Russian Water Supply System: 24x7
Osh water supply System

(Himat. J. Karia)

Preamble:

Osh is a city of Kyrgyzstan (formal USSR, Russia).Present Population is about 2, 60,000.Source of water is river Akbura. Present water supply system is 24x7 bases.

The Kyrgyz Republic has received a Loan for 32.057 million SDR (USD 51.5 million) under Loan Number 2668-KGZ (SF) and a Grant for US $ 51.50 million under Grant Number 0217 – KGZ (SF) under a Financing Agreement LPS: KGZ 44236 for Emergency Assistance for Recovery and Reconstruction (EARR) signed between Kyrgyz Republic and the Asian Development Bank (ADB) on 27 September 2010.

It aims to improve water supply and sanitation in the cities of Osh, Jalal-Abad and Bazar-Korgon.

Under the water supply system, it is expected to rehabilitate water supply intake works, rehabilitate or laying new transmission lines from intake to the treatment plants and reservoir.

Under the sewerage system, it is expected to rehabilitate or construct new sewage treatment plants and main sewer lines.

Current Situation of Water Supply System in Osh:

* Osh's population was 259,100 in 2009 and is forecasted to be 291,955 by 2025. The city covers about 1,505 sqkm.

* Osh city has an abundance of water resources. The water supply system in the city comprises a combination of surface sources using direct intakes at the bank of Ak-bura River supplemented by bore holes. The existing direct intake at Plotina (on river Ak-bura) was constructed in 1972 and has been functioning since then. There is a water treatment plant (WTP) of 180 mld capacity at Ozgor, which has not been in operation for the last 17 years due to expensive chemicals required for the coagulation process and other operational issues.

In view of above, the following are the main activities expected to be covered by the present assignment:

(i) Osh City Water Supply Improvement work components include:

1) Plotina Intake: Rehabilitation of the new intake constructed in 2009/10, but not commissioned, to include site security, flood protection and rehabilitation and/or completion of works for the intake structure.

2) Transmission Line: Construction of a new transmission line from the Plotina Intake to the current WTP at Ozgor of approximate length 7.2 Km, to include connection to the new transmission line to the Reservoir at the Brick Factory..

3) Water Treatment Facility at Ozgor. Assess the condition of the current WTP at Ozgor for rehabilitation and compare with a new build WP to be constructed at the Brick Factory Reservoir, as a comparison for approval of most cost effective solution.

4) Pumping Station at Ozgor. Rehabilitation of the current and unused pumping station to connect between the new Transmission line at 2) above, and the current transmission line to the Brick Factory Reservoir.

5) Reservoir at the Brick Factory: Rehabilitation of the 6,000 cubic meter reservoir to include installation of a bacteriological treatment facility to meet potable water drinking standards. Analysis of the geo-technical situation at the Reservoir site to investigate the risk of potential landslide.

Following reports and documents: (AS per TOR) are to be submitted

(i) Site Investigation Report which shall include all site investigation information, environmental considerations, social assessment, developed options and recommended options;

(ii) Preliminary Design Report for the approved options;

(iii) Detailed Design Report, including Environmental Management Plan and Resettlement Action Plan for the selected sites;

(iv) Prequalification and Bidding Documents in accordance with ADB Procurement Guidelines.

Preliminary assessment of Osh city water supply:

Plotina Intake:

Centralized supply of potable water to Osh, meeting the requirements of state standards, has started since 1952. Water is supplied to Osh from several water sources. The main one is the water intake from surface water located on Ak-Buura River.

Water intake on Ak-Buura River was constructed in 1975 to supply potable water to Osh. Water intake on Ak-Buura River is of a dam type with a double-chamber curvilinear water intake with a capacity of 2.34 m^3/ s or 202 000 m^3/ day.

In 2009 an infiltration drain about 600 m long was constructed on the territory of the water intake. But at present moment the infiltration drain does not work, because designing and construction were made with some violation. One of the main problems in construction of the drain is the absence of hydraulic engineering calculations. The constructed drain is in high-water bed, there is no three-layered gravel filter and in this connection the drain, by its parameters, does not cope with the set task.

It was found that the state of the bypasses and conveying elements such as inlets and outlets, channels and flumes, sluices, concrete chambers, screens seemed to be working properly and in a good state of preservation.

Water Transmission Line:

With the help of two water conduits (diameters 1000 and 800 mm) water flows by gravity to "Ozgur" treatment plant. The length of water conduits from the water intake to "Ozgur" treatment plant is about 4.5 km. Rated discharge capacity of 1000 mm water conduit is 2.4 m^3/s and that of 800 mm water conduit is 1.3 m^3/s.

Water treatment plant "Ozgur"

The designed capacity of "Ozgor" water treatment plant (WTP) is 180000.0 m^3/day at water turbidity of 1500 mg/L. The process flow sheet of the water treatment plant consists of two stages:

A water treatment plant of the first stage (capacity:50000 m3/day) was constructed in 1981 by the design of "Kazvodocanalproject" Institute. At the water treatment plant water was subject to reagent processing on horizontal sediment tanks with built-in flocculation chambers and filtering on rapid filters through loading of silica sand with gravel supporting layers. Aluminium sulphate was used as coagulant and lime was used for alkalization of water during the periods of insufficient alkalinity. Water was disinfected by liquid chlorine.

In 1983 the second stage of the water treatment plant was designed for the capacity of Q_{day} = 130 000 m^3/day. The water treatment plant is designed according to the following scheme:

Raw water is supplied by the existing water conduits from the existing water intake to the water treatment plant, where it is separated, proportionally to the capacity, into the existing block and designed facilities.

A water conduit D=1000 mm supplies water to a block of vertical mixers and filters. To accelerate mixture fallout coagulation with aluminum sulphate $(Al_2SO_4)_3$) is used.

To intensify the process of contact clarification (coagulation and precipitation of suspension) supply of flocculants – polyacrylamide is foreseen to the water being treated.

To improve the process of flocculation during flood period alkalifying reagent - soda ash is added to water.

After mixing of water with the mentioned reagents in vertical mixers the initial water is supplied to a thin-layer clarifier of AzNIIVP system, where water is clarified and sediment is accumulated and thickened.

Then the clarified water with 8-12 mg/l of suspended matter flows to a rapid sand filter for final clarification. After filtering turbidity of water does not exceed 1.5 mg/l (according to GOST 2874-73 for potable water)

Purified water flows to reservoirs of pure water and then it is supplied by gravity-head conduits to the distribution water-supply network of Osh.

Water is disinfected with liquid chlorine from chlorinating chamber. The design provides primary water chlorination before mixers and secondary chlorination before reservoirs.

Concentration of residual free chlorine in water taken from reservoirs should be not less than 0.3 mg/l and not more than 0.5 mg/l.

From early 90-s of the last century due to shortage of funds at “Oshgorvodocanal” coagulant and other reagents were not being bought.

Thus, at present time “Ozgor” WTP conducts only mechanical purification (sedimentation, filtration) + disinfection with chlorine. Due to the absence of coagulation the result of purification is being decreased accordingly.

Water flows in treatment plant facilities by gravity.

On the territory of the water treatment plant there are 4 reservoirs for water accumulation (2 reservoirs with a volume of 2000 m^3 each and 2 reservoirs with a volume of 3000 m^3 each). Water flows by gravity from the reservoirs to the distribution network of the city.

Pumping station at Ozgor:

Pump plant located on the territory of “Ozgur” water treatment plant was constructed as a pump plant of the second rise and provides potable water to “Amir-Timur” micro district. At present time the pump plant is not in working condition, there is no power equipment, a control board has been dismantled, shut-off-and-regulating fittings are in emergency condition.

The pump plant needs rehabilitation by means of replacement of processing equipment and shut-off-and-regulating fittings.

Reservoir at the Brick Factory:

For constant water supply a reservoir with capacity of 6000 m^3 was constructed in north-western part of the city. The rated capacity is determined for water supply for about 35000 people.

Actual state of the reservoir requires immediate action for its rehabilitation.

Numerous leakages may lead to complete destruction of filling ground and to the collapse of the reservoir to the brick factory quarry.

The field visit to the site of the so called Brick Factory reservoir was conducted during a dry weather period, so any sign of moisture on the reservoir walls and/or adjacent surfaces are not due to rainfall events.

Part of the cover of the concrete tank has been removed allowing us to see the exterior surface of what seems to be precast concrete panes right above the outlet conduits.

Proposed design option for Osh city Water Supply:

“Plotina” Intake

In 2009 an infiltration drain about 600 m long was constructed on the territory of the water intake.

The main task is to rehabilitate the existing drain on the territory of “Plotina” water intake.

Rated capacity of this structure was about 3 m^3/sec. But due to the fact that in earlier fulfilled design there were no hydraulic engineering research, actual capacity is much lower.

Besides, the drain has been constructed in high-water bed of Ak-Bura River, there is no three-layered gravel filter, which leads to absence of water purification by turbidity indices.

A version of the drain rehabilitation is possible at the availability of full complex of hydrogeological researches with a possibility to move the drain from the high-water bed. At the same time it is necessary to analyze the possibility of the use of underflow waters with determination of rated capacity.

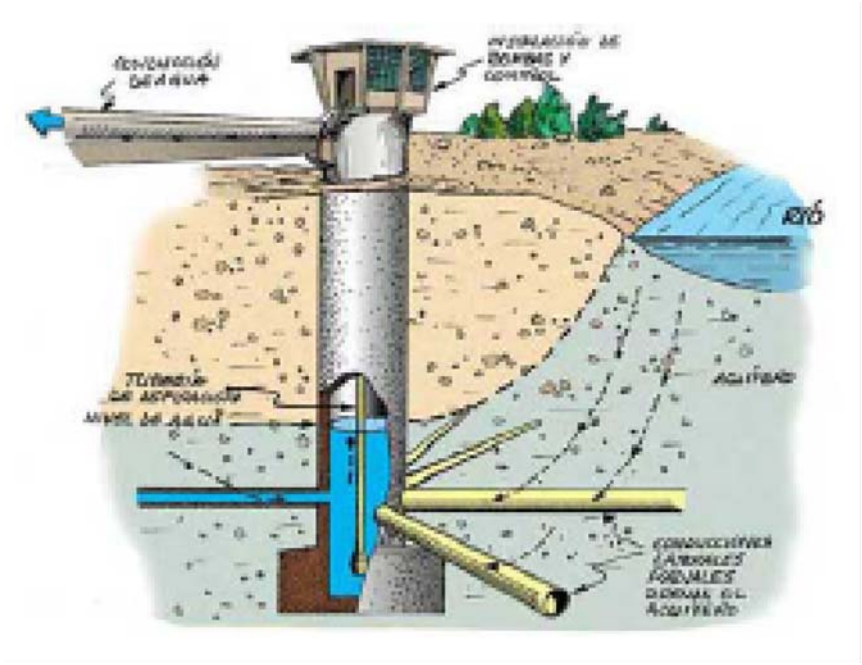
Such researches will allow highly reliable determination of the capacity of “drain” water intake being rehabilitated.

As a result of the field reconnaissance performed at the existing intake in Plotina, we propose the following alternatives in order to improve water supply, which will be designed in detail once all surveillance and corresponding set of tests are conducted.

New underground water intake:

Construction of a well with radial horizontal drains pointing towards the riverbed (Ranney or some other construction methods) can be placed either on the right bank of the river or left, depending on the lithological composition of the area.

The following picture shows a sketch describing this type of facility.



Drainage gallery in the center of the riverbed can be difficult to execute due to high velocity of flows in the river.

Rehabilitation of the existing underground intake, currently not operating

There are several ways by which this can be achieved:

* Deepening of the existing gallery for greater infiltration;
* Run horizontal drains from the gallery towards the river;
* Replacement of the filtering material with one with an appropriate particle size.

Previous to the final and detail design of any of the alternatives above, it would be necessary to conduct through hydro-geological studies on this area. It should be determined width, depth and layout of the alluvial deposit and its hydraulic characteristics (transmissivity, conductivity, specific yield, etc.) as well as its quality, particularly turbidity.

In order to do so some investigation boreholes might be conducted, as well as, at least, one pumping test.

Alternative study of Intake:

In order to reduce water turbidity, plans a new intake on the river AK-Buura upstream of the confluence of the tributary of the watershed that contributes mainly suspended matter, this point is located about 2 km upstream from the Plotina intake.

Moreover the impoundment located approximately 4,5 km from this point acts as a decanter.

Then again, these assumptions need confirmation based on turbidity tests.

Access to the left bank already exists consisting on an unpaved road and a power supply transition line runs along this road. It has to be confirmed by further inquiries to the local authorities that this line is functional.

So, after describing and roughly pointing out the characteristics of this site, two different sorts of facilities may be considered as possible options:

* Making direct use of the existing irrigation canal on the left bank that flows parallel to the river, and divert flow out of it in a location close to the actual facilities of Plotina.

This option may require the review of the irrigation procedures and rights concerning the users of the channel, and rehabilitate and/or adapt the surface of the channel, or its replacement by the appropriate pipeline.

* Adapting the existing intake on the right side. Then, a short distance downstream the transmission line would cross the riverbed to the opposite bank and from that point on it would run along the riverside down to Plotina.

This alternate version is based on the fact that during flowing of flood water (as representatives of water-channel organization have said) turbidity at this section may be much lower than at "Plotina" water intake. But there are no observations over water turbidity of the water near to proposed water intake.

For the water intake it is not possible to fulfill rated dimensions of the 1st sanitary protection zone, which should be surrounded with blind fence and should have 100 meters to both sides from the water intake, 200 meters upstream and 100 meters downstream. On the left bank of the river there is a road connecting a number of villages located on the banks of Ak-Bura River.

According to the analysis of water turbidity the extremely high indices (more than 2250 mg/L) were observed approximately 10-15 times a year. This year the turbidity of 19000 mg/L was recorded. "Plotina" water intake and "Ozgor" plant cannot operate at the extremely high turbidity indices. On such days the water-channel organization stops supplying water to the city at all. It means that the designed water intake will operate only during such period, i.e. 10-15 times a year. It may not be economically and financially feasible to consider this option.

Construction of the water intake on the river having unstable seasonal flow requires a very serious approach from the side of ecology and observance of all necessary nature-conservative conditions.

Altitudes difference between the site of the new water intake and "Plotina" water intake is not more than 20 meters. This situation dictates such engineering solution that gravity water conduits (they should be 2) are to be designed only parallel to the riverbed. But visual inspection of the supposed route shows that on the way of the water conduits on the river banks there are bassets of hard rock. Besides, on the way of the water conduit route there is a village, and it is very problematically to lay pipes on private land.

Water Transmission pipeline:

At present moment two water conduits (diameters 1000 and 800 mm) are laid from "Plotina" water intake, by which water flows by gravity to "Ozgur" treatment plant. The length of water conduits from the water intake to "Ozgur" treatment plant is about 4.5 km. Rated discharge capacity of 1000 mm water conduit is 2.4 m^3/s and that of 800 mm water conduit is 1.3 m^3/s.

In case of rehabilitation of infiltration drain the terms of reference stipulate to lay one more line of a water conduit directly to the reservoir located in the brick factory. A preliminary analysis shows that the existing water conduits can provide flow of water (conveyance capacity is 3.7 m^3/s or 319 thous.m^3/day) received from the drain. On a condition the conveyance capacity of the water treatment plant is 180 thous.m^3/day, the conveyance capacity of the existing water conduits allows provision of additional flow of water in a volume of 140 thous.m^3/day. So, technically, there is no need in construction of the third line of a water conduit. This issue needs immediate decision from the client side.

Water treatment plant «Ozgur»

Measures on rehabilitation of "Ozgur" water treatment plant should foresee complete rehabilitation of earlier designed process flow sheet of the treatment plant with rehabilitation of reagent facilities in full volume. The adopted scheme of water treatment cannot work in full without the use of chemical reagents.

Therefore, first of all it is necessary to restore a complex of water treatment facility of reagent sector.

As an alternative solution it is possible to arrange a new complex of treatment facilities. At the same time, it should be clearly understood that a new complex should be constructed on the existing territory of "Ozgur" WTP, because altitude marks of this area allow starting the plant without construction of additional pump plants and reservoirs.

Pumping station at Ozgur WTP:

Pump plant located on the territory of "Ozgur" water treatment plant is a pump plant of the second rise and provides potable water to "Amir-Timur" micro-district. At present time the pump plant is not in working condition, there is no power equipment, control boards have been dismantled, shut-off-and-regulating fittings are in emergency condition. The pump plant needs rehabilitation by means of replacement of processing equipment and shut-off-and-regulating fittings.

As a version, it is supposed to use the water from new intake or from rehabilitated plant for water supply to 6000 m^3 reservoir located at the Brick Factory.

Reservoir at the brick factory:

One of the main problems is the lack of constant water supply in the northwest part of the city in spite of the available reservoir with a capacity of 6000 m^3.

Its capacity is not sufficient to provide about 35000 people with water.

Besides, actual state of the reservoir requires immediate action for its rehabilitation. Numerous leakages may lead to complete destruction of filling ground and to the collapse of the reservoir to the brick factory quarry.

Once the geotechnical research in the area of the reservoir is conducted, and depending on their corresponding results, different solutions may be rise:

* Treatment and consolidation of land in the affected areas.
* Treatment for the waterproofing and rehabilitation of existing reservoir. That includes the completion of a storm-water drain of the reservoir area.
* Construction of a new reservoir.

In any case, no trees, crops, or plants whatsoever whose roots may damage concrete structures or conduits nearby shall be permitted around the reservoir.

It is necessary fully to eliminate leakages in the reservoir and to fulfill a complex of measures aimed at prevention of further wetting and destruction of the foundation. A set of constructive measures will be developed after geological engineering survey and after determination of the foundation state.

It is supposed that during repairing work on rehabilitation of the reservoir leak tightness the reservoir will be completely removed from operation of the water supply system in the northwest part of the city. Water will be supplied directly from WTP “Ozgur”.