

Bajo Water Treatment Plant Wangduephodrang, Bhutan

1. Background Information

Wangduephodrang Dzongkhag (District) is one of the largest districts in Bhutan. It is located in the western central part of Bhutan. Bajo is the urban town of Wangduephodrang which lies at an altitude of 1310m above sea level. The Bajo Water Treatment Plant (BWTP) serves approximately 6,000 water users through 330 metered pipe connections and is located about 1 Km from the Bajo town. The gravity water supply system was constructed in the early 2000s with raw water source from Baychu (a surface river). The intake in the river is located around 20 km from the town. Owing to increasing demand, in 2013 a compact water treatment plant of capacity 2400m³/day was commissioned to replace the conventional treatment plant that previously supplies drinking water to the town. BWTP is currently operating with the capacity of 1200 m³/day.

Table 1 Overall Information of Bajo Water Treatment Plant

Year of commissioning	2013
Water source	Baychu (surface source)
Design capacity (m ³ /day)	2400
Operating capacity (m ³ /day)	1200
Automated	Semi-automated
No. of operators working at the plant	2
Population served	6000 approx.
No. of connections	330
Treated water standard	WHO guidelines for drinking water quality
Date of access of the source information	2015
References	Water safety plans for BWTP

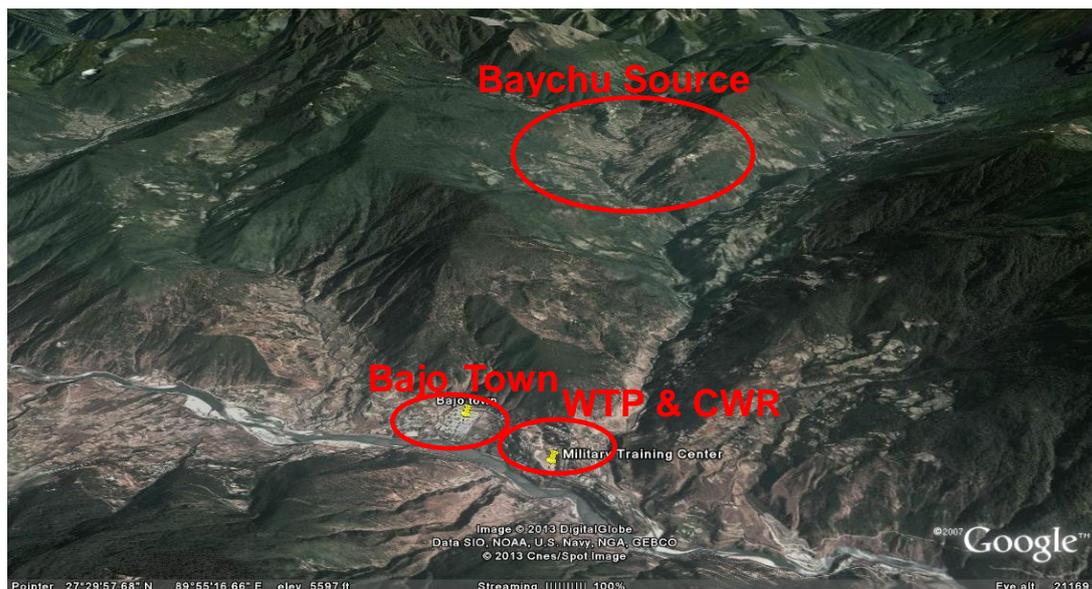


Figure 1 Bajo Water Supply System

2. Water treatment process flow

The water treatment process at BWTP is illustrated in **Figure 2**.

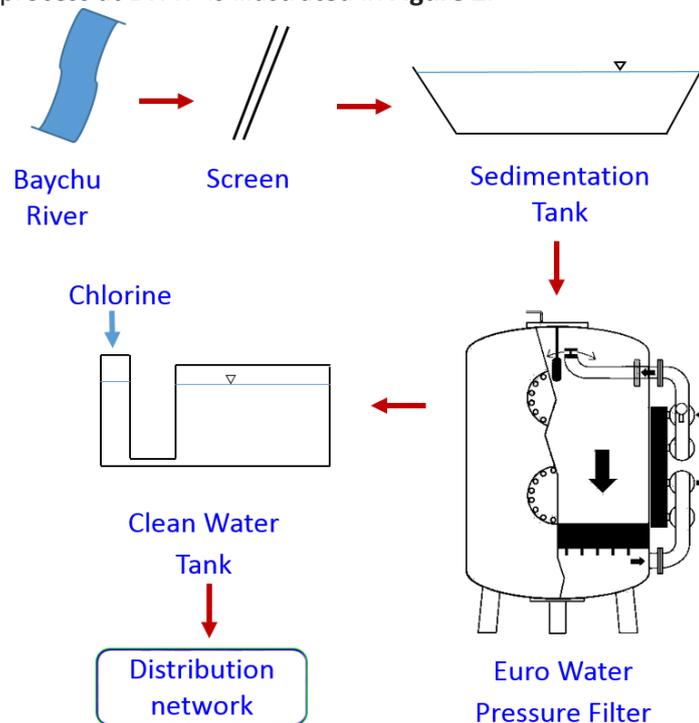


Figure 2 Schematic Diagram Water Treatment Process

The major water treatment process at BWTP includes:

Raw water extraction → Sedimentation → Euro Water Pressure Filter → Chlorination → Clearwater Reservoir → Distribution

BWTP lacks any kind of sludge treatment unit. The sludge collected from the sedimentation tank is disposed of in the allocated location nearby the sedimentation tank while the backwash water from the filtration unit is discharged to the storm water drain.

2.1 Water intake and Sedimentation

The source for the treatment plant is Baychu, a surface river with its intake located around 20 km from the town. The intake chamber outlet is equipped with a screen with adequate spacing to filter out grass, pieces of wood, straw and other materials. A plain sedimentation tank of size 24m x 8m is constructed at the source due to lack of space at the treatment plant. The retention time of the sedimentation tank is 3 hours. Two 150 mm Ø Ductile iron Pipe carries the water from the sedimentation tank at the source to the treatment plant. There is no proper sludge drying bed for the generated sludge from the sedimentation unit and the sludge is dumped in a designated area nearby where it is left to dry



Figure 1 Baychu Source and intake

2.2 Pressure filter

There are four units of Euro Water pressure filters at the BWTP and the media for these filters is hydro-anthracite. Like any other pressure filter, water passes through the media under pressure which is developed by pumping. Backwashing has to be carried out manually by operating the valves. Backwashing is done by blowing air through an air compressor followed by backwashing with treated water from the clear water reservoir. Backwashing is done once in a week on normal days and more frequent during monsoon. It takes around 20 to 30 minute to backwash each filter. The backwash water is not recycled but is drained to the storm water drains.



Figure 2 Pressure filters



Figure 3 Pressure filter pumps

2.3 Chemicals

Only one kind of chemical is used for the water treatment process which is bleaching powder (calcium hypochlorite) for disinfection. The mechanical dosing equipment consists of a mixing tank with a mechanical agitator and a dosing pump with connecting pipes and fittings. The required quantity of chlorine batch is prepared in the mixing tank and is agitated vigorously by the agitator until the bleaching powder is fully dissolved.

2.4 Disinfection process

Chlorination is carried out using bleaching powder through a mechanical chlorine dosing equipment. The dose is calculated with the target to maintain a residual chlorine of 0.2 mg/L at the end point of the distribution. Standard operating procedures for chlorine batch preparation and calculation of chlorine dose have been prepared and the operators are well trained to carry out these operations. Chlorine is dosed at the inlet of the clear water reservoir and a chlorine contact time of around 30 minutes is maintained in the clear water reservoir before the distribution.



Figure 4 Chlorine dosing equipment

2.5 Clear water storage and distribution

The treated water is stored in the four reinforced cement concrete tanks of capacity 437 m³, 537 m³, 257 m³ and 258 m³ respectively before being distributed. The distribution is done utilizing the gravitational flow.

3. Aspects of treatment process posing most difficulty for daily operation

Some of the aspect causing problem in the treatment are as follow:

- On the upstream side of the intake, there are few settlements which discharge untreated waste water and solid waste in the raw water source making it difficult for the treatment.
- During the monsoon, the turbidity spikes to more than 200 NTU thereby overloading the treatment plant and also increasing the frequency of backwash.
- As the raw water source is located far (20 km) from the treatment plant, operation and maintenance of the intake and the raw water mains are resource consuming.
- A caretaker is stationed at the intake and sedimentation tank and the area is well fenced. However, for cleaning, the operators from the WTP has to travel all the way to the intake site which is posing difficulty for regular operation.

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

Leakages and illegal connections in the distribution line are causing serious problem to the BWTP and it accounts a huge portion of the Non-Revenue Water (NRW). Although sufficient water is distributed to the customers, sometime complaints on water shortage are received due to loss of water due to leakages. Additionally, BWTP lacks financial and human resources for the smooth operation of the plant.

5. Measures taken now to cope with 3) and 4)

The installation of the compact water treatment plant to replace the conventional treatment plant has significantly improved the quality of water supplied. In addition, the water safety plan (WSP) for BWTP has been developed and its implementation started since 2013. As identified from the water safety plan, system operation and management have been strengthened through training of operators; development of operational monitoring plan; and development of standard operating procedures. This has contributed to significant changes in the infrastructure and management improvement thereby improving the quality of the supplied water.

6. Recent investment made for the plant's improvement

Following improvements were made recently:

- Provision of standby pumps for filter backwashing.
- Training program for development of operational monitoring plan.
- Provision of water quality testing kits for pH, turbidity, and residual chlorine.
- Refilling of filter media (hydro anthracite) for the pressure filters.

7. Technologies, facilities or other types of assistance needed to better cope with operational and management difficulties in 3) and 4).

- Improvement of laboratory facilities and equipment
- Need for online operational monitoring of the water treatment plant
- Development of skills of the operators on operational monitoring of the treatment plant

8. Customer's opinion on water quality and water services in general

The municipality maintains a complaint register and majority of the complaints are related to the quantity of water such as water shortages, pipe breakages, etc. There was a total of 55 complaints from January 2015 to January 2016.

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

In Bajo WTP, Euro water pressure filters are being used. The media used is hydro-anthracite which is very effective in reducing the turbidity of the water.

10. Water quality data

Water quality is monitored at the treatment plant as a part of the operational monitoring plan. The parameters monitored are pH, turbidity and residual chlorine. The water quality data for 2015 is as shown in **Table 2**.

Table 2 Water quality data (2015)

Parameter	Unit	Raw Water		Treated water	
		Min	Max	Min	Max
Turbidity	NTU	1.5	217	0	4.56
pH		6.5	8.5	6.5	7.5
Residual Chlorine	mg/L			0.2	0.8

11. References

Bajo Water Treatment Plant. (2013). Water safety plan for BWTP 2015 (Internal Report)

Bajo Water Treatment Plant. (2013). Operational monitoring plan for BWTP 2015 (Internal Report)

Prepared by:

Mr. Chhimi Dorji & Ms. Tshering Chhoden
ChhimiD Consulting
Thimpu, Bhutan

Disclaimer:

This report was prepared for the NewTap project, which is funded by the Japan Water Research Center. JWRC assumes no responsibility for the content of the report or for the opinions or statements of fact expressed in it. This report is presented solely for informational purposes. The copyright of this report is reserved by JWRC. For more details about the copyright, please refer to the site policy of the NewTap website.

Date: 31 March, 2016



URL: <http://www.jwrc-net.or.jp/aswin/en/newtap>

Email: newtap@jwrc-net.or.jp