GUIDELINES FOR WASTEWATER CONVEYANCE SYSTEMS, STORM WATER MANAGEMENT AND COMMON EFFLUENT TREATMENT PLANTS IN INDUSTRIAL PARKS

(Draft / Vs. 0.3)

INDIA

Consultancy services for "Environmental Infrastructure in Industrial Parks" under the project "Sustainable Environment-friendly Industrial Production" - (SEIP) Phase 2"

PN 18.2074.5-001.00

October 2020

Table of Content

List of Figures

List of Tables

LIST OF ABREVIATIONS

AbwAG	Abwasserabgabengesetz – German waste water tax Act
AbwV	Abwasserverordnung – German waste water Regulations
ACF	Activated Carbon Filter
ASP	Activated Sludge Process
AVB	General Terms and Conditions of Contract (AVB) for supplying services and work 2018
BIADA	Bihar Industrial Area Development Authority
BMZ	German Federal Ministry for Economic Cooperation and Development
BOD	Biochemical Oxygen Demand
BSPCB	Bihar State Pollution Control Board
CCA	Consolidated Consent and Authorization
CETP	Central Effluent Treatment Plant
CGWA	Central Ground Water Authority
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CPPP	Central Public Procurement Portal
CtO	Consent to Operate
CHWTSDF	Common Hazardous Waste Treatment Storage and Disposal Facility
DBFOT	Design-Build-Finance-Operate-Transfer
DIS	Digital Information System
DPR	Design Preparation Report
EPC	Engineering-Procurement-Construction
EU	European Union
FDS	Fixed Dissolved Solids
FIDIC	International Federation of Consulting Engineers
GC	General Conditions
GFR	General Finance Rules
GIS	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
GoI	Government of India
GoUK	Government of Uttarakhand
GPP	Green Public Procurement
IED	Industrial Emissions Directive
IFB	Invitation for Bids
IPPC	Integrated Pollution Prevention and Control
MBR	Membrane Bio Reactor
MBBR	Moving Bed Bio-Reactor
MEE	Multi Effect Evaporator
MGF	Multi Grade Filter
MoEFCC	Ministry of Environment, Forest and Climate Change, Government of India
MVR	Mechanical Vapour Recompression
NEERI	National Environmental Engineering Research Institute

O&G	Oil & Grease
O&M	Operation & Maintenance
PC	Particular Conditions
PETP	Primary Effluent Treatment Plant
PIM	Project Information Memorandum
PLC	Programmable Logic Controller
PPP	Public Private Partnership
RFP	Request for Proposal
SBD	Standard Bid Document
SBR	Sequential Batch Reactor
SCGJ	Skill Council for Green Jobs
SEIP II	Sustainable and Environment-friendly Industrial Production (SEIP) Phase II
SIDC	State Industrial Development Corporation
SIIDCUL	State infrastructure and Industrial Development Corporation of Uttarakhand Ltd.
SPCB	State Pollution Control Board
SPV	Special Purpose Vehicle
SS	Suspended Solids
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TSS	Total Suspended Solids
ToRs	Terms of Reference
UEPPCB	Uttarakhand Environment Protection & Pollution Control Board
WPI	Wholesale Price Index
WWTP	Waste Water Treatment Plant
ZLD	Zero Liquid Discharge

LIST OF REFERENCES

CPCB 2019	"Guidelines for Utilisation of Treated Effluent in Irrigation" (Source: CPCB vide its letter # No. CPCB/IPC-I V/G L/Irrigation/ 2019-20/ dt. October 4, 2019) https://www.cpcb.nic.in/NGT/Guidelines-UTE-Irrigation.pdf)
DoE 2019	Manual on Procurement of Works 2019, Ministry of Finance, Govt. of India https://doe.gov.in/sites/default/files/Manual%20for%20Procurement%20of%20works%202019.pdf
DWA 2000	ATV-DVWK-A 134E: Planning and Construction of Wastewater Pumping Stations
DWA 2002	ATV-DVWK M 807E - Allocation of Production Costs and Maintenance Expenditure for Sewage Plants
DWA 2005 a	DWA-A 133E: Valuation of Wastewater Systems
DWA 2005 b	DWA-M 180E: Real Time Control
DWA 2005 c	DWA-A 138E: Planning, Construction and Operation of Facilities for the Percolation of Precipitation Water
DWA 2006 a	DWA-A 100E: Guidelines of Integrated Urban Drainage (IUD)
DWA 2006 b	DWA-M 143-17E: Rehabilitation of Drain and Sewer Systems Outside Buildings
DWA 2007 a	DWA-M 153E: Recommended Actions for Dealing with Storm water
DWA 2007 b	DWA-A 199-2E: Operating Instructions Sewers
DWA 2007 c	DWA-M 804E: Assurance of the Quality and Economic Efficiency of Wastewater and Waste Facilities also with the Performance of Tasks by Third Parties
DWA 2007 d	DWA-A 199-2E: Part 2: Operating Instructions for the Personnel of Sewerage Systems and Storm water Treatment Systems
DWA 2008	DWA-M 149-4E: Conditions and Assessment of Drain and Sewer Systems Outside Buildings — Part 4: Detection of Bedding Defects and Cavities by Means of Geophysical Techniques
DWA 2012 a	DWA-A 118E: Hydraulic Dimensioning and Verification of Drain and Sewer Systems
DWA 2012 b	DWA-M 144-3E: Supplementary Technical Contract Conditions (ZTV) for the Rehabilitation of Drainage Systems outside of Buildings, Part 3: Renovation with Hose Liner Process (locally cured hose liner) for Sewers
EU 1996	EU Directive on Integrated Pollution Prevention and Control (IPPC) from 1996. The IPPC Directive has recently been codified (Directive 2008/1/EC).
EU 2013	Green Public Procurement Criteria for Waste Water Infrastructure https://ec.europa.eu/environment/gpp/pdf/waste_water_criteria.pdf
EU 2017	L. Alcalde-Sanz, B. M. Gawlik, Minimum quality requirements for water reuse in agricultural irrigation and aquifer recharge – Towards a water reuse regulatory instrument at EU level, EUR 28962 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-77176-7, doi 10.2760/887727, PUBSY No.109291
FIDIC	FIDIC Suite of contracts https://fidic.org/sites/default/files/FIDIC_Suite_of_Contracts_0.pdf

GOPA 2019	Mission Report - Rapid Assessment of CETP Bid documents floated by BIADA, Bihar following visit to proposed CETP sites 26 - 28 Dec., 2019; [SEIP phase II]; John Thomas, Senior National Expert, Dec. 2019; GOPA Infra GmbH Hindenburgring 18, 61348 Bad Homburg, Germany; gopa-infra.de
Haryana 2016	Guidelines for Project Execution/Public Procurement of Development Works under Swiss Challenge Method 2016 Government Of Haryana https://hsiidc.org.in/sites/default/files/media/E%20Documents/SwissChallengeNotification22.08.2016.pdf
IGEP 2015	Common Effluent Treatment Plants: Overview, Technologies and Case Examples, May 2015; http://seip.urban-industrial.in/content/e62771/live/hrdpmp/hrdpmaster/igep/content/e54413/e54441/e61172/e63630/20150522_CETP_RefDocument_i.pdf
IV 2017	Pre-Feasibility Study on GIDC Vapi Industrial Estate's – Storm Water Management System, August 2017, Ingenieurbüro Vössing, Düsseldorf, Germany; voessing.de
Karnata-ka 2010	Guidelines for Procurement of PPP Projects through Swiss Challenge Route, Infrastructure Development Department, Government of Karnataka https://www.adb.org/sites/default/files/institutional-document/31313/ppp-swiss-challenge-route.pdf
MoEF & CC 2016	Treated Effluent Quality Standards for Common Effluent Treatment Plants (CETP) – Gazette dated 1st January, 2016 (F.No.Q-15017/18/2014-CPW) https://cpcb.nic.in/displaypdf.php?id=SW5kdXN0cnktU3BlY2lmaWMtU3RhbmRhcmRzL0VmZmx1ZW50L0NFVFAucGRm
NEERI 1992	Common Effluent Treatment Plant : State-of-the-Art (Ref: https://www.ircwash.org/resources/common-effluent-treatment-plant-state-art)
PPP	Toolkits and Resource materials on PPP projects https://www.pppinindia.gov.in/
RSPCB	Guidelines for O & M Agency for Operations & Maintenance of CETPs, for SPV and for the Member Units connected with the CETPs; http://environment.rajasthan.gov.in/content/dam/environment/RPCB/Guidelines/For%20CETP%20Trust.pdf
SGCJ	Wastewater Treatment Plant Operator/ Technician (Qualification Pack # SGJ/Q6601)
SGCJ	Wastewater Treatment Plant Helper level (Qualification Pack # SGJ/Q6602)
WHO 1994	Operation and maintenance of urban water supply and sanitation systems – A Guide
World Bank 2020	"Rodriguez, Diego J.; Serrano, Hector A.; Delgado, Anna; Nolasco, Daniel; Saltiel, Gustavo. 2020. From Waste to Resource: Shifting paradigms for smarter wastewater interventions in Latin America and the Caribbean." World Bank, Washington, DC.

1 INTRODUCTION

1.1 TASKS AND OBJECTIVES

The core objective is the preparation of Guidelines according to the TOR 1.3 “Scope of Services”: The objective of the consultancy services is to support selected state agencies (SIIDCUL, BIADA and WBIDC) in capacity building on the environmental infrastructure in industrial areas related to storm water management, conveyance systems and common effluent treatment plants (CETPs).

In the first phase, a gap analysis and needs assessment was conducted in order to determine where the stakeholders and managers of industrial areas face challenges or problems with regards to storm water and wastewater management. A number of site visits were conducted by the GOPA Infra experts to get a general idea of what the conditions in industrial areas in the three states are like. A draft Gap Analysis and Needs Assessments report was then put together which was forwarded to all relevant stakeholders and interested parties, before a 3-hour online workshop was conducted in order to brief all participants on the results of the assessment, and to give them a chance to ask questions and to give feedback. This feedback was then incorporated into the final Gap Analysis and Needs Assessment report.

In this second phase of the project, the Consultant shall develop guidelines for:

- Storm water infrastructure in industrial areas;
- Wastewater conveyance systems in industrial areas; and
- Tendering and bid process management for setting up of CETPs in industrial areas.

Finally, a training of the staff of the public agencies (viz. SIIDCUL, BIADA and WBIDC) on the topics detailed in this report will be held. It has been agreed that a one-week-training will be organized in Dehradun, Uttarakhand, where stakeholders from other states, viz. Bihar and West Bengal will also join. In the case that, due to Covid-19, travel is not possible, the experts will complete the training via an online workshop.

2 STORM WATER INFRASTRUCTURE IN INDUSTRIAL AREAS

2.1 GUIDELINES OF INTEGRATED URBAN DRAINAGE

2.1.1 FOREWORD AND AIMS

The DWA's Rules and Standards contain several single Standard and Advisory Leaflets dealing with the field of urban drainage (= subtask of wastewater disposal: collection and transport of wastewater as well as collection, transport, treatment and discharge of storm water).

Primarily, they deal with individual construction- and system-related individual topics. The available regulations can roughly be classified into two major topics, which are based on completely different concerns and aims:

- safe and flood-free drainage (wastewater, combined sewage and storm water);
- prevention and/or reduction of the pollution of bodies of water.

Partially, they contain in-depth, detail-related regulations on calculation, dimensioning, constructive design, and operation of urban drainage systems. These detailed regulations, often with specific requirements concerning certain measures, can lead to a loss of flexibility in practice. On the other hand, the high number of single regulations supports in dealing with problems in an integrated way.

At the same time, various developments have led to broadened aims and in individual cases also to target conflicts between the mentioned concerns and thus also between the corresponding single regulations:

- source-based storm water management or harvesting instead of discharge-accentuated drainage concepts (prevention of discharge; utilisation, infiltration and retention of storm water);
- specification of the required flood protection by the European Standard series DIN EN 752;
- integrated concepts of wastewater disposal, partially connected with alternative approaches of domestic wastewater disposal;
- demands on water pollution control taken from demands on emissions and immissions in accordance with the European Water Framework Directive ("combined approach").

As a superior framework for action, this guideline is intended to allow a holistic point of view on the urban drainage (= "integrated urban drainage") and is to support the user when it comes to selecting the single regulations that have to be applied in a specific case. Here, special emphasis is put on the necessary dovetailing with related fields and sub-systems (catchment area, drain system, wastewater treatment plant, surface bodies of water, groundwater).

It is required to be a superior aim of integrated urban drainage to keep changes in the natural water balance, which are caused by residential activities, as small as it is technically, ecologically and economically justifiable in terms of quantity and pollutant matter. In connection with the legal and social boundary conditions and the precept of sustainability there is need for a re-orientation of the aims in terms of the subjects and aims of protection presented in Figure 2. This set standard requires a holistic consideration of the planning, the construction, the operation, the maintenance and the rehabilitation of drainage systems in the course of the planning of integrated urban drainage. Here, also the interfaces to wastewater treatment in wastewater treatment plants and to the receiving waters as well as links with the other components of water management are taken into account (among others ERBE 2004).

Residential and urban areas change the natural water balance. Construction and surface pavements as well as the accompanying reduction of vegetation lead to a reduction of evaporation as well as to changes in the soil water balance and groundwater recharge. This results in an increase of the

(direct) surface discharge. At the same time changes in the conditions of the water circuit's components occur due to increased input (among others WELKER 2005).

If in former days the collection and discharge of municipal wastewater and its treatment was the primary aim of urban drainage in order to prevent disease and epidemics, today it has inevitably been amended in terms of ecological concerns of bodies of water and specific pollutants, and in special cases also in terms of hygiene (drinking water abstraction, bathing water), the protection of groundwater, the securing of anthropogenic usage and other concerns (e. g. protection of species).

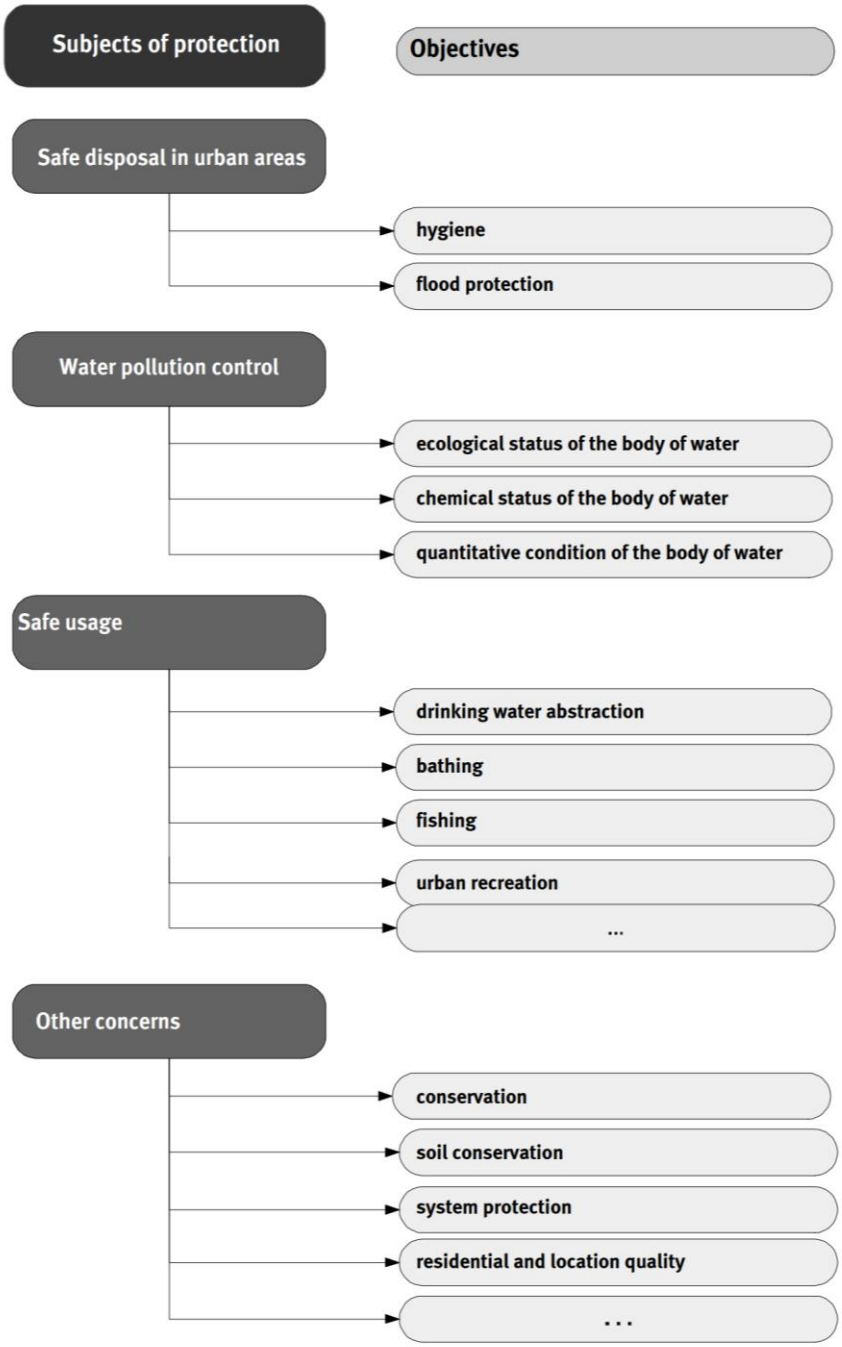


Figure 2-1: Integrated urban drainage

Integrated drainage planning comprises the working steps that are illustrated in Figure 2-2 and that might (have to) be completed in several loops as an iterative process. To accelerate the planning processes, sub-tasks that depend on each other or that influence others with their results should be completed as parallel as possible regarding time (e.g. calculation of the sewer network, verification of polluting load, immision verification).

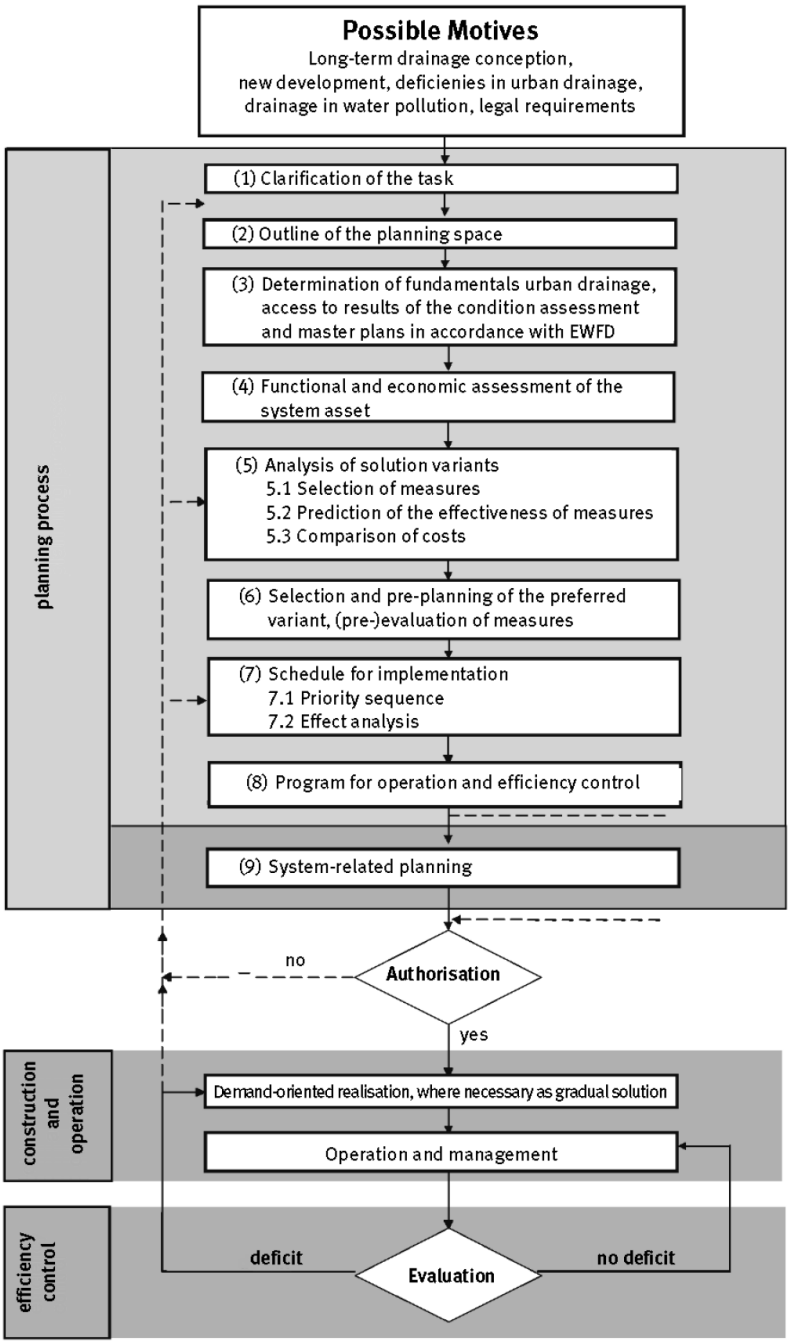


Figure 2-2: Working steps of integrated drainage planning

2.2 GEOGRAPHICAL CLASSIFICATION

The Geographical Classification shall provide a design basis for the use of the location to set up an industrial area. At existing industrial parks, the geographical classification might provide information concerning possible improvements, e.g. in case of planned extension of the area. The geographical classification shall consider the following information:

- Geodetic coordinates,
- Distance to coastline, national borders, capital, etc.
- Distance to water bodies (river, lake, sea)
- Country, state, district, and city,
- Illustration by satellite photo or map (overview and cut-out),
- Number of inhabitants,
- Infrastructure like highways, railways, and airport,
- Short reflection of local economy (industry, agriculture, tourism, and local recreation),
- Expectation on further expansion and population growth.

Geographical data shall provide information for present and future storm water flow to design an optimum wastewater conveyance system.

2.3 Topography

The topography shall provide information regarding potential of flooding, flow velocities etc. It is most important for the design of an appropriate sewer system with a strong influence on investment costs.
The topography shall consider the following information:

- Distances between e.g. sea and mountain region,
- Elevation of the industrial area,
- General orientation of slope (e.g. distinct southward slope, flat area),
- Abrupt topographical undulations (e.g. hill rocks, canyons)
- Contour survey of the area and surroundings with description,

Factors that may impact the sewer design can include things like the arrangement of shafts or the material and size of sewer pipes for example.

2.4 Geology and Soil Characteristics

The geology and soil characteristics shall provide information concerning retention of storm water, infiltration, and erosion. The following information shall be provided:

- Physiographic division,
- Mainland,
- Description of geological structures (e.g. rocky highlands, alluvial plains,),
- Classification regarding geological era,
- Geological map of the area and surroundings,
- Map with bore holes for soil investigation,
- Description of sediments by soil investigation (e.g. bore hole, different depths)
- Presentation of soil profile,
- Hydrogeology (maps with water table, depth to water, etc.)

Infiltration and measures to protect the soil from erosion can be optimized depending on the soil characteristics and the geology of the site.

2.5 Climate

The climate of the area provides information concerning rainfall characteristics, and seasonal aspects. The following information shall be provided:

- Climate zone,

- General description of climate (e.g. wet / dry, rainy seasons, short winters)
- Maximum and minimum temperature and humidity,
- Average annual rainfall and highest rainfall,
- Map with annual rainfall of the region,
- Table of annual rainfall, e.g. of the last 10 years

With regard to the catchment area, the climate data provides most important information for the design of the storm water sewer system. However, certain data, for example the statistical data of annual rainfall, requires adjustment due to the impact of climate change.

2.6 Natural Drainage

The natural drainage describes water for uptake of drain, main flow direction and water partings. For planning process, it provides basis for optimum set up of artificial drainage.

- General description of drainage (rivers, sea),
- Characteristics of natural water bodies (e.g. riverbanks, meandering),
- Degree of sealing.
- Catchment areas of the water bodies,

In order to minimise investment costs and to find the technical solution most suited to the surrounding environment, natural run-off should be assessed, as it can impact the design of the storm water network.

2.7 Rainwater Pollution

The degree of contamination of surface runoffs is wide and dynamic. Pollution is already caused by atmospheric components. During the runoff formation and runoff concentration processes, contact with surface contaminants results in a further absorption of substances. Depending on the use and nature of the surface, many substances, sometimes with considerable concentrations, can be contained in the surface runoff.

Table 2-1: Spectrum of substance concentrations in surface runoffs

Parameter	Precipitation		Rooftops		Traffic areas (low load)		Traffic areas (high load)	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max
SS (mg/l)	0.2	52	13	120	74	150	60	937
HOI (mg/l)	0.29	0.41	0.11	314	-	-	0.51	6.5
PAC (mg/l)	0.04	0.76	0.35	0.60	0.16	3.50	0.24	17.1
Cu (µg/l)	1	355	6	3416	21	140	97	104
Cd (µg/l)	0.1	3.9	0.2	1	0.2	1.2	0.3	13
Pb (µg/l)	2	76	2	491	98	98	11	525
Zn (µg/l)	5	235	24	4880	15	15	120	2000

The pollution of surface runoff occurs through "wet" deposition (washing out of air pollutants during rain, snow or precipitation) and through "dry" deposition in non-precipitation times (sedimentation, adsorption, turbulent diffusion on surfaces). According to Muschak (1989), the precipitation mainly

contains soluble components (Zn, Pb, Cu, P, NH4 and fine dust). These precipitates, which are contaminated with dust, mainly contain poorly soluble solids (Cd, Cr, Fe).

The surface structures of the drainage-effective industrial areas are mainly characterized by roof and street areas as well as paths, access roads and squares. Industrial spills shall be avoided. Hazardous substances shall be stored inside, under sheds or in covered containers.

In North-Rhine Westphalia, Germany, the criteria for evaluating the obligation to treat surface runoffs are based on a use-dependent categorization of the areas. The respective assessment criteria for this are contained in the separation decree. All the drainage-relevant areas can therefore be assigned to one of three possible categories:

- Category I: unpolluted rainwater - generally not subject to treatment
- Category II: lightly contaminated rainwater - generally requiring treatment - exceptions are possible, however
- Category III: heavily polluted rainwater - generally requiring treatment

In contrast to mixed water treatment, in the case of pure rainwater treatment, the dimensioning of the treatment plants is not represented by an indicator parameter (such as the COD), but a causal relationship between the use of the area and the pollution of the runoff is assumed.

The regional water law of North-Rhine Westphalia calls for the local removal of rainwater (§ 51a LWG). Measures to avoid, reduce and infiltrate the rainwater runoff are preferable to rainwater treatment.

Contamination by traffic depends on the number of vehicles per diem.

2.8 TREATMENT PROCESSES

2.8.1 OVERVIEW

If rainwater is to be treated, the following system-specific treatment options currently exist:

- Sedimentation systems (e.g. rain overflow basin, rain clarifier, separator), which currently make up the largest proportion by far as conventional systems in Germany,
- Filter systems (mechanical filters or retention soil filters), whereby retention soil filter systems consist of a first sedimentation stage and the subsequent filter system,
- Compact (decentralized) systems that are currently offered by different manufacturers, but for which long-term experience regarding their effectiveness and mode of operation is lacking so far,
- Drainage to the CETP by connecting or changing the rainwater channel to the wastewater or combined water channel,
- Infiltration via surface filters into the live soil and via side ditches alongside traffic routes.

The following criteria must be taken into account in the development and long-term consideration of the effectiveness of rainwater treatment plants (Dierkes, 2006):

- Rain events sometimes generate high drainage rates, which lead to short dwell times in the treatment systems and, in the case of filter systems, short contact times with the filter surface,
- The high volume of solids (especially in traffic areas) leads to a filter cake being built up in filter systems and thus to a reduction in effectiveness and an increase in maintenance cost,
- A significant proportion of substances in the surface runoff is in dissolved form or has particle sizes smaller than 50 µm. Sedimentation systems or purely mechanical filter systems do not effectively retain these substances,

- Monitoring devices that indicate that the system is overloaded or exhausted in time are uncommon.

2.8.2 LIMITS OF CONVENTIONAL TREATMENT METHODS

So far, rain clarifiers and infiltration systems have mainly been used as conventional measures for treating surface runoffs, especially road runoffs. Removal is achieved by mechanical separation of settleable substances and floating substances (baffle boxes). Depending on the mode of operation, a distinction is made between rainwater clarifiers without permanent accumulation (RKBoD) and rainwater clarifiers with permanent accumulation (RKBmD).

The critical rain runoff of r_{krit} = 15 l/(s · ha) in relation to the connected effective drainage area is decisive for the dimensioning of the rainwater clarifiers. The degree of separation of the solids largely depends on the pollution load of the tank, the settling behaviour of the wastewater constituents and the tank design. The permissible surface loading is usually 9 or 10 m/h. The effect of the rain clarifier is largely determined by the course of the hydraulic load over time. There is a risk of remobilization and displacement processes, particularly in the case of rainwater clarifiers in permanent accumulation.

2.9 NEAR-NATURAL HANDLING OF STORM WATER

The art behind near-natural planning is to approximate the balance of the natural water cycle and the volume and frequency of discharge peaks from undeveloped areas as closely as possible, and to keep the effort required for creating and maintaining systems of urban area drainage as low as possible. The most effective measure in storm water management is to keep the number of sealed areas as low and as permeable as possible. In this way, storm water is still able to seep away laminary at the point of occurrence.

If sealing cannot be avoided, e.g. for road and roof surfaces, attempts should be made to re-distribute the water on a greater area away from the location where it occurs in a very concentrated manner. In many cases, however, only an even smaller area than the original one is available for such distribution and laminar infiltration. In such cases, suitable retention measures need to ensure that the discharge is regulated and thus a smaller area can be used for infiltration.

On a property, laminar infiltration through overgrown topsoil can be achieved by designing garden areas appropriately, e.g. by grass-grown swales. Storm water from paths, roads and squares should seep away with the smallest possible collection on the sides of the sealed surface. If local conditions, the condition of the subsurface or the volume of the resulting water, do not allow laminar infiltration, infiltration via other infiltration systems should be considered, depending on the hydrogeological conditions.

Besides the desirable, possibly laminar infiltration, it is also possible to discharge storm water into sufficiently powerful surface waters. Special importance is attached to retention and throttled discharge. This also applies for discharge from unsealed areas if it can enter the drainage system in the event of intensive precipitation. Discharge from sealed, compacted or saturated urban areas affects flood peaks the stronger the smaller the catchment area of the water; for big rivers, the discharge from sealed areas is lower.

Infiltration and retention of storm water in and on the area, may affect the "home-made" increase in discharge in small waters positively. All individuals are given the opportunity to retain water on their land and property. Each cubic metre of water that is retained entails a benefit for nature and eases the local flood situation.

