the walkways connecting the two ends of these platforms shall have a width not less than 2500 mm. The two operating platforms shall be intermediately connected at least at seven points by 1200 mm wide walkways. The walkways at the rear of the filters and on the cross walls shall be 1000 mm wide. A platform of adequate size shall be provided outside the building on part of the filter inlet channel to give access to the inlet sluice gates. hand railings as specified in shall be provided on all walkway and operating platforms. Tenderers shall also include for the supply of not less than two stairs (at least 1 metre wide) of mild steel construction to give access to the top of the filtered water channel from the operating platforms.

There shall be at least three manholes fitted with cast iron manhole cover and frame for getting into the filtered water channel.

There shall be a 900 mm wide R.C.C. staircase at the rear end (end opposite to the annexe building) of the filter house to give access to the filter house from ground level to operating platform.

Chlorination

General

The chlorinating plant shall be designed to administer a maximum dose of 2 mg/l for post-chlorination. Tenderers shall provide two chlorinators each of 12 kg/hr. capacity. One shall be in normal operation and the other will act as standby. The chlorinators shall be of vacuum type operated by water pressure. They shall be of reputed and approved make having proven records of trouble free service for long periods of use.

The chlorine drum room and chlorine store room shall be provided with one manually operated traveling hoist (capacity 3 M.T.) complete with R.S.J. runners and two sets of drum lifting tackles. Chlorine drum room and chlorine store room shall be provided with adequate chlorine neutralization pit with arrangement of neutralization.

This shall be done in conformity with the explosive and other department's acts and regulations.

The chlorination room and the chlorine drum room shall each be provided with one exhaust fans which shall be fixed near floor levels. Each exhaust fan shall be capable of giving four air changes per hour.

Tenderers shall also include for the supply of four sets of chlorine gas masks 4 protective suits and 2 chlorine kits as per standard norms. Chlorine leak detectors with alarm shall be provided in both chlorine drum room and chlorination room. Tenderers shall supply spare parts that may be required (requirement being specified by the manufacturer) for the maintenance of the chlorinators for one year. They shall also supply of 8(eight) tonner chlorine drums with necessary test certificates and filling permissions etc. all complete as per statutory requirements including license from regulatory authority for transport of hazardous chemicals.

Civil Works

See Chemical House for chlorine drum rooms.

A separate chlorine storage room with cradles having capacity for storage of 6(Six) tonners with adequate ventilation, neutralization pits and handling equipments like HOT crane etc. shall be provided outside the chemical house in conformity with the provision of Explosive Department. If separate chlorine storage is not provided, then chlorine drum room should have sufficient area to keep 8 nos. chlorine drums.

Filtered Water Conveyance

The finally treated water shall be conveyed from the filter house to the existing clear water reservoir through a DI pipe of diameter not less than 800 mm. Tenderers shall include for this pipeline upto the sump with Proper connection including necessary mild steel bends, valves etc. The DI pipes shall be laid on continuous concrete bedding.

2.8 Plant Waste Water Disposal

2.8.1 Natural drainage

Arrangements shall be made for the disposal of waste water from the different treatment plant units and rain water by gravity into natural drainage system. For this purpose the disposal point shall be at the west corner (towards river Brahmaputra) of the site and the tenderers shall satisfy themselves as to the suitability of this point for natural drainage. The waste disposal system shall be designed to make the discharge of the waste water into the outlet channel by gravity alone.

2.8.2 Sludge Pump House

2.8.2.1 General

Nor with standing the arrangements provided for natural drainage of the plant waste water, there shall be a sludge pump house primarily meant for dealing with the clarifier sludge and in addition, when necessary, dealing with the overflow of filter waste water from the overflow weir, and wash water from the collecting well and flash mixers during emptying in case natural drainage is not feasible. The sludge collected in the sludge well of the pump house shall be pumped into sludge line (750 mm dia.) with provision of Y connection and with two valves. The sludge line terminal points are the inlets of two sludge ponds (earthen) of size 5000m^2 x 250 m deep. The sludge ponds and sludge line are included in the scope of contract.

The sludge collecting sump of the pump house shall have a capacity not less than 100 m^3. There shall be four pumps 15 M head, two of which will be under operation and one will act as a standby. The pumps shall be of 40 LPS discharge capacity that each will deliver 70 litres of sludge per second when two pumps are running in parallel. Arrangements shall be made for the standby pump being capable of replacing either of the two pumps in operation at any time.

Adequate provisions shall be made to scour sludge accumulated in the sludge pump sump by air and water jet. Water for water jetting may be obtained from the proposed authorities main available within 150 M. The offer shall include all piping, fixed jets valves & nozzles etc. For air, two nos. of air blowers with fixed air nozzles at the bottom of the sludge pump sump shall be provided.

Each pump shall be completed with driving motors, necessary cast iron sluice and reflux valves and cast iron piping for suction and delivery including all fittings. Tenderers shall include for delivery and laying pipeline sludge line upto sludge ponds shown in tender drawing.

A manually operated chain pulley block of 3 tone capacity shall be provided for handling the pumps and motors in the pump room.

