



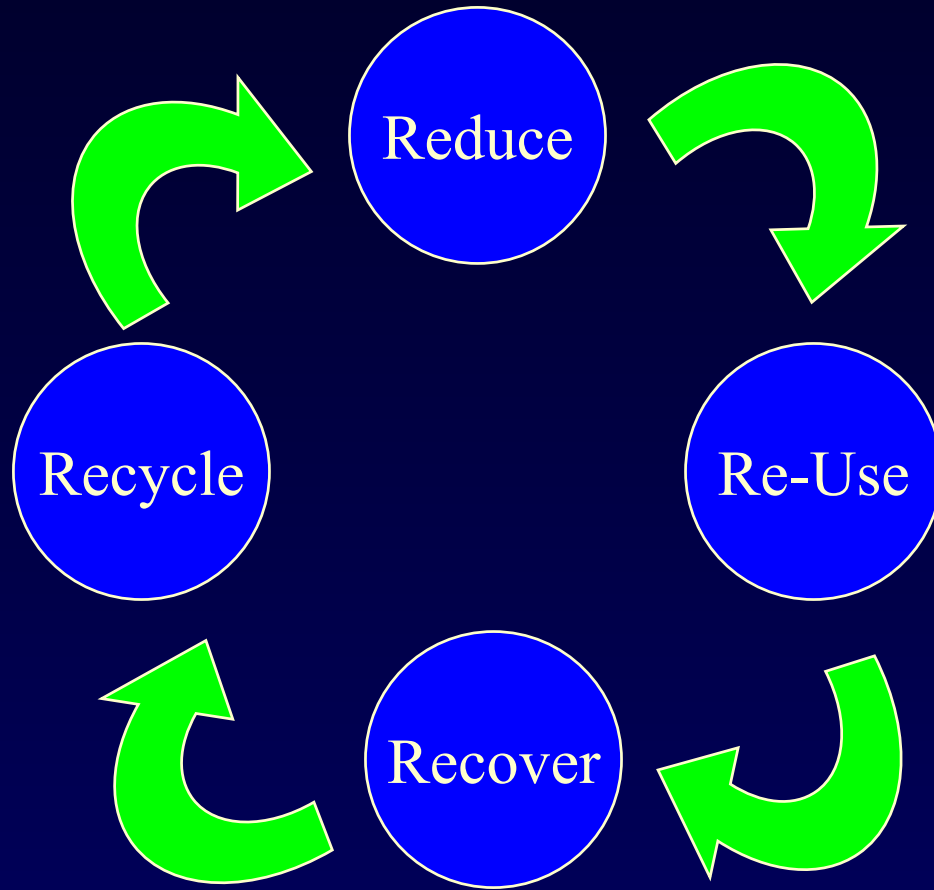
Perennial Source of Water!?
“Wastewater”!

