Implementation of Pilot Project to Improve Environmental Conditions in Estero de Paco

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Pilot Project Location

Construction

Collector box

ABR

constructed wetland:
gravel layer and outfall

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Finished Units

sump pit, 2 pumps, solar panel

constructed wetland

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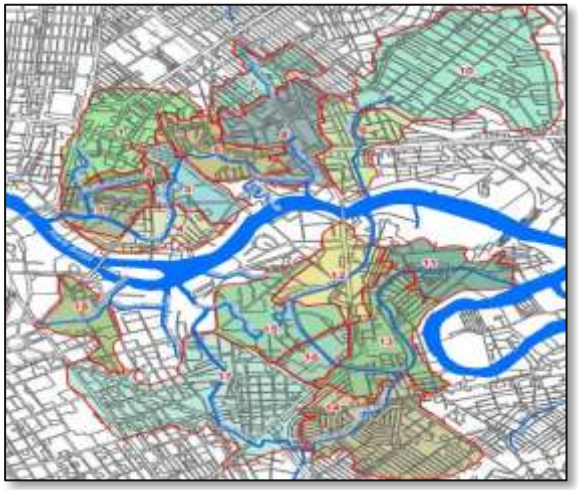
Wastewater treatment pilot



- **Reduce the pollutants** reaching the Estero, rather than treating the water within it

- **Main Goal: Show the way to** improve water quality.

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Pilot Project Components & Design Features

- **Condominial Sewerage System (CSS)**

  low cost sewage conveyance thru shallow collector pipes/boxes

- **Anaerobic Baffled Reactor (ABR)**

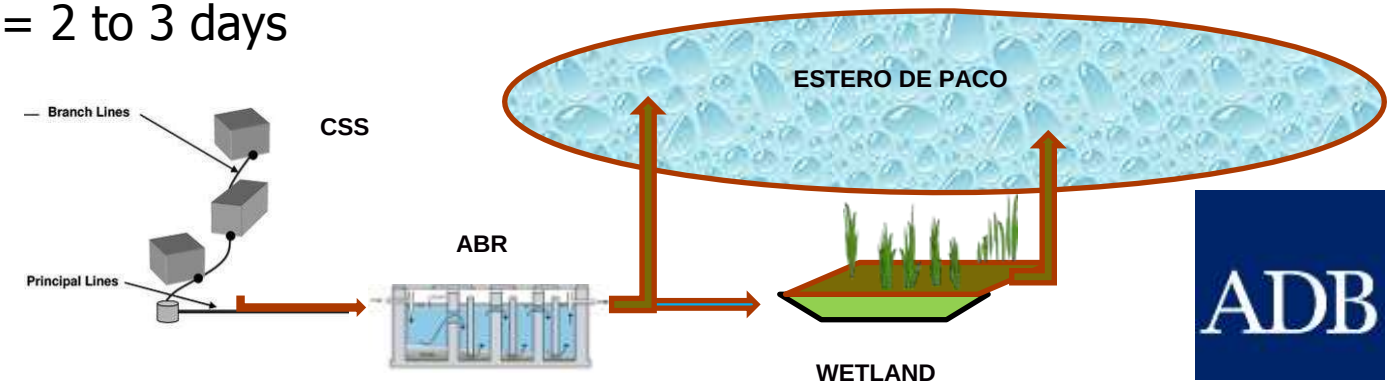
  Size: 9 m (length) x 2 m (width) x 2.5 m (depth)

  Retention time = 1.5 days

- **Constructed Wetland (CW)**

  Size:19 m (length) x 2 m (width) x 1 m (water depth)

  Retention time = 2 to 3 days



Anaerobic Baffled Reactor (ABR)

- Improved septic tank with a series of baffles
- Better anaerobic degradation of suspended and dissolved organic pollutants
- ABR *increases contact between biomass and wastewater*

Reported Efficiency of ABR

Parameters	Removal (%)
Chemical Oxygen Demand	65-90
Biological Oxygen Demand	70-95
Total Suspended Solid	80-90
Pathogen	Low pathogen reduction