The specification for pumps and other equipment shall strictly conform to specification of equipment of these tender specifications.

The electric motors, switch gears and other electrical equipment provided in the sludge pump house shall conform strictly to specifications for electrical work given in Section 'H' of this tender document.

2.8.2.2 Civil Works

The sludge pump house shall be of R.C.C. under ground structure with brick panel walls in the superstructure and shall be provided with pile foundation.

The sludge sump shall be circular in shape and shall be provided with a dry pit at the centre for accommodating sludge pumps and air blowers. The diameter of the pump area shall not be less than 8 meters and the volume in the annular space shall be not less than 300 m^3. The floor of the pump shall be placed at a sufficiently low level to receive the discharge of clarifier sludge coming out at the lowest level of the clarifier sludge pipe. The floor of the sump shall be given a slope not less than 1 in 12 towards the dry pit where a channel 600mm wide and 400 mm deep shall also be provided. A 2000 mm wide walkway shall be provided to give access to the pump room and R.C.C. steps 1000 mm wide shall be provided from the walkway to floor level of the dry pit. An annular platform shall be provided on the outer wall at plinth level excepting the portion over part of the steps. Steps shall be provided to give access to the walkway from ground level. Hand railing, as specified, shall be provided on the walkway platform and one side of the steps.

Adequate skylight and windows shall be provided in the sludge pump house building to admit sufficient natural light. The total shutter area of doors windows and skylights shall not be less than 25% of the plinth area. The windows and skylights shall be provided with grills of approved design. The main entrance door shall be a 1.5 meter wide mild steel rolling shutter.

The roof of the pump house shall be provided with roof water proofing treatment (E-8) with adequate arrangements for rain water drainage.

All the basic construction works and finishing works shall be carried out as per specifications of this tender document.

2.9 Laboratory

There shall be one Laboratory for the treatment plant suitably equipped for carrying out physical chemical and bacteriological tests. As already stated the laboratory shall be located in the first floor of the chemical house. The layout and dimensions of the laboratory room shall be according to International Standards. Tenderers shall supply all the furniture accordingly and all the equipment as listed here in under. A 500 lit R.C.C./brick overhead water tank for water supply to the laboratory are to be provided.

2.9.1 Sampling Table

Tenderers shall provide and install one sampling table with a granite top. The sampling table shall be provided with three clarity bowls to indicate the clarity of raw water, clarified water and filtered water; a stainless steel sink; and three faucets with sqan necks to give independently samples of raw water, clarified water and final filtered and chlorinated water. Individual supply line of the sampling table shall be marked distinctively as RAW, CLARIFIED and FILTERED WATER. Independent electrically operated pumps shall be provided for collection of samples of raw and clarified water and the third faucet for the filtered and chlorinated water shall be connected to the proposed pressure main.

In addition, three similar clarity bowls shall also be provided in the entrance hall of the annexe building at a prominent place and shall have decorative finish.

2.9.2 Laboratory Equipment

All the laboratory equipment shall be of reputed and approved make. Tenderers shall submit with their offer detailed specifications and catalogues of the equipment they have proposed to supply. All the equipment are to be installed in position and commissioned including supply of all accessories, stands, tables etc. The quoted rate shall be inclusive of all such installations, supply of all accessories, stands, tables with complete air conditioning arrangements where necessary, excluding laboratory glass apparatus and chemical reagents.

i) One set of Electrical Mono-Pan balance of100 g. capacity having sensitivity of 1/100 mg. complete with weight box and digital display.

ii) One Distilling Apparatus, electrically heated, with low water cut off and automatic shut off, 1 gph. Complete.

iii) Muffle furnace made of high illuminate Muffle and illuminate Bricks. The outer body is made of heavy gauge mild steel sheet finished in heat proof and rust proof silver ash hammer stone painting fitted with swing type hinged door with peep holes, temperature upto 1200^0C provided with excess temperature protection and accessories for direct connection to laboratory AC main 220/230 volt, single phase, 50 cycles. Size of the Muffle Chamber 6" x 6" x 12" (150 mm x 150 mm x 300 mm) or close to this size - two nos.

iv) One PH Meter of digital display type with a range 0 to 14 in 0.01 PH subdivisions. It should be compact direct reading type with a built-in voltage stabilizer, a temperature compensator and an ant parallax mirror. Electrode assemblers shall comprise a glass electrode, calomel reference electrode and a resistance thermometer for temperature compensation housed in an immersion type housing. Operation should preferably be push button type and the instrument shall be suitable for operating in a temperature range of 0 to 66^0C - complete.

vi) One Jar Test Apparatus. Each should be provided with six transparent glass jars, each containing a paddle mixer hanging from a long horizontal shaft through a level gear. The horizontal shaft shall be run by a variable speed motor with the provision of measuring r.p.m. of paddle mixer R.P.M. of paddle should be in the range of 0-150 r.p.m. - complete.

vii) Two Hot Plates, operating on 230W, single phase, 50 cycles, AC, capable of adjusting at different range of 750, 1000 and 1200 watt beating elements - complete.

viii) One Magnetic Stirrer - Complete.

