

# Small Wastewater Treatment Systems



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H2FLOW EQUIPMENT INC.

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# Why do you need one?

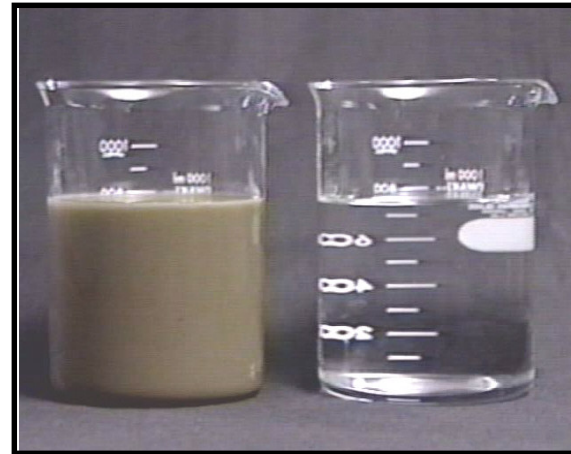
- Typical Reasons
  - Environmental Regulations
  - New Development
  - Failing Septic Systems
  - Cost of Sewers & Pumping to Closest Municipality
  - Centralized Operations may be costly
  - Politics
  - Autonomy
  - Keeping the Water
  - Reuse



# What are you looking for?

A low cost, highly efficient wastewater treatment system capable of consistently producing:

- < 5-10 mg/L BOD
- < 5-10 mg/L TSS
- < 0.5-2 mg/L NH<sub>3</sub>
- < 0.1-0.5 mg/L TP
- < 200 FColi / 100ml
- TN ?



.... with minimal electrical cost, high degree of automation, low operator attention and minimal sludge production !!!!

(I WILL ORDER ONE OF THOSE, THANKS VERY MUCH....)

# Definitions

- On-Site systems for 0 to 5m<sup>3</sup>/day and can be up to 20 m<sup>3</sup>/day
- A small wastewater plant is usually referred to flows between 10 to 300 m<sup>3</sup>/day but can range up to 3800 m<sup>3</sup>/day
- We will focus on 20m to 300m<sup>3</sup>/day range

5<sup>th</sup> Wheel Truck Stop WWTP – Dorchester, ON – 45m<sup>3</sup>/day SBR



# What is a Package Plant?

- Term “package plant” is loosely used
- Industry definition is a transportable plant that comes pre-assembled ready for plug and play, made in steel or pre-cast tankage
- Sometimes this term is also used to refer to small pre-engineered plants which are poured in place concrete. Should be referred to as Pre-Engineered plants



Sentinel WWTP – 33m<sup>3</sup>/day SBR  
Photos Courtesy of Fluidyne



# Package & Pre-Engineered Plants



**PACKAGE PLANT**  
(usually up to 200m<sup>3</sup>/day)  
Steel or Pre-cast Tanks



**PRE-ENGINEERED PLANT**  
(usually up to 3800m<sup>3</sup>/day)  
Poured In Place Concrete Tanks

# Package & Pre-Engineered Plants



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(usually up to 200m<sup>3</sup>/day)  
Steel or Pre-cast Tanks

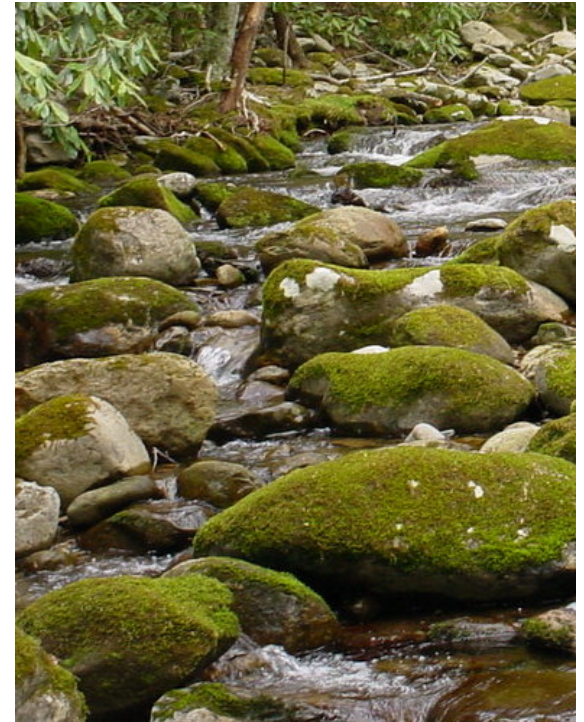


**PRE-ENGINEERED PLANT**  
(usually up to 3800m<sup>3</sup>/day)  
Poured In Place Concrete Tanks

# Types of Small Plants

Most Common Biological Processes:

- Extended Aeration
- RBC (Rotating Biological Contactor)
- SBR (Sequencing Batch Reactor)
- ISAM (Modified SBR)
- MBR (Membrane Bio Reactor)
- Others (Contact Stabilization, Lagoon) not discussed as they are not common or no longer marketed



# Extended Aeration

- **Rectangular up to 400 m<sup>3</sup>/ d**
- **Concentric Design > 400m<sup>3</sup>/ d**
- **Very popular up to recent years**
- **Usually Consists of :**
  - **Aeration Tank (outboard)**
  - **Clarifier (internal tank)**

## **PLUS**

- **Aerobic Digester**
- **Disinfection**
- **Equalization Chamber**
- **Tertiary Filters**
- **Continuous Flow Discharge**
- **Declined in popularity as better processes went on the market**

