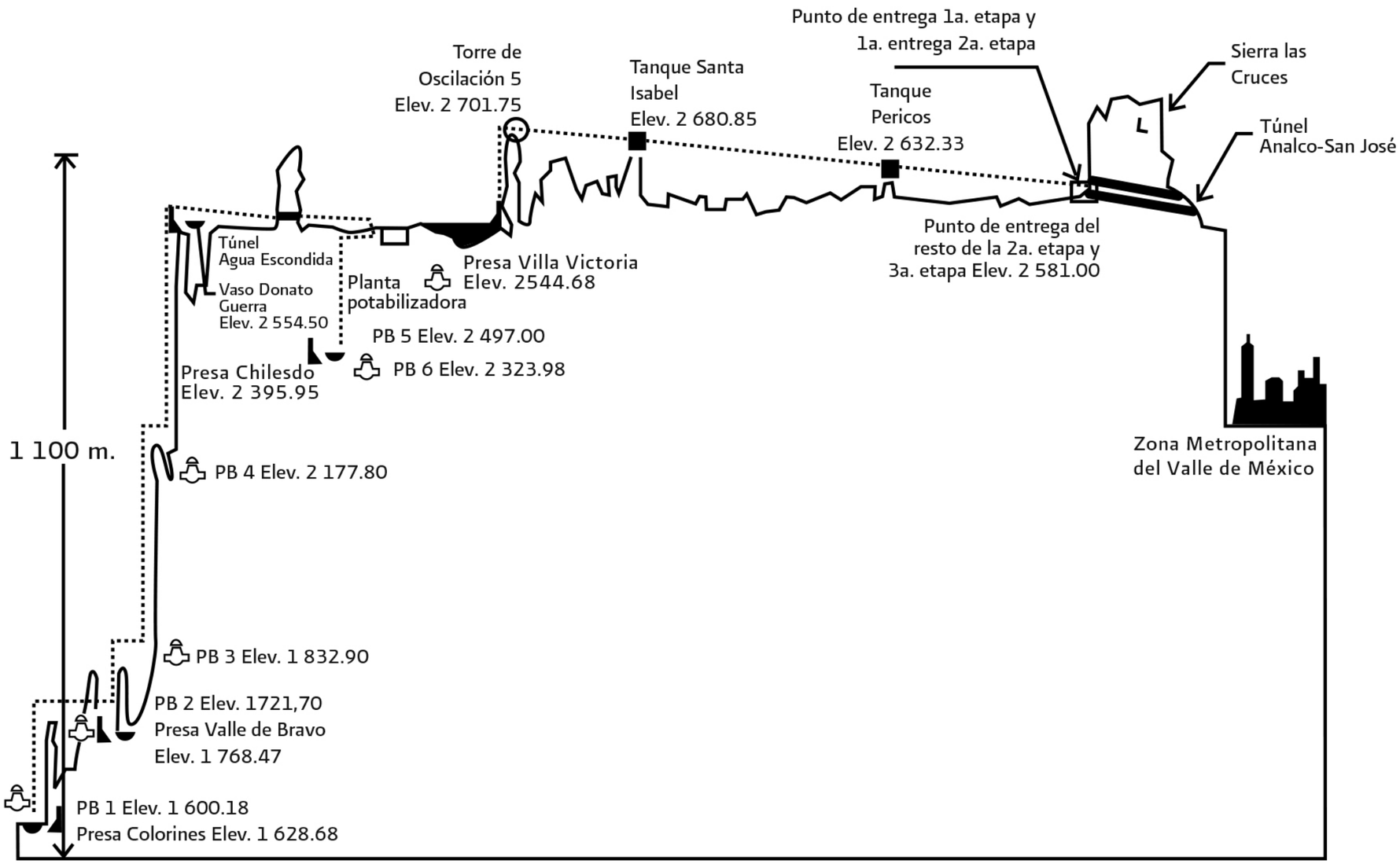
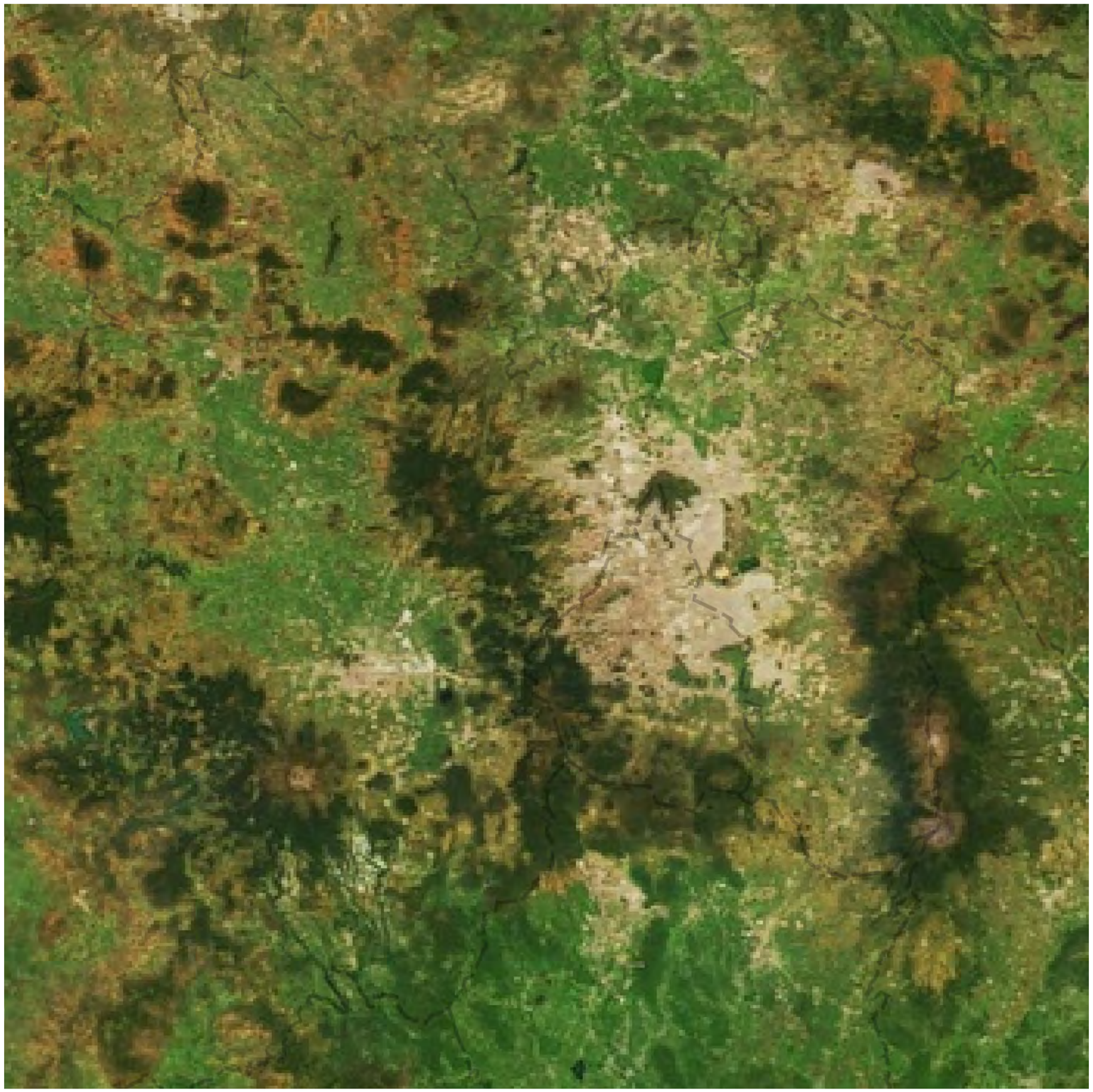



PRESA TUXPAN
Elevation: 2.16km
Water transf.: 303hm³
CUTZAMALA BASIN
LERMA BASIN
TEXCOCO/ZUMPANGO SUBBASIN
PRESA VILLA VICTORIA
Elevation: 2.54km
Water transf.: 185hm³
PRESA EL BOSQUE
Elevation: 1.68km
Water transf.: 202hm³
PRESA EL SALITRE
Elevation: 2.55km
Water transf.: 121hm³
CIENEGAS DE LERMA
Elevation: 2.57km
Water transf.: 68hm³
TOTAL OF 837hm³
INTO MEXICO CITY
METROPOLITAN AREA
PRESA CHILESDO
Elevation: 2.39km
Water transf.: 289hm³
IXTAPAN EL ORO
Elevation: 1.98km
Water transf.: 102hm³
FUTURE EXPANSION
TOWARD TEMASCALTEPEC BASIN
PRESA COLORINES
Elevation: 1.62km
Water transf.: 98hm³
VALLE DE BRAVO
Elevation: 1.76 km
Water transf.: 394hm³
TEMASCALTEPEC BASIN

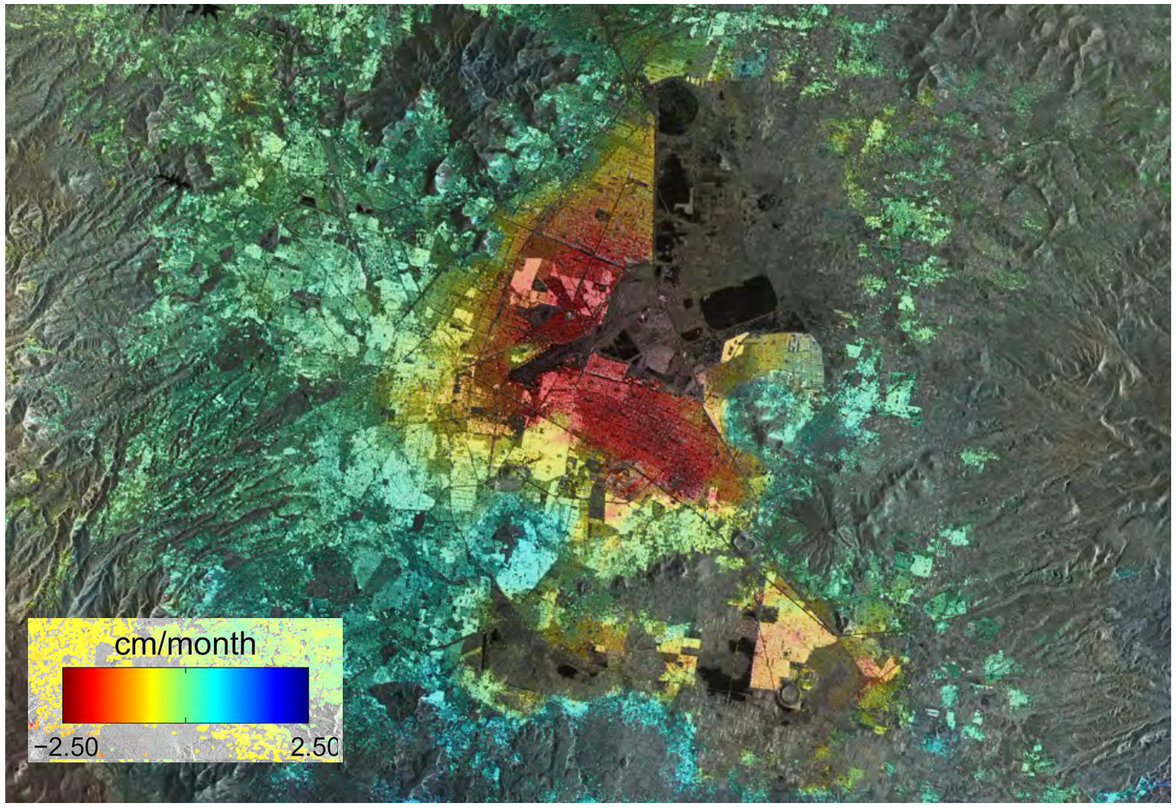

Punto de entrega 1a. etapa y
1a. entrega 2a. etapa
Torre de
Oscilación 5
Elev. 2 701.75
Tanque Santa
Isabel
Elev. 2 680.85
Tanque
Pericos
Elev. 2 632.33
Sierra las
Cruces
Túnel
Analco-San José
Punto de entrega del
resto de la 2a. etapa y
3a. etapa Elev. 2 581.00
Túnel
Agua Escondida
Vaso Donato
Guerra
Elev. 2 554.50
Planta
potabilizadora
Presa Villa Victoria
Elev. 2544.68
PB 5 Elev. 2 497.00
PB 6 Elev. 2 323.98
Presa Chilesdo
Elev. 2 395.95
1 100 m.
PB 4 Elev. 2 177.80
PB 3 Elev. 1 832.90
PB 2 Elev. 1721,70
Presa Valle de Bravo
Elev. 1 768.47
PB 1 Elev. 1 600.18
Presa Colorines Elev. 1 628.68
Zona Metropolitana
del Valle de México

Future plans to expand the existing infrastructure
Increased water transfer & distribution line

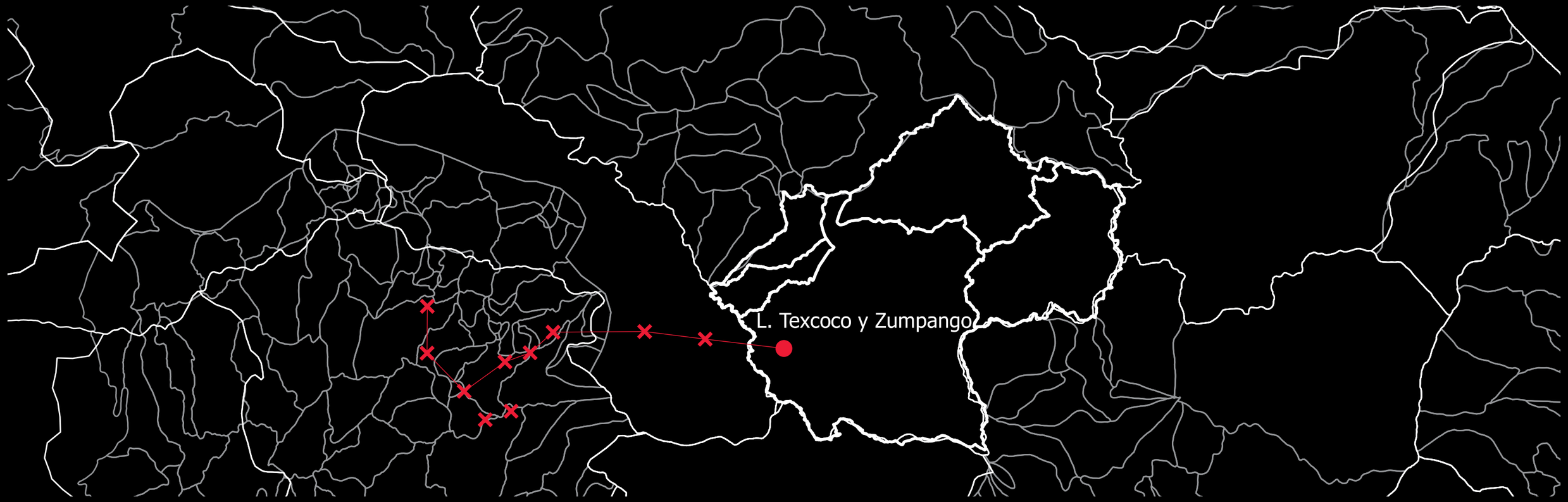


Inter-basin water transfer.
Ethical implication of current
water supply system

Inter-basin water transfer.
Ethical implication of current
water supply system



Can water sensitive urbanization in Mexico City's periphery help enhance the basin's own potable water sources in order to gradually decrease the need for inter-basin water transfer?

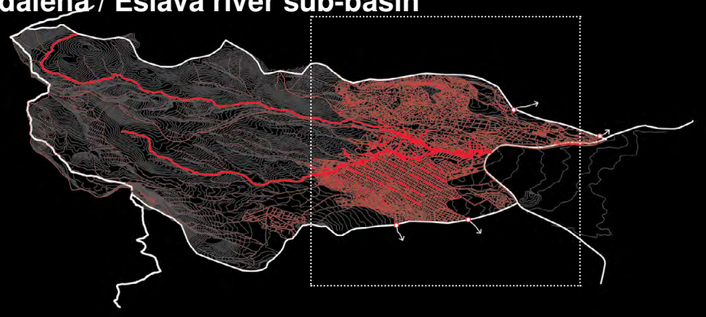


1.1 How can the basin become hydrologically autonomous?

1.1 Texcoco / Zumpango sub-basin

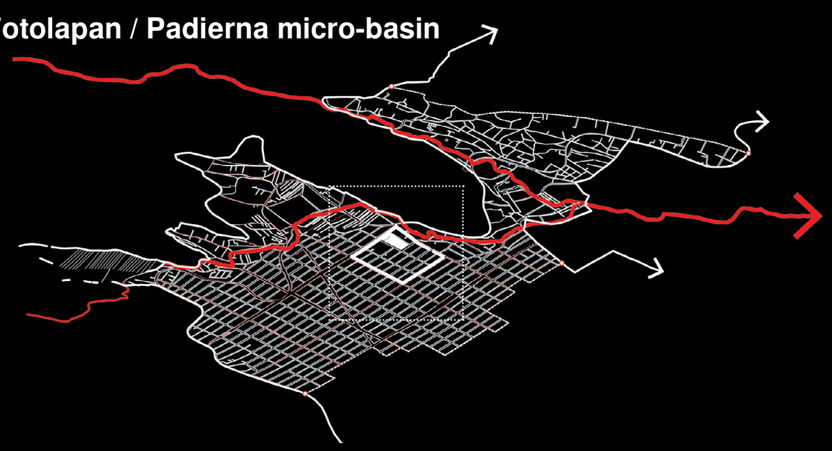
1.2 How can the mountainous region and transition zones help balance the aquifer recharge rate?

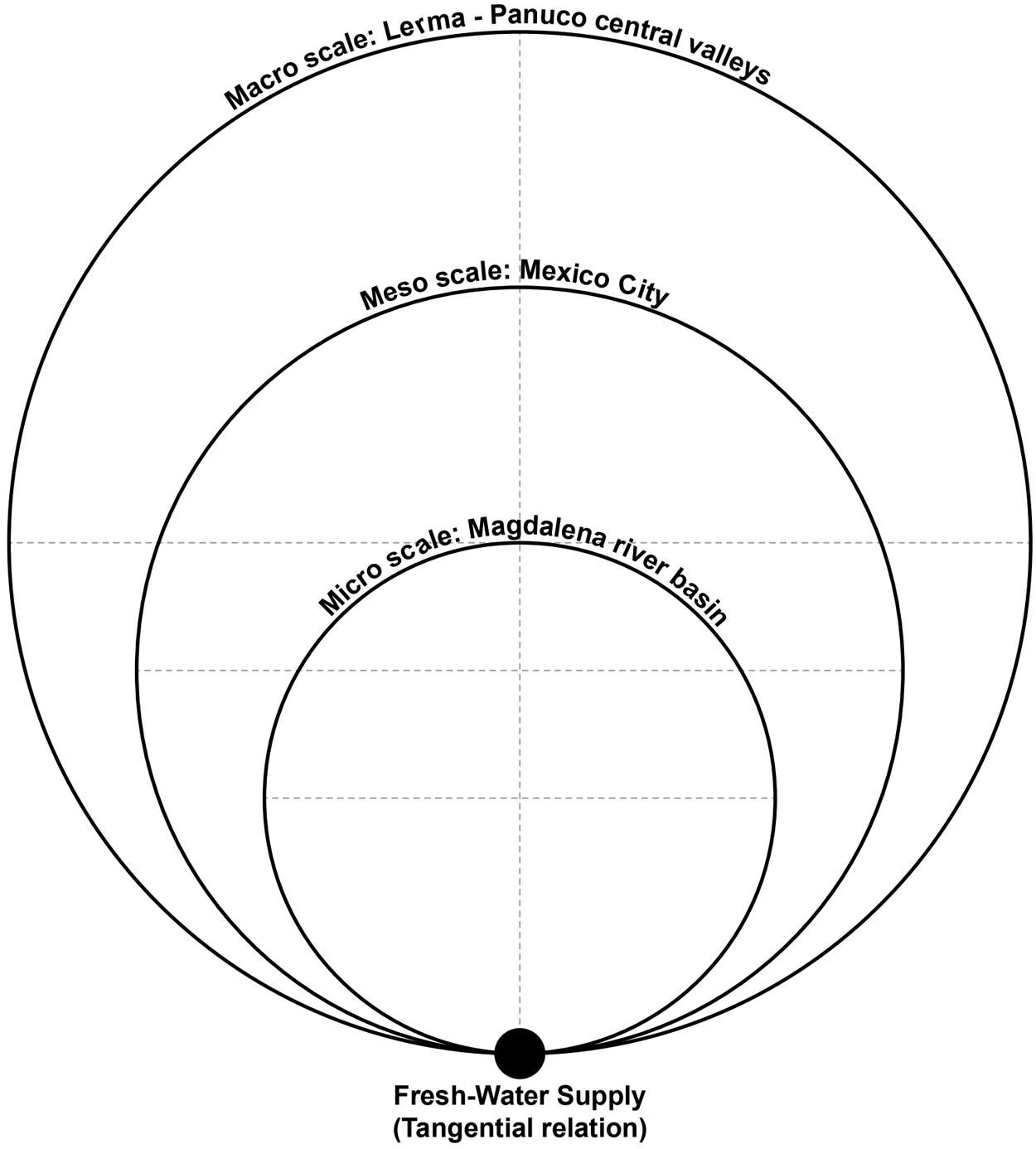
1.2 Magdalena / Eslava river sub-basin

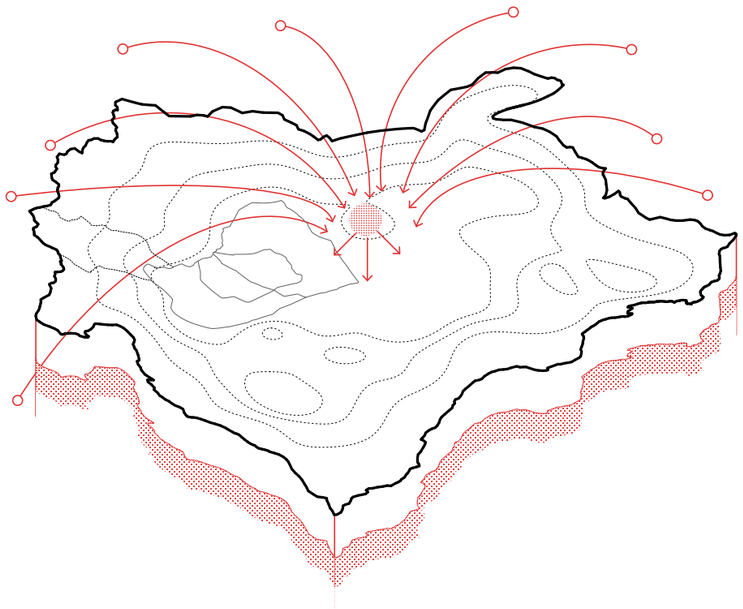


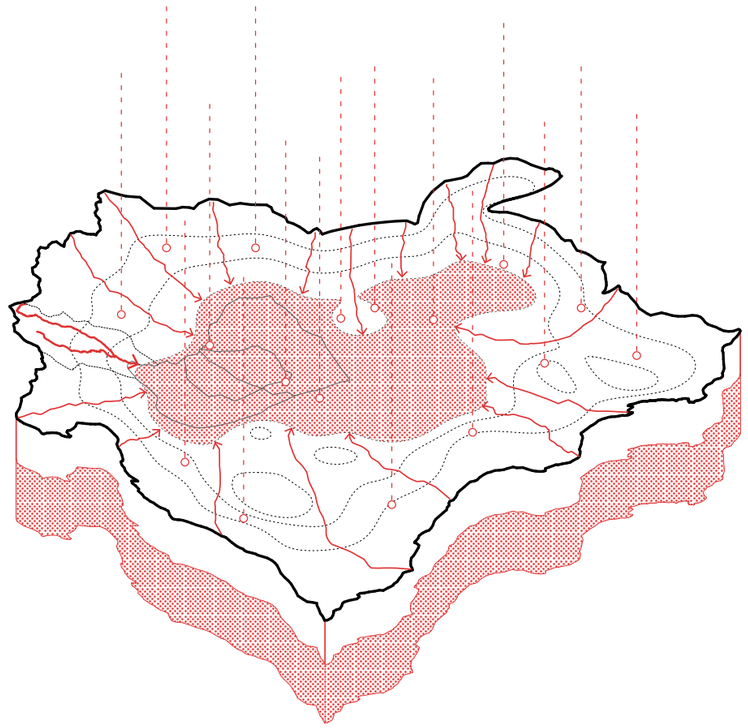
1.3 How can water sensitive urbanization enhance existing potable water sources?

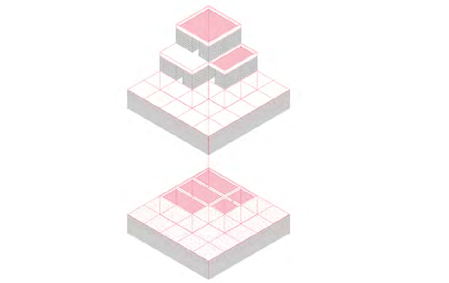
1.3 Totolapan / Padierna micro-basin

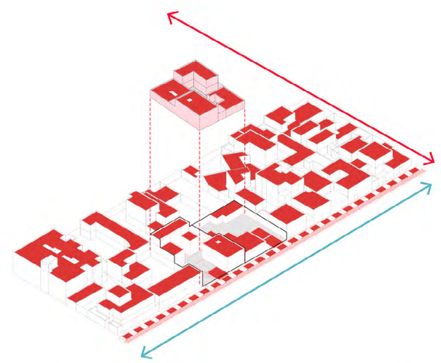


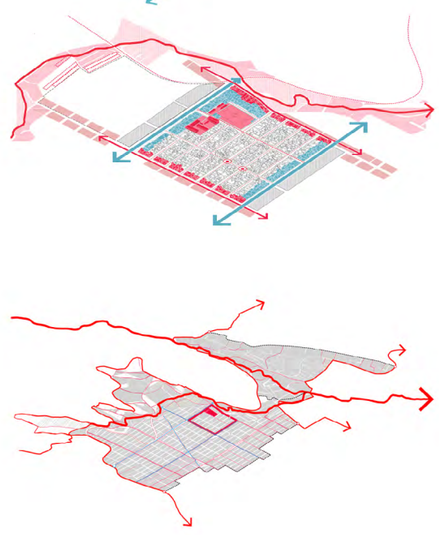

Macro scale: Lerma - Panuco central valleys
Meso scale: Mexico City
Micro scale: Magdalena river basin
Fresh-Water Supply
(Tangential relation)

