GRAVITY TYPE WASTEWATER COLLECTION, TREATMENT, AND DISPOSAL SYSTEM IN TH. VEYMANDOO

Detailed Design Report

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Project Title: Consultancy Services for Design and Works Supervision for Provision of Sewerage facilities in 05 (Five) Islands, Maldives.

Client: Ministry of Environment and Energy, Male', Republic of Maldives

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1 EXECUTIVE SUMMARY

This report addresses the detailed design for the gravity type wastewater collection and disposal system for Th.Veymandoo Island. The existing systems are mainly based small bore sewers. Without proper maintenance these systems are prone to damage and contamination of groundwater can occur. Therefore the current setup is not environmentally ideal. Furthermore, the consequential pollution of groundwater often renders the water unusable for cooking, drinking and other uses thereby adversely impacting the health and hygiene aspects of the community.

In order to establish a sustainable sewerage design, a concept design was initially prepared after compiling the data collected from a physical survey conducted during the early stages of the project. This survey aided in collecting information on existing sewerage system as well as clarifying the specific needs of the community. The detailed design is based on this approved concept presented. Furthermore, statistical projections on the population as well as households were calculated as primary information for the basis of the designing the sewerage network. Technical design parameters such as Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF) and Peak Wet Weather Flow (PWWF) were compiled for this sewerage network.

The sewerage system for Th.Veymandoo will be a gravity sewerage system where sloping pipelines will allow waste water from the entire island to flow to three zonal pumping stations. The pumping stations will transfer the sewage collected through a pressure main to the sewage treatment plant. The sewerage system shall comprise of elements of a given specification for sewer mains, cleanouts, manholes, vents, pump stations, outfall pipeline and diffuser that will ensure a 30 year design flow.

Based on design criteria and specifications, three zonal pumping stations are necessary to effectively service the entire island. Each pumping station will have 2 pumps each capable of pumping peak flow. A Sewage Treatment Plant (STP) of capacity 275 m^3/d will be designed to treat the sewage before disposal through the sea outfall. In addition to this, an administration building will be located at the site to operate and maintain this network.

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2 INTRODUCTION

This is a detailed design report for the proposed Gravity Type Wastewater Collection and Disposal System for Th.Veymandoo Island. This report will outline the system and infrastructure requirements necessary to implement a Gravity type sewer system. The detailed design is based on approved conceptual design adapted for this project and will be in compliance with the Design criteria and technical specifications for conventional gravity sewerage systems (EPA- Water and Sanitation unit). Hence, this report will act as the basis for detailed design drawings and construction of the gravity type sewer system.

2.1 BACKGROUND

2.1.1 Geographical Setting

The Island of Veymandoo, belonging to Thaa Atoll, is located in the southern region of Maldives at 2°11'12.13"N and 73°05'42.49"E. It is approximately 225 km south of the capital Male'. It has an area of about 42 hectares, occupied by a population of about 1270 as per the island council register. The island extends up to 0.85 km in length and a width of .80 km.

Table 1: Island Geographical Data

Island	**Veymandoo**
Atoll	Thaa
Location	2°11'12.13"N.73°05'42.49"E
Area	42 (hectares)
Length	0.85 km
Width	0.80 km

2.1.2 Existing sewerage facilities

The existing sewerage facilities on the island are based on septic tanks and small bore sewer systems. Poor maintenance and standard design and workmanship in the gravity lines and septic tanks has led to improper functioning of the system. This has resulted in damages to the pipeline and septic tanks contaminating the ground water. Consequently this may compromise the use of groundwater for cooking and other uses by the residents of the island. Therefore this is not environmentally ideal and unsafe for the health and hygiene aspects within the island.

2.1.3 Survey

During the topography survey road levels were taken at approximately 10 meter intervals. The survey reveals that the island has topography ranging from 0.6m to 2.0m from MSL. There is noticeable slope in the ground levels going from east to west of the island. Ground levels with in close proximity show little variance. Taking these conditions into account, having three pump stations is economical and technically viable.

3 EXISTING & FUTURE POPULATION/HOUSING PROJECTIONS

3.1 Existing Population & Housing

According to the census result of 2014, total population of the island is 928. However, the existing registered population is 1270 as per current register at Island Council. The total number of households including empty plots is 362. The population density of the island is 30 per hectare.

Table 2: Existing Population & Housing Figures (Island Council Registry)

Existing Population	1270
Population Density (per hectare)	30
Households	362

3.2 Future Population & Housing

According to statistics published by the National Planning Department, population growth rate of Veymandoo is 1.48%. This growth rate is used to estimate the future population of the island. Based on this growth rate of 1.48%, the population of the island by the year 2031 and 2046 is expected to be 1583 and 1973 respectively.

