APPENDIX B FUNCTIONAL DESIGN SPECIFICATIONS (Sequence of Operation)

B.1 WATER SUPPLY FACILITIES

1. General

A. The tag number of the equipment comprise three designations (W10 CM 01), where the three designations refer to plant area, equipment type and sequence number as follows:

Area designation		Equipment		Sequence Number
W	**Water Supply**			
W00	general	AB	air blower	
W10	intake facility	AC	air compressor	
W11	intake pump station	AT	air tank	
W12	surge control house	AV	air valve	
W13	flow control facility	BP	backwash recovery pump	
W14	access road	CL	chlorinator	
W15	yard pipe	CM	chemical mixer	
W16	miscellaneous work	CP	chemical pump	
W17	intake sub-station	CT	chemical tank	
W20	raw water transmission facility	CV	check valve	
W30	water treatment facility	DP	sump drainage pump	
W31	distribution chamber	EF	exhaust fan	
W32	receiving well	EV	evaporator	
W33	flocculation basins and sedimentation basins	GW	gas scrubber (washer)	
		HC	hand operated crane	
W34	rapid sand filter	HG	hand operated gate	
W35	distribution pump station	HH	hand operated hoist	
W36	washing drain basin	HS	hand operated screen	
W37	sludge thickener	HV	hand operated valve	
W38	sludge drying bed	MC	motorised crane	
W39	sludge cake yard	MG	motorised gate	
W40	yard pipe	MH	motorised hoist	
W42	miscellaneous work	MP	sampling pump	
W43	water treatment building	MV	motorised valve	
W44	administration building	RP	raw water pump	
W45	chemical building	SC	sludge collector	
W46	guard house	SI	siphon	
W47	WTP sub-station	SP	sludge pump	
W100	distribution pipeline	SS	sludge thickener	
		ST	surge tank	
		SW	surface wash piping	
		WP	distribution pump	
		VP	vacuum pump	
		VT	vacuum tank	

2. Intake Pump Station

A. Raw water enters the intake from the Vyacheslavsky Reservoir through three inlet pipes. From each inlet, which is provided with stop logs for isolation during periods of maintenance, flow passes through three screens (W11 HS 01, W11 HS 02 and W11 HS 03) arrangements to prevent gross solids flow into the pipes.

B. After the screens, flow passes to raw water pumps through one of three electrically operated valves (W11 MV 01, W11 MV 02 and W11 MV 03), which convey raw water from a suitable water level, and also isolate the suction pipe.

C. Under normal operation, only one screen and valve is open and the stop logs and valves are closed only for maintenance.

D. The pump station includes space for eight vertically mounted centrifugal pumps. Six pumps are installed in this phase (W11 RP 11, W11 RP 21, W11 RP 31, W11 RP 41, W11 RP 51 and W11 RP 61) with space left for the seventh and eighth pumps. Each pump system comprises a electrically operated suction butterfly valve (W11 MV 11, W11 MV 21, W11 MV 31, W11 MV 41, W11 MV 51 and W11 MV 61), check valve (W11 CV 11, W11 CV 21, W11 CV 31, W11 CV 41, W11 CV 51 and W11 CV 61) and electrically operated discharge butterfly valve (W11 MV 12, W11 MV 22, W11 MV 32, W11 MV 42, W11 MV 52 and W11 MV 62). The suction and delivery pipework and valves (W11 HV 71 and W11 HV 72) for the seventh pump and for the eighth pump (W11 HV 81and W11 HV 82) are installed in this phase and blanked off but the check valve is not included in this phase. Pressure gauges with an isolating valve and diaphragm are mounted on the suction and discharge side of each pump.

E. Two sump drainage pumps, check valves and manual gate valves are provided in the pump dry well for drainage (W11 DP 01, W11 DP 02, W11 CV 06, W11 CV 06, W11 HV 06 and W11 HV 07 respectively).