Reference: Sustainable sanitation and water management. Retrieved 18 September 2014 at http://www.sswm.info/category/implementation-tools/wastewater-treatment/hardware/semi-centralised-wastewater-treatments-8

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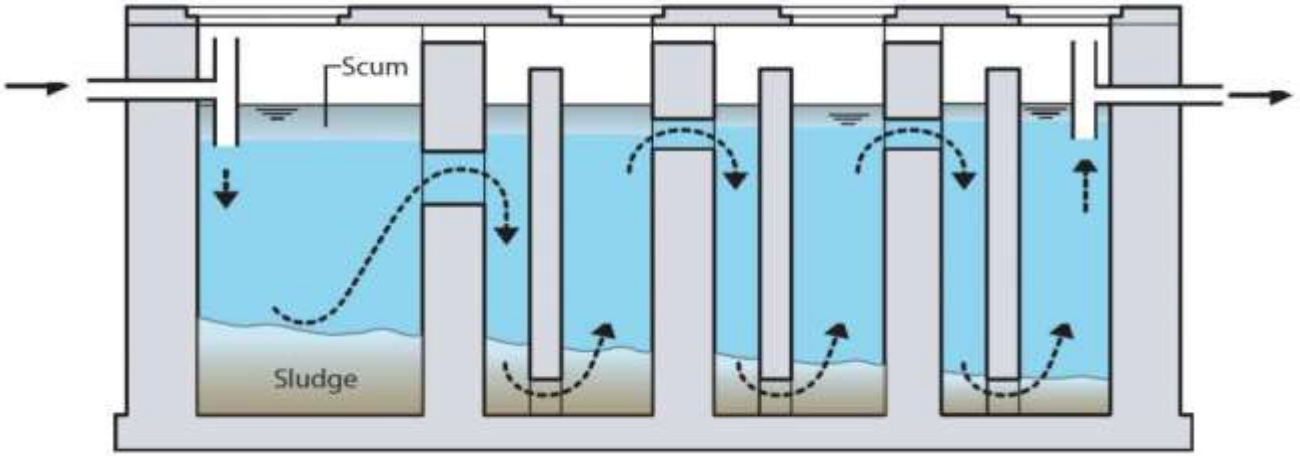
Quality of effluent influenced by: HRT



- *Amount of time* that the wastewater is in contact with the biomass or HRT (pilot project ~ 1.0 to 1.5 days)
- *Typical HRT = 1 day but may be extended to 2 to 2.5 hours during start-up*

$$HRT = \frac{V}{Q}$$

Where: Q is volumetric flow rate and V is the volume of the reactor

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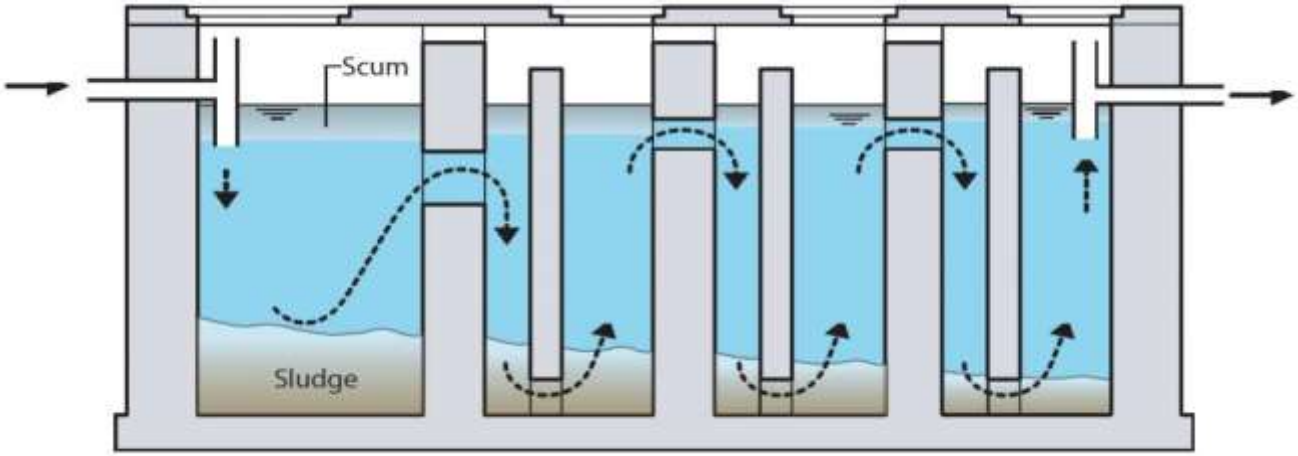
Quality of effluent influenced by: sludge concentration

