

# PHILTER HOUSING

Urban Regeneration of Metro Manila by Filtering the Pasig River

As part of considering cosmopolitan growth in the urban infrastructure and architecture of a 21st-century ASEAN city, a redefinition of what it means to grow as a nation that integrates both social and environmental awareness in design must be rudimentarily established, developed, and accomplished.



## MANILA'S BIGGEST CHALLENGES

Although Metro Manila has been hailed one of South-East Asia's fastest growing cities, there remains the stigma of urban poverty which prevails at every corner of the city. **The Philippines' capital is the 11th most populous city in the world, and according to an Asian Development Bank 2010 report, 35% of which are comprised of informal settler households.** As much as the government has attempted to relocate and provide them with housing, the people return to their informal homes as the housing provided to them are far from their workplace, which is the main purpose of their arrival and stay in the city, and the substandard quality of their new abodes.

Not too far from the informal settler issue is the **Pasig River, the main waterline of Metro Manila that was once described as crystal clear, today is biologically dead.** It spans 27 km long with an average depth of 1.3 meters, bisecting 5 major cities (Taguig, Pasig, Makati, Mandaluyong, and Manila) of Metro Manila, and runs from Manila Bay to Laguna de Bay. Most of its pollution began in the 1930s as the industrial age reached the Philippines and has continued to be battered after administrative negligence and the citizens' reckless ignorance, moreover degraded by the lack of proper waste management and sanitation infrastructure especially for the informal settlers who have chosen to live along the 43 minor tributaries / esteros (little estuaries that branch out from the main riverline like canal streets) that are mainly located in Manila. Basically, the esteros became the slums' main sewer and trash can, leading to and keeping the Pasig River in its vilest state.

Efforts by the Pasig River Rehabilitation Commission (PRRC), a Private-Public Partnership (PPP) entity established in 1999 that seeks to clean the river and revive the city with it, to relocate these settlers and build linear parks are slow and remain ineffective as the informal settlers lapse and return to the esteros (in the last 17 years of PRRC's programs, only 9 of 43 esteros have been successfully rehabilitated), thus the immediate need for **a firmer and more sustainable solution, and this time through architecture.**

Hydrological Map of Pasig River and its Tributaries

## SITE INFORMATION

**LOCATION** Barangay 385, San Miguel, Manila **PH**  
**SITE AREA** 9261.18 square meters

World Map  
The Philippines  
CITY OF MANILA  
National Capital Region (NCR)

The location was chosen as a means to demonstrate the current situation of the Pasig River and the informal settlers that live alongside its esteros, especially since it is amidst the capital of the Philippines, where urban growth, along with the major issue of land scarcity, is most tangible.

**The goal of the project is to be able to make this development a template for all esteros, leading to a cleaner and more habitable Manila.**

Site Location, Estero de San Miguel  
 ■ SITE AREA  
 ■ MAIN VEHICULAR ACCESS  
 ■ PASIG RIVER / ESTERO

**NUMBER OF RESIDENTS OF ESTERO DE SAN MIGUEL** of the 1596 informal settler families affected, only 337 have been relocated properly, a remaining balance of 1259 remain along Estero San Miguel. (PRRC, 2014)

## VISION SITE ANALYSIS

### FILTER FOR ILOG PASIG

Foremost in the regeneration of urban Metro Manila is to assess and create solutions to sustain and conserve its environmental surroundings, thus the immediate need for an integrated hydrological system through architectural design to rehabilitate and filter the Pasig River, especially as further urbanization is in tow.

### BETTER HOUSING, BETTER CITIZENS

Informal settlers living along the esteros of Pasig River have cultural behaviors, which are detrimental to the community and the environment (illegal obtaining of electricity and water from nearby buildings, defecating and throwing waste into the estero), it is tantamount for an ameliorative housing both for their livelihood and their quality of living.

### FUTURE TROPICAL LOW-COST HOUSING

In filtering the river and cultivating responsible citizens, Manila is more poised to regenerate itself as an urban oasis, a city of the future that is conscious of the essence of environmental protection, sustainable low-cost housing, and innovation as a means to instill great change within the social, urban, and political fabric of the capital, inspiring other parts of the country, even the world, as well.