ix) One Dissolved Oxygen Meter - Complete with necessary electrodes.

x) One frost free Refrigerators, 165 liters (approx) - capacity.

xi) Twelve Crucible, Gooch, F 30 ml.

xii) One Water Bath with 8 nos. of hole, electrically operated SS made - complete.

xiii) Two thermometer gehaval lab engraved stem - 10^0 to 260^0c subdivision.

xiv) One Thermometer, precision - 1^0 to 101^0 C, $1/10^0$ subdivision.

xv) One Interval Timer, spring wound.

xvi) One stop watch.

xvii) One Chloroscope for measurement of residual chlorine with necessary reagents - complete.

xviii) One electrical turbidity-meter (nephelometric method) capable of measuring turbidity in the range of 0-2000 NTU - complete.

xix) All necessary furniture (eg. tables, drawers, sinks, tools etc.) and plumbing (eg. wash bashings, water connections at different points etc.) as required in a standard laboratory.

Laboratory glass apparatus and chemical reagents shall be separately colligated by the purpose and supply of them does not come under the scope of this tender. Approximately 40% of the carpet area of the laboratory are to be covered by tables, fitted with necessary drawers and sinks. The height and top width of the tables should be 900 mm. and 750 mm. respectively. All the furniture should have a decorative finish. The furniture shall be of best quality teak wood/NUWUD of approved quality and the top of the tables shall be acid/alkali &

heat resistant and the drawer units shall be provided with sun mica decolam or equivalent make laminate sheets. The laboratory sinks shall be of best quality precedence make.

2.10 Tool Box and Tools

Tenderers shall supply three tool box (overall dimensions 1200 mm x 900 mm x 750 mm) made of best quality wood/NUWUD and polished or painted as per direction of the Engineer. The box shall be compartmentalized inside suitable to hold different types of tools separately. The edges of the box shall be protected by alluminium angles and the box shall be fitted with lock and key arrangement. Tenderers shall supply all the tools listed in Appendix V.

In addition, Tenderers shall quote separately on their own letter heads for supply of one set special tools and tackles that they feel shall be necessary for maintenance, overhaul or replacement of the equipment under this contract. The quotation shall be attached with the Schedule of Prices.

2.11 Scaled Model and Animated Flow Diagram

Tenderers shall supply scaled (1:200) model of the entire treatment plant and separate models on a larger scale (1:100) of one clarifier tank and one filter unit. These models shall be displayed at a suitable place in the entrance shall. The models shall be mounted on suitably designed stands fitted with trolley wheels. Adequate illuminations shall be provided for this display. The larger models of the clarifier and the filter unit shall be fitted with all equipment and the bridge on the clarifier shall be arranged to rotate by an electrically operated switch. In addition, an animated flow diagram of the process showing the colour of the water during the different stage of the treatment shall be provided. The flow diagram shall be in a wooden cabinet with glass cover suitable for hanging on the wall of the entrance hall. The switch buttons shall be located at the bottom of the frame.

2.12 30-Tonne Road Weighbridge

Tenderers shall supply, install and put into commission 1 30 - tone Road Weighbridge complete with platforms, weight indicator, recording device, electrical installation and all other accessories. The Road Weighbridge is required of weigh empty and loaded trucks, with print out for gross & tare weight facilities, date of weighing & serials etc. Standard weights as per stature are to be supplied and stamping by competent authority are to be obtained.

2.13 Leveling of the site

After completion of the work, the entire site all round the chemical house, filter house and annexe building and other structures within the scope of this contract shall be cleared and all construction equipment shall be removed within a period not exceeding 3(three) months from the date the plant is put into trial run. The site shall be graded and leveled to the required level as specified in Section E.

3. Procurement of Equipment etc.

The successful bidder has to submit full list of vendors from whom the supplies are obtained to the Engineer for approval before placing any order.

Chief Executive Officer
Guwahati Metropolitan Development Authority

ANNEXURE TO SECTION - G

Signature of the Authorised Person
of the Contractor

Chief Executive Officer
Guwahati Metropolitan Development Authority

ANNEXURE

TENTATIVE DESIGN OF VARIOUS COMPONENTS OF WTP

Considering two modules in each WTP as shown in the proposed layout plan, calculations are given of one module of each site. WTP capacity of each WTP will be twice of each module. Plant loss @ 5% and UFW @ 10% may be considered.

