



# risk, resettlement, & renewal

*geneviève mae shymanski*

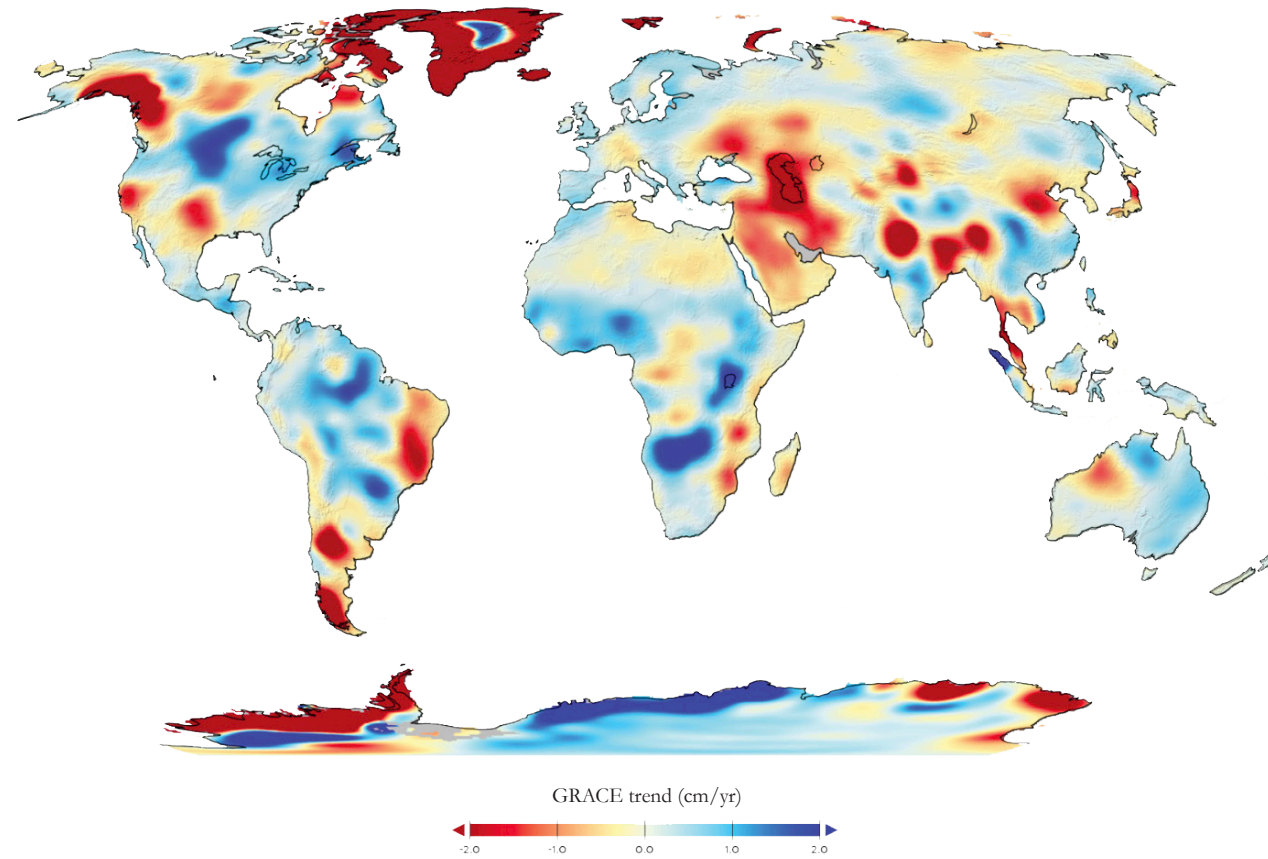
*Global Housing Graduation Studio - São Paulo: Repair and Consolidate*

*TU Delft*

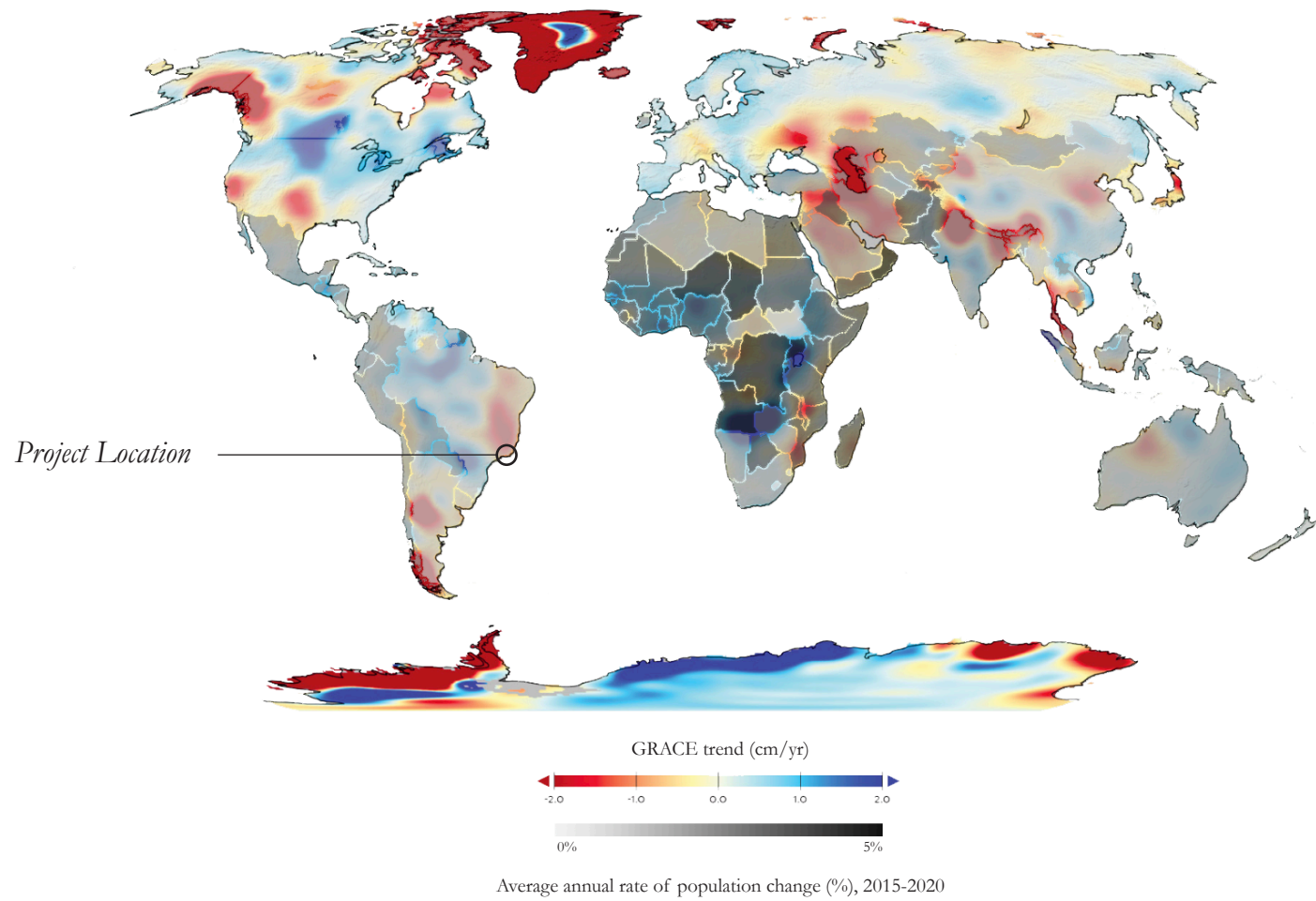
*November 9th, 2023*

## introduction

*Resource Scarcity vs Urban Growth*



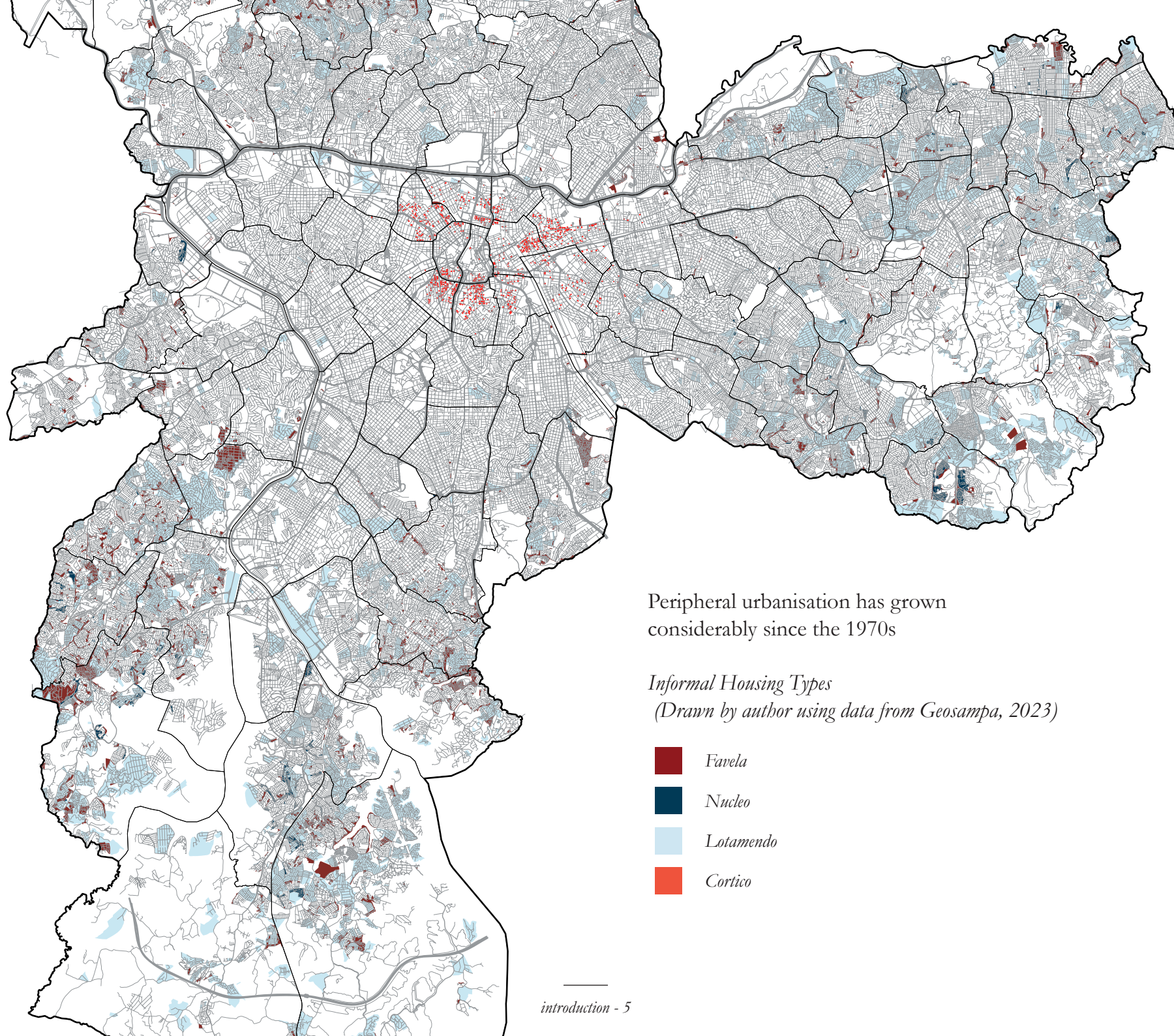
*Global freshwater availability trends from 2002 to 2016 (Famiglietti, 2019)*



*Population growth rate (Overlay drawn by author using data from the United Nations, 2019)*



*São Paulo, Brazil - the 4th largest city in the world with over 11 million residents as of 2020 (Google Earth, 2023)*



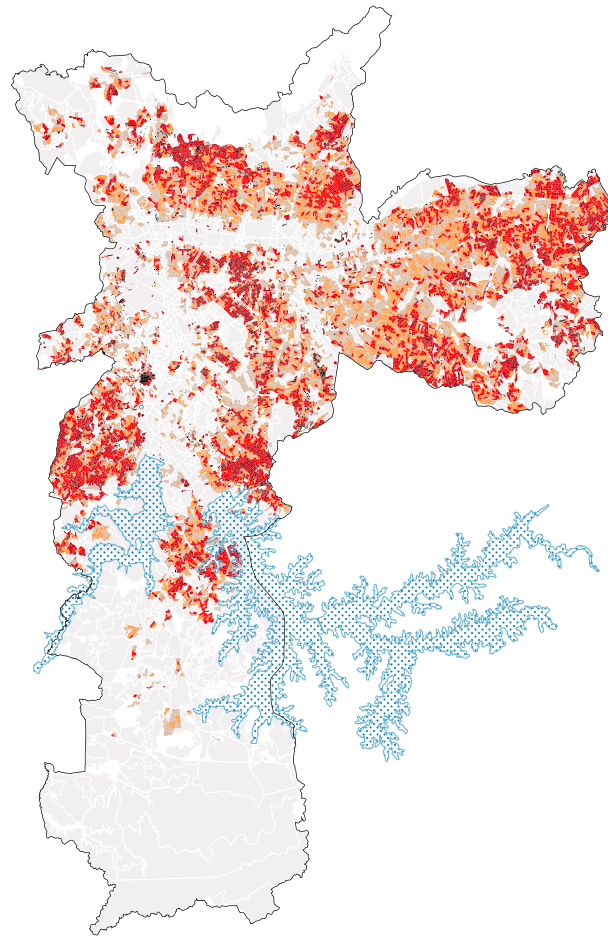
Peripheral urbanisation has grown considerably since the 1970s

*Informal Housing Types  
(Drawn by author using data from Geosampa, 2023)*

- Favela*
- Nucleo*
- Lotamendo*
- Cortico*



*Informal Settlements in the peripheries of São Paulo*  
*Images by author, 2022*



Over 2 million people live in the Billings and Guarapiranga watershed areas. These two reservoirs are São Paulo's main source for water consumption and energy production.



*Density - inhabitant/ha*  
*(Drawn by author using data from Geosampa, 2023)*

**problem statement**

*Three Challenges*



**water and infrastructure  
scarcity**



**housing instability due to  
environmental risk**



**social impact of development-  
induced displacement**

*Anchieta Neighborhood, Grajaú, São Paulo  
Images by author, 2022*



**problem statement**  
*Water & Infrastructure Scarcity*

Inadequate sewage and sanitation services  
Detrimental to personal health and environmental ecosystems



*Precarious housing without sewage infrastructure  
in Heliópolis, São Paulo (Author, 2022)*

**problem statement**

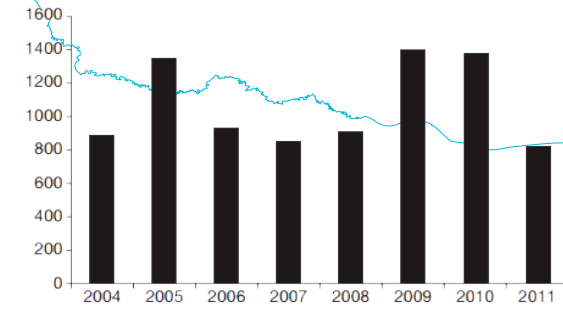
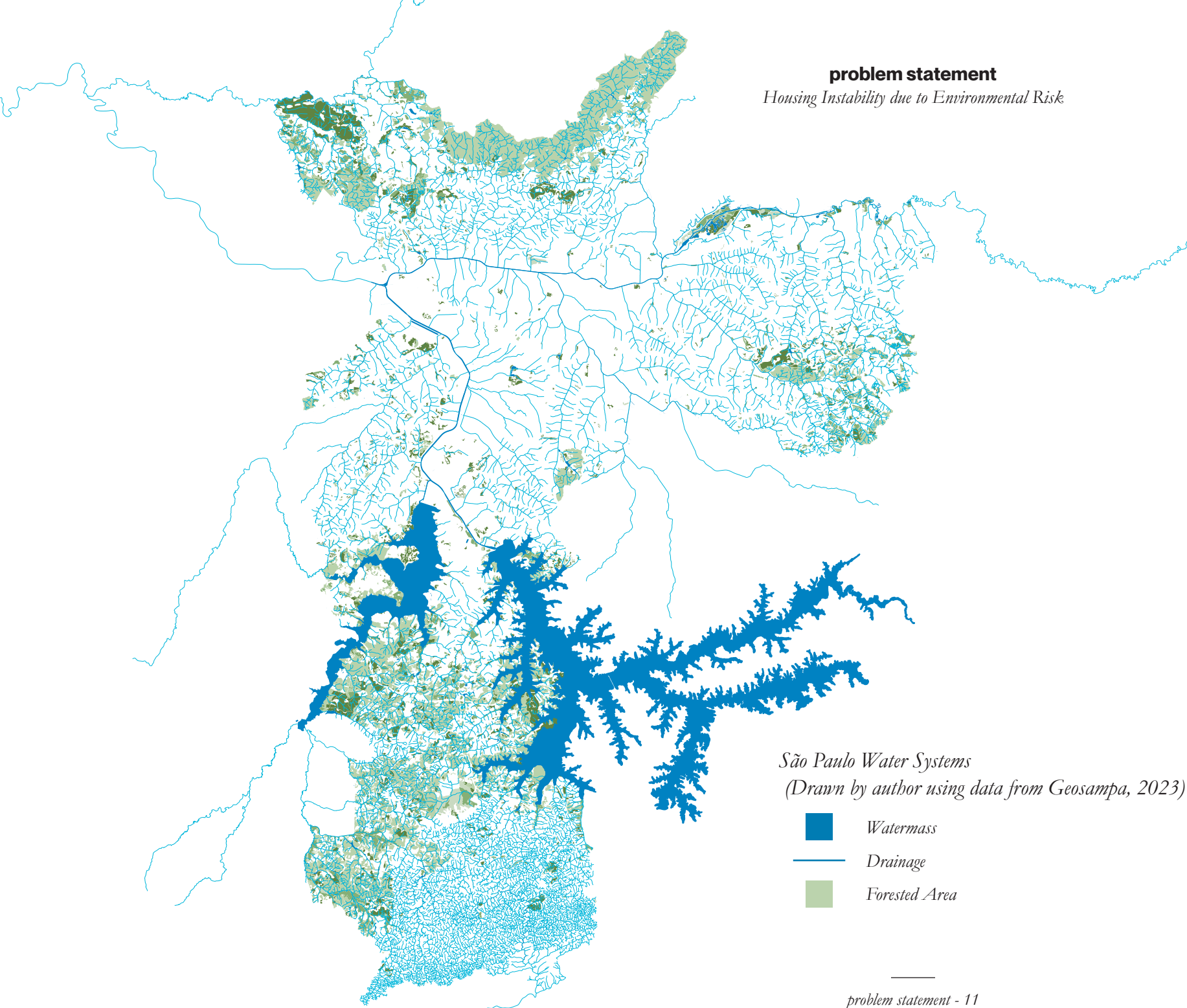
*Water & Infrastructure Scarcity*

Inconsistent water supply  
Increasing vulnerability to drought

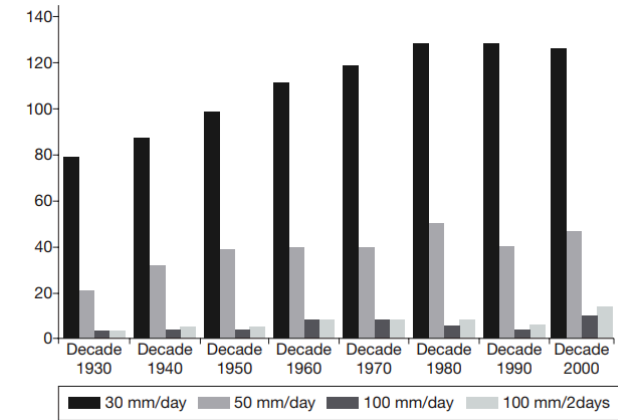


*Rooftop water cisterns in Copacabana, Rio de Janeiro  
(Huub Fenten, 2022)*

**problem statement**  
*Housing Instability due to Environmental Risk*

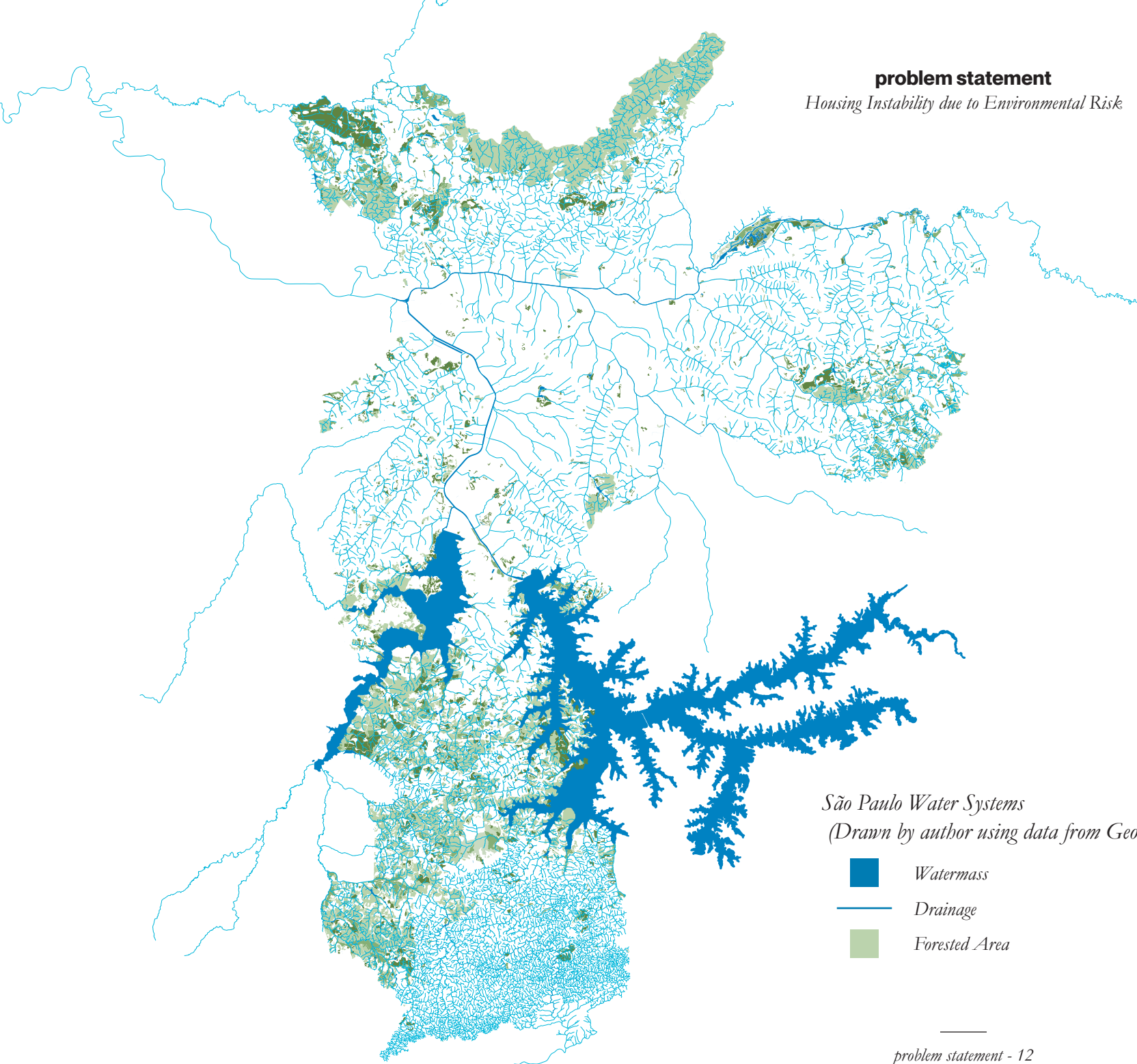


*Number of Flooding Points Registered by CGE in São Paulo per year, 2004-2011 (Dickson, 2012)*



