



ALTERNATIVE SITE PLANNING

in Chrang Chamreh, Cambodia

date: 21 / 11 / 2014

project phase: feasibility study

client: People in Need and Sahmakum Teang Tnaut

consultants: Collective Studio with Advancing Engineering

CONTENTS

1 Introduction

- 1.1 purpose
- 1.2 location of study site
- 1.3 highway expansion
- 1.4 land tenure
- 1.5 environmental context
- 1.6 social context
- 1.7 economic context
- 1.8 urban fabric

2 On-site Upgrading

- 2.1 narrative description
- 2.2 drainage
- 2.2 electrical poles
- 2.3 water supply
- 2.4 waste collection
- 2.5 urban interventions
- 2.6 wall repair

3 Low Cost Housing

- 3.1 narrative description
- 3.2 concept diagrams
- 3.3 masterplan
- 3.4 masterplan: cross section
- 3.5 masterplan: highway edge
- 3.6 masterplan: river road
- 3.7 masterplan: street block / hierachy / commercial
- 3.8 masterplan: infrastructure / renewable energy
- 3.9 masterplan: housing
- 3.10 masterplan: costing

4 Summary

- 4.1 summary

1 introduction

1.1 purpose

In 2013, People in Need (PIN) and its local partner Sahmakum Teang Tnaut (STT) received a grant from European Union and Czech Development Agency to implement a project focusing on alternative spatial planning in urban poor areas of Phnom Penh.

STT identified four villages within Sangkat Chrang Chamreh Muoy, Phnom Penh, as being in threat of eviction due to the proposed expansion of highway no 5.

PIN & STT engaged the architecture practice, Collective Studio to propose alternative re-development options for these villages. The objective was to avoid re-location and offer an on-site solution acceptable to residents, local authorities and other stakeholders.



Fish drying in Chrang Chamreh

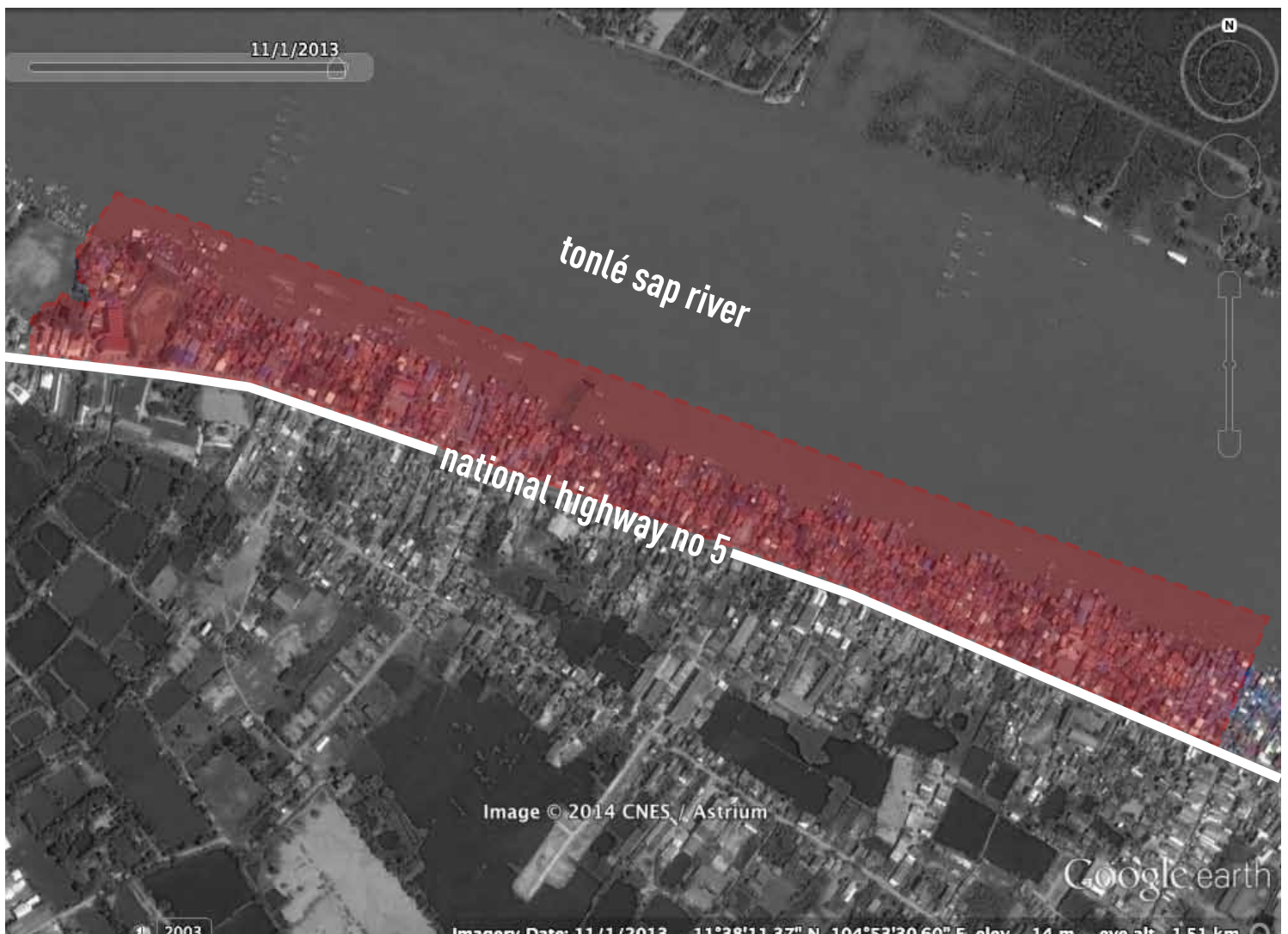


1.2 location of study site

The study site is located in Sangkat Chrang Chamreh mouy on the northwestern edge of Phnom Penh city. The site consists of 4 villages located along a narrow stretch of land approximately 1600m long by 100m wide. The Tonlé Sap River bounds the site to the northeast. National highway no 5 bounds the site to the southwest.

The four villages have a total of 1295 Households and approximately 8000 residents.

Several mosques are located in the study site serving the predominantly Cham community. Multiple primary and secondary schools also are located here along with one of Phnom Penh's largest fish distribution depots.



1.3 highway expansion

National highway no 5 will be expanded. The amount of widening has yet to be confirmed by local authorities. Planning documents given to collective studio throughout this process provided conflicting information with regards to how this area would be zoned and how wide the road would become.

Two pieces of information were selected with regards to the road widening to help define this important planning parameter for the project:

1. Markings 13m from the centre of the existing highway were spray-painted onto the houses that sit immediately adjacent the road.
2. National highway no 1 was recently expanded, this was measured and used as a case study as one of the 'more likely' scenarios of what would take

place at highway no 5.

Using the above information it was decided the 26m road widening including a footpath corridor would be used as a fixed parameter in this site planning exercise.



13m spray paint markings on house holds

national highway no 5



1.4 land tenure

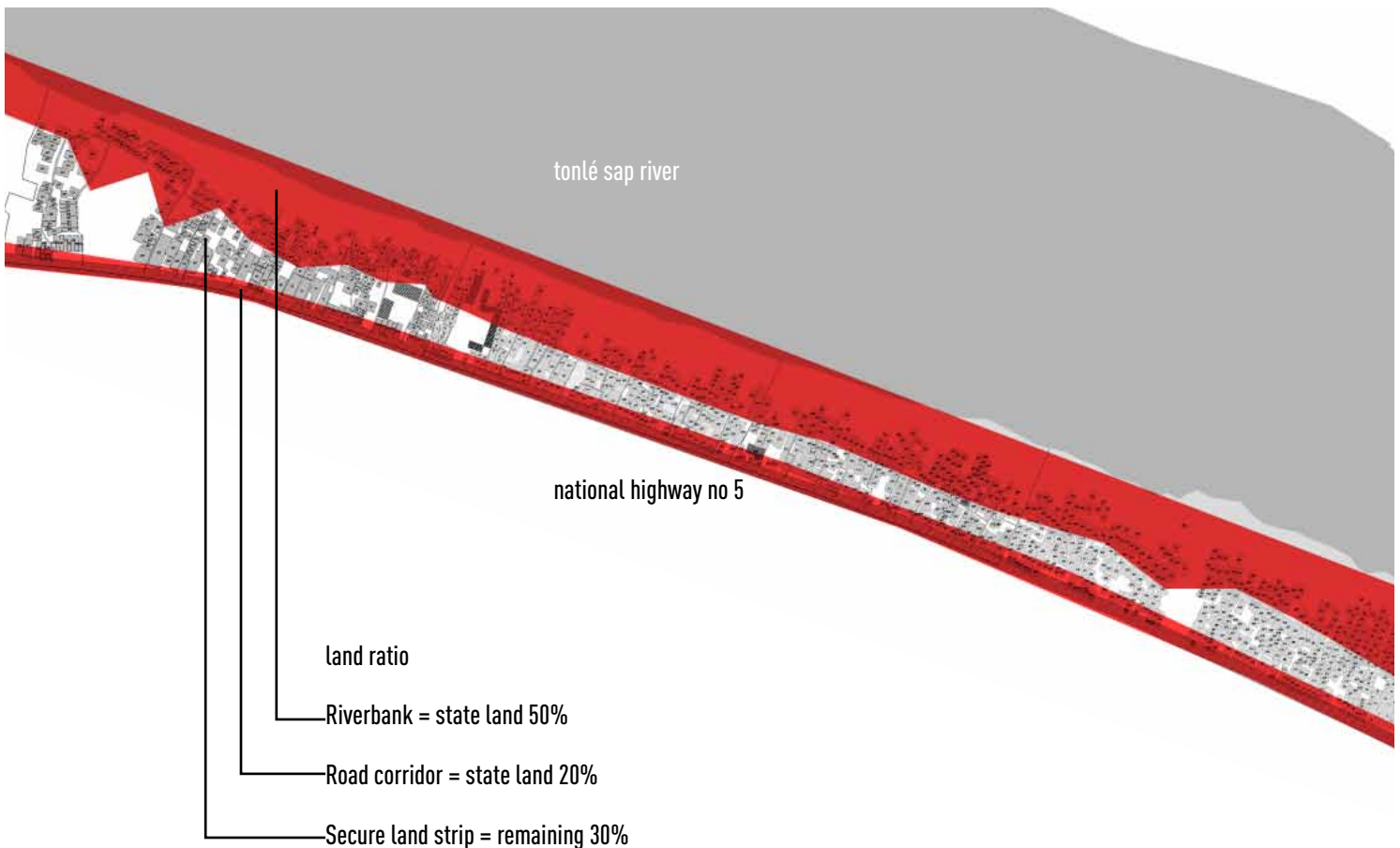
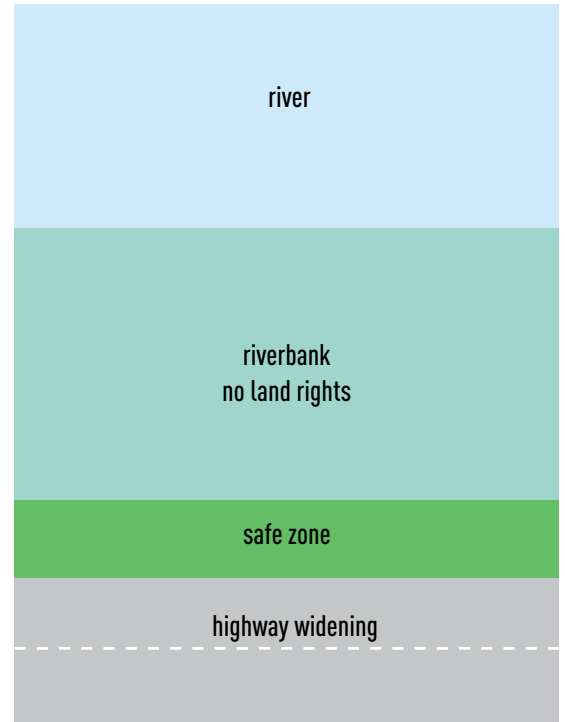
The findings from the legal survey should be referred to in conjunction with the information below.