References: CPHEEO Manual - 1999 Edition (May)

Sl No	Design Criteria	Unit	North Guwahati	East Zone	Central Zone	West Zone
	Average Plant Output Capacity	MLD	19.00	44.00	96.00	53.50
	i.e	m^3/day	19000	44000	96000	53500
	i.e	m^3/hr	791.67	1833.33	4000.00	2229.17
	Overload considered	%	20	20	20	20
	Inlet Water Quality					
	pH : 6.7 - 8.4					
	Turbidity (NTu) : 30 - 1200					
	Total Solids (mg/l) : 250 - 800					
	Suspended Solids (mg/l) : 85 - 650					
	Total Dissolved Solids (mg/l) : 100 - 300					
	Process Unit Sizing					
1	**Collecting Well**					
	Average Plant Output Capacity (Q)	m^3/hr	791.67	1833.33	4000.00	2229.17
	Filter Backwash loss considered @ 3 % av. Flow	m^3/hr	23.75	55.00	120.00	66.88
	Outlet suspended solids permitted from inclined plate settler	ppm	20	20	20	20
	Net suspended solids to be removed (650 - 20)	ppm	630	630	630	630
	Loss of water as sludge in clarification for maximum inlet SS of 650 ppm '= (Q x 24 / 1000) x 630	kg/day	11970.00	27720.00	60480.00	33705.00
	Assume sludge consistency	%	1.5	1.5	1.5	1.5
	Volume of return sludge	m^3/day	798.00	1848.00	4032.00	2247.00
	Total losses within unit = (filter backwash loss x 24 + vol of return sludge)	m^3/day	1368.00	3168.00	6912.00	3852.00

Sl No						
	Total inlet flow to be considered for collecting well					
	= (Q x 24 + Total losses within unit)	m^3/day	20368.00	47168.00	102912.00	57352.00
	i.e	m^3/hr	848.67	1965.33	4288.00	2389.67
	Say	m^3/hr	850.00	1970.00	4290.00	2390.00
	Considering overload	m^3/hr	950.00	2200.00	4800.00	2675.00
	Retention time considered for the collecting well	sec	30	30	30	30
	Volume of collecting well = (Total inlet flow / 24 / 3600) x Retention time	m^3	7.07	16.38	35.73	19.91
	Depth of well assumed	m	2.60	3.50	3.50	3.50
	Diameter of well (d_w)	m	1.86	2.44	3.61	2.69
	Say, d_w	m	2.00	3.00	4.40	3.30
	Entry Velocity = Total inlet flow x ($4/\pi/d_w^2$) / (24 x 3600)	m/sec	0.075	0.077	0.078	0.078
	Permissible limit	m/sec	0.06 - 0.08	0.06 - 0.08	0.06 - 0.08	0.06 - 0.08
	Hence,					
	Size of collecting well provided (Dia x SWD + FB)		***2.0 x 2.6 + 0.5***	***3.0 x 3.5 + 0.5***	***4.4 x 3.5 + 0.5***	***3.3 x 3.5 + 0.5***
2	**Areator (Casacade Type)**					
	Treated Water Production (Capacity of Plant), Q	MLD	**38.00**	**88.00**	**192.00**	**107.00**
	Hours of Operation	Hrs	24	24	24	24
	Overload considered	%	20	20	20	20
	For design purpose, considering over load as 20 %	MLD	45.60	105.60	230.40	128.40
	or	m^3 / Hr	1900	4400	9600	5350
	or	m^3 / Sec	0.53	1.22	2.67	1.49
	Assume loss in backwash	%	2.00	2.00	2.00	2.00
	Assume loss in desludging	%	3.00	3.00	3.00	3.00
	Total flow of raw water					
	Q/ = {[((1.20Q) / 0.98) / 0.97} / 24}*1000/2	m^3 / Hr	1998.74	4628.66	10098.88	5628.02
	or	MLD	47.97	111.09	242.37	135.07
	No of Aerator	nos	2	2	2	2
	Assuming Velocity in the inlet shaft to be, V	m / sec	0.75	0.75	0.75	0.75

Sl No	Design Criteria	Unit				
	=					
a)	**Inlet Shaft**					
	Raw water flow per Aerator	m^3 / Hr	999.37	2314.33	5049.44	2814.01
	Raw water flow per sec per Aerator, q =	m^3 / Sec	0.278	0.643	1.403	0.782
	Therefore area of shaft = q / V = (0.278 / 0.75)	m^2	0.37	0.86	1.87	1.04
	Diameter of the shaft = d =	m	0.686	1.045	1.543	1.152
	say	m	0.70	1.10	1.60	1.20
	or	mm (I.D) pipe	700	1100	1600	1200
	So provide	mm (I.D) pipe	700	1100	1600	1200
	Wall thickness	mm	100	100	100	100
	Bell Mouth dia, B =	m	0.90	1.30	1.80	1.40
b)	**Size and number of steps**					
	Assume area requirement of cascade aerator	m^2 /m^3 / hr	0.03	0.03	0.03	0.03
	Area of cascade = (0.03 x 999.37)	m^2	29.98	69.43	151.48	84.42
	say	m^2	30.00	70.00	152.00	85.00
	If D is the diameter of the cascade, then					
	$30 = \pi /4 [(Da)^2 - (0.9)^2]$					
	Therefore D_a	m	6.25	9.53	14.03	10.50
	say	m	6.50	10.00	14.50	10.50
	Assume number of steps =	nos	5	5	5	5
	Size of tread = (6.00 - 0.9) / (5 x 2)	m	0.560	0.870	1.270	0.910
	say	m	0.60	0.90	1.30	0.95
	Actual size of aerator = 0.60*10+0.9 =	m	6.90	10.30	14.80	10.90
	Assume rise of each step	m	0.30	0.30	0.30	0.30
	Height of total rise of steps = (5 x 0.30) =	m	1.50	1.50	1.50	1.50
c)	**Size of collecting Launder**					
	The collecting peripheral launder is designed for					
	Flow in Launder, q_L = q / 2 = 999.37 / 2	m^3 / Hr	499.68	1157.16	2524.72	1407.01