Planning, construction and operation of systems for storm water infiltration are described in Standard DWAA 138E. Standard DWA-A 117E regulates the dimensioning of rainwater storage.

Measures:

Near-natural handling of storm water is achieved by taking the following measures, for example:

- infiltrating away minimally polluted water from roofs on-site via overgrown topsoil,
- keeping construction of access roads in residential or industrial areas to a minimum,
- creating grass strips, green areas and woodland next to roads to increase evaporation and for infiltration,
- designing drainage systems as near to nature as possible and using organic material,
- making slightly dirty traffic areas permeable by using semi-permeable surface sealing such as paving without joint sealant, grass pavers, interlocking pavers, etc. (examples: traffic-calmed and service streets, yards, rarely used car parks, parcel roads),
- extensive infiltration trough overgrown side-strips of roads, paths or squares,
- transferring storm water through simple gutters and trenches to not directly neighbouring soil areas for retention and evaporation in ponds and plant beds or for infiltration in green areas,
- installing centralised infiltration systems if decentralised infiltration in not possible,
- collecting storm water is indispensable; it is best done aboveground in overgrown gutters, swales and trenches to enhance retention, evaporation and infiltration,
- retaining storm water by green roofs, water-filled roofs, ponds, plant beds, swales, trenches with cross bars, etc.,
- storing non-seeped away storm water in ponds, swales, trenches or cisterns and discharging it into surface waters in a throttled way,
- storing storm water to use it for various purposes (examples: watering in gardens, public parks, nurseries, tree nurseries, cemeteries, watering of tennis courts, riding stables, football grounds, golf courts, ice skating facilities, private and business utilisation of rainwater).

The design options to enhance laminar infiltration are manifold. They should be put into practice by building owners, architects, engineers, and planners using their creativity.

Storages for storm water utilisation of rainwater can reduce runoff and the use of drinking water, respectively, in the annual balance (BULLERMANN 1996). This includes rain barrels and cisterns. Open water surfaces such as ponds are able to evaporate parts of the discharged storm water and thus influence the water volume balance positively. All storages require an overflow leading into an infiltration system or discharge system. The influence on the discharge peak in the discharge system depends on the size of the storage and its usage. Storages within the discharge system can result in mechanic cleaning as in a storm water retention basin.

2.10 Special Needs for Industrial Yards

Industrial yards in front of warehouses are areas with high traffic loads and large catchment areas. That is why it is necessary to drain large amounts of water in the shortest possible time, especially in heavy rain events. There are different options for controlled storm water management. The decisive factors are the local conditions, such as the terrain and plan heights, the degree of pollution of the rainwater collected and the legal requirements.

2.11 Open Drains

Open drains for storm water collection shall be avoid where possible. However, while the investment cost are quite low, the required space and safety measures are high. The following aspects shall be considered:

- Fencing and signing against unauthorised entry,
- Regularly cleaning from solid waste,
- Cutting of plants or grass mowing,

- Regularly inspection of concrete surface and joints,
- Regularly inspection of crossings, connections and bridges,
- Section of drain shall allow optimum flow velocity at highest and lowest flow,
- Minimize constrictions through e.g. crossings, pipelines, or cables.

Figure 2-3: Open storm water drain in Vapi, Gujerat (Photo Vössing)

In the German DWA standards there are not any leaflets regarding open storm water drains available. Wastewater conveyance in open drains is illegal in Germany. For 'hydraulic calculation of flowing waters' there is DVWK-M 220 – this leaflet will be translated into English (only available in German).

Also only available in German: M-224: 'Methods and ecologic impacts of mechanical maintenance of water bodies' and 'landscape ecology aspects at riverbanks'. Important abstracts will be presented during the training.

Figure 2-4: Sign warning of open drain

2.12 Covered Drains

Underground drains allow minimum footprint. Drains and storage volume can be constructed under or beside roads.

Aspects in industrial areas:

- Traffic by heavy load vehicles needs to be considered,
- Storm water tanks help to throttle flow to water body,
- Storm water tanks with overflow reduces flow,
- Infiltration systems reduce flow to drains.

System structure in the planning space of urban drainage (with reference to ATV-DVWK 2003a).

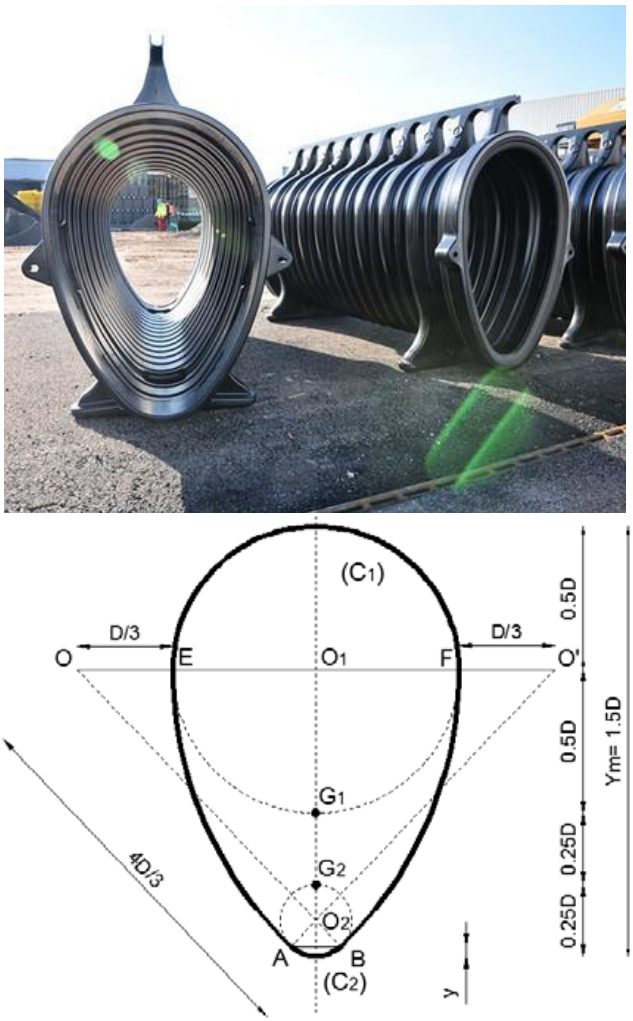


Figure 2-5: Egg-shaped conduit profile for heavy load (Photo: ACO)

2.13 Sewer With Storage Capacity and Overflow

Storage space ducts are elongated accumulators, which are usually used as pipelines with a large diameter. They are a special type of rain overflow basin, only the required pool volume is distributed over the length of the sewer route and created in the form of large pipe diameters. Storage channels are always formed in the main stream. They differ by the arrangement of the overflow in storage space ducts with top relief, with bottom horizontal relief or with central relief. With bottom relief, (see Figure 2-6) there is a risk that sedimented sludge will be remobilized under strong hydraulic load and will discharge with the overflow into the water body. A volume surcharge of 50% (factor 1.5) is therefore necessary here.

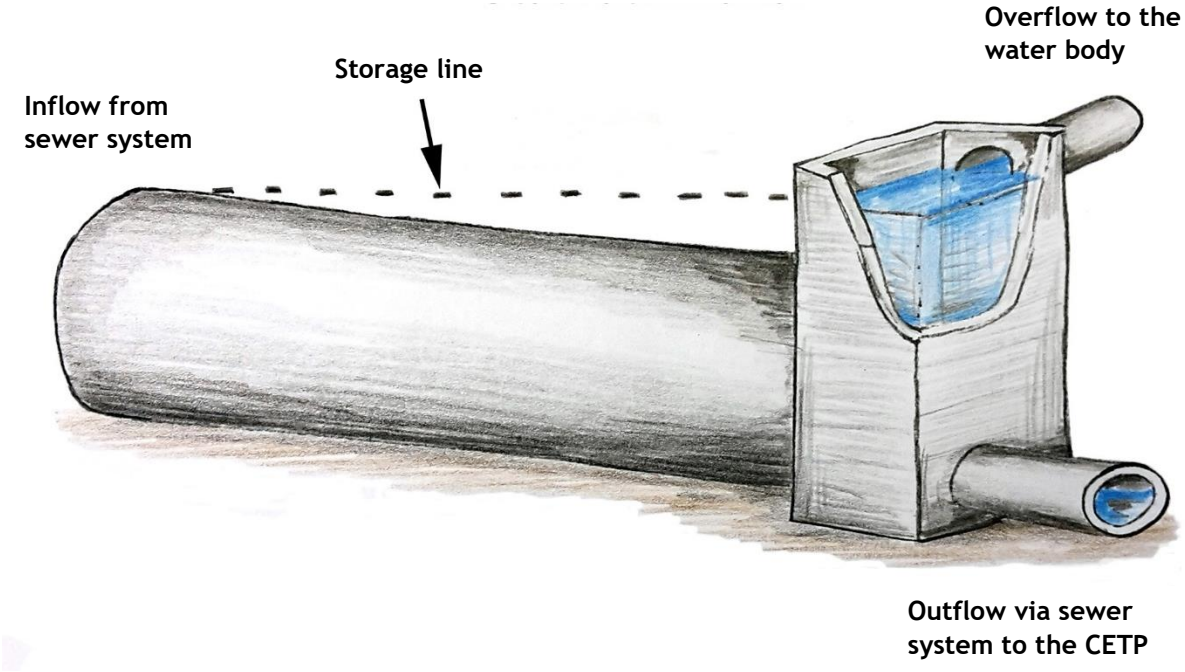


Figure 2-6: Storage sewer with overflow

2.14 Storm Water Overflow Tank

Storm water overflow basins (see Figure 2-7) are large, mostly underground storage basins in the sewer network. They collect the most heavily polluted wastewater that drains into the sewer network shortly after the start of precipitation. The storm water flows through the basin, the solids carried along settle on the bottom. When the basin is full, the mechanically treated storm water reaches the nearest body of water via an overflow. After the end of the precipitation, the stored wastewater is fed back into the sewer network and then reaches the CETP. A drainage pump station is usually required for this.

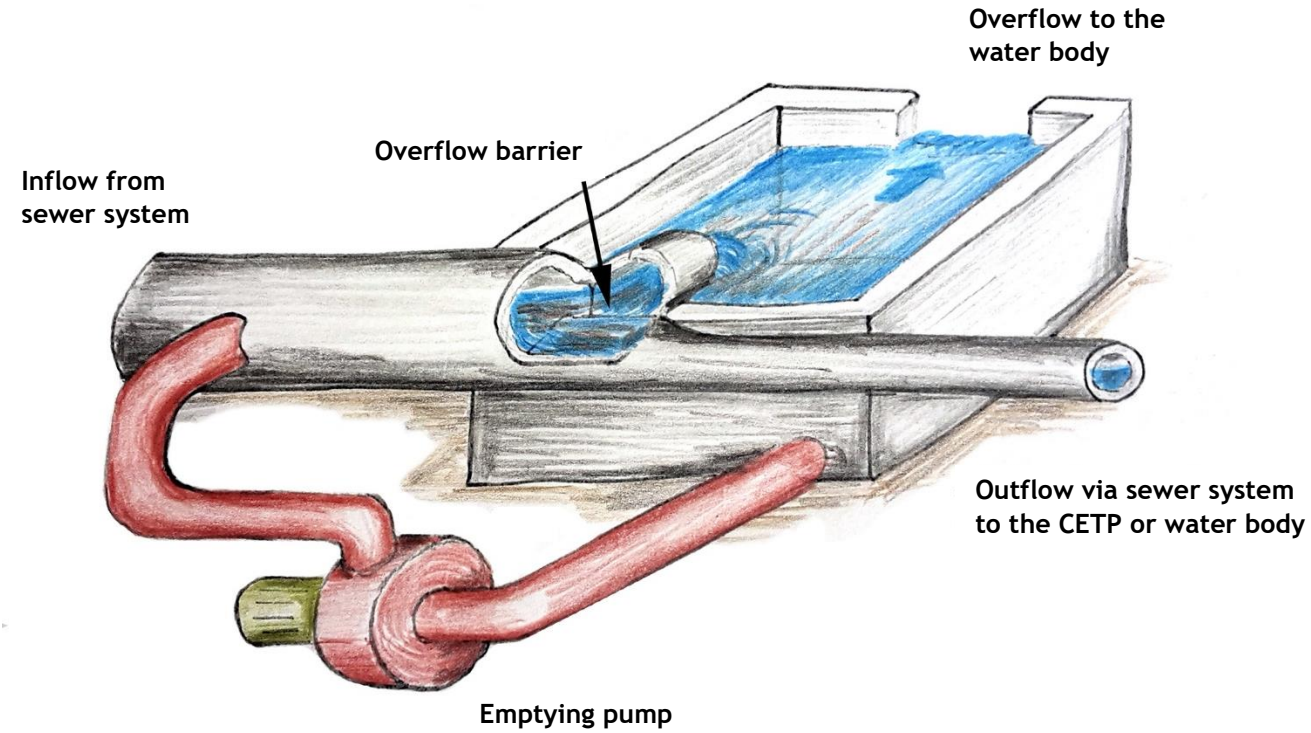


Figure 2-7: Storm water overflow tank

2.15 Storm Water Detention Tank

A storm water detention tank is a storage reservoir for surface water peak flow in separate sewer system for regulation of runoff. These tanks are part of the sewer system. They store high inflows during heavy rains and allow the stored volume to flow to the network downstream, into the CETP or into the water body in a reduced and delayed manner.

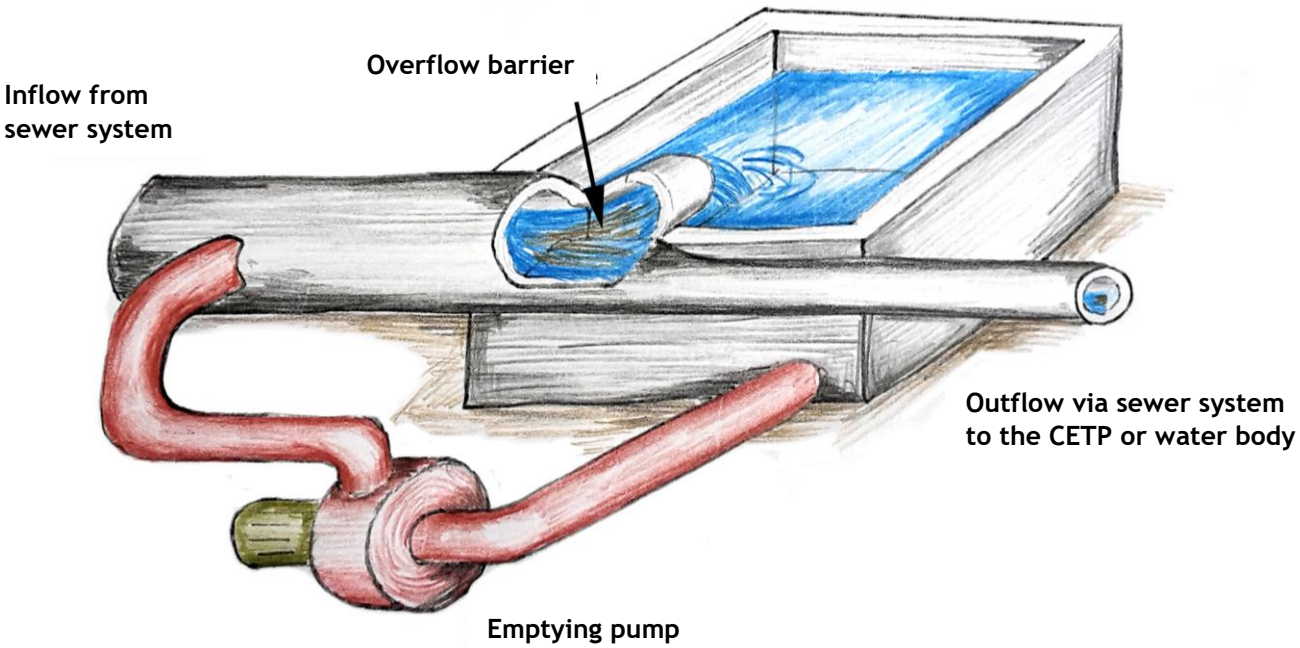


Figure 2-8: Storm water detention tank

Their function is the damping of the drainage wave. Plants for rainwater retention are arranged in both the mixing and separation systems.

Storm water detention tanks, as defined in guideline DWA-A 117 (2006), can be used as pools in open, closed, technical or natural design, as retention channels, retention trenches or retention ponds and in combination with infiltration systems.

Also, large-volume parts of the drainage system (channels, trenches, diversion ways) as far as they can be stored according to plan are supporting storm water detention.

The criteria for the arrangement of rain retention areas are:

- Cost savings through smaller sewers for new constructions or as renovation measures at structurally sound lines with hydraulic overload
- Connection of additional areas (expansion) without expansion of existing sewers or new installation
- Reduction of peak outflows upstream of pump stations
- Reduction of hydraulic water load at the discharge through separating structures

Economic goals are given for the first three criteria. The protection of the water body has ecological reasons. Here the water is exposed to hydraulic shock loads (hydraulic stress).

The storm water detention tank's function is not to have a cleaning effect, although uncontrolled sedimentation of solids can happen.

In addition to the precipitation, the system load, the intensity and the time course of inflows and outflows are relevant for the dimensioning of the detention volume. To determine the required tank detention volume according to worksheet DWA-A 117 (2006) there are two methods available:

1) The simple procedure using statistical precipitation data for small and/or simple structured drainage systems.
2) The detection method using precipitation-runoff-long-term simulation (long-term simulation).

For the volume the following are relevant:

- The permissible throttle outflow,
- The selected or specified exceedance frequency, and
- The drainage effective area of the catchment area.

When designing, the system sizes (area, flow time, etc.) and a load approach for the rainfall set the required volume.

In the case of proof, the performance is determined, considering a selected or existing volume for a given throttle outflow the frequency of exceedance is calculated.

The **simple procedure** considered here is limited on the following catchment area-specific criteria:

- The catchment area is $A_{E,k}$ = 200 ha or $A_{E,b}$ ≈ 60 to 80 ha or flow times limited to t f = 15 min.
- The selected or permissible frequency of exceedance is in the range n ≥ 0.1 a^{-1} (or T_n ≤ 10 a).
- The drainage system should be simply structured (throttle discharge intensity $q_{dr,r,u}$ more than 2 l/(s·ha) and without prior overflow).

Local statistical data of rainfall (frequency and time), r in l/(s·ha) are basis for calculations (available from the national weather data services):

- The frequency of exceeding the storm water detention tank corresponds to the frequency of rainfall, which will not necessarily be the case.
- The precipitation loads as block rain
- The throttle discharge remains constant even with changing fill levels in the pool.

To determine the volume, the maximum difference between that in the specified period the precipitation runoff that has flowed into the retention area and the derived discharges determined (difference between inflow volume and outflow volume). The design procedures are presented in the Germen leaflet DWA-A 117 which is only available in German. Abstracts from this standard will be translated and presented during the training.

2.16 Storm Water Overflow Structure

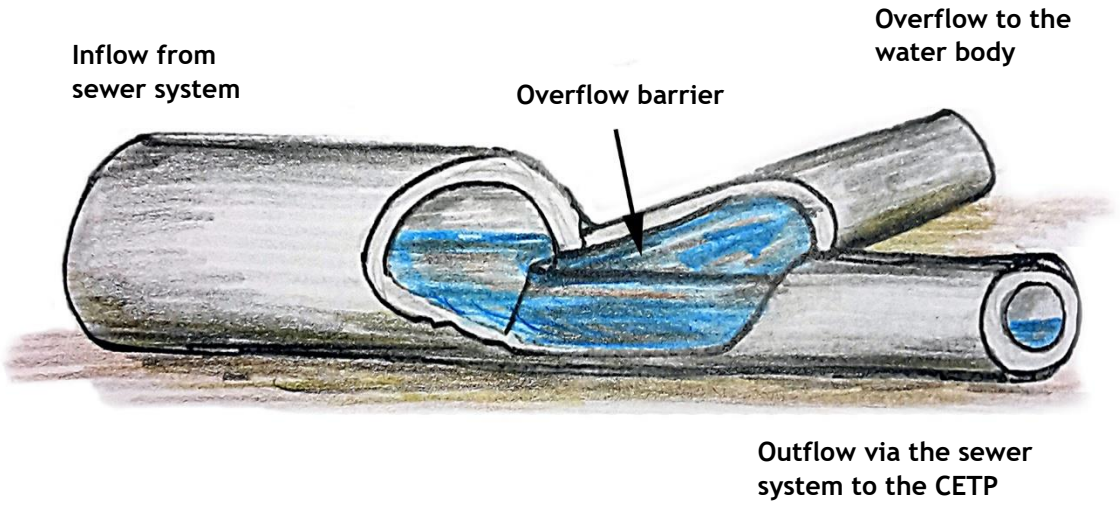


Figure 2-9: Storm water overflow structure

2.17 Inlet Structures

Inlet structures are provided in order, as far as permitted under water management aspects, to accept surface water in sewer systems.

They are to be arranged in a manner so that the surface water can be accepted and discharged without flooding the ground. If required, in order to keep deposits as small as possible, sand or shingle traps and/or course screens are to be provided.

Solutions for inlet structures are:

- inlet structure with shingle and sand trap in near-natural construction,
- inlet structure with rectangular shingle and sand trap
- inlet structure with circular shingle and sand trap in near-natural construction,
- outlet tower (special case).

2.17.1 Inlet Structure with Shingle and Sand Trap in Near-natural Construction

They can be employed both with small inflows with slight sand conduction and also with larger inflows with larger bed loads.

The structural form of the sand traps should be in line with the existing mechanical clearance equipment. Here a low-lying sand trap space can be positioned in place of a drainage facility.

For the arrangement of the screen and other covers see below. With subordinate structures the inlet can be so arranged that it is at the top.

2.17.2 Inlet Structure with Rectangular Shingle and Sand Trap

These inlet structures (see Figure 2-10) are to be employed with larger inflows and heavier shingle and sand conduction. With particularly heavy shingle conduction sufficiently dimensioned shingle traps are to be provided. For the sand trap, the minimum length should be 3.0 m, the minimum width 1.0 m and the minimum depth 0.5 m.

A screen, preferably inclined, whose bar separation does not exceed 120 mm for reasons of safety, is to be located in the outlet cross-section. In order that, with a blocked screen, an even more rapid flow is ensured a free cross-section of 120 mm in height should be available above this screen. It is recommended that there is a free flow cross section of max. 120 mm provided above the invert.

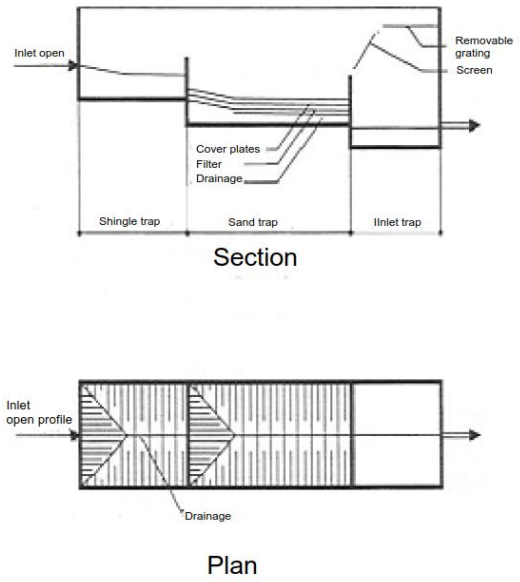


Figure 2-10: Inlet structure with shingle and sand trap

2.18 Outlet Tower

Outlet towers (Figure 2-11) can be used if an impounded water level has to be regulated.

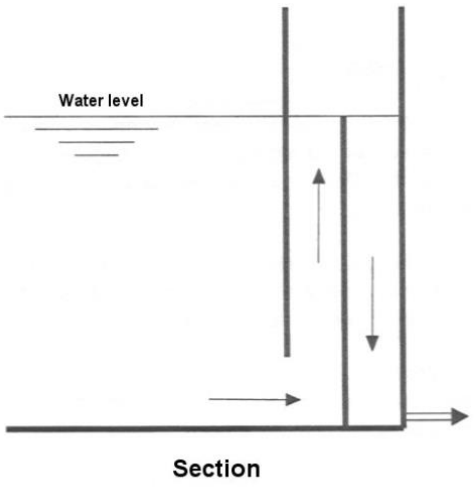


Figure 2-11: Outlet tower

2.19 OUTLET STRUCTURES

Outlet structures are installations at the point of outlet of sewers into surface waters.
With outflow into a near natural body of water, attention is to be paid with the design of the outlet structure to an appropriate connection.

The design possibilities here are strongly dependent on local conditions. Ecological interests are to be taken into account. Natural construction materials (e.g. quarry stones, stone fillings, native woods) are preferred.

Discharge conditions are to be coordinated in agreement with the authority responsible for the body of water.

A cut-off wall or sheet piling, a row of piles or a safety embankment made from a pile of hydraulic bricks is to be arranged at the exit into the surface water.

The bottom and the embankments of the surface water above and below (the exit) as well as, if required, the opposite side to the sewer outlet are to be reinforced and secured against under washing.

If required, a manhole is to be installed before the sewer exits into the surface water. The exit velocity of the water should be kept as low as possible, if necessary, by widening the exit profile. Sewer exits are, for example, to be secured against any form of access by using a grating with a clear bar width of max. 120 mm.

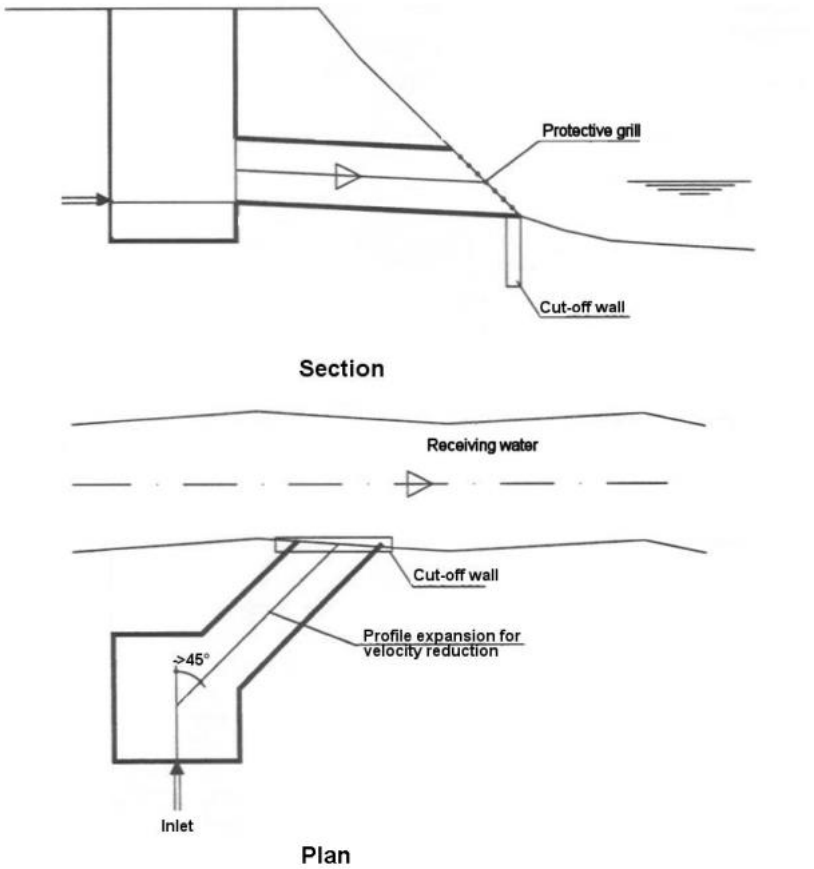


Figure 2-12: Outlet structure (ATV-DVWK-A 157E)

2.20 Gate Valve Structures

Gate valve structures are required in order to temporarily cut off a flow completely or partially, and/or to prevent the entry of floodwater into the sewer (Figure 2-13).

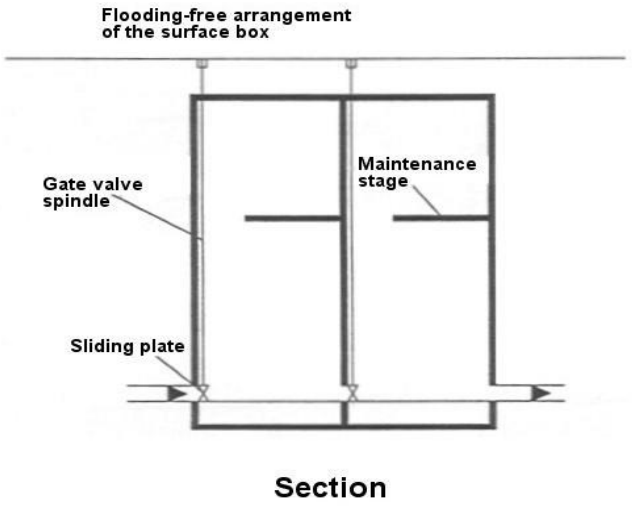


Figure 2-13: Gate valve structure (flooding gate valve, ATV-DVWK-A 157E)

The seal consists of a hand or motor operated gate valve. The drive units are as far apart as possible to be accommodated in a watertight chamber. Attention is to be paid to an explosion-protected construction. It is recommended that stop log slits are provided in front of and behind the gate valve for its maintenance. The threaded spindle and the articulated parts of the gate valve must be designed to be corrosion resistant. Lubrication points must be easily accessible and maintained regularly. For this, a maintenance stage with foldable grating (safety grid) should be provided in manholes with larger profiles – as far as the construction height allows.

With sewer profiles, which are to be closed against floodwater it, is recommended that double gate valves are provided. Anti-flooding flaps are not suitable as secure protection against the entry of flood water. The operation of the flood seals should also be possible during flooding.

2.21 Storm Water Infiltration

The main advantage of storm water harvesting by infiltration is that the natural water balance is largely retained. This considers evaporation, infiltration, and runoff in industrial areas.

Infiltration of storm water is therefore a high priority. In the soil passages of infiltration systems, the components of the seeping rain runoff are retained, stored, and broken down by physical, chemical and biological processes.

Due to the biological activity and the constant loosening, the overgrown top of the soil ensures high cleaning performance. Uncovered floor layers have significantly less cleaning effects.

There can be technical and general reasons against the harvesting of storm water. These are for example:

- Polluted rainwater (e.g. traffic areas, areas in commercial areas)
- High groundwater levels in the area of the construction site (risk of waterlogging),
- Impermeable layers of soil (soils with a high clay or silt content for example),

- Old deposits with dangerous substances, or substances from which pollutants can be washed out with the water,
- Landscape protection zones, drinking water protection zones or
- Narrow buildings so that minimum clearances cannot be maintained.

