2.3.2 Existing Facilities of the Sewerage system

(1) Sewage Treatment Facility

1) General Condition

More than 40 years has passed since the sewage treatment facilities were constructed. Rehabilitation work was conducted in 1998, only one time, for these facilities as shown below. However, the details of the work are not available.

-Inlet pump station (pump equipment)
-Three (3) pressure pipes from inlet pump station to grit chamber
-Primary sedimentation tank (structure and equipment)
-Aeration tank (structure and diffuser)
-Final sedimentation tank (structure and equipment)
-Effluent pump station (pump equipment)
-Discharge pipe
-Sludge Digestion Tank
-Gasholder

Modified conventional activated sludge method was employed for sewage treatment, which is so called "contact stabilization method". The process of thickening, digestion and drying is adopted to treat sludge. Dried sludge is stored in the premises of the STP. The same capacity pump stations are installed at the inlet and at the outlet of the STP. The effluent is discharged into the Taldy Kol reservoir.

Judging from the appearance, the structure, equipment, and underground conduits are already superannuated. Specifically, most mechanical equipment is deteriorated and some of main facilities are out of operation because of mechanical breakdown. Specific features of the STP are shown in Table 2.3.1 in view of improvement of the existing facilities.

Table 2.3.1 Specific Features of the STP

PERFORMANCE	The pump capacity both for inlet and discharge pump station is 129,600m^3/d in operation of each 2 pump units (excluding 3 standby pump units), which is below the nominal capacity of 136,000m^3/d. The primary sedimentation tank is the critical element for the performance of the treatment capacity at present. The treatment capacity is envisaged to be 102,000m^3/d. Effluent water quality is rather in good condition by the continuous effort of maintenance personnel in spite of frequent occurring of troubles of the facilities. A number of the facilities and equipment are overloaded and deteriorated.

CONDITION OF THE FACILITIES	Although almost all facilities look like so much deteriorated, civil structures and superstructures may have more than 10~20 year life in the durability of the concrete structure that has ordinarily over 50years life span. This was confirmed by the concrete neutralization test in the field, which was conducted for the principal structures. The structures that accommodate machines (high speed rotating) such as pumps and blowers are vibrating, revealing inadequate mass or weight of the structures to prevent vibration. Aeration tank No.3 and 4, final sedimentation tank No.9 and 10, gravity thickener No.1 and 2, and digesting tank No.1 are not operating because of mechanical breakdown. Buried conduits are observed under extremely corroded conditions.
ENVIRONMENTAL PROBLEM	The odor caused by sludge drying bed and other facilities in the plant is considerable. In addition, distribution of bacteria from the aeration tank that has no superstructure to avoid scattering the contaminated air implies hygienic problem to the surrounding area. Sludge has been stored near the sludge drying beds, which may cause environmental problem.
OCCUPATIONAL HEALTH & SAFETY	The working circumstance for the maintenance personnel is not necessary favorable and sometimes dangerous, because of lacking of enough safety measures such as strong handrail, sufficient ventilation and lighting at the underground floor.
MAINTENANCE EASINESS	Unpaved roads are left around the main facilities such as primary sedimentation tank, aeration tank, and secondary sedimentation tank. There are places inaccessible because of no preparation of the site, though the pipes and cables are buried there. It makes the personnel difficult to maintain the facilities.

2) Current Status of STP

a) Flow Rate and Water Quality

Current Status on inflow amount and water quality is shown in Table 2.3.2. Influent water quality is within the common range of domestic sewage. Daily maximum inflow of 158,000m^3/day was recorded in the years 2000 and 2001, which is much higher than the nominal daily maximum capacity of the STP (136,000m^3/day). However, the effluent water quality in terms of SS and BOD is satisfactory.

Disinfection of effluent from the STP is not provided before discharge to the Taldy Kol reservoir. Therefore, E-coliform is on a high level in the effluent and the water of the Taldy Kol reservoir. Water quality of the Taldy Kol reservoir is better than that of effluent, in spite of the concentrating circumstance through water evaporation.

Table 2.3.2 Current Status on Flow and Water Quality

Item	Inflow/Water Quality		Period	Remarks
Flow	Average	99,561m^3/day	Dec 2000 – Oct 2001	Proposed treatment capacity; **136,000m^3/day**
	Maximum	**157,840m^3/day**		
	Minimum	52,770m^3/day		
SS	Influent	190mg/L	2000,2001	
	Effluent	8.2mg/L		
	Taldykol	6.2mg/L		
BOD	Influent	158mg/L	2000,2001	
	Effluent	7.9mg/L		
	Taldykol	6.2mg/L		
E-coliform	Influent	157 x 10^6	2000,2001	
	Effluent	6.7 x 10^6		
	Taldykol	5.0 x 10^4		

On the other hand in the FS conducted in 2001, inflow amount for 2010 was estimated at 112,224m^3/d (daily max.) considering rapid increase as shown Table 2.3.3. Inflow volume exceeding even proposed 136,000m^3/d is an evidence of urgent needs of improvement and expansion of facilities.

Table 2.3.3 Projected Peak Day Wastewater Flows

Unit: m^3/day

Flows	1999		**2010**		2020		2030	
	Water Demand	Discharge	Water Demand	Discharge	Water Demand	Discharge	Water Demand	Discharge
Domestic	74,233	66.810	76.688	69.020	124,418	111,977	163.880	147,492
Institutional	5.777	5,199	6,620	5,958	9,612	8,651	11.114	10,003
Commercial	17,745	12,424	5,239	10,744	6.442	15,654	6,674	18,781
Industrial excl. Thermal plants	0	-	15,349	3,667	22,363	4,509	26,830	4,672
Technical excl. Thermal plants	22,200	2,220	23,400	2,340	27,300	2,730	31,200	3,120
Thermal Plants	26,712	8,014	34,308	10,292	40.608	12,182	43,536	13,061
Total	146,670	94,666	161.605	102,022	230,743	155,703	283,235	197,129
Infiltration, 10%*		9,467		10,202		15,570		19,713
Total arriving at STP		104,133		**112,224**		171,273		216,S42

Source: FS report 2001 by JICA Study Team

b) Taldy Kol reservoir

After biological treatment, the treated effluent is discharged to Taldy Kol reservoir. The reservoir was planned as an evaporator and a storage facility for irrigation. However, irrigation plan is suspended because agricultural development declined. Specification of Taldykol reservoir is shown in Table 2.3.4. As long as discharged into the Taldykol reservoir, restrictions will not be imposed to the STP effluent.

Yearly inflow to the reservoir is 36.5 million m^3/yr in assumption of approx. 100,000 m^3/d treatment at the STP without considering rainfall. When rainfall is included, the figure becomes 42.8 million m^3/yr (300 mm/yr, that is equal to 6.3 million m^3/yr inflow, 15% of reservoir volume). Therefore evaporation is assumed to be 35.9million/yr from the table. This equals to 8.1 mm/d evaporation during no ice coverage season (35.9million m^3/21 km^2/7months; surface is freezing another 5 months). Infiltration is not known precisely.

It can be observed from Table 2.3.5 that improvements in many parameters (BOD, COD, SS, Oils/fats, detergents, ammonium, nitrate, iron, fecal and total coliform) occur after retention within the reservoir. Remarkable changes in parameters are shown in ammonium, nitrate and alkalinity even rainfall dilution effect included (As stated above, 15% of the volume is assumed to be rainfall). It suggests that aqueous plants such as algae are taking in. However, analysis of this purification mechanism is complicated because a lot of variables are included in the reactions or changes. More detailed investigation about discharge, dilution, evaporation, infiltration, sedimentation, algae productivity, waterside plant productivity, and debris decomposition is necessary for the analysis.

Daily water level rise in the reservoir is computed to be 4.7 mm from 100,000 m^3/d average inflow and 21 km^2 area of the reservoir. To overcome the rise in water level in Taldy Kol reservoir an emergency siphon is used to discharge water to marsh land to the west of the reservoir during the spring thaw. The total discharge is assumed to be 6.9 million in the duration as shown in Table 2.3.4. Since the water level rise and the discharge to the marsh will continue, some other measure should be taken.

Through the investigation, information that deals with this issue was derived. There is a study that recommends employing advanced treatment in the area of STP to treat the reservoir water (80,000 m^3/d) and effluent of STP (120,000 m^3/d), aiming to discharge whole treated water to Ishim river. At this Basic Design stage, the information is not confirmed as the condition of designing.

