Aerated Pond Digestion

Efficient Upgrade Opportunities for Existing Pond Based Systems

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Presentation Overview

- Outlining lagoon surface aeration
- Potential applications for existing systems
- Advantages and disadvantages
- Case Study – Shortland STP
- Relevance to “Smart Island Water”
- Questions

Lagoon Surface Aeration – What Is It ?

- Tankage provided by lagoons
- Aeration / Mixing of Contents provided by floating surface aerators
- Fixed bridges or secured with cables
- Effluent decanted from either fixed pipe or purpose built decanting equipment

Retrofitting Existing Ponds

From This….

To This

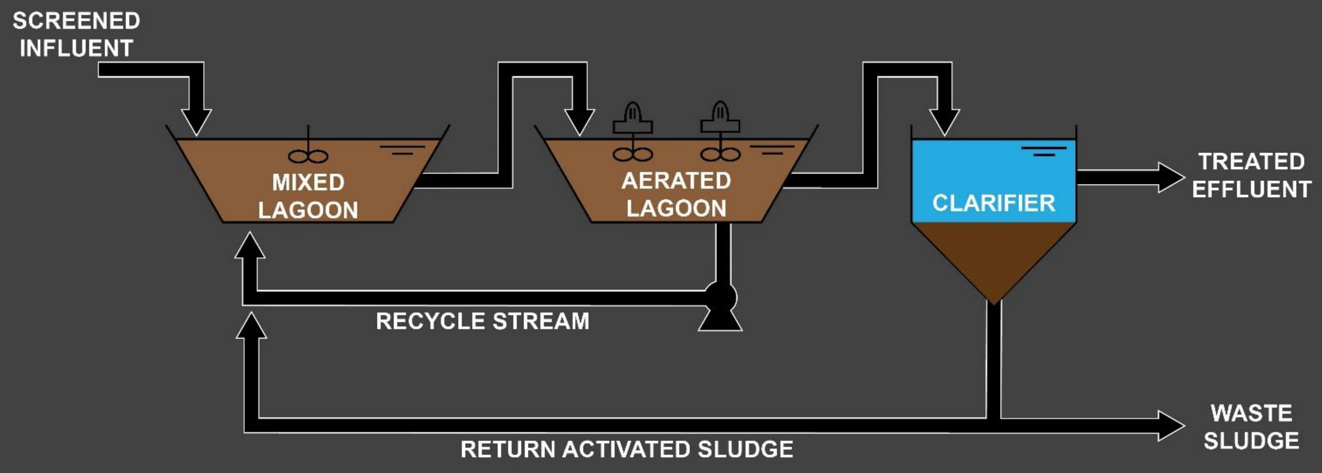
Applications

- Activated Sludge & Aerobic Digestion
- Key drivers for upgrades often
  - Greater Capacity
  - Improved Performance
- For the same volume;
  - Activated sludge can treat > 20 x inflow and delivery better effluent quality
  - Aerobic digestion can deliver s similar stabilization and around 5 x amount of waste activated sludge
- Attractive on sites with constrained footprint or where odour is an issue
- Suited for converting;
  - Pond systems to activated sludge
  - Sludge lagoons accepting activated sludge to aerobic digestion
- Key consideration – maintaining effective treatment whilst conversion completed

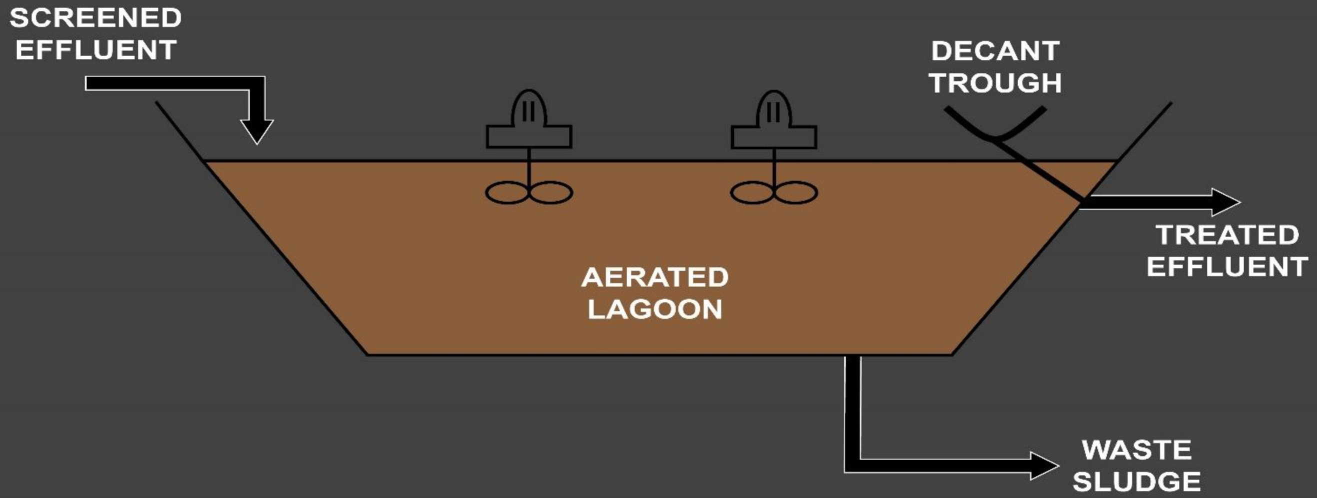
Activated Sludge

- Assuming nutrient removal required –likely lagoon applications include
  1. Aerated Compartment of Continuous Process
  2. Intermittent Reactor
- Cyclic aeration / anoxic conditions promote biological N removal
- Metal salt dosing provides phosphorus removal
- Sludge age of around 20 days – waste sludge to digestior
- Key Advantages include;
  - Improved effluent quality – TN < 10 mg/L continuous doing better TP < 1 mg/L
  - Removal of algae in the effluent – much lower BOD and TSS concentrations
  - Significantly greater capacity
- Key Disadvantages include;
  - Upfront capital cost – many multiples more expensive than ponds
  - Increased power demands compared to near zero for pond systems
  - Greater operational intensity and knowledge required
  - Significantly increased sludge stream to manage

Continuous



Intermittent



Aerobic Digestion

- Absence of substrate – WAS left to consume lysis products
- Ever diminishing bacteria populations = stabilization
- Cyclic aeration used to manage system pH
- Sludge age of around 20 days used, concentrations of 1 -1.5% adopted to maintain aeration efficiency
- Key Advantages include;
  - Significantly greater capacity
  - Lower footprint and therefore less odour
  - Means for continuous sludge removal
- Key Disadvantages include;
  - Upfront capital cost – many multiples more expensive than ponds
  - Increased power demands compared to near zero for pond systems
  - Greater operational intensity and knowledge required
  - Continuous dewatering equipment required.

Case Study – Shortland STP

- Originally Trickling Filter from early 1900's
- Upgraded in 1998 to 20,000 EP intermittent activated sludge
- Upgrade in 2002 to include additional IDAL doubling capacity
- 2013 upgrade increased capacity to 60,000 EP – to provide feed water for industrial reuse scheme
- Unique scenario of inflow held constant through catchment diversion to supply reuse scheme

Shortland STP Process – Pre Upgrade

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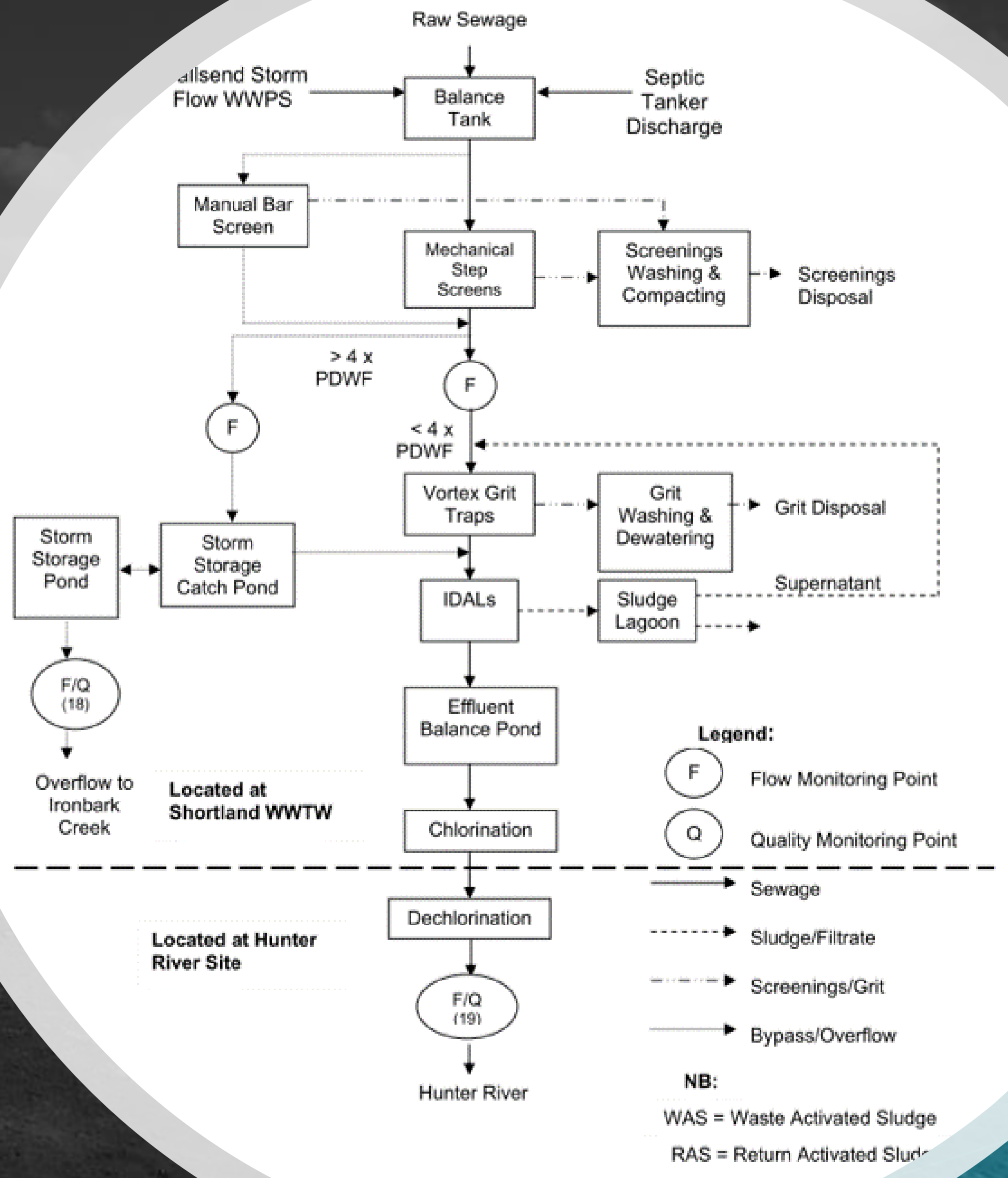
- Inlet Works
  - Balance Tank
  - 5mm Step Screens with manually raked bypass
  - Vortex style grit removal
  - Wet Weather screening facility
  - Residuals handling
  - Odour control
  - Foul water pump station
- Two Identical Intermittent Decant Aerated Lagoons (IDALs)
  - 3 Selector cells per IDAL complete with recycle pumps
  - Diffused aeration system (1 turbo and 2 positive displacement blowers
  - Vertical decant troughs
  - Waste activated sludge pumps
- Catchpond
- Chlorine Contact Tank (CCT) and associated gas chlorine dosing system
- Hunter River effluent discharge pumps and associated gas sulphur dioxide dichlorination system
- Storm storage catch pond and associated return pump station
- Additional storm storage pond
- 3 Sludge lagoons and associated supernatant pump station
- Site effluent reuse system



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Business Case

- Four options considered;
    1. Expanded lagoon system
    2. Heated anaerobic digestion
    3. Aerobic digestion
    4. Directed dewatering
- Options assessment identified 3 as preferred;
    - Aerobic digestion (concrete cells) receiving mechanically thickened WAS from the IDALs
    - Sludge thickening and dewatering system
    - Sludge outloading facility
- Subsequent review identified further savings through;
    - conversion of the existing lagoons instead of construction of new concrete tanks
    - transfer of thickened WAS following the settle phase within the IDALs (i.e. extraction of settled sludge) in lieu of mechanical thickening.
- Savings in order of $10M (>30% saving).

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Upgrade Approach

- Modelling showed 2 lagoons of 5 ML required
- Lagoons 1 & 2 originally nominated – conversion of Lagoon 3 into 2 x 5.1 ML lagoons realized a number of advantages;
    1. Lower capital cost and less risk of escalation due to unknowns associated with latent conditions within the older lagoons
    2. Smaller construction area / footprint. Retains more site for future upgrades
    3. Reduced impact on site traffic during an following the upgrade
    4. Lower odour emissions due to smaller surface area
    5. Reduced flooding risk, with their position allowing them to act as emergency overflow from the new ADLs.
    6. Retention of Lagoons 2 and 3 provides greater dewatering flexibility during construction.

Upgrade Configuration

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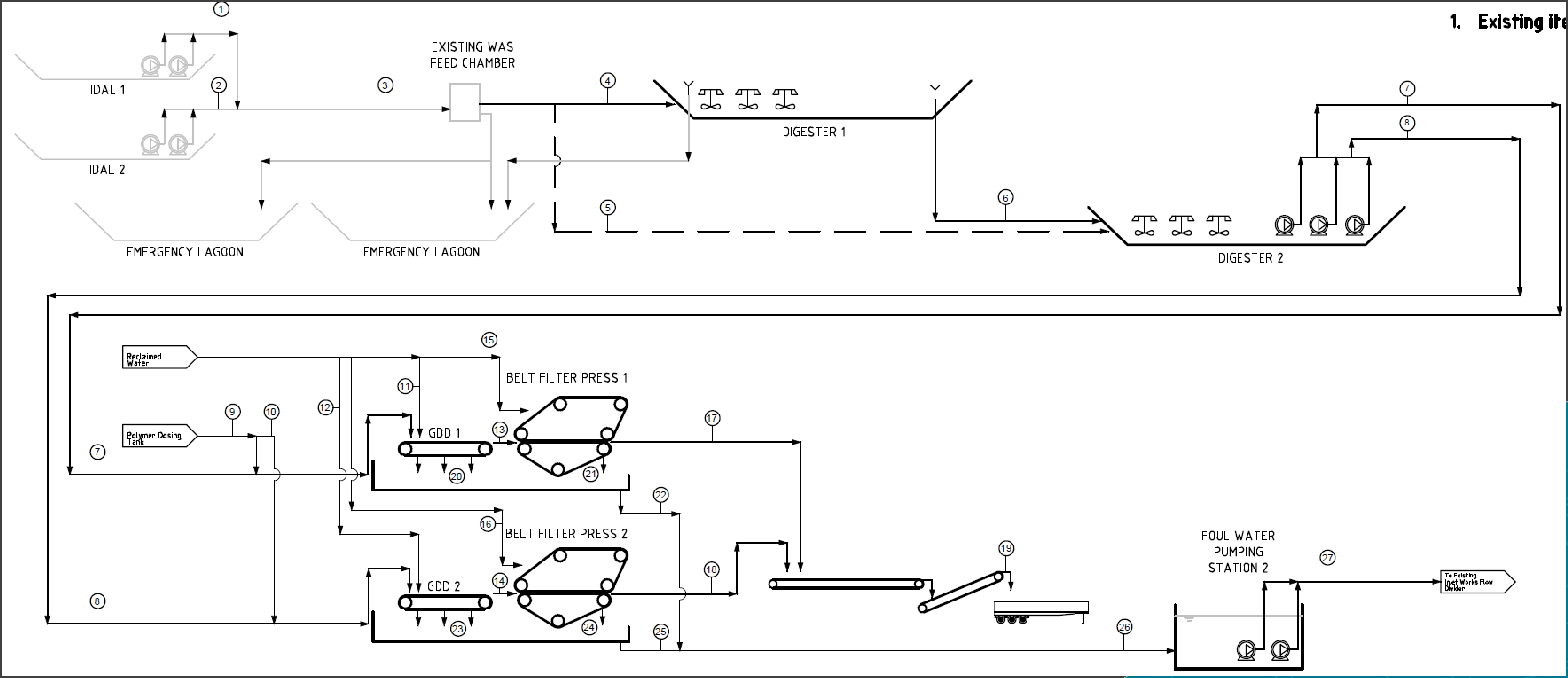

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EPCM Delivery Method

- Delivered by Hunter H2O under an Engineering, Procurement, Contract Management (EPCM) framework.
- Collaborative, partnering approach which required consultation with multiple stakeholders during planning and implementation phases.
- The project required integration of various design disciplines and the application of project delivery, contract management, construction supervision and commissioning expertise.
- The entire project ran for approximately 2 years, from problem definition through to handover and covered all key project stages
- Key advantages of the EPCM delivery model at Shortland STP;
  - Allowed sludge digestion solution to be fast tracked
  - Resulted in significant cost savings by properly resourcing planning and design stages
  - Simplified administration as all components were completed by the one main contractor
  - Consistency of dealing with the one project team throughout the project streamlined review
  - Allowed for a risk allocation that reduced overall project costs.

Interim Sludge Management

- Interim sludge management strategy key to project success
- Managed risks associated with reduced sludge lagoon volume (i.e. Lagoon 3 offline)
  - A number of options were investigated including;
  - Increased frequency of dewatering – producing Grade C sludge
  - Recuperative thickening to increase lagoon capacity
  - Reshaping of existing lagoons to increase lagoon capacity
  - Construction of a temporary lagoon
  - Supplementary geotubes
  - Tankering sludge to alternate sites
  - Direct dewatering from the IDALs
- MCA found increased dewatering frequency as preferred
- Redundancy provision to tanker WAS to other sites if odour / compliance issues arose
- Reduced stability required alternate management at biosolids reuse sites
- Through proper planning impact of taking lagoons offline for conversion can be managed

Smart Island Water

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- Is well suited to the pacific given the number of pond systems already employed
- Leads to lower cost upgrades – saving communities money
- Delivers better treatment objectives – leading to better social and environmental outcomes
- Increasing treatment intensities – reducing footprints and lowering odour emissions
- Improved effluent quality may increase effluent reuse opportunities – agile water resource management.
- Requires greater treatment / operational knowledge – upskilling communities

Questions ?