INTEGRATED MITIGATION

Flood Risk mitigation fostering Social Integration

Transitional Territories studio

FRANCISCO MONSALVE

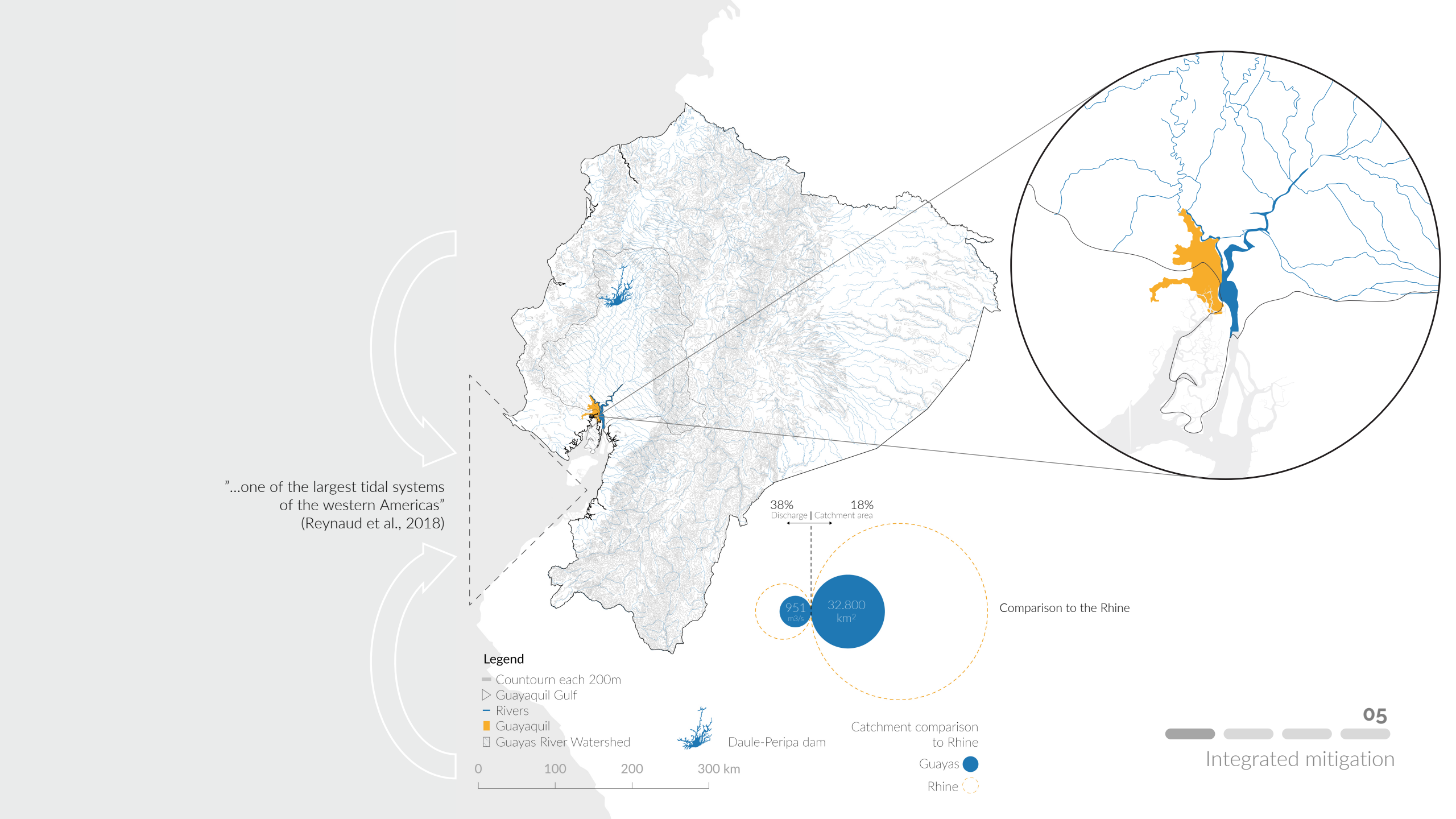
1st mentor: Fransje Hooimeijer

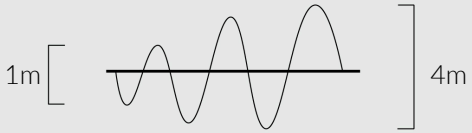
2nd mentor: Taneha Kuzniecow Bacchin

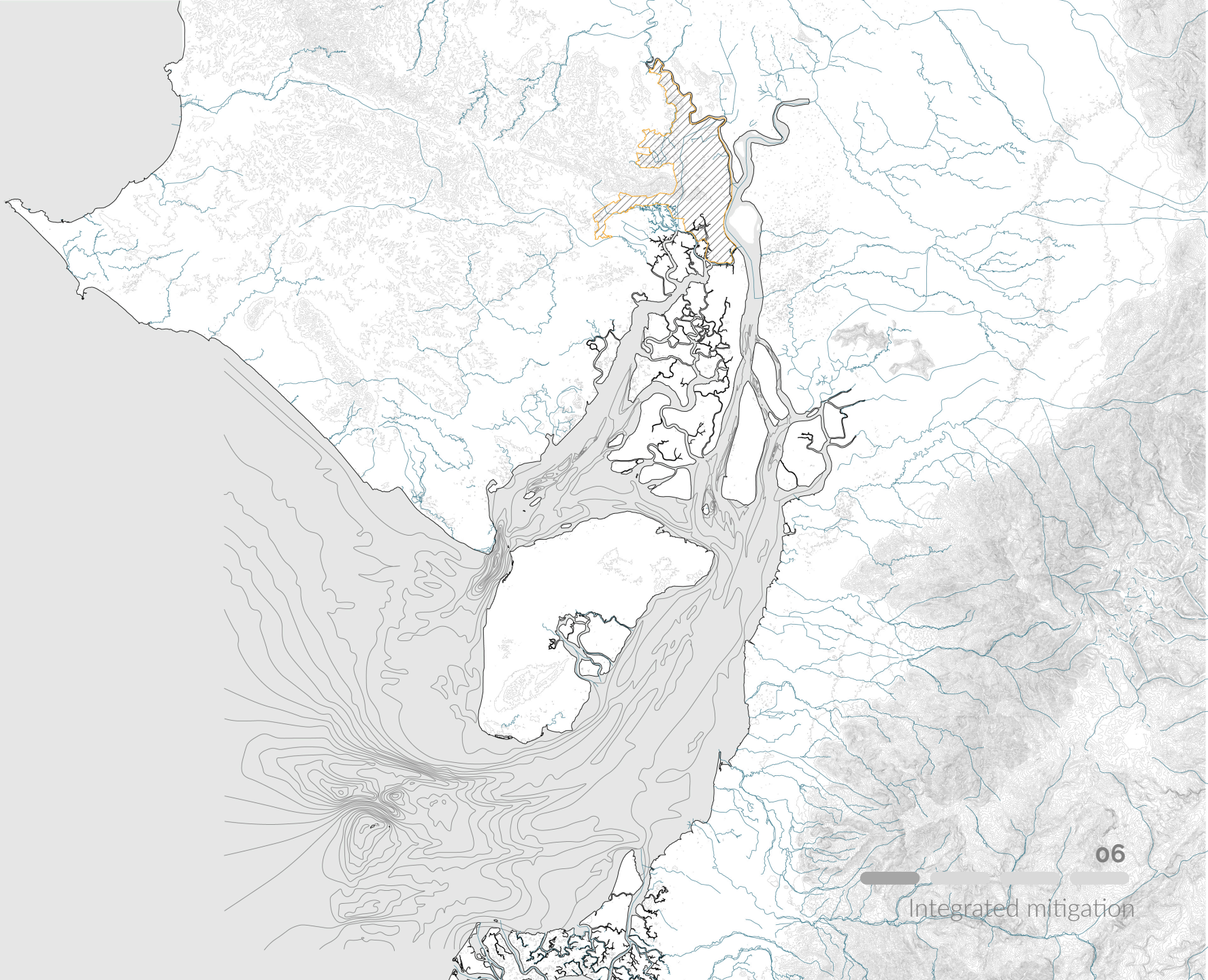
“Even in resource-rich nations, meeting infrastructural needs continues to be a daunting task. The problems are almost unimaginably more severe in developing nations, which face a host of additional difficulties related to rapid urbanization; lack of financial, organizational, and human capital; and diminishing natural resources” (Brown & Stigge, 2017)

“Even in resource-rich nations, meeting infrastructural needs continues to be a daunting task. The problems are almost unimaginably more severe in developing nations, which face a host of additional difficulties related to rapid urbanization; lack of financial, organizational, and human capital; and diminishing natural resources” (Brown & Stigge, 2017)

Flood Risk & spatial segregation

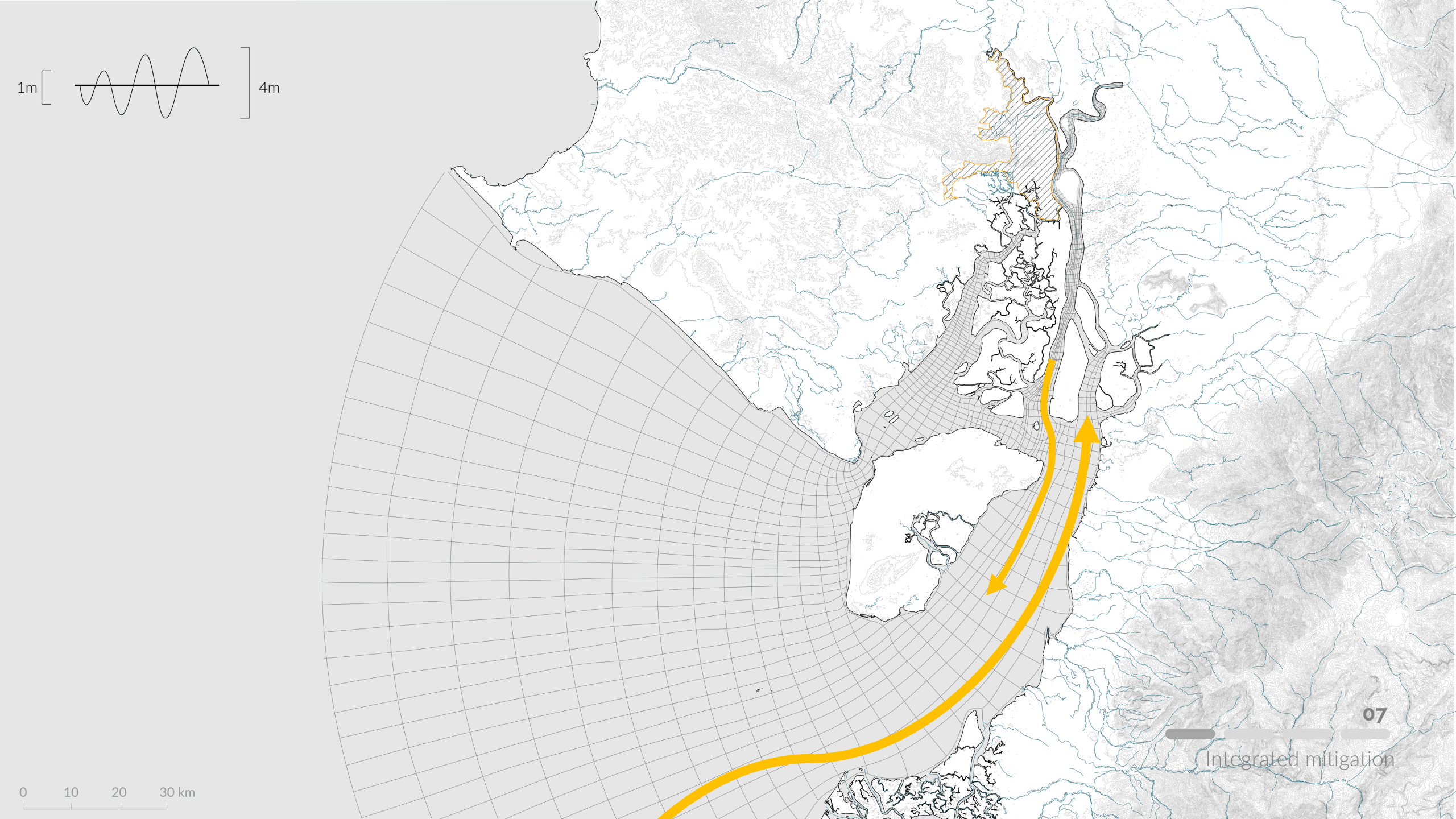

"...one of the largest tidal systems
of the western Americas"
(Reynaud et al., 2018)
38%
18%
Discharge | Catchment area
951
m3/s
32.800
km²
Comparison to the Rhine
Legend
Countourn each 200m
Guayaquil Gulf
Rivers
Guayaquil
Guayas River Watershed
Daule-Peripa dam
Catchment comparison
to Rhine
Guayas
Rhine
0
100
200
300 km





06

Integrated mitigation

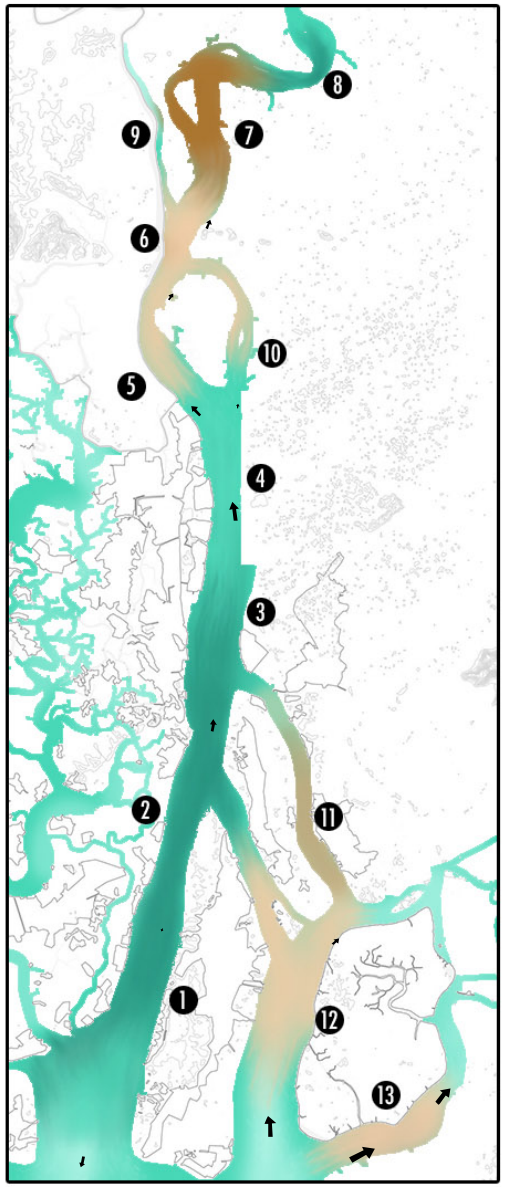


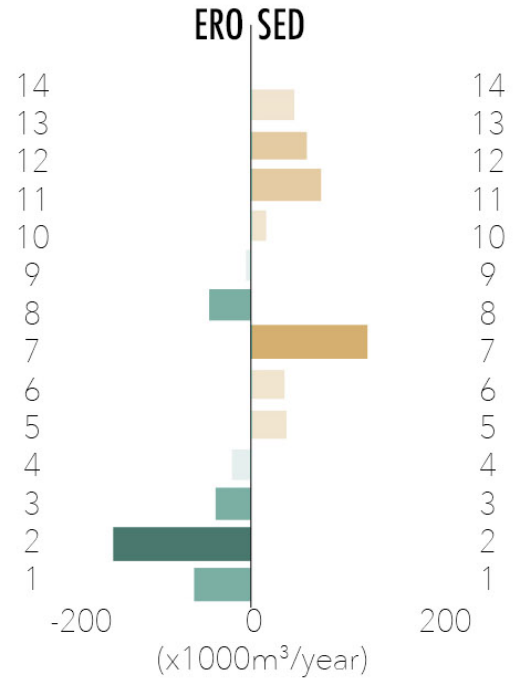
07

Integrated mitigation

Source: Sigtierras

Sedimentation



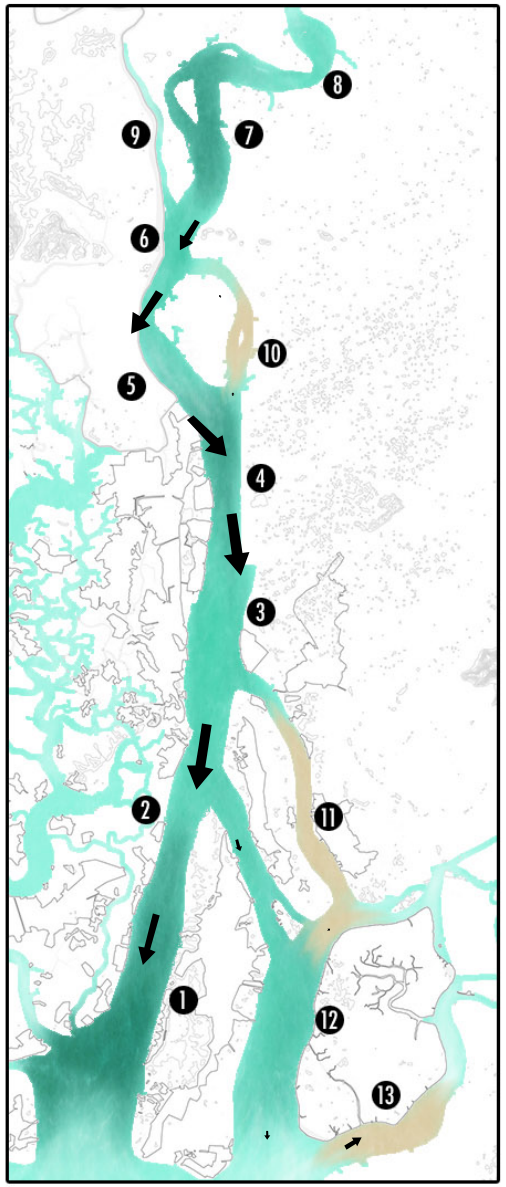


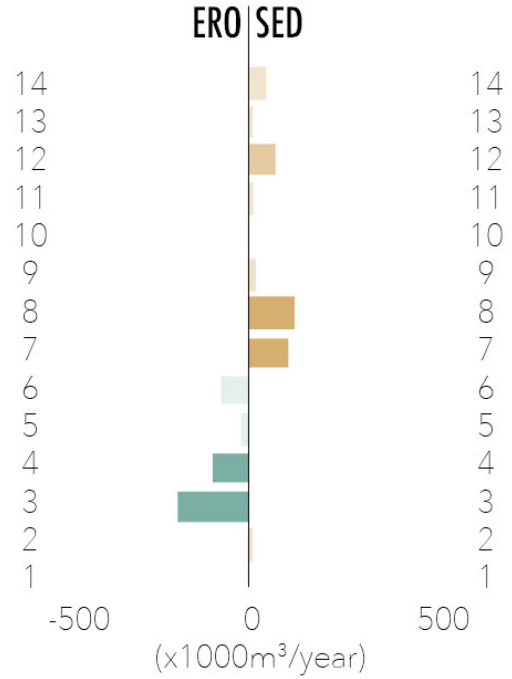
CURRENT
SEDIMENT BALANCE

YEARLY AVERAGE

Image based on: Barrera Crespo, P. D., Mosselman, E., Giardino, A., Becker, A., Ottevanger, W., Nabi, M., & Arias Hidalgo, M. (2018).

Sedimentation

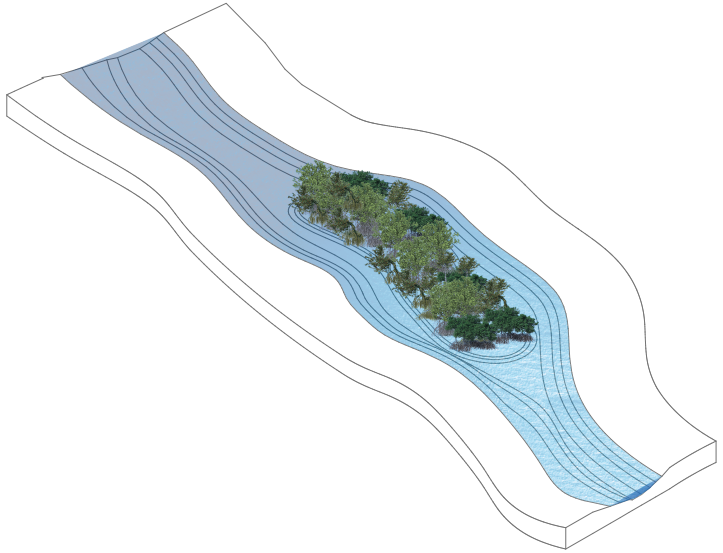


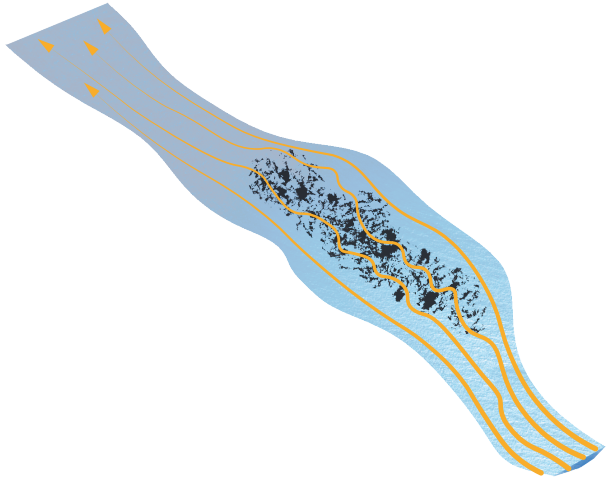


SEDIMENT BALANCE PRIOR SHRIMP FARMING AND MANGROVE DEFORESTARION

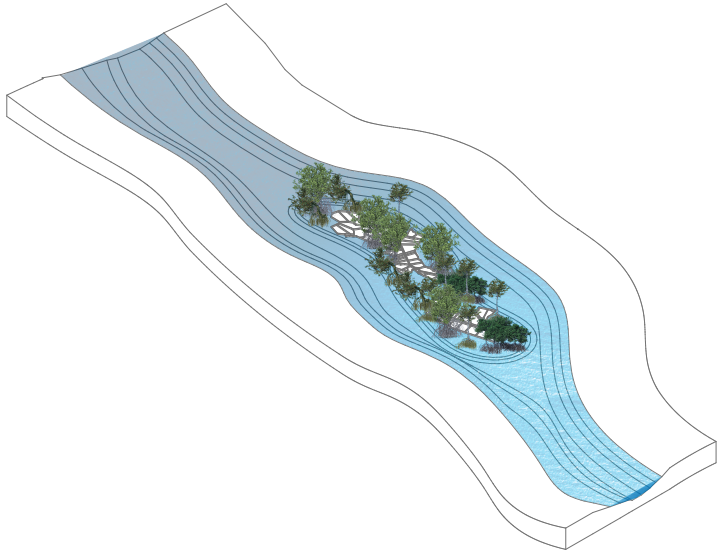
YEARLY AVERAGE

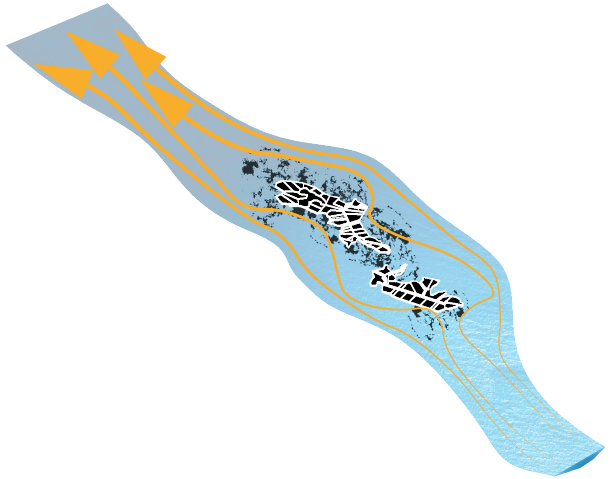
Image based on: Barrera Crespo, P. D., Mosselman, E., Giardino, A., Becker, A., Ottevanger, W., Nabi, M., & Arias Hidalgo, M. (2018).



