Urban Sanitation & Public Health

MAIN CONCEPTS

LEARNING OBSERVING THINKING

\+ +

THEORY ENVIRONMENT HYPOTHESIS

KHIN MAUNG YI – VICE CHAIR , MES – WATSAN TD

ENVIRONMENTAL SANTATION (10 Cs)

1. Safe Drinking Water
2. Sewage Treatment (S.Pit, Septic Tank, IMT, TF, AS, MF)
3. Refuse Disposal (Dump[N:], San. LF, CP, Incen[N]: Hog Feed[N:])
4. Personal Hygiene
5. Environmental & Soil (free Disease Produc[N:] Bat, Path: Organism)
6. General Sanitation (Building orientation to all)
7. Air Sanitation (Pollution, CO_2, CO, H_2S, NO, CLFLC, CH_4, NH_3)
8. Lighting (minimum 50 foot candle=60 Watts for reading)
9. Ventilation (30%-40% of walling, 50-70ft^2/c, 35m^3/c.hr)
10. Sound Sanitation (Noise Control <80 decibel)

Source: Environmental Engg; & Sanitation- Joseph A. Salvato New York Nov: 1971

What is Sanitation?

A) Definitions **Excreta & liquid wastes hygienic way disposing**

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a)

Sanitation is the means of collecting and disposing of excreta and liquid wastes in a hygienic way so as not to endanger the health of individuals or the community as a whole. [1]

B) Reduce pathogens spread & maintain healthy living environment

b) *(less common)*

General term used to describe a battery of actions that all aim to reduce the spread of pathogens and maintain a healthy living environment. Specific actions related to sanitation include wastewater treatment, solid waste management and stormwater management. [2]

C) Municipal Concerns – Wastewater T, Solid W T, Strom W Management

So it mostly addresses on– WW treatment, solid waste T & storm water management

WORLD = 7000 Million **35% Global**

Sanitation Challenges **WITHOUT Sanitation**

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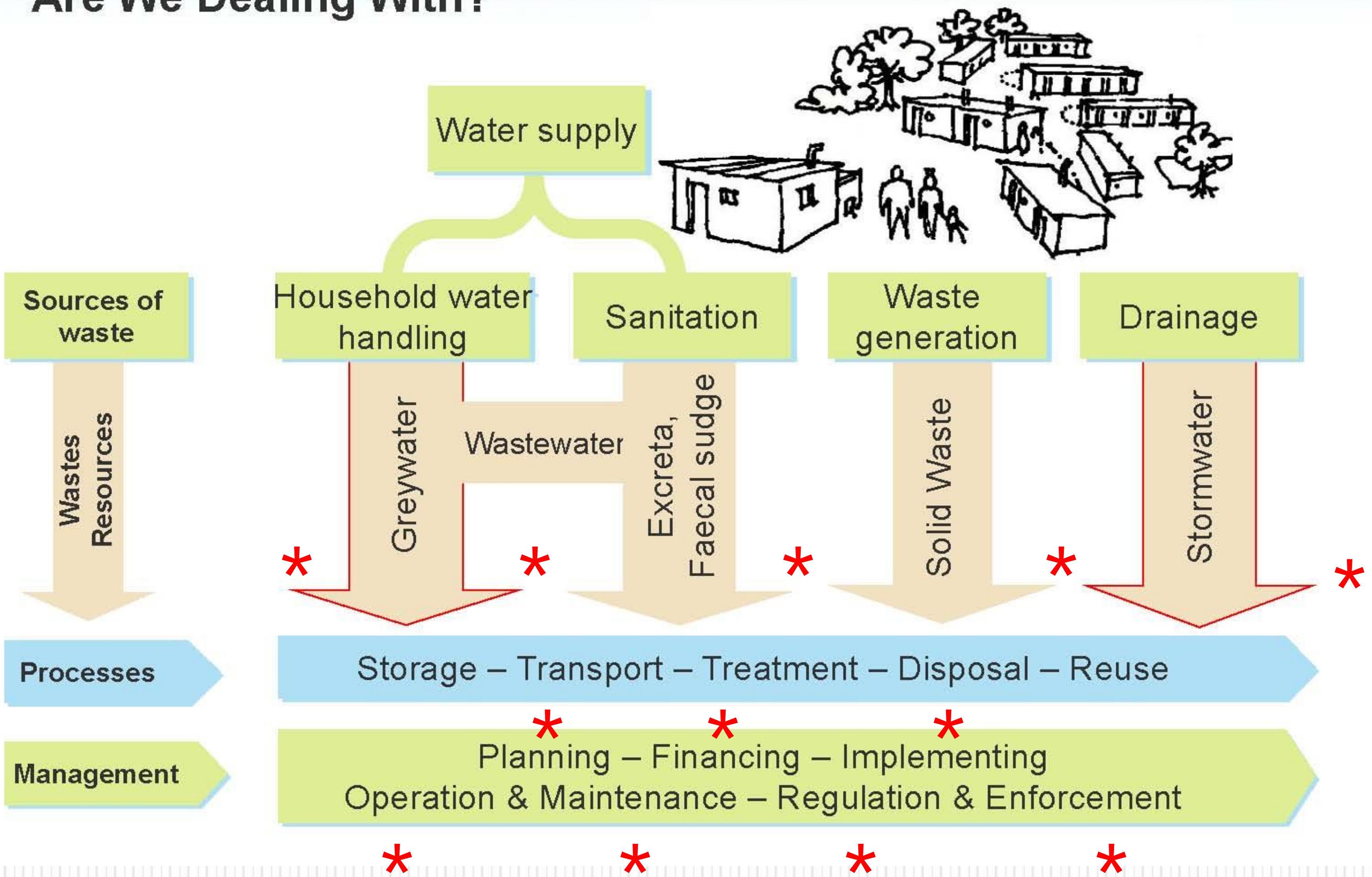
1. INDIA–818 2.CHINA-607 3.INDONESIA-109 4.NIGERIA-103 5.BANGLADESH–75

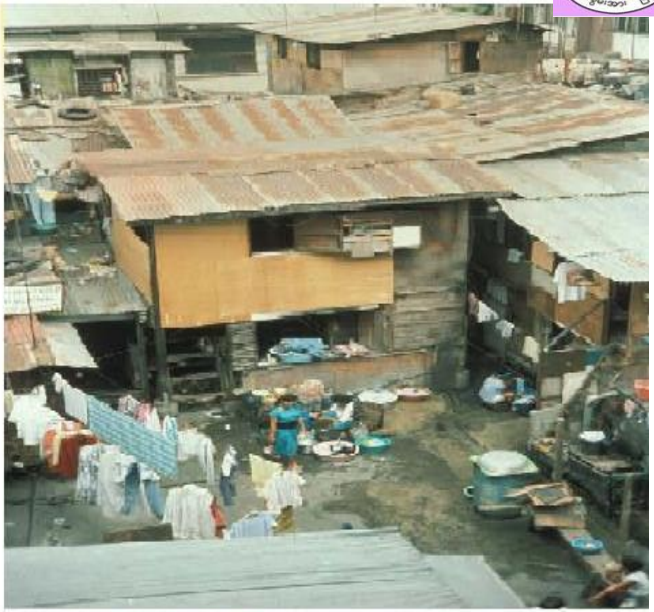
What Waste, Resource and Management Systems Are We Dealing With?

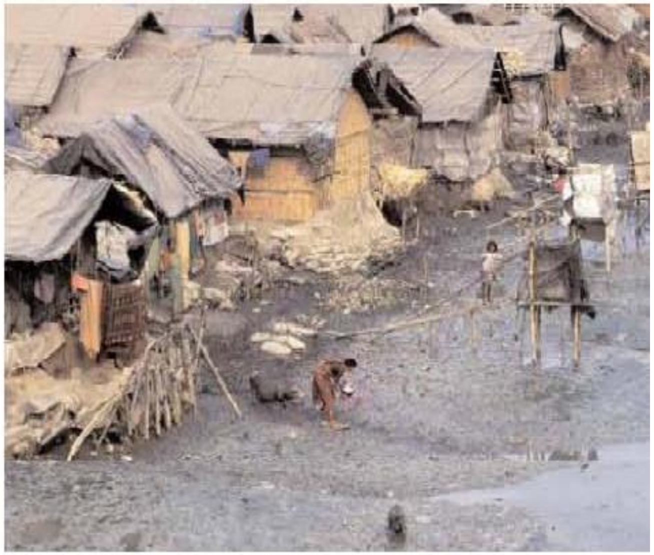


URBAN

Sanitation Challenges: Urban

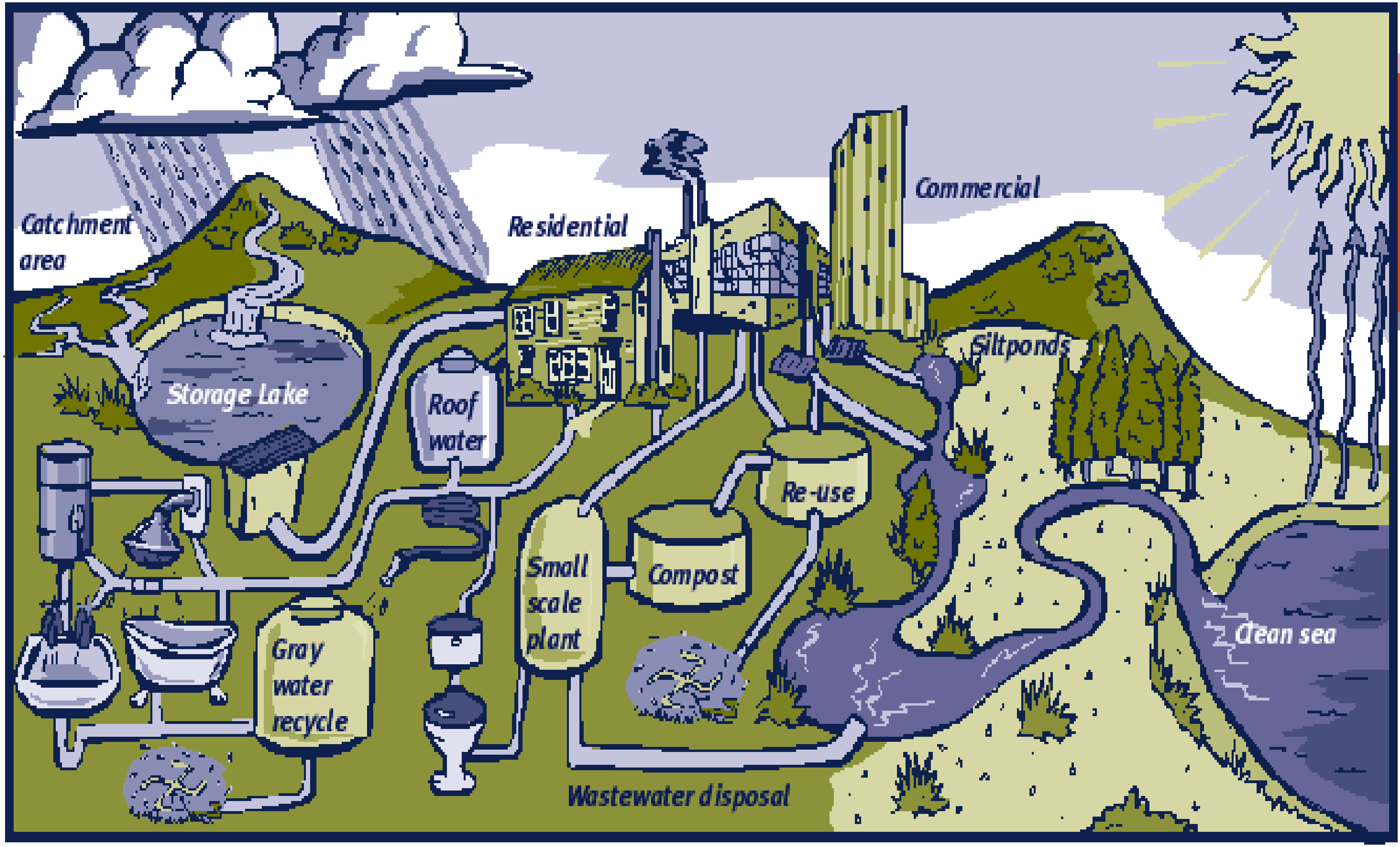
- Greatest socio-economic & technical challenges
- Disease transmission – public health
- The numbers !
- Simple (rural) versus complex (urban) solutions





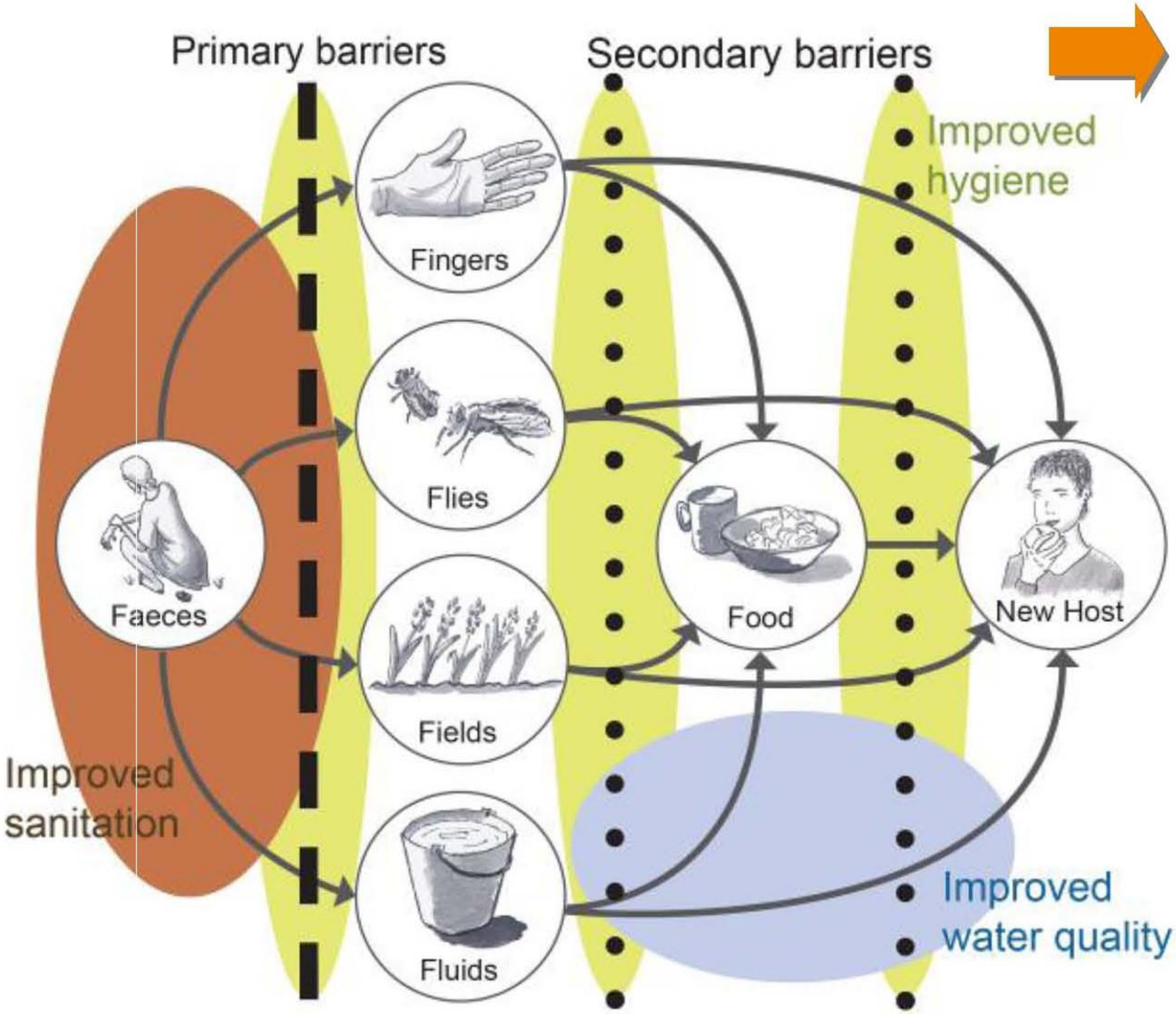
URBAN –Complex RURAL - Simple

The Water Cycle and Related Urban Infrastructure



Source: http://www.mfe.govt.nz/publications/waste/wastewater-mgmt-jun03/html/figure3-3.html

Where can we disrupt the transmission routes?



adapted from WHO 2005

Washing hands after defecation or constructing safe sanitation facilities are **primary barriers** which prevent pathogens from entering the environment.