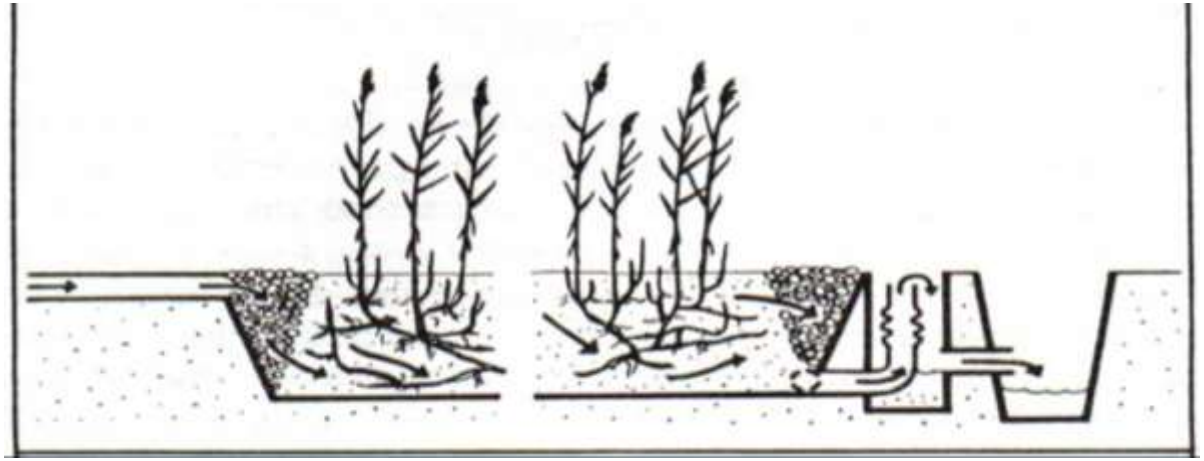


- *Amount biomass and bio-solids settling in the compartment (SRT)*
  - *at least 30% of the tank volume*
  - *Pilot has now Imhoff reading of 30 to 40% (Sep 2014)*
- ABR will not operate at full capacity after installation, because anaerobic digestion of sludge needs a 3-month start up.

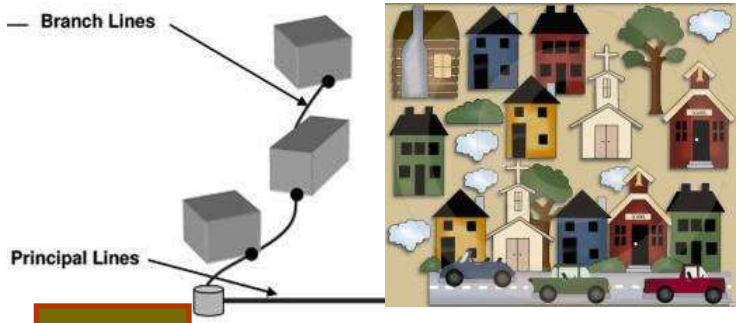
Post Treatment: Constructed Wetlands

Subsurface Flow

- No accumulation of water
- Better removal of organic as post-treatment
- Removal of pathogens



Pilot Project Process



BOD: 127 mg/l
Flow: 30 m^3/d

Grey and Black Water

Marsh plant: 3 -4 plants/m^2
75% BOD removal

CONSTRUCTED WETLAND

BOD: 127 mg/l
Flow: 30 m^3/d

ABR

ANAEROBIC BAFFLED REACTOR (ABR)