Table 2.3.4 Major Characteristics of Taldy Kol Reservoir

Item	Contents
Surface Area	21.3 km^2 (10 km in length and 2 km in width) (current surface area: 15 km^2)
Average Depth	2.1 m
Design Capacity	45 million m^3 (current capacity: 36 million m^3)
Inflow (1999)	36.5 million m^3/year (discharge of the effluent from STP)
Evaporation etc.	29.6 million m^3/year (in case of Taldy Kol Reservoir being full)
Discharge (1999)	6.9 million m^3/year (discharge from Taldy Kol Reservoir to wetland in flood season)
Purpose of Reservoir	Receiving the effluent of STP
Water Quality	Parameters / Effluent of STP / Taldy Kol / Time BOD (mg/l) / 6.7 / 7.2 / Sep.-Oct.2000 COD (mg/l) / 72 / 72 / Sep.-Oct.2000 T-N (mg/l) / 18 / 4 / Sep.-Oct.2000 T-P (mg/l) / 1.7 / 1.4 / Sep.-Oct.2000 TC (MPN/100ml) / 47 / 47 / Sep.-Oct.2000 SS (mg/l) / 16 / 14 / Sep.-Oct.2000
Problems or Issues	As an exclusive reservoir for receiving the effluent of STP, Taldy Kol Reservoir actually functioned as an advanced treatment of the effluent of STP especially for the removal of nutrients (nitrogen and phosphorus). 1) Reuse of the Water in Taldy Kol (irrigation): In the past, the water in Taldy Kol was used for irrigation of the agricultural land in the south area of Astana City. However, the water volume used for irrigation has sharply decreased recently. 2) Area Occupation: Taldy Kol now occupies a large area near the center of Astana City. 3) High Water Level: About 29.6 million m^3/year of the effluent from STP was designed to be evaporated and infiltrated in Taldy Kol. However, with the development of Astana City, the sewage volume keeps increasing (36.5 million m^3/year in 1999), which resulted in the water level in Taldy Kol getting the rise. As the countermeasures, the following alternatives were proposed in the Master Plan Study and Feasibility Study of JICA: a) Agricultural use (with Taldy Kol Reservoir); b) Discharging the effluent of STP to Ishim River after an advanced treatment (without Taldy Kol Reservoir), and c) Discharging the effluent of STP to Nura River after an advanced treatment (without Taldy Kol Reservoir). In addition, Akim also implemented a study for Taldy Kol Reservoir and proposed the following alternatives[5)]: a) To construct an advanced treatment facilities to treat the effluent of STP and the water of Taldy Kol simultaneously, then to discharge the treated water into the rivers; b) To construct an advanced treatment facilities only to treat the effluent of STP and then discharge the treated water into rivers. While the water in Taldy Kol will be diverted to another reservoir. c) To discharge both the effluent of STP and the water of Taldy Kol into another reservoir.

Source: JICA M/P report and F/S report1[), 3)], Akimat[5)]

Table 2.3.5 Average Monthly Record of Influent and Effluent at the STP between July 1999 and August 2000 Source: FS report 2001

Location		Influent			Effluent			Reservoir (about 50m from shore)		
Parameter	Units	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum
BOD_5	mg/1	213	156	120	14.5	8.3	4.5	9.5	6.0	4.0
COD (dichromate)	mg/1	548	362	251	89	77	58	82	62	41
Suspended Solid	mg/1	343	185	124	17	10	6	15	7	3
Oil and fat	mg/1	31.8	6.8	3.2	0.3	0.2	0.0	0.2	0.0	0.0
Total Alkalinity	meq/1	6.7	5.8	5.0	5.0	4.2	3.6	5.8	5.0	3.8
Detergents	mg/1	4.5	2,5	1.6	1.4	1.1	0.5	0.8	0.3	0.0
Ammonium, NH_3	mg/1	30.0	26.6	21.0	10.3	6.9	1.8	8.8	4.3	0.3
Nitrate, NO_3	mg/1	1.4	0.8	0.2	70.0	44.8	6.7	36.0	17.4	4.0
Phosphate	mg/1	7.6	5.7	4.3	7.2	5.5	4.5	5.8	4.2	3.6
Chlorides	mg/1	324	284	242	313	269	235	292	253	219
Sulphate, $S0_4$	mg/1	320	241	214	270	219	195	270	208	184
Iron	mg/1	7.2	3.3	1.4	1.2	0.7	0.3	1.3	0.5	0.1
Zinc	mg/1	0.9	0.5	0.2	0.3	0.1	0.0	0.2	0.1	0.0
Fecal Coliform	Nr./100ml	3.88E+05	2.82E+05	1.74E+05	17,750	8,361	6,000	1,050	342	51
Total Coliform	Nr./100ml	2.50E+10	4.62E+09	1.10E+08	6.75E-+06	3.99E+06	2.20E+06	6.00E+05	1.69E+05	7.00E+03

c) Sludge Disposal

Before the soviet union collapsed, digested sludge used to be collected by the farmers for agricultural use on fields, but now many farms have reduced their production and none of the farmers collect sludge from the STP anymore because of the high cost for transportation. In general, agricultural use of sludge is most desireble for sludge disposal in view of environmental and economical aspects as long as hazourdous matter concentration is low enough for agricultural use.

Sludge generated at STP is categorized into Industrial Solid Waste in Kazakhstan law and disposal of sludge from the STP is not allowed at the city landfill site. For this reason, dried sludge is presently stored at open space of the STP. This will cause a serious issue in the near future.

Although this issue was discussed in the master plan, countermeasures are not yet provided. Further investigation and planning will be necessary in view of overall waste disposal program in Astana city.

Existing sludge drying bed has been functioning as sludge treatment facility, however it will be abolished upon completion of this project.

d) Process Units

Process units specifications of existing facilities are as presented in Table 2.3.6.

e) Description of the unit process

Figure 2.3.3 shows the layout plan of existing STP. The facilities are arranged in accordance with the water flow from the inlet pipe to discharge into the Taldy Kol reservoir. The plant has no definite boundary by structure. Northern part of the site is largely occupied by sludge drying beds. Figure 2.3.4 shows the flow chart diagram of the existing STP.

Since the site has sufficient area, there seems to be no problem for future expansion. There is no residential area or public facilities in the vicinity of the STP excluding the power station that is providing the power directly to the plant.

Effluent pipe is installed on the dike at the discharge point of Taldy Kol. Figure 2.3.5 shows the conduits of the plant. Each facility is stated from item a to item.