The following types of trickling or infiltration are provided for the disposal of storm water, which should also be understood as a list of priorities in the series listed below:

1. Surface infiltration
2. Trough infiltration
3. Infiltration basin
4. Trough trench infiltration
5. Trenches and pipe infiltration
6. Shaft infiltration (in exceptional cases)

2.21.1 SURFACE INFILTRATION

Surface infiltration is usually done through overgrown soil on lawns or unpaved edge strips of impermeable or only partially permeable terraces, courtyards and traffic areas. Surface infiltration comes closest to natural infiltration and requires a high percentage of open space and high infiltration capacity (with k_f of at least 2 x 10^{-5} m/s, corresponding to 173 cm/day).

In contrast to former conventions, permeable surfaces, e.g. paving with widened joints, are basically no longer considered as an area of infiltration (Standard in Germany). These are permeable areas. Regarding infiltration capacity, water-permeable plasters and slabs, water-permeable asphalt, water-permeable concrete or surface layers without binders (water-bound ceilings) are subject to an aging process.

Over time, the permeability decreases due to the entry of fine mineral and organic materials. Therefore, some permeable surface fastenings require drainage after a certain time; however, the drainage capacity required for these permeable surface fastenings is much lower compared to impermeable fastened surfaces.

2.21.2 TROUGH INFILTRATION

In the case of trough infiltration, the rainwater is temporarily stored before the infiltration. The infiltration trough is a flat depression, mostly covered with grass. The supply lines for conveying storm water from the connected areas to the troughs should be above ground via open channels, so that the troughs can be laid flat.

The maximum storage height (design criterion) should not exceed 30 cm. Depending on the permeability of the subsoil; the space required for an infiltration trough is about 10 % of the connected area. Connected areas such as roof or court areas are calculated as completely sealed. The application limit is a k_f value of 5 · 10^{-6} m / s (silty sand / sandy silt). The edge distance from troughs to buildings should be at least 5 m. To maintain the growth and ventilation of the topsoil, the damming should be limited to a few hours.

2.21.3 TRENCHES AND PIPE INFILTRATION

In the case of trench and pipe infiltration, the storm water is led above ground into a trench filled with gravel or other material, or underground into a perforated pipe string embedded in gravel or other material (pipe infiltration). A an underground system in which the rainwater does not seep through a living layer of soil and its groundwater protection value is therefore lower than with for aboveground systems. Since the infiltration level is lower than that of the above-mentioned infiltration types, the aquifer distance must be correspondingly large. Hollow body elements which can store storm water after heavy rainfall are increasingly being offered by the plastic industry (see Figure 2-14 and Figure 2-15) The special feature of these elements is the large available storage

volume of approx. 95 %, so that only a small excavation volume and thus a low availability of space is required. Elements that can also be installed below traffic areas are also available.

Figure 2-14: Example for hollow body elements for storm water storage "Stormbricks" (Photo:ACO)

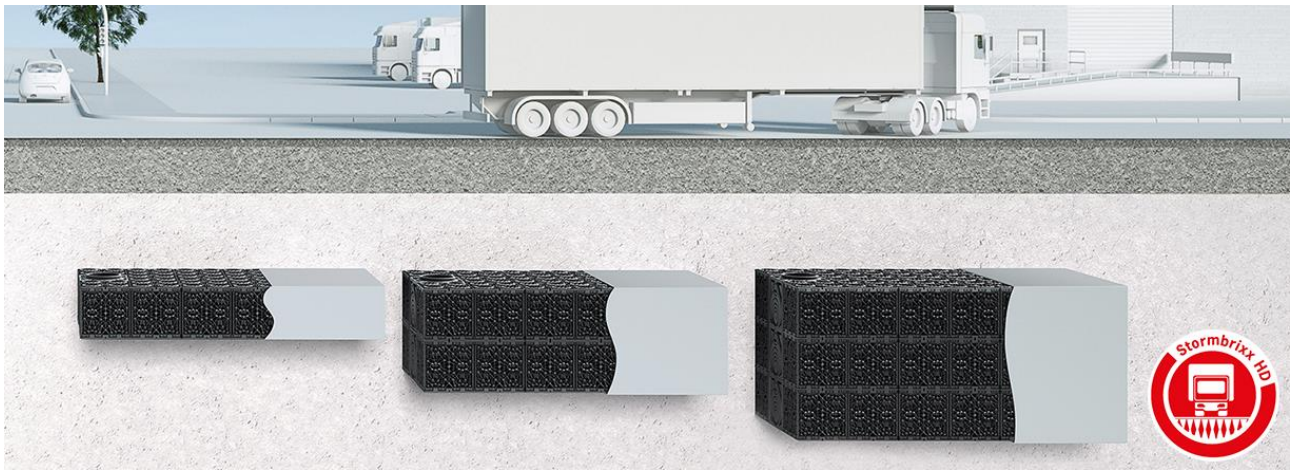


Figure 2-15: Example for storage of storm water in industrial yards through "Stormbricks" (Photo:ACO)

2.21.4 TROUGHS AND TRENCH INFILTRATION

Troughs and trenches are arranged one above the other. The trough sole consists of a 30 cm thick layer of grassy topsoil. The underlying trench is covered with a geotextile that prevents solids from entering the trench system. Lattice works made of plastic have established themselves as fillers, which have a usable cavity volume of over 90 % of the total volume. The trenches can be linked by transport trenches, drains and pipelines, open water surfaces (e.g. lagoons) and other elements, as well as by inspection shafts to form a special infiltration and drainage system. At k_f values < $5 \cdot 10^{-7}$ m / s, the infiltration rate from the infiltration trenches into the subsoil is so low that a relief

discharge is essential in a networked system. Still, the advantages of efficient rainwater treatment, when seeping into green troughs and decentralized retention, are used.

2.21.5 Infiltration Basin

The infiltration basin is a central infiltration system because the storm water runoff from larger catchment areas is brought together at one point via a rainwater network and infiltrated there. Infiltration basins usually have a high hydraulic load, i.e. the ratio of the connected paved area to the seepage effective area is greater than 15:1, and damming heights of over 1 meter can also occur. However, to ensure that an appropriate emptying time is not exceeded, a permeability of $k_f = 1 \cdot 10^{-5}$ m / s (fine to medium sand) is required as a site requirement.

2.21.6 Shaft Infiltration

Shaft infiltration is applied by leading rainwater into an infiltration shaft, which is usually built from concrete. The small space requirement is advantageous. As a subterranean facility, the retention and implementation capacity of storm water constituents is low. Shafts are therefore only suitable for unpolluted drains. The construction depth requires a large distance to the aquifer. Shaft infiltration should be installed if no alternative methods are possible and there is no local discharge into surface water.

2.22 Dimensioning & Planning

The planning, dimensioning and construction of an infiltration system is to be carried out in accordance with the Advisory Leaflet DWA-A 138 (DWA, 2005a) "Planning, Construction and Operation of Facilities for the Percolation of Precipitation Water".

2.23 Operation & Maintenance

Infiltration systems must be subjected to maintenance and care at regular intervals. As in any other technical wastewater treatment plant, deposits and dirt can occur due to the entry of leaves and dust, which can clog the plant. Therefore, depending on the system type the following maintenance may be required:

- Cleaning of chutes
- Loosening work on the trough surface, or
- Maintenance of the plant cover for infiltration troughs as maintenance work.

In addition, no pesticides may be used in the care of the infiltration systems. If oils, fuels, or other water-contaminating substances have leaked out on the areas connected to the system, this must be reported immediately to the responsible water authority so that suitable countermeasures can be taken to avert groundwater pollution.

2.24 Green Roofs

Green roofs are a valuable habitat for plants and animals. They also hold back rainwater and release water directly back into the environment through evaporation processes via the plants (evapotranspiration). They also make a valuable contribution to reducing the heat load in cities, as well as being an aesthetic enrichment for the living environment.

The structure of a green roof is always similar. A first layer serves as a root protection layer and ensures that the plant roots cannot damage the roof skin. The following drain layer stores water that is consumed or evaporated by the plants. A filter layer separates it the drain layer from the substrate layer. The thickness of the substrate layer depends on the type of plants chosen.

In general, there are two categories of green roofs that can be differentiated:

- Intensive greening: meadows, shrubs or ornamental trees are cultivated here with relatively high investment and maintenance costs. In some cases, utility gardens are even created on the roof or roof terrace.
- Extensive greening: The maintenance effort is limited because it consists of undemanding mosses, grasses and herbs. The most common and simplest green roof consists of sedum sprout sowing. Here short sprouts are placed on the roof, together with the substrate, which spreads to a closed plant cover within a few months.

On average, green roofs hold back about half of the rainfall. Accordingly, many cities reduce the precipitation fee for green roofs. Water retention also effects the temperature in the rooms below. It stays warmer in winter under the green roof and cooler in summer. Furthermore, the roof skin is protected from UV radiation.

Basically, roofs can be greened up to an incline of around 25 degrees, but the construction effort increases with increasing inclination. Before a greening of the roof is decided on, the structural suitability of the roof must be assessed. The greening of garages is not a problem, and some companies already offer their own kits with cut components.

In the initial phase, regular irrigation is important. Weeds and also small birches or poplars, must be removed from the green roofs about twice a year. These take light and food from the desired plants and can damage the roof membrane. A visual check for leaks should also take place. In any case, one important consideration when it comes to the greening of roofs is that the greenery and plants are adapted to the local climate.

3 WASTEWATER CONVEYANCE SYSTEMS IN INDUSTRIAL AREAS

3.1 WASTEWATER CHARACTERIZATION

Fresh domestic and industrial sewage has little odour, it is grey in colour, the sewage solids are only slightly disintegrated, decomposition is not evident, and dissolved oxygen is present. As sewage becomes stale and finally septic, its odour intensifies, the colour turns black, the solids disintegrate, decomposition becomes active, dissolved oxygen eventually disappears, and hydrogen sulphide is then evolved. Specific character of industrial wastewater depends on production process and can vary in a wide range (high organic contents, heavy metals, nutrients such as nitrogen and/or phosphate).

A significant factor influencing the flow pattern would be the shift nature of work at factories. These shifts may be 8 h or 12 h shifts and there can be up to three shifts per day. Wastewater characteristics within a factory can also vary with time because it may practice batch manufacturing, or it my practice slug discharge (accidental discharges) on top of its usual discharges.

In most industries, wastewater effluents result from the following water uses: sanitary wastewater (from washing, drinking, and personal hygiene), cooling (from disposing of excess heat to the environment), process wastewater (includes water used for making goods, washing the products, waste and byproduct removal, and transportation), and cleaning (includes wastewater from cleaning and maintenance of industrial areas).

Commonly, it is beneficial to jointly treat municipal sewage and industrial effluents in one plant. Attention must be given to the presence of toxic and other harmful compounds in the industrial wastewater that could damage the treatment plant operation, biota to tanks, or cause a violation of effluent and/or stream standards. In such cases, pre-treatment may be necessary.

3.2 MATERIAL AND INSTALLATION ON ASSETS

Regarding temperature, pH as well as chemical and mechanical resistance there are high quality standards required regarding the material of sewer pipes. If the character of the wastewater allows it, the use of standard sewer base pipes is recommended.

This type of pipe is mainly used for wastewater conveyance in the ground from a building to the public sewer system. The mostly light brown plastic pipes (see Figure 3-1) are manufactured in different nominal sizes (DN 100 to 600 mm; Length: 500 to 5.000 mm). It is not allowed to install sewer base pipes inside the buildings due to hot wastewater. They would outgas at a wastewater temperature of around 65 °C; in addition, a house fire would produce toxic gases.

Figure 3-1: PVC-Pipe with foamed core

The simplest version of the sewer base pipe made of hard polyvinyl chloride (PVC-U) corresponds to a ring stiffness (SN) of 4. Furthermore, there are sewer base pipes made of hard polyvinyl chloride (PVC-U) with a ring stiffness (SN) of 8. For PVC-U-SN8, there are core-foamed pipes and solid wall pipes. In the case of the core-foamed pipes, the space is co-extruded, for example, filled with foamed recycled material, while in the case of solid wall pipes, the entire wall consists of the basic material. Both SN4 and SN8 pipes are recognisable by their mostly orange color (RAL 8023).

The more resilient version of this sewer pipe is the polypropylene pipe (PP pipe). This has a ring stiffness (SN) of 10 and is manufactured in either green, orange or blue. Other designs with a corrugated surface or combinations of hard polyvinyl chloride (PVC-U) and polypropylene (PP) are offered by the industry with a wide range of ring stiffness.

Other alternatives are pipes made of stoneware, concrete, reinforced concrete, ductile iron or in rare cases steel.

For installation of sewer base pipes on the assets minimum gradient for the installation of sewer base pipes in main and collecting pipes is:

- inside buildings according to DIN 1986-100: 0.5 cm/m
- outside of buildings according to EN 752-4: for diameters smaller than DN 300 at least 1 : DN, lower gradients are permitted if a flow rate of at least 0.7 m/s come up daily for self-cleaning.

Pipes shall be installed with short distance to outside area and at union of pipes an inspection shaft shall be arranged.

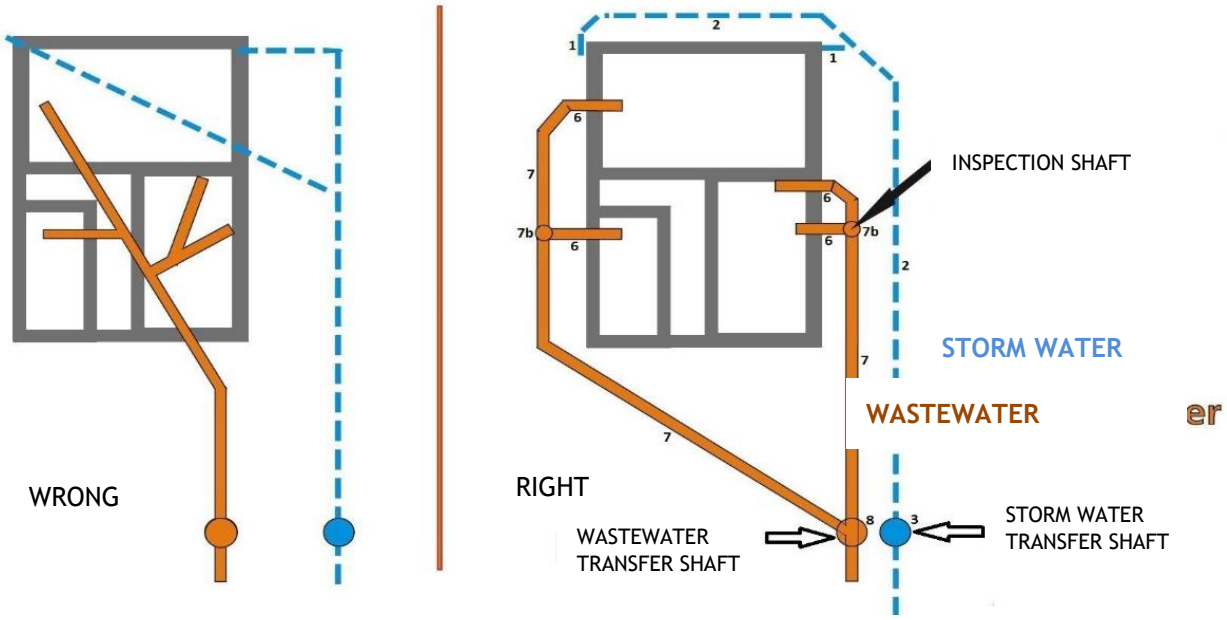


Figure 3-2: Example for stormwater drains and sewer arrangement

3.3 Transfer to Public Sewer System

A transfer shaft shall define the point of discharge to the public sewer network. Here sampling and online measurement for quality control can be conducted. The following parameters shall generally be monitored:

- Flow
- pH
- Temperature

Depending on the surrounding industry, additional relevant parameters shall be monitored. The best available method is the use of an automatic sampling machine for representative 24-h mixed samples. Lab analysis for following parameters are to be conducted:

- COD (industries with high organic loads or ETP for reduction of organics.
- Fats, Oil and Grease (FOG, Food Processors)
- Heavy metals (e.g. Cd, Cr, Cu, Pb, Hg, Ni, Ag, Zn)
- Cyanide

3.4 Pipe Construction and Materials

3.4.1 General

There are several different pipe materials available for wastewater collection systems, each with a unique characteristic used in different conditions. The four different pipe materials described here are ductile iron, concrete, plastic, and vitrified clay.

Pipe material selection considerations include trench conditions (geologic conditions), corrosion, temperature, safety requirements, and cost. Key pipe characteristics are corrosion resistance (interior and exterior), the scouring factor, leak tightness, and the hydraulic characteristics.

Pipe manufacturers follow requirements set by the American Society of Testing Materials (ASTM) or the American Water Works Association (AWWA) for specific pipe materials. Specification standards cover the manufacture of pipes, and specify parameters such as internal diameter, loadings (classes) and wall thickness (schedule). The methods of pipe construction vary greatly with the pipe materials.

Some new pipe materials and construction methods use the basic materials of concrete pipes with modifications (i.e. coatings). Other pipe manufacturing methods use newly developed resins which offer improvements in strength, flexibility, and resistance to certain chemicals. Construction methods may also allow for field modifications to adapt to unique conditions (i.e. river crossings, rocky trenches, etc.) or may allow for special, custom ordered diameters and lengths.

3.4.2 Ductile Iron Pipe

Ductile iron pipe (DIP, see Figure 3-3) is an outgrowth of the cast iron pipe industry. Improvements in the metallurgy of cast iron in the 1940's increased the strength of cast iron pipes and added ductility, an ability to slightly deform without cracking. This was a major advantage, and ductile iron pipes quickly became the standard pipe material for high pressure service for various uses (water, gas, etc.).

Figure 3-3: Ductile iron pipes (photo: McWane Ductile)

3.4.3 Concrete Pipe

Two types of concrete pipe commonly used today are the pre-stressed concrete cylinder pipe (PCCP) and the reinforced concrete pipe (RCP). PCCP is used for force mains, while RCP is used primarily for gravity lines. PCCP may be constructed either as an embedded cylinder (EC) or as a lined-cylinder (LC). The construction process for both LC and EC pipes begins by casting a concrete core in a steel cylinder. This single process produces the LC pipe. Once the cylinder has cured, it is wrapped with a pre-stressed steel wire, and coated with a cement slurry and a dense mortar or concrete coating to produce the EC pipe. The manufacturing process for reinforced concrete cylinder pipes (RCCP) is similar to that of the embedded cylinder, however, a reinforcing cage and the steel cylinder are positioned within a reusable vertical form and the concrete is cast, instead of using the pre-stressed wire. RCCP can be cured by using either water or steam.

Figure 3-4: Concrete pipe manufacturing, Jaipur (photo: Yash Raj)

3.4.4 Plastic Pipe

Plastic pipes are made from either thermoplastic or thermoset plastics. Characteristics and construction vary, but new materials offer high strength and good rigidity. Fluorocarbon plastics are the most resistant to attack from acids, alkalis, and organic compounds, but other plastics also have high chemical resistance. Plastic pipe design must include stiffness, loading, and hydrostatic design stress requirements for pressure piping.

Thermoplastics are plastic materials that change shape when they are heated. Common plastics used in pipe manufacturing include Polyvinyl Chloride (PVC), Polyethylene (PE or HDPE for High Density PE), Acrylonitrile-butadiene-styrene (ABS), and Polybutylene (PB). HDPE is commonly used to replace pipes when the pipe bursting method is used. PVC is strong, lightweight, and somewhat

flexible. PVC pipe is the most widely used plastic pipe material. Other plastic pipes or composites with plastics and other materials may be more rigid.

Thermoset plastics are rigid after they have been manufactured and are not able to be reformed. Thermoset plastic pipes are composed of epoxy, polyester, and phenolic resins, and are usually reinforced with fiberglass. Resins may contain fillers to extend the resin and to provide specific characteristics to the final material. The glass fibers may be wound around the pipes spirally, in woven configurations, or they may be incorporated into the resin material as short strands. The pipes may be centrifugally cast. Stiffness may also be added in construction as external ribs or windings. Reinforced Plastic Mortar (RPM) and Reinforced Thermosetting Resin (RTR) (or Fiberglass Reinforced Plastic Pipe (FRP)) are the two basic classes of these pipes. Another name is Fiberglass Reinforced Polymer Mortar (FRPM). Thermoset pipes are often manufactured according to the specific buyer requirements and may include liners of different composition for specific chemical uses.

For plastic pipes, resins composed of polymerized molecules are mixed with lubricants, stabilizers, fillers, and pigments, to produce mixtures with different characteristics. Plastic pipes are generally produced by extrusion. Plastic pipes may be used for slip lining or for rehabilitating existing pipes by inserting or pulling them through a smaller diameter pipe. HDPE pipes may also be used for bursting and upgrading. The smaller diameter pipe may be anchored into place with mortar or grout.

3.4.5 VITRIFIED CLAY PIPE

Vitrified clay pipes are composed of crushed and blended clay that is formed into pipes, then dried and fired in a succession of temperatures. The final firing gives the pipes a glassy finish. Vitrified clay pipes have been used for hundreds of years and are strong, resistant to chemical corrosion, internal abrasion, and external chemical attack. They are also heat resistant. These pipes have an increased risk of failure when mortar is used in joints because mortar is more susceptible to chemical attack than the clay. Other types of joints are more chemically stable. It has been shown that the thermal expansion of vitrified clay pipes is less than many other types (such as DIP and PVC).

Figure 3-5: Vitrified clay pipes (photo: Rajhansh Ceramic Industries)

3.4.6 APPLICABILITY

The applicability of different pipe materials varies with the site and the system requirements. The pipe material must be compatible with the soil and groundwater chemistry. The pipe material also must be compatible with the soil structure and topography of the site, which affects the pipe location and depth, the supports necessary for the pipe fill material, and the required strength of

the pipe material. The following list shows background information to be used in determining what type of pipe best fits a particular situation:

- Maximum pressure conditions (force mains).
- Overburden, dynamic, and static loading.
- Lengths of pipe available.
- Soil conditions, soil chemistry, water table, stability.
- Joining materials required.
- Installation equipment required.
- Chemical and physical properties of the wastewater.
- Joint tightness/thrust control.
- Size range requirements.
- Field and shop fabrication considerations.
- Compatibility with existing systems.
- Manholes, pits, sumps, and other required structures to be included.
- Valves (number, size, and cost).
- Corrosion/cathodic protection requirements.
- Maintenance requirements.

3.4.7 Advantages and Disadvantages

The advantages and disadvantages for specific pipe materials are listed in Table 3-1. The primary advantages and disadvantages to consider for pipes used in sewer applications include those that are related to construction requirements, pressure requirements (force mains), depth of cover, and cost.

Table 3-1: Advantages and disadvantages of different materials

Advantages	Disadvantages
Ductile Iron	
• Good corrosion resistance when coated	• Heavy
• High strength	
Concrete	
• Good corrosion resistance	• Requires careful installation to avoid cracking
• Widespread availability	• Heavy
• High strength	• Susceptible to attack by H_2S and acids when pipes are not coated
• Good load supporting capacity	
Vitrified Clay	
• Very resistant to acids and most chemicals	• Joints are susceptible to chemical attack
• Strong	• Brittle (may crack); requires careful installation
	• Short length and numerous joints make it prone to infiltration and more costly to install
Thermoplastics (PVC, PE, HDPE, ABS)	
• Very lightweight	• Susceptible to chemical attack, particularly by solvents
• Easy to install	• Strength affected by sunlight unless UV protected
• Economical	• Requires special bedding
• Good corrosion resistance	
• Smooth surface reduces friction losses	
• Long pipe sections reduce infiltration potential	
• Flexible	
Thermosets(FRP)	
• High strength	• High material cost
• Lightweight	• Brittle (may crack); requires careful installation
• Corrosion resistant	• High installation cost

Source: Lamit, 1984, Moser, 1990, Peggs, 1985.

3.4.8 Design Criteria

Design requirements can vary greatly. Pipe design must be approached differently for both materials and construction methods. The mechanics of the soil that will surround the pipes is a fundamental design aspect for the support characteristics, especially for flexible pipes. The soil type, density, and the moisture content are important characteristics.

3.4.9 COSTS

When comparing the costs for piping, the costs of the materials as well as the construction costs should be considered. The pipe cost is given in dollars per unit length, traditionally in $/linear foot, plus the costs of the fittings, connections, and joints. Construction costs will depend on the type of digging necessary, special field equipment requirements, and an allowance for in-field adjustments to the system. Access to pipe systems will also be a relevant cost factor, as manhole spacing is dependent on pipe size.

Sanitary sewer construction costs depend on several variables, including depth, type of soil, presence of rock, type of bedding material, location (rural vs. urban areas) clearing costs, and other factors.

Typical pipe materials for small diameter sanitary sewers (8" through 24" diameter) include PVC, vitrified clay, and ductile iron. Typical average costs for sanitary sewers (excluding service connections and manholes) are provided in Table 2.

The cost per linear foot in the table is based on an average trench depth of eight feet and excludes service connections and manholes. The following is not included in the cost per linear foot:

1. Asphalt and gravel driveway repair.
2. Open cut of roads.
3. Boring and jacking.
4. Concrete encasement of pipe at stream crossings or other locations.
5. Erosion control.
6. Relocation of other utilities.

Soil material is assumed to be silt, clay, or other soil mixtures with no requirement for shoring, rock removal, or dewatering.

The table should present and overview of cost comparison. However, update to present time price index and local conditions is required.

Table 3-2: Average cost/linear foot by pipe diameter

Pipe Material	2"	4"	6"	8"	12"	15"	18"	24"
VCP	-	-	$25	$30	$38	$50	$65	$110
DIP	-	-	-	$38	$50	N/A	$75	$110
RCP	-	-	-	-	$11	$17	$23	$31
PVC	$15	$19	$23	$25	$30	$38	$50	$75
PE	-	$7	$12	$14	$9*	-	$16*	-
FRP	$21	$30	$42	$60	-	-	-	-
ABS	$11	-	-	-	-	-	-	-

* Corrugated
Source: RS Means Heavy Construction Guide (1998).

3.5 Separator

This installation prevents discharge of harmful substances into a drainage system by gravity separation. E.g. grease separator, light liquid separator (petrol separator, oil separator, coalescence separator), heavy liquid separator, starch separator.

3.6 Public Industrial Sewer System

There are numerous drainage system structures in the urban planning space (see Figure 3-6). In general, there are two systems for wastewater and storm water drainage:

- Combined System (CS) – only one sewer system for wastewater and storm water
- Separate System (SS) – network of storm water and wastewater sewers.

Each system can be modified. The simple CS (System IIa) requires a storm water tank with overflow and a CETP. An area with a separated system can be connected to areas with combined systems downstream. The storm water is discharged to the water body and only the wastewater is handed over to the combined system (see. area 1 and area 2 / system IIa and IIIa). In area 3, there is a modified combined system, where, for example, new buildings are connected with wastewater only. The storm water will be infiltrated on site or sent to the water body either by open trenches or by new pipelines. In the modified separated system, (area 4) storm water can be sent to infiltration systems nearby, too.

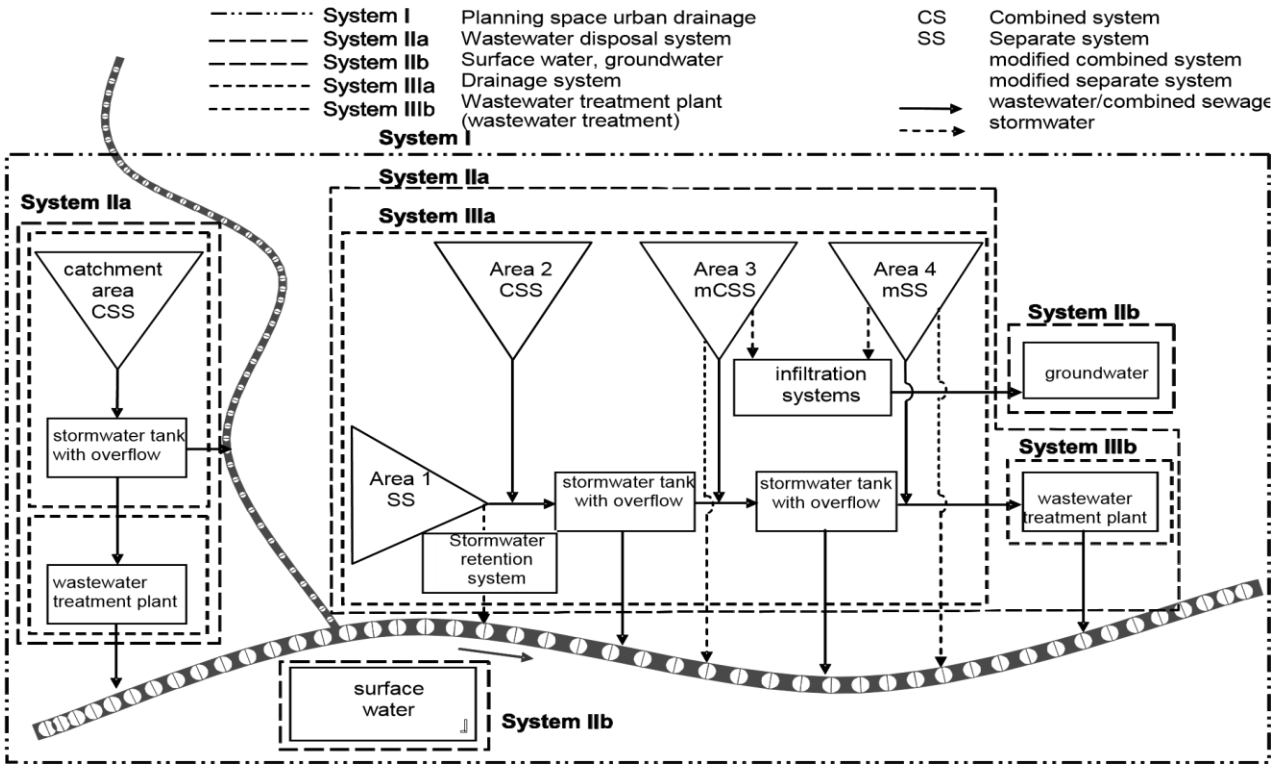


Figure 3-6: System structure in the planning space of urban drainage (with reference to ATV-DVWK 2003a)

The recently newly constructed industrial areas in India are of the separate system. The sewer for conveyance of industrial wastewater carry clean water from groundwater infiltration, cross-connections between storm water drainage, and basement and foundation drainage connections. The clean water inputs into industrial sewers may be of the same order or even greater than the industrial inputs. Clean water inputs into sanitary sewers should be avoided wherever possible. Excessive clean water inputs into sanitary sewers will result in CETP hydraulic overloads and thus bypasses and overflows of untreated sewage into receiving waters.