*Days with Intense Rainfall per decade (Dickson, 2012)*

**problem statement**  
*Housing Instability due to Environmental Risk*

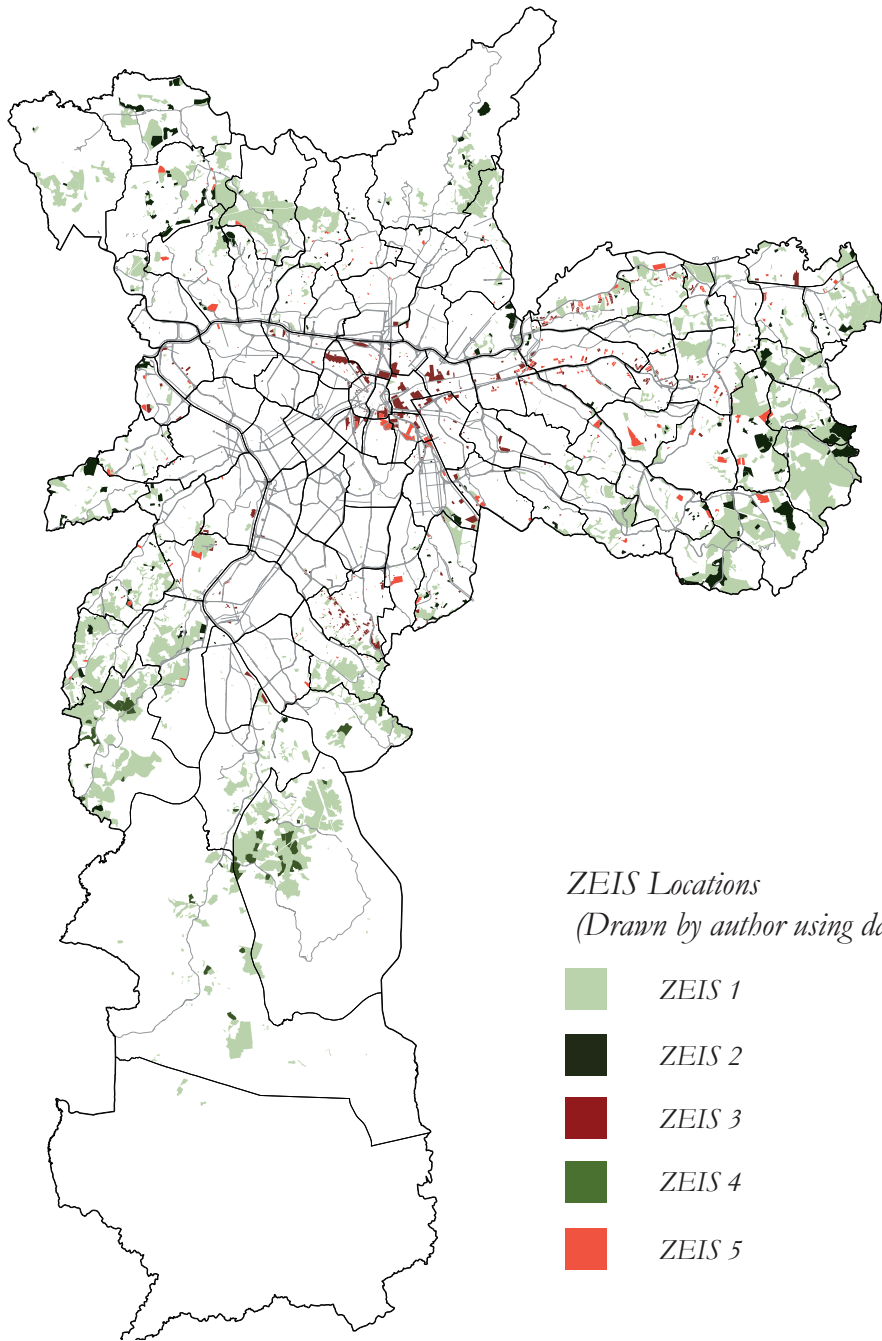


*São Paulo Water Systems  
(Drawn by author using data from Geosampa, 2023)*

- Watermass
- Drainage
- Forested Area



*Landslide in Morro São Bento, Santos,  
State of São Paulo (Felixx Drone, 2020)*



*ZEIS Locations  
(Drawn by author using data from Geosampa, 2023)*

- ZEIS 1
- ZEIS 2
- ZEIS 3
- ZEIS 4
- ZEIS 5

**ZEIS - SPECIAL ZONES OF INTEREST**

Land designated as social housing stock for low-income residents

**HIS - SOCIAL INTEREST HOUSING**

Income groups designated for housing located in ZEIS

\$\$\$

**HMP**

6 - 10 minimum wages  
R\$7812 - R\$13 000  
€1500 - €2500

**HIS 2**

3 - 6 minimum wages  
R\$3906 - R\$7812  
€990 - €1500

**HIS 1**

1 - 3 minimum wages  
R\$1302 - R\$3906  
€250 - €750




**> HIS 1**

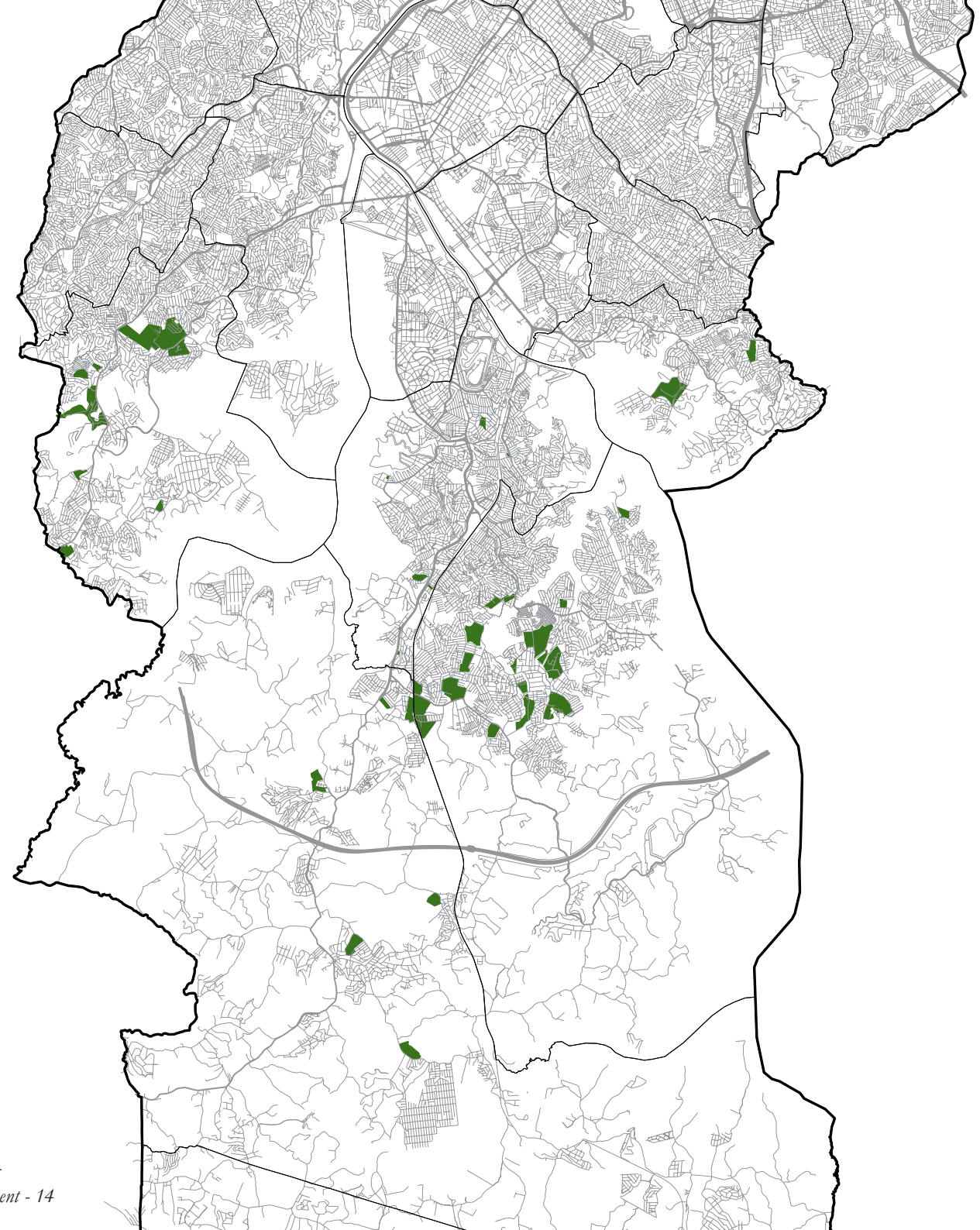
>1 minimum wage  
R\$0 - R\$1302  
€0 - €250

€

ZEIS 4 are located in environmentally protected areas, designated as land for future urbanization to rehouse those displaced from ecologically fragile areas without proper infrastructure. (Pimentel Walker & Arquero de Alarcón, 2018)

*ZEIS 4 Locations*  
(Drawn by author using data from Geosampa, 2023)

-  ZEIS 4
-  Highway
-  Sub and Arterial Roads



## problem statement

*Social Impact due to Development-Induced Displacement*



*Demolished home of an evicted family in Cantinho do Céu, São Paulo (Author, 2022)*

Robert Muggah, the author of *Os Deslocados: Conceptualizing Internal Displacement in Brazil* (2014), defines internal displacement as

*“involuntary population movement resulting in coerced resettlement between or within cities, or among neighborhoods”*



*Demolished home of an evicted family in Cantinho do Céu, São Paulo (Author, 2022)*



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*“involuntary population movement resulting in coerced resettlement between or within cities, or among neighborhoods”*

Development-induced displacement has a direct impact on

*-social networks*

*-mental well-being*

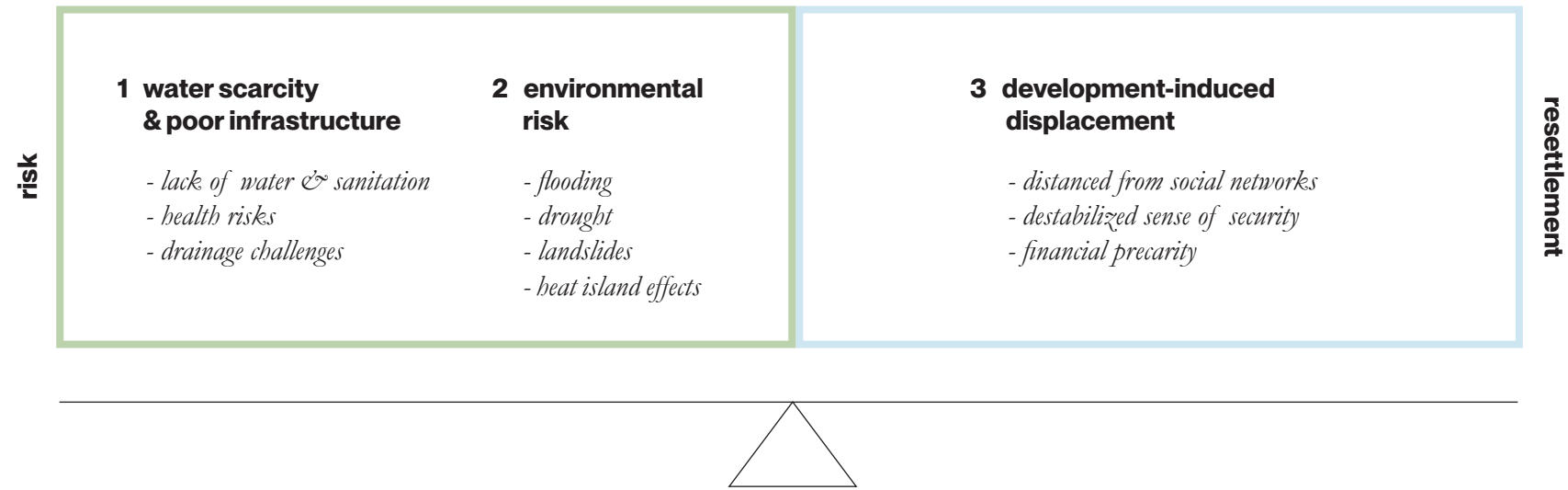
*-income-generation patterns, and*

*-safety*



**research question**

*Balancing Risks*



“  
*how can design mitigate the impact of displacement on São Paulo residents that live without proper access to public infrastructure in ecologically fragile areas?*  
”

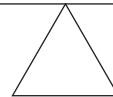
## renewal

*how can an integrated approach to housing and urban public space connect displaced residents to their new place of settlement, socially, culturally, and ecologically?*

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*how can urban spaces within informal neighborhoods combat the effects of water scarcity and poor infrastructure, while promoting climate resilience?*

**risk**

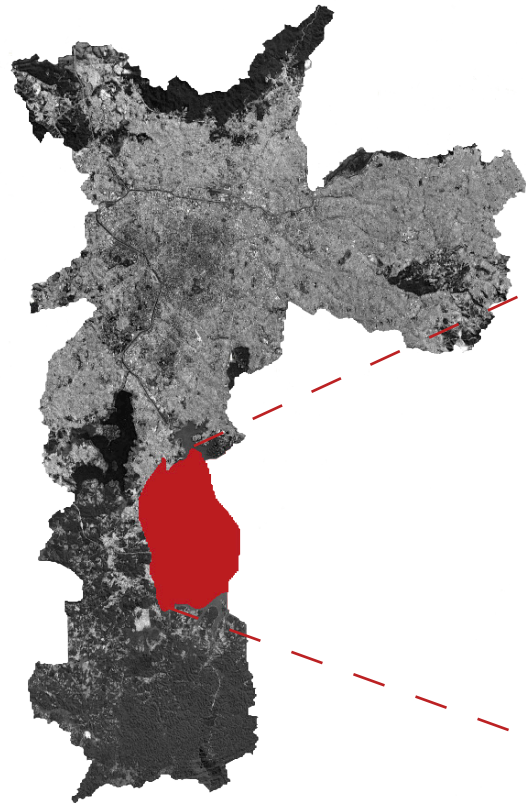


*what are examples of safe and ethical processes to displace and rehouse at-risk residents of São Paulo?*

**resettlement**

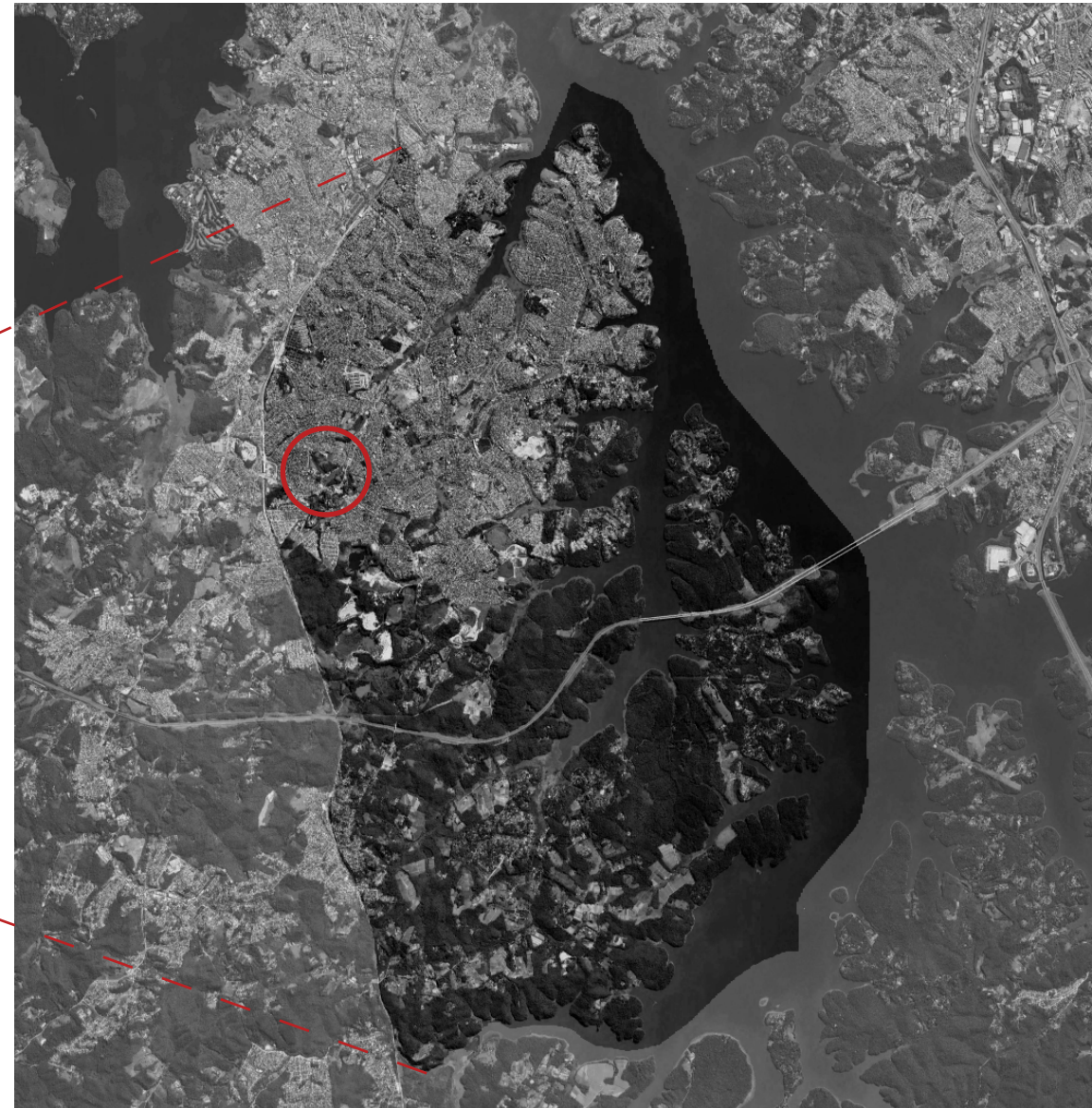
**contextual analysis**

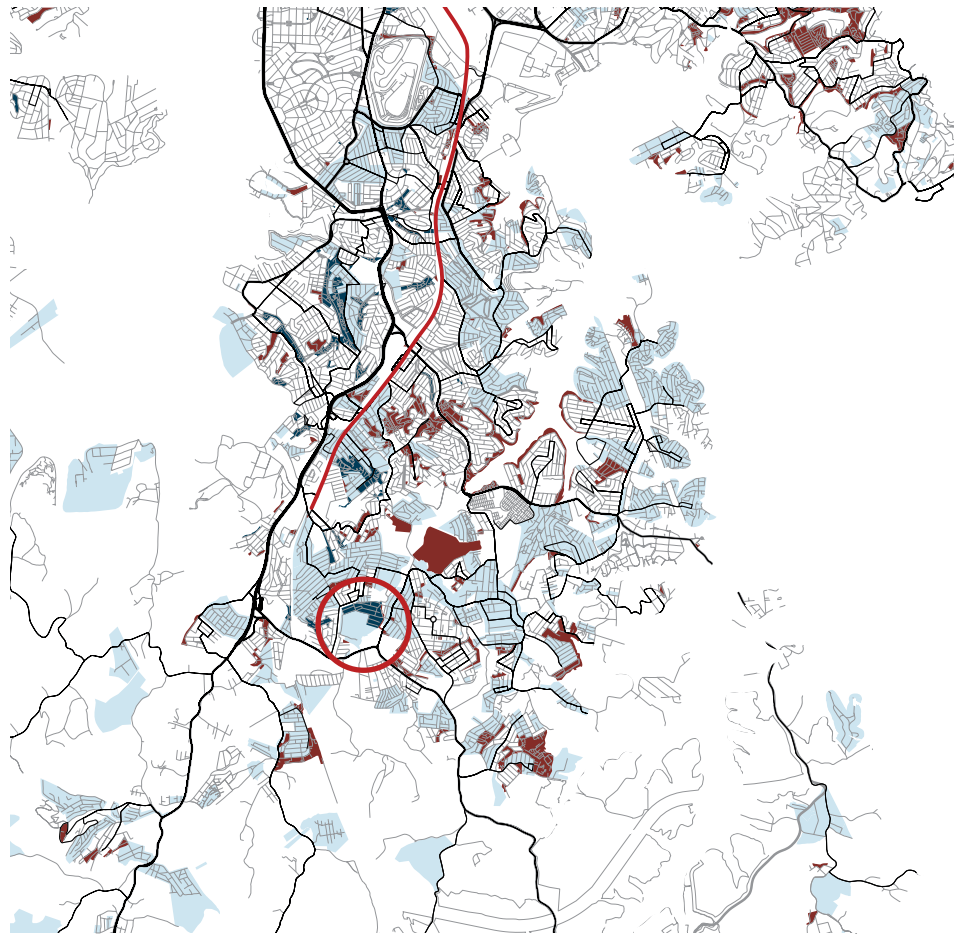
*Grajaú, São Paulo*



Grajaú is located along the billings reservoir

Project location on western edge of Grajaú





360 800 inhabitants  
 92.5 km<sup>2</sup>  
 3900 people/km<sup>2</sup>  
 3.5 people per average household