The government's proposed zoning for this parcel of land makes it seem difficult for the majority of the 1295 households located here to obtain a land title. The short and long-term development plans are to: widen national highway 5 and develop the riverbank as public space.

The extent of the annual flood line was used to demarcate the riverbank zone. This line was identified by the community and mapped by STT. The road widening was discussed in section 1.3 highway expansion within this report.

Approximately 70% of households sit

in one of these two zones. In-between remains a narrow parcel of land. This represents the only available space on this site free of state development plans and therefore where a land title could be obtained.



note: percentages are approximate only.
refer to legal survey report for accurate no house holds effected by zoning and development plans.

1.5 environmental context

The proximity of existing dwellings to the Tonlé Sap River creates two major concerns; flood risk and poor hygiene for residents.

The analysis of the hydrological system, such as rainfall-runoff process and modelling of the river to predict frequency of future flood events is very complex and is out of the scope of this report. A general assessment was carried out to understand the relationship between the community and Tonlé Sap River that borders one length of this site.

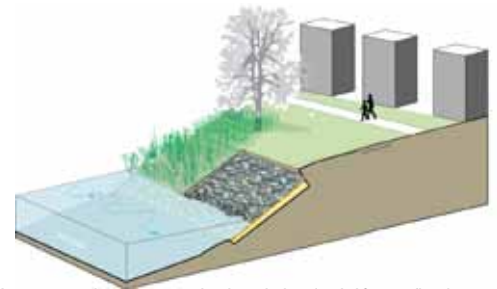
The following observations were made following informal interviews with local residents, field investigations and a review of past flood events.

1.No setback from the river's edge

currently exists: 40-50% of existing households (stilted homes) sit above the annual water level. Disaster risk to homes, commerce, and day-to-day life is high with any event greater than the annual occurrence capable of causing damage.

2.Hygiene: ground floor sanitation systems are consistently flooded. When toilets become unusable during the wet season, the alternative is often defecation directly into the river.

3.Sand dredging: sand is dredged at multiple points along the river edge in close proximity to households. Noise pollution is a common complaint by residents. This process can cause an unstable river edge and this needs to be considered when planning types of river embankment.



International context - setback and plan for 1:10 year flood event

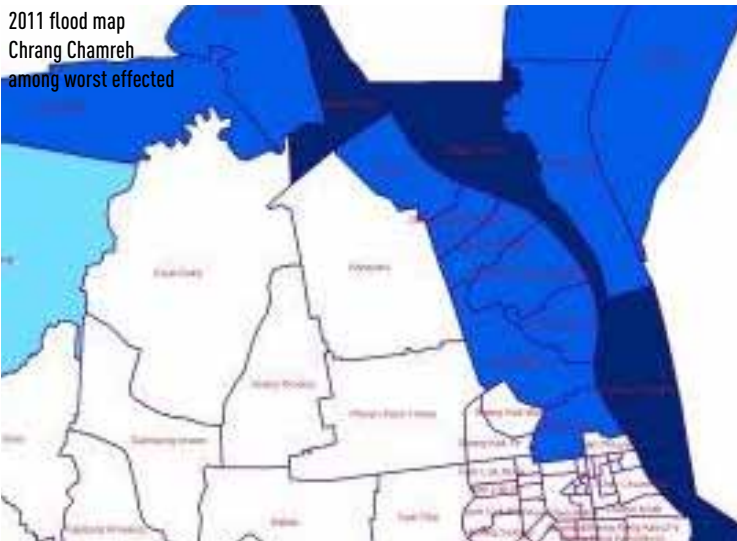


Phnom Penh context - river side - 60 - 80m setback



Chrang Chamreh - no setback

2011 flood map
Chrang Chamreh
among worst effected



2011 floods in Chrang Chamreh



water level



mixed waste
in water underneath
homes

1.6 social context

The majority of residents that live in these 4 villages are Cham (Muslim) religion. Thus an important daily routine is visiting the local mosques. Many male residents attend prayer at the mosques five times a day.

Most children attend one of the local schools in the community along with additional religious studies outside of school.

Outside of religion, daily life focuses on commerce and family. The two are more often than not inseparable as most households share a family business and the majority of this business operates underneath or in front of the family home. It is under the house where life is lived; cooking, selling goods, socialising with neighbours.

Residents along the highway edge generally receive the most business and live in larger dwellings with a more formal shop at the front of their household. In comparison, those who live closer to the river edge, generally receive less business, and live in slightly smaller dwellings usually with an informal shop or hanging goods beneath an elevated, stilted household.



Main mosque in village khor

site photo: gathering beneath the home



1.7 economic context

A guide to the value of land in Phnom Penh was produced by V-trust and published in the journal of real estate in March 2014, 'final report of the land price survey in Phnom Penh'.

In order to attract investors to a proposal for low cost housing, a commercial incentive for the investor would need to be included within the scheme. PIN therefore used this survey as a guide to the value of land in Sangkat Chrang Chamreh mouy and this was taken into account in the planning process.

Whether or not residents will be compensated from the government for demolition of their homes remains to be confirmed.



private land adjacent the northern site boundary

extract from v-trust guide

VTRUST Journal of Real Estate | Volume 1, Issue 2 | Land Price 2014: Final Report of the Land Price Survey in Phnom Penh | Page 5

RESULTS OF LAND PRICE SURVEY IN Q4 2013 BY VTRUST GROUP				LAND PRICE REPORT 2014 BY VTRUST REALTY (ACTUAL TRANSACTIONS)					
Location Stratifications	Asking Prices			On Main Street			On Sub Street		
	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum
Chamkarmon District	\$ 2,360	\$ 1,010	\$ 5,900	\$ 3,250	\$ 1,500	\$ 5,000	\$ 1,650	\$ 750	\$ 1,800
Boeng Keng Kang Areas	\$ 2,500	\$ 1,000	\$ 5,900	\$ 3,500	\$ 2,000	\$ 5,000	\$ 2,850	\$ 1,200	\$ 3,300
Boeng Keng Kang Bei	\$ 2,000	\$ 1,100	\$ 2,600	\$ 2,750	\$ 2,000	\$ 3,500	\$ 1,500	\$ 1,200	\$ 1,800
Boeng Keng Kang Muoy	\$ 3,300	\$ 1,200	\$ 5,900	\$ 3,900	\$ 2,800	\$ 5,000	\$ 2,800	\$ 2,300	\$ 3,300
Boeng Keng Kang Pir	\$ 2,100	\$ 1,000	\$ 3,800	\$ 3,250	\$ 2,000	\$ 4,500	\$ 1,500	\$ 1,200	\$ 1,800
Boeng Trabaek	\$ 1,810	\$ 1,200	\$ 2,970	\$ 2,050	\$ 1,800	\$ 2,300	\$ 1,400	\$ 1,100	\$ 1,700
Oulampik	\$ 2,680	\$ 1,440	\$ 4,520	\$ 2,150	\$ 1,800	\$ 2,500	\$ 1,400	\$ 1,100	\$ 1,700
Phsar Daeum Thkov	\$ 1,750	\$ 770	\$ 2,710	\$ 1,950	\$ 1,500	\$ 2,400	\$ 1,125	\$ 750	\$ 1,500
Tumnob Tuek	\$ 2,620	\$ 1,530	\$ 4,810	\$ 2,250	\$ 2,000	\$ 2,500	\$ 1,250	\$ 900	\$ 1,600
Tuol Svay Prey Areas	\$ 2,790	\$ 2,020	\$ 4,030	\$ 2,150	\$ 1,800	\$ 2,500	\$ 1,450	\$ 1,200	\$ 1,700
Tuol Svay Prey Muoy	\$ 2,780	\$ 2,120	\$ 3,460	\$ 2,150	\$ 1,800	\$ 2,500	\$ 1,450	\$ 1,200	\$ 1,700
Tuol Svay Prey Pir	\$ 2,800	\$ 2,020	\$ 4,030	\$ 2,150	\$ 1,800	\$ 2,500	\$ 1,450	\$ 1,200	\$ 1,700
Tuol Tumpung Muoy	\$ 1,850	\$ 1,150	\$ 2,610	\$ 2,200	\$ 1,600	\$ 2,800	\$ 1,350	\$ 1,000	\$ 1,700
Tuol Tumpung Pir	\$ 2,100	\$ 1,580	\$ 3,470	\$ 2,200	\$ 1,600	\$ 2,800	\$ 1,350	\$ 1,000	\$ 1,700
Daun Penh District	\$ 3,628	\$ 1,042	\$ 5,830	\$ 3,750	\$ 2,500	\$ 5,000	\$ 2,200	\$ 1,600	\$ 2,800
Chaktomukh	\$ 3,390	\$ 1,250	\$ 5,310	\$ 4,000	\$ 3,000	\$ 5,000	\$ 2,300	\$ 1,800	\$ 2,800
Chey Chumneah	\$ 4,200	\$ 2,500	\$ 5,160	\$ 3,500	\$ 3,000	\$ 4,000	\$ 2,250	\$ 1,700	\$ 2,800
Phsar Thmei Areas	\$ 3,450	\$ 1,040	\$ 5,830	\$ 3,250	\$ 2,500	\$ 4,000	\$ 2,150	\$ 1,800	\$ 2,500
Meanchey District	\$ 830	\$ 100	\$ 2,990	\$ 1,175	\$ 350	\$ 2,000	\$ 925	\$ 250	\$ 1,600
Boeng Tumpun	\$ 1,680	\$ 880	\$ 2,990	\$ 1,800	\$ 1,600	\$ 2,000	\$ 1,150	\$ 700	\$ 1,600
Chakangrae Areas	\$ 930	\$ 420	\$ 1,620	\$ 1,200	\$ 900	\$ 1,500	\$ 600	\$ 400	\$ 800
Chbar Ampov Areas	\$ 910	\$ 220	\$ 2,030	\$ 1,350	\$ 900	\$ 1,800	\$ 800	\$ 500	\$ 1,100
Nirouth	\$ 760	\$ 230	\$ 1,800	\$ 750	\$ 600	\$ 900	\$ 400	\$ 300	\$ 500
Preaek Aeng	\$ 330	\$ 100	\$ 670	\$ 375	\$ 300	\$ 450	\$ 275	\$ 250	\$ 300