Industrial sewers are designed commonly as gravity flow conduits. Pressure or vacuum sewers are still rare.

Sewers can be divided into building sewers, lateral sewers, branch sewers, main trunk sewers, interceptors, and outfall sewers.

Building Connections connect the building plumbing to the nearest lateral or branch public sewer line. The building connections should be equipped by backwater gates if there is a danger of sewer backup and basement flooding. This device consists of agate or float or a hydraulically regulated check valve that opens only in the direction toward the sewer. Building sewer lines from upper elevations should bypass the basement. The minimum recommended size of building connections is 100 mm (4 in.) for small single assets comparable to a single family home and the minimum slope should be 2 %.

Lateral and Branch Sewers are used to collect wastewater from building connections and convey it to a main sewer. A lateral has no other sewer tributary except building connections. The minimum diameter of lateral and branch sewers should be 250 mm (10 in.).

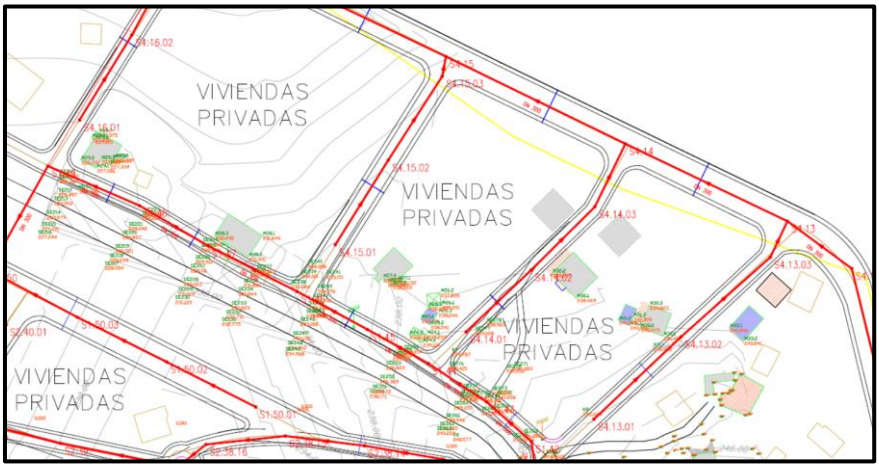


Figure 3-7: ***Typical design of a wastewater sewer network***

Main (Trunk) Sewers accept flow from several branch or lateral sewers and convey it to a CETP or to an intercepting sewer. In older combined sewer systems trunk sewers convey the mixture of sewage and storm water runoff to a flow divider whereby the excess flow is diverted into a relief sewer and then to the nearest watercourse. Regulations in some countries now require interception and treatment of combined sewer overflows.

Interceptors are large sewers that were originally designed to accept dry weather flow from a number of trunk sewers and carry the flow to a treatment facility.

The layout of main sewers and interceptors should follow the natural slope of the terrain. Separate interceptors for upland and low lying areas should be considered, since in low areas or when pumping of sewage is required installing safe storm water overflows may not be possible.

Longitudinal Profiles (Sewer Slopes). The minimum slope of sewers should result in flow velocities large enough to prevent deposition of solids (self-cleaning velocity) and keep sewage fresh. Commonly, the slopes are calculated assuming a minimum velocity for the dry weather (sewage) flow of 0,6 mg/s (2 fps) when will normally have a higher specific gravity than sewage-suspended solids, a minimum velocity of 0.9 m/s (3 fps) is recommended for full flow (wet weather) of combined and storm sewers. European practices permit minimum velocities for sand free, dry weather sewage flow of 0.4 m/s.

The maximum velocity for concrete pipes and common sewage-storm water mixture or storm water should be 3 m/s. When grit is not a problem, maximum velocities can be increased up to 6 m/s or 8 m/s. At velocities exceeding 12 m/s abrasion by cavitation becomes a problem.

After selecting the minimum and maximum velocity the slope of the sewer for a given diameter or cross section can be determined from nomographs or calculation software. For circular pipes with diameters up to 1 m see Figure 3-8. For larger diameters the critical slope can be computed using a simple formula proposed by Schütz or

$$S_{crit} = 0{,}001 \times D^{-1.3}$$

S_{crit} = dimensionless critical minimum slope (m/m), and
D = the cross-sectional diameter in meters.

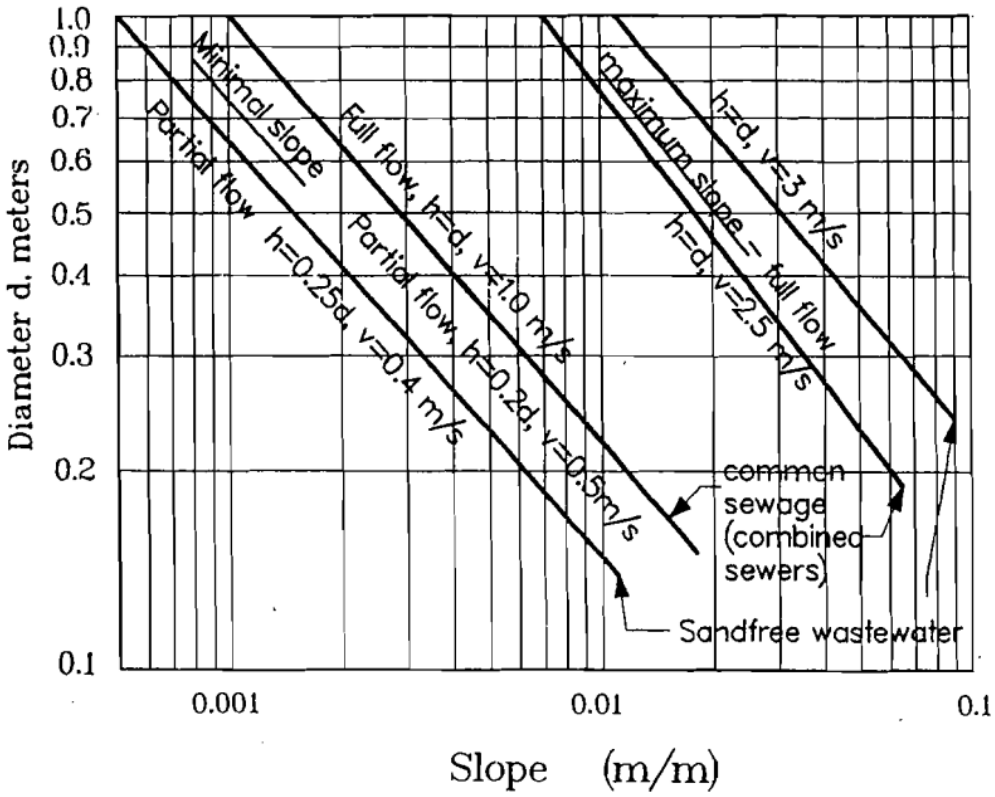


Figure 3-8: Critical slopes and velocities for sewers

3.6.1 Large Industrial Parks and Regulatory Acts

In Germany there are a number of industrial parks, many situated along the river Rhine, e.g.:

- Chempark Uerdingen/Dormagen/Leverkusen (https://www.chempark.com/en/index-en.html). More than 70 companies specializing in production, research and services help generate synergies at CHEMPARK. The sites in Leverkusen, Dormagen and Krefeld-Uerdingen account for around one-third of the total chemical production in North Rhine-Westphalia. The three parks have a total area of approximately eleven square kilometers.
  From here, around 350 million consumers are reachable within one day's journey by truck. CHEMPARK offers ideal access via waterways, railways and an extensive freeway network and is within easy reach of the international airports Cologne-Bonn and Dusseldorf.
- BASF Ludwigshafen (https://www.basf.com). With an area of approximately ten square kilometers the Ludwigshafen Verbund site is the world's largest integrated chemical complex (see Figure 3-9 As the headquarters of BASF, it is also the cradle of the Verbund concept, where production facilities, energy flows and logistics are networked together intelligently in order to utilise resources as efficiently as possible.

Figure 3-9: BASF Ludwigshafen - worlds largest factory (Photo: dpa/BASF)

The aim of industrial production is to keep the environmental footprint as small as possible. The management systems are monitored by external auditors as part of the certification process (ISO 14001, EMAS, ISO 50001) and by internal environmental risk assessments (environmental due diligence process).

The general concepts for wastewater management are as following:

- Minimize water consumption for industrial process.
- If possible, recycling for multiple uses of wastewater (e.g. by separation process).
- Re-use of wastewater for other processes with lower quality needs.
- If required, pre-treatment of wastewater before discharge in sewer network (e.g. pH adjustment, aerobic or anaerobic biological pre-treatment to reduce organic load).
- Treatment of collected wastewater in CETP before discharge to the water body.

The industrial areas are all equipped with the separated system. The wastewater conveyance system is monitored regularly according to maintenance management plan. Relevant parameters, e.g. flow, temperature, pH, are monitored in each single workshop by online measurement. Other required physical or chemical parameters are analysed by grap samples or mixed samples.

Regulation for industrial parks concerning wastewater discharge is according to the German Water Resources Act (WHG - Wasserhaushaltsgesetz), which defines the frame for the whole country.

In addition to framework regulations and provisions for individual analysis and measurement methods, currently 57 annexes contain special pollutant-related requirements for wastewater from

different areas of origin Appendix 1 of the AbwV applies, for example, to domestic and municipal wastewater, while Appendix 22 makes demands on wastewater from the chemical industry.

Detailed regulations can be set up by the single states of the Federal Republic of Germany via the regional water acts (Landeswassergesetze).

In addition to the Water Resource Act and the legal ordinances based on it, there are other federal regulations on water protection law. The Wastewater Tax Act - AbwAG states that for the direct discharge of wastewater into a body of water a tax shall be paid.

This levy is the first nationwide environmental levy with a steering function. It applies the ‘polluter pays principle’ in practice, since direct dischargers have to compensate for at least part of the costs of using the environmental water. The wastewater tax also implements the requirements of the EU Water Framework Directive, according to which the environmental and resource costs must also be internalized to cover costs for water services. This means that a financial compensation (levy) must also be made for residual pollution of the water if all legal requirements are met.

The levy depends on the amount and the harmfulness of certain contents that are discharged with the wastewater. To determine the harmfulness, the oxidizable substances (as chemical oxygen demand), the nutrients phosphorus and nitrogen, the heavy metals mercury, cadmium, nickel, chromium, lead, copper and the organic halogen compounds (AOX) as well as the fish egg toxicity of the wastewater are used as a basis for the evaluation. A “harmful unit” expresses the harmfulness (SE).

The fee per unit of damage has increased from DM 12 initially in 1981 in several steps to DM 70 since 01/01/1997 (converted to € 35.79 since the beginning of 2002) and has remained at this level since then. The aim of the levy is to create economic incentives to reduce wastewater discharges as far as possible. For this reason, the AbwAG also provides for reductions in the tax rate for cases in which the taxpayer meets certain minimum requirements. In addition, certain investments to improve wastewater treatment can be offset against the levy.

The wastewater tax is payable to the federal states. It is intended to be used for water pollution control measures.

The main aim of these introductory standards is to ensure that all that is technically feasible is done when it comes to the discharge of pollutants from so-called ‘point sources’, regardless of the respective water quality. They therefore contribute to the implementation of the precautionary principle in water protection law.

4 GUIDELINES ON PRECURSORY ACTIVITIES FOR TENDER & BID DOCUMENT PREPARATION FOR CETPS

The concept of Common Effluent Treatment Plant (CETP) evolved as a centralized environment infrastructure and is run as a co-operative initiative to manage the industrial effluents generated by a cluster of micro, small and medium enterprises. CETPs allow effluents to be treated in an efficient and cost effective manner, which would be much harder to do as individual units given their technical, financial, skill, scale, space and other constraints. Further, CETPs also minimize the number of discharge points in an industrial estate, leading to better enforcement, given the manpower constraints faced by the regulatory agencies. Centralized infrastructure can also pose certain business continuity risks as the failure of a CETP could mean the shutting-down of wastewater generating operations in the whole cluster.

The Central and State Government heavily supported the CETPs initially established in India by means of grants of around 50-75% and with additional support of up to 15% from the banks to cover the capital expenditure towards plant and machinery. The State Industrial Development Corporations (SIDC) are also to develop the CETPs as one of the essential environmental infrastructure to be built in the industrial parks developed and marketed by them.

Sustenance of the CETP infrastructure also needs proper Institutional mechanisms, Stakeholder engagement supported with various legal and financial instruments. The guidelines developed here are primarily focused on guiding the SIDC or Industry Associations in making the right choices and in following a systematic process in the planning and building of an effective effluent management infrastructure, as well as managing it sustainably. The SIDC may at its discretion handover the infrastructure to a Special Purpose Vehicle (SPV) formed from the industrial stakeholders for the management of the environmental infrastructure.

Hence, many precursory activities like planning, assessment studies, regulatory requirements etc. need to be undertaken to have clarity on the type and scale of the CETP to be established that best suits the interests of the stakeholders concerned. This document covers the key aspects the project proponents need to look into at the precursory stage, as well as the guidelines for preparation of tender documents for inviting bids for construction of CETPs; followed by the guidelines for drafting the byelaws for effective management of the CETPs.

4.1 PLANNING OF CETPS:

The planning of a CETP is not a stand-alone activity and has to be integrated with the overall planning of the industrial park development to ensure the right placing of the CETPs and to ensure optimal life cycle cost, for example by minimizing pumping and other Operational expenses. However, this may not be possible in the case of a brownfield industrial park where a CETP has to be established in the left over space within the industrial park or the additional land that is acquired for the CETP. The implications of such a compromise could be increased capital and operational costs, which effectively are transferred to the member industries operating in those industrial parks.

From the effluent management perspective, the planning of a homogenous/ dedicated industrial park would be much easier compared to a heterogeneous/ multi-sector industrial park. The factors, which influence the proper planning and operation of the CETPs, include the following:

i. Identifying categories of effluent generating member industries
ii. Estimating qualitative/quantitative fluctuations of effluent (equalization/ homogenization / modules) based on sector specific factors/ benchmarks
iii. Specify pre-treatment requirements at industry level
iv. Specify segregation of effluent streams at individual member industry

v. Decide on collection and monitoring mechanisms and combinations where required
vi. Conduct Treatability studies (to assess biodegradability, interferences) and choose appropriate technology
vii. Mode of disposal, point of discharge
viii. Cost sharing/ Tariff mechanisms; and
ix. Institutional Mechanisms (Financial, Operational, Monitoring, etc.)

Detailed design allows a precise description of the building in advance. The quality of components can be described and proof during site supervision is possible. The same standard in different projects of the Authority allow cost savings in operation of maintenance, e.g. storage of spare parts. The detailed design is more time consuming because there is no overlap of the design and construction phases, however, cost-saving potential is high during the early design phases (see Figure 4-1).

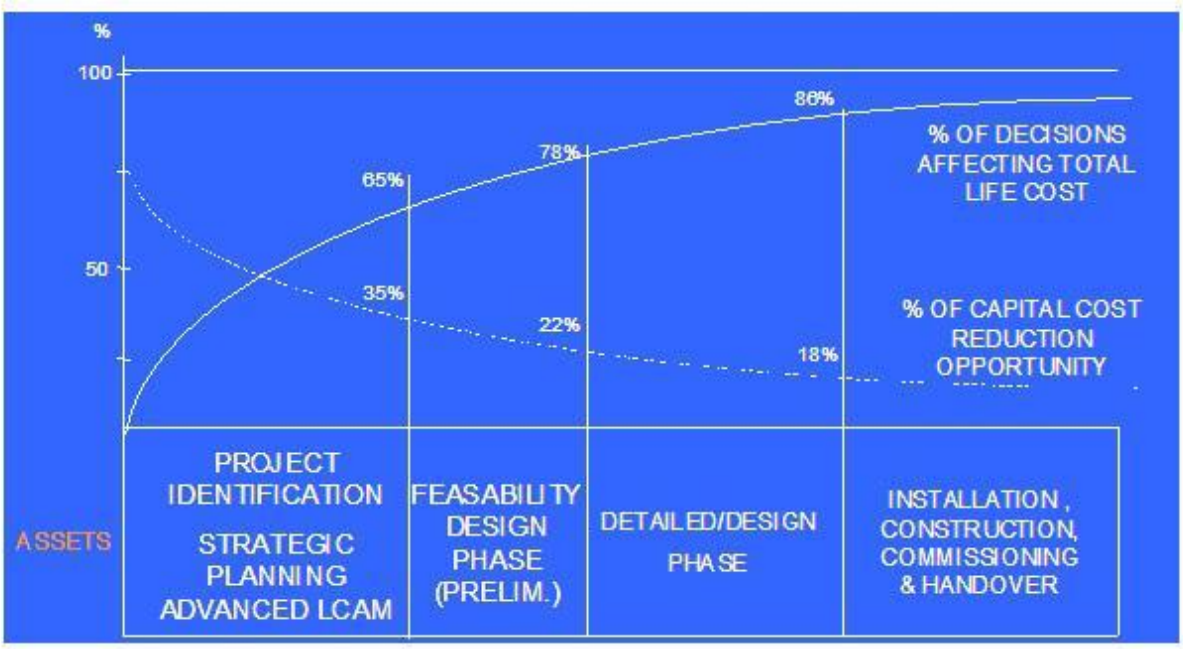


Table 4-1: Cost saving potential in planning process

The studies conducted during the planning phase or thereafter constitute the technical component of the bid document, which would be the basis for the potential bidders to respond effectively to the Request for Proposals. The Project Specific Conditions/ Particular Conditions should essentials be derived out of these studies.

4.2 Technical Requirements:

4.2.1 Assessment of capacity for CETP:

To assess the capacity requirements of the proposed CETP, the first step is to develop a detailed inventory of the member industries, nature of operations and likely constituents of the effluents. This process involves:

- identifying the potential users of CETP, their type and the number of industries in the geographic area
- identifying the type (organic/inorganic/toxic) and volume of wastewater likely to be generated (concentrated/dilute, etc.) and what the pattern of flow is (continuous/ batch)

- estimating future waste loads on the CETP – helps in designing the plant capacity on a modular basis
- identifying treatment options – examining the compatibility and identifying the treatment options

The inventorization process may be classified as dry and wet (involves sampling in brownfield projects). In the dry inventory process, information may be collected through questionnaire surveys with regards to raw materials used, intermediates and final products, water use profile, wastewater generation, likely characteristics, proposed pre-treatment etc. Based on the preliminary information gathered, the prospective member industries can be approached for further details, such as specific characteristics, specific/ typical waste streams (if any), volumes, frequency of discharges, product change patterns, etc. The effluent quantity/ hydraulic load can be assessed based on the details gathered, product details furnished by the individual industry with a comparison from literature values or from the water balance submitted by individual industries to SPCB in their consent application.

In the wet inventorization process, grab and composite samples of effluents are collected from the existing units and analysed to evaluate the pollution loads. This can also help to decide whether such streams should be segregated to an alternate/ specialized mode of conveyance and treatment, rather than being directly taken to the CETP, to optimize treatability and treatment costs.

Most of the CETPs, which are located in and around metros / cities, are availing sewage for either enhancing treatability. (Specifically facilitates in respect of COD and TDS). If the regulator (SPCB) approves this option then the CETP's capacity must also be increased in order to handle the additional hydraulic load contributed by the additional municipal sewage.

4.2.2 Wastewater Discharge Limits applicable:

4.2.2.1 Inlet Standards:

As vide Notification No. S.0.4 (E) dated 01.01.2016, the Ministry of Environment, Forest and Climate Change (MoEF&CC), Govt. of India has notified the treated effluent quality standards for Common Effluent Treatment Plants (CETP) and mandated that for each CETP, the State Pollution Control Board will prescribe Inlet quality standards for General Parameters, Ammoniacal Nitrogen and Heavy metals as per design of CETP and local needs and conditions for achieving of the same by constituent units discharging their effluent to CETP.

Copy of the Office Order dt. January 5, 2019; prescribing the Inlet Standards to the CETP as specified to the three CETPs in Uttarakhand by Uttarakhand Environment Protection & Pollution Control Board is attached as Annexure # 5-1. It may be noted that the inlet standards to different CETPs can vary as in this case.

4.2.2.2 Outlet Standards:

The Ministry of Environment, Forests & Climate Change (MoEF& CC) has notified the Treated Effluent Quality Standards for Common Effluent Treatment Plants (CETP) as part of Environment (Protection) Amendment Rules, 1986; vide its Gazette dated 1st January, 2016 (F.No.Q-15017/18/2014-CPW).

[Source: https://cpcb.nic.in/displaypdf.php?id=SW5kdXN0cnktU3BlY2lmaWMtU3RhbmRhcmRzL0VmZmx1ZW50L0NFVFAucGRm]

The Standards prescribed by the above referred notification are as follows:

S. No.	Industry	Parameter	Standards		
(1)	(2)	(3)	(4)		
"55.	Common Effluent Treatment Plants (CETP)				
	A. Inlet Quality Standards	For each CETP, the State Board will prescribe Inlet Quality Standards for General Parameters, Ammoniacal- Nitrogen and Heavy metals as per design of the CETP and local needs & conditions.			
	B: Treated Effluent Quality Standards		Max. permissible values (in milligram/ liter except for pH and Temperature)		
			Into inland surface water	On land for irrigation	Into sea
		General Parameters			
		pH	6 – 9	6 - 9	6 - 9
		Biological Oxygen Demand, BOD_3, 27° C	30	100	100
		Chemical Oxygen Demand (COD)	250	250	250
		Total Suspended Solids (TSS)	100	100	100
		Fixed Dissolved Solids (FDS)	2100	2100	NS*
		Specific parameters			
		Temperature, ° C	**Shall not exceed more than 5°C above ambient water temperature**	Shall not exceed more than 5°C above ambient water temperature	Shall not exceed more than 5°C above ambient water temperature
		Oil & Grease	**10**	10	10
		Ammoniacal Nitrogen	**50**	NS*	50
		Total Kjeldahl Nitrogen (TKN)	**50**	NS*	50
		Nitrate- Nitrogen	**10**	NS*	50
		Phosphates, as P	**5**	NS*	NS*
		Chlorides	**1000**	1000	NS*
		Sulphates, as SO4	**1000**	1000	NS*
		Fluoride	**2**	2	15

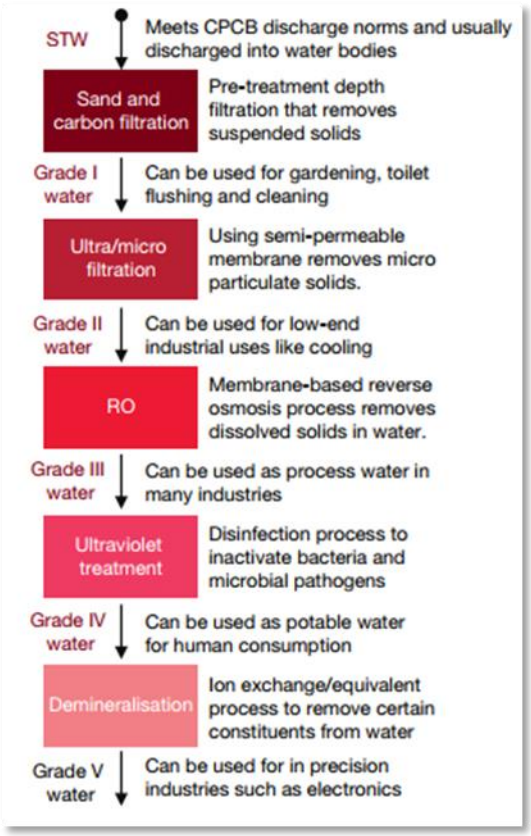
S. No.	Industry	Parameter	Standards		
(1)	(2)	(3)	(4)		
		Sulphides, as S	**2**	2	5
		Phenolic compounds (as C_6H_5OH)	**1**	1	5
		Total Res. Chlorine	**1**	1	1
		Zinc	**5**	15	15
		Iron	**3**	3	3
		Copper	**3**	3	3
		Trivalent Chromium	**2**	2	2
		Manganese	**2**	NS*	2
		Nickel	**3**	NS*	3
		Arsenic	**0.2**	NS*	0.2
		Cyanide, as CN	**0.2**	NS*	0.2
		Vanadium	**0.2**	NS*	0.2
		Lead	**0.1**	NS*	0.1
		Hexavalent Chromium	**0.1**	NS*	0.1
		Selenium	**0.05**	NS*	0.05
		Cadmium	**0.05**	NS*	0.05
		Mercury	**0.01**	NS*	0.01
		Bio-assay test	**As per industry-specific standards**	As per industry-specific standards	As per industry-specific standards
	*NS-Not specified **Notes:** 1. Discharge of treated effluent into the sea shall be through proper marine outfall. The existing shore discharges shall be converted to marine outfalls. In the cases where the marine outfall provides a minimum initial dilution of 150 times at the point of discharge and a minimum dilution of 1500 times at a point 100 m away from discharge point, then, the State Board may relax the Chemical Oxygen Demand (COD) limit:				

<table>
<tr><th>S. No.</th><th>Industry</th><th>Parameter</th><th>Standards</th></tr>
<tr><td>(1)</td><td>(2)</td><td>(3)</td><td>(4)</td></tr>
<tr><td></td><td colspan="3">Provided that the maximum permissible value for Chemical Oxygen Demand (COD) in treated, effluent shall be 500 milligram/liter.
2. Maximum permissible Fixed Dissolved Solids (FDS) contribution by constituent units of a Common Effluent Treatment Plant (CETP) shall be 1000 milligram/liter. In cases where Fixed Dissolved Solids (FDS) concentration in raw water used by the constituent units is already high (i.e. it is more than 1100 milligram/liter) then the maximum permissible value for Fixed Dissolved Solids (FDS) in treated effluent shall be accordingly modified by the State Board.
3. In case of discharge of treated effluent on land for irrigation, the impact on soil and groundwater quality shall be monitored twice a year (pre- and post-monsoon) by Common Effluent Treatment Plants (CETP) management. For combined discharge of treated effluent and sewage on land for irrigation, the mixing ratio with sewage shall be prescribed by State Board.</td></tr>
<tr><td></td><td colspan="3">4. Specific parameters for some important sectors, selected from sector-specific standards</td></tr>
<tr><td></td><td>Sector</td><td colspan="2">Specific Parameters</td></tr>
<tr><td></td><td>Textile</td><td colspan="2">Bio-assay test, Total Chromium, Sulphide, Phenolic compounds</td></tr>
<tr><td></td><td>Electroplating Industries</td><td colspan="2">Oil & Grease, Ammonia-Nitrogen, Nickel, Hexavalent Chromium, Total Chromium, Copper, Zinc, Lead, Iron, Cadmium, Cyanide, Fluorides, Sulphides, Phosphates, Sulphates,</td></tr>
<tr><td></td><td>Tanneries</td><td colspan="2">Sulphides, Total Chromium, Oil & Grease, Chlorides</td></tr>
<tr><td></td><td>Dye & Dye Intermediate</td><td colspan="2">Oil & Grease, Phenolic compounds, Cadmium, Copper, Manganese, Lead, Mercury, Nickel, Zinc, Hexavalent Chromium, Total Chromium, Bio-assay test, Chlorides, Sulphates,</td></tr>
<tr><td></td><td>Organic chemicals manufacturing industry</td><td colspan="2">Oil & Grease, Bio-assay test, Nitrates, Arsenic, Hexavalent Chromium, Total Chromium, Lead, Cyanide, Zinc, Mercury, Copper, Nickel, Phenolic compounds, Sulphides</td></tr>
<tr><td></td><td>Pharmaceutical industry</td><td colspan="2">Oil & Grease, Bio-assay test, Mercury, Arsenic, Hexavalent Chromium, Lead, Cyanide, Phenolic compounds, Sulphides, Phosphates."</td></tr>
</table>

4.2.3 Recycle/ Reuse aspects of Treated Wastewater

"In a world where demands for freshwater are continuously growing, and where limited water resources are increasingly stressed by over-abstraction, pollution and climate change, neglecting the opportunities arising from improved wastewater management is nothing less than unthinkable in the context of a circular economy."
***UN World Water Development Report** (WWAP 2017)*

Traditionally[1], treatment focused on removing contaminants and pathogens to recover water and safely discharge it into the environment. Today, treatment plants should be viewed as water resource recovery facilities that recover elements of the wastewater for beneficial purposes: water (for agriculture, the environment, industry, and even human consumption), nutrients (nitrogen and phosphorus), and energy.



[2]Wastewater can be treated to various qualities/ grades as per the demand of the buyers/ stakeholders, ranging from industry to agriculture. It may also be used to maintain the environmental flow and can even be reused as drinking water. Wastewater treatment for reuse is one solution to the world's water scarcity problem, freeing scarce freshwater resources for other uses, or for preservation. Further, by-products of wastewater treatment can become valuable for agriculture and energy generation, making wastewater treatment plants more environmentally and financially sustainable. Hence, advanced wastewater management can become a value proposition in terms of financial returns that can cover operation and maintenance costs partially or fully, apart from the environmental and health benefits of wastewater treatment. Resource recovery from wastewater facilities in the form of energy, reusable water, biosolids, and other resources, such as nutrients, represents an economic and financial benefit that contributes to the sustainability of water supply and sanitation systems and the water utilities operating them.

Currently, there is limited demand / uptake of water reuse solutions in spite of the huge potential, which remains untapped. The Communique 'Closing the loop – An EU3 action plan for the Circular Economy' (COM/2015/614) and the Inception Impact Assessment of the EU, has identified agricultural irrigation and aquifer recharge as the high potential avenues for reclaimed water utilization; in the context of both water scarcity alleviation and EU relevance. However, to foster development of safe reuse of treated wastewater, the EU is

1 "Rodriguez, Diego J.; Serrano, Hector A.; Delgado, Anna; Nolasco, Daniel; Saltiel, Gustavo. 2020. From Waste to Resource: Shifting paradigms for smarter wastewater interventions in Latin America and the Caribbean." World Bank, Washington, DC.
2 Image Source: https://www.pwc.in/assets/pdfs/publications/2016/pwc-closing-the-water-loop-reuse-of-treated-wastewater-in-urban-india.pdf
3 L. Alcalde-Sanz, B. M. Gawlik, Minimum quality requirements for water reuse in agricultural irrigation and aquifer recharge - Towards a water reuse regulatory instrument at EU level, EUR 28962 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN 978-92-79-77176-7, doi 10.2760/887727, PUBSY No.109291

developing a Legal Instrument on 'Minimum quality requirements for water reuse' at EU level for two specific uses, agricultural irrigation and aquifer recharge.