96% urban population  
 located in North Grajaú  
 (São Paulo Census, 2010)

*Informal housing types in Northern  
 Grajaú, drawn by author using data  
 from the Prefeitura de São Paulo  
 (Geosampa, 2023)*

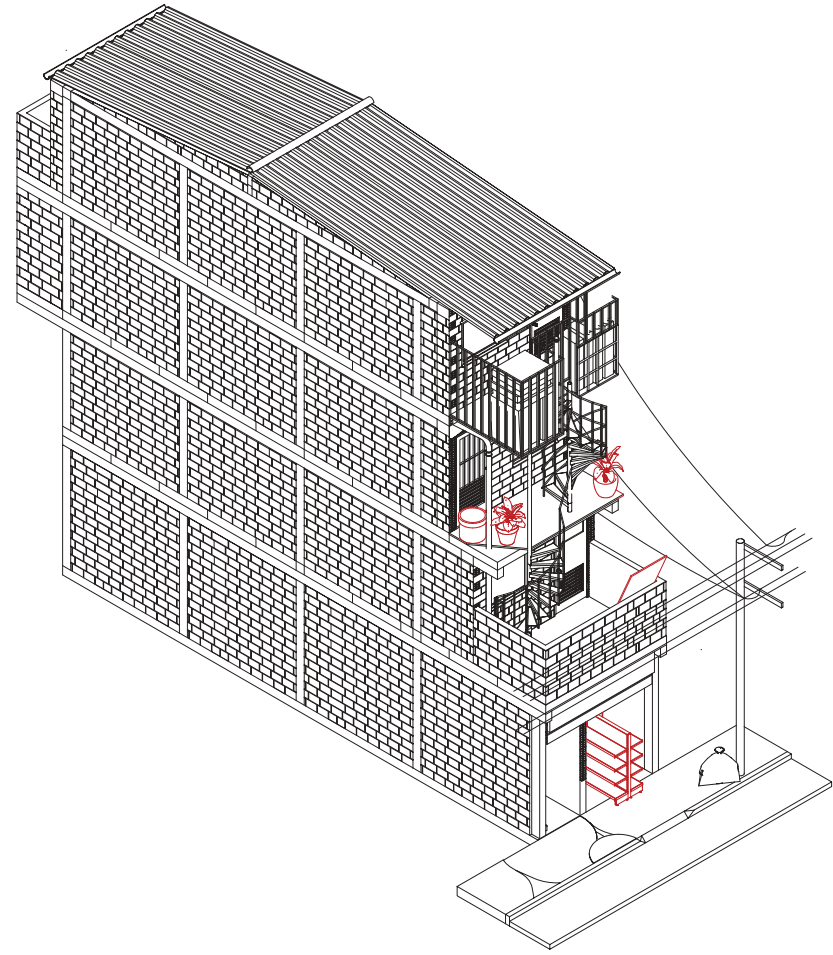
- Favela*
- Núcleo*
- Lotamendo*
- Bus routes*
- Train line*



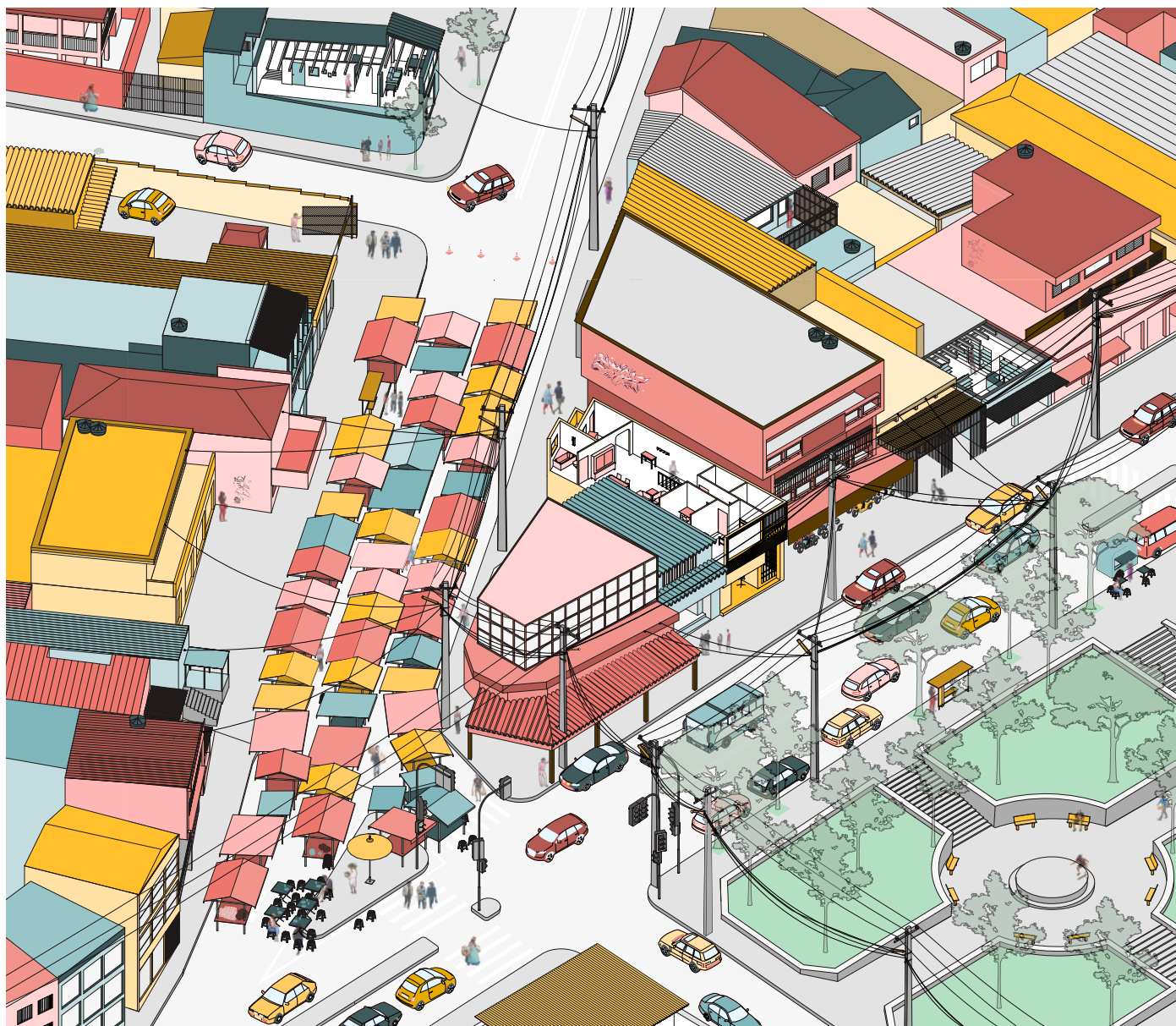
*Aerial view of Grajaú (Boldarini, 2012)*



*Informal Shack Type, Anchieta, São Paulo*  
(Angelina Torbica, Aleksandra Jodłowska, & Beatrijs Kostelijk, 2022)



*Irregular Settlement, São Paulo*  
(Sanette Schreurs, Robbert Laan, & Huub Fenten, 2022)



*Atmospheric Synthesis of Grajaú, São Paulo (Drawn by author in collaboration with Winnie Goldsteen, 2022)*

**contextual analysis**

*Risk - Cantinho do Céu, São Paulo*

**cantinho do céu  
urbanisation project**

2009 - 2012

154.4 ha

43 556 inhabitants

70 dwellings/ha

(Franca & Barda, 2012)

By Boldarini Arquitetos & SEHAB

*Aerial views of Cantinho do Céu development before, during, and  
after revitalization by Boldarini Arquitetos (Boldarini, 2023)*



Post resettlement housing campaign for families  
in at-risk housing



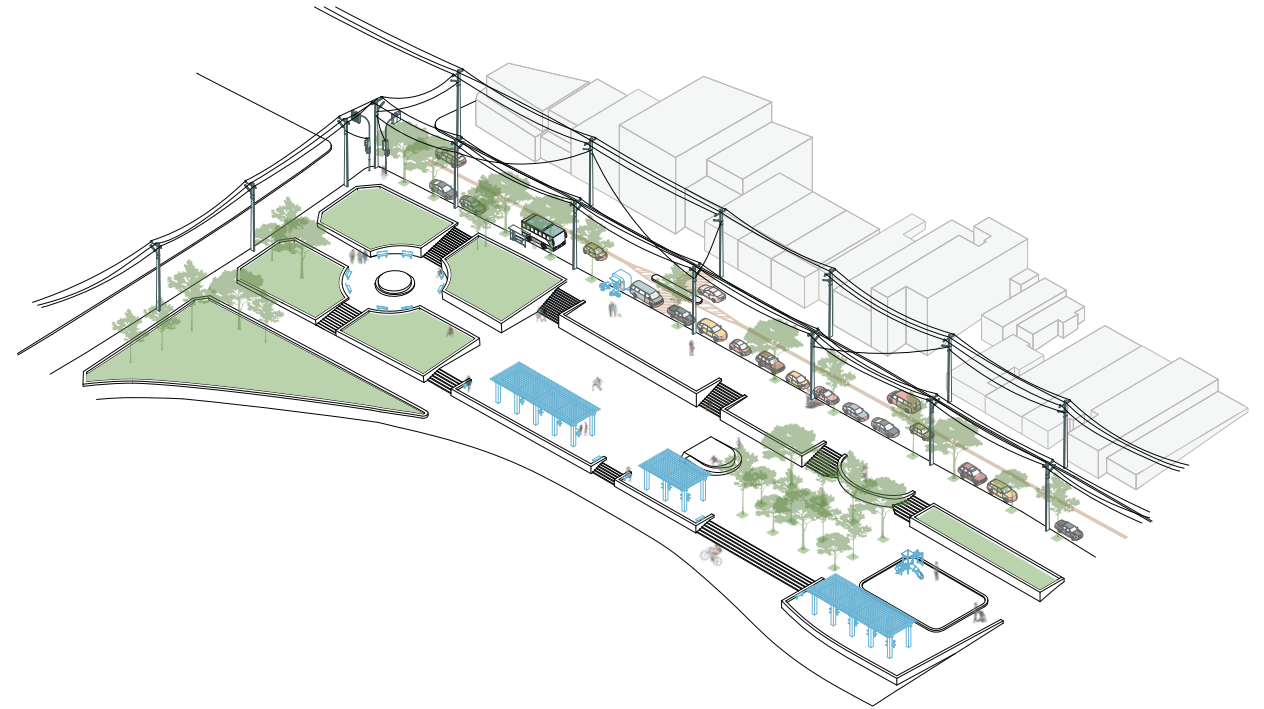
Public infrastructure upgrading



Creation of linear park along billings reservoir



*Cantinho do Céu Linear Park (Boldarini, 2023)*



*Contextual Analysis of Public Space in Grajaú, São Paulo  
(Drawn by author in collaboration with Winnie Goldsteen, 2022)*



## contextual analysis

Resettlement - Chácara do Conde & Residencial Espanha

For families displaced by the Urbanisation of Precarious Settlements Program (UAP)

Located On ZEIS 4 Plots

Accompanied by SEHAB social support service

- maintenance guidance
- code of conduct
- financing support
- employment programs



*Chácara do Conde Aerial View  
(JAA Arquitetura, 2022)*

### chácara do conde

2018  
10.4 ha  
1290 units for 5000 inhabitants  
124 dwellings/ha  
(JAA Arquitetos, 2023)

By JAA Arquitetos & SEHAB



*Residencial Espanha Aerial View  
(Lopes Jr, 2019)*

### residencial espanha

2018  
30 ha  
3860 units for 15 000 inhabitants  
128 dwellings/ha  
(Prefeitura de São Paulo, 2018)

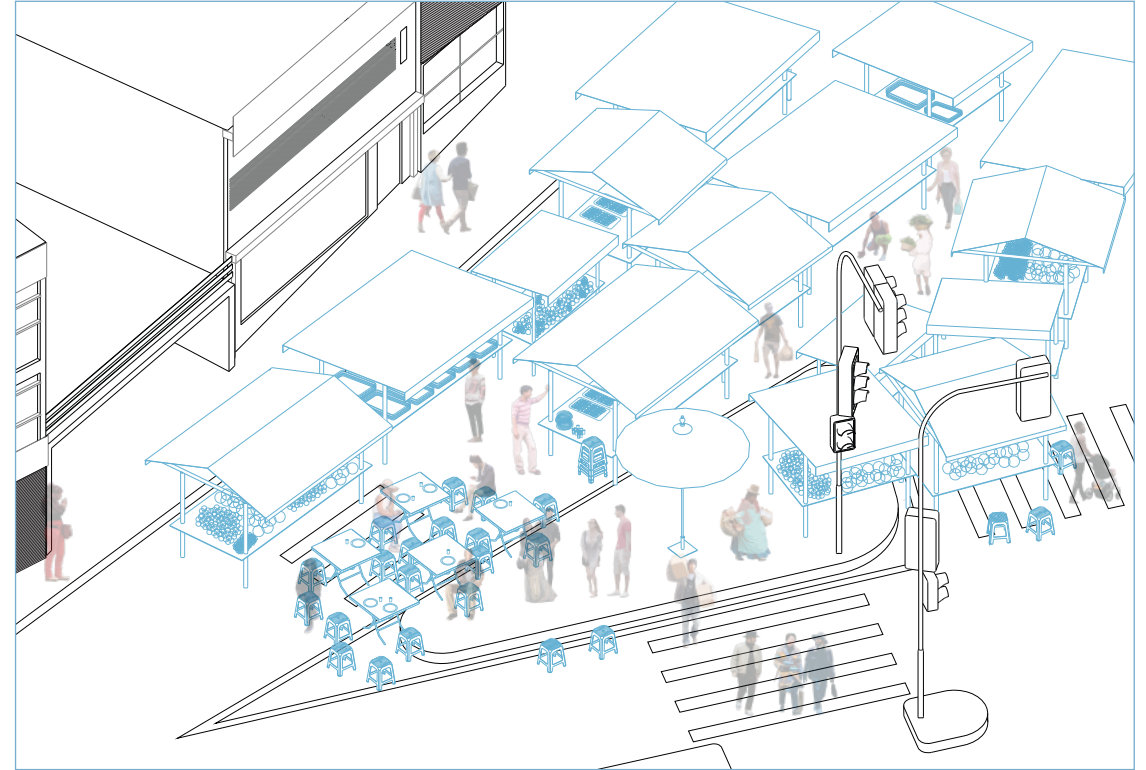
By SEHAB



*Atmospheric Synthesis of Chacara do Conde Housing Complex  
(Sanette Schreurs, Robbert Laan, & Huub Fenten, 2022)*



*Lack of Income-Generating Spaces at Residencial Espanha Housing Complex (Lopez Jr, 2019)*

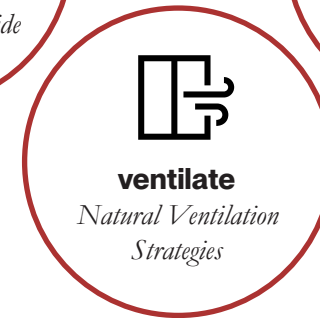
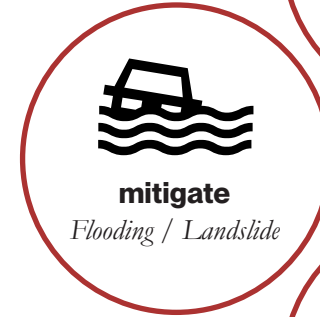
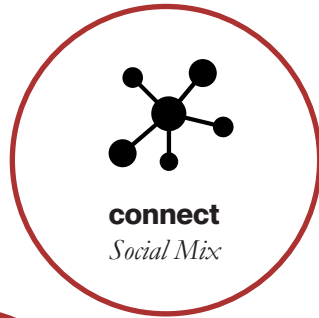


*Contextual Analysis of Informal Economy in Grajaú, São Paulo (Drawn by author in collaboration with Winnie Goldsteen, 2022)*

**design hypothesis**  
*Transforming Risk To Opportunity*

**social resilience**

**climate resilience**



**urban resilience**  
*At all 4 scales*

*Dwelling*

*Cluster*

*Sector*

*Neighborhood*

**site analysis**  
*Jardim Campinas*



*≈ 65 dw/ha*









**DENSITY**

150 to 300 inhabitants per hectare  
(Geosampa, 2023),  
with an average of 3.5 inhabitants per  
household

40 to 90 dw/ha across areas



*Jardim Campinas Community Analysis  
(Drawn by author using data from Geosampa, 2023)*

-  *Favela housing*
-  *Church*
-  *Groceries*
-  *Health Care Centres*
-  *Clubs/Community Activities*
-  *Schools*
-  *Bus Lines*
-  *Bus Stops*



*Regularized land plots with matured housing  
(Author, 2022)*





*Favela settlements bordering creek  
(Author, 2022)*



*City Signage stating it is "Prohibited to dispose of garbage and construction waste"  
(Author, 2022)*



*Jardim Campinas Environmental Analysis  
 (Drawn by author using data from Geosampa, 2023)*

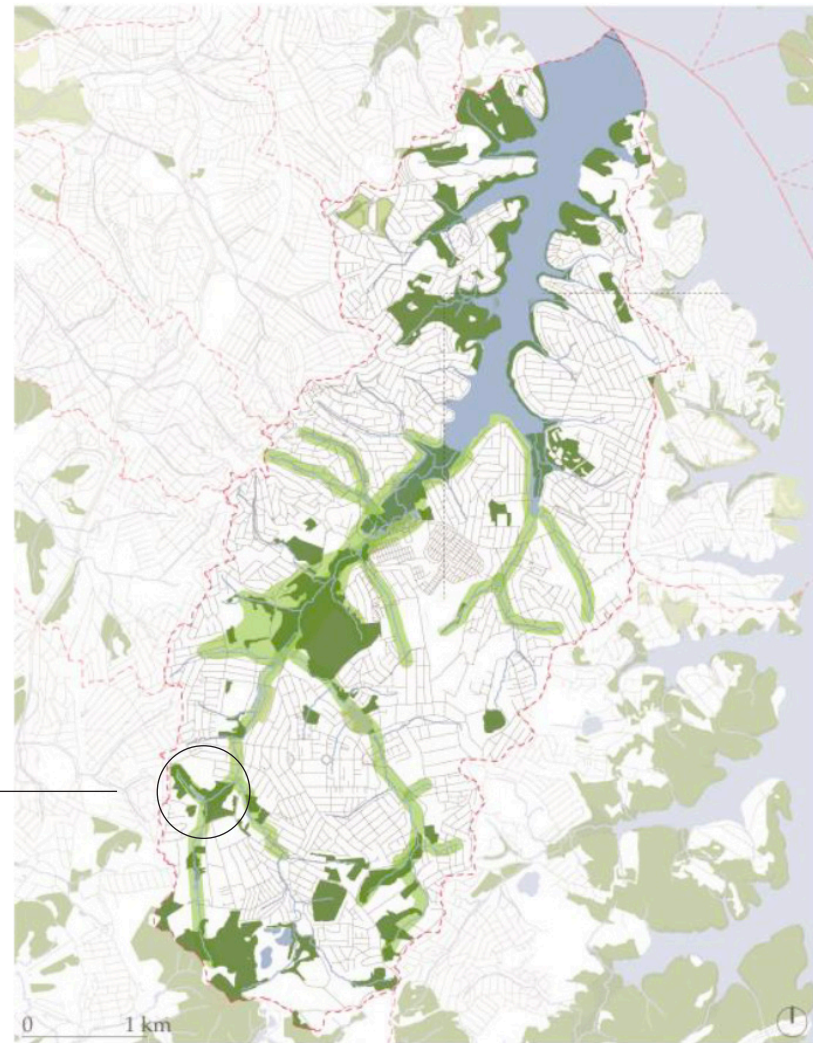
-  *Proposed Riberão Cocaia Linear Park*
-  *Marsh Vegetation*
-  *Floodplain*
-  *Dense Forest*
-  *Forest*
-  *Fields / Shrubbery*
-  *Illegal dump site area*
-  *Drainage*
-  *Water Body*