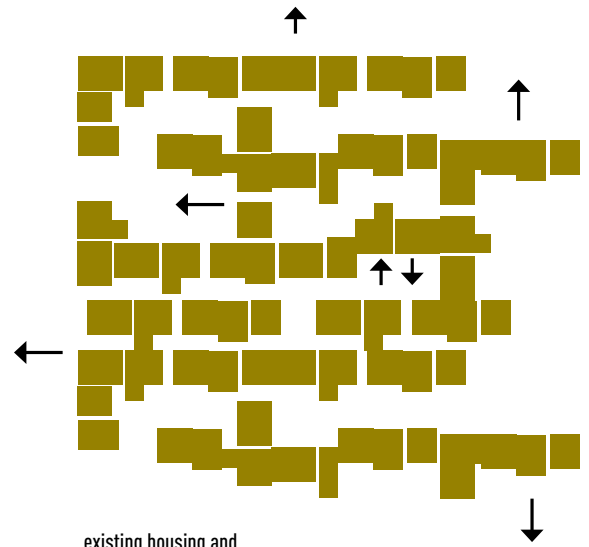
1.8 urban fabric

Individual dwellings are built in close proximity to each other with varying street widths (1-3m) in-between.

Nearly all residents have elevated their homes to mitigate flooding. Homes float on the tonlé sap above plastic barrels, those closest to the river edge are built on bamboo or timber stilts, further towards the highway some households are elevated with concrete columns, others built above concrete plinths and many along the highway have a solid masonry base.

The close proximity of homes to one another and the narrow network of streets maximise opportunity for commerce. The streets become spaces to play, cook and sell goods.

Fishing nets are used for shade and any trees are popular places to sit beneath due to their rarity in the villages.



existing housing and multi layered urban fabric maximises interaction for commerce



2 On-site Upgrading

2.1 narrative description

The option to rehouse all residents in a new low cost housing scheme requires large monetary investment, time and co-ordination with all stakeholders.

The on-site upgrading option therefore proposes a set of small-scale interventions that are tangible in the short term and provide improvements to the quality of the public environment throughout all four villages.

Workshops were held with each village to determine priorities and then to receive feedback on the subsequent ideas.

The following pages outline the six options that resulted from this community consultation and site investigation. Further community

consultations, construction documentation, bills of quantity are required prior to implementation.

upgrading options

1. Drainage
2. Electrical poles
3. Water supply
4. Waste collection
5. Urban interventions
6. Wall repair



2.2 drainage

Problem to be addressed

Pooling of water on dirt roads, creating difficulty for residents to walk and drive motorcycles across these roads

Proposed upgrade

Pave dirt roads with concrete and install a spoon drain adjacent the newly paved road

General notes / reference drawings

Refer to map D100 for location of dirt roads

Refer detail D-01 for typical cross section of road and spoon drain

Cost

\$100 / m² . Refer to table (a) for combined upgrading total

note: this is an estimate only. A detailed survey of selected roads is needed to produce construction drawings, determine quantities and cost. This is the responsibility of the contractor.

Desired outcome

Following a rain event, water will drain to the river faster then the current situation on the selected roads.

Before



After



2.3 electrical poles

Problem to be addressed

Some existing electrical poles are broken and/or unstable. See photo 01 for example

Some streets have no electrical poles and cabling is attached directly to house awnings / walls. See photo 02 for example

Proposed upgrade

Replace broken or unstable poles with new concrete poles

Locate and install new concrete poles on streets that do not have any

General notes / reference drawings

Based on community feedback, an estimate of 10 poles have been allocated per village. This quantity is flexible pending detailed survey.

Refer to detail D-02 for specification of the pole. Refer to Electricity of Cambodia (EDC) for standard installation specification.

Cost:

\$230 / pole (new cabling not included) Refer to table (a) for combined upgrading total

Note: this is an estimate only. A detailed survey of existing electrical cabling and connections is needed to produce construction drawings, determine quantities and cost. This is the responsibility of the contractor.

Desired outcome

Reduce maintenance required to repair timber poles that fall down

Reduce electrical failures with a more reliable and safer cabling layout

01 - unstable / makeshift electrical poles



02 - streets without electrical poles



2.4 water supply

Problem to be addressed

The majority of the community's water supply comes from a private supplier, see photo 03. The quality of this water is not known. The cost is greater than state supplied water.

Proposed upgrade

Connect residents to the state water supply.

General notes / reference drawings

A water quality test of the private supplied water is needed to determine if there is a health benefit in switching to state supplied water.

Survey of the community is required to determine who wants to switch. Refer plan D200 for type of water supply / household

Cost

\$300 / household is current connection fee. Negotiation between STT and local authorities is required to arrive at an agreed connection fee.

Desired outcome

improved water quality and a cheaper monthly water bill for residents

03 - private water plant - khor village



2.5 waste collection

Problem to be addressed

Solid waste is prevalent throughout the community. Rubbish particularly accumulates on the river edge and beneath stilted homes during the wet season. See photo 04

Proposed upgrade

Create a waste collection system and education program. Assign one team per village responsible for collecting rubbish and delivering it to the highway where Cintri has 'pick up points'.

General notes / reference drawings

STT to carry out waste collection survey, to determine community willingness to participate and how much they will pay for this service. STT will negotiate with Cintri the supply of public rubbish bins. A community clean up day will begin the campaign.

Desired outcome:

Behavioural change with disposal of everyday waste

Creation of jobs

cleaner river edge, a location where children bathe and play

Visual amenity improved

Smell of waste beneath homes reduced

04 - river edge - khor village



2.6 urban interventions

Problem to be addressed

lack of community and public spaces where residents can gather under shade, carry out commerce and kids can play.

Proposed upgrade

Plant trees, place bins and introduce public artwork on selected streets and school grounds

General notes / reference drawings: 3 categories of urban intervention 1 School 2 Street and 3 Art

1 School: STT to co-ordinate 'plant and paint' day for each school. All materials are brought to the schools. Refer detail D-03 for proposed trees and planters. Refer plan D300 and image 1.School for possible layouts. Install with students and parents. Contact Collective Studio if you would like a consultant to layout these activities & elements on site.

2 Street: STT to co-ordinate community activity day in unison with School 'plant and paint' day. Refer detail D-03 for proposed trees, planters and bins. Refer plan D400 and montage images for possible layout. Quantities have been estimated for 1-2 streets per village. This can be increased if funds allow. Community to decide which streets are priority

3 Art: Select one wall per village to be the site for a painted wall mural. Refer image 3.Art for example of wall to be used. Refer plan D500 for possible wall locations, note: collaborate with community to select priority locations. Engage local artist to create site-specific artwork

Cost (Refer to table (a) for combined upgrading total, estimate of quantity and specification of material)

paint \$4.2 / m²

trees \$25 / tree

steel drums \$15 / item

note: this is an estimate only. contact to the supplier is necessary for a fixed quote.

Desired outcome:

Increased shade for residents to gather, sit, talk and cook below

Shade and new interactive environment for students

Greater pride in community environment

Improved space for commerce

Residents use rubbish bins

2.6 urban interventions - school



before



after

2.6 urban interventions - streetscape



2.6 urban interventions - art



2.7 wall repair

Problem to be addressed

Large holes in sidewalls of homes. see photo 05 for example

Proposed upgrade

supply corrugated sheeting to each village to be used by the households who need to make repairs

General notes / reference drawings

This upgrade is intended for households which have wall type 8,6,4 or 3 as per STT 'HRBSP' survey. According to the survey 77 Households have this wall type. Based on this, 2-3m² of corrugated sheeting has been allowed per household for general maintenance. This can be given to the village cheif to be distributed to the Households who require it.

Note: to obtain exact quantities and cost, a detailed survey of each household and the extent of their damaged walls would be required.

Cost

\$6 / m² . Refer to table (a) for combined upgrading total, estimate of quantity and specification of material

note: this is an estimate only. A detailed survey of selected roads is needed to produce construction drawings, determine quantities and cost. This is the responsibility of the contractor.