4.2.3.1 Zero Liquid Discharge (ZLD):

The term Zero Liquid Discharge in the context of wastewater management means that there is discharge of wastewater from Industries into the environment. A ZLD system involves a range of advanced wastewater treatment technologies to recycle, recover and re-use the 'treated' wastewater and thereby ensure there is no discharge of wastewater.

A typical ZLD system comprises of the following components:

- Pre-treatment (Physico-chemical & Biological)
- Reverse Osmosis (Membrane Processes)
- Evaporator & Crystallizer (Thermal Processes)

It was noted that adopting ZLD practices may not be feasible in many cases because of various techno-economic reasons. Hence, the industries should still be encouraged to recycle and reuse wastewater as far as practicable, in order to minimize the fresh water consumption and the discharge of wastewater into the environment.

The treated wastewater of an industry may also be utilised for irrigation. This type of utilisation/application is considered an efficient approach for managing/conserving water resources and for compensating water shortages caused by seasonality or the irregular availability of water sources for irrigation throughout the year.

However, the possible risks of wastewater usage in agriculture may range from changes to physico-chemical and microbiological properties of soils to impacts on human health. In unfavourable economic conditions, the search for alternative irrigation sources, such as the use of untreated or inadequately treated wastewater may result in risk factors. Thus, it is necessary to ensure the beneficial aspects of this practice before application of treated wastewater in irrigation.

Hence, the Central Pollution Control Board constituted an Expert Group, comprising of members from the Indian Institute of Technology (IIT), National Environmental Engineering Research Institute (NEERI) and Central Pollution Control Board (CPCB); to lay down guidelines as directed by the Hon'ble National Green Tribunal (NGT). The "Guidelines for Utilisation of Treated Effluent in Irrigation" was then issued to all State Pollution Control Boards by CPCB vide its letter No. CPCB/IPC-I V/G L/Irrigation/ 2019-20/ dt. October 4, 2019.

4.2.4 TREATMENT TECHNOLOGIES:

This section details the requirements of the Pre-Treatment requirements at the industrial unit level, prior to discharge to the conveyance system of the CETP and subsequently it describes the various processes and technologies involved at various stages of effluent treatment in a CETP.

4.2.4.1 Pre-treatment requirements:

Pre-treatment standards: Effluents from industrial processes require some form of pre-treatment prior to sending the effluents to the CETP for further treatment. This is mainly required to minimize corrosion, clogging, and degradation of biodegradable organics in the conveyance systems thereby reducing maintenance costs and ensuring extended life of the gravity based effluent conveyance systems. The Honourable Supreme Court of India vide its judgement has mandated installation of Primary Effluent Treatment Plant (PETP) in all industrial units connected to a CETP.

Pre-treatment standards for sulphides, sulphates and pH are concerned with preventing corrosion of concrete parts in gravity pipes and the anaerobic conditions leading to the formation of hydrogen sulphide, which can lead to fire accidents. Limits for the discharge of oil, grease, grit and heavy

sediments are prescribed in order to prevent the clogging of pipelines. Limits to heavy metals and toxic organics ensure proper performance of biological treatment and minimize accumulation of contaminants in residual sludge.

4.2.4.2 Technology Selection:

Treatability studies are conducted to aid in characterizing the physical, chemical and biological nature of the liquid waste streams of interest and to devise effective and economical ways to treat and manage such wastewater in order to meet the regulatory criteria for safe disposal and for reuse.

Design of the actual treatment system for a CETP involves the selection of alternative processes based on the requirement / ability of individual treatment processes to remove specific waste constituents. Various technologies available for the treatment of industrial wastewater are given in the following table below.

4.2.5 Laboratory facilities:

Accurate and reliable testing of raw, process and treated wastewater is a fundamental requirement to ensure efficient operation of a wastewater treatment facility.

Process monitoring is required in wastewater treatment plants to ensure appropriate corrective measures are taken well in time to ensure effective treatment of the effluents as well as to protect the system from collapse. The odds in case of a CETP is quite high as the cascading effect of failure of a CETP is borne by all member units connected to unit and can result huge production losses and associated economic losses. Moreover, the laboratory in CETP also has to be well equipped to expeditiously check the samples drawn from the industries as part of the surveillance activities. Commercial billing to members, especially penalties imposed on violations must be supported by reliable inputs from the CETP's laboratory.

4.2.6 Online Continuous Effluent Monitoring Systems:

The CETPs are expected to install online continuous effluent monitoring systems at the inlet and outlet of the CETP to measure flow and parameters, as specified by the SPCB/ CPCB. The data from the sensors needs to be transferred directly to the servers at CPCB and concerned SPCB for continuous online monitoring of the CETP performance.

4.2.7 Sludge Management:

Owing to its constituents, primary sludge generally attracts provisions under Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016. The secondary sludge from biological treatment predominantly contains nutrients. However, it can be utilized for agricultural use only when it is free from hazardous constituents or more specifically once the concentrations of the constituents are within the acceptable range. In such case, the secondary sludge may be used, for example, as manure, especially for dry land or forest disposal at controlled rates. This need to be studied on a case-to-case basis and with due permission from the concerned regulatory authorities.

Both primary and secondary sludge will have to be dewatered to reduce the amount of sludge and to maintain consistency of not less than 20% solids. Energy efficient equipment, such as a screw press can be used for dewatering and solar sludge drying units. The figures show the Sludge Drying unit based on Solar Thermal based and Waste Heat Recovery respectively installed at a CETP in Surat, India.

Figure 4-1: Solar Thermal Sludge Drying unit in Surat, India

Any sludge suspected of containing hazardous material should be disposed of in proper TSDF, after required analysis. If so required, the hazardous sludge may need to be stabilized prior to land disposal. However, resource recovery options or co-incineration in cement kilns maybe explored in consultation and written consent of the SPCB.

4.2.8 Requirements of Skilled Personnel/ Technicians:

For effective and efficient operation and maintenance of the CETPs, sufficient number of appropriately skilled persons should be deployed in the plant. The number and skillset requirements would depend on the size, scale and complexity of the CETP operations. Generally, the same team monitors the conveyance network and the discharge flowing from individual units. In such cases, there should be

sufficient field team equipped and empowered for field monitoring and vigilance against any encroachment on unauthorized activities/ vandalizing, etc.

Well-equipped laboratory and laboratory technicians' staff are also part of the key Skilled Personnel required.

Skill Council of Green Jobs (SCGJ), Ministry of Skill Development & Entrepreneurship, Govt. of India has Certification programs for Wastewater Treatment Plant Operator/ Technician (Qualification Pack # SGJ/Q6601) and Wastewater Treatment Plant Helper level (Qualification Pack # SGJ/Q6602) personnel and have several reskilling initiatives. It is recommended to ensure Skilled and certified personnel are deployed at least in a phased manner in the existing CETPs, while the upcoming ones may preferably deploy only certified skilled professionals and undertake annual reskilling/ skill upgradation initiatives.

5 TENDERING AND BID PROCESS MANAGEMENT

The Government of India (GoI) has issued new instructions in the domain of public procurement. Some of these important changes include the introduction of Central Public Procurement Portal (CPPP), preference for domestic contractors, inclusion of integrity pact, etc. The General Finance Rules (GFR) have been revised comprehensively in March 2017, covering inter-alia these set of new instructions. The new Manual on Procurement of Works 2019 has been extensively revised in keeping with GFR 2017 and in consonance with the fundamental principles of transparency, fairness, competition, economy, efficiency and accountability. The Manual on Procurement of Works 2019 is more relevant to CETP and related Works may be accessed from the link below.
https://doe.gov.in/sites/default/files/Manual%20for%20Procurement%20of%20works%202019.pdf

The Manuals issued by the Department of Expenditure, Ministry of Finance, GoI are to be taken as generic guidelines, which are necessarily broad in nature. Ministries and Departments are advised to supplement this manual to suit their local/ specialized needs, by issuing their own detailed manuals (including customized formats), Standard Bidding Documents and Schedule of Procurement Powers to serve as detailed instructions for their own procuring officers.

The Ministry of Finance has published standardized bidding documents, which include Model Request for Qualification (RFQ) for Pre-Qualification of Bidders for PPP Projects, Model Request for Proposal (RFP) for invitation of Financial Bids for PPP Projects and also a Model RFP for engaging financial consultants and technical advisers for PPP Projects.

Standardized contractual documents such as sector specific Model Concession Agreements, which lay down the standard terms relating to allocation of risks, contingent liabilities and guarantees as well as service quality and performance standards have also been developed by various Central Ministries such as the Ministry of Road Transport and Highways, Ministry of Shipping, etc. These standardized bidding and contractual documents which are being adopted by project implementation agencies for developing PPP infrastructure projects in sectors such as ports, roads, airports, food storage (silos), water supply, etc. Toolkits and Resource materials on PPP projects may be accessed from https://www.pppinindia.gov.in/. The Process map for Procurement for projects undertaken in Public Private Partnership (PPP) mode is attached at Annexure 5-1.

5.1 BIDDING PROCESS

The international competitive bidding (ICB) process includes six main phases: (i) advertisement and notification, (ii) preparing and issuing the Bidding Document, (iii) bid preparation and submission, (iv) bid opening, (v) bid evaluation, and (vi) contract award.

5.1.1 ADVERTISEMENT AND NOTIFICATION

Invitation for Bids (IFB) shall be advertised on the Authorities' website as well as in (i) a newspaper of general circulation in the borrower's country (in at least one English language newspaper if available), or (ii) an internationally known and freely accessible website in English.

For large or specialized contracts, Authority may additionally require that the IFB be advertised in well-known technical magazines or trade publications, or in newspapers of wide international circulation, in sufficient time to enable prospective Bidders to prepare and submit Bids.

5.1.2 PREPARING AND ISSUING A BIDDING DOCUMENT

The Employer is responsible for preparing and issuing the Bidding Document for a specific contract.

The Bidding Document shall be prepared by the Employer based on the appropriate SBD issued by the Authority.

The Employer shall prepare the Bidding Document using the published version of the SBD without suppressing or adding text to the sections of the document that must be used without modification, which are Section 1 (Instructions to Bidders) and Section 7 (General Conditions of Contract).

All information and data particular to each individual bidding process must be provided by the Employer in the following sections of the Bidding Document:

- Section 2 Bid Data Sheet
- Section 3 Evaluation and Qualification Criteria
- Section 4 Bidding Forms
- Section 5 Eligible Countries
- Section 6 Employer's Requirements
- Section 8 Particular Conditions of Contract
- Section 9 Contract Forms

The following directions should be observed by the Employer when finalizing the Bidding Document:

- In preparing the Bidding Document, the Employer should refer to this User's Guide to Procurement of Works as it contains guidance and instructions for the Employer.
- Specific details, such as name of the Employer, address for bid submissions, qualification requirements, etc. should be provided in the spaces indicated by italicized notes in brackets.
- The "italicized notes," giving guidance and instructions for the Employer, except those that apply to forms to be filled out by Bidders or instructions to Bidders, should be deleted from the actual Bidding Document.
- Where alternative clauses or text are shown, the Employer shall select the most appropriate for the particular works and discard the unused clauses or text.
- The Employer shall allow Bidders sufficient time (generally, not less than 6 weeks from the issuance or publication date of the Invitation for Bids or the date of availability of Bidding Documents, whichever is later), to study the Bidding Document, prepare complete and responsive Bids, and submit their Bids.

The Contents of Standard Bid Document (SBD) for Procurement of Works with brief explanation of each section is attached as Annexure 6-2.

5.1.3 Bid Preparation and Submission

The Bidder is solely responsible for the preparation and submission of its Bid. During this stage, the Employer shall

- promptly respond to requests for clarifications from Bidders and amend the Bidding Document as needed; and
- amend the Bidding Document only with prior approval of financial institution if any involved.

5.1.4 Bid Opening

The Employer is responsible for the Bid Opening, which is a critical event in the bidding process. The Employer shall appoint experienced staff to conduct the Bid Opening, as inappropriate procedures at Bid Opening are usually irreversible and may require cancellation of the bidding process with consequent delays and waste of resources.

The Employer, in observance of best practices, shall perform the following checks:

- Conduct the Bid Opening strictly following the procedures as specified in the Instructions to Bidders for all Bids received no later than the date and time of the bid submission deadline. The term "Bid Opening" should be understood in the context of the ITB because, as provided in the ITB, a Bid for which a Bid Withdrawal or Bid

Substitution notice was received on time shall not be opened, but returned unopened to the Bidder. The sequence in which Bids are handled, opened, and recorded is crucial.

- Ensure that all Bids that were received on time are accounted for, before starting the Bid Opening, as Bids that are not opened and read out at Bid Opening shall not be considered further.
- Not reject any Bid at Bid Opening, except for late bids received after the date and time of the bid submission deadline. Technically, late bids should not reach the Bid Opening, but in certain cases, a Bidder may attempt to submit its bid at the Bid Opening place after the deadline. This late bid shall also not be considered.
- Examine the Bids at Bid Opening in accordance with the provisions of the Instructions to Bidders. The Employer shall, however, verify at Bid Opening the validity of the documentation such as Power of Attorney or other acceptable equivalent document as specified in the Instructions to Bidders, confirming the validity of a bid modification, bid withdrawal, or bid substitution, because a withdrawn or substituted Bid shall not be opened and consequently not read out and, therefore, shall not be considered by the Employer. Similarly, a bid modification shall be opened, read out, and recorded to modify a Bid that was received on time.

5.1.5 Bid Evaluation and Contract Award

The Employer is responsible for bid evaluation and contract award. The Employer shall appoint experienced staff to conduct the evaluation of the Bids. Mistakes committed at bid evaluation may later prompt complaints from Bidders, requiring re-evaluation of the Bids, with consequent delays and waste of resources.

The Employer, in observance of best practices, shall

- keep the bid evaluation process strictly confidential;
- reject any attempts or pressures to distort the outcome of the evaluation, including fraud and corruption; and
- strictly apply only and all the evaluation and qualification criteria specified in the Bidding Document.

5.2 FIDIC CONTRACTS

The projects financed by multilateral and bilateral development financial institutions like World Bank and KfW use International Federation of Consulting Engineers' (FIDIC) Contracts as the base document, in their procurement process. FIDIC publishes General Conditions (GCs) of Contract that are widely used for international construction contracts. They are intended to be used in any jurisdiction. FIDIC, provides fair, balanced and well-recognised forms of construction and engineering contract and agreement forms.

FIDIC GCs are based on fair and balanced risk/reward allocation between the Employer and the Contractor and are widely recognised as striking an appropriate balance between the reasonable expectations of these contracting Parties. Hence, FIDIC Contracts are perceived to provide commercial value to both the Employer and the Contractor, both at the tendering stage, and during execution of the Contract. GCs are prepared for use in a wide range of projects and jurisdictions inevitably require supplementing with PCs that address the requirements of the Site location, the unique features of the specific project and (usually) the Employer's preferences.

Selecting Appropriate FIDIC Contract Documents: The main conditions of contract in the suite (across the different books) contains a core of common conditions with little significant difference between them. The FIDIC suite[4] of contracts now covers a wide range of projects and methods of procurement.

(i) **Engineering Works Contract**: The Red Book is applied for a building or engineering works contract based on a detailed design by the contracting authority, and the tender documents will include precise specifications of the different project components, and there will be limited possibilities for the tenderers to offer other solutions. Therefore, the use of GPP award criteria in this phase of the project implementation should be limited.

(ii) **Design & Build Type:** When construction works may include elements of contractor-designed civil, mechanical, electrical and/or construction works, the tenders are typically based on the contract form Yellow Book (design and build). For this form of contract, the contracting authority typically prepares a conceptual design defining the main wastewater treatment technologies and design parameters, which provides a high degree of control and the possibility for clear GPP criteria. If the project is tendered based on a design-build contract, it will be more open for the tenderer to offer innovative solutions, and the weights of GPP award criteria should be higher, and technical specifications setting minimum requirements for the design will play a role as well.

(iii) **Engineering, Procurement & Construction (EPC turnkey projects):** The Silver Book is applied for establishing projects on an engineering, procurement and construction basis (EPC turnkey projects) with the Contractor assuming total responsibility for the design including choice of technology and execution of the project until handing over to the contracting authority. While the contracting authority has little influence on the design of the plant, it is still able to set clear GPP criteria to be fulfilled by the contractor. Operation of the works constructed is either an integrated part or a separate contract of the turnkey project when operation is shorter than say 5 years.

(iv) **Design, Build and Operate Contract**: For long-term GPP Criteria for Waste Water Infrastructure operation, the **Golden Book** (design, build and operate) contract form can be utilised, where the operation period is typically not less than 20 years.

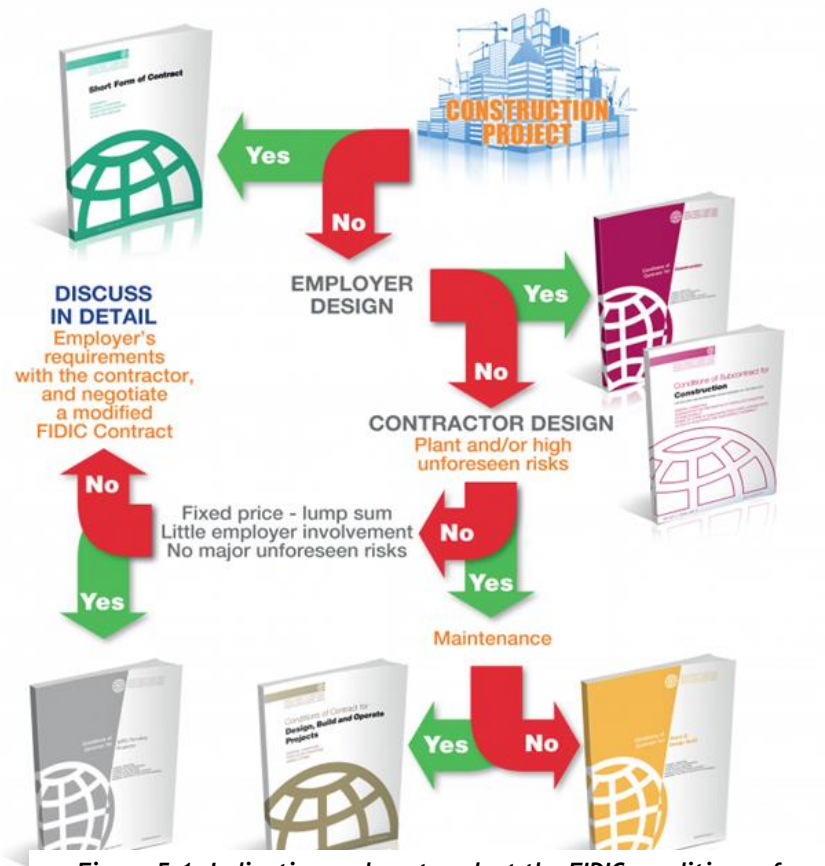


Figure 5-1: Indication on how to select the FIDIC conditions of contract based on the project

[4] https://fidic.org/sites/default/files/FIDIC_Suite_of_Contracts_0.pdf

Depending on the choice of contract used for a specific project, the need for and comprehensiveness of life cycle costing will differ.

5.3 GREEN PROCUREMENT:

The European Commission has developed Green Public Procurement (GPP) criteria, recommended for the procurement of wastewater infrastructure projects. The details of which may be referred at (https://ec.europa.eu/environment/gpp/pdf/waste_water_criteria.pdf).

The use of GPP criteria should be seen as an opportunity for wastewater managing authorities to build and operate wastewater infrastructures in an environmentally friendly manner. The criteria are divided into criteria for the consultancy service contract and construction contracts covering design, construction and operation, separately or together, depending on the type of contract as indicated below:

- ✓ GPP criteria for consultancy services (consultancy service contract)
- ✓ GPP criteria for design, construction and operation, separately or together (construction contract)
- ✓ Energy performance requirements
- ✓ Water consumption
- ✓ Waste water treatment efficiencies
- ✓ Treatment efficiency for flue gas treatment
- ✓ Contract performance clauses.

It may be noted that in case of building or engineering works contract based on a detailed design by the contracting authority, the tender documents will include precise specifications of the different project components, and there will be limited possibilities for the tenderers to offer other solutions. Hence, the use of GPP award criteria in this phase of the project implementation would be limited.

When construction works may include elements of contractor-designed civil, mechanical, electrical and/ or construction works [design and build]; the contracting authority typically prepares a conceptual design defining the main wastewater treatment technologies and design parameters, which provides a high degree of control and the possibility for clear GPP criteria. Hence, if the project is tendered based on a design-build contract, it will be more open for the tenderer to offer innovative solutions, and the weights of GPP award criteria should be higher, and technical specifications setting minimum requirements for the design will play a role as well.

In case of an engineering, procurement and construction (EPC turnkey projects) with the Contractor assuming total responsibility for the design including choice of technology and execution of the project until handing over to the contracting authority; the contracting authority has little influence on the design of the plant. However, the authority will still be able to set clear GPP criteria to be fulfilled by the contractor.

Depending on the choice of contract used for a specific project, the need for and comprehensiveness of life cycle costing will differ. The decision whether to use core or comprehensive environmental GPP criteria and whether to conduct Life Cycle Assessments and/or Life Cycle Cost analysis are illustrated in the decision tree are attached as Annexure # 6-5.

The environmental performance requirements will, for the purpose of precision, normally be spelled out in annexes to the contract. Best practices are reflected in the FIDIC standard contracts in the Red and Silver Book standard contracts

6 INSTITUTIONAL MECHANISMS

Proper Institutional Mechanisms are to be in place to ensure the infrastructure established is effectively and sustainably managed. Most often CETPs are managed as a Co-operative with the Industry Association taking the initiative to form the SPV and administer the Operations & Maintenance of the CETP in the interest of its Members. This would essentially require the SPV to actively engage with the Stakeholders, particularly the Member Industries, SIDC, SPCB, District Administration representatives, Bankers, etc.

SPV must also form Core Committees to administer and manage specific tasks like

- Administration
- Finance & Tariff Review
- Monitoring, Surveillance & Enforcement
- Environment, Safety, Health & Regulatory.

The cost-effective treatment must be supported with a system of regular collection / payment of treatment charges by each member unit, while maintaining its effluent quality within acceptable norms are some of the prerequisites. The system of payment should be legally supported to provide a check for non-payment of dues and to take actions against defaulters.

6.1 GUIDELINES FOR CETP STAKEHOLDER ENGAGEMENT:

The guidelines[5] for the key stakeholders of CETPs, which is implemented in Rajasthan under the initiative of Rajasthan State Pollution Control Board. Viz.

- Guidelines on Institutional Role & Responsibility of Industrial Park Owner (SPV) for overseeing the functions of CETP Operations,
- Guidelines for Selection of O&M Agency for Operations & Maintenance of CETPs
- Guidelines for the Member Units of the SPV

These guidelines are detailed in the sub-sections below. However, it is advised to use due discretion and the CETP management may work out the details as per customized needs of the CETP.

6.1.1 GUIDELINES ON INSTITUTIONAL ROLE & RESPONSIBILITY OF INDUSTRIAL PARK OWNER (SPV) FOR OVERSEEING THE FUNCTIONS OF CETP OPERATIONS

1. CETP shall be professionally managed only through the Special Purpose Vehicle (SPV) formed under the Companies Act, 2013 as amended from time to time in the form of a Public Limited Company and shall follow all applicable laws under the Companies Act, 2013. The CETPs which are presently being operated by entities other than SPVs will form SPV within a period of 3 months failing which the consent granted to the CETPs under Water (Prevention & Control of Pollution) Act,1974 and Air (Prevention & Control of Pollution) Act,1981 will be revoked or consent applications under process will be refused by SPCB.
2. The SPV so formed shall have two government representatives on the Board of Directors / Management, preferably one nominated by SIDC and other by the District Collector.

5 http://environment.rajasthan.gov.in/content/dam/environment/RPCB/Guidelines/For%20CETP%20Trust.pdf

3. The CETP will be operated through a professionally qualified O&M agency only as defined in Part-A of the guidelines and the agency will be made responsible for proper operation and maintenance of the CETP.

4. A corpus fund of a minimum of 4 months O&M expenditure (based upon present estimate of O&M cost) shall be maintained by the SPV in its bank account at all times. Additionally, the SPV will provide a two-month equivalent of O&M expenditure as revolving Bank Guarantee at the beginning of the contract, which will remain valid until the end of the contract period to O&M agency as assurance of timely payment for ensuring un-interrupted operations of the CETP.

5. SPV will distribute the total available CETP treatment capacity among the member units in a rational and transparent manner. Also, in case there is a need to redistribute/reallocate discharge among the existing member units, the same will be done in a completely transparent and logical manner on first-come first-serve basis after obtaining due approval from the general body as per the business practices incorporated in the Companies Act, 2013 as amended from time to time.

6. The user charges to be levied on the member units will be based on pollution load/wastewater quantity being discharged by each member unit.

7. Membership to the SPV will be limited to the industrial units established in the industrial estate. The member units will need to have valid document issued by SIDC/ industrial estate developer.

8. The SPV will lay down its own POLICY in line with quality system documentation and maintain relevant records. The policy documented by SPV will also include that the member industry should be established only after following due procedure of law regarding registration, allotment of land and other permission/consent from competent authority. SPV will not provide membership to any unit, which has been established and operated in violation of the due process of law.

9. Cancellation of the Membership of individual unit with CETP will be effected immediately by SPV, if:- Any violation of the guidelines is observed on the part of member units

   a. Any default in regular payment of CETP user charges is observed

   b. Primary Treatment Plant installed is not operated or the inlet quality standards of CETP are not complied with

   c. Effluent discharge quantity is found to be exceeding the consented capacity or the guidelines issued by SPCB from time to time

   d. Any quality deviance from the outlet norms permitted by SPCB is observed

   e. Flow Meter to measure effluent quantity is not installed and maintained as prescribed, and/or not maintaining record / not maintaining on line arrangements for data capturing as prescribed

   f. Having more than one discharge point, beside the single point connected to the closed conduit pipeline

   g. Non-compliance of any additional instructions in force is observed at any time

10. SPV shall submit status of non-complying units and action taken against them on monthly basis to the SPCB with recommendation for revocation/refusal of the consent and issuance of closure directions against the defaulting unit.

11. The SPV will ensure that the quantity of wastewater received at the CETP never exceeds

the designed capacity of the CETP so that at no point of time, untreated wastewater is discharged bypassing the CETP. A scientific mechanism shall also be developed by the SPV to monitor quantity of effluent being discharged by the member units.

12. SPV will install and maintain online monitoring system for online monitoring of treated effluent quality at outlet of CETP and real time online IT based linkage shall be provided to the SPCB.

13. SPV will grant membership to the new industries or permission for increase in wastewater quantity to be discharged in CETP only when adequate hydraulic treatment capacity is available with the CETP concerned and the CETP is able to comply with the prescribed effluent standards. However, this may be allowed after obtaining prior approval of the District Monitoring Committee and shall be in line with the Consent issued to the member industries by SPCB.

14. The raw effluent from all the member units should be conveyed to the CETP through closed conduit pipelines only. SPV will be responsible for laying closed conduit pipelines in the industrial areas in a time bound manner at its own cost. However, this condition will not restrict the SPV from obtaining financial assistance or funding from the Industrial Area Development Authority or under any other Government Scheme. In the industrial areas where closed conduit pipelines are yet to be laid, the concerned SPV will submit a detailed Project Report along with time bound action plan within a period of six months.

15. The SPV will carry out annual third-party Environmental Audit right from the commissioning stage of CETP from a MoEF&CC recognized consultant/SPCB approved consultants. The environmental audit report shall be submitted to SPCB within 90 days from end of financial year with factual documentation of the quality improvements achieved.

16. An agreement between the SPV and its member units clearly delineating their relationship and mutual obligations should be executed. The cost recovery formula developed for the smooth operations and maintenance of the CETP should be ratified by all members of the general body as per the business practices and shall be in accordance with the Companies Act, 2013 as amended from time to time.

17. Power back up arrangement in the form of D.G. sets of adequate capacity should be installed by the SPV to ensure continuous operation of CETPs even during power failure. Further, the SPV will strive for utilization of green energy for meeting the power requirement of the CETP.

18. The SPV will strive to arrange for recycling of the treated effluent by installing R.O. plant. Accordingly, all the existing CETPs that do not have arrangements for recycling of the effluents, will submit an action plan to SPCB within a period of six months for installation of R.O. and treatment of R.O. reject. Such an action plan shall include proposals for recycling and reuse of treated effluent back in the original process leading to Zero Liquid Discharge (ZLD).

19. The SPV will obtain authorization as per provisions of the Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016. Further, the sludge generated at the CETP will be stored in covered sheds as per the prescribed guidelines and should be preferably co-incinerated in cement kilns.

20. That the SPV will be responsible for carrying regular surface water and ground water quality monitoring of the receiving water and ground water along its reaches, covering all the parameters prescribed in the Stream Standards at least once a year. Such analysis report(s) will form part of Environmental Audit being conducted annually.

21. The Monitoring Committee headed by the District Collector will be responsible for overall supervision of operation and maintenance of all the CETPs in the district including CETPs established/being established in the industrial estates or being established by the private industrial estate developers.

6.1.2 Guidelines for Selection of O&M Agency for Operations & Maintenance of CETPs

1. CETP should be operated and maintained by a professional agency having minimum 5 years of experience in operation and maintenance of similar type of CETPs. Average turnover of the agency for past three years should be equal to bid estimated cost.
2. The O&M agency will be responsible for entire operation & maintenance of CETP including purchase of chemicals, engagement of manpower, payment of power bills, disposal of hazardous waste etc. and SPV will have no direct involvement in day-to-day functioning of CETP.
3. The O & M agency will be responsible for minor maintenance of all nature including civil, electrical, mechanical etc. to a maximum specified amount as decided by SPV. However, all the major repairs, replacement of equipment etc. over and above the specified amount will be arranged by SPV.
4. Selection of the O & M agency should be done by inviting tenders online through double envelope system in a completely transparent manner. While inviting bids, 70% weightage should be given to technical criteria and rest 30% to the price quoted. The tender document shall be finalized in consultation with SPCB. The tendering process should be carried out by SPV under the supervision of CETP District Monitoring Committee headed by District Collector. SPCB will develop a model bid document, which will be used by all SPVs for inviting tenders.
5. The O&M Agency should have technically qualified personnel and expertise on wastewater management. Further, laboratory facilities need to be established on site by the SPV or by the agency responsible for O&M of the CETP at least for the routine parameters.
6. The O&M Agency shall monitor specified quality outlet parameters and flow rate on daily basis and submit the monitoring data to the SPCB on regular basis through SPV. Parameters to be specified by SPCB shall be monitored by the O&M Agency online at outlet of CETP and real time online IT based linkage shall be provided by SPV to enable the O&M agency to carry out regular online and real time data transmission to the SPCB. The O & M agency will be responsible for regular calibration and maintenance of the online monitoring equipment and data transmission equipment and its connectivity.
7. SPV with prior intimation to the SPCB shall be entitled for removal of the O & M agency in case of violation of the prescribed standards or the conditions of consent or non-compliance of any other directions issued by the SPCB. SPCB can also issue directions to the SPV to terminate the contract with the O & M Agency in case it is found violating the prescribed standards or the conditions of consent or non-compliance of any other directions issued by SPCB.