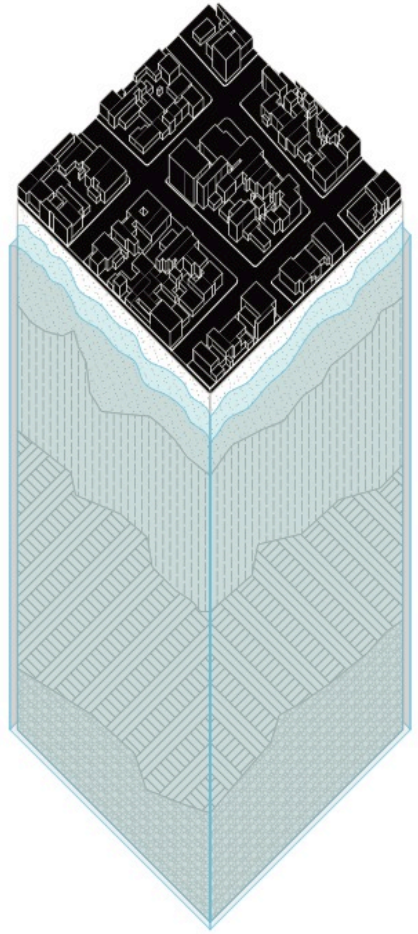


90 % of tidal energy





Less friction
Less Space

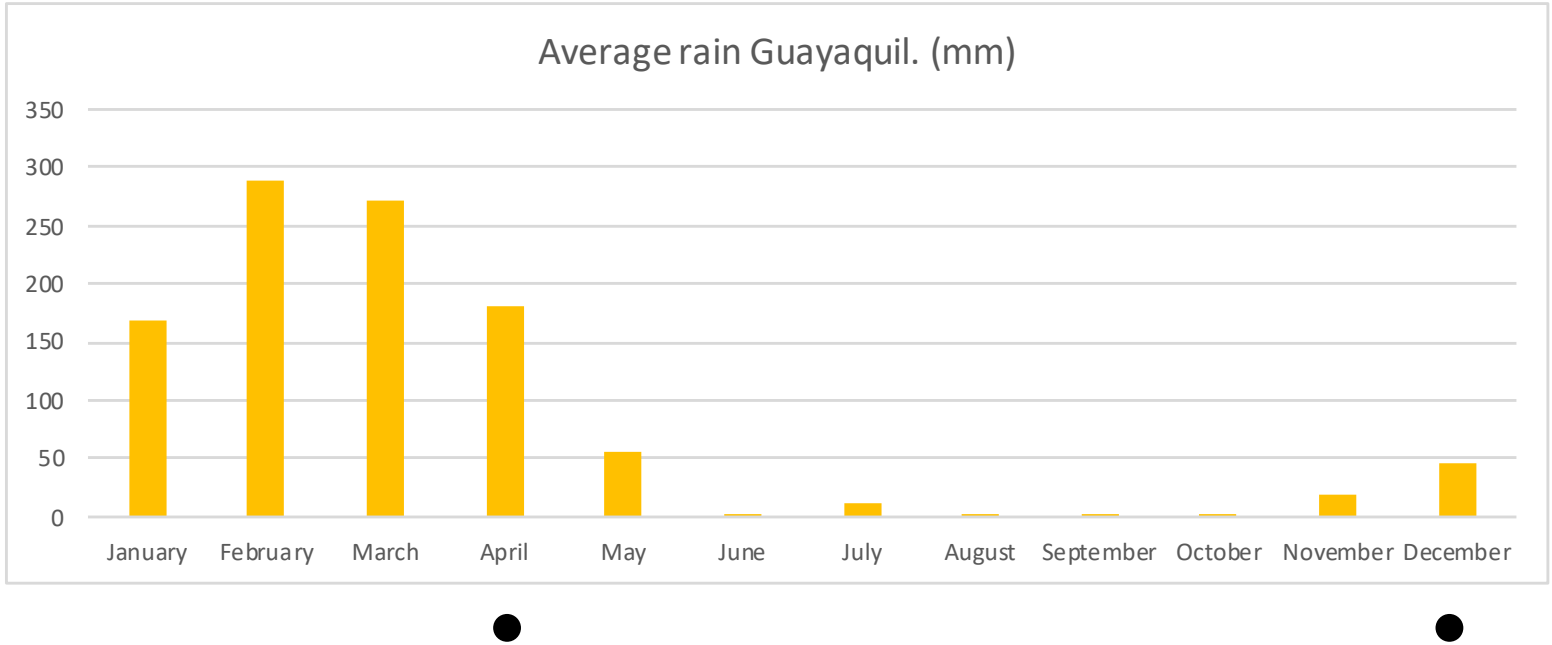


Seasons – Overlapping of Water abundant systems

"90% of the rainfall falls between December and April.... high discharges and high precipitation rates are likely to coincide, possibly leading to an increased flood risk. "

-880mm/ year in NL
280 in March"in Guayaquil

(Molenaar, Pak, de Pous, & van de Werff, 2018)



Source: Inocar

Table 1 | City ranking by risk (AAL) and relative risk (AAL in percentage of GDP) for 2005.

	Ranking by AAL (US$ million)					Ranking by relative AAL (percentage of city GDP)			
	Urban agglomeration	100 year exposure	AAL, with protection (US$ million)	AAL, with protection (percentage of GDP)		Urban agglomeration	100 year exposure	AAL, with protection (US$ million)	AAL, with protection (percentage of GDP)
1	Guangzhou	38,508	687	1.32%	1	Guangzhou	38,508	687	1.32%
2	Miami	366,421	672	0.30%	2	New Orleans	143,963	507	1.21%
3	New York—Newark	236,530	628	0.08%	3	Guayaquil	3,687	98	0.95%
4	New Orleans	143,963	507	1.21%	4	Ho Chi Minh City	18,708	104	0.74%
5	Mumbai	23,188	284	0.47%	5	Abidjan	1,786	38	0.72%
6	Nagoya	77,988	260	0.26%	6	Zhanjiang	2,780	46	0.50%
7	Tampa—St. Petersburg	49,593	244	0.26%	7	Mumbai	23,188	284	0.47%
8	Boston	55,445	237	0.13%	8	Khulna	2,073	13	0.43%
9	Shenzen	11,338	169	0.38%	9	Palembang	1,161	27	0.39%
10	Osaka—Kobe	149,935	120	0.03%	10	Shenzen	11,338	169	0.38%
11	Vancouver	33,456	107	0.14%	11	Hai Phòng	6,348	19	0.37%
12	Tianjin	11,408	104	0.24%	12	N'ampo	507	6	0.31%
13	Ho Chi Minh City	18,708	104	0.74%	13	Miami	366,421	672	0.30%
14	Kolkata	14,769	99	0.21%	14	Kochi	855	14	0.29%
15	Guayaquil	3,687	98	0.95%	15	Tampa—St. Petersburg	49,593	244	0.26%
16	Philadelphia	22,132	89	0.04%	16	Nagoya	77,988	260	0.26%
17	Virginia Beach	61,507	89	0.15%	17	Surat	3,288	30	0.25%
18	Fukuoka—Kitakyushu	39,096	82	0.09%	18	Tianjin	11,408	104	0.24%
19	Baltimore	14,042	76	0.08%	19	Grande_Vitória	6,738	32	0.23%
20	Jakarta	4,256	73	0.14%	20	Xiamen	4,486	33	0.22%

A comparison with a ranking by exposure is proposed in the Supplementary Information.

Source: Hallegate, S., Green, C., Nicholls, R. J., & Corfee-Morlot, J. (2013). Future flood losses in major coastal cities. Nature clamate change, 802-806.

Flood prone areas

[1]

[2]

[3]

Img 1: El Tiempo
Img 2: Teleamazonas
Img 3: Expreso

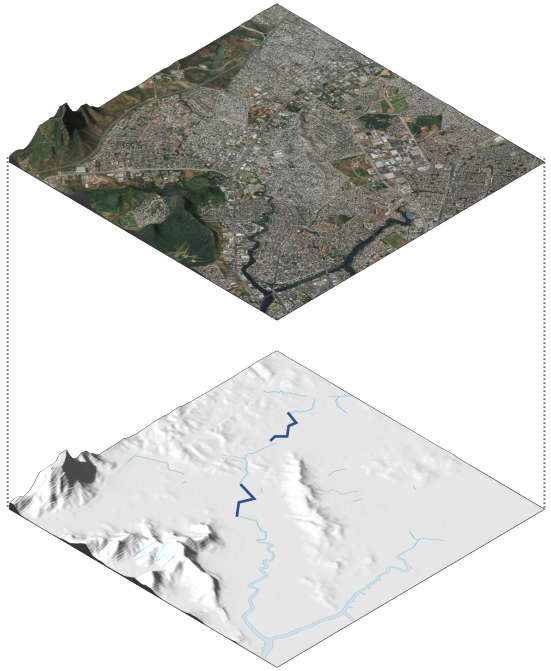
Water Basin Analysis

Input: Sigtierras DEM

Current state

Water Basin Analysis

Input: Sigtierras DEM

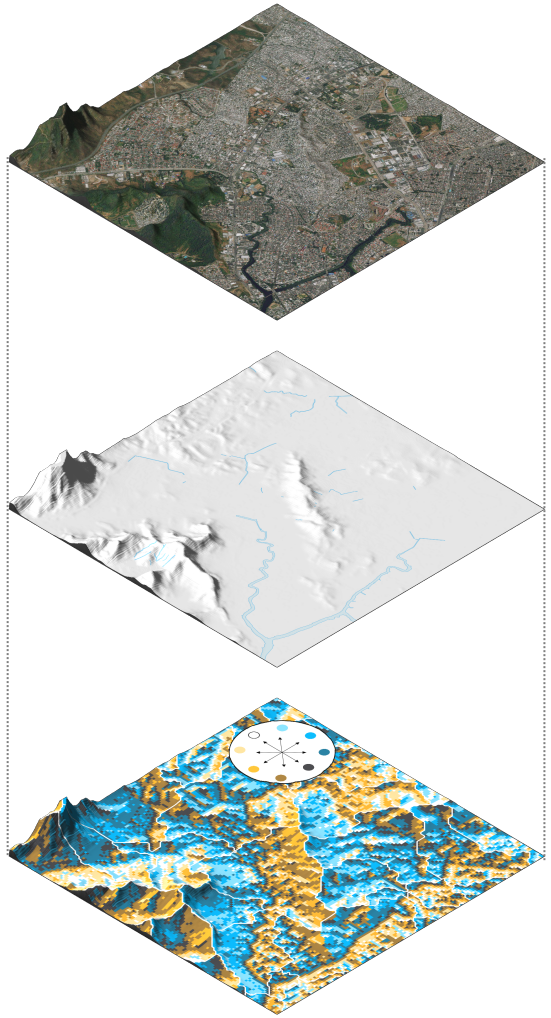


Current state

Topography
Water bodies

Water Basin Analysis

Input: Sigtierras DEM



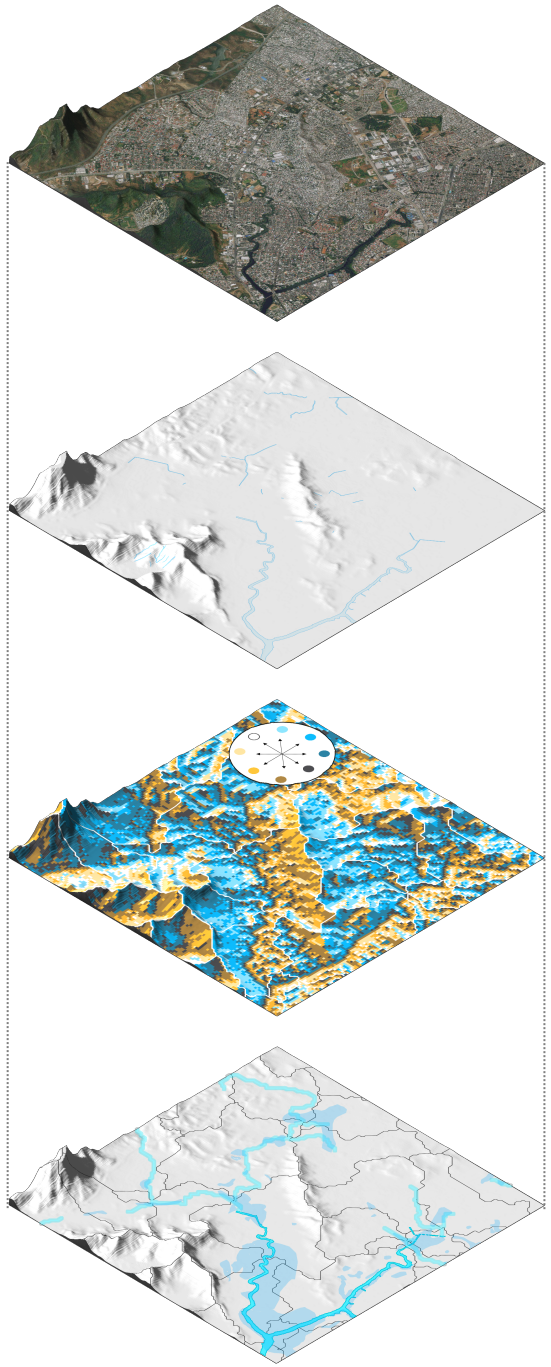
Current state

Topography
Water bodies

Surface water
Direction Flow

Water Basin Analysis

Input: Sigtierras DEM



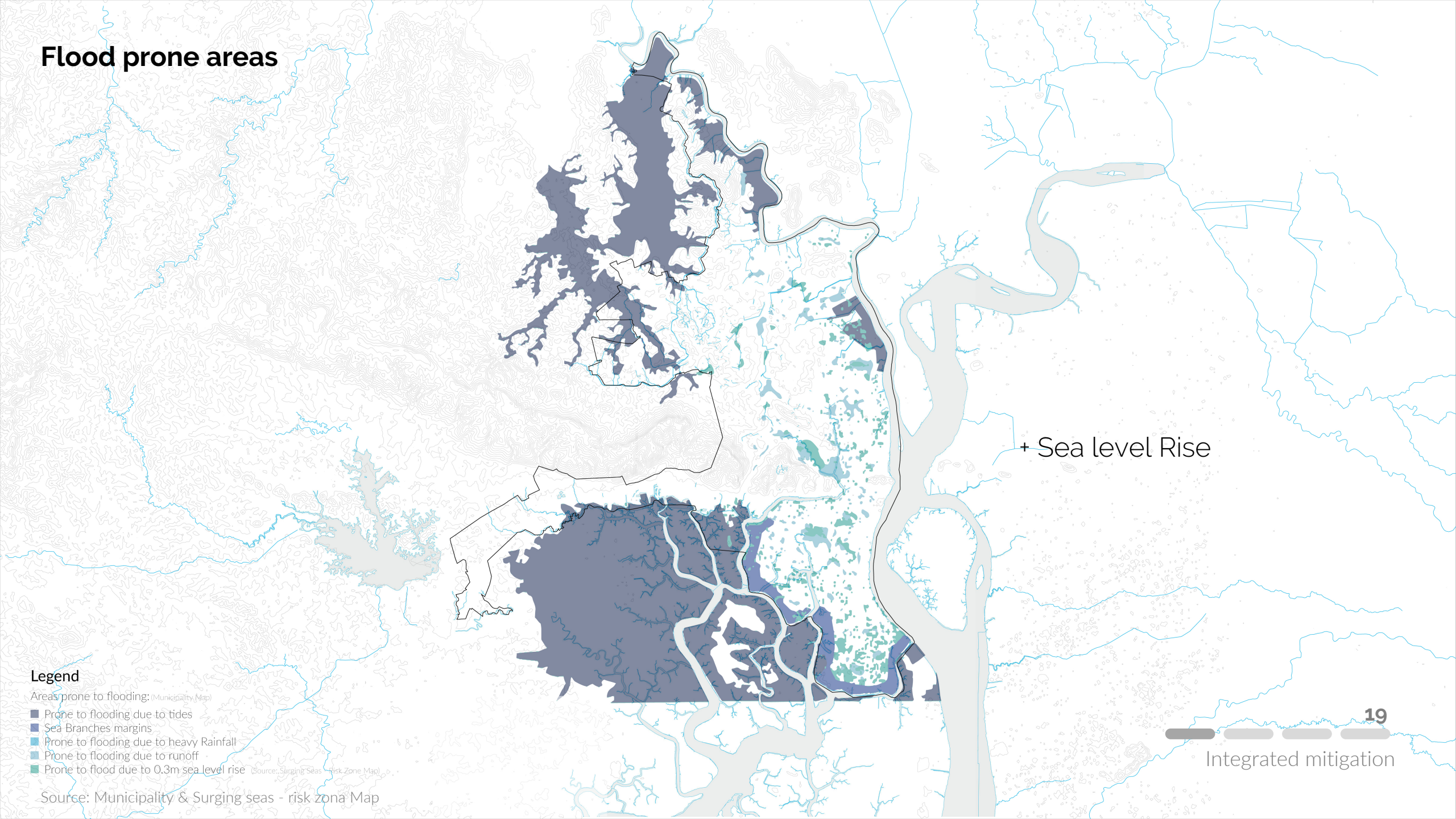
Current state

Topography
Water bodies

Surface water
Direction Flow

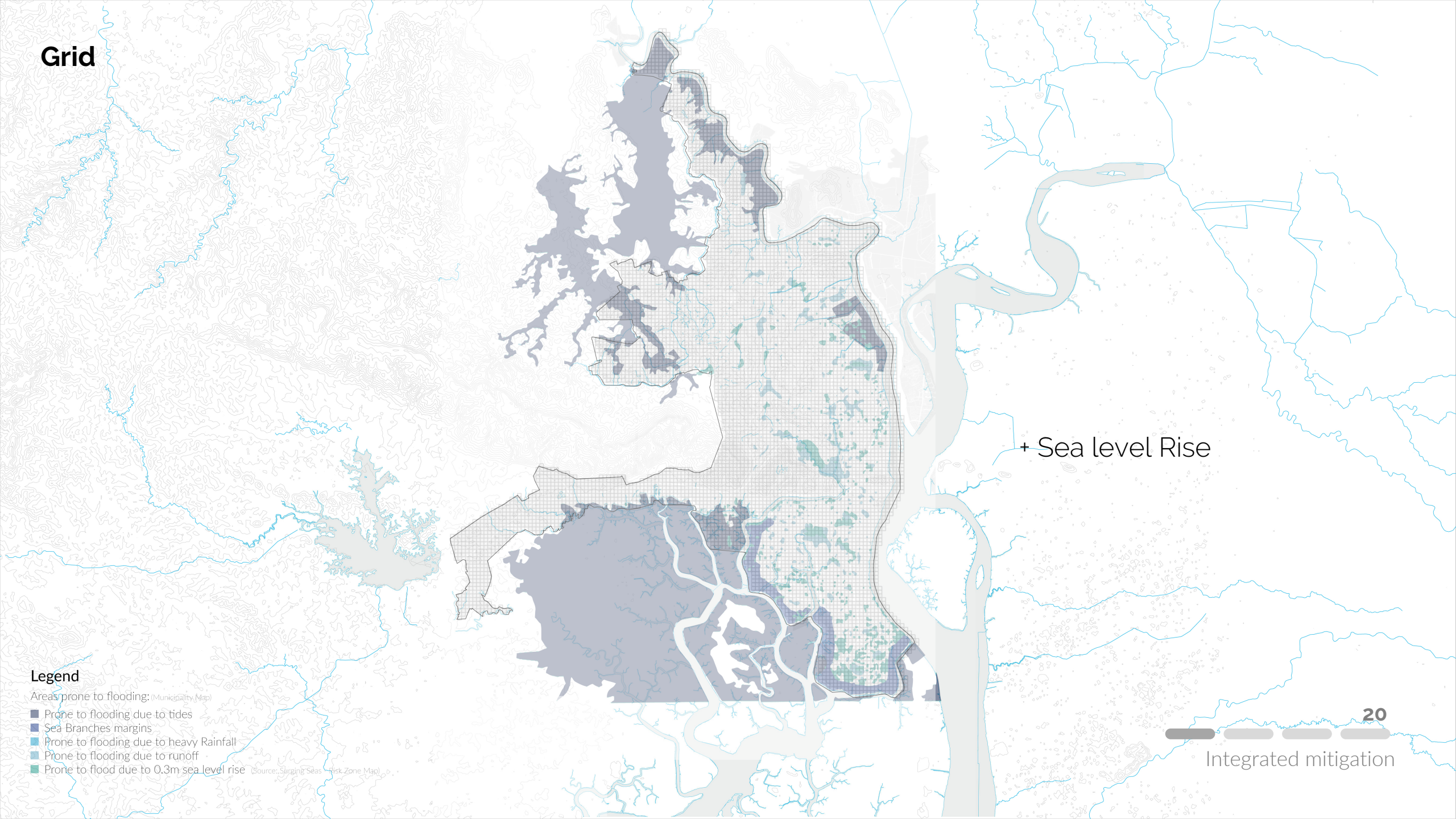
Water Drainage Segments
Flood prone areas