Washing hands before eating or protecting food from flies are **secondary barriers** which prevent pathogens from infecting a new host or contaminating food.

Water related diseases

I. Water-borne
Pathogens carried by water
Faecal-oral transmission

- umv0rf;a&m*g
wdkufzGdKufa&m*g
- 0rf;udkufa&m*g
- tonf;a&miftom;0ga&m*g
- ausmufuyfysuftonf;a&mifa&m*g
- txufvSefatmufavQma&m*g

II. Water-washed
(Water- scarce)
water quantity problem

- 0Ja&m*g ? ta&jym;jynfwnfem
- rsufcrf;pyfa&m*g? 0rf;ysuf0rf;avQm
- rsufpda&mif&rf;a&m*g? temMuD;a&m*g

Water transmitted infectious disease

III. Water-based
Pathogen depe[nds]
on water
animal/plant

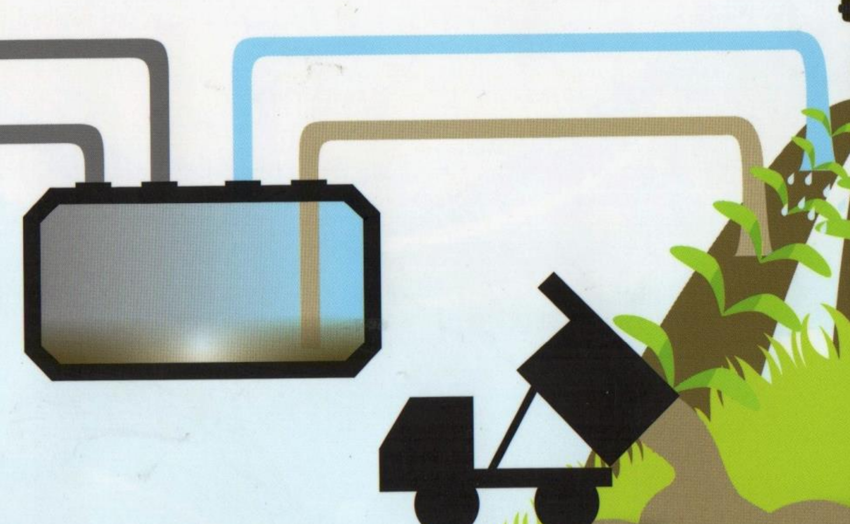
- qD;vrf;aMumif;ESifh tpma[mif;tdrfydk;0ifjcif;a&m*g
(Urinary and rectal schistomiasis)
- oHaumifa&m*grsm;

IV. Wate[r]-related
Pathogen
transmitted
close/near water
Mosquito-borne

aoG;vGefwk yfauG;? iSufzsm; ? qifajc axmuf? *syefOD;aE

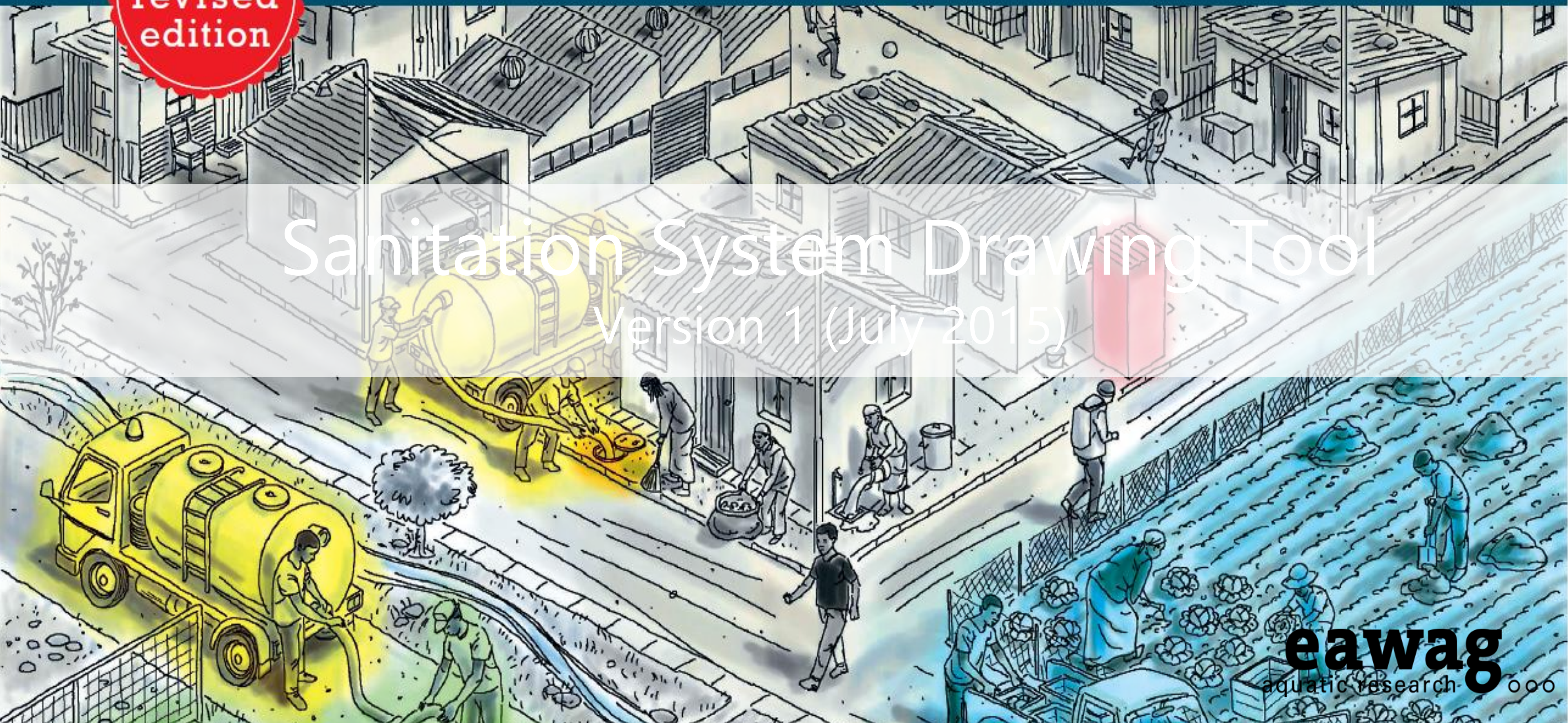
SANITATION SAFETY PLANNING

MANUAL FOR SAFE USE AND DISPOSAL OF WASTEWATER, GREYWATER AND EXCRETA



Compendium of Sanitation Systems and Technologies

2nd revised edition



Sanitation System Drawing Tool

Version 1 (July 2015)

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SANITATION SAFETY PLAN - 6 MODULES

1. PREPARE FOR SANITATION SAFETY PLAN
2. DESCRIBE THE SANITATION SYSTEM
3. IDENTIFY HAZADOUS EVENTS, ASSESS EXISTING CONTROL MEASURES & EXPOSURE RISKS
4. DEVELOP AND IMPLEMENT AN INCREMENTAL IMPROVEMENT PLAN
5. MONITOR CONTROL MEASURES & VERIFY PERFORMANCE
6. DEVELOP SUPPORTING PROGRAMME & REVIEW PLANS

SOURCE: WHO

MODULE 1
PREPARE FOR SSP

MODULES

1.1 Establish priority areas or activities

1.2 Set objectives

1.3 Define the system boundary and lead organization

1.4 Assemble the team

OUTPUTS

- **Agreed priority areas, purpose, scope, boundaries and leadership for SSP**
- **A multidisciplinary team representing the sanitation chain for development and implementation of SSP**

MODULE 2
DESCRIBE THE SANITATION SYSTEM

MODULES

2.1 Map the system
2.2 Characterize the waste fractions
2.3 Identify potential exposure groups
2.4 Gather compliance and contextual information
2.5 Validate the system description

OUTPUTS

- A validated map and description of the system
- Potential exposure groups
- An understanding of the waste stream constituents and waste related health hazards
- An understanding of the factors affecting the performance and vulnerability of the system
- A compilation of all other relevant technical, legal and regulatory information

MODULE 3

IDENTIFY HAZARDOUS EVENTS, ASSESS EXISTING CONTROL MEASURES AND EXPOSURE RISKS

MODULES

3.1 Identify hazards and hazardous events
3.2 Refine exposure groups and exposure routes
3.3 Identify and assess existing control measures
3.4 Assess and prioritize the exposure risk

OUTPUTS

- **A risk assessment table which includes a comprehensive list of hazards, and summarizes hazardous events, exposure groups and routes, existing control measures and their effectiveness**
- **A prioritized list of hazardous events to guide system improvements**

MODULE 4

DEVELOP AND IMPLEMENT AN INCREMENTAL IMPROVEMENT PLAN

MODULES

4.1 Consider options to control identified risks

4.2 Use selected options to develop an incremental improvement plan

4.3 Implement the improvement plan

OUTPUTS

- An implemented plan with incremental improvements which protects all exposure groups along the sanitation chain

MODULE 5

MONITOR CONTROL MEASURES AND VERIFY PERFORMANCE

MODULES

5.1 Define and implement operational monitoring

5.2 Verify system performance

5.3 Audit the system

OUTPUTS

- An operational monitoring plan
- A verification monitoring plan
- Independent assessment

MODULE 6

DEVELOP SUPPORTING PROGRAMMES AND REVIEW PLANS

MODULES

6.1 dentify and implement supporting programmes and management procedures

6.2 Periodically review and update the SSP outputs

OUTPUTS

- Supporting programmes and management procedures that improve implementation of the SSP outputs
- Up to date SSP outputs responding to internal and external changes

Ammonia & Nitrate Pollution

- **Nitrogen Cycle & pollution**

$2\ NH^{4+} + 4O_2 = 2NO_3 + 4H^+ + 2H_2O$

$1\ mg\ NH_4 = 3.6\ mg\ O_2$

$1\ mg\ NH4^+ = 3.44\ mg\ NO3^-$

- **Iron & Manganese Removal**

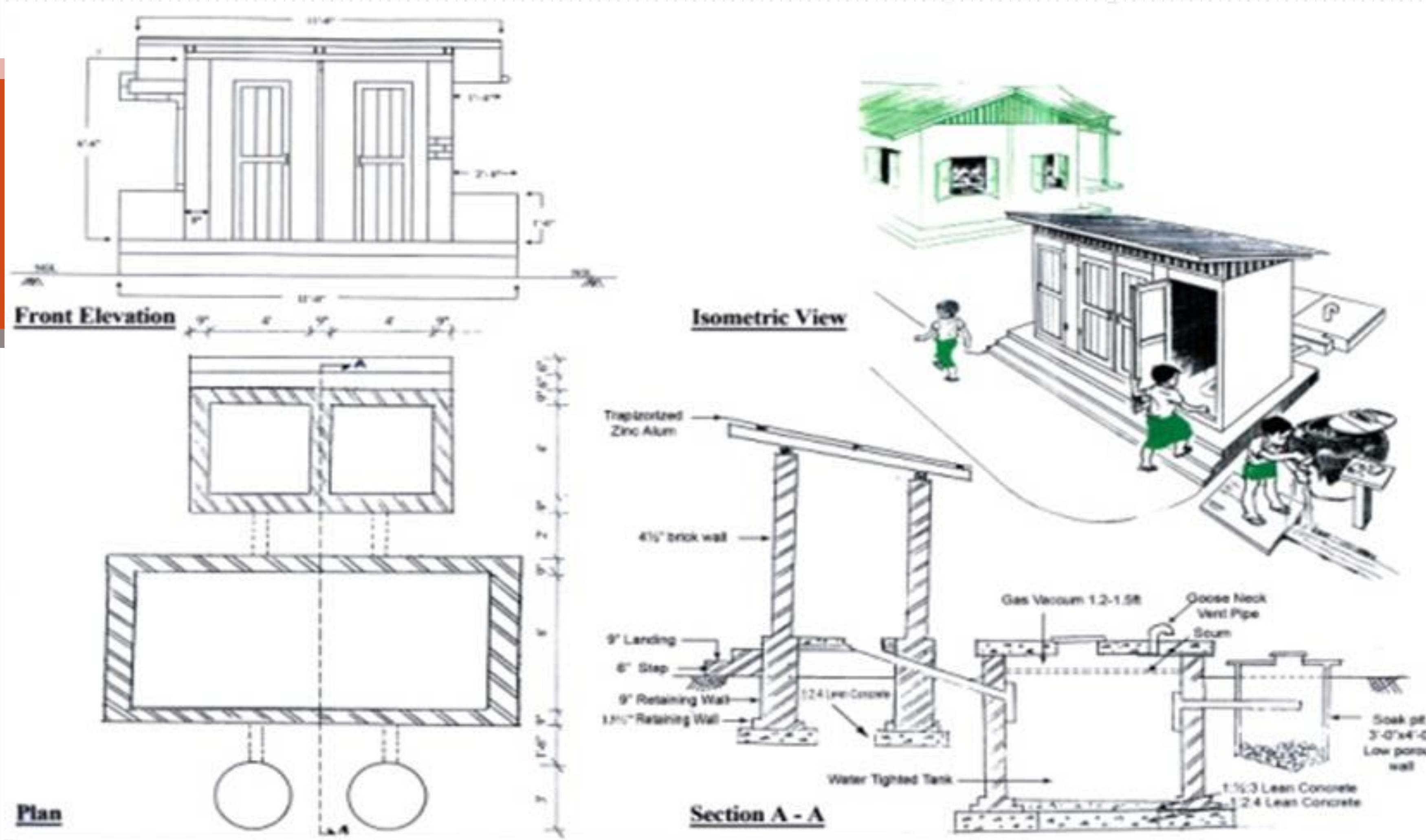
$4\ Fe^{2+} + O_2 + 10\ H_2O = 4\ Fe\ (OH)_3 + 8H^+$

