Guheshowri Wastewater Treatment Plant (32.4) MLD treatment process and plant layout.

1.1 Pre-treatment

The pre-treatment is to remove the floating material, grit and sand from the influent wastewater. The influent invariably contains floating materials which are removed before feeding into further treatment units by passing the influent through bar screens. Grit is removed in grit chambers. In the grit chamber heavy particles (grit) with a high settling velocity are removed by sedimentation. Organic material like oil and grease is removed by the flotation process in the aerated grit chamber. The degritted wastewater from the grit separator units is then routed to primary treatment.

1.2 Primary Treatment

The primary treatment solids are settled in primary sedimentation tank under relatively quiescent conditions to remove the settleable organic solids which itself accounts for part of BOD removal, with the settling and withdrawal of primary sludge.

1.3 Biological Treatment

After the primary settling, the wastewater is subjected to biodegradation in an aeration tank, which operates on conventional activated sludge process, basically an aerobic suspended growth system, with bio-sludge re-circulation. The principal of biological treatment is to convert soluble or dispersed organic wastewater constituents, which cannot be removed from the wastewater by preliminary treatment, into biomass. Thus, the pollutants are converted into a settleable form, which in turn can be removed from the wastewater by a final sedimentation step. At the same time, the soluble and colloidal organic materials, which remain following primary treatment of screening, de-gritting and primary sedimentation is metabolized by a diverse group of microorganisms to carbon dioxide and water, to derive energy. Activated sludge comprises of a mixed microbial culture wherein the bacteria are responsible for oxidizing the organic matter, while protozoa consume the dispersed un-flocculated bacteria and rotifers consume the unsettled small bio-flocs in the treated sewage, performing the role of polishers. The utilization of substrate by a bacterial cell can be described as a three-step process:

- The substrate molecule contacts the cell wall
- The substrate molecule is transported into the cell
- Metabolism of the substrate molecule by the cell

However, as the bacteria requires the molecule in the soluble form, colloidal and spherically incompatible molecules, which cannot be readily biodegradable have to be first adsorbed to the cell surface and then broken down or transformed externally to transportable fractions by exoenzymes or wall bounded enzymes. The bacteria, resulting in cell synthesis and energy for maintenance, will utilize the organic matter.

The following reaction best describes the overall organic utilization by the aerobic bacteria:

Oxidation:

$COHNS + O_2 + Bacteria \rightarrow CO_2 + NH_3 + other\ end\ Products + Energy$

Synthesis:

$COHNS + O_2 + Bacteria \rightarrow C_5H_7O_2N\ (New\ Bacterial\ Cell)$

Endogenous Respiration:

$C_5H_7O_2N + 5\ O_2 \rightarrow 5CO_2 + NH_3 + 2H_2O + Energy$

The nutrients viz. Nitrogen and Phosphorous present in the wastewater are adequate to cater to the nutrient requirements of the aerobic microorganisms and to enhance the activity of the aerobic microbes. In addition to the nutrient requirements, the aerobic microbes require oxygen to sustain their microbial activity. Oxygen also functions as a terminal electron acceptor in the energy metabolism of the aerobic heterotrophic organisms, indigenous to the activated sludge process. In other words, a portion of the organic material removed is oxidized to provide energy for the maintenance function and the synthesis function.
If the bacteria are starved of nutrients, the bacterial death rate exceeds the production of new cells. This is because the microorganisms are forced to metabolize their own protoplasm without replacement, resulting in decrease in the biological mass. This is also known as the endogenous phase. Any oxidation must be coupled with reduction, and oxygen satisfies this requirement in the aerobic microorganisms. Oxygen is supplied in the form of air to satisfy the aeration requirement of the aerobic microorganisms. Sufficient numbers of membrane diffusers are installed in the aeration tank to transfer the necessary oxygen from the air supplied by air blowers, to sustain the activity of the aerobic microbes. The overflow from the aeration tank contains a high concentration of microorganisms. A secondary clarifier helps in separating the microorganisms from the liquid stream in the bottom sludge and to produce high quality sewage. The underflow sludge is recycled to the activated sludge system as it helps to maintain the desired mixed liquor suspended solids concentration in the aeration tank.

1.4 Tertiary Treatment

In tertiary treatment solids in wastewater from secondary clarifier outlet are removed by using disc filters to meet the design TSS level of < 10 mg/l. The disc filters has fiber cloth as a filtering media.