Desired outcome

Sealed holes in wall / roof providing protection from rain

Visual amenity improved

05 - hole in house wall



3 low cost housing

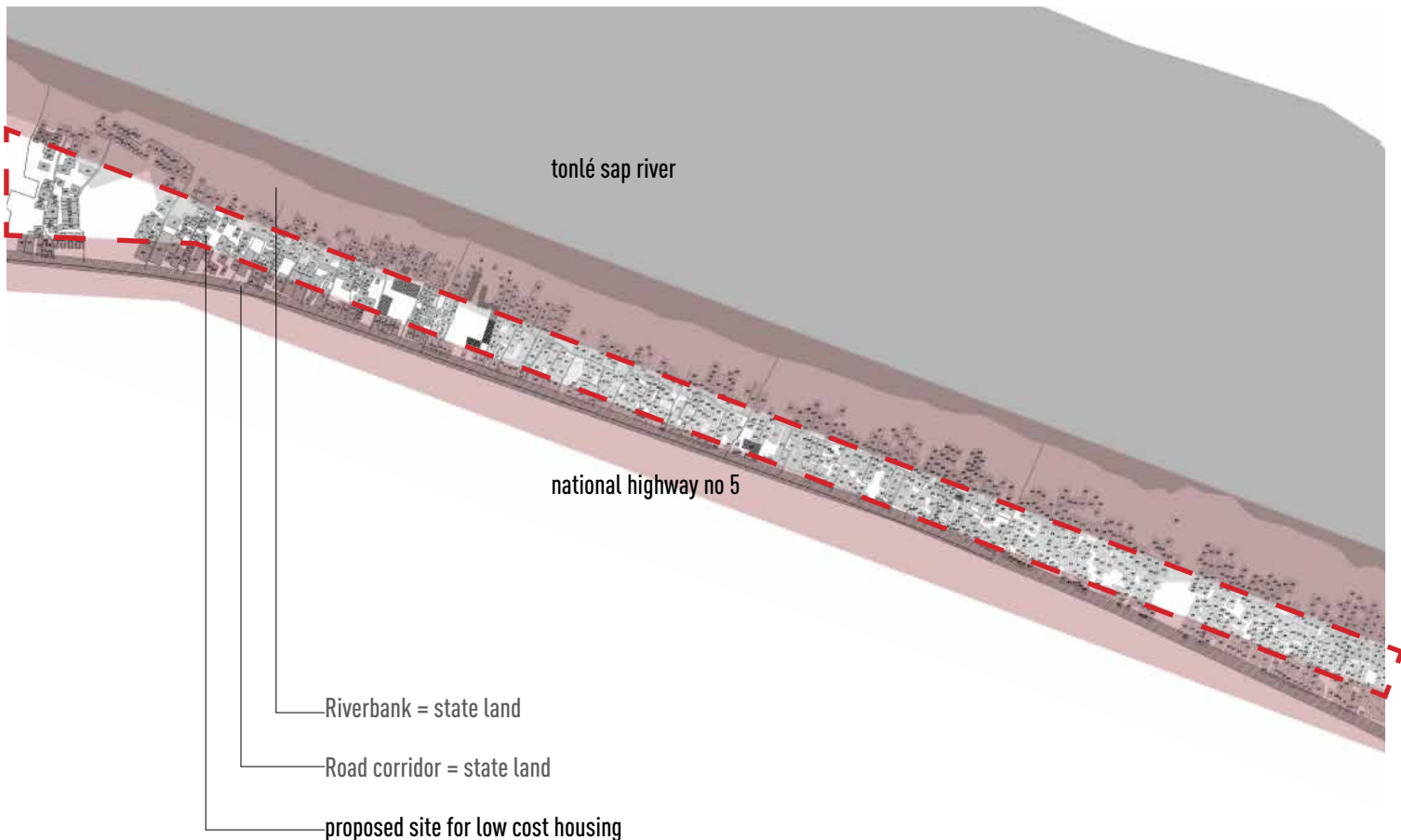
3.1 narrative description

The majority of households in this study site face one of the following dilemmas;

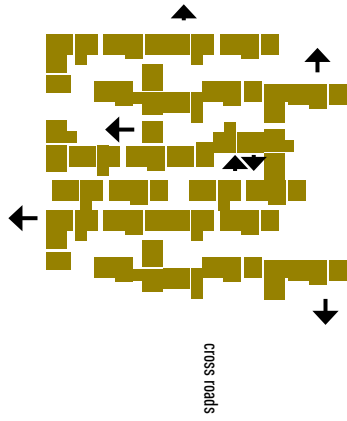
1. eviction due to state land zoning,
2. having their dwelling cut in half due to the widening of highway no 5 or
3. damage or loss of home in the next serious flood event.

As identified in section 1.4 land tenure, a narrow corridor of land exists where residents could gain land titles and live in a space setback from the annual flood events.

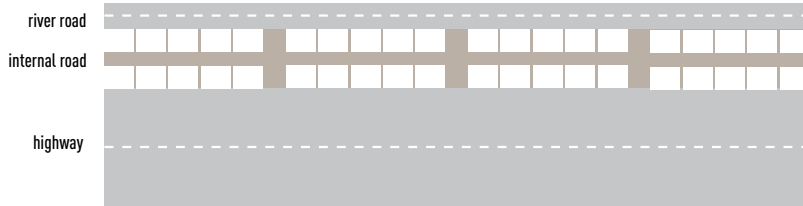
The following masterplan proposes to develop this strip of land into a mixed residential commercial zone. A 4-5 storey low cost housing development in this zone is capable of re-housing all 1295 households in the existing community.



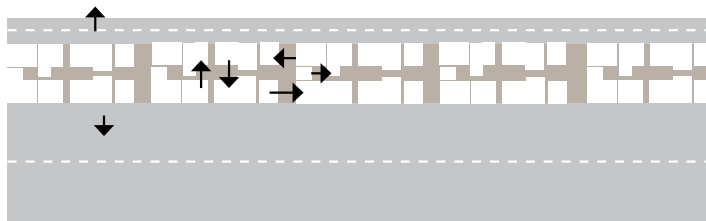
3.2 Concept diagrams



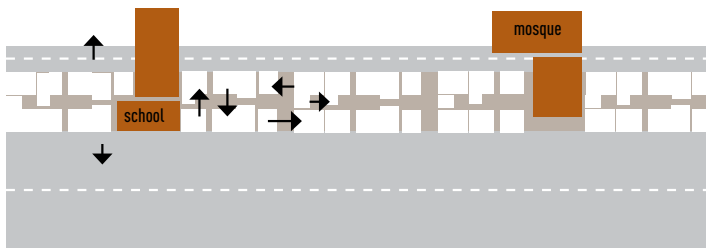
existing urban fabric.
how to recreate this in available space?



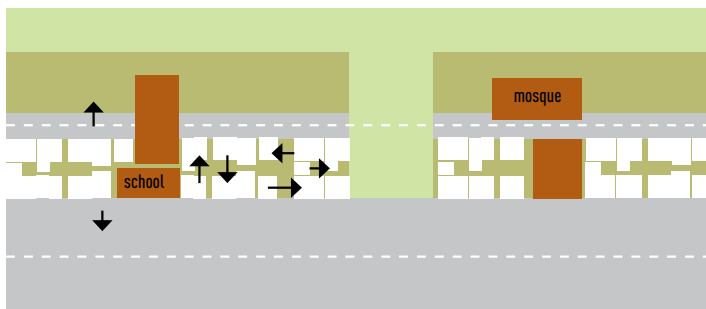
two layers of housing separated by an
alleyway heirarchical 'layers' of housing
and access



vary the size and position to create a
variety of public spaces.
buildings are multi directional to
maximise opportunities for street /
commerce interaction



protect key public buildings and cluster
housing around these facilities



housing and public buildings on
elevated platforms for flood protection
green space along river for flood
control and public space

3.3 masterplan

5 storey apartment blocks

mosque

lower green areas between and behind housing for flood mitigation, cooling, and useable public space in dry season