### SUN PATH & TRADE WINDS

### MAJOR THOROUGHFARES

### SITE AREA

## SITE DEVELOPMENT PLAN

**EXISTING DEVELOPMENTS**

- 1 P. CASAL STREET
- 2 MAIN ENTRANCES TO BLOCKS
- 3 PARKING LOT
- 4 BASKETBALL COURTS & MAIN COMMONS
- 5 HOUSING BLOCK (A, B, C, D, E, F, and G)
- 6 CONNECTING BRIDGE
- 7 COMMON GARDENS
- 8 MATERIAL RECOVERY FACILITY
- 9 COCONUT MESH FOR SLOPE PROTECTION
- 10 PHYTOREMEDIATING PLANTS
- 11 ESTERO DE SAN MIGUEL
- 12 FRATERNAL STREET
- 13 VEHICULAR ENTRANCE

**EXISTING BUILDING**

**TECHNOLOGICAL INSTITUTE OF THE PHILIPPINES - MANILA**

**EXISTING DEVELOPMENTS**

## INTEGRATED SUSTAINABLE SYSTEMS

### LIVING WATER FILTRATION SYSTEM

per residential block

Volume Flow Rate of Pasig River 275 m<sup>3</sup>/s MAX. (Oct-Nov)  
12 m<sup>3</sup>/s MIN. (Mar - May)

### RAIN HARVESTING

Manila receives an average of 2061 mm (81.1 in) of rainfall every year and annual count of 144 wet days (probability of rain on a day). For a block two stormwater harvesting tanks (32 cubic meters) shall be placed directly under the structure for storage as rain is caught from the roofs, rain gardens, bioswales, and then may be transmitted back into the water filtration system through the wet gardens for flushing use and also irrigation purposes.

### SOLAR PANEL ENERGY

Climate Averages of Manila:  
 Solar Irradiation: 4.42 KW/m<sup>2</sup>/d  
 Wind Speed: 2.73 m/s  
 Humidity: 74.44 %  
 Earth Temperature: 27.50°C  
 Air Temp: 28.30°C  
 Pressure: 99.06 kPa

The averages prove auspicious for solar panel technology to be implemented for the development.

For feasibility purposes the solar panels may be scooped and maintained through a Purchase Power Agreement (PPA) with a solar power developer, that in case of the Philippines, is FirstGen; They install and maintain the system, whilst supplying the blocks with electricity at a lower rate than connecting to the grid, also through renting the roofspace of the block for a fixed rate for 10-25 years.

### 01 SEPARATOR

4.0 x 4.0 x 4.8 m concrete aerobic anaerobic water tank

### 02 AEROBIC ANAEROBIC WATER TANK

76800 liters of water can be taken in by the tank at a time

### 03 MICROALGAE CLEAR PVC PIPES

as with constructed wetlands, the wetgardens are downsized sedimentation-based filtration systems for the wastewater after going through the microalgae pipes on a 2% slope bed. The macrophytes, sand, silt, and gravel therein shall be able to finalize the step to further clean the water from the detester, releasing an effluent safe enough for fertilizing the gardens and also water safe enough to be directed to the public sewage lines and rain-harvesting tanks.

### 04 CONSTRUCTED WETGARDENS

available resources for irrigation and flushing use yield to 703/98511 gallons/mo. for the whole site.

### 05 RAINWATER HARVEST TANKS

each block will have two underground rainwater harvesting tanks (4.0 x 4.0 x 2.0 m) designed to hold 16653 gallons of rainwater considering the 5251 gallons of rain harvested by the 366 sqm roof area of the building.

### 06 MIXING PIT

110 cubic meters enough for cooking needs of 264 pax / day

### 07 BIODIGESTER

where anaerobic process takes place such that the mesophilic bacteria eats the organic matter and creates biogas, a clean nontoxic fuel, which is both odorless and smokeless, chemically contains 50-70% methane, 35-40% carbon dioxide, and less than 5% of other gases (ammonia, hydrogen, carbon monoxide, etc.), a process called methanization; most productive store temperature is 30°C, with a balance of 6-7 PH level

### 08 BIOGAS STORAGE

after the digester, a booster pump directs the biogas to gas storage tanks from which each household's biogas stove connects for cooking use

### 09 SLURRY STORAGE PIT

the digested slurry, a byproduct of the methanization process, can be used as fertilizer; shall be stored here until overflow happens

### 10 BIOLURRY FERTILISER

once natural overflow of the storage pit occurs, the slurry is deflected to the gardens as fertilizer via drip irrigation; this increases agricultural production because of its high content of soil nutrients, growth hormones, and enzymes

### 01 SEPARATOR

a simply designed screen separates the solid waste from the wastewater before the aerobic/anaerobic tank begins. A fiber bin is located within the solid waste catchment that could be easily taken out by residents for transfer and segregation in the MRF.