Flood prone areas



Source: Municipality & Surging seas - risk zona Map

Grid



Legend

Areas prone to flooding: (Municipality Map)

- Prone to flooding due to tides
- Sea Branches margins
- Prone to flooding due to heavy Rainfall
- Prone to flooding due to runoff
- Prone to flood due to 0.3m sea level rise (Source: Surging Seas - Risk Zone Map)

People Affected by flooding

Data: 2010 CPV - Ecuador

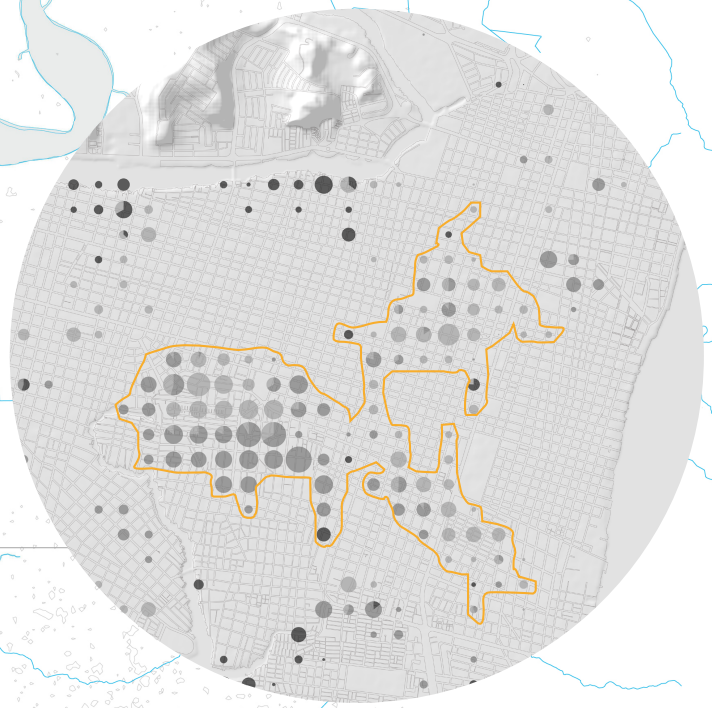
19.000 cases exposed to river overflow

75.000 cases exposed to heavy rainfall & canal overflow

110.000 cases exposed water concentration and run-off

115.000 cases exposed to sea-level rise

Area of intervention



Legend

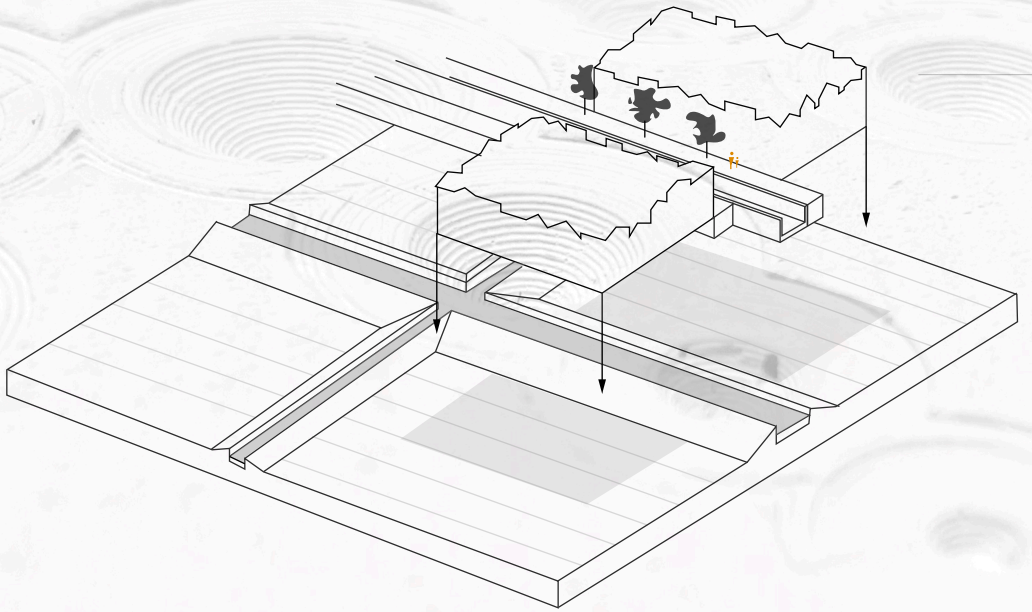
- Areas prone to flooding due to river runoff.
- Areas prone to flooding due to heavy rainfall.
- Areas prone to flooding due to runoff.
- Areas prone to flooding due to 0.3m sea level rise

How to save resources and execute the best strategy for the context?

How to mitigate the risk?

Are there enough resources even to deal with this problem?

Is there anything positive from Guayaquil's current condition?



2nd private property

1st collective works

Strong sense of Nationhood

Source: Meyer (2017)

What is a Nation?

Made by its members desire to stay together

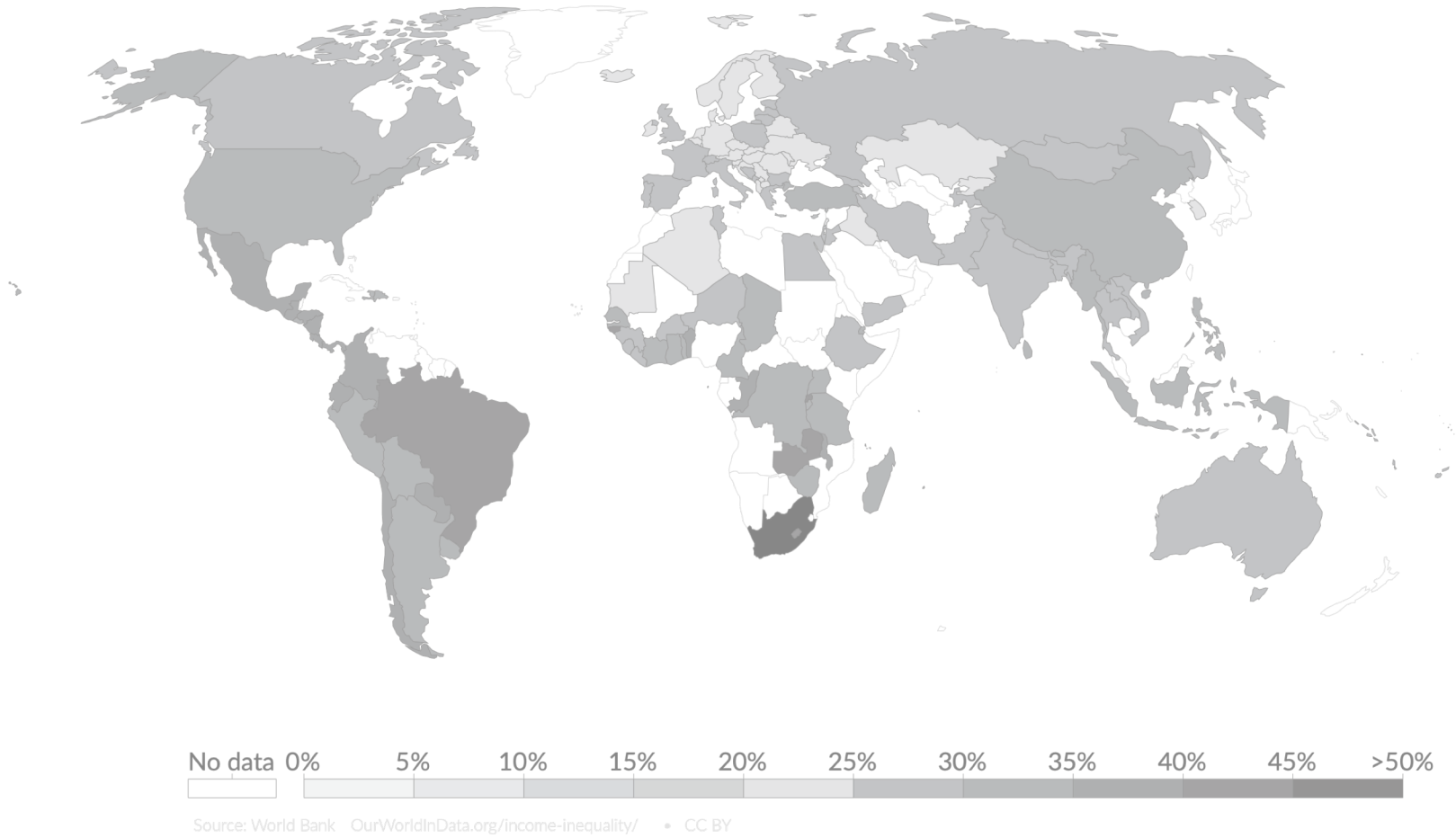
past
experience

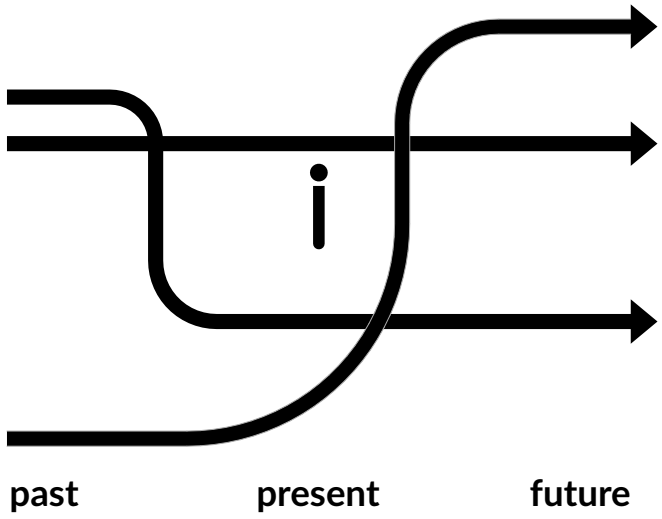
present
history

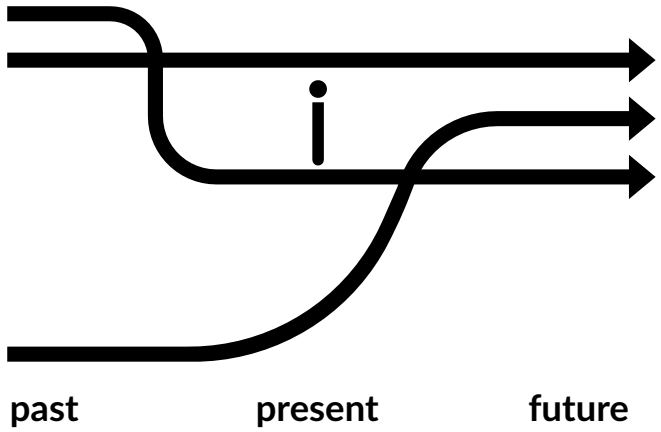
future
prospects

Source: Meyer (2017)

Income share held by the richest 10%




i
past
present
future


i
past
present
future

Different Realities

Spatial Segregation

Research question

-How can a coordinated strategy mitigate flood risk and diminish spatial segregation following the Infrastructural Ecologies paradigm?

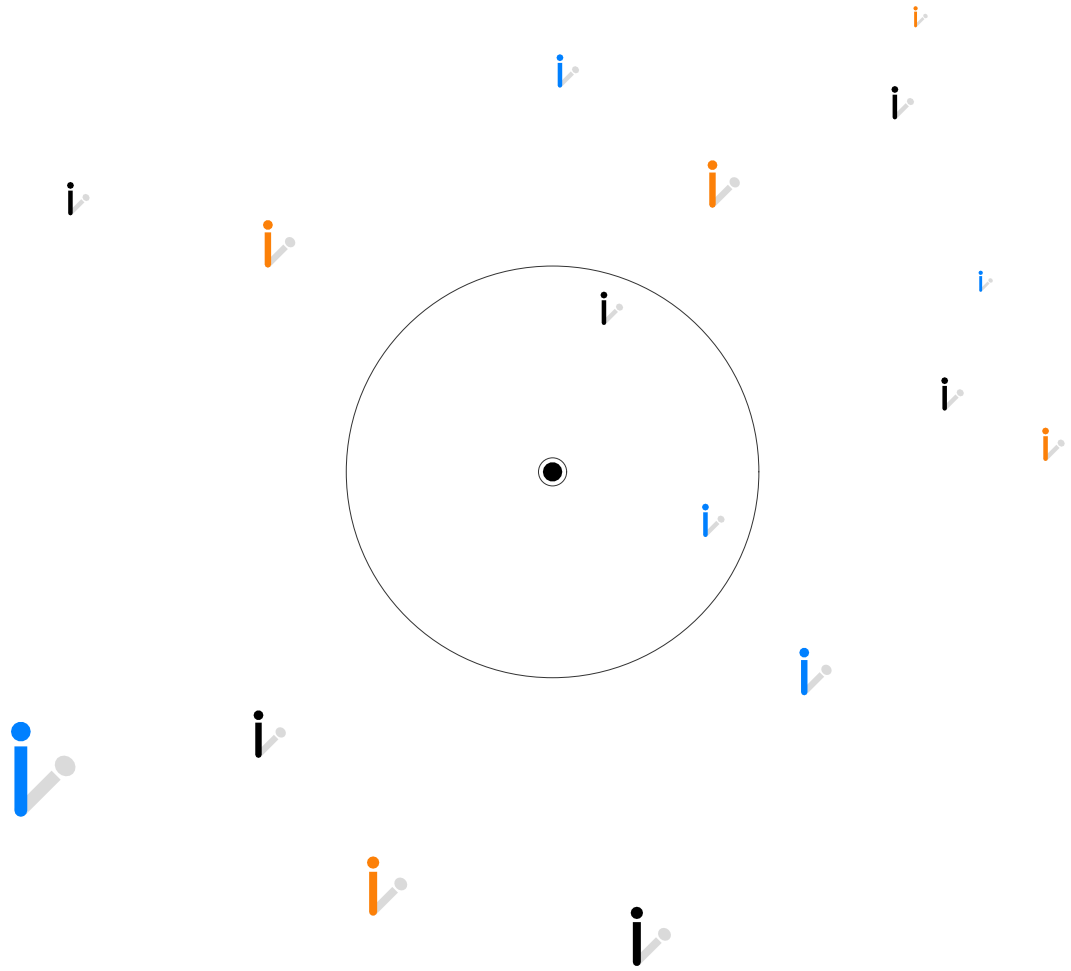
This is tested in case study of Guayaquil (Ecuador) by conducting a case study with explanatory and exploratory research methods.

Flood Risk

Spatial segregation

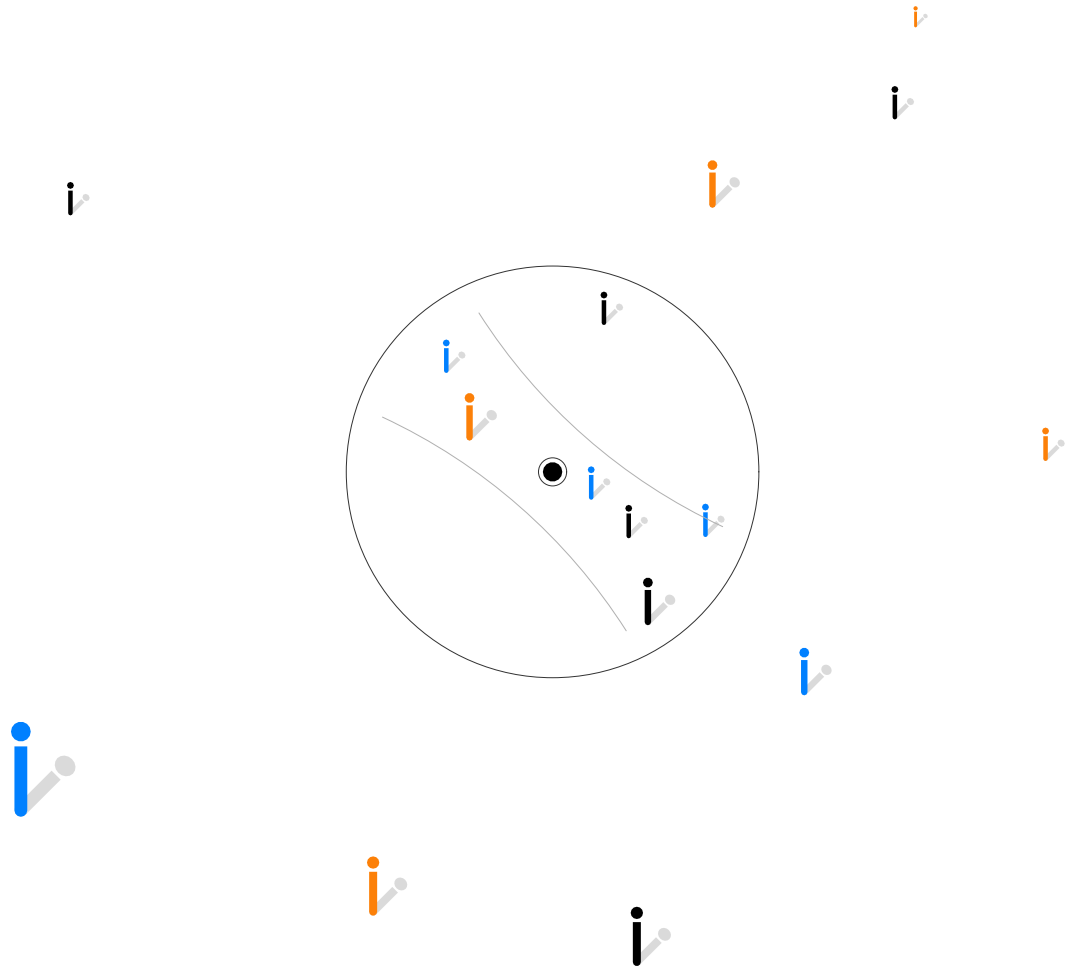
Co-presence

Non Locals – residing 1000m away

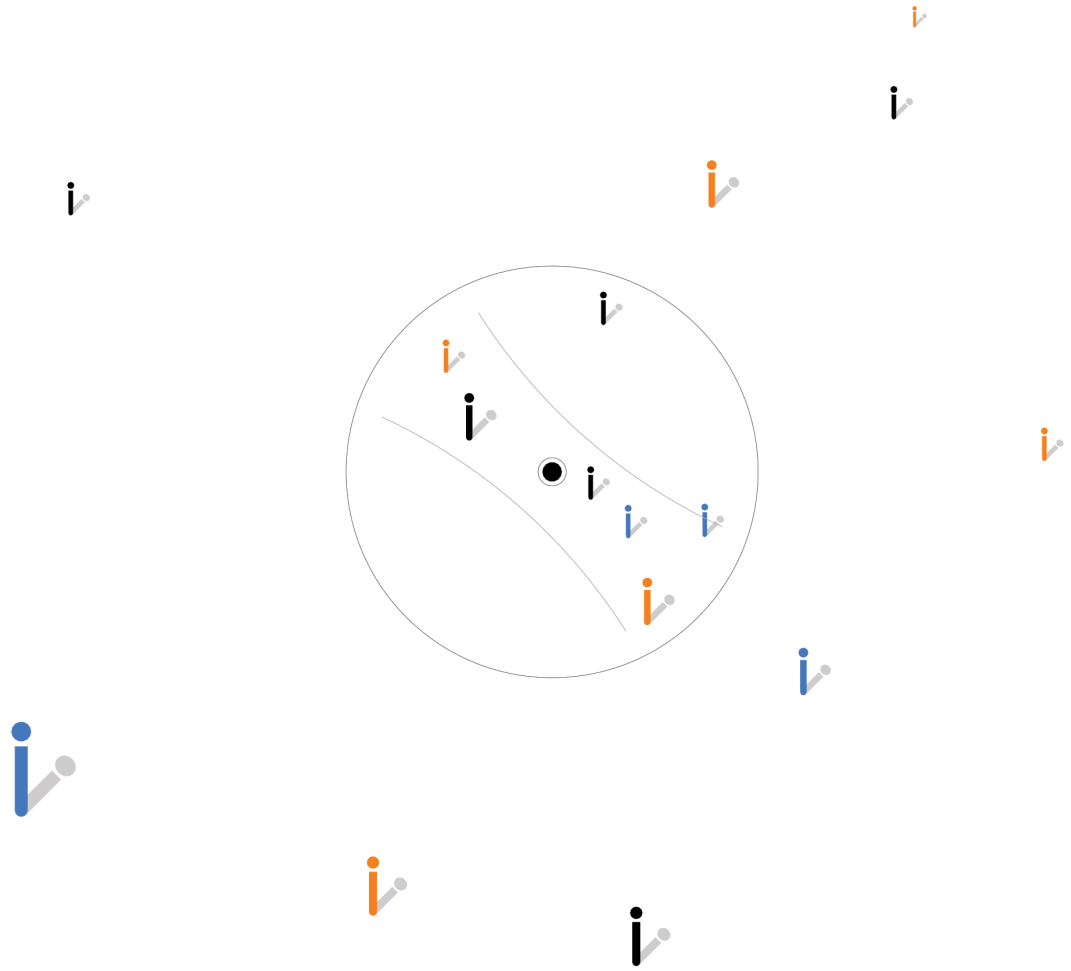


Co-presence

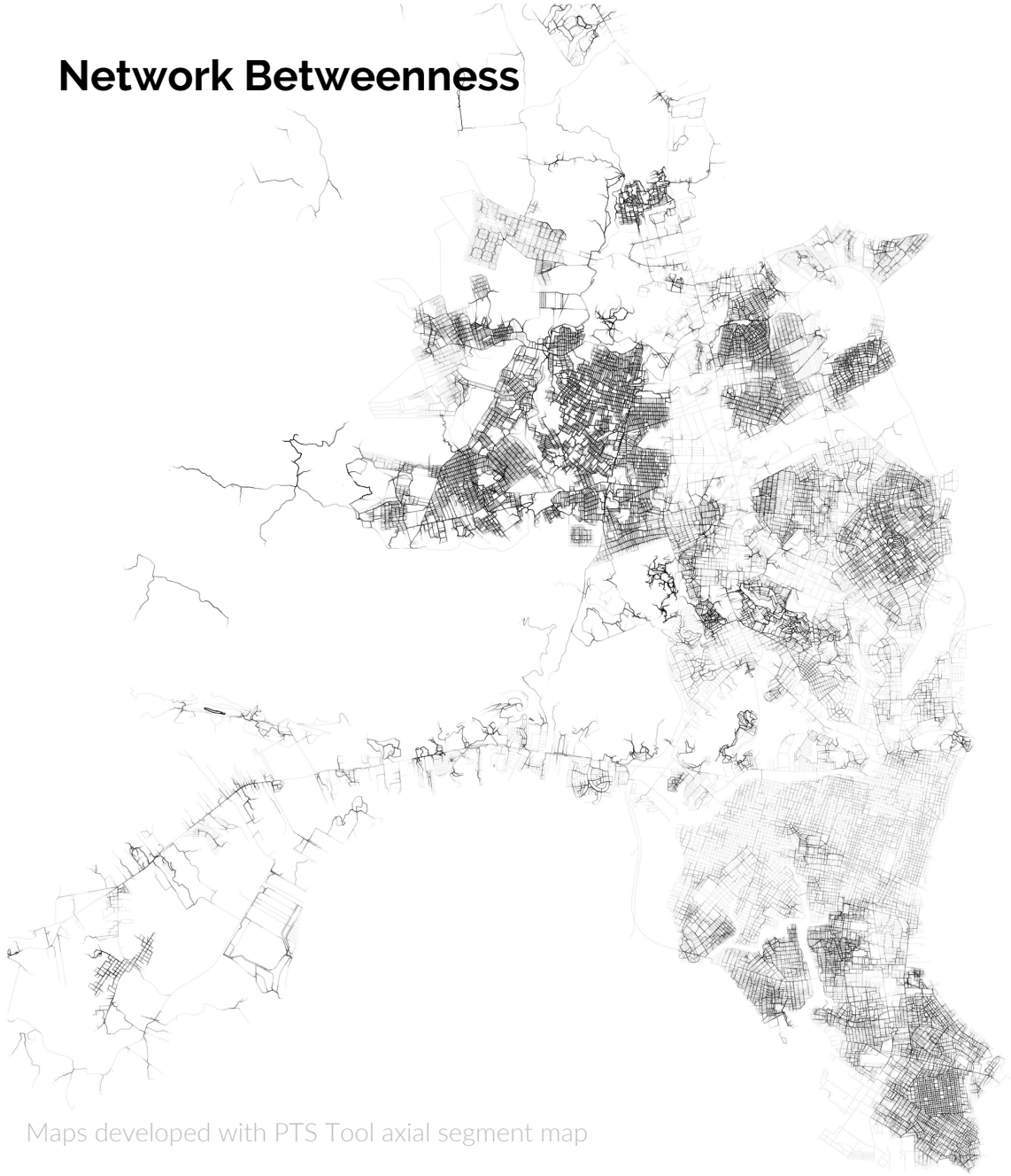
Access improving diversity



Co-presence



Network Betweenness

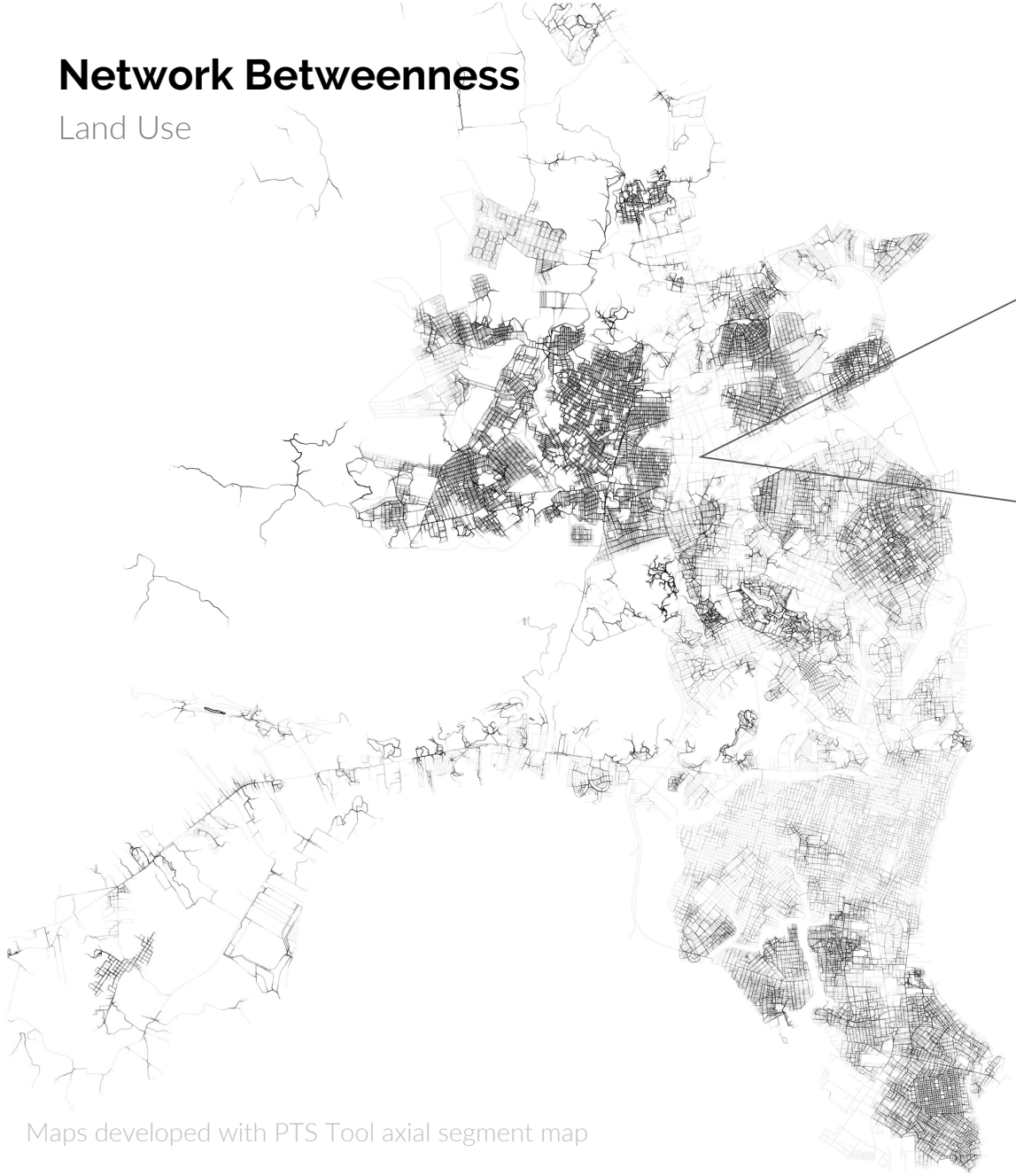


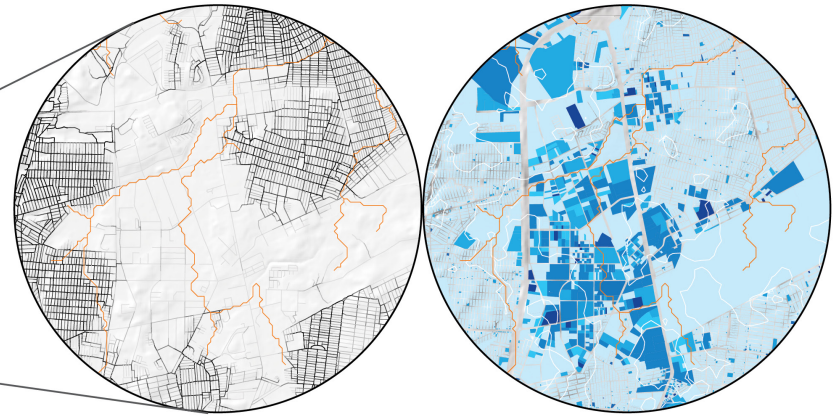
Maps developed with PTS Tool axial segment map

Evidence what streets are more likely to fall into the shortest paths. Meaning they are likely to be taken in-between origin and destination

Network Betweenness

Land Use





Legend

Water Drainage Segments

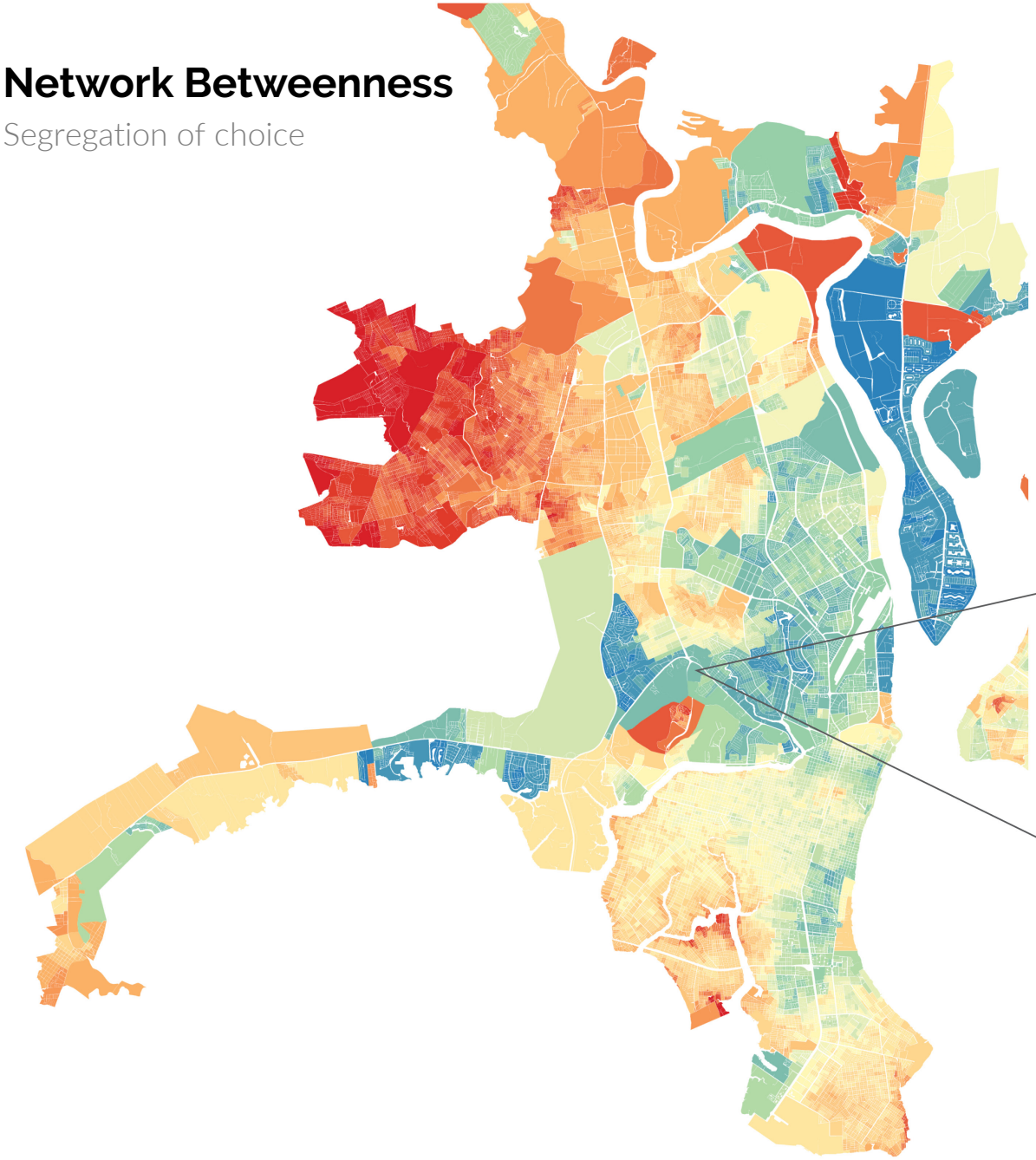
Land Use

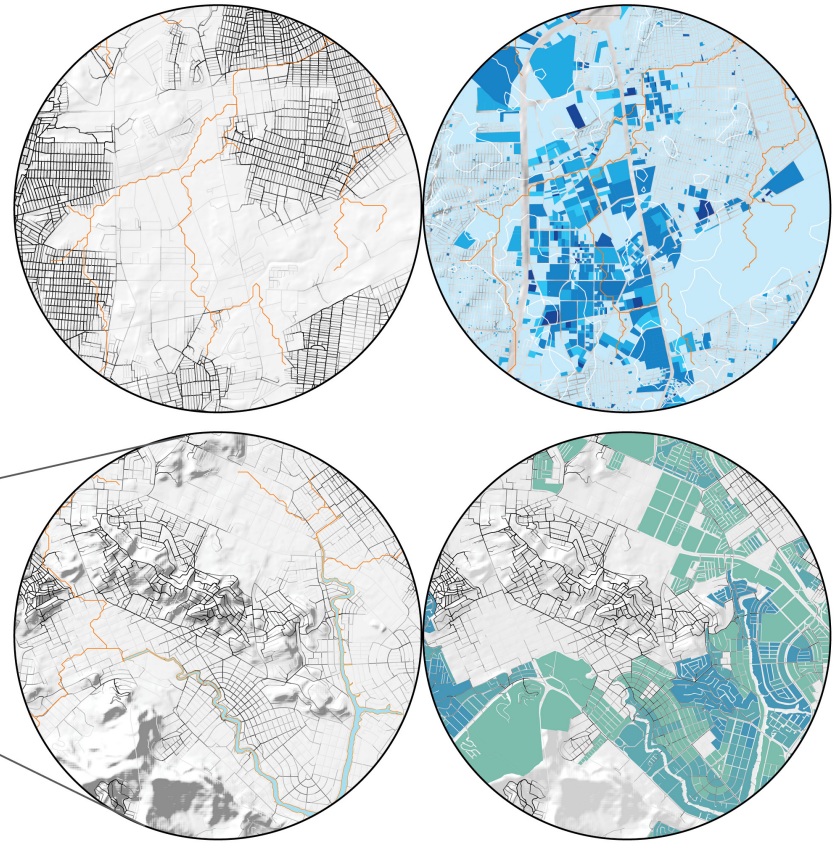
- Retail
- Education
- Storage
- Industry
- Office
- Other
- Park
- Parking
- Health
- Mecanic Shop
- Housing