$1\ mg\ Fe^{2+} = 0.14\ mg\ O_2$

- **$6\ Mn^{2+} + 3\ O_2 + 6\ H_20 = 6\ Mn\ O_2 + 12\ H^+$**

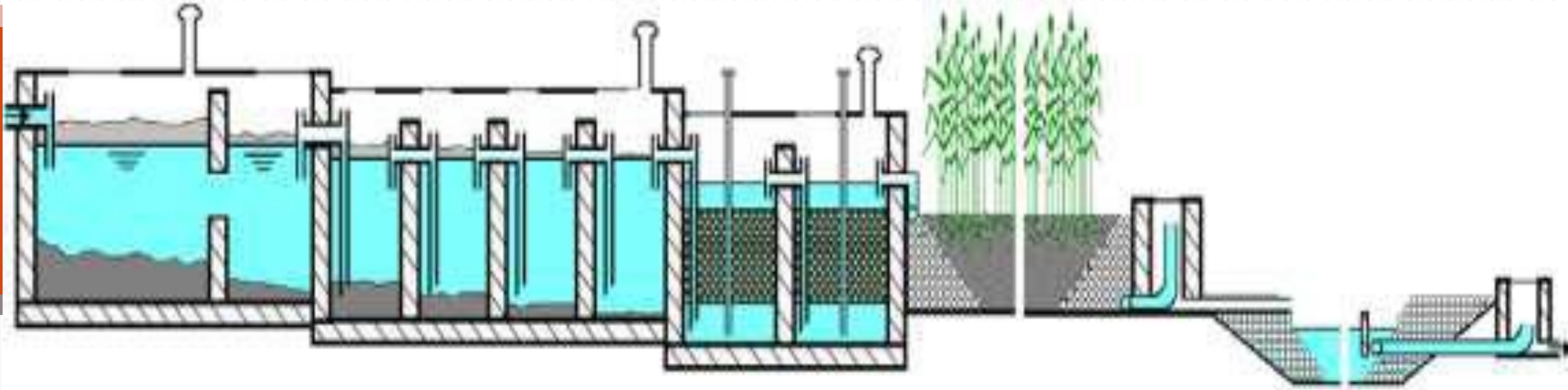
$1\ mg\ Mn^{2+} = 0.29\ mg\ O_2$

PRIMARY - SEPTIC TANK

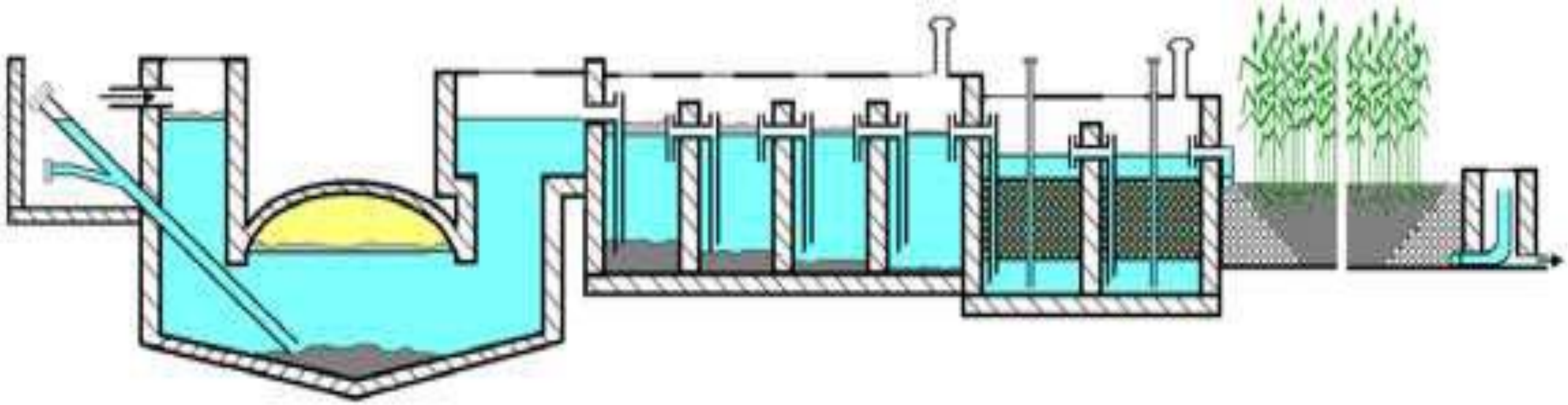


CDD- Consortium DEWATS Disemination

Decentralized Wastewater Treatment System



Settler – ABR – AF – PGF – polishing pond (not true to scale)



fixed dome biogas settler – ABR – AF – PGF (not true to scale)

Thumb Rules (Settler)

1. Sludge volume l/g BODrem=0.005 BODr
2. SS/COD = 0.35 - 0.55 – 0.42
3. Surface load =0.6 m3/m2 w/w peak flow
4. CH4 produced /kg COD rem=0.35 m3/kg
5. Height(scum) = 0.2 – 0.3 m
6. Hydraulic RT = 1.5 – 2.0 hrs
7. **L/B ratio = 2.1 – 3.1**
8. **Outlet Liq depth=1.8–2.2 m**
9. 1st & 2nd Chamber ratio
   If 2 Chams, 1st Cham = 2/3 of total length
   If 3 Chams, 1st Cham = 1/2 total length.
11. Assure wall opening bet. under scum & sludge top, have MH, Water tight, Vent
12. Desludg interval = 18–24 m

Thumb Rules (ABR)

1. SS/COD–Dom. =.35–.55–.42
2. Sludge Volume – 5-10% of volume of ABR
3. CH4–produced /KgCODrem – 0.35 m3/kg
4. Scum volume 10 l/cap
5. HRT– not <8 hrs, better 16-20 hrs, if > 20 hrs, pollution removal is very minimum
6. **B/H ratio – 0.4**
7. Distance bet: pipes - not exceed 0.30 m
8. Nos of Chambers – At least 4 chambers
9. **Outlet water depth- 1.8 m- 2.2 m**
10. Up-flow vel: – 0.9 – 1.2 m/h
11. Organic load - < 6 kg/m3* day BOD

Thumb Rules (AF)

1. **SS/COD - Domestic: 0.35–0.45–0.42**
2. **HRT – 24-48 hrs**
3. **Filter height – 0,75 – 1 m**
4. **Specific surface of filter medium 80 -120 m2/ m3**
5. **Voids in the filter mass 30-45%**
6. **Size of filter 8-14 cm dia,cinder**
7. **Up-flow velocity Max 2m/h**
8. **Organic load <4 kg/m3 *day COD**
9. **Outlet water depth – 1.8- 2.2 m**
10. **CH4–produced /Kg CODrem – - 0.35 m3/kg**

Thumb Rules (HPGF)

1. **Void of gravel – 35%- 45%**
2. **Max BOD on X sectional area- 150 g/m3 s**
3. **Max organic on chosen surface (Organic load limit) – 10 g//m2 BOD**
4. **Gravel size– 5-7mm, 10- 12 mm, 50-70mm dia., bigger size at inlet & outlet**
5. **Slope 1%**
6. **Height of filter 50 - 60 cm**
7. **Construction – Swivel at inlet & outlet to adjust water level**

No Thumb Rules

(Polishing Pond)

V = 12 m3/d*2d=24m3

Sur. Area= .24m3/1m= 24 m3

Dimensions:

W= 4 m, L=6m

Diameter 5.5 m

CDD- Consortium DEWATS Disemination

Reutilizing Wastewater for Plants






PRIMARY - IMHOFF TANK

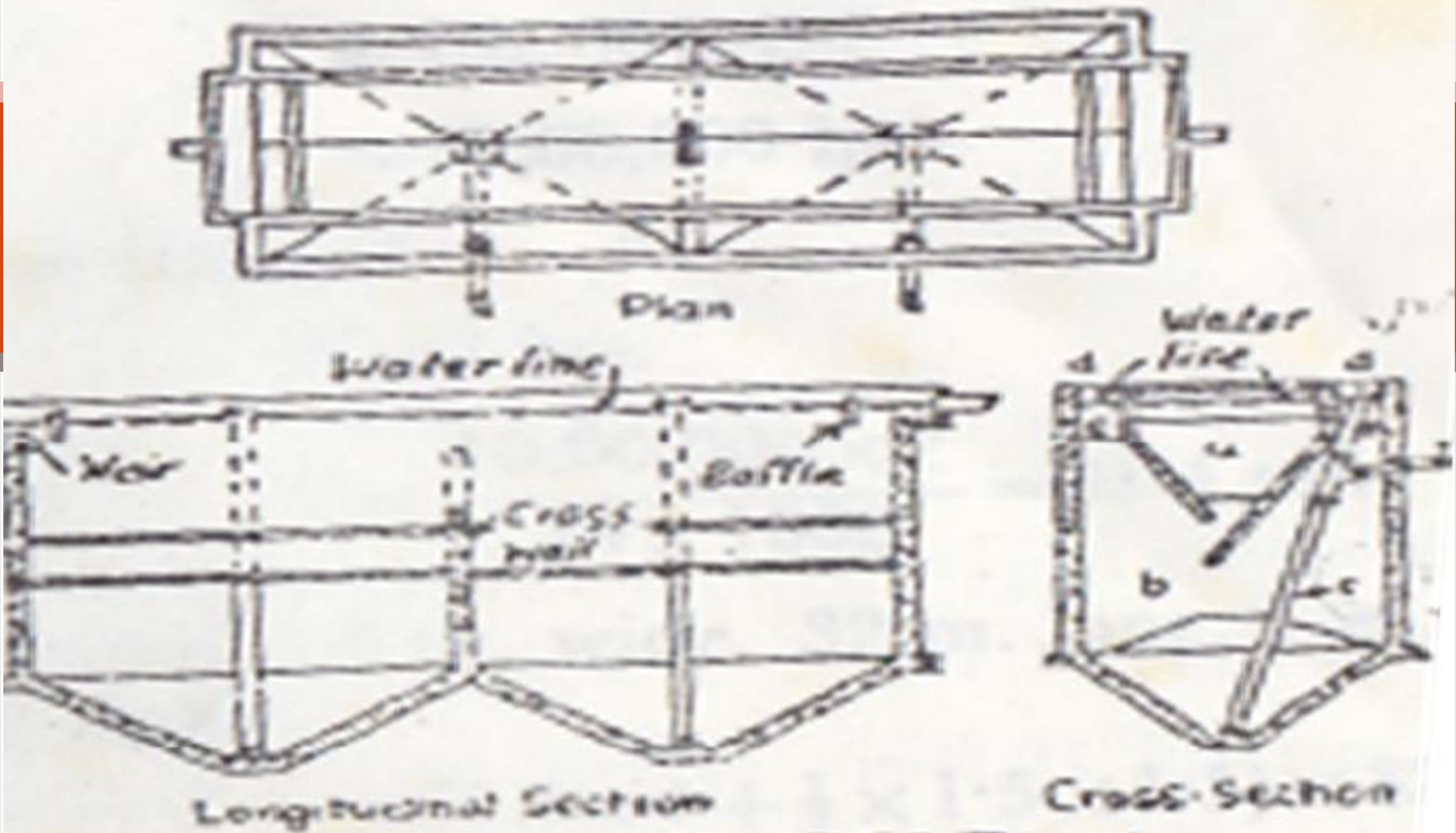
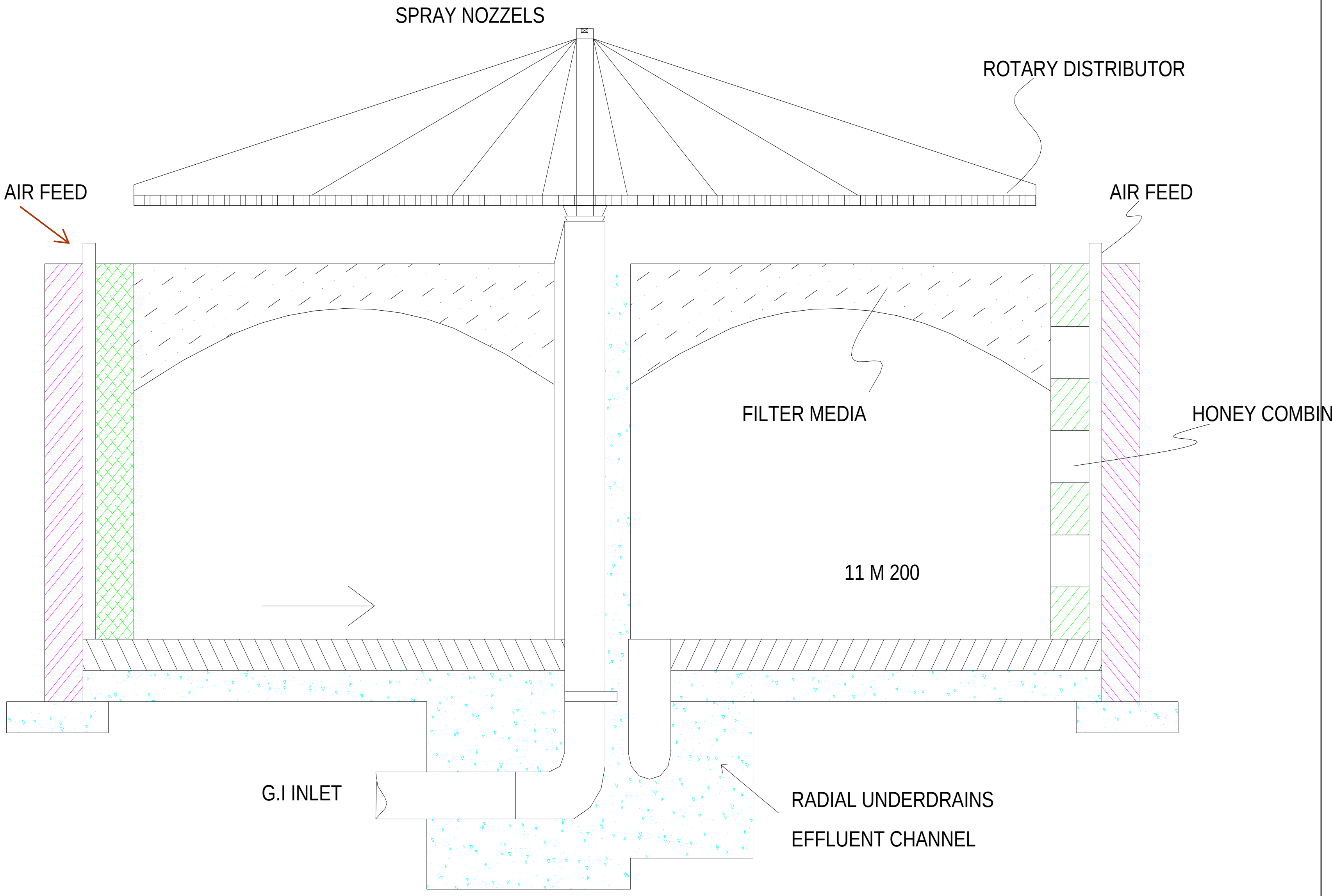