Planned linear park named Riberão Cocaia  
under implementation since 2006

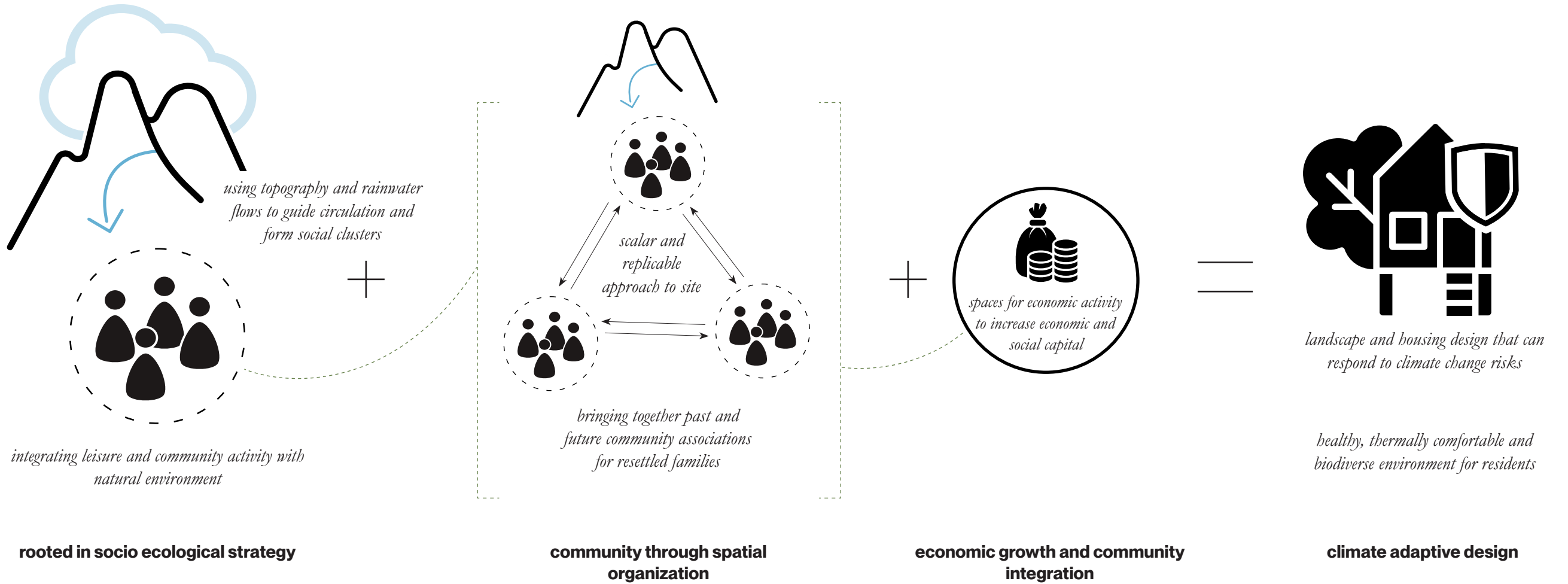


*Project Location*



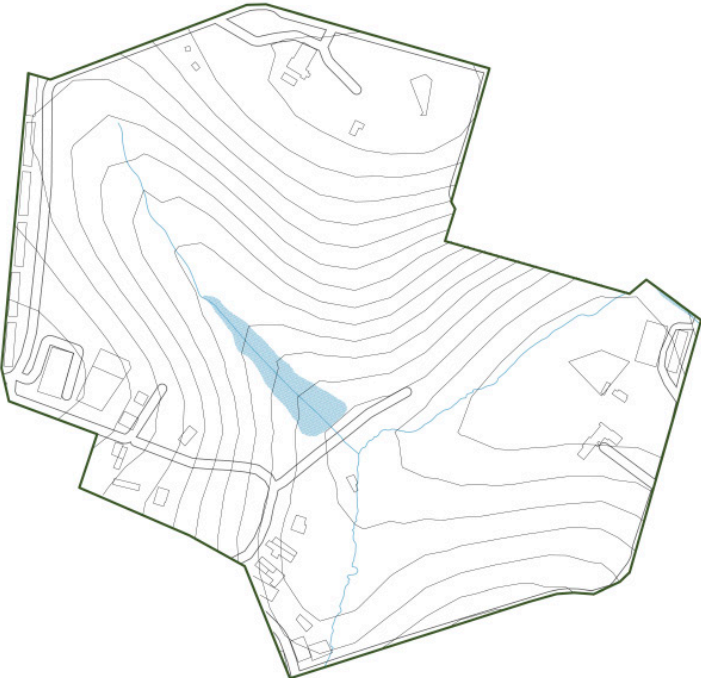
*Projected Linear Park (Walker & de Alarcón,  
2018)*

**design approach**  
*design principles*



**design approach**

*Program Of Requirements*



**DENSITY**

*current*  
 ≈65 dw/ba

*goal*  
 ≈100 dw/ba

<b>socio-environmental</b>	<b>social</b>	<b>economical</b>	<b>environmental</b>
Urban strategy centered on water flows  Linear park  Diverse green public spaces for social mix  Rainwater collection integrated with public space	Amenities -community center -grocery -church -shopping streets -transit stop  Community clustering  Dwelling type variety for various income groups & family sizes	FSI ≤ 2 HIS 1 & 2 >60% HIS 1  Inclusive financing system  Local income generation integrated with housing	Flood & landslide risk management  Rainwater harvesting & recycling  Thermal comfort  Site Adaptability

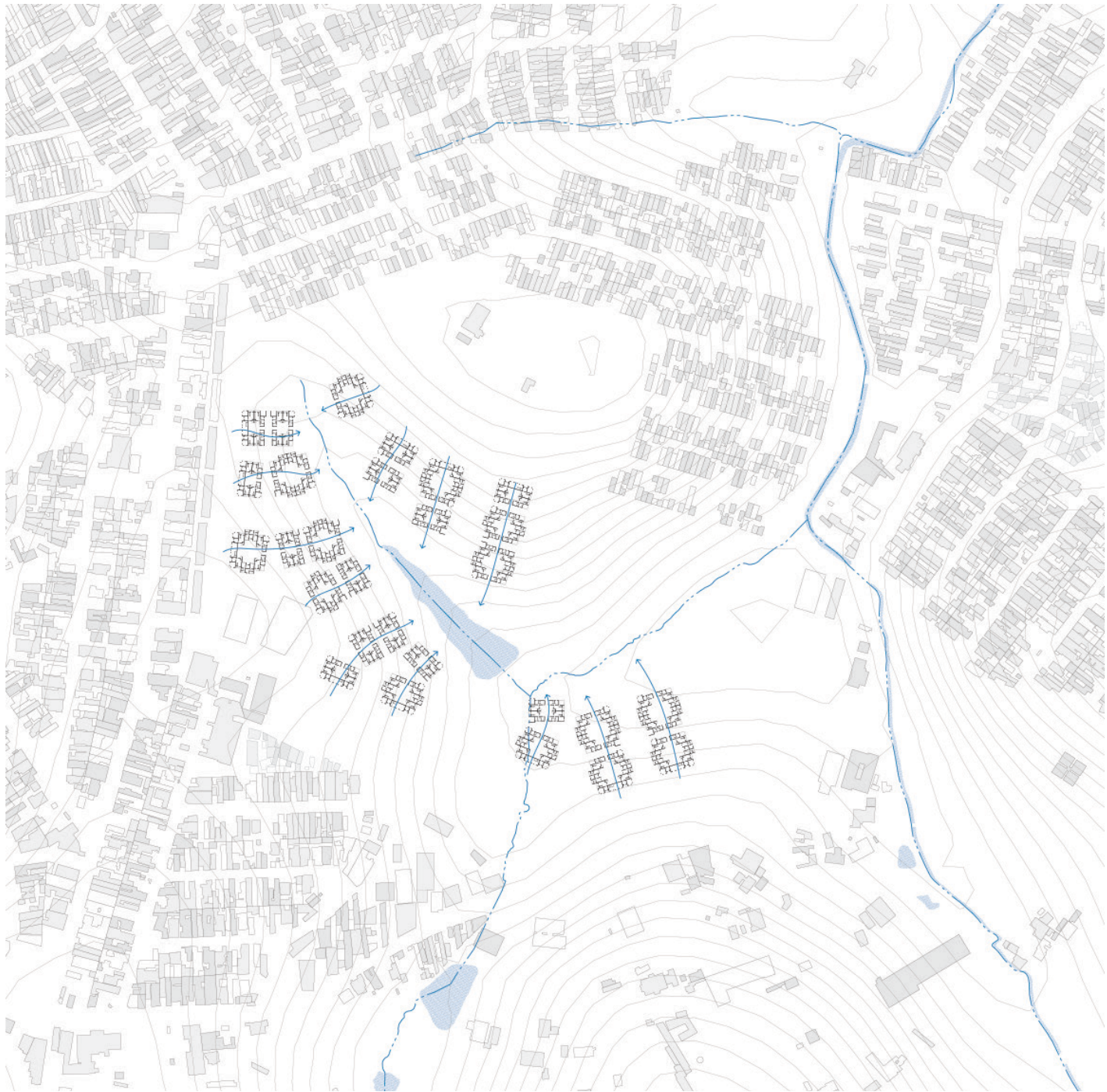
**urban strategy**  
*Masterplan*



**urban strategy**  
*Community Continuity*









**urban strategy**  
*Radburn Principle*



-  *Boulevard*
-  *Through Street*
-  *Local Street*
-  *Green Street*
-  *School*
-  *Higher density housing*

*Radburn Principle in Varsity Village*  
*Concept Diagram, drawn by author with*  
*satellite imagery (Google Earth Pro, 2023)*





*Intersecting pedestrian pathways  
(Allegra Bentrin & Chris Borsos, 2023)*



*Green street that connects local street to large central park  
(Allegra Bentrin & Chris Borsos, 2023)*



**urban strategy**  
*Radburn Principle*

**main boulevard**



**side streets**



**local streets**

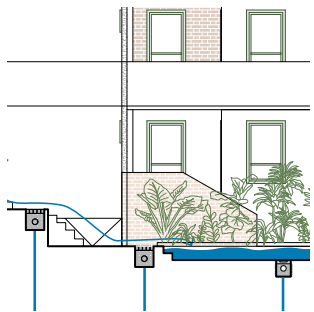


**green streets**



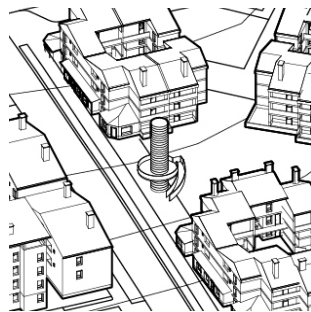


**urban strategy**  
*Public Infrastructure as Public Space*



*drainage systems*

**harvest**



*water tower with viewing platform*



*bioremediation pond*

**retain**

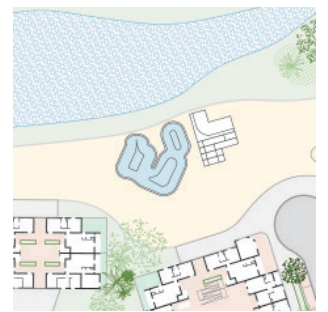


*rain gardens*



*shallow ponds for play*

**overflow**



*skateboarding bowl*



urban strategy

amenities

Clube do Laércio  
sports club and  
swimming pool



Community centre



Grocery store



Campo do Rivelino  
football club  
-Existing football field  
renovated with new  
community space



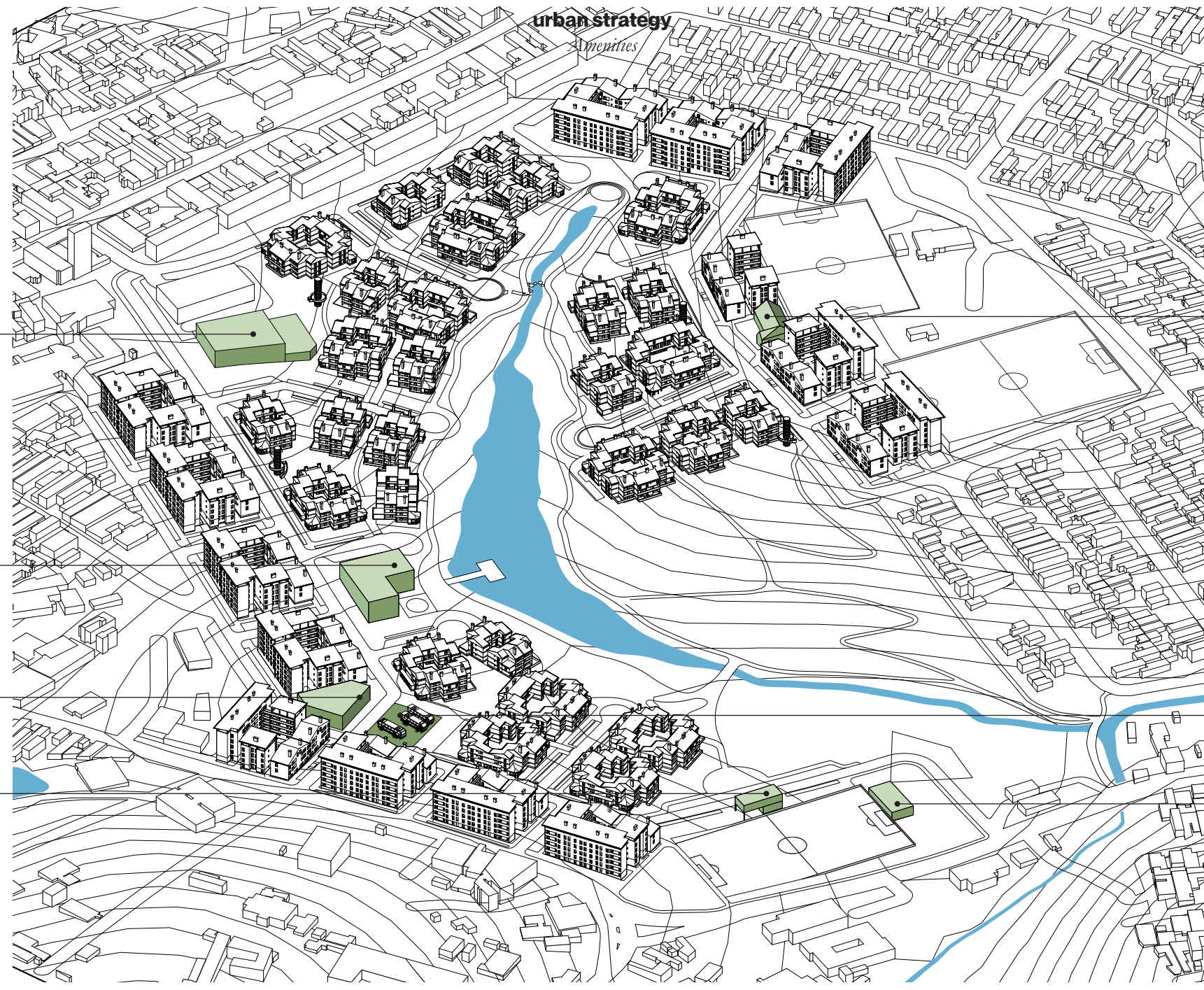
Church



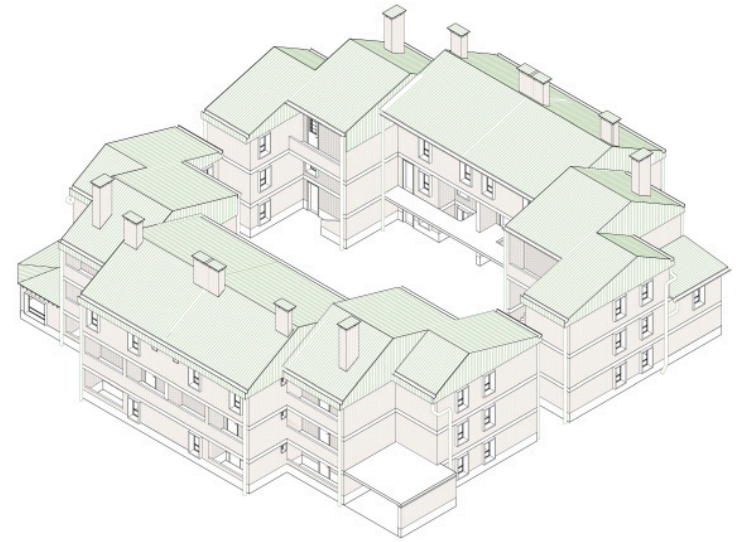
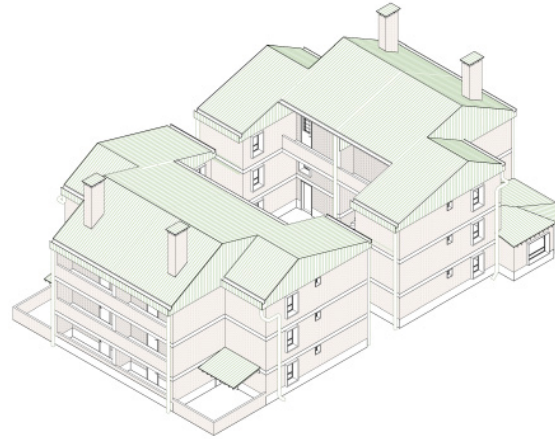
Public transit bus  
terminal



Carlos' Deposito de  
Reciclagem  
-Existing business  
renovated



**cluster strategy**  
*Three Housing Clusters*



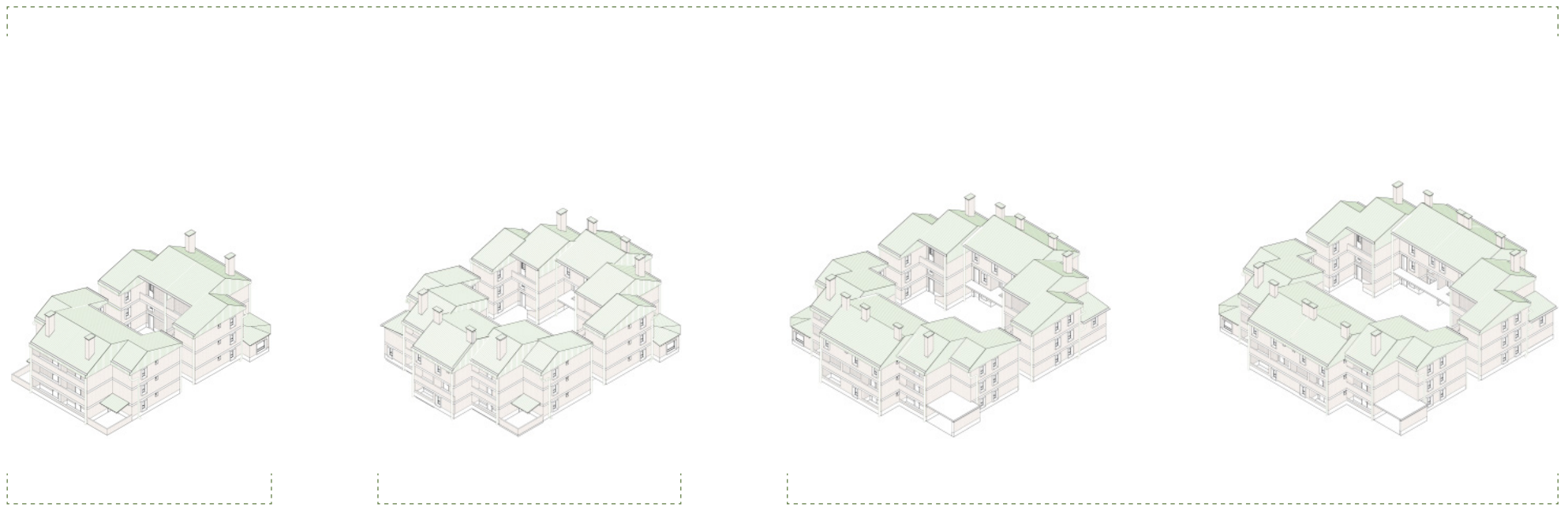
**cluster strategy**  
*Income Groups*

**COURTYARD CLUSTER**



>HIS 1, HIS 1 & HIS 2

**ROW HOUSE CLUSTER**



HIS 2

HIS 1 & HIS 2

HIS 1

## cluster strategy

*Income Groups*

### > HIS 1

>1 minimum wage  
R\$0 - R\$1302  
€0 - €250

### HIS 1

1 - 3 minimum wages  
R\$1302 - R\$3906  
€250 - €750

### HIS 2

3 - 6 minimum wages  
R\$3906 - R\$7812  
€990 - €1500



*communal access - shared balcony*  
*higher density*  
*1 - 3 bedrooms*  
*1 bathroom*

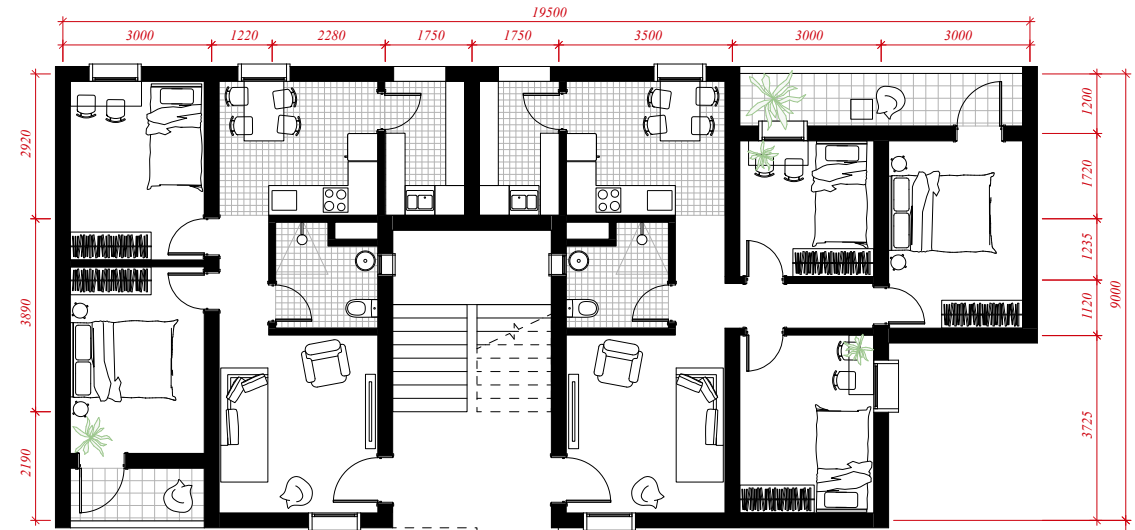
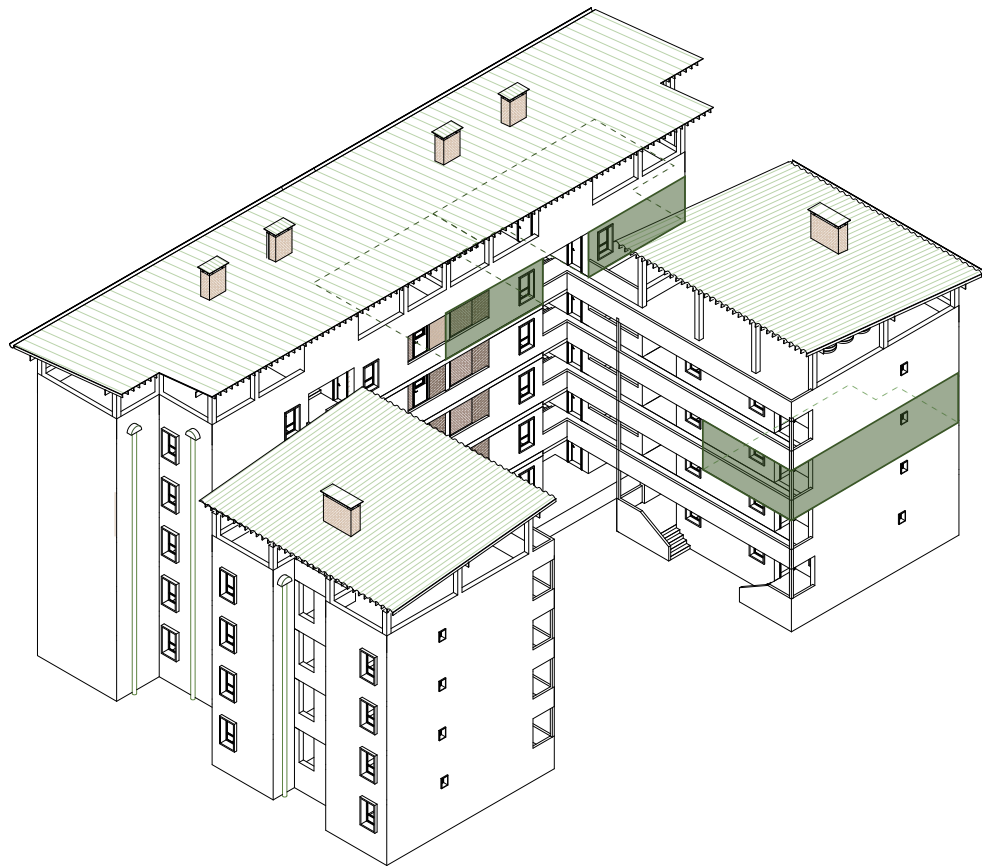
*private access - haagse portiek entrance*  
*lower density*  
*2 - 4 bedrooms*  
*2 bathrooms*