Sl No						
	or	m^3 / sec	0.139	0.321	0.701	0.391
	Velocity in the Launder, v_L (assumed)	m / Sec	0.80	0.80	0.80	0.80
	Area requirement, $a = q_L / v_L$ = (0.139 / 0.80)	m^2	0.174	0.402	0.877	0.489
	Assume width of Launder, w_L =	m	0.600	0.600	0.600	0.600
	Height of Water (SWD) = (0.174 / 0.60)	m	0.289	0.670	1.461	0.814
	Provide	m	0.300	0.700	1.500	0.900
	Assume free board in Launder =	m	0.200	0.200	0.200	0.200
	Depth of Launder = (0.30 + 0.20)	m	0.500	0.900	1.700	1.100
d)	**Inlet pipe connecting Inlet shaft**					
	Assume the velocity in the inlet pipe	m / sec	0.90	0.90	0.90	0.90
	Diameter of inlet pipe					
	= 0.278 = $(\pi / 4) \times D^2 \times 0.9$	m	0.627	0.954	1.409	1.052
	say	m	0.65	1.00	1.45	1.10
	or	mm (ID)	650	1000	1450	1100
3	**Pre Settling Tank**					
	No of Tanks	No	4	6	8	6
	Detention Time	Hours	1	1	1	1
	Total flow in WTP	m^3 / day	22800	52800	115200	64200
	Flow per PST	m^3 / day	5700	8800	14400	10700
	Over flow rate assumed	m^3 / m^2 /day	30	30	30	30
	Surface srea of each PS tank provided	sqm	190.00	293.33	480.00	356.67
	Depth of PS tank provided	m	2.00	2.00	2.00	2.00
	Provide size of PS tank (L) x (W) x (LD) + (FB)		***7.5 x 25.5 x 2.0 + 0.5***	***9.5 x 32.0 x 2.0 + 0.5***	***12.0 x 40.0 x 2.0 + 0.5***	***10.5 x 35.5 x 2.0 + 0.5***
4	**Parshall Flume for Flow Measurement**					
	Total inflow	m^3/sec	0.236	0.547	1.192	0.664
	Dimensions of Parshall Flume (Table 4.7 of CPHEEO manual)					
	For 19.00 MLD					

Sl No	Design Criteria						
		W =	150	mm	F =	300	mm
		A =	610	mm	G =	600	mm
		B =	600	mm	K =	75	mm
		C =	315	mm	Z =	225	mm
		D =	391	mm			
	For 44.00 & 53.50 MLD						
		W =	300	mm	F =	600	mm
		A =	1350	mm	G =	900	mm
		B =	1322	mm	K =	75	mm
		C =	600	mm	Z =	225	mm
		D =	831	mm			
	For 96.00 MLD						
		W =	450	mm	F =	600	mm
		A =	1425	mm	G =	900	mm
		B =	1397	mm	K =	75	mm
		C =	750	mm	Z =	225	mm
		D =	1010	mm			
	Depth of water u / s of hydraulic jump is calculated as per eqn						
	$Q = 2.42\ W\ (h_u)^{2.58}$						
	or h =		m	0.846	0.896	1.036	0.966
	Assume the depth of water h_d, down stream of hydraulic jump as						
	hd = (0.60 x hu)		m	0.508	0.538	0.621	0.580
	(a) Channel upstream of parshall flume						
	Length of channel (assumed)		m	5.00	5.00	5.00	5.00
	Depth of water upstream of flume is						
	hu = h + Z		m	1.07	1.12	1.26	1.19
	If the velocity of flow is considered as		m/sec	0.80	0.80	0.80	0.80
	then, Q = [v (h x b)]						
	Therefore width b=		m	0.28	0.61	1.18	0.70
	D as per chart		mm	391	831	1010	831
	Provide , b		mm	400	900	1100	900
	(b) Channel downstream of parshall flume to distribution chamber						