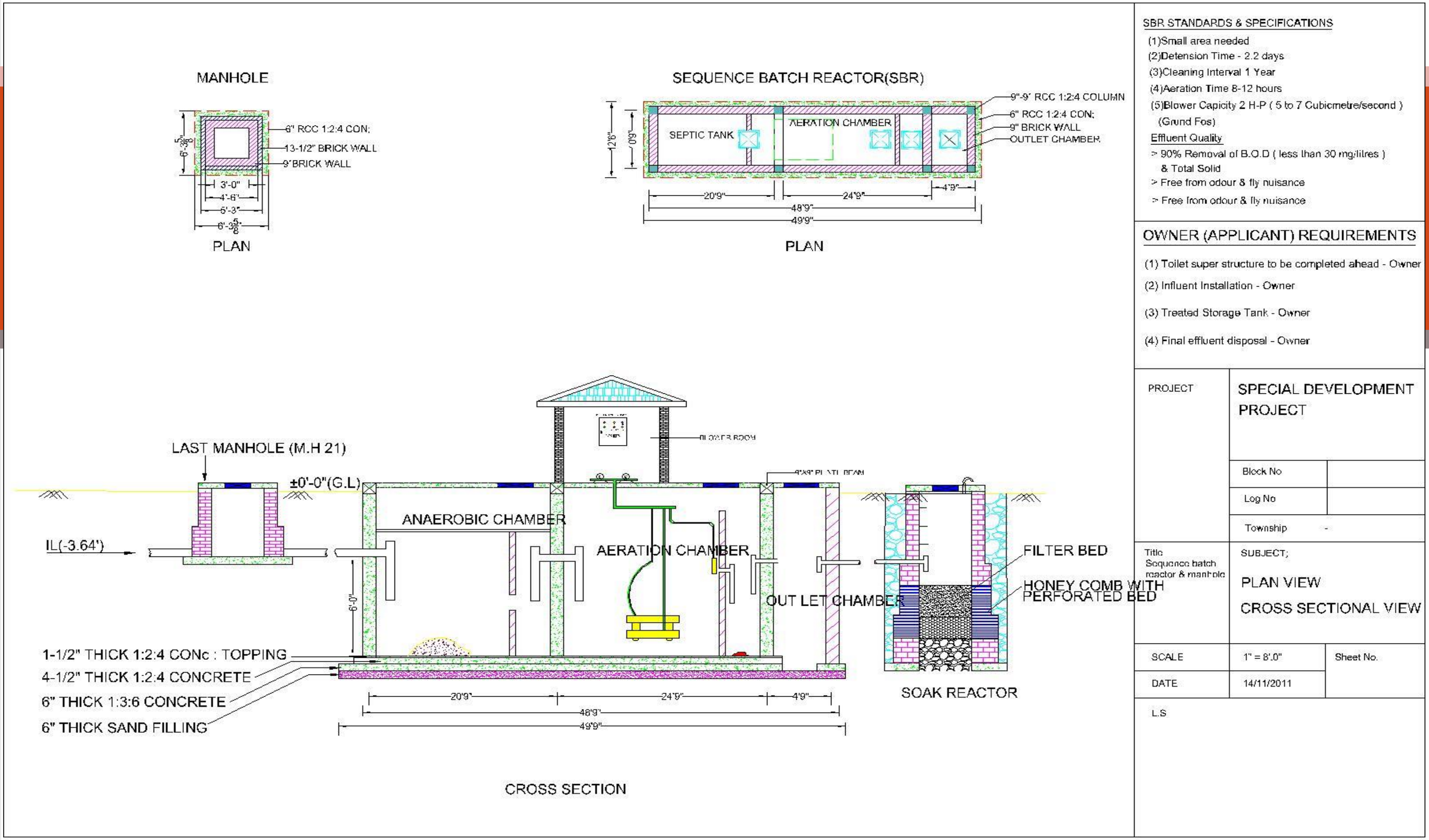
FIG. 6-8. IMHOFF TANK

SECONARY - TRICKLING FILTER

- 10

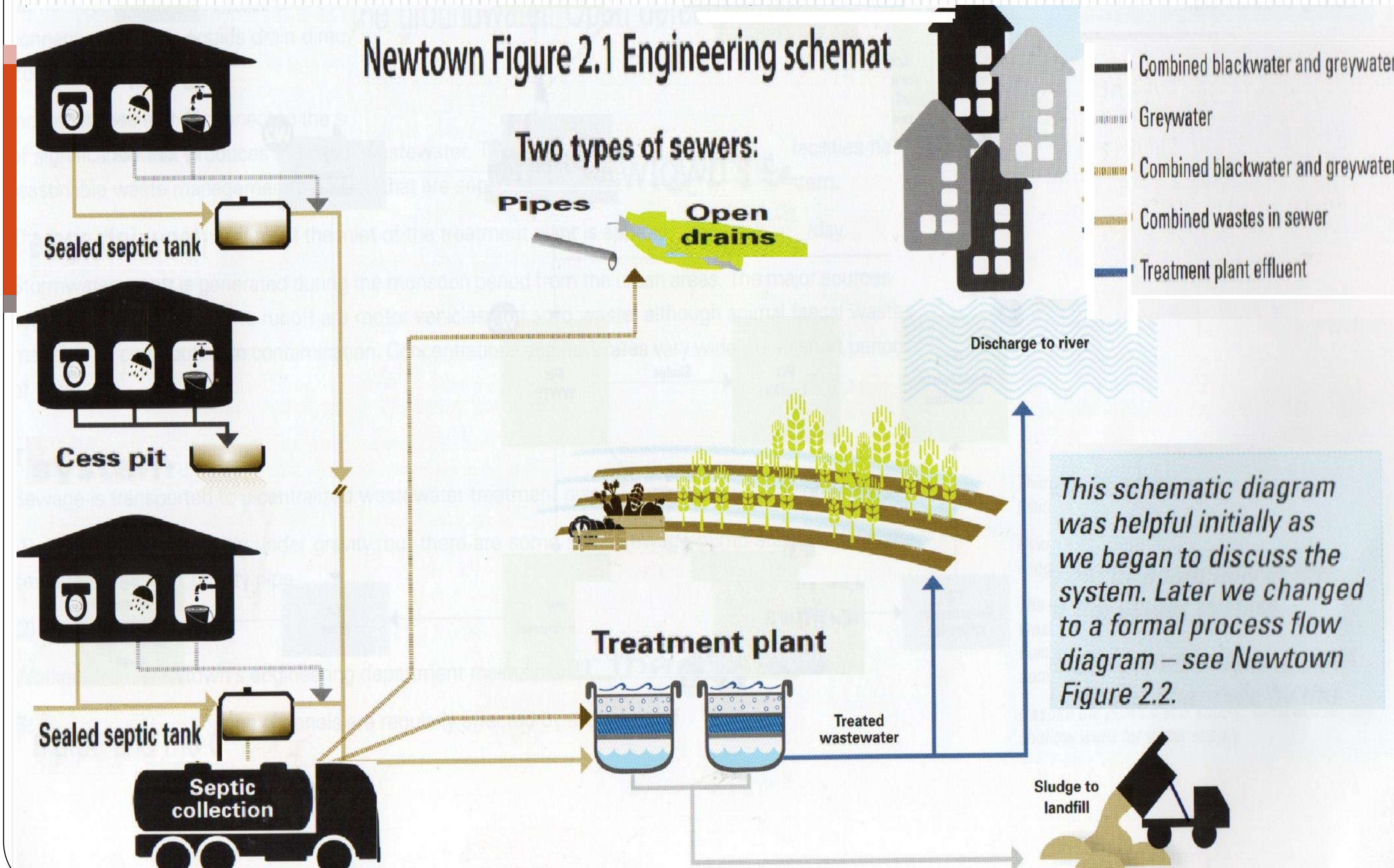


SECONARY - ACTIVATED SLUDGE or SBR



Module 2.1 Map the system

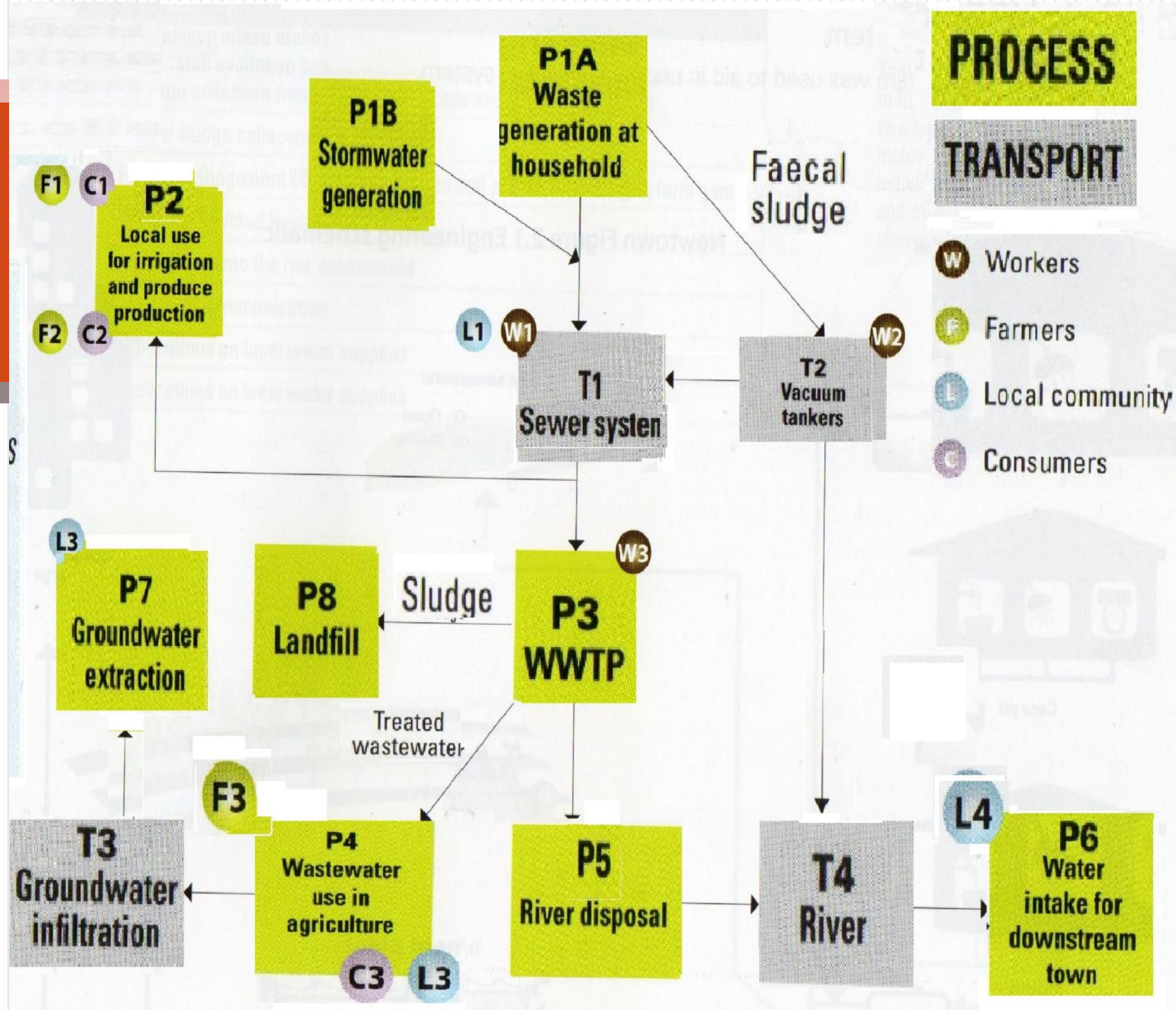
An initial engineering diagram was used to aid in understanding the syster



This schematic diagram was helpful initially as we began to discuss the system. Later we changed to a formal process flow diagram – see Newtown Figure 2.2.

Newtown Fig 2.2 Process Flow Diagram

This is the process F.D adopted during Module 2.1



The process and Transport nos (P1, P2, T1, T2 etc) helped as system information.

Nytrogen Cycle & Effects

- $NH^{4+} + 2O_2 = NO_3 + 2H^+ + H_2O$
- 1 mg $NH_4^+ = 3.6$ mg O_2
- 1 mg $NH_4^+ = 3.44$ mg $NO3^-$

In Water Quality

If $NO3^-$ is > 50 mg/l→Cause Blue Baby disease

Denitrification

12.1 Basic Technology of Denitrification

- ***Nitrification***

$$\mathbf{NH_4^+} + (3/2)O_2 \rightarrow NO_2^- + H_2O + 2H^+$$

$$NO_2^- + (1/2)O_2 \rightarrow \mathbf{NO_3^-}$$

- ***Denitrification***

$$2NO_2^- + 3(H_2) \rightarrow \mathbf{N_2}\uparrow + 2\,H_2O + 2OH$$

$$\mathbf{2NO_3^-} + 5(H_2) \rightarrow \mathbf{N_2}\uparrow + 4\,H_2O + 2OH^-$$

- In this reaction 4.6 kg of oxygen are consumed to oxidize 1 kg of NH_3-N, and the oxidation of ammonia ***reduces the alkalinity in the water.*** As the nitrification bacteria are sensitive to temperature and pH, the pH control and temperature range maintenance shall be performed carefully to effectively promote the reaction.

The result of folding a string with successive elements until it fits into a table (e.g. under the condition that the resembling elements Li, Na en K are within one column) is given in table 3.10.

Key: Atomic number → 1 H 1 0079 ← Atomic mass

Transition metals

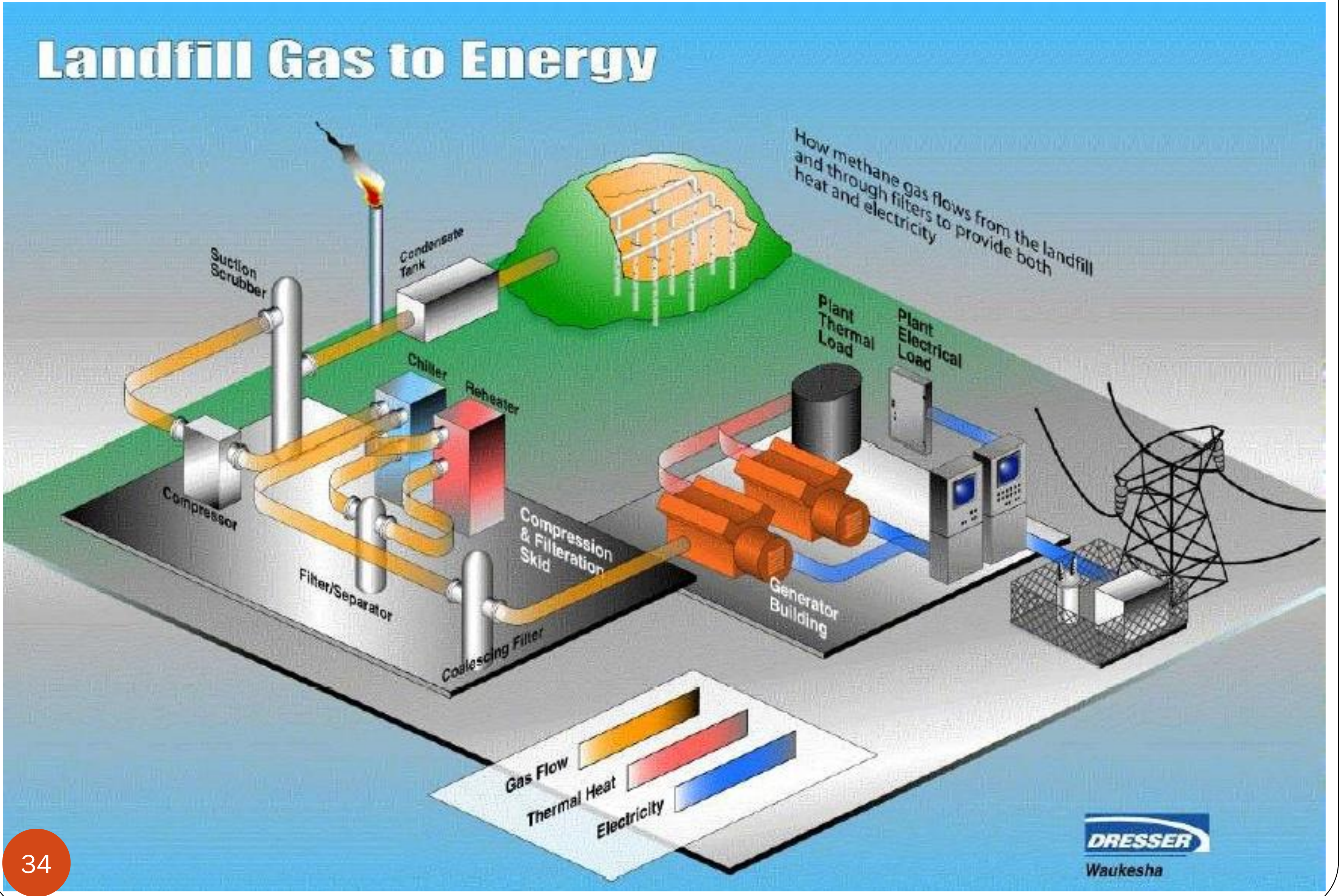
Periods	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	Noble gases 0
1	1 H 1 0079																	2 He 4 00260
2	3 Li 6 941	4 Be 9 01218											5 B 10 81	6 C 12 011	7 N 14 0067	8 O 15 9994	9 F 18 998403	10 Ne 20 179
3	11 Na 22 98977	12 Mg 24 305											13 Al 26 98154	14 Si 28 0855	15 P 30.97376	16 S 32 06	17 Cl 35 453	18 Ar 39.948
4	19 K 39 0983	20 Ca 40 08	21 Sc 44 9559	22 Ti 47 90	23 V 50 9415	24 Cr 51 996	25 Mn 54 9380	26 Fe 55 847	27 Co 58.9332	28 Ni 58 70	29 Cu 63 546	30 Zn 65 38	31 Ga 69 72	32 Ge 72 59	33 As 74 9216	34 Se 78 96	35 Br 79 904	36 Kr 83 80
5	37 Rb 85 4678	38 Sr 87 62	39 Y 88 9059	40 Zr 91 22	41 Nb 92 9064	42 Mo 95 94	43 Tc (98)	44 Ru 101.07	45 Rh 102 9055	46 Pd 106 4	47 Ag 107 868	48 Cd 112 41	49 In 114 82	50 Sn 118 69	51 Sb 121.75	52 Te 127 60	53 I 126 9045	54 Xe 131 30
6	55 Cs 132 9054	56 Ba 137 33	57 *La 138 9055	72 Hf 178 49	73 Ta 180 9479	74 W 183 85	75 Re 186 207	76 Os 190 2	77 Ir 192.22	78 Pt 195 09	79 Au 196 9665	80 Hg 200 59	81 Tl 204 37	82 Pb 207 2	83 Bi 208 9804	84 Po (209)	85 At (210)	86 Rn (222)
7	87 Fr (223)	88 Ra 226 0254	89 †Ac 227.0278	104 Unq (261)	105 Unp (262)	106 Unh (263)												