All apartments feature

*shared water supply*  
*balcony*

**cluster strategy**

*Balcony Access*



**HIS 1**

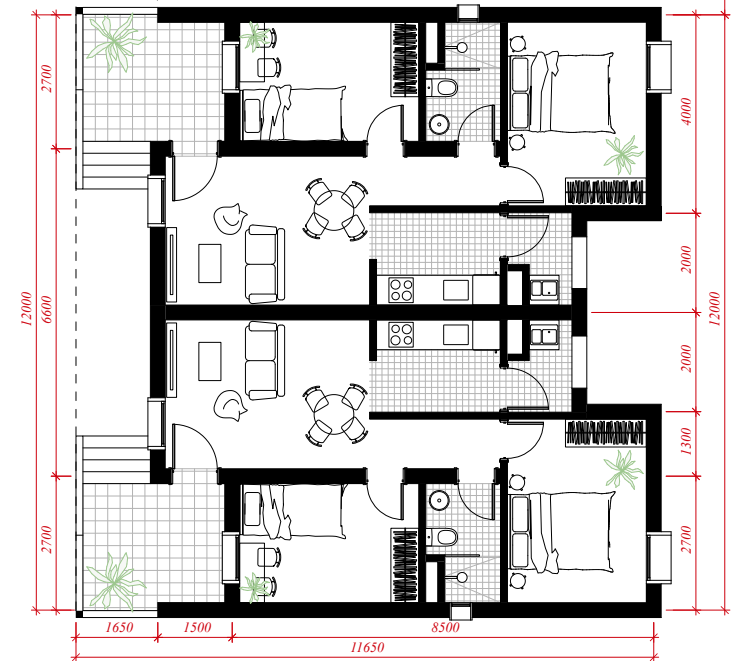
54m<sup>2</sup>  
2 bedrooms

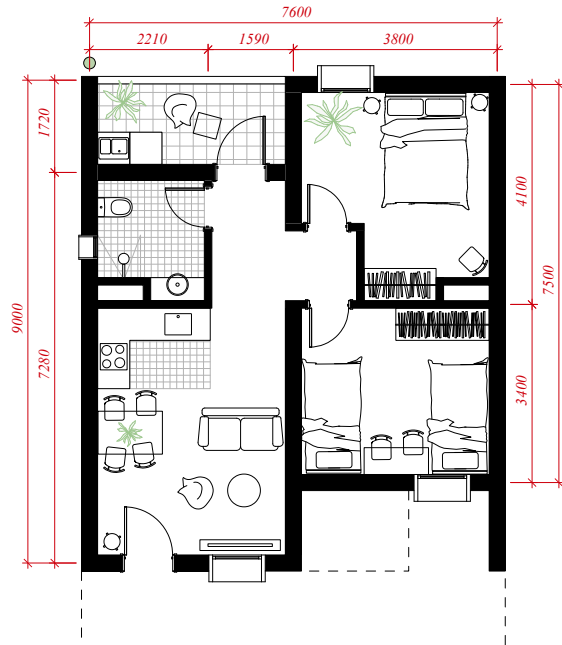
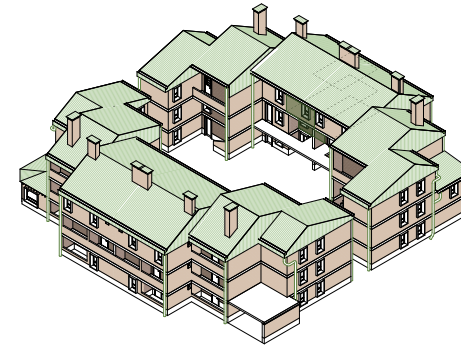
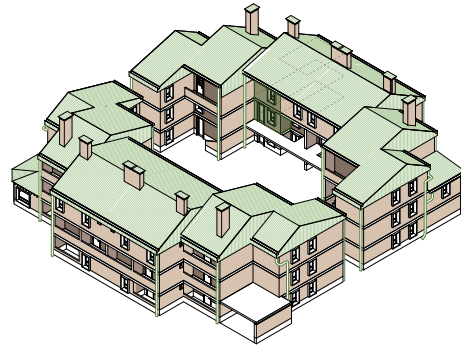
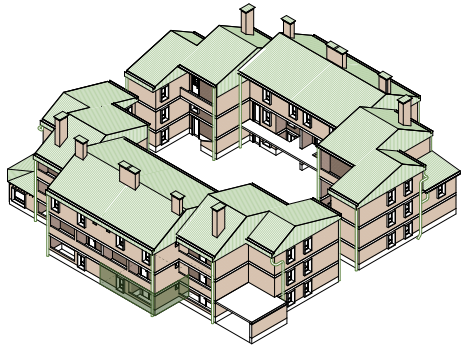
**HIS 1**

67m<sup>2</sup>  
3 bedrooms

**HIS 1**

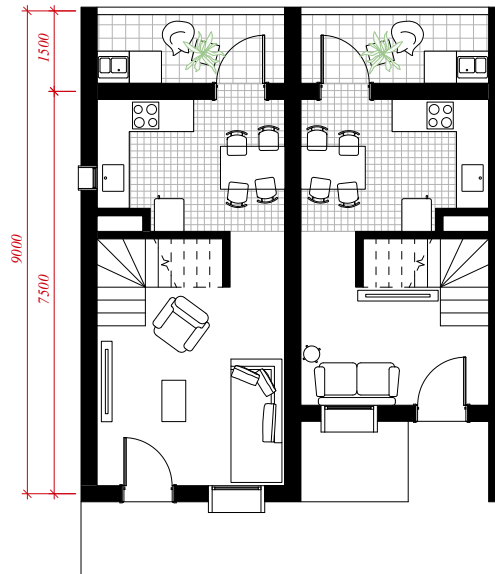
48m<sup>2</sup>  
2 bedrooms





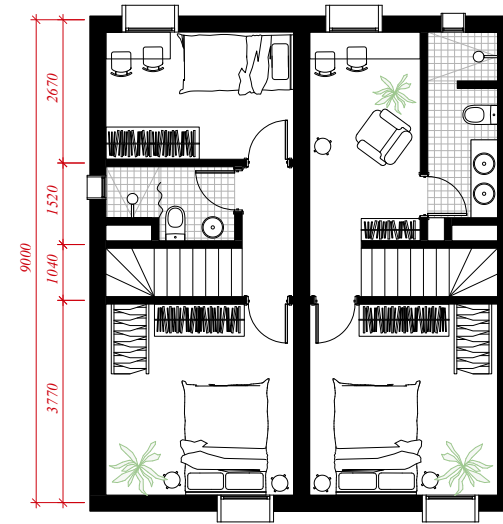
**HIS1**

ground level - 58 m<sup>2</sup>  
2 bedrooms



**HIS1**

duplex left - 52 m<sup>2</sup>  
2 bedrooms + mezzanine



**HIS1**

duplex right - 46 m<sup>2</sup>  
1 bedroom + mezzanine

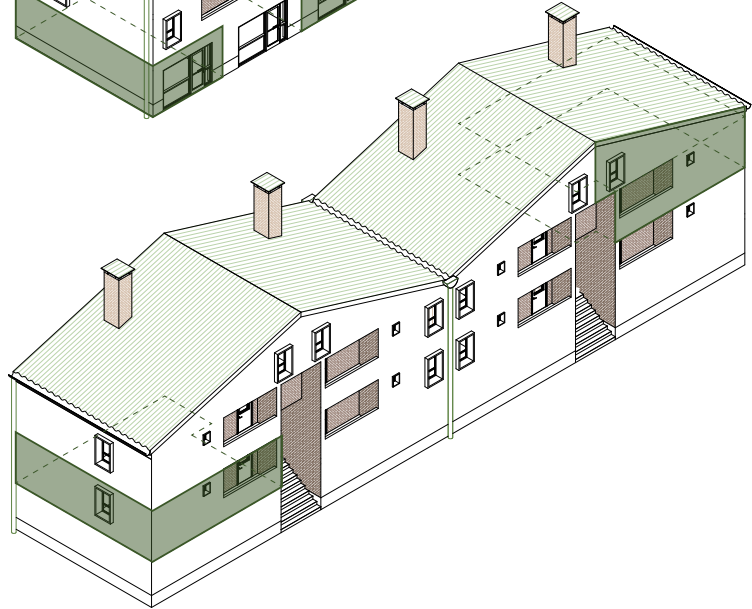
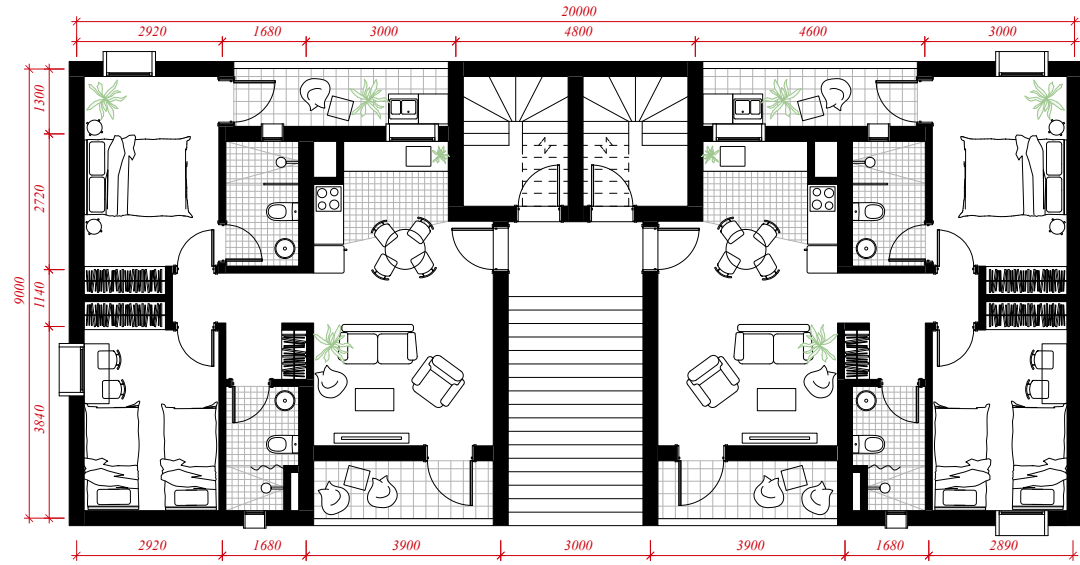
**cluster strategy**

*Haagse Portico*



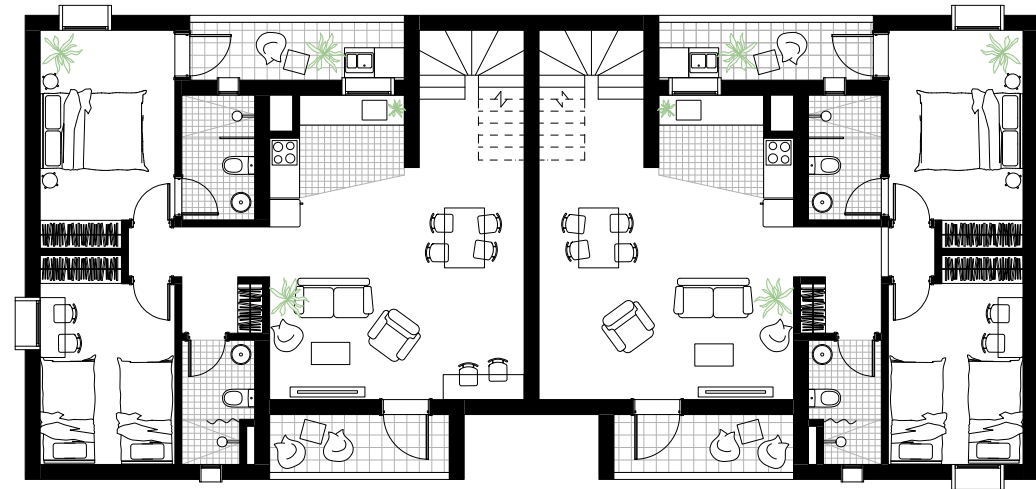
**HIS 2**

first level - 67 m<sup>2</sup>  
2 bedrooms

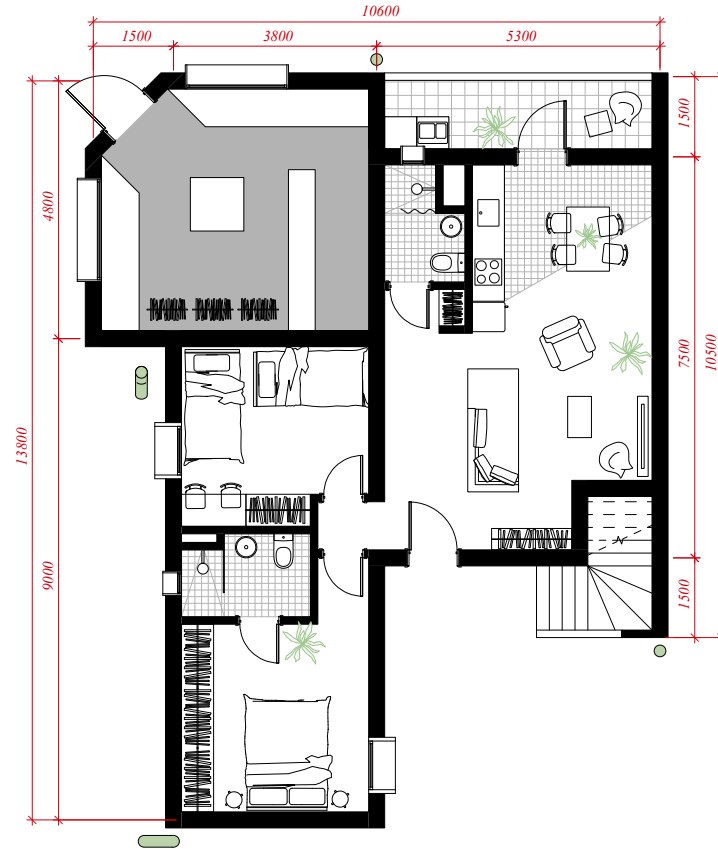
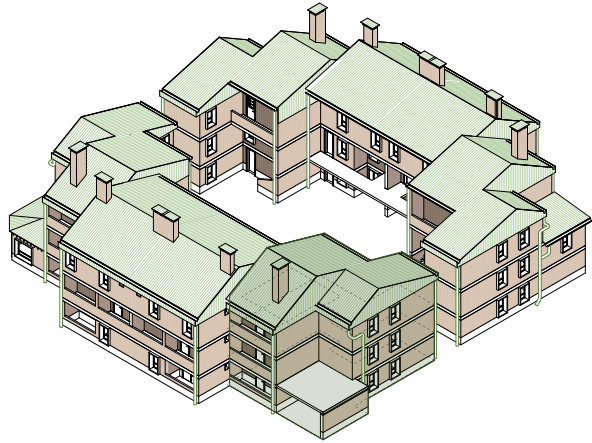


**HIS 2**

second level - 76 m<sup>2</sup>  
2 bedrooms + mezzanine

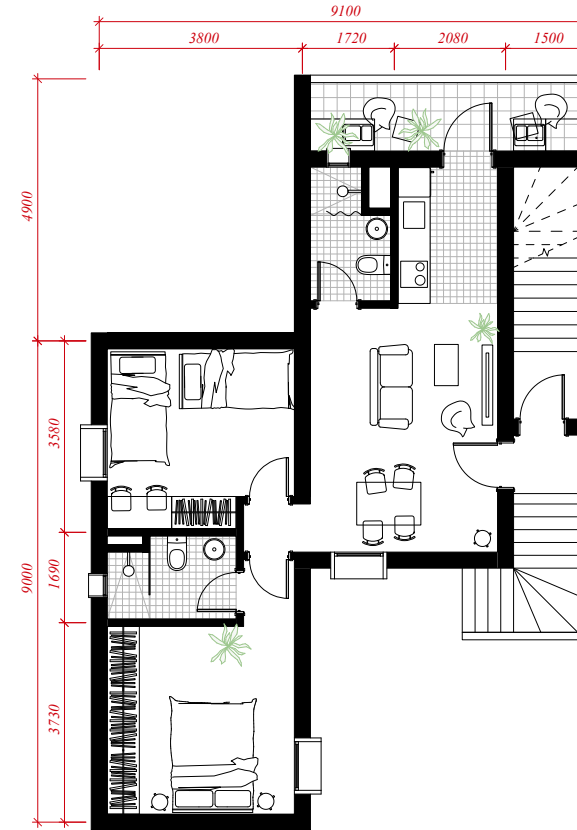


**cluster strategy**  
Haagse Portico



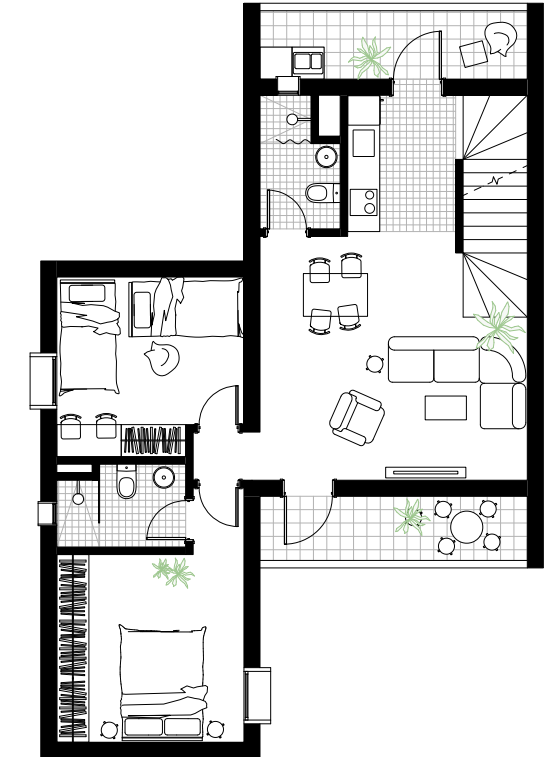
**HIS 2**

ground level - 68 m<sup>2</sup>  
2 bedrooms



**HIS 2**

first level - 60 m<sup>2</sup>  
2 bedrooms



**HIS 2**

second level - 76 m<sup>2</sup>  
2 bedrooms + mezzanine



**cluster strategy**

*Courtyard Cluster*

safe, private place for kids to play and  
community gathering - eyes on the street