Table 3: Future Projected Population

Year	2016	2031	2046
Growth Rate	1.48	1.48	1.48
Projected Population	1270	1583	1973

3.2.1 Updated Projected Connections

As per the current register at Island Council, total number of registered household is 362. However, projected connections for the 30 year design period are approximately 480 based on the average household size of 6.

4 WASTEWATER LOADING DESIGN CRITERIA

4.1 Average Dry Weather Flows (ADWF)

Average per capita wastewater generation will be taken as 120 lpcd for the design of *Average Dry Weather Flow (ADWF)* (Refer Table 5). This is a reasonable value suitable for islands with a small land area in the Maldives based on previous experiences.
For the purpose of estimating additional demand for industrial, commercial, institutional, parks and other uses will be taken from Table 4. This table refers to the Design criteria and technical specifications for conventional gravity sewerage systems guideline released by the Water and Sanitation Unit of the Environmental Protection Agency.

Table 4: Standard Wastewater Design Loadings (EPA Design criteria and technical specifications for conventional gravity sewerage systems)

Source/Development	Average Daily Flow L/unit	Unit
Auditorium/theater	10-15 L/day	Seat
Automobile repair garage	300 L/day	Garage
Carwash - garage	1000 L/day	Garage
Bakery	1000 L/day	Bakery
Cafeteria	100 L/day	Seat
Mosque	20 L/day	Person
Community centre	10-15 L/day	Person
Health Facility		Bed
Hospital	300 L/day	Bed
Laboratory	200 L/day	Laboratory
Manufacturing - industry	As per Assessment	
Office building	500 L/day	1000 square feet
Dormitory – college or residential	150 L/day	Student
Residential – boarding house	150 L/day	Bed
Residential – 1 bedroom apartment	150 L/day	Per person
Residential – 2-3 bedroom apartment	150 L/day	Per person
Residential – guest house	150 L/day	Per person
Restaurant – fixed seat	800 L/day	1000 square feet
School – day care center	20 L/day	Child
School – Kindergarten	20 L/day	Child
School – elementary/junior high	20 L/day	Student
School – high school	25 L/day	Student

For the design, utilization percentage considered in design will be 90% of the average daily demand (Refer Table 5).

Table 5: Average Dry Weather Flow (ADWF)

	15 Years	30 Years
Parameter	**Design Value / Unit**	**Design Value / Unit**
Average daily flow (ADF)	120 lpcd	120 lpcd
Design population	1583	1973
Utilization %	90%	90%
Institutional Demand	31 m^3/day	31 m^3/day
Average Dry flow (ADWF)	199 m^3/day	241 m^3/day

4.2 Peak Dry Weather Flow (PDWF)

Manning's Equation will be used to design the sewerage system. Peak Flow Factor shall be 4as per Babbit's formula for the 30 year project population at the growth rate of 1.48 %.

Table 6: Peak Dry Weather Flow (PDWF)

	15 Years	30 Years
Parameter	**Design Value / Unit**	**Design Value / Unit**
Daily average flow (ADWF)	199 m^3/day	241 m^3/day
Peak factor (PF)	4	4
Peak Dry flow (PDWF)	797 m^3/day	965 m^3/day

4.3 Peak Wet Weather Flow (PWWF)

4.3.1 Inflow / Infiltration (Storm Allowances)

Sewer pipes have flexible joints, so for the purpose of estimating *Average Wet Weather Flows (AWWF)*, infiltration will be taken as 10% of ADWF and other flows such as storm water inflow will be 4% of ADWF (Refer Table 7).

Table 7: Peak Wet Weather Flow (PWWF)

	15 Years	30 Years
Parameter	**Design Value / Unit**	**Design Value / Unit**
Daily average flow (ADWF)	199 m^3/day	241 m^3/day
Infiltration	10%	10%
Other flows	4%	4%
Average Wet Flow (AWWF)	227 m^3/day	275 m^3/day
Peak factor (PF)	4	4
Peak Wet Flow (PWWF)	825 m^3/day	999 m^3/day

The flow characteristic is primarily domestic and the average wet weather flow is 275 cubic meters per day and the corresponding peak flow rate is 11.6 litres per second for the 30 year projected population. However, all associated hardware including pumps and initial wastewater module will be designed for the first 15 year projected population with average wet weather flow of 227 cubic meters per day and corresponding peak flow of 9.5 litres per second.