F. Three electrically operated overhead hoists (W11 MH 01, W11 MH 02 and W11 MH 03) are provided in the pump station for maintenance, two in the superstructure and one in the substructure.

G. Two electrically operated valves (W11 MV 04 and W11 MV 05, respectively) are provided for maintenance of two pipelines.

H. The raw water is conveyed to the surge control house and then to a distribution chamber in the water treatment plant through the raw water transmission pipelines.

3. Surge Control House

A. Surge tanks (W12 ST 01 and W12 ST 02) are provided near the intake pump station to protect the raw water transmission pipelines from surge phenomenon. The tanks are connected to the raw water transmission pipeline with manually operated butterfly valves (W12 HV 01 and W12 HV 02). The valves are normally opened and they are used for maintenance.

B. Pressure and water level of the tanks are automatically control to maintain conditions to prevent surge phenomenon. Pressured air is supplied by air compressors (W12 AC 01 and W12 AC 02) and it is stored in air tank (W12 AT 01).

C. Motorised butterfly valve (W12 MV 11) is provided to control the flow of raw water and manual butterfly valve (W12 HV 11) is provided for isolation of the raw water transmission pipeline in the surge control house.

4. Distribution Chamber

A. Raw water delivered to the distribution chamber from the raw water transmission pipelines flows through two electrically operated inflow pressure control valves (W31 MV 11 and W31 MV 21). The valves sustain the pressure in the raw water transmission pipelines at required level.

B. Three electrically operated distribution weirs (W31 MG 11, W31 MG 21 and W31 MG 31) control flow for the three trains of the treatment facilities. One weir (W31 MG 31) is for future use and is closed for this stage.

C. A pipeline from the washing drain basin connects to the chamber to recover filter wash water. Also an overflow pipe and a drain pipe with manually operated valve (W31 HV 01) are provided for the chamber.

D. Activated carbon powder solution is dosed downstream of the inflow control valves. The dosage (in mg/l) of activated carbon powder at the distribution chamber will be:

	Max.	Ave.	Min.
Activated Carbon Powder (3%)	30	20	10

E Control of the activated carbon dosing system is described in the Chemical Room section although the relevant facilities are located at the distribution chamber.

F A valved tapping is provided on the raw water transmission pipeline in the inflow control valve chamber to deliver water for quality monitoring to the Administration Building.

5. Receiving Well

A. Raw water delivered to the receiving well from the distribution chamber flows through two electrically operated inflow valves (W32 MV 11 and W32 MV 21) and flows over two weirs into the coagulation (rapid mixing) basins.

B. An electrically operated gate is provided on each outlet from the receiving well to the flocculation basins for isolation and maintenance purposes (W32 MG 11 and W32 MG 21 respectively.

C. Drainage facilities, controlled by manually operated valves (W32 HV 11 and W32 HV 21), are provided in the receiving well.

D. Chemicals – coagulant (alum), flocculant (polymer) and chlorine are also dosed into the raw water at the receiving well. Mixing is effected hydraulically by the weirs and the dosages (in mg/l) of each chemical at the distribution chamber will be:

	Max.	Ave.	Min.	
Coagulant (10% Alum $(Al_2(SO_4)_3 18H_2O)$	30	7.5	1.0	
Flocculant (1% Polymer)	0.1	0.05	0.025	
Chlorine (99% Cl_2)	5.0	3.0	1.5	(pre-chlorine)

E. Control of the chemical dosing system is described in the Chemical Room section although the relevant facilities are located at the distribution chamber.

6. Flocculation/Sedimentation Basins

A. From the receiving well the coagulated raw water flows into the flocculation basins. Six basins are provided so that in case of lower flows than the designed capacity one train may be shut down to attain a suitable flocculation intensity, or maintenance work is undertaken on any one of the six basins, the remaining one can provide adequate capacity. The coagulated raw water flows through six electrically operated inflow gates (W33 MG 11, W33 MG 21, W33 MG 31, W33 MG 41, W33 MG 51 and W33 MG 61). The flocculation will be effected in vertical-flow baffled channels with three staged tapered flocculation. From each flocculation basin flocculated water flows to the attached sedimentation tank where the solids settle out as sludge.