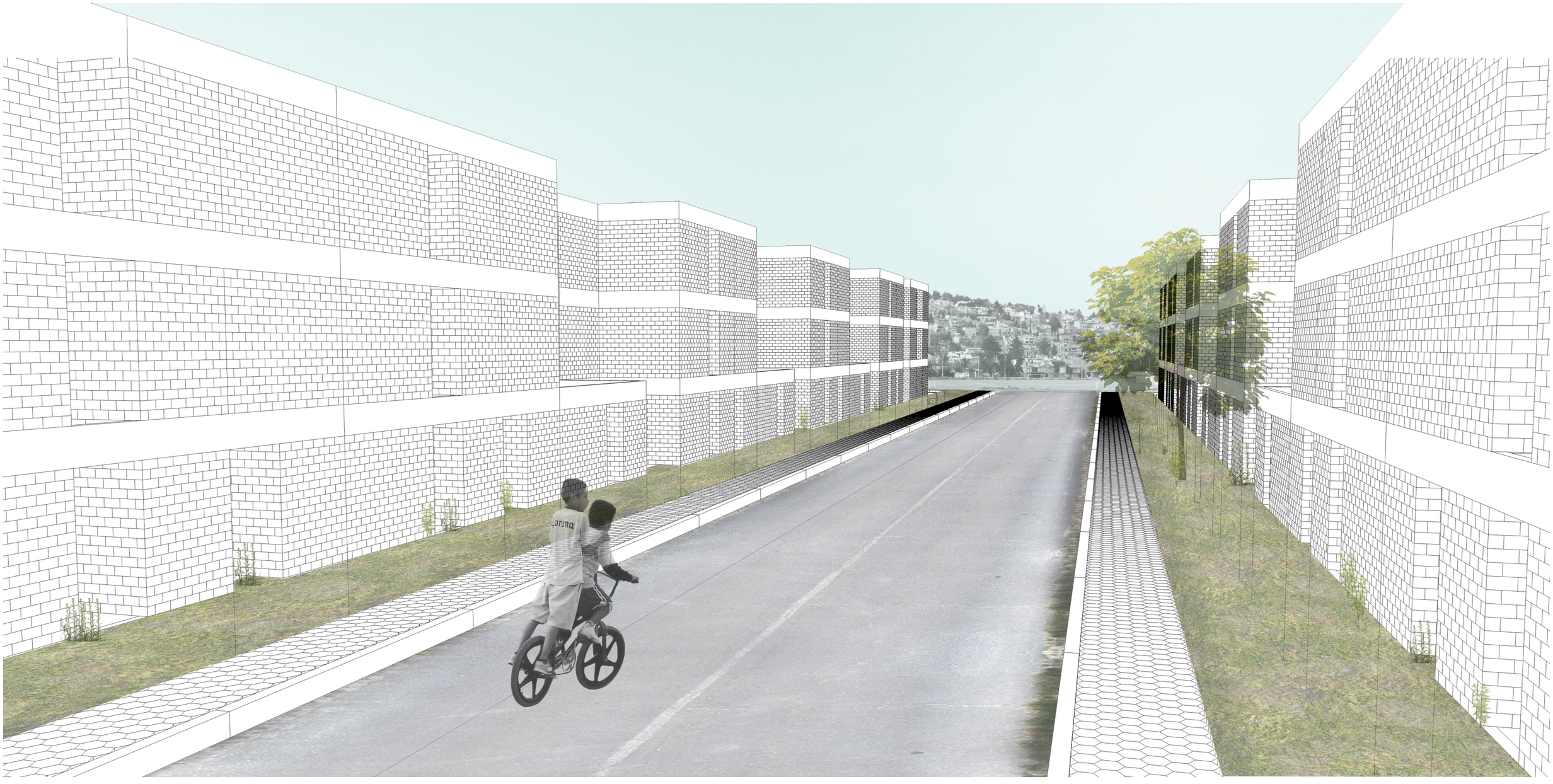


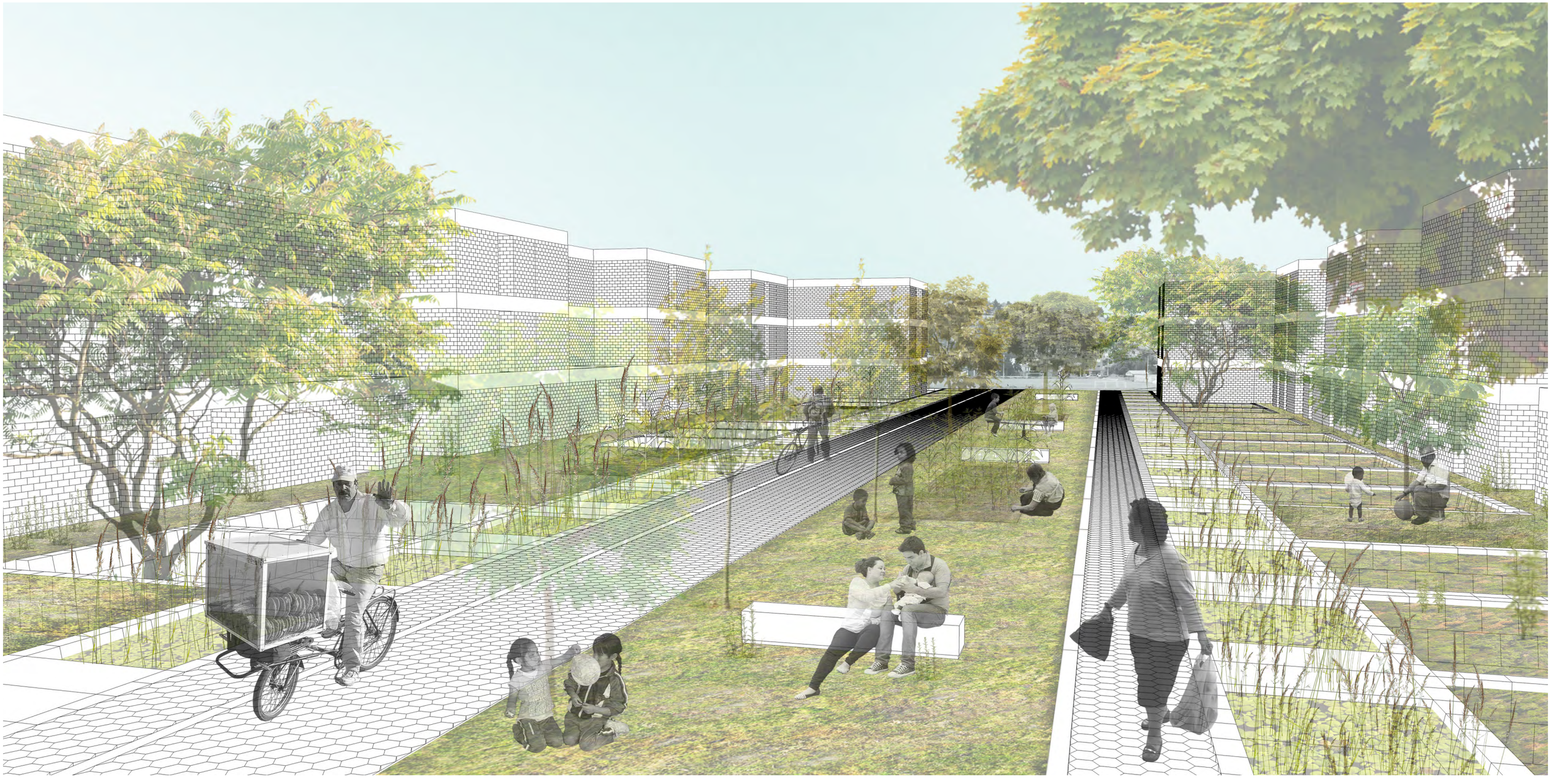


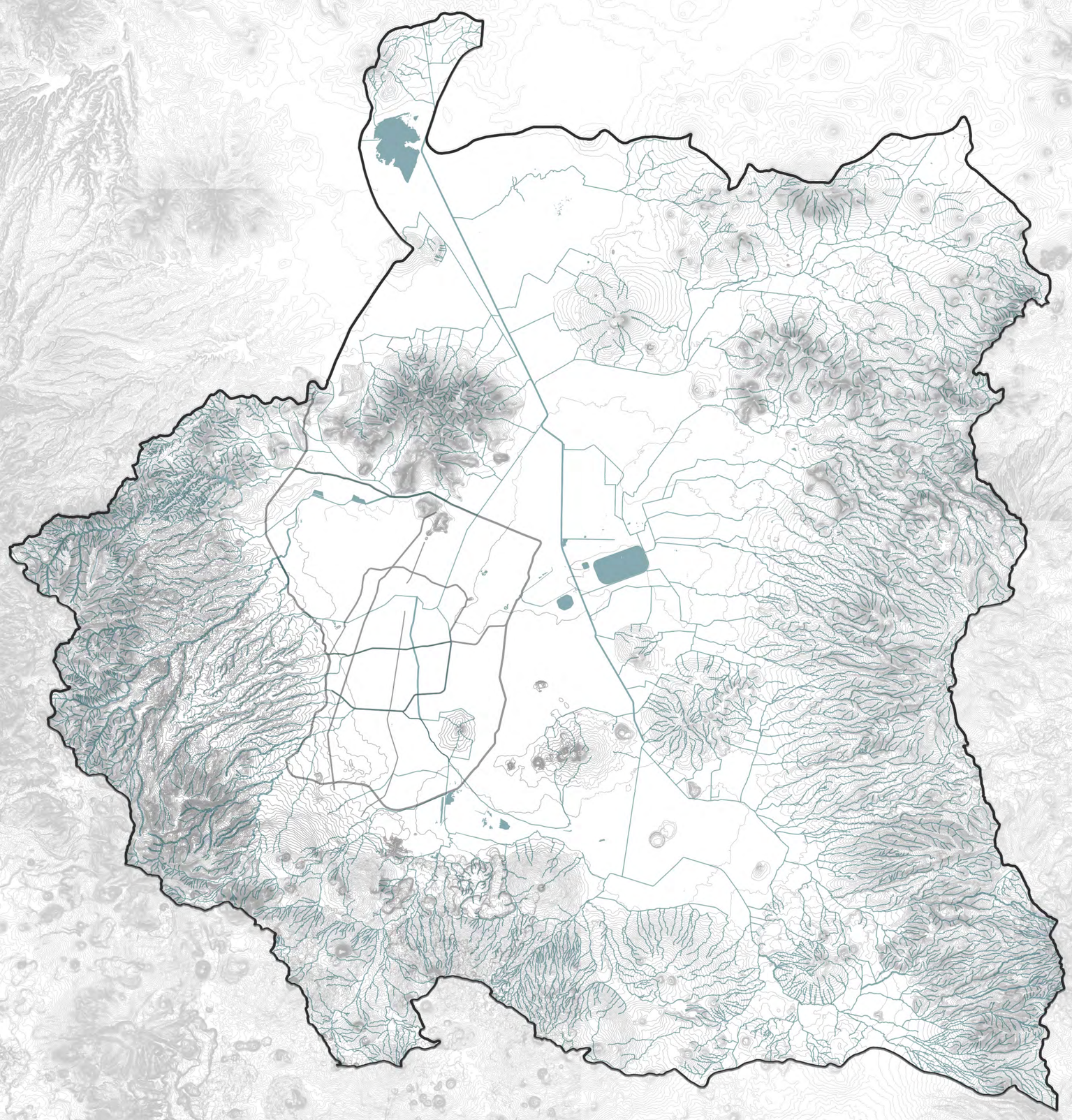




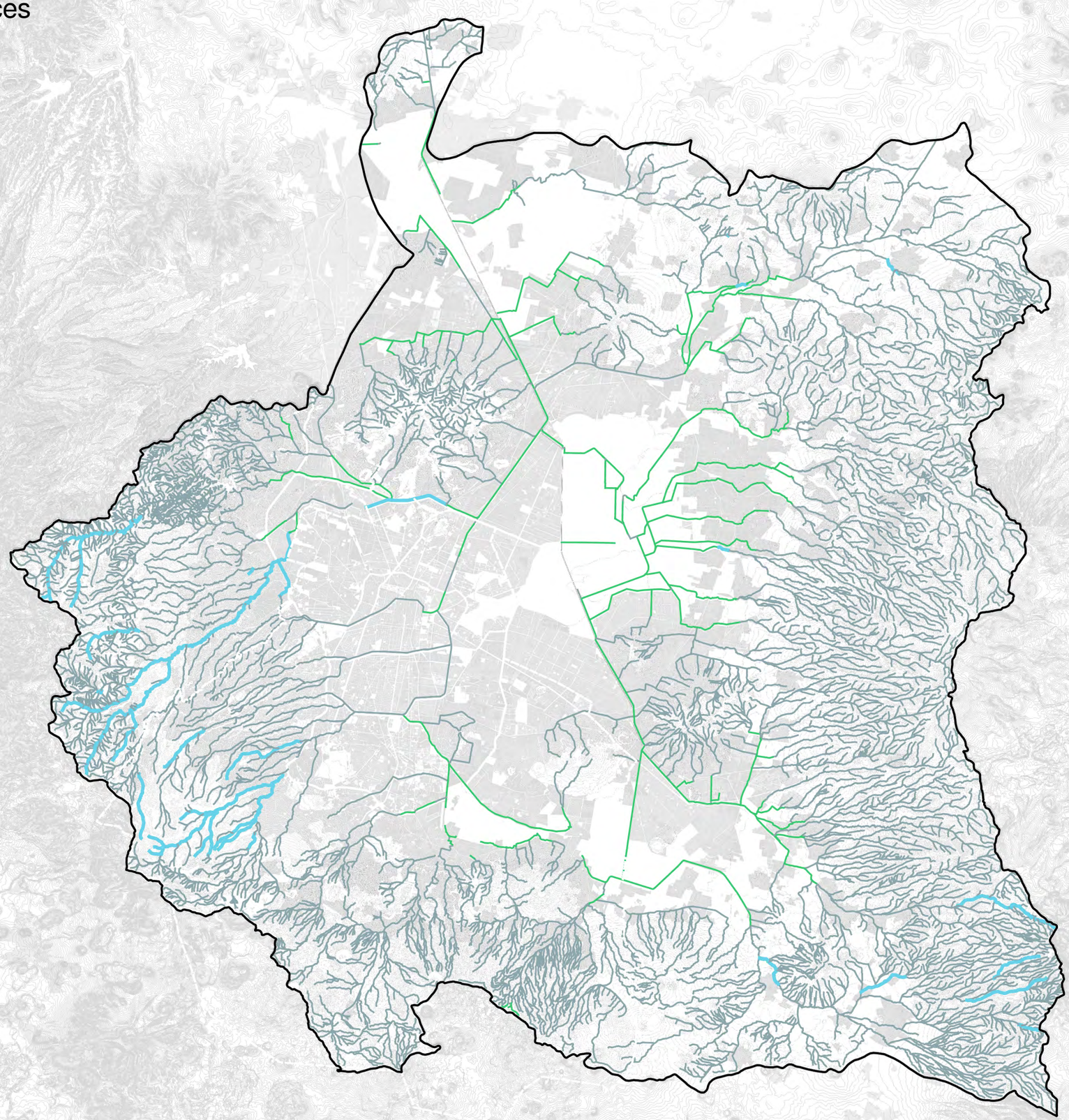






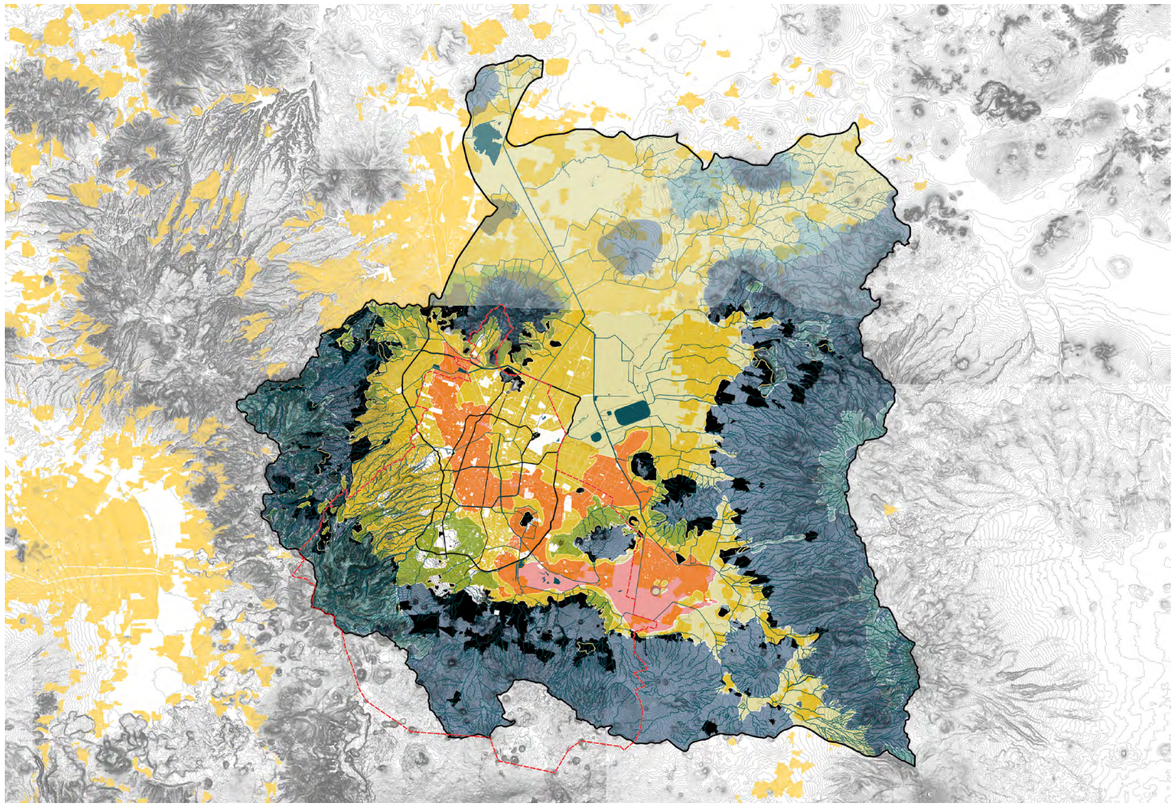


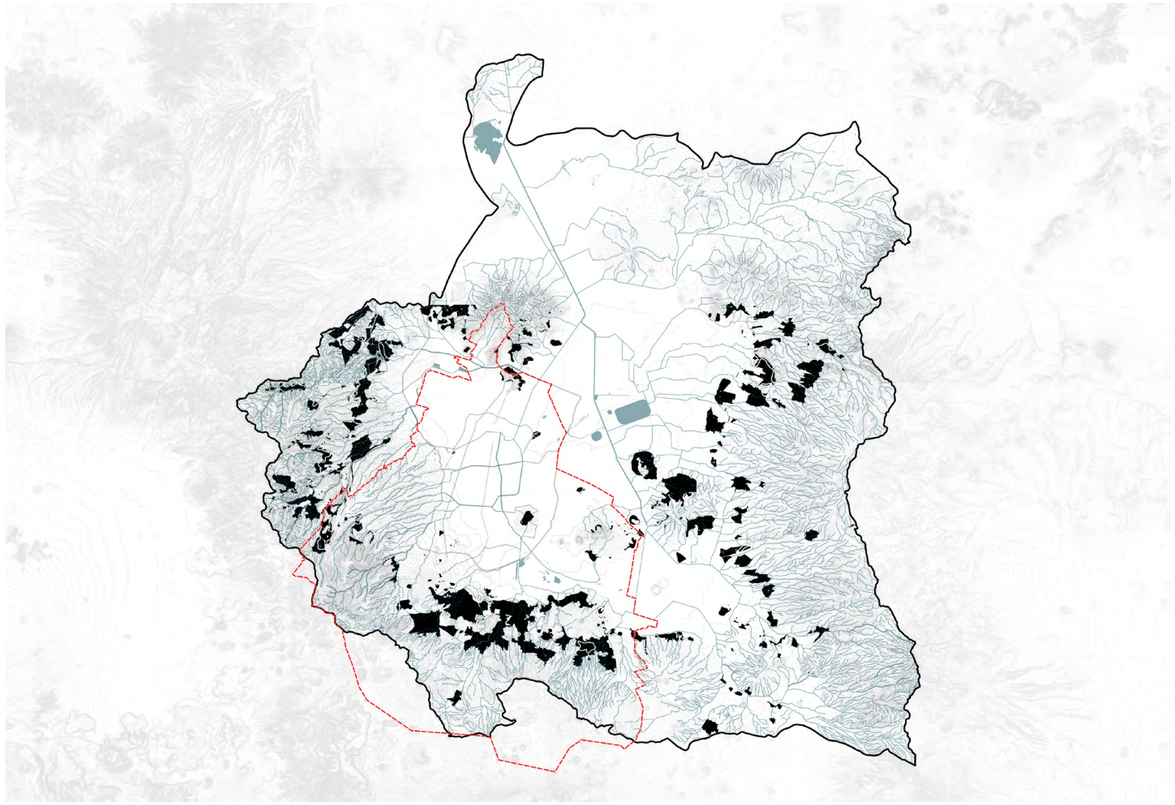
Texcoco / Zumpango basin
Remaining potential sources
of potable water



Perenneal rivers
Intermitent streams
Hdrologic infrastructure

Texcoco / Zumpango basin
Groundwater structure & infiltration capacity





High transmisivity

Lake bed

Low infiltration capacity

Medium infiltration capacity

High infiltration capacity

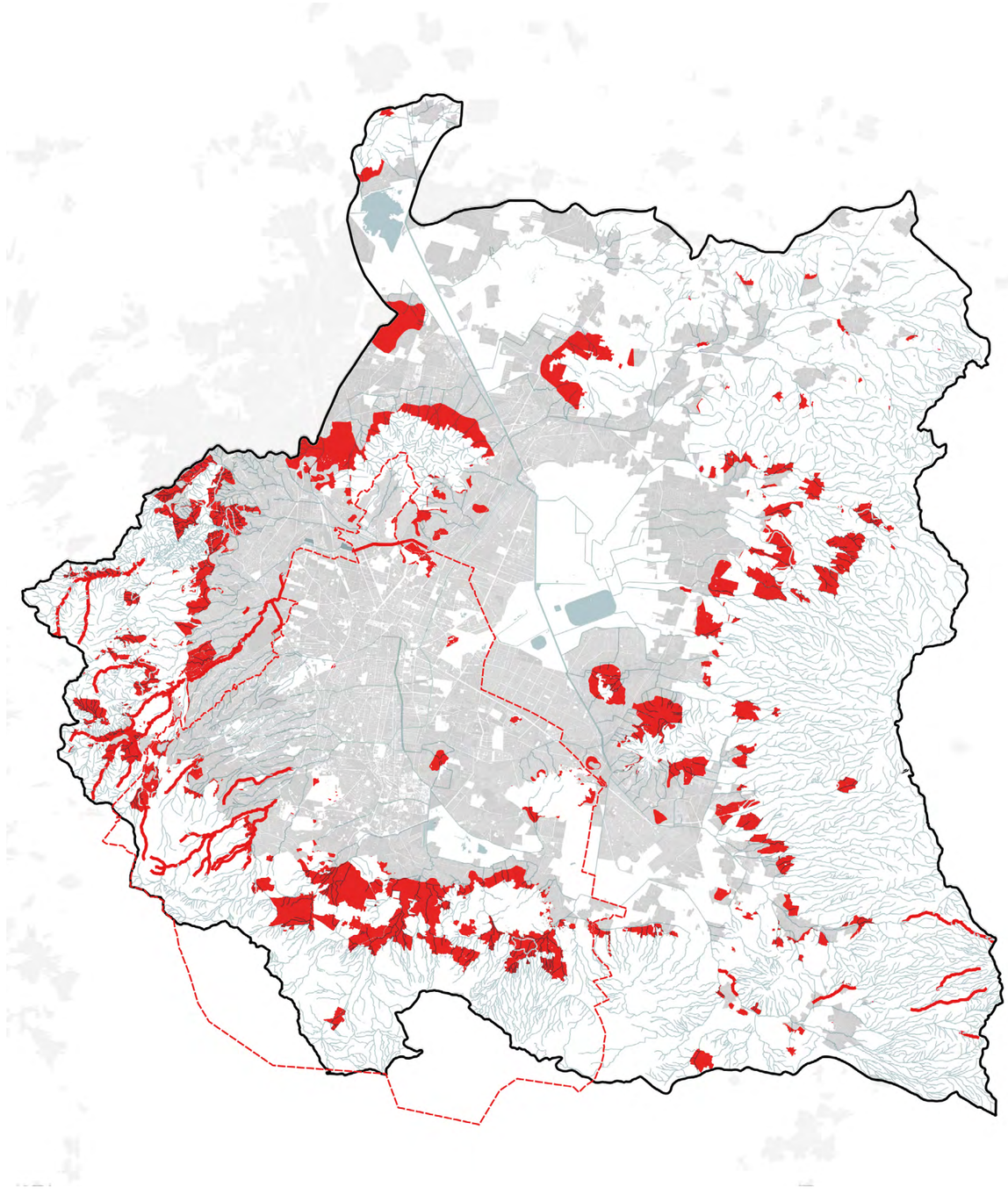
Occupation

Occupation on conservation soil

Occupation on conservation soil

Basin structure

Potential potable water sources ranked based on soil conditions and surface pollution



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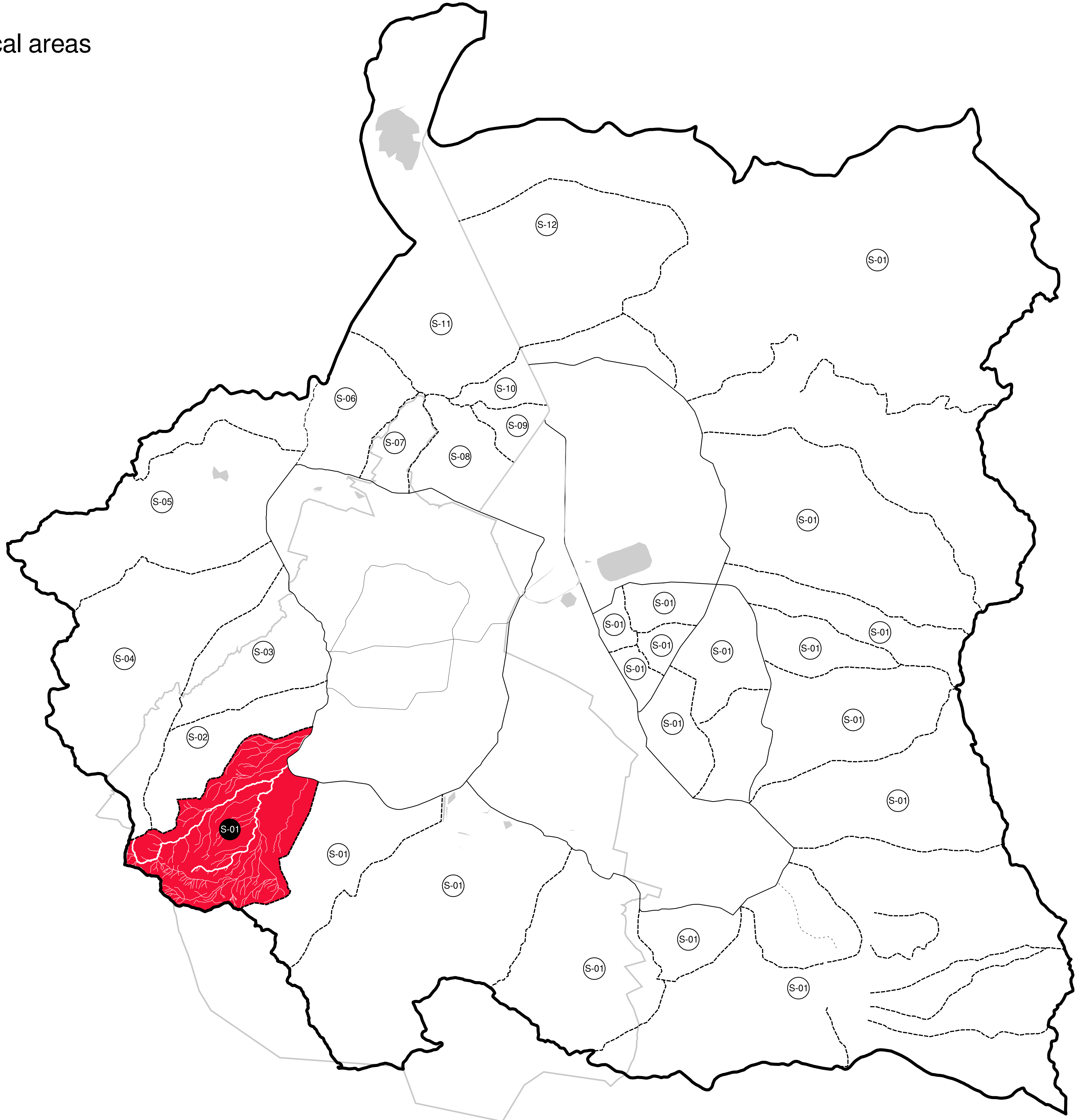
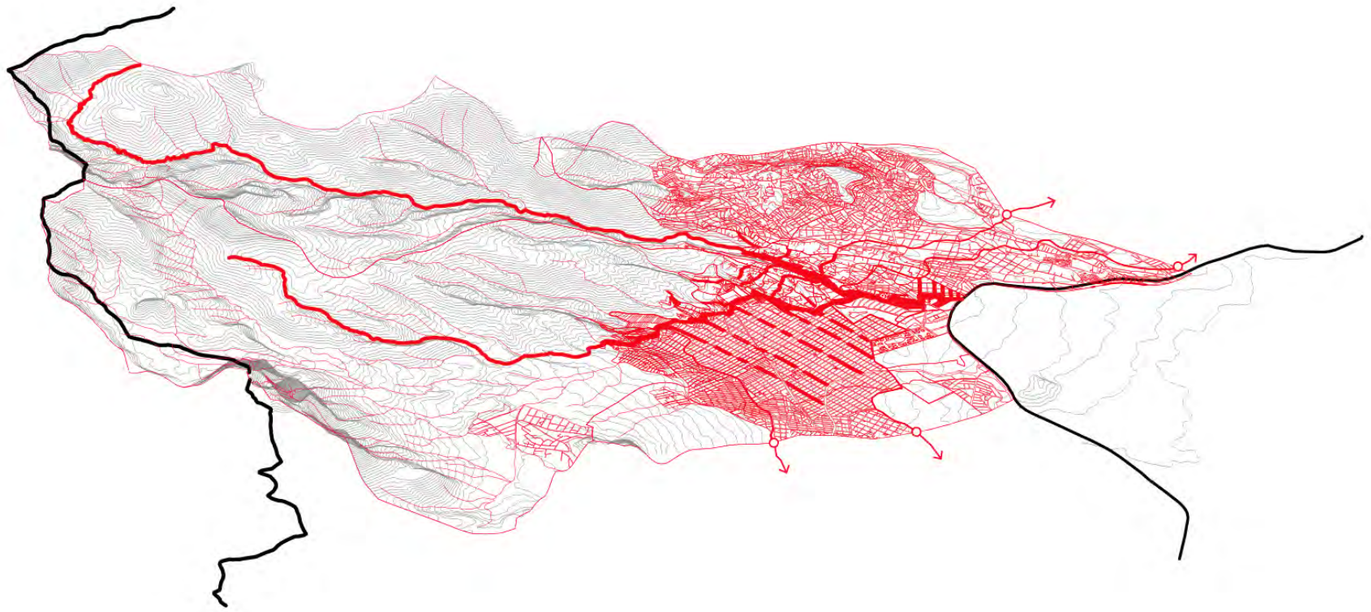
Basin structure

Sub-basin division, critical areas & morphological zoning

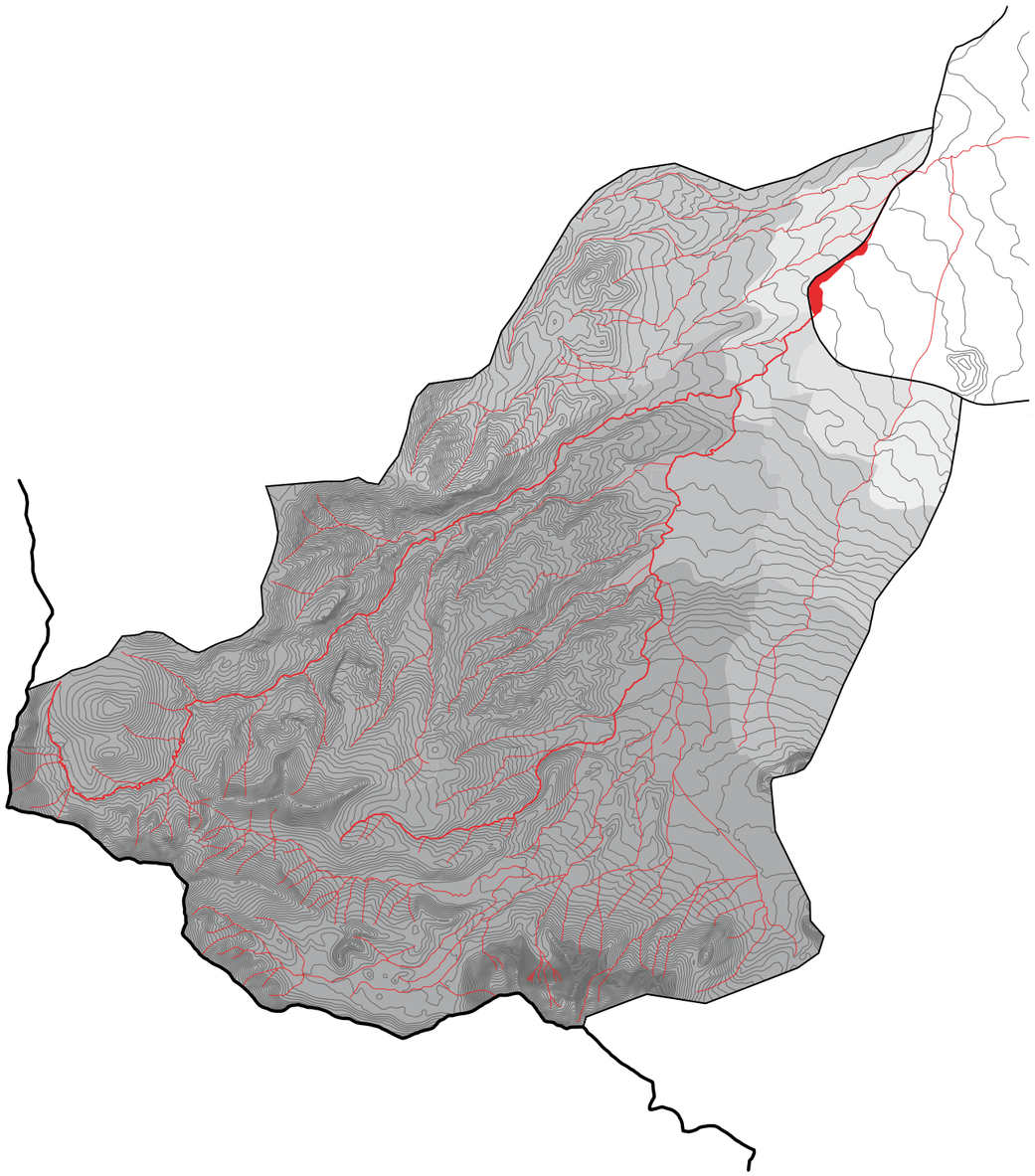


Magdalena/Eslava river Subbasin

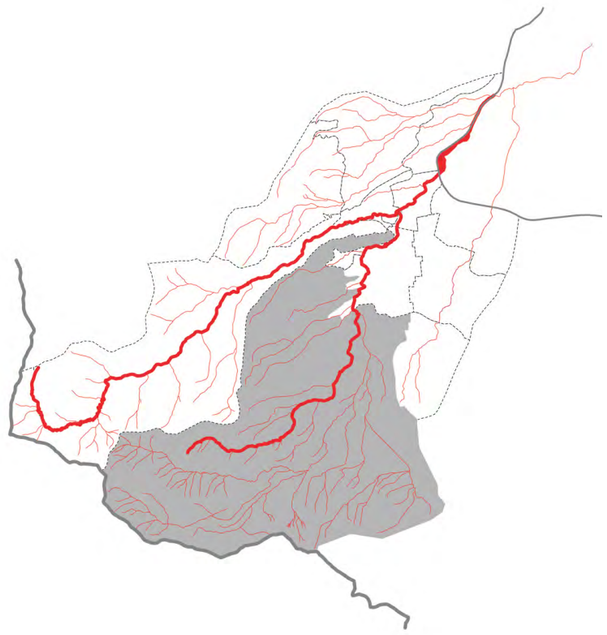
Magdalena-Eslava Sub Basin



Magdalena-Eslava Sub Basin
Stream condition



Magdalena C. Upstream



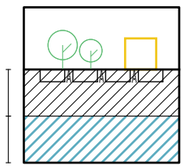
Tlalpan Upstream

Magd./Tlal. Midstream

Magd./Tlal. Downstream

Sub-basin structure
Upstream condition

Soil condition



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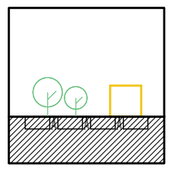
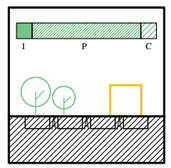
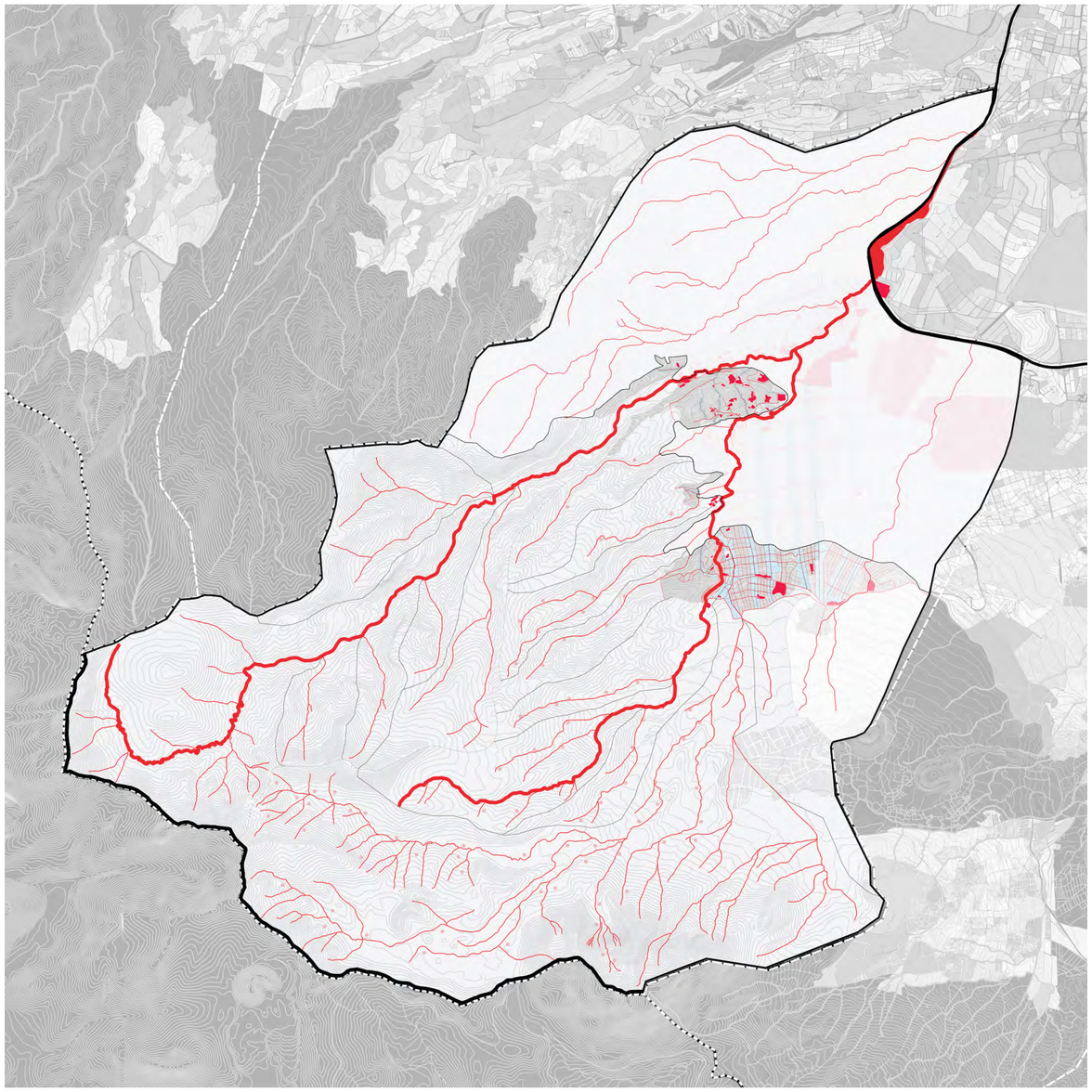


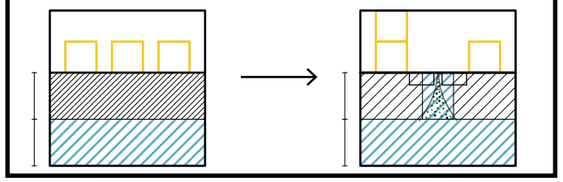
Income level





Sub-basin structure
Midstream condition

Soil condition



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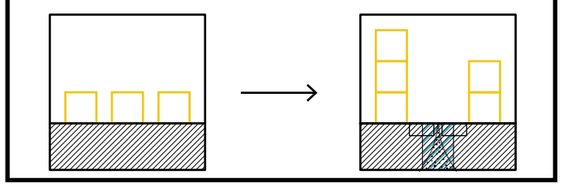

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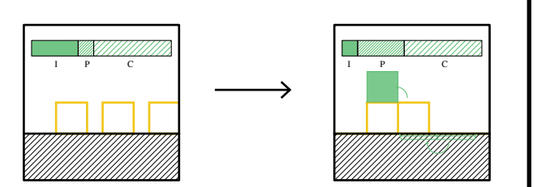
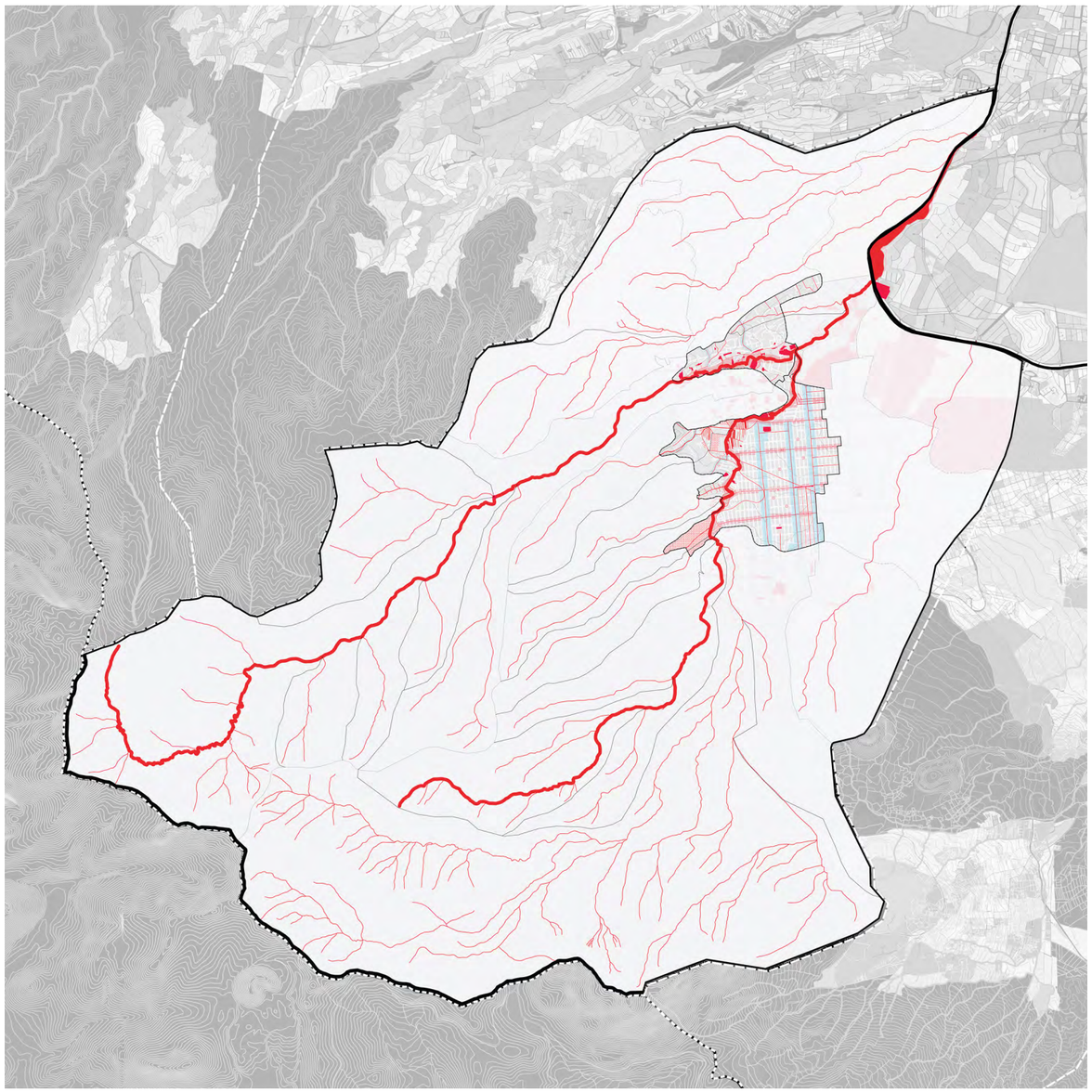
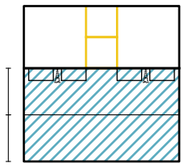