Maps developed with PTS Tool axial segment map

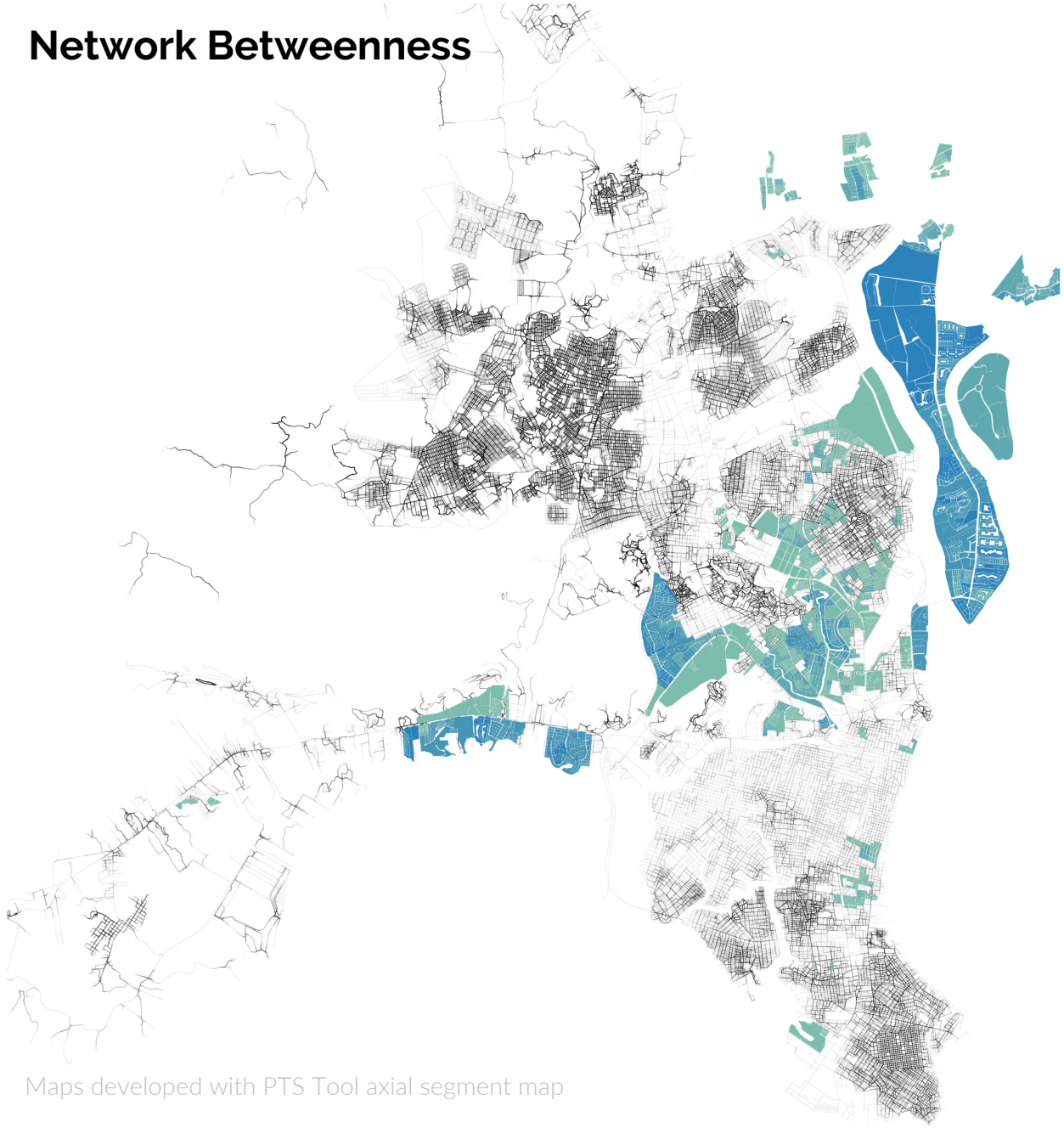
Network Betweenness

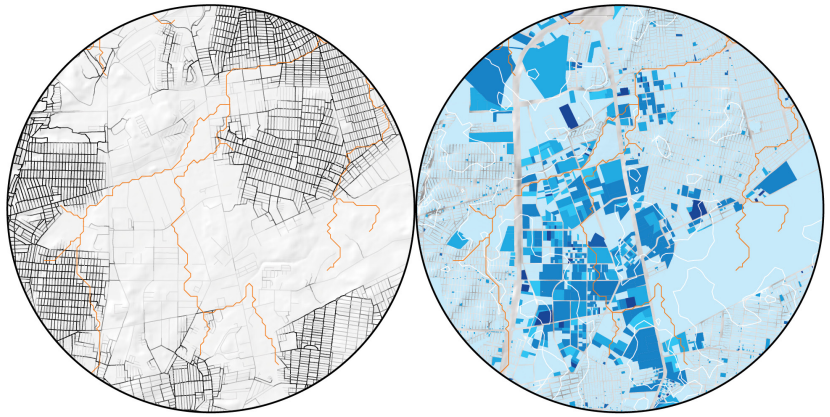
Segregation of choice





Network Betweenness





Legend

Water Drainage Segments

Land Use

- Retail
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- Housing

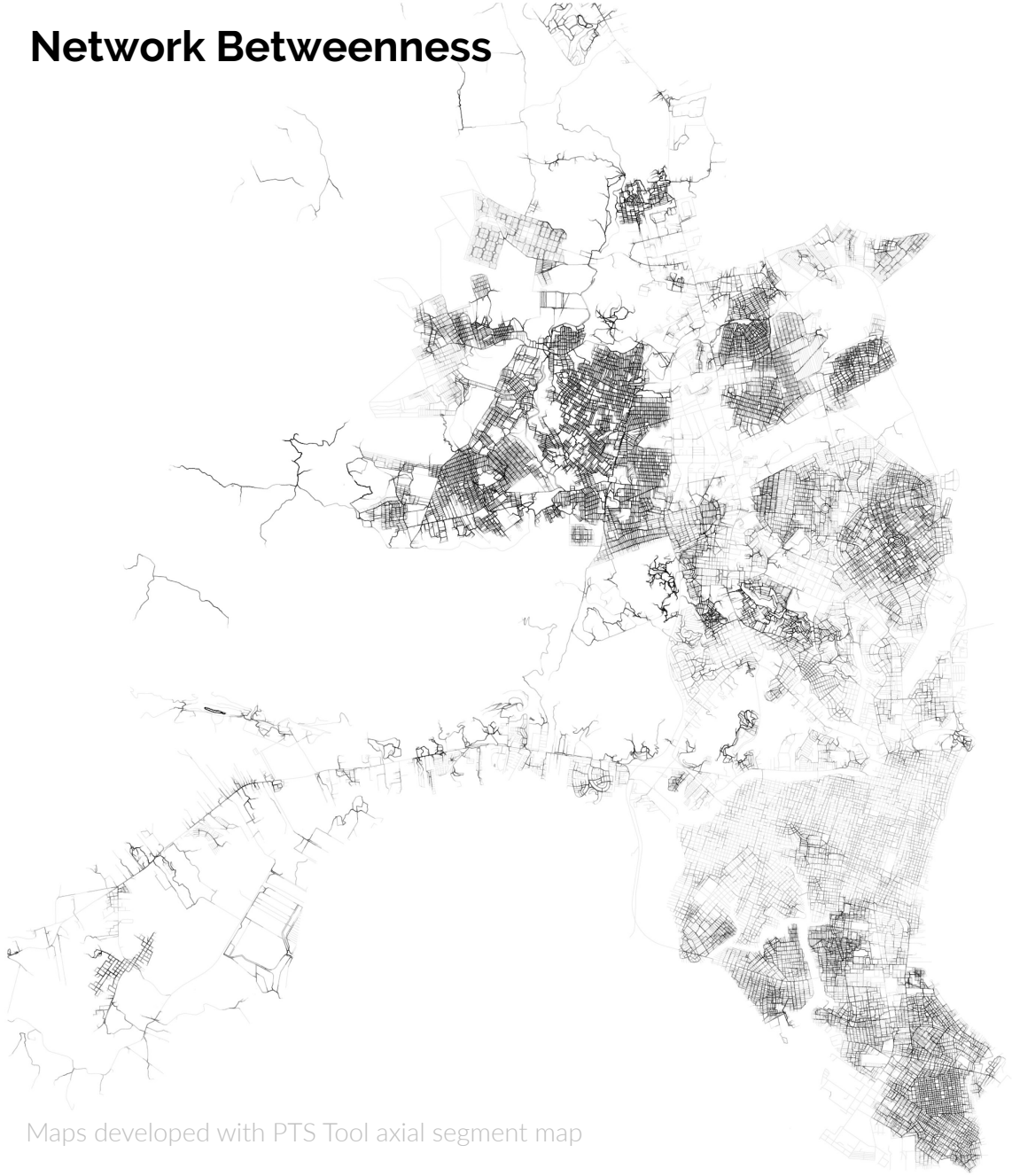
Legend

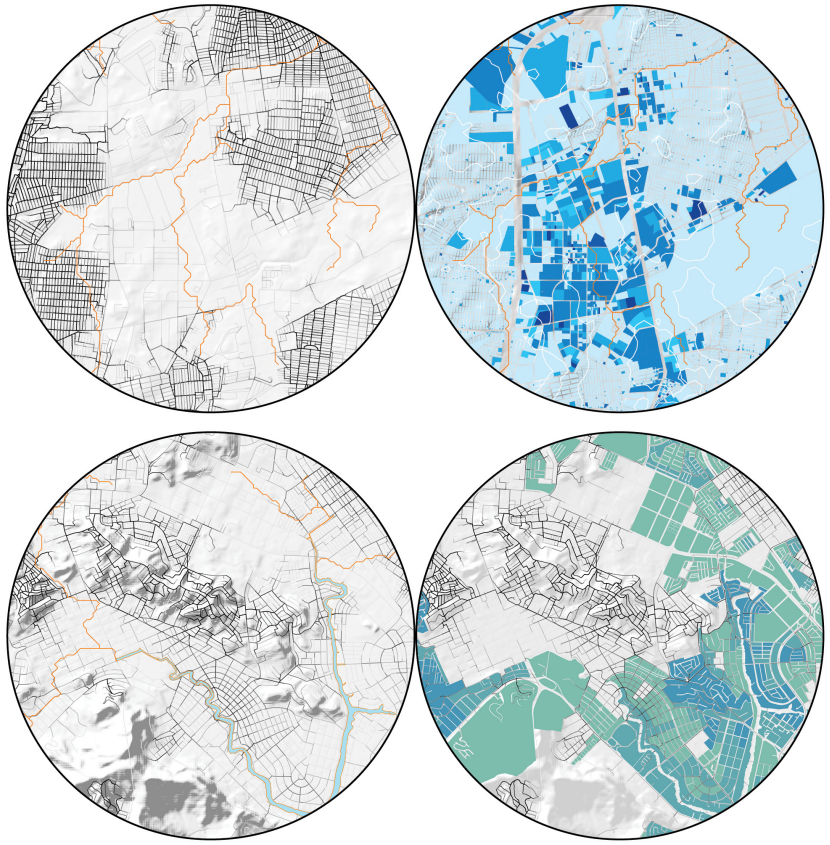
Socio - Economic index

- Underprivileged
- Priviliged

Maps developed with PTS Tool axial segment map

Network Betweenness

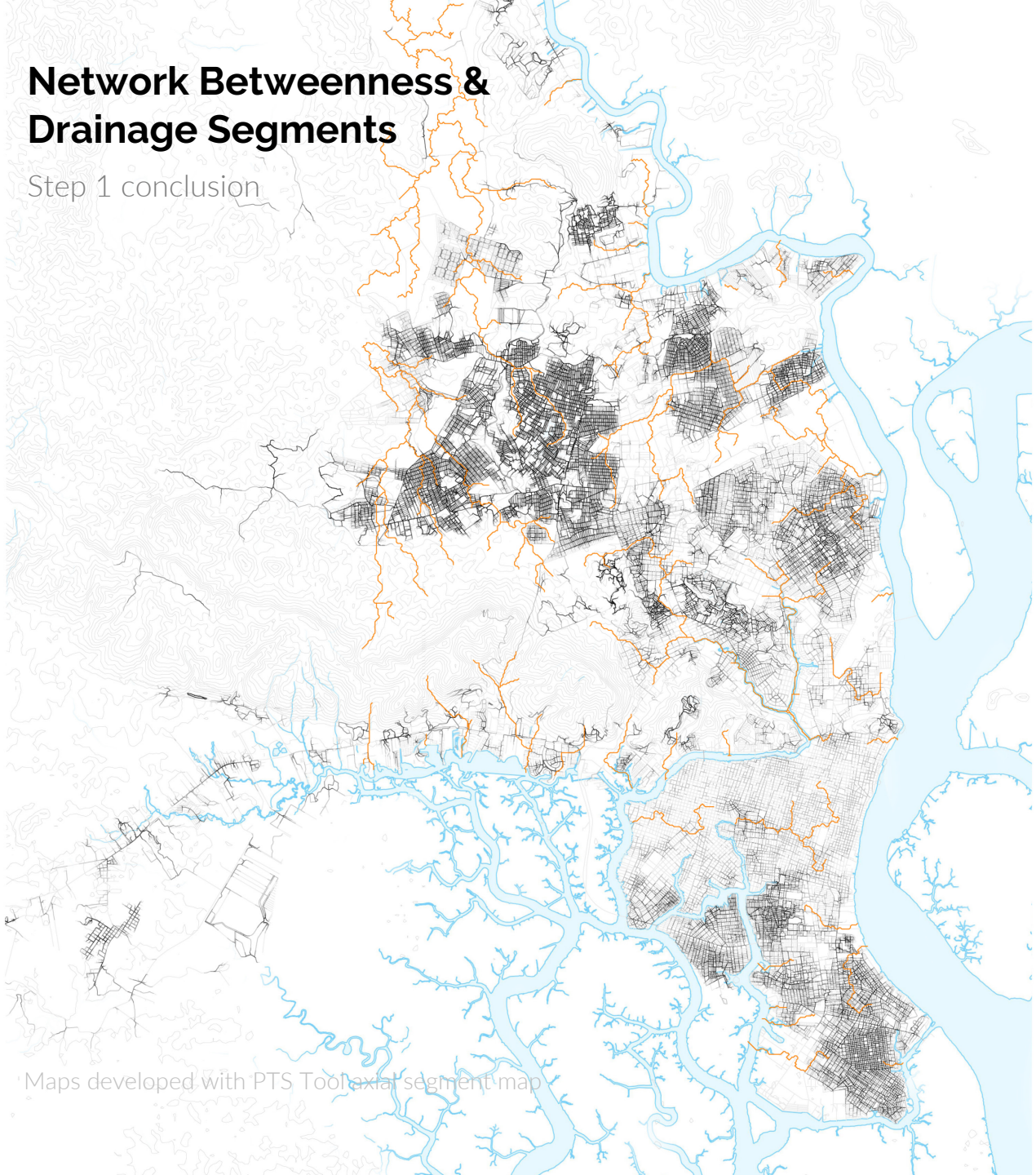




Maps developed with PTS Tool axial segment map

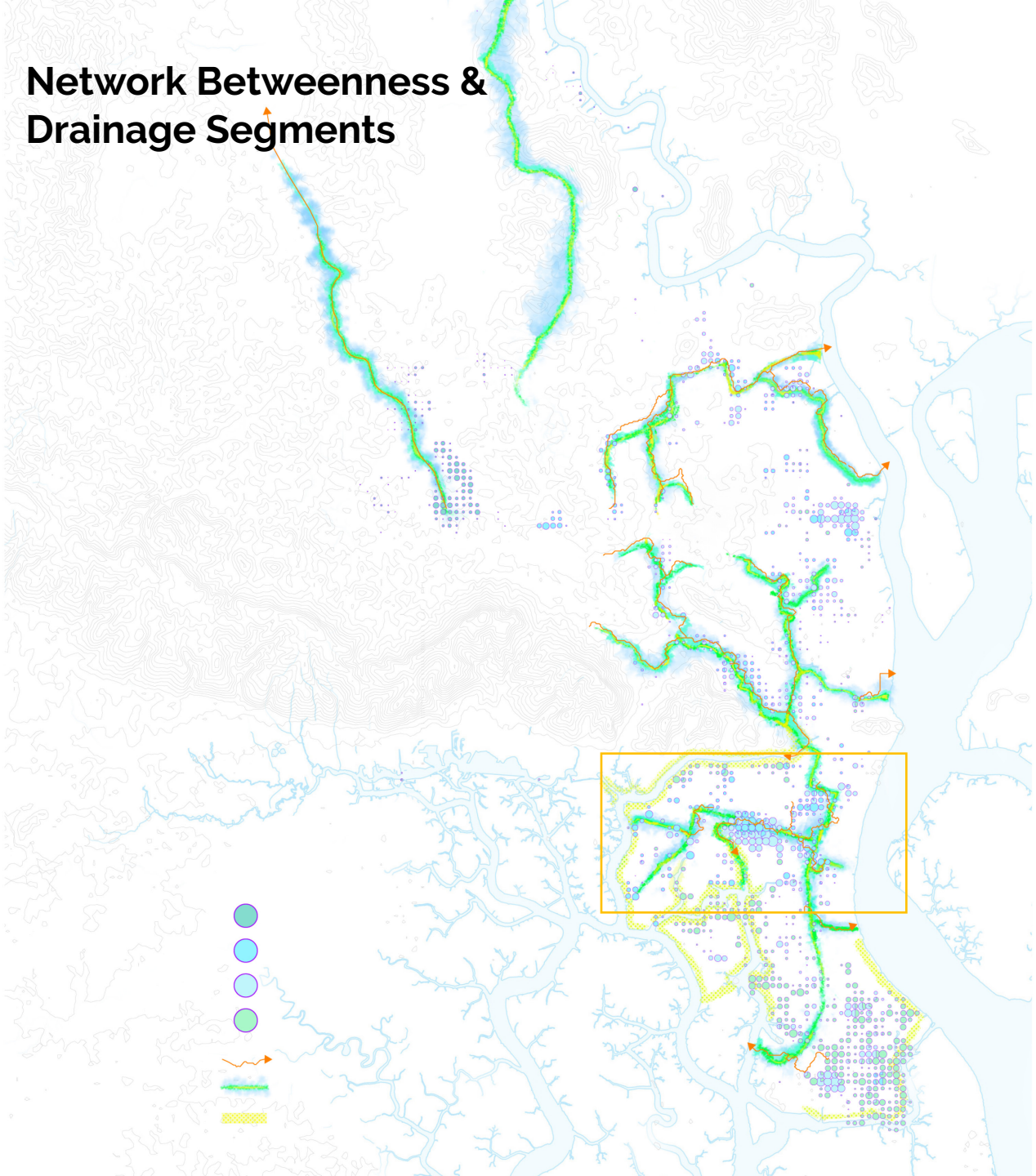
Network Betweenness & Drainage Segments

Step 1 conclusion

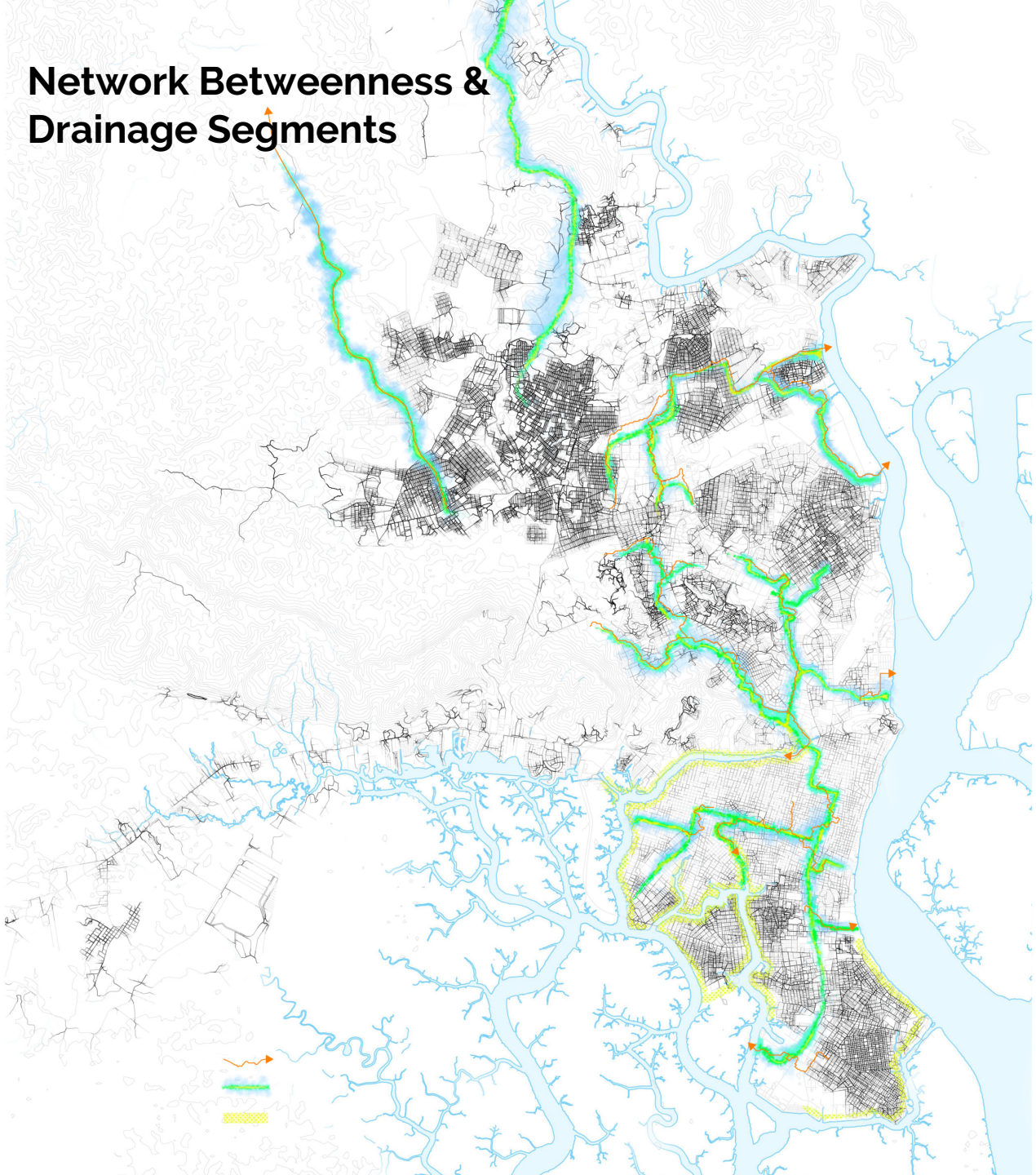


Maps developed with PTS Tool axial segment map

Network Betweenness & Drainage Segments



Network Betweenness & Drainage Segments



Network betweenness

Fragmentation on 2 sides of sea branch

Legend

Network Betweenneess - 500m range

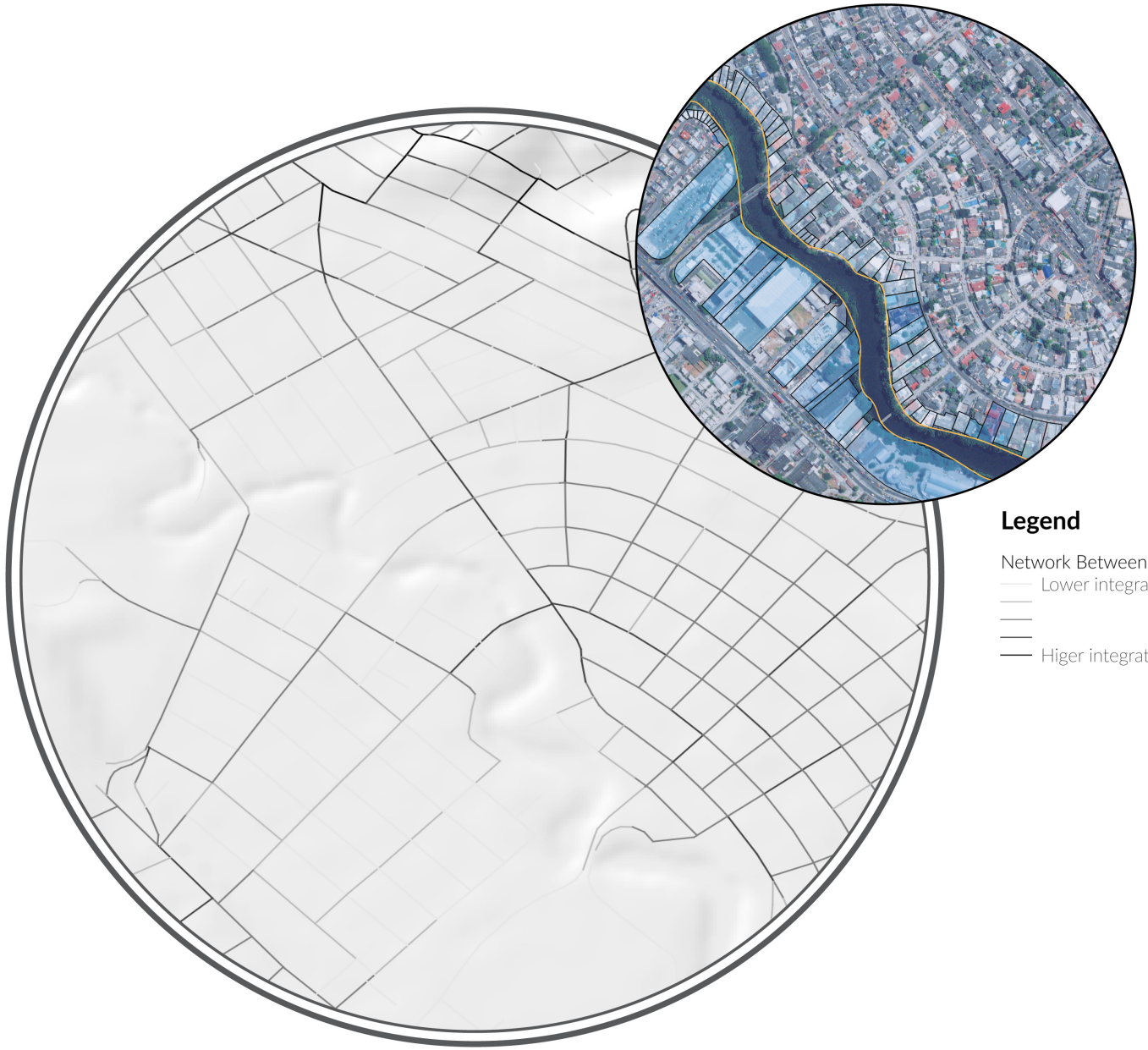
Lower integration

Higer integration

Maps developed with PTS Tool axial segment map

Network betweenness

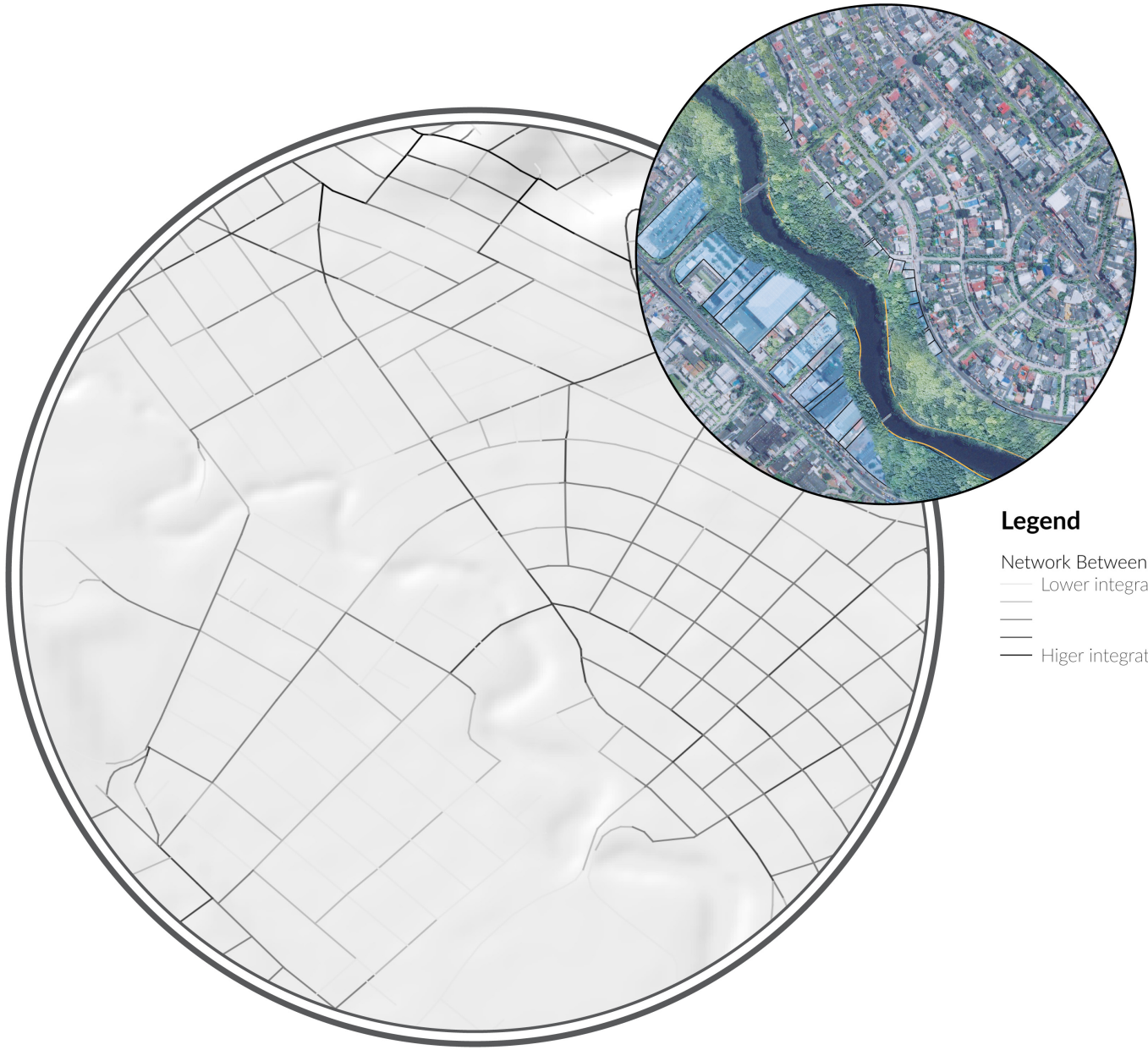
Fragmentation on 2 sides of sea branch



Maps developed with PTS Tool axial segment map

Network betweenness

Fragmentation on 2 sides of sea branch



Legend