*	58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.4	63 Eu 151.96	64 Gd 157.25	65 Tb 158.9254	66 Dy 162.50	67 Ho 164.9304	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.967
†	90 Th 232.0381	91 Pa 231.0359	92 U 238.029	93 Np 237.0482	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (254)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Table 3.10 The Periodic table

Waste Collection

Waste-to-Energy

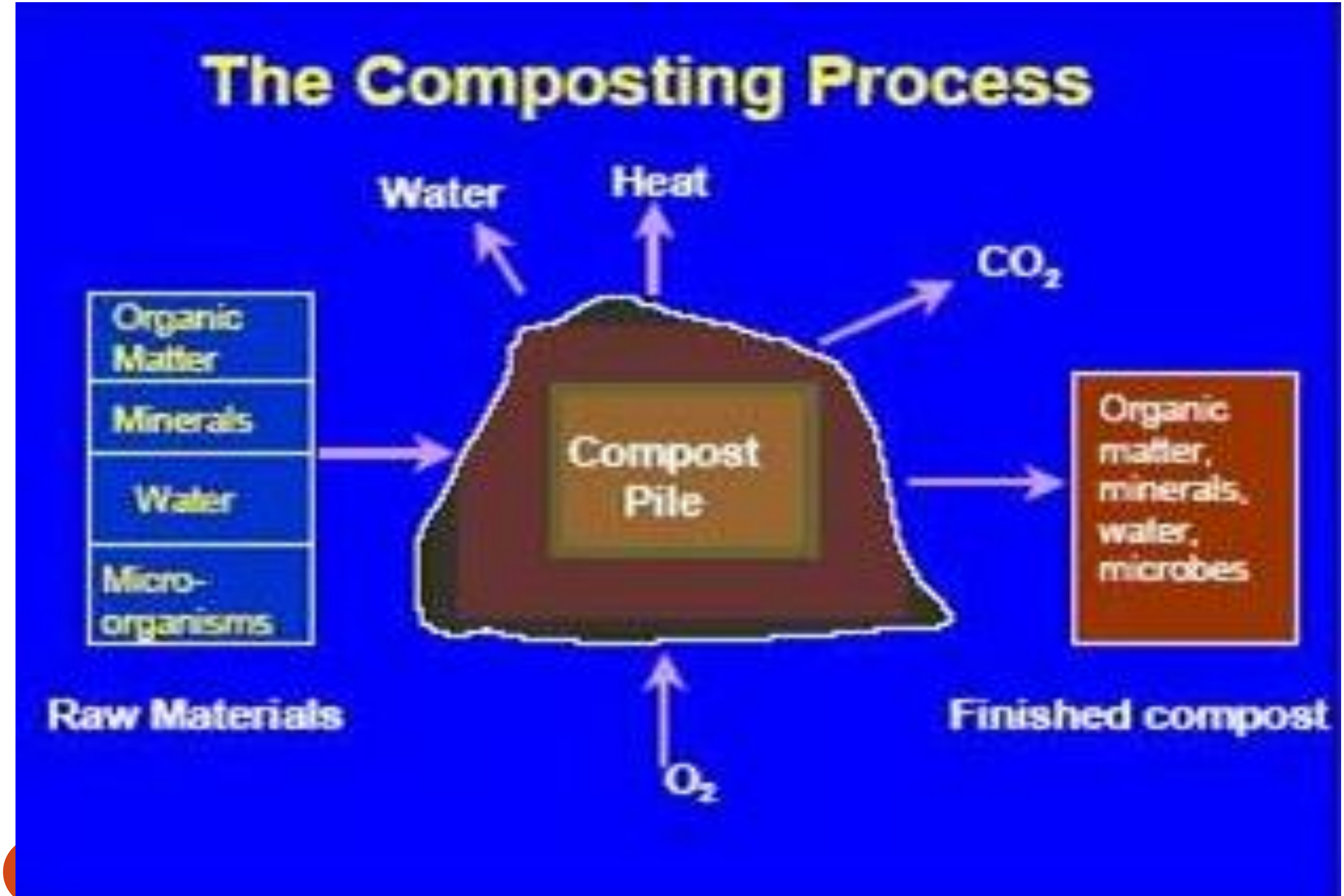


Waste Reduction & Recycle

R

C

Waste Composting



Solid Waste Management Needed!

SEAMEO SEARCA

ISSN 1656-8818

Policy Brief Series 2006 - 1

Solid Waste Management Badly Needed in Myanmar[1]

Asia's urbanized areas produce about 760,000 tons of solid waste daily, and are expected to be more than double by year 2025. And that is not even the worse case scenario.

According to the World Bank, municipalities in developing countries spend 20-50% of their budget on solid waste management. Sadly though, 30-60% of urban solid wastes in Asian countries remain uncollected and less than 50% of the population served. In some cases, as much as 80% of the trash collection and transport equipment is non-functional.

Despite the palpable urgency to solve this issue, local governments in third world countries are stumped in the achievement of an effective solid waste management system (SWMS) in urban areas for several factors. These factors include lack of funds and resources, community involvement, collective and participatory planning, technical know-how of staff, discipline on the part of waste producers, and updated policies.

A Microcosm of the Waste Management Concern

Yangon City, the capital of the Union of Myanmar, exemplifies an alarming neglect of this waste management issue. Currently, the City has a population of 5.5 million with an annual growth rate of about 2%. More people mean more waste. Rapid urbanization and population growth renders the City's human health and environment vulnerable to the effects of inefficient waste management system.

Seinn Lei Aye, in her dissertation titled "Strategic Solid Waste Management Planning for Yangon City, Myanmar", defined solid waste management (SWM) as the "generation, storage, collection, transfer, and transport, processing, and disposal" of solid waste, according to social and economic needs and environmental standards.

In the case of Yangon City, the municipal area generates approximately 2,900 tons of solid waste daily, with a daily collection efficiency of 54%. The average waste generation of public sector is about 0.53 kilogram per capita per day.

Yangon City's SWMS is "centrally implemented, labor-intensive, and uncontrolled." The Pollution Control and Cleansing Department (PCCD), under the Yangon City Development Committee (YCDC), administers and performs the municipal SWMS. The 33 Townships in the City are classified into 4 Districts - North, South, East and West. PCCD maintains offices in each township, and each township also executes waste collection, street sweeping, and transportation practices.

The current system, however, proves inadequate. This lack of an adequate SWMS in terms of planning, legislation, capacity building, and low level of awareness on environmental management, obsolete equipment, and insufficient budget, among other limitations, is quite alarming.

High Cost. In the 2003-2004 Financial Year, the Yangon City SWMS incurred a total expense of 1.2 million US dollars to collect a total waste volume of 245,098 tons. Meanwhile, the system recovered a mere total of 0.98 million US dollars.

Lack of Technical Know-how. Aside from the high cost of the overall SWMS, waste management officials and staff lack the proper know-how on waste management technologies and have not yet fully grasped its social, economical, and ecological implications.

Outdated policies and legislations. For an SWMS to be adequate and effective in a rapidly growing city such as Yangon, there has to be a strategic plan. Unfortunately, legislation on Yangon City's SWM was formulated way back in 1922, and nothing else followed ever since. This legislation is contained in Sections 111 and 112 of the City of Rangoon Municipal Act of 1922 entitled "Scavenging and Cleansing Acts". This empowers YCDC to act on waste management within their jurisdiction and to adopt regulations and standards for the storage, collection, and disposal of solid waste. However, implementing rules and regulations have yet to be put in place, and the existing ones updated.

Policy Recommendations

Based on Aye's study, the SWMP will be rendered effective if supported by policies in the form of legislation, regulations, and administrative orders issued by YCDC and the Mayor. The recommended policies and ordinances that need to be drawn are:

1. An ordinance to support the ecologically sound practices on SWM such as the requirement for environmental impact assessment (EIA) for the industries and waste segregation programs for residential, commercial, and other establishments;
2. An ordinance to support the collection of waste management charges in the form of direct-user charges (which depend on volume of waste generated) and monthly charges from households, institutions, commercial establishments, and industries;
3. An anti-littering ordinance that penalizes illegal dumping of wastes.

Other recommendations toward an effective SWMS are:

- Active community involvement and participation through appropriate information dissemination and knowledge proliferation on proper SWM;
- Waste minimization;
- Efficient and effective solid waste collection and transportation system; and
- Effective cost recovery program essential in developing waste management practices. *(Marie Fjel I. Mananan)*

[1] *Seinn Lei Aye, PhD. Strategic Solid Waste Management Planning for Yangon City, Myanmar. University of the Philippines Los Baños (UPLB). December 2005.*

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Yangon City's SWMS

"centrally implemented, labor-intensive, and uncontrolled."

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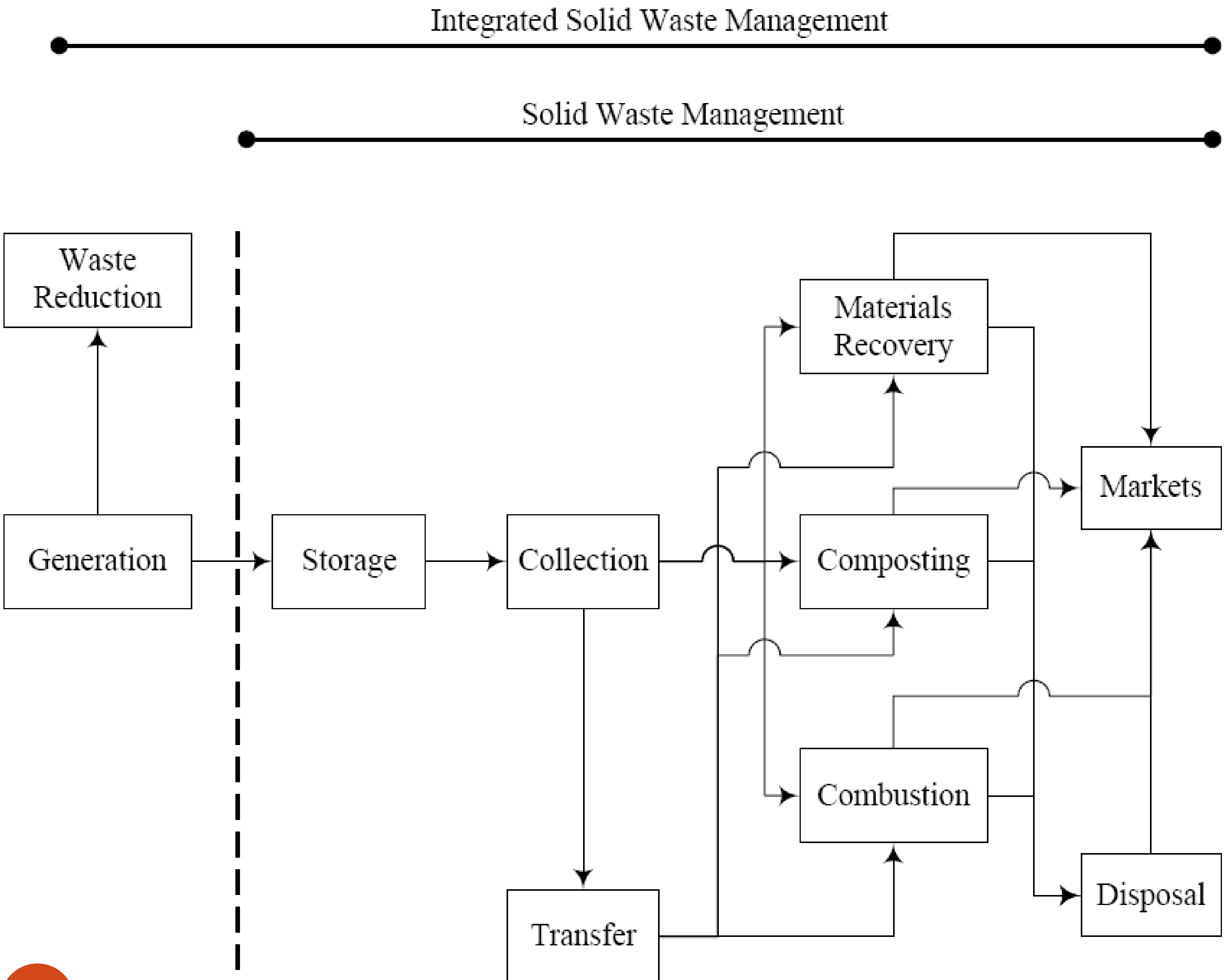
- The 33 Townships in the City are classified into 4 Districts - North, South, East and West.
- PCCD maintains offices in each township, executing waste collection, street sweeping, and transportation practices.
- The current system, however, proves inadequate.
- Lack of an adequate SWMS in terms of
  - planning,
  - legislation,
  - capacity building,
- Low level of awareness on environmental management,
- Obsolete equipment, and insufficient budget,
- Other limitations



Source: Hickman

Processing and Disposal of MSW

- *Landfill*
- *Composting*
- *Recycling and recovery*
- *Incineration*

Landfill

- **The most preferred method for the final disposal of solid waste.**
- **Most of these sites practice open dumping.**
- **Landfill Gas**
- **Waste-to -Energy**

Sanitary Landfill

New York State Dept. of Health, Albany, 1969).