Sub-basin structure
Downstream condition

Soil condition



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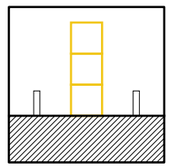

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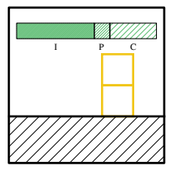

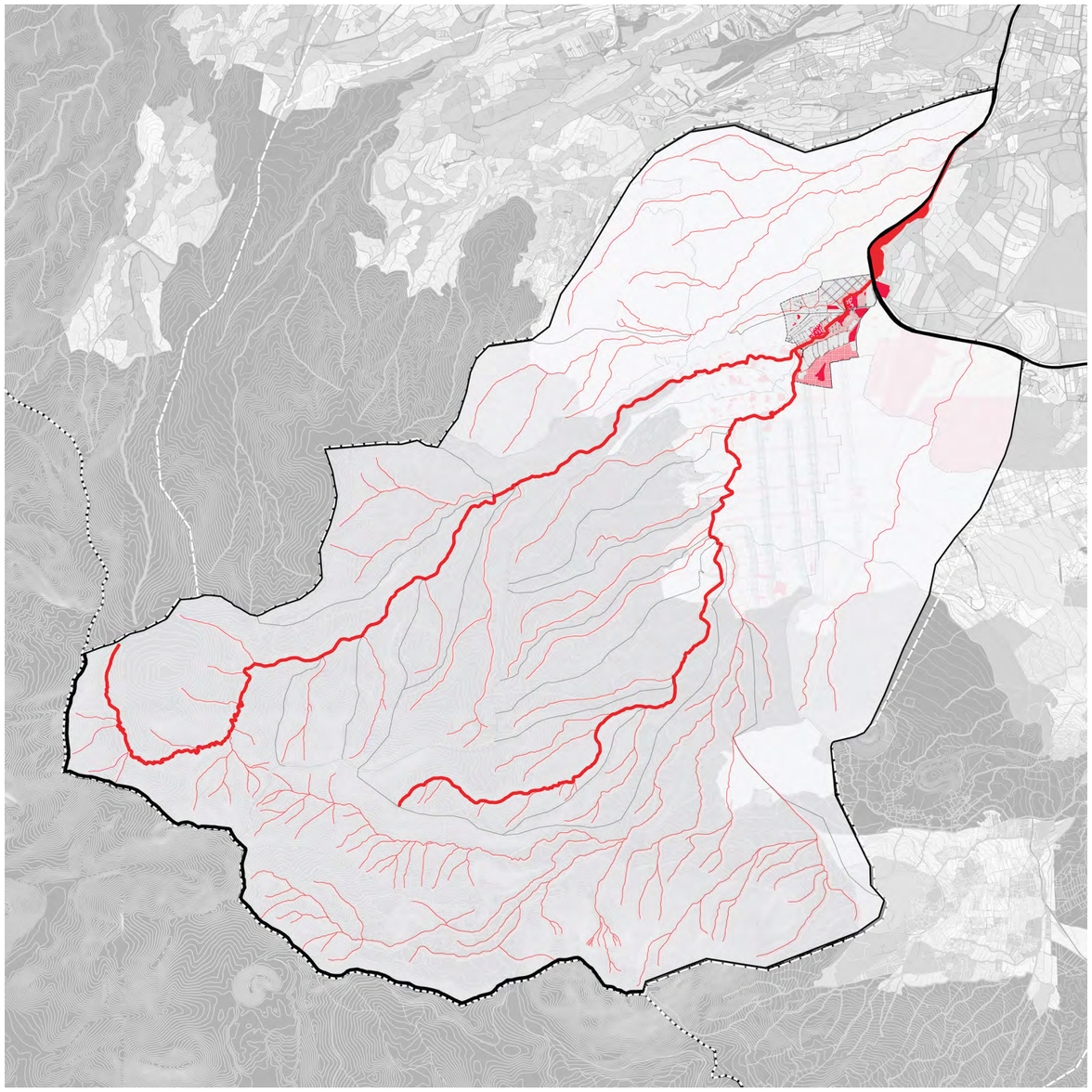


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VENDO
CONDOM HORIZONTAL
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Informar un problema
19°16'25.87" N 99°13'54.28" O elevación 2649 m alt. ojo 2.65 km


12 12 Calle Del Rincón
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Informar un problema
19°17'36.41" N 99°14'40.85" O elevación 2543 m alt. ojo 2.54 km


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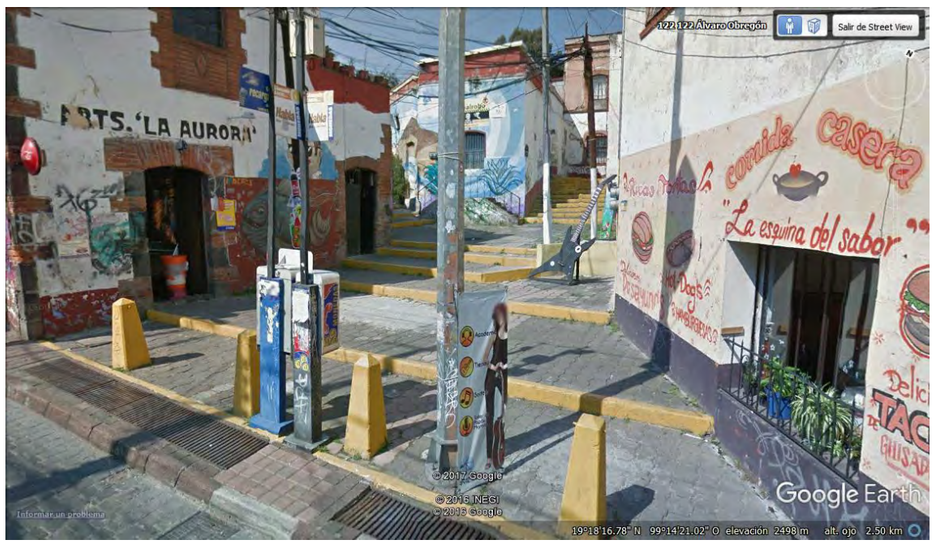
Informar un problema
19°16'22.74" N 99°14'48.32" O elevación 2675 m alt. ojo 2.69 km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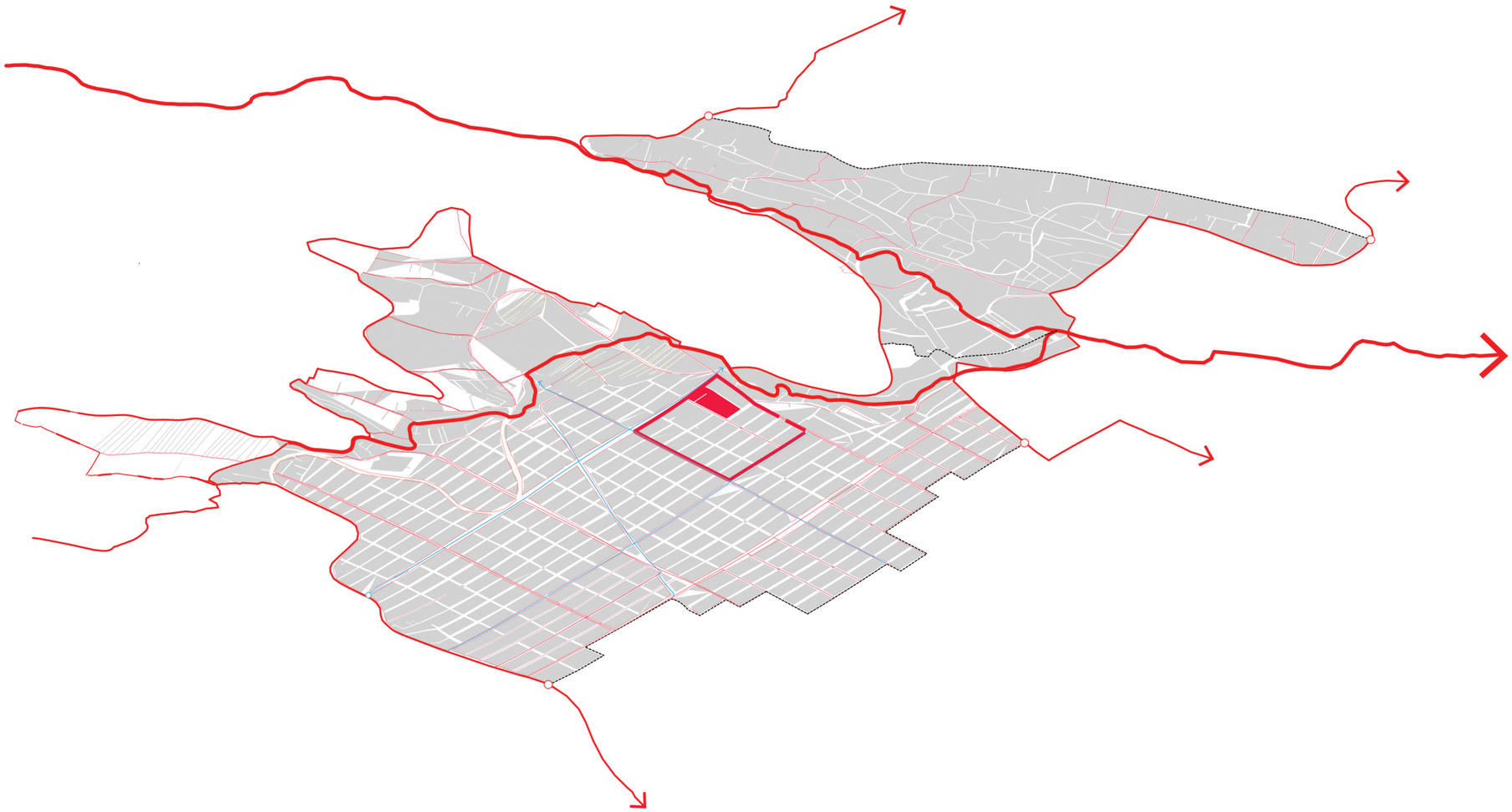
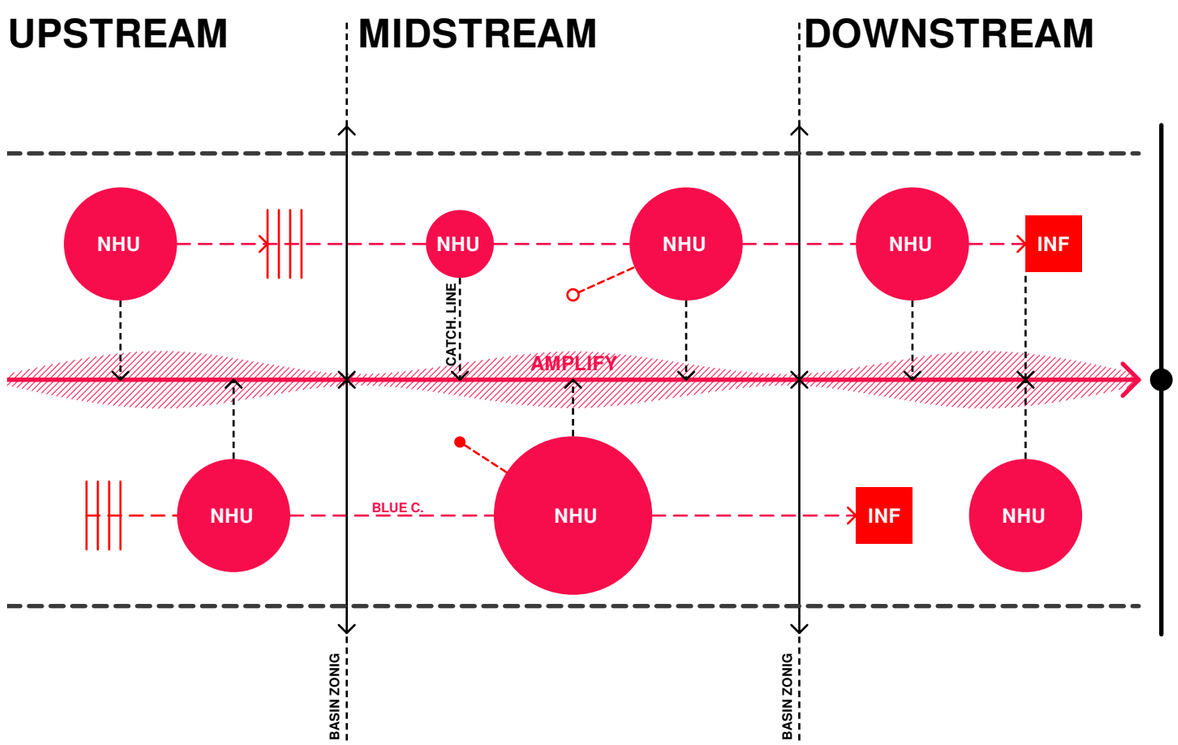
19°18'16.78" N 99°14'21.02" O elevación 2498 m alt. ojo 2.50 km

Totolapan/Pad. Micro-basn
Midstream hydrological structure




UPSTREAM
MIDSTREAM
DOWNSTREAM
NHU
NHU
NHU
NHU
INF
CATCH LINE
AMPLIFY
NHU
BLUE C.
NHU
INF
NHU
BASIN ZONIG
BASIN ZONIG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CONDOM HORIZONTAL
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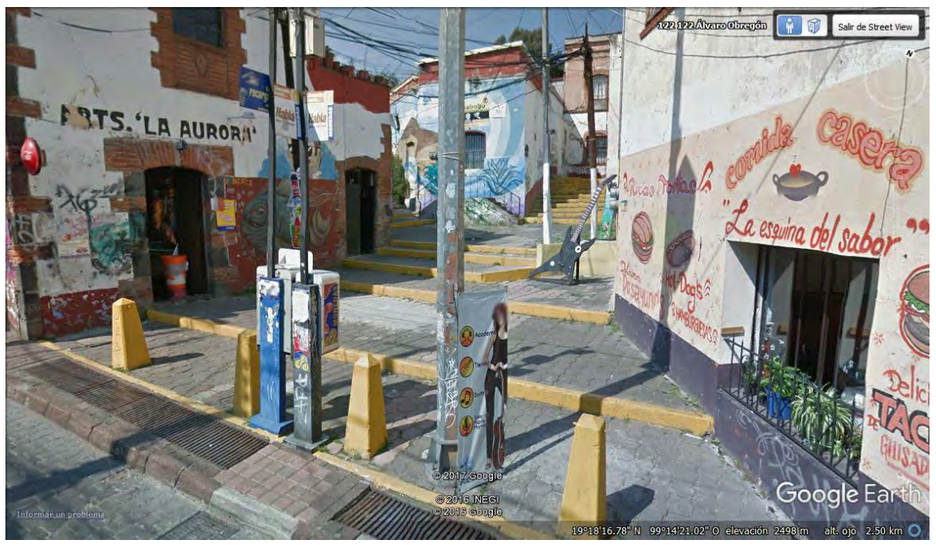
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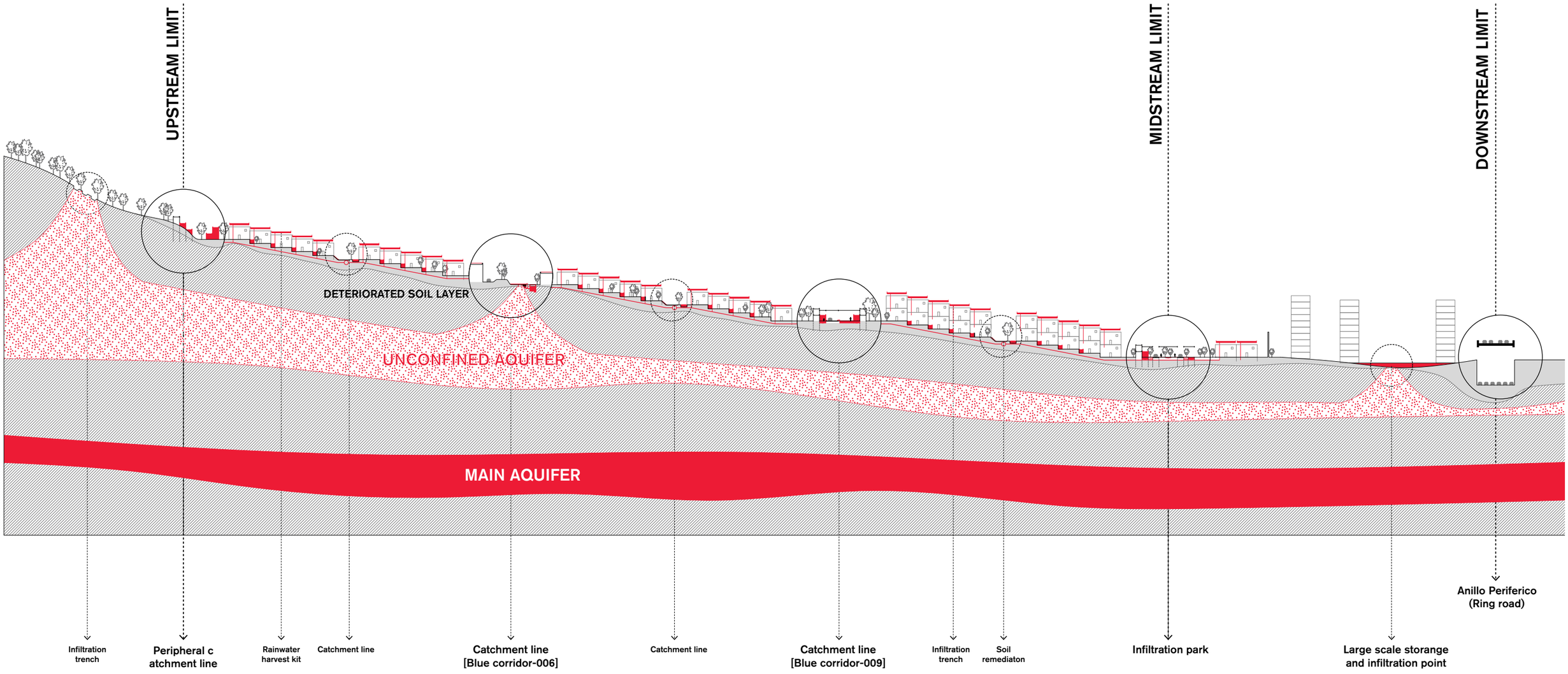
19°18'16.78" N 99°14'21.02" O elevación 2498 m alt. ojo 2.50 km

Sub-basin structure
Spatial strategy

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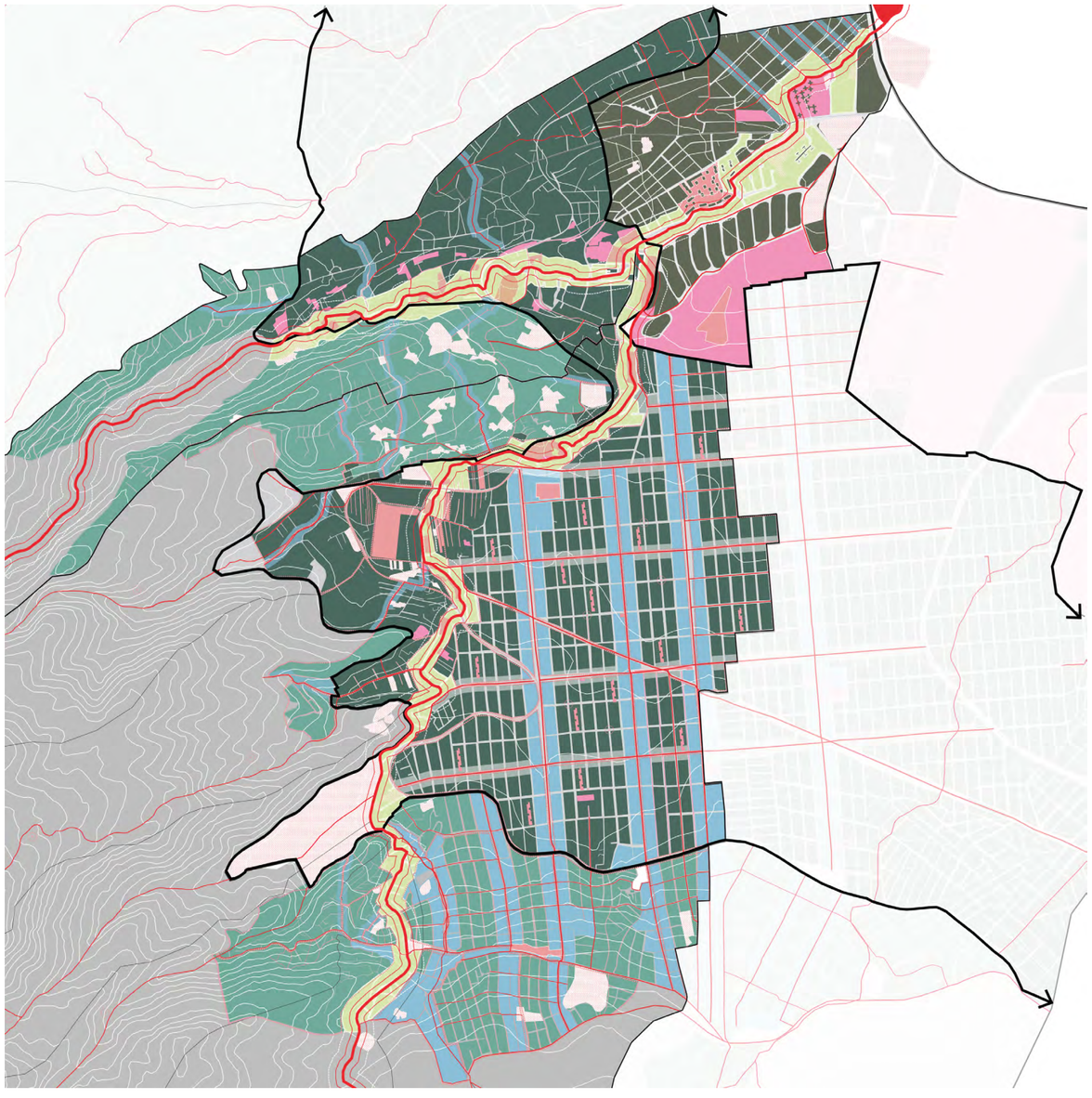
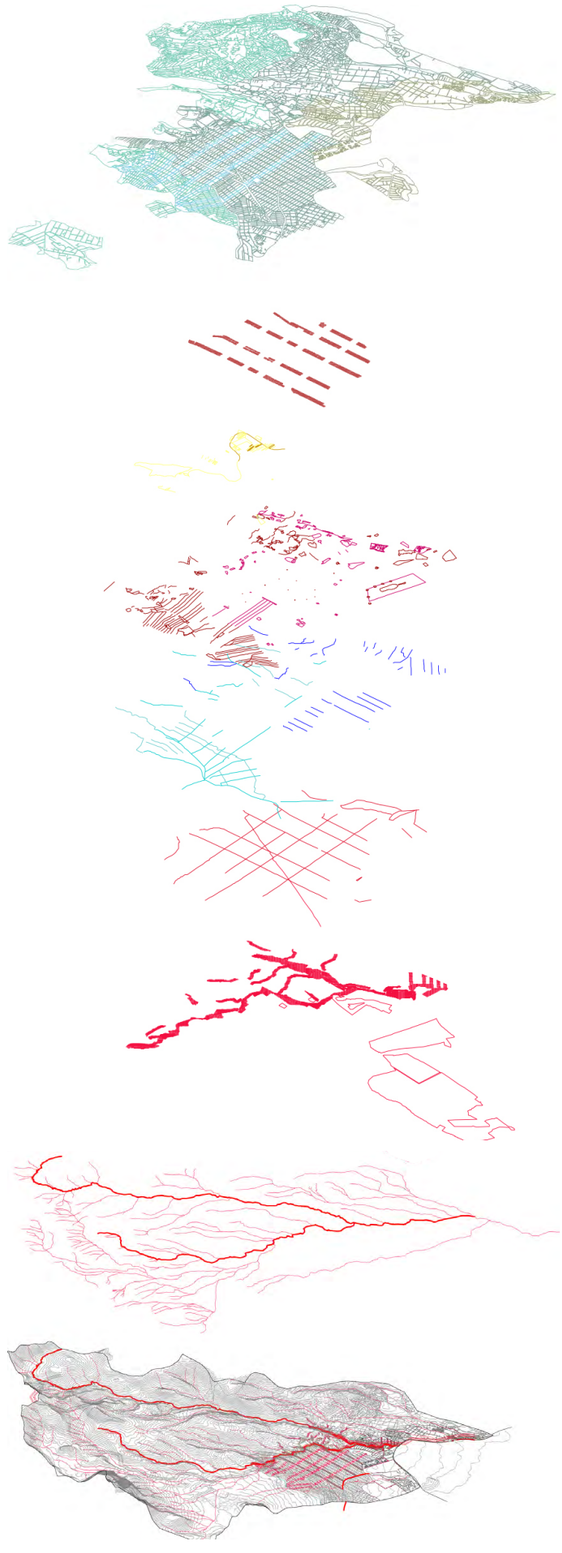
TEL.26