1.5 Chlorination

Treated wastewater is then disinfected by chlorination to reduce the coliforms level present in the treated wastewater to the desired levels. After disinfection, the treated wastewater is disposed of to the nearby Bagmati River through existing tunnel. Electro chlorination system is provided for chlorination. Electro chlorination is a simple and proven technology to convert ordinary salt water

into Sodium Hypochlorite by means of Electrolysis. Sodium hypochlorite is dosed into chlorine contact tank for chlorination of wastewater.

1.6 Sludge Handling

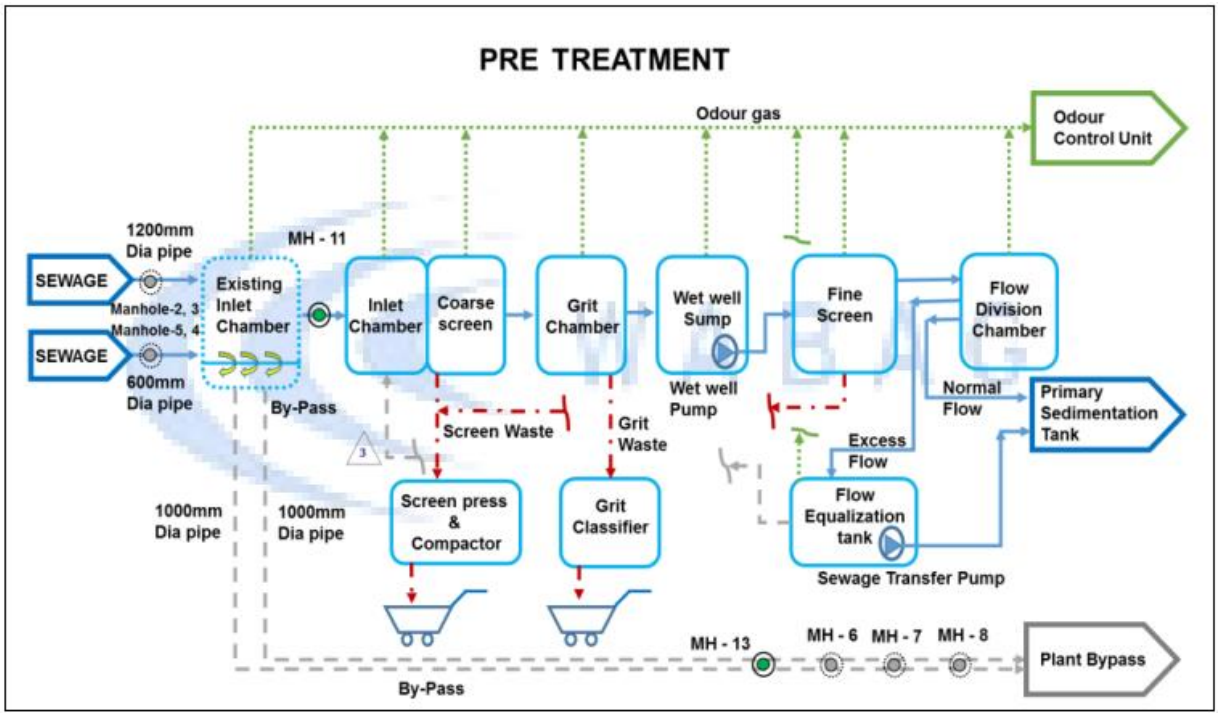
The sludge handling and treatment section consists of thickening and anaerobic digestion of the sludge for gas production and disposal of dewatered digested sludge in the form of cake. Biogas produced from anaerobic digestion is utilized to produce power by gas engine.

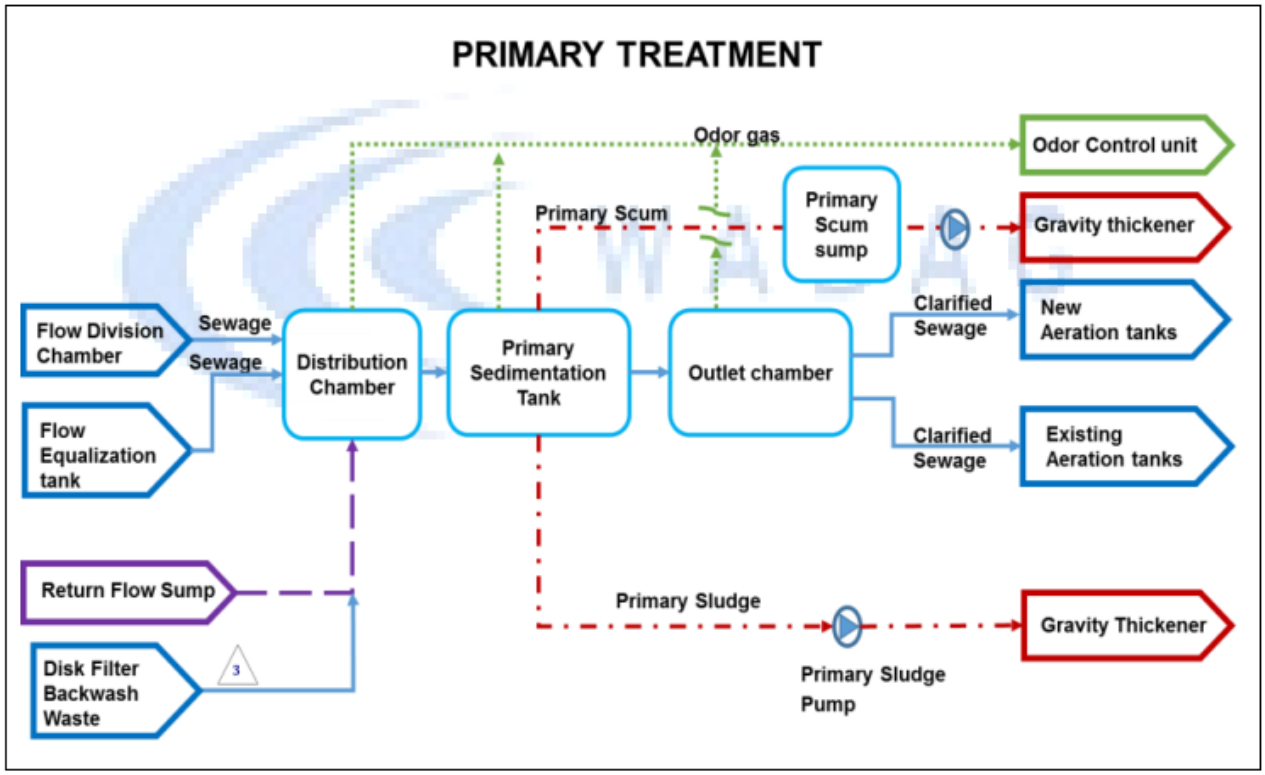
The primary sludge from the primary clarifiers and excess activated sludge from the secondary clarifiers are thickened in the gravity sludge thickener & belt thickener and the combined thickened sludge is subjected to anaerobic digestion. Pre-thickening of sludge before digestion results in the following benefits:

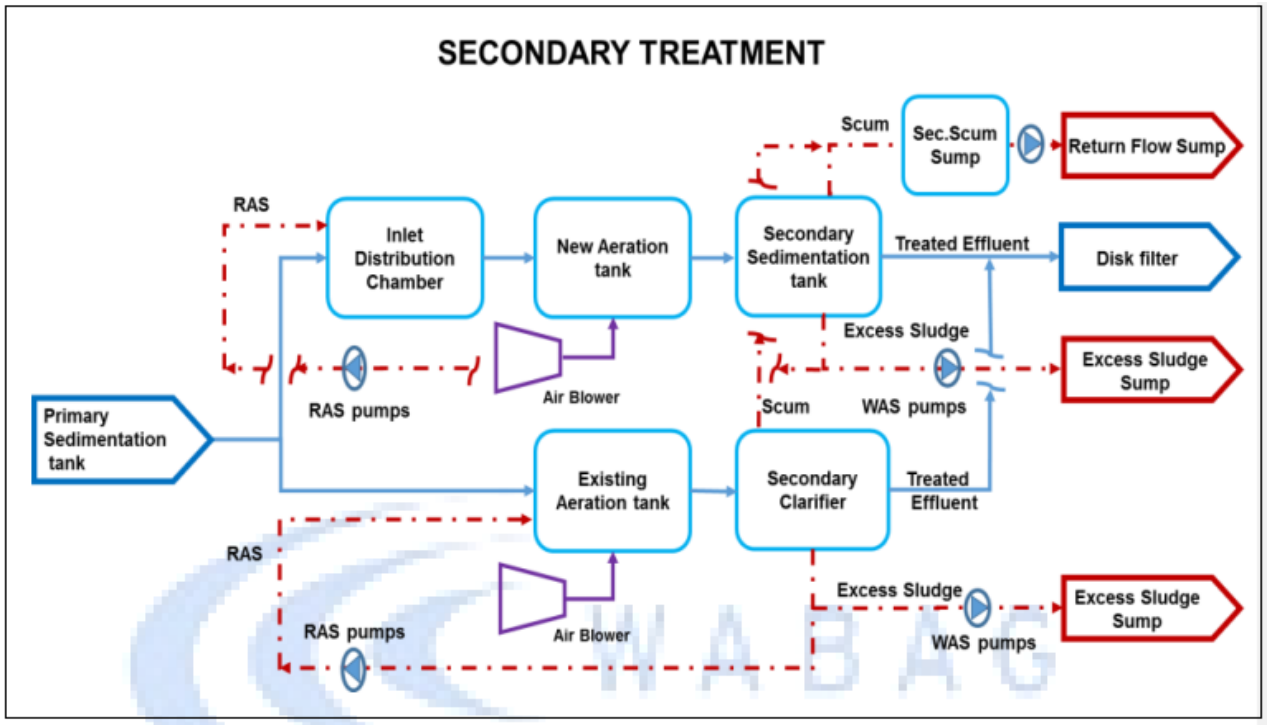
- Reduction in Digester volume requirement
- Less mixing energy requirement

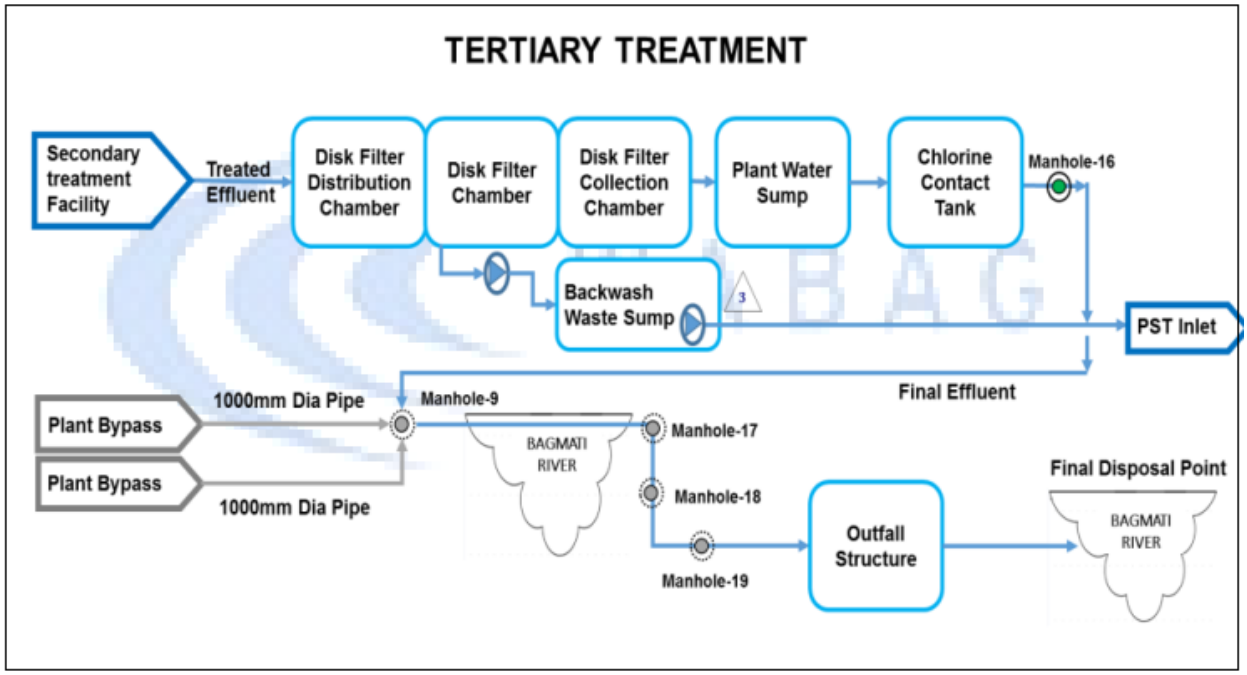
The digested sludge is de-watered in centrifuge aided by the polyelectrolyte dosing and mixed with lime and then disposed off safely to the landfill site.

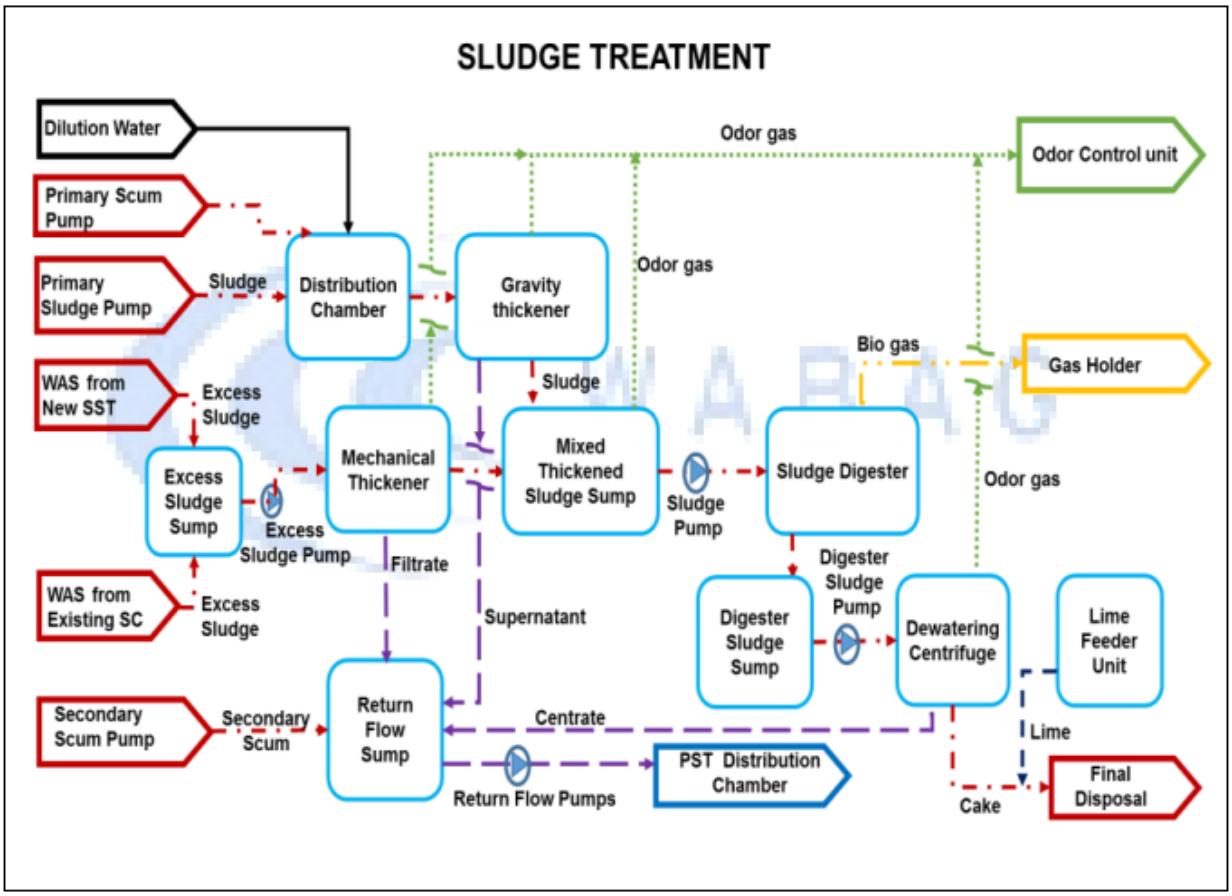
2 Plant Layout






SECONDARY TREATMENT
Scum
Sec.Scum Sump
Return Flow Sump
RAS
Inlet Distribution Chamber
New Aeration tank
Secondary Sedimentation tank
Treated Effluent
Disk filter
Excess Sludge
Excess Sludge Sump
RAS pumps
Air Blower
Scum
WAS pumps
Primary Sedimentation tank
Existing Aeration tank
Secondary Clarifier
Treated Effluent
RAS
Excess Sludge
Excess Sludge Sump
RAS pumps
Air Blower
WAS pumps


TERTIARY TREATMENT
Secondary treatment Facility
Treated Effluent
Disk Filter Distribution Chamber
Disk Filter Chamber
Disk Filter Collection Chamber
Plant Water Sump
Chlorine Contact Tank
Manhole-16
Backwash Waste Sump
3
PST Inlet
Final Effluent
1000mm Dia Pipe
Manhole-9
Plant Bypass
Plant Bypass
1000mm Dia Pipe
BAGMATI RIVER
Manhole-17
Manhole-18
Manhole-19
Outfall Structure
Final Disposal Point
BAGMATI RIVER


SLUDGE TREATMENT
Dilution Water
Primary Scum Pump
Primary Sludge Pump
Sludge
WAS from New SST
Excess Sludge
Excess Sludge Sump
Excess Sludge Pump
WAS from Existing SC
Excess Sludge
Secondary Scum Pump
Secondary Scum
Distribution Chamber
Gravity thickener
Odor gas
Odor Control unit
Sludge
Mechanical Thickener
Mixed Thickened Sludge Sump
Sludge Pump
Sludge Digester
Bio gas
Gas Holder
Odor gas
Filtrate
Supernatant
Digester Sludge Pump
Digester Sludge Sump
Dewatering Centrifuge
Lime Feeder Unit
Lime
Return Flow Sump
Centrate
Return Flow Pumps
PST Distribution Chamber
Cake
Final Disposal