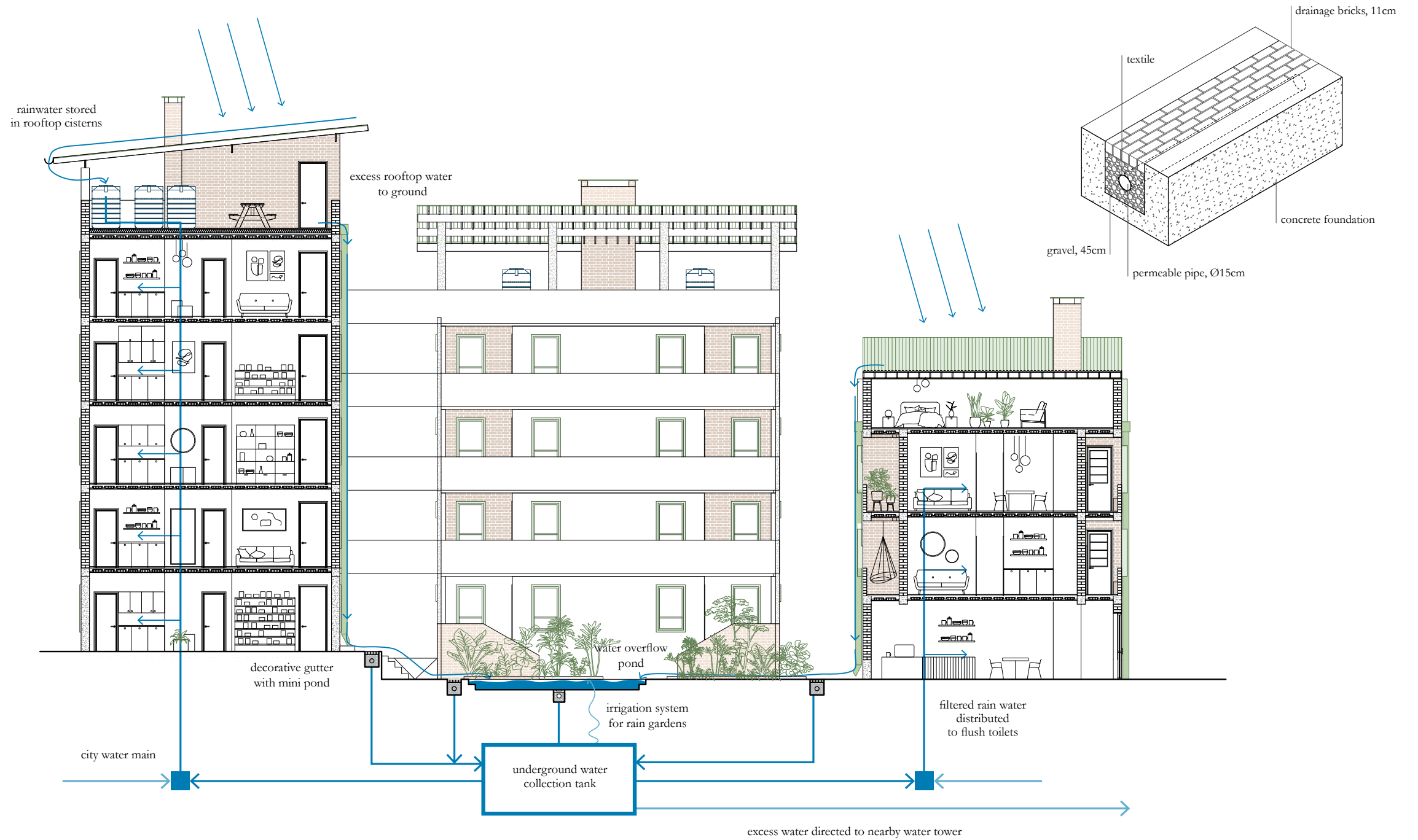
possible uses for the shared space

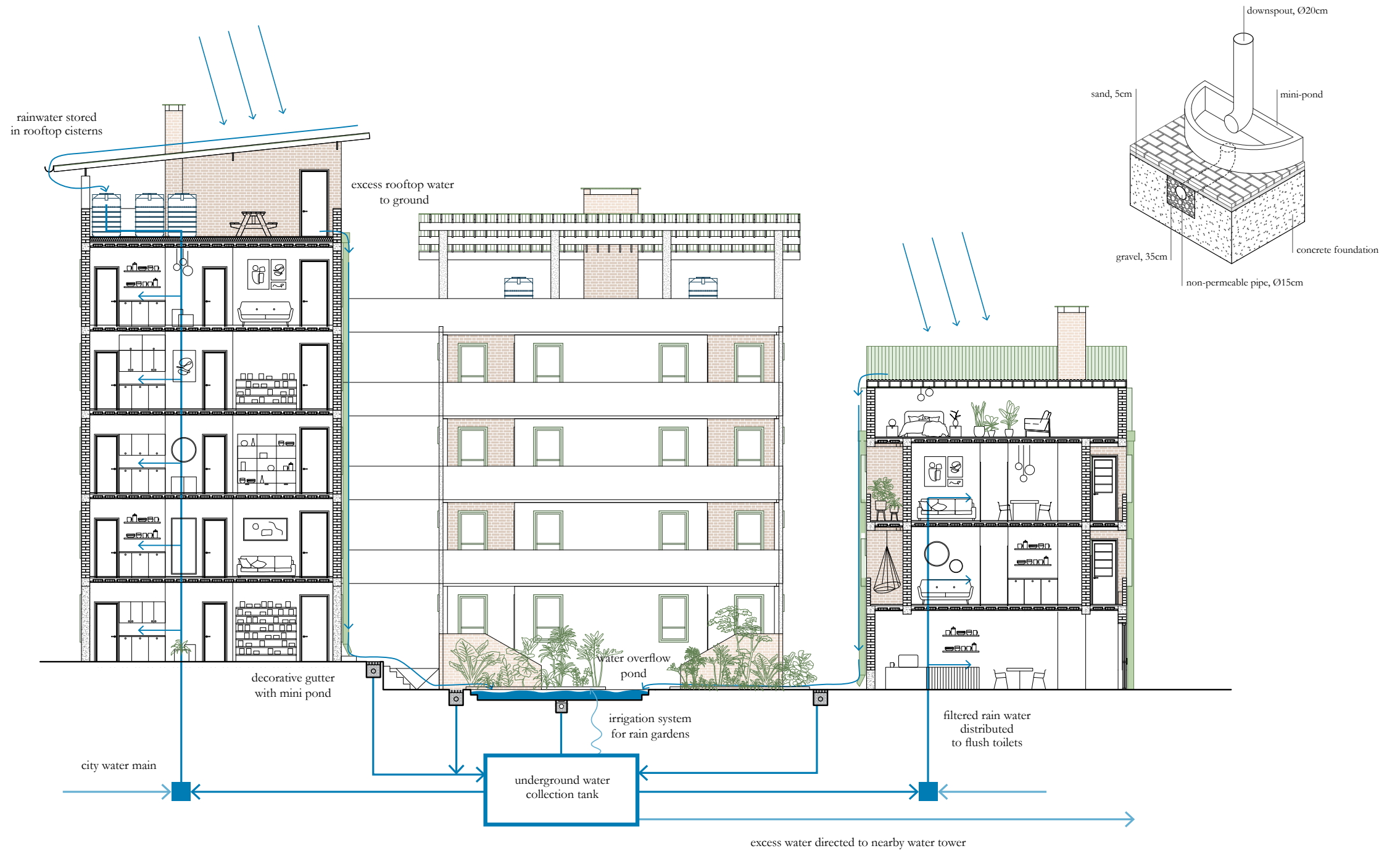
- play set/ swing*
- pergola + seating*
- bike rack*
- plants*
- storage*



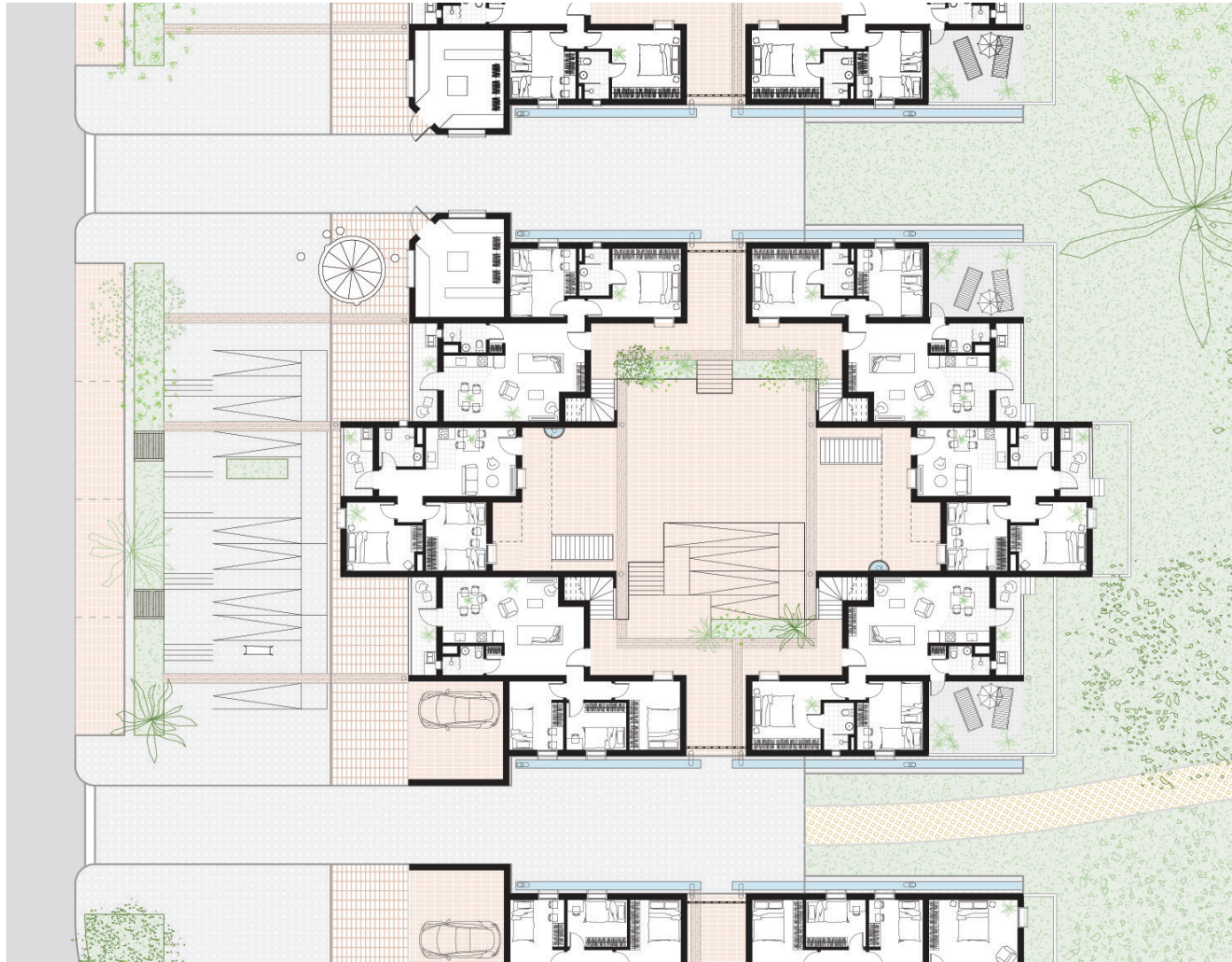
**cluster strategy**  
*Courtyard Cluster Water Management*







**cluster strategy**  
*Rowhouse Cluster*



tetris shape

*level of privacy*  
*sense of community*  
*spatially diverse*

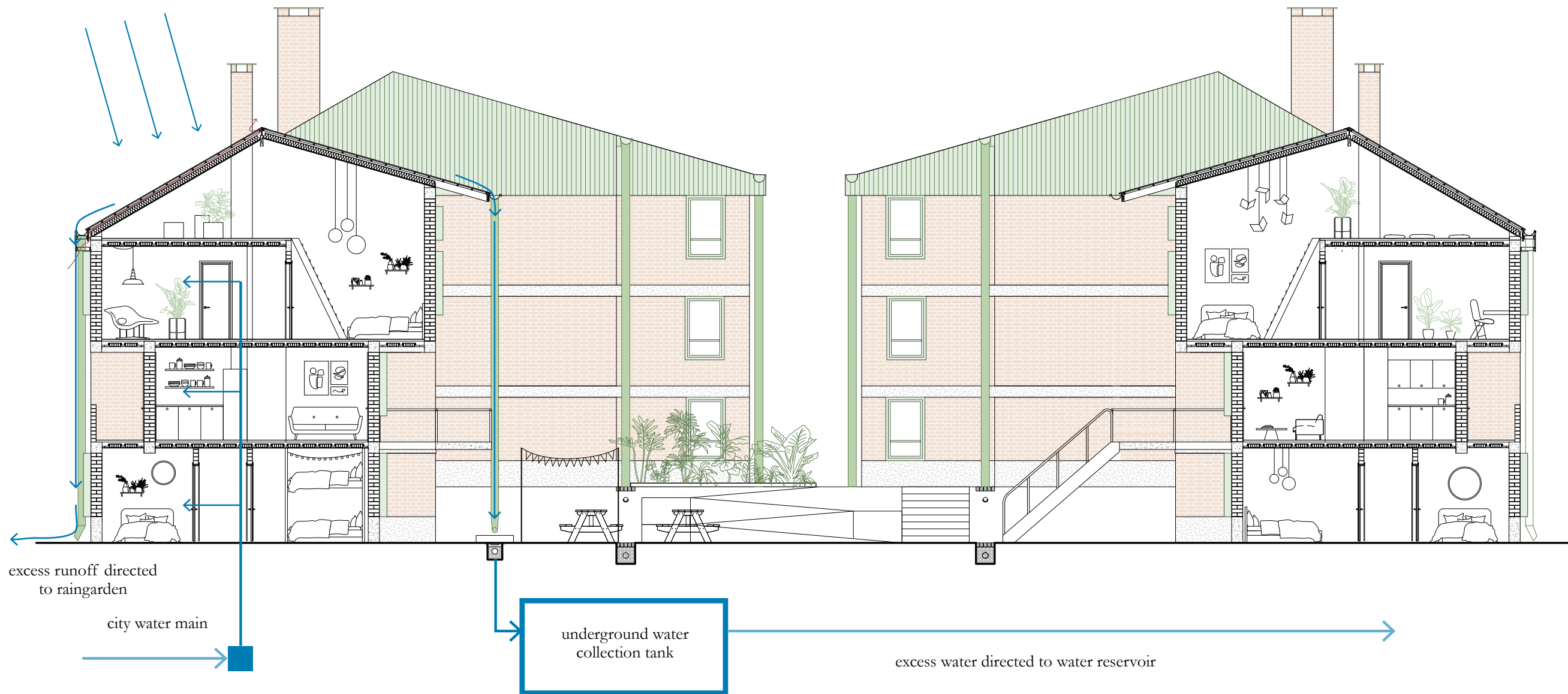
**cluster strategy**  
*Rowhouse Cluster Adaptability*



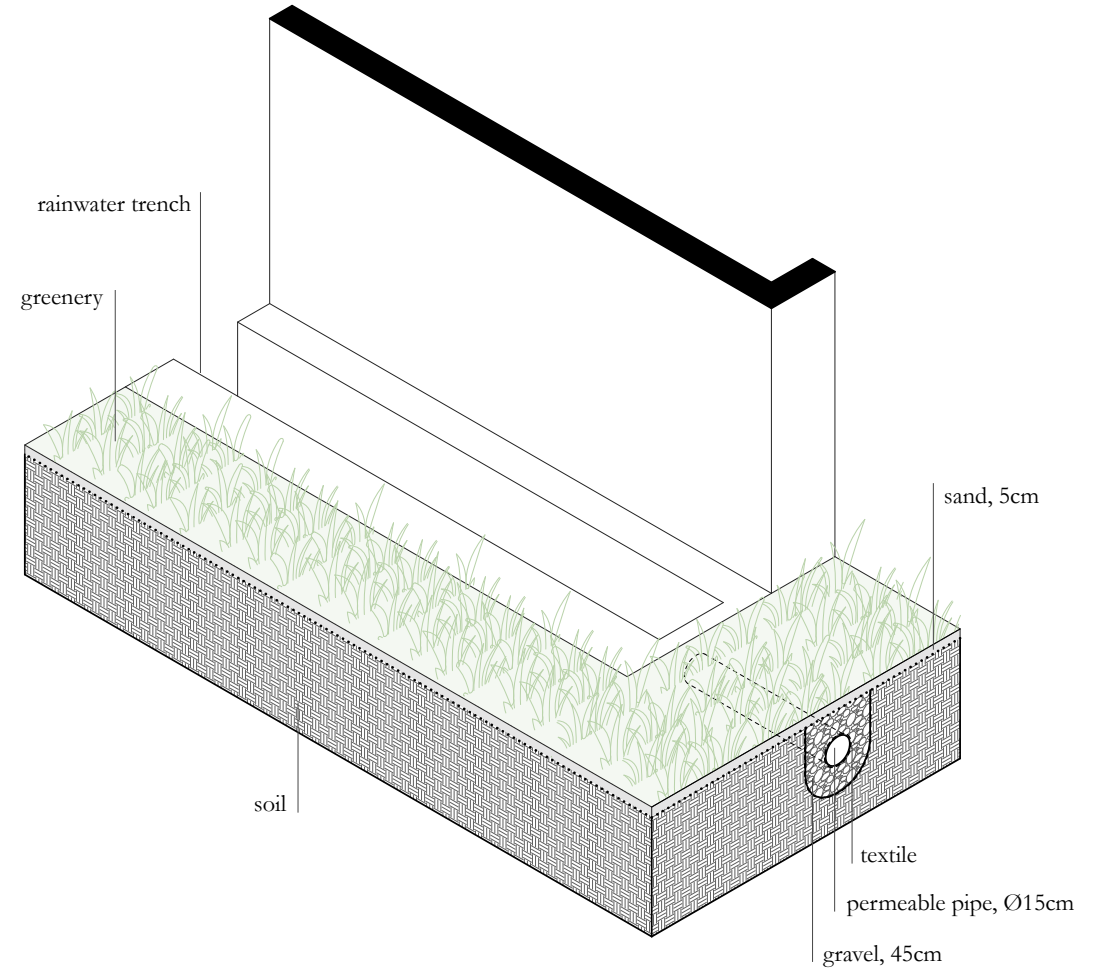
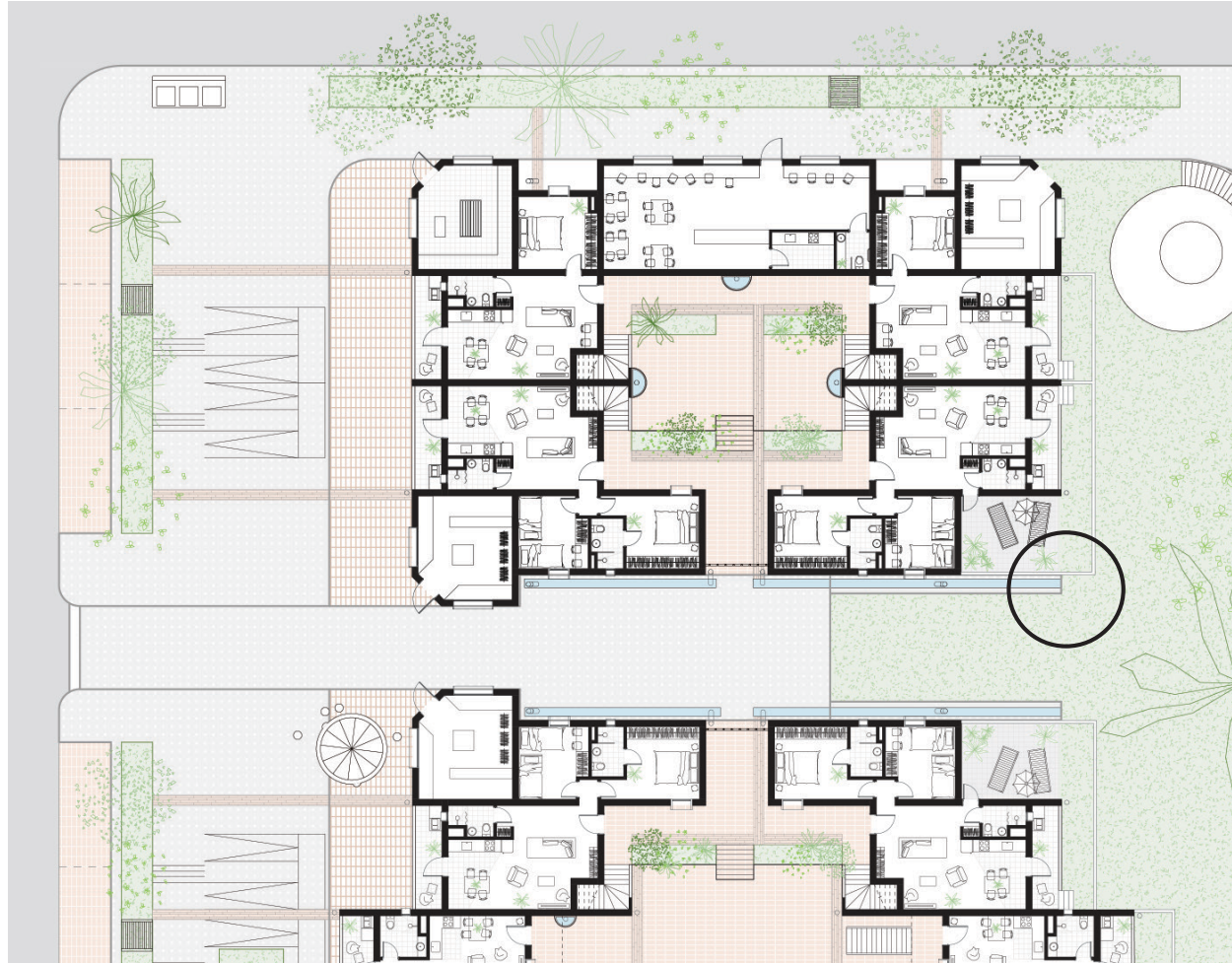
expandable in size to adapt to site & community