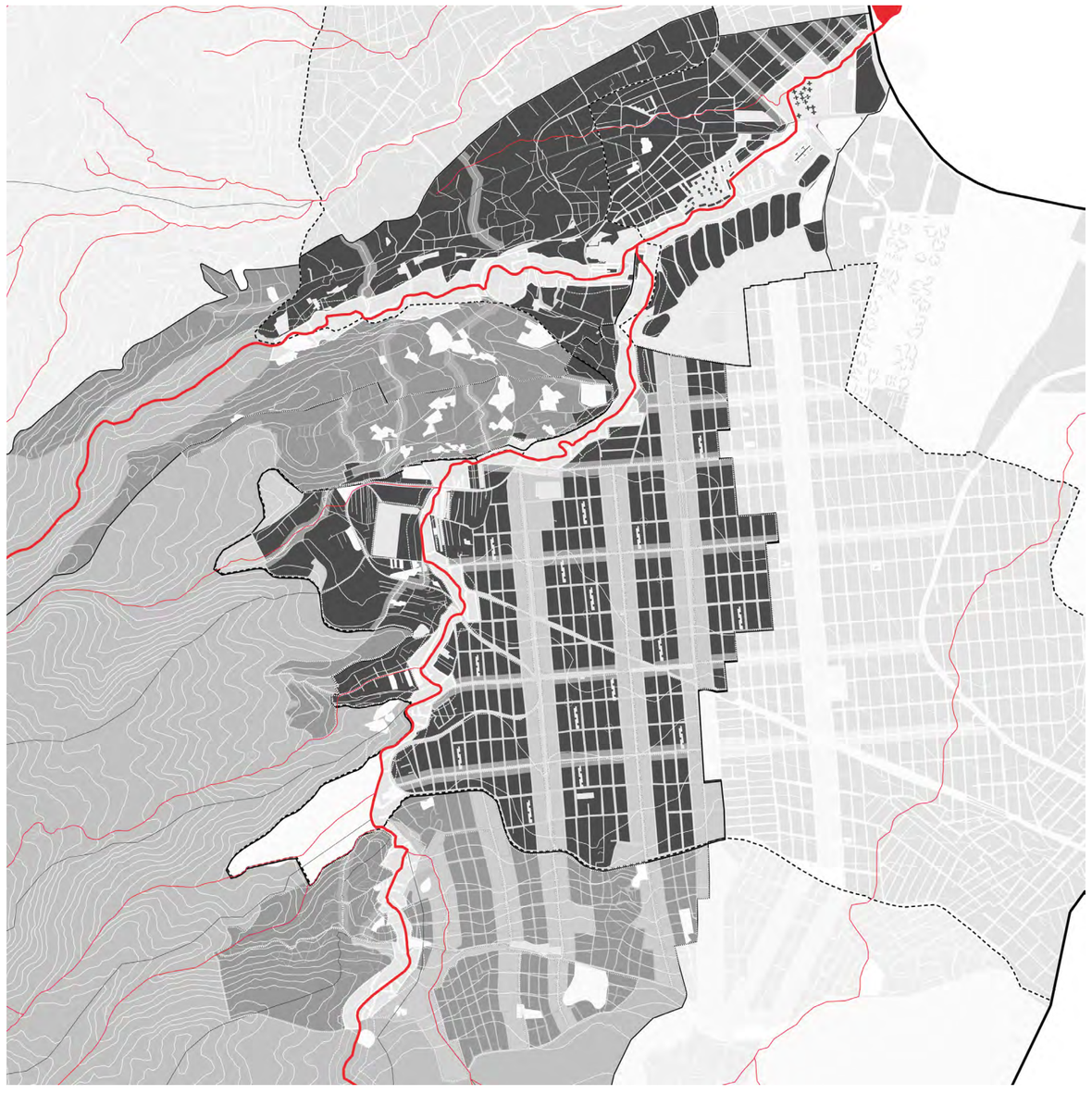

Zeek

Micro-basin structure
Proposed hydrological network

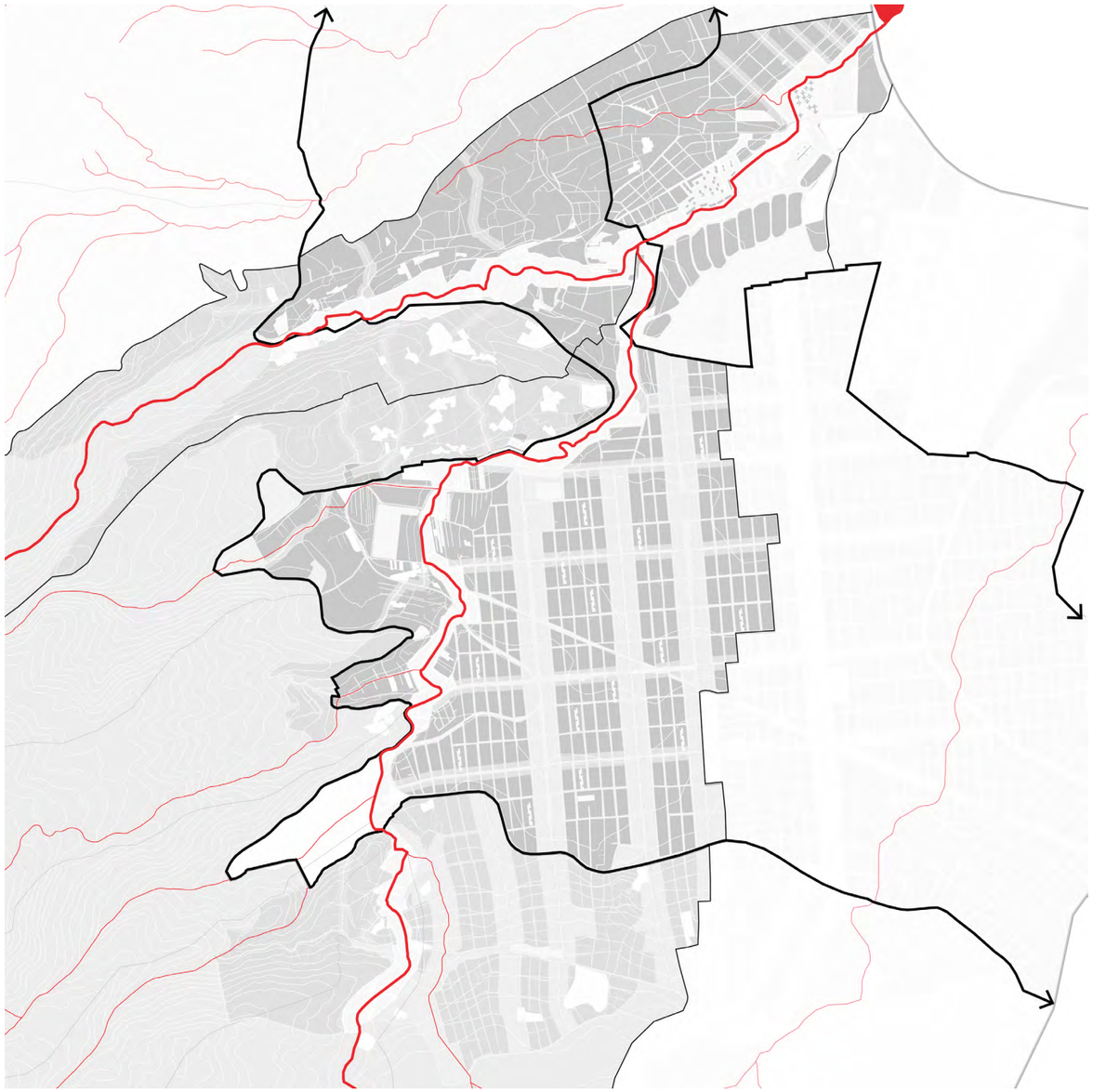




Micro-basin structure
Magdalena/Eslava River

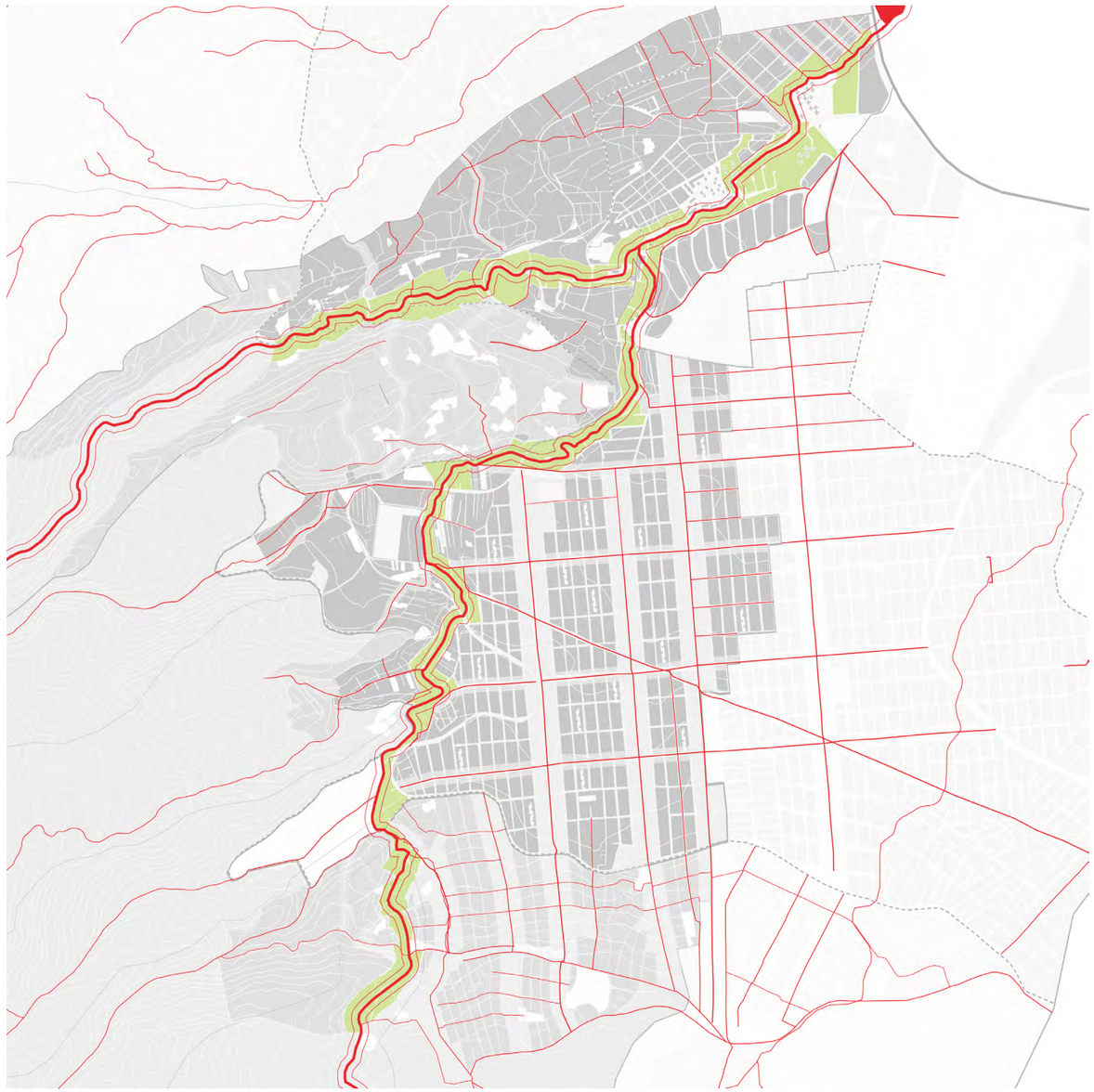


Micro-basin structure
Geomorphological delimitation

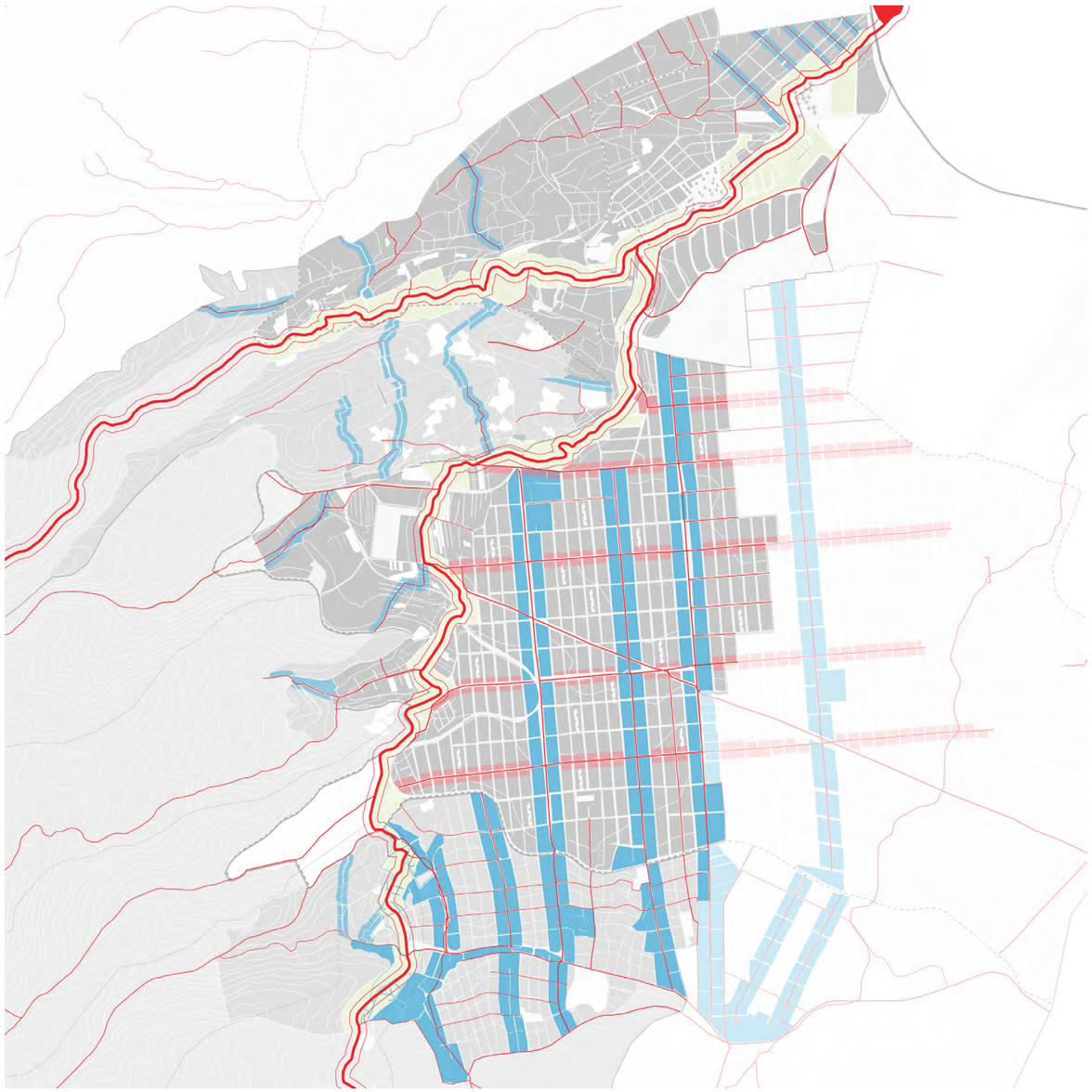


Micro-basin structure
Amplification strategy

Micro-basin structure
Green corridors & catchment lines



Micro-basin structure
Blue corridors



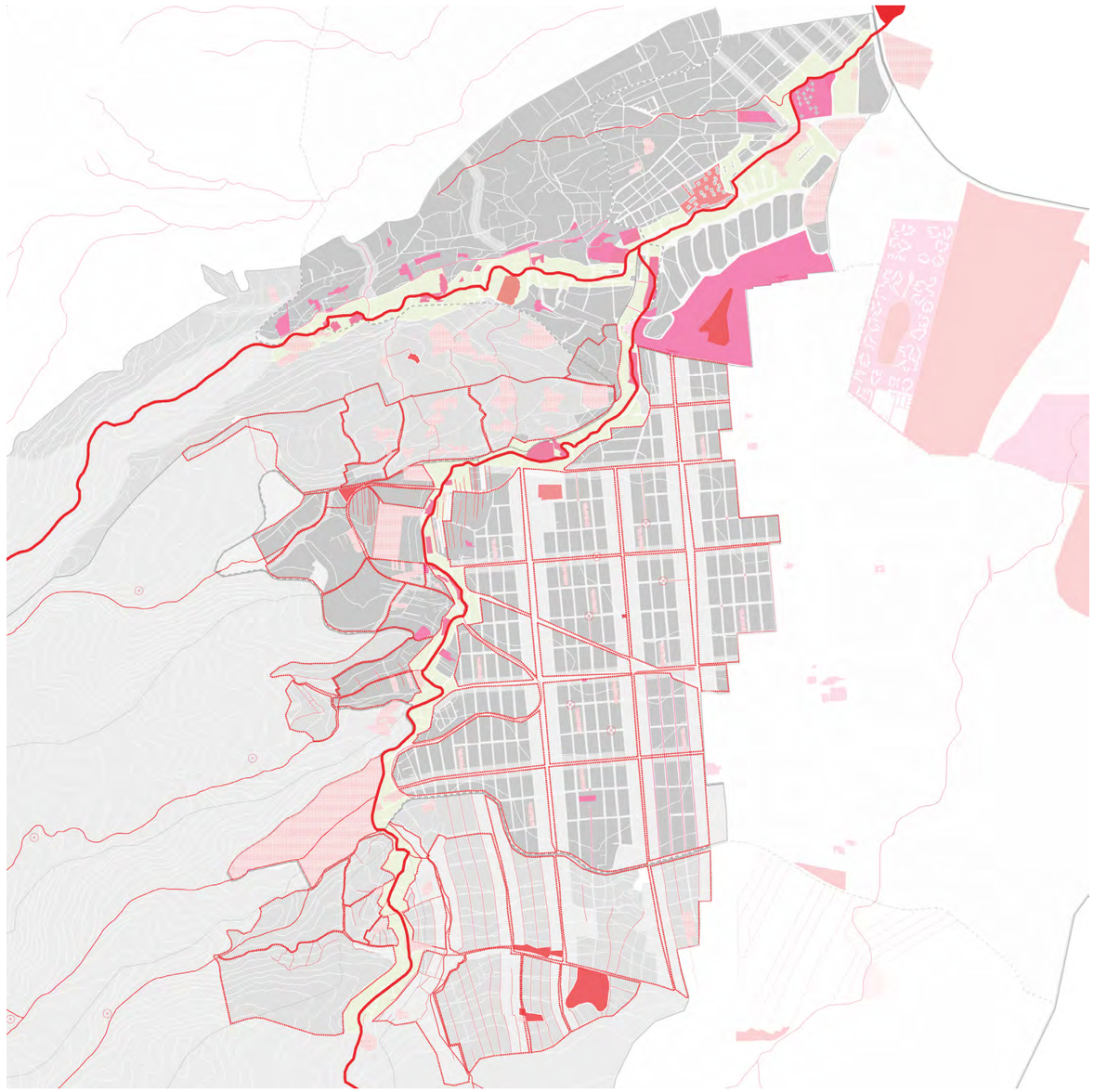
First order blue corridor

Second order blue corridor

Micro-basin structure
Proposed ‘Neighborhood Hydrological Units’

Neighborhood Hydrological Unit boundary

Micro-basin structure
Infiltration, storage & soil remediation

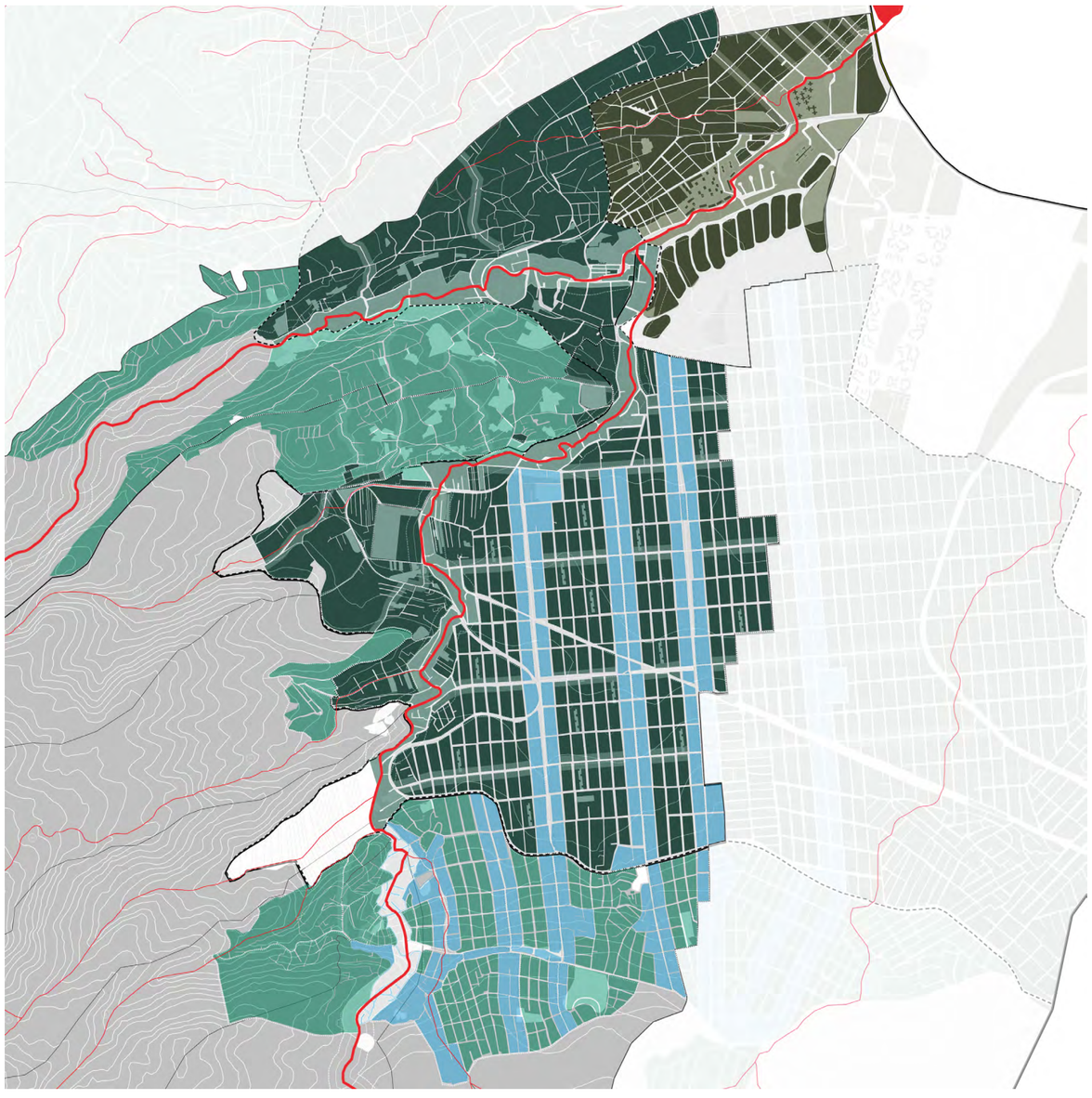


Storage

Soil remediation

Infiltration

Micro-basin structure
Proposed zoning



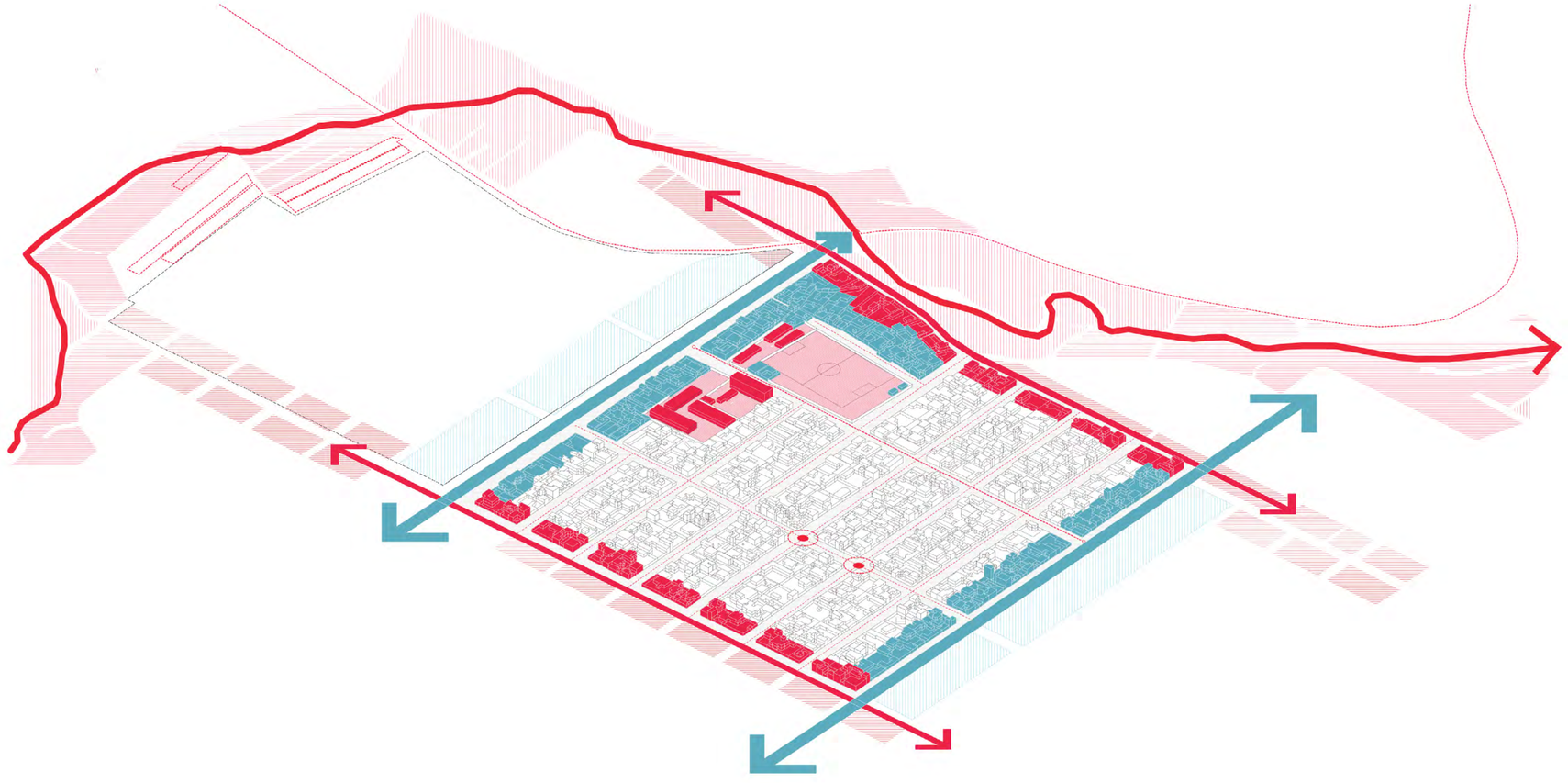
Upstream occupation

Midstream occupation

Downstream occupation

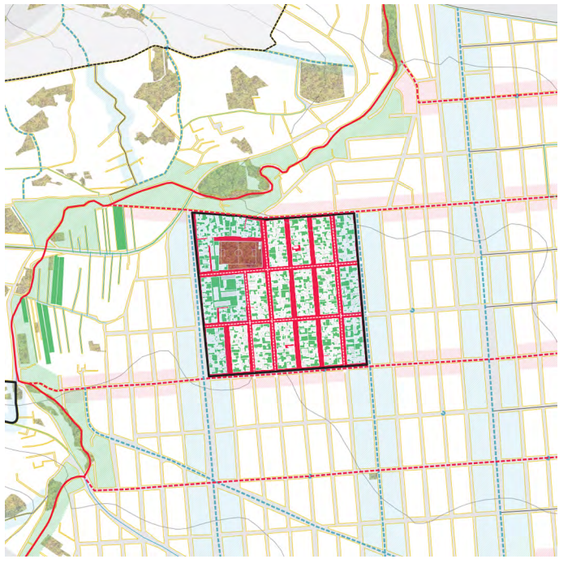
First order blue corridor

Neighborhood Hydrologcial Unit Structure

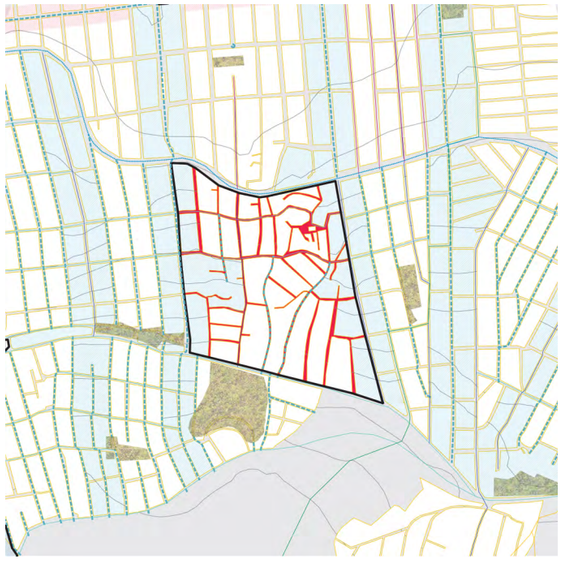


Neighborhood Hydrologcial Unit Structure

NHU typologies

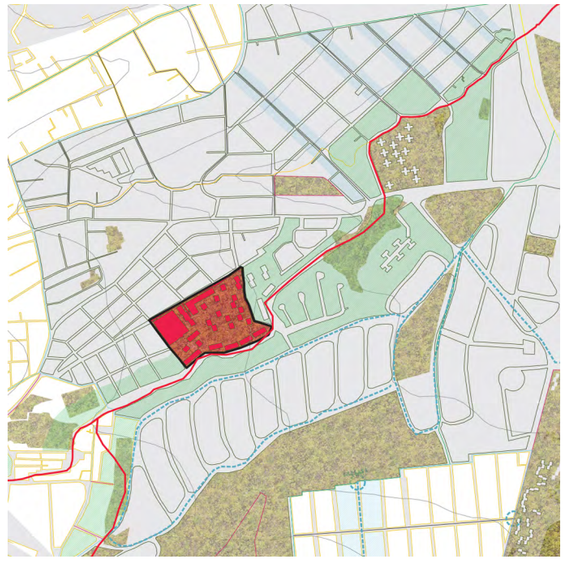


Midstream - Heroes de Padierna neighborhood type

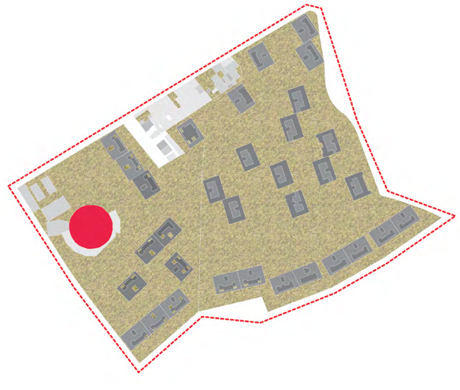


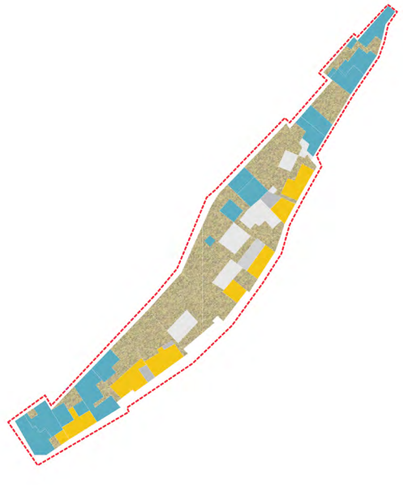
Upstream - Lomas de Cuilotepec neighborhood type

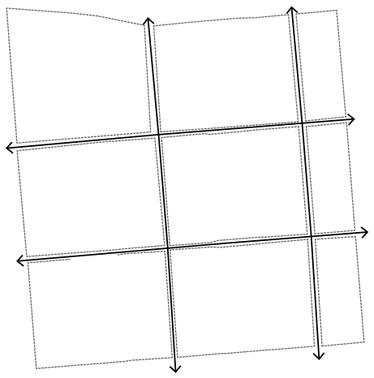
Midstream - San Nicolas Totolapan neighborhood type

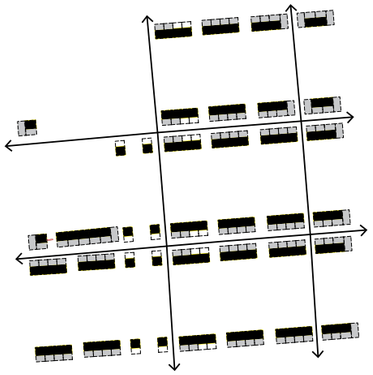


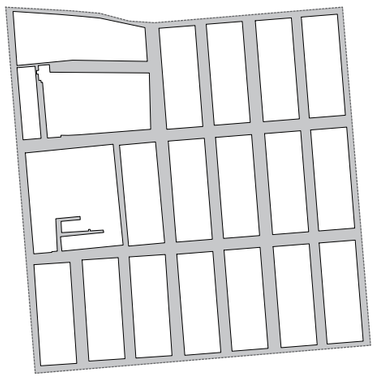
Downstream - Magdalena neighborhood type

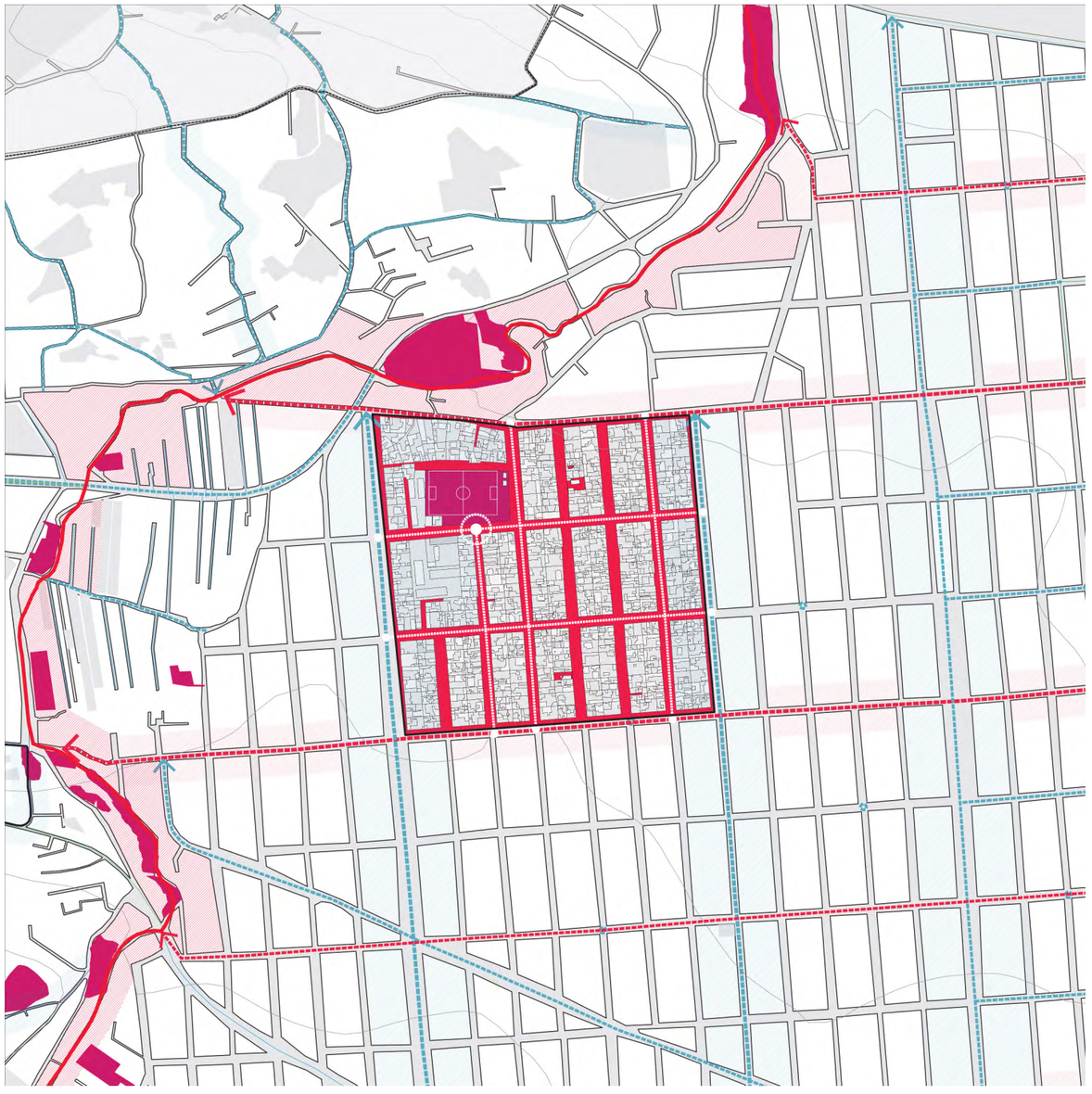




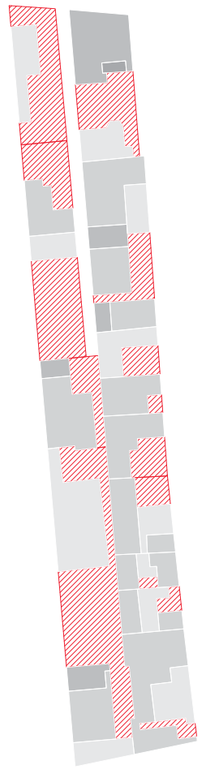


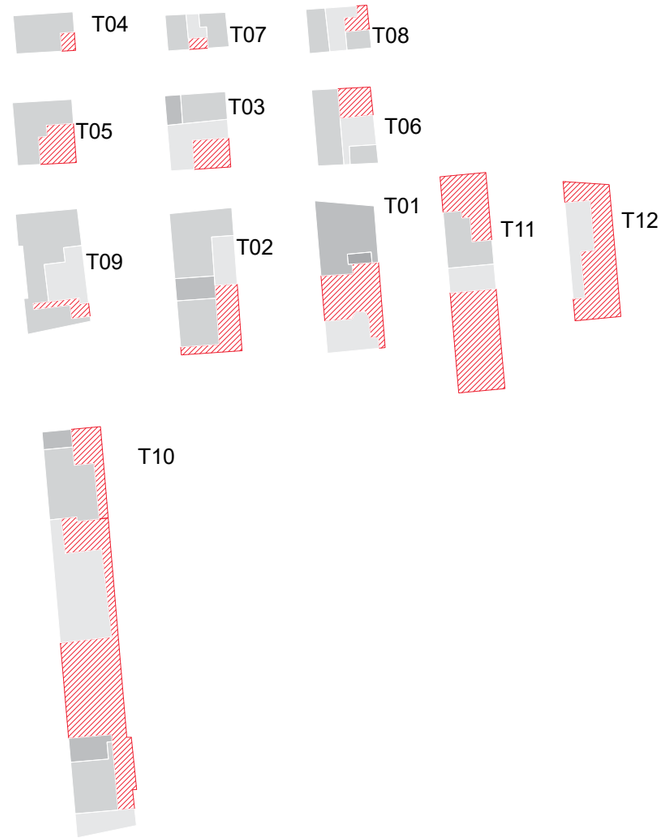






Block density





Block 01

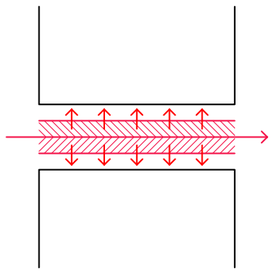
	Area de terreno)	Areá libre	Area de desplante (B)	Area construida total (F)	% Area Libre	% Area Construida	FSI	GSI	OSR	FAR	N
Plot 01	240	58	182	264	24.2	75.8	1.10	0.76	0.22	110.00%	
Plot 02	258	66	192	261	25.6	74.4	1.01	0.74	0.25	101.16%	
Plot 03	251	80	171	234	31.9	68.1	0.93	0.68	0.34	93.23%	
Plot 04	242	128	114	170	52.9	47.1	0.70	0.47	0.75	70.25%	
Plot 05	298	108	190	331	36.2	63.8	1.11	0.64	0.33	111.07%	
Plot 06	211	71	140	223	33.6	66.4	1.06	0.66	0.32	105.69%	
Plot 07	508	138	370	811	27.2	72.8	1.60	0.73	0.17	159.65%	
Plot 08	495	315	180	180	63.6	36.4	0.36	0.36	1.75	36.36%	
Plot 09	487	146	341	505	30.0	70.0	1.04	0.70	0.29	103.70%	
Plot 10	503	394	109	272	78.3	21.7	0.54	0.22	1.45	54.08%	
Plot 11	477	217	260	456	45.5	54.5	0.96	0.55	0.48	95.60%	
Plot 12	485	21	464	1348	4.3	95.7	2.78	0.96	0.02	277.94%	
Plot 13	521	299	222	372	57.4	42.6	0.71	0.43	0.80	71.40%	
Plot 14	498	327	171	379	65.7	34.3	0.76	0.34	0.86	76.10%	
Plot 15	250	250	0	0	100.0	0.0	0.00	0.00	-	0.00%	
Plot 16	477	172	305	472	36.1	63.9	0.99	0.64	0.36	98.95%	
Plot 17	195	25	170	334	12.8	87.2	1.71	0.87	0.07	171.28%	
Total	6396	2815	3581	6612	44.0	56.0	1.03	0.56	0.43	103.38%	

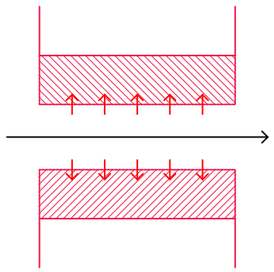
Block 02

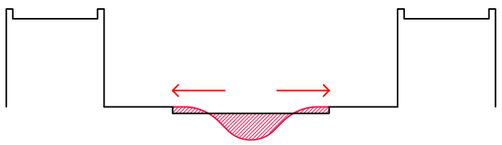
	Area de terreno	Area libre	Area de desplante	Area construida total	% Area Libre	% Area Construida	FSI	GSI	OSR	FAR	N
Plot 01	248	90	158	385	36.3	63.7	1.55	0.64	0.23	155.24%	
Plot 02	253	52	201	396	20.6	79.4	1.57	0.79	0.13	156.52%	
Plot 03	131	30	101	161	22.9	77.1	1.23	0.77	0.19	122.90%	
Plot 04	66		59	120	10.6	89.4	1.82	0.89	0.06	181.82%	
Plot 05	107	37	70	140	34.6	65.4	1.31	0.65	0.26	130.84%	
Plot 06	130	27	103	173	20.8	79.2	1.33	0.79	0.16	133.08%	
Plot 07	61	6	55	98	9.8	90.2	1.61	0.90	0.06	160.66%	
Plot 08		13	64	100	16.9	83.1	1.30	0.83	0.13	129.87%	
Plot 09	206	15	191	329	7.3	92.7	1.60	0.93	0.05	159.71%	
Plot 10	686	266	420	615	38.8	61.2	0.90	0.61	0.43	89.65%	
Plot 11	288	200	88	140	69.4	30.6	0.49	0.31	1.43	48.61%	
Plot 12	179	127	52	51	70.9	29.1	0.28	0.29	2.49	28.49%	
Total	2432	870	1562	2708	35.8	64.2	1.11	0.64	0.32	111.35%	