### 02 AEROBIC / ANAEROBIC TANK

after separation of water from the solid waste, exposure to microorganisms shall decompose and break down the colloidal and dissolved biodegradable organic matter as food for their growth and multiplication; sludge is collected at the bottom, as in septic tank.

### 03 MICROALGAE CLEAR PIPES

with the solar powered pump, the wastewater is led up through clear PVC pipes with microalgae through the structure pipes are exposed to sunlight for water treatment), as the water goes up, the algae takes inorganic nitrogen and phosphorus in the water; subsequently, the wastewater goes down by gravity, the water then receives an increase in dissolved oxygen (DO).

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### 05 RAINWATER HARVEST TANKS

3000 liters / 4 days PER BLOCK IS FILTERED

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### BIOGAS PRODUCTION SYSTEM

where biomass ingredients (kitchen waste, human waste, and water hyacinths) are mixed to create the optimal balance to create biogas

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# BUILDING FEATURES

**01 COMMERCIAL & COMMUNITY SPACES**  
the ground floor of each block contains spaces in where possible sources of livelihood and community learning and gathering are fostered and utilized

**02 DWELLING UNITS**  
residential spaces are placed above ground for flood protection and security purposes

**03 COMMON ROOF DECK**  
most Filipinos prefer to dry laundry in the outdoors without the use of dryers, this space provided for clotheslines and community gatherings, the roof decks are also lined with planters, cooling the roof deck while maximizing air flow

**04 OPEN SPACES**  
each open space contains wetgardens, raingardens and other landscape features, which is not only part of the living filtration system but where residents may use them for leisure, spending time with the family

**05 LINEAR PARKS**  
the linear parks are lined with sidewalks for pedestrian use and slope protection using coconut geo meshes that are layered over the banked slopes to prevent erosion and to allow floodwaters to permeate straight through the ground raingardens and biophilic swales (biowales) are integrated into the banks and the sidewalks (also in open areas) for rainwater harvesting that directly go to the rainwatering tank

**06 INTEGRATED SUSTAINABLE SYSTEMS**  
the living water filtration system and the biogas production system integrated with the whole residential block, as it fits lymphatic system, cleanses and provides self-sustaining energy that does little to no impact onto the environment, even improving it and the lives of its users

**BIOWALE**  
**COCONUT MESH**  
**RAINWATER HARVESTING**  
**THE LIVING FILTRATION SYSTEM**  
**BIOGAS STORAGE TANK**  
**BIOGAS PRODUCTION SYSTEM**  
**RAINGARDEN**

## USE OF LANDSCAPE ARCHITECTURE

Although the use of technology is usually associated with sophisticated systems, designing and utilizing vegetation is an overlooked factor in changing and improving a habitable development and users' experiences.

Landscape architecture and the constituents thereof provide the most salubrious and sustainable benefits, not only for the urban environment, yet also for growth and conservation.

**PHYTOREMEDIATION**  
plants are vegetation which not only absorb heat yet also filter water into the primary category of the living filtration system

**WAYFINDING**  
residential buildings are lined with vertical gardens whose particular plant species may point out as signifying the offshoot blocks for residents to easily find their way

**SHADE**  
the presence of shady trees and plants around the site provides thermal comfort for residents, reducing the need for using mechanical air conditioning systems

**EROSION CONTROL**  
as the situation is already alongside a water source, erosion control for flooding is vital to the protection of the structure and the facility of the land

**NOISE BUFFERS**  
vegetation is one of the best predictors of development's acoustic environment, especially in the busy streets of Manila, they act natural, low-cost, green barriers

**COOLING**  
the presence of vegetation instantly cools the site and its constituent structures by reducing heat stress effect systems

**LINEAR PARK PERSPECTIVE**

**INTEGRATING THE USE OF NATIVE LANDSCAPING**  
species found and native to the Philippines are most conducive for restoring the natural state of the environment, reduces the need for extra irrigation, and can be easily maintained aside from their specific individual benefits such as:

- 01 BAMBUSA PHILIPPINENSIS**  
noise buffer, heat mitigation
- 02 COLOCASIA ESCULENTA**  
air purifier
- 03 PHILLODENDRON SELLOUIM**  
air purifier, shade tolerant
- 04 CHRYSOPOGON ZIZANIODES**  
non-invasive, hardy, increases soil fertility, erosion control, water purifier
- 05 BASSICA JUNCEA**  
wetland-tolerant water purifier
- 06 CLADIUM PROCEROM**  
wetland-tolerant water purifier
- 07 EICH-HOMIA CRASSIPES**  
aquatic, withstands extremes of nutrient supply, pH levels
- 08 STREBLUS ASPER**  
medium tree, drought tolerant, wind hardy, edible fruit, leaves for tea, coarse bark treats leprosy, dysentery, diarrhea, anti-cancer and anti-malaria, erosion control
- 09 PODOCARPUS MACROPHYLLUS**  
hedging, hardy, noise buffer
- 10 CYNOMETRA RAMIFLORA**  
small tree, endangered, anti-cancer/blood glucose lowering, seeds

# METHOD OF CONSTRUCTION

**01 UNDERGROUND**  
foundations for the reinforced concrete columns and steel beams are set with the underground sustainable systems

**02 SLABS**  
slabs are made of reinforced concrete

**03 ROOF**  
galvanized iron sheets and steel framing are used for roofing

**04 WALLS**  
non-loadbearing walls are made using recycled plastic as aggregate in the concrete mix for the precast concrete hollow eco-block

**05 INTEGRATION OF SYSTEMS & SUNSHADING**  
utility systems are integrated with the facade as the storm drainage and filtering pipes frame the sunshading bamboo panels

**06 PARTICIPATORY DESIGN**  
starting as informal settlers, the residents are well-versed in building their homes from scratch, thus constructing the development is made more efficient through their participatory labor and their ready knowledge of vernacular building construction

## MATERIALS

**EMBODIED ENERGY OF MATERIALS CO2/kg**

PVC	2.7
STEEL	2.7
CEMENT	1.0
GLASS	0.9
RECYCLED WOOD	0.3
CONCRETE	0.1
STONE	0.1
BAMBOO	0.1

**NEAREST OFFSITE FACTORY: 1.7 KM**

**PREFABRICATED MATERIALS**

**CONCRETE HOLLOW ECO-BLOCK**

After segregating solid waste through the MRF, the plastics obtained shall be further processed and applied as aggregates for the concrete hollow block

**BAMBOO PANEL BLOW UP DETAIL**

The sunshading components of the structure are of simple materials (bamboo, pvc, and steel) easily sourced from nearby factories. PVC pipes from the water system serve also as frames of each bamboo panel and attached according as shown in the diagram at right.

This provides an economic, environmental, and aesthetically pleasing facade for the units.

## SUNSHADING

**EXTERIOR PERSPECTIVE OF BLOCK (VIEW FROM BRIDGE)**

## TYPICAL FLOOR PLANS (ONE BLOCK)

**BLOCK SCHEMATICS** (377.25 sqm)  
For this particular site, there are 7 blocks with every block consisting of 5 storeys with 44 housing units (4 main floor for residential units each and 1 main floor for commercial / communal activities). Commercial spaces are especially concentrated on the ground floor for convenience and security purposes.

**BASE UNITS** (24 sqm)  
Both UNIT TYPES A and B are equipped with an open plan, a kitchen, a toilet & bath, and a space for growth. The design anticipates incremental variations the users shall apply as they live and grow within these units.

**SPACE FOR GROWTH** (5 sqm)  
each Philter unit considers the essence of giving the users a space to improve on their situations, thus the addition of a space of possibilities. The space can be transformed into anything; a room, a small store, a library, a garden... etc. this also provides the users a sense of ownership which enables them to be more responsible members of the community.

## INCREMENTAL VARIATIONS

- From vernacular Filipino architecture, the open plan amongst residents of a household is most propitious to them; ancestors and Filipinos today tend to sleep together in a single space, transforming the space according to the time and activity within the day.
- 01 1 BEDROOM WITH PATIO (B)
  - 02 1 BEDROOM WITH PATIO (A)
  - 03 1 BEDROOM (B)
  - 04 1 BEDROOM WITH SHOP (B)
  - 05 1 BEDROOM WITH SHOP (A)
  - 06 1 BEDROOM WITH OUTDOOR SHOP (B)
  - 07 1 BEDROOM WITH OUTDOOR SHOP (A)
  - 08 1 BEDROOM WITH USABLE SPACE ON LEFT (A,B)
  - 09 1 BEDROOM WITH USABLE SPACE ON RIGHT (A,B)
  - 10 2 BEDROOM SAME SIZE (A,B)
  - 11 2 BEDROOM VARIED SIZE (A,B)

**INTERIOR PERSPECTIVES**

RESIDENTS ARE GIVEN THE FREEDOM TO CUSTOMIZE THEIR UNITS BY ADDING INTERIOR WALLS AND OTHER SPACES WHICH WOULD FIT THEIR HOUSEHOLD LIFESTYLE.

