ABU DHABI SEWERAGE SERVICES COMPANY (ADSSC)

DESIGN GUIDELINES

SECTION 3

SEWERAGE SYSTEM DESIGN

DOCUMENT CONTROL SHEET

Revision No.	Date	Revision Description / Purpose of Issue
01	April 2008	First Issue
02	April. 2011	- ADSSC new logo - Method of determining flows to account for populations less than 500, and use of Babbitt Formula. - Clause # 3.3.5 added defining of trade effluent regulation as per RSB commentary - Added Table 3.2.5.1 – for Sewer Corridor - Added Table 3.2.5.2 – for Sewer Under the Road Works
03	Dec. 2012	- Sub-Section # 3.7 – Vacuum Sewer (Revised) - Note # 1 has been added under the Table # 3.2.5.1; to read “For the location of sewer corridor ADSSC reference shall be made to the UPC's "Utility Corridor Design Manual" (UCDM) - Table # 3.2.7 – Design Flows has been amend for the following Developments High Cost Residence - 210 L/H/D Large Villas / Palaces - 210 L/H/D High Rise - 210 L/H/D - Sub-Section # 3.2.4 – Clause (c) Note has been added “For selected / remote area application an option of locking tops which utilize a unique locking key to open the tops designed to resistance non-authorized access. The option shall be agreed with ADSSC prior to ordering”. - Sub-Section # 3.2.3 – Layout of Manholes, Table has been added to define revised Manholes spacing
04	May. 2015	- Sub-Section # 3.2.4 – Clause (c) has been modified to include hinged manhole covers (added) - Sub-section # 3.2.7.1 – Design Flows (spec. revised) - Sub-Section # 3.3.6.2 – Grease Separators (spec. revised) - Sub-Section # 3.3.6.4 - Acid Neutralization System (added) - Sub-Section # 3.3.6.5 - Lint Interceptor (added) - Sub-Section # 3.3.6.6 – Boundary Trap (added) - Sub-Section # 3.4.1.1 – Location of Pumping Station (spec. revised)

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3.1 GENERAL

3.1.1 APPLICATION

This guide is for use by design consultants and developers when planning, designing and constructing conventional foul water gravity sewers, property connections and pumping stations (including but not limited to, the pumping/force mains) intended for adoption by ADSSC.

There shall be no departures from these guidelines except where formally confirmed by ADSSC; such departures being technically justified or representing advances in knowledge or technology.

ADSSC is committed to using new and innovative technologies where they, in ADSSC's opinion, represent the best technical solution, provide low life cycle costs and value for money. All technologies will be considered for use by ADSSC providing they have been proven in terms of performance, quality and cost.

ADSSC will approve plans for new systems, extensions to new areas or replacement sewers only when designed upon the separate system, and when they meet the requirements of these guidelines. ADSSC reserve the right not to adopt any system that fails to meet the minimum standards of these guidelines.

3.1.2 SPECIALIST SEWERAGE SYSTEMS

The design of vacuum sewerage, sewerage rehabilitation, non-disruptive methods together with special structures (including but not limited to inverted siphons, vortex drop manholes, overflows, energy dissipaters and flow control structures) are outside the scope of this Guide and should be discussed and agreed separately with ADSSC.

3.1.3 DESIGN CONSIDERATIONS

The layout of the network shall take account of the following:

a) Best use of available reservations shall be made to ensure economy of design.

b) Sewer depths shall be sufficient to accommodate not only all existing properties but also any future properties likely to be erected within the area. In certain cases, the depth of basements may need to be borne in mind.

c) Where main sewers are laid at considerable depths, it may be more economical to lay shallow rider sewers to receive the local house connections and to connect the riders at a small number of convenient points into the main sewer.

d) Consideration should be given to the likely form and method of construction as a consequence of depth and other factors such as nature of ground, groundwater and the proximity of foundations, services, etc.

e) Sewers shall generally be kept as short as possible and unproductive lengths avoided.

f) Sewer gradients shall be chosen to ensure velocities are high enough to prevent deposition of solid matter in the invert. Gradients shall be maintained without sudden changes.

g) Where a scheme is to be developed in phases, consideration shall be given to the likely flows following the initial stages of construction so that self-cleansing velocities are attained at times of peak flow each day.

h) The route and depth of a new sewer shall take account of land where there is a possibility of future development.

i) Steep gradients/high velocities shall be avoided to reduce problems of turbulence and the consequent gas/odour release and increased corrosion potential.

j) Adequate access provision for maintenance, sewers shall be laid out in straight lines, as far as is as practical.

k) Consideration shall be given to such aspects as:

   i. The position of other existing or proposed services.
   ii. The proximity of existing buildings and their foundations.
   iii. The nature of the road construction.

l) The impact of the construction of the sewer and subsequent maintenance activities upon road users and the general public.

m) When areas are being improved or redeveloped the possibility of replacing the existing sewerage system shall be considered with a view to its relocation to a more suitable layout.

n) Septicity development shall be avoided as far as possible.

3.1.4 HEALTH AND SAFETY CONSIDERATIONS

Considerations in design to mitigate risks will include but not be limited to:

a) The designer shall develop designs that preclude the need to enter into confined spaces wherever possible.

b) Safe access shall be provided to all plant requiring maintenance.

c) All aboveground systems shall be fenced off and be inaccessible to the general public.

d) Craneage or mobile lifting facilities shall be provided for all heavy equipment.

e) Stairways shall be equipped with hand railing and toe plates in accordance

with BS 5395 and BS 4592.

f) All hazards shall be signposted.

g) Lighting, to the requirements of Section 16200: Luminaires, is to be provided wherever access is required.

h) Welfare facilities shall be provided to allow operatives to clean up after maintenance work.

i) Manholes shall be equipped with covers that are secure yet can be easily removed for maintenance purposes.

j) Flow isolation facilities.

k) Access to long tunnels to allow delisting equipment as necessary.

l) Hazardous Area Zoning classification, in accordance with Section 16680 Hazardous Area Applications Guidelines, shall be established for all work carried out on any existing and proposed infrastructure.

m) The Designer shall ensure that all designs comply with the requirements of the ADSSC Health and Safety Manual.

3.1.5 SITE CONSIDERATIONS

a) Information on topography, belowground conditions, existing services, service reservations, future development, etc. shall be collected.

b) Prior to design, the positions of all existing services should be ascertained as accurately as possible and physically checked by exploratory holes if considered necessary.

c) Ground investigation should be considered in the light of the knowledge of site conditions already gained and of the probable disposition and depths of excavation.

d) At pumping station sites, investigations should establish the historical and predicted maximum flood level and subsoil conditions and physical properties of the soil to a depth of at least 1.5 x depth to station foundation together with safe allowable bearing capacity of formation, the nature of groundwater and its normal level.

e) Service reservations are prescribed by Town Planning Department of the Municipality.

3.1.6 DELIVERABLES

Design/drawings/plans should be provided to ADSSC for assessment of new systems. These include but are not limited to:

a) Location Plan – at large and small scale (1:50,000 and 1:5,000 minimum respectively).

b) Site Plan (scale 1:500) showing:

i. Levels related to an agreed datum.
ii. Site Boundary.
iii. Roads.
iv. Sewers and Property Connections.
v. Pumping stations including compound.
vi. Pumping Mains.
vii. Existing Sewers.
viii. Site Contours.

c) Longitudinal Sections (sewers and pumping mains) (scale 1:2500 to 1:500 horizontal and 1:250 to 1:100 vertical) including:

i. Existing Levels.
ii. Proposed Cover and Invert Levels.
iii. Pipe Material and Strength.
iv. Pipe Diameters.
v. Bedding Details.
vi. Air Valves and Washouts.

d) Copies of Hydraulic Calculations showing:

i. Foul System.
ii. Parameters Used.

e) Construction Details (scale 1:50 and 1:20) showing:

i. Manholes.
ii. Chambers.
iii. Pumping Stations.
iv. Ancillary Structures.
v. Building General Arrangements.

f) Pumping Station Details (scale 1:50 and 1:20) including:

i. General Arrangement.
ii. Wet well capacity/storage/start and stop levels.
iii. Pumping Main Capacity.
iv. Structural Calculations and Floatation check.
v. Surge Analysis, if required.
vi. Pump curves/pumping regimes.

3.2 SEWERAGE SYSTEMS

3.2.1 PIPE MATERIALS

Types of pipe materials should be discussed in advance with ADSSC. Guidance

regarding pipe materials acceptable to ADSSC is provided in the Design Guidelines, Section 1, General, Appendix 6 Part 3.

3.2.2 DESIGN CAPACITY

In general, sewer capacity shall be designed for the estimated ultimate contributing population, except in consideration of parts of the systems that can be readily increased in capacity.

A similar consideration shall also be given to the maximum anticipated capacity of institutions, industrial and commercial areas, etc.

In determining the required capacity of sewers, the following factors should be considered:

a) Maximum hourly domestic sewage flow.

b) Additional maximum sewage or waste flow from industrial plants.

c) Topography of the area.

d) Location of the sewage treatment plant.

e) Depth of excavation.

f) Pumping requirements.

The basis of design for all sewer projects shall accompany the plan documents. More detailed computation may be required by ADSSC for critical projects.

3.2.3 LAYOUT OF MANHOLES

Manholes and sewers should be sited with due regard for other utility services.

a) a) Manholes and sewers should be sited with due regard for other utility services.

Pipe Diameters (mm)	Maximum Manhole Spacing
150 – 200	100 meters
300 – 600	120 meters
600 – 800	160 meters
Up to 1000	200 meters
1200 and above	300 meters (subject to the ADSSC Approval)

The above mentioned spacing's are based on typical installation conditions and shall only be taken as indicative. The Consultant / Contractor shall undertake

design calculations and site investigation to determine manholes spaces to suite the site conditions / layout.

Further, for industrial application the privilege shall be given to the site layout subject to meet all the design conditions required for sustainable operations.

b) A manhole should be built at:

i. At changes of slope in pipeline.
ii. At changes of direction.
iii. At junctions including property connections.
iv. At changes of pipe diameter.
v. At termination of sewers.
vi. At any designated special locations.

c) No connection pipe should enter the manhole at an angle of greater than 90° to the direction of the flow.