**cluster strategy**  
*Rowhouse Cluster Water Management*









**urban conditions**

*Public to Private*

**public** ↑

existing streets

main boulevard

linear park

side streets

green streets

pedestrian local streets

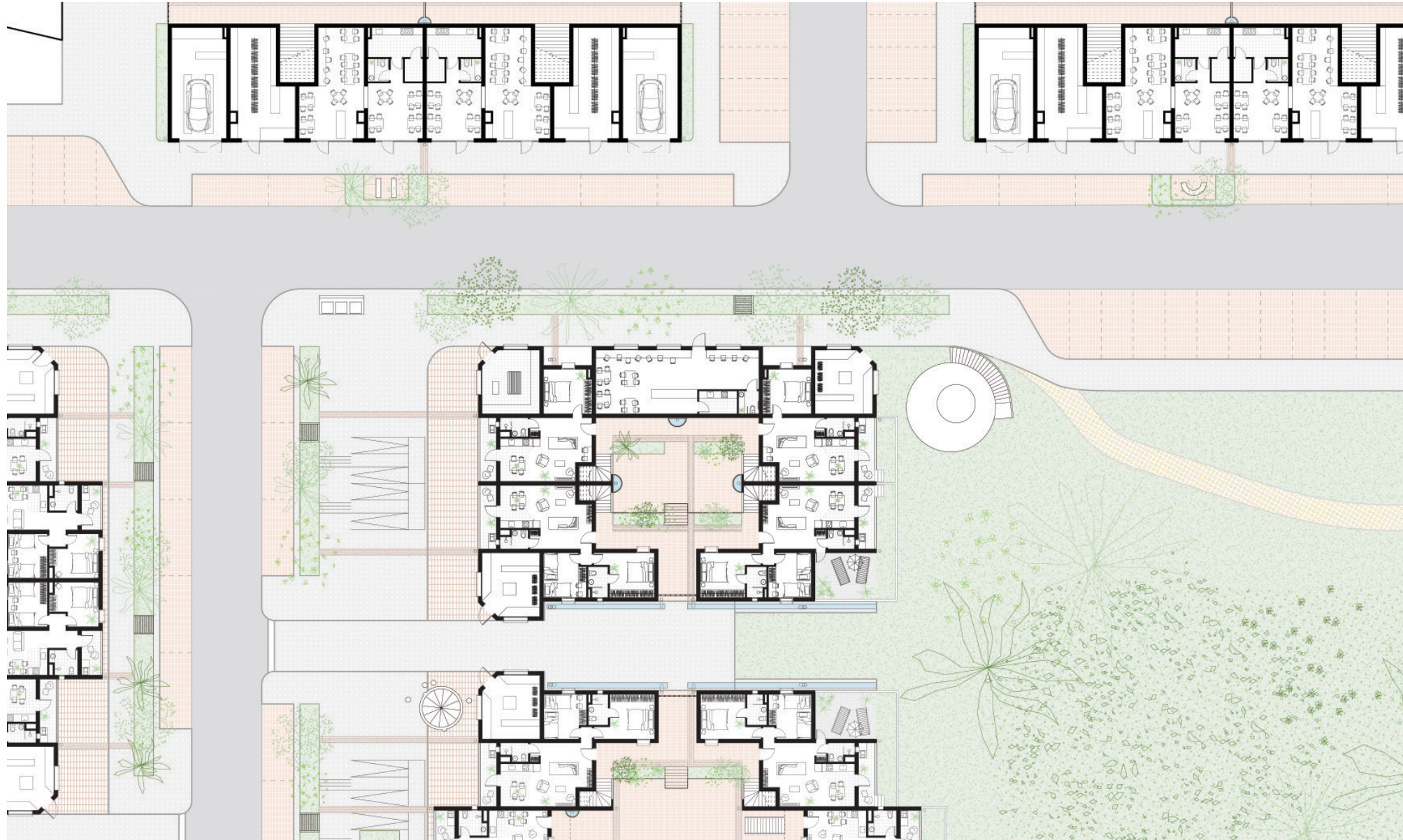
cluster inner shared space

**private** ↓

dwelling

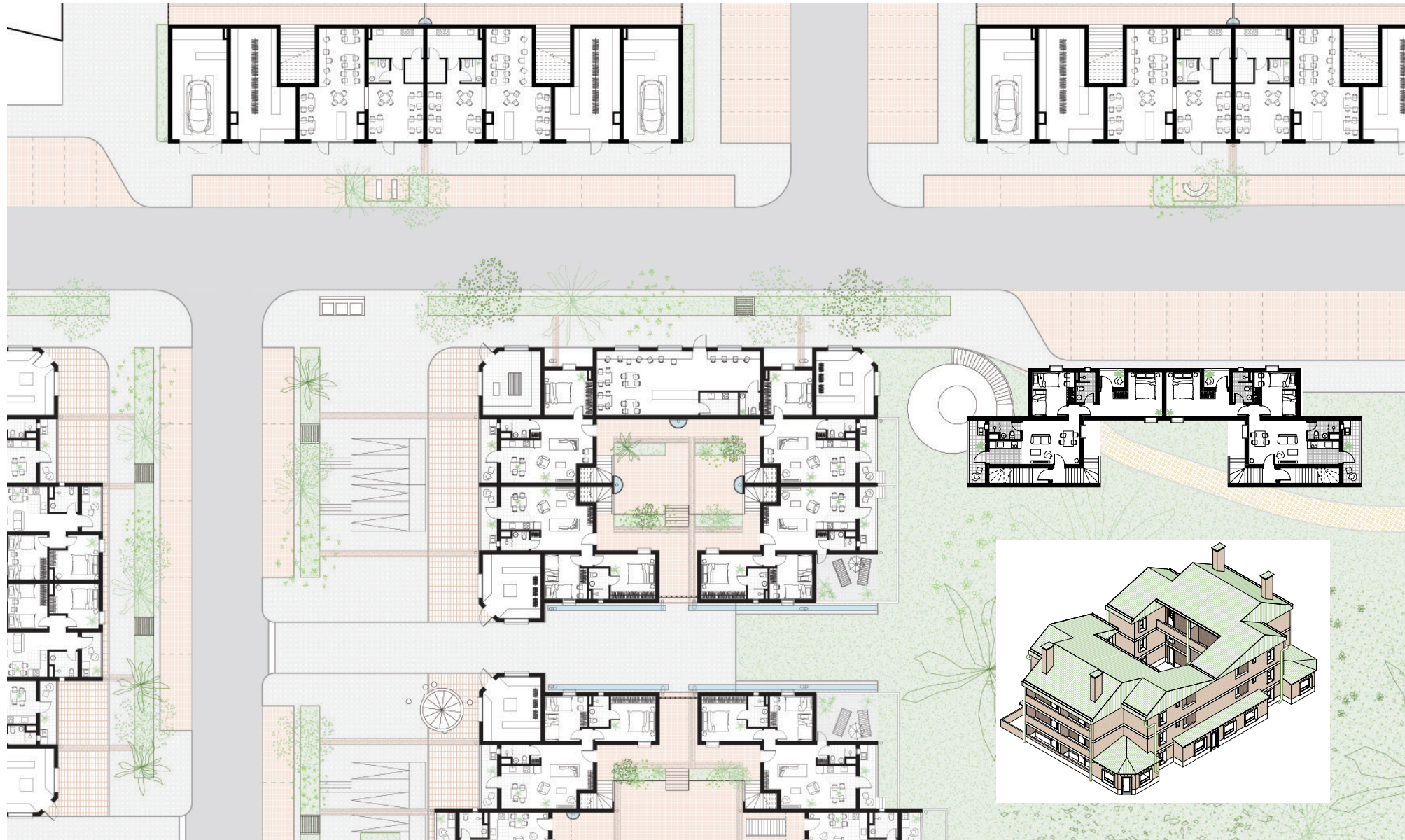


urban conditions  
*Main Boulevard*



**urban conditions**

*Main Boulevard*



**managerial strategy**

*Cluster Formations*

**DIFFERENT COMMUNITIES**

"Cantinho do Céu"



"Erundina"

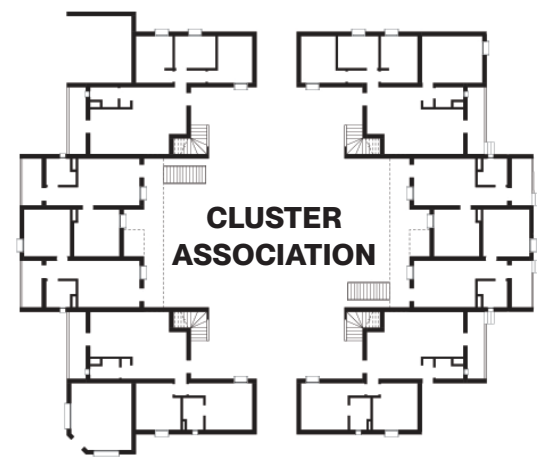


"Cocaia"

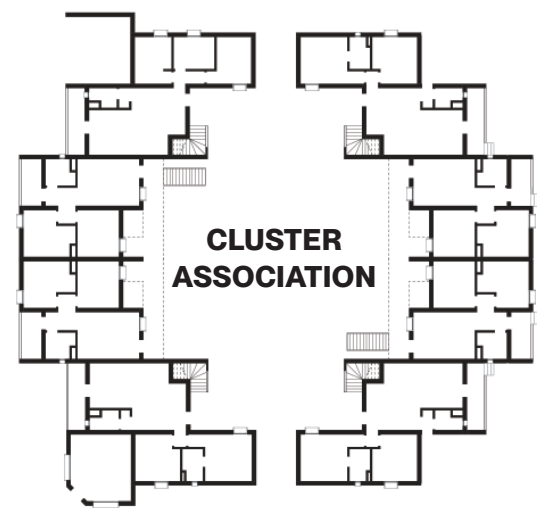


**ENTIRE COMMUNITIES & INDIVIDUAL FAMILIES**

One or two families without strong prior community ties

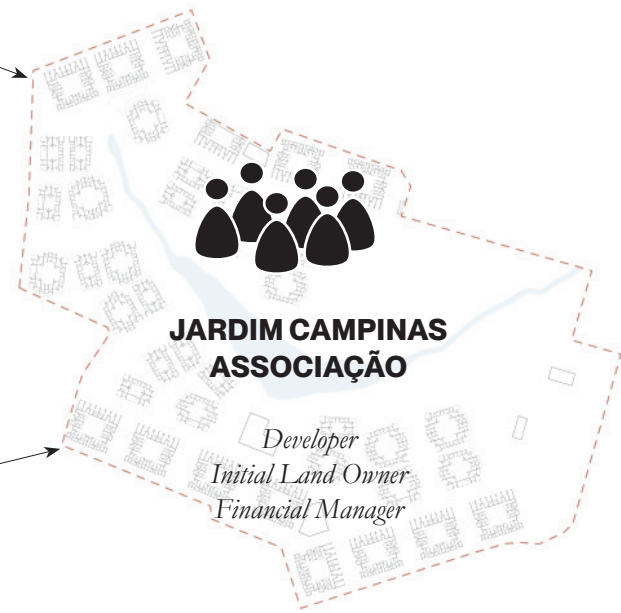


**CLUSTER ASSOCIATION**



**CLUSTER ASSOCIATION**

Head of Cluster Association



**JARDIM CAMPINAS ASSOCIAÇÃO**



*Developer*  
*Initial Land Owner*  
*Financial Manager*

**CLUSTER ASSOCIATION RESPONSIBILITIES**

- Cluster site maintenance
- Individual labour contributions
- Choosing Cluster & Unit Types

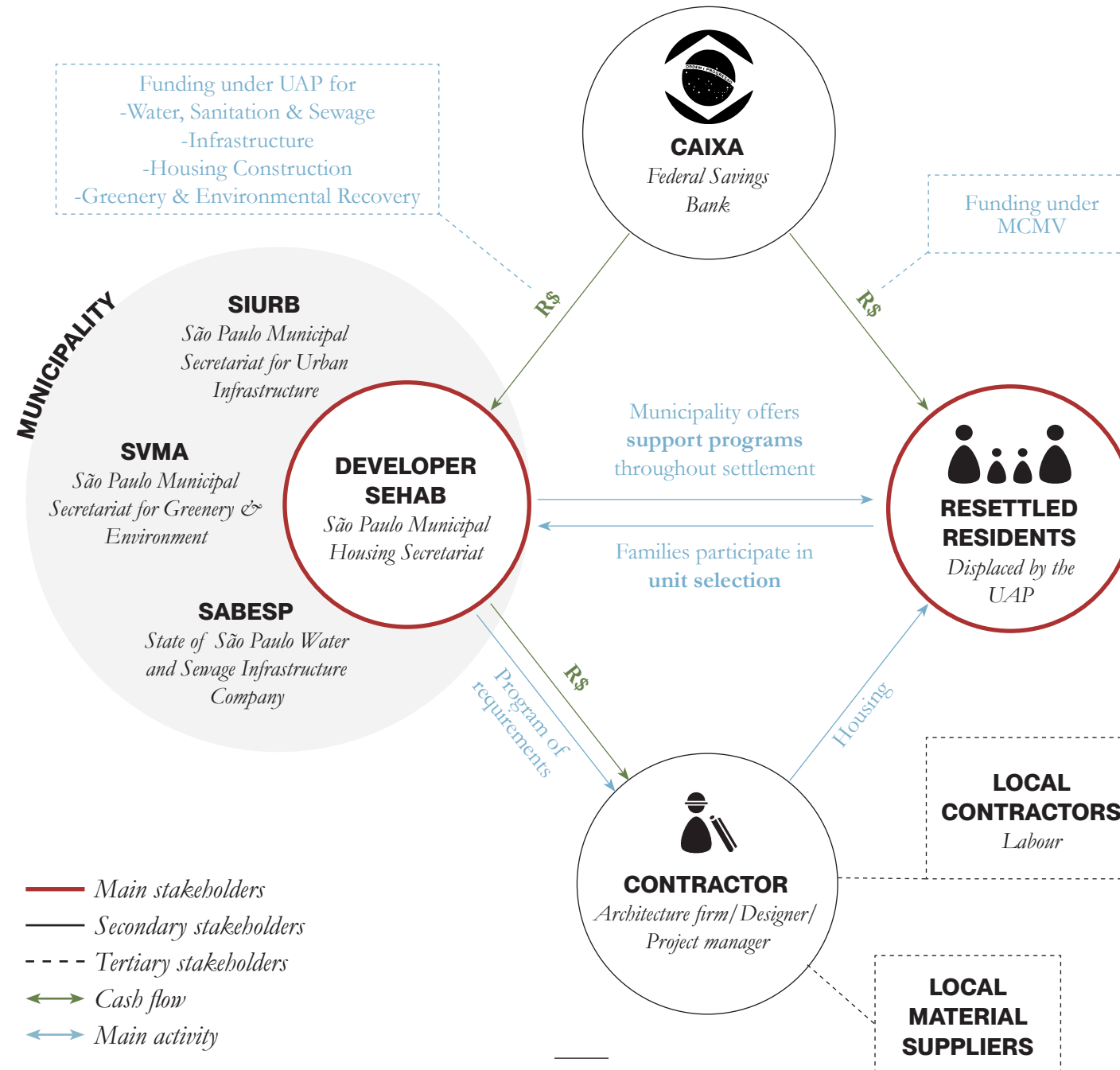
**JARDIM CAMPINAS ASSOCIAÇÃO RESPONSIBILITIES**

- Overall site maintenance
- Rent-To-Own financing program
  - Community labour financing
- Rental management
- Career Opportunity Workshops

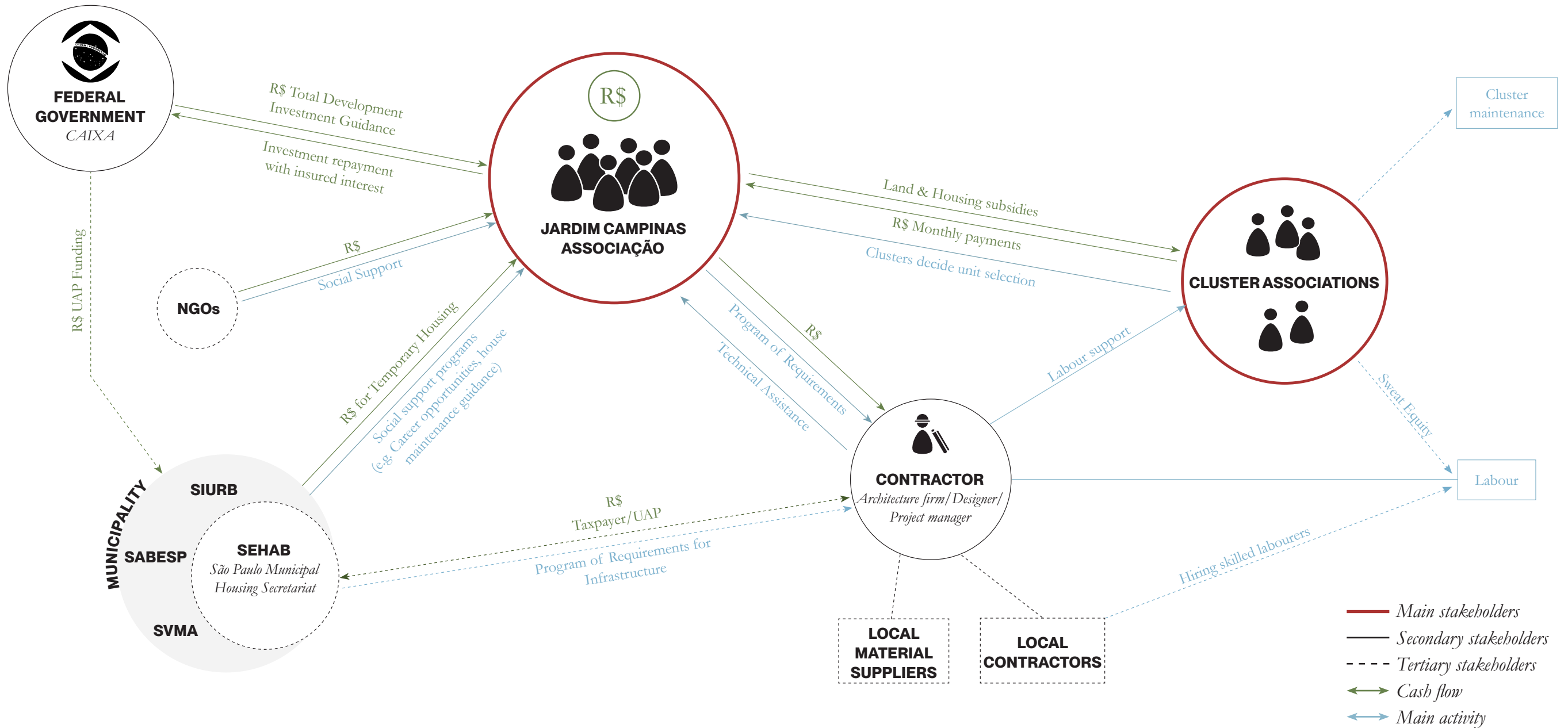


Cluster Associations are based on  
*Prior communities*  
*Relative income*  
*Ownership interest*

**managerial strategy**  
Current Stakeholder Practice



**managerial strategy**  
*Jardim Campinas Stakeholder Analysis*

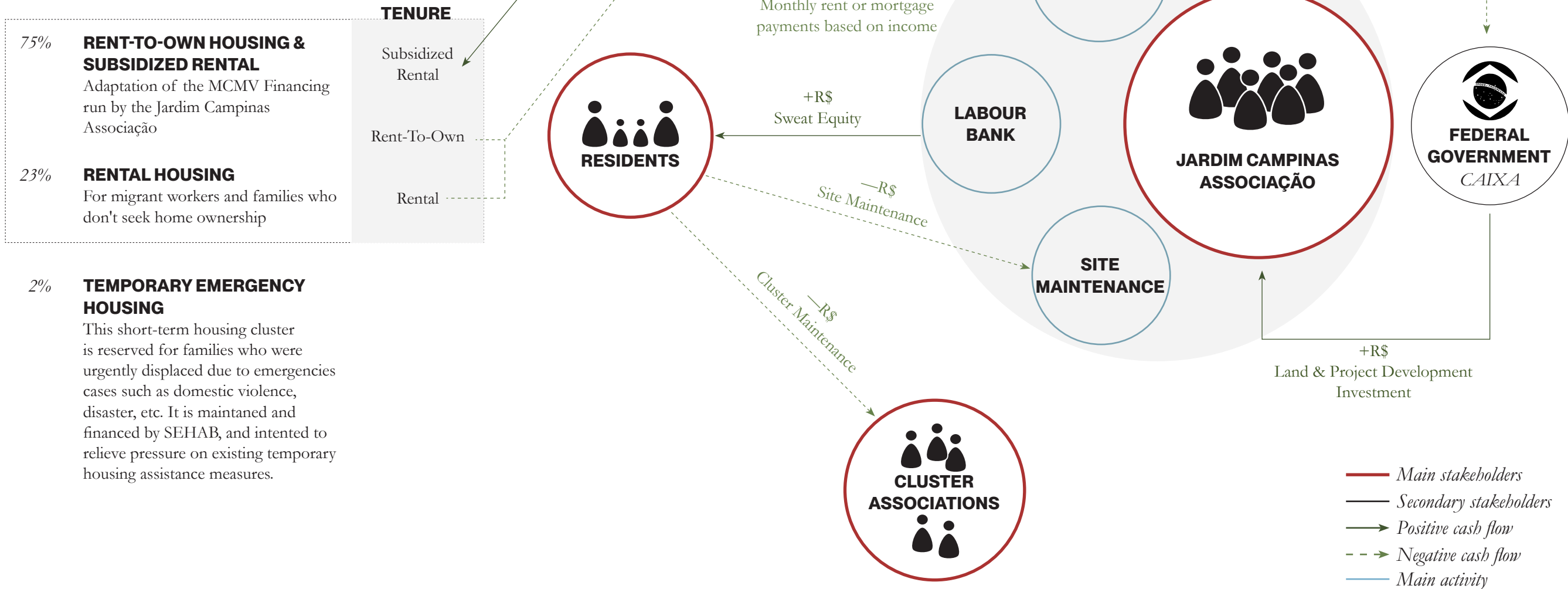


**managerial strategy**  
Rent-To-Own Scheme

≈ 1060

**TOTAL DWELLINGS**

75 dw/ha whole site  
90-110 dw/ha within sectors





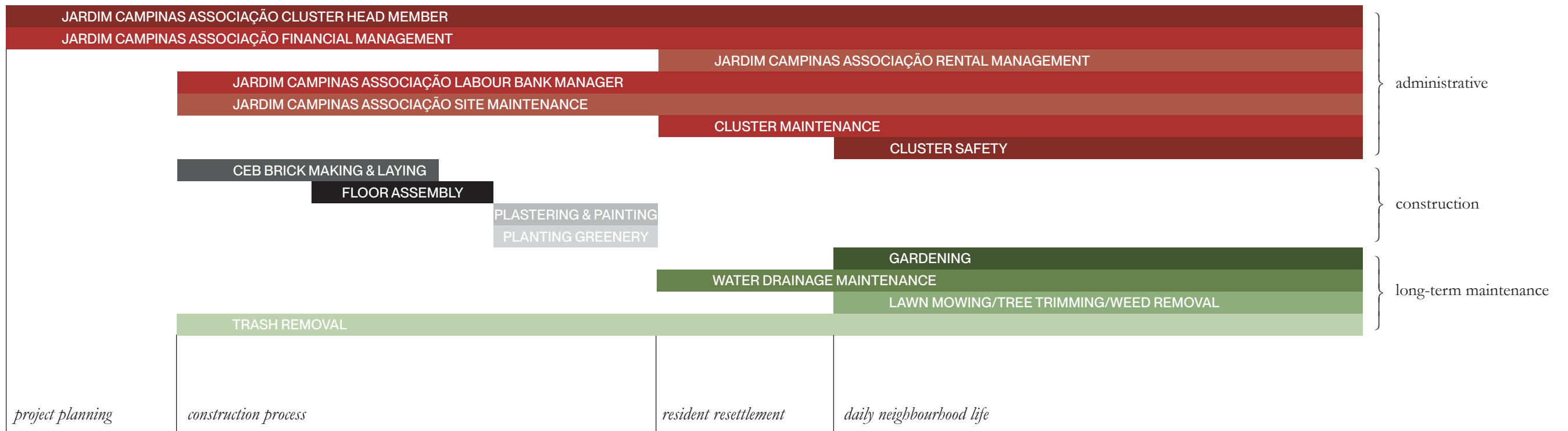
**managerial strategy**

*Sweat Equity*

These tasks are examples on how residents can lower their overall home-ownership debt. They are entirely on a **voluntary basis**.

The incentive is **rent reduction** for those struggling to pay rent but still seek the rent-to-own financing.

These tasks are a great opportunity to form community connections and **build social capital**.