TRANSOM LOUVERS ARE A RECOMMENDED DESIGN FEATURE PLACED AT THE TOP OF THE INTERIOR WALLS FOR VENTILATION.

# INSULATION ANALYSIS

## SHADOWS AT DIFFERENT TIMES = SUN EXPOSURE

**LEGEND / LEGENDA**

- Blue: Area unshaded for 7 hours or more during the day (sun between 7 AM and 5 PM)
- Yellow: Area unshaded for 6-7 hours during the day (sun between 7 AM and 5 PM)
- Orange: Area unshaded for 5-6 hours during the day (sun between 7 AM and 5 PM)
- Red: Area unshaded for 4-5 hours during the day (sun between 7 AM and 5 PM)
- Pink: Area unshaded for 3-4 hours during the day (sun between 7 AM and 5 PM)
- Light Blue: Area unshaded for 2-3 hours during the day (sun between 7 AM and 5 PM)
- Light Green: Area unshaded for 1-2 hours during the day (sun between 7 AM and 5 PM)
- Green: Area unshaded for 1 hour or less during the day (sun between 7 AM and 5 PM)
- Dark Green: Area shaded for 1 hour or less during the day (sun between 7 AM and 5 PM)
- Dark Blue: Area shaded for 1 hour or less during the day (sun between 7 AM and 5 PM)

## DAYLIGHT SIMULATION ANALYSIS

**UNIT DAYLIGHT SIMULATION**

according to the Velux simulation, areas which receive the most sunlight are the common living room areas and the kitchen; and the those which receive the least are the bedroom, toilet & baths, and the dining.

## BCA GREEN MARK SCORE (RESIDENTIAL)

CODE	CATEGORY	POINTS
<b>ENERGY EFFICIENCY</b>		
RB 1-1	HEALTHY OPERATIONAL USE OF BUILDING ENVELOPE (BEST)	15
RB 1-2	NATURALLY VENTILATED DESIGN AND AIR CONDITIONING SYSTEM	20
RB 1-3	DAYLIGHT	4
RB 1-4	ARTIFICIAL LIGHTING	7
RB 1-5	VENTILATION IN CARPARKS	6
RB 1-6	LIFTS	0
RB 1-7	ENERGY EFFICIENT FEATURES	5
RB 1-8	RENEWABLE ENERGY	15
CATEGORY SCORE FOR PART 1 - ENERGY EFFICIENCY		
72		
<b>WATER EFFICIENCY</b>		
RB 2-1	WATER EFFICIENT FITTINGS	7
RB 2-2	WATER USAGE MONITORING	1
RB 2-3	IRRIGATION SYSTEM AND LANDSCAPING	2
CATEGORY SCORE FOR PART 2 - WATER EFFICIENCY		
10		
<b>ENVIRONMENTAL PROTECTION</b>		
RB 3-1	SUSTAINABLE CONSTRUCTION	9
RB 3-2	SUSTAINABLE PRODUCTS	8
RB 3-3	GREENERY PROVISION	6
RB 3-4	ENVIRONMENTAL MANAGEMENT PRACTICE	3
RB 3-5	GREEN TRANSPORT	3
RB 3-6	STORMWATER MANAGEMENT	3
CATEGORY SCORE FOR PART 3 - ENVIRONMENTAL PROTECTION		
32		
<b>INDOOR ENVIRONMENTAL QUALITY</b>		
RB 4-1	NOISE LEVEL	1
RB 4-2	INDOOR AIR POLLUTANTS	2
RB 4-3	WASTE DISPOSAL	1
RB 4-4	INDOOR AIR QUALITY IN WET AREAS	2
CATEGORY SCORE FOR PART 4 - INDOOR ENVIRONMENTAL QUALITY		
6		
<b>OTHER GREEN FEATURES</b>		
RB 5-1	GREEN FEATURES AND INNOVATIONS	4.5
CATEGORY SCORE FOR PART 5 - OTHER GREEN FEATURES		
4.5		
<b>GREEN MARK SCORE (RESIDENTIAL)</b>		
124.5		
<b>PLATINUM RATING</b>		