3.2.4 DESIGN OF MANHOLES

a) Types:

i. Refer to standard drawings.
ii. ADSSC may consider application of new materials (HDPE, uPVC) for construction of prefabricated manhole, providing that that there is sufficient proof for viability of the application.

b) Manhole cover levels:

i.	Paved areas	cover level = final paved level.
ii.	Landscaped areas	cover level = final ground level +0.1m.
iii.	Open, unpaved areas	cover level = final ground level +0.25m.

c) Manhole covers:

i.	Rectangular	600mm x 750mm.
ii.	Circular	750mm diameter.

Note : Manhole's Covers Security : Following measures / options shall be adopted to resistance the non-authorized access to the manholes and to stop the stealing of manholes covers from the sites, please be noted that the adoption of one or both security options shall be subject to an agreement with the ADSSC in advance prior to ordering of any covers / frame :

i. Manhole covers with unique 1/4 turn locking mechanism, the cover's opening key(s) shall also be provided by the manufacturer.
ii. Covers with hinges (single / double) to allow the opening of a cover to 130° (degree) as minimum and shall be incorporated with a 90° hinge blocking feature that's to prevents cover from accidental closure. (Note : all the accessories hinges pins, locks, keys, etc… shall be resistive to harsh corrosive environment and shall designed to assure long maintenance free service)

d) Drop manhole or backdrop connection:

i. Use to be limited to unavoidable situations.
ii. For a diameter pipe of 150 mm the minimum drop is 0.7 m.
iii. See standard drawing.

To avoid odour nuisance, ventilation of the manhole(s) shall be considered.

3.2.5 DEPTH OF SEWERS AND STRUCTURAL DESIGN

Sewers laid within highways shall have a minimum cover of 1.2m, measured from the top of the pipe barrel to the finished road level, to avoid interference with other services. Where this is not practical, special protection may be required. The structural design of the pipeline shall take account of the passage of construction plant as well as normal design loading.

a) Minimum cover to pipelines:

i.	Without protection	1.2m (depth to top of pipe).
ii.	With protection	0.5 m (depth to top of protection).
iii.	Under existing services	0.3m (minimum distance between).

b) Protection:

i. Concrete bed and surround.
ii. Bunds can be used in ground to be raised if initial cover is 1.0 to 1.5m.

A design check shall be carried out when a shallow depth beneath a highway is needed.

Basis of design used in allocating the service corridors and the proposed widths has been summarized

Table 3.2.5.1 – Sewer Corridor

Sewer diameter (mm)	Corridor Width (mm)
150 - 500	2,000
600 - 900	2,800
1,000 - 1,200	3,200
1,400 - 1,700	4,000
1,800	4,100
1,800 - 2,400	4,400

Note 1: Sewer corridor width is dictated by chamber size for gravity sewers. For rising mains the corridor shall be dictated by valve chamber dimensions on a case by case basis.

Note # 1 : For the location of sewer corridor ADSSC reference shall be made to the UPC's "Utility Corridor Design Manual" (UCDM)

Table 3.2.5.2 – Sewer Under the Road Works

Roadway classify - cation	Roadway type		Surface	Sewer Diameter						Rising Mains Diamet - er (mm)		Remark
				150mm - 400mm		400mm - 1,000mm		> 1,000mm		150mm-300mm	> 300mm	
				depth up to 4m	depth > 4m	depth up to 4m	depth > 4m	depth up to 4m	depth > 4m	depth < 4m		
A. Major Highway	Freeway		Asphalt	NO								Note 1
	Expressway											
B. Minor Highways	Arterial links (minimum of 2 carriageways in both directions)		Asphalt	YES						NO		X
C. Sector Roads see below	Sub-arterial links											Note 2
	Single carriageway	One way	Asphalt	YES		NO		NO		NO		Notes 2, 3.
			Interlocking paving									Notes 2, 3.
	Single carriageway	Two way	Asphalt	YES				NO				Notes 2, 3, 4.
			Interlocking paving									Notes 2, 3, 4.
	Double carriageway or more	One way	Asphalt									Notes 2, 3, 4, 5.
			Interlocking paving									Notes 2, 3, 4, 5.
	Double carriageway or more	Two way	Asphalt					YES				Notes 2, 3, 4, 5.
			Interlocking paving									Notes 2, 3, 4, 5.
D. Parking and turning areas			Asphalt							YES		X
			Interlocking paving									

Note 1: Always asphalt surfaced. Not allowed in case of parallel laying, however direct crossing is permitted under Non Disruptive Road Crossing (NDRC), Crossings must be the shortest distance possible. Excludes STEP Tunnel and connecting infrastructure which can be placed under any highway

Note 2: Road crossings allowed but must be the shortest distance across carriage way and have manholes located at each side of the crossing.
Note 3: NO if the maintenance or excavation works at any stage will block the traffic flow. If traffic can be diverted without blocking entire carriageway during maintenance or excavation then YES
Note 4: If YES then sewer to be located in one carriage-way so that during excavation traffic can be diverted onto the other carriageway
Note 5: Traffic crossing points required in median.
Note 6: All sewers installed under roads must be designed to accommodate road traffic loadings

3.2.5.1 STRUCTURAL DESIGN

The structural design of buried pipelines shall take the following into consideration:

a) Soil loading:

Use the Marston formulae

b) Superimposed loading:

Use highway design standards as appropriate.

c) Bedding factors (or load factors):

Refer to standard drawings.

d) Pipe strength:

i. International standards specify strengths for diameters and class of rigid pipe.

ii For flexible pipes, use the modified Spangler equation. The initial pipe stiffness shall be used for calculating the initial pipe deflection expected after backfilling. Maximum long-term deflection shall not exceed 5% using long-term pipe stiffness data.
In the areas where high ground water table is encountered, the possibility of flotation shall be considered.

3.2.6 MINIMUM SEWER SIZE

The minimum size of gravity sewer conveying raw sewage shall be 150mm nominal internal diameter.

3.2.7 HYDRAULIC DESIGN - SEWERS

Potable water consumption was not historically monitored, though the recent introduction of metering systems will eventually allow the production of usage statistics, though they are not yet available for assessment.

In this region, a large quantity of potable water has been drawn from the distribution system for use in irrigation purposes both for private developments

and by the other concerned authority.

3.2.7.1 DESIGN FLOWS

a) Per capita flow:

Design flows shall be calculated in accordance with a relevant international standard such as BS EN 752 : Drain & Sewer System Outside Building (latest edition) or another equivalent standard. Calculations shall clearly state which standard has been used with a full justification for its use further this shall be supported by the collection of data and site specific evidence to validate the proposal. Design consultants shall also need to refer to international industry guides and codes of practice such as British Water Code of Practice for Flows & Loads for the guidance of flow rate calculations

For ease of transition to the use of international standards ADSSC has retained the table below for reference only. ADSSC emphasise that all sewerage design shall be done in accordance with accepted international standards. Where deviations from standard are required it must be fully justified on a case by case basis

Table 3.2.7 – Design Flows (not to be used, for information only…see 3.2.7.1 above)

Development Type	Occupancy rate	Average Daily Flow Litres/Head
Low Cost Residential	0 - 16	180
Medium Cost Residential	0 - 16	225
High Cost Residential	0 - 16	210
Large Villas/Palaces	0 - 50	210
High Rise	Number of flats × 5	210
Educational	Number of pupils + staff	70
Hospital [1]	Number of beds + staff	350
Commercial	Number of staff/visitors	50
Mosques	Floor area m^2	100
Wet Industry	Not applicable	Varies to be advised
Dry Industry	Number of staff	50 at 8 per m^2

Development Type	Occupancy rate	Average Daily Flow Litres/Head
Army Camps	Number of occupants	100
Hotels	Number of rooms	885 litres per room per day
Permanent Labour Camps	Per Labour	160

1. Number of persons taken as twice the number of beds.

b) Peak flow.
Sewers shall be designed on a peak flow basis using one of the following methods:

i. The ratio of peak to average daily flow as determined from the equation:

$$Q_{max} / Q_{ave} = (18+\sqrt{P}) / (4+\sqrt{P})$$

(where P is the population in thousands)

ii. Value established from a hydraulic modelling study acceptable to ADSSC.

iii. Use of other values for peak design flow, (such as the use of the Babbitt formula) if justified on the basis of extensive documentation.

iv. For populations less than 500 where the flows are insufficient to give self-cleansing velocities a sewer is considered to be self-cleansing if a 150mm nominal internal diameter gravity pipe having a gradient not less than 1 in 133 is provided and at least 10 dwelling units are connected.

To provide a self-cleansing regime within gravity sewers, the minimum velocity shall be above 0.75 m/s at peak flow. In general, the maximum mean velocity shall not exceed 3 m/s at the design depth of flow.

c) Depth of flow:

i. The design depth of flow shall be 0.7 of the pipe diameter at peak flow.
ii. Minimum flow shall be considered to avoid sedimentation and achieve self-cleansing velocities.
iii. Maximum flow shall be able to clear sedimentation.

d) Minimum gradient:

i. 150mm diameter 0.75%.
ii. 200mm diameter 0.30%.

ADSSC O+M Section shall be notified of those locations where gradients are less than those associated with minimum velocity.

e) Maximum depth to invert:

i. Nominally 10m.

3.2.7.2 HYDRAULIC DESIGN EQUATIONS

Design of sewers shall be based on equations such as Manning, Colebrook-White and Hazen Williams Pipe roughness factors, as follows:

a) Manning n = 0.013.

b) Colebrook-White k_s = 0.6 mm.

c) Hazen Williams 140 for pipe diameters >500mm.
135 for pipe diameters <500mm.

Consideration shall be given to dynamic modelling in designing systems for more than 10,000 inhabitants.

3.2.8 STRUCTURAL DESIGN

The design of structures associated with sewerage systems shall comply with the requirements of the Design Guidelines Section 1, General paragraphs 1.4.12 to 1.4.14.

3.3 PROPERTY CONNECTIONS

3.3.1 LAYOUT OF WORKS

a) Future connection provision:

i. A chamber to be constructed in the approved reserve at the boundary of each known plot such that a connection can be made at any time in the future. Approval is required from ADSSC for each connection.
ii. Also, stub pipes to be incorporated in selected manholes to facilitate system extension and property connection of possible future development.

b) Chamber Spacing:

Spacing of collection chambers and inspection chambers shall be between 20m and 50m where practical.

c) General arrangement:

Each plot to drain separately to an inspection chamber outside the boundary.

3.3.2 DESIGN OF CHAMBERS

a) Classification:

i. Refer to standard drawings.
ii. Non-standard chambers may be required to accommodate the arrangement and number of outlets from the property internal drainage layout, and in restricted areas where plan area/depth requirements are not available.

b) Chamber cover levels:

i.	Paved areas	cover level = final paved level.
ii.	Landscaped areas	cover level = final ground level +0.1m.
iii.	Open and unpaved areas	cover level = final ground level +0.25m.

c) Chamber covers (minimum sizes):

i.	Rectangular	600mm x 600mm

d) Venting:

Should be provided at head chamber of every branch if not already installed within the property and should extend to 1m above roof of building

3.3.3 DEPTH OF PROPERTY CONNECTIONS

a) Minimum Cover:

i.	Without protection	1.2m (depth to top of pipe).
ii.	With protection	0.5m (depth to top of protection).
iii.	Under existing services	0.3m (minimum clearance between services)

If plot internal system requires, then minimum cover with protection can be reduced to 0.3m.

b) Protection:

i. Concrete bed and surround.
ii. When at shallow depth beneath the highway then a design check shall be carried out.

3.3.4 HYDRAULIC DESIGN OF PROPERTY CONNECTIONS

a) Minimum diameter:

To be 150mm.

b) Design Gradient:

i.	Minimum	1%.

ii. Maximum 10%.

3.3.5 TRADE EFFLUENT CONTROL REGULATIONS

Trade effluent is defined by three classes with respect to the quality and quantity in compliance with the ADSSC current treatment facilities as follows:

3.3.5.1 PROHIBITED WASTE

a) Hazardous waste

As defined in Federal Law No (24) of 1999 for the protection and development of the environment and its executive order regarding the handling of hazardous materials, hazardous wastes and medical wastes.

b) Medical waste

As defined in Federal Law No (24) of 1999 for the protection and development of the environment and its executive order regarding the handling of hazardous materials, hazardous wastes and medical wastes.

c) Radioactive waste

As defined in Federal Law No (1) of 2002 regarding the regulation and control of the use of radiation sources and protection against their hazards substance, either by itself or in combination with other substances, that will

i. Give rise to an explosion or flammable atmosphere in a Sewerage or Treatment System;
ii. Cause the obstruction of a Sewerage System because of its quantity, nature or size; and
iii. Cause an atmosphere in a Sewerage or Treatment System that is hazardous to human life or causes a Public Nuisance.

3.3.5.2 RESTRICTED SUBSTANCES

Table A: General characteristics

Substance	Unit	Maximum allowable concentration or characteristic
Chemical Oxygen Demand (COD)	mg/l	1000
Total Suspended Solids (TSS)	mg/l	500
Total Dissolved Solids (TDS)	mg/l	3000
Temperature	Degrees Celsius	45
pH	unit	> 6 and < 9
Grease & oil (hydrocarbon)	mg/l	60
Grease & oil (non hydrocarbon)	mg/l	100
Maximum physical size of non-fecal matter	mm in 2 dimensions	15

Table B: Inorganic compounds

Substance	Unit	Maximum allowable concentration or characteristic
Chloride (as Cl- ion)	mg/l	1000
Cyanide (as CN-)	mg/l	2
Fluoride (as F- ion)	mg/l	15
Sulphate (as SO4)	mg/l	1000
Sulphide (as S)	mg/l	1
TotalKjeldahl Nitrogen	mg/l	150
Total Phosphorus	mg/l	50

Table C: Organic compounds

Substance	Unit	Maximum allowable concentration or characteristic
Detergents (Linear Alkylate Sulphonate as Methylene blue active substances)	mg/l	30
Phenolic Compounds (as Phenol)	mg/l	0.5
Polycyclic Aromatic Hydrocarbons (PAH)	mg/l	0.05
Organophosphrus Pesticides	mg/l	0.01
Organochlorine Pesticides	mg/l	0.01

Table D: Metals

Substance	Unit	Maximum allowable concentration or characteristic
Aluminium	mg/l	100
Arsenic	mg/l	5
Barium	mg/l	10
Beryllium	mg/l	5
Boron	mg/l	5
Cadmium	mg/l	1
Chromium (Total)	mg/l	5
Cobalt	mg/l	5
Copper	mg/l	5
Iron	mg/l	50
Lead	mg/l	5
Lithium	mg/l	2.5
Manganese	mg/l	10
Mercury	mg/l	0.5
Molybdenum	mg/l	10
Nickel	mg/l	10
Selenium	mg/l	10
Silver	mg/l	5
Tin	mg/l	10
Vanadium	mg/l	1
Zinc	mg/l	10

3.3.5.3 LOW RISK TRADE EFFLUENTS

Following Trade Effluent Types are considered to be Low Risk Trade Effluents

a) Small Laundry services
b) Restaurants and cafes (including fast food and takeaways)

The Trade Effluent as generally of low volume, low strength, possessing a low risk to the Sewerage and Treatment Systems receiving.

3.3.6 SPECIAL REQUIREMENTS

3.3.6.1 SAND TRAPS.

Sand traps shall be installed on property connections, where required, and approved by ADSSC.

a) Location:

The trap shall be installed at the upstream end of the property connection and upstream of the grit separator or petrol interceptor. It shall be located to afford adequate access for maintenance and emptying.

b) Capacity:

As per German Standard DIN 1999 Part 2, provide recommended minimum capacities for flows up to 6 l/s as given in Table 3.3.5.

Table 3.3.6 – Sand Traps Capacities

Flow (l/s)	2	3	4	5	6
Internal Dimensions mm	1000 × 800	1400 × 800	1750 × 1000	2000 × 1000	2500 × 1000
Minimum Capacity litres (l)	520	840	1400	1800	2500

In addition, the minimum capacity for car wash plants should be 5,000 litres even when the rate of flow is under 6l/s.

These capacities assume an emptying schedule ensures that only half the trap capacity has been utilised and a maximum interval of six months.

For a more frequent emptying schedule of say once per month, the following guidelines can be used:
i. For every l/s wastewater through flow, a multiple of 100 litres of trap

capacity shall be provided for an anticipated small accumulation of sediment.

ii. For every l/s wastewater through flow, a multiple of 200 litres of trap capacity shall be provided for an anticipated normal accumulation of sediment.

iii. For every l/s wastewater through flow, a multiple of 300 litres of trap capacity shall be provided for an anticipated large accumulation of sediment.

3.3.6.2 GREASE SEPARATORS

Where it is determined by the ADSSC that waste pre-treatment is required, an approved type of grease interceptor(s) complying with the provisions of this section shall be correctly sized and properly installed in grease waste line(s) leading from sinks and drains, such as floor drains and floor sinks and other fixtures or equipment in serving establishments such as restaurants, cafes, lunch counters, cafeterias, clubs, hotels, hospitals, sanatoriums, factory or school kitchens, or other establishments where grease is introduced into the drainage or sewage system in quantities that can effect line stoppage or hinder sewage treatment or sewage disposal system.

The grease interceptor shall be supplied in accordance with the Section 1003 of the "Uniform Plumbing Code for Abu Dhabi", the code of practice as published by the RSB for "Low-Risk Trade Effluent discharges from Restaurants and Cafes" and ASTM C 1613 the "Standard Specification of Precast Grease Interceptor Tanks". In general the grease separators should be provided as closely as possible to the outlet from the premises and wherever possible in the open and away from traffic but readily accessible for cleaning.

Note : Water closets, urinals, and other plumbing fixtures conveying human waste shall not drain into or through the grease interceptor.

3.3.6.2.1 GREASE SEPERATOR DESIGN

1) The total capacity of the interceptor shall be determined by the table given hereunder

Grease separator Sizing

Pipe Diameter (mm)	Full Pipe Flow (Nominal) *	Interceptor Size Based on Thirty (30) Minute retention time. Rounded up to the next nominal size (Litres)**
50	1.22	3,000
75	3.70	8,000
100	7.93	16,000
125	14.49	30,000
150	23.68	60,000

*- 6.4mm/m slope per meter based on Manning's formula with friction factor N=0.012
**- Based on 30 minute retention time (ref.) Metcalf & Eddy, Inc. 3rd Ed.
- Alternatively the grease interceptor tank can be sized by using the peak design flow rates from all fixtures leading to the grease interceptor with minimum retention time of 30 minutes

2) The air scum volume above the liquid shall be at least 12.5 % of the volume of

liquid but not less than 230 mm high for entire surface above the liquid.

3) Pipe-to-tank connections shall employ flexible connectors conforming to the requirements of specification ASTM C923. Materials for the connectors shall have demonstrated resistance to the effects of fats, oils, grease, and fluid temperatures of at least 70°C.

4) Minimum liquid depth shall be 760 mm and maximum liquid depth shall not be more than be 1800 mm unless otherwise approved by the engineer

5) Tank dividing walls shall be monolithically cast or placed secondarily utilizing a non-sealed joint with the tank body, or any combination thereof, the multiple units installed in series are also acceptable.

6) The transfer port between compartments shall be sized to maintain a low velocity as liquid moves between compartments. A minimum of 320 cm2 shall be used where internal codes do not specify otherwise. The transfer port between compartments shall be in the middle and 25 % of the distance from the bottom of the tank to the water line. No tee, outlet filter unit(if use), or tank-dividing wall shall extend to the interior roof. The cross-sectional area of a vent shall be at least equivalent to a 100 mm diameter pipe. Poured-in-place inlet and/or outlet baffles are not permitted.

7) The inlet pipe shall be no less than 100 mm in diameter and the difference between the invert of the inlet pipe and the invert of the outlet pipe shall be a minimum of 50mm but shall not exceed to 100 mm.

8) Baffles or tees shall be placed at the inlet pipe and outlet pipes, the inlet baffle or tee shall be submerged to a depth located in the middle and 25 % of the distance from the bottom of the tank to the water line and at least 125 mm above the liquid level. The outlet baffle, tee or filter shall be submerged to a depth 150 mm to 300 mm above the tank floor. It shall extend a minimum of 125 mm above the liquid level. Outlet filter (when used) shall be maintained in accordance with manufacturer's recommendations

9) All access openings and inspection openings shall be 600mm or greater and shall be brought to ground using risers or other assemblies. An access opening shall be located over the inlet baffle or tee and the outlet baffle or tee as applicable but shall be approved by the engineer. The access openings are also to permit the pumping out of all compartments.

10) Each access opening and inspection opening shall be provided with a cover and with a means to prevent unauthorized entrance and to be water and air tight for all the operations.

3.3.6.2.2 GENERAL STRUCTURAL REQUIREMENTS

1- Manufacturer to demonstrate that failure will not occur by physically applying loads to 2.2 times of the design live load or 1.5 times of the dead load, whichever is greater. Such testing shall be witnessed and certified by a registered professional engineer, in all case the tank shall not collapse or rupture when

subjected to all the anticipated loading and hydrostatic pressures when the tank are either full or empty.

2- At a minimum the tank structural shall be designed to fully satisfy the loading criteria as stipulated in ASTM C890 designation to A-16 loading for (AASHTO HS20-44).An Independent laboratory tests and engineering calculations certifying the grease interceptor structural stability shall be submitted FOR engineer's approval.

3.3.6.2.3 WATER TIGHTNESS TEST METHOD

1- Testing for water tightness shall be performed using either vacuum testing or hydrostatic testing as instructed by the engineer.

2- For vacuum testing the tank shall be emptied and seal and a vacuum of 100 mm of mercury shall apply and will hold for 5minutes, during the initial 5 minute period the vacuum test, the test will considered as successful provided the pressure shall not drop beyond 13 mm of mercury, contrary to that that tank will again brought back to vacuum level of 100 mm of mercury and again will held for a further 5 minutes but this time no loss of vacuum is permitted. In case the tank fails to satisfy the these conditions the structure will inspected to rectify the reason to be fixed as per approved manner and as per the manufacturer recommendations and engineer approval.

3- For hydrostatic testing the tank shall be sealed and to be filled with water to its operational level, and left for 8 to 10 hours (as instructed by engineer) at ambient condition, if there is a measurable drop in the water surface elevation the tank shall be refill and the test will be repeated for another 8 to 10 h, the tank shall be considered fit for use if there is not further drop in level otherwise the manufacture shall have to submit the method of repair to the engineer for approval and test will be repeated after the repaired job as per engineer approval.

4- The tank shall considered as rejected if the tank failed during the second testing or found to be non-compliance with the any section of the specification.

Note :

- Tanks shall not be rejected for damp spots on the exterior concrete surface however the fault shall be rectified in approved method to approved by the engineer.

- Water for the testing shall of potable grade and shall be discharged to the environment in an approved way on completion of the test.

3.3.6.2.4 LIMITATION

Only wastewater containing organic grease and oils shall be discharged to a grease separator. In particular, the following shall not be is charged to a grease separator:

_ wastewater containing faeces ("black" water);

_ rainwater;

_ wastewater containing light liquids, e.g. grease or oil of mineral origin

3.3.6.2.5 EFFICIENCY DETERMINATIONS

The minimum required efficiency of grease trap at all the conditions of operations shall require to exceed to the value of 80% .

$$\text{Efficiency} = \frac{\text{Grease Added - Grease Skimmed}}{\text{Grease added}}$$

An Independent laboratory tests and engineering calculations certifying the grease interceptor capacity and efficiency shall be provided.

3.3.6.2.6 PUMP-OUTS AND GREASE REMOVAL

1- Owner must established a cleaning or pump-out routine for each grease removal devise. The maximum allowable period between pump-out or cleaning shall be 12 weeks unless otherwise agreed by the ADSSC.

2- A grease removal device requires pumping or cleaning when one or more of the following conditions exists:

- Sampling confirms the discharge is approaching the maximum allowable concentration defined in Scheduled B of the Trade Effluent Control Regulations 2010 for:
  (i) Grease and oil (non-hydrocarbon); or

  (ii) Total suspended solids; or

- There are gross solids, oil or grease visible in a sample or access point downstream of the grease removal device

3- Or, the grease separator tank shall be subject to the complete pumped-out for the removal of all the constituents if any of the condition have been observed during the inspector's inspection, These include:

(a) The surface layer of oil and grease in the interceptor is greater than 10% of the total depth of the interceptor at the measured position; or
(b) The bottom layer of captured solids in the intercept or is greater than 20% of the total depth of the interceptor at the measured position; or
(c) The total amount of floating and settled solids exceeds25% of the depth of the trap

4- Pump-outs and cleaning of externally located grease interceptors shall be performed by an environmental service provider registered with the Center of Waste Management- Abu Dhabi. (CWM) under the Technical Guideline No.5 sets out the standard operation procedures.

3.3.6.3 PETROL / OIL INTERCEPTORS

Petrol interceptors shall be provided on the outlets from vehicle washing bays,

maintenance areas and the like, prior to connection to the sewer.

a) Location:

Interceptors must be installed as closely as possible to the point of wastewater source. Adequate access is essential so that the removal of its contents can be conveniently and effectively carried out. Interceptors shall not be installed in closed premises.

b) Arrangement:

Provision of the following shall be taken into consideration.

i. Adequate ventilation.
ii. Odour seals at inlet and outlet.
iii. Secure, non-inflammable covers.
iv. Uniform flow through the separation compartment.

Note:

i. Domestic wastewater shall not be taken to the interceptor.
ii. Pumping installations must be located after the separation of the petrol/oil.
iii. Collection chambers are normally provided into which the separated petrol/oil is drawn off. This enables further separation in a non-agitated environment.

c) Capacity:

Comply with the following recommendations:

i. For vehicle washing facilities allow 2 l/s per wash line.
ii. Size of separator should be based on double the wastewater flow.
iii. For light liquids, retention time shall be a minimum of 3 minutes up to a design flow of 20 l/s. For higher flows, an additional minute can be added per 10 l/s increase.
iv. For vehicle maintenance bays where heavier liquids can be expected, the retention time should be increased to 6 or even 9 minutes.
v. Width to length ratio should be 1:1.8.

vi. Specialist input should be sought for the provision of a purpose-designed interceptor for wastewater from commercial or industrial manufacturing processes.

3.3.6.4 ACID NEUTRALIZATION SYSTEM

The Neutralization Tank is positioned so that acidic waste is collected and passed through Acid Neutralization & Monitoring System prior to discharging into the public sewer system. All the acidic effluent should be gathered separately from other non-acidic waste and all the non-acidic waste should by-pass the neutralization system. The acidic waste is chemically neutralized in the

neutralization system.(Note ; It is not recommended that acidic waste to be diluted by any mean prior to neutralization at the tank)

A) General Considerations:

1- An acid neutralization system shall be provided and installed as indicated on plans approved by the engineer.

2- All acid waste requires neutralization to a pH of 6 or below before it is permitted to discharge into any public sewer for disposal.

3- All the system shall be installed in strict accordance with the manufacturer's recommendations and best engineering practices.

4- Acid neutralization system design shall conform to criteria set for the construction under ASTM C-913"Standard Specification for Precast Concrete for Water and Wastewater Structures", and ADSSC Specification 02300 Sewage Works.

5- The exhaust from the system shall always be separately vented to the atmosphere, under no circumstances the vent from the acid neutralization shall be allow to interact with any other venting system available in the building.

6- Acidic Waste Neutralization Tank Sizing Table

Number of Laboratory Sinks	Tank Size * (liters)
2	20
4	60
8	115
16	210
22	285
27	350
30	410
40	570
50	670
For higher numbers of sinks	Design to be submitted to ADSSC for approval

7- Contractor shall submit the required copies of manufacturer's equipment specification and drawings for ADSSC / Engineer review and approvals shall be inclusive but not limited to the following details

a) Detailed manufacturer's data including installation plan/elevation drawings, rebar layout drawings, and buoyancy calculations, all certified by a registered profession engineer.

b) Manhole frame/ cover, GRP sealing plate specification & drawings.

c) Joint sealant & coatings specifications

d) Neutralization tank internal lining details

e) Pipeline & neutralization tank specifications& drawings

f) Chemical Rock (neutralization fill) Specifications

g) Method statement of installation, testing & commissioning

C) Materials:

1- Acid Neutralization Basin :
The neutralization basin shall be constructed of precast concrete to ADSSC specification 03400 (Precast Concrete). Lifting inserts to be installed for handling all as per manufacturer's requirements. Manufacturer shall certify that the vault design is accounted for the prevention of buoyancy effect. The tank shall be provided with a ductile Iron cover and frame with sealing plates shall comply with requirements against BS EN 124; size to 600mm diameter clear opening and to be water& air tight. The cover shall be marked with letters indicating “ACID NEUTRALIZATION BASIN” in addition to all the other details as per ADSSC standard drawing No. SD 403A.Inlet/outlet/vent pipe & fittings shall be made of HDPE and fused welded in assurance of leak free system

2- Interior Liner: The inner protective lining of the neutralization tank shall be constructed of either material and shall be subject to be approved by the engineer:

GRP as per ADSSC specification section 03600 for the concrete protection, the liner shall be self-supporting and rated for continuous operation temperature of 72 degrees C, and intermittent operation at 94degreesC **OR** HDPE(High Density Polyethylene) conforming to ASTMD1248 for polyolefin materials. Liner shall beminimumof5mm thick. Liner shall have integral anchors for embedment into precast concrete shell. The liner shall withstand temperatures of 72degrees C, and intermittent operation at 94 degrees C.

3- Exterior Liner : as per ADSSC specification for the concrete protection

4- Neutralization Fill : The chemical rock (neutralization fill) shall be furnished by the system manufacturer. The neutralization fill shall consist of laboratory quality dolomitic limestone (53% calcium carbonate, 45% magnesium carbonate OR Limestone with Carbonate content in exceed of 90% OR equivalent shall be certified by the accreditation authority for the specific usage). The tanks fill shall be sized to 25mm - 75mmas recommended by the manufacturer.

D) Installation:

1. The acid neutralization system shall be installed in strict accordance with the manufacturer's recommendations and according to plans and specifications approved by ADSSC / engineer.

2. The acid neutralization tank shall be installed on level, undisturbed soil.

3. The neutralization tank shall be backfilled after placement with an approved backfill material further the backfilling shall be performed simultaneously to prevent unbalanced lateral pressures on the tank. (please refer to the sketch hereunder for the typical installation)

4. System shall be filled with clean water prior to each fresh start-up of system operations. (whenever the cleaning or replacement works of the fill has been performed)

5. As far as possible all the acid containing piping shall avoided be installed within the ceiling or exposed areas, when the situation is unavoidable, special provisions shall need to made to protect the space below from leakage or accidental damage to the piping system.

6. All the vents shall be dedicated for the purpose, as the acidic fumes are more corrosive than the itself liquid acid. vent pipe shall be run independently through the building roof.

7. A discharge pH sensor must be provide to ensure that the system is operating properly in comply with the RSB guidelines for the trade effluent discharge to the public sewer system

E)- Chemical Rocks (Neutralization fill) Testing.

The fill shall be tested and third party test report shall be submitted in confirmation that propose fill is capable to neutralized all the acidic waste that's expected to be generated at the facility

F)- Maintenance

The Acid Neutralization Tank shall be periodically inspected for the proper operations as per manufacturer's recommendation or afterwards shall be scheduled as based on the performances of the system operations . Each inspection shall be consisting of removal of foreign debris and adding of chemical rock as to level the quantity.

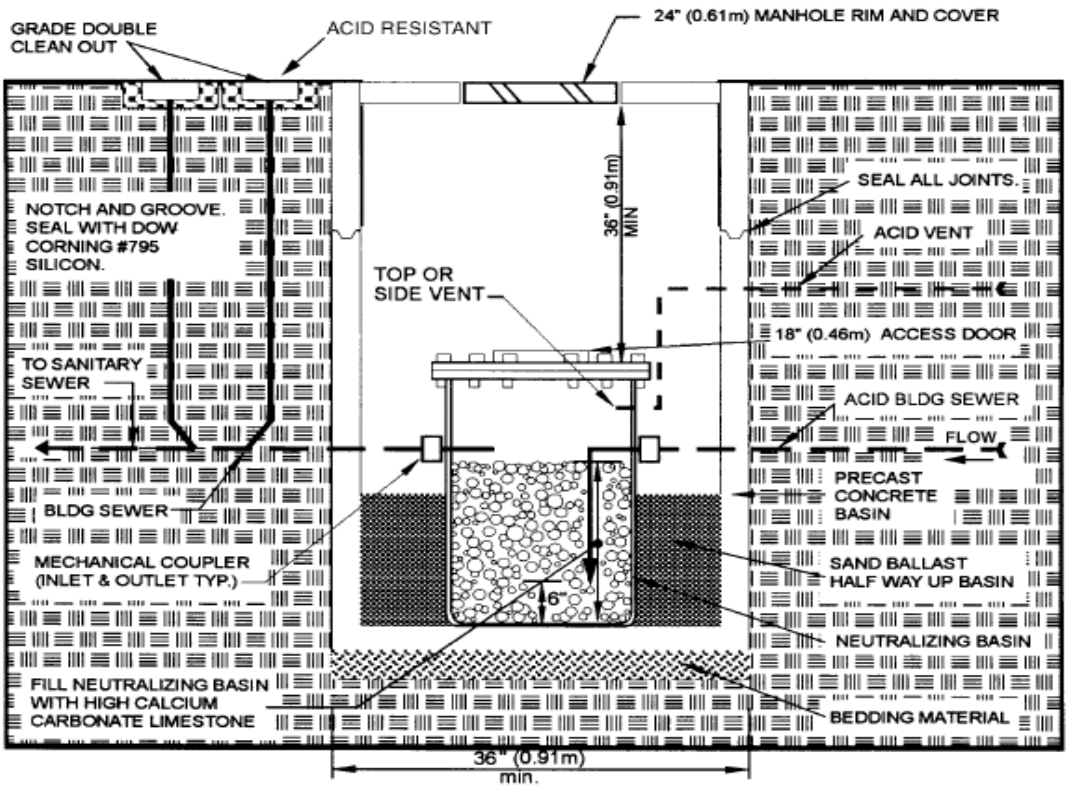
G)- Notes

i. ADSSC is not responsible for the construction or maintenance of the system.

ii. ADM NOC to be issues to the party who is responsible for constructing of the system.

iii. To be implemented as required by RSB guidelines.

iv. To be implemented on special cases such as clothing industries and labor camps



Typical Installation Sketch : Acid Nutralization System
(Courtesy to American Socity of Plumbing Engineering Data Book; Volume 3 - Special Plumbing System)

3.3.6.5 LINT INTERCEPTOR

Lint interceptors shall be used to remove excessive amounts of lint and silt that may cause blockage in the public sewer system. Chapter 10 of the Uniform Plumbing Code for Abu Dhabi requires all laundry facilities to be equipped with an interceptor. This interceptor must be fitted with a wire basket or similar device that is removable for cleaning and prevents the passage of solids which are 12.5 mm or larger lint. This interceptor shall be fitted at a point in the internal drainage network to prevent the discharge of solid wastes into the public sewerage system.

Any solid wastes removed from solids interceptors shall be placed in a leak-proof bag or container and disposed of into a solids waste bin controlled by a service provider registered with the Centre of Waste Management Abu Dhabi.

The laundry operatorsshall regularly inspect solids interceptors and baskets to ensure they are structurally intact, undamaged and in a condition that enables effective solids capture. The Interceptors and baskets shall be emptied and cleaned as required to ensure effective performance.

Laundry operatorsshall operate an effluent cooling pit, cooling channel or similar device, if required as to ensure that the temperature of the discharge to the sewerage system shall remain as below then 45°C. Laundry operatorsrequire to familiarize them self with the latest edition of RSB's Code of Practice for low-risk

Trade Effluent discharges from laundry services and shall comply with all requirements as stipulated.

A- Materials of Construction:

1- Concrete: The lint interceptor tank shall be constructed of precast concrete to ADSSC specification 03400 (Precast Concrete). Lifting inserts to be installed for handling all as per manufacturer's requirements. Manufacturer shall certify that the vault design is accounted for the prevention of buoyancy effect. The tank shall be provided with a ductile Iron cover and frame with sealing plates shall comply with requirements against BS EN 124; size to 600mm diameter clear opening and to be water& air tight. The cover shall be marked with letters indicating “LINT TRAPS” in addition to all the other details as per ADSSC standard drawing No. SD 403A.Inlet/outlet/vent pipe & fittings shall be made of HDPE and fused welded in assurance of leak free system

2- Interior Liner: The inner protective lining of the neutralization tank shall be constructed of either material and shall be subject to be approved by the engineer:

GRP as per ADSSC specification section 03600 for the concrete protection, the liner shall be self-supporting and rated for continuous operation temperature **OR** HDPE(High Density Polyethylene) conforming to ASTMD1248 for polyolefin materials. Liner shall be minimum of 5mm thick. Liner shall have integral anchors for embedment into precast concrete shell.

5- Exterior Liner : as per ADSSC specification for the concrete protection

6- Filtration Basket Assembly: The lint interceptor shall be equipped with a filtration basket strainer. The basket shall be removable through the man way cover and have handles not more than 6” from grade elevation. All materials shall be grade 316L stainless steel construction. The assembly shall have an emergency by-pass device in the event the basket filter becomes clogged.

7- Lint Trap Sizing

Number of Machines	X	2 Cycles per Hours	X	Wash Flow Rate(‡)	X	Retention Time©	X	Storage Factor®	=	Interceptor Size (Liquid Capacity)

‡ _ Laundries, self-service (minimum 10 hours per day) 189.3 L per wash cycle per day
Commercial - Per manufacturer's specifications

©_ Lint (laundry) .....2.0 hours

®_ Laundries, Laundromats .....1.5 (allows for rock filter)

8- Notes

i. ADSSC is not responsible for the construction or maintenance of the system.
ii. ADM NOC to be issues to the party who is responsible for constructing of the system.
iii. To be implemented as required by RSB guidelines.

iv. To be implemented on special cases such as clothing industries and labor camps

3.3.6.6 BOUNDARY TRAP

A boundary trap is a fixture to be installed within the property boundary where the customer's service drainage line is connected to public sewer, owner of the property shall be responsible for proper construction and periodic maintenance of boundary traps installed inside their premises. Boundary traps can either be of a 'P' or 'Running' type to provide the water seal that aerially disconnects the customer drain from public sewer. One of its main functions is to prevent sewer gases from entering the customer's drainage system. Boundary trap must be installed and maintained as per AN / NZS 3500.2 - Plumbing and Drainage Code.

Only standard boundary trap will be allowed subject to the engineers approval, fabricated boundary traps shall not be acceptable. Boundary traps shall be suitably design to allow the hindrance free flow of all the drainage from the property to the public sewer system as well as to permit to carry out all the inspection and cleaning services such as passage of CCTV cameras, drain cleaning equipment, etc...

Boundary traps materials other than ductile iron, shall be directly supported on a solid foundation by placing under the trap a concrete pad that shall be not less than 100 mm thick; and extend upwards to the inlet socket of the trap. The size of the boundary traps shall be not smaller in size than the drain that discharges to it, or smaller than DN 100.

3.4 PUMPING STATIONS

3.4.1 GENERAL

3.4.1.1 LOCATION OF PUMPING STATIONS

Pumping stations shall be readily accessible by maintenance vehicles during all weather conditions. The facility should be located off the traffic way of streets and alleys.

Pumping stations shall be generally of the submersible type designed in accordance with typical pumping station layout drawings in the Standard Drawing Section 6 and with Section 15030: Pump Sets and Associated Equipment.

Pumping station structures and electrical and mechanical equipment shall be protected from physical damage and fully operational and accessible during all the years, the complete facility shall be constructed at elevated level with due consideration of 25 years of flooding history and shall be higher in level with respect to the surrounding roads.

Pumping station shall be connected to the nearest storm water network to facilitates the safe disposal of all the surface runoff from the station. In case of unavailability of area storm water network for the connection a properly sized soak pit shall be constructed at the site for the safe and complete disposal of all

the surface runoff from the station.

3.4.1.2 SELECTION OF EQUIPMENT

Commercially available standard pumps shall be chosen and they shall be capable of impeller adjustment to modify output.

Pump type, size and numbers shall be selected to achieve the desired maximum and minimum pumping rates and so accommodate the variations in rate of discharge from the station.

Pumping stations serving only a small tributary area shall have a minimum of two identical units, either one capable of handling the design flow.

In large stations, the number of duty pump and standby units shall be chosen appropriate to the strategic importance of the station. The possible consequences of pump failure at a time of peak incoming flow or with one pump set undergoing maintenance at such a time shall be considered.

3.4.1.3 DETERMINATION OF FLOW RATES

In pump selection, the following flow rates shall be considered:

a) The design peak flow.

b) The initial and design average flow.

The pumps shall be capable of handling the design peak flow.

The initial and design average flow rates shall be considered for efficient operation of the pumping equipment. In addition, low flow rates shall also be considered when sizing the force main to ensure that settlement does not occur and cause blockages.

3.4.1.4 ELECTRICAL EQUIPMENT

Electrical equipment located in the wet well shall be suitable for use under corrosive conditions and be rated for a hazardous area in accordance with Section 16680: Hazardous Area Applications Guideline.

Where cables pass through hazardous area boundaries, suitable precautions shall be taken to prevent the passage of flammable gasses, vapours or liquids across the boundary. This shall be achieved via a proprietary gas tight seal or transit system.

The method of sealing hazardous area boundaries shall take due consideration of operational and maintenance requirements.
Where the sealing on a hazardous area boundary is likely to be modified on a regular basis, the selected method of sealing the boundary shall be suitable for regular modification whilst retaining a gas tight seal.

A fused disconnecting switch located aboveground shall be provided for all pumping stations. It shall be protected to NEMA IP65 or equivalent.

3.4.1.5 ENVIRONMENTAL ASPECTS

Pumping stations are conspicuous by their function and every effort should be made to disguise them and reduce their environmental impact to a minimum.

Architectural and layout design and materials shall be chosen for access roads, boundary walls, building superstructures and landscaping to ensure that the general appearance of the aboveground structures blend in naturally with the neighbouring arrangements.

Odour control is of primary importance to ensure that such nuisance does not arise.

3.4.1.6 ARRANGEMENT CONSIDERATIONS

The following shall be incorporated so that the pumping station installation facilitates operations and maintenance work:

a) Provision of facilities and standards of equipment that are considered suitable and acceptable to the Abu Dhabi environment and are necessary in the types of pumping stations adopted.

b) Provision of all necessary health, safety and welfare features appropriate to the numbers of personnel and the frequency of visits to the station.

c) Where applicable, duplication of incoming sewers, inlet sumps, valves, penstocks, control panels, pumps and incoming power supplies.

d) Pump operation shall be automatically controlled using a wet well level sensing system which sequences pump operation with the rise and fall of the water surface.

e) Consideration of planned capacity in relation to development phasing.

f) Appropriate wet well and sewer inlet design to minimise free fall of influent at entry, turbulence, surface vortices and air entrainment and so reduce odour emission, corrosive potential of the atmosphere and possible pump cavitation. For large stations, model tests shall be considered.

g) The wet well volume between high level and low level and the number of pumps should be such that the pumps will not be cycled more often than recommended by the manufacturer and that the retention time of the sewage will be as short as possible.

h) The lower part of the wet well or sump shall be shaped to suit pump suction and to prevent deposition of grit and sewage solids.

i) Efficiently designed, all-flanged pipework shall include the following:

i. Suitably robust pipework support and anchorage,
ii. Drainage facilities for emptying isolated pumps and pipework,
iii. Cross connections and valves to enable suction lines to be back flushed,
iv. Flexible and dismantling couplings.
v. Station bypass connections.

j) Provision of a valve chamber separate from the wet well to accommodate differential settlement.

k) The valve chamber shall be provided with a gravity drain into the wet well with the discharge of the drain protected by a flap valve or other isolating device.

l) Each pump set shall be supported from, and automatically coupled to, the outlet pipework by its own weight and shall be positively guided during installation and removal operations.

m) The guide system shall allow the pump set to be raised to the top of the wet well without the need to undo any fixing arrangements or enter the wet well.

n) Liberal dimensional tolerance in level and location for all installed items, such that they can be conveniently fitted together and fixed to the associated structure.

o) Good access facilities to and working space around all equipment.

p) Adequate access openings for the introduction and removal of all operational and safety items.

q) Adequate ventilation to all areas to be accessed.

r) Exhausted gases from the wet well should to be deodorised before discharge to the atmosphere.

s) Provision of adequate lighting and electrical power points for portable lights and tools.

t) Hosing facilities for cleaning.

u) Floor drainage in the pump well and valve chambers.

v) Provision for emptying the wet well and any other vessels.

w) Good access to site for vehicles and plant for maintenance and emergency considerations.

x) Provision of irrigation connection to wet well for flushing.

y) For pumping stations forwarding significant quantities of grease, ensure the upstream network has adequate provision for grease removal.

3.4.2 DESIGN CONSIDERATIONS

3.4.2.1 SUBSTRUCTURE CONFIGURATION

a) Unless specific or special circumstances prevail, the arrangement shall be circular. Refer to standard and typical drawings.

b) In all cases, the ground floor slab level shall be 300mm above predicted maximum flood level.

c) Pump start/stop levels shall be spaced to suit a pumping regime that produces the best compromise between stop/starts and continuous flow. The minimum live volume in the sump per pump is:

$$V = 0.25\ QT$$

where Q is the pump capacity and T is the minimum on/off cycle time offered by the pump manufacturer.

d) For an installation with several identical duty pumps, the start and stop levels of all the pumps differ by a constant value determined by the characteristics of the control system. The difference in levels should be large enough to eliminate accidental pump starts and is normally in the range 200mm to 300mm.

e) The inlet arrangement shall minimise turbulence and hence emission of gases.

f) Side slopes to wet well benching should be a minimum of 40° to 45°.

3.4.2.2 GENERAL REQUIREMENTS

a) The design shall cater for future increases in peak flow by suitable sizing of pump casings within a range to permit upsizing of impellers.

b) Consideration shall be given to provide a suitable high level emergency overflow/bypass to prevent flooding of structures during emergency conditions.

c) Three pumping station types, related to design flow, have been identified:

Type 1 - Design flow up to 100 l/s.
Type 2 - Design flow greater than 100 l/s up to 300 l/s.
Type 3 - Design flow greater than 300 l/s.

d) The factors and general requirements for each type of pumping station are given in Tables 3.4.2 a to 3.4.2 g inclusive.

Table 3.4.2 a – Design Parameters

General Requirement	Pumping Station Type 1	Pumping Station Type 2	Pumping Station Type 3
Minimum number of duty pumps	1	2	3
Minimum number of standby pumps	1	1	1
	Number of pumps depends on flow regime favoured		
Control Philosophy	Pumps to duty rotate after each start/stop cycle (see Section 16640: Control Philosophy Sewage Pumping Stations)		
Service rating for Civils	30 years design life		
Service rating for pumps	15 years design life		
Type of impeller	Mixed flow		
Solids handling capacity	100mm		
Running hours per day per pump	8 to 10 hours		
Pipework velocity at:			
Maximum flow	2.5m/s		
Minimum flow	1.0m/s		
Maximum velocity through valves	2.5m/s		
Maximum speed for pumps over 5l/s	1500rpm		
Maximum speed for small pumps up to 5l/s	3000rpm		

Table 3.4.2 b – Wet Well Arrangement

General Requirement	Pumping Station Type 1	Pumping Station Type 2	Pumping Station Type 3
Number of wells	1	2	2
Number inlets	1	2	2
Inlet control	Penstock motorised or manual		
Screens	To be used only where required when possibility of large size material is anticipated		
	Manual	Raked Either Manual or Automatic	Raked Motorised Automatic
Macerators	Submersible type and used as an alternative to screens		
Inlet baffle	To be included (or other suitable arrangement to reduce turbulence and odour)		
Station pipework	Protective coatings internally and externally		
Benching	Shaped to suit pump suctions and to prevent deposition of solids		
Access	Temporary Access used	Landings, hand railing and ladders provided only if directed by ADSSC	
Deodorisers	Activated carbon or chemical scrubbing units depending on H_2S concentration anticipated		
Internal finish	Protective liners or coatings		
Lifting equipment	Portable davit or fixed frame	Fixed motorised overhead lifting equipment to be provided.	

Table 3.4.2 c – Dry Well Arrangement

General Requirement	Pumping Station Type 1	Pumping Station Type 2	Pumping Station Type 3
Number of pumps and arrangement	1 duty 1 standby	1 duty 1 standby	2 duty 1 standby
		At least 1m clear access around pumps	
Station pipework	Protective coatings internally and externally		
Suction line control	Isolation valves required		
Delivery line control	Isolation valves and NRVs required. Throttling valves not recommended. All valves manual unless size requires motorisation.		
Station bypass	Provision to be considered for each installation		
Sump pump provision	Required if return drain to wet well not included		
Access	Safe access required by 'man hoist' and appropriate harness system		
Internal finishes	Protective liners or coatings		
Lifting equipment	Portable davit	Fixed motorised overhead lifting equipment to be provided	

Table 3.4.2 d – Superstructure

General Requirement	Pumping Station Type 1	Pumping Station Type 2	Pumping Station Type 3
Wet well no superstructure	RC cover slab with protective coating to underside. Openings with covers and sealing plates sized and located to suit access needs.		
Wet well with superstructure	Not applicable	Not applicable	Construction of control room integral with pump well

Table 3.4.2 e – External Works

General Requirement	Pumping Station Type 1	Pumping Station Type 2	Pumping Station Type 3
Minimum area of land required	100m^2	400 m^2	900m^2
Delineation of boundary	Preferably wall with pedestrian and vehicular access for operation and maintenance		
Vent locations	To be located away from the control room		
Markers	Underground services are to be appropriately signed		
Signage	Required		
Exterior Lighting	Required (switchable). Light pollution outside the boundary to be minimised.		
Interior Lighting	Required for control room, etc. (switchable).		
Access	At least 6m wide turning circle with hard standing for vehicles preferably with loading bay		
Landscaping	ADSSCs instructions to be obtained		
Services	Telephone lines for outstation telemetry	Telephone lines for outstation telemetry and hand set water supply for mess room and possible irrigation	
Watchman facilities	Toilet facilities required on all, plus fully-equipped mess room on larger stations.		

Table 3.4.2 f – Ancillaries

General Requirement	Pumping Station Type 1	Pumping Station Type 2	Pumping Station Type 3
Small power and lighting provisions	Full internal and external site lighting. All stairways and landings to be provided with emergency lighting.		
Fire protection and detection (detectors, alarms, portable hose reel system, electrical protection)	Fire detection and alarm	Fire detection, alarm and optional firefighting system	Fire detection, alarm and firefighting system
Earthing system	All pumping stations to rely on earth rods. It is recommendation to use a TN-S system.		
Standby generator	Always provide socket for portable generator.		Permanent generator required
Welfare facilities	To be provided		
WED supply - Transformer requirements	Not applicable	Possible space requirement	
Vehicular access to sump to clean sand debris	Not applicable	Always required to access sump	
Ventilation equipment for personnel and auxiliary cooling	Portable only	Provide minimum air change capacity of 15 per hour during maintenance. 5 per hour at other times.	
Air conditioning	Air conditioning of Control Panel rooms only		
Surge protection and auxiliary equipment	To be reviewed on a scheme by scheme basis	Always provided	

Note:

1) Where a fixed standby generator is provided, it shall comply with the requirements of Section 15060: Diesel Engine Generator System.

2) Where provision for a mobile generator is included, sufficient external space shall be provided to adequately accommodate the generator, its associated cabling and any refuelling needs without compromising any other requirement for vehicular access and parking.

Table 3.4.2 g – Instrumentation

General Requirement	Pumping Station Type 1	Pumping Station Type 2	Pumping Station Type 3
Wet well water level sensor	Ultrasonic level detection for sump level monitoring and pump control		
Wet well H_2S level sensor	Required		
SCADA equipment	Provide data transmission through Etisalat lines compatible with existing system		
Pumping monitoring	Running/stopped Isolated/Power on Healthy/Tripped	Running/stopped. Isolated/Power on Healthy/Tripped Larger motor units will be fitted with temperature monitors for alarm and protection circuits	
Flow monitoring	Electromagnetic flowmeters to provide integrated flow		
Valve status indication	None	If motorised valves then valve status indication provided	

3.4.3 PUMPING/FORCE MAINS

3.4.3.1 HYDRAULIC DESIGN

a) Design basis:

The following equations shall be used:

i. Manning.
ii. Colebrook-White.
iii. Hazen Williams.

b) Pipe roughness factors for the above are as follows:

i.	Manning	n = 0.0075.
ii.	Colebrook-White	k_s = 0.15mm (for velocity 1.1 to 1.8m/s).
		k_s = 0.3mm (for velocity less than 1.1m/s).
iii.	Hazen Williams	140 for pipe diameters >500mm.
		135 for pipe diameters< 500mm.

Energy losses through fittings given as equivalent pipe length i.e. factor × pipe diameter as given in Table 3.4.3 overleaf:

Table 3.4.3 – Energy Losses through Fittings

Fitting	Factor
Non Return Valve	45
Gate Valve	7
Butterfly Valve	45
Radial Tee	22
Tee Piece	54
Taper 15°-60° angle	22
Bell mouth exit	9
22½° Bend (r = d)	7
45°Bend (r = d)	14
90°Bend (r = d)	34
22½° Bend (r = ≤ 7d)	5
45° Bend (r = ≤ 7d)	9
90° Bend (r = ≤ 7d)	18

a) Minimum velocity: 1.0m/sec.

b) Maximum velocity: 2.5m/sec.

c) Minimum gradient :None.

d) Minimum pipe diameter: 100mm.

e) Maximum bend:

i. 90º with radius to suit deflection measurement requirements.
ii. Sharp bends to be avoided as much as possible.

f) For surge protection, the maximum negative pressure is 1.0m water head.

g) Means of surge control:

i. Air valves shall be used, as required.
ii. Regulating vessels are the preferred method of regulating surge. The use of regulating valve shall only be considered as a final option.
iii. Air valves along the main are not to be included in surge analysis.

h) For surge analysis, pressure and velocity changes can be calculated by the

Joukowskey equation or an approved equivalent.

i) Pump flywheels are not suitable for submersible type pumps.

j) Septicity:

Measures to avoid septicity shall be considered. Typically, they consist of:

i. Adherence to Section 16640: Control Philosophy Sewage Pumping Stations.
ii. Reduced system retention time – by smaller diameter pumping mains.
iii. Reduced pumping stations storage volumes – small enough to prevent deposition but large enough to permit good pump suction.
iv. Chemical dosing (to lessen OPEX costs – only to be used where other measures are deemed inadequate).

3.4.3.2 OTHER FEATURES

a) Minimum cover:

i. Without protection 1.2m (depth to top of pipe).
ii. With protection 0.5m (depth to top of protection).

b) Pipe bedding: Refer to the standard drawings.

c) Pipeline protection: Use of concrete slab, where required.

d) Thrust blocks:

i. Refer to the standard drawings.
ii. Check manufacturer's recommendations for maximum bend without restraint.
iii. Wherever possible, blocks shall take the form of a cradle wedged against the undisturbed trench side and design based on the safe bearing pressure of the ground.
iv. Piling may be required to achieve support from the ground at depth, subject to results of soils investigation.
v. Arrangement should not impede flexibility or expansion.
vi. Check for friction factor of safety 1.5, sliding factor of safety 2.0, overturning factor of safety 2.0 and bearing capacity.

e) Washouts:

i. Shall be installed at all low points along the pumping main.
ii. Refer to the standard drawings.

f) Air valves:

i. At all high points along pumping main.
ii. At changes in grade.
iii. At minimum 500m spacing.

iv. Also, at selected locations to suit isolation and emptying of the main, including in the vicinity of the pumping station so that the station pipework can be dismantled without emptying the whole main.
v. Refer to the standard drawings.

g) A Cleaning chamber shall be provided at the start of the main in the vicinity of the pumping station for all pipe diameters, and additionally for 100mm and 150mm diameter mains chambers are to be provided at 200m spacing.

h) Discharge chamber:

i. Shall be arranged so as to avoid turbulence or splashing. Vertical drop pipes shall be avoided and the end of the pumping main shall always be full.
ii. Surfaces of the structure shall be suitably protected against corrosion.
iii. Refer to the standard drawings.

i) Twin mains:

i. As required, to accommodate the short-term/long-term requirements of the pumping arrangement.
ii. Duplication could be limited to critical lengths if restraints are applied.
iii. Also used where pump characteristics do not lend themselves to combined working through a single main.
iv. A space between the mains shall ensure no interaction.

j) Crossover chambers: They shall be at selected locations for isolation and emptying and hence are dependent on the individual configuration of a project.

k) Marker Posts are to be provided at bends, features and crossings.

3.5 NON DISRUPTIVE METHODS

Use of the NDM technology, as an alternative to the traditional method of open-cut method, will be employed where excavating the trench is not feasible, based on ADSSC approval. Selection of the trenchless technique should be made on the basis of analysing soil conditions, suitability of the method, risks involved, related costs of the works, effects on the environment and disruption to others in the area. In major road crossings, possible settlement can be decisive criteria, and based on the approval of ADSSC and concerned authorities.

The following documents deal with the subject and can provide some guidance:

"Guidelines and Requirements for Planning and Design of NDRC". - Abu Dhabi Municipality.
"Guide to Pipe Jacking and Micro-tunnelling Design" - Pipe Jacking Association, 1987.
"Trenchless construction for underground services" - CIRIA Special Publication No.127, 1987.
"Trenchless and Minimum Excavation Techniques. Planning and selection" - CIRIA Special Publication No.147, 1998.
BS EN 14457: 2004 "General Requirements for Components Specifically Designed for Use in Trenchless Construction of Drains and Sewers".

3.6 SEWER REHABILITATION TECHNIQUES

Sewer rehabilitation techniques expanded significantly in the recent 20 years using new materials and methods of applications. Selection of the method should be carried out after investigation hydraulic, environmental and structural aspects of the sewerage network. Good guides are "Sewerage Rehabilitation Manual" by WRc, the most recent edition 2000, BS EN 13566 "Plastic piping systems for renovation of underground non-pressure drainage and sewerage networks, parts 1 to 4 and 7".

It is important to consider the behaviour of the pipeline after rehabilitation in view of the changed cross section.

Currently acceptable systems for the rehabilitation of sewers are considered to be:

a) 'Cured in place' pipe liner.

b) Deformed and reformed high density polyethylene (HDPE) pipe liner.

c) Spiral-wound pipe liner with stainless steel reinforcement. Only for sewers of 250mm diameter and greater.

d) Slip lining.

e) Pipe bursting / Pipe splitting / Pipe eating

With progress in technology, ADSSC may accept new materials and working

methods.

3.7 VACUUM SEWERS

Vacuum sewers comprise a system of conveying the waste water using an air-stream generated by vacuum for transfer of the effluent. This new technology is known to ADSSC but has had limited application to date in the Emirate. Vacuum sewers are generally used in areas of low density population, areas of flat terrain or where ground water levels are high and where conventional gravity systems may not be economical.

This technology is currently not widely used by ADSSC and its selection would only be considered following a detailed evaluation of technical, environmental, operational, maintenance and economical aspects. Approval shall be sought from ADSSC before selection.

Vacuum sewer systems are essentially mechanized systems of wastewater transport. Unlike typical gravity sewers, it uses differential air pressure to transport the wastewater and all the sewer mains are under vacuum (under negative pressure). The vacuum sewer system operates usually as follows:

- Wastewater is drained from a house to a collection chamber by gravity.

  Once the wastewater reaches a pre-determined volume within the waste water collection sump, the hydrostatic pressure activates a pneumatic controller in response to the level raise to the predetermined value this controller pneumatically opens a vacuum valve which is the interface between the vacuum systems with the collection sump. When the valve is open the wastewater is evacuated into the sewer.
- The wastewater is then transported through the collection network until it reaches the vacuum station.
- At the vacuum station the wastewater is collected in collection vessels and then pumped to its final destination using forced pressure mains or conventional gravity sewer system network.

3.7.1 SYSTEM COMPONENTS

The Vacuum Sewerage System shall consist of the following and shall comply with the requirements of general specification section 15250 Vacuum Sewerage System, the main components of this system that make the collection system operate by vacuum are :

- collection chambers (with valve chamber, pneumatic or solenoid type of vacuum valves and valve controllers)
- vacuum sewer lines “saw tooth profile” (included specific fittings)

- central vacuum station (with vacuum vessel, vacuum pumps, sewage pumps, valves, level and pressure sensors, control panel, odor control system, surge system. etc.)

The vacuum system shall comply to BS EN 1091 or equivalent or better as minimum requirements in the design of all system components as well as the system installation, testing and commissioning.

The clauses summarizes hereunder shall be incorporated by the Vacuum Designer to provide complete, operative & economical run vacuum sewerage system.

3.7.2 DESIGN REQUIREMENTS

The approved vendor shall endorse the design of the vacuum system in line with the BS EN 1091 or equivalent or better as minimum, each individual component shall comply with the relevant ADSSC general specification. Design of complete vacuum system from collection to disposal of sewerage shall be carried by a single entity / party.

3.7.3 SYSTEM OPERATIONS

3.7.3.1 COLLECTION CHAMBER / SUMP

The collection chambers serve as an interface between the gravity line from the household and the vacuum collection system, the wastewater is collected in a sump until a pressure sensor tube connected to the valve controller in response to the level raise to the predetermined value is activated and to open the the vacuum valve. Option for the manual operation shall be present in the event of a power failure or similar emergency, account shall be considered of all the storage / hauling of sewage in the system till the rescue of the system and failure alarm shall be annunciated at the main control building.

3.7.3.2 VACUUM SEWER PIPING

The vacuum sewer piping creates a network connecting the valve chambers to the central vacuum station. A so called “saw tooth profile” allows it to follow the slope of the surface and guarantees the creation of water pockets that are needed to operate the system. The piping material shall be Polyethylene (HDPE) or Polyvinyl Chloride (PVC), both with a pressure nominal of PN 10 which is equal to SDR 21 (PVC) or SDR 11 (HDPE) (d90 – d250 pipe sizes). The joints and pipe fittings shall be solvent welded PVC piping and electro fusion welded for HDPE to avoid internal rings that cause friction loss. The vacuum mains are laid at the same slope as the ground maintaining a minimum slope of 0.2 percent.

The piping has a general downward slope toward the vacuum station with the exception of vertical lifts that help maintain the shallow trench depths.. The vacuum pipeline components, including pipes, fittings, joints and sealing materials shall comply with prEN 1293, sharp bend shall be avoided. The installation of the vacuum pipeline and ancillaries shall be in accordance with the provisions of the prEN 805 relating to the installation of pipeline

Means of isolating lengths of vacuum sewer to permit repairs or to locate faults shall be provided at distances of not more than 450 m and on branch sewers not longer than 200 m. Buried valves shall have extension spindles and surface boxes. The valve clear opening shall be not less than the DN/ID of the pipe.

3.7.3.3 INTERFACE VALVE & CONTROLLER

On Wastewater reaches a pre-determined volume within the waste water collection sump, the hydrostatic pressure activates a pneumatic controller. This controller shall response to the level raise to the predetermined value and opens a vacuum valve which is the interface between the vacuum system with the collection sump. When the valve is open the wastewater is evacuated into the sewer.

In all designs the vacuum valve unit must be separated from the waste water sump ensuring the vacuum valve unit remains clean, dry and easily accessible for maintenance, The valve chamber shall include means for manual isolation of the vacuum valve unit from the vacuum service connection line so that the valve can be serviced in the absence of vacuum. The chamber shall also include means for the attachment of an evacuation hose for sump cleaning.

The sensor pipe shall be self-cleansed every time the valve cycles and in order to avoid any buildup of fats or grease in it.

3.7.3.4 SEWER PROFILE

All the pipeline layout shall confirm to the saw tooth profile. Pipeline profiles shall be self-cleansing and prevent the accumulation of solids. For service connections the minimum distance between lifts shall be 1,5 m. Vacuum sewers shall have a minimum gradient of 1 in 500. Where the ground has a gradient of 1 in 500 or more in the direction of flow the vacuum sewer may be laid parallel to the surface. Where a downhill section is followed by an uphill section, the profile shall ameliorate water-logging at the change of gradient.

To provide for efficient vacuum transport the size of individual lifts should be kept as small as possible. Many small lifts are preferable to one large lift. The change in invert at each lift should not exceed 1,5 m. For vacuum sewers the minimum distances between lifts should be 6 m. Profile changes should be made where necessary to ensure that the pipe depth does not become excessive.

3.7.3.5 VACUUM STATION

The vacuum stations maintain the vacuum in the collection system by vacuum pumps, collect wastewater in one or more vessels, and the discharge pump shall pump all the collected wastewater to the force main or nearby lift station or waste water treatment plant or a nearby gravity sewer as available. The Vacuum vessels shall be of steel with protective coatings in compliance with Section 15004 Corrosion Protection of ADSSC Standard Specification. . The level of the sewage in the vacuum vessel shall be monitored by a level controller which activates the discharge pumps (forwarding pumps) and motorized discharge valves. If the sewage rises high to the predetermined level in the vessel a high level sensor will stop and would lock out the vacuum pumps to prevent the flow of sewage into the vacuum tank. The vacuum in the vacuum vessel shall be maintained by adjustable pressure switches set to hold the desired operating range of sewer level inside the vacuum tank.

3.7.3.6 VACUUM SYSTEM OPERATIONS

Controls shall permit the selection of duty, standby vacuum pump and discharge (forwarding). Pumps controls shall be provided for the automatic introduction of the standby units in the event of failure.

3.7.3.6.1 COMMON CONTROLS:

Operation of the vacuum and transfer pumps is controlled through a PLC with software from the approved system supplier designed to ensure optimum demand-driven operation with long standing commitments. Level controls have to principally guide the following functions for the vacuum vessels:

Level Regulator System for each vessel installation includes:

Analogue level regulator for each tank with the necessary connection cables to the switchboard/control panel inside of the building prepared for the following operation programs that's the level control system shall respond to the following sewage levelsin the vacuum vessel or the sewage sump:

Emergency Stop Level	- stops vacuum generation - discharge (forwarding) pump(s) operate
Start level	- starts discharge (forwarding) pump(s);
Normal stop level	- stops discharge (forwarding) pump(s);

The vacuum station shall have a standby power generator or a socket outlet into which a mobile power generator can be connected

3.7.3.6.2 VACUUM PUMPS

Vacuum switches and/or pressure transmitters control the vacuum pumps. The parameters for pump start and stop are adjustable at the control panel (PLC based) , the vacuum level inside the vacuum tank at the station shall have a provision to vary as per designed values. The vacuum pumps shall be start and stop in a duty and Standby mode as required.

3.7.6.3 DISCHARGE PUMPS (FORWARDING PUMPS)

The level of the sewage in the vacuum vessel is monitored by a level controller which activates the discharge pump and discharge valves. If the sewage rises to high in the vessel; then a high level sensor stops and locks out the vacuum pumps to prevent the overflow of sewage into the vacuum tank.

3.7.6.4 VACUUM GAUGES / PRESSURE GAUGES

All vacuum gauges (scale from 0 to 100 kPa. vacuum) and pressure gauge shall have a stainless steel bourdon tube and socket and to be provided with ½-in. bottom outlets. Stainless steel ball valves should be used as gauge cocks. Vacuum gauges shall be provided on each incoming main line to the collection tank, immediately upstream of the isolation valve and shall be positioned to easy view from the operating position of the isolation valves.

All the general requirements shall be comply with the Section 16690 - Pressure Gauges

3.7.6.5. CONTROL PANEL

Control Panel shall be provided in compliance with ADSSC Standard Specification Section # 16020 Factory Built Assembly with all relays, starters, disconnects instruments, switches, touch screen panel, terminal boards, and wiring to perform the but not limited to the following functions. The panel shall be freestanding and color to of the panel shall comply to ADSSC Specification Section # 15001 General M&E Requirements :

- Provide control and interlock contacts for control &operation of the two (2) or more sewage discharge (forwarding) pumps in the automatic and manual modes.
- Provide control and interlock contacts for control &operation of two (2) or more vacuum pumps in the automatic and manual modes
- Provide control and interlock contacts for emergency generator operation.
- Provide control and interlock contacts for operation of a high level cut-off for vacuum pumps.
- Provide local alarm, for high wastewater level in vacuum vessel, low vacuum pressure and loss of normal electrical power.

- Provide automatic basic modem (tele-service-modem for general alarm transfer to a phone line / optical fibre system).
- Provide vacuum vessel pressure indicating receiver.
- Provide a touch panel for set-up parameter and overview the functions (HMI).
- Provide an intelligent motor control system by PLC.
- Provide an easy to use user interface.
- Monitoring the working / availability of each interface unit / valve.
- Provision of Remote access for the software maintenance / system operations.

Typical electrical controls include but not limited to :

- Vacuum level control
- Liquid level control suitable for sanitary sewage
- Motor starters with overloads
- General purpose relays
- Automatic alternators for pump cycling
- Hour run meters
- Hour for next Maintenance

Additional controls as required shall be provided necessary for the smooth operation with no additional cost to the ADSSC.

3.7.6.6 HYDRO-PNEUMATIC DESIGN

The system design shall achieve a specified minimum partial vacuum, under no flow conditions, at each interface valve. The minimum partial vacuum shall be 25 kPa. The vacuum recovery time shall not exceed the 30 min. The system shall be designed to achieve automatic restart after mechanical or electrical breakdown

3.7.6.7 ODOR CONTROL SYSTEM

Exhaust gases from the system shall be deodorized before discharge to the atmosphere. Odor control measures shall be employed in compliance with Section # 15080 Odour Control, at every venerable point.

3.8 USE OF GREY WATER

Grey water is generally defined as “Wash water from domestic properties other than toilet and kitchen wastes”. It can be used for irrigation although it requires full treatment if stored and can cause a health risk if not treated properly.

There are additional costs related to the separate plumbing / drainage system and storage / treatment facilities, and grey water systems present a much higher capital cost due to the doubling of collection systems and the deepening of the conventional sewerage network to deal with the stronger and more concentrated black water. In addition, there is currently no clear legal framework for the regulation and proper control of grey water systems.
Separate systems for grey water are attractive in some countries, as conservation techniques, when treated sewage effluent is discharged to the marine environment or local water bodies.

In Abu Dhabi Emirate, all sewage effluent is treated to irrigation standard. It is therefore considered to be best practice in Abu Dhabi for grey water to be directed to the sewer, where it will receive treatment that is better and more cost-effective than that provided by an in-situ plant, where the water will in any case be used for irrigation (wherever possible) and where the risks to human health are minimized.

Note : Please refer to RSB Guideline available on website. (www.rsb.gov.ae)

END OF SECTION