

TCEQ Pristine Streams Stakeholder Meeting

Treatment Technologies

LOUIS C. HERRIN, III, P.E.

BALTAZAR LUCERO-RAMIREZ, PH.D, P.E.

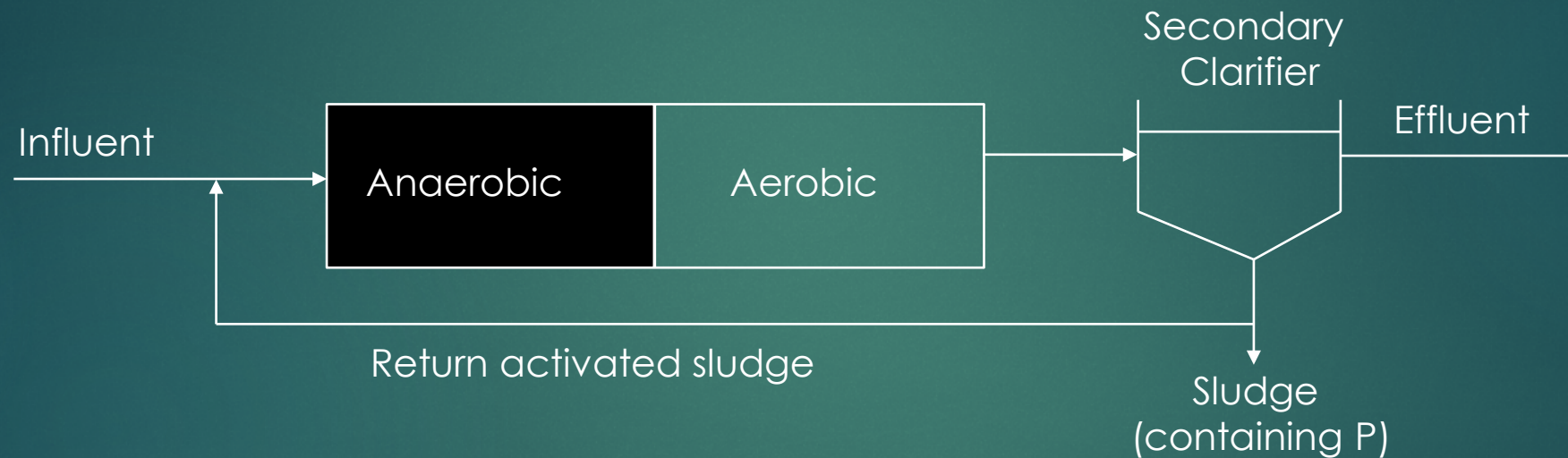
Available treatment technologies

- ▶ Review of different treatment technology options, including biological treatment, chemical additions, membranes technologies, and blending technology options.
- ▶ The treatment level each technology can achieve from properly operated wastewater treatment plants.

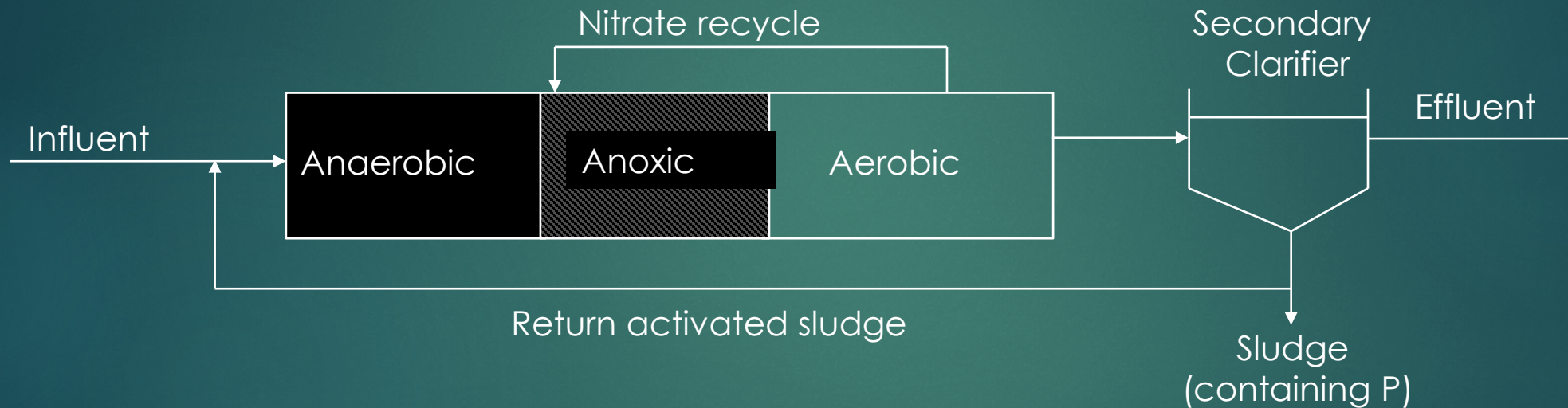
Biological Phosphorus Removal

- ▶ Common Process Configurations
- Process Design Requirements
 - Preliminary sizing using standard design criteria and optional use of modeling software for process design optimization
 - Influent Characteristics
 - Volatile fatty acids (VFAs)
 - Rapidly Biodegradable Chemical Oxygen Demand (rbCOD)
 - Rapidly Biodegradable Chemical Oxygen Demand divided by Phosphorus (rbCOD/P ratio)
 - Solids Retention Time (SRT)
 - Mixed Liquor Suspended Solids (MLSS)
 - Hydraulic Retention Time (HRT) Limits
 - Dissolved Oxygen Limits
 - Internal Recycle Rates
- Operational and Control Parameters

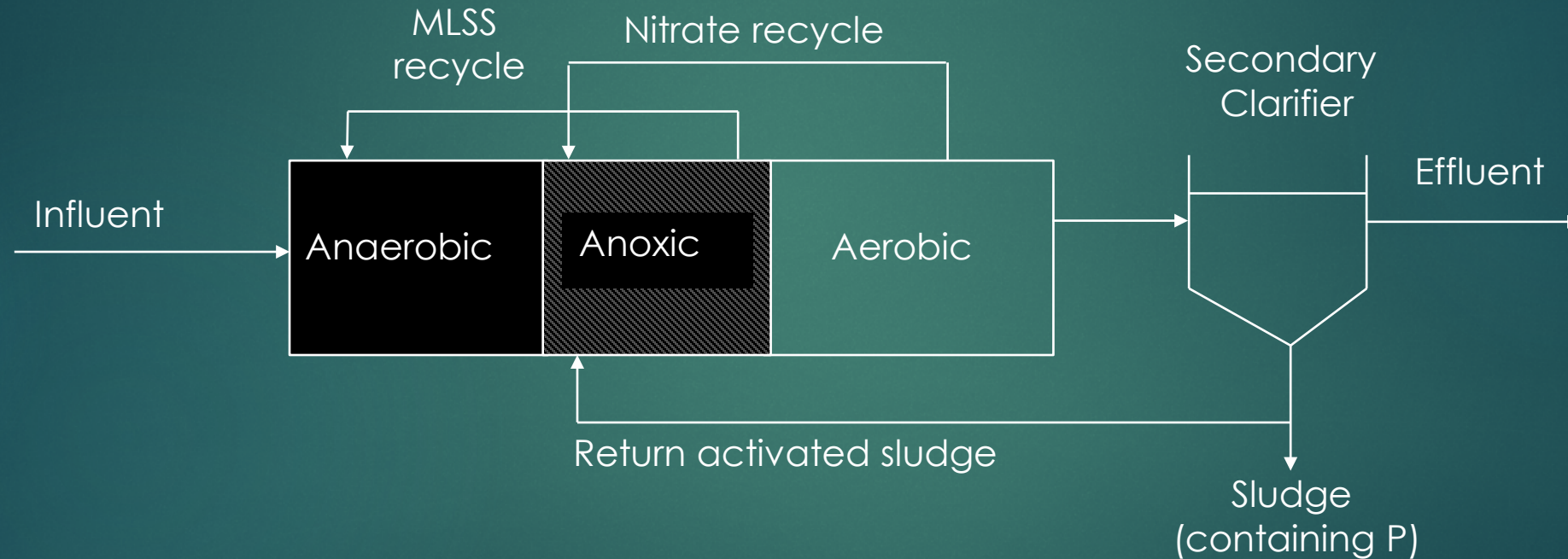
Anaerobic/Oxic (A/O) Process



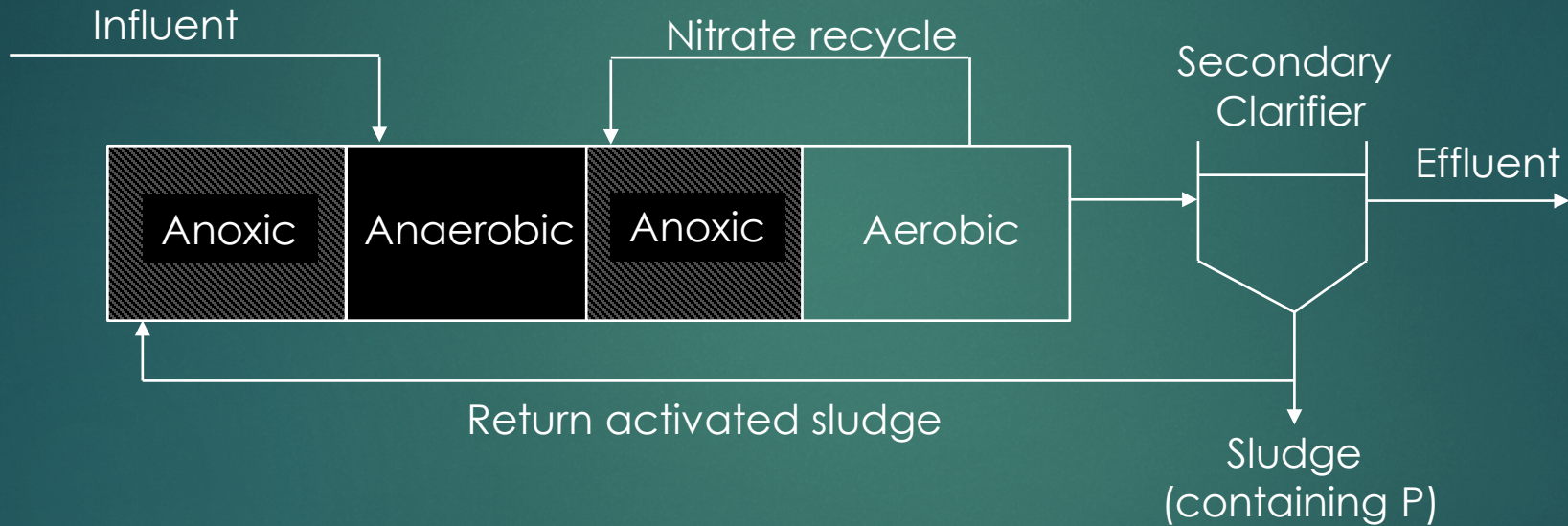
Anaerobic/Anoxic/Oxic (A²/O) Process



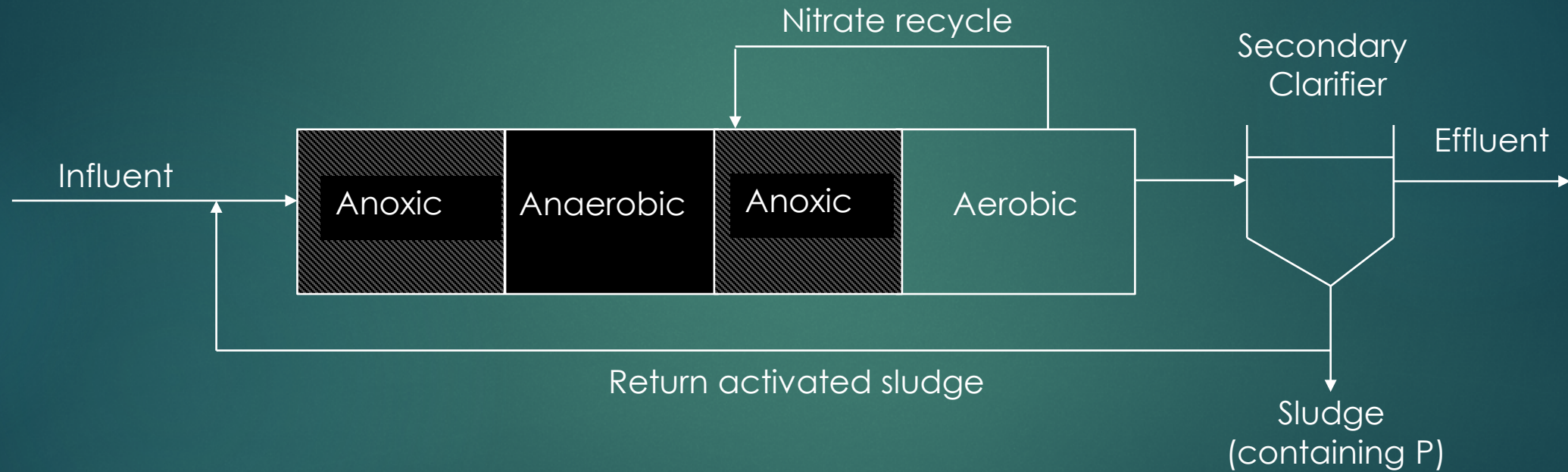
University of Cape Town (UCT) Process



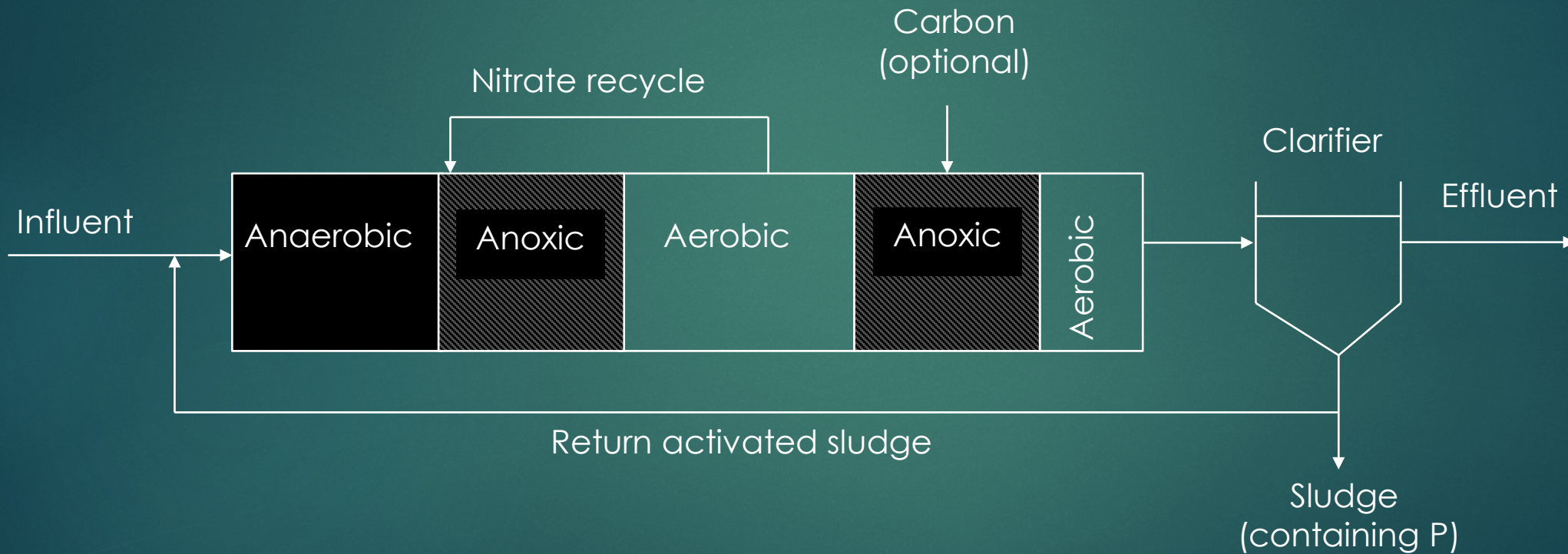
Johannesburg (JHB) Process



Westbank Enhanced Biological Phosphorus Removal (EBPR) Process

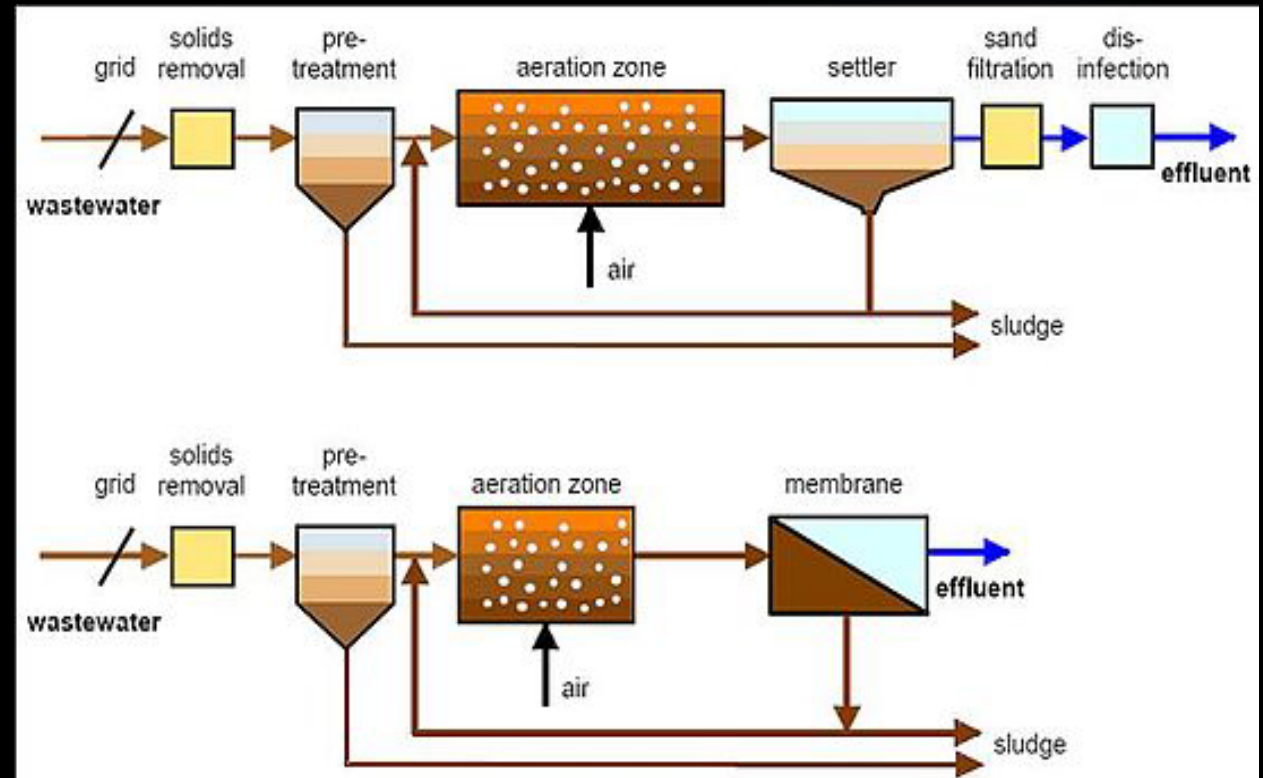


Five-Stage Modified Bardenpho Process



Activated Sludge Treatment Process with Membrane Bioreactor

- It is possible to achieve Total Phosphorus (TP) removal with the Activated Sludge Process by removing the final clarifiers and adding MBR filters. You may still need to add chemical addition to achieve low TP



Phosphorus Removal by Chemical Addition

- ▶ Phosphorus Precipitation Chemicals
 - ▶ Alum
 - ▶ Ferric Chloride
- ▶ Chemical Addition Points
 - ▶ Chemical Addition to Primary Treatment
 - ▶ Chemical Addition to Secondary Treatment
 - ▶ Chemical Addition to Tertiary treatment
- Process Design Requirements
 - Mixing Requirements
 - Chemical Feed and Storage Requirements

Chemical treatment is the most common method used for phosphorus removal to meet effluent concentrations below 1.0 mg/L.

Treatment levels that can be achieved from properly operated wastewater treatment processes (EPA, 2015)

Process Configuration	Achievable Effluent TP
Conventional and Extended Aeration Activated Sludge Process (Secondary treatment only)	4 – 10 mg/L
Anaerobic/Oxic (A/O) - EBPR only	0.5 – 2.0 mg/L
Anaerobic/Anoxic/Oxic (A ² O) - EBPR and denitrification	1.0 – 2.0 mg/L
5-Stage Modified Bardenpho (EBPR and denitrification)	0.5 – 2.0 mg/L
UCT (EBPR and Denitrification)	0.5 – 2.0 mg/L
Johannesburg*	0.1 – 0.5 mg/L
Chemical Phosphorus Removal*	< 0.1 mg/L

* Typically combined with tertiary filters or membranes to achieve TP concentrations < 0.5 mg/L

Optimization options



How existing treatment technologies can be optimized to improve or maximize efficiency.

Optimization options at existing non-advanced WWTP's (EPA, 2015)

- ▶ Optimizing Nutrient Removal in Activated Sludge Systems
 - ▶ Aeration Modifications – Changes to aeration equipment (i.e., energy efficient blowers), controls (Variable Frequency Drive's (VFD) airflow meters, control valves), operation (on/off cycling)
 - ▶ Process Modifications – Adjustments to process control characteristics:
 - ▶ solids retention time (SRT), mixed liquor suspended solids (MLSS), food-to-mass ratio (F/M), and return activated sludge (RAS) rate)
 - ▶ Configuration Modifications (i.e., changes to process configuration and channels)
 - ▶ Chemical Modifications (changes to supplemental alkalinity or organic carbon feed)
- ▶ Training wastewater treatment plant (WWTP's) Staff on Nutrient Removal and Optimization

How can the existing Wastewater Treatment Plants Achieve Nutrients Limits for these Segments

- ▶ Most of the Activated Sludge Process plants could achieve limits by adding chemical additions and/or adding a membrane bioreactor (MBR) process or other filtering processes.
- ▶ The pond systems and primary treatment systems (septic system) will need to replace their treatment system

What is currently permitted within these watershed

- ▶ 44 permits that the disposal methods are irrigation or evaporation
 - ▶ 7 are currently listed as inactive
 - ▶ 5 evaporation permits
 - ▶ 22 Subsurface Area Drip Dispersal Systems (SADDS) permits
 - ▶ 18 surface irrigation permits
 - ▶ 3 have some form of nutrients limits
 - ▶ 6 permits are for primary treatment or pond systems

What is currently permitted within these watershed

- ▶ 19 permits have the disposal method as discharge
 - ▶ 2 permits are inactive
 - ▶ 7 permits have a Total Phosphorus limits
 - ▶ 3 permits have a Total Nitrogen limits or is required to report
 - ▶ 3 permits for pond systems