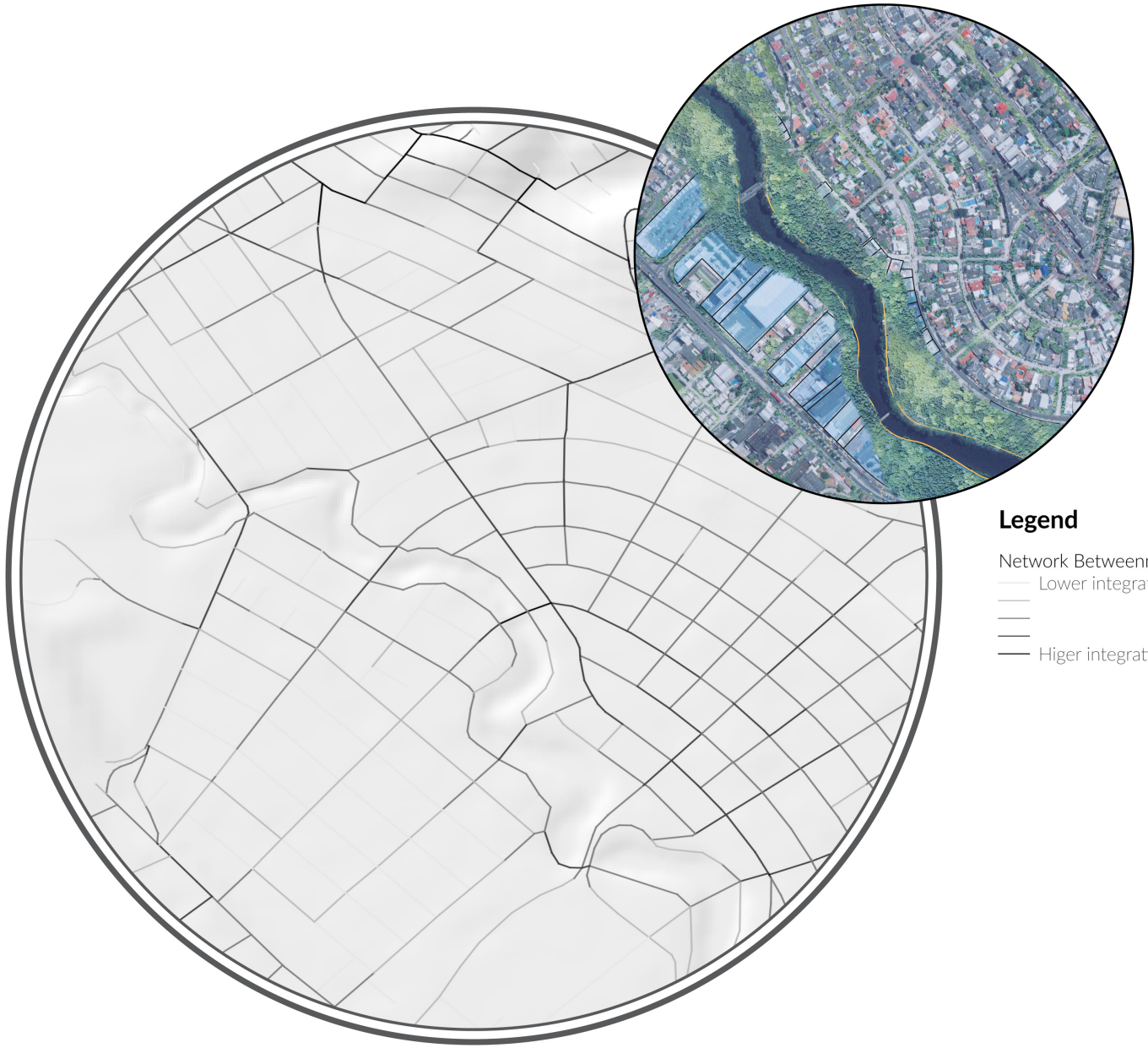
Network Betweenneess - 500m range

Lower integration

Higer integration

Maps developed with PTS Tool axial segment map

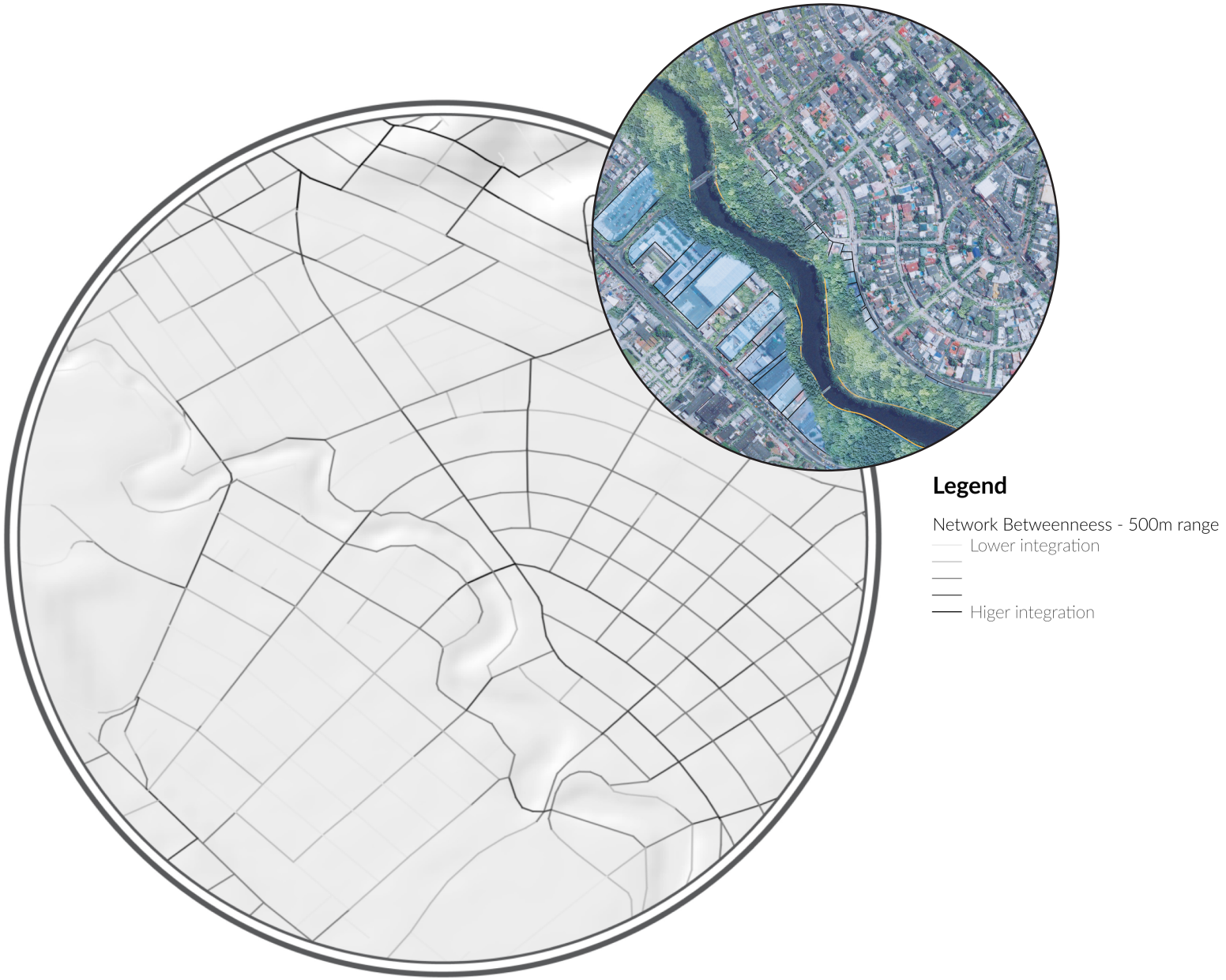
Network betweenness



Maps developed with PTS Tool axial segment map

Network betweenness

Similarly develop for entire city

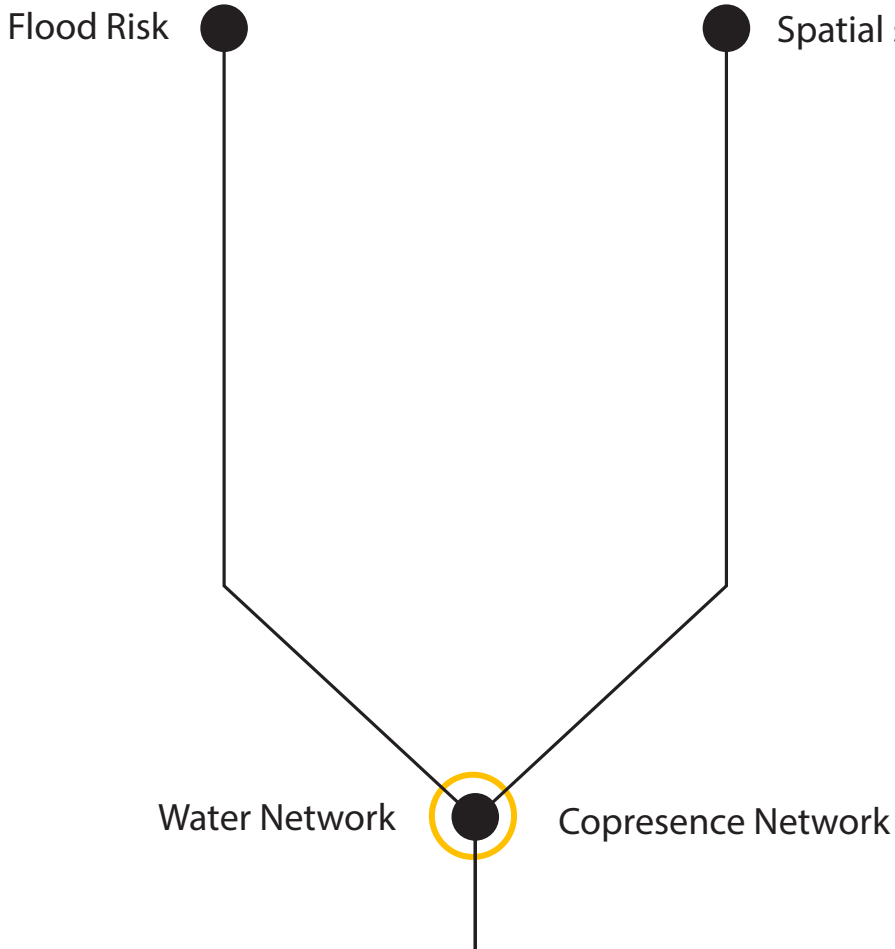


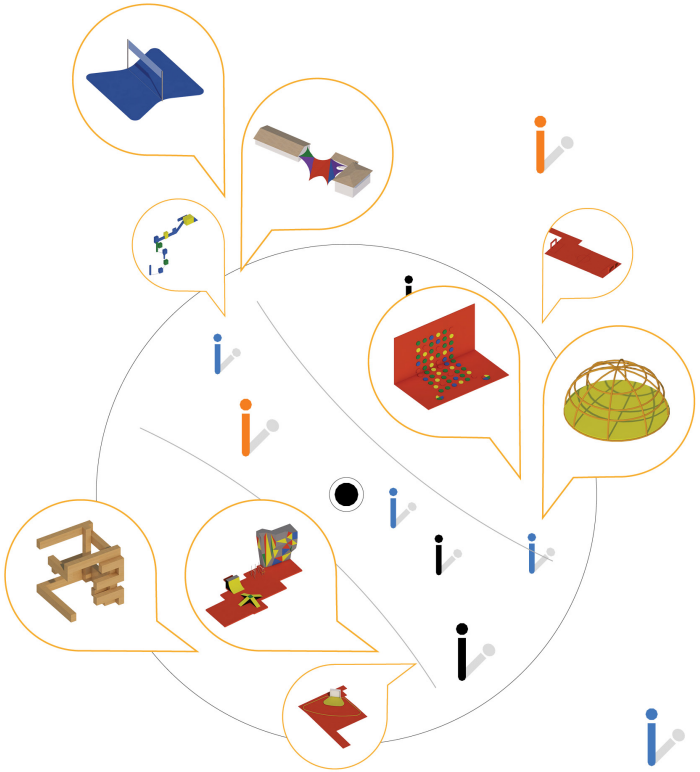
Maps developed with PTS Tool axial segment map

Further Steps

At core of interaction, participants develop single focus of attention

Co-presence is necessary but no sufficient toward interaction outcomes. (Collins)



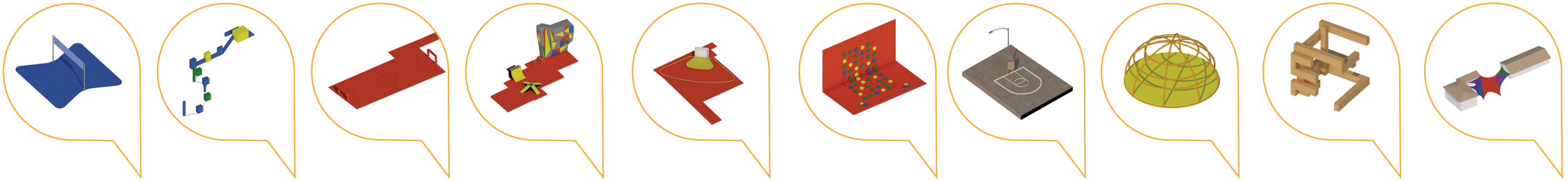


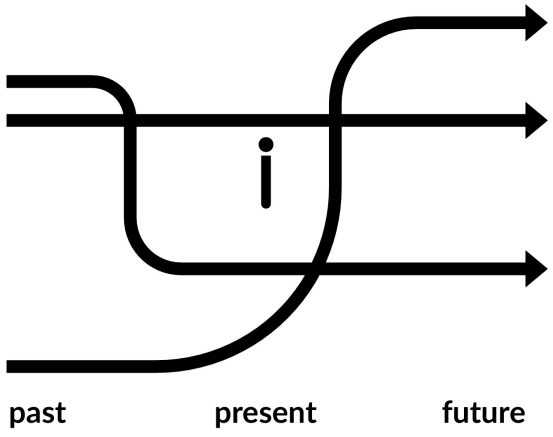
Need for activators able to trigger a single focus of attention

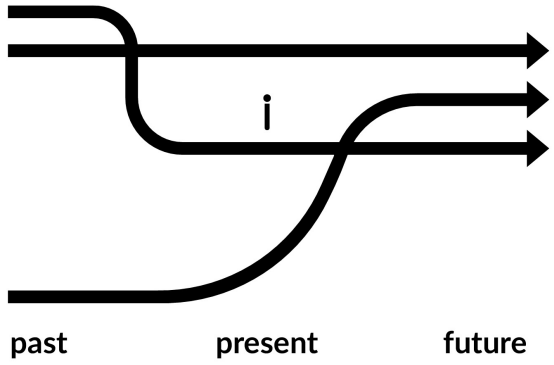
Interaction – Single focus of attention

Implemented in Europe and Australia

"Playing Sports and participating in physical recreation offers important opportunities to enhance health and wellbeing…participation can offer a social and political space in which to cultivate cultural diversity and promote social inclusion" (Cortis, Pooja, & Muir, 2007)



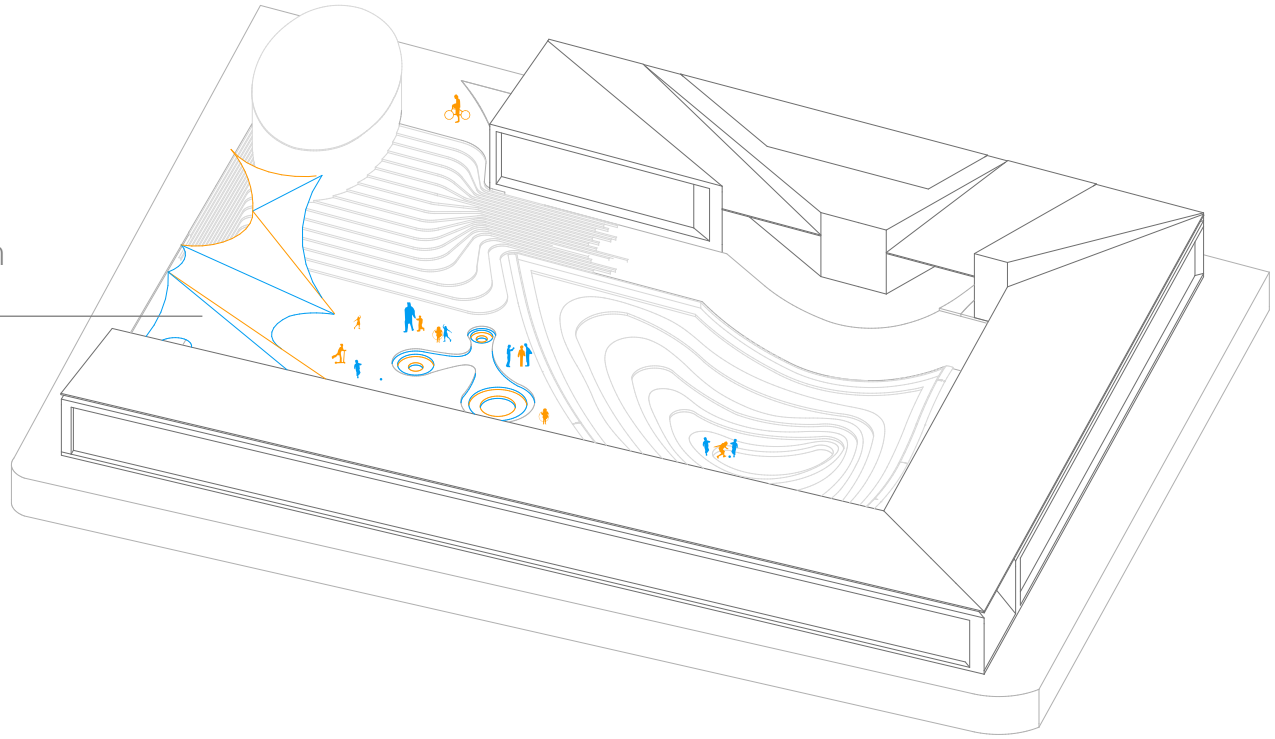




Interaction – Single focus of attention

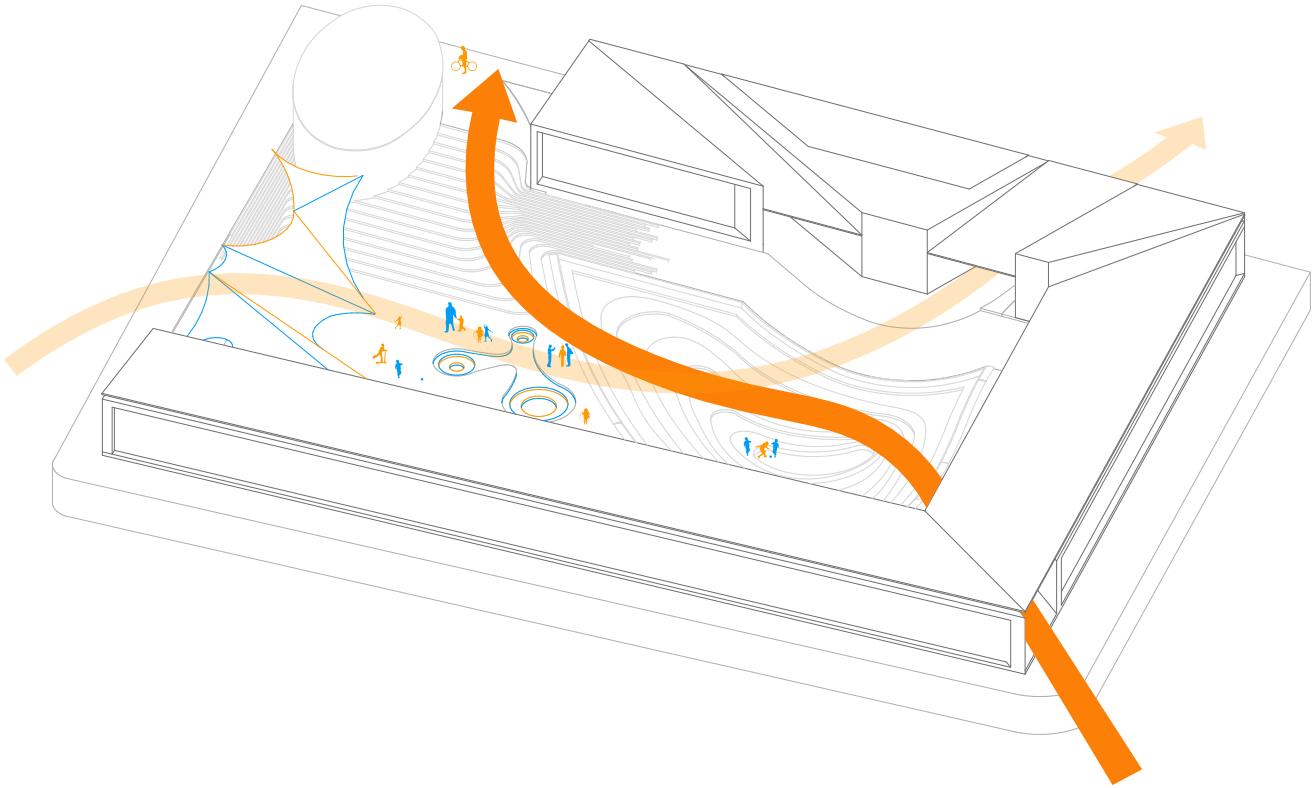
Public space – off education hours
For locals and non- locals passing by