Sl. No						
	Length of channel (assumed)	m	5.00	5.00	5.00	5.00
	Depth of water down stream of flume is	m	0.508	0.538	0.621	0.580
	If the velocity of flow assumed is	m/sec	0.80	0.80	0.80	0.80
	then, Q = [v (h x b)]					
	Therefore width b=	m	0.58	1.27	2.40	1.43
	D as per chart	mm	315	600	750	600
	Provide , b	mm	600	1300	2400	1500
	Therefore, dimensions of parshall flume					
	Throat width, W	***mm***	***150***	***300***	***450***	***300***
	Upstream width, D	***mm***	***391***	***831***	***1010***	***831***
	Upstream channel width, Du	***mm***	***400***	***900***	***1100***	***900***
	Upstream gauged depth, hu	***mm***	***1071***	***1121***	***1261***	***1191***
	Downstream width, C	***mm***	***315***	***600***	***750***	***600***
	Downstream channel width, Dd	***mm***	***600***	***1300***	***2400***	***1500***
	Downstream gauged depth, hd	***mm***	***508***	***538***	***621***	***580***
	Free Board	***m***	***300***	***300***	***300***	***300***
	Total length including inlet & outlet	***m***	***12.80***	***14.12***	***14.20***	***14.12***
	Say	***m***	***12.80***	***14.20***	***14.20***	***14.20***
5	**Flash Mixer**					
	Design Flow = Q x overload	m^3/hr	950.00	2200.00	4800.00	2675.00
	Mixing Time	sec	30	30	30	30
	Volume of Flash Mixer	m^3	7.92	18.33	40.00	22.29
	Liquid depth considered	m	2.00	2.50	3.50	2.50
	Plan area of Flash Mixer	m^2	3.96	7.33	11.43	8.92
	Size of Flash Mixer (L) x (W) x (LD) + (FB)	***m***	***2.0 x 2.0 x 2.0+ 0.5***	***3.0 x 2.5 x 2.5+ 0.5***	***4.0 x 3.0 x 3.5+ 0.5***	***3.0 x 3.0 x 2.5+ 0.5***
	MOC		RCC	RCC	RCC	RCC
	No of Agitators	nos	One	One	One	One
6	**Flocculator**					

Chief Executive Officer
Guwahati Metropolitan Dev. Authority

Sl No	Design Criteria	Units				
	Design Flow through Flocculator	m^3/hr	950.00	2200.00	4800.00	2675.00
	Detention Time (assuming)	Min	30	30	30	30
	Volume of Flocculation tank	m^3	475.00	1100.00	2400.00	1337.50
	Depth of flocculation tank assumed	m	4	4	4	4
	Plan Area of Flocculator	m^2	118.75	275	600	334.375
	Size of Flocculator (L) x (W) x (LD) + (FB)		***10.3 x 10.3 x 4.0 + 0.3***	***15.7 x 15.7 x 4.0 + 0.3***	***23.2 x 23.2 x 4.0 + 0.3***	***17.3 x 17.3 x 4.0 + 0.3***
	Type of Agitator		Paddle Type	Paddle Type	Paddle Type	Paddle Type
	No. of Agitator	nos	Four	Four	Four	Four
7	**Inclined Plate Settler**					
	No. of Units	No	2	2	2	2
	M. O. C. of Plates		P.V.C	P.V.C	P.V.C	P.V.C
	Output capacity of Plate Settler	MLD	19.00	44.00	96.00	53.50
	i.e	m^3/hr	791.67	1833.33	4000.00	2229.17
	Per unit	m^3/hr	395.83	916.67	2000.00	1114.58
	Overload considered	%	20	20	20	20
	Output capacity of Plate Settler (considering overload) per unit	m^3/hr	475.00	1100.00	2400.00	1337.50
	i.e	m^3/sec	0.13	0.31	0.67	0.37
	Thickness of Plate	mm	3	3	3	3
	Surface loading rate (Max)	$m^3/m^2/hr$	1.5	1.5	1.5	1.5
	Considering Surface loading rate	$m^3/m^2/hr$	1.4	1.4	1.4	1.4
	Size of each plate (mm) x (mm) x (mm thk)		***1200 x 2400 x 3***	***1200 x 2400 x 3***	***1200 x 2400 x 3***	***1200 x 2400 x 3***
	Width of each plate	mm	1200	1200	1200	1200
	Inclined length of each plate	mm	2400	2400	2400	2400
	Angle of inclination of plates	degree	55	55	55	55
	Vertical free board above water level	mm	100	100	100	100
	Vertical length of each plate = Inclined length x sin(angle of inclination)	mm	1965.96	1965.96	1965.96	1965.96
	Effective vertical length of each plate = vertical length - vertical free boar	mm	1865.96	1865.96	1865.96	1865.96
	Effective inclined length of each plate					

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Guwahati Metropolitan Dev. Authority