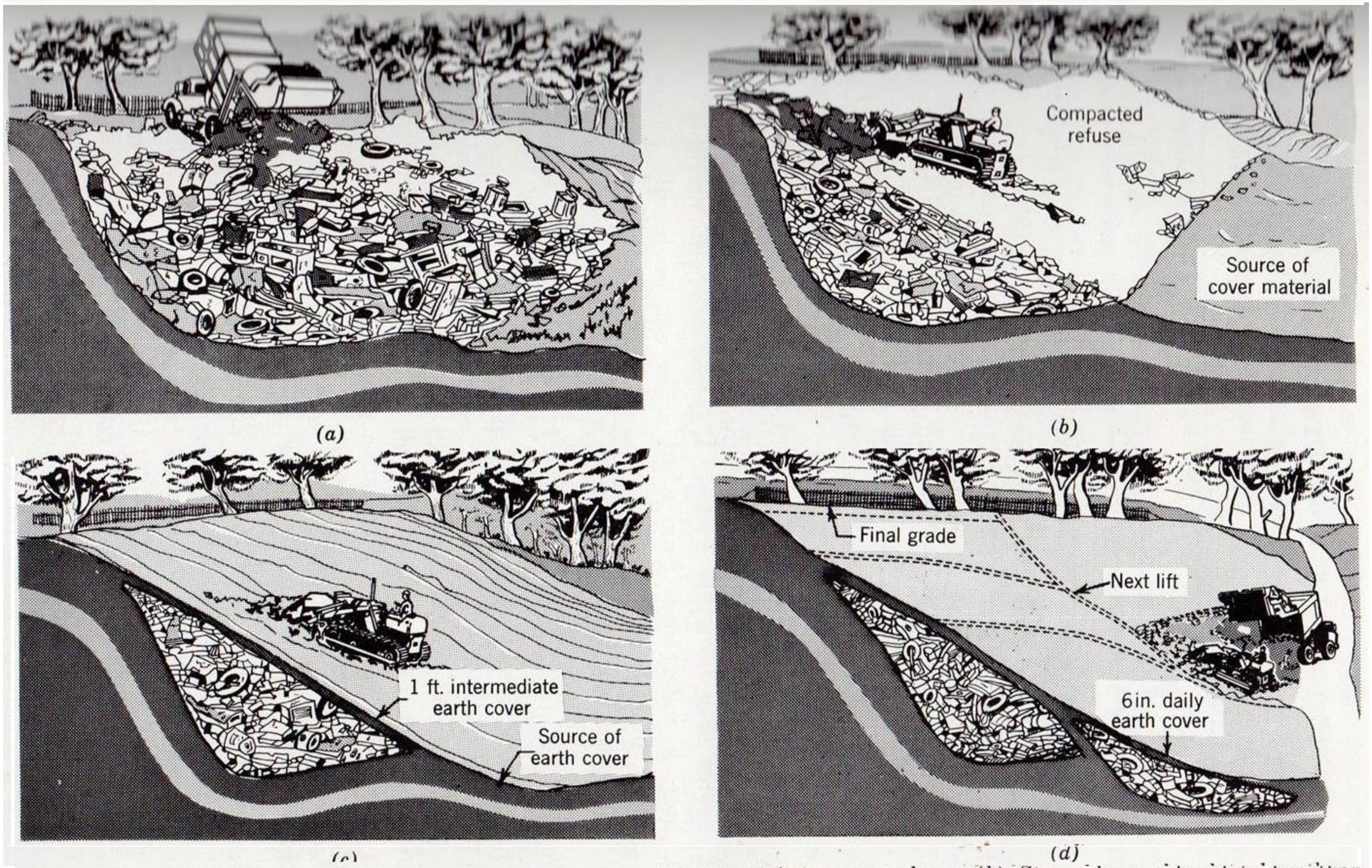


Figure 5–13 Conversion of an open dump to a sanitary landfill. (*a*) Existing open dump (*b*) Steep slope reduced to less than 2:1 to allow safe operation of equipment (*c*) Refuse compacted and covered (*d*) Refuse area operated as a sanitary landfill

Composting

- **The second preferred method of solid waste disposal,**
- **Due to the high % of organic materials.**
- **Compost**
- **Biofertilizer**
- **Organic Farming**

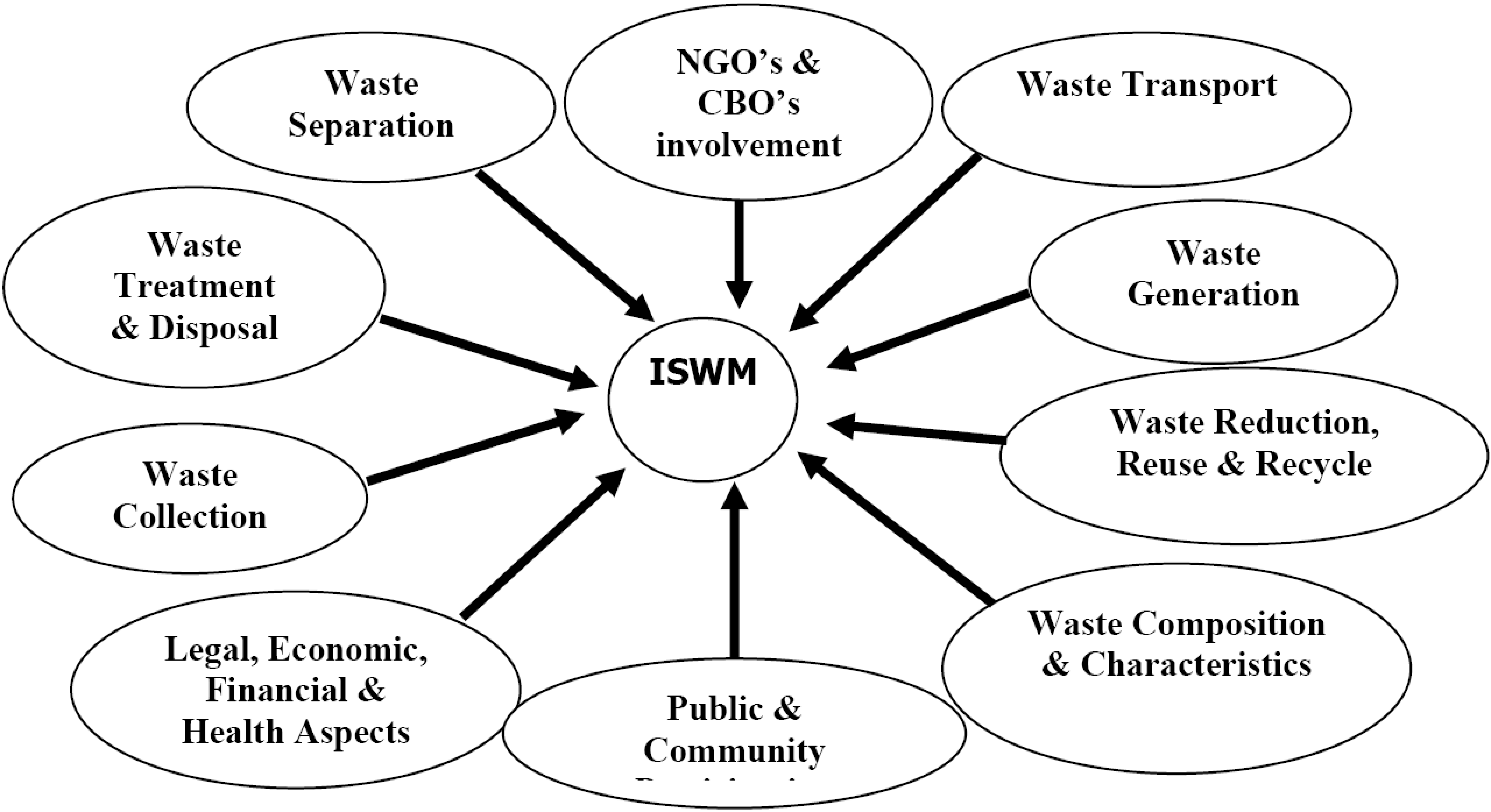
Recycling and recovery

- **Generally carried out by the informal sector.**
- **Collection of recyclable waste is done in several steps such as**
  - **door to door collection,**
  - **collection at secondary and primary transfer stations**
  - **even in the disposal sites.**
- **Due to the collection systems**
  - **the low quality of scrap,**
  - **the recycling rate is low**
  - **high number of waste pickers working.**

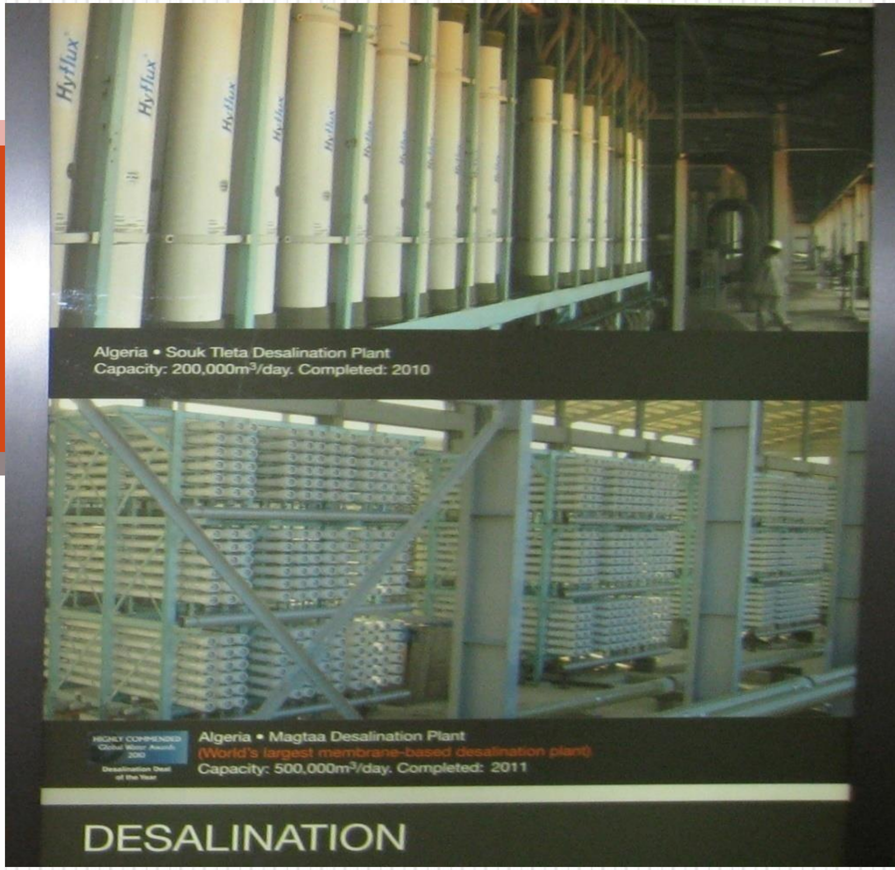
Incineration

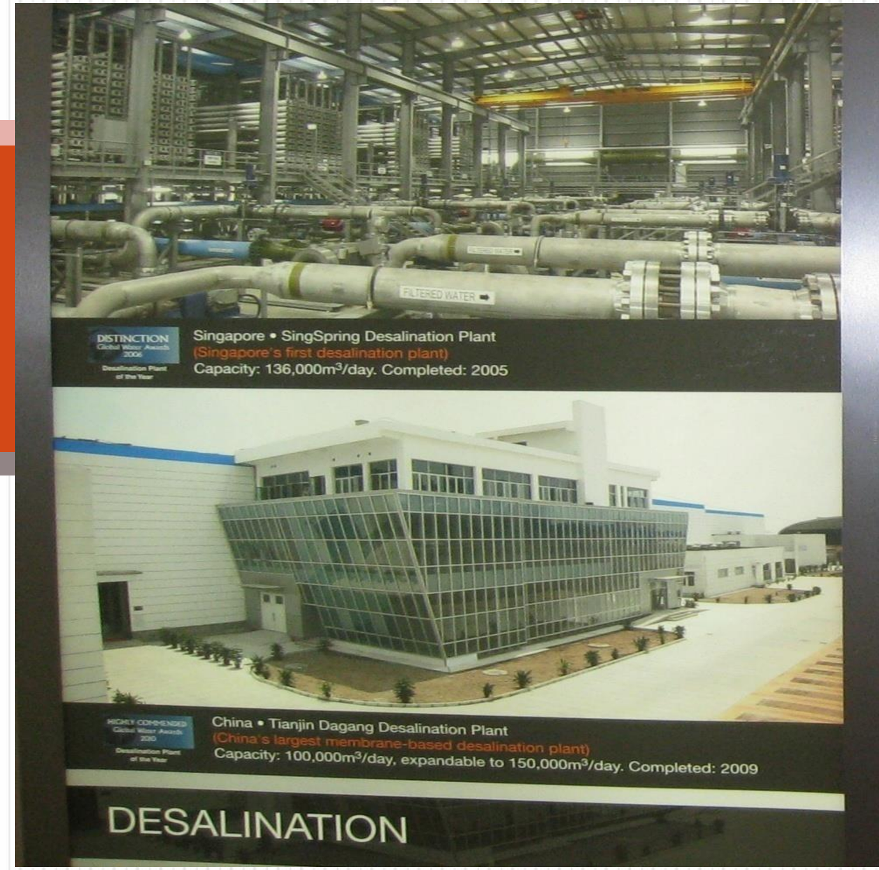
- **Due to the high capital, operation and maintenance costs involved for the installation of incineration plants,**
  - **incineration is not popular as a waste disposal system.**
- **the major portion of the MSW is organic with relatively high moisture content**
  - **leads to a low calorific value**