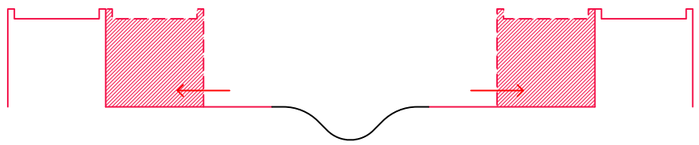
NHU structure
Phasing development

Block Structure
Main design operation

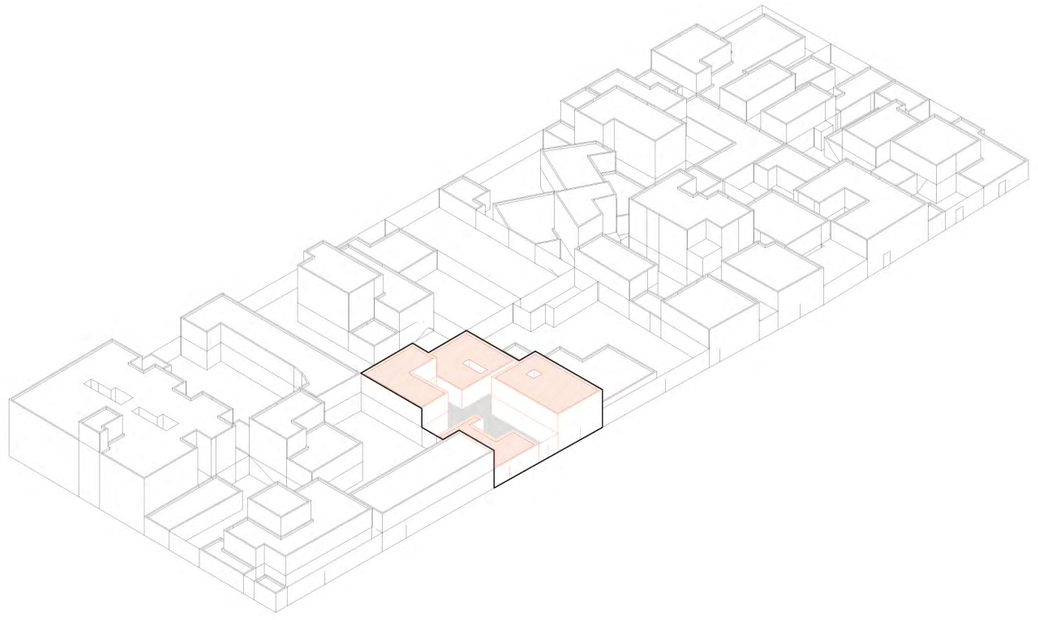




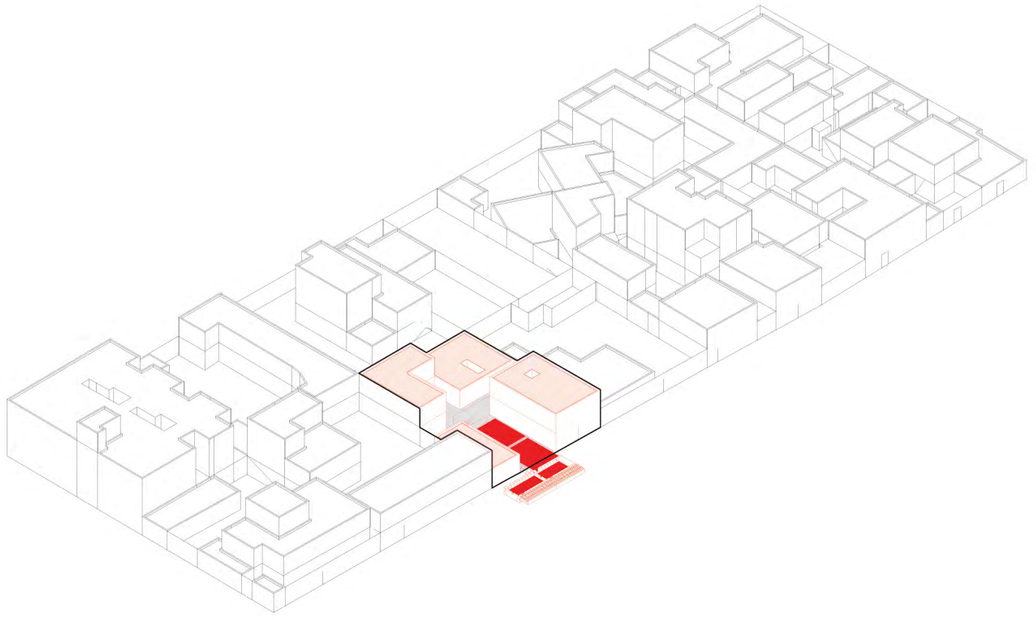




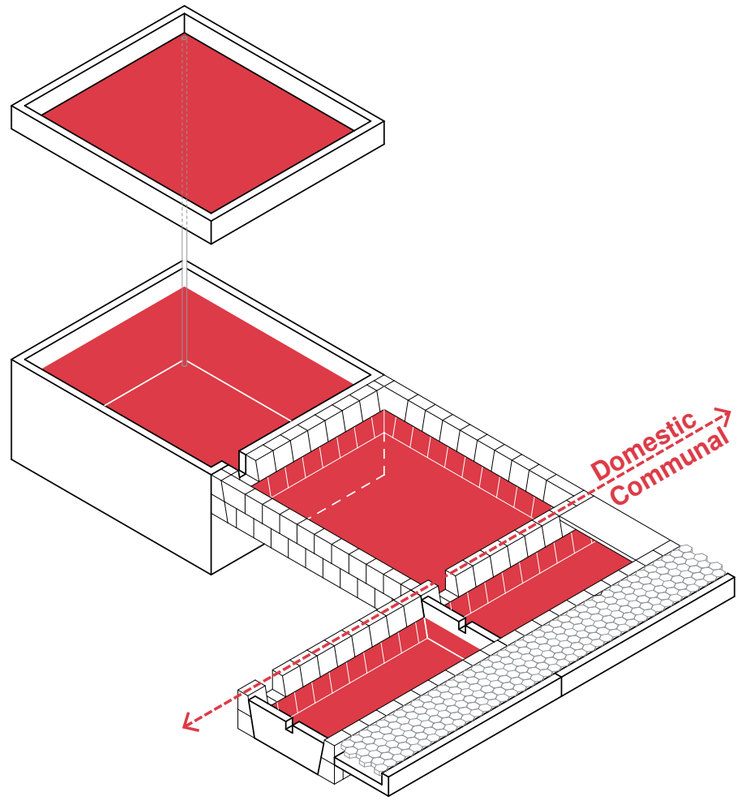
Block tranformation
Collective water management

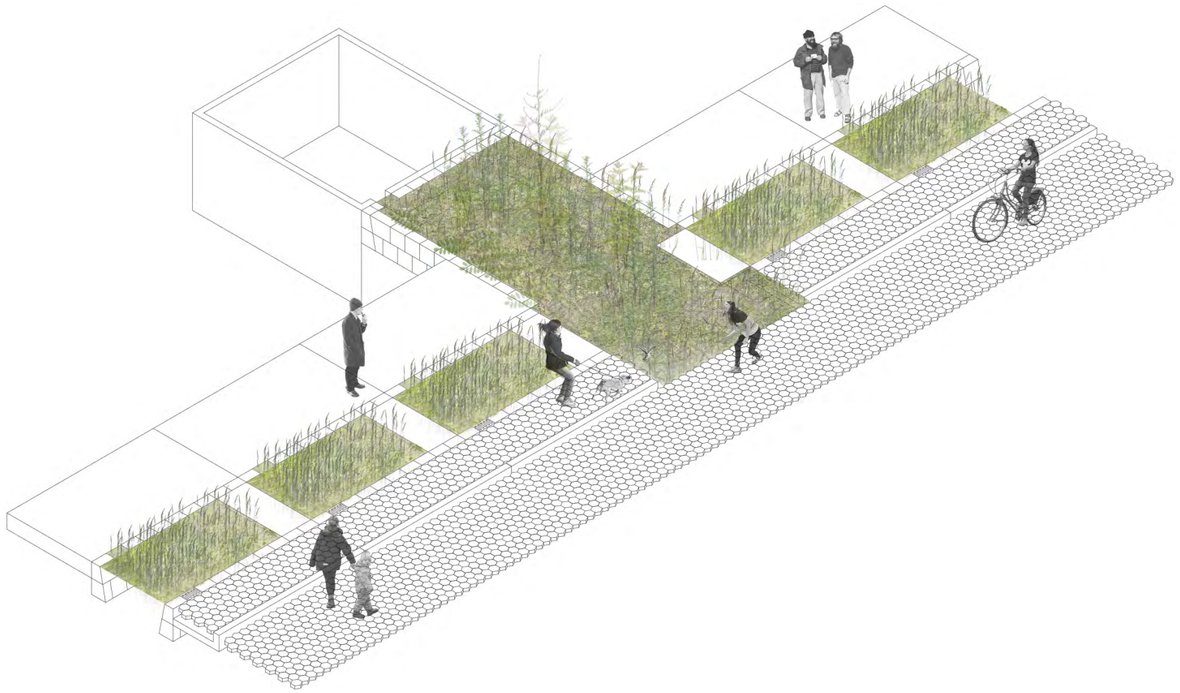


Block tranformation
Collective water management

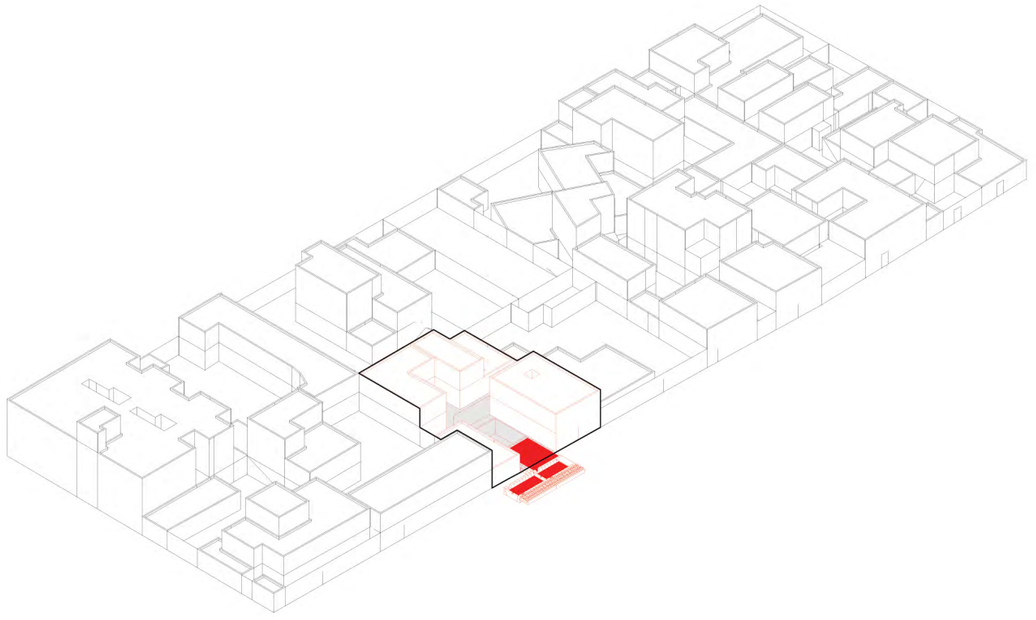


Domestic struture
Rainwater storage &
treatment kit

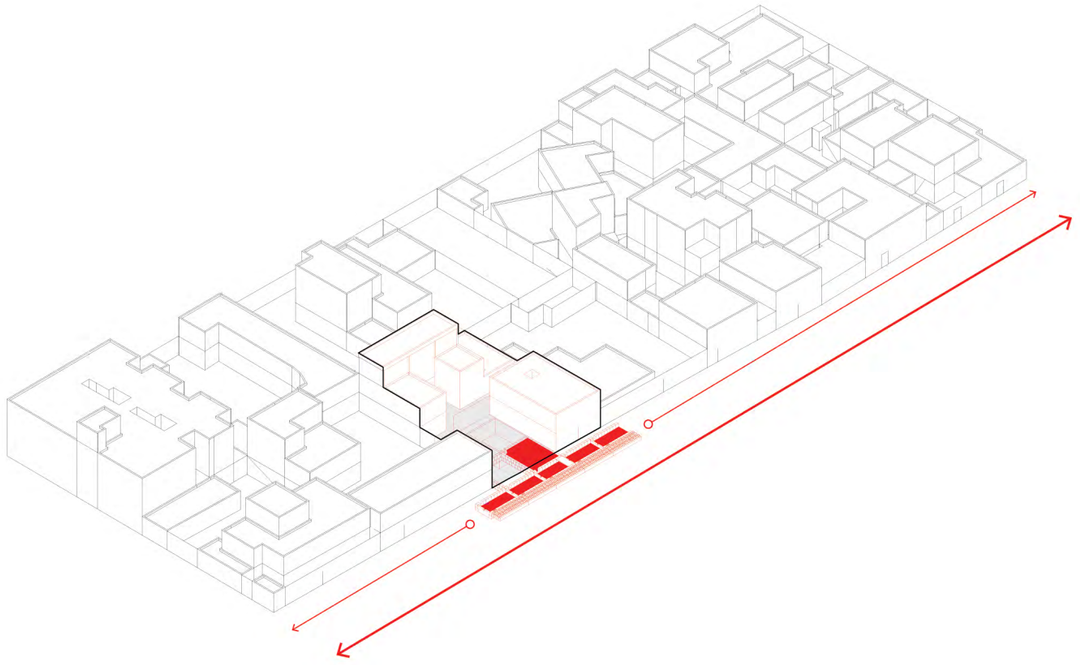




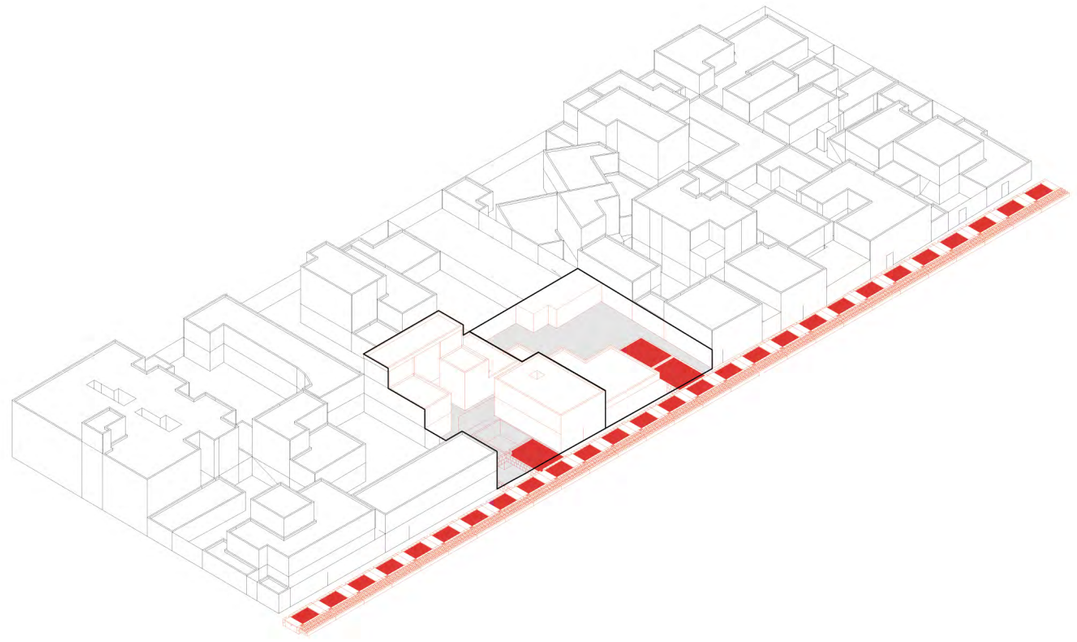
Block tranformation
Collective water management



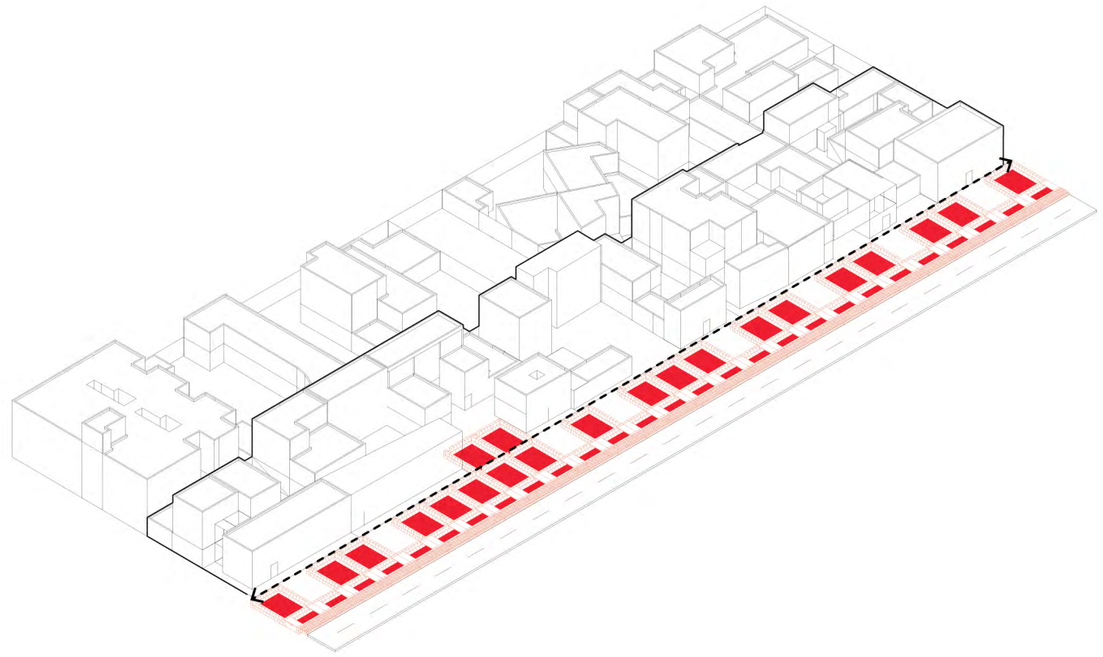
Block tranformation
Collective water management



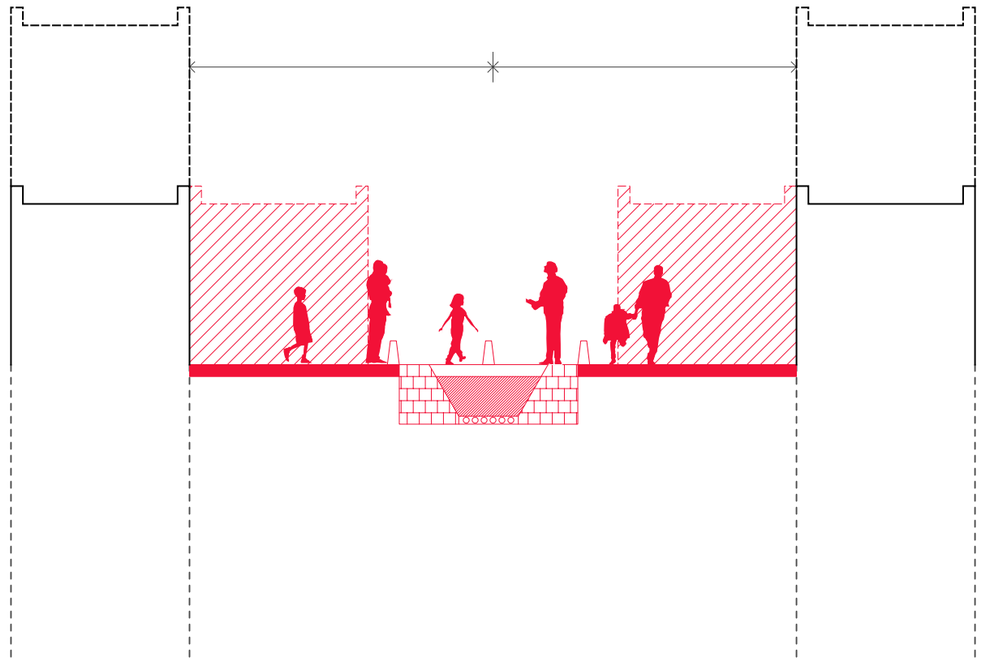
Block tranformation
Collective water management



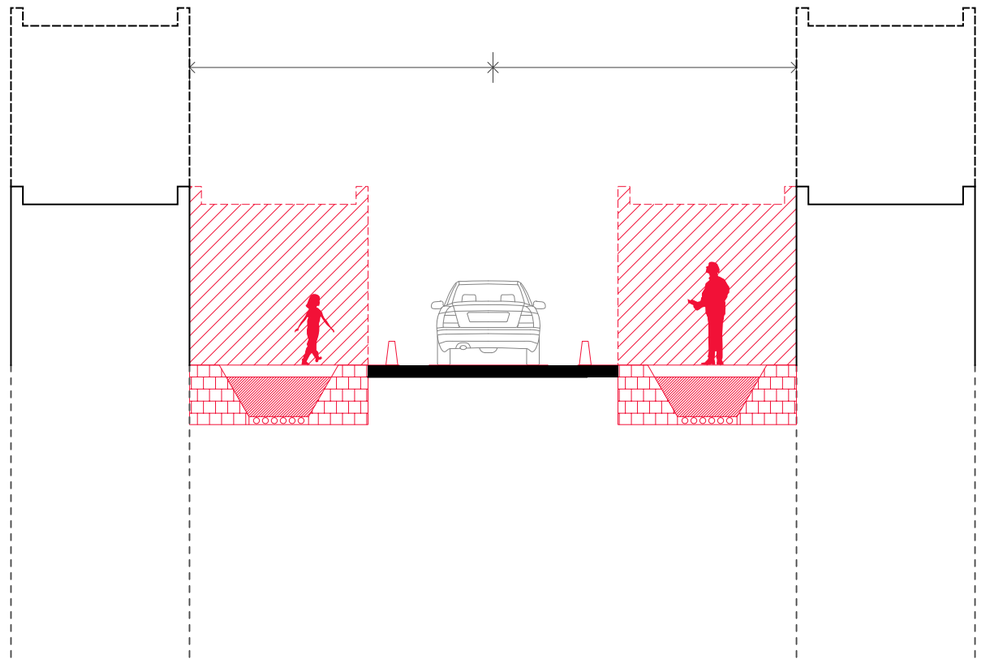
Block tranformation
Collective water management



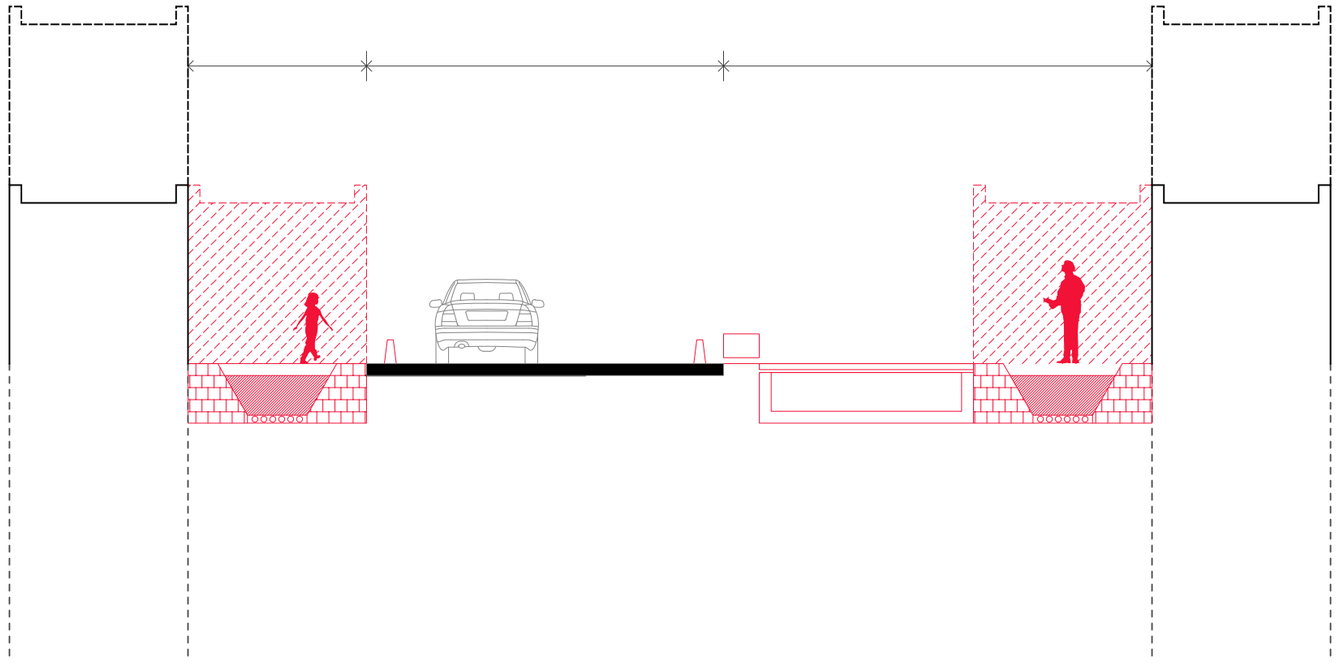
Second order corridor
Open space reorganization



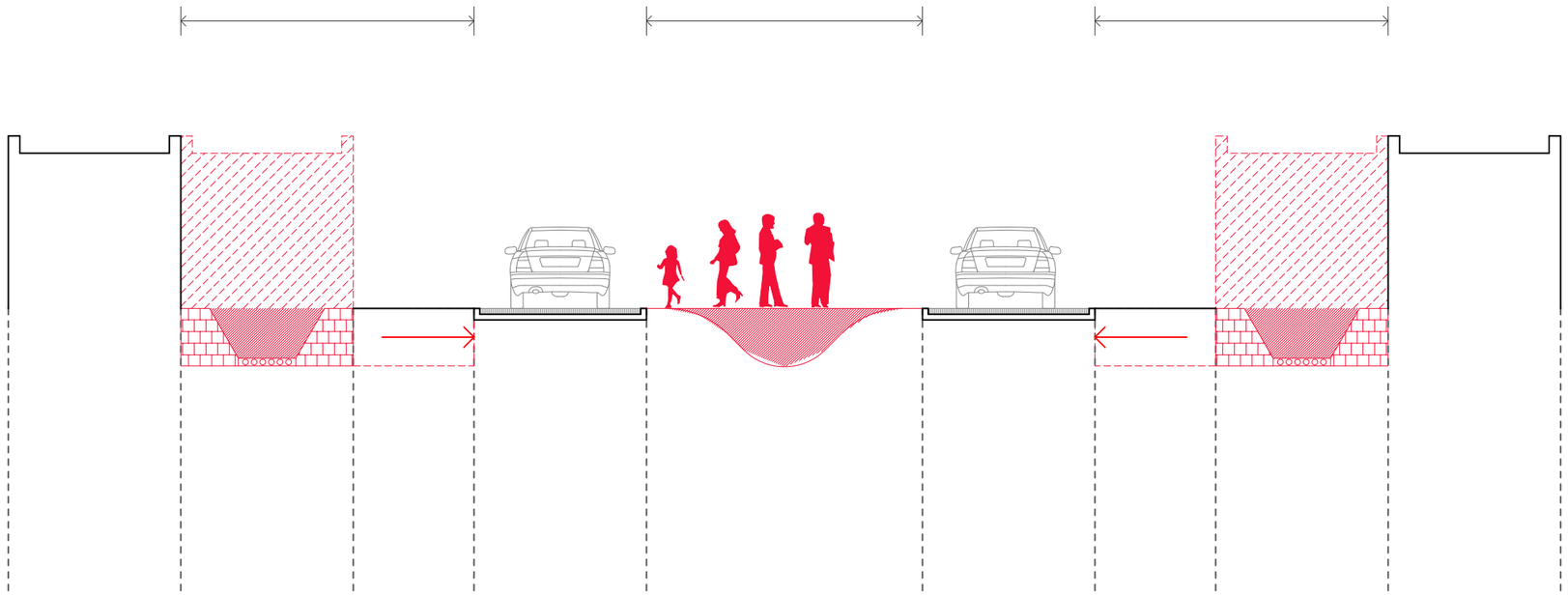
Second order corridor
Open space reorganization



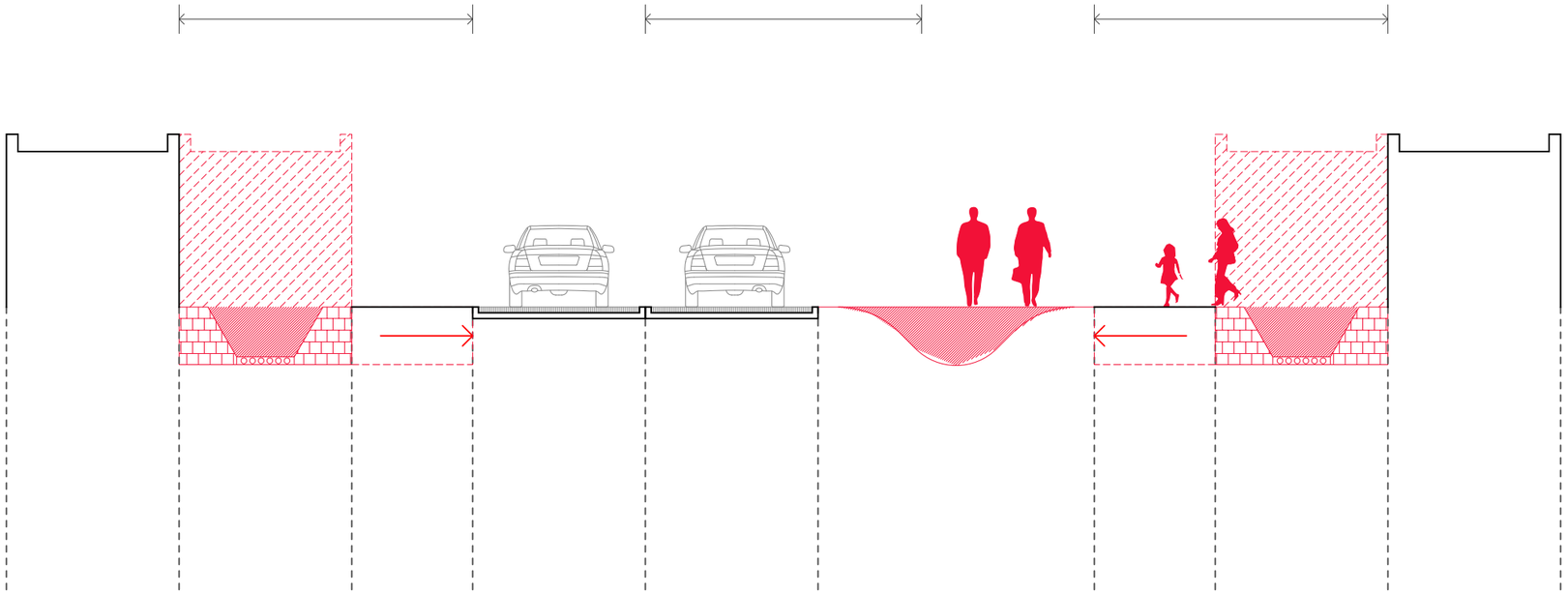
Second order corridor
Open space reorganization



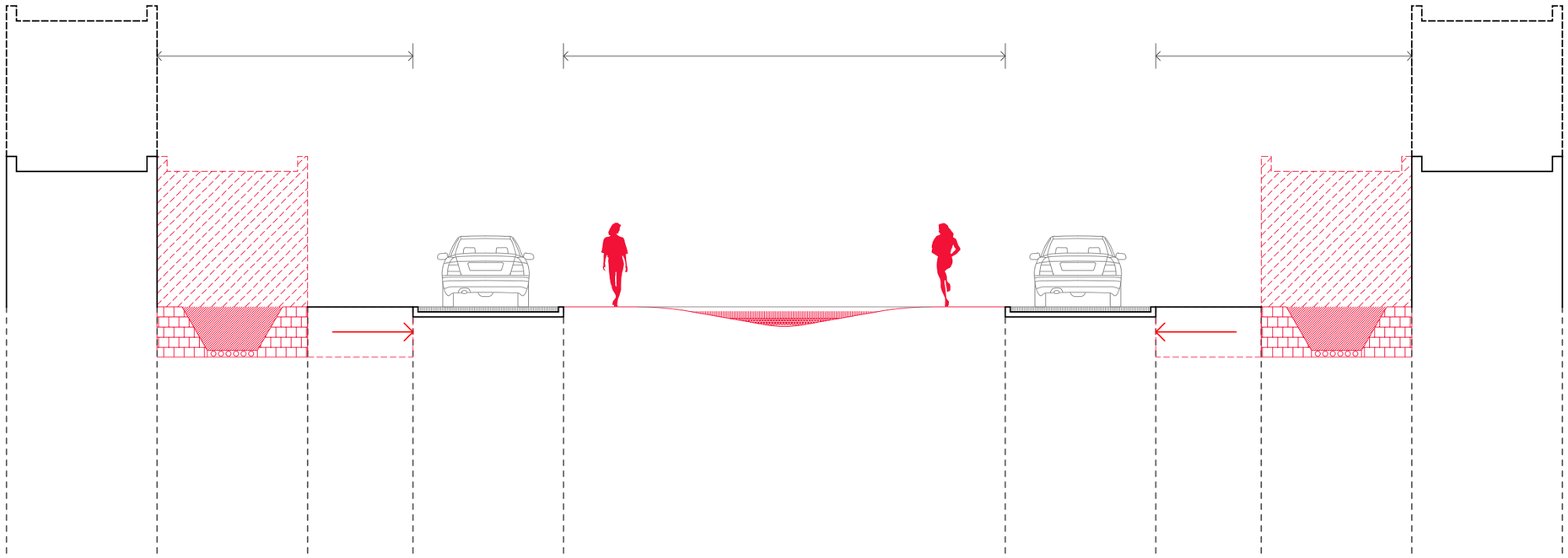
First order corridor
Open space reorganization



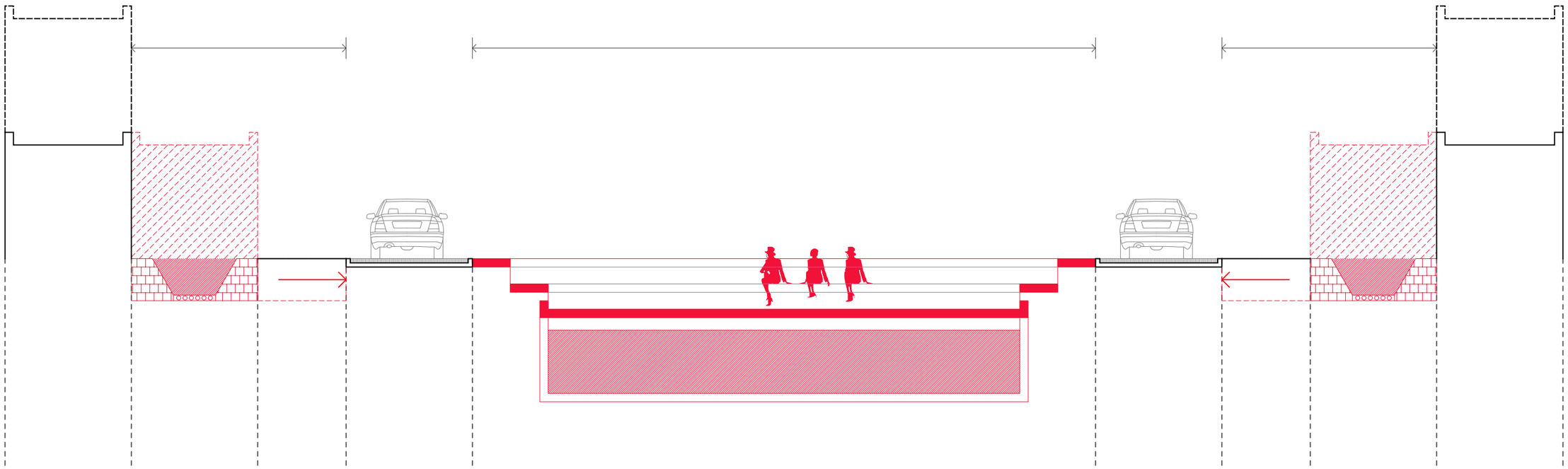
First order corridor
Open space reorganization



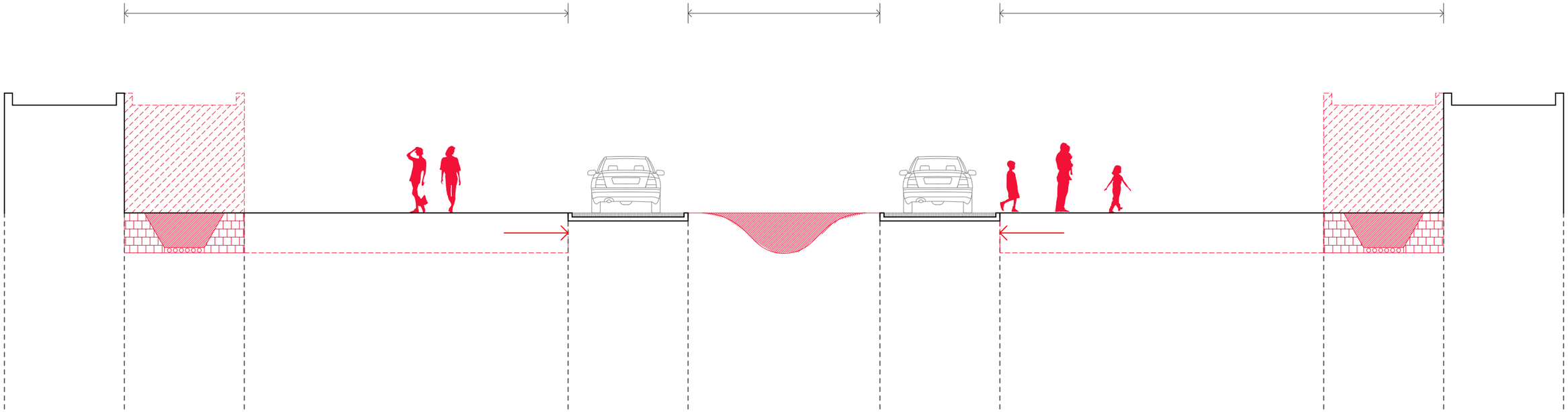
First order corridor
Open space reorganization