B. The solids settle in the sedimentation tanks and are moved to the inlet end of the tanks by means of sludge collectors (W33 SC 11, W33 SC 21, W33 SC 31, W33 SC 41, W33 SC 51 and W33 SC 61). The collector will be continuously operated to scrape the tank.

C. Sludge is withdrawn hydrostatically from each tank through four pneumatically operated desludging valves (W33 PV 11, W33 PV 12, W33 PV 13 and W33 PV 14 for tank No.1, W33 PV 21 to W33 PV 24 for tank No.2, W33 PV 31 to W33 PV 34 for tank No.3, W33 PV 41 to W33 PV 44 for tank No.4, W33 PV 51 to W33 PV 54 for tank No.5 and W33 PV 61 to W33 PV 64 for tank No.6, respectively). The valves in each basin shall be manually pre-set to open and shall close automatically after a manually pre-set time interval. Valves shall be interlocked such that only one of those in all basins can open. The valves discharge into the sludge header pipe which conveys the sludge to the sludge thickeners.

D. Each pneumatically operated valve has a manually operated maintenance valve upstream on the sludge withdrawal pipeline (W33 HV 11 to W33 HV 14 for tank No.1, W33 HV 21 to W33 HV 24 for tank No.2, W33 HV 31 to W33 HV 34 for tank No.3, W33 HV 41 to W33 HV 44 for tank No.4, W33 HV 51 to W33 HV 54 for tank No.5 and W33 HV 61 to W33 HV 64 for tank No.6, respectively).

E. Four sump drainage pumps, check valves and manual gate valves are provided in the sludge collection chamber for drainage (W33 DP 01, W33 DP 02, W33 DP 03, W33 DP 04, W33 CV 01, W33 CV 02, W33 CV 03, W33 CV 04, W33 HV 01, W33 HV 02, W33 HV 03 and W33 HV 04, respectively).

F. Intermediate chlorination is provided at the settled water effluent channel.

G. A settled water sampling pump is provided at the settled water effluent channel. The pump (W33 MP 01) with foot valve, manually operated valve and check valve deliver water for quality monitoring to the Administration Building.

7. Rapid Sand Filter

A. The filtration flow rate is to be maintained and distributed into each of the twelve filters by an influent weir installed at the inlet to each filter from the distribution channel, which receives flow from the sedimentation tanks. The highest filtration level at which back washing will start will be controlled by means of the water level in each filter and backwashing will then run for a pre-set time period. Thus the head of water above the sand level of the filter will increase during the filtration cycle until backwashing is required.

B. Settled water from the sedimentation basins flows into the filter distribution channel where twelve pneumatically operated siphons (W34 SI 011, W34 SI 021, W34 SI 031, W34 SI 041, W34 SI 051, W34 SI 061, W34 SI 071, W34 SI 081, W34 SI 091, W34 SI 101, W34 SI 111 and W34 SI 121, respectively) distribute flows to each of the twelve filters. The small diameter valves required for the siphon systems are not detailed in this FDS.

C. Flow exits each filter into the filtered water channel through manually operated effluent isolation gates (W34 HG 011, W34 HG 012, W34 HG 021, W34 HG 022, W34 HG 031, W34 HG 032, W34 HG 041, W34 HG 042, W34 HG 051, W34 HG 052, W34 HG 061, W34 HG 062, W34 HG 071, W34 HG 072, W34 HG 081, W34 HG 082, W34 HG 091, W34 HG 092, W34 HG 101, W34 HG 102, W34 HG 111 W34 HG 112, W34 HG 121, and W34 HG 122, respectively) and then passes through ten effluent weirs (W34 HG 01, W34 HG 02, W34 HG 03, W34 HG 04, W34 HG 05, W34 HG 06, W34 HG 07, W34 HG 08, W34 HG 09, and W34 HG 10, respectively) to the chlorination mixing basin.