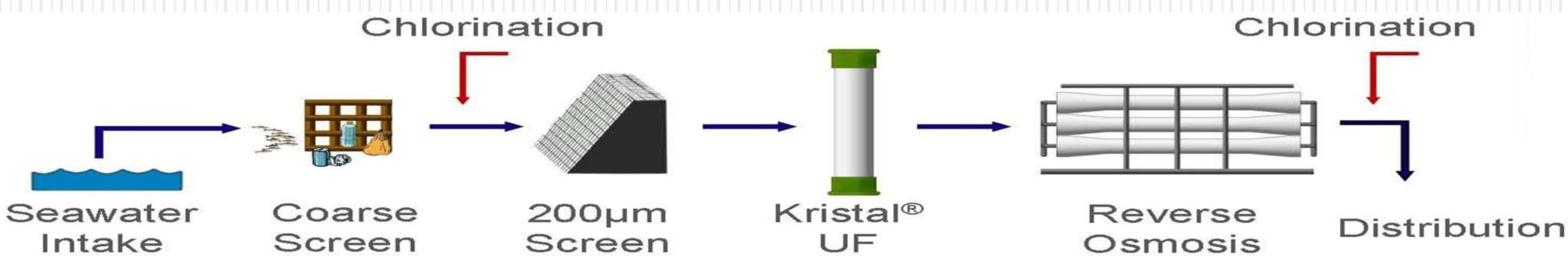
Integrated Solid Waste Management



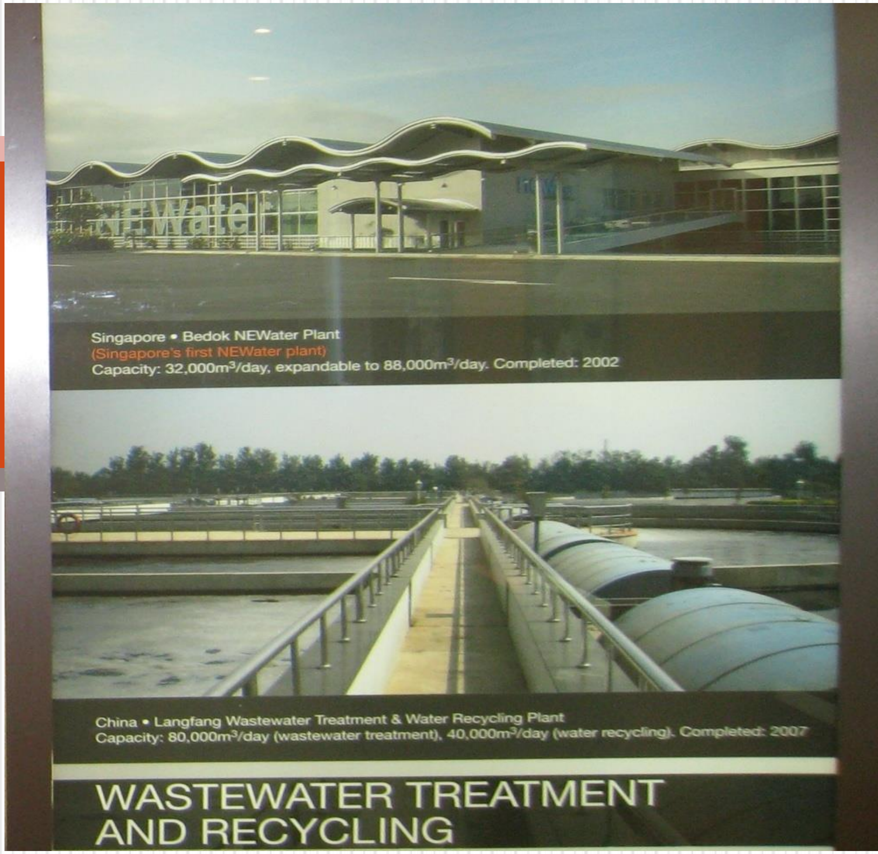
DESALINATION



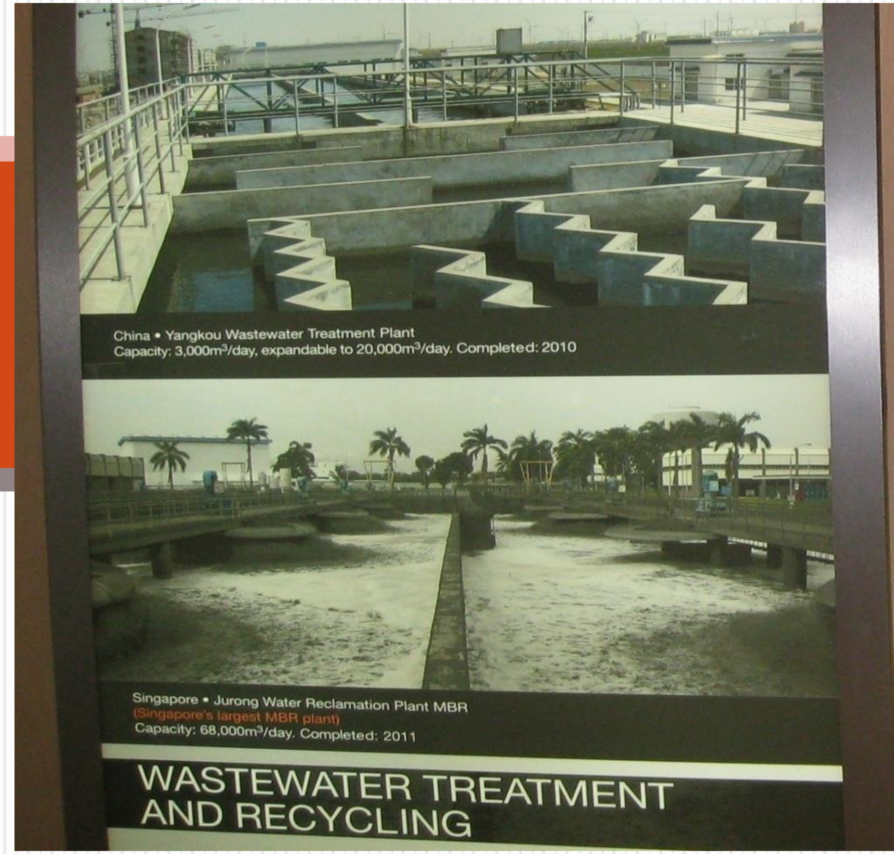




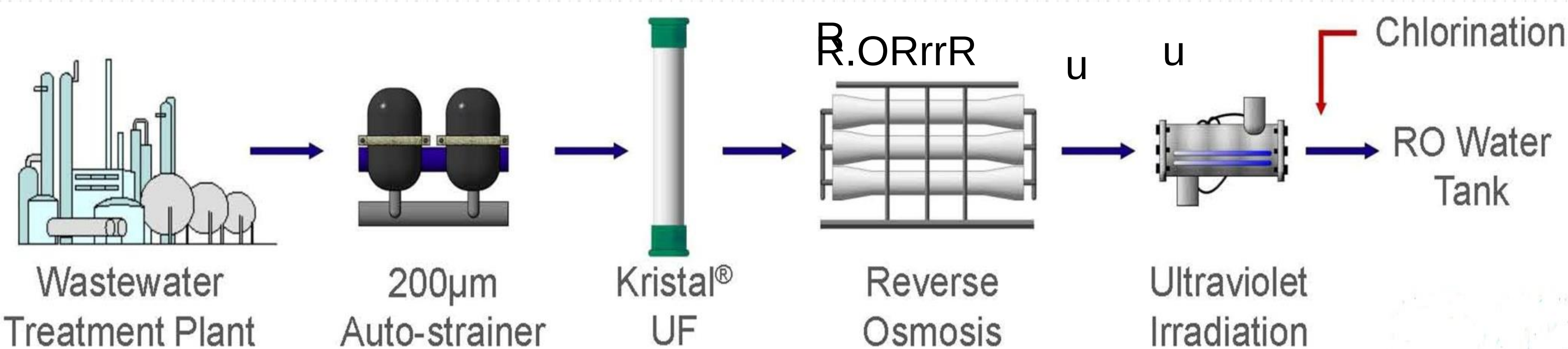
WASTE WATER



Singapore • Bedok NEWater Plant
(Singapore's first NEWater plant)
Capacity: 32,000m³/day, expandable to 88,000m³/day. Completed: 2002
China • Langfang Wastewater Treatment & Water Recycling Plant
Capacity: 80,000m³/day (wastewater treatment), 40,000m³/day (water recycling). Completed: 2007
WASTEWATER TREATMENT AND RECYCLING



China • Yangkou Wastewater Treatment Plant
Capacity: 3,000m³/day, expandable to 20,000m³/day. Completed: 2010
Singapore • Jurong Water Reclamation Plant MBR
(Singapore's largest MBR plant)
Capacity: 68,000m³/day. Completed: 2011
WASTEWATER TREATMENT AND RECYCLING



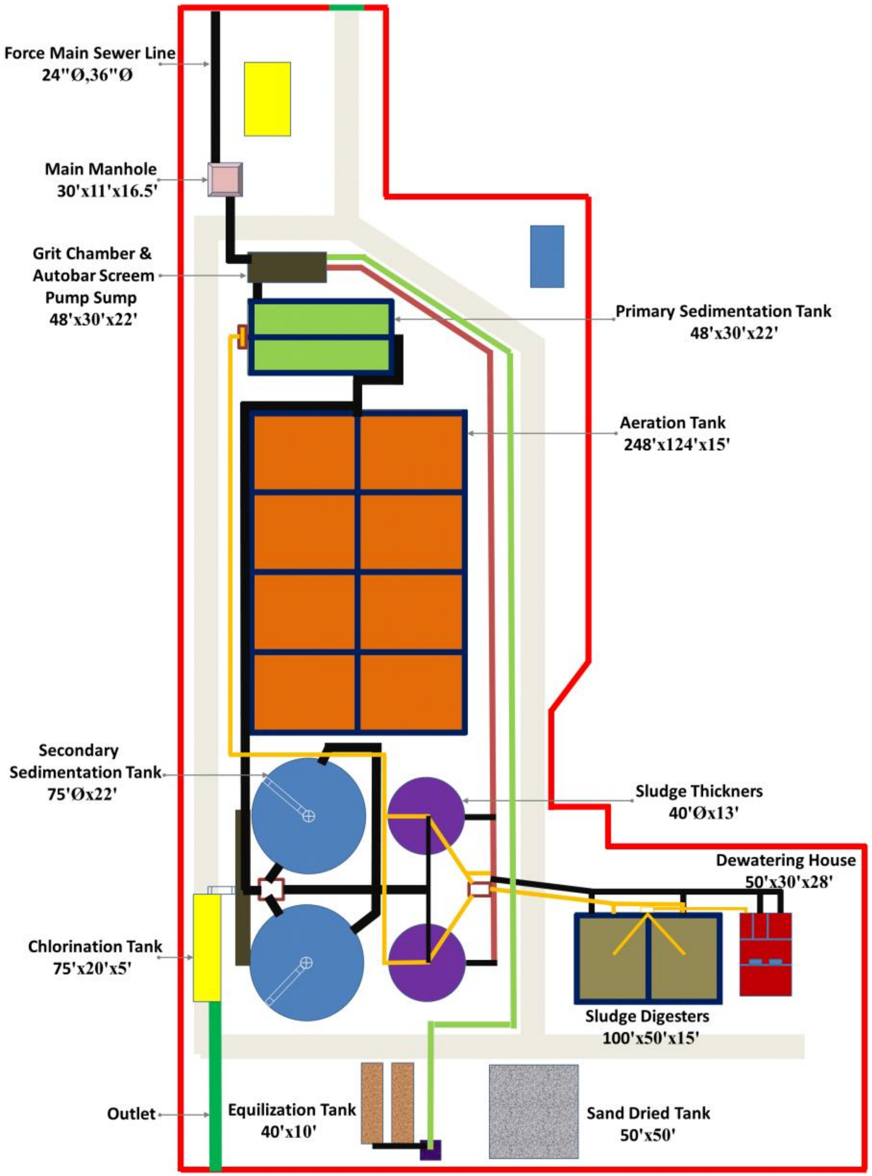
R
R.ORrrR
u
u
Chlorination
RO Water Tank
Wastewater Treatment Plant
200µm Auto-strainer
Kristal® UF
Reverse Osmosis
Ultraviolet Irradiation

Main Air Compressor in Botadaung Township, Sewage are driven by air compressing to Treatment Plant

- Year of Establishment - 1888 year
- (6) Steam Turbine Engines
- Change of year to electrical driven -(1962-1963)
- (2) Electrical Air Compressors of 200 Horse power were reinstalled
- (2) Electrical Air Compressors of 120 Horse power were reinstalled
- Total land areas - 2.75 acres

Establishment of Sewage Treatment Plant

Layout plan of Treatment plant



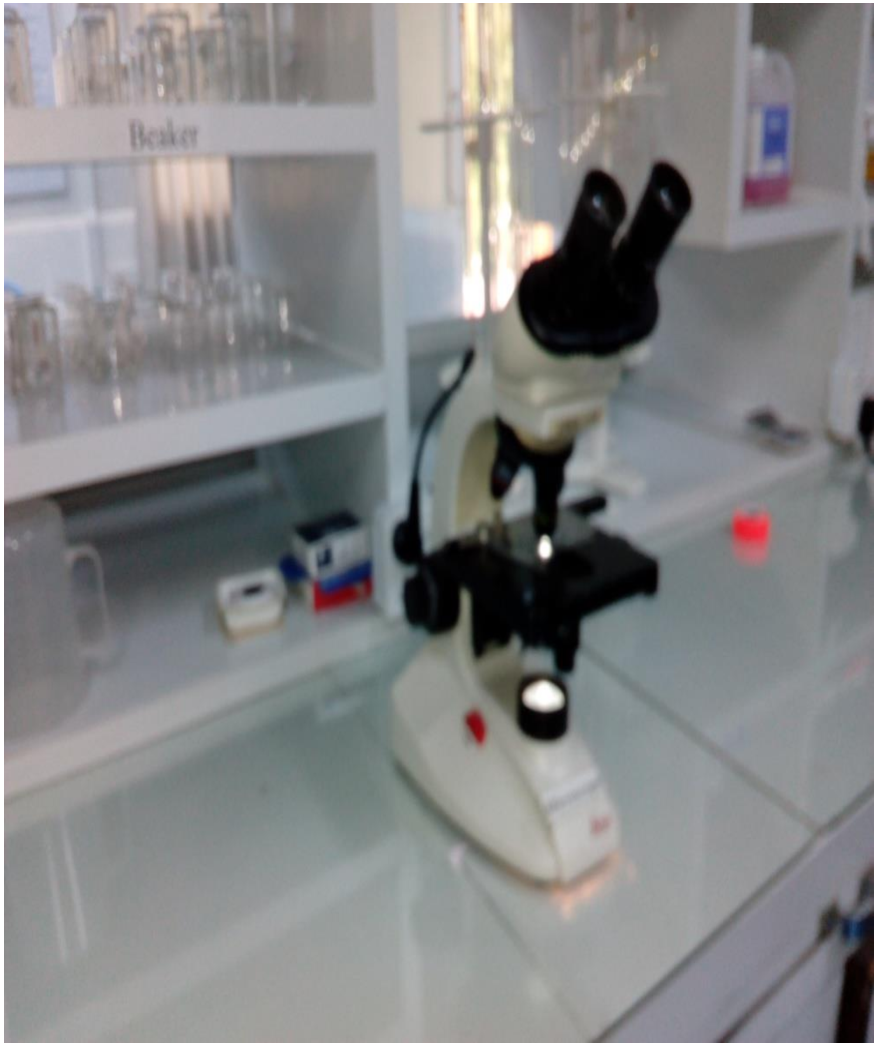
Programme for Sewage Treatment Project

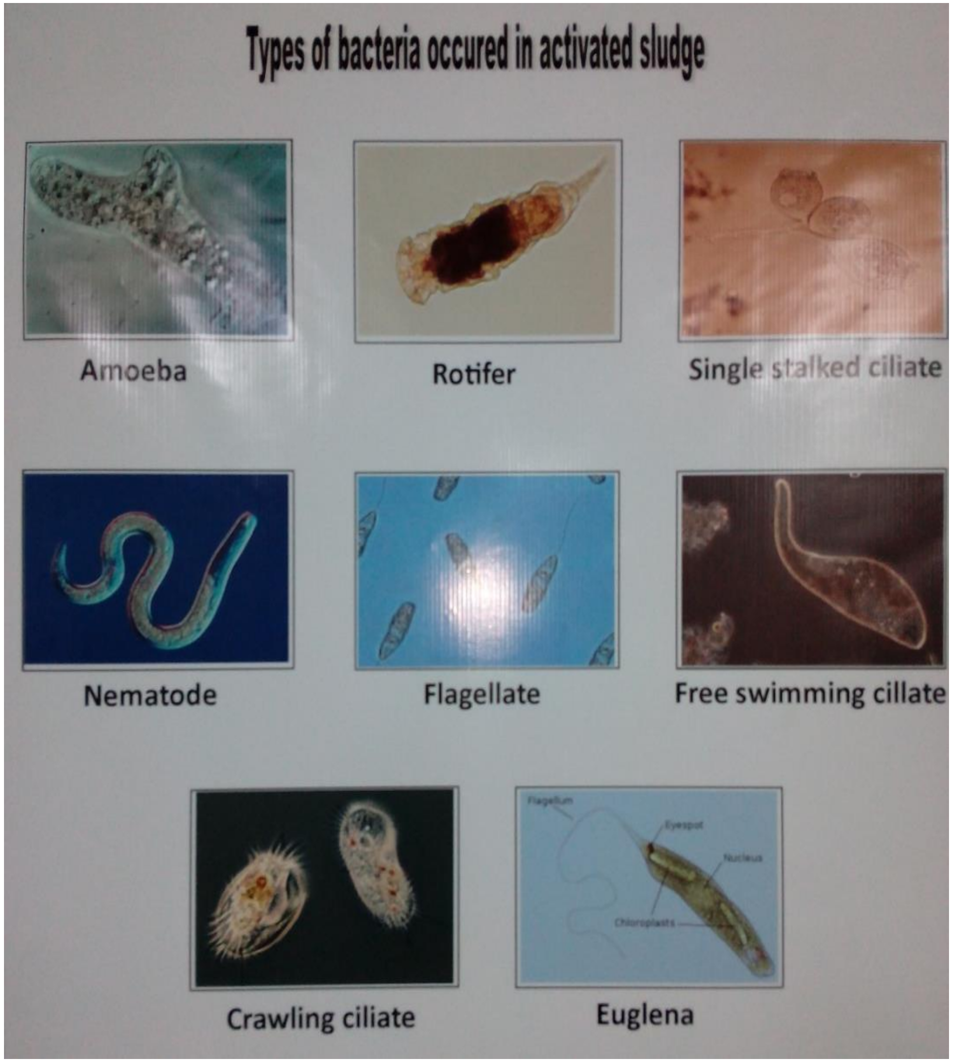
- ❑ Detail Design
- ❑ Implementation
- ❑ Installation
- ❑ Commissioning
- ❑ Installation
- ❑ Training

Design Criteria:

- Area of Plant - 5.56 acres
- **Design population - 300,000**
- Daily wastewater discharge- - 14775 m3/day
- **BOD influent - 600mg / l**
- **BOD effluent - 20 mg / l**
- **Suspended solid influent- 700 mg /**
- **Suspended solid effluent- 40 mg / l**