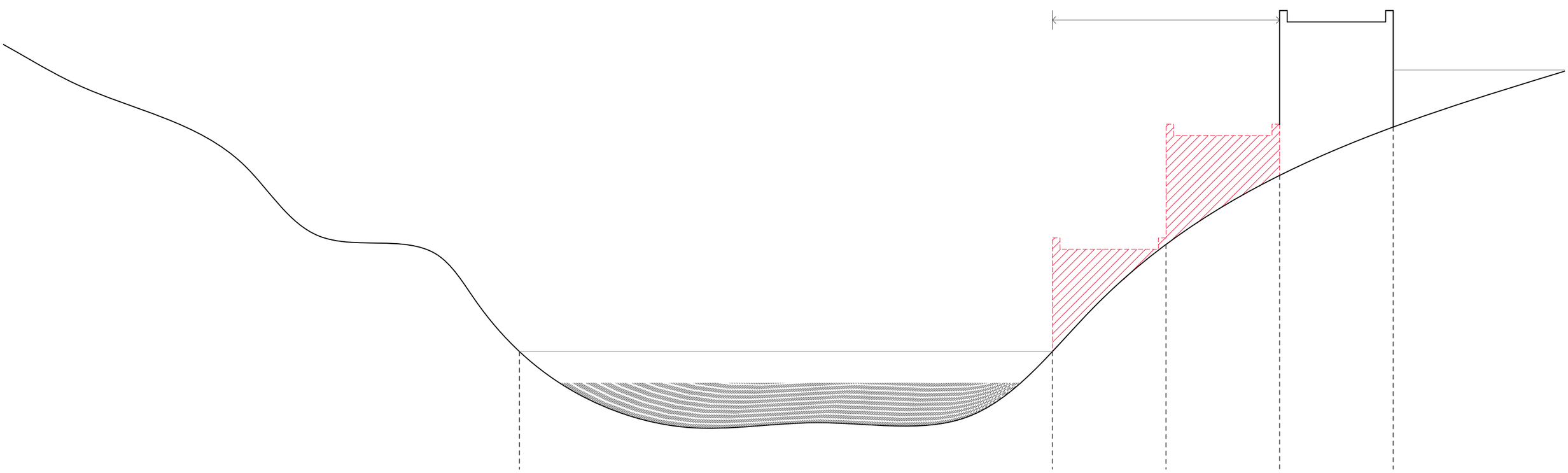
First order corridor
Open space reorganization



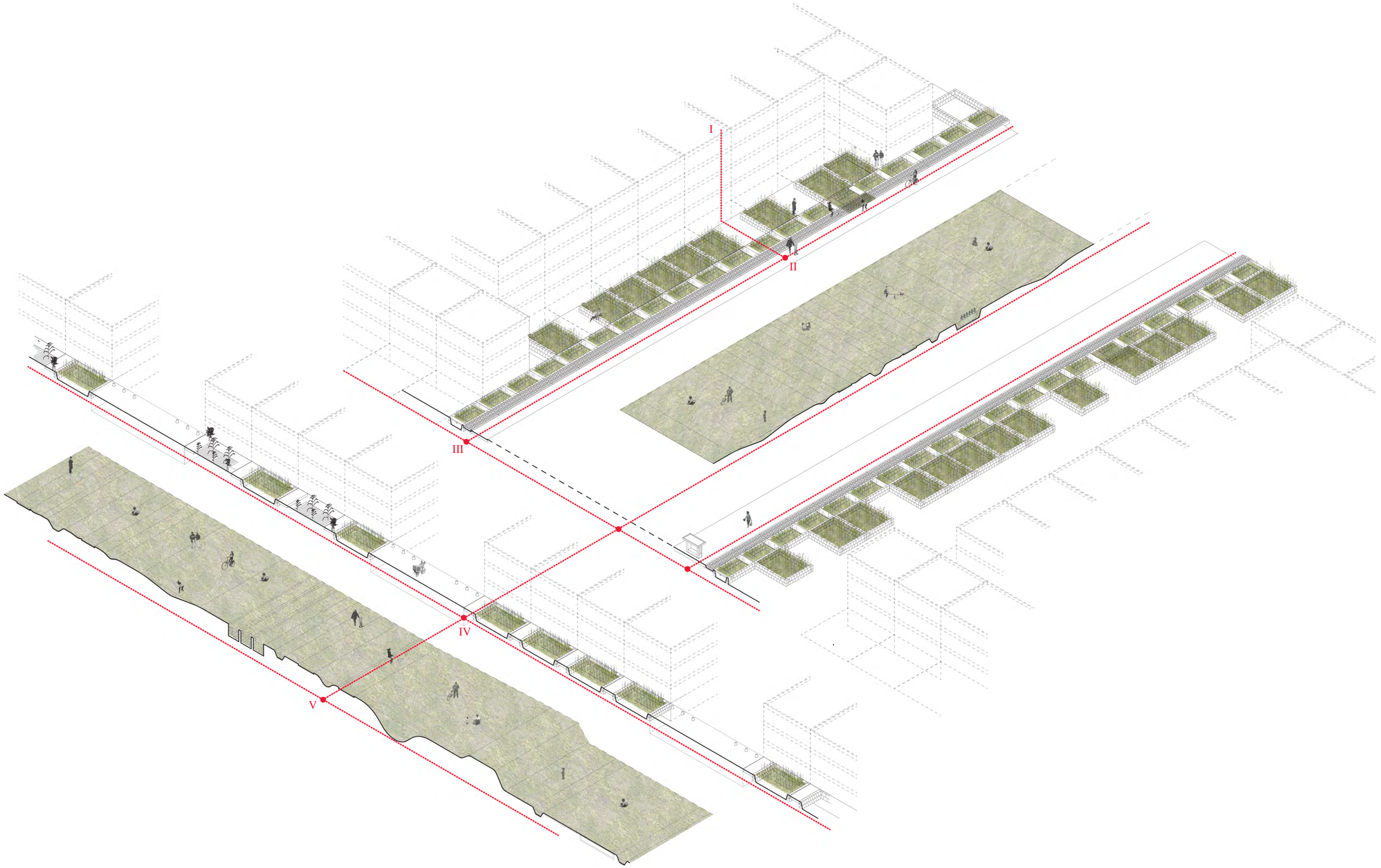
First order corridor
Open space reorganization



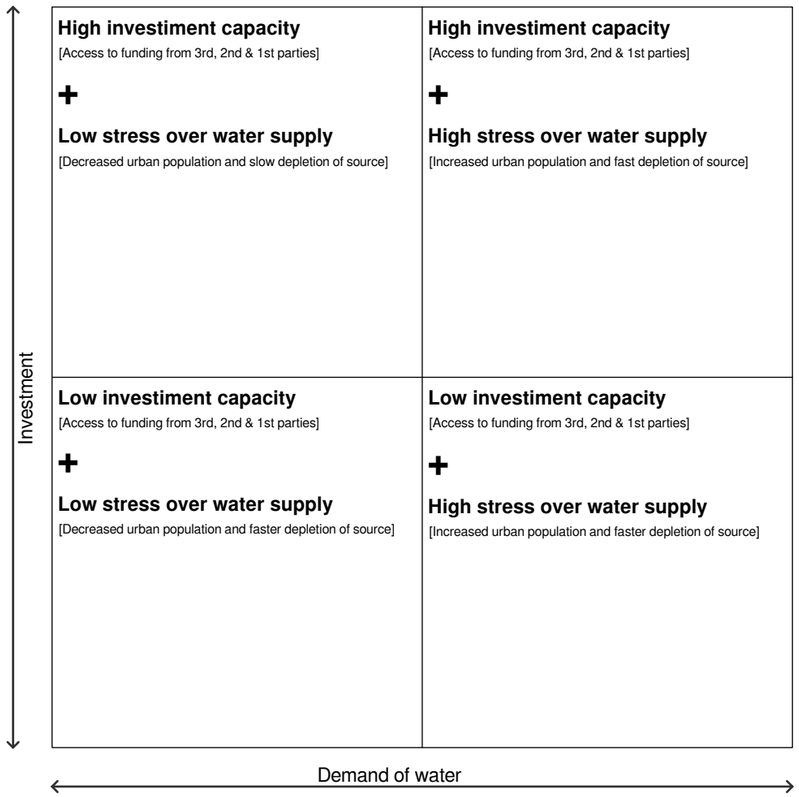
Amplification corridor
Housing relocation &
redensification



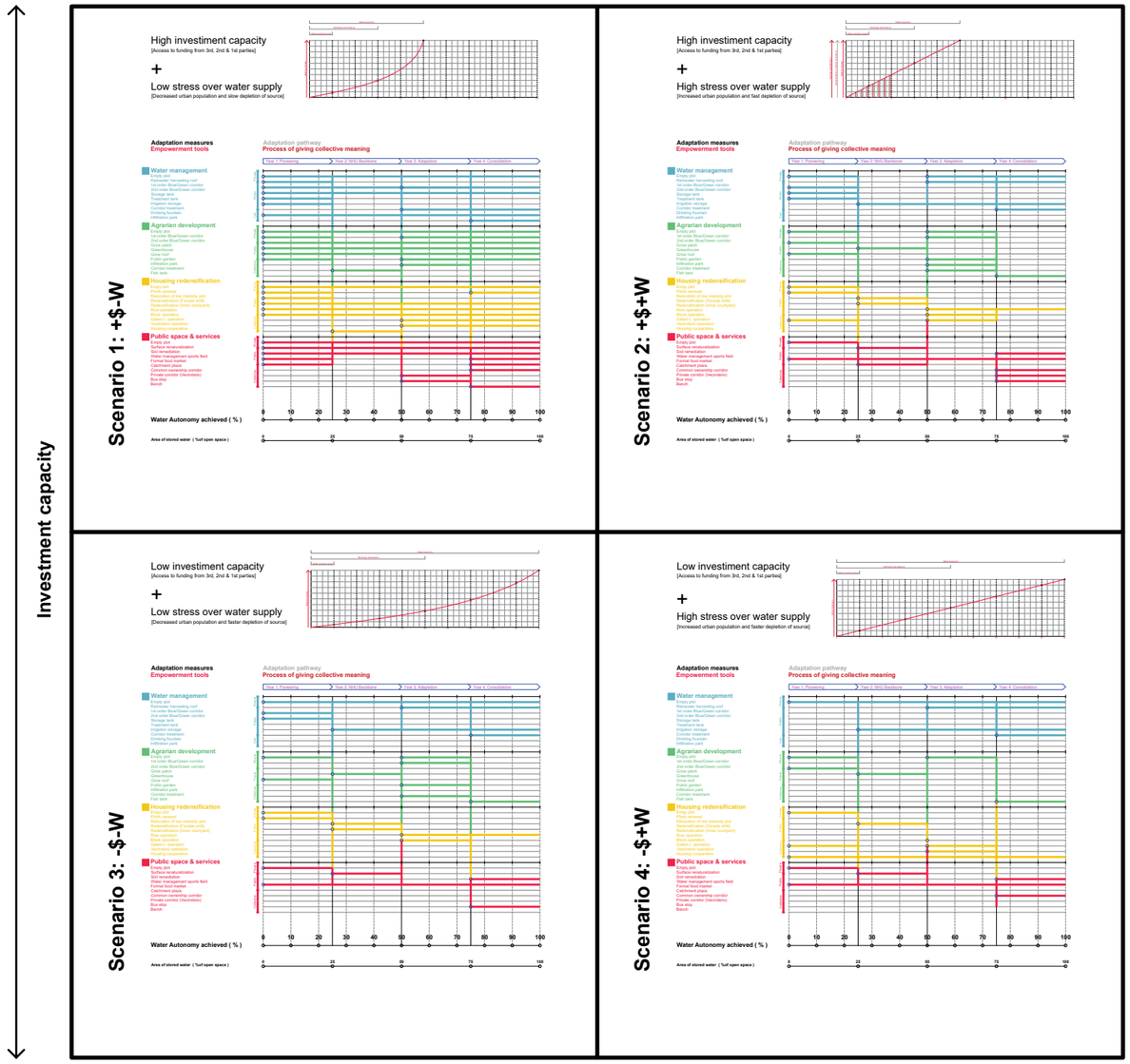
Implementation mechanisms


I
II
III
IV
V

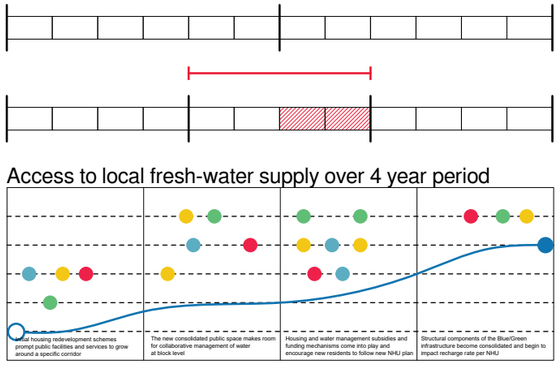
Adaptation pathways
Scenario planning for
neighborhood collaboration

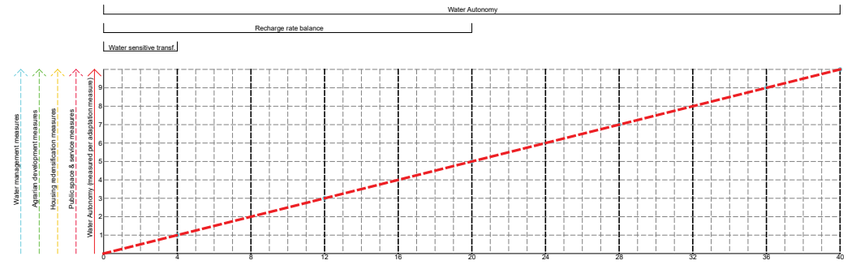


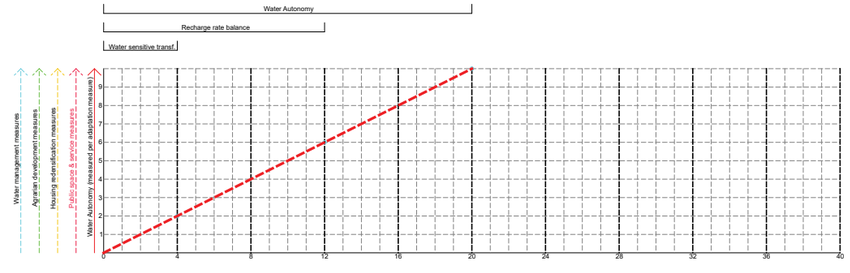
ADAPTATION PATHWAY PER SCENARIO

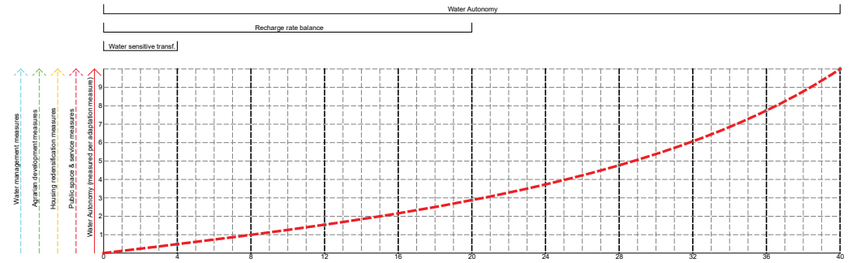


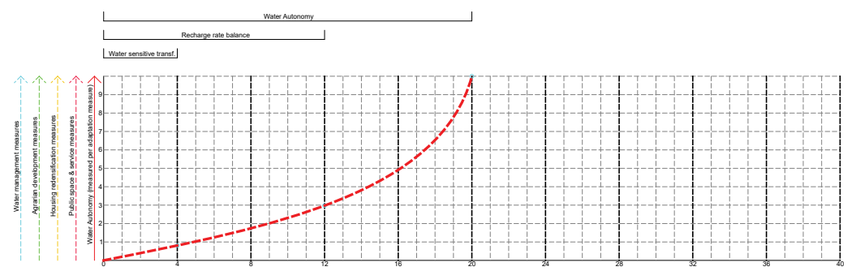
Demand for water



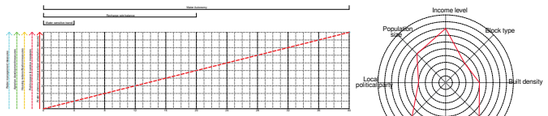


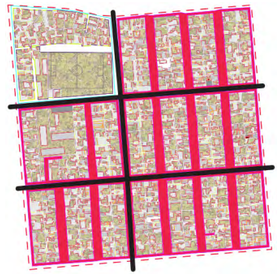


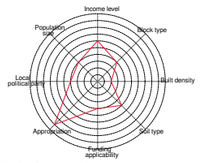


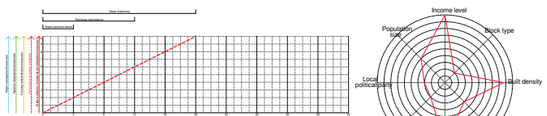


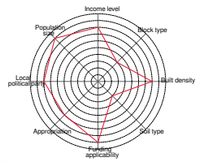
Access to local fresh-water supply over 4 year period

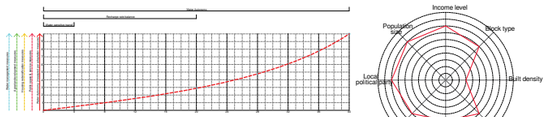


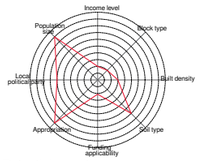


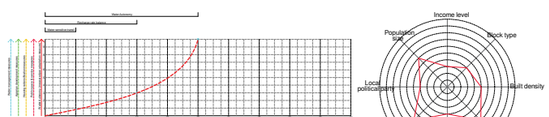


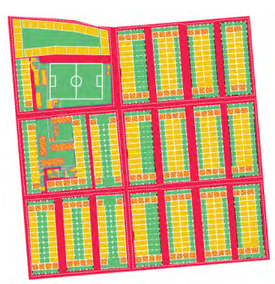












Current condition

Potential condition

Current condition

Potential condition

Current condition

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Current condition

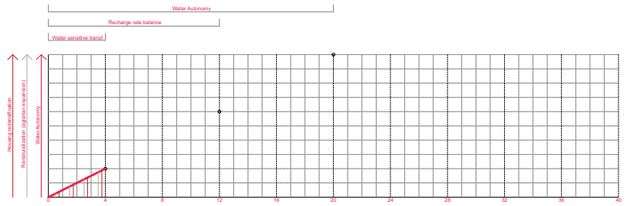
Scenario 02
High investment capacity + High stress over water

Scenario 2: +$+W

High investiment capacity
[Access to funding from 3rd, 2nd & 1st parties]

+

High stress over water supply
[Increased urban population and fast depletion of source]



Adaptation measures
Empowerment tools

Water management
- Empty plot
- Rainwater harvesting roof
- 1st order Blue/Green corridor
- 2nd order Blue/Green corridor
- Storage tank
- Treatment tank
- Irrigation storage
- Corridor treatment
- Drinking fountain
- Infiltration park

Agrarian development
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- Fish tank

Housing redensification
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- Plinth renewal
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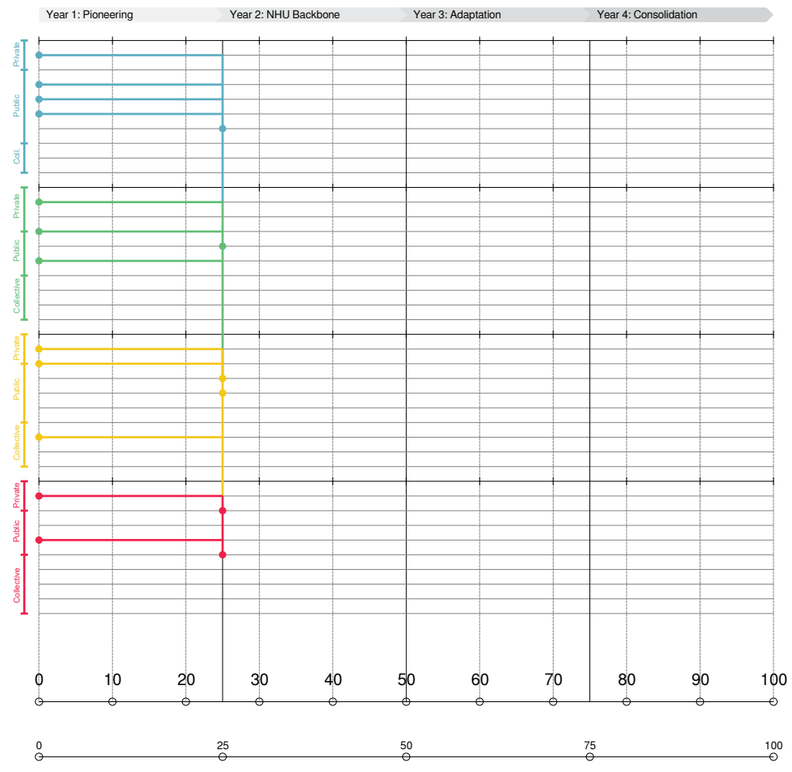
- Redensification (Inner courtyard)
- Row operation
- Block operation
- Gated c. operation
- Vecindario operation
- Housing cooperative

Public space & services
- Empty plot
- Surface renaturalization
- Soil remediation
- Water management sports field
- Formal food market
- Catchment plaza
- Common ownership corridor
- Private corridor (Vecindario)
- Bus stop
- Bench

Adaptation pathway
Process of giving collective meaning



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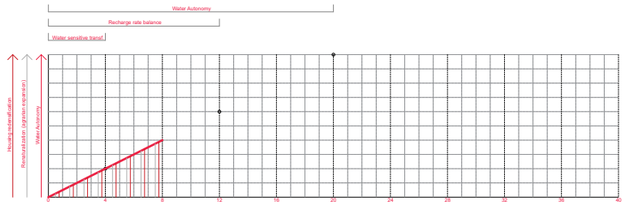

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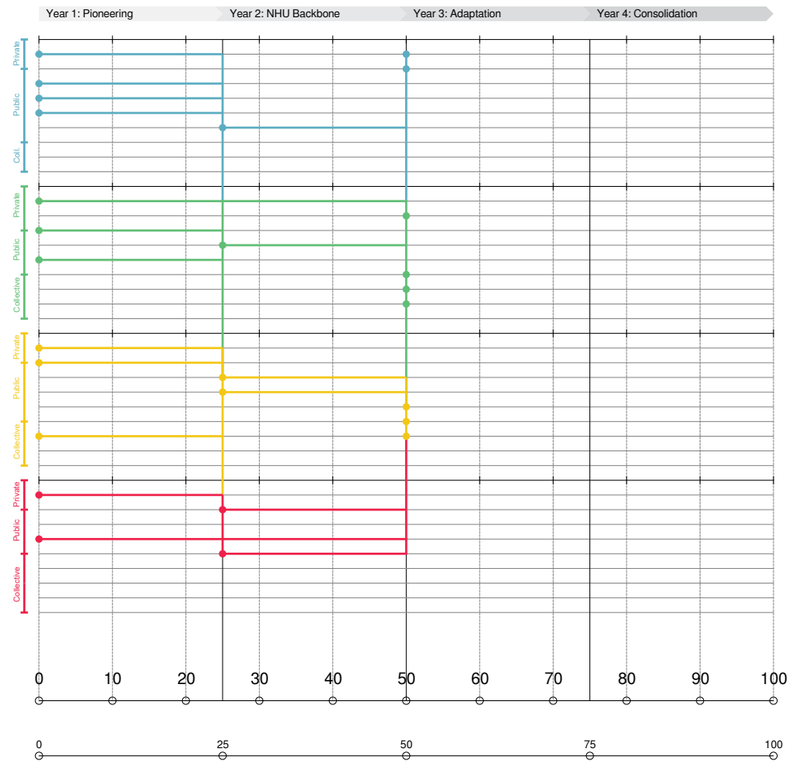

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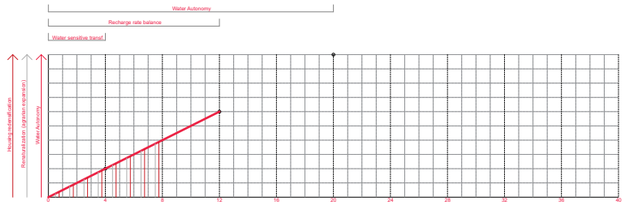

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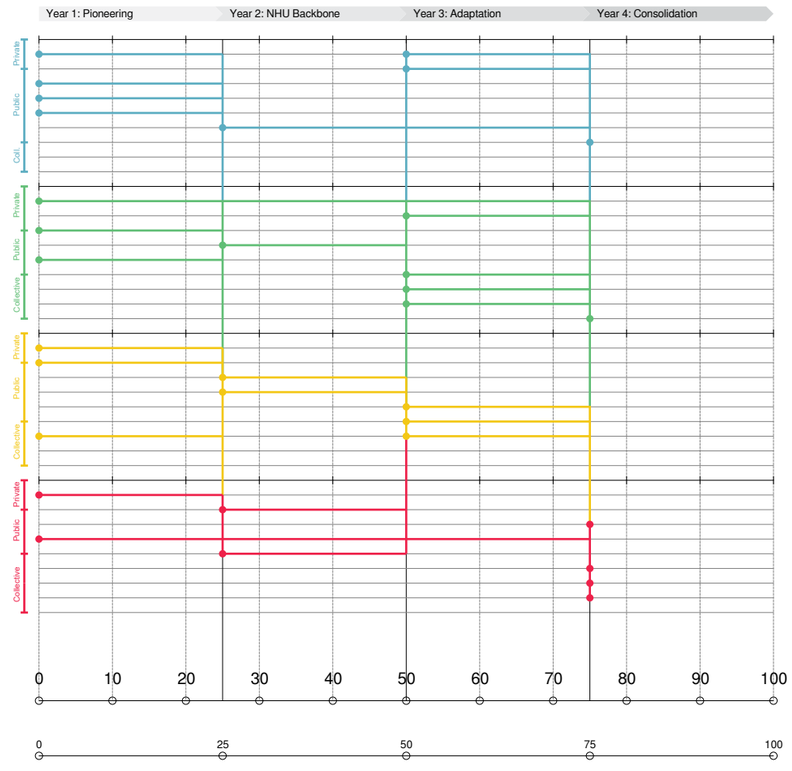

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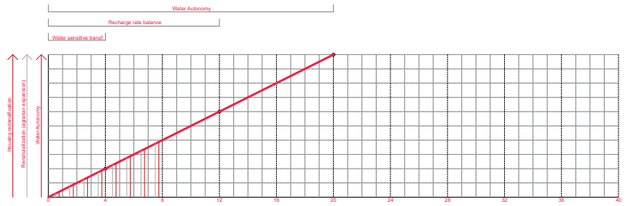

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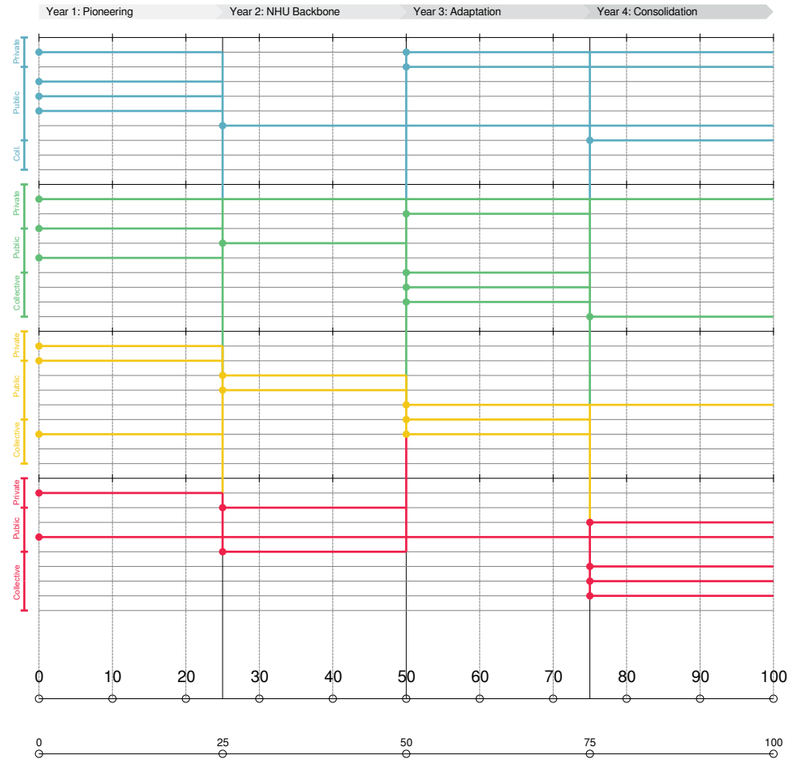
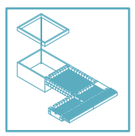


Empowerment tools

Spatial measures to give collective meaning to public space

I P C

People: Neighbours
Politics: Self management
Place: Plot scale

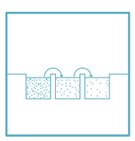


People: Owner
Politics: Self management
Place: Plot scale

People: Owner
Politics: Self management
Place: Plot scale

People: Owner
Politics: Self management
Place: Plot scale

People: Neighbours
Politics: Self management
Place: Plot scale



People: Neighbours
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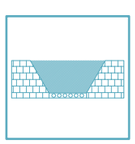

People: Neighbours
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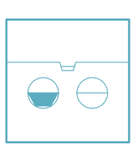

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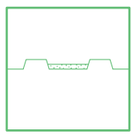

People: Neighbours
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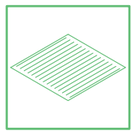
Place: Plot scale



People: Neighbours
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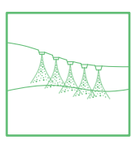

People: Neighbours
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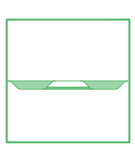

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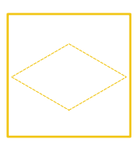

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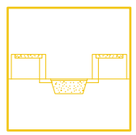

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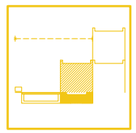

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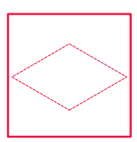

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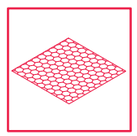

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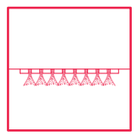

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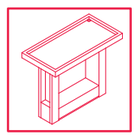

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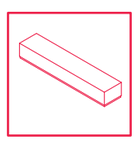

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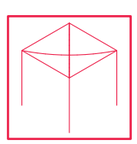

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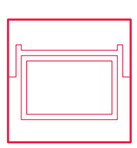

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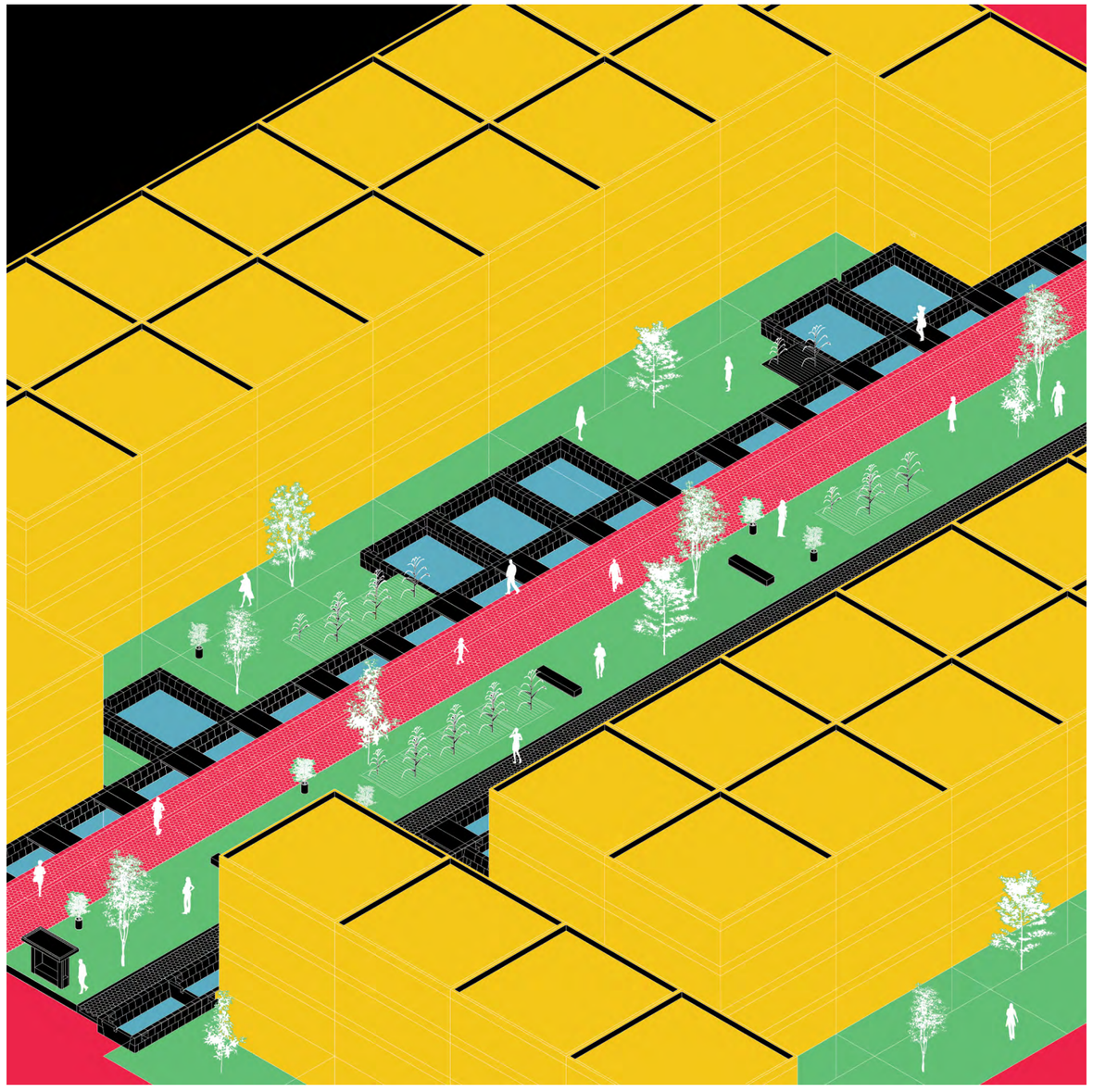

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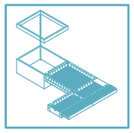

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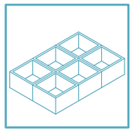

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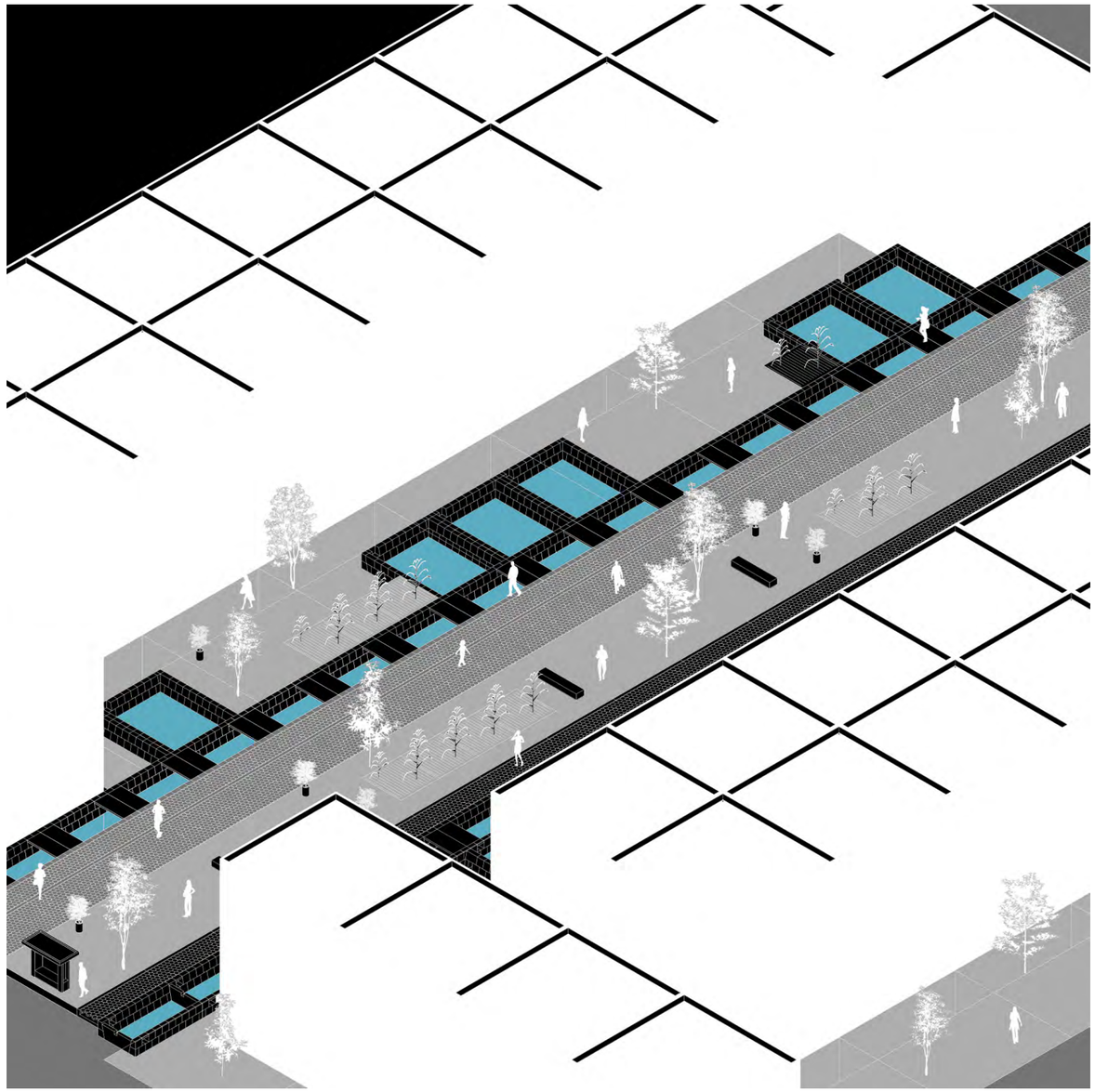

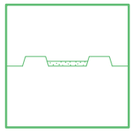

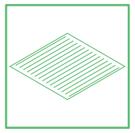

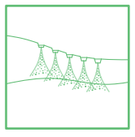

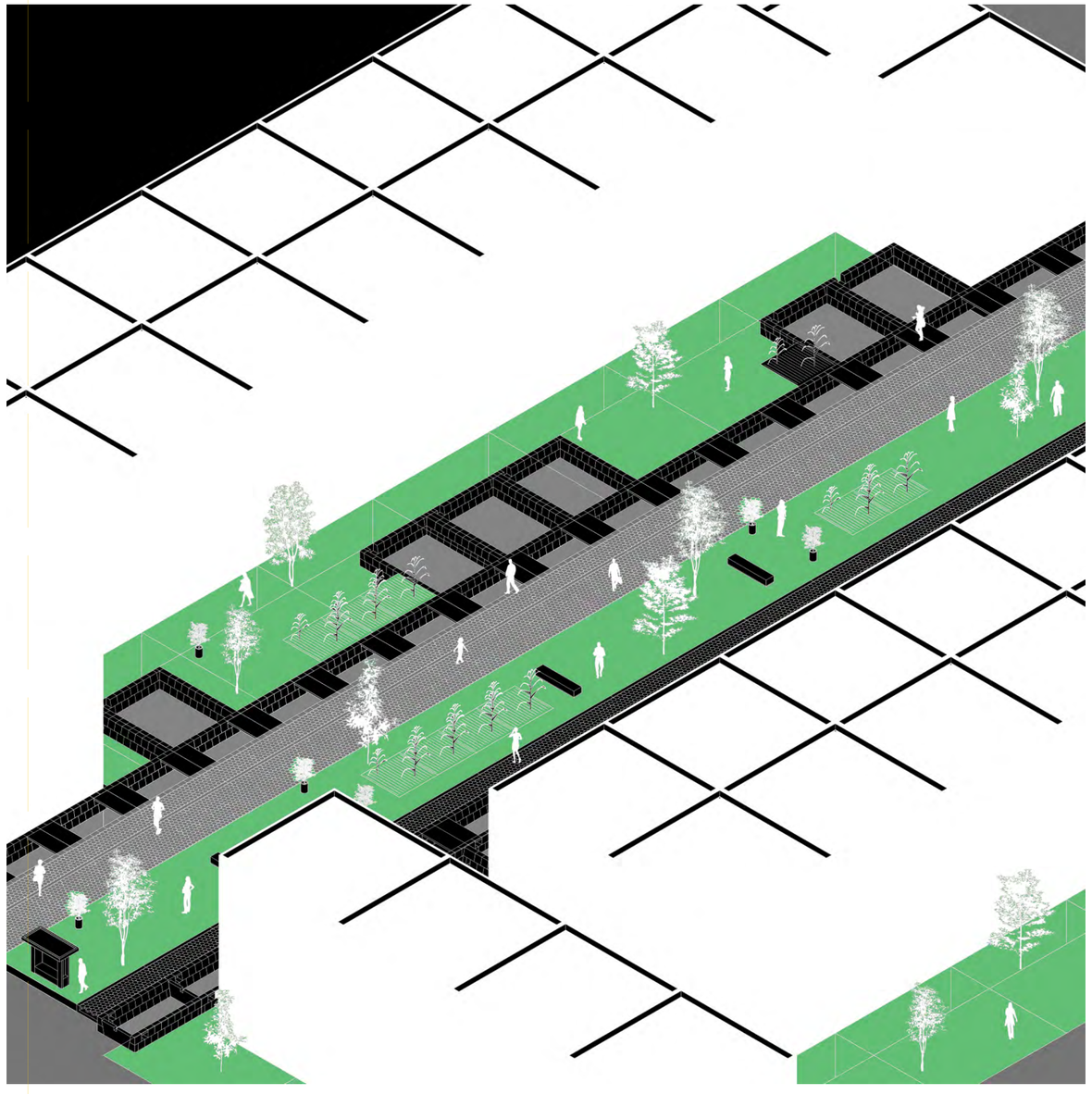

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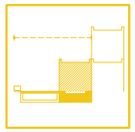

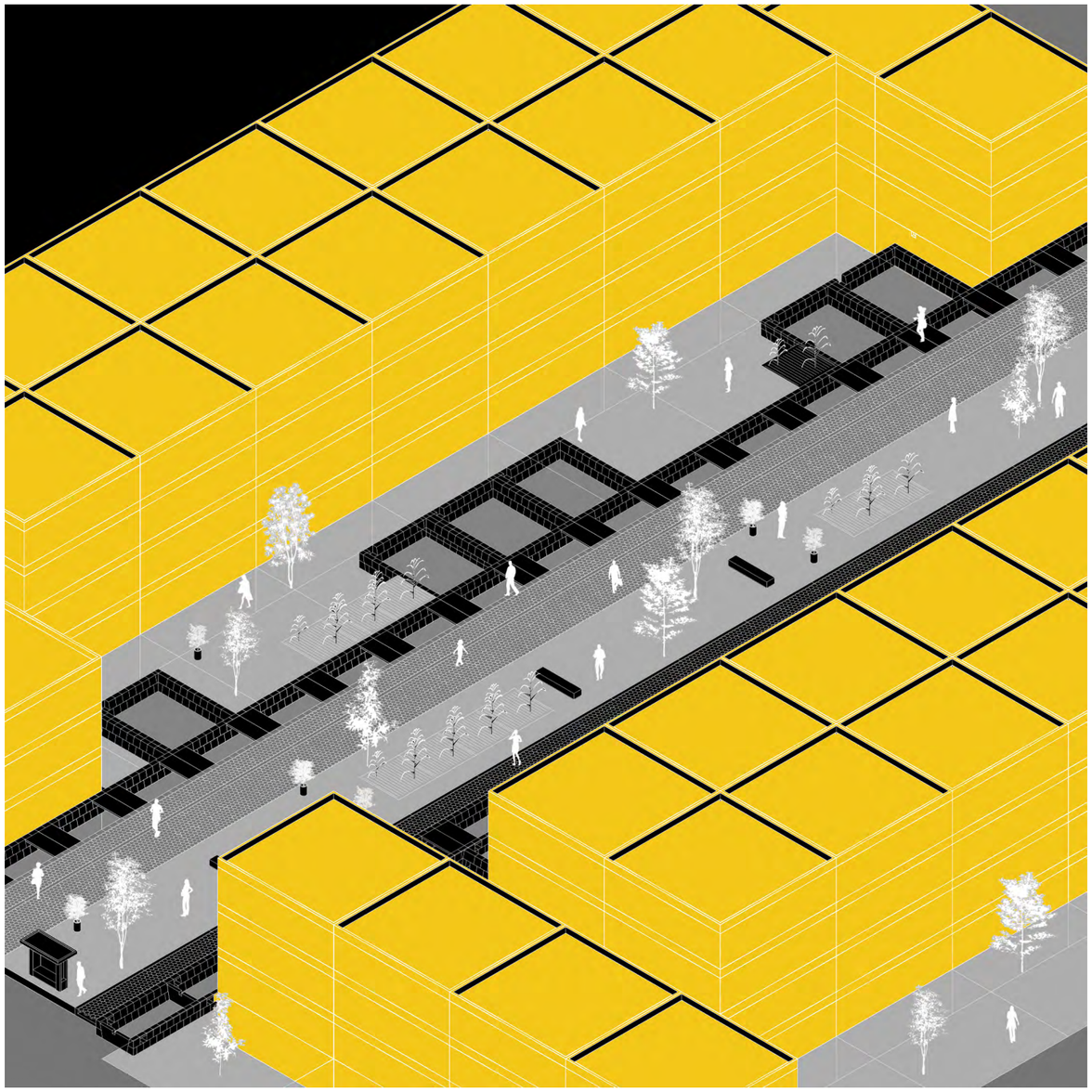

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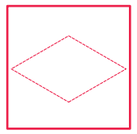

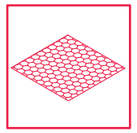

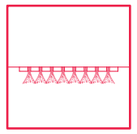

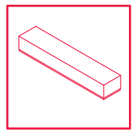

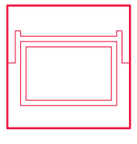

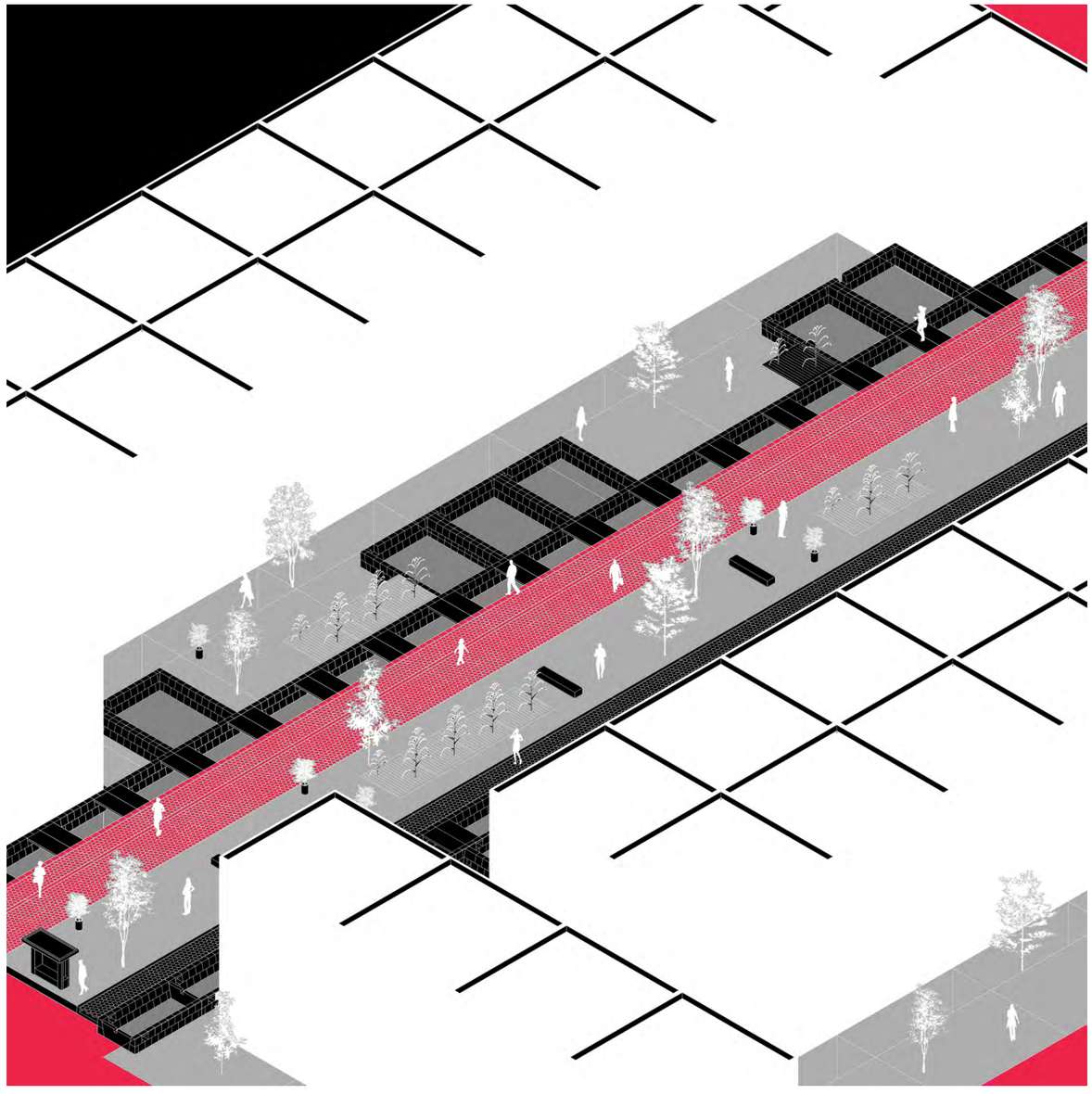

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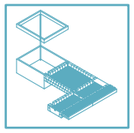

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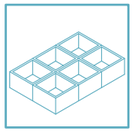

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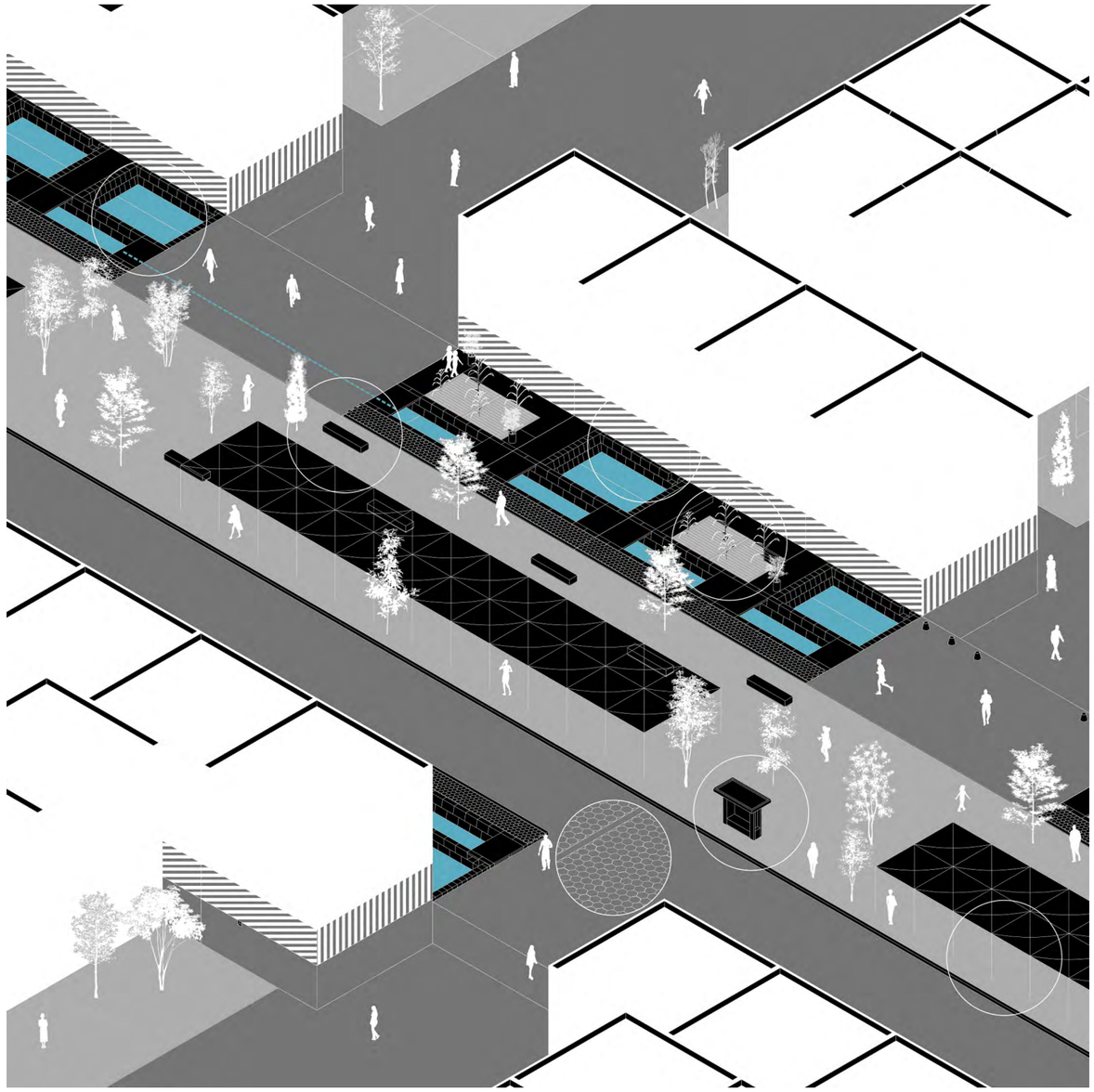

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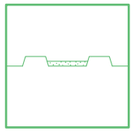

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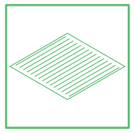

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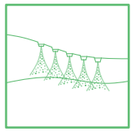

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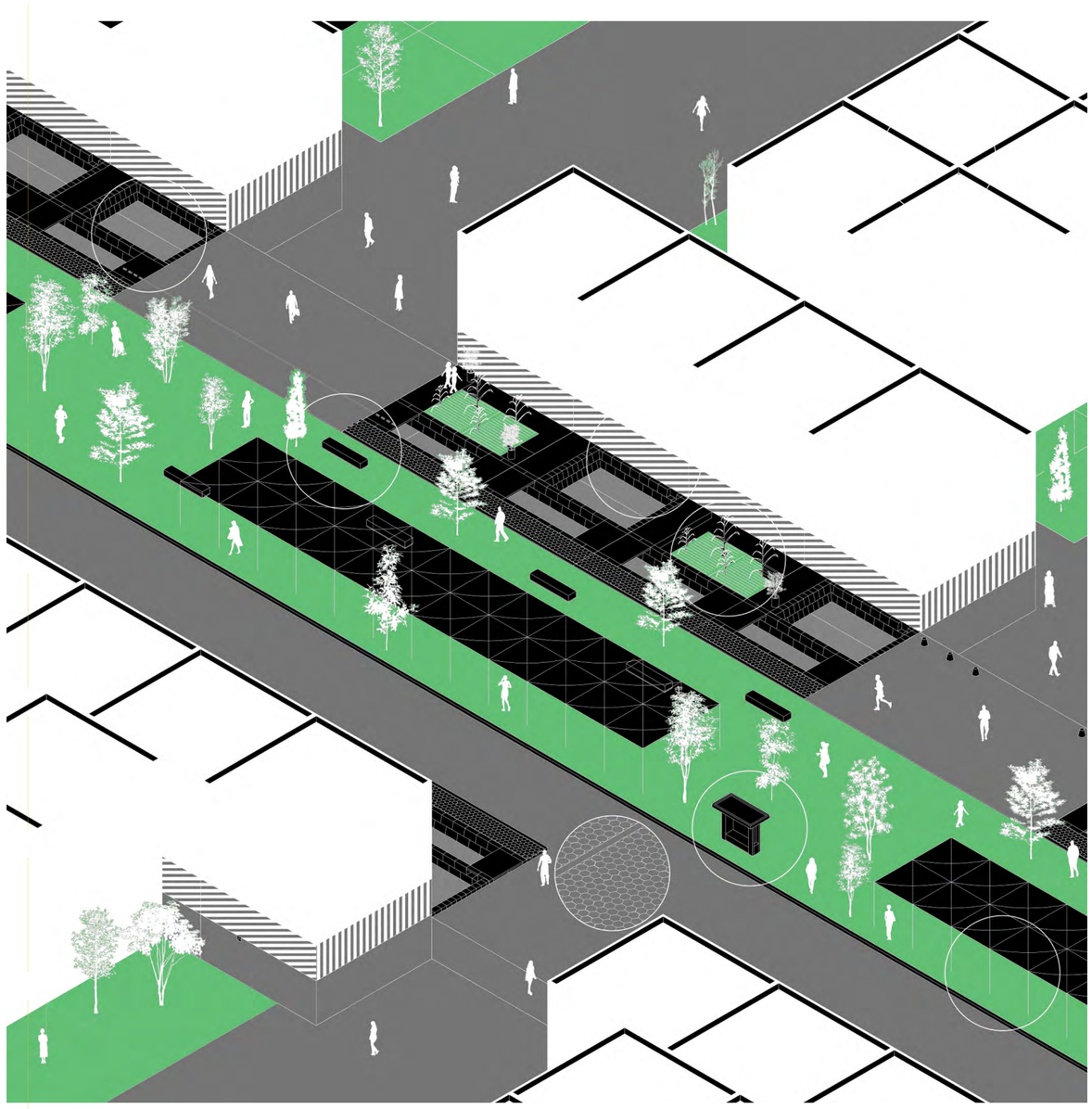

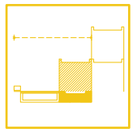

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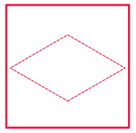

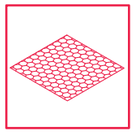

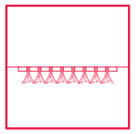

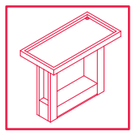

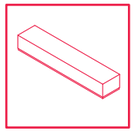

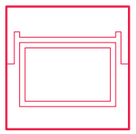

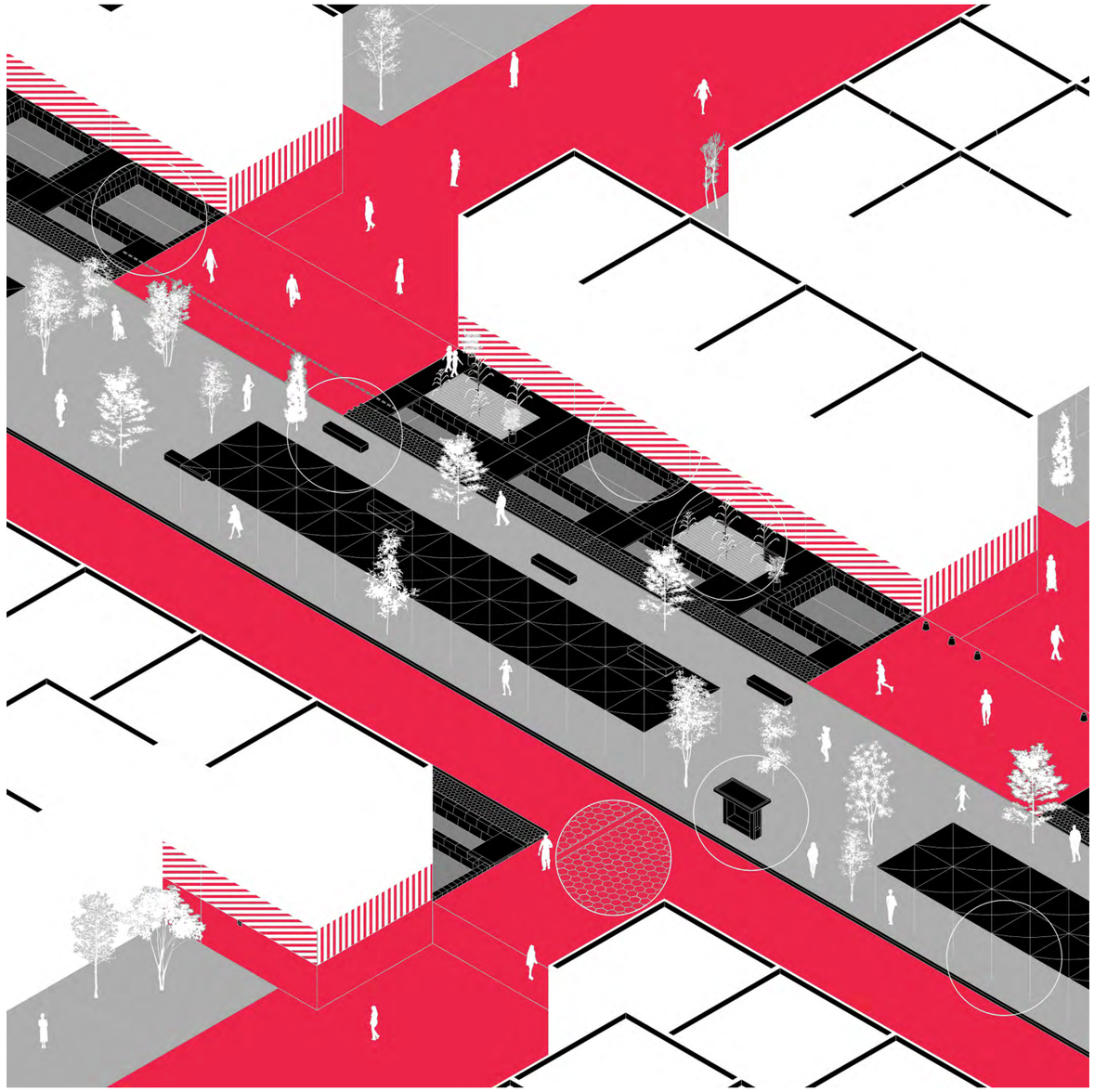

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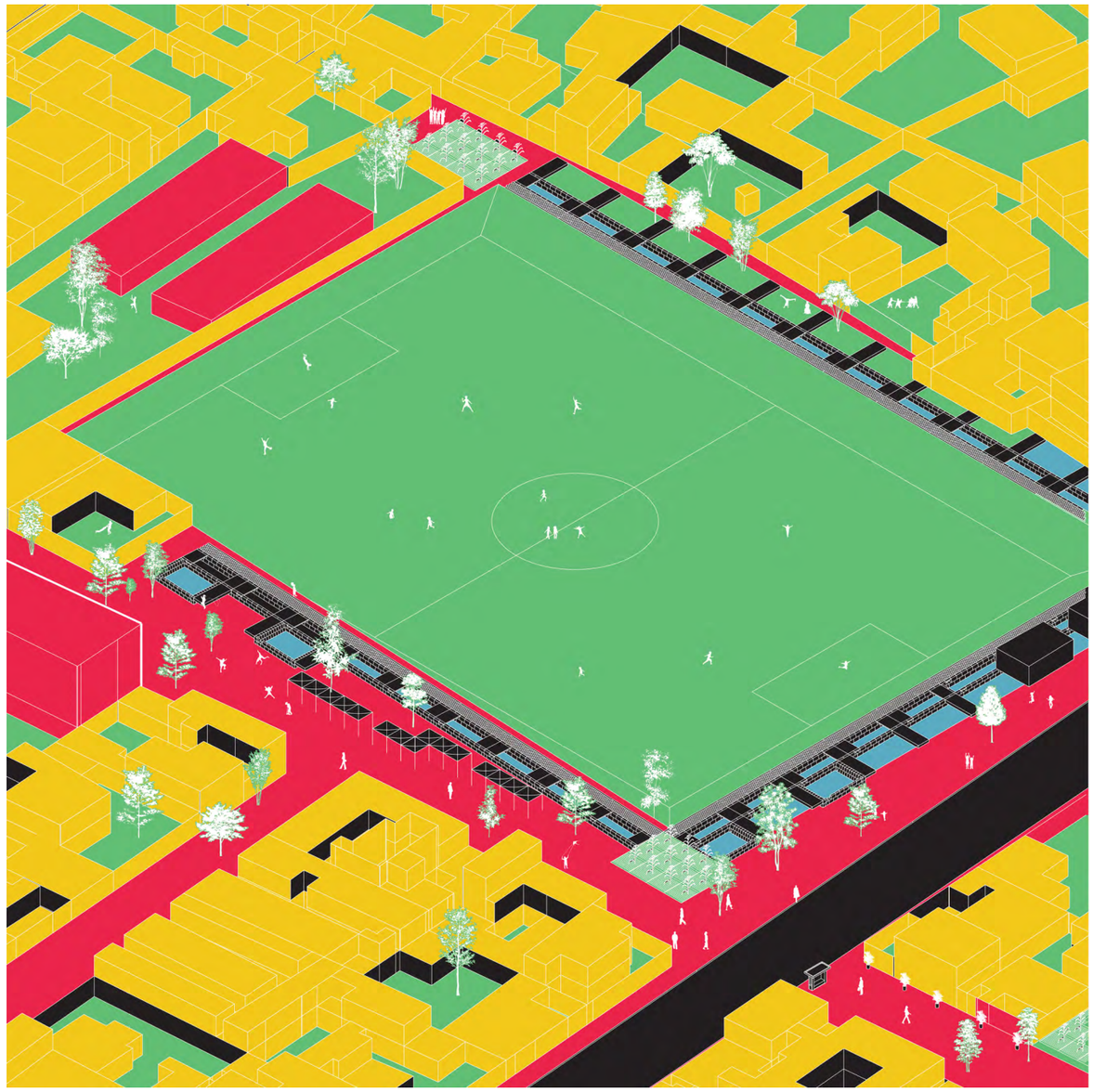

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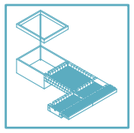

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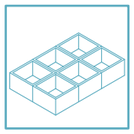

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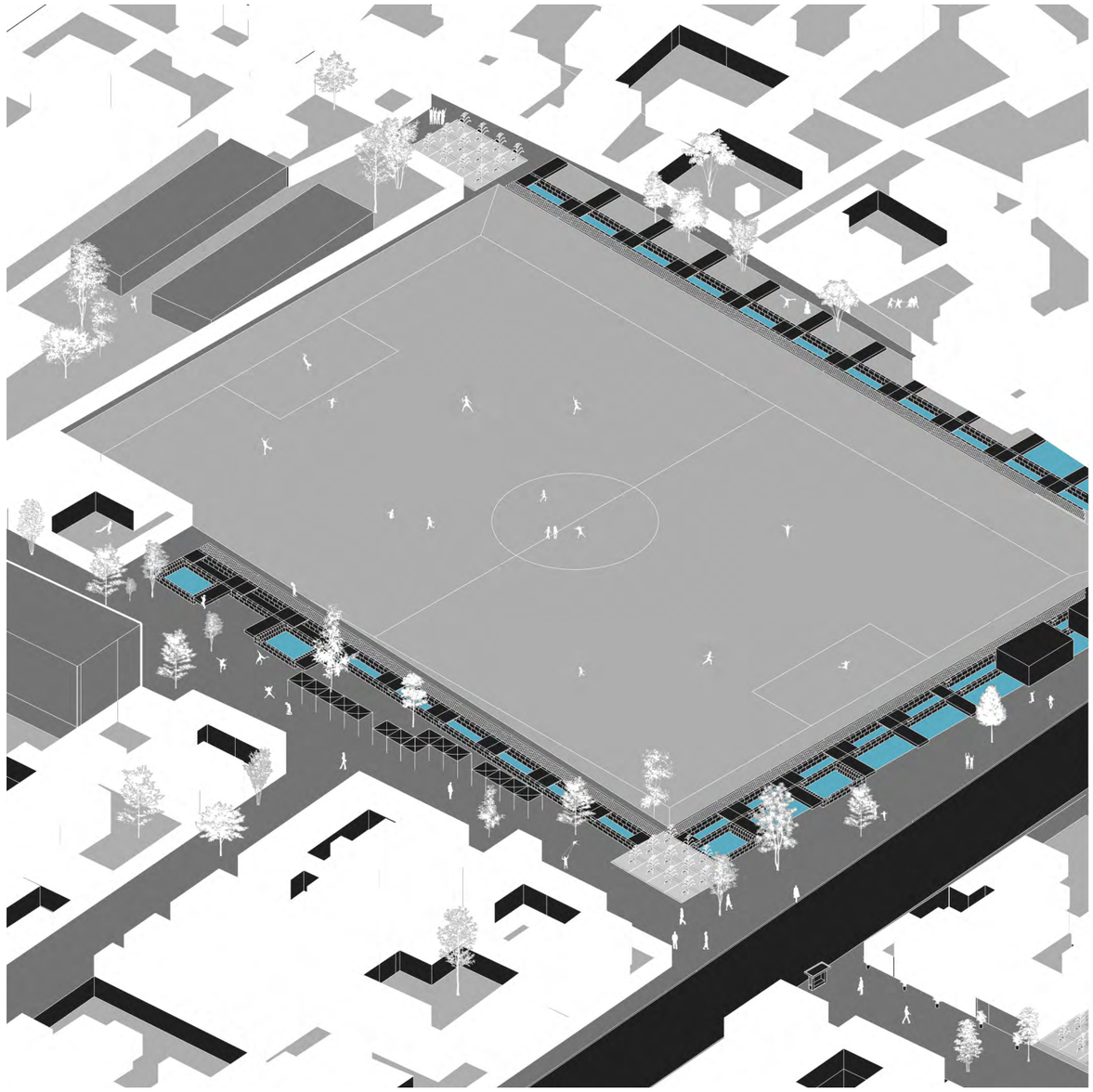

