Nyaungnapin Water Treatment Plant
Yangon, Myanmar

1 Background Information

Surface water is the major source of drinking water in Yangon city. Gyobyu, Phugyi, Hlawga, and Nga Moe Yeik are the four main reservoirs that serve the purpose, as shown in Figure 1. In some areas, groundwater wells are also used. Six hundred MLD of waster is required for 5.8 million people in Yangon city. The authorities of Yangon City Development Committee (YCDC) distribute 340 MLD of water from Nyaungnapin Water Treatment Plant alone. The plant was established with an initial treatment capacity of 170 MLD. In April 2014, the planning and construction of the second phase of the water treatment plant and water channel were started which would expand the treatment capacity of the plant to 340 MLD.

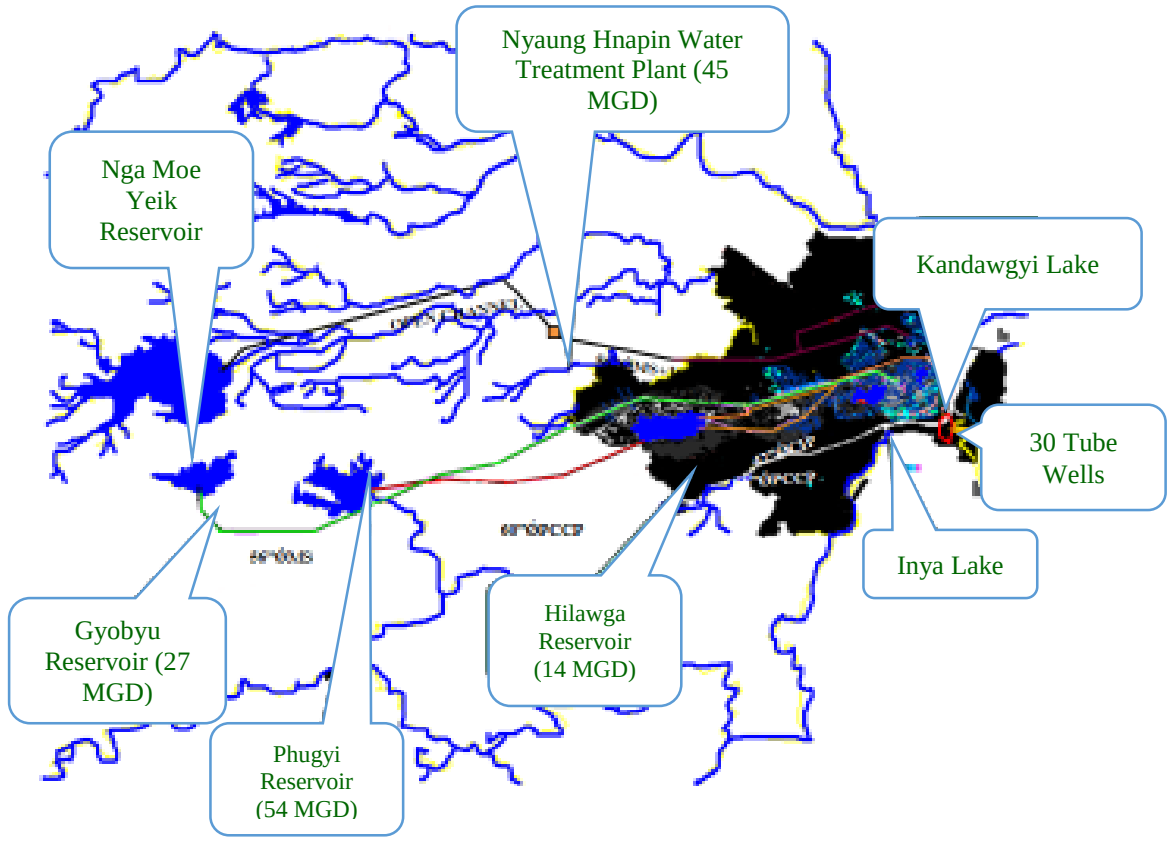

Figure 1: Location of raw water sources to Nyaungnapin WTP

Figure 2: Aerial view of Nyaungnapin WTP

2 Water treatment process flow

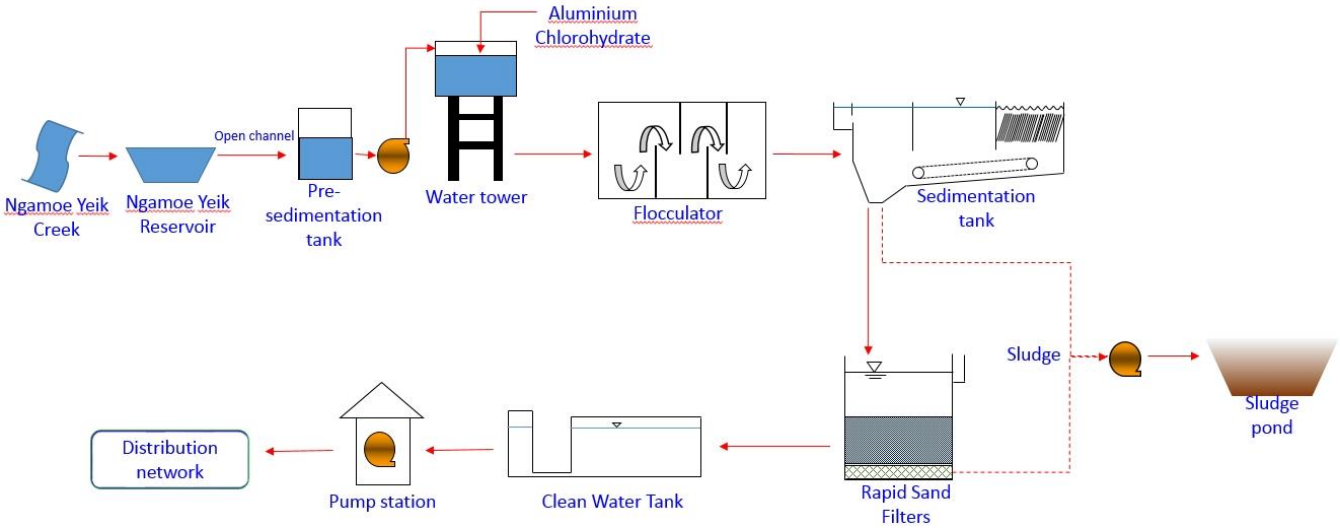

Figure 3: Schematic diagram of water treatment process in Nyaungnapin WTP

Ngamoe Yeik Creek → Ngamoe Yeik (water intake) reservoir → Pre-sedimentation tank → Addition of Aluminium Chlorohydrate [$Al_2Cl(OH)_5$] in the water tank → Flocculation unit → Sedimentation tank → Rapid Sand Filtration→ Clear well → Pump station → Distribution Network

2.1 Water intake

The raw water from Nag Moe Yeik reservoir is supplied to the water treatment plant by a trapezoidal open channel. The open channel is 10 km long and has a top width of 12.8m and a bed width of 7.3m.

The channel is 1.2m deep. The water flows into the channel with a carrying capacity of 7 m^3/s and the velocity of 0.6 m/s.

Figure 4: Nga Moe Yeik reservoir and open channel for transmission

2.2 Pre-sedimentation tank

Raw water is collected in two pre-sedimentation tanks, each with a dimension of 91 m length, and 61 m breadth. Each pre-sedimentation tank has a depth of 4.1 m. As raw water is conveyed using an open channel, the intake water quality varies depending on the weather pattern. This pre-sedimentation process helps to reduce the chemical dosing rate in the treatment process.

Figure 5: Pre-sedimentation tank

2.3 Low-lift pump

The water from the pre-sedimentation tanks is pumped to the water tower by using low lift pumps. There are four pumps available; while three pumps are in operation, and one is used as a standby for the alternating system. The operating capacity of the pumps is 57,000 m^3/d. Each pump has the specifications of 100 kW horsepower and 9.7m pump head.

Figure 6: Pumps to lift water from pre-sedimentation tank to water tower

Figure 7: Incoming water into the water tower

2.4 Water tower

The water tower allows the gravity flow of water to the purification processes. Thus, this system reduces the mechanical power requirement and saves the operation and maintenance costs. The length of the water tower is 12.1 m, and the breadth and the height are 6.4m and 6.5m respectively.

Figure 8: Water tower

2.5 Flocculator

The treatment process uses Aluminium chlorohydrate (ACH) as a coagulant to destabilize and increase the participle sizes of unwanted suspended solids and non-settable solids such as clay and organic substances in the water. The tanks are baffled with palm wood fiber board which allow the vertical (up and down) flow of water. This enables a gentle mixing of the water and brings the microflocs into contact with each other through the process of slow mixing. The collisions of the microfloc particles cause them to bond to produce larger, visible flocs, which, in turn, increases the particle size from submicroscopic microfloc to visible suspended particles. The detention time for this flocculation process is 22 minutes. There are 6 tanks, each with 22 m length, 7.3m breadth and 3m depth.

Figure 9: Flocculation unit (vertical baffled tanks)

2.6 Chemical dosing and storage

The treatment plant imports Aluminium Chlorohydrate (ACH) twice a year. To control and operate the chemical addition process, the plant uses an automatic sensing equipment. The treatment plant has recently started to store ACH in roofed storage spaces. The sensor detects the dosing rate of ACH automatically, and the unit is monitored for its smooth operation.

Figure 10: Chemical storage (uncovered-left, covered with roof-right)

Figure 11: Chemical injection equipment

2.7 Sedimentation tank

After flocculation, the water is sent to the sedimentation to allow settling of the flocs. The detention time for sedimentation is 2 hours, and the effluent is collected at the last part of the sedimentation unit with the constructed effluent collection system. There are 12 sedimentation tanks installed, each with a dimension of length 38m, breadth 11m, and depth 4m.

Figure 12: Sedimentation tanks

2.8 Rapid sand filter

The water from the sedimentation tank is then sent to the rapid sand filter. Small particles, bacteria, and virus in settled water from sedimentation tank are filtered in this process. There are 28 basins but only 14 work at a time (the other 14 stay in standby). However, due to intermixing of the filter media, filtration process is not very efficient.

The dimension of each sand filtration unit is 7.3 m length x 4.5m breadth x 4.7m depth. The filtration rate is 9.6m/h.

Figure 13: Rapid sand filtration unit (left) and model of the filter media (right)

Backwashing of media filters is done once every day using clear water to remove the trapped particles from the filter.

Figure 14: Backwashing pipelines

2.9 Clear well

After rapid sand filtration, the treated water is sent to the underground clear water tank (clear well) until it is distributed for the Yangon City. The clear water tank can hold 5300 m^3 of water. It has a length of 58m, breadth of 19m and depth of 5.4m.

Figure 15: Clear Water Well (or Treated Water Storage Tank)

2.10 Pumping stations and distribution

There are two pumping stations to distribute the treated water from this water treatment plant to Yangon City. Booster pumps are installed in pumping station to pump the treated water for

distribution. In the first pumping station, there are four pumps of which three are operating and one is kept as a backup. The installed capacity of the 4 pumps is 68,000 m^3/d. At the second pumping station, there are six pumps of which four are operated and two kept in standby. The computerized control system controls all the low lift pumps and booster pumps. The specifications of the pumps can be summarized as following:

Table 1: Specifications of the pumps in the two pumping stations

	Pumping station 1	Pumping station 2
Capacity	68,000 m^3/d	51,143 m^3/d
No. of pumps	4	6
Horse Power	800 kW	560 kW
Head	72m	72 m
Speed	1480 rpm	991 rpm

Figure 16: Pumping stations in Nyaungnapin WTP

2.11 Sludge removal

At the sedimentation tank, sludge removing pipes are installed to pump out the sludge. With this system, the sludge removal process is done once a year. However, the existing system needs drastic improvement since it does not function effectively and the sludge needs to be taken out manually. The discharged sludge is put in the open pond to dry.

Figure 17: Discharging sludge from the sedimentation tanks

3 Advanced technology used in this water treatment plant or any points to improve the process, water quality and capacity

The water treatment plant is a conventional one that operates in a pre-sedimentation-sedimentation-filtration-disinfection based mechanism. No other advanced technology is in use.

4 Aspects of treatment process posing most difficulty for daily operation

Four aspects of the treatment process have a few deficiencies in their working mechanism which, in turn, have caused nuisance in the treatment of water in Nyaungnapin WTP:

i. Lack of roofs at the storage site of ACH
ii. Difficulties in adjusting the chemical dosage to counter the frequent changes in water quality since water quality parameters are measured once a day
iii. Inefficient removal and disposal of sludge from the sedimentation basin
iv. Filtration system does not function efficiently due to intermixing of filter media

5 Aspects of water services management, in general, posing most difficulty at the moment

Problems such as excessive non-revenue water (NRW) due to leakages have been posing problems in the water supply. There are also some problems in the installment of water meters and billing systems.

6 Measures taken now to cope with 4) and 5)

The following measures have been adopted to improve or cope with the problems identified in points 4 and 5:

i. Roof construction at the storage site to store ACH and prevent damages or losses in concentrations
ii. Hourly measurement and monitoring of water quality parameters to better adjust to fluctuating water quality parameters
iii. Re-aligning (lowering) the sludge disposal pipe to ensure a smooth flow of the sludge, and installation of a mechanical scrapper to remove sludge collected far away from the discharge pipes
iv. Replacement of filtration media such that four layers of filter materials, viz. 20 cm of anthracite, 40 cm of sand, 30 cm of gravel, and perforated blocks, are stacked in a vertical later.
v. Training the staff to enhance their core competency in conducting timely repairs and maintenance to mitigate NRW.

7 Recent investment made for the plant's improvement

In 2014, USD 19 million was invested for the second phase of Nyaunghnapin Water Treatment Plant which dealt with HDPE pipe installation from Kabaraye pagoda road to Yankin town as well as the construction of the second Nyaungnapin Pump Station. USD 610, 000 was also invested recently as a part of the NRW Reduction project in Mayangon town.

8 Other Highlights

For the mitigation of NRW, the staffs of the treatment plant have been participating in several training, including NRW reduction pilot project by grass root grant of the Japanese government.

9 Water quality data

The water quality laboratory at the Nyaungnapin WTP monitors six parameters every hour as listed in Table 2.

Table 2: Water quality data at Nyaungnapin WTP

SN	Parameters	Unit	Nyaungnapin WTP		Myanmar standard
			Raw water	After treatment	
1	pH	-	7.37	7.22	6.5-8.5
2	Turbidity	NTU	45	1.3	5
3	Colour	Pt-unit	<5.00	5	15
4	Total Dissolved Solids	mg/L	122.3	55	1000
5	Salinity	Parts per thousand (ppt)	0.06	0.06	0.5
6	Electrical conductivity	µS/cm	116.7	118.3	1500

10 References

i. Oo, Thwe Naing (2015). *Situation of Water Supply System of Yangon City and its future demand*. Yangon City Development Committee

ii. Nippon Koei Co. Ltd., et. al. (2013). *A Strategic Urban Development Plan of Greater Yangon: The Project for the Strategic Urban Development Plan of the Greater Yangon. Final Report-I, Part-I: The Current Conditions.* **http://open_jicareport.jica.go.jp/pdf/12122529_01.pdf**

iii. *Project for the Improvement of Water Supply, Sewerage and Drainage System in Yangon City. Final report: Volume IV-Water Supply System Feasibility Study.* **http://open_jicareport.jica.go.jp/pdf/1000017297_02.pdf**

Prepared by:

Ms. Su Su Myat, Mr. Phyo Myint Oo, and Ms. June Khaing Wint Tun
Asian Institute of Technology
P.O. Box 4, Klong Luang
Pathumthani 12120 Thailand

Date: February 1, 2017

URL: http://www.jwrc-net.or.jp/aswin/en/newtap
Email: newtap@jwrc-net.or.jp