Sl No		Unit	[illegible]	[illegible] Zone	[illegible] Zone	West Zone
	= inclined length - (vertical FB/sin(inclination angle)	mm	2278	2278	2278	2278
	Effective projected area of each plate = width of plate x effe. Inclined length x cos(inclination)	m^2	1.568	1.568	1.568	1.568
	Total surface area of plates required (flow / SLR)	m^2	339.29	785.71	1714.29	955.36
	Total no. of plates required	nos	216.40	501.13	1093.38	609.33
	No of plates provided	nos	220	510	1100	610
	Total no of plates in each settler	nos	110	255	550	305
	Plate gap	mm	50	50	50	50
	Size of the unit is fixed such that the plates can be evenly arranged providing 50 mm gap between each plate and considering the area required for provision of ovverflow launders		2.75	6.32	13.7	7.65
	Length of settlers	m	5.75	9.32	16.70	10.65
	Say	m	6.00	9.50	17.00	11.00
	Width of settler	m	9.50	9.50	9.50	9.50
	Size of inclined plate settler (L) x (B) x (LD) + (FB)	***m***	***6.0x 9.5 x 3.5 + 0.3***	***9.5 x 9.5 x 3.5 + 0.3***	***17.0 x 9.5 x 3.5 + 0.3***	***11.0 x 9.5 x 3.5 + 0.3***
	Providing 4 nos RCC H-section launders between plate packs,	m^2	0.0412	0.0955	0.2083	0.1161
	Size of each M.S. launder provided (W) x (LD) + (FB)	***mm***	***250 x 225+ 100***	***350x 275 + 100***	***600 x 350 + 100***	***420 x 275 + 100***
	Providing peripheral R.C.C. launders for collection of clarified water					
	Flow through each R.C.C. launder	m^3/hr	237.50	550.00	1200.00	668.75
	Velocity of flow considered	m/sec	0.8	0.8	0.8	0.8
	Assuming width of launder	m	0.6	0.6	0.6	0.6
	Liquid depth required	m	0.45	0.45	0.45	0.45
	Liquid depth provided	m	0.5	0.5	0.5	0.5
	Free borad	m	0.3	0.3	0.3	0.3
	Size of RCC Launder (W) x (TD)	***m***	***0.6 x 0.8***	***0.6 x 0.8***	***0.6 x 0.8***	***0.6 x 0.8***
	Clarifier Outlet Channel					
	Maximum water flow	m^3/hr	475.00	1100.00	2400.00	1337.50
	Velocity considered	m/sec	1	1	1	1

Chief Executive Officer
Guwahati Metropolitan Dev. Authority

Sl No	Design Criteria	Units				
	Width of channel considered	mm	1000	1000	1000	1000
	Depth of flow arrived					
	= Max water flow / 3600 / velocity	m	0.132	0.306	0.667	0.372
	Freeboard considered	m	0.30	0.30	0.30	0.30
	Total Depth	m	0.432	0.606	0.967	0.672
	say	mm	600	700	1000	700
	Size of common Clarifier Outlet Channel (W) x (TD)	***mm***	***1000 x 600***	***1000 x 1000***	***1000 x 1700***	***1000 x 1100***
8	**Gravity Sand Filters**					
	Design Filtration Flow (Q + overload)	m^3/hr	475.00	1100.00	2400.00	1337.50
	Type of filter bed is Constant Head Type					
	No of filter beds (assumed)	nos	5	8	10	8
	Flow per filter	m^3/hr	95.00	137.50	240.00	167.19
	Rate of filtration as per NIT	$m^3/m^2/hr$	4.8 - 6.0	4.8 - 6.0	4.8 - 6.0	4.8 - 6.0
	Considering filtration rate	$m^3/m^2/hr$	5.0	5.0	5.0	5.0
	Area of filter	m^2	19.00	27.50	48.00	33.44
	Width of filter considered	m	5.0	6.0	8.0	7.0
	Length of filter bed	m	3.80	4.58	6.00	4.78
	say	m	4.00	5.00	6.00	5.00
	Final area of twin bed filter	m^2	20.00	30.00	48.00	35.00
	Size of each twin bed excluding wash water gutter width (L) x (W)	***m***	***8.0 x 5.0***	***9.5 x 6.0***	***12.0 x 8.0***	***10.0 x 7.0***
	Length to width ratio		0.80	0.83	0.75	0.71
	Maximum limit of length to width ratio is 1.66, Hence		**C. K.**	**O. K.**	**O. K.**	**O. K.**
	Back Washing					
	Rate of Backwash flow	$m^3/m^2/hr$	34	34	34	34
	Area of each twin bed	m^2	20.0	30.0	48.0	35.0
	Water required per single bed = Rate of backwash x area of twin bed	m^3/hr	680.00	1020.00	1632.00	1190.00
	Dirty Backwash Sump & Pumps					
	Dirty Backwash flow to sump	m^3/hr	680.00	1020.00	1632.00	1190.00

Sl No	Particulars	Unit	Alternative 1	Alternative 2	Alternative 3	Alternative 4
	Backwash time considered for sump for one twin back wash	min	10	10	10	10
	Volume of sump required					
	= (Dirty backwash flow in m^3/min / backwash time)*10% additional	m^3	124.67	187.00	299.20	218.17
	say	m^3	125.00	190.00	300.00	220.00
	Depth of sump considered	m	3.5	3.5	3.5	3.5
	Size of sump considered (L) x (W) x (LD) + (FB)	***m***	***7.5 x 5.0 x 3.5 + 0.3***	***8.5 x 6.5 x 3.5 + 0.3***	***11.0 x 9.0 x 3.5 + 0.3***	***9.0 x 7.0 x 3.5 + 0.3***
	Interval time of backwash between any two filter beds (24 hrs/no of filter bed)	min	4.8	3.0	2.4	3.0
	say (the value must be less than the calculated value)	min	4.0	2.0	2.0	2.0
	Capacity of Dirty backwash transfer pumps @ 15 m Head	lt/min	521	1583	2500	1833
	Filter Air Scour Blower					
	No of Blowers (1 W + 1 S)	nos	2	2	2	2
	Rate of Air Flow	$m^3/m^2/hr$	36 - 54	36 - 54	36 - 54	36 - 54
	Air scour rate considered	Nm^3/hr	44	44	44	44
	Air required for one twin bed backwash					
	= area of each twin bed x air scour rate	Nm^3/hr	880.00	1320.00	2112.00	1540.00
	say	Nm^3/hr	900	1350	2150	1550
	So capacity of Blowers provided @ 0.35 kg/cm^2(g)	Nm^3/hr	900	1350	2150	1550
	Sand Media specifications					
	Effective Size : 0.45 mm to 0.70 mm					
	Uniformity coefficient : 1.3 to 1.7					
	Soluble fraction in HCL : < 5 % by weight					
	Silica Content : Greater than 90 %					
	Specific Gravity : 2.55 to 2.65					
	Attrition loss per year : Less than 3 %					
	Estimation of sand depth (Ref: Page 634 of CPHEEO Manual, May 1999, Edition)					
	Assume the depth of sand as 600 mm and effective size of sand as 0.60 mm					

Sl No.	Design Criteria	Unit	Zone I	Zone II	Zone III	Zone IV	Zone V
	The sand depth can be checked against break through of floc through sand bed by calculating minimum depth required using Hudson formula, $Qd^3H/l = B \times 29323$ where, Q : Rate of filtration in $m^3/m^2/hr$: 10 m3/m2/kr considering 100 % overloading of filter under exigencies D : Sand size in mm - 0.6 mm (Mean Dia) H : Terminal Head loss in M - 2.5 M (under exigency condition) B : Break through index, 4×10^{-4} considered for poor response to filtration and average degree of pre treatment Therefore sand depth (l) : 0.460 m = 460 mm Hence assumed depth of 600 mm is sufficient to avoid breakthrough of floc						
	Estimation of gravel and size gradation (Ref. Page 635 of CPHEEC Manual, May Edition, 1999) Provide a size gradation of 2 mm at top to 50 mm at the bottom The requisite depth 'l' in cm of a component gravel layer of size d' in mm is computed from empirical formula l = 2.54k(!ogd) 'k' varies from 10 to 14 For k = 11 (considered) the depth of various layers of gravel are:						
	Size in mm (d)		2	5	10	20	40
	Depth in cm (l)		8.41	19.53	27.94	36.35	44.76
	Increment in cm		8.41	11.12	8.41	8.41	8.41
	Gravel Depth in cm		8	11	8	9	9
	Provide a gravel depth of 450 cm against requirement of 44.76 cm						
	False bottom nozzle under-drain system						
	Size of each twin bed (L) x (W)	m x m	8.0 x 5.0	9.5 x 6.0	12.0 x 8.0	10.0 x 7.0	
	Size of single bed (L) x (W)	m x m	4.0 x 8.0	4.75 x 6.0	6.0 x 8.0	5.0 x 7.0	

266

150

Sl No						
	Area of single bed	m^2	20.0	30.0	48.0	3
	a. No of nozzles required based on inlet flow and backwash flow					
	Flow per twin bed filter	m^3/hr	95.00	137.50	240.00	167.19
	Backwash water flow per single bed	m^3/hr	680.00	1020.00	1632.00	1190.00
	As the backwash flow is higher than the inlet flow, the nozzles are designed for backwash flow					
	Capacity of each filter nozzle	m^3/hr	1.5 - 2.0	1.5 - 2.0	1.5 - 2.0	1.5 - 2.0
	Considering capacity of nozzles	m^3/hr	1.5	1.5	1.5	1.5
	No. of nozzles required per single bed	nos	453.33	680.00	1088.00	793.33
	Total number of nozzles required for 5 twin beds	nos	2266.67	5440.00	10880.00	6346.67
	say	nos	2270	5440	10880	6350
	b. No. of nozzles required based on surface area					
	No. of nozzles required / m^2 area of filter bed	nos	40 - 50	40 - 50	40 - 50	40 - 50
	Provide no of nozzle per sq.m area of filter bed	nos	40	40	40	40
	No. of nozzles required per twin bed	nos	800	1200	1920	1400
	Total number of nozzles required for 5 twin beds	nos	4000	9600	19200	11200
	say	nos	4000	9600	19200	11200
	Therefore, provide no of filter nozzles	nos	4000	9600	19200	11200
	Filter Inlet & Outlet pipes					
	Inflow	m^3/hr	475.00	1100.00	2400.00	1337.50
	Velocity considered	m/sec	1.0	1.0	1.0	1.0
	Dia. of Inlet pipe selected	DN(mm)	298	690	1505	839
	say	***DN(mm)***	***300***	***700***	***1600***	***900***
	Outflow (per section of filter bed)	m^3/hr	237.50	550.00	1200.00	668.75
	Velocity considered	m/sec	1.0	1.0	1.0	1.0
	Dia. of Outlet pipe selected	DN(mm)	149	345	753	420
	say	***DN(mm)***	***150***	***350***	***800***	***500***
	Back wash water main					
	Velocity considered	m/sec	2.5	2.5	2.5	2.5
	Backwash flow per twin bed	m^3/hr	680	1020	1632	1190