Kohalpur Small Town Drinking Water Supply Project
Kohalpur, Banke, Nepal

1. Background Information

Kohalpur Small Town Water Supply Project (KSTWSP) was started with the initiation of Kohalpur Small Town Drinking Water Supply and Sanitation Users Association (KSTDWSSUA). The KSTWSP was initiated with a budget of approximately 1.16 million US dollars (85,756,643 Nepalese Rupees) with 50% funding support from the Nepal Government, 30 % from Regional government and 20 % from the water user's group. The construction of KSTWSP started in September 22, 2005 and completed in December, 26, 2008. The KSTWSP is managed by the KSTDWSSUA who elects a working committee of President, Vice President, Secretary and Treasurer for five-year tenure and the committee formed under the regulation of Nepal Drinking Water Regulation 2055 (1998 A.D.). The central working committee appoints technical and non-technical staffs to support the activities and operation of the KSTWSP and currently it has 21 employees including the central committee. The general information of KSTWSP is shown in **Table 1**.

Table 1 Overall Information of KSTWSP

Year of commissioning	2008
Type of source	Ground water
Climate	Sub-tropical climate
Elevation (m)	200 m above the mean sea level
Design capacity (m^3/d)	3283
Design period (yr)	15
Demand (m^3/d)	3110
Number of connected households	2350
Present production (m^3/d)	1555
Distribution length (km)	82
Automation	No
No of employees	21
Treatment technology	Sedimentation, DynaSand filter, chlorination

2. Water treatment process flow

The water treatment process at KSTWSP is illustrated in **Figure 1**.

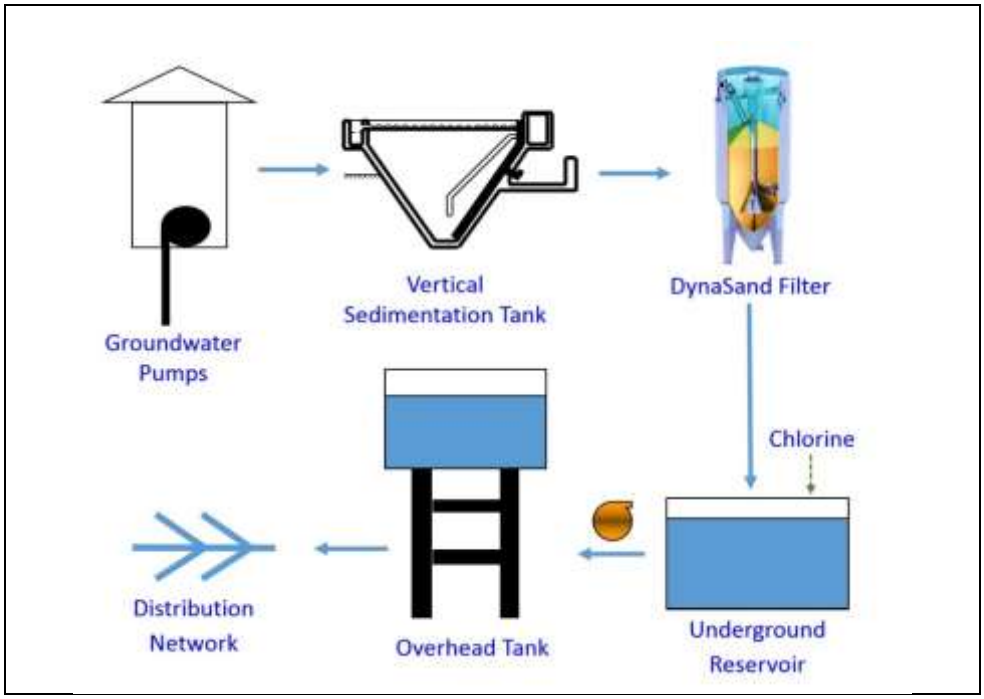

Figure 1 Schematic Diagram of Water Treatment Processes

The components of KSTWSP is presented in the **Figure 2**, which consists groundwater pumping stations, vertical water aerator and sedimentation tank, sand filter, manual chlorination and storage in underground reserve tank, overhead tank and distribution networks:

- ✓ Raw water extraction →Vertical Sedimentation Tank→ Filtration (DynaSand Filter) → Chlorination→ Underground reservoir → Overhead tank→ Distribution

KSTWSP does not produce any chemical sludge from the water treatment process. The sediments collected from the Vertical Sedimentation Tank is mainly composed of sand and soil particles which is either flushed to the drain along with the wash water or sometimes reused as construction material (for filling) or disposed in open fields.

Figure 2: A – Perforated aerator (10 m^3); B – Sand filters and C – Underground reservoir (100 m^3)

2.1 Water intake

The groundwater is being used as a main source of water for the KSTWSP. The groundwater can be pumped from the six deep bore holes (details in **Table 2**). **Figure 3** shows one of the two bore holes and pumping stations located inside the water treatment facility while four are located about 2 km from the facility.

Figure 3: Bore holes inside the water treatment facility

Table 2: Details on deep bore holes for groundwater extraction

Bore holes	Diameter (inch)	Discharge (L/s)	Location
I	8	N.F.	Inside the water treatment facility
II	8	6.5	Inside the water treatment facility
III	10	3.5	Near Kohalpur bus park
IV	6	14.0	Kohalpur highway
V	6	14.0	Kohalpur highway
VI	10	N.F.	Kohalpur highway

NF- Not Functioning

2.2. Vertical Sedimentation Tank

Water treatment system includes one Vertical Sedimentation Tank (**Figure 2A**) where the extracted groundwater passes through the perforated sheets and finally settles. The perforated plates contribute in aeration. The volume of the tank is 10 m^3 and have a diameter of 3 m and height of 5 m. The design flow rate of the vertical sedimentation tank is 36 L/s. The tank is cleaned every 7 – 15 days through the drain present at the bottom of the tank.

2.3 Chemical

Besides chlorination, the treatment plant does not exclusively use any chemicals in the water treatment process. KSTWSP does not produce chemical sludge from the primary sedimentation process.

Figure 4: Facility for the storage of chemicals

2.4 Filtration

The water from Vertical Sedimentation Tank flows gravitationally to the sand filters (DynaSand® Filters). There are two units of DynaSand® Filters with the volume of 10 m^3 and diameter of 3 m. The designed flow rate of the filtration tank is 18 L/s. The filter is cleaned annually and the filter is equipped with automatic backwashing mechanisms which uses compressors for cleaning the filter. However, due to technical failures of the backwashing mechanism, the filter is currently being cleaned manually. The sand collected from cleaning operation is washed manually and reused in the filtration process. The wastewater generated during cleaning is discharged to the public sewers.

2.5 Storage and Disinfection process

The clean water is stored in a ground reservoir of 100 m^3 volume. The chlorination is done manually at the reservoir. The dosing for chlorination is done according to 1 kg of bleaching power to 100 m^3 of water. The calculated contact time is approximately 15 – 16 min (Contact Time, T = V_{eff} x BF/peak flow, Baffling factor = 0.2, flow = 20 L/s, Effective volume (V_{eff}) = 100,000 x 0.95 L).

2.6 Distribution

The clean water stored in a underground reservoir is pumped to the overhead tank of volume 450 m^3 and height 30 m (**Figure 5**) to create the service head. The water is then distributed to the residential areas. Besides the residential areas, Nepalgunj Medical College and nearby restaurants are among the highest consumers of the drinking water supply (about 43 m^3/d).

Figure 5: Over head tank of 450 m^3(Left) and Gate valve for the water distribution network (Right)

2.7 Sludge Management

The primary sludge or sediments collected from the Vertical Sedimentation Tank is being disposed inside the water supply facility (**Figure 6)** temporarily and disposed nearby open fields and /or sometimes used as construction material for filling purpose. The KSTWSP does not have a sludge treatment facility. The wastewater used in cleaning operation is discharged into the public sewer systems.

Figure 6: The silt deposit collected from the aeration tank

3. Aspects of treatment processposing most difficulty for daily operation

- The source of water for KSTWSP is mainly groundwater, therefore, the project relies on pumping stations for groundwater extraction. The Nepal Electricity Authority does not supply adequate electricity, therefore, the KSTWSP is forced to used fossil fuel (diesel) based electric generator (**Figure 7**) for the pumping and other operational activities of the water treatment plant.

Figure 7: Generator (160 kVA) and electric switches for pumping stations

- The operation of the KSWTP lack automation. Chlorination is done manually.
- The water treatment plant lacks a laboratory for the water quality analysis.
- Lack of capable technical human resources

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

- KSTWSP spends large amount of the annual budget for the replacement of distribution pipes due to the clogging (**Figure 8**). The problem intensifies during the summer period (April – August).

Figure 8: Calcification in drinking water distribution pipes (50 mm)

- Insufficient extraction to meet the demand
- Low discharge during summer

- Illegal groundwater extraction by public through pumping and hand pumps might deteriorate the quantity groundwater in long-term
- Non-revenue water due to illegal connection

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

For most the issues related to the issues (3) and (4) any measures have not been taken due to lack of budget. However, distribution pipes are frequently replaced as a measure to the calcification of pipes. Also KSTDWSSUA is planning to extent the service by increasing the capacity of the treatment plant.

6. Recent investment made for the plant's improvement

There have been no further investments made to improve and expand the services immediately. However, the user's association is preparing to expand its services in future.

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

The KSTWSP urgently needs a low cost water treatment plant for the removal of hardness to solve the calcification problems in the drinking water distribution networks. The KSTWSP needs following improvements:

- Detail research about the water treatment technology applicable for Kohalpur's ground water
- Construction of new treatment plant, overhead tank, new reservoir and water distribution networks to extent the production capacity
- Capacity building of the technicians in the KSTWSP for the smooth operation
- Technology to reduce the hardness in the water.
- Laboratory facility for continuous monitoring of the water quality parameters

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

The KSTWSP is not able to meet the current water demand. The water pressure in the households is not consistent. Similarly, users have complaints regarding the quality of water due to the hardness. Nevertheless, the user's association are positive towards future expansion of the KSTWSP.

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

DynaSand Filter is one of the new water technologies for the water treatment plants in Nepal. The filter occupies less space in comparison to conventional sand filters like slow sand filters.

10. Other Highlights

There are 4500 members associated with the KSTDWSSUA and about 2350 households are connected to the metered water supply. The users are getting about 8 hours of water supply per day i.e. from 5.00 to 9.00 am and 5.00 to 9.00 pm. On average, KSTWSP collects 5,200 US Dollars (5,50,000 Nepalese rupees) on monthly basis from the 2350 households. However, most of the revenue is utilized for the maintenance and operation of the KSTWSP.

11. Water quality data

Table 3 presents the quality of treated water quality of KSTWSP in 2013. Some of the parameters are above the National Drinking Water Quality Standard (NDWQS), 2005.

Table 3: Water Quality in 2013

S.N.	Parameter	Observed	NDWQS, 2005
1	pH	7.46 (at 30 ºC)	6.5-8.5
2	Electrical conductivity (µS/cm)	559	1500
3	Turbidity (NTU)	7.07	5
4	Color (TCU)	10	5
5	Total Dissolved solids (mg/L)	273	1000
6	Total hardness (as mg/L $CaCO_3$)	364	500
7	Ammonia (mg/L)	N.D.	1.5
8	Nitrate (mg/L)	3.49	50
9	Calcium (mg/L)	140.95	200
10	Arsenic (mg/L)	N.D.	0.05
11	Magnesium (mg/L)	0.078	0.2
12	Total *coliform* count (MPN/100 mL)	10	0 in 95% samples

N.D. Not Detected

12. References

- NDWQS. (2005).Nepal Drinking Water Quality Standards. URL: <http://www.wsportal.org/uploads/IWA%20Toolboxes/WSP/NDWQS%20Nepal.pdf> [accessed 10.04.2016]

Prepared by:

Anish Ghimire, PhD., M.E.
VarshaNiraoula, B.Tech.
Associate Professor Nawa Raj Khatiwada, D.Eng.
Department of Environmental Science and Engineering
Kathmandu University
Dhulikhel, Nepal

Date: 3 May, 2016

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

Email: newtap@jwrc-net.or.jp