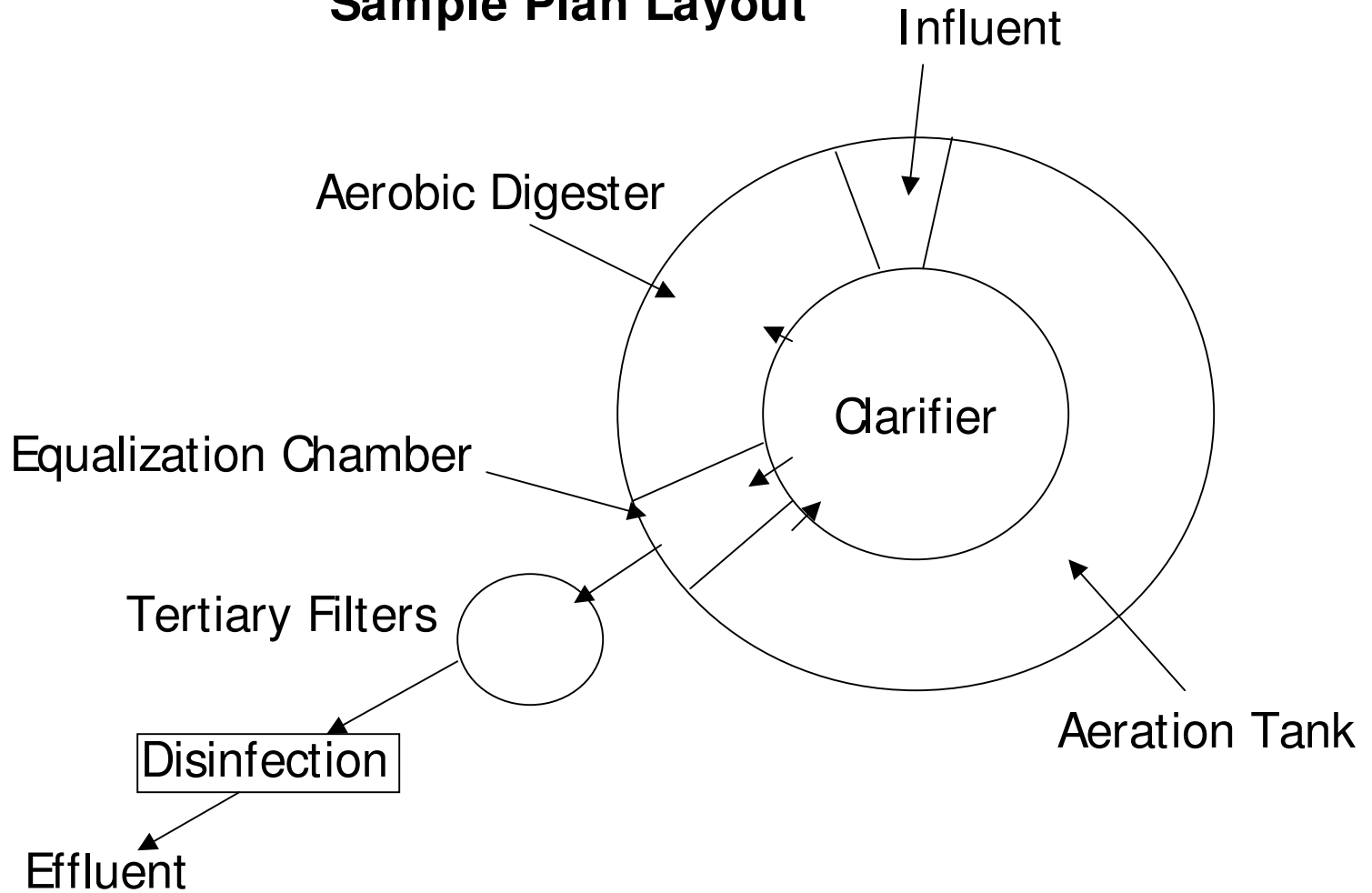


Photo Courtesy of Permastore Ltd.



# Extended Aeration

## Sample Plan Layout

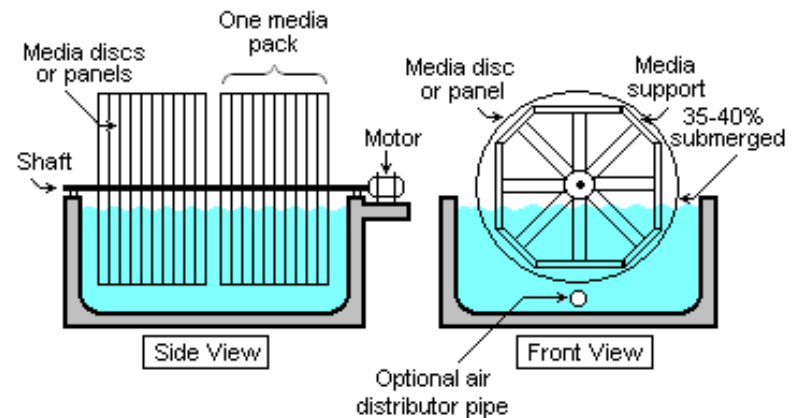


# Rotating Biological Contactor

- Declined in popularity due to mechanical issues and low effluent quality
- Usually Consists of :
  - Primary Tank
  - Rotating Disk
  - Secondary Clarifier

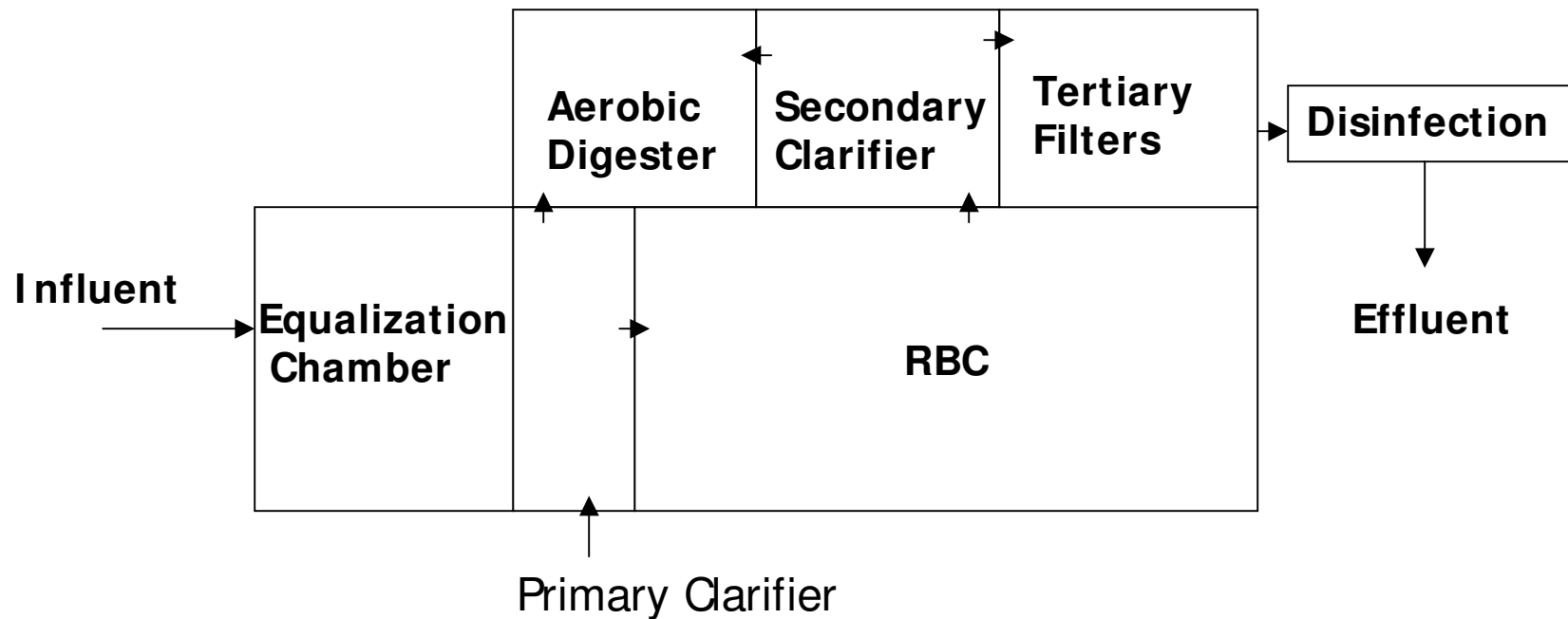
## PLUS

- Aerobic Digester
- Disinfection Chamber
- Tertiary Filters
- Continuous Flow Discharge
- Needs to be covered
- Low operator attention



# Rotating Biological Contactor

## Sample Plan Layout

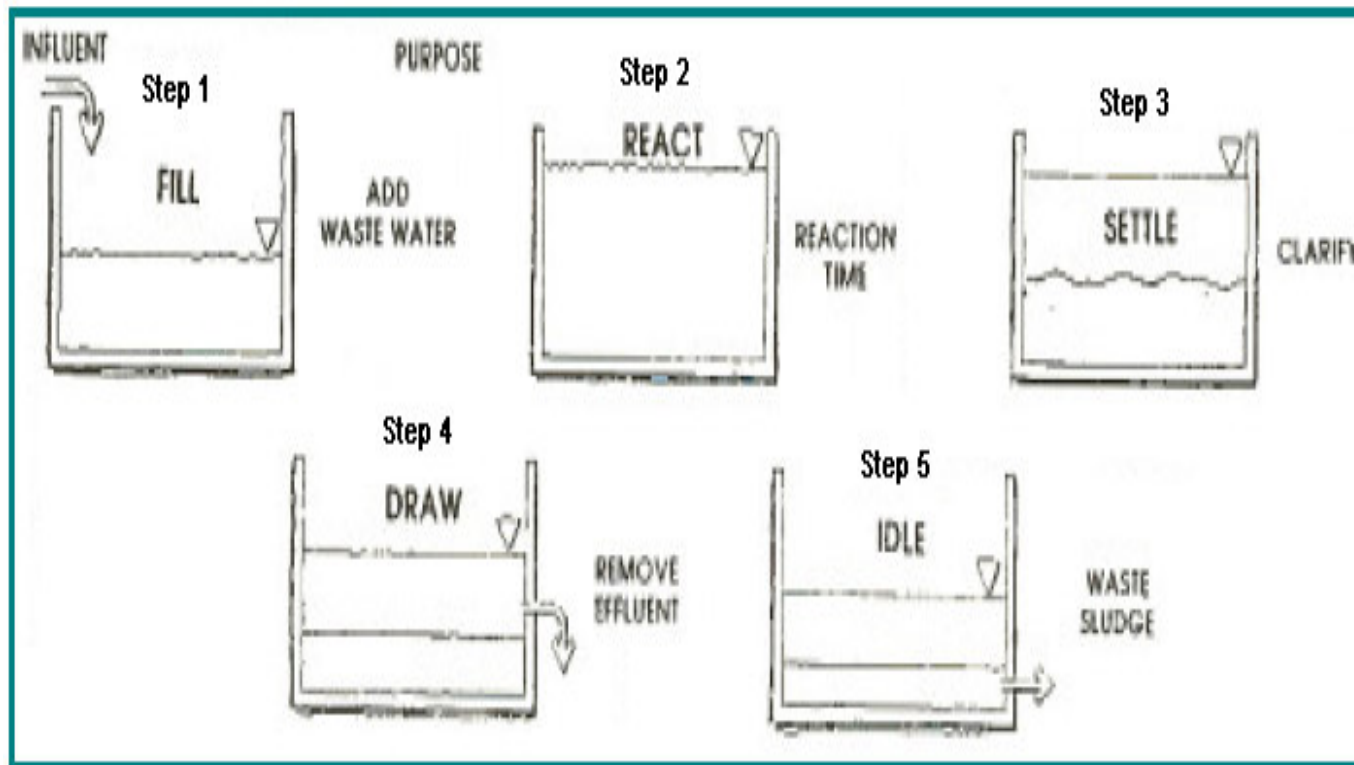


# Sequencing Batch Reactor

- **Modified Extended Air Process**
  - **Mostly Rectangular**
  - **Batch Discharge**
  - **Various Variations**
  - **Usually Consists of :**
    - **Selector Tanks**
    - **Upstream Equalization Tank or Two Tanks in series**
    - **Tank for React/ Settle/ Decant**
- PLUS**
- **Aerobic Digester**
  - **Post Equalization Chamber**
  - **Disinfection**
  - **Tertiary Filters**



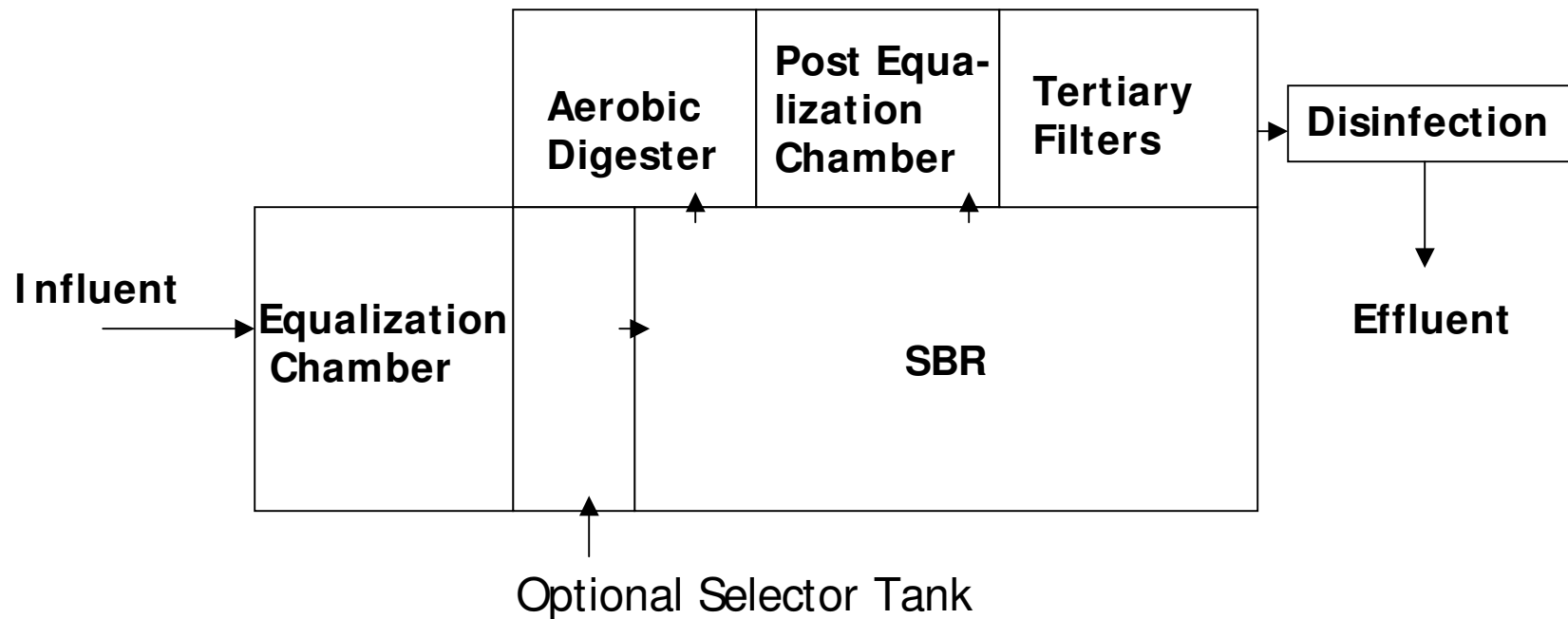
# Sequencing Batch Reactor



SBR Steps: Fill, React, Settle, Decant & Idle

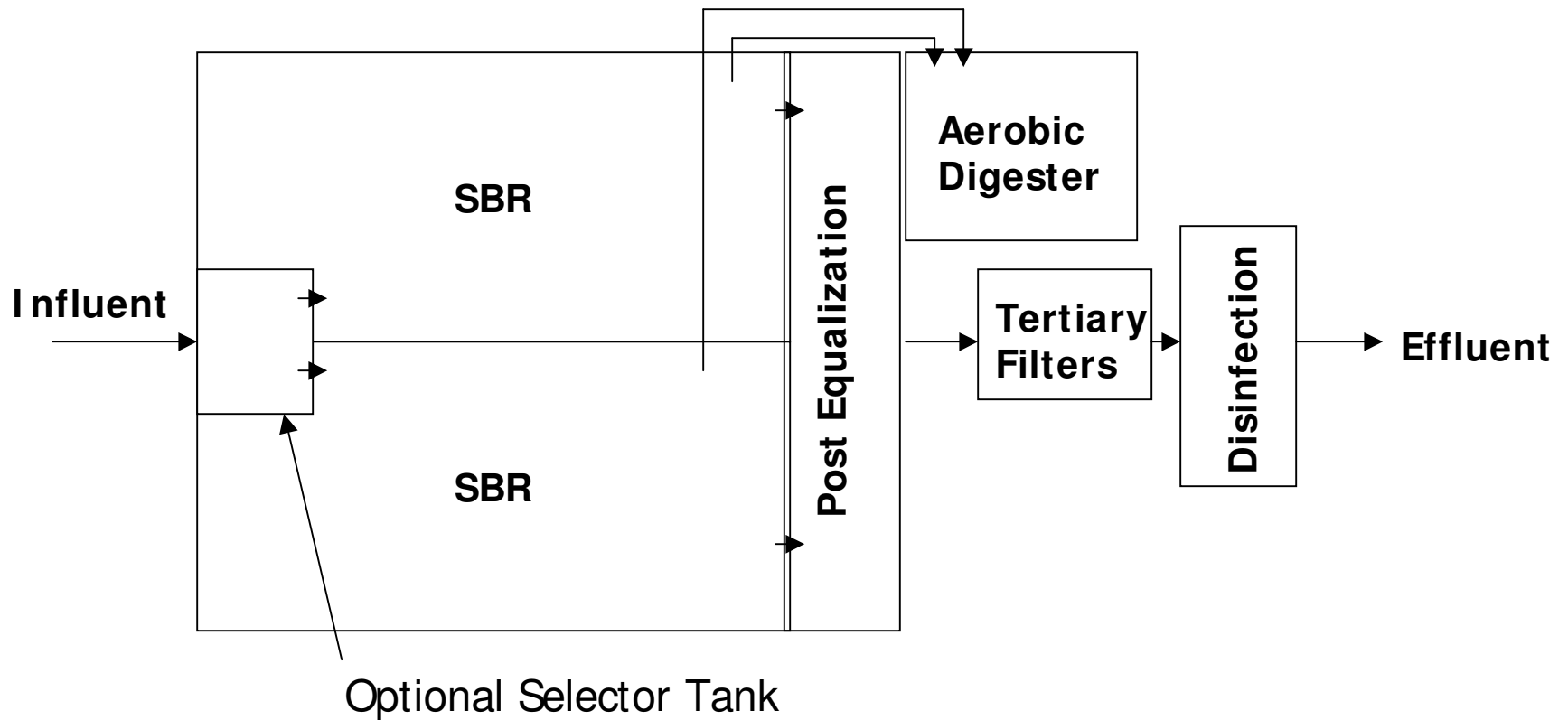
# Sequencing Batch Reactor

## Single Train Layout



# Sequencing Batch Reactor

## Dual Train Layout

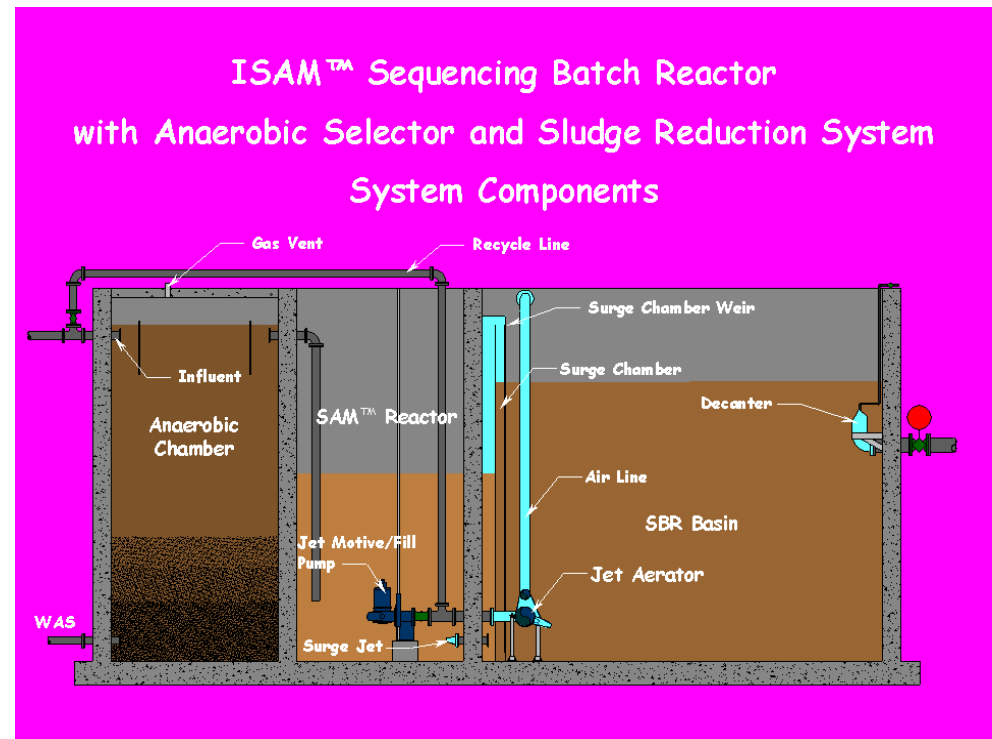


# Modified Sequencing Batch Reactor (ISAM)

- Rectangular
- Batch Discharge with Fill, Interact, Settle, Decant
- Usually Consists of :
  - Anaerobic Trash Trap Tanks
  - Equalization Tank
  - React/ Settle/ Decant Tank

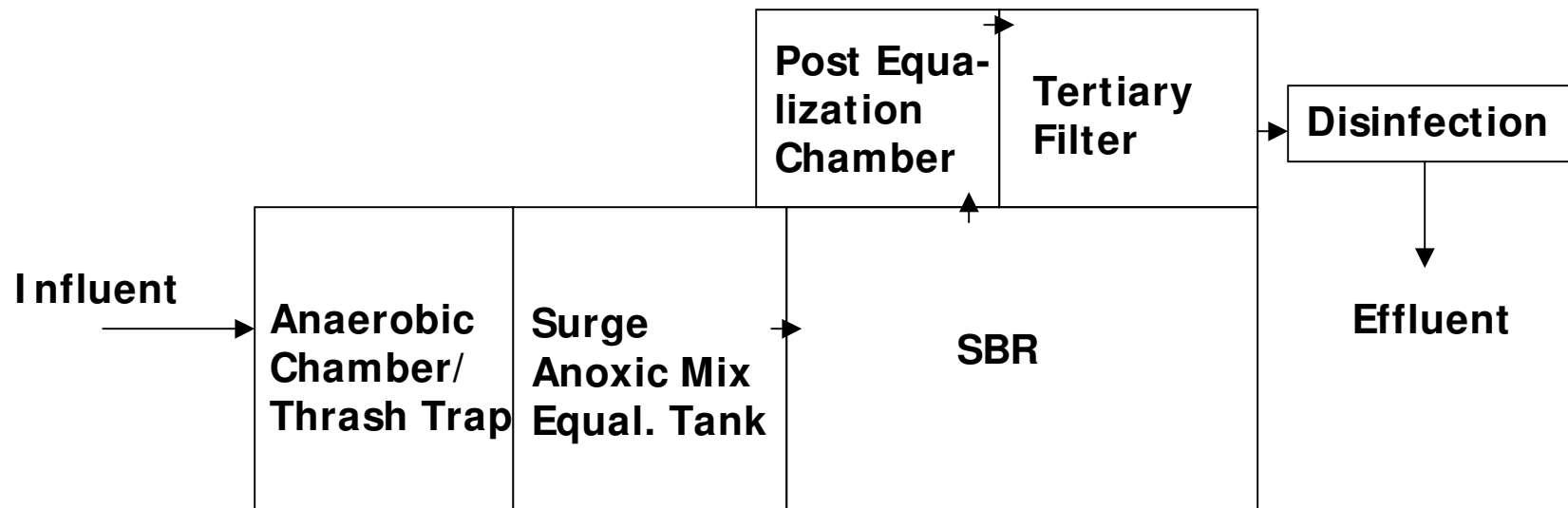
## PLUS

- Post Equalization Chamber
  - Disinfection
  - Tertiary Filters
- 
- Low sludge production



# Modified Sequencing Batch Reactor (ISAM)

## Sample Plan Layout

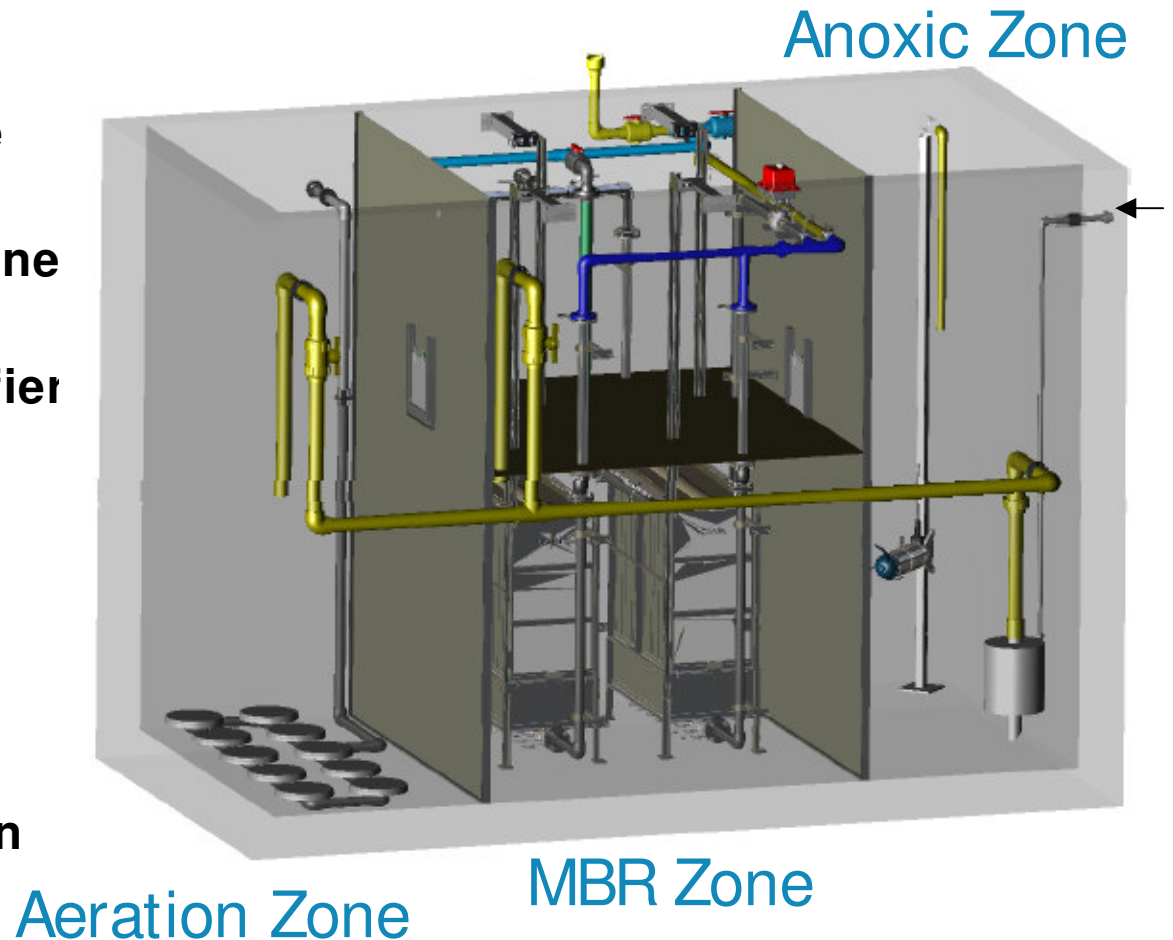


# Membrane Bio Reactor

- **Mostly Rectangular**
- **Continuous Discharge**
- **Various Variations**
  - **Selector / Anoxic Zone**
  - **Aeration Zone**
  - **Membranes as Clarifier**

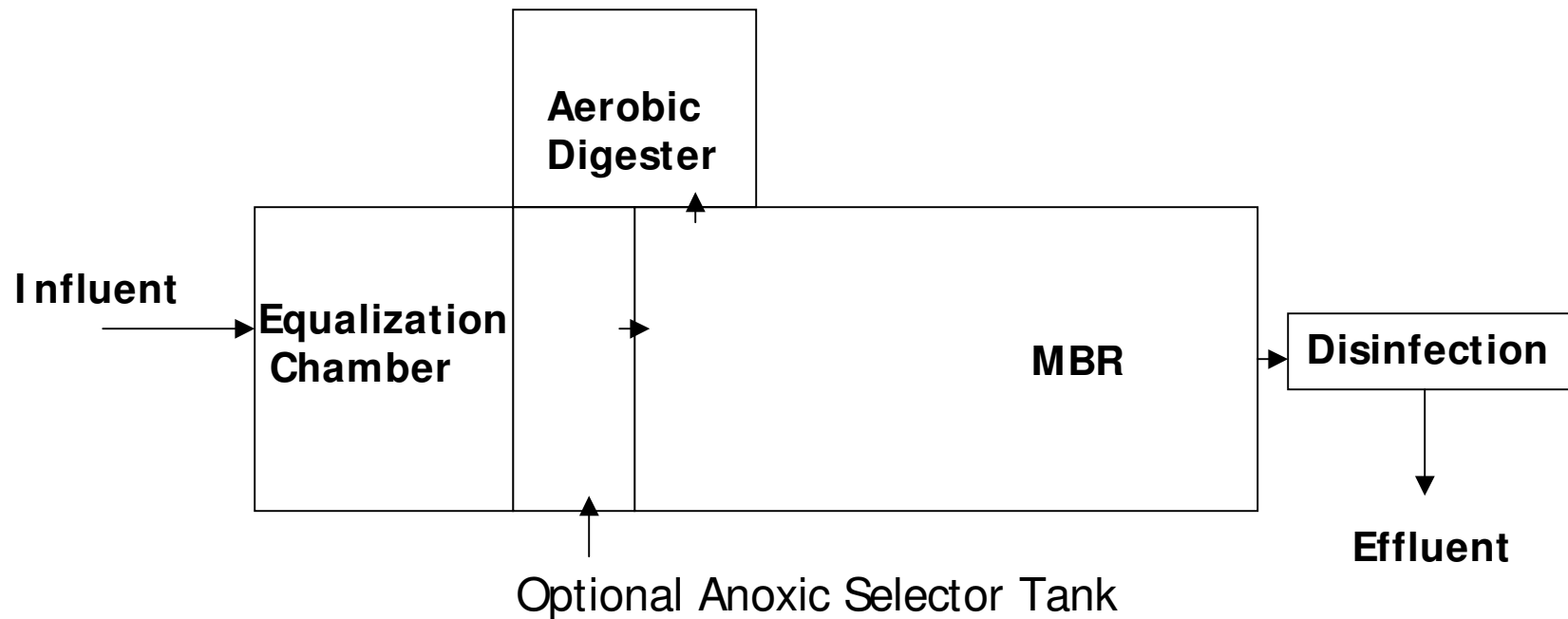
## PLUS

- **Aerobic Digester**
  - **Disinfection**
- 
- **NO Tertiary Filters**
  - **Smallest Footprint**
  - **Some MBR models can thicken sludge**

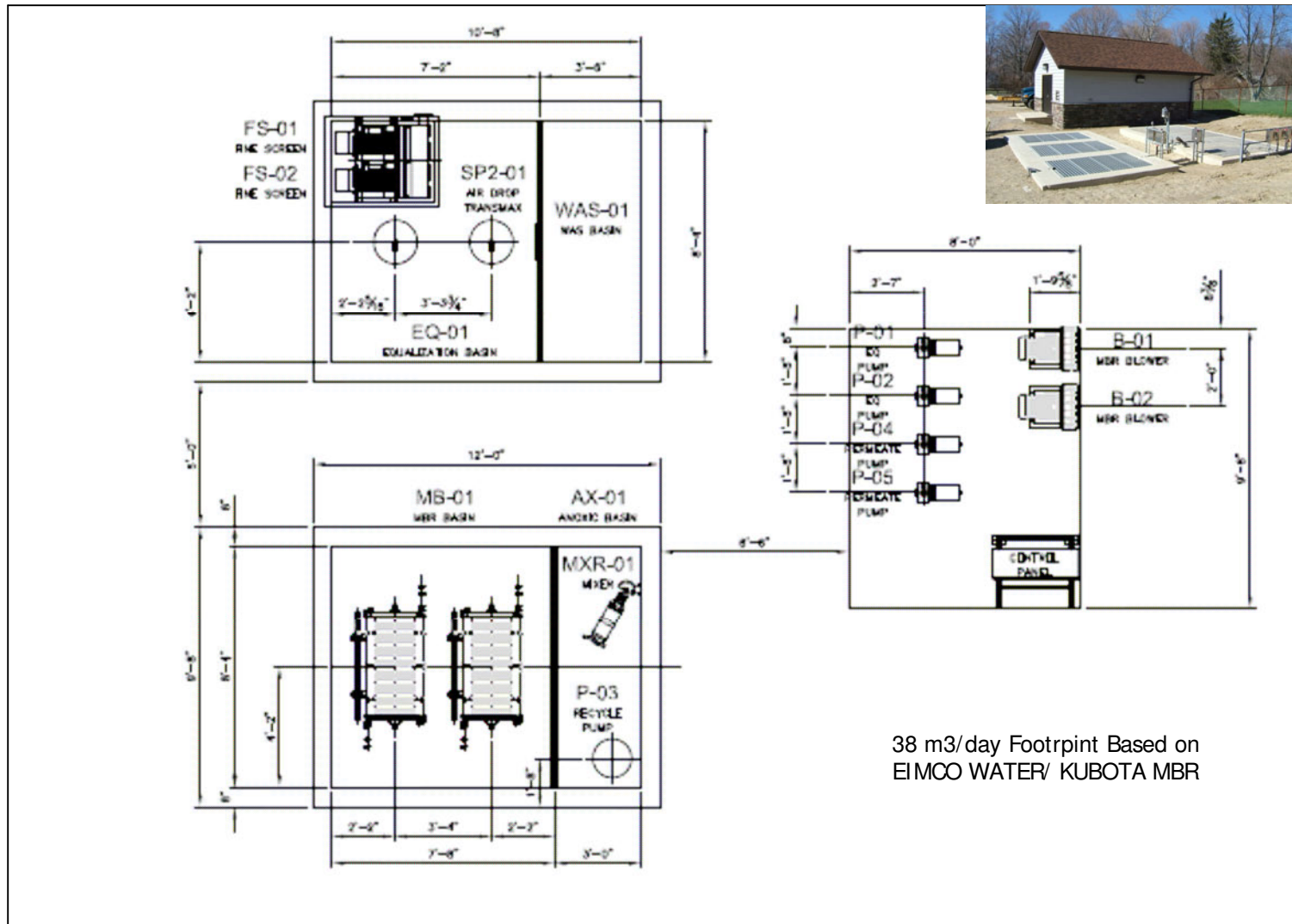


# Membrane Bio Reactor

## Sample Plan Layout



# Membrane Bio Reactor



38 m<sup>3</sup>/day Footprint Based on  
EIMCO WATER/ KUBOTA MBR

# Design Issues



- Large fluctuations in flow and BOD loads
  - (watch your pump sizing!)
- Effluent Limits may determine which technology
- External Loads like Septage – this is high BOD load – we need to design for it
- Sludge Production and Disposal - usually removed by vac truck, but if you can produce less that reduces frequency
- Odour considerations if neighbours are nearby
- Pretreatment; Screening, Grinding or Trash Trap
- Downstream processes; Filters and Disinfection

# Large fluctuations in loads



Hydraulic shock loads and large variation in flows from small communities are accentuated by the use of oversized pumps where wastewater is pumped.

Example: Based on per capita unit flow, you determine you need a 30m<sup>3</sup>/day plant for a community.

Smallest sewage pump (2") is rated for **120 lpm @20ft head**

**When pump is on it equates to 173m<sup>3</sup>/d !**

(about 6 times ADF). Designing for 8-10 is not uncommon, by using equalization tanks.

# Pretreatment

- Fine screening is recommended (and is a must for MBR)
- Grinding can be adequate for SBR, ExAir, RBC
- Trash trap works well for SBR, ExAir
- Grit removal may be required but for small systems it is typically not included or use Trash trap
- Size for Instantaneous Peak Flow not ADF



Channel Grinder – Photo Courtesy of Franklin Miller Corp.

# Pretreatment – Screening

- If screening, then fine screening is recommended (6mm openings)
- 2 or 3mm if going with MBR
- Removes grease balls!
- Screw Screen popular choice
- Will have to dispose of removed screened material
- Bagger Unit can help with odours and housekeeping
- Can be located outdoors (no building) but must equip screening unit with heat tracing and insulation.



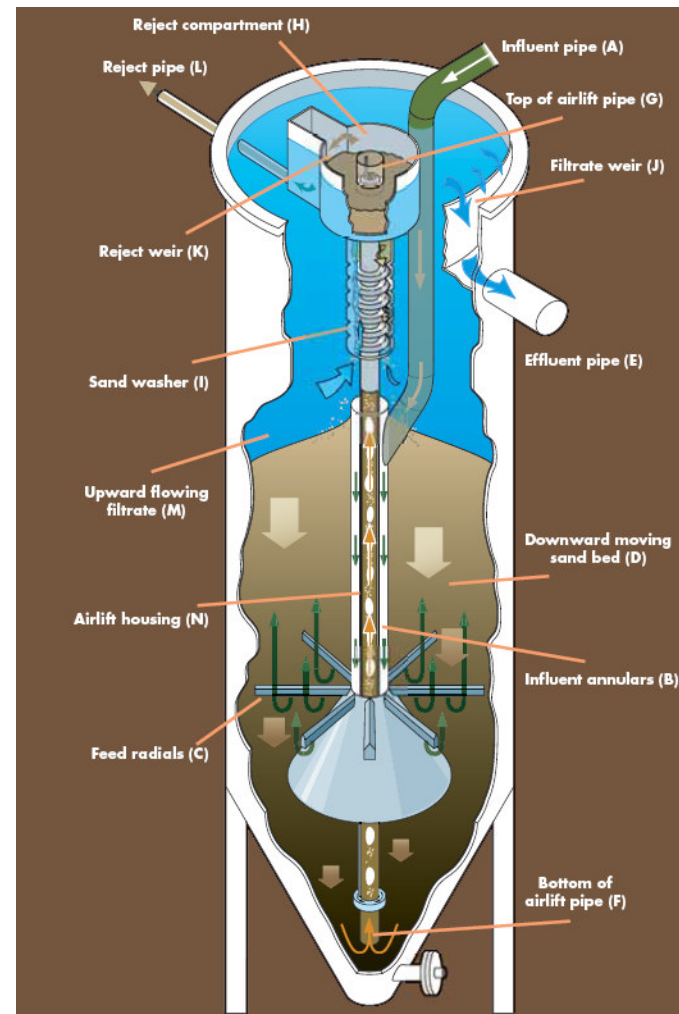
Screw Screen – Photo Courtesy of Parkson Corp.

# Tertiary Filters

- Pressure filter type or Continuous Backwash Type
- Not needed for MBR
- Size for Instantaneous Peak Flow not ADF
- Watch Volume of Backwash!



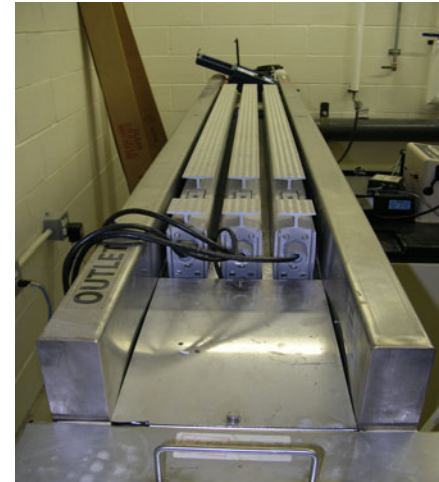
Snow Valley Ski Hill WWTP – Pressure Filters



Dynasand – Photo Courtesy of Parkson Corp.

# Disinfection

- UV or Chlorine are typical
- With Chlorine, Dechlorination is needed more and more
- UV is simple, no chemicals, less operator attendance
- Can be inside or outside building
- Size for Instantaneous Peak Flow



UV unit indoors – Photo Courtesy of Trojan Inc.



UV unit outdoors – Photo Courtesy of Trojan Inc.

# SUMMARY

This presentation was mainly an overview of available technologies for small wastewater treatment plants, plus considerations and general design issues associated with them. In conclusion:

Select your treatment system process based on

- Capital cost
- Operational costs
- Site Conditions (Temperature)
- Effluent criteria
- Sludge production
- Footprint
- References
- Support



THANK YOU VERY MUCH !

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Any questions?

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