fish market

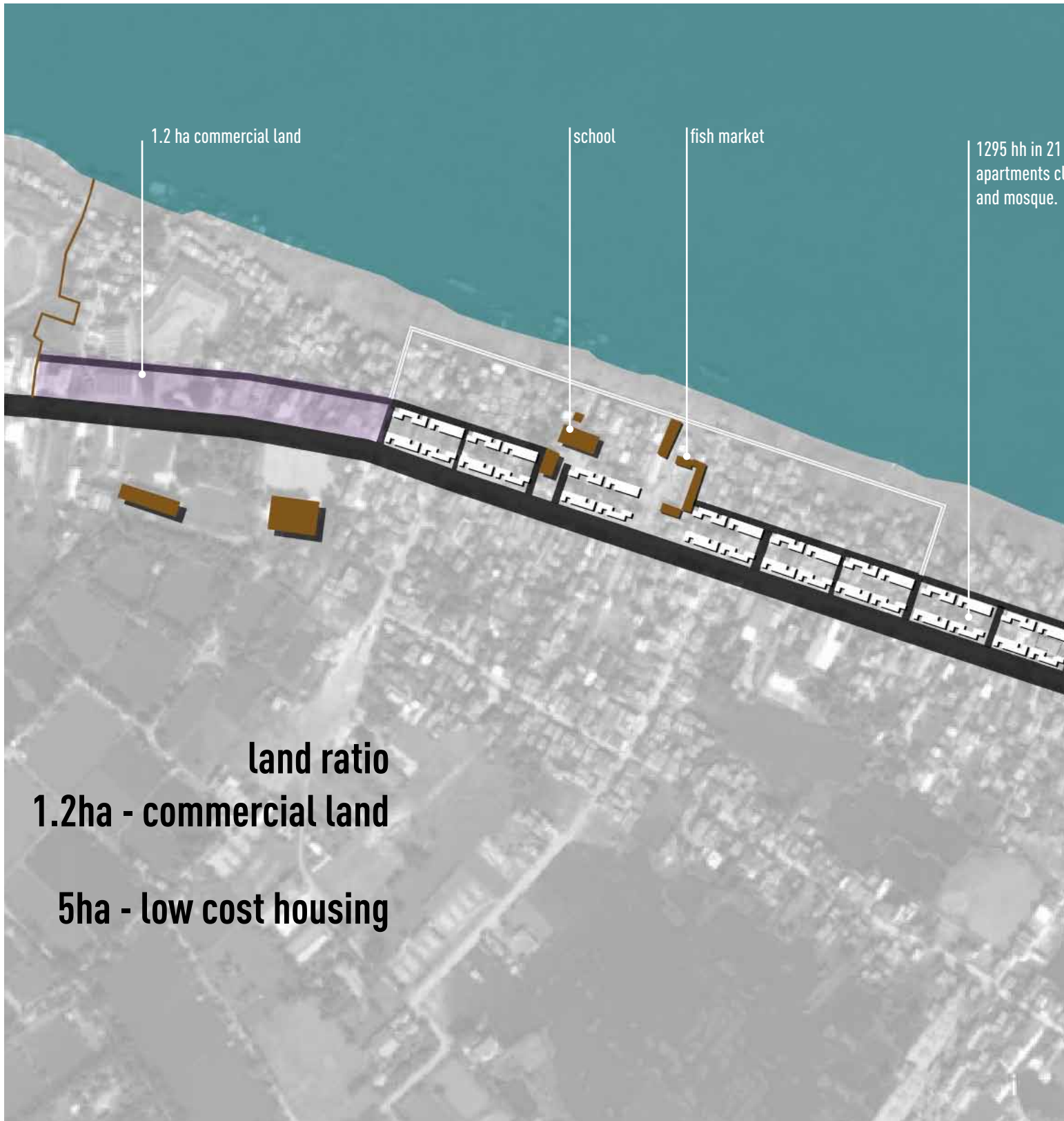
school

raised hard surface platforms
define housing and public space zones

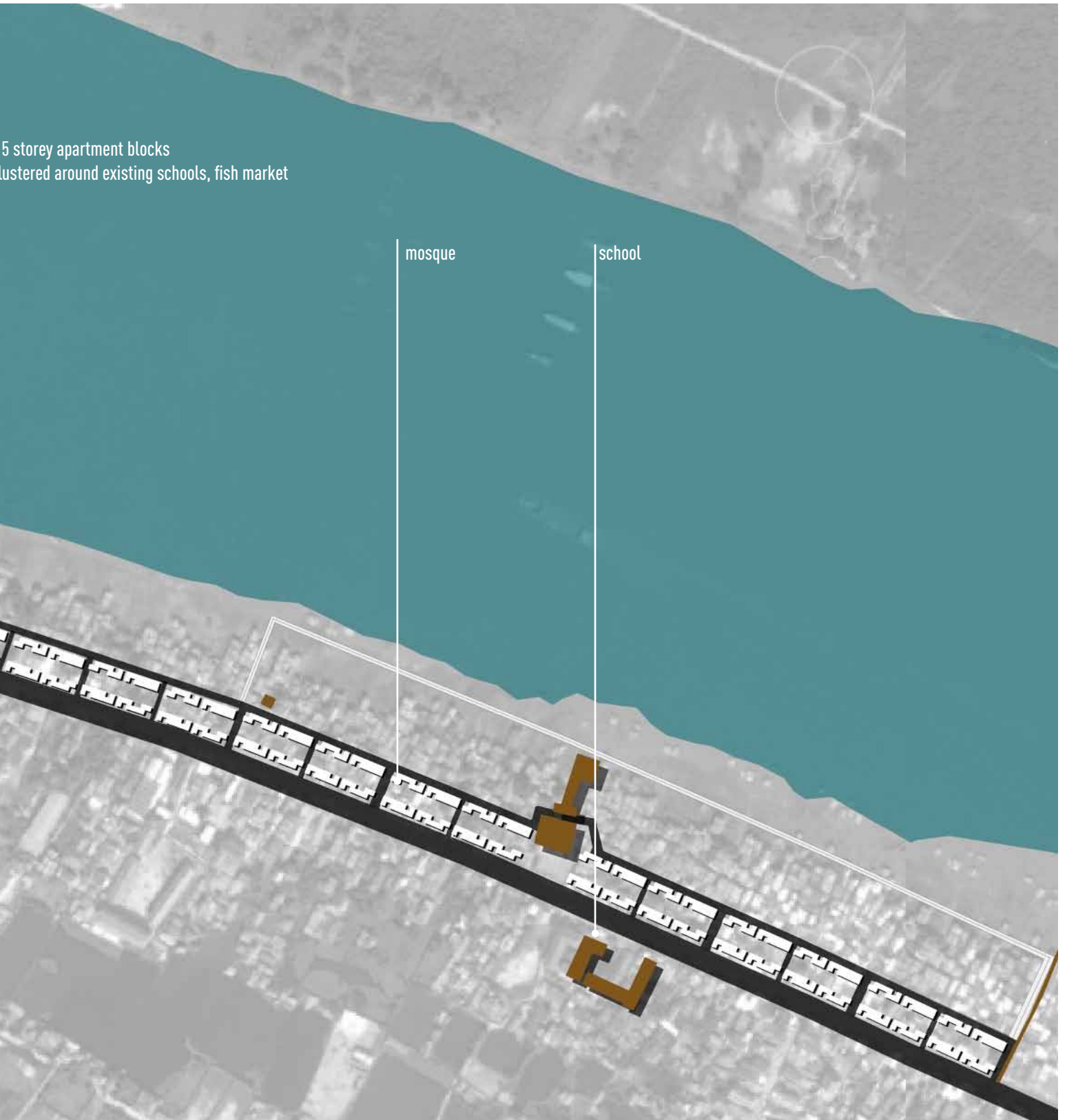
land for commercial use



3.3 masterplan

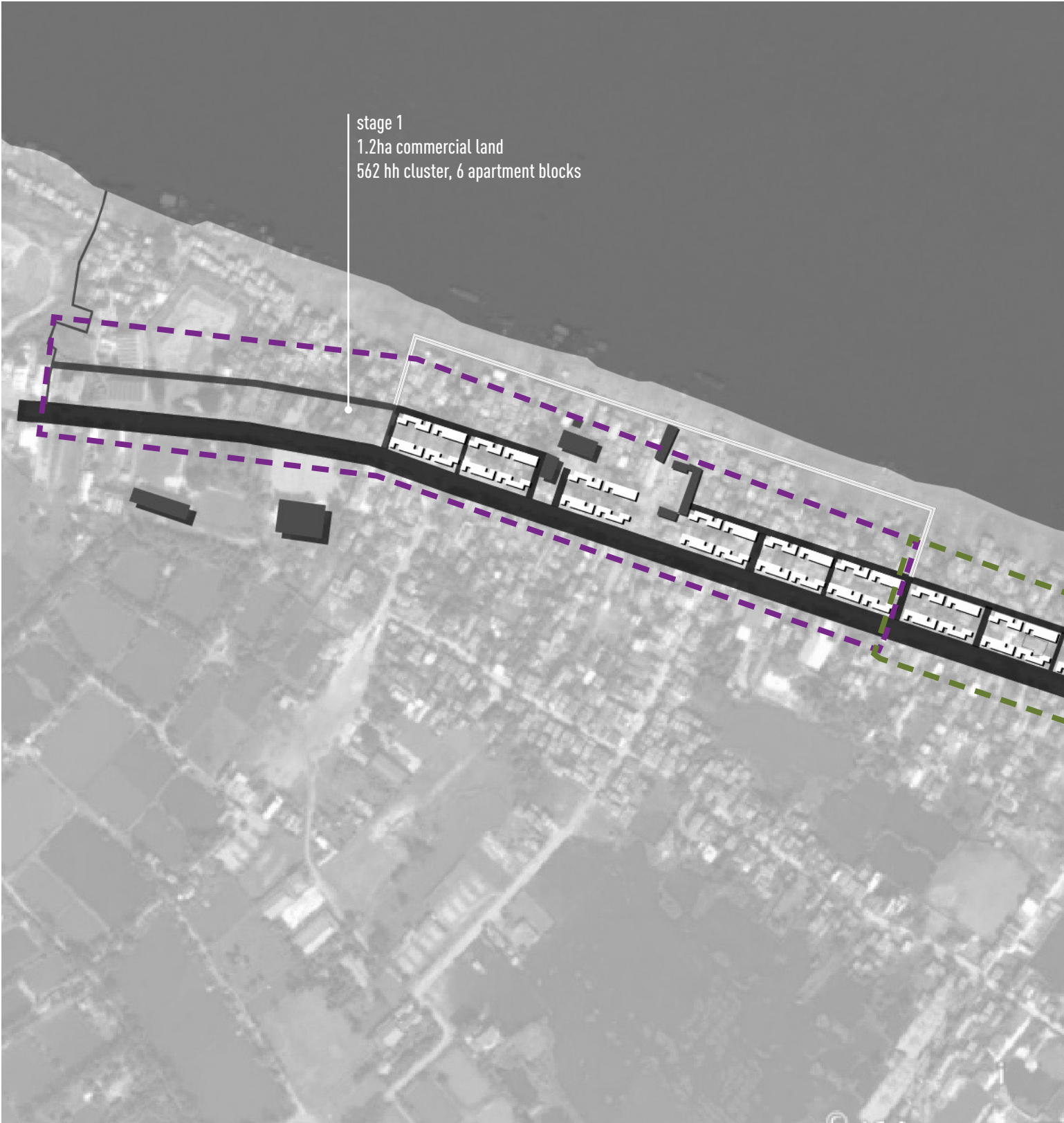


5 storey apartment blocks
clustered around existing schools, fish market

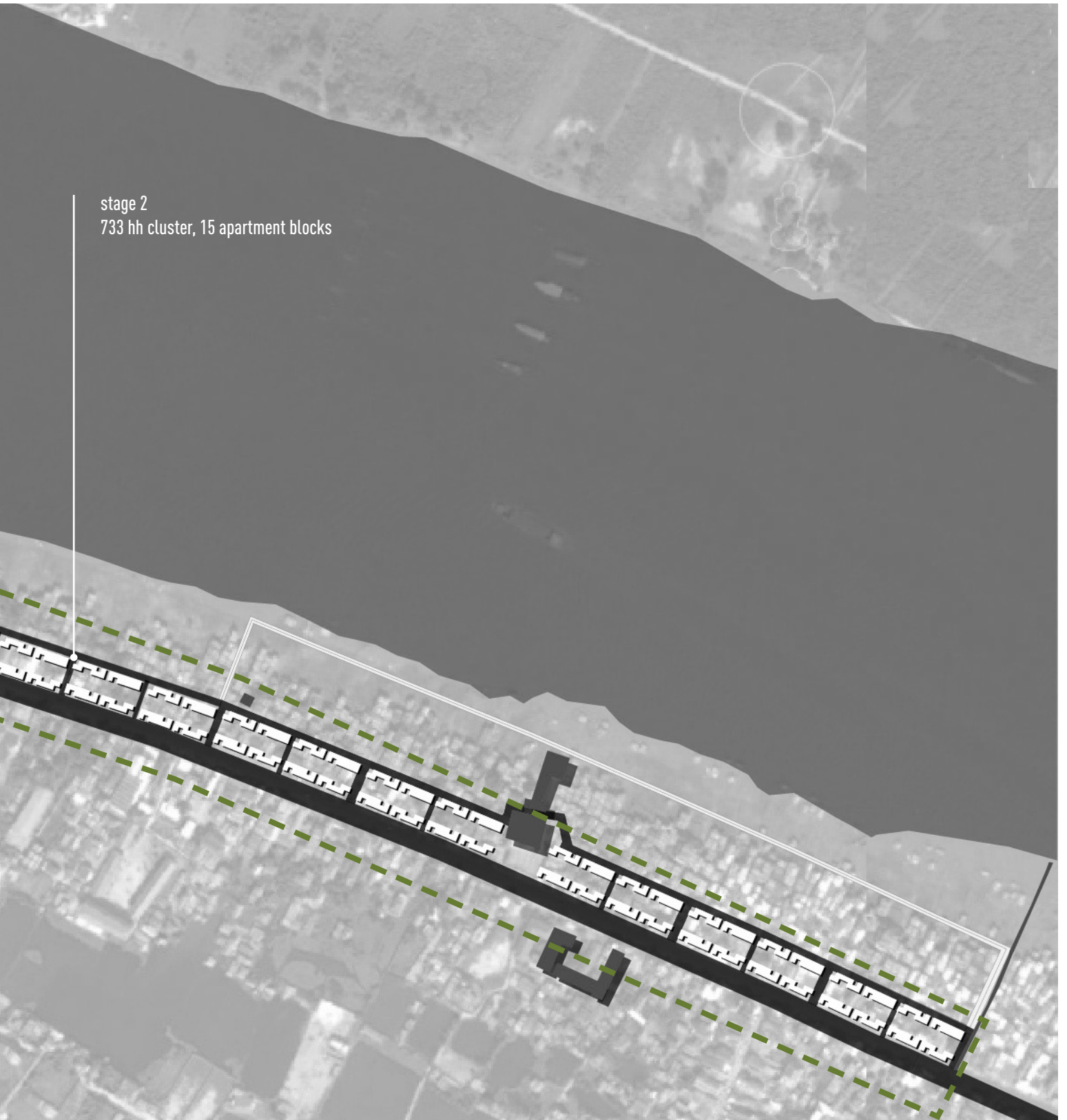


3.3 masterplan - staging

stage 1
1.2ha commercial land
562 hh cluster, 6 apartment blocks

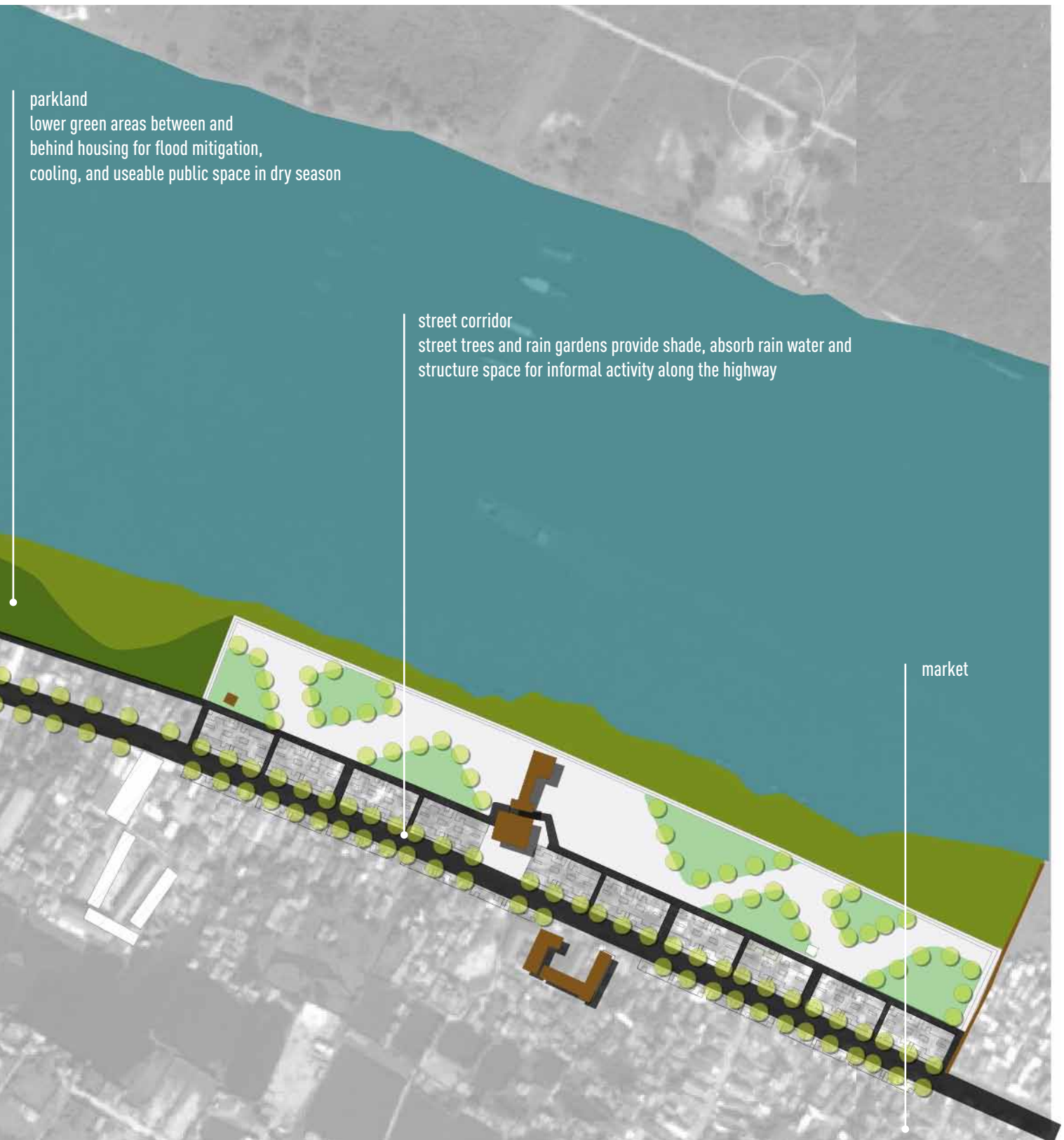


stage 2
733 hh cluster, 15 apartment blocks



3.3 masterplan - public space





parkland
lower green areas between and
behind housing for flood mitigation,
cooling, and useable public space in dry season

street corridor
street trees and rain gardens provide shade, absorb rain water and
structure space for informal activity along the highway

market

3.3 masterplan - all





housing cluster & public space
raised hard surface platforms define housing/public buildings, provide
public space and elevate living spaces from annual flood risk

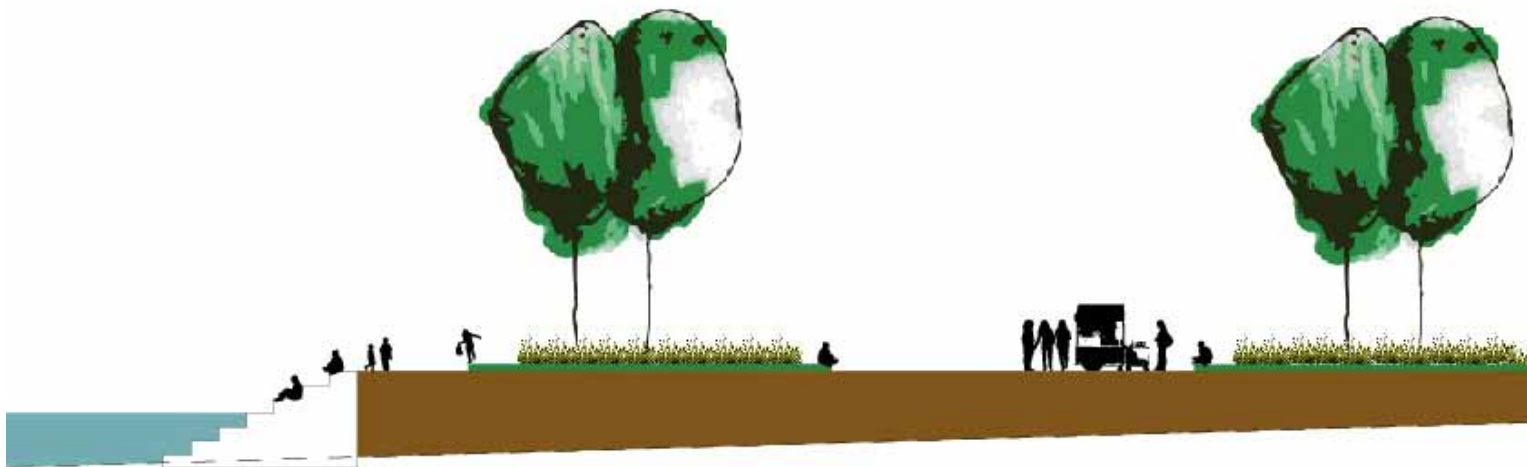
3.4 masterplan - cross section



gabion river embankment



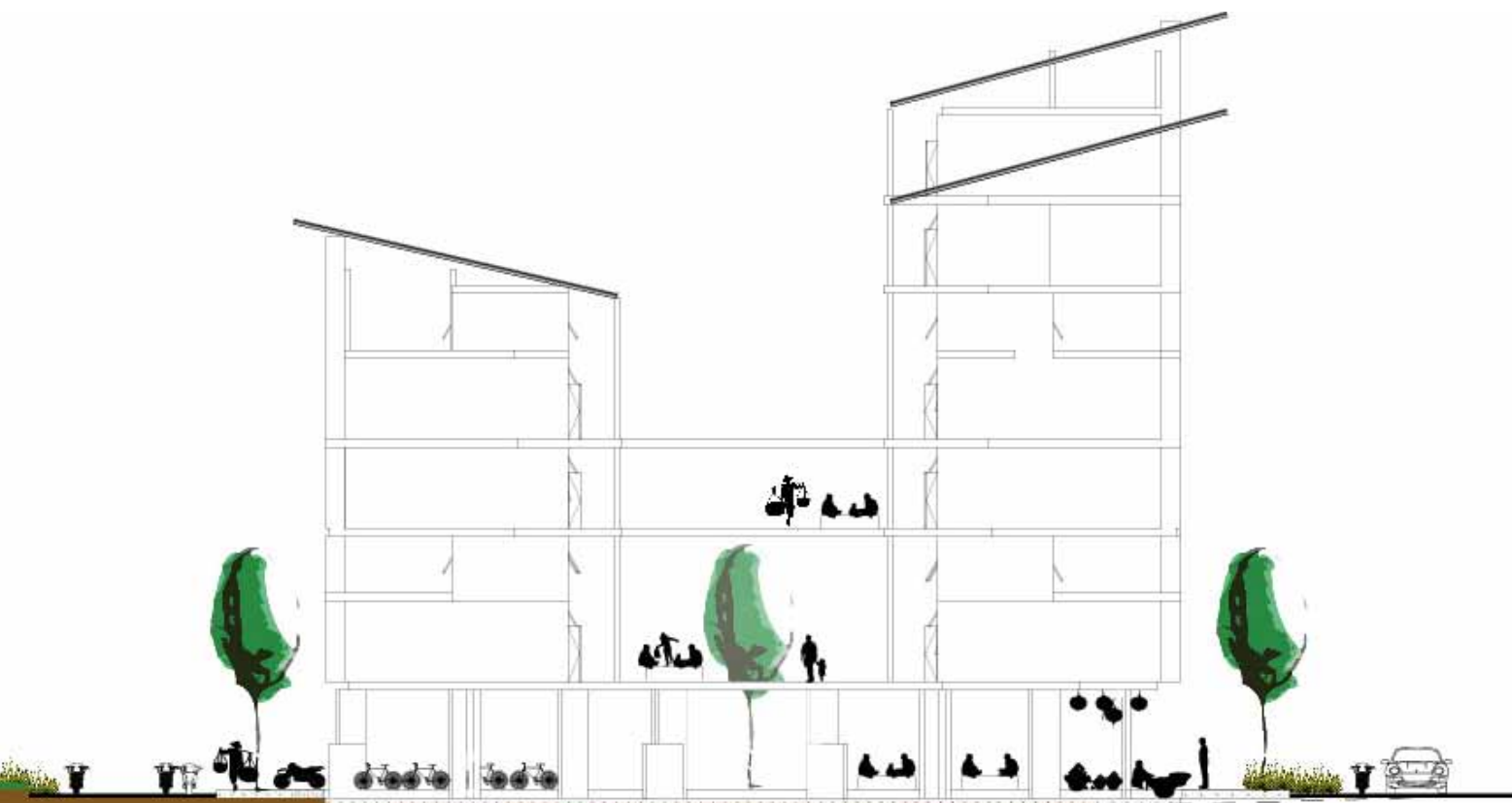
elevated public space zone





4 - 6 storey apartments

street planting



3.5 masterplan - highway edge

national highway no 5

rain garden with
stormwater overflow drain

permeable paving footpath
motorbike parking between
rain gardens

market space at street
level



3.6 masterplan - river road

public park

rain garden with
stormwater overflow drain

main access road
on river side of
apartment blocks

permeable paving footpath
space for infromal activity

parking



3.7 masterplan - street block

The street blocks aim to recreate the existing urban fabric. Housing has been clustered around important public facilities such as the main mosque and schools. Two strips of buildings will be located in this zone with a narrow alleyway inbetween allowing day to to interaction between residents to continue.

To mitigate flooding the apartment blocks and adjacent public space will be built above the annual flood level. This fits in with the government plans to extend riverside up to this region.

A gabion wall system is proposed for the r and public space systemproposed in this plan is a gabion wall system

1. green public space



2. central alleyway gives semi private space to apartment owners



mosque and school

raised platform above the annual water level creates public urban space around housing zones

re-vegetate riverbank

river

5 storey apartment blocks



riverside road for access and commerce

highway commerce

internal alleyway for recreation, commerce

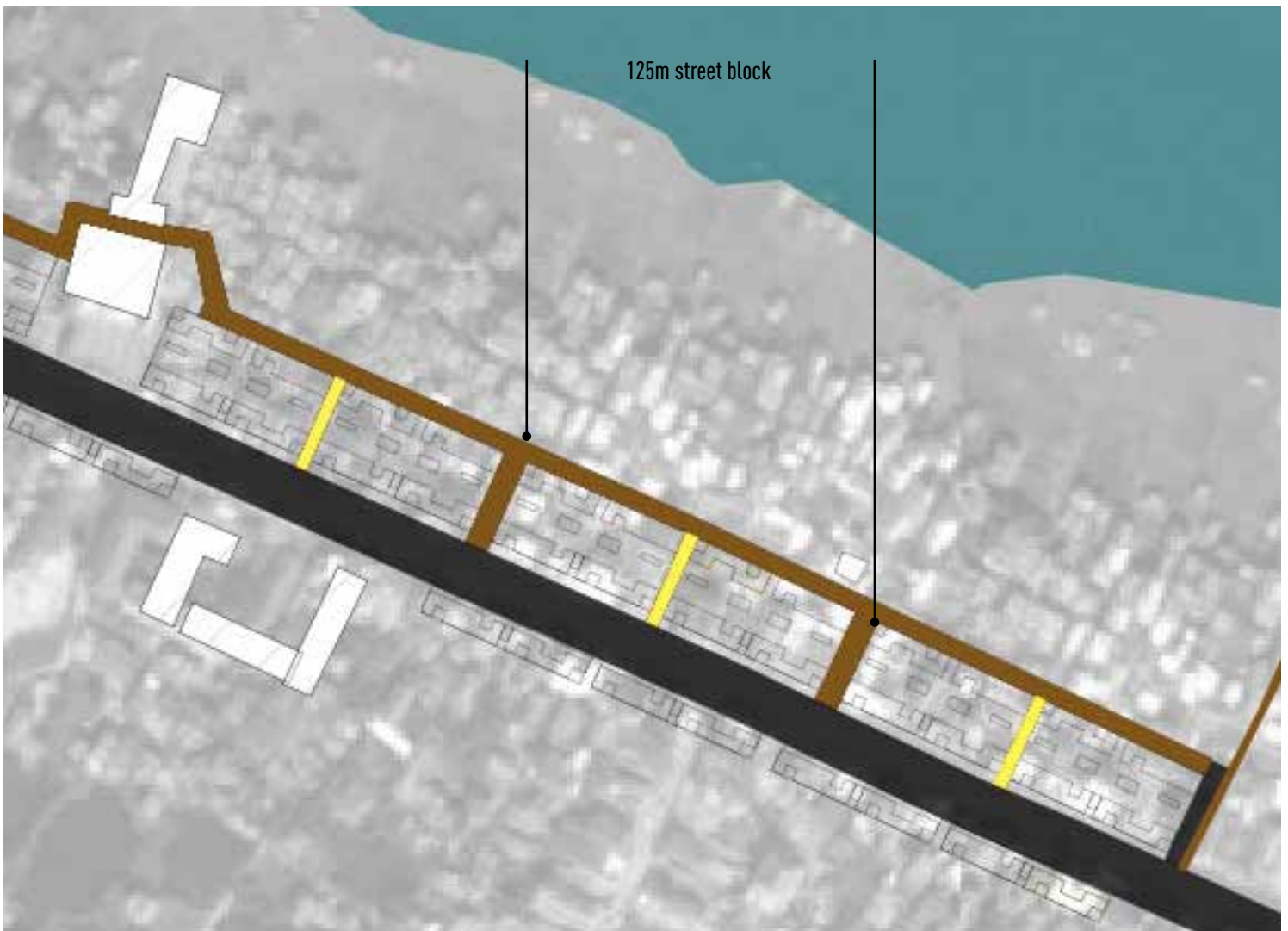
3.7 masterplan - street hierachy

highway no 5 - 13 m expansion

main access street: 7m wide 2 way

commercial street: 5-6 m wide, shops either side

park alley: 4m wide, local traffic + pedestrian



3.7 masterplan- commercial space

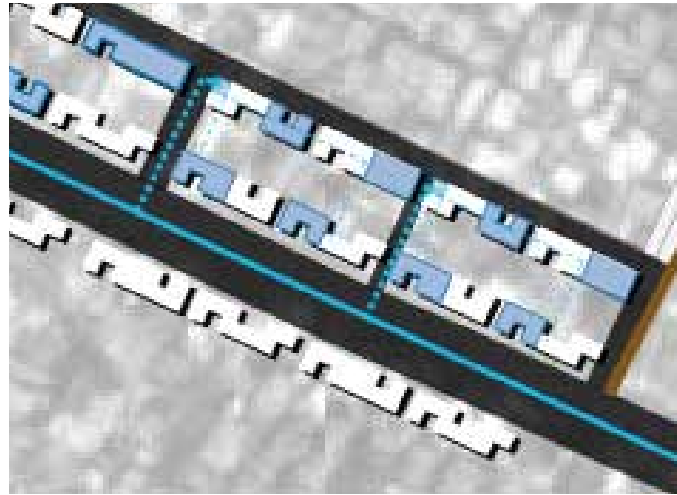
The highway edge will continue to provide best opportunities for commerce and a new central alleyway will provide space for business and socialising between residents. New commercial opportunities and informal activity will arise along the river edge, therefore some apartments will face inward to the alley and others outward to the river.

1. shop front - highway
2. central alley
3. riverside market

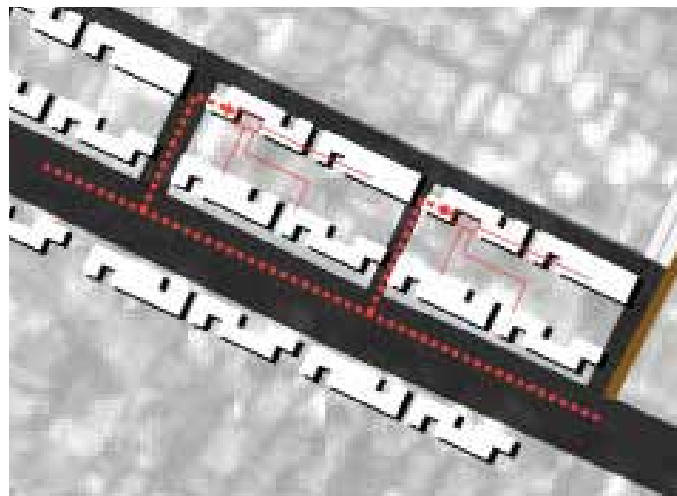


3.8 masterplan- infrastructure

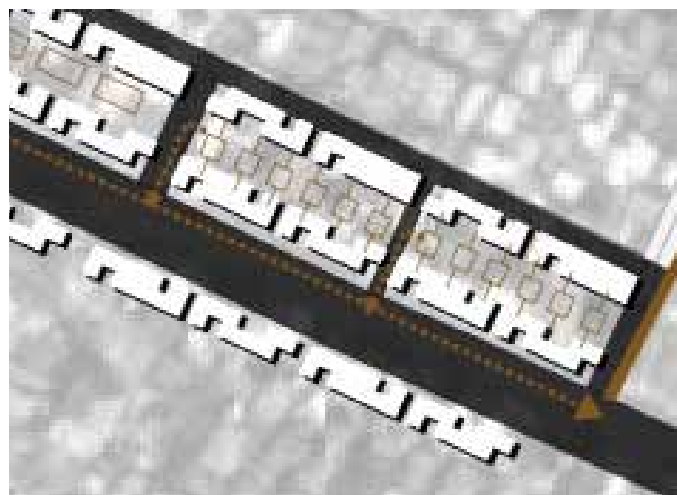
The opportunity exists for both conventional and renewable forms of energy. The diagrams below illustrate the connections to state infrastructure with the possibility of managing storm water and harvesting rainwater in a more sustainable way.



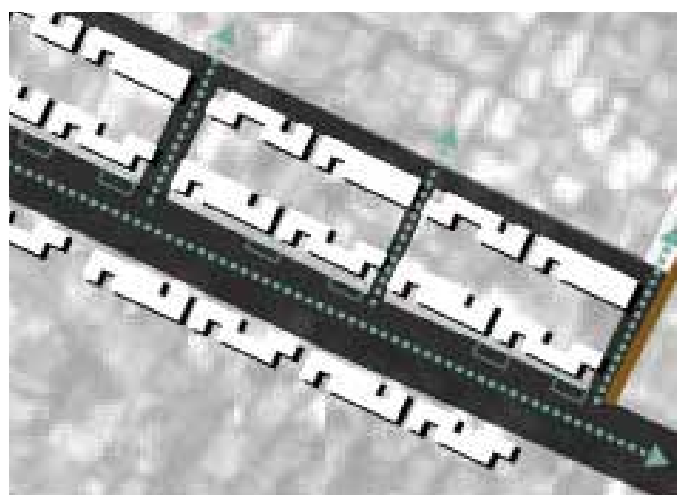
water supply
rainwater + state



electrical
4 transformer boxes
state connection



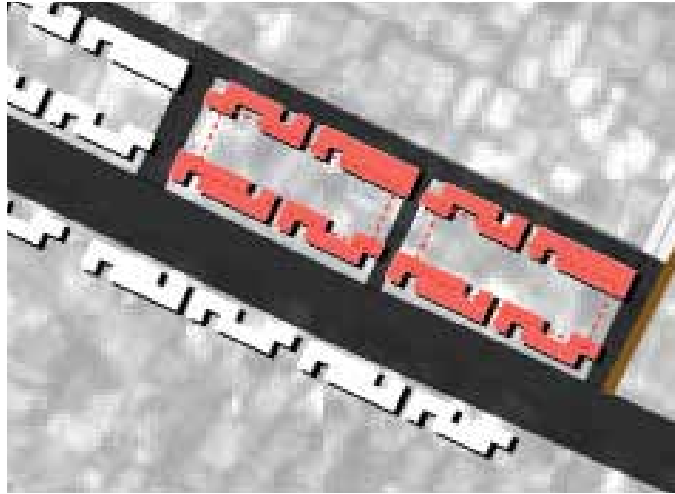
sewer
6 tanks per block



stormwater
rain gardens, bio swales +
overflow pit to SW pipe

3.8 masterplan- renewable energy

The possibility for renewable energy may depend on the type of investor interested in the project. The scale of development here provides a roof surface sufficient to house enough solar panels to power this community autonomously. The advantage of this is jobs in operations and management and potentially free street lighting. A significant amount of design, research and collaboration with interested investors is needed to determine the feasibility of this idea.



solar - 1700m2 roof surface area per block



reference image



wetland black water system

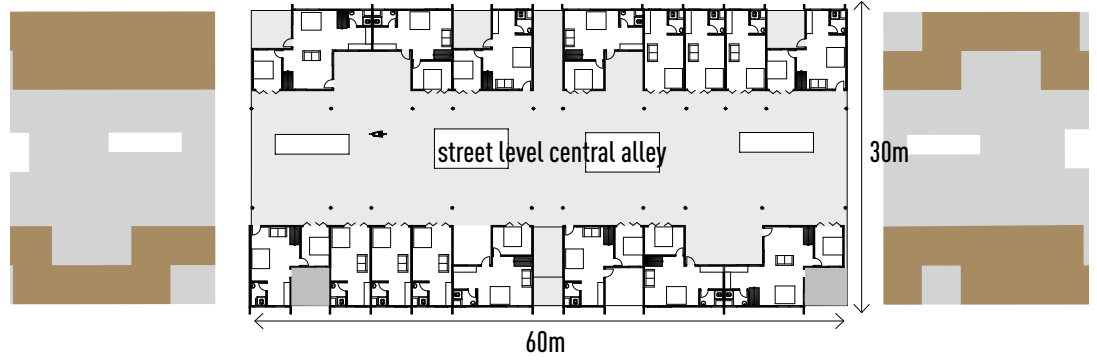


reference image

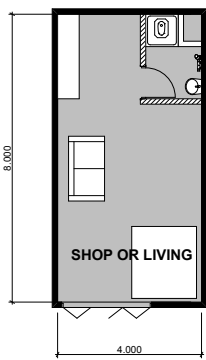
3.9 masterplan- housing

Three apartment typologies have been designed into each apartment block. The smallest apartment is 32m² and is a simple flexible open space. The 56m² model includes the installation of the structure for a mezzanine level, this allows residents to install flooring and expand their space when able.

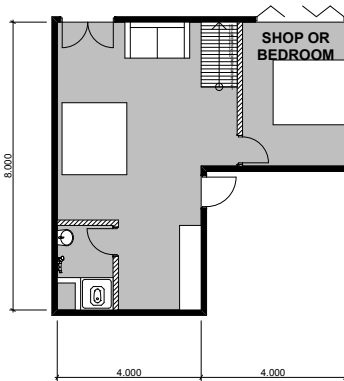
The 80m² model includes the structure for two mezzanines and shares with all three the principles of the kitchen and bathroom located towards the front or back of the apartment to receive best light and airflow.



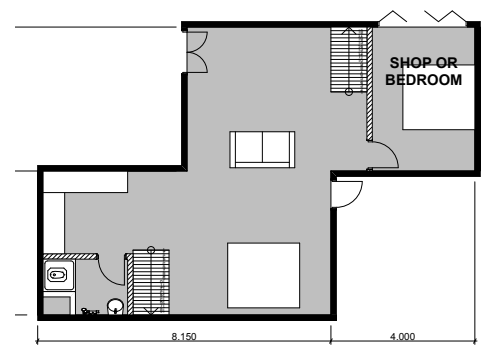
1 block = 62 apartments
 20 blocks = 62
 1 block = 55
 total = 1295 apartments



32m²
28/block



56m²
25/block



80m²
9/block



3.9 masterplan - housing

national highway no 5

market space at street level

central alleyway gives semi private space to residents recreates existing urban dynamic

permeable paving footpath

potential for solar on roof



3.10 masterplan - costing

Item	Spec	Quantity	Unit	unit cost	total
House holds / Apt Block		62			
Foundation	RC. Pile	128	pile cap	250	32000
Structure	RC concrete posts/beams	550	m3	400	220000
Walls	cement block paint finish (no plaster)	2480	m2	8	19840
Slab - house hold	RC slab, cheap tile finish, paint ceilings	3230	m2	80	258400
Slab - terrace	RC slab	190	m2	50	9500
Folding doors (shop door)	Metal frame, no glass, metal panel	35	item	90	3150
External Doors	Metal frame, no glass, metal panel	33	item	90	2970
Internal Doors	Metal frame, no glass, metal panel	111	item	90	9990
Windows	Metal frame, no glass, metal shutters	400	m2	30	12000
Equipment	pour flush WC, basin, shower, sink	62	set	150	9300
Roof	steel frame, zinc sheet, insulation	1700	m2	40	68000
Electrical / apt	neon lights	62	unit	120	7440
water and Sewage / apt		62	unit	120	7440
Concrete staircase		10	unit	1800	18000
TOTAL / APT BLOCK (62 APTS)					678030
COST/ APARTMENT					10936
TOTAL AREA (m2) / APT BLOCK					3420
COST / m2					198
AREA (m2) / APARTMENT					55
GRAND TOTAL (21 APT BLOCKS)					14238630
				Contingency 15%	16374424.5

Note: This is an estimate only. These drawings and costings are NOT for construction purposes. Detailed design and construction documentation is required for a bill of quantities. All pricing and quantity calculation is the responsibility of the building contractor.

public works

Elevating housing + public space

Key to the possibility of building in this zone is mitigating flood. A detailed flood analysis is needed to determine finished levels for the building. Based on the general assessment carried out in this scope of works it is recommended that at any new development sits no lower than the existing level of highway no 5. This plan proposes to elevate the ground floor above this level. A topographic survey and spot heights are needed in conjunction with detailed design drawings to estimate quantities of fill and river embankment material. As a guide only:

River embankment – gabion wall – \$60 / m3. Approximate = 10920m3 = \$655200

Fill - \$4 / m3 – Approximate = 240000m3 = \$960000

Roads + State infrastructure connections

The average cost to connect to state water and electricity is shown below. This is a guide only as based on the income status of the community and scale of development it has been told to the consultant these can be negotiated substantially

Asphalt road - \$15 / m2 – Approximate = 12500m2 = \$187500

State water connection – \$ 300 / HH

State electricity connection - \$ 400 / HH

4.1 summary

- The widening of highway no 5 is inevitable. This report aims to illustrate how the widening of highway no 5 to 26m (including a footpath corridor) can co-exist with the re-housing of all residents. If the government implements an expansion greater than this, it would be difficult to re-house the residents on this parcel of land. Furthermore a highway wider than that proposed in this report seems disproportionate to the residential community and public facilities that occupy the surrounding landscape.
- The existing relationship between the river and residents of these 4 villages is seemingly unsustainable. Many households in the 4 villages have been built immediately above the dry season river edge that bounds one length of the site. Therefore the zoning of the riverbank as public space seems appropriate on this site, given residents are compensated or re-housed in the proposed scheme.
- The boundaries of this 'study site' somewhat limit the opportunities to plan for this region in a holistic way. Should this project proceed into a design and construct process, it is recommended to identify a boundary that better relates to the context of development in this region.
- The design and size of the apartments were based on the demographic data available to the consultants at the time of work. A financial study of the community has yet to be carried out. A system of apartment typologies related to income level is recommended to best cater to the demographic of this community. This can significantly influence the design and size of the proposed apartments and therefore the overall cost.