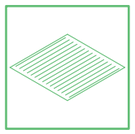

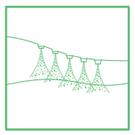

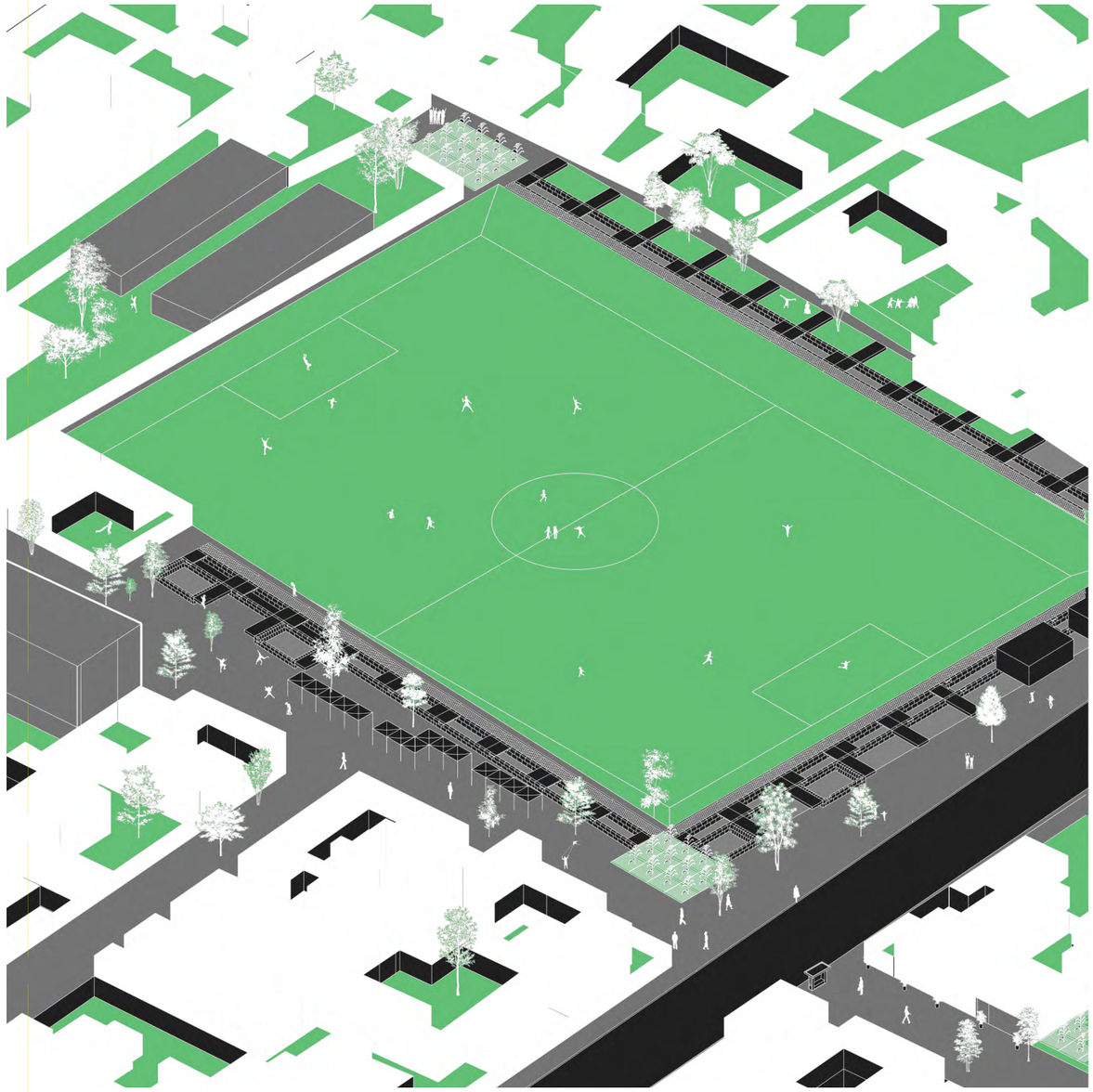

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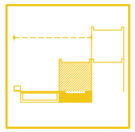

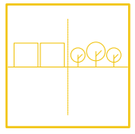

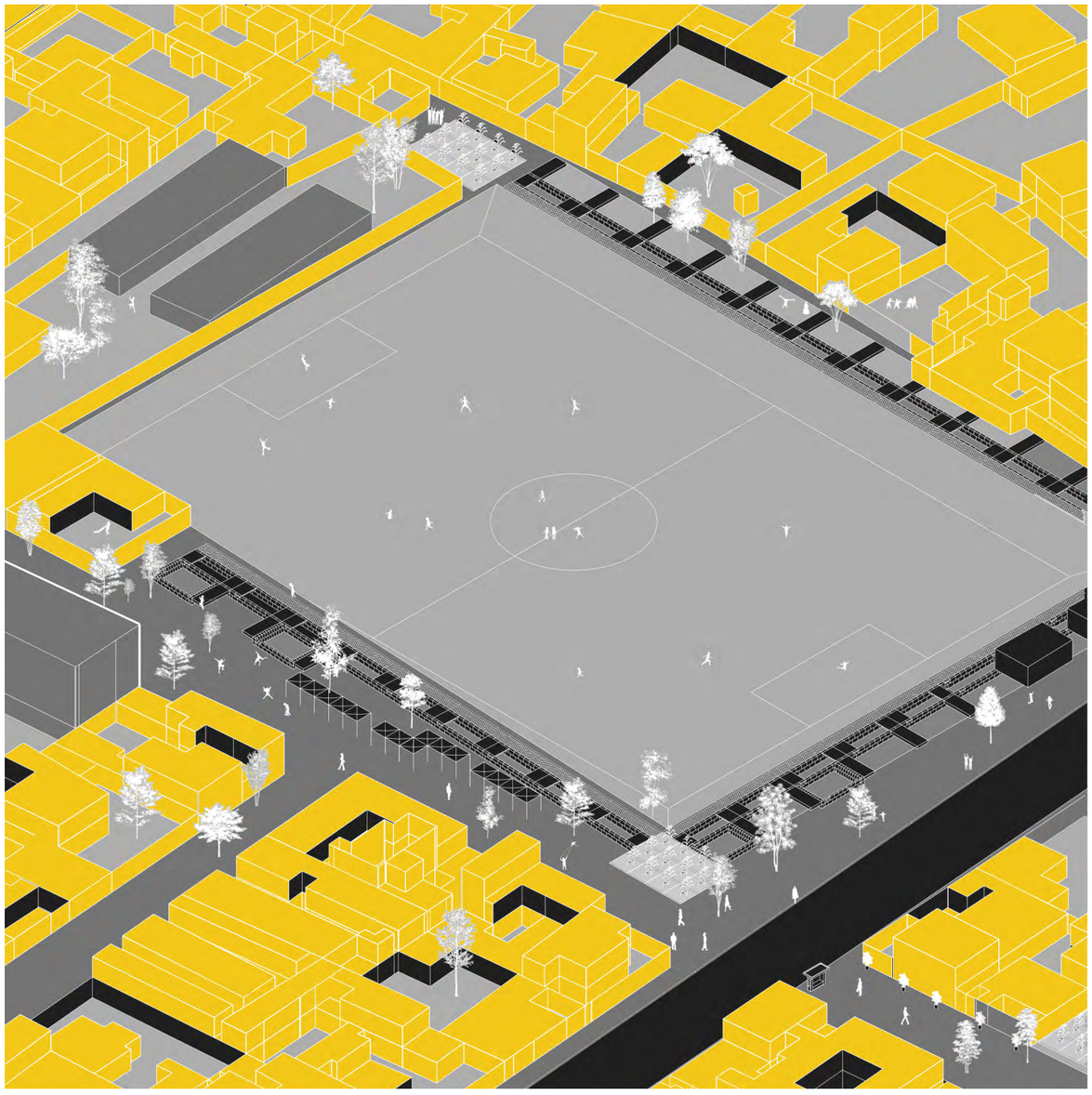

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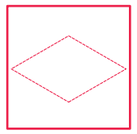

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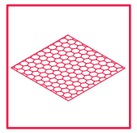

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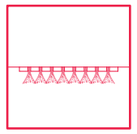

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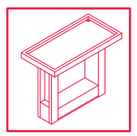

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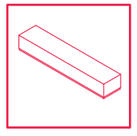

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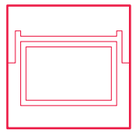

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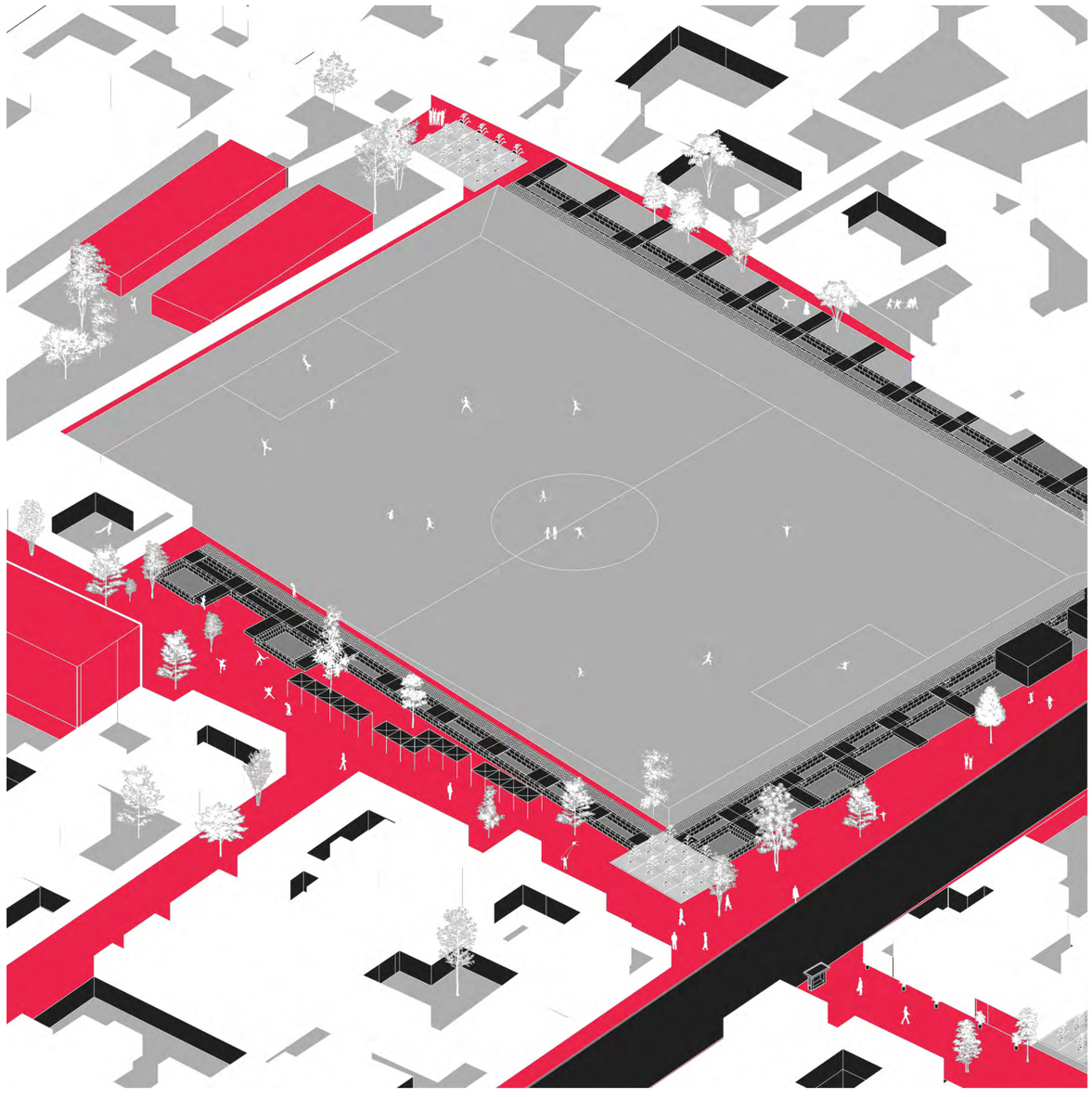


Water treatment strategy

MICRO

WATER TREATMENT INFRASTRUCTURE

Constraints	Enablers
-Poor solid waste management	-High rainfall

MESO

WATER RETENTION

Constraints	Enablers
-Highly densified	-Good soil mechanics

MACRO

GROUNDWATER RECHARGE

Constraints	Enablers
-Degraded soil quality	-Highly infiltratable soil

Health and Food production strategy

MICRO

LOCAL FOOD PRODUCTION

Constraints	Enablers
-Short rainy seasons	-Highly productive landscape

MESO

RENATURALIZE URBAN PERIPHERY

Constraints	Enablers
-Increasing housing market	-Strong existing green network

MACRO

DECREASE URBAN SPRAWL

Constraints	Enablers
-Increasing population de to immigration from rural areas	-Good preservation of forests and natural areas

Housing regen. strategy

MICRO

HOUSING REDENSIFICATION

Constraints	Enablers
-Competition for housing market is highly monopolized	-Financial incentives from SEDUVI

MESO

COOPERATIVE HOUSING SCHEME

Constraints	Enablers
-Lack of community organi-zation	-Well knit community

MACRO

REDISTRIBUTION OF URBAN DENSITY

Constraints	Enablers
-Strict zoning laws	-Pressure from federal fund-ing programs

Public space and services strategy

MICRO

PUBLIC SPACE REGENERATION

Constraints	Enablers
-Low maintainance budget	-High demand

MESO

DECENTRALIZATION OF PUBLIC SERVICES

Constraints	Enablers
-High demand of services	-Abundant informal services

MACRO

CREATION OF STRONG LOCAL ECONOMY

Constraints	Enablers
-Large scale monopolies	-Distance is favorable

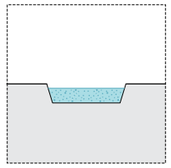
Housing strategy

Neighbor cooperation to ensure correct urban water treatment

Water treatment infrastructure

-$

Water retention



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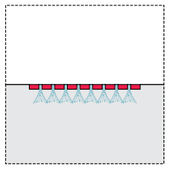
Groundwater recharge



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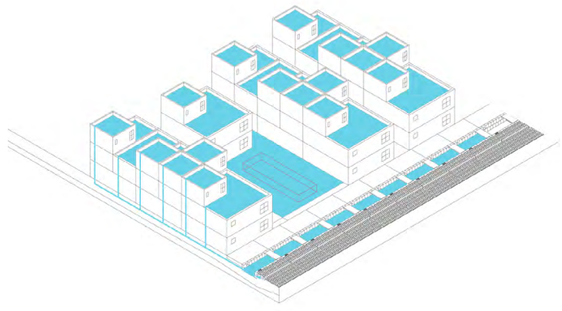
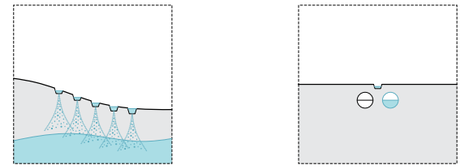


Water treatment infrastructure



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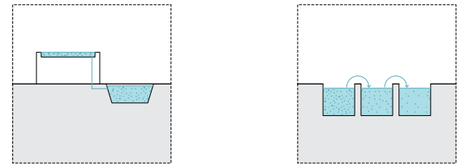
Water retention



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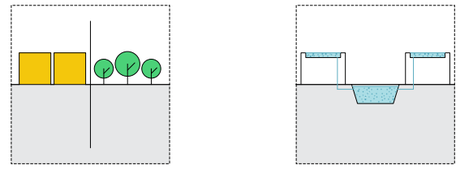
Groundwater recharge



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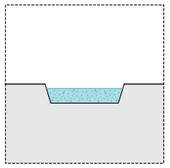
Agrarian development strategy

How to generate an autonomous source of irrigation water for food production

Local food production



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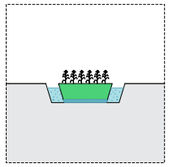
Renaturalize urban periphery



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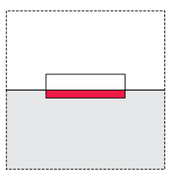
Decrease urban sprawl



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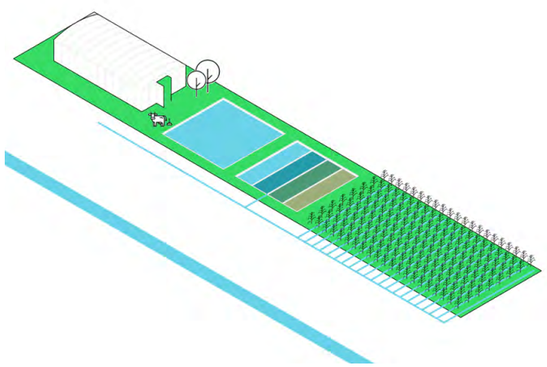
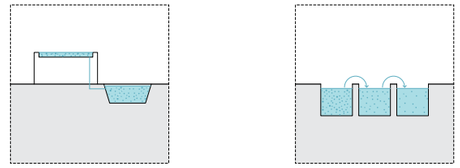


Local food production



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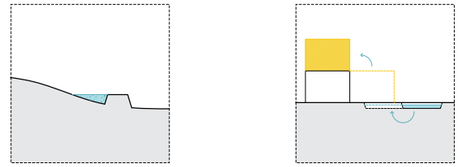
Renaturalize urban periphery



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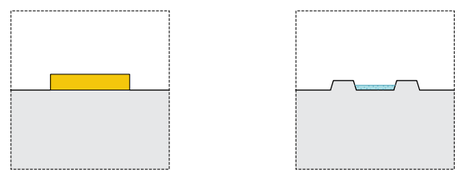
Decrease urban sprawl



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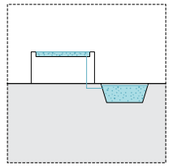
Housing redensification strategy

Neighbour cooperation to ensure correct urban water treatment

Housing redensification



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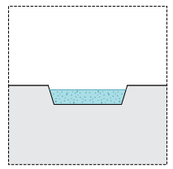
Cooperative housing scheme



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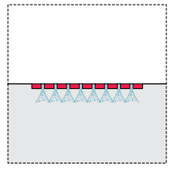
Redistribution of urban density



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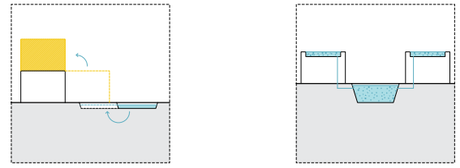
Housing redensification



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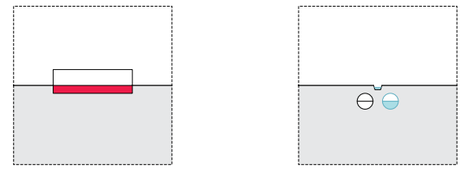
Cooperative housing scheme



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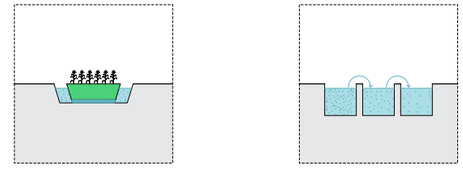
Redistribution of urban density



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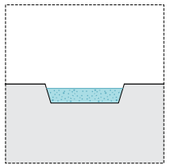
Public space and services strategy

Neighbor cooperation to ensure correct urban water treatment

Public space regeneration



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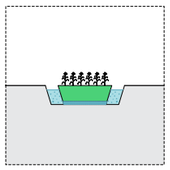
Decentralization of public services



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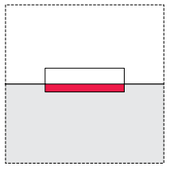
Creation of strong local economy



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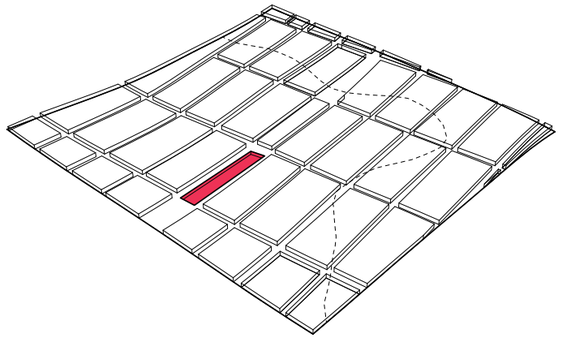
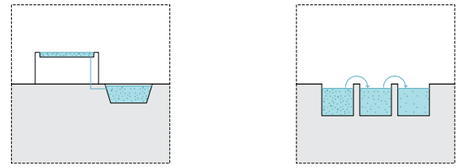


Public space regeneration



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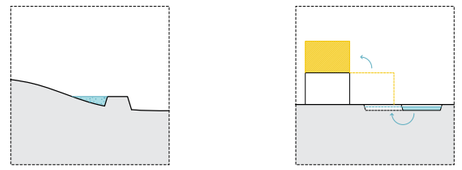
Decentralization of public services



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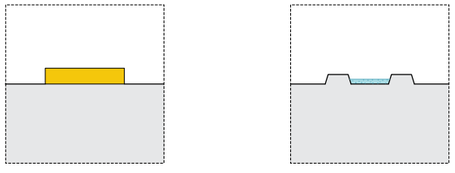
Creation of strong local economy



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Conclusions

Conclusion 01: Water autonomy may not be reached,
but population can still be benefited

Conclusion 02: Community appropriation enables continuity

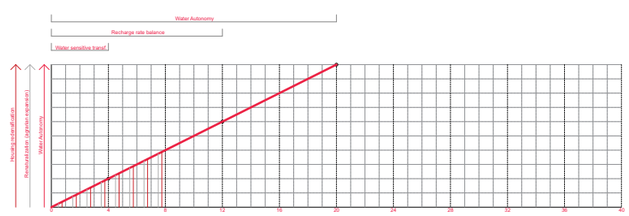
Conclusion 03: Planning culture must permeate public institutions

Conclusion 04: Short term actions can create a path dependency for long term objectives

High investiment capacity
[Access to funding from 3rd, 2nd & 1st parties]

+

High stress over water supply
[Increased urban population and fast depletion of source]



Scenario 2: +$+W

Adaptation measures
Empowerment tools

Water management
- Empty plot
- Rainwater harvesting roof
- 1st order Blue/Green corridor
- 2nd order Blue/Green corridor
- Storage tank
- Treatment tank
- Irrigation storage
- Corridor treatment
- Drinking fountain
- Infiltration park

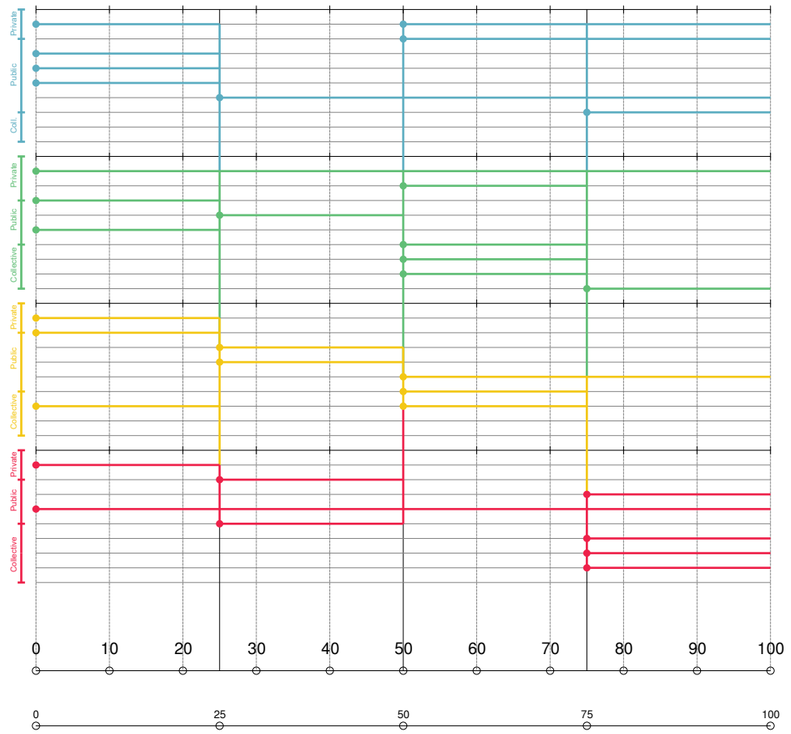
Agrarian development
- Empty plot
- 1st order Blue/Green corridor
- 2nd order Blue/Green corridor
- Grow patch
- Greenhouse
- Grow roof
- Public garden
- Infiltration park
- Corridor treatment
- Fish tank

Housing redensification
- Empy plot
- Plinth renewal
- Relocation of low intensity plot
- Redensification (Facade shift)
- Redensification (Inner courtyard)
- Row operation
- Block operation
- Gated c. operation
- Vecindario operation
- Housing cooperative

Public space & services
- Empty plot
- Surface renaturalization
- Soil remediation
- Water management sports field
- Formal food market
- Catchment plaza
- Common ownership corridor
- Private corridor (Vecindario)
- Bus stop
- Bench

Adaptation pathway
Process of giving collective meaning

Year 1: Pioneering | Year 2: NHU Backbone | Year 3: Adaptation | Year 4: Consolidation



Water Autonomy achieved (%)

0 10 20 30 40 50 60 70 80 90 100

Area of stored water (% of open space)

0 25 50 75 100

Further direction of the research

Further steps

FEDERAL FUNDS:
Food security and public health program

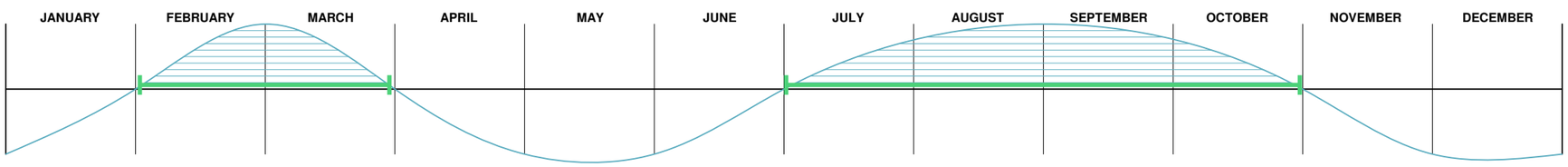
Funds for becoming a certified organic food producer (SEMARNAT)

FEDERAL FUNDS:
Water treatment program

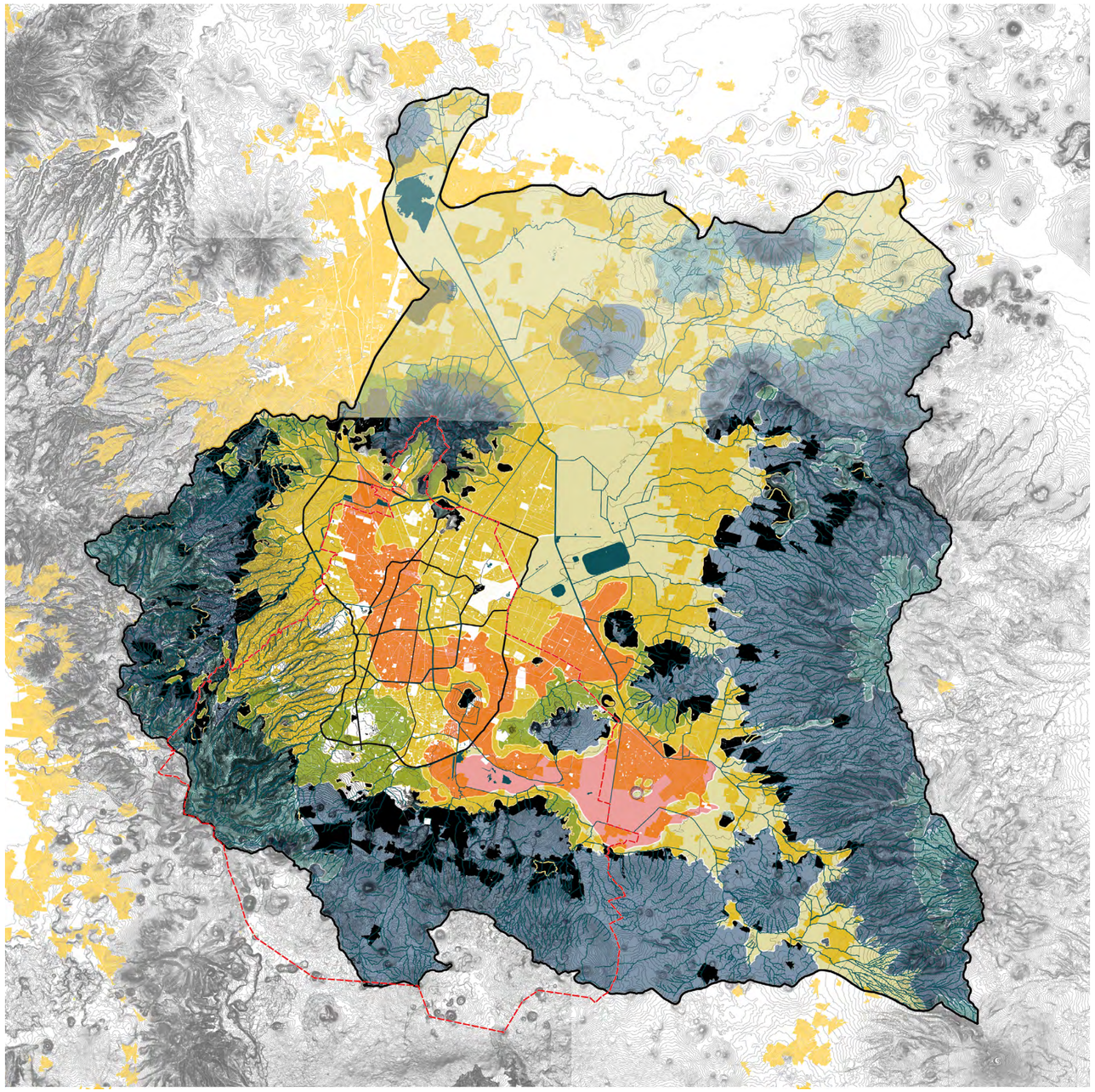
Funds for returning clean water to the municipality (CONAGUA)

FEDERAL FUNDS:
Sustainable rural development programs

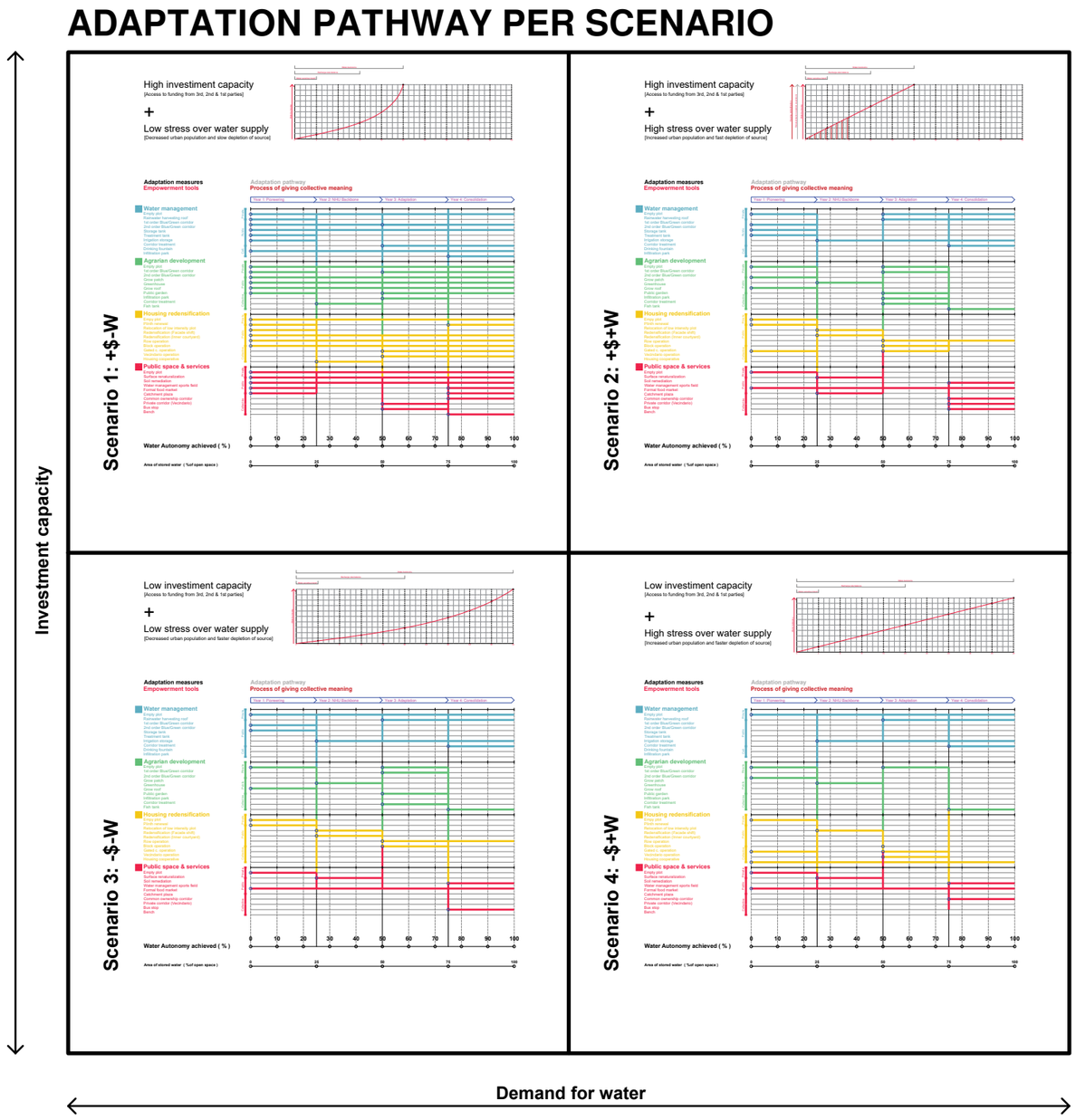
Funds for infrastructure construction and training (APARURAL)



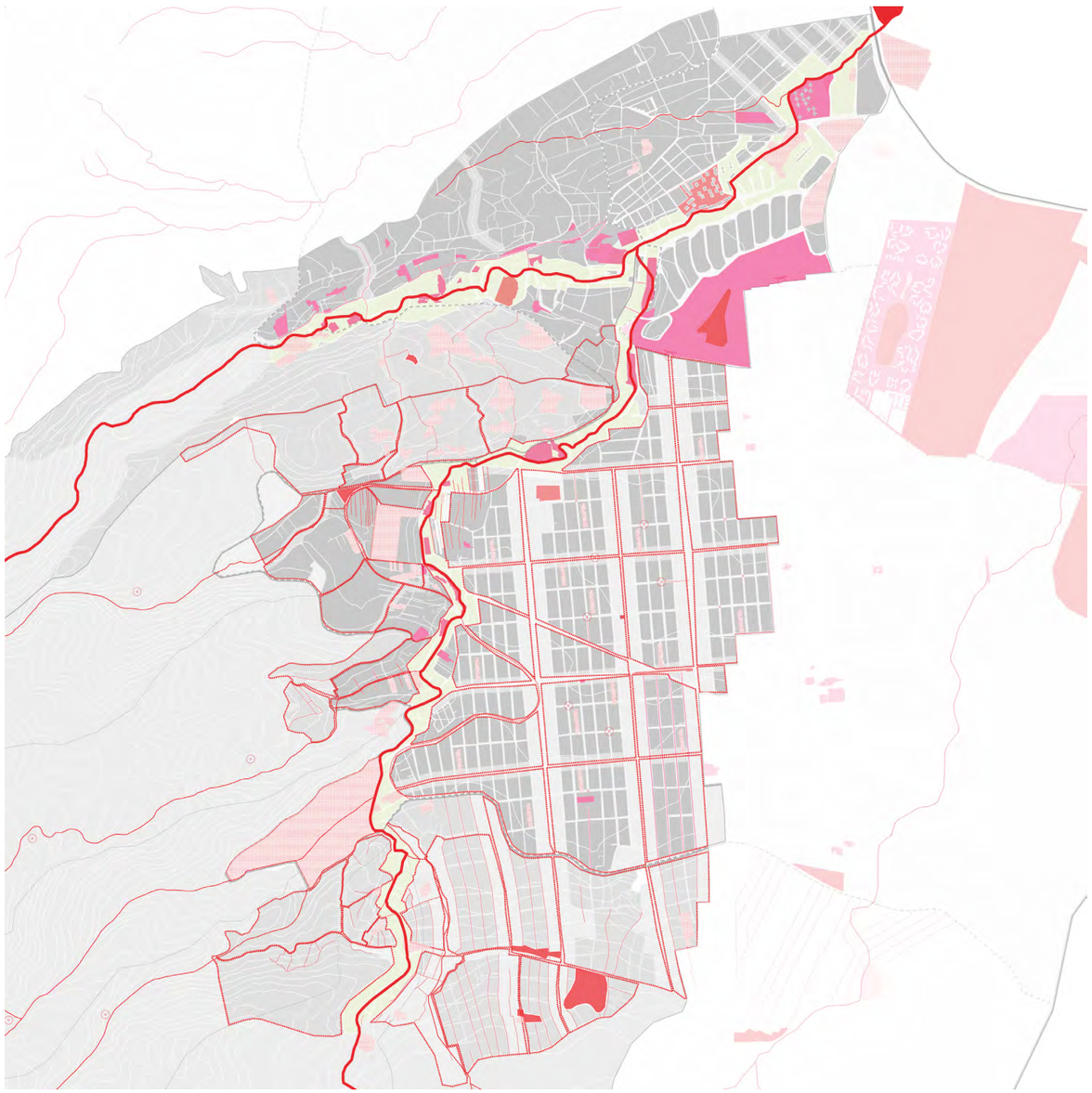
Further steps



Further steps



Further steps



Recommendation 01: Water autonomy may not be reached, but population can be benefit ed

Recommendation 02: Sub & Micro-basin level council groups should be established