Central focus of attention

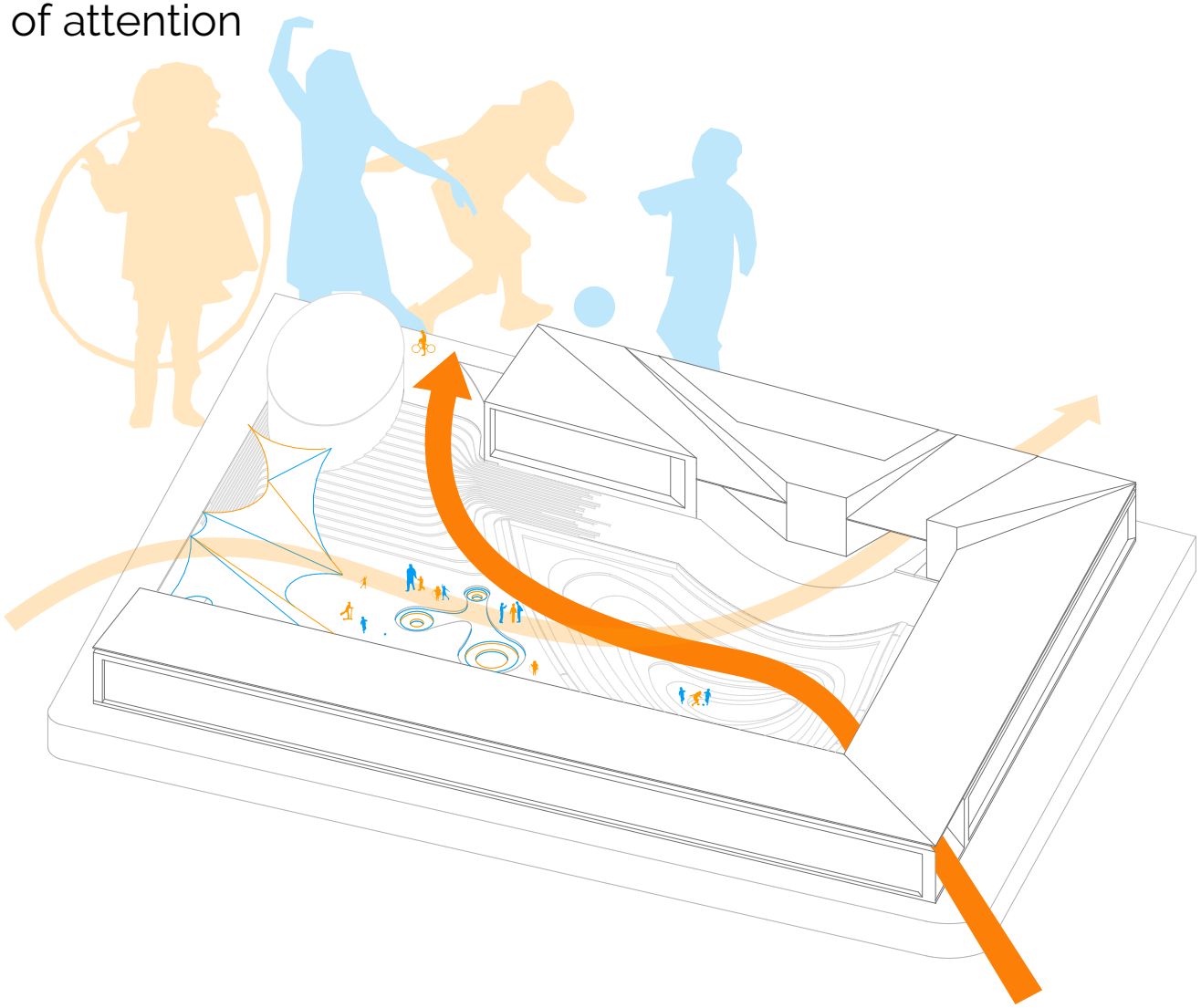


Interaction – Single focus of attention

Public space – off education hours



Interaction – Single focus of attention



Central nodes

Central nodes surrounded by activators

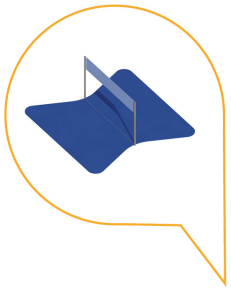
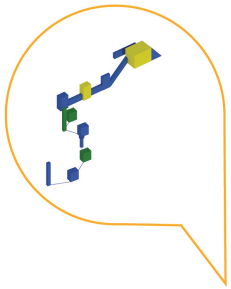
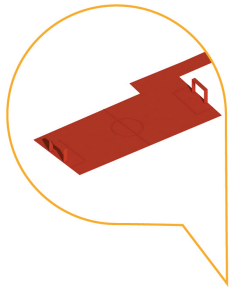
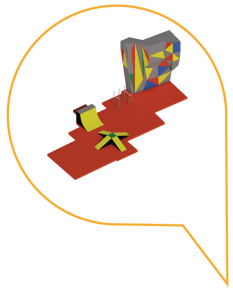
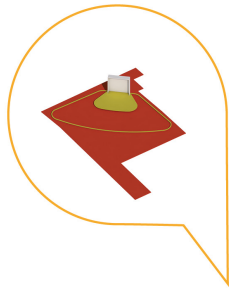
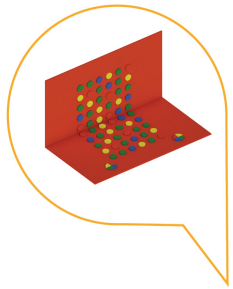
Revolve around central focus

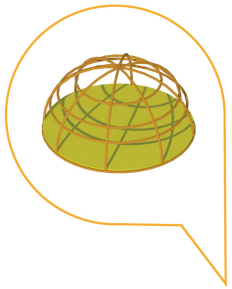
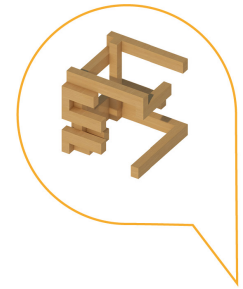
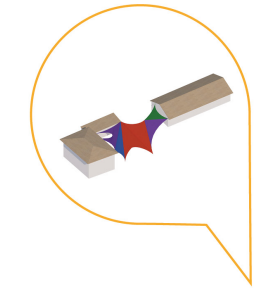
Interaction – Activator

sports

urban gamification

playground

adults

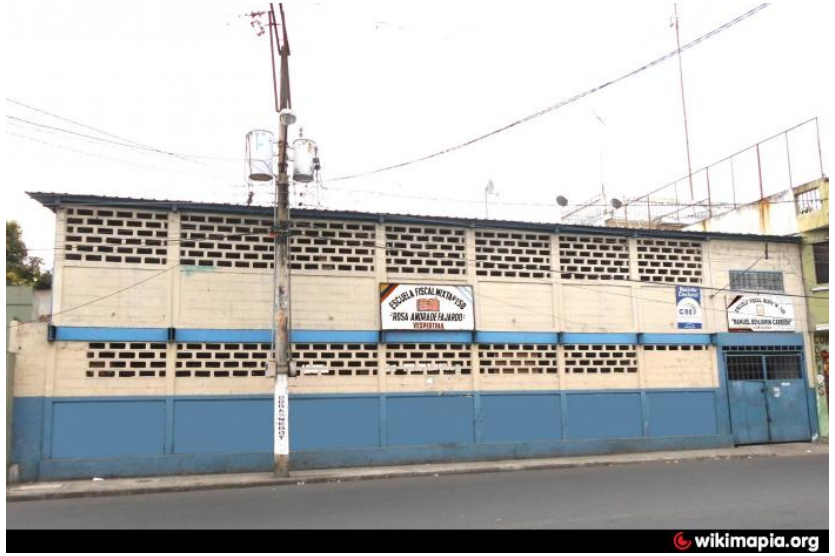
young people

kids

Design Area

Design Area

Area of intervention

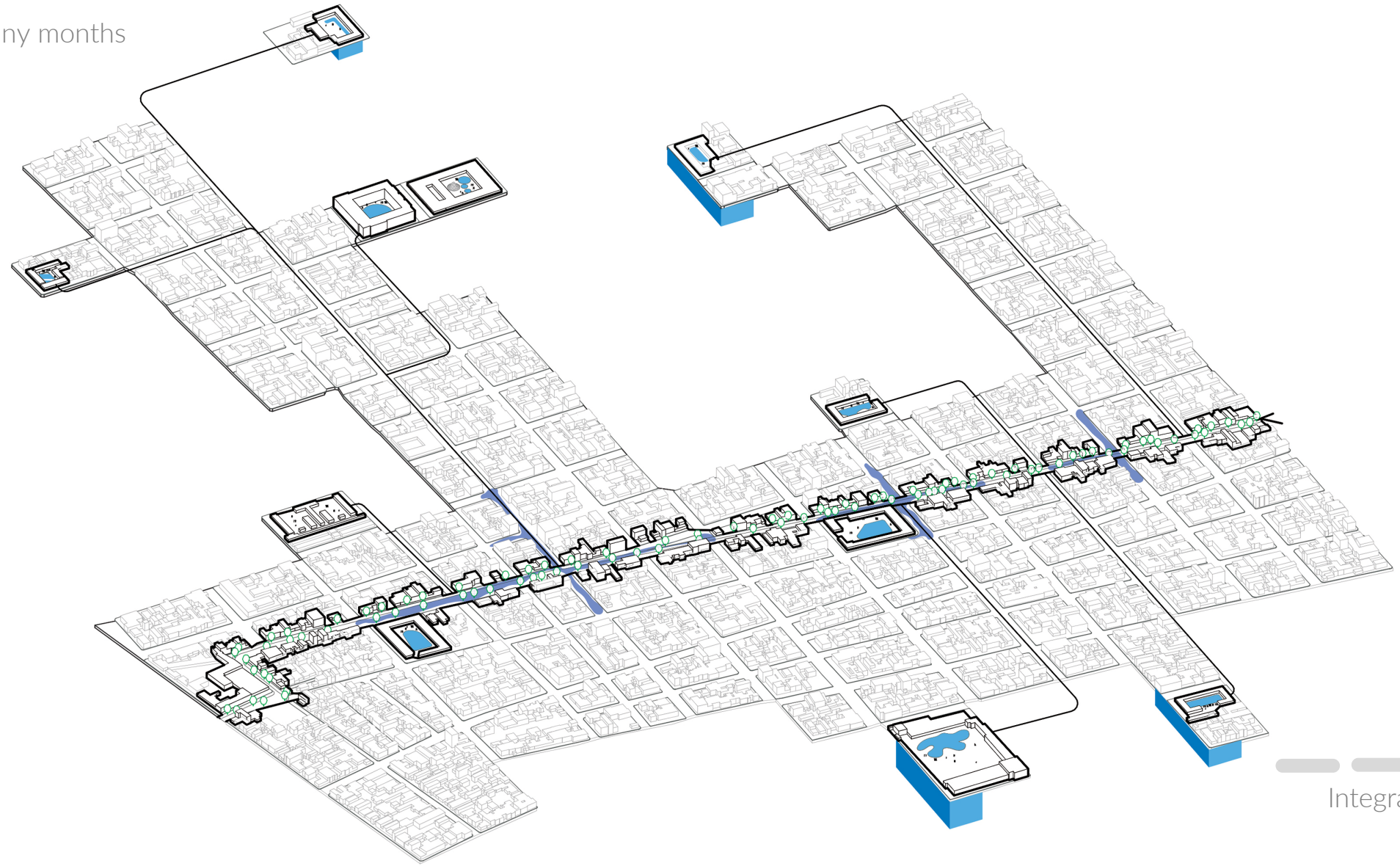


Design Area

Schools to become central storage

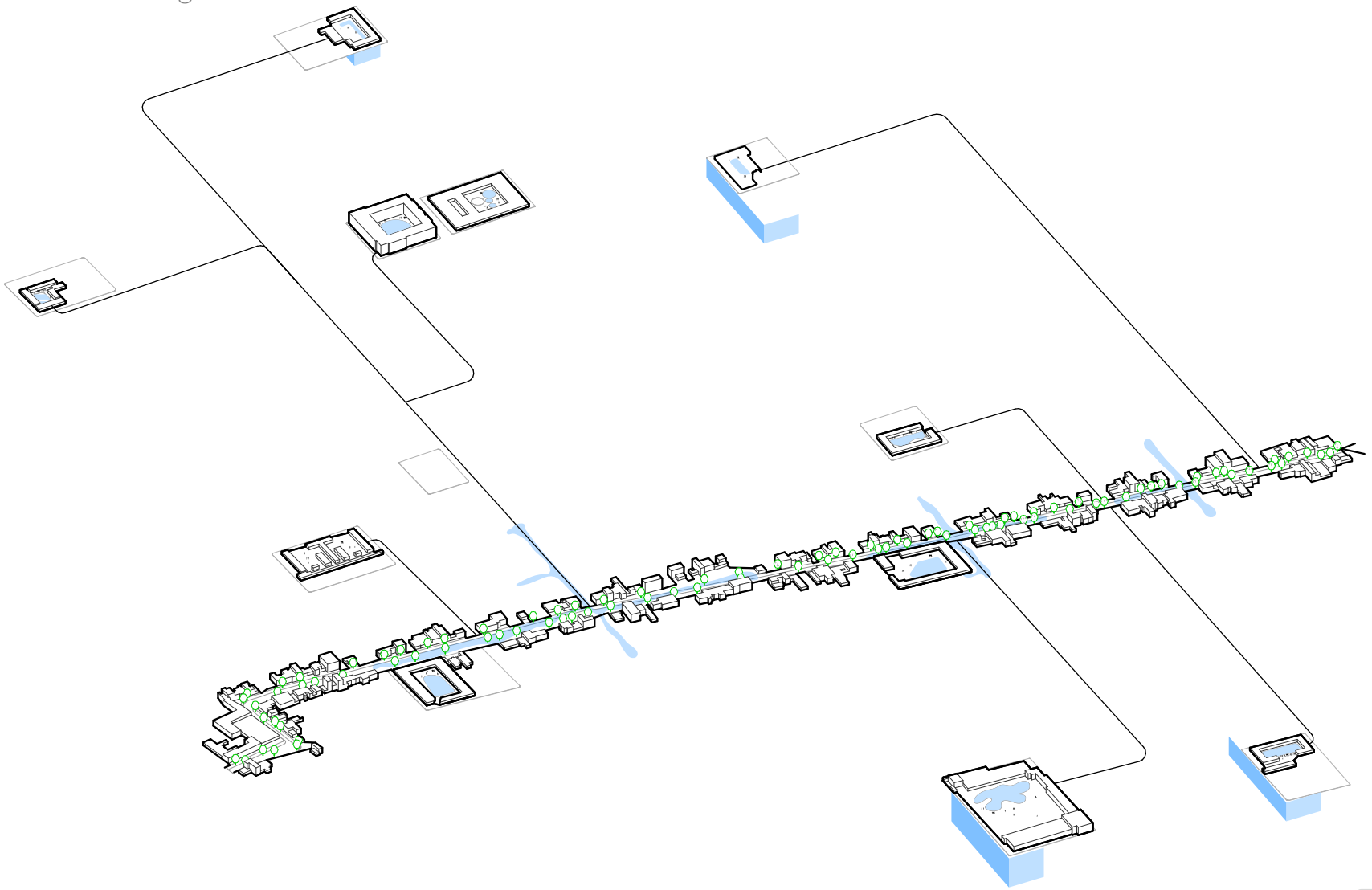
Concavely depressed areas

Available in rainy months



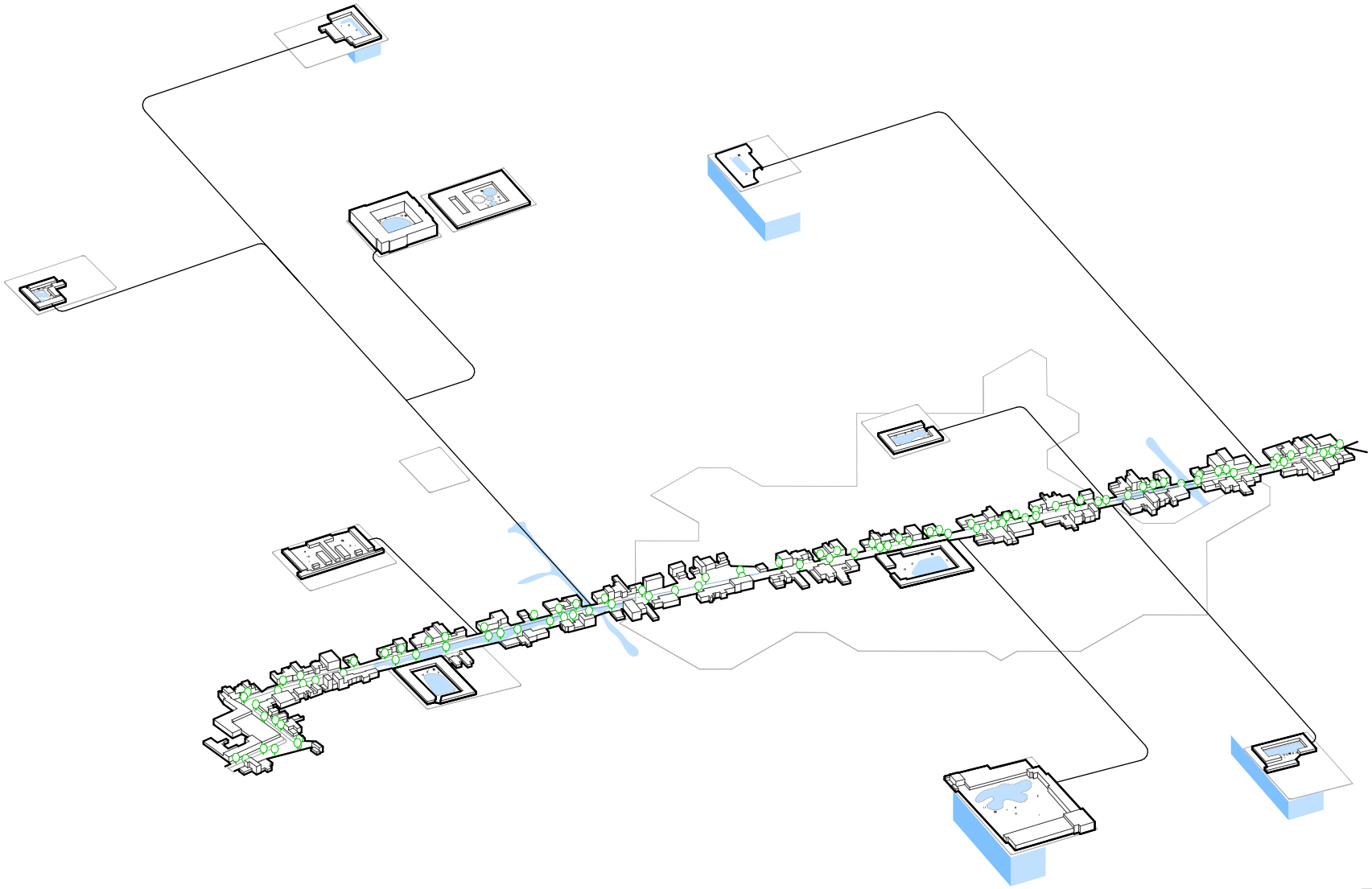
Design Area

Immersed in Green & Blue taking water in&out

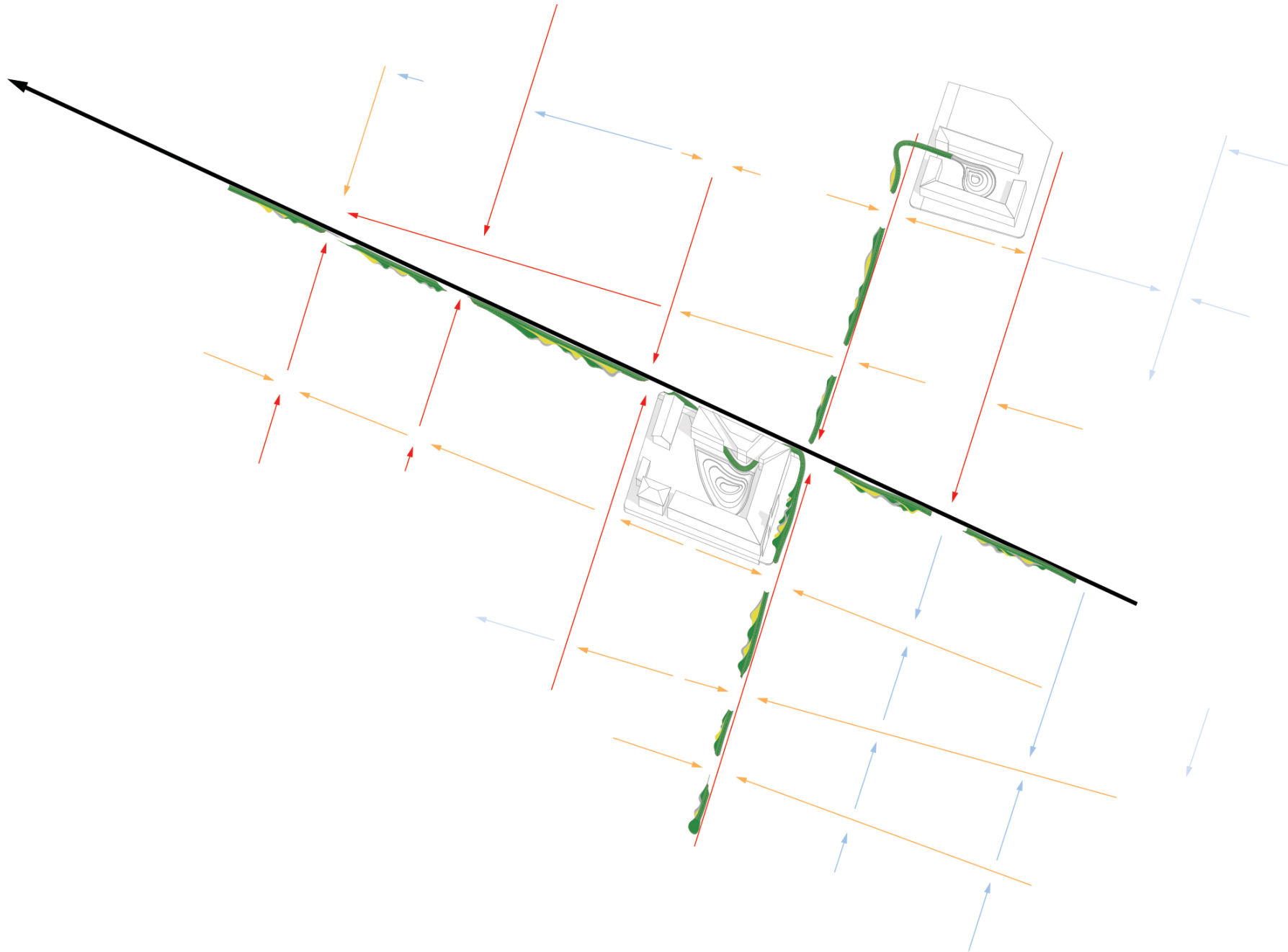


Design Area

Area of intervention



Bio swale



Design Area

Area of intervention

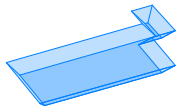
Intensity (mm/hours)	Duration (hours)					
Return period	1	2	4	8	12	24
2 years	49,9	35,4	21,9	12,5	9	5,1
5 years	58,9	42,8	26,5	15,1	10,9	5,3
10 years	66,2	48,3	29,9	17,1	12,3	7,1
25 years	76,2	55,5	34,4	19,6	14,2	8,2
50 years	84,1	60,9	37,7	21,5	15,7	9,1
100 years	92,3	66,3	41,1	24,1	17,1	9,9

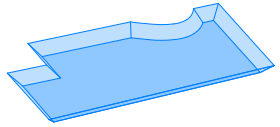
Source: Molenaar, F., Pak, T., de Pous, H., & van der Werff, B.-J. (2018). Flood Prevention Guayaquil. Delft: TU Delft Repository.

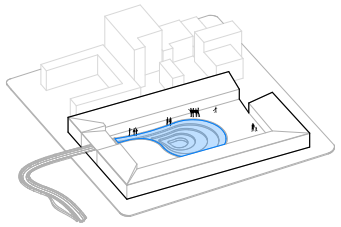
	Total of Surplus in m3	Total	Area Schools	m of Depression Storage
Rp=2_2Hours	3.758,27	7.516,53	2500	3,01
Rp=2_4Hours	1.628,94	6.515,77		2,61
Rp=10_2Hours	5.787,73	11.575,47		4,63
Rp=10_4Hours	2.252,46	9.009,84		3,60
Rp=100_2Hours	8.681,67	17.363,33		6,95
Rp=100_4Hours	3.314,65	13.258,60		5,30

Surplus water= Rain - Absorption - storage capacity

Source: Van de Ven, F., Hooijmeijer, F., & Aalbers, K. (2018). BK3TE4 ST water flow calculation sheet.







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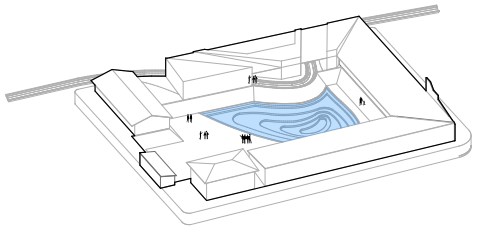
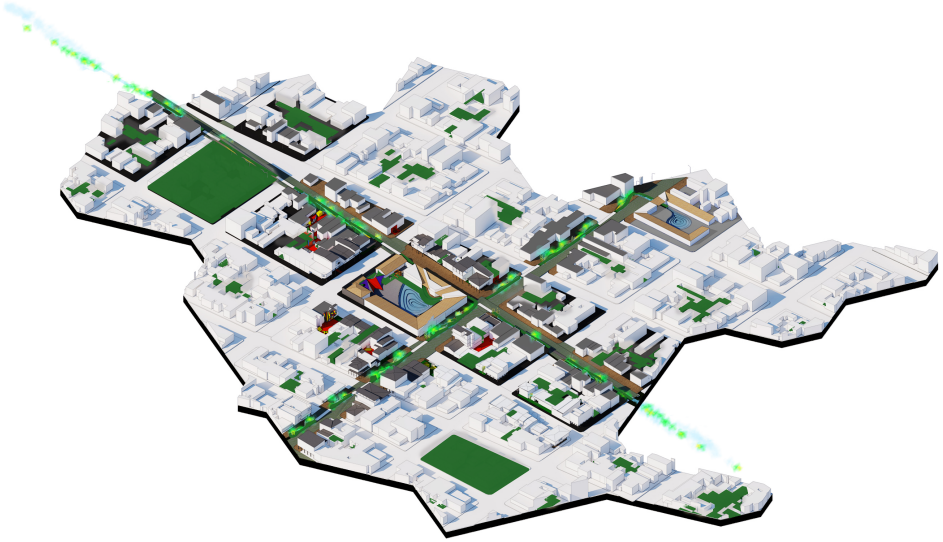


= **8.147 m3**

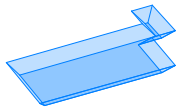
Design Area

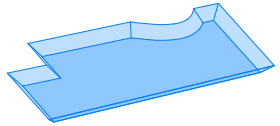
3,29m of storage

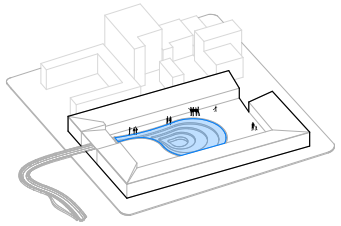


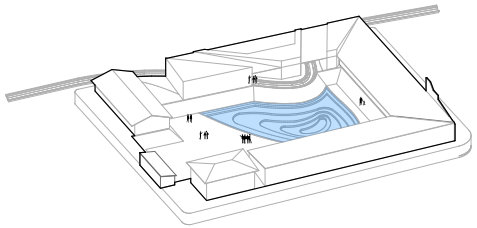
	Areas in Case A	Adjustement	Porcentaje of unpaved	Adjusted surfce	Improved areas. Case B	Incoming water	Surplus water
Garden open soil (private)	2.930,90	1	42%	2.930,90	24.935,02	82,29	82,29
public							
Surface water	-						
Rain garden, infiltration field	-						
Lawn, green belt, shrub (public)	1.706,26	1	24%	1.706,26	14.516,23	47,90	47,90
Playground, footpath	-						
Vegetated swales	2.373,09	1	34%	2.373,09	20.189,38	369,47	369,47
			Porcentaje of total		Rested area		
PAVED							
private							
Roofs – sloping	77.939,83	0,7	48%	54.557,88	54.557,88	2580,59	2580,59
Roofs – flat, tar	-						
Green roofs – extensive	-						
Green roofs – intensive	-						
Garden tiled	8.394,45	0		-	-	0,00	0,00
public							
Roads, car parks – asphalt	-		0%				
Roads, car parks – porous asphalt	46.881,15	0,7		32.816,81	32.816,81	567,73	567,73
Roads, car parks – brick	-						
Roads, car parks – porous pavement	-						
Sidewalk, terraces –tiles	22.632,10	0,7	14%	15.842,47	15.842,47	464,18	464,18
	162.857,78			**110.227,41**	**162.857,78**	**m3 water**	**4112,16**
						Storage Hight	3,29

Method Source: Van de Ven, F., Hooijmeijer, F., & Aalbers, K. (2018). BK3TE4 ST water flow calculation sheet.



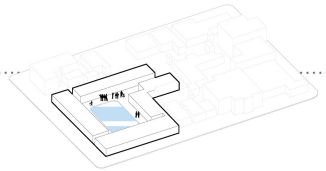
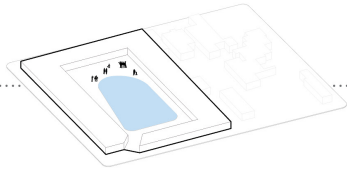
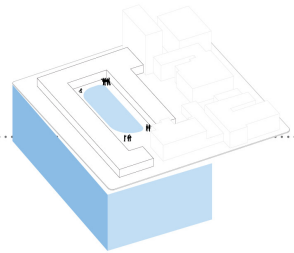
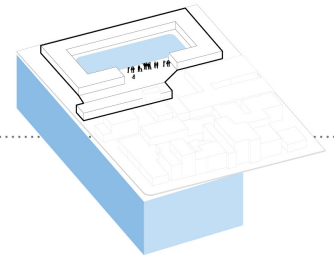
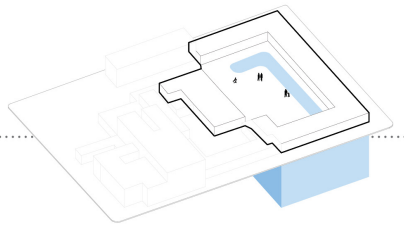
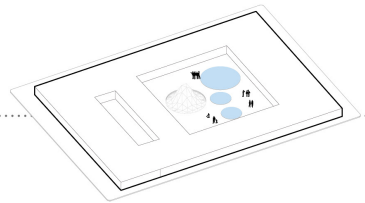
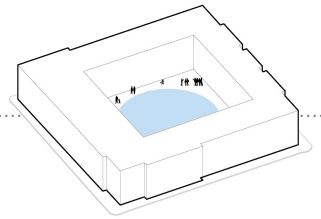
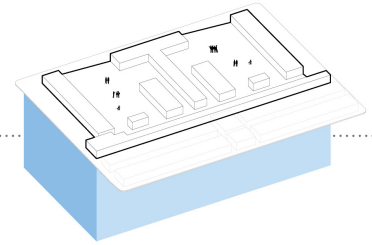
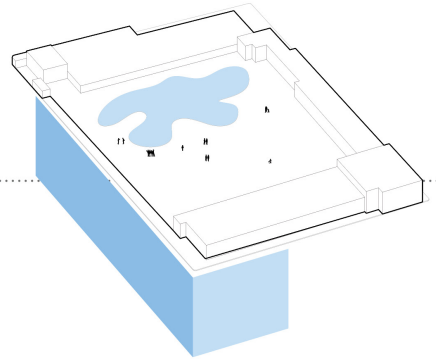
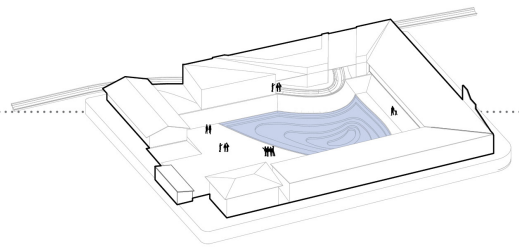


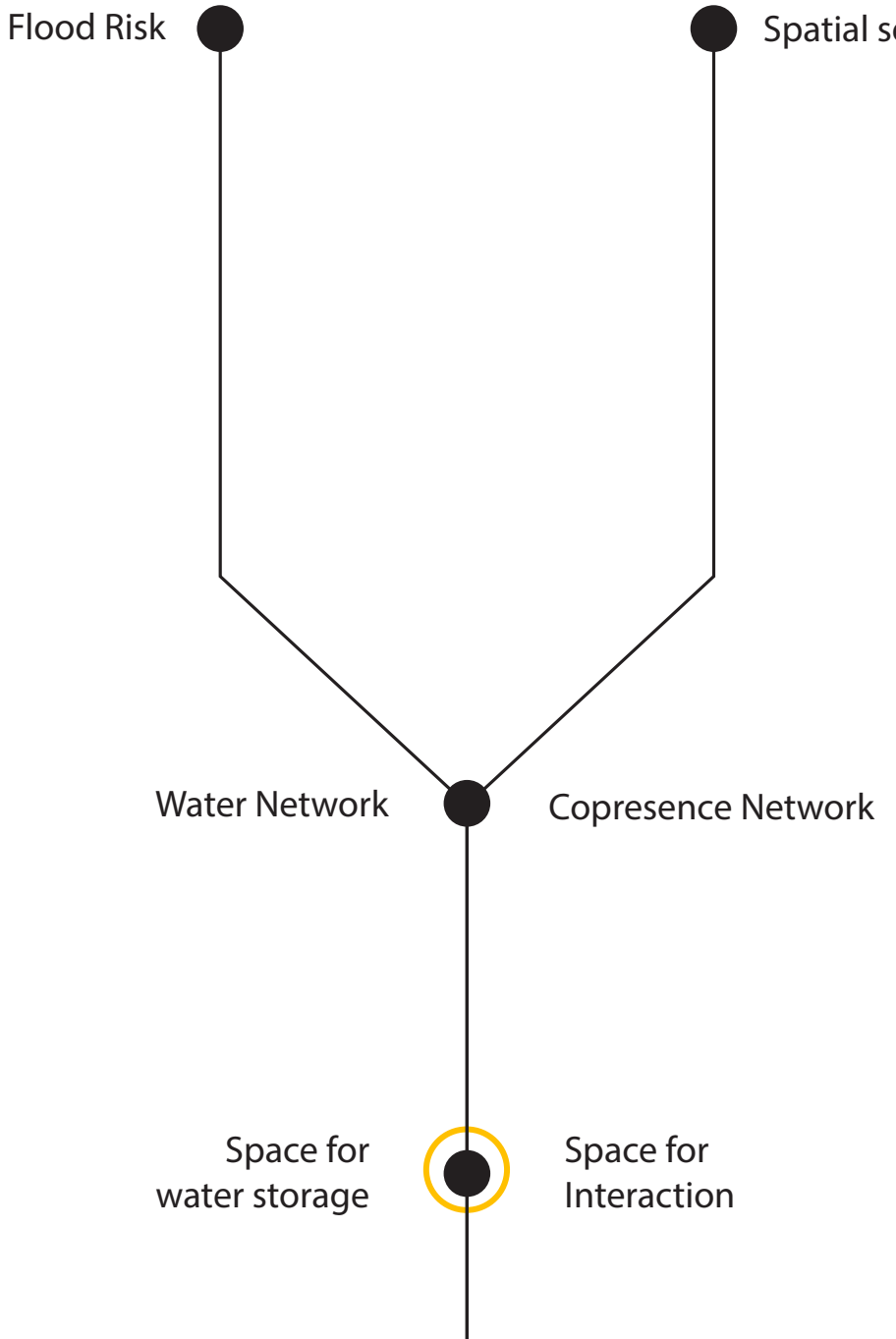




Design Area

Schools can potentially mitigate risk


Flood Risk
Spatial segregation
Water Network
Copresence Network
Space for
water storage
Space for
Interaction

Design Schools for a fair cycle

Scarcity won't have an even impact in society

Rights to water need to be sought after and defended

H2O

Source: Henriquez, L., & Van Timmeren, A. (2017). Under Pressure: Wayer and thr city. Delft: TU Delft & AMS Institute.

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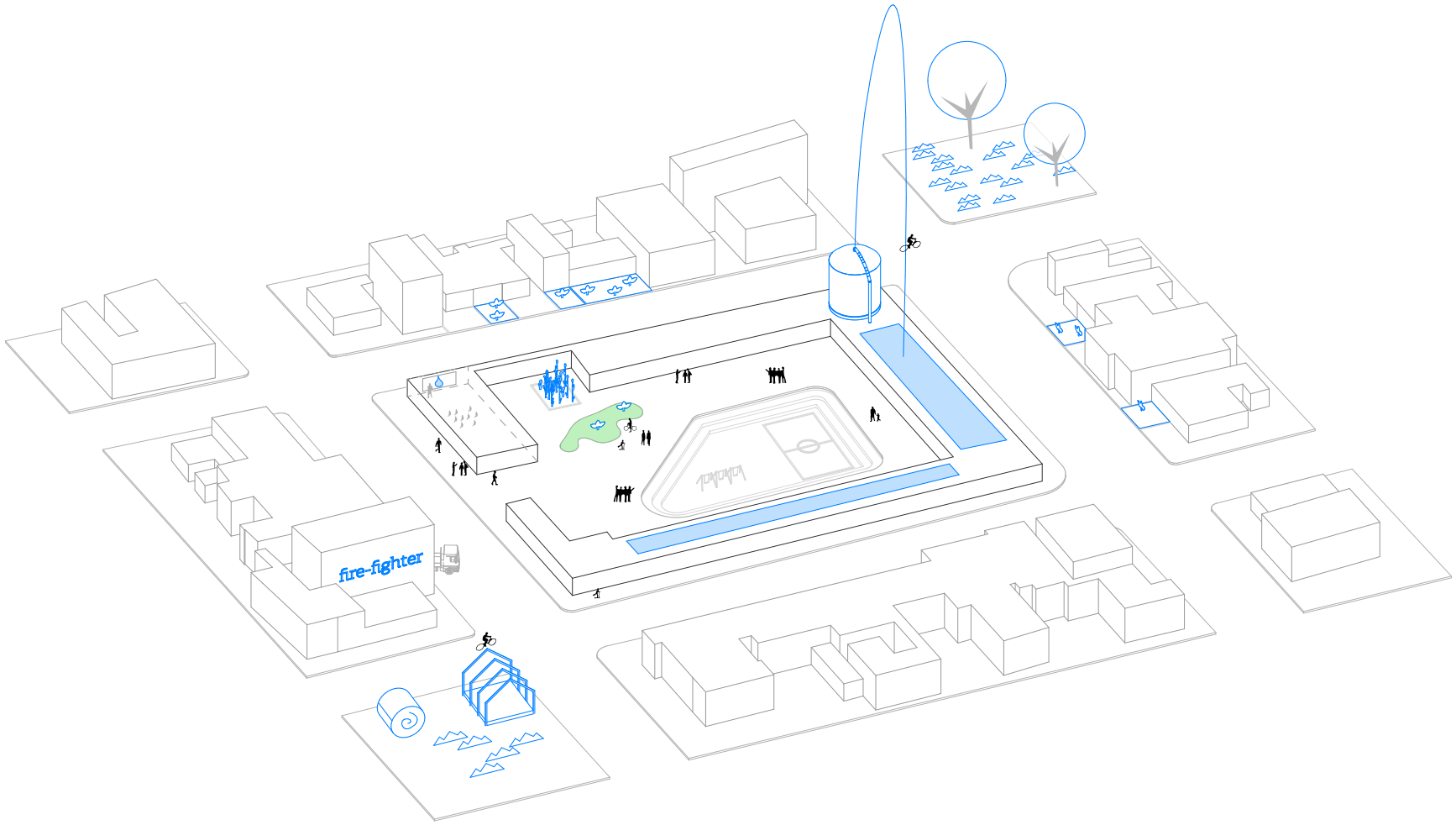
Design Schools for a fair cycle

Spatial Manifestation in the city to maintain the rights for water



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Spatial Manifestation in the city to
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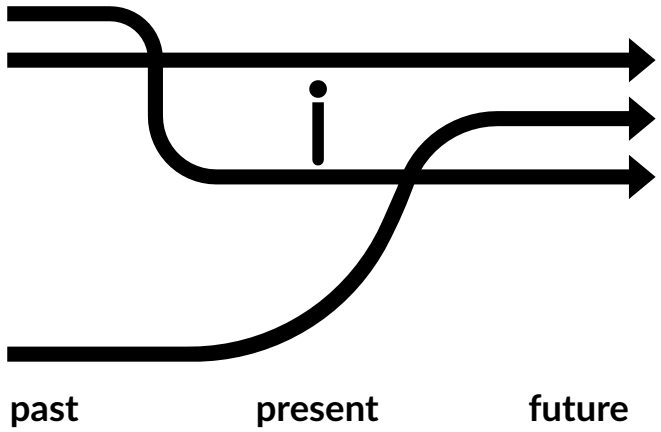
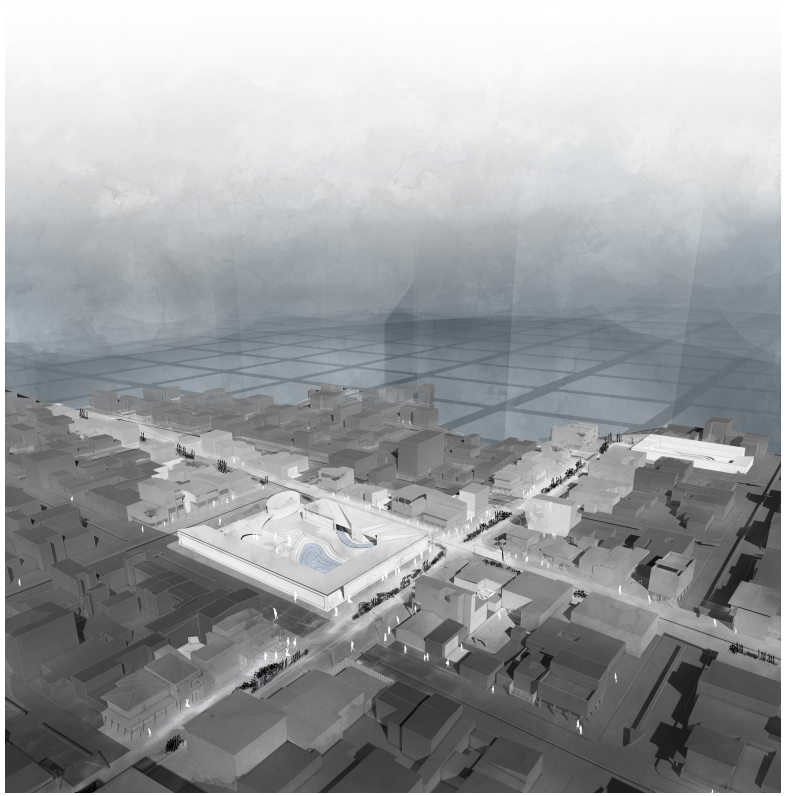
Collaboration





Thank you!!

INTEGRATED MITIGATION

Flood Risk mitigation fostering Social Integration

Transitional Territories studio

FRANCISCO MONSALVE

1st mentor: Fransje Hooimeijer

2nd mentor: Taneha Kuzniecow Bacchin