D. Twelve pneumatically operated siphons for washwater discharge (W34 SI 012, W34 SI 022, W34 SI 032, W34 SI 042, W34 SI 052, W34 SI 062, W34 SI 072, W34 SI 082, W34 SI 092, W34 SI 102, W34 SI 112 and W34 SI 122, respectively), twelve pneumatically operated butterfly valves for surface wash (W34 PV 011, W34 PV 021, W34 PV 031, W34 PV 041, W34 PV 051, W34 PV 061, W34 PV 071, W34 PV 081, W34 PV 091, W34 PV 101, W34 PV 111 and W34 PV 121, respectively) and surface wash piping (W34 SW 011, W34 SW 021, W34 SW 031, W34 SW 041, W34 SW 051, W34 SW 061, W34 SW 071, W34 SW 081, W34 SW 091, W34 SW 101, W34 SW 111 and W34 SW 121, respectively) are provided for filter washing. The water for surface wash is supplied from the main distribution pipeline.

E. On actuation of the backwash cycle for the first filter, the inlet siphons (W34 SI 011) will be suspended and the discharge siphons (W34 SI 012) will be actuated. After a manually pre-set time the surface wash valve (W34 PV 011) will be open, and the valve will be closed after anther manually pre-set time for duration of surface wash. After further manually pre-set time for backwashing the discharge siphons (W34 SI 012) will be suspended to finish backwashing. The inlet siphons (W34 SI 011) will be actuated to recommence filter operation.

F. The sequencing for the other filters will be a similar operation.

G. Pressurised air for operation of the backwash and surface wash facilities is provided from air compressors (W34 AC 01 and W34 AC 02 (one as duty and one as automatic standby)), air dryers (W34 AD 01 and W34 AD 02, respectively) and air receiver tank (W34 AT 01) and twelve sets of operating panels, one for each filter. The vacuum system comprises vacuum tank (W34 VT 01), two vacuum pumps (W34 VP 01 and W34 VP 02 respectively (one as duty and one as automatic standby)) and separator tanks. The minor valves and controlling systems for these vacuum and pressurised air facilities are not described in this FDS.

H. Drainage of the filter distribution channel for maintenance purposes can be effected through flat bottom valve (W34 HV 012, W34 HV 022, W34 HV 032, W34 HV 042, W34 HV 052, W34 HV 062, W34 HV 072, W34 HV 082, W34 HV 092, W34 HV 102, W34 HV 112 and W34 HV 122, respectively).

I. Filter drainage for maintenance purposes can be effected through drain valve (W34 HV 011, W34 HV 021, W34 HV 031, W34 HV 041, W34 HV 051, W34 HV 061, W34 HV 071, W34 HV 081, W34 HV 091, W34 HV 101, W34 HV 111 and W34 HV 121, respectively).

J. Drainage of the filter effluent channel for maintenance purposes can be effected through drain valve (W34 HV 01 and W34 HV 02) while drainage of the washwater drain channel for maintenance purposes can be effected through drain valve (W34 HV 03 and W34 HV 04).

K. Spent backwash water is discharged to the washing drain basin for further treatment.

L. A filtered water sampling pump is provided at the filtered water effluent channel. The pump (W34 MP 01) with foot valve, manually operated valve and check valve delivers water for quality monitoring to the Administration Building.

M. Two electrically operated overhead hoists (W34 MH 01 and W34 MH 03) are provided for maintenance.

8. Distribution Pump Station

A. Disinfected water from the chlorination mixing basin is delivered to the existing drinking water reservoirs and then delivered to the existing distribution pump station.