Table 2.3.6 Process Units Specifications of Existing Facilities

Process Unit	Design Parameters	Size & Specification (Units for duty and stand-by)
Pump Station Structure	Retention Time: 5 min	Diameter 21.6 m x Depth 11 m
Sewage Lift Pump		Vertical Shaft Centrifugal Pump Dia 500 mm x 0.75 m^3/sec x 26.5 m x 400 kW x 3 units Dia 500 mm x 0.75 m^3/sec x 26.5 m x 315 kW x 2 units
Screens	Screen Clearance: 6 mm	Double Chained Rake Type Width 1.3 m x Depth 2.25m x OP. 15 mm x 1.5 kW x 3 units
Grit Chamber Structure	Flow Velocity: 0.13 m/sec Settlement Velocity:0.013m/sec Retention Time: 1.3min	Length40m x Width 6m x Depth1.5m (For all chambers)
Grit Collecting Unit		Horizontal with Air Lift Type 10chambers x 3 units
Screen	Screen Clearance: 30 mm	Manual Screen Width 0.51m x Depth 1.0m x 5 units
Primary Sedimentation Tank Structure	Hydraulic Load: 21.6m^3/m^2/day Settling Time: 3.7 hr	Dia 28.0 m x Depth 3.5m x 6 tanks
Primary Sludge Pump	Operation Hours: 2-3 hrs/day	Non-clog Type Sludge Pump Dia 150/100 mm x 2.66 m^3/min x 29 mx 37.0 kW x 2 units
Aeration Tank	BOD-SS Loading: 0.2 kg/kg/day MLSS Concentration: 2,000 mg/l Hydraulic Retention Time: 9.7 hr	Width 8.0m x Length 119.0 m x Depth 4.0m x 4 lanes x 4 tanks
Air Diffuser	Dissolution Efficiency $\geqq$ 30 %	28 pieces/unit x 24 units x 4 basins
Blower		Multi Turbo Blower Dia 400 mm x 375 m^3/min x 60 kPa x 530 kW x 7 units
Secondary Sedimentation Tank Structure	Hydraulic Load: 14.4m^3/m^2/day Settling Time: 5.5 hr	Dia 28.0 m x Depth 4.0m x 10 tanks
Effluent Lift Pump		Vertical Shaft Centrifugal Pump Dia 500 mm x 0.75 m^3/sec x 26.5 m x 400 kW x 3 units Dia 500 mm x 0.75 m^3/sec x 26.5 m x 315 kW x 2 units
Return Sludge Pump Waste Sludge Pump	Return Sludge Ratio: 50-200% Operation Hours: 24 hr/day	Non-clog Type Sludge Pump Dia 200/150mm x7.5 m^3/min x 22.5 m x 75 kW x 3 units
Gravity Thickener Structure Sludge Pump	DS: 4.0% Operation Hours: 8hrs/day	Dia 20.0 m x Depth 3.5m x 2 tanks Non-clog Type Sludge Pump Dia 150/100mm x2.66 m^3/min x 29 m x 37 kW x 2 units
Sludge digestion tank Structure Sludge Circulation Pump Boiler	Retention Time: 5.9 days	Dia 17.0 m x Depth 8m x 2 tanks Non-clog Type Sludge Pump Dia 200/150mm x7.5 m^3/min x 22.5 m x 75 kW x 3 units Gas Boiler: 2.5 t-steam/hr x 1unit Coal Boiler: 4.0t-steam/hr x 2unit
Sludge Drying Bed		Old: Width 20mx Length 100m x Depth 1m x 26 beds New: Width 64mx Length 82m x Depth 1m x 4 beds Under Construction: Width 64mx Length 82m x Depth 1m x 2 beds
Buildings Structure		Administration Building: 300 m^2 2-story Sludge Pump Room: 150 m^2, 1-story Blower House: 900m2 x 2story Workshop: 210 m^2,1-story; Ware house: 320m2 x 1 story Canteen: 400 m^2, 1-story

NOTE: Some of the data are subject to revision through further investigation.

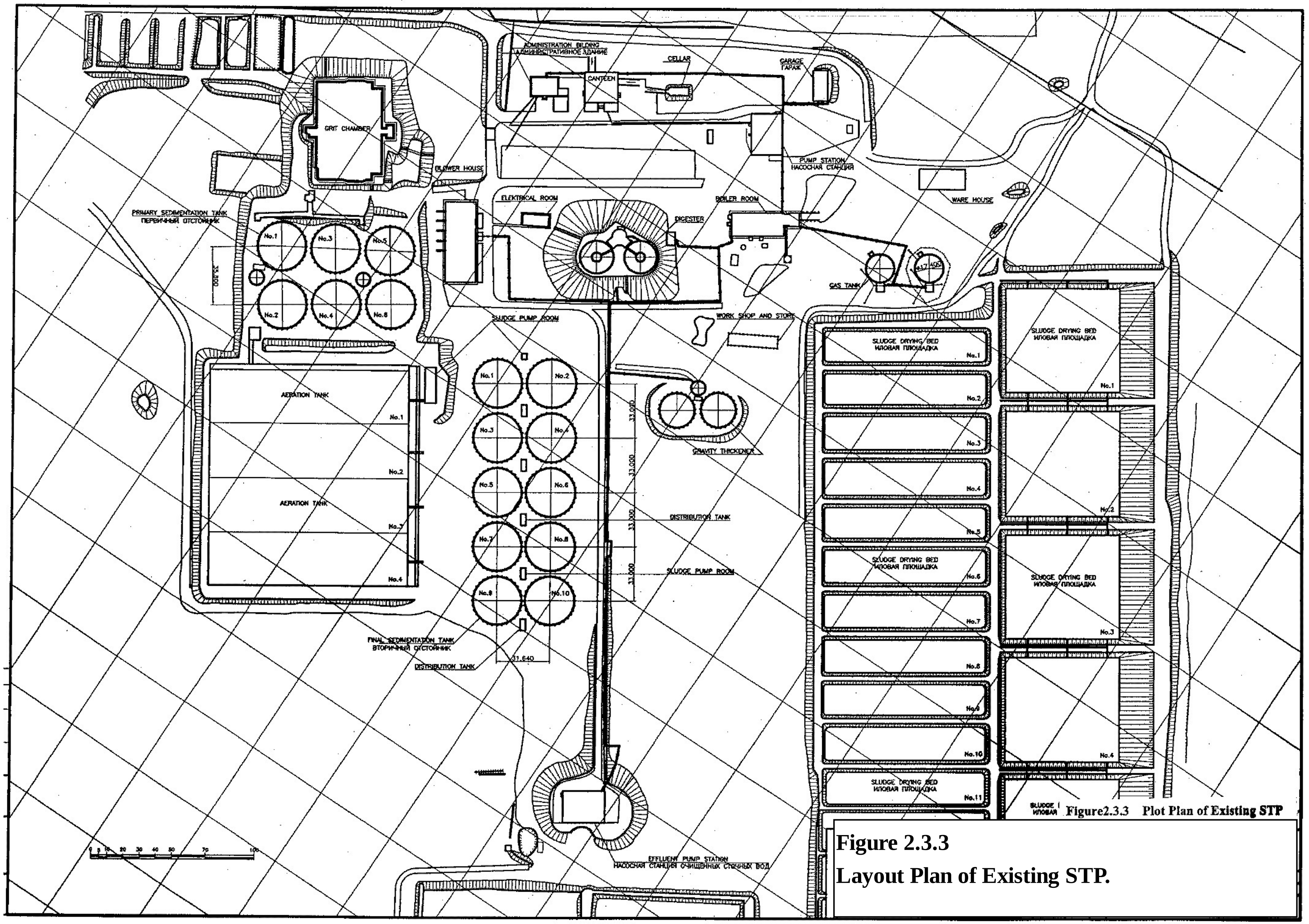


Figure 2.3.3
Layout Plan of Existing STP.

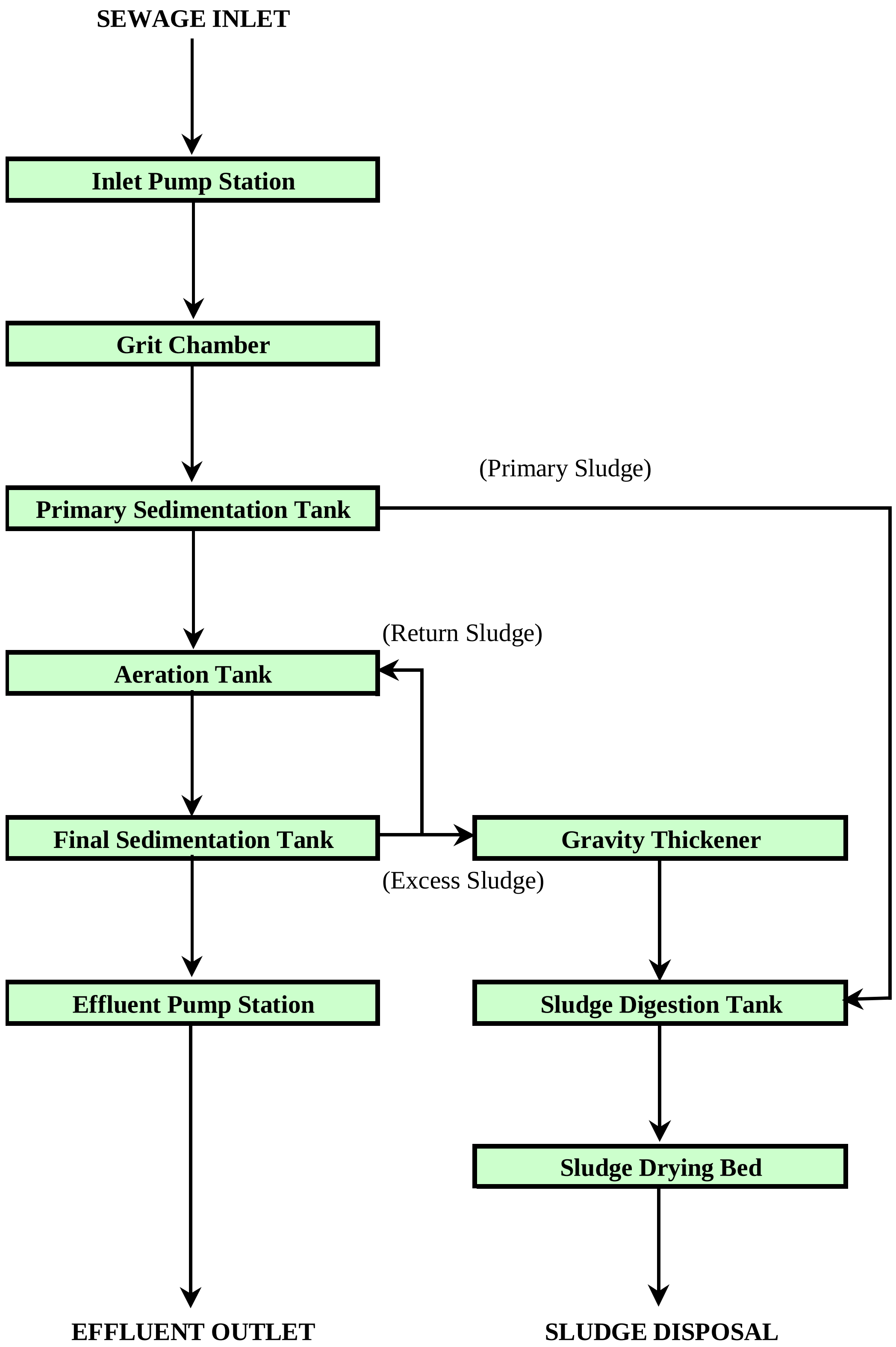
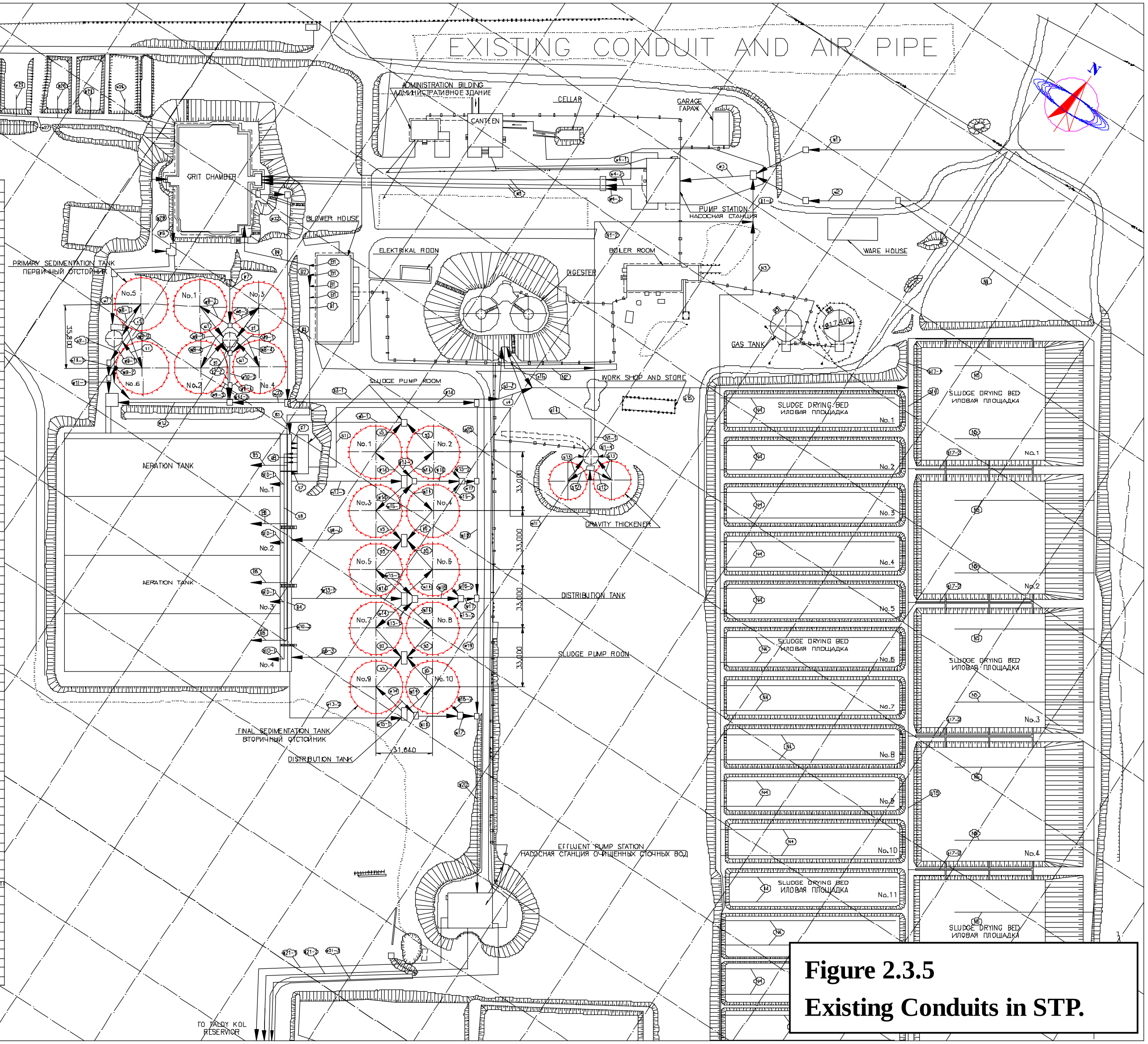


Figure 2.3.4 Flow Diagram of STP



LEGEND

Simble	Name of Pipe	Diameter/Number	Length: Each	Length: Total
WASTEWATER PIPE				
W1	Influent Pipe	ø1500RCx1	L=27.1m	L=27.1m
W2	Influent Pipe	ø1500RCx1	L=27.1m	L=27.1m
W3	Influent Pipe	ø1400RCx1	L=39.5m	L=39.5m
W4-1	Influent Pressure Pipe	ø800SPx1	L=47.9m	L=47.9m
W4-2	Influent Pressure Pipe	ø800SPx1	L=23.3m	L=23.3m
W4-3	Influent Pressure Pipe	ø800SPx1	L=44.7m	L=44.7m
W5	Influent Pressure Pipe	ø800SPx3	L=190.2m	L=570.6m
W6	Conduit	ø1500RCx1	L=31.9m	L=31.9m
W7	Conduit	ø1750RCx2	L=26.8m	L=53.6m
W8-1	Conduit	ø500SPx1	L=15.5m	L=15.5m
W8-2	Conduit	ø500SPx1	L=25.2m	L=25.2m
W8-3	Conduit	ø500SPx2	L=18.9m	L=37.8m
W8-4	Conduit	ø500SPx2	L=28.0m	L=56.0m
W9-1	Conduit	ø800RCx3	L=21.5m	L=64.5m
W9-2	Conduit	ø800RCx1	L=5.3m	L=5.3m
W9-3	Conduit	ø800RCx1	L=3.7m	L=3.7m
W9-4	Conduit	ø800RCx1	L=4.0m	L=4.0m
W10-1	Conduit	ø1000RCx1	L=5.5m	L=5.5m
W10-2	Conduit	ø1000RCx1	L=19.9m	L=19.9m
W11-1	Conduit	ø1300RCx1	L=7.0m	L=7.0m
W11-2	Conduit	ø1300RCx1	L=6.4m	L=6.4m
W12	Conduit	ø1300RCx1	L=61.3m	L=61.3m
W13-1	Conduit	ø1800RCx2	L=62.1m	L=124.2m
W13-2	Conduit	ø1800RCx1	L=88.7m	L=88.7m
W14	Conduit	ø1000RCx10	L=19.6m	L=196.0m
W15-1	Conduit	ø800RCx5	L=11.3m	L=56.5m
W15-2	Conduit	ø800RCx5	L=5.7m	L=28.5m
W16	Conduit	ø1000RCx3	L=23.4m	L=70.2m
W17	Conduit	ø1100RCx3	L=5.7m	L=17.1m
W18	Conduit	ø1500RCx1	L=62.2m	L=62.2m
W19	Conduit	ø1500RCx1	L=62.6m	L=62.6m
W20	Conduit	ø1600RCx1	L=97.9m	L=97.9m
W21-1	Discharge Pipe	ø800SPx1	L=400.0m	L=400.0m
W21-2	Discharge Pipe	ø800SPx1	L=400.0m	L=400.0m
W21-3	Discharge Pipe	ø800SPx1	L=400.0m	L=400.0m
W22	By-pass Pipe	ø1500RCx1	L=129.2m	L=129.2m
W23	By-pass Pipe	ø1500RCx1	L=29.5m	L=29.5m
W24	By-pass Pipe	ø1500RCx1	L=103.2m	L=103.2m
W25	By-pass Pipe	ø1500RCx1	L=106.3m	L=106.3m
W26	Conduit	ø300RCx6	L=12.2m	L=73.2m
W27	Conduit	ø500RCx1	L=113.5m	L=113.5m
W28	Conduit	ø600RCx1	L=72.9m	L=72.9m
			Total	3 809.5m
Sludge Pipe				
S1	Primary Sludge Pipe	ø200SPx6	L=18.9m	L=113.4m
S2-1	Primary Sludge Pipe	ø300SPx1	L=32.5m	L=32.5m
S2-2	Primary Sludge Pipe	ø300SPx1	L=29.8m	L=29.8m
S3-1	Primary Sludge Pipe	ø350SPx1	L=207.8m	L=207.8m
S3-2	Primary Sludge Pipe	ø350SPx1	L=28.8m	L=28.8m
S4	Primary Sludge Pipe	ø350SPx1	L=19.6m	L=19.6m
S5	Return/Excess Sludge Pipe	ø500SPx10	L=22.0m	L=220.0m
S6-1	Return/Excess Sludge Pipe	ø200SPx1	L=69.3m	L=69.3m
S6-2	Return/Excess Sludge Pipe	ø300SPx1	L=62.1m	L=62.1m
S6-3	Return/Excess Sludge Pipe	ø200SPx1	L=62.2m	L=62.2m
S7	Return/Excess Sludge Pipe	ø600SPx4	L=3.3m	L=13.2m
S8	Return Sludge Pipe	ø200SPx3	L=2.3m	L=6.9m
S9	Return Sludge Pipe	ø300SPx1	L=50.2m	L=50.2m
S10-1	Return Sludge Pipe	ø200SPx3	L=8.1m	L=24.3m
S10-2	Return Sludge Pipe	ø200SPx1	L=65.5m	L=65.5m
S11	Excess Sludge Pipe	ø250SPx1	L=278.7m	L=278.7m
S12	Excess Sludge Pipe	ø200SPx2	L=24.4m	L=48.8m
S13	Thickened Sludge Pipe	ø200SPx2	L=30.0m	L=60.0m
S14	Thickened Sludge Pipe	ø250SPx1	L=92.7m	L=92.7m
S15	Degested Sludge Pipe	ø300SPx1	L=27.2m	L=27.2m
S16	Degested Sludge Pipe	ø300SPx1	L=700.0m	L=700.0m
S17-1	Degested Sludge Pipe	ø200SPx1	L=100.0m	L=100.0m
S17-2	Degested Sludge Pipe	ø200SPx5	L=70.0m	L=350.0m
			Total	2 663.0m
Supernataut Pipe				
N1-1	Supernataut Pipe (From Gravity Thickener)	ø500SPx1	L=128.1m	L=128.1m
N1-2	Supernataut Pipe (Mixed)	ø500SPx1	L=89.0m	L=89.0m
N1-3	Supernataut Pipe (Mixed)	ø500SPx1	L=24.1m	L=24.1m
N1-4	Supernataut Pipe (Mixed)	ø300SPx2	L=6.0m	L=12.0m
N2	Supernataut Pipe (From Digester)	ø250SPx1	L=60.0m	L=60.0m
N3	Supernataut Pipe (From Sludge Drying Bed)	ø300SPx1	L=678.0m	L=678.0m
N4	Supernataut Pipe (Mixed)	ø100SPx32	L=100.0m	L=3200.0m
N5	Supernataut Pipe (Mixed)	ø100SPx12	L=80.0m	L=960.0m
N6	Supernataut Pipe (Mixed)	ø300SPx1	L=550.0m	L=550.0m
			Total	5 701.2m
Air Pipe				
B1	Air Pipe	ø400SPx5	L=4.7m	L=23.5m
B2	Air Pipe	ø800SPx1	L=11.8m	L=11.8m
B3	Air Pipe	ø1500SPx1	L=179.3m	L=179.3m
B4	Air Pipe	ø800SPx1	L=32.5m	L=32.5m
B5	Air Pipe	ø600SPx4	L=19.8m	L=79.2m
B6	Air Pipe	ø600SPx1	L=51.4m	L=51.4m
			Total:	377.4m

0 5 10 20 30 40 50 70 100

Figure 2.3.5
Existing Conduits in STP.

a. Receiving Tank And Inlet Pipe

Pipes from receiving tank to pump station are as follows:

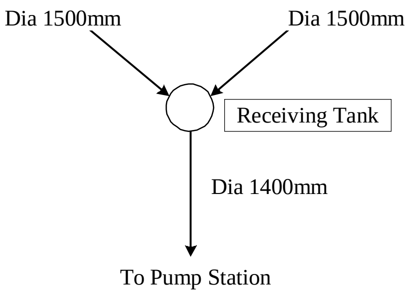


Figure 2.3.6 Receiving Tank Flow

Pipe capacity from receiving tank to the pump station is smaller than that installed upstream. Thus, pipe capacity from receiving tank to pump station is not sufficient. Furthermore, outlet pipe from the pump station is reduced to 1000mm dia. causing obstruction of sewage flow.

One pump station is under construction near the STP site 3km upstream, and its discharge pipe is planned to connect to this receiving tank one or two years later. In this regard, increase of the capacity for inlet pipe to the inlet pump station is an urgent need.

b. Inlet Pump Station

Inlet gate with diameter 1000mm is badly corroded and not working.

In the existing three (3) screens at B1 floor, one (1) is broken down and two (2) are badly corroded. For maintenance work, it is very dangerous requiring immediate replacement.

Existing five (5) lift pump units at B2 floor are damaged by corrosion and rusty. Immediate replacement is necessary including suction pipe of all the pump units. The total pump capacity for duty is 129,600m^3/d, therefore stand-by pump should be operated during snow melting season, if necessary.

Structures under B1 floor (3 channels and reservoir) is impossible to investigate.

In order to replace all the equipment and suction pipes, it is necessary to dry up the facility. Some measures should be taken to replace the equipment, including installation of new by-pass pipe.

As stated above, one inflow pipe construction to increase the capacity is necessary, but construction of additional channel and installation of gate and screen are quite difficult under operating condition.

c. Grit Chamber

Since this facility has no superstructure, all existing equipment of grit chamber has been exposed to the nature, rainfall and severe low temperature. They are no longer serviceable condition. The odor from the chambers and dry bed for grit sand is the problem.

Structural concrete is seriously damaged by corrosion. Construction of the new grit chamber including mechanical equipment is a requisite.

d. Primary Sedimentation Tank

Six (6) primary sedimentation tanks are normally operated. As sludge pump units and sludge collectors are so old and damaged that break down frequency is very high. Odor from these facilities without cover is a problem.

Existing six (6) tanks do not have enough capacity for proposed flow of 136,000m^3/day when examined by Kazakhstan standard (Two (2) more tanks are necessary.). On the contrary, when examined by Japanese standard, the capacity of existing tanks meets the proposed capacity. Replacement of six (6) sludge collectors and sludge pump units for existing tanks seems to be necessary from observation and hearing.

Overflow water depth at the weir varies tank by tank that causes differences of effluent flow rate, though the same capacity is adopted to all tanks. Adjustable weir plates for all the tanks are necessary to ensure flow rate balance and better treatment efficiency.

e. Aeration Tank

There are four (4) aeration tanks. However two of them haven't been working; one caused by mechanical problem and the other blockade of air pipe from blower and return sludge channel. Although condition of air diffusers at the bottom of the aeration tank could not be confirmed, it seemed no problem from the hearing.

The manner of operation is similar to the contact stabilization method, using first lane of 4 lanes as a contact tank of return sludge and air. Effluent from the primary sedimentation tank flows into the second lane. This manner was applied through maintenance experience, to make up for the insufficient return sludge ability. The treatment capacity is evaluated to be approximately 200,000m^3/d.

Surface of concrete structure, especially the channels and wall are corroded. All of the four (4) aeration tanks are necessary to be rehabilitated.

Return sludge pump station is installed closely to return sludge channel of the aeration tanks for suction and deliver activated sludge. Structures and equipment are r deteriorated and the pump capacity is not adequate for the design flow. Improvement or repair is necessary for return sludge pipeline.

Immediate rehabilitation of two (2) aeration tanks that are not working at present is indispensable.

f. Blower Unit

Seven (7) blowers are installed, and two (2) blowers are operated constantly. However, all blowers are very old and seemed to be damaged. They have been used beyond two times period of common life span, thus replacement of proper number of blowers is necessary.

g. Final Sedimentation Tank

There are ten (10) final sedimentation tanks. However, two of them haven't been working due to the limited capacity of sludge pump units.

Existing ten (10) tanks do not have enough capacity for proposed flow 136,000m^3/day, when examined in use of Kazakhstan standard (Two (2) more tanks are necessary.). On the contrary, when examined by Japanese standard the existing capacity is enough. Replacement of eight (8) sludge collectors and sludge pump units for existing tanks is necessary.

Overflow water depth varies at each tank that causes differences of effluent flow rate by tank. Adjustable weir plates are necessary for ensuring balanced flow distribution and better treatment efficiency.

Excess sludge is removed and delivered to the return sludge channel of the aeration tank by gravity without sludge suction pump. The shape of the bottom of the tank is flat without sludge pit.

The structures seem to be affected by uplift flow of groundwater that causes serious damage to the structures when the tank is dried.

h. Effluent Pump

Total pump capacity of effluent discharge pump station is the same as that of inlet pump station. All pump units are already superannuated and necessary to be replaced.

The structure is always vibrating resonant affected by the pump rotation. Structure of pump station is not damaged conspicuously. However, underground pump pit wall and the pertision wall is dirty with the stain or rust. Condition of wet well is not known because of no inspection access to the inside of the well. Rehabilitation of the structure may be necessary.

i. Gravity Thickener

There are two (2) gravity thickeners. The structure is substantially similar to the primary sedimentation tank, with only a difference of diameter. One of thickeners hasn't been working due to trouble of sludge collector. But treatment capacity is enough in operation of only one tank as confirmed by capacity calculation.

Mechanical equipment of one thickener is old and damaged. Rehabilitation of sludge collectors and sludge pump units for two (2) existing tanks is considered to be necessary.

j. Sludge Digestion Tank

The adopted process is the high rate method that uses thermophilic range of 53 deg.C. High rate method is desirable for compact facility design by quick reaction in the tank, but it is energy consuming type caused by its heat demand. It is also susceptible under the change of conditions. Standard retention time is not provided in SNiP. However, from the capacity calculation according to the method described in SNiP, retention time of 6 days is estimated, that is shorter than that used in other countries such as the United States and Japan. (Approximately 15-day retention time for high rate method)

One (1) of two (2) sludge digestion tanks is not working, because of break-down of equipment. Mechanical equipment of these digestion tanks has been damaged by corrosion.

The roof of the tanks is not made of reinforced concrete, but made of steel with thin cover on it.

Although existing two (2) tanks have enough capacity for proposed flow of 136,000m^3/day, construction of one (1) more unit was proposed in the F/S. However, the construction of one digester was canceled after study.

k. Boiler and Gas Holders

One (1) boiler is working at present. However, mechanical equipment of this is old and damaged. Replacement of two (2) boilers with required mechanical equipment is necessary.

Two gasholders exist, but only one is working. One (1) has no cover over the facility. Two (2) of them need rehabilitation.

l. Sludge Drying Bed

There are thirty (30) existing sludge-drying beds (old: 24, new: 4) and two (2) under construction. As observed that water content of dewatered sludge at the beds is rather low, this facility has been working properly. But, there are environmental problems in odor and breeding of harmful insects. This problem might be highlighted as a hygienic issue, since the new governmental area is located in its vicinity.

The sludge beds occupy the largest area in the STP and its location is convenient for expansion of facilities.

m. Administration Building/Laboratory

Existing STP has one administration building/laboratory. It consists of manager's room, engineer's room and laboratory without centralized instrumentation and control room. Laboratory doesn't have enough room and equipment for water/sludge quality analysis. There is no staff room for plant maintenance personnel.

For the administration, plant control, and also maintenance personnel, new administration building equipped with full function as stated below is necessary.

i) Instrumentation, Control and Data recording
ii) Library for Keeping Data on construction and maintenance
iii) Office and Meeting room
iv) Laboratory
v) Room for Maintenance

n. Connecting Conduit and Others

There are many kinds of connecting conduits between each facility. According to STP management, all the pipes are very old and buried at deep locations. It is believed that pipes are damaged badly by corrosion.

Most of manhole covers are damaged and some of them are missing. Replacement need of conduits is unknown so far. Manhole covers should be provided or replaced for safe maintenance.

Power distribution line is directly connected from the neighboring power station at the 3points in STP with 2 circuits. Since the power lines are buried and no drawings are kept, condition of the power cables is unknown.

o. Yard Work

Existing access roads to each facility are not good condition. Some of them are broken and no access road from main road to some facilities. Rehabilitation and new construction is necessary for operation and maintenance.

3) Current Status of Intermediate Pump Station

Thirty nine (39) pump stations are installed in the sewerage service area under relatively flat topography. However the pump stations in the inventory of ASA are 34 as of October 2002, and 5 (=39-34) intermediate pump stations were unable to find in the sewer pipeline network map. Figure 2.3.7 shows the locations of intermediate pump stations.

Thirty four (34) intermediate pump stations shown in the inventory of ASA were field confirmed. It was found in the fieldwork that there are some discrepancies in their locations, description of equipment and structure.

Superstructure of intermediate pump stations is round shape and one-story brick built. Most of them are round shape even under the ground.

The capacity of the pump with the head at each intermediate pump station is shown in Tables 2.3.7 and 2.3.8. However, they are on nominal base and actual condition is not known. “Submergible” pump is not employed in the existing sewerage system.

Table 2.3.7 Details of Existing 34 Intermediate Pump Stations (1/2)

Facility	Location	Operation start	Capacity	GL	Depth	Shaft diameter	Super-structure	Structure under GL
			(m^3/hr)	(m)	(m)	(m)		
1A	Prospect Abaya	—	9600	344.00	10.00	16.00	brick16*16	ferrocon.
2	Geroev Krasnodona St.	1956	700	347.30	7.00	9.00	brick	ferrocon.
3	Bejsekova-Orenburgskaya St	1963	1750	346.00	9.00	16.00	brick φ16	well
4	Litmash	-	400	352.00	7.00	12.00	brick12*14	in-situ
5	Akzhaik St.126	-		350.00	6.00	6.00	brick φ6	in-situ
6	Koktal village	1970	2800	343.80	6.00	12.00	brick6*30	ferrocon.
7	Molodezhnyj micro-district	1970	2500	347.00	12.00	24.00	brick16*24	in-situferrocon
8	Prospect Respubliki	1975	144	346.60	5.50	7.50	brick	in-situ
9	Sever restaurant area	1970	450	353.00	6.00	6.00	brick	ferrocon.
10	Agromash plant	1966	400	352.80	12.00	16.00	brick12*14	ferrocon.
11	Hospital area	1964	180	352.80	8.00	6.00	brick	ferrocon.
12	Sewege treatment plant	1967	3550	343.60	12.00	21.00	brick16*22	ferrocon.
13	Sewege treatment plant	1967	3550	343.50	12.00	21.00	brick16*22	ferrocon.
14	Block No214	1965	160	349.30	7.00	4.00	brick	ferrocon.
15	Tselinny micro-district	1963	250	348.20	7.00	6.00	brick	ferrocon.
16	11Skladskaya st.	1984	100	351.40	6.00	6.00	brick4.5*6	ferrocon.
17	Moskovskaya st.	1961	114	346.90	6.00	3.00	brick	ferrocon.
18	Etalon plant,Almatinskaya St.	1980	250	346.20	7.00	6.00	brick7*7	ferrocon.
19	Potania-9May st.	1999		350.00	9.00	9.00	brick10*10	ferrocon.
20	UPTK Kazakhtrastehmontazh	1980	250	345.00	6.00	7.00	brick	ferrocon.
21	Prigorodny village	1965	250	-	8.00	6.00	brick	ferrocon.
22	Promyshlenny village	1963	114	361.90	8.00	6.00	brick	ferrocon.
23	Prospect Respubliki samal	1999	80	346.70	8.50	7.00	brick10*10	ferrocon.
24	21/1Moskovskaya.st	1970	80	349.80	8.00	4.00	brick5*6	ferrocon.
25	Meat packing plant	-	50	346.40	5.00	3.00	brick4.5*7	ferrocon.
26	Energetik village	1980	50	347.70	4.00	3.00	iron3*3	ferrocon.
27	Arsenal Warehouses		114	352.60	8.00	8.00	brick9*9	ferrocon.
28	Kombinat Avtomatiki		50		5.00	3.00	RC4.5*2.5	ferrocon.
29	Kombinat Avtomatiki		144	-	6.00	6.00	brick	ferrocon.
30	Al-Farabi micro-district	1999	160	358.00	7.00	8.00	bric9.5*9.5	ferrocon.
31	President reception house	1999	50	345.40	7.50	5.50	bric6*6	ferrocon.
32	Etnopark	1999	50	344.00	8.00	5.50	bric6*6	ferrocon.
33	Chubary village	1990	50	345.00	4.00	2.00	RC?3*5	ferrocon.
34	PDU village	1970	50	345.00	4.00	3.00*4.00	RC6.5*4.5	ferrocon.

NOTE: Capacity is in nominal.

Table 2.3.8 Details of Existing 34 Intermediate Pump Stations (2/2)

Fac.	Pump Type1				Pump Type2				Pump Type3				Pump Type4			
	Dliv. cap.	Head (m)	Capa (kV)	Num.	Dliv. cap.	Head (m)	Cap. (kV)	Num.	Dliv. cap.	Head (m)	Capa (kV)	Num	Dliv. cap.	Head (m)	Capa (kV)	Num
1A	800	22.5	160	3(2)	450	22.5	–	1								
2	450	22	55	2(1)	368	16	55	1								
3	650	22.5	125	4(2)	450	22.5	110	1								
4	800	22	75	1(1)	450	22	37	4(3)								
5	450	22		1	250	22		2(1)								
6	1600	22.5	250	3(2)	800	22.5		1								
7	3500	19.5	370	2(2)	1600	25	250	2(1)	800	22	132	1	450	22		2
8	250	22		1(1)	144	22	22	2(1)								
9	360	22		1	144	22		1	114	22		1(1)				
10	800	22	125	1(1)	450	22	75	4(2)								
11	144	22		1	114	22		1(1)								
12	2700	26.5	400	5(3)												
13	2700	26.5	400	5(3)												
14	160	10	7.5	2(1)												
15	250	22		1	114	22		1(1)								
16	114	22	22	1	114	22	5.5	1(1)								
17	114	11	11	2(1)												
18	250	22		2(1)												
19	250	22		1	125		45	2(2)								
20	250	22.5		2(1)												
21	250	22	30	2(1)												
22	144	22	11	2(1)												
23	80	24	22	2(1)	250	22	30	1(1)								
24	80	20	15	1												
25	114	11	15	1												
26	50			2(1)												
27	114	22	22	2(1)												
28	50			1												
29	114	22		2(1)												
30	80		22	2	250	22	37	1(1)								
31	50	12.5	5.5	3(2)												
32	50	12.5	5.5	2(1)												
33	50	11.5		1												
34	50	11.5		1												

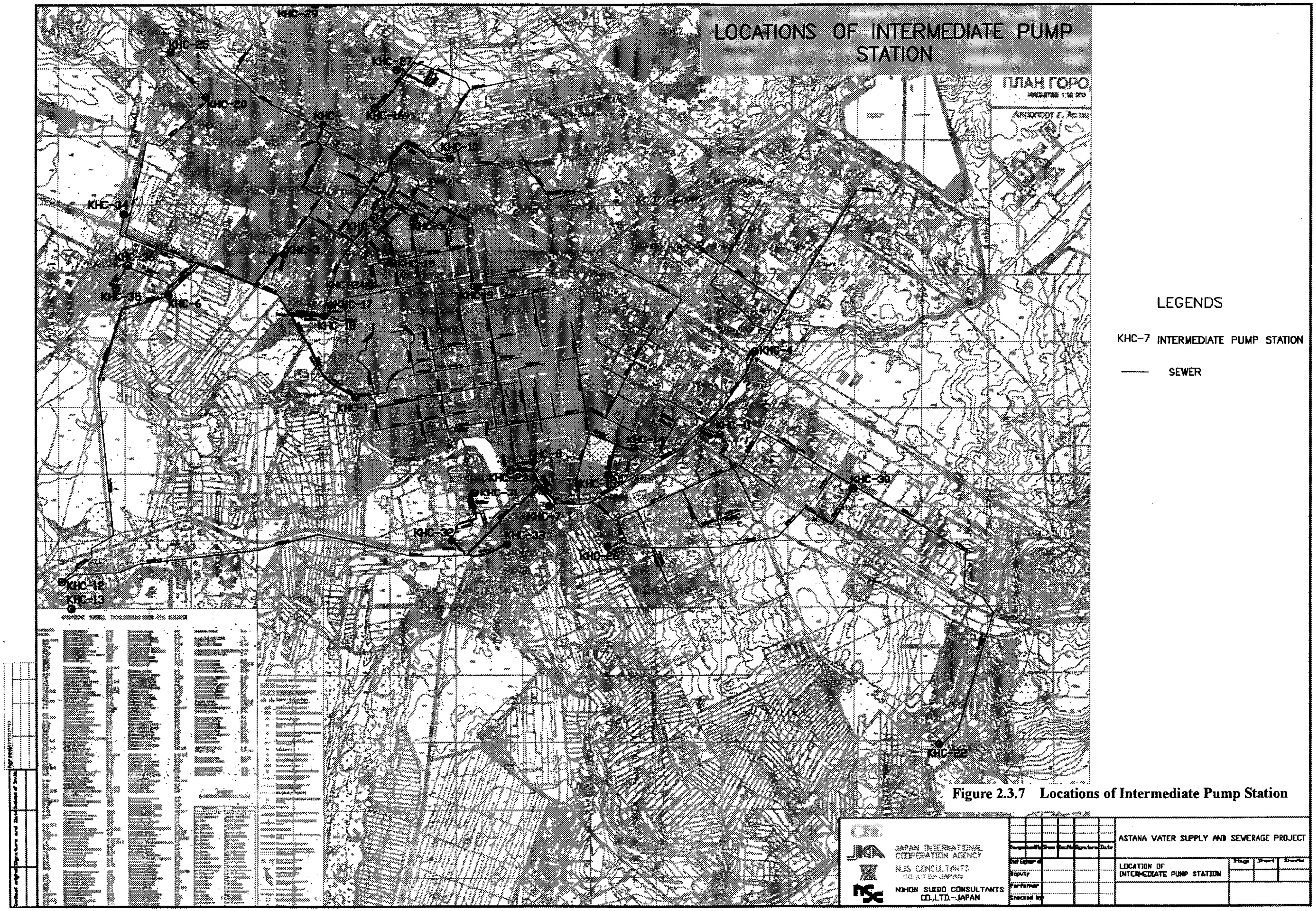


Figure 2.3.7 Locations of Intermediate Pump Station

Scale wise classification of the 34 pump stations was made as shown in Table 2.3.9. From this table, allowance ratio (Safety factor) is mostly beyond 2.0. Typical pump station is shown in Figure 2.3.8.

Table 2.3.9 Classification of Intermediate Pump Stations

Item	Small scale	Medium scale	Large scale
Capacity normal operation	0 ~ 250 m^3/hr 23 PSs	450~1750m^3/hr 7 PSs	2400~5400m^3/hr 4 PSs
Pump number, (Standby)	1(0) 5 PSs: 2(1) 14 PSs: (2) 3 PSs: 3(1) 1 PS.	3(1) 3 PSs: 4(2) 1 PS: 5(2) 1 PS: 5(3) 1 PS: 5(4) 1 PS	4(2) 1 PS: 5(3) 2 PSs: 7(3) 1 PS
Allowance Ratio (Most of them)	1.0 ~ 5.3 (2.0)	1.23 ~ 5.78 (1.23 ~ 2.89)	1.33 ~ 3.09 (2.5)
Pump pit	Dry Pit (21) No dry Pit (2)	Dry Pit	Dry Pit
Reservoir	Installed except for KHC33	Installed	Installed
Screen	Installed except for shaft dia. within φ3000	Installed	Installed
Grit chamber	Not installed	Not installed	Not installed
Control	Automated	Automated	Automated
Operator	None	Exist	Exist

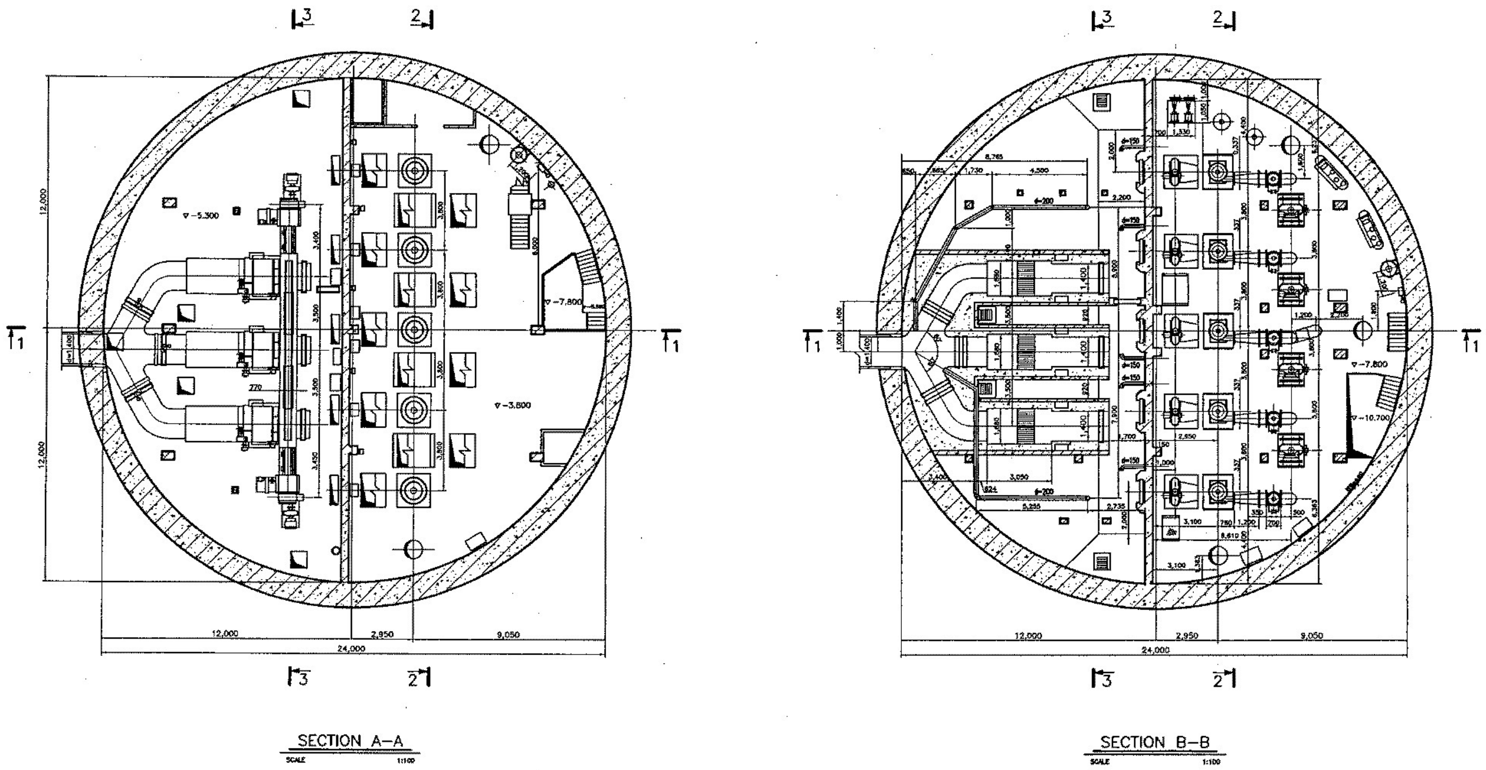


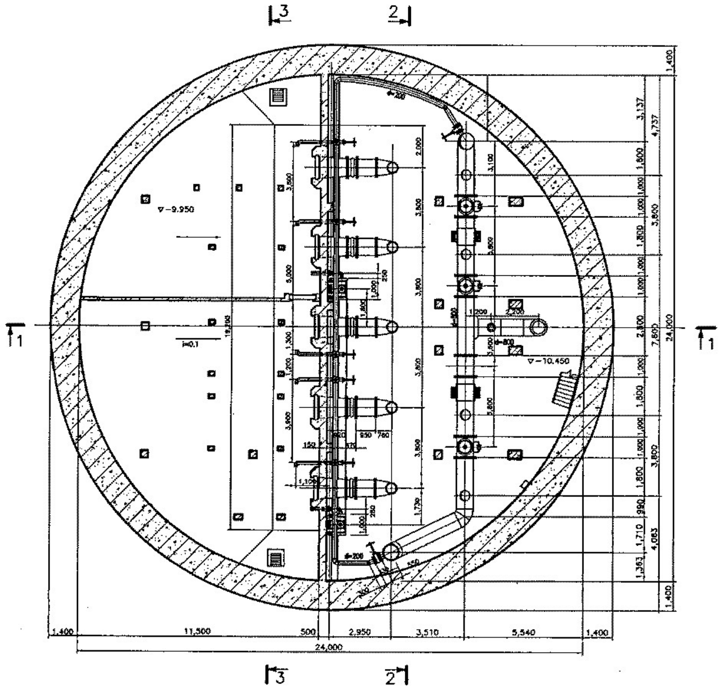
Figure 2.3.8-1

Drawing of Typical Pump Station (Large Size) – 1/3

КОРПОРАЦИЯ РАЗВИТИЯ СТОЛИЦЫ
JAPAN INTERNATIONAL COOPERATION AGENCY
NJS CONSULTANTS CO.,LTD.–JAPAN
NIHON SUIDO CONSULTANTS CO.,LTD.–JAPAN

THE DETAILED DESIGN STUDY OF THE WATER SUPPLY AND SEWERAGE SYSTEM FOR ASTANA CITY
ДЕТАЛЬНОЕ ПРОЕКТИРОВАНИЕ СИСТЕМ ВОДОСНАБЖЕНИЯ И ВОДООТВЕДЕНИЯ В ГОРОДЕ АСТАНЕ

TYPICAL PLAN OF SPS
ТИПОВОЙ ПЛАН КНС



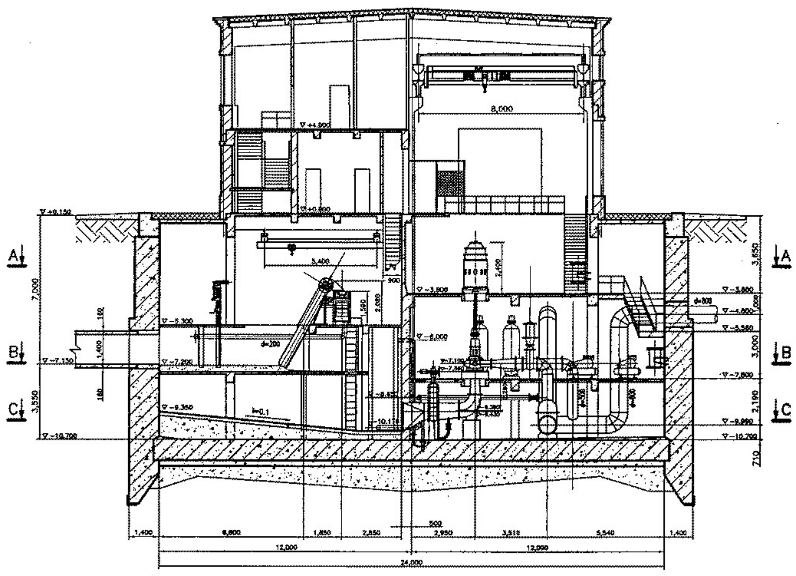


Figure 2.3.8-2

Drawing of Typical Pump Station (Large Size) – 2/3

КОРПОРАЦИЯ РАЗВИТИЯ СТОЛИЦЫ
JAPAN INTERNATIONAL COOPERATION AGENCY
NJS CONSULTANTS CO.,LTD.–JAPAN
NIHON SUIDO CONSULTANTS CO.,LTD.–JAPAN

THE DETAILED DESIGN STUDY OF THE WATER SUPPLY AND SEWERAGE SYSTEM FOR ASTANA CITY
ДЕТАЛЬНОЕ ПРОЕКТИРОВАНИЕ СИСТЕМ ВОДОСНАБЖЕНИЯ И ВОДООТВЕДЕНИЯ В ГОРОДЕ АСТАНЕ