**managerial strategy**  
*Rowhouse Cluster Corner*

**public street side**

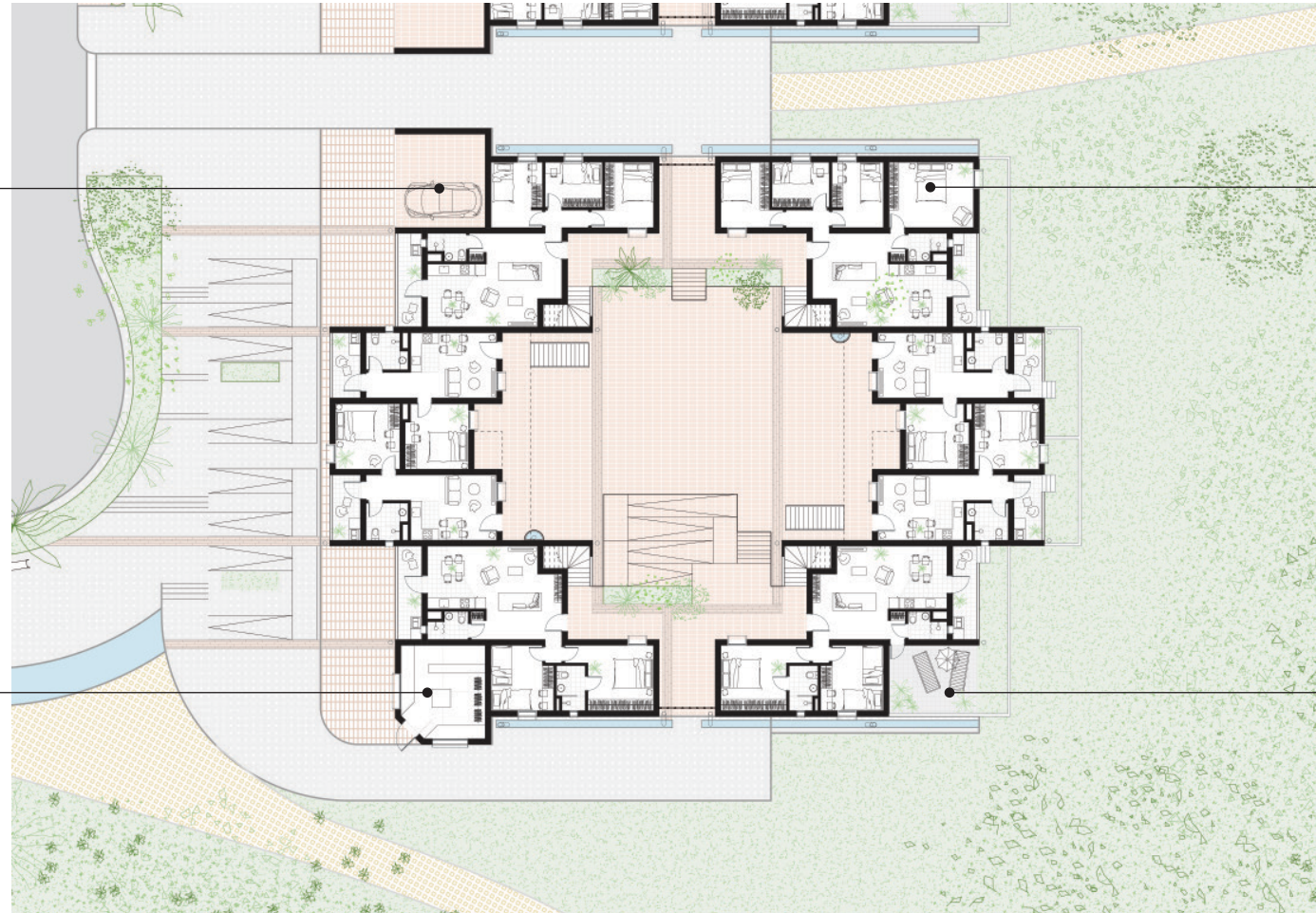
**green side**

*parking garage  
or storage for cluster*

*incremental growth*

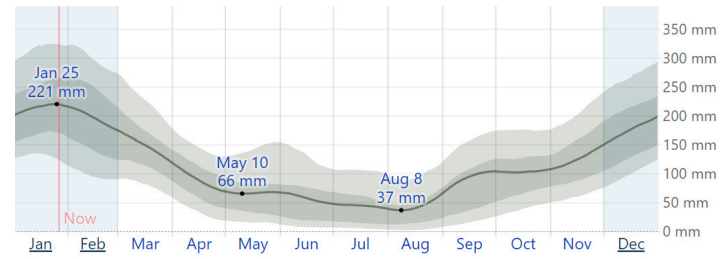
*corner shop*

*yard*

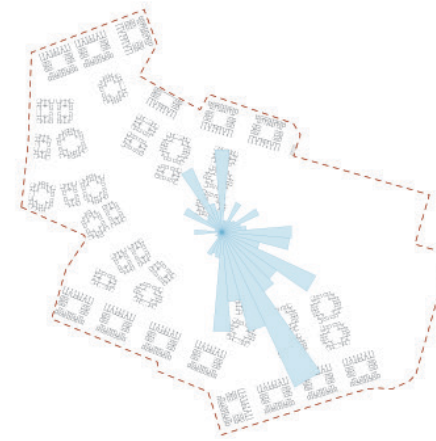


## building technology

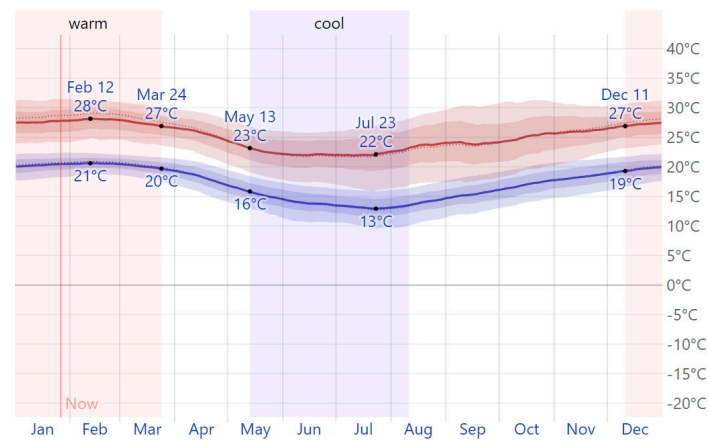
### Local Climate



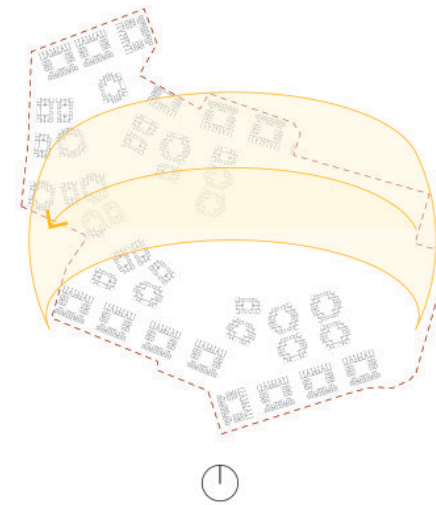
*Average Monthly Rainfall in São Paulo  
(Weather Spark, 2023)*



*Site Wind Analysis*



*Average High and Low Temperature in São Paulo  
(Weather Spark, 2023)*



*Site Sun Analysis*

**building technology**  
*Local Building Practices*



*Local Building Practices in Cantinho do Céu (Autor, 2022)*

**bricks or  
concrete blocks**



*(Veysseyre, 2014)*

**plaster**



*(United Painting,*

**beam and  
block floor**



*(Monteiro, 2014)*

**corrugated metal roof**



*(Autor, 2022)*

**concrete columns  
and ring beams**



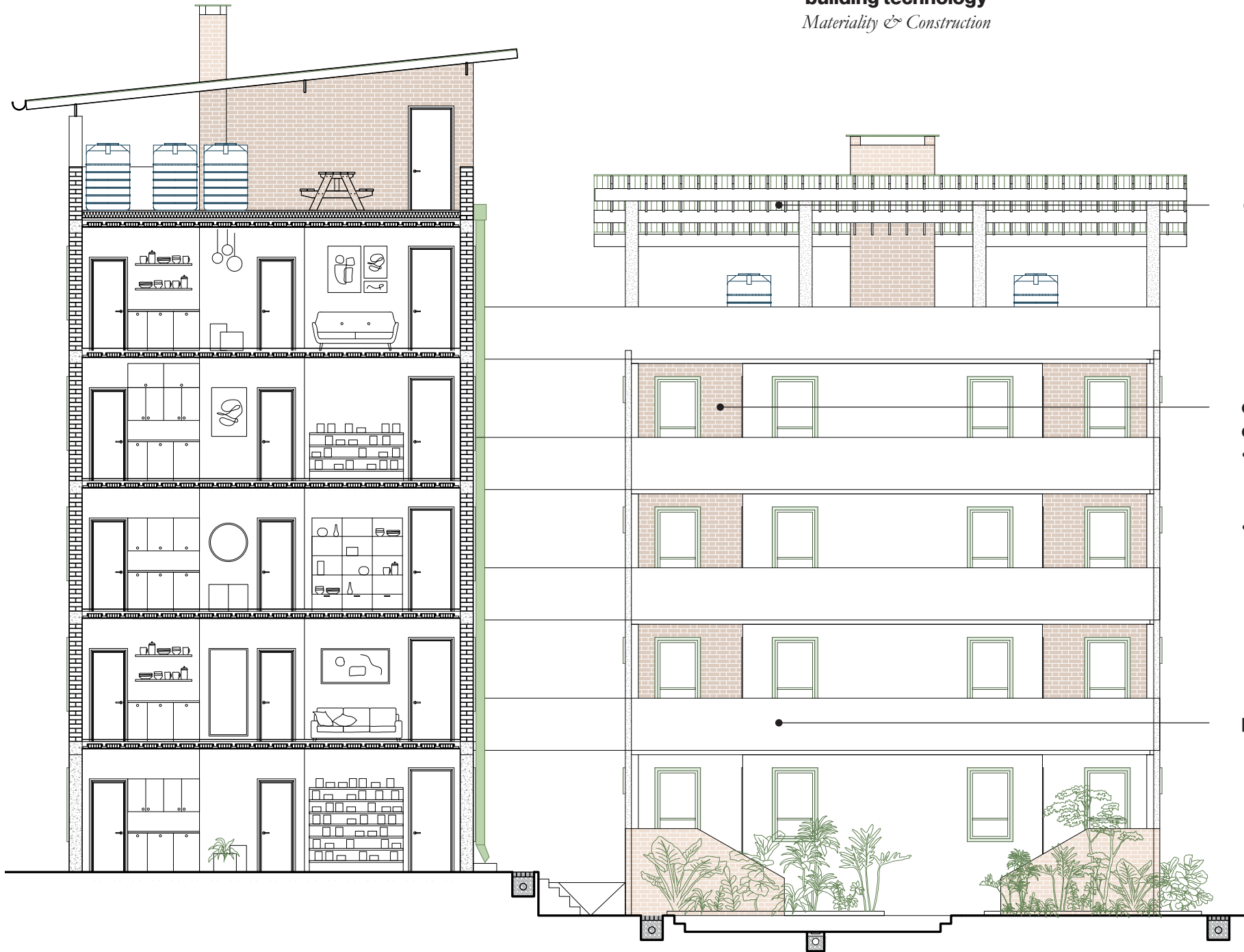
*(Ballinger & Wilke, 2015)*

**simple window  
models**



*(Alive, 2012)*

**building technology**  
*Materiality & Construction*



**colored corrugated metal roof**

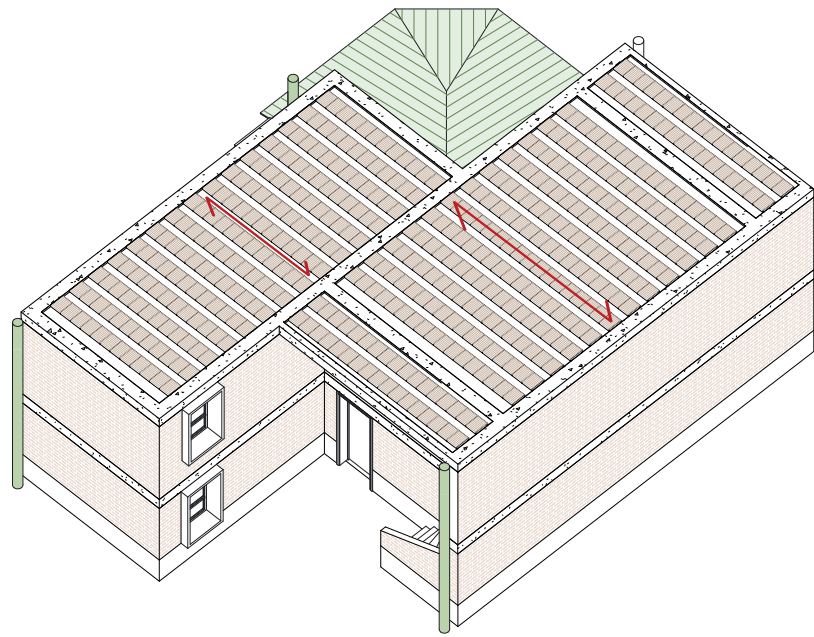
- ideal for collecting rainwater
- fun color to give new association to stigmatized material

**compressed stabilized earth brick (CSEB)**

- structural wall material that functions as thermal mass for passive cooling/heating strategy
- locally sourced from site during construction

**plaster**

- additional material for courtyard cluster to create visual diversity across the site



**deep window frames**

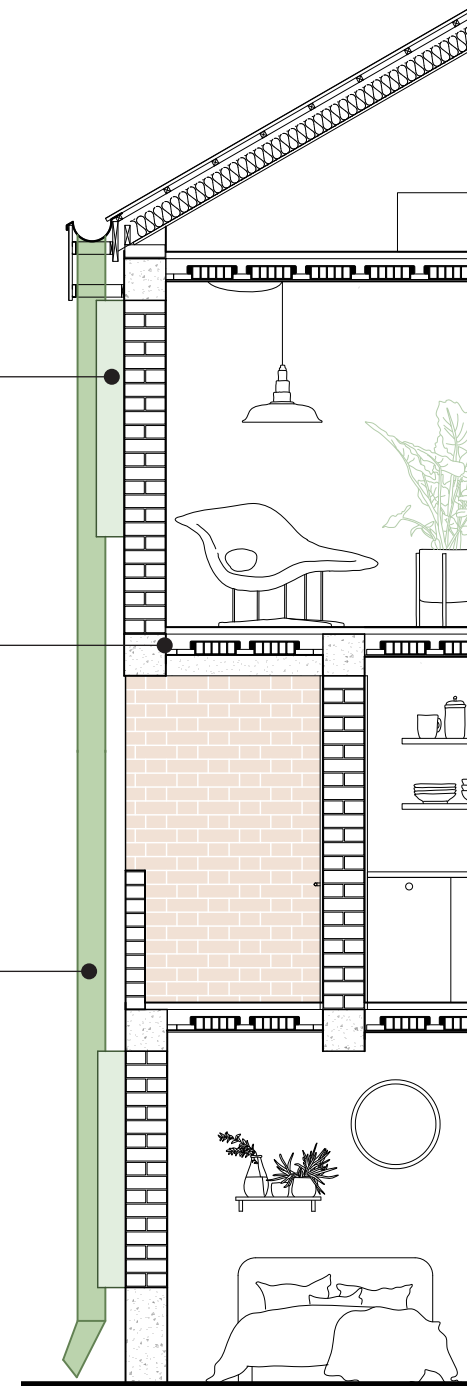
- shades the facade
- can be appropriated by resident

**concrete ring beam & beam and block floor**

- structural floor
- local building practice

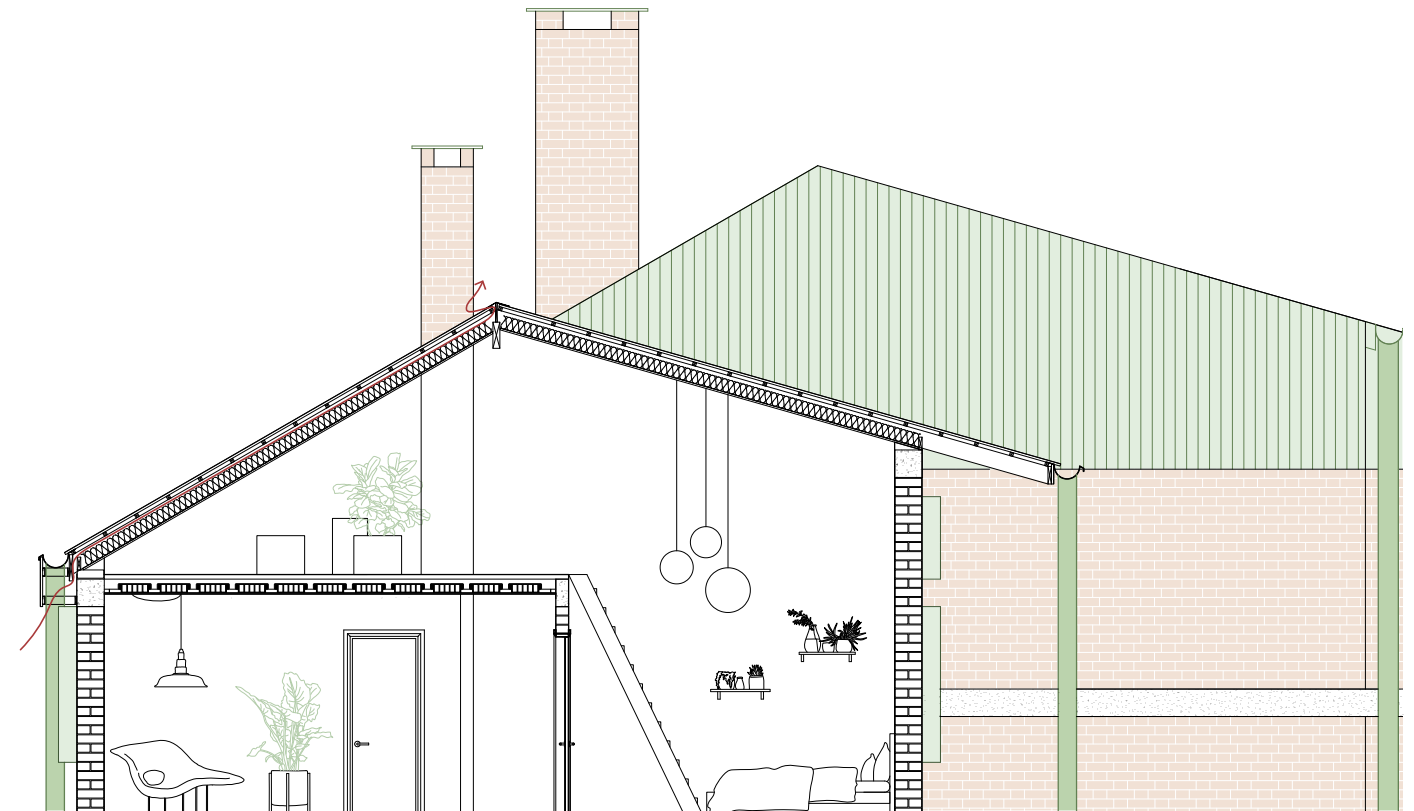
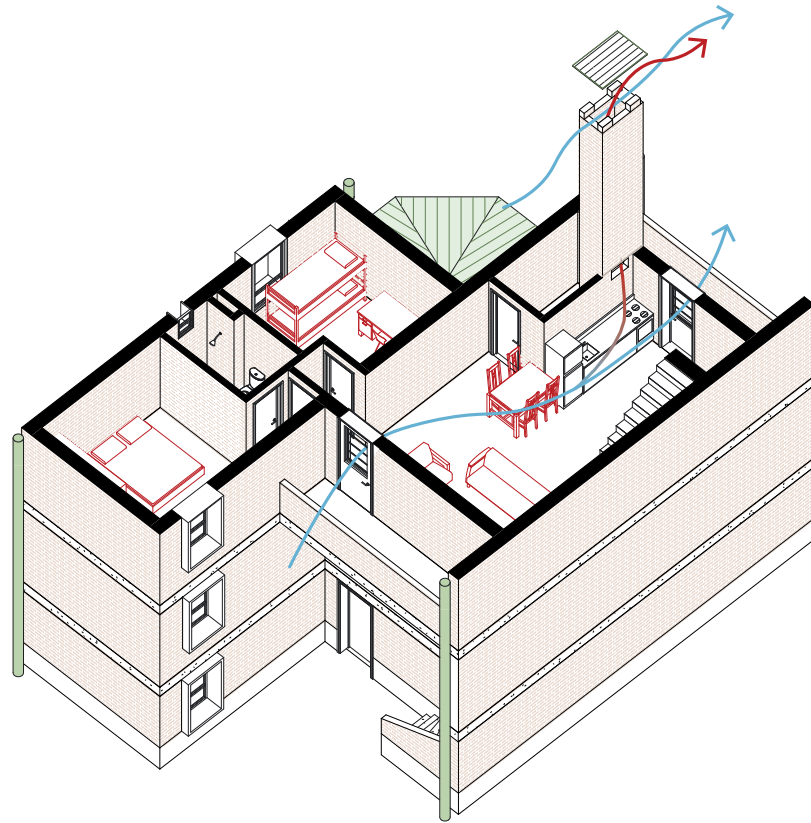
**colorful gutter and downspout pipe**

- highlights the water drainage detail



## building technology

### *Ventilation*



Stack ventilation from the ventilation chimney is improved by cross ventilation in the dwelling unit, ventilated roof design, and the Venturi effect caused by the chimney roof

**conclusion**  
*Density*

*≈ 1060*

**TOTAL DWELLINGS**

3600 estimated dwellers (assuming  
3.5 persons per household)

*100 dw/ha*

**SITE AVERAGE**

84 dw/ha whole site  
-including 1/3rd of linear park  
-not including unbuildable land

90-110 dw/ha within sectors

**FSI:** 1.02  
**GSI:** 0.28

**70%** HIS 1 Dwellings  
**30%** HIS 2 Dwellings





**conclusion**

*Replicability*

*≈730*

**TOTAL DWELLINGS**

2500 estimated dwellers

*103 dw/ha*

**FSI:** 0.97

**GSI:** 0.27

**78%** HIS 1 Dwellings

**22%** HIS 2 Dwellings



*Hamada Farm*

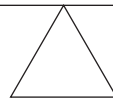


*Jardim  
Campinas  
(Project Site)*



## urban renewal

**social resilience**



**climate resilience**