B. The existing distribution pump station includes two pumps for backwash, eight distribution pumps for drinking water and three distribution pumps for technical water. Three distribution pumps for drinking water are replaced in this stage; two pumps (No. 4 and No. 7) with large capacity (W35 WP 11 and W35 WP 21) and one pump (No. 8) with small capacity (W35 WP 31). Each pump system comprises an electrically operated suction valve (W35 MV 11, W35 MV 21 and W35 MV 31), check valve (W35 CV 11, W35 CV 21 and W35 CV 31) and electrically operated discharge valve (W35 MV 12, W35 MV 22 and W35 MV 32).

C. The No. 4 pump (W35 WP 11) is driven by a variable speed motor and it will be controlled automatically by pressure of distribution pipe, while Nos. 7 and 8 pumps (W35 WP 21 and 31) will be started/stopped manually by operators.

D. Two sump drainage pumps, check valves and manual gate valves are provided in the distribution pump station for drainage (W35 DP 01, W35DP 02, W35 CV 01, W35 CV 02, W35 HV 01 and W35 HV 02 respectively)

E. An electrically operated overhead crane (W35 MC 01) is provided in the pump station for maintenance.

F. Water for in-plant use is supplied through the plant water supply valve (W35 VV 03).

9. Washing Drain Basin

A. Spent backwash water is discharged to the washing drain basins from the filters. Spent backwash water is then discharged to the distribution chamber.

B. Spent backwash water is taken by float suction units (W36 FU 11 and W36 FU 11), while settled sludge is taken from lower suction pipes.

C. The tank contains three pumps to pump recycled backwash water to the distribution chamber, and two pumps to pump accumulated sludge to the sludge thickeners. The backwash recovery pumps (W36 BP 11, W36 BP 21 and W36 BP 31) are provided two for duty and another for standby. Two sludge pumps (W36 SP 11 and W36 SP 21) are provided, one for duty and ones for standby. Each pump system comprises the pump,

inflow valve, check valve and manually operated discharge valve (W36 HV 11, W36 HV 21, W36 HV 31, W36 CV 11, W36 CV 21, W36 CV 31, W36 HV 12, W36 HV 22 and W36 HV 32, respectively for the backwash recycle pumps and W36 HV 13, W36 HV 23, W36 CV 12, W36 CV 22, W36 HV 23 and W36 HV 33, respectively for the sludge pumps).

D. Two sump drainage pumps, check valves and manual gate valves are provided in the distribution pump station for drainage (W36 DP 01,W36 DP 02 , W36 CV 01, W36 CV 02, W36 HV 01 and W36 HV 02 respectively).

10. Sludge Thickener

A. Sludge is discharged from the sedimentation basins and washing drain basins to the sludge thickeners where mechanical sludge scrapers (W37 SS 11 and W37 SS 21) are installed. Sludge thickeners discharge supernatant to discharge pools by gravity and the accumulated sludge flows by gravity and by sludge pumps (W37 SP 11 and W37 SP 21) to sludge drying beds. Each pump system includes, manually operated inflow valve, check valve and manually operated discharge valve (W37 HV 11, W37 HV 21, W37 CV 11, W37 CV 21, W37 HV 12 and W37 HV 22, respectively).

B. Accumulated sludge is discharged to sludge drying beds in summer, while it is stored in the thickeners in winter. Therefore the sludge pumps are manually operated observing the conditions of sludge drying beds.

C. Two sump drainage pumps, check valves and manual gate valves are provided in the distribution pump station for drainage (W37 DP 01 and W37 DP 02, W37 CV 01, W37 CV 02, W37 HV 01 and W37 HV 02 respectively).

11. Sludge Drying Bed

A. Accumulated sludge in the sludge thickeners is pumped to six sludge drying beds where manually operated inlet valves (W38 HV 11, W38 HV 21, W38 HV 31, W38 HV 41, W38 HV 51 and W37 HV 61) and manually operated outlet valves (W38 HV 12, W38 HV 22, W38 HV 32, W38 HV 42, W38 HV 52 and W37 HV 62) are installed. Dried sludge is manually removed using heavy machines such as wheel loaders.

12. Discharge Pool

A. Wastewater from the sludge thickeners and sludge drying beds is discharged to the discharge pool through manually operated inlet valves, series A and B (W40 HV 11, W40 HV 12, W40 HV 21 and W40 HV 22, respectively). Stored wastewater is pumped to the sewer in the plant by wastewater discharge pumps (W40 WP 11 and W40 WP 12) for final disposal. Each pump system includes, manually operated inflow valve, check valve and manually operated discharge valve (W40 HV 11, W40 HV 21, W40 CV 11, W40 CV 21, W40 HV 12 and W40 HV 22, respectively).

B. Two sump drainage pumps, check valves and manual gate valves are provided in the distribution pump station for drainage (W40 DP 01 and W40 DP 02, W40 CV 01, W40 CV 02, W40 HV 01 and W40 HV 02 respectively).

13. Chemical Room

13.1 General

A. The chemical room comprises four independent sections for coagulant (alum), flocculant (polymer), activated carbon and chlorine preparation and dosing facilities. An electrically operated hoist (W45 MH 01) is provided for the activated carbon storage area for transporting bags. Another electrically operated hoist (W45 MH 02) is provided in the chlorine container storage area for lifting of chlorine tonne containers. The small diameter valves required for the systems are not detailed in this FDS.

13.2 Coagulant (Alum) Dosing System

A. Alum stones are dissolved at the existing chemical building. The dissolved alum solution is pumped to the new chemical building by coagulant transfer pumps (W45 CP 11 and W45 CP 21) from the existing chemical building to coagulant tank in new chemical room. Each pump system comprises a suction valve, a check valve and a discharge valve.

B. From coagulant tank the coagulant pumps (W45 CP 31 and W45 CP 41) discharge to the coagulant distribution tank (W38 CT 01) at the receiving well after automatically control the flow of coagulant by flow control valve (W45 MV 31) and coagulant flowmeter. The flow control can be also done by a manual flow control valve and manometer.

C. Manually operated drain valves are provided from each tank .

D. Plant water can be flushed through the alum suction system from valve on plant water supply pipe and discharged to drain through valve on drain pipe.

E. At the receiving well the coagulant discharges to coagulant distribution tank (W32 CT 01) containing two v-notch weirs to equalise flow to each receiving well. Each receiving well two dosing pipes are provided, one at outlet of the inflow pipe and another at overflow weir.

13.2 Flocculant (Polymer) Dosing System

A. Bagged polymer will be stored the storage area in chemical room. Bags are opened and the contents emptied into the dissolving tanks. A flocculant tank (W45 CT 01) is provided. The tank is provided with a mixer (W45 CM 01) to assist in dissolving the flocculant in water.

B. Water is added to the flocculant tanks through manually operated valves from the plant water system.

C. Flocculant is discharged from the tank through a manually operated valve to the flocculant pump suction pipe. Flocculant is pumped to the flocculant distribution tank at the receiving well by flocculant pumps (W45 CP 51 and W45 CP 61). Each pump system comprises a suction valve, a check valve and a discharge valve. Manually operated drain valves are provided from each tank

D. Manually operated valves are provided from the plant water system to flush out the flocculant suction systems and which can be discharged to drain through valve.

E. Manual control valves are provided to control the flow of flocculant monitoring the flow by manometer.

F. At the receiving well the flocculant discharges to flocculant distribution tank (W32 CT 02) containing two v-notch weirs to equalise flow to each receiving well. The dosing point is at overflow weir.

13.3 Activated Carbon Dosing System

A. Bagged activated carbon powder will be manually transported to the store area using electrically operated chemical hoist (W45 MH 01). Bags are opened and the contents are manually emptied into the activated carbon tank. The tank is provided with air mixing piping connecting to air blowers (W45 AB 11 and W45 AB 21) to assist in dissolving the activated carbon powder in water.

B. Water is added to the flocculant tanks through manually operated valves from the plant water system.

C. Activated carbon is discharged from the tank through manually operated valves to the activated carbon pump suction pipe. Activated carbon is pumped to the distribution chamber by activated carbon pumps (W45 CP 71 and W45 CP 81). Each pump system comprises a suction valve, a check valve and a discharge valve. Manually operated drain valves are provided from the tank

D. Manually operated valves are provided from the plant water system to flush out the activated carbon suction systems and which can be discharged to drain through valve.

E. Manual control valves are provided to control the flow of activated carbon monitoring the flow by manometer.

F. Dust is controlled by an extract fan (W45 EF 01) and a scrubber (W45 GW 01).

13.4 Chlorination System

A. Chlorine will be stored in one tonne containers and two duty containers will be coupled to the system. The duty cylinders will be placed on a weighing device (W45 WD 01) using chlorine hoist (W45 MH 02). Change over from the duty to the other containers will be effected manually.

B. Liquid chlorine will be drawn off from the bottom of the cylinders through flexible pipes into a pipe manifold from where it will be fed to two evaporators (W45 EV 11 and W45 EV 21). Liquid chlorine is gasified by two evaporators (W45 EV 01 and W45 EV 02) and they are manually selected as duty/standby.

C. Gaseous chlorine will be fed to four chlorinators. Two chlorinators (W45 CL 31 and W45 CL 41) are manually selected as duty/standby to regulate the amount of chlorine solution delivered for pre-chlorination at the receiving well or upstream of the filters and two chlorinators (W45 CL 11 and W45 CL 21) for post chlorination at the chlorine mixing basin prior to discharge to the reservoir.

D. Pre chlorinators and post chlorinators can be isolated by manually operated valves.

E. Water will be supplied from the chlorinator booster pumps to injectors into which chlorine will be drawn from the respective chlorinators to form a chlorine solution for pre and post chlorination respectively.

F. The injectors can be isolated by manually operated valves.

G. Extract fan (W45 EF 01), which is activated by chlorine detector removes air from the chlorinator room and extract fan (W45 EF 02) which is activated by chlorine detector, removes air from the chlorine drum area.

14. Miscellaneous

A. Sampling pumps deliver water from various locations on the treatment plant site to the administration building laboratory to enable water quality to be continuously monitored. The pumps (W33 MP 01 and W34 MP 01) with valves are located at the outlet end of the sedimentation basins and rapid sand filter. In addition, tapings are provided on the raw water transmission pipeline and distribution main.

APPENDIX B FUNCTIONAL DESIGN SPECIFICATIONS
(Sequence of Operation)

B.2 SEWERAGE FACILITIES

1. General

A. The tag number of the equipment comprises three designations (For example: S01 MG 01). The three designations refer to plant facility, equipment type and sequence number respectively as follows:

Principal Facility designation		Principal Equipment		Sequence Number
S	**Sewerage**			
S00	General	MG	Motor driven Gate	
S01	Inflow tank	MS	Mechanical screen	
S02	Influent pump station	GC	Grit collector	
S03	Grit chamber	SC	Sludge collector	
S05	Primary sedimentation tank	AB	Air blower	
S08	Blower house	HW	Adjustable weir	
S10	Secondary sedimentation tank	SP	Sludge pump	
S11	Return sludge pump station	CP	Vertical shaft type mixed flow pump	
S12	Discharge pump station			
S21	Gravity thickener	MV	Motorised valve	
S23	Digester & pump house	SM	Sludge mixer	
S24	Sludge treatment building	CH	Cake hopper	
S25	Hopper house	GH	Gas holder	
S26	Gas holder	CB	Coal boiler	
S27	Boiler building			

2. Description of Functional Design

2.1Influent Pump Station

A. Three units of Fine Screen (S02 MS 11,S02 MS 21 and S02 MS 31) remove the screenings from the influent sewage. The Influent Pumps (S02 IP 10,S02 IP 20,S02 IP 30,S02 11,S02 IP 21) deliver the sewage to the Grit chamber.

B. The screenings of Fine Screen shall be stored in the container tentatively and it shall be finally transferred to outside of influent pump station with Hoist Block (S02 HH 01).

C. Control of pump operation numbers shall be performed by water level of the reservoir with water level meter.

2.2 Grit Chamber

A. Grit collectors (S03 GC 01,S03 GC 02) shall remove settled solids.

B. Grit Pumps (S03 GP 01,S03 GP 02) shall transfer the sediment solid to Grit Scrubber (S03 GS 01).

C. The Grit Scrubber shall separate solid from liquid.

2.3 Primary Sedimentation Tank

A. Sludge Collector (S05 SC 01,S05 SC 02) shall operate continuously.

B. Sludge Pump (S05 SP 01,S05 SP 02,S05 SP 03and S05 SP 04) shall transfer sludge to Gravity Thickener.

C. The operation of sludge pump shall be made periodically by timer.

2.4 Air Blower

A. Air Blowers shall transfer air from Air Filter (S08 AF 01, S08 AF 02, S08 AF 03, S08 AF 04,and S08 AF 05) to aeration tanks.

B. The air volume shall be controlled with operation numbers of units.

2.5 Return Sludge Pump

A. The flow rate of return sludge shall be adjusted with the numbers of operation unit of Return Sludge Pumps (S11 SP 01,S11 SP 02,S11 SP 03,S11 SP 04and S11 SP 05).

B. Flow meter shall be installed to measure the flow rate of return sludge.

2.6 Gravity Thickener

A. Sludge Collectors (S21 GS 01,S21 GS 02) shall be operated continuously with rotating motion.

B. The GRP dome of Gravity Thickener shall prevent odour emission and the gas inside shall be vented out for de-odour.

2.7 Digester & Pump House

A. Digester shall be stirred up by Sludge Pump (S23 SP 01,S23 SP 02).

B. The heating energy for thermo-philic operation of digester shall be supplied by steam from the boiler house.

2.8 Sludge Treatment Building

A. Waste Sludge shall be transferred from Sludge Holding Tank to Mechanical Thickener (S24 MT 01,S24 MT 02, S24 MT 03) by Waste Sludge Feed pumps (S24 SP 03,S24 SP 04 and S24 SP 05).

B. Polymer shall be mixed with water in Polymer Tank (S24 PT 01,S24 PT 02) and transferred to Mechanical Thickener and Dewatering Unit by Polymer Feed pumps(S24 PP 01,S24 PP 02 and S24 PP 03).

C. Dewatering Machine (S24 DM 01,S24 DM 02 and S24 DM 03) shall dewater digested sludge with continuous operation.

D. In the odour generating places, such as Sludge Holding tank, Cake Conveyor, and Gravity Thickener, the gas inside the air tight structure shall be drawn by duct with Odour Fans (S24 EX 01and S24 EX 02) to deodorise with Scrubbers (S24 BS 01).

2.9 Hopper House

A. Cake Conveyor (S25 CC 01,S25 CC 02 and S25 CC 03) transfers Sludge Cakes to Sludge Hopper (S25 CH 01,S25 CH 02,S25 CH 03,S25 CH 04,S25 CH 05 and S25 CH 06) at the 2^{nd} floor in the Hopper House. The cakes shall be stored for sludge disposal by dump.

2.10 Discharge Pump Station

A. The Discharge Pumps (S12 CP 01, 02, 03, 04 and 05) deliver the sewage to the Grit chamber.

B. Control of pump operation numbers shall be performed by water level of the reservoir with water level meter.