Hydraulic retention time: 1.5 days
70% BOD removal

BOD: 38 mg/l
(70% reduction)
Flow: 6 m^3/d

BOD: 9 mg/l
(93% total reduction)
Flow: 6 m^3/d

BOD: 38 mg/l
Flow: 24 m^3/d

ESTERO DE PACO

Latest pictures (as of September 8, 2014):

Wetland Plants (~ 1meter tall)

Flexible hose outlet for leak repair

Sampling Port (outlet)

Samples collected last Aug 28

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Assessment of Performance (ABR & wetlands)

Pollutant Parameter	Month 1 (actual)	Target Month 2-4	Target Month 5-7
BOD (mg/l)	48% reduction Influent – 145 Effluent – 75	60% reduction Influent – 145 Effluent – 58	90% reduction Influent – 145 Effluent – 15
	Standard for Class C – 50 mg/l		
Coliform (MPN)	1 log reduction Influent – 10^8 Effluent – 10^7	2 log reduction Influent – 10^8 Effluent – 10^6	2 log reduction Influent – 10^8 Effluent – 10^6
	Standard for Class C – 10^4 (Additional disinfection may be required)		

ABR+CW Performance Monitoring

PARAMETERS	ABR Influent				ABR Effluent				CW Effluent				Class C Effluent Standards
	Aug 29	Sep 22	Oct 15	Nov 24	Aug 29	Sep 22	Oct 15	Nov 24	Aug 29	Sep 22	Oct 15	Nov 24	
BOD (mg/L)	145	158	279	107	149	58	62	78	75	29	36	27	50
TSS (mg/L	242.5	NA	185	230	82.5	NA	21.0	25	17.5	NA	9.0	36	70
pH	6.70	NA	7.0	6.6	6.90	NA	7.10	6.7	7.20	NA	7.40	7.0	6.5 – 9.0
Oil and Grease (mg/L)	*16.0*	NA	17.0	12	7.5	NA	6.5	8.5	4.0	NA	0.8	4.5	5.0
Total Coliform (MPN/100 ml)	1.7×10^8	1.1×10^8	4.9×10^7	4.9×10^7	2.2×10^8	2.3×10^7	4.6×10^5	3.3×10^6	2.8×10^8	7.9×10^6	4.9×10^5	2.3×10^7	10,000

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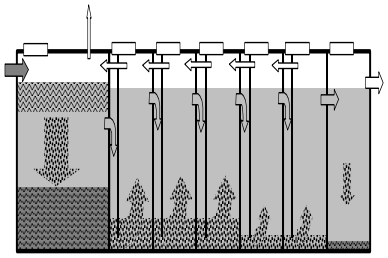
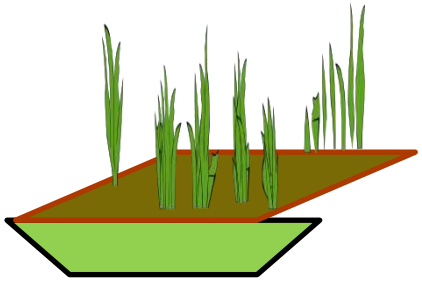
Monitoring October 2015

(3 month after start of commissioning)





ABR	Wetland	Estero
BOD = 279 ppm	BOD = 62 ppm	BOD = 36 ppm (88% reduction)
SS = 185 ppm	SS = 25 ppm	SS = 9 ppm (96% reduction)
Oil/grease = 17 ppm	Oil/grease = 6.5 ppm	Oil/grease = 0.8 ppm (90% reduction)
Coliform = 10^7 MPN/100 ml	Coliform = 10^5 MPN/100 ml	Coliform = 10^5 (20% reduction) MPN/100 ml

Conclusions

- Small bore sewers need maintenance.
- Fat traps are the best option.
- ABRs work better with high organic load.
- Sludge needs to be emptied every 2 years.
- CWs can reduce pathogens to Class C.
- Reed needs to be cut every 4-6 months.
- CSS with ABR+CWE in Philippines costs $120/person