6.1.3 Guidelines for the Member Units of the SPV:

1. The membership of the CETPs will normally be reserved for units discharging effluents less than 200 KLD unless specified by SPCB for the concerned CETP.
2. The industry should be established only after following due procedure of law regarding registration, allotment of land and other permission/consent from competent authority.

3. Industry should obtain membership of the SPV with allowed quantity of effluent discharge in the CETP. In no case, the effluent discharged in the CETP by the member unit will exceed the allowed discharge by the SPV without its prior approval.
4. Adequately designed primary treatment facility to achieve standards prescribed for inlet of CETP should be installed. Industries without installing adequate primary treatment facilities will not be given membership or connectivity with the CETP.
5. A good quality water meter (tamper proof) should be installed at the outlet of the primary treatment facility. Industries having effluent generation less than 10 KLD may install a mechanical water meter, however, the industries having effluent generation equal to or more than 10 KLD needs to install electronic water meter.
6. Industry should have only one outlet for discharge of effluent to a closed conduit pipeline leading to CETP.
7. Good housekeeping shall be maintained by keeping check on leaking valves, cracks and fissures in pipes, faulty equipment etc. to avoid wastage of water and other raw materials/resources.
8. That every industry will make adequate arrangement for storage and disposal of the hazardous waste generated from the primary treatment and will obtain authorization as per the provisions of Hazardous and Other Wastes (Management & Transboundary Movement) Rules, 2016.
9. That in case groundwater is to be abstracted then NOC from Central Ground Water Authority (CGWA) is required to be obtained before establishment of the new unit. Also, in case of additional groundwater abstraction by existing unit, NOC from CGWA will be required.
10. In case the member industries fail to comply with these guidelines, the SPV will take action for cancellation of the membership granted to such industries. Further, State Board will also initiate action against these units under the provisions of Water (Prevention & Control of Pollution) Act, 1974 and Air (Prevention & Control of Pollution) Act, 1981.
11. Industry will strive for adopting process/ plant modifications, which result into waste minimization and conservation of chemicals, energy and water. Further, the industry will strive for utilization of green energy for meeting the power requirement of the CETP.
12. Industry needs to carry out plantation in 33% of the factory area.

6.2 DRAFT AGREEMENT:

A Draft agreement that maybe entered into by the CETP management and the member industry units to ensure smooth functioning of the CETP is attached as Annexure # 6.1. The Agreement necessarily need to be customized as per specific requirements of the CETP and its stakeholders, purpose and terms of engagement covering each of the components like roles, responsibilities, obligations of each parties involved. The agreement has to be well balanced and in compliance with the legal provisions of the land.

6.3 MECHANISMS: FOR FIXING OR MODIFYING USER CHARGES FOR THE TREATMENT OF WASTEWATER

To Sustain CETP operations, it is particularly important to ensure that cash flow is not constrained, and the members pay their dues well on time. To avoid conflicts and ensure a fair, equitable and transparent pricing policy, and clear understanding of the deliverables/ services that the member units get must be clearly indicated to them.

6.3.1 CRITERIA FOR COST:

The cost sharing should be decided in such a way that volume of effluent becomes an important norm, but its share in the total cost should not be such as to encourage bypassing of dilute streams and conveying highly toxic / non-biodegradable waste to CETP. The treatability factor should also be given due consideration in cost estimation. An effort by the industry to segregate toxic, highly acidic / highly basic, or toxic metal bearing waste be made to explore the possibility to de-toxify / neutralize or to attempt the recovery of metals by installing recovery plants, which are feasible and economically viable on account of their pay-back potentials.

It must be understood that the costs are dynamic and there should be built in mechanisms to ensure review at periodic intervals to review the tariffs and then decide upon the mechanisms to adjust the pricing. Given below are a few formulations that may be considered to arrive at a justifiably fair and equitable apportionment of the costs incurred or funds needed to cover all O&M costs.

6.4 COST SHARING SYSTEMS:

Equitable sharing should be the prime objective while developing a financial apportionment model for the CETP. The direct and indirect benefits accrued by the CETP also need to be proportionally distributed amongst its members. Though it is difficult to cover all aspects, realistic models have been developed for financial apportionment of the costs. The concerned SPV body can decide on the most suited and viable system based on the local situation and feasibility to implement. The system exercised in most of CETPs operational in India is partly based on Quality-Quantity method with case specific modifications.

6.4.1 THE QUALITY METHOD:

The Quality Method is the simplest Method and is applicable for joint treatment of sewage and low strength industrial wastes. The total cost of CETP Operations and the cost for debt service are divided by total volume (quantity) of effluents handled to arrive at the Service Charge to be levied per cubic metre of effluent. If the effluents from the industries are generally uniform in nature, this approach is acceptable. However, in highly industrialized areas, the user generating dilute effluents ends up subsidizing the users with high strength effluents, which would then not be a fair or equitable method of charging the users.

6.4.2 QUANTITY – QUALITY METHOD:

In the Quantity – Quality method charges are proportional to the benefits from the treatment plant. The calculation of treatment costs can be summarised in the following steps:

- Step-1: Identify the critical design - parameters for the treatment plant. Let us assume they are BOD, SS and volume.
- Step-2: Workout fixed cost (depreciation, loan repayment etc.) and operational cost on annual basis, for all major components like conveyance system, pumps, clarifiers, digesters etc.

- Step-3: Identify the variables (BOD, SS, volume) and the extent of dependence the variable is considered for design specification for the given component. e.g. Conveyance system and digesters are designed based primarily on volume and SS respectively, whereas for clarifier, volume and SS are equally considered.
- Step-4: Workout apportionment of the total treatment cost (fixed and operational), based on the function of the variables.
- Step-5: Depending upon design specification of the plant, against critical parameters, work out the cost component for unit volume treated, kg BOD removed and kg SS removed.
- Step-6: Calculate the cost of treatment for effluent from any industry based on unit cost component as in Step-4 and effluent characteristics in terms of quantity (volume) and quality (BOD, SS etc.) for the given industry.

This is considered the most equitable method in practice. However, to administer this, the SPV/ CETP operator need to monitor the quality parameters of each users apart from the flow.

6.4.3 MALZ FORMULATION:

The Malz Formulation is based on "Polluter Pays" principle and provides an acceptable measure for pollution control if a rational and simple method could be established to estimate the cost of fulfilling the legal obligations of each industry member of the CETP. This procedure is based on the volume and degree of noxiousness of wastewater contributed to the system for an equitable distribution of annualized financial burden, which was developed by Malz and used in USA.

The factors considered in cost computation are volume, degree of noxiousness 'S' of wastewater and dilution factor 'V' to ensure survival of fish (48 hr. exposure).

$$V = \frac{A}{A_0} + \frac{B}{B_0} + \frac{TDS}{TDS_0} + F - 1$$

Where

A = Settleable matter, mg/L
B = COD of settled sample, mg/L
TDS = Total dissolved solids mg/l
F = Fish Toxicity
Ao, Bo & TDSo = Effluent Discharge Standards as specified by SPCB.

The noxiousness degree 'S' is estimated from the dilution factor, V expressed in appropriate slabs rather than in discrete numbers to account for deviation in sampling and analysis of wastewater.

Dilution Value (V)	Noxiousness Degree (S)
1-2	1
3-4	2
4-6	3
6-7	4

Annual treatment cost apportioned to each polluter is calculated as follows:

$$Cost\ Share = \frac{S \times Q \times Z}{\sum (SXQ)}$$

Q = Annual flow of an individual industry
Z = Total cost of collection/ conveyance & treatment

Note: The formula for calculating dilution factor, V and slabs for determining degree of noxiousness, S can be appropriately changed to suit specific case.

6.4.4 ROMAN FORMULATION:

In Roman Formulation, it is presumed that the scale of operation makes the overall treatment cost in a CETP comparatively less than the cost to be borne by individual small-scale units on their own. Roman (74) proposed the following formula, which is widely used in Poland to calculate the share of each participating member units of the CETP.

$$I_u = \frac{Q_u}{Q} X \left[I_O \times \left(I + \left(\frac{S_u - S}{S}\right) \times e\right) + I_d\right.$$

I_u	Amount expressing share of the participating industrial unit
Q_u	Average daily effluent flow from the given industrial plant discharged to the CETP in m^3/day.
Q	Average daily effluent flow from all industrial plants discharged to the CETP in m^3/day.
I_o	Construction Costs of the CETP
I_d	Construction costs of all additional facilities for transport of effluents to the CETP, expressed as BOD_5 in kg O_2/m^3.
S_u	Average Strength of the mixture of the given industrial unit, expressed as BOD_5 in kg O_2/m^3
S	Average Strength of the mixture of all effluents discharged to the CETP, expressed as BOD_5 in kg O_2/m^3
e	Cost of the treatment plant units depending on the pollution load to construction costs to the whole treatment plant

Roman Formulation is propounded on two assumptions, viz.

(i) The share towards cost of building a CETP should correspond to the amount and strength of discharged effluent.
(ii) The cost of effluent conveyance facilities to the CETP to be shared proportionate to the quantum of effluent discharged by each member unit, irrespective of the distance of transport.

The amount of penalties for transgression of requirements for effluent discharge depends on the pollution load contained in the discharged effluent above the admissible limit and the type of polluting matter. The penalties imposed are much higher than the actual cost incurred for the treatment. In Poland, Penalties and imprisonment were applied depending on the size of damage caused by the pollution.

6.4.5 CHEMTECH FORMULATION:

This formulation was developed by Chemtech Consultants (80) and is based on the proportion of the CETP usage. Industries are to pay according to the load they impose on the CETP – both in terms of hydraulic load (volume of effluent) and Pollutant load (chemical, physical and biological conditions of the waste) that have direct influence on the capital and operational cost of CETP.

The formulation is as given below:

$$CC_{(i)} = \frac{Q_{(i)}}{Q_{(T)}} \times CC_{(Q)} + \left[0.5 \times \frac{B_{(i)}}{B_{(T)}} + 0.5 \times \frac{C_{(i)}}{BC_{(T)}}\right] \times CC_{(B)} = a \times CC_{(A)}$$

CC_i	Capital Cost contribution by the i^{th} industry (INR)
Q_i	Volume of Wastewater generated by the i^{th} industrial plant and discharged to the CETP in m^3/day.
Q(T)	Total Wastewater flow to the CETP in m^3/day.
CC(Q)	Flow dependent cost of the CETP (INR)
$B_{(i)}$	BOD load of the effluent from the i^{th} industrial plant and discharged to the CET in kg/day.
$B_{(T)}$	BOD capacity of CETP in kg/day
$C_{(i)}$	COD load of the effluent from the i^{th} industrial plant and discharged to the CET in kg/day.
$C_{(T)}$	COD capacity of CETP in kg/day
$CC_{(B)}$	BOD and COD Capacity dependent cost of the CETP (INR)
$CC_{(A)}$	Cost of Common facilities for the CETP (INR)
a	Factor that is a function of the i^{th} industry's design flow.

Cost of neutralisation is not considered, as this operation should be part of pre-treatment by the individual industry.

Connection fees: Recommended to be charged separately based on the actual cost of labour and materials at the time of connection, distance from collection system, size of piping and other existing conditions at site.

Recovery of Operations & Maintenance Costs:

The suggested formula for calculating O&M recovery from individual units is as follows:

$$CM_{(i)} = \frac{Q_{(i)}}{Q_{(T)}} \times CM_{(T)} \times PF_{(i)}$$

$CM_{(i)}$	Operation & Maintenance Cost for the i^{th} industry (INR)
$CM_{(T)}$	Total Operation & Maintenance Cost of the CETP (INR)
$PF_{(i)}$	Pollution Factor for the i^{th} industry

$$\mathrm{PF}_{(i)} = 0.5 \times \frac{\mathrm{BOD}_{(i)} + 200}{600} + 0.5 \times \frac{\mathrm{COD}_{(i)} + 500}{1500}$$

If $BOD_{(i)}$ and or $COD_{(i)}$ values result in $PF_{(i)} < 1$, then $PF_{(i)} = 1$

It is convenient to express the individual industry's contribution as a combined figure, capturing the Cost for Capital Recovery as well as the Operations & Maintenance costs. This will allow the SIDC or if the CETP Operator is a private investor to recover all costs plus profit. The formulas maybe combined to work out a single payment schedule and is as follows:

$$CO_{(i)} = \frac{Q_{(i)}}{Q_{(T)}} \times PF_{(i)} \times CO_{(T)} + A$$

$CO_{(i)}$	Total Annual Contribution by the i^{th} industry (INR)
$CO_{(T)}$	Total Income required by the CETP Operator (INR)

A	Minimum contribution by each industry

$$PF_{(i)} = 0.5 \times \frac{BOD_{(i)}+200}{600} + 0.5 \times \frac{COD_{(i)}+500}{1500}; \quad \text{for } PF_{(i)} > 1.0$$

$$PF_{(i)} = 0, \ for\ PF_{(i)} < 1.0$$

6.4.6 GRADUATED PAYMENT FORMULATION:

Graduated Payments Formulation is based on the following concept:

i. Large industries pay marginally higher cost
ii. Cost paid by smaller industries is fixed as minimal amount thus eliminating intricate accounting procedures.

Generally, large industries are few in number in any industrial estate, but are the major contributors to the flow. A differential pricing mechanism could help the industries in micro and small scale industrial units contributing to less than 10 m^3/day of effluents to pay a minimal fixed amount for being connected to the CETP.

The Chemtech Formulation for the annual contribution from each industry, $CO_{(i)}$, can be easily corrected by eliminating all but the minimum contribution, A for small industries:

$$CO_{(i)} = \frac{Q_{(i)}}{Q_{(T)}} \times PF_{(i)} \times CO_{(T)}; \ for\ Q(i) > 10\ m^3/day$$

$$CO_{(i)} = A; \ for\ Q_{(i)} < 10\ m^3/d$$

ANNEXURES

ANNEXURE # 4-1

Inlet Standards to CETP in Uttarakhand[6]

HEAD OFFICE
UTTARAKHAND ENVIRONMENT PROTECTION & POLLUTION CONTROL BOARD
29/20, Nemi Road, Dalanwala
DEHRADUN (Uttarakhand)
उत्तराखण्ड पर्यावरण संरक्षण एवं प्रदूषण नियंत्रण बोर्ड
29/20 नेमी रोड़, डालनवाला,
देहरादून (उत्तराखण्ड)
Ph: 0135-2658086, Fax: 0135-2718092 ; Web: www.ueppcb.uk.gov.in

कार्यालय आदेश

एतद्द्वारा राज्य बोर्ड की 20 वीं0 बैठक दिनांक 23.08.2018 में उत्तराखण्ड राज्य में संयुक्त उत्प्रवाह शुद्धीकरण संयत्रों के अंर्तगम मानक (Inlet Standard) के सम्बन्ध में निम्न निर्णय लिये गये हैं:–

Inlet effluent quality standards for CETP, IIE, Ranipur, Haridwar, Distt. Haridwar

S.N.	Parameters	Concentration (Maximum)
1.	pH	5.5 – 9.0
2.	BOD	500 mg/L
3.	COD	900 mg/L
4.	Total Dissolved Solids (TDS)	2100 mg/L
5.	Total Suspended Solids (TSS)	1500 mg/L
6.	Oil & Grease	20 mg/L
7.	Phenolic Compounds (as C_6H_5OH)	5.0 mg/L
8.	Ammonical Nitrogen (as N)	50.0 mg/L
9.	Cynide (as CN)	2.0 mg/L
10.	Hexavalent Chromium (as Cr^{+6})	2.0 mg/L
11.	Total Chromium (as Cr)	2.0 mg/L
12.	Copper (as Cu)	3.0 mg/L
13.	Lead (as Pb)	1.0 mg/L
14.	Nickel (as Ni)	3.0 mg/L
15.	Zinc (as Zn)	15.0 mg/L
16.	Arsenic (as As)	0.2 mg/L
17.	Mercury (as Hg)	0.01 mg/L
18.	Cadmium (as Cd)	1.0 mg/L
19.	Selenium (as Se)	0.05 mg/L
20.	Fluoride (as F)	15.0 mg/L
21	Boron (as B)	2.0 mg/L
	Radio Active Materials	
22.	Alpha Emitters, micro curie/mL	10^{-7}
23.	Beta Emitters, micro curie/mL	10^{-8}

[6] https://ueppcb.uk.gov.in/files/CETP_HAridwar.pdf

ANNEXURE # 4-2

Industrial Wastewater Treatment Schemes

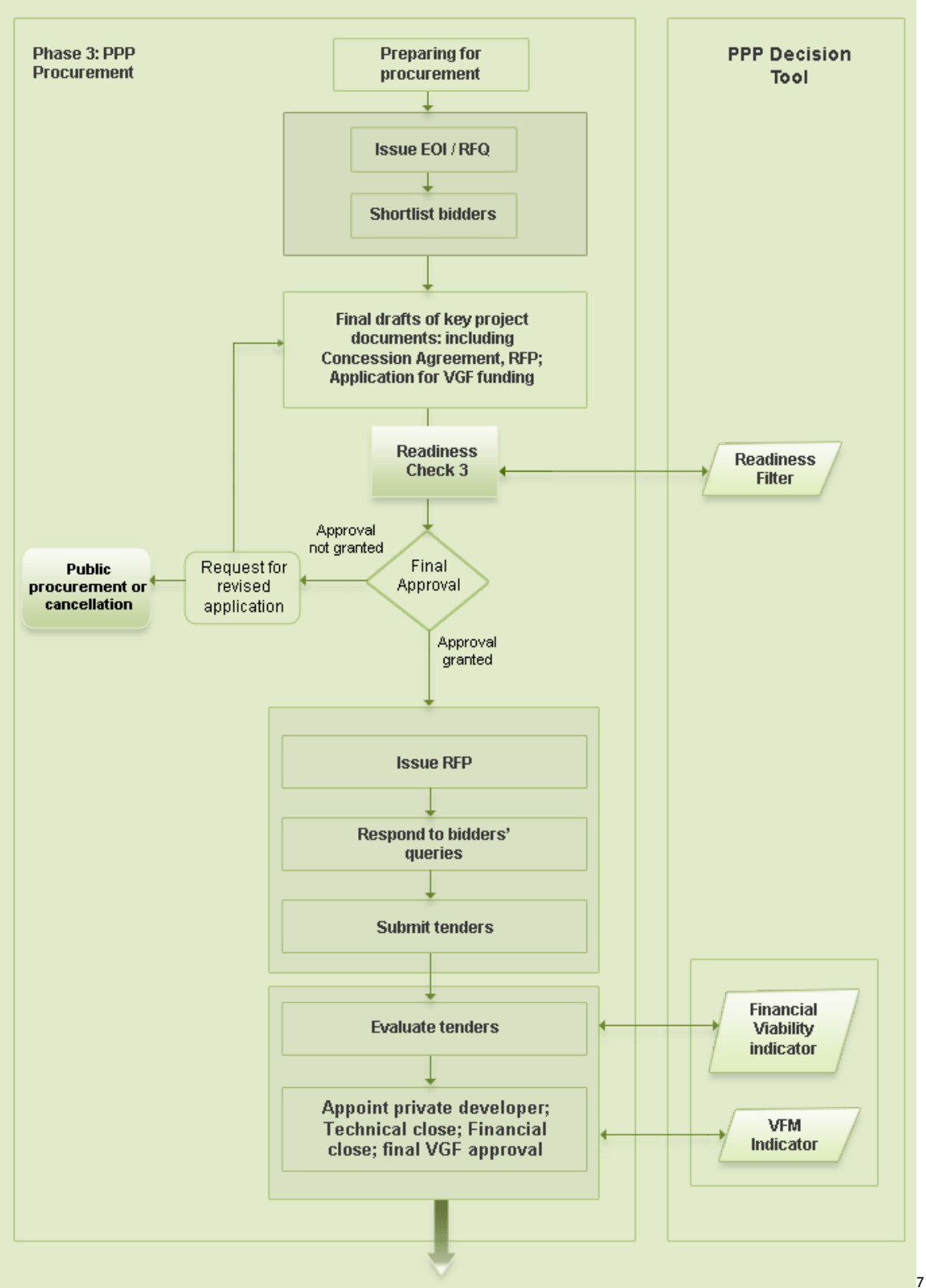
Preliminary Treatment	
PROCESS / TECHNOLOGY	**DESCRIPTION**
Screening	▪ Provided at the intake point to prevent floating matter that could clog the systems or cause damage to pumps.
Grit Removal	▪ Used in WWTP to remove heavier inorganic matter (like sand), by settling in Grit Chambers. These pollutants can adversely impact secondary treatment processes.
Oil and Grease (O&G) removal	▪ Oil and grease are separated using O&G traps and are then skimmed-off from the surface of the tank. This process can be rendered more efficient by dissolved air flotation or vacuum flotation processes.
Primary Treatment	
PROCESS / TECHNOLOGY	**DESCRIPTION**
Equalization	▪ The prime objective is to homogenize the quality of effluents coming to CETP and to avoid surges in hydraulic loads to the subsequent treatment processes. ▪ In cases where high fluctuation in quality of effluents and flow rates are expected, CPCB suggests having equalization tank with hydraulic retention capacity of 24 hours. ▪ Coarse diffused aeration is provided in the equalization tanks to avoid putrefaction or settling.
Neutralization	▪ Applicable for highly acidic and highly alkaline effluents. ▪ Acidic effluents may be neutralized by treatment with lime, lime slurry or caustic soda. ▪ Alkaline waste may be neutralized by treatment with acids.
Clari-flocculation & Sedimentation	▪ This process is adopted to remove fine suspended particles, reaction material (emulsified metal compounds, polymers and their monomers), etc. by adding coagulation aids in a rapid mixing chamber and then passing through a flocculation chamber where flocs are formed. The heavy flocs are then allowed to settle down to the bottom of the tank and are withdrawn as primary sludge.
Secondary Treatment	
Aerobic Treatment: Various technologies are utilized for aerobic (in presence of air) treatment of the effluents to remove biodegradable organic pollutants; utilizing microbes as described below.	
TECHNOLOGY	**DESCRIPTION**
Activated Sludge Process (ASP)	• The effluents from the primary treatment processes are conveyed to an aeration tank and are aerated with mechanical devices such as fixed/ floating/diffused aeration/ oxygen injection systems; *etc*.; where bio culture feeds upon the biodegradable organic matter.

Aerated Lagoons	• The effluents from primary treatment processes are collected in lagoons where aerobic microbes feed on the organic matter and are aided by aeration with mechanical devices such as floating/ fixed aerators.
Trickling Filters/ Bio filters	• In the trickling or percolating filter process, microorganisms get attached and grow on highly permeable media; through which the wastewater is trickled – or percolated. • Used when effluent is highly loaded with COD. • Maybe used as a roughing plant followed by another advanced secondary treatment system.
Sequential Batch Reactors (SBR)	• SBR are relatively evolved technology and is an advanced variant of ASP; where multiple processes of Aeration Tank and Secondary Clarifier are coupled into a single tank where the four processes, viz. FILL, AERATE, SETTLING and DECANT happens in a sequence and are automated using Programmable Logic Controllers (PLCs). • This technology is utilized especially when there are land constraints and higher degree of effluent purification is required.
Moving Bed Biofilm Reactor (MBBR)	• This technology is based on principle of treating the wastewater by keeping the media with the biofilm (caused by the attached growth of microbes) in motion inside the aeration tank. The media is kept in motion using diffused aeration techniques.
Membrane Bioreactor (MBR)	• Treats municipal and industrial wastewater. • MBR is considered as one of the advanced aerobic treatment technologies where highly concentrated biomass culture is maintained in much more compact tanks compared to other technologies and the treated wastewater is taken out through ultra-filtration membranes. Hence, MBR is a technology which has aeration tank, secondary clarifier and filtration unit rolled into one. • Comparatively expensive technology. However, it is ideal in cases where space is a constraint and to meet stringent effluent quality standards.
Tertiary Treatment	
PROCESS / TECHNOLOGY	• DESCRIPTION
Sand Filters	• Sand filter remains the most economical and effective filter for polishing effluents post-secondary treatment to take out any fine suspended particles. • Sand filters can be of a single grade (same size) or multi-grade (pebbles to find sand) through which the wastewater is made to trickle down. The sand filters need to be given backwash to flush out any contaminants that clog the media bed.
Activated Carbon Filters	• Activated Carbon Filters are used as part of the polishing unit in combination with the Sand filters. Activated Carbon adsorbs organics and odour causing substances when the effluent is passed through a bed of Activated carbon granules.

Micro Filtration	• Applied when a solid free wastewater is desired for downstream facilities, such as reverse osmosis or complete removal of hazardous contaminants. • Used in metal particle recovery. • Used in metal plating wastewater treatment. • Used in sludge separation after activated sludge process in a central biological WWTP, replacing secondary clarifier.
Ultra-Filtration	• Removes pollutants such as proteins and other macromolecular compounds and toxic non-degradable components. • Separates heavy metals after complexation or precipitation. • Separates components not readily degradable in sewage treatment effluents, which are subsequently recycled to the biological stage. • It is a pretreatment step prior to reverse osmosis or ion exchange. • Removes SS along with attached COD as a polishing step and avoiding secondary clarification.
Retention ponds	• Used to avoid hydraulic overload of downstream facilities. • Separates solid pollutants (such as sediment, organic matter, dissolved metal compounds and nutrients) from rainwater. • Applied to industrial sites with highly contaminated surfaces.
Nano-Filtration	• Applied to remove larger organic molecules and multivalent ions to recycle and reuse the wastewater or reduce its volume. • Increases the concentration of contaminants to such an extent that subsequent destruction processes are feasible.
Reverse Osmosis (RO)	• Reverse Osmosis is the process used to treat effluents with high levels of Total Dissolved Solids (TDS) and separate them into streams of concentrate and permeate [low TDS levels] as required. The number of stages of RO plants to be deployed depends on the strength of the inflow and the recovery percentage required. • Separates water and dissolved constituents down to ionic species. • It is applied when a high purity water is required. • In Wastewater treatment, permeate is the product stream, whereas the concentrate is likely to be the pollutant stream that needs to be managed separately. At times, the concentrate can also be of commercial value (e.g., as brine solution, which may be recycled in textile industry).
Evaporators & Crystallizers	• Different technologies and Processes like Multi Effect Evaporation (MEE), Mechanical Vapour Recompression (MVR) are utilized to distill out purer forms of water from concentrate stream. • It is a very intensive operation and is utilized as part of concentrate management and to recover utilizable water. • Crystallizers are used to achieve liquid-solid separation. The residue needs to be disposed off

ANNEXURE # 5-1

PPP Project Procurement – Bid Management - Process Map



[7]

[7] https://www.pppinindia.gov.in/toolkit/images/module2-intro-fig5.gif

ANNEXURE # 5-2

Contents of Standard Bid Document (SBD) for Procurement of Works

These Standard Bidding Documents for Procurement of Works apply either when a prequalification process has taken place before bidding or when a prequalification process has not taken place before bidding (provided alternative documents should be selected as applicable).

A brief description of these documents is given below.

PART 1 – BIDDING PROCEDURES

Section I: Instructions to Bidders (ITB)	• This Section provides relevant information to help Bidders prepare their bids. • Information is also provided on the submission, opening, and evaluation of bids and on the award of Contracts. • Section I contains provisions that are to be used without modification.
Section II. Bid Data Sheet (BDS)	• This Section includes provisions that are specific to each procurement and that supplement Section I, Instructions to Bidders.
Section III. Evaluation and Qualification Criteria *(alternative Section III to be used when Prequalification has taken place before bidding)*	• This Section specifies the criteria to determine the lowest evaluated bid and to ascertain the continued qualification of the Bidder to perform the contract.
Section III. Evaluation and Qualification Criteria *(alternative Section III to be used when Prequalification has not taken place before bidding)*	• This Section includes the criteria to determine the lowest evaluated bid and the qualifications of the Bidder to perform the contract.
Section IV: Bidding Forms	• This Section includes the forms, which are to be completed by the Bidder and submitted as part of his Bid.
Section V. Eligible Countries	• This Section contains information regarding eligible countries.
Section VI. Employer's Requirements	• This Section provides the Bidders with the reference to Employer's Requirements applicable to this process.

PART 2 – WORKS REQUIREMENTS

Section VII. Works Requirements	• This Section contains the Specification, the Drawings, and supplementary information that describe the Works to be procured. • The Works Requirements shall also include the environmental and social (ES) requirements (including requirements relating to Sexual Exploitation and Abuse (SEA) and Sexual Harassment (SH) which are to be satisfied by the Contractor in executing the Works.

PART 3 – CONDITIONS OF CONTRACT AND CONTRACT FORMS

Section VIII. General Conditions (GC)	This Section refers to the "General Conditions" which form part of the Conditions of Contract for Construction (Second Edition 2017) published by the Federation Internationale Des Ingénieurs – Conseils (FIDIC).
Section IX. Particular Conditions (PC)	This Section includes Particular Conditions of the contract consisting of: • Part A- Contract Data • Part B -Special Provisions • PART C – Employer's Requirements/ Policies (e.g.- Corrupt and Fraudulent Practices) • PART D – Environmental and Social (ES)Reporting Metrics for Progress Reports. The contents of this Section supplement the General Conditions and shall be completed by the Employer.
Section X: Contract Forms	This Section contains the Letter of Acceptance, Contract Agreement and other relevant forms

ANNEXURE # 5-3

Request for Proposals (RfP) Checklist[8]

No	Information commonly covered in the RFP document	Covered? (yes, no)
1	**Introduction**	
1a	Background to the project	
1b	Brief description of the bidding process	
1c	Schedule for the bidding process	
2	**Instructions to applicants**	
2a	**General**	
2a.1	Terms of bidding	
2a.2	Change in consortium; change in ownership	
2a.3	Cost of bidding	
2a.4	Site visit	
2a.5	Right to accept / reject bids	
2b	**Documents**	
2b.1	Contents of the RFP	
2b.2	Clarifications, amendments of the RFP	
2c	**Requirements for preparation and submission of application**	
2c.1	Format, signing, delivery arrangements for bids	
2c.2	Submission date	
2c.3	Late bids	
2c.4	Content of bids	
2c.5	Modification, withdrawal of bids	
2c.6	Rejection of bids	
2c.7	Validity of bids	
2c.8	Confidentiality of bids	
2c.9	Clarifications sought from bidder	
2d	**Bid security**	

[8] https://www.pppinindia.gov.in/toolkit/water-sanitation/module3-dg-rfp-ecf.php?links=dg1d

3	**Evaluation process**	
3a	Opening and evaluation of bids	
3b	Test of responsiveness	
3c	Selection of bidder	
3d	Contacts during evaluation	
4	**Fraud and corrupt practices**	
5	**Pre-bid conference**	
6	**Miscellaneous**	
7	**Schedules**	
7a	Concession Agreement	
8	**Annexes**	
8a	Letter comprising the bid	
8b	Bank guarantee for bid security	
8c	Formats for powers of attorney	

Annexure # 5-4

SAMPLE LIST: Detailed Design and Engineering Deliverables

Please note for engineering projects individual adaption is required.

1. Process Design

- Basis of Design
- Process Flow Diagrams (PFDs), Utility Flow Diagrams (UFDs) and Heat & Material Balances
- Process & Operational Control Description
- Process Equipment List
- Process Datasheets for Main Equipment (per Equipment List)
- Piping & Instrumentation Diagrams (P&ID's)
- Line list
- Tie-in Schedule
- Cause & Effects Diagrams
- Process Data Sheets for instrumentation
- Process Alarm & Trip Schedule
- Effluent and Emission Summary
- Catalyst and Chemicals Summary
- Process Simulation Report (including Process Simulations files)
- Process Design Calculations
- Flare and Relief System Study/Sizing Calculations
- Distribution P&ID for the flare headers
- HAZOP Report
- Performance Guarantees Statement
- Performance Test Procedure
- Pre-commissioning and Commissioning Manual
- Operating & Maintenance Manual

2. Civil and Structural Design

- Earthworks Specifications defining procedures for excavation, filling and compaction.
- Earthworks Grading Drawings Layouts
- Piling Specification
- Piling Layouts identifying capacities, locations and cut-off elevation of piles.
- Civil Design Criteria
- Structural Design Criteria
- Reinforced Concrete Specification
- Structural Steelwork Specification
- Design Calculations complete with index
- Fireproofing of Structural Steelwork Specification (If applicable)
- Civil Layouts
- Underground Services Specification
- Underground Services Layout

- Underground Service Design Details Drawings
- Foundation & Concrete Structure General Arrangement Drawings (GA's)
- Drawings of platforms, ladders, handrails and stairs associated with equipment and vessels
- Cable Trench Layouts
- Cable Trench Details
- Paving Plan and Details Drawings
- Foundation and Concrete Structure RC Details
- Road Layouts and Details
- Structural Steel Layout and Details for Pipe racks Structures and Pipe Supports
- Requisitions for Structural Steelwork

3. Architectural Design

- Building layout drawings
- Building detail drawings
- Specifications for Buildings
- Schedules of Finishes (Buildings)
- Schedules of doors and windows

4. Piping & Layout

- Good flow line layout
- Overall Site Plot Plan
- Process Area Plot Plans
- Piping Material Specifications
- Special Piping (SP) Item Schedule and Data Sheets
- Standard Piping Details
- Fabrication and Installation of Pipe-work Specification
- Heat Tracing/Jacketing Specification and Schedules
- Piping General Arrangement Drawings
- Isometric drawings for 2" and above pipe-work above and below ground
- Material take-offs
- Key Plans of Piping General Arrangements.
- Stress Analysis Specification
- Stress Critical Line List
- Stress Sketches
- Final Stress Report
- Pipe Supports Design details
- Special Pipe Support Register
- Pipe Support Spring Register and Calculations
- Hydrostatic test diagrams

5. Electrical Design

- Area plans
    - Hazardous area classification drawings
    - Area key plans for Lighting, tray and grounding layouts
- Layout drawings
    - Grounding layouts
    - Plant cable tray and cable routing layouts
    - Plant and buildings lighting layouts
    - Substation layouts
    - Switchgear building equipment layout
    - U/G duct bank layout etc.
- Single line diagrams showing interlocks, inter tripping, system capacity, Voltage levels, currents, impedances, generation power levels etc.
    - Key single line diagram
    - 138/4.16 kV single line diagram
    - 4,16 kV (MV) single line diagrams
    - 480V single line diagrams
    - 120 VAC UPS single line diagrams
    - 125 VDC UPS single line diagrams
    - Emergency power single line diagrams etc.
- Schematics
    - 4 kV motor schematics
    - 460 V motor schematics
    - MOV control schematics
    - Lighting control schematics
    - Heat tracing isometrics etc.
- Equipment drawings including vendor prints
- These drawings shall be supplied for all the major tagged equipment such as Transformers, Switchgears, MCCs, UPS, Chargers, Generators, Power supplies, PTs, CTs, Control panels, packaged equipment etc.
    - Front and interior layout showing all the components
    - Wiring drawings and terminal connections
    - Installation details including manuals
    - Component maintenance and instruction manuals
    - Electronic equipment manuals and settings
    - Fuse ratings and characteristic curves
    - Equipment and component datasheets
    - Weights and measurements
    - Schematics
    - Equipment specifications
    - Motor datasheets
    - Circuit breaker settings
    - 3 Line diagrams
    - Battery details including amp-hour ratings
    - Relay settings and relay discrimination curves
    - Data sheets and environment limitations
    - HVAC requirements

  - Manufacturing data books
  - Spare parts lists etc.
- Inter connection diagrams
  - Inter connection drawings between panels
- Details
  - Hazardous area classification details
  - Installation details for Lighting, grounding, heat tracing etc.
  - Duct bank details
- Lists and Schedules
  - Cable routing schedules
  - MCC schedules
  - Lighting and Distribution panel schedules
  - Heat tracing panel schedules
  - Load lists
  - Electric equipment list
  - Bulk material lists and catalogue numbers
  - Cable tray penetration details into buildings
- Calculations
  - Tray sizing calculations
  - Heat tracing calculations
  - Equipment sizing calculations
  - Lighting level calculations
  - Emergency power load requirements
- Studies and reports
  - System studies showing fault levels, short circuit current, Minimum/ Maximum
  - Load flow analysis, motor starting effects and system stability, voltage levels
  - Transformer tap settings
  - Motor protection settings
  - Relay setting schedules including setting curves
-

6. Instrumentation and Controls

- System Block Diagrams
- Specifications Defining functionality of systems and interfaces between systems
- System Graphic Displays
- Control Logic Diagrams based upon ISA2
- Instrument Specifications for equipment and materials
- Instrument Data Sheets based on ISA S20 templates Data Sheets
- Instrument Index
- Relief and Safety Device Index
- Alarm and Trip Schedule
- Control Room and Control Building Layouts
- Instrument Location Drawings
- Instrument Cable Routing
- Panel and Rack Layouts
- Instrument and Control System Schematics

- Instrument Power and Utility Requirements
- Power Distribution Single line
- Power Distribution Schedule
- Grounding Diagrams for instruments and control system
- Instrument Junction Box Schedules
- Instrument Cable Schedule
- Termination Schedule/Diagram
- Instrument Hook-Up Diagrams (Electric, Pneumatic, hydraulic and/or Process)
- Air Distribution Diagram
- Instrument Junction Boxes and Panels Block Diagrams
- Interconnection Diagrams
- Loop Diagrams
- Requisitions for equipment and bulk materials
- Input / Output Schedules
- Instrument Design Data and Engineering Calculation

7. Fire Fighting and Safety

- Safety Design Philosophy
- P & ID for Fire Water Ring Main
- Fire Fighting Equipment Layout
- Fire Fighting Equipment List / Requisitions
- Fire & Gas Cause & Effects Matrix
- Fire & Gas Detection Equipment Schedule
- Extinguishing Systems Design (where/if apllicable) of fixed fire extinguishing systems (e.g. foam, carbon dioxide, clean agent, and/or dry powder systems)
- Mobile Fire Fighting Equipment Schedule
- Safety Equipment Schedule

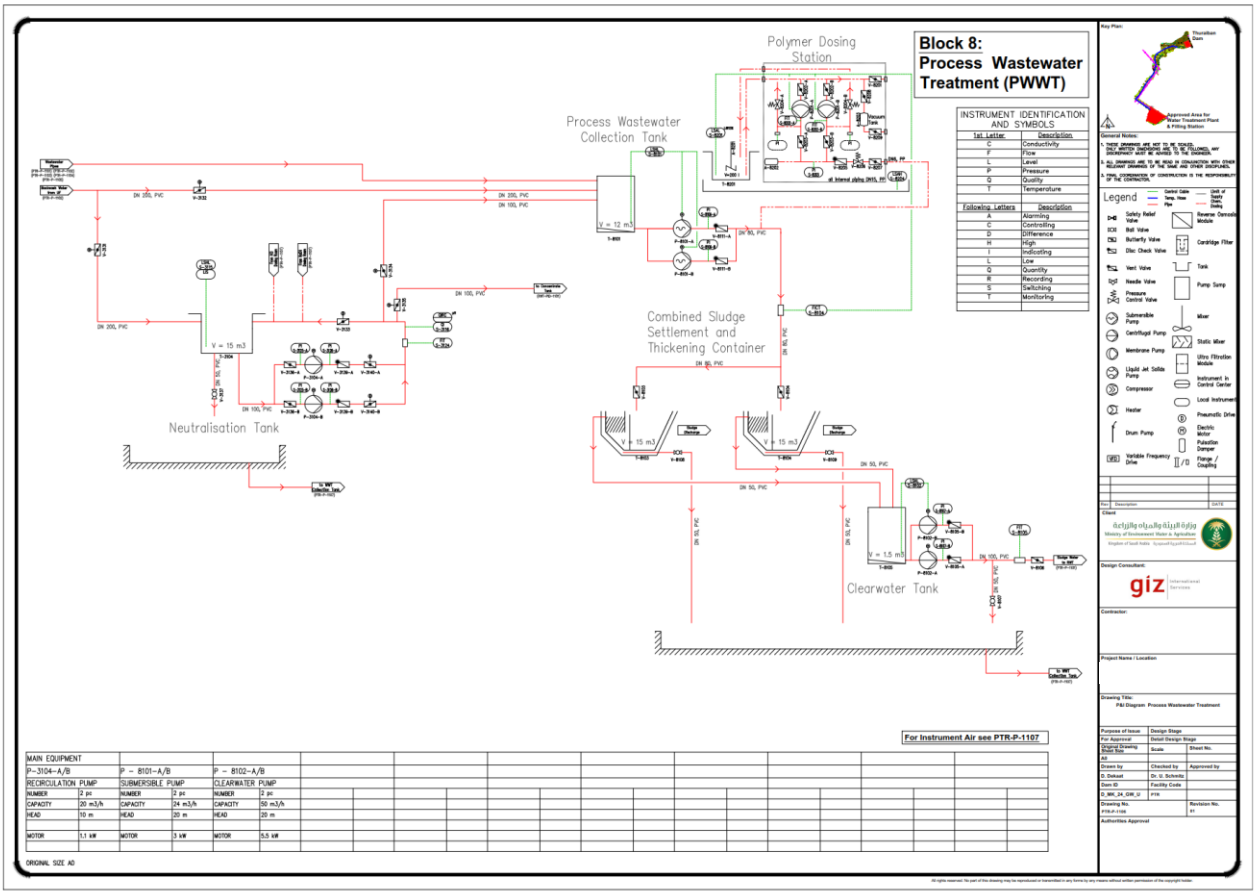


Figure 6-1: Example for piping and instrumentation diagram

						Tag No.		P-2002 A/B
						Project No.		1504
						Data Sheet No.		P1504-DS-P2002AB
			SLUDGE FEEDBACK PUMP FLOCCULATION			Purchase Order No.		TBA
Tag Number: P-2002 A/B		P&ID: PTR-P-1101	Service Description: Recirculation & Discharge Flocculation Unit					
Equipment: NA		Line Number: TBA		Loop Drawing:		Remarks:		
Rev.					Units	Data by Buyer		Deviation from Spec.
	SERVICE		Fluid			Slurry water		
			Fluid State			Liquid		
			Pipe Size			DN50		
			Pipe Schedule / Material			Stainless Steel 5331GL		
			Operating Pressure	Min./Norm./Max.	bar	0	1	10
			Flow Rate	Min./Norm./Max.	m³/h	20.0	38	50
			Fluid Temperature	Min./Norm./Max.	°C	15	25	35
			Density	Min./Norm./Max.	kg/m³	1,000	1,010	1,020
			Viscosity	Min./Norm./Max.	mm²/s	1	1	1
			Suspended Solids (% by weight) / Solids PSD Size (µm)			<2%		
			Material Build-up			No		
			Requested flow rate		m³/h	37.5		
			Requested developed head		m	10		
			Max. ambient temperature		°C	50		
	MOTOR		Efficiency pump		%	72.2		
			Efficiency motor at full load		%	84.2		
			Efficiency total		%	60.8		
			Power absorbed	$P = \frac{9.81 \cdot H \cdot Q\gamma}{\eta_{tot} \cdot 3.600}$ (kW)	kW	1.70		
			Motor power		kW	2.20		
			Speed of rotation		rpm	3,525		
			Supply Voltage		V	400 / 220 V AC, 60 Hz		
			Duty Type			S9		
			Environmental Protection			IP55		
			Efficiency class, acc. to IEC60034-30-1		-	IE3		
			Isolation class to IEC 35-5		-	F		
	PUMP		Type			vertical, inline		
			Suction nominal dia.		DN	80		
			Suction nominal pressure		PN	16		
			Suction flange drilled			EN1092-2		
			Discharge nominal dia.		DN	80		
			Discharge norminal pressure		PN	16		
			Discharge flange drilled			EN1092-2		
			Material pump housing			A/STM A743 CF8M		
			Material impeller			A/STM A743 CF8M		
			Bush material			Grafion		
			Material code seal			BQ1EGG-WA		
			NPSH available		m	2.02		
			Shutoff head		m	13		
			Earthing Electrodes			Grounding Rings		
	Supplier :							
	Manufactr :							
	Model No.:							
	Notes:	1. A stainless steel tag engraved with the tag number shall be fixed to the instrument with stainless steel wire.						

Rev	Date	Description of Revision	Design/Process	Design Appr'd	Project Appr'd	Client Approved
1		Issued for approval				
0	30-Mai-18	Issued for Tender	DD	US		

Figure 6-2: Example Design Data Sheet

Annexure # 5-5

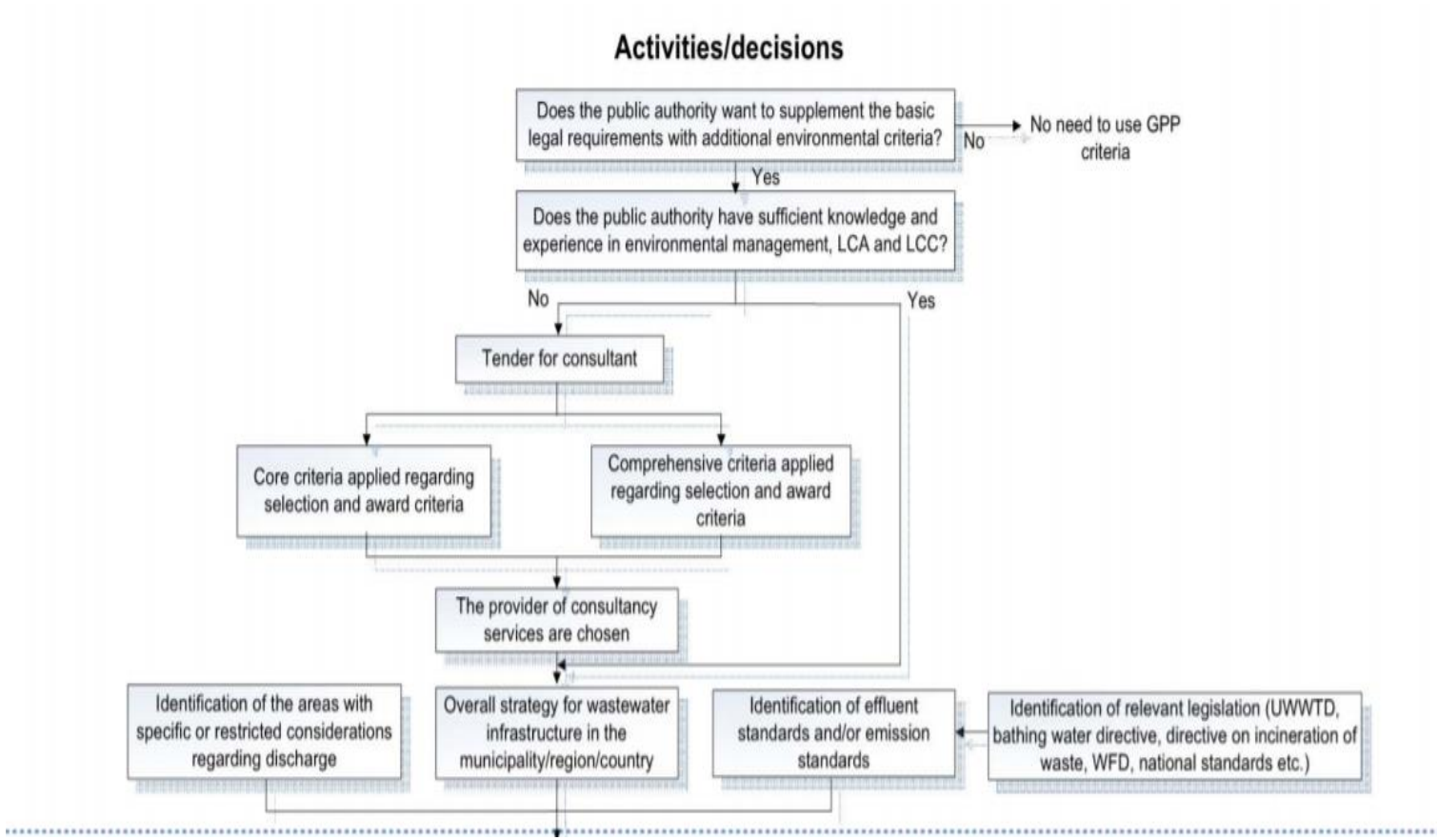
Life Cycle Assessments- Decision Tree[9]

GPP Criteria for Wastewater Infrastructure

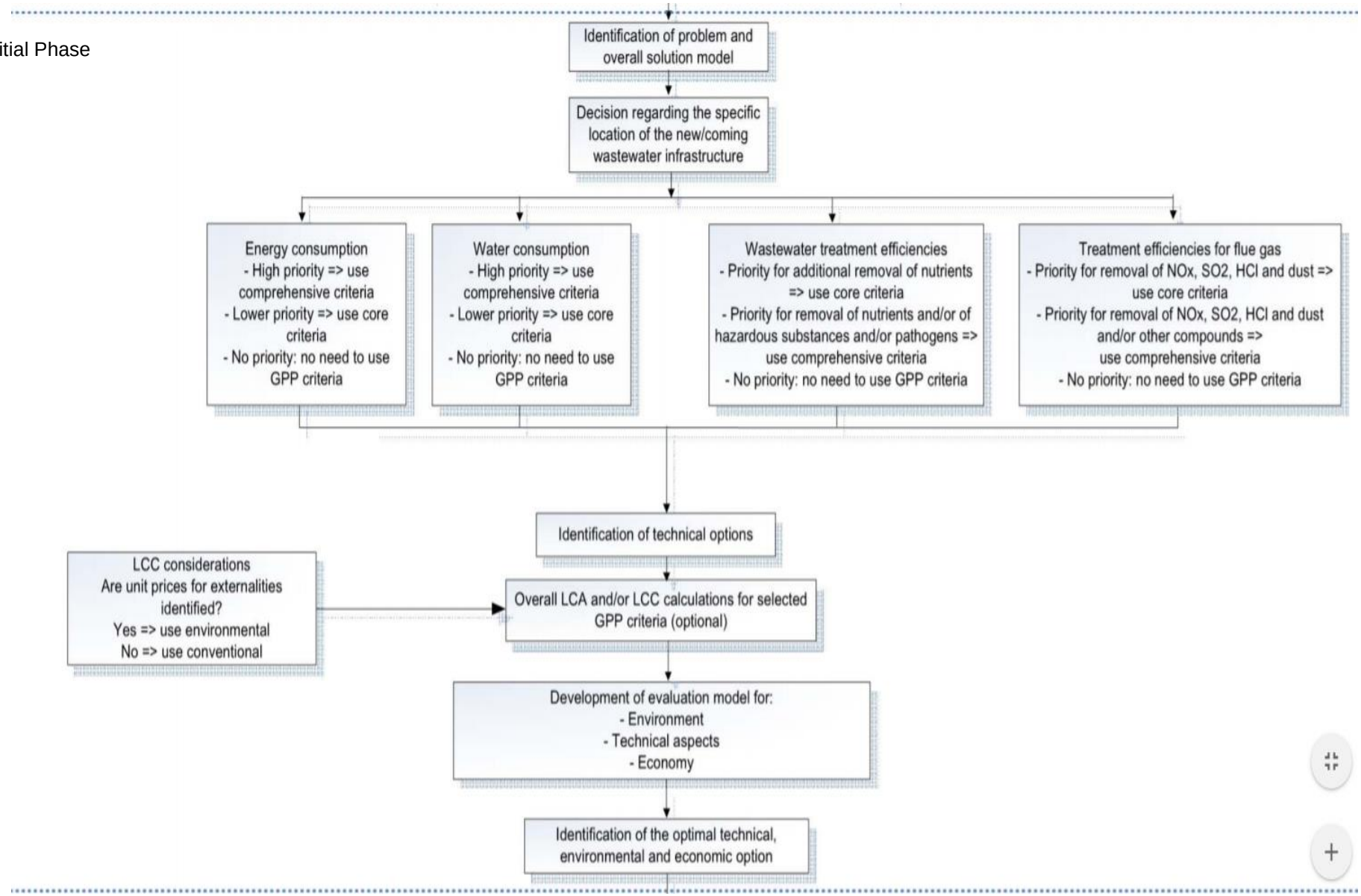
9 https://ec.europa.eu/regional_policy/sources/docgener/studies/pdf/green_public_procurement_en.pdf

GPP Criteria for Waste Water Infrastructure

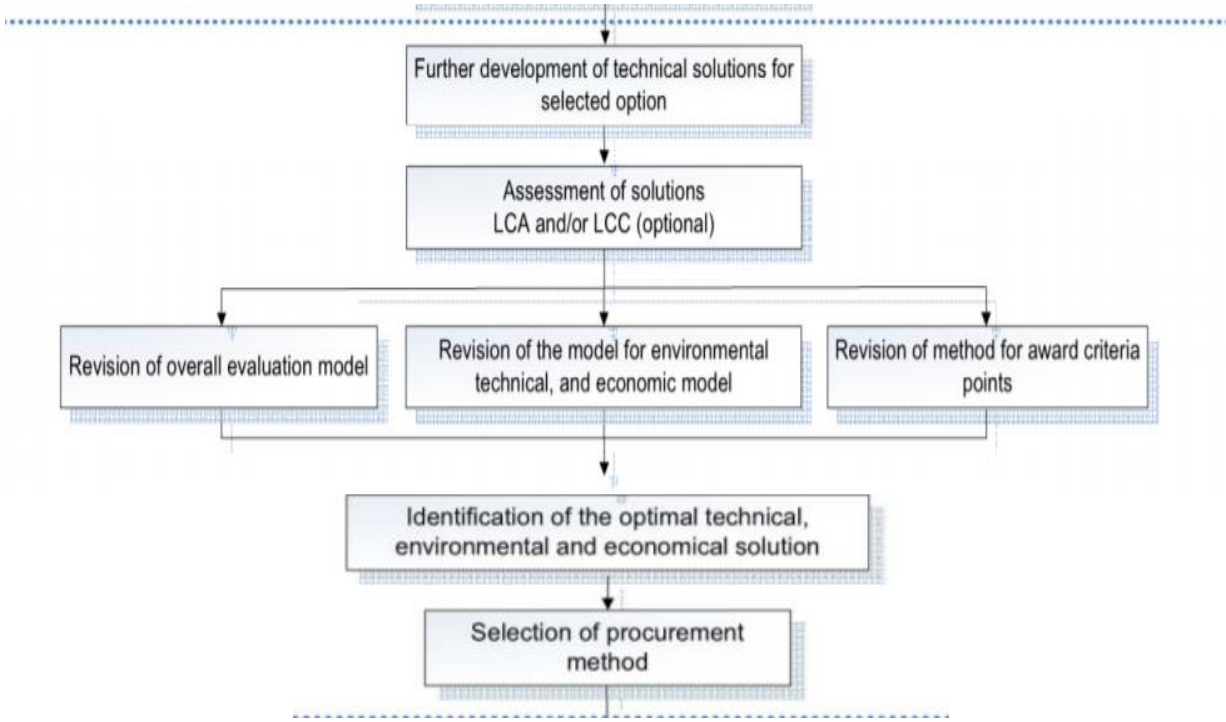
Tender for consultancy services Phase



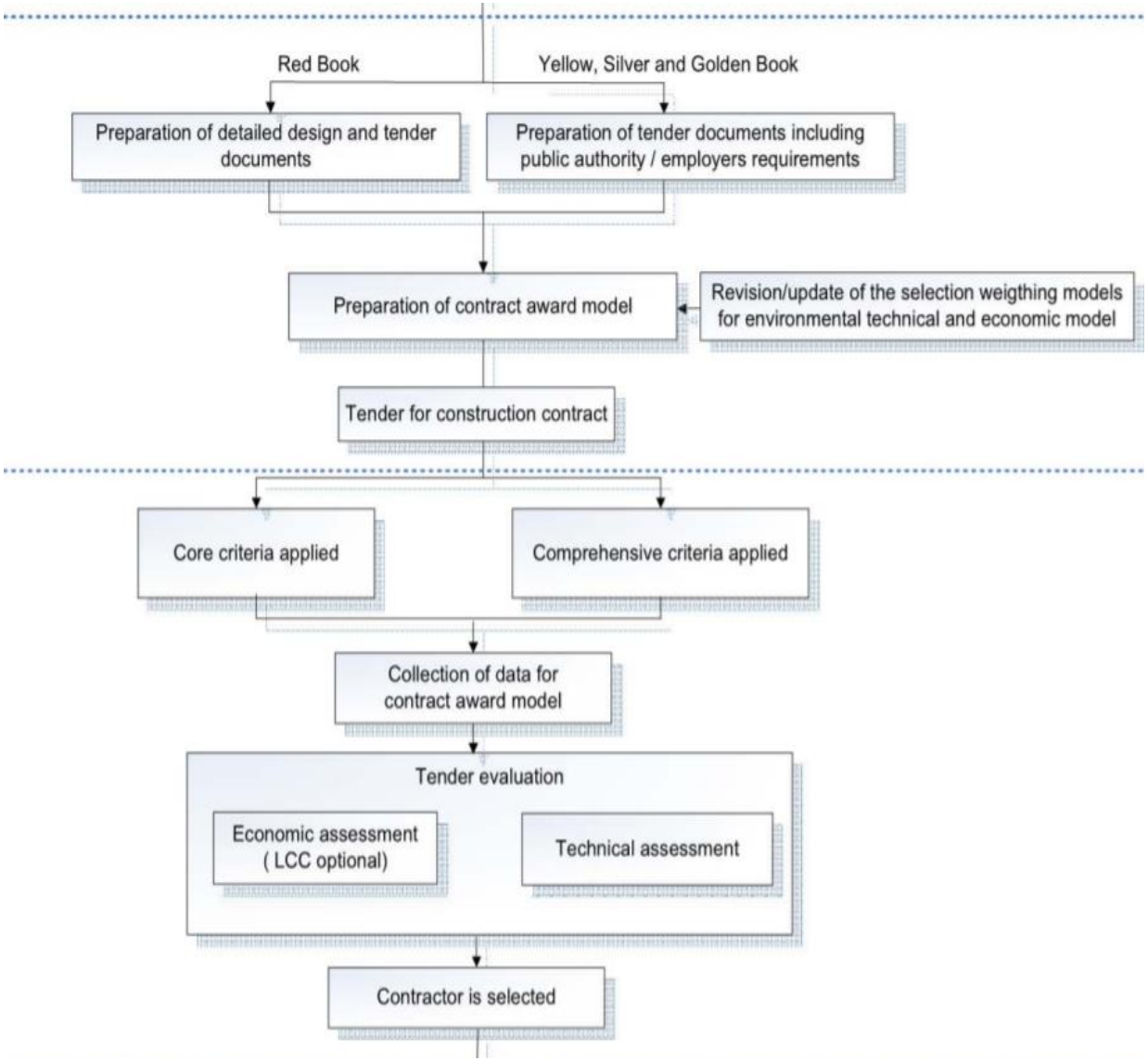
Initial Phase



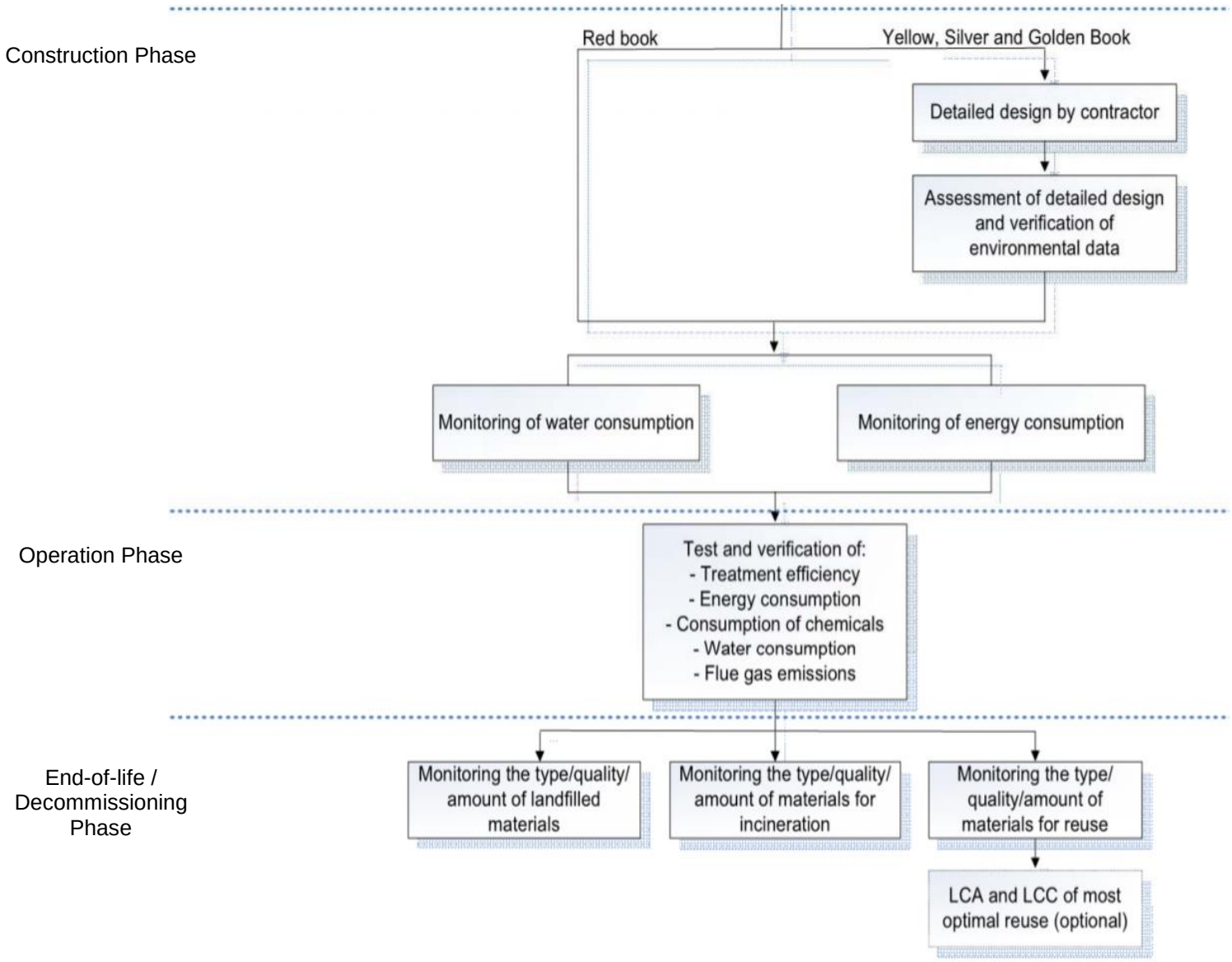
Preparatory Phase



Detailed design and development of tender documents Phase



Tendering Phase for Contractors


Construction Phase
Red book
Yellow, Silver and Golden Book
Detailed design by contractor
Assessment of detailed design and verification of environmental data
Monitoring of water consumption
Monitoring of energy consumption
Operation Phase
Test and verification of:
- Treatment efficiency
- Energy consumption
- Consumption of chemicals
- Water consumption
- Flue gas emissions
End-of-life / Decommissioning Phase
Monitoring the type/quality/ amount of landfilled materials
Monitoring the type/quality/ amount of materials for incineration
Monitoring the type/ quality/amount of materials for reuse
LCA and LCC of most optimal reuse (optional)

ANNEXURE – 6.1

AGREEMENT

FOR

CONVEYANCE, COMMON TREATMENT, REUSE/RECYCLE AND DISCHARGE OF EFFLUENT

BETWEEN

M/S.XYZ PVT.LTD.

Pantnagar – xxx xxx, Uttarakhand

(MEMBER UNIT)

AND

M/s. UKDA INFRASTRUCTURE LIMITED.

Regd. Office: Pantnagar- xxx xxx, Uttarakhand.

AGREEMENT

FOR

CONVEYANCE, COMMON TREATMENT,

AND DISHCHARGE OF EFFLUENT

This **AGREEMENT** is made on this **1st day of July 2020** between **M/s UKDA Infrastructure Ltd. (hereinafter referred to as 'UKIL') (a Special Purpose Vehicle- SPV promoted by M/s UKDA Focal Point …)** a company incorporated and registered under the Companies Act, 1956, having its registered office at ……, hereinafter referred to as "The Party of the First Part" which expression shall where the context so requires or admits of, be deemed to include its successors or assigns of on FIRST PART and **M/S.XYZ PVT.LTD.** Partnership firm proprietorship firm/ Private Limited Company/Public Limited Company/ Co-Operative Society/ Association Company of person registered under the _____and having its registered Office at**,**

.

PANTNAGAR, UTTARAKHAND. (Hereinafter referred to as "MEMBER" or Party of the Second Part which expression shall where the context so requires or admits of, be deemed to include its successors or assigns of the SECOND PART.

WHEREAS:-

The Party of the First Part a Special Purpose Vehicle has established Common Effluent Treatment Plant for Acceptance and treatment of raw effluent water received from the Members of UKIL as well as parent body M/s UKDA Focal Point …… Welfare Co Operative Society Limited (UKDA…). Therefore UKDA…. having necessary permissions from UEPPCB has authorized UKIL to use this approval for its operations in compliance of UEPPCB norms for treatment, reuse/recycle and discharge EFFLUENT after treatment as per UEPPCB norms and discharge values

AND THEREFORE, the party of the Second Part is:

(a) a member of UKDA... & has participated and contributed in promotion and formation of UKIL for the purpose of setting up of Common Effluent Treatment Plant for the requirements of the member units of UKDA...
(b) a process house engaged in dyeing and printing of textiles
(c) Generates polluted waste water from the processing of textile fabric which requires specific treatment before discharging it into the underground drainage line connected with CETP of UKIL but do not have the treatment facilities and desires to send its untreated / partly treated effluent to UKIL (hereinafter referred to as "EFFLUENT") for treatment, reuse/recycle and final discharge.

The Party of the First Part has agreed to receive the EFFLUENT at its CETP sent by the MEMBER on the terms and conditions stated hereunder, which have been mutually agreed to between the UKIL and the Member unit.

THIS AGREEMENT WITNESS AS FOLLOWS:

DEFINITIONS AND INTERPRETATIONS

1. 'TIME' shall be stated in 'Hours' and shall mean Indian Standard Time.
2. 'DAY' means period of twenty four (24) consecutive hours beginning and ending at 00.00 hours
3. 'WEEK' means a period of seven (7) consecutive days beginning from a day.
4. 'FORTNIGHT' means a period of fifteen (15) consecutive days beginning from a day. Considering different number of days of each calendar month of a year, it is clarified that 'FIRST FORTNIGHT' would commence from the first day to the fifteenth day of the month and 'SECOND FORTNIGHT' from sixteenth day to the last day of the month.
5. 'MONTH' means a period beginning at 00.00 hours on the first day of the calendar month and ending at 00.00 hrs on the first day of the succeeding calendar month.
6. **"FINANCIAL YEAR"** means a period of three hundred and sixty five (365) consecutive days or three hundred and sixty six (366) consecutive days when such period includes a twenty ninth (29^{th}) day of February beginning at 00.00 hours from a day. It starts from 1^{st} day of April month of the year and ending on 31^{st} day of March month of next year.
7. **"STENTER CHAMBER" means Hot Air Chambers attached to each Stenter. Each chamber is upto 3 Meters in length.**
8. The headings of or title to the Clauses in this **AGREEMENT** shall not be deemed to be a part thereof or be taken into consideration in the interpretation of construction thereof of the **AGREEMENT.**
9. Words imparting the singular only also include the plural and vice versa where the contexts so require.
10. The present agreement is entered into between UKIL and its members for collection, conveyance, treatment, and final discharge of treated effluent generated by its Members.
11. **UEUEPPCB** means Uttarakhand Pollution Control Board.
12. **Inlet norms** mean the maximum permissible limits of waste water quality parameters specified by UKIL to its members for the effluent discharged by members at the outlet of the doorstep of the member into conveyance system.
13. **Outlet norms** means the maximum permissible limits of treated waste water parameters specified by UEPPCB to UKIL for the discharge.
14. **CC & A** means Consolidated consents and authorization granted by UEPPCB to UKIL under Water Act, Air Act and Hazardous Wastes (Management & Handling) amended rules'2008.
15. **EFFLUENT PIPELINE** means underground drainage line or effluent conveyance system through which effluent is conveyed upto CETP
16. **MEMBER** means the industrial unit registered as member of UKDA... as well as UKIL.
17. **CETP** means Common Effluent Treatment Plant designed, developed, operated and maintained by UKIL.

18. **CUT OFF VALVE** means the disconnection of flow of effluent by operating cut off valve to the point of authorized chamber at the doorstep of member unit.

A. COMMENCEMENT OF AGREEMENT

This Agreement comes into force from the date member unit pays all money to UKIL, submit all the documents along with application including No dues certificate of UKDA... and UKDA.../ UKIL issues NO OBJECTION to give connection in Effluent Conveyance line and on application or receipt of CC & A by UKIL.

B. ADDITIONAL QUANTITY DURING PERIOD OF AGREEMENT

1. If the member desires to send its additional quantity of raw effluent in addition to committed under this present agreement it shall give 5 months advance notice to UKIL of its desire of increase in effluent quantity, UKIL shall, subject to availability of capacity, consider the request and may in its absolute discretion, offer terms for the Fresh agreement. Both the parties hereto shall after reaching an agreement on the offered terms, execute a fresh agreement at least three months before accepting the additional effluent quantity.

2. Both the parties hereto agree that the present agreement shall automatically come to an end in any of the following circumstances:

- On expiry of CCA granted to the member & the same having not been renewed by the member of the same having been not granted by UEPPCB.
- On expiry of CCA issued to UKDA... a Promoter of UKIL and if the same is cancelled, refused, or not granted by UEPPCB.

3. Both the parties here to further agree, in case of present agreement coming to end owing to any of the aforesaid eventualities, it will be the sole responsibility of the member to handle, treat & dispose off its raw effluent.

C. MEMBERSHIP AND OTHER CHARGES:

1. The UKIL shall provide Membership Certificate of CETP to the MEMBER on receipt of Rs 50,000 or any other amount as may be decided by the Board from time to time towards Share Capital Contribution and NO DUE CERTIFICATE issued by UKDA... that Member has paid all other contributions. The membership Certificate shall specify the committed quantity of raw Effluent water for treatment.

2. The Membership Application Form submitted by the member on 01st day of July 2020 declaring various information forms part of this agreement.

3. After having become the member, if the membership is terminated, because of any reason stated in this agreement, then in that event, the membership can be restored on the payment of required fees which shall be non- refundable.

4. The member undertakes to pay a Minimum Guarantee Charge (MGC) equivalent to 70% of charges payable per chamber per month. This is subject to change which may be notified from time to time.

5. The Member shall further provide a security deposit equivalent to two (2) months user charges based on MGC. This security deposit is adjustable against effluent treatment charges only, in the event either party decides to terminate this Agreement. No Financial Charges are applicable on the security deposit collected by Operator.

In case the member wants to take closure of the unit, the member shall inform ONE WEEK in advance to UKIL in writing mentioning the period of closure. If the closure is for more than 30 days, Member shall pay minimum guarantee charge as stated above.

6. EXESS/PENALTY CHARGE: If a member does not comply with the inlet norms OR release effluent in excess of contracted quantity, he undertakes to pay extra/additional charges as may be decided by UKIL from time to time. UKIL has the right to refuse to accept such effluent including additional quantity if inlet norms are not met with or plant capacity is not sufficient to accept additional quantity.

D. OBLIGATION OF THE UKIL

1. The UKIL is obliged to accept effluent; complying with the inlet norms and specified quantity; from the MEMBER through underground pipeline to CETP, treat the effluent at CETP, recycle/reuse to the extent possible and finally discharge treated EFFLUENT as per the outlet norms, prescribed by UEPPCB to the approved effluent discharge point.

2. UKIL is obliged to ensure proper collection, storage and disposal of solid hazardous wastes generated from CETP; as per the regulatory requirements and conditions of CC&A granted to UKDA... by UEPPCB.

3. UKIL shall be responsible for all the activities starting from the effluent collection chamber situated at the entrance of premises of every member, its conveyance, receipt, treatment, reuses / recycles to the extent possible and final discharge of treated effluent as per UEPPCB norms.

4. UKIL shall maintain daily records of wastewater flow at inlet and outlet of CETP, consumption of Energy and chemicals, solid wastes generated and all other relevant information.

5. UKIL shall ensure adequate power back up facility for ensuring smooth functioning of CETP during power failure.

E. OBLIGATIONS OF THE MEMBER

1. The MEMBER should arrange for minimum 8 hours holding capacity for storage of its effluent to meet with the emergency situation or during maintenance of CETP Plant or pipeline or for any other unforeseen situation as per its declared load of EFFLUENT.

2. The MEMBER shall also agree to comply with inlet norms of UKIL and or UEPPCB, whichever is stringent at the discharge point at member premises as specified below before discharging his raw EFFLUENT in the Conveyance System.

Sr. no	Parameters	Units	Outlet Norms for Individual Industrial Unit
1	PH	-	6 - 8.5
2	BOD	ppm	400
3	COD	ppm	900
4	TSS	ppm	300
5	Oil & Grease	ppm	15
6	Colour	Pt.co.	400

7	Temperature	oC	30
8	TDS	ppm	1800
9	Chromium	ppm	2.0
10	Sulfide	ppm	0.5
11	Phenolic compounds	ppm	1.00
12	Sulphates	ppm	1000
13	Chlorides	ppm	600

3. The MEMBER is obliged to maintain discharge limits like heavy metals and other toxicants as may be intimated by the UKIL from time to time.

4. The MEMBER is obliged to pay the bill raised by the UKIL within 7 DAYS time from the date of bill.

5. The MEMBER is obliged to pay any contribution required to fulfill the economic liabilities of UKIL pertaining to waste water, CETP and related activities; as per the formula, derived and approved by the Board of Directors, which may be notified from time to time.

6. If the party of the Second Part disconnect, dismantle or reduce any stenter chamber in existence as declared by the party while entering into this agreement, than in such situation the party of the Second Part shall do so after obtaining prior written approval of UKIL and payment of transfer fees prevailing at the time of giving approval. Thereafter it is entitled to sell the proportionate shares in reference to such chambers to any other member of UKDA.../UKIL who wants to buy the shares or has to comply with the condition of shareholding with reference to installing new chambers in its unit. However, party of Second Part will not be entitled to ask for any refund of its initial Or subsequent contributions of whatsoever nature made by it to the party of the First Part. Both the Parties to the contract (i.e. transferor & transferee) are required to clear all the dues before the transfer of shares is executed

7. The MEMBER is obliged to pay and maintain interest free refundable Security Deposit of minimum two month's billing until its membership is terminated or it is decided by UKIL to return the same to all MEMBERS.

8. Subject to review from time to time as per the prevailing monthly charges per chamber and member shall be liable to make good the deficit in the required deposit amount.

9. The MEMBER shall get the consent from the Uttarakhand Pollution Control Board directing the MEMBER to send its raw EFFLUENT to the chamber of UKIL fixed for the member near its Gate connected through pipeline up to inlet point of the CETP for treatment as per their standard procedure and norms.

10. MEMBER shall not discharge any effluent treated or untreated outside his premises leading to any open drain or surface drain or nallah, which shall be subjected to verification and vigilance of UKIL or any other regulatory authority. The member shall maintain zero discharge; other than CETP chamber; throughout the year. They shall provide necessary provisions/facilities to take care of additional water in rainy seasons.

11. In the event of CETP break down, the member will immediately close down its unit and stop discharging the effluents.

12. The Member shall ensure that chemicals, solvents such as methyl chloride and other toxic solvents are not discharged in CETP.

13. The MEMBER declares that the MEMBER shall make all arrangements and installations for the measurement of flow of the EFFLUENT if required by UKIL and shall be open to inspection by UKIL or competent authorized agency appointed by UKIL.

14. UKIL shall reserve its right to amend/change the inlet norms of raw EFFLUENT from the MEMBER, if the MEMBER's EFFLUENT is found to affect the performance of the CETP in achieving the treated effluent norms prescribed by UEPPCB or any other regulatory authority.

15. The MEMBER shall make all proper and adequate arrangements for keeping accurate and classified daily log book records of production, daily water consumption and daily waste water generation and daily waste water discharge to CETP and send the compiled records to the UKIL; for compilation and submission to UEPPCB. In case of change in product or manufacturing process/ route, the MEMBER shall also inform UKIL in advance and get confirmation for the acceptability of EFFLUENT for treatment in UKIL. UKIL shall submit above information/ data to UEPPCB or any other regulatory authority up on their request.

16. The UKIL or its Authorized Representative(s) shall have right of entry at all hours for the purpose of monitoring the Effluent Collection Facilities, quality and quantity of effluent, to inspect inventory of Stenter chambers & machineries inside the MEMBER's premises.

17. The MEMBER shall make adequate arrangements at its own cost as approved by and to the satisfaction of the UKIL for flow measurement, collection and storage of its raw EFFLUENT in its premises and shall give access to the UKIL to its storage facility for all 24 hours of the day.

18. The member shall stop the production and other activities generating wastes water during the planned/ accidental shut down of CETP operations; as per the instructions of UKIL.

19. The member shall put the metering System for their daily water consumption from the Bore well and shall keep the records of their water consumption.

20. Member shall not permit to any third party to join their line with member's chamber inside its premises from which effluent is ultimately discharged to Effluent Conveyance System. This includes the chamber outside his gate which is his discharge point.

21. The member shall not be entitled to seek membership to any other CETP and that shall consistently and permanently send the effluent to CETP of UKIL only.

F. CONVEYANCE

1. The MEMBER shall at its own cost discharge its EFFLUENT in Conveyance System maintained by UKIL complying to the inlet norms of CETP

2. The MEMBER for avoiding pollution from the discharge of its EFFLUENT has examined possibilities of having its EFFLUENT treated at its site and it has found that it is not going to be economically viable. The MEMBER states that this is the reason, which prompted him to enter into AGREEMENT with the UKIL by which it undertakes to send its EFFLUENT to be treated and processed by the UKIL.

G. QUANTITY & QUALITY OF EFFLUENT

1. The quality and quantity of EFFLUENT shall not exceed to that declared in Application Form without written consent from UKIL. UKIL will procure and install real time monitoring systems to monitor parameters like pH, TSS, TDS and flowmeters; as well as remote controlled valves in the only effluent line permitted to be connected to the conveyance network. UKIL may add more sensors at its member units, if mandated by the

regulatory authorities or if required to improve the tracking and monitoring systems. These sensors, control equipment will be installed in the premises of its members in tamper resistant boxes.

2. UKIL will establish a Control Centre at the CETP location, where all the sensors, control systems from each individual units would be tracked. Alerts on exceedances over monitored quality and quantity will be generated and send to individual member. Exceedance over the prescribed limits would also be send to UEPPCB, if so insisted. The Central Software would help in generating monthly bills, penalties against violations.

3. The MEMBER shall be responsible to provide uninterrupted power supply for the continuous operation of these sensors and control equipment. The member shall bear all the capital as well as Operation & Maintenance costs associated with RTEQMS for the calibration of the flow meter as per the instructions of UKIL. UKIL will engage agencies for calibration and regular maintenance of these sensors/ control equipment. The calibration of flow meter shall be carried out only by competent agency authorized by UKIL.

4. The UKIL may temporarily disconnect the effluent drainage connection on exceeding the sanctioned effluent quantity for the day. RTEQMS systems will generate alerts to the individual member units on crossing 90% of sanctioned effluent quantity. The connection will be restored at midnight.

5. The decision of the UKIL in disconnecting the EFFLUENT drainage connection of the MEMBER for non-compliance with various clauses shall be final and it will not be called in question and the MEMBER shall have to pay the UKIL the extra cost which shall be charged by the UKIL for the expenditure incurred in analyzing, and extra treatment charges and related other expenditures.

6. The member shall be liable to pay cost of any damage directly or indirectly caused to Effluent conveyance system and Common Effluent Treatment Plant of UKIL consequent to change in quality of effluent discharged by member in conveyance system

7. The MEMBER shall be bound to accept the said disconnection and reconnection shall be given only after the UKIL is satisfied that the member has made adequate arrangement for the pre-treatment of effluent to the acceptable inlet norms, and if it fails to do so, its membership will be suspended. The MEMBER shall have to pay to UKIL charges for the disconnection and reconnection as decided by the Board of Directors.

H. BILLING AND PAYMENT OF TREATMENT CHARGES

1. The MEMBER shall pay to the UKIL the charges as mentioned in Schedule of Charges plus applicable taxes as may be notified/made effective from time to time for treating its industrial EFFLUENT. The UKIL shall raise monthly bill for treatment to the MEMBER. The MEMBER shall make payment of the bill within 7 days from the date of the bill.

2. The applicability of service tax for the services in the form of treatment of effluents is not clearly defined in the relevant Act and Rules and therefore shall not be recovered in the bill. However, if it is established by the department at a later date that service tax is attracted on such charges, the member undertakes to pay the same from the date the department raises its demand alongwith penalties and interest for the period covered by the department in Demand Notice.

3. The member shall be liable to pay any taxes or levies or cess; if imposed by any authority from the date it is made effective.

4. In case there is any dispute regarding billing, the MEMBER shall not withhold payment. After making full payment of such invoices, the MEMBER shall lodge the claims to the UKIL giving full particulars within a period of TEN (10) DAYS from the date of making the payment, and such claims if found correct, the UKIL shall give adjustment for the same in the next bill.

5. The MEMBER shall pay interest on all delayed payments @18%. Delayed payment means any payment not received within the stipulated due date of any invoice raised against the MEMBER by the UKIL. The UKIL reserves right to disconnect and stop treatment of effluent on account of non-payment, till payment is received against the said invoice.

6. In case of dishonour of cheque, the member has to pay the amount by way of Pay Order or Demand Draft and shall have to pay the charges for dishonour of cheque and allied costs as may be fixed by UKIL from time to time.

7. The MEMBER shall be bound by the analysis of the UKIL for levy of treatment charges and shall not call it in question for any reason whatsoever. In case of dispute, joint testing may be carried out at UKIL or any Approved accredited laboratory at the MEMBER's cost.

8. The MEMBER shall be bound to pay Extra Treatment Charges and cost of damage as may be fixed for the quality and quantity of effluent treated by UKIL, which does not meet the inlet norms of CETP.

9. The UKIL shall impose penalty and / or disconnect the effluent drainage connection after giving 3 days prior notice to the MEMBER, if it is found that the MEMBER has carried out tampering with flow meter and / or declared incorrect number of operating and total installed stenter chambers.

10. Charges are subject to revision from time to time due to escalation in operations and Maintenance cost or for any other reasons not within the control of UKIL during currency period of this agreement as may be decided by the board.

11. UKIL shall impose additional charges to the member in any form in case the change in legal requirements/ directions etc. result in any treatments/ discharge/ collection/ conveyance/ operation & maintenance requirements and therefore the cost of treatment.

12. UKIL shall inform member in advance for any planned shutdown of conveyance or treatment infrastructure and may direct the member to close down/ slow down its production and related activities generating wastewater. The member has to follow the directions without questioning the same, whatsoever.

13. In case of accidental/unplanned breakdown of treatment and/or conveyance facilities; member is obliged to stop its activities; strictly in line with UKIL's directives.

I. <u>DEFAULT</u>

1. If the MEMBER defaults in the discharge of any of the obligation under the present agreement, and in the event of default by the MEMBER in payment of treatment recovery / service charges due from the MEMBER, the UKIL shall

   i. Refuse to accept EFFLUENT from the MEMBER for treatment and disconnect.

   ii. Notify to Uttarakhand Pollution Control Board AND/OR appropriate authorities the name of the MEMBER committed such default and that its EFFLUENT would not be taken for treatment by the UKIL on account of such defaults.

   iii. Inform the MEMBER that its EFFLUENT would be deemed to cause pollution and the MEMBER shall be liable as polluter under the Environmental Act/ laws/ Regulations and

iv. Notify to UEPPCB to take such action as may be deemed necessary under Environmental Act/ laws/ Regulations against such MEMBER.

2. The MEMBER declares that the MEMBER alone shall be liable for any action initiated against the MEMBER by the Uttarakhand Pollution Control Board or any other regulatory authority under the Water (Prevention and Control of Pollution) Act, 1974 or Environmental laws.

3. UKIL reserves the right to accept or refuse membership, in the event of member committing any breach / violation of the condition of the present agreement or any provision of law /Act/ Rules for the timing being in force, UKIL reserves its right to suspend / cancel the membership for such period as it deem fit without giving any reason or prior notice

4. Where an offence under the Environment Protection Act or under the rules framed there under, has been committed by the member or is attributed to any negligence on the part of the member which shall include its Directors, partner, proprietor ,manager, secretary, officer, partner, etc. and if such member is guilty to the offence or is liable to be prosecuted against and punished accordingly , No suit ,prosecution or legal proceeding (s) shall lie against UKIL for the offence committed by its member and member shall be solely responsible to bear the cost of damage including compensating towards any damage to UKIL**.**

5. It is also agreed by the MEMBER that the UKIL is not and shall not be liable in any manner whatsoever, due to any negligence and for any reason or otherwise of the MEMBER, the untreated EFFLUENT is discharged by the MEMBER at a place other than authorized by UEPPCB.

J. TRANSFER OF RIGHTS

1. The UKIL may at any time transfer or assign its rights and obligation under the AGREEMENT to any other company or business concern. Upon such transfer or assignment, only the transferee or assignee shall be liable for the obligations herein contained.

2. The MEMBER may, subject to approval of the UKIL obtained in advance in writing, transfer and assign its rights and obligations under this AGREEMENT to any other Firm or company. Upon such transfer and / or assignment, only the transferee and / or assignee shall be liable for the obligations herein contained. The MEMBER shall produce satisfactorily evidence and documents as required by the UKIL at the time of transfer of rights. No part transfer of rights shall be approved.

3. Provided further that the MEMBER shall first make payments of all bills issued by the UKIL for the EFFLUENT treatment in full including interest, if any, thereon for delayed payments before applying for the approval of transfer and / or assignment as aforesaid to the UKIL. The member shall pay the transfer fees along with application of Transfer of chambers to other member as may be decided by Board from time to time In the event of the failure on the part of the MEMBER to comply with the provisions of this agreement, the UKIL reserves the its rights to discontinue accepting EFFLUENT either to the MEMBER or to its transferee and / or assignee and without prejudice to any other rights, which the UKIL may be having under the terms of the AGREEMENT or otherwise.

4. The incoming member OR existing shall have to pay the transfer and other charges as may be fixed by UKIL from time to time.

K. PENALTIES

1. The MEMBER undertakes to pay penalties as may be notified by the UKIL for non-compliance of Clauses of this AGREEMENT as decided by the Board from time to time.

L. FORFEITURE

1. In case of failure of the MEMBER to pay charges as notified by the UKIL and as specified in various Clauses of this AGREEMENT, the UKIL shall be at the liberty to adjust the amount from deposit of the MEMBER and UKIL have right to use spare capacity to other prospective MEMBER.

M. SUSPENSION OF MEMBERSHIP

1. The MEMBER shall be suspended for non-compliance with the Clauses of this AGREEMENT at the sole discretion of the UKIL without assigning any reason whatsoever. The UKIL shall not receive any EFFLUENT from the MEMBER during the period of suspension

2. The UKIL shall inform the UEPPCB about the suspension of any MEMBER. The suspension shall be revoked only at the sole discretion of the UKIL after it is satisfied that its conditions have been met.

N. FORCE MAJEURE

1. I case of any force majeure, UKIL shall not be saddled with any liability contingent otherwise but in that case, and it shall be the sole liability of the MEMBER.

2. Statuesque neither party.

3. Both the parties hereto agree that due to change in any laws related to pollution or due to any directive of any court or Authority, if UKIL is to incur any additional financial burden consequent upon any alteration and/ or modification on the site or because of any other reason, then, in that case the MEMBER shall be liable to contribute for the same proportion to its disposal of raw effluent quantity in UKIL's chamber provided at the gate of the member.

4. The term FORCE MAJEURE in this AGREEMENT means act of God, war, revolt, riot, fire, tempest, flood, earthquake, lightening, direct or indirect consequences of war (declared / undeclared), sabotage, hostilities, national emergencies, civil disturbances, commotion, embargo or any law of promulgation, regulation or ordinance whether Central or State or Municipal, breakage, bursting or freezing of pipeline, break down in plant. Upon occurrence of such cause and on its termination, the parties rendered unable as aforesaid shall notify other party within Twenty-Four (24) hours of the beginning and the ending, giving full particulars and satisfactory evidence thereof. Any action of labour employed by the MEMBER shall not be considered as FORCE MAJEURE.

O. PREVIOUS CORRESPONDENCE

1. All discussions and meetings held and correspondence exchanged between the UKIL and the MEMBER in respect of the AGREEMENT and any decisions arrived at therein, in the past and before the coming into force of the AGREEMENT and no reference of such discussions or meetings or past correspondence shall be entertained by either the UKIL or the MEMBER for interpreting the AGREEMENT or otherwise.

P. LAWS GOVERNING THE AGREEMENT

1. The present AGREEMENT shall be subject to Indian laws and rules and regulations, notifications etc. issued under such laws.

Q. AMENDMENTS

1. Any amendments to any of the clause of the AGREEMENT shall be proposed and sent in writing to the other party by the party proposing such amendment and if both the UKIL and the MEMBER agree to such amendment, then same shall be incorporated in the AGREEMENT.

R. INDEMNITIES

1. The MEMBER shall be deemed to be in exclusive possession and control of the said EFFLUENT and fully liable and responsible for its arrangements, appurtenances and properties before the effluent leave the premises of the MEMBER through drainage connection into Effluent Drainage Line. of UKIL.

2. Accordingly the MEMBER agrees to fully protect, indemnify and hold the UKIL or its employees, agents & successors and assigns harmless against any and all claims, demands, actions, suits, proceedings and judgements and any and all liabilities, costs, expenses, damages or losses arising out of or resulting from or incidental to or in connection therewith, which may be made out against the UKIL, whether by the MEMBER, its employees, agents or successors and assigns or by third parties on account of damages or injury to property or person or loss of life resulting from or arising out of the installation, presence, maintenance or operation of the intake arrangements, appurtenances and properties of the MEMBER.

S. ARBITRATION

1. In case of any disputes or difference of opinion arising out of the present agreement the matter shall be referred to an Arbitrator mutually agreed upon by the member and UKIL whose decision on the issue shall be final and binding on both the parties.

T. TERMINATION OF AGREEMENT

1. The UKIL has the unrestricted right to terminate this AGREEMENT and deduct its all pending claims from the amount of contribution paid by the MEMBER.

2. This AGREEMENT can be terminated by either party, by giving a written notice of at least **120** days to the other. If the MEMBER requests cancellation, the provision relating to minimum charges shall be applicable, also during the notice period.

U. JURISDICTION

1. The UKIL and the MEMBER mutually agree that only the civil court at Pantnagar shall have jurisdiction for all the disputes/ differences arising out of this agreement.

2. The addresses of parties hereto unless changed by written notification to be given at least 15 days in advance by registered letter prior to proposed date of change,

IN WITNESS WHEREOF the parties hereto acting through their properly constituted representatives have set their hands to cause this AGREEMENT signed and executed in their respective names and on their behalf.

For and on behalf of UKIL **For and on behalf of the MEMBER**

Name:	Name:
Designation:	Designation:
Address:	Address:
WITNESS:	WITNESS: