Determining Wastewater Treatment Standards; Discharge to Surface Water

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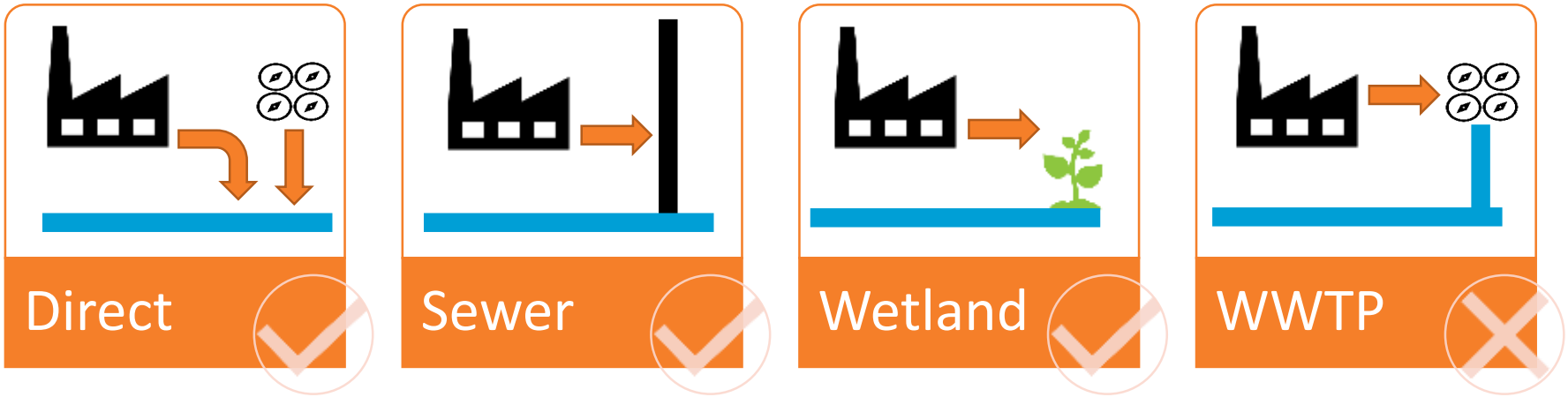
Sources of Wastewater

Determination applies to untreated discharges to surface water of,

- Process wastewater (industrial)
- Sanitary wastewater (domestic)
- Stormwater runoff



Discharge to sewer connected to a municipal wastewater treatment plant → national pre-treatment requirements, operator to confirm can accommodate the flow and load

Factors to Consider

1. National standards for effluent discharge and the applicable ambient WQ (if absent use equivalent)
2. Good international industry practice for sector or equivalent, apply if more stringent than national standards

Table 5 - Effluent Guidelines
(To be applicable at relevant wastewater stream: e.g., from FGD system, wet ash transport, washing boiler / air preheater and precipitator, boiler acid washing, regeneration of demineralizers and condensate polishers, oil-separated water, site drainage, coal pile runoff, and cooling water)

Parameter	mg/L, except pH and temp
pH	6 – 9
TSS	50
Oil and grease	10
Total residual chlorine	0.2
Chromium - Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1.0
Zinc (Zn)	1.0
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

Note: Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants

Table 4—Effluent Standards for Landfills in the US

Parameter	Units	Guideline[a]			
		Hazardous Waste Landfills		MSW Landfills	
		Daily Max	Monthly Avg.	Daily Max	Monthly Avg.
BOD_5		220	56	140	37
pH		6-9	6-9	6-9	6-9
Total Suspended Solids	mg/L	88	27	88	27
Ammonia (as N)	mg/L	10	4.9	10	4.9
Arsenic	mg/L	1.1	0.54		
Chromium	mg/L	1.1	0.46		
Zinc	mg/L	0.535	0.296	0.20	0.11
a-Terpineol	mg/L	0.042	0.019	0.033	0.016
Aniline	mg/L	0.024	0.015		
Benzoic Acid	mg/L	0.119	0.073	0.12	0.071
Naphthalene	mg/L	0.059	0.022		
p-Cresol	mg/L	0.024	0.015	0.025	0.014
Phenol	mg/L	0.048	0.029	0.026	0.015
Pyridine	mg/L	0.072	0.025		

Source: U.S. EPA Effluent Guidelines for Centralized Waste Treatment, 40 CFR Part 437

Table 2. Effluent Levels for Health Care Facilities

Pollutants	Units	Guideline Value
pH	S.U	6 - 9
Biochemical oxygen demand (BOD_5)	mg/L	50
Chemical oxygen demand (COD)	mg/L	250
Oil and grease	mg/L	10
Total suspended solid (TSS)	mg/L	50
Cadmium (Cd)	mg/L	0.05
Chromium (Cr)	mg/L	0.5
Lead (Pb)	mg/L	0.1
Mercury (Hg)	mg/L	0.01
Chlorine, total residual	mg/L	0.2
Phenols	mg/L	0.5
Total coliform bateria	MPN[a] / 100ml	400
Polychlorinated dibenzodioxin and dibenzofuran (PCDD/F)	Ng/L	0.1
Temperature increase	°C	<3[b]

Notes:
[a] MPN = Most Probable Number
[b] At the edge of a scientifically established mixing zone which takes into account ambient water quality, receiving water use, potential receptors and assimilative capacity

Factors to Consider

3. Sensitivity and intended uses of receiving waters, depending on national standards consider tighter standard to protect aquatic ecology and public health






https://www.epa.ie/pubs/advice/water/quality/Water_Quality.pdf

Factors to Consider

4. Receiving water's assimilative capacity

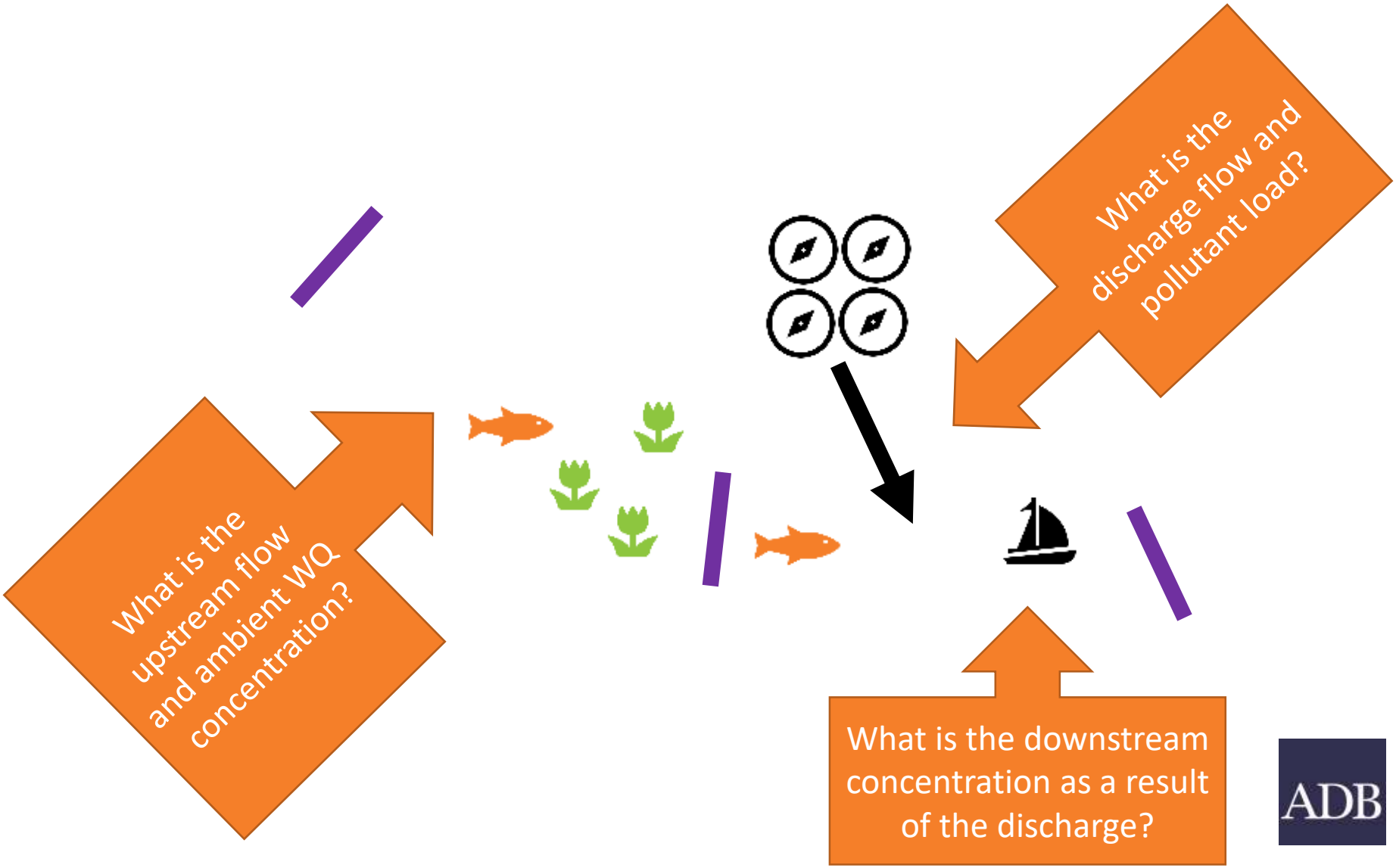
   i.e. ability to dilute and absorb pollutants,

   calculate for key parameters; BOD, NH_3-N, and P

- If national ambient WQ standards met, and sufficient assimilative capacity to protect aquatic ecology and public health discharge is acceptable
- If insufficient assimilative capacity is available design flow and load should be revisited
- If the assimilative capacity already exceeded then the receiving water is degraded, further deterioration of the ambient WQ should be avoided

5. Temperature does not result in a >3°C increase over ambient at the edge of the scientifically established mixing zone

Assimilative Capacity Calculations



Assimilative Capacity Calculations

$$C_{final} = \frac{(C_{back} * F_{river}) + (C_{dis} * F_{dis})}{(F_{river} + F_{dis})}$$

$C_{final} > C_{target}$	unacceptable
$C_{target} > C_{final}$	acceptable

C_{target} = ambient WQ standard based on factors 1, 2 and 3 (mg/l)

C_{final} = downstream concentration after discharge (mg/l)

C_{back} = background concentration in river (mg/l)

F_{river} = 95%ile flow in river, for toxic substances use DWF (m^3/s)

C_{dis} = maximum concentration in discharge(mg/l)

F_{dis} = flow of discharge (m^3/s)

Assimilative Capacity Calculations

to work out design flow and/or load based on target concentration:

$$C_{dis} = \frac{(C_{target} * (F_{river} + F_{dis})) - (C_{back} * F_{river})}{F_{dis}}$$

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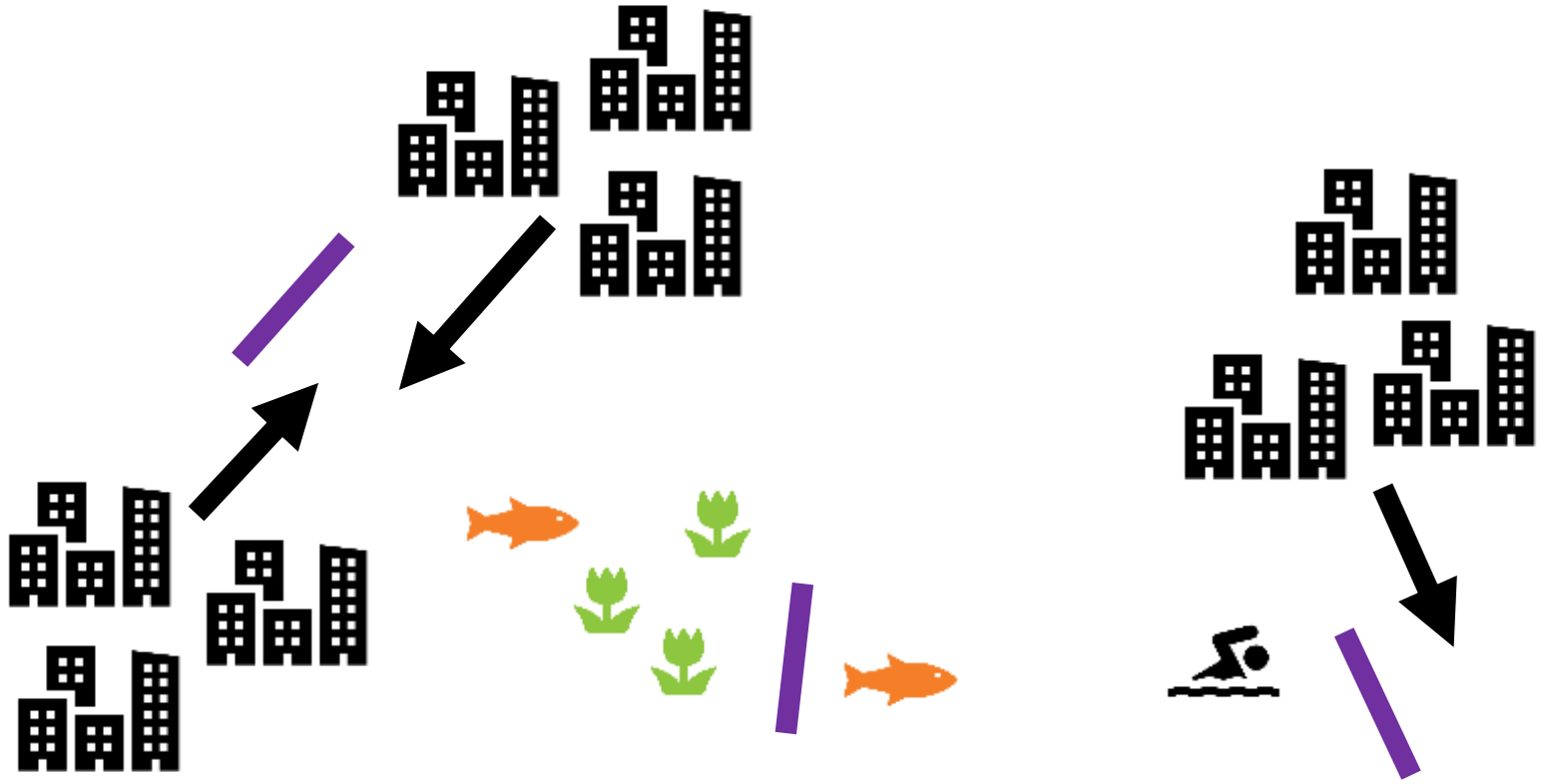
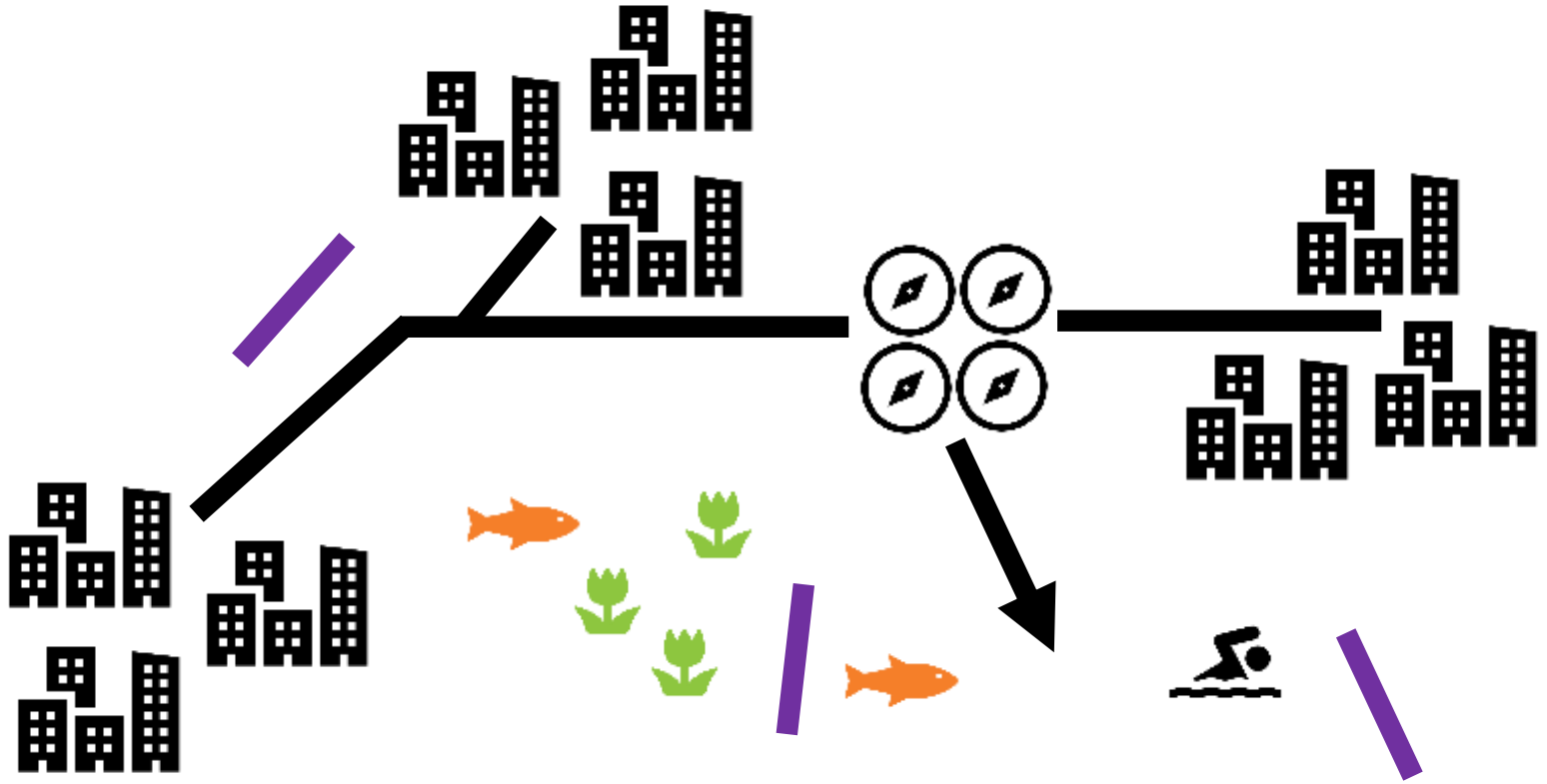
Flow & Load (Quantity & Quality)



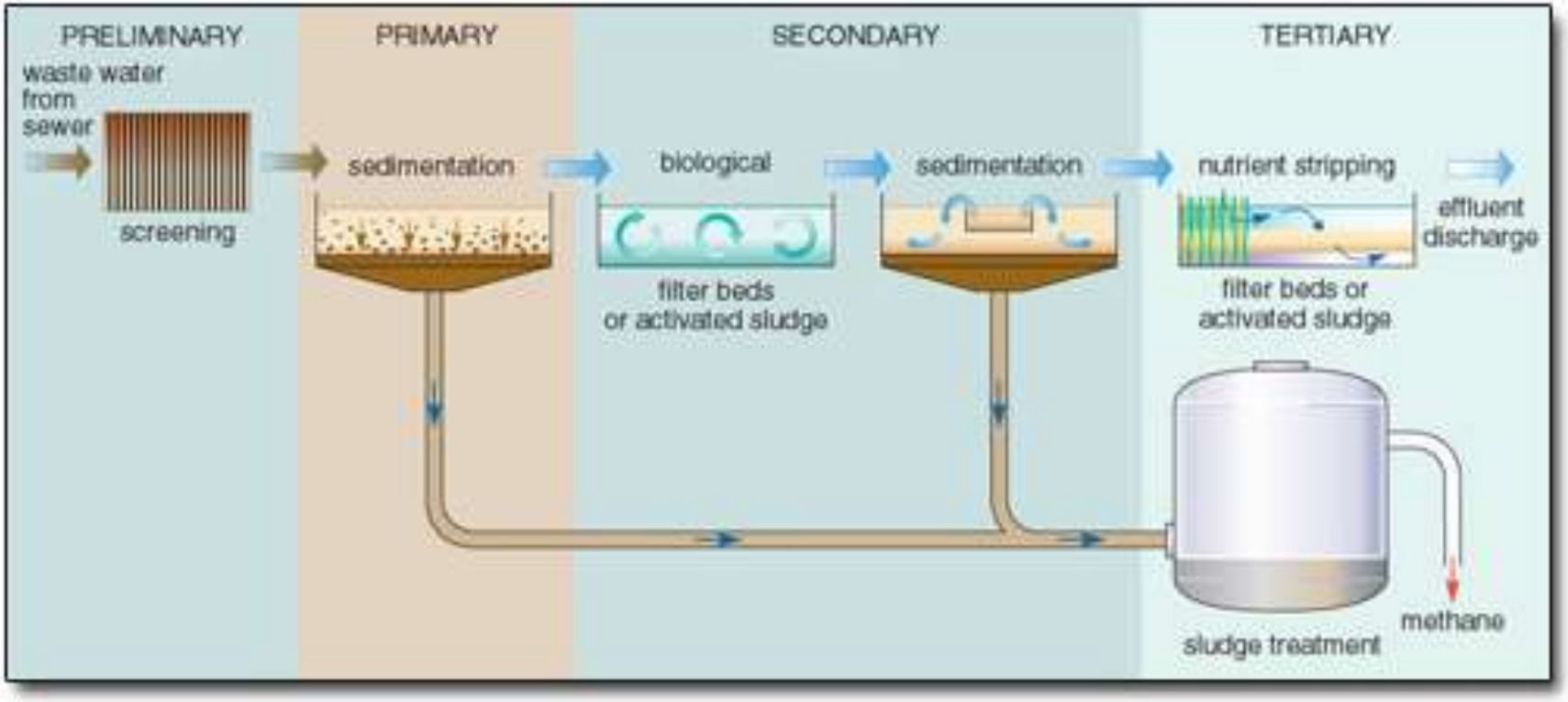
Upstream	Fisheries Wetland	Fisheries Bathing	Downstream

Flow & Load (Quantity & Quality)



Flow no change Load no change	Flow ↓ (?) Load ↓ (+ve)	Flow ↑ (?) Load ? (?)	Flow no change Load ↓ (+ve)

Stages in the Wastewater Treatment Process



Preliminary Treatment

→ remove coarse solids and debris from the effluent

→ physical removal process

→ screening and/or commutation

- Grit removal
- Fat, oil and grease removal
- Removal of plastic bags etc.

→ no significant effect on the pollution load

Primary Treatment

→ remove organic and inorganic suspended solids

→ physical and/or chemical removal process

- Straightforward settlement, in *primary* settlement tanks sediment settles to the bottom as sludge, scum skimmed
- Enhanced settlement, with coagulation and flocculation using a polymer added to effluent to aid sedimentation
- pH neutralization if acid or alkali content to wastewater

→ reduces SS of effluent by approximately 50-70%

→ reduces the BOD of effluent by approximately 25-50%

Secondary Treatment

→ remove dissolved organics and remaining suspended solids

→ generally uses biological treatment processes (microorganisms metabolize the organic matter) but can use a physical process

- Conventional filter beds [trickling filters or rotating biological contactors]
- Conventional activated sludge (separate aeration and final settlement tank)
- Sequencing batch reactor activated sludge (aerate and settle in single tank)
- Anaerobic systems (using microorganisms that do not require any oxygen)
- Membrane systems (MBR)

→ removal of SS and BOD by 85%, meets basic discharge standard

→ final effluent to receiving waters, or tertiary treatment if tighter standards required

Secondary Treatment

Tertiary Treatment

→ polishing of final effluent to remove any final solids

→ removal of nutrients to tighter discharge standards

- Chemical dosing or enhanced biological treatment for the removal of phosphorus
- Enhanced biological treatment for removal of nitrogen (usually measured as ammoniacal nitrogen)

- Sand filters
- Grassland or reedbed (constructed wetlands)

Disinfection

→ is not a wastewater treatment process

→ may be required by national legislation

- Chlorination (liquid, sodium hypochlorite)
- Ozonation
- UV approach

If treated wastewater is to be used for application to land (irrigation) it must be consistent with public health-based guidance from the WHO
http://www.who.int/water_sanitation_health/sanitation-waste/wastewater/wastewater-guidelines/en/

Other Treatment Methods

- Stabilization ponds

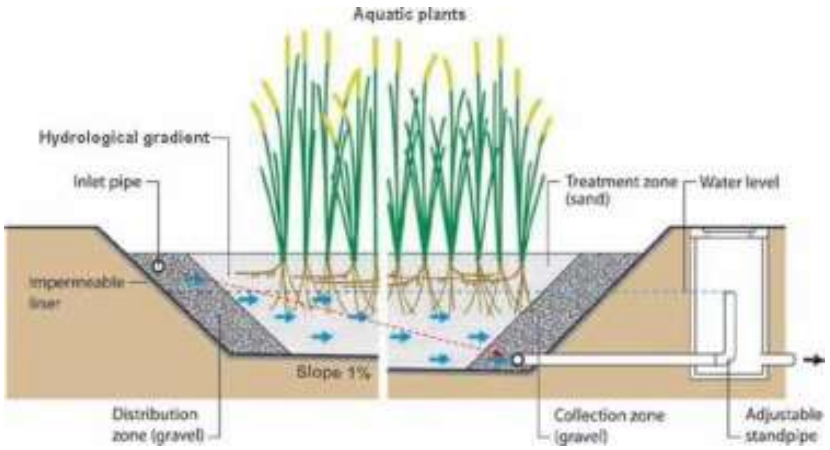
[facultative and maturation]

Large land take, cheap and skilled labour not needed

Odour especially if anaerobic stage as essentially open septic tanks

Effluent normally 50-70mg/l from facultative pond, following maturation 25mg/l

- Constructed wetland
- Nutrient film removal



Provision for Peak Flows

- Separate wastewater streams to reduce volumes to be treated
- Storm water storage needs to be provided as first flush highly polluting if allowed to overflow to surface water
- From road and hardstanding drainage picks up oils and heavy metals etc.
- For wastewater treatment plant also needed for load balancing
- Slow down flow with the use of weirs and tanks, after first flush send to a CSO (combined sewer overflow)
- Design is to be based on acceptable spill frequency

Septic Tanks

→ use only for treatment of sanitary wastewater

→ design and install per national requirements

→ but DO NOT use them in areas that are poorly drained or with a high groundwater table

→ locate sufficient distance from groundwater wells and surface waters, up to 500m as a precautionary distance but can be closer depending on soil percolation character

→ ensure system in place for the removal of septic sludge and a facility exists to accept the septage for treatment (otherwise consider using a package sewage treatment)

ADB

Thank you.