Microscope



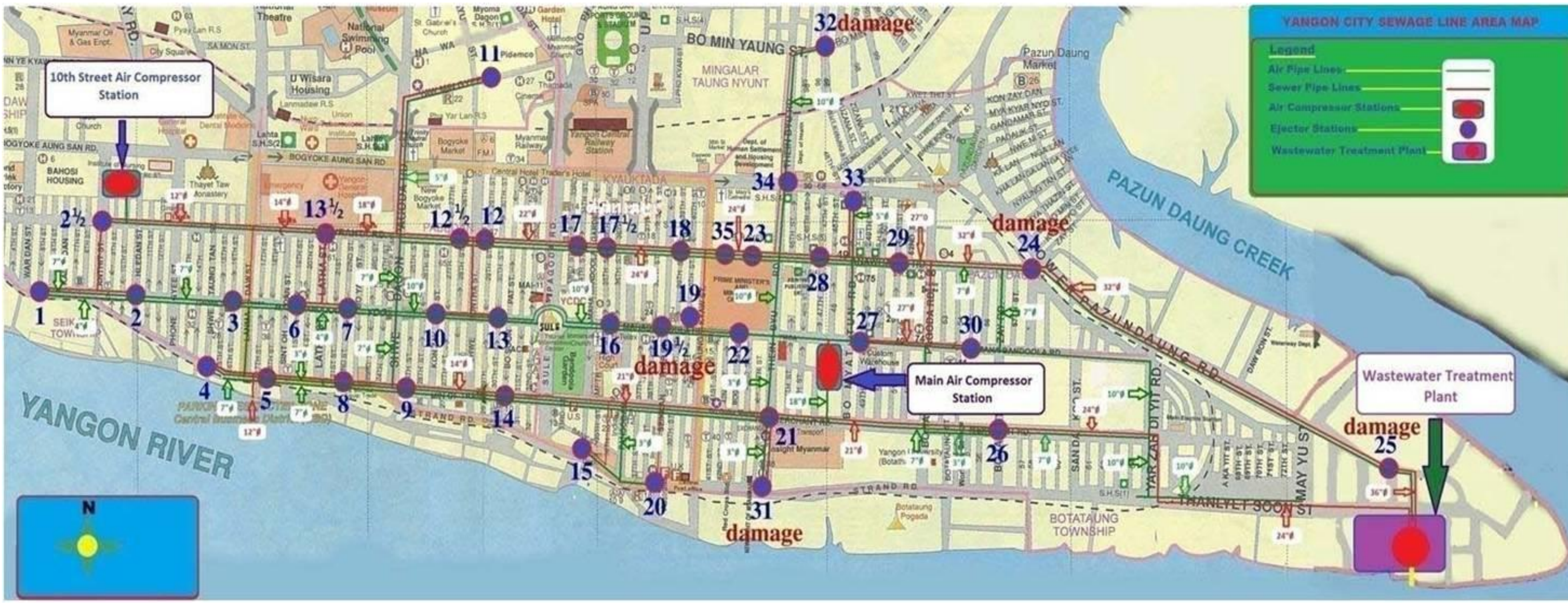

Types of bacteria occured in activated sludge
Amoeba
Rotifer
Single stalked ciliate
Nematode
Flagellate
Free swimming cillate
Crawling ciliate
Euglena

Sewerage System of YCDC

Estimated population with sewer(conventional sewer system) is 300,000 people . Main content of system are

1) Air Compressor Station(2) Pneumatic Ejectors(3) Air Pipeline

4) Gravity sewer pipeline(5) Wastewater Treatment Plant



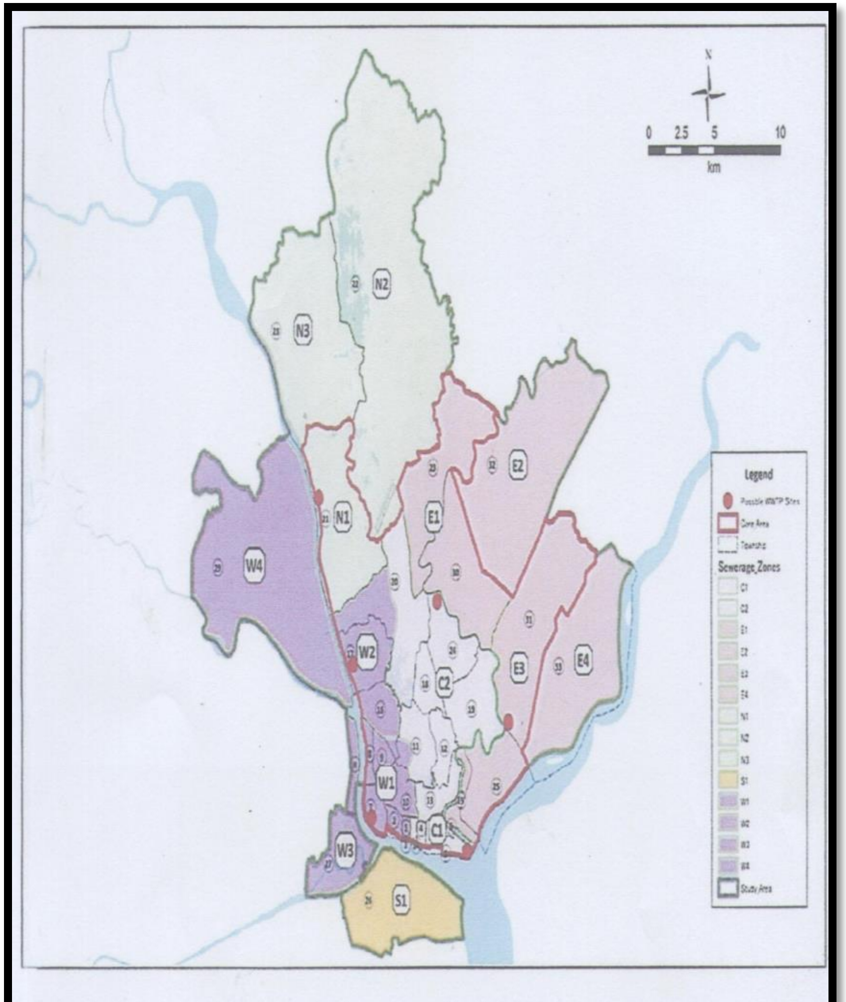
Wastewater treatment plant

Air compressor station

Total length of sewer pipe line - (10.75) km(12"CI to 36"CI Pipe)

Sewage ejector - (35) Nos Manholes - 2114 Nos

SEWERAGE ZONES AREA (13 ZONES)

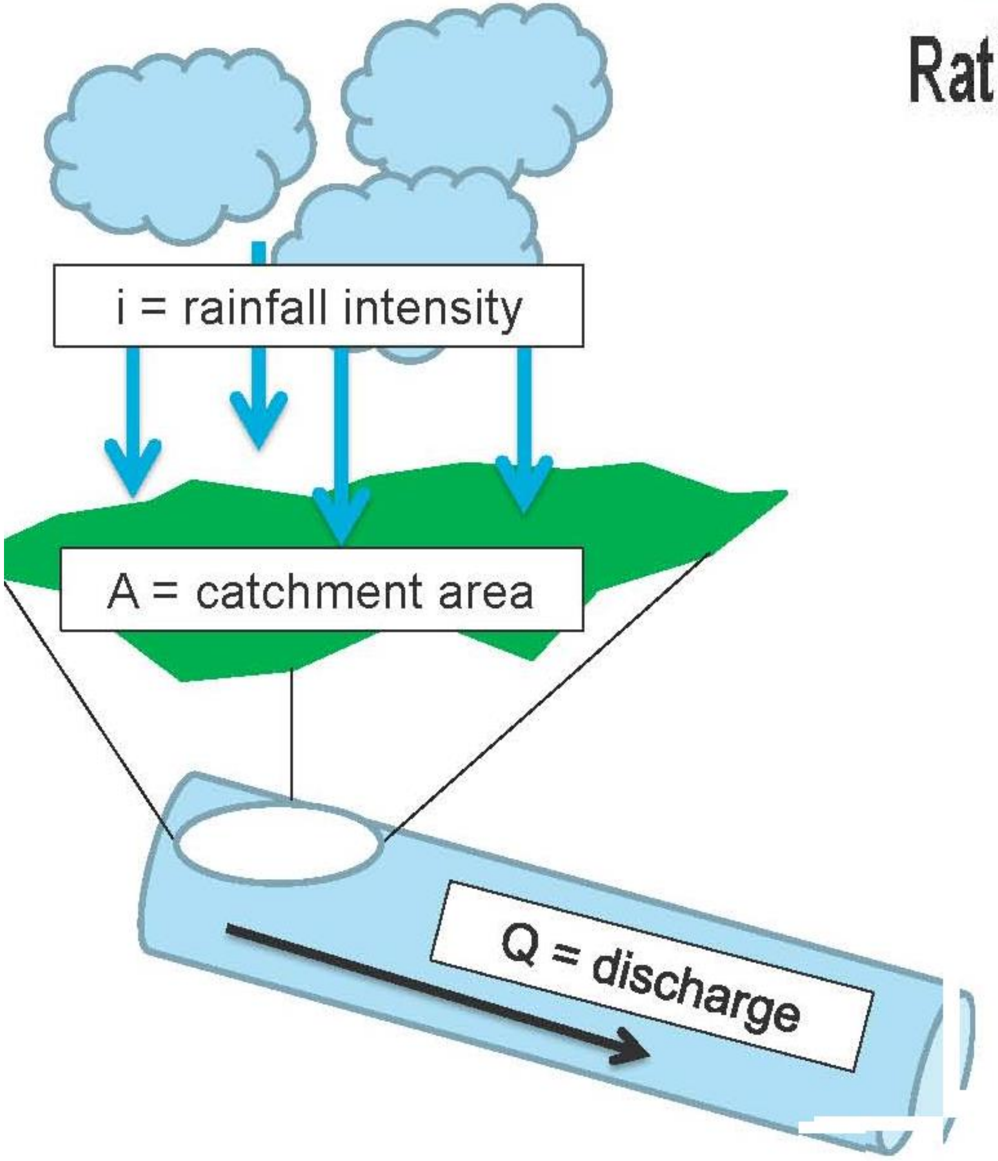


Zone	Township
C1	Botahtaung,Puzundaung,Kyauktada,Pebedam,
W1	Lanmadaw,Latha,Alone,a part of Kyeemyintdaing,Dagon,a part of Bahan,a part of Kamaryut,Sanchaung
C2+E1	a part of Bahan,Mingalartaungnyunt,Yankin,Thingangyun,Tamwe, S-Okkalapa,a part of Mayangone,N-Okkalapa,N-Dagon
W2	a part of Kamaryut,Hlaing,a part of Mayangone
E3	Taketa,Dawbon,S-Dagon
N1	Insein
E4	Dagon Seikkan
E2	East Dagon
N2	Mingalardon
N3	Shwepyithar
S1	Dala
W3	a part of Kyeemyintdaing,Seikgyi khanaungto,Seikkan
W4	Hlaing Tharyar

DRAINAGE WITH CONTOUR MAPPING

Contour Mapping & should be disposed to Agriculture & Low Lying Area

Relation Between Drain Discharge and Rainfall Intensity



Rational method (Lloyd-Davies)

Q $$Q = 2.78CiA \quad [L/s]$$

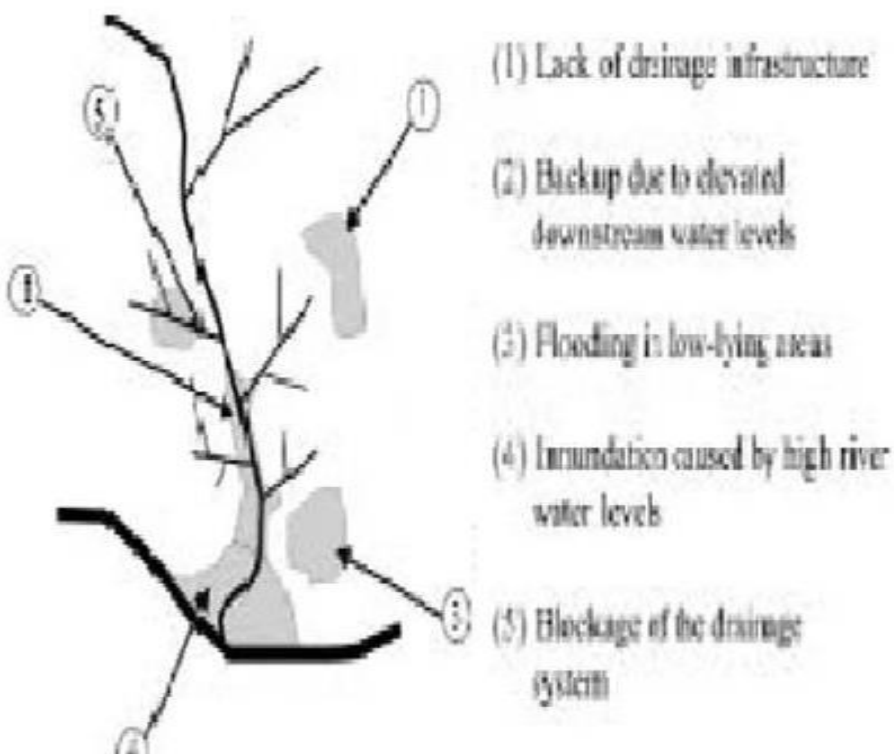
2.78	dimensional term for unit conversion
C	runoff coefficient between 0 and 1 describing the permeability of the ground
i	rainfall intensity [mm/h]
A	catchment area [hectares]

Findings — Drip irrigation

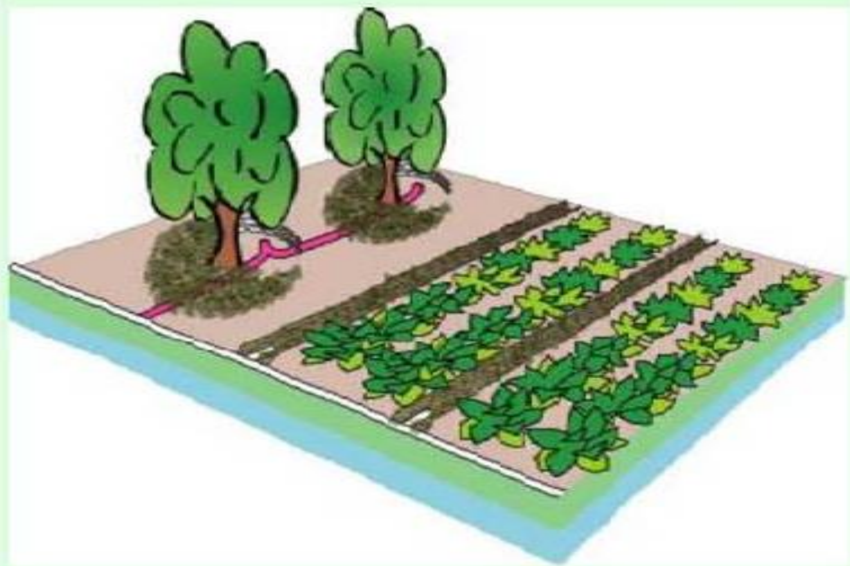
- Drip irrigation and mulch trench systems are most appropriate (sub-surface or close to surface
- Alternative where greywater volumes are small and soils are inappropriate for agriculture: Tower gardens

The Problem

- Causes and Types of Urban Flooding



Mulch trench system



Mulch: mixture of leafs, wood, straw,...

Enables even distribution of greywater in trenches or around trees

Requires only primary treatment

ENVIRONMENTAL MITIGATION

BEST WISHES

Thank You

Credtics – WHO, eawag, Dr. Pham Duc Phuc:, Assoc. Prof. Dr. Nguyen Viet Anh, Ms. Thu Le (MPH), CENPHER, HANOI, AIT, Bangkok,YCDC, MES-MMR, CDD, Bangalore, India & BORDA

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