Table 8: Design Wastewater Loadings

	15 Years	30 Years
Parameter	**Design Value / Unit**	**Design Value / Unit**
Average Dry flow (ADWF)	199 m^3/day	241 m^3/day
Average Wet Flow (AWWF)	227 m^3/day	275 m^3/day
Peak Dry flow (PDWF)	797 m^3/day	965 m^3/day
Peak Wet Flow (PWWF)	825 m^3/day	999 m^3/day
Average flow	2.6 l/s	3.2 l/s
Peak flow	9.5 l/s	11.6 l/s

4.4 Water Design Allowances

In the design of the sewer system, allowances will be made for the leakage of groundwater into the sewers and building sewer connections (infiltration) and for other extraneous water entering the sewers from such sources as leakage through manhole covers, drains, roof down spouts, etc. Due to the extremely high peak flows that can result from roof down spouts, they should not, in any circumstances, be connected directly or indirectly via drains, to the sewer system.

5 SEWERAGE SYSTEM

5.1 System Overview

The sewerage system comprises of the following:

- Household inspection chambers,
- A gravity sewerage reticulation network,
- Reticulation pumping stations and pressure main system.

The sewerage system for Th.Veymandoo will be a gravity sewerage system. Wastewater from the entire island will be drained using a gravity pipe system to zonal pumping stations. The Pumping mains will transfer the sewage to the Wastewater treatment plant where by the sewage will be treated and the remaining effluent will be discharged into the sea directly through sea outfall. Pump stations located at each catchment will be able to effectively cater the wastewater generated at Average Wet Weather Flows.

The sewerage system design will be based on an assumption velocity of at least 0.60m/sec, with a pipe slope of 1 in 250 throughout, and access chamber spacing of not more than 60m, and an inspection chamber within the boundary perimeter of each house.

5.2 Sewerage System Components

5.2.1 Sewer Mains

The length of the gravity sewer main required is 9734m. Minimum uPVC pipe diameter for house laterals will be 110mm OD. Minimum main sewer uPVC pipe diameter used will be 160mm OD and above as per hydraulic design. Force main pipes will be of HDPE material and discharge capacity of sewer depends on size of sewer and flow velocity. Pipe cover over sewer pipes are of 600mm, unless deemed necessary onsite in a special case. Minimum slope required for 160 mm diameter pipe conventional sewer of 1 in 250 (0.4%) is maintained to lay the pipes within a depth range of 0.6m to 2.5m. However, the slope is adjusted if the minimum cover could not be achieved. As such few of the main lines will be at slopes greater than 0.4%. Due to the small gradient and limited sewage generated at the current flow levels, minimum velocity could not be maintained at upper reaches. Average present flow is 2 l/s and ultimate flow is 8 l/s.

The designed Sewer profiles are attached in the Annex II.

5.2.2 Cleanouts, and Manholes

5.2.2.1 Cleanouts (CO)

Cleanouts or rodding points will be installed at the start of all main sewer lines with a 160mm OD PVC 45 degree bend, a threaded end cap and a rubber gasket.

5.2.2.2 Manholes

Pre‐fabricated HDPE circular shafts for manholes and inspection chambers of minimum clear opening access 600mm diameter as standard size will be used and will be of non-biodegradable and resistant to salt. The manholes are at a maximum of 60m intervals and at every road junction. The manholes/access chamber covers is designed for heavy duty load.

5.2.2.3 Bends

All bends will be provided with reaction blocking, tie rods or restrained joints designed to prevent movement.

5.2.3 Vents

Vents in household plumbing are sufficient. However to avoid foul gases inside the network and pump stations , a 9m high GI pipe vent stack will be provided at the pumping stations.

5.2.4 Pumping Stations (or Lifting Stations)

The pumping station will be comprised of a wet well, submersible sewage pumps (one duty and one standby) and an adjacent valve chamber/discharge chamber. The pumping station will be below ground level with an adjacent weatherproof and vandal proof cabinet housing the pump controls. Locations of the pumping stations were decided after a meeting with the Island Council.

Three zonal pumping stations are required to effectively service the entire network based on the design criteria and specifications. Each pumping station will have 2 pumps (one duty and one standby) each capable of pumping peak flow. Since the pump life is approximately 5 years, pumps will be selected for the 15 year design flow.

5.3 Other Considerations

5.3.1 Emergency Storage

Pumping stations will be designed with emergency storage capacity to retain the maximum dry weather sewage inflow for a minimum response time of two hours.

5.3.2 Emergency Overflow System

5.3.2.1 Catchment Overflow Links (LO)

All catchments will be interlinked via a catchment overflow 160mm OD pipe laid at a flat grade at the closest point between two catchments to provide relief during an event where the pump station in a given catchment fails. The catchment flow links will be provided as per engineers approval.

5.3.2.2 Emergency Flow Relief Structures (EFRS)

Emergency flow relief structