CITIWATER TOWNSVILLE

CLEVELAND BAY WASTEWATER PURIFICATION PLANT

Sewage (or wastewater) is the name given for water that you have used in the toilet, in the shower, bathroom, kitchen sink and laundry. Shops, restaurants and factories also produce large quantities of wastewater. The Cleveland Bay Wastewater Purification Plant receives sewage from many suburbs in Townsville. These include for example North Ward, Wulguru, Annandale, Hyde Park, Hermit Park, Currajong, Railway Estate, Mundingburra, Oonoonba, Cluden, Rosslea, Vincent, Gulliver, Castle Hill, Cranbrook and Stuart.

After you have used water, the wastewater (or effluent) starts a journey through a series of pipelines, and pump stations, which we call the Sewerage System, where water is pumped to the Wastewater Treatment Plant. Wastewater therefore is the liquid that flows through the Sewerage System to the Treatment Plant. While the wastewater arriving at the CBPP is 99% water, there are many different kinds of pollutants in it including human waste, paper, grease and oils, detergents, and even plastic bags and needles. Wastewater also contains dissolved nutrients such as nitrogen and phosphorus, assorted chemicals and a range of microscopic bacteria and viruses. The Cleveland Bay Wastewater Purification Plant receives and treats an average of 20 million litres of sewage everyday. This Treatment Plant has two Flow Measuring Flumes that monitor the volume of wastewater coming in to the Plant.

The aim of the Wastewater Treatment Plant is to remove as much solid and organic materials, nutrients and harmful bacteria from the water as possible, so that it is possible to discharge it back into the environment or to reuse it in many different ways. Treated wastewater is an important resource that can be reused for many purposes including irrigation of parks, public gardens, agriculture and pasture. For example, effluent is reused by this very Treatment Plant to water its lawns. By reusing wastewater we are not only recycling this valuable resource but also conserving clean, fresh water from the catchment.

Sludge and gases can also be reused. For example the treated sludge from this Plant is reused by industry for mulching and topsoil purposes. Methane and associated gases are reused to produce electricity. Wastewater at the Cleveland Bay Purification Plant goes through primary and secondary treatments.

Primary Treatment

The primary treatment starts at the Raw Sewage Inflow Channels, where sewage enters the Plant. The purpose of the Primary Treatment is to remove solid materials from the incoming wastewater. This is done using rakes and screens. In addition, two large cylindrical screens catch small objects (greater than 3 mm), such as food particles and some grit/sand. The solid materials caught from these processes, are taken away to landfill.

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Aerated Grit Tanks

The removal of these solids not only helps treat the water but also prevents damage or blockage of the Treatment Plant downstream. The remaining wastewater, containing dissolved nutrients, organic matter, viruses and bacteria, flows to the Aerated Grit Tanks, where the water is aerated with diffused air. The consequence of bubbling air into the water helps to separate the remaining grit from the organic material. The grit falls to the bottom of the tank and settles in collection hoppers. Pumps are used to remove the grit from the hoppers which are then buried. The wastewater then flows to the Flow Distributor, which acts like a large pump, distributing wastewater and Activated Sludge around the Treatment Plant. From here water goes to the Secondary Treatment.

Secondary Treatment

It is in the Aeration Basin that the secondary treatment of the wastewater starts. The Basin is 130m x 20m and is 2.4m deep. It receives wastewater from both Primary Treatment and Returned Activated Sludge from the Clarifier. Here, nature is given the opportunity to lend a hand as good microbes (you can't see them without a microscope) begin to devour organic material and nutrients in the water. As they eat and reproduce, the microbes use the oxygen contained in the water.

Aeration Basin

Aerators, paddles and concrete weirs in the Basin ensure the wastewater is constantly mixed and aerated, allowing oxygen to enter the Basin and the microbes to eat as much as they can of the waste. The nitrogen from this process is converted to nitrogen gas and it is released into the atmosphere. The phosphorus consumed by the microbes remains in their bodies while the organic material is converted to microbe bodymass. By the time the microbes have eaten all they can, the water is virtually free of solids. Cleaner water from this process goes to the Clarification Tank (Clarifier).

The Clarifier is a large tank where the water flows into very slowly. This slow flow allows the microbes and any remaining organic material to settle on the bottom of the Tank as sludge. The cleaner water flows off the top of the Tank (launder) while the muddy sludge is pumped off the bottom.

Sludge

Around 10% of the sludge from the bottom of the Clarifier is pumped to the Primary Sludge Digester Tanks where it is further broken down. The

Clarifier Number 2

remaining 90% of the sludge is injected back into the Flow Distributor and to the Aeration Basin to breakdown the incoming raw sewage. We call this Activated Sludge and it ensures that there are always plenty of hungry good microbes in the system, ready to eat organic material and nutrients in the wastewater, for a cleaner product.

Sludge from the Clarifiers consists of water (around 98%), nutrient-rich microbes, organic material and microbe waste. There may also be some pathogens such as viruses and bacteria. Treatment of the waste activated sludge is important for making disposal easier, reducing health risks and preventing odour problems. When returning to the Flow Distributor, a proportion of the return activated sludge is pumped to the Dissolved Air Flotation Thickener Tanks (DAF Unit).

DAF Unit

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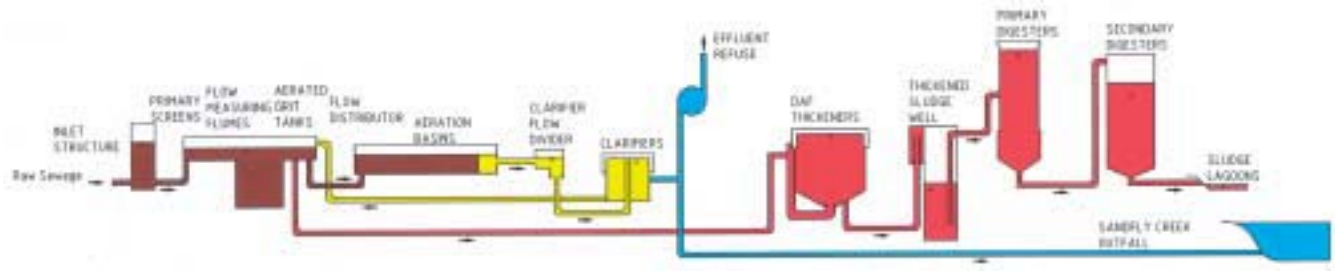
At the DAF Unit, a polymer solution (granules mixed in water) is added to the sludge to aid the flocculation process (microbes and organic matter in the water clump together). In the next step, dissolved air (high pressure injected air) is added which mixes with the flocs (clumps) causing them to float to the top. The floating sludge is then skimmed off the top of the DAF Tank and pumped to the two Primary Sludge Digester Tanks to feed the microbes.

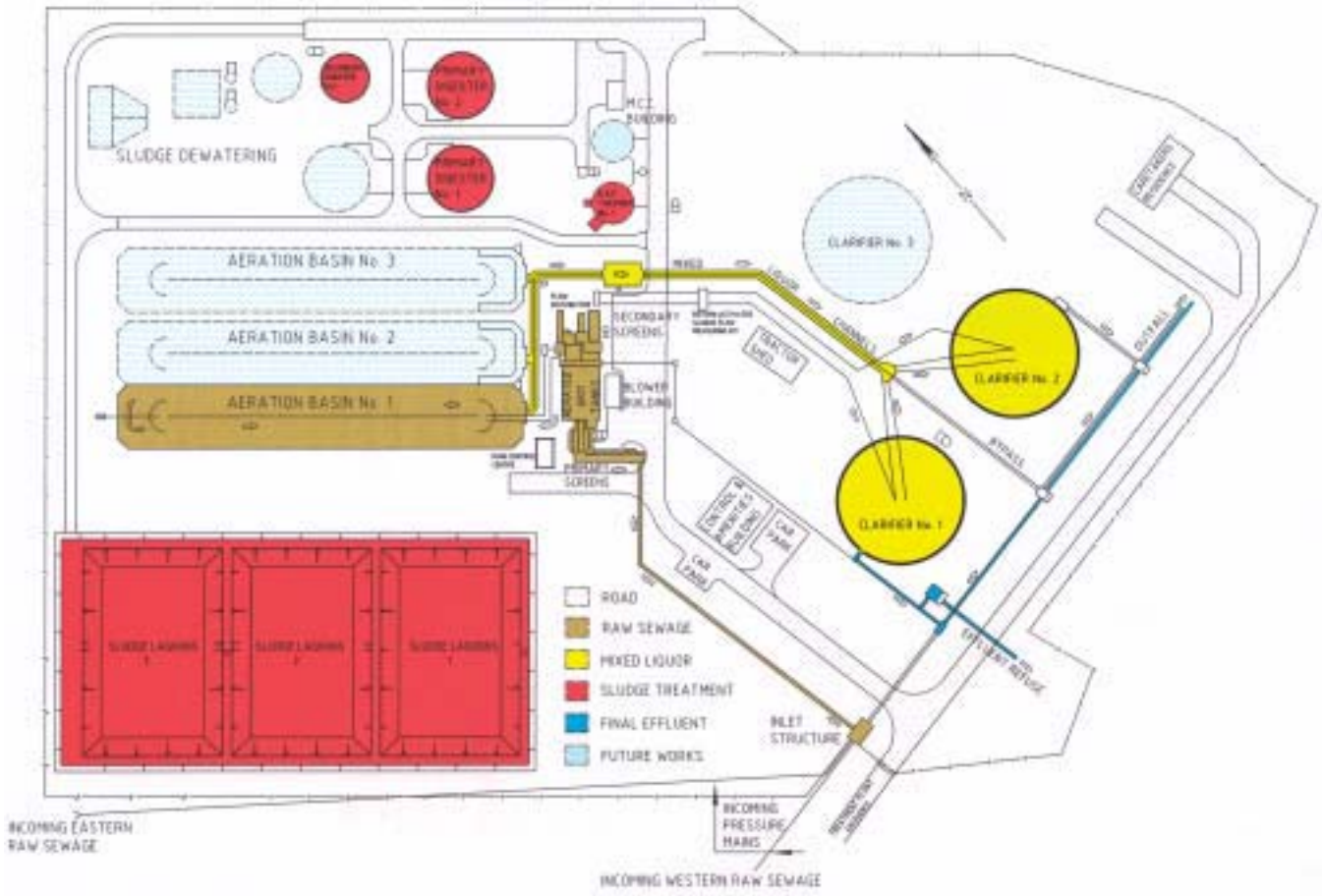
Sludge entering the two Primary Digester Tanks contains 95% of water. Each tank can hold 2ML (million litres) of sludge.

Inside, the sludge is heated to a temperature of 35°C (approximately body temperature), using methane gas produced by the Sludge Digester Tanks. The microbes in the 2 Primary Digester Tanks eat and digest most of the remaining organic material in the water.

Flow Diagram



Site Layout



Sludge Digester Tanks

Because there is no air in it (anaerobic), the microbes use oxygen from other chemicals in the sludge such as sulphates, nitrates and phosphates, breaking down their composition. Sludge stays in the 2 Primary Digester Tanks for around 30-40 days, then is pumped to the Secondary Digester Tank for further digestion and dewatering.

Inside the Secondary Digester Tank, the heavy sludge settles on the bottom and flows by gravity out to the Sludge Drying Lagoons. The lagoons allow water in the sludge to evaporate, while UV rays from the sun kill any remaining pathogens. The dried sludge in the lagoon is removed annually to prevent the drying bed from filling up. Future plans for this Plant include a Belt Filter Press that squeezes the sludge dry, eliminating the need for the Drying Lagoons.

Biogas

Methane gas is produced in the Primary Sludge Digester Tanks and is collected to generate and provide electricity for this Treatment Plant. We call this process Biogas. The Biogas collects 100% of the methane and associated gases produced from the sludge treatment and it provides 30% of the electricity needed to maintain this Treatment Plant. Methane is a greenhouse gas that causes global warming. By reusing this gas we are cutting methane emission into the atmosphere, and thus we are keeping our air cleaner.

Treatment of wastewater at Cleveland Bay Wastewater Purification Plant is in accordance with standards set by the Department of Environment. Citiwater operates a Quality Management System that complies with the requirements of international standards ISO 9002. We also adopt a professional and best practice approach to manage Townsville's water and wastewater business. Citiwater is committed to evaluate alternatives to improve the water system in Townsville, and to reuse resources generated by the wastewater treatment such as effluent, gases and sludge. The advantages of reusing these resources benefit the community in many ways such as keeping our air clean and conserving the fresh clean water from the catchment, avoiding polluting our environment. Thus we are helping Australia to achieve sustainable development.

Biogas and Primary Digester

Technical Data

Influent Characteristics (95%)
BOD_5: 200 mg/L
Suspended Solids: 125 mg/L
Ammonia: 30 mg/L
Organic Nitrogen: 20 mg/L
Total Phosphorus: 15 mg/L

Effluent Requirements
BOD_5: 30 mg/L
Suspended Solids: 20 mg/L

Plant Capacity
Dry Weather Flow rate: 29 ML/d
Wet Weather Flow rate: 87 ML/d
Equivalent Population: 126,000 EP

Commissioning Dates
Activated Sludge Treatment Stage 1: August 1988
Waste Sludge Treatment Stage 1: June 1994

Unit Operations Details

Aeration Tank
Number: 1
Total Volume: 6 ML
Length: 130 m
Width: 20 m
Water Depth: 2.4 m
Aerator (horizontal mammoth): 10 (5 dual units)
Length: 9 m
Diameter: 1 m
Minimum Velocity: 0.3 m/s
Oxygen Transfer (SOR): 6.2 Kg 0_2/m/h at 200 mm rotor immersion
Sludge Age: 1-2 days
F/M ratio (current): 0.8 kg BOD/kg MLSS

Clarifier
Number: 2
Diameter: 38.4 m
Water Depth: 4.2 m

Control System
Siemens PLC and Citect Software

DAFT Unit
Number: 1
Diameter: 12 m
Water Depth: 3 m
Solids Loading: 2 Kg/m^2/h

Grit Chambers
Number: 2
Section: 4m x 3m
Length: 17 m

Primary Digester
Type: Floating cover
Number: 2
Diameter: 20.4 m
Height: 8.6 m
Effective Capacity: 2260 m^3
Operating Temperature: 35°C
Gas Production: 1300 m^3/day
Heater Capacity: 150 kW

Return Sludge Pump Station
Number Pumps (1 duty): 2
Pump Flow rate (1 pump): 200 L/s
Pump Type: Archimedian Screw

Rotary Drum Screens
Number: 2
Screen Capacity: 45 ML/d
Wedgewire Slot width: 3.0 mm

Secondary Digester
Number: 1
Diameter: 15.0 m
Height: 7 m
Effective Capacity: 1130 m^3

CITIWATER TOWNSVILLE
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