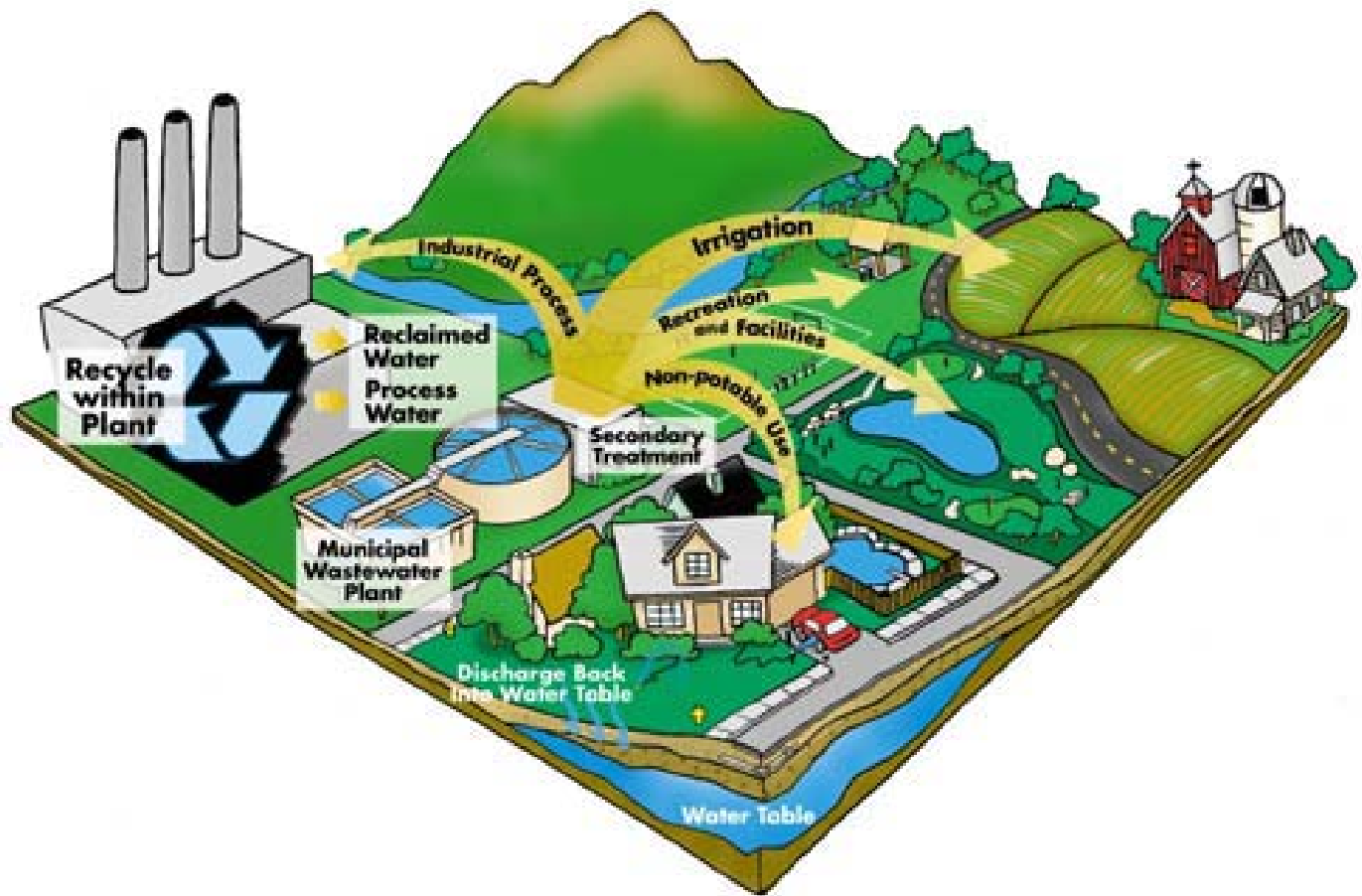
Treatment, Recovery & Reuse

by

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Typical Contaminants in Wastewater

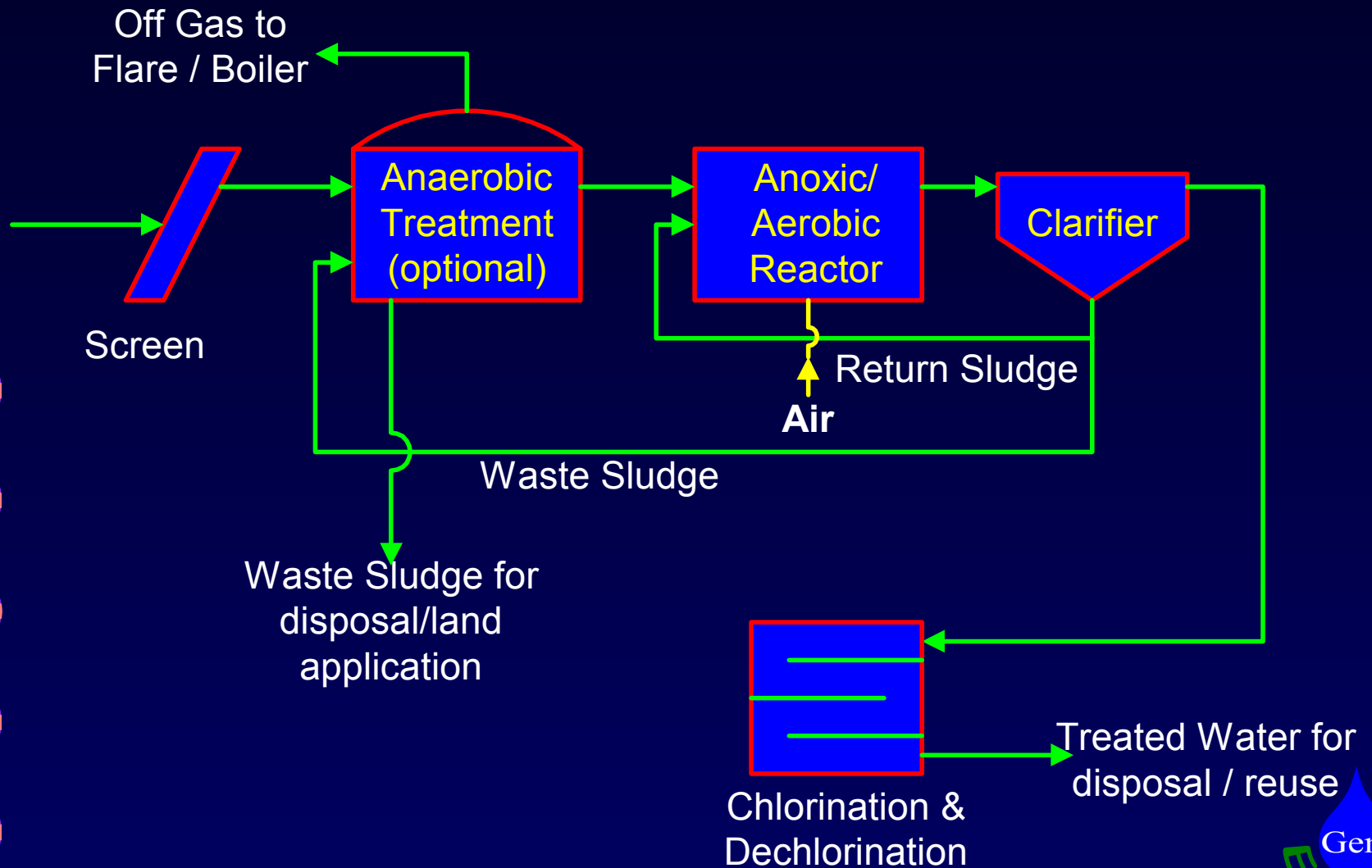
- ◆ Organic Compounds - generally measured as Biological Oxygen Demand (BOD)
- ◆ Suspended Solids
- ◆ Oil & Grease
- ◆ Nitrogen (ammonia, organic nitrogen, etc.)
- ◆ Phosphorus
- ◆ Inorganic Compounds (metals, salts, etc.)



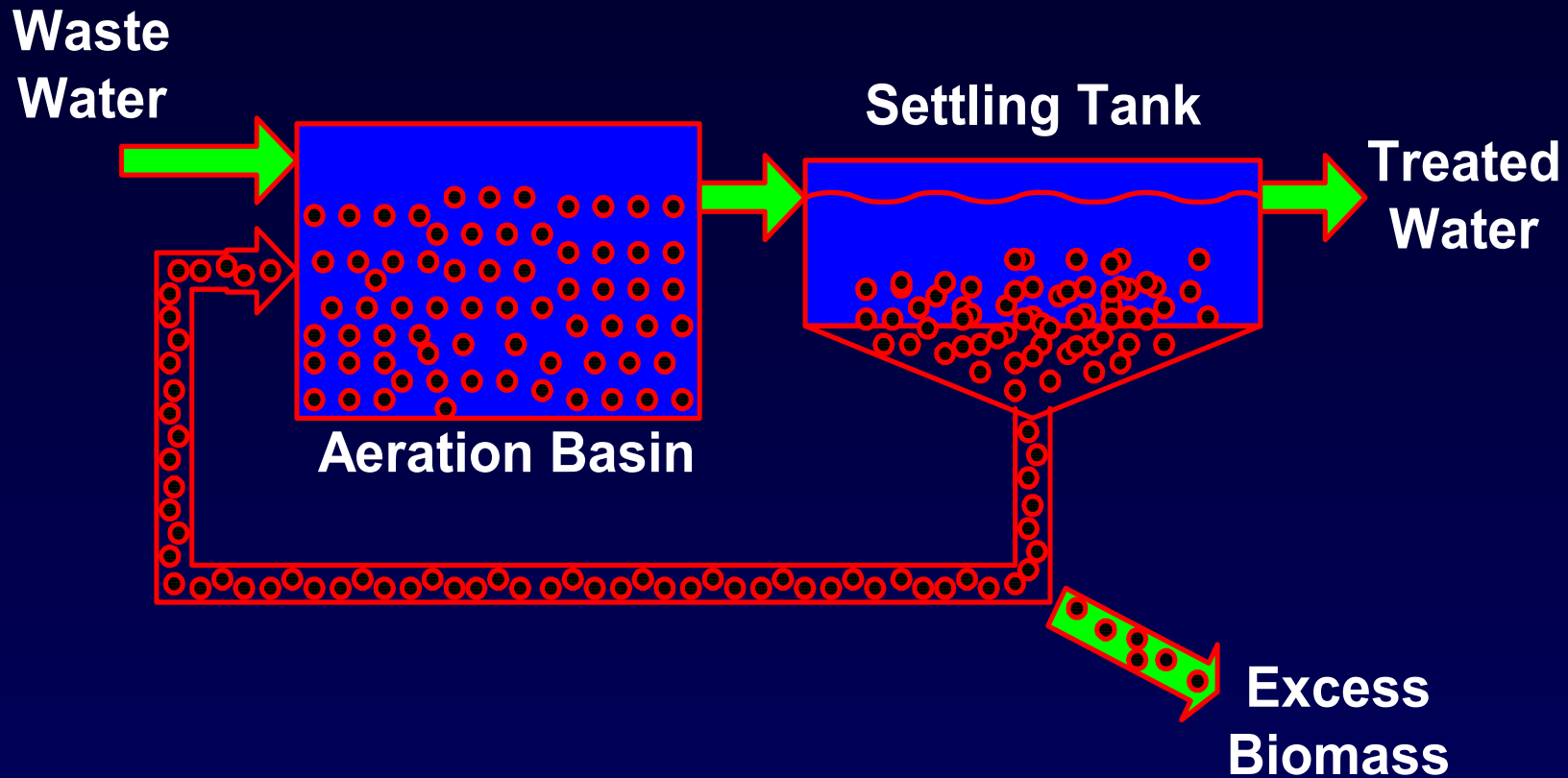
Progression

- ◆ Lagoons
- ◆ Sand Beds -- Trickling Filter
- ◆ Septic Tanks
- ◆ Activated Sludge System
- ◆ Rotating Biological Contactor
- ◆ Advanced Biological Systems

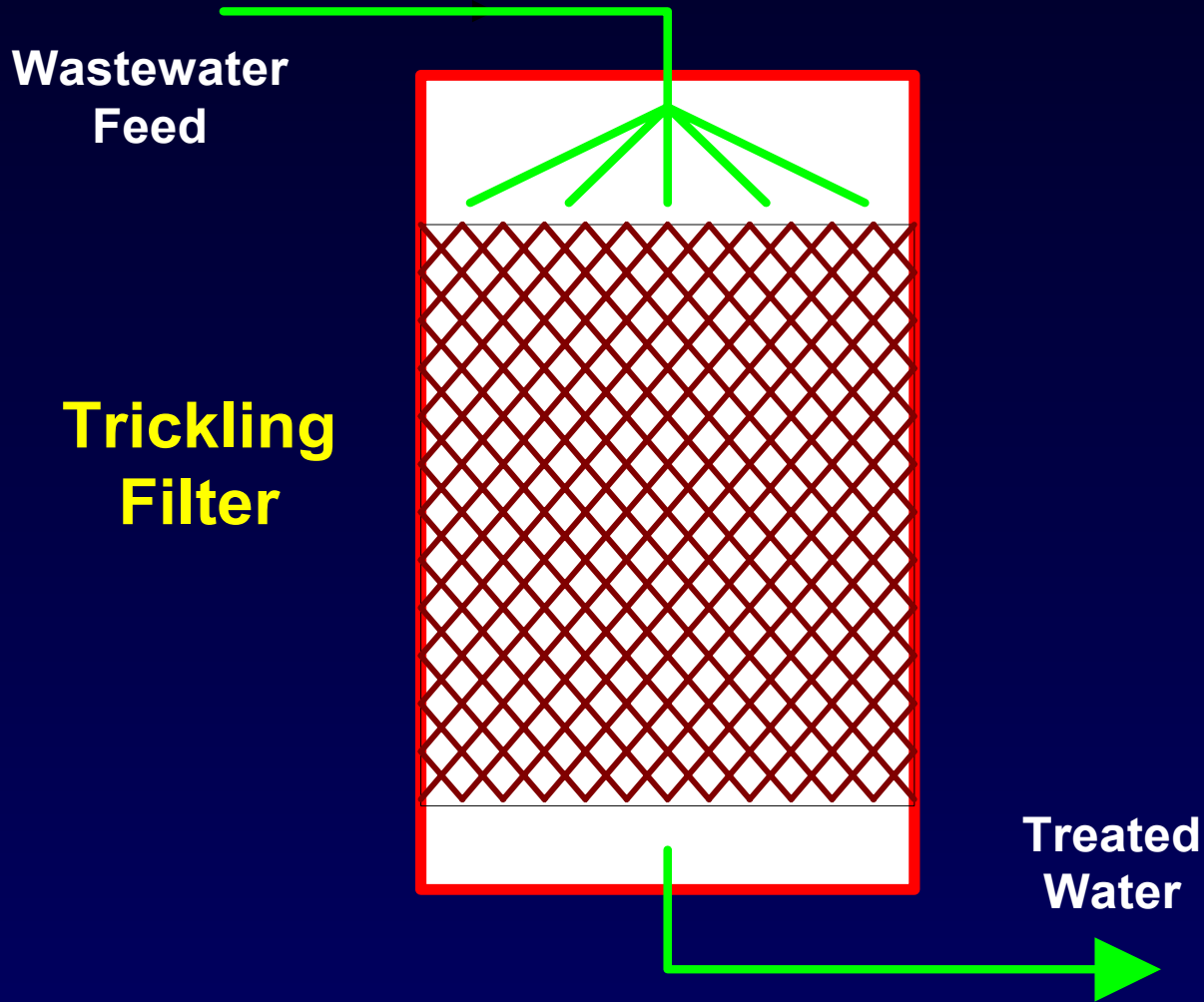
Example of an Industrial Wastewater Treatment Plant



Typical Biological Wastewater Treatment (Suspended Growth System)



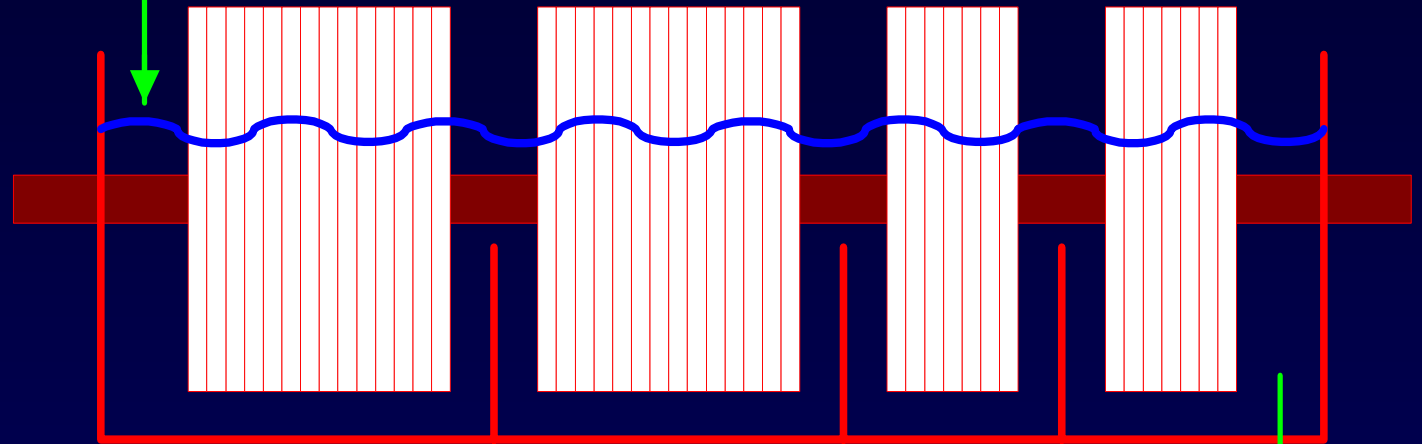
Typical Biological Wastewater Treatment (Attached Growth System)



**Trickling
Filter**

Rotating Biological Contactor

Wastewater
Feed

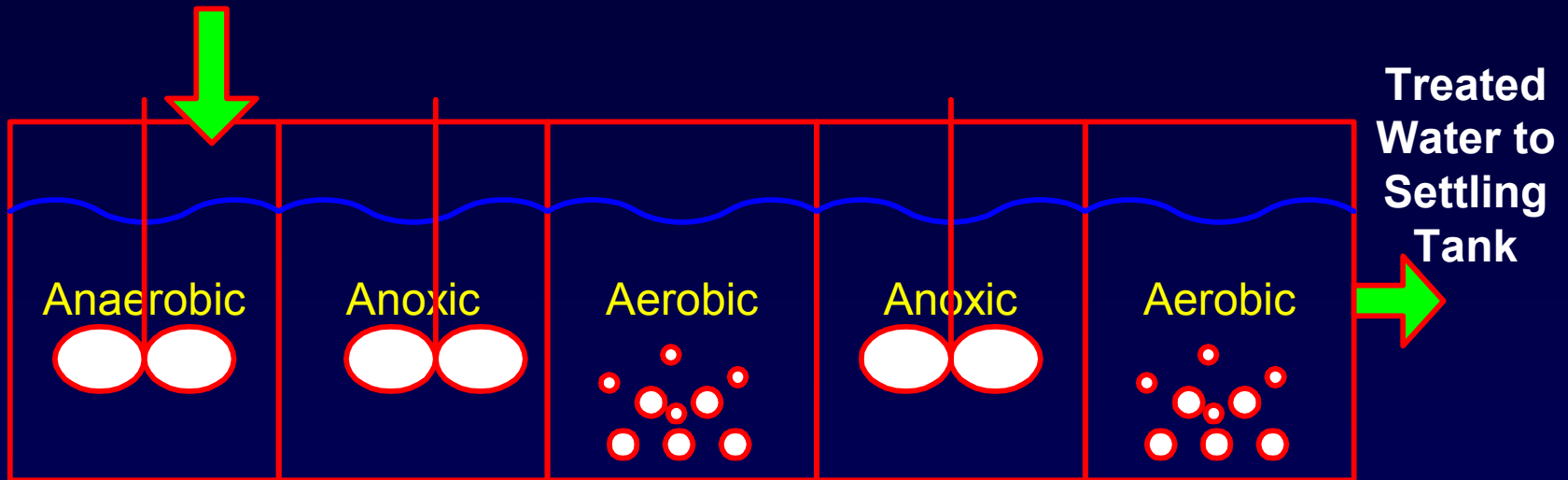



Treated
Water



Advanced Wastewater Treatment (Biological Nutrient Removal)

Waste
Water





*“No higher quality water,
unless there is a surplus of it,
should be used for a purpose
that can tolerate a lower
grade”*

*UN Economic & Social
Council, 1958-Policy*





Types of Reuse

- ◆ Direct Reuse
- ◆ Indirect Reuse
- ◆ Inadvertent Reuse




Areas for Water Reuse

- ◆ Landscape application
- ◆ Scenic Waters/Fountains
- ◆ Irrigation
- ◆ Municipal
- ◆ Agricultural
- ◆ Ground-Water Recharge



Areas for Water Reuse

- ◆ Industrial
 - Cooling Towers
 - Boiler
 - Floor Wash
 - Fire Fighting
 - Stack gas scrubbers
 - Toilet/urinal flushing



General Guidelines for water reuse with critical quality requirement

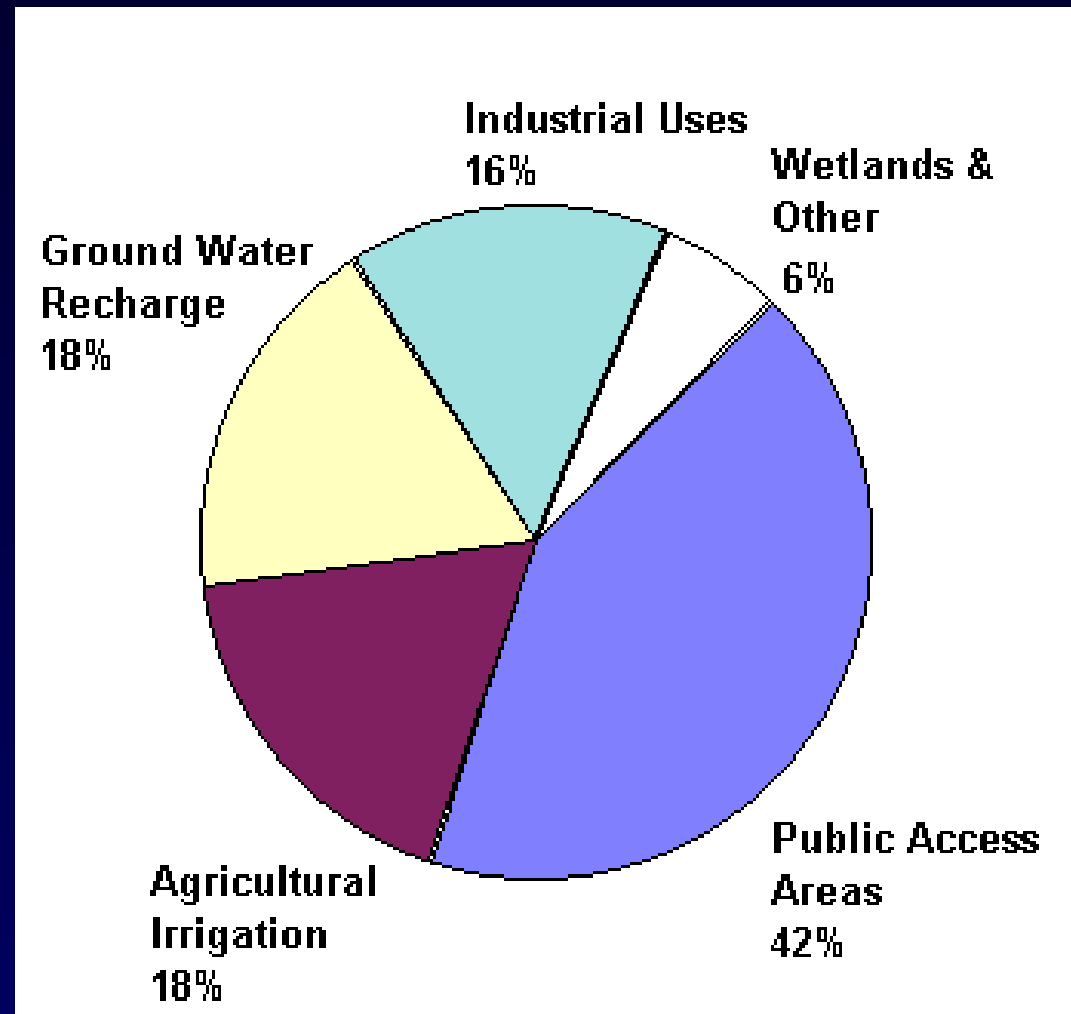
- ◆ WHO
- ◆ US EPA
- ◆ California
- ◆ Florida



Case Studies

- ◆ Orange County, CA – Water Factory 21
- ◆ West Basin, California
- ◆ Commercial Buildings
- ◆ Theme Parks
- ◆ Industries

Typical Water Reuse - CA



Effluent Water Quality for Alternative Levels of Usage

	Irrigation	Open Surface	Lakes	Industrial
BOD – mg/L	30	10	10	5
TSS – mg/L	30	10	5	1
NO ₃ -N – mg/L	5.6	5.6	5.6	5.6
Total P – mg/L	10	10	1	1
TDS – mg/L	1500	1500	1500	500
Turbidity – NTU	-	5	1	1
Fecal Coliform, cfu/100 mL	1000	25	2.2	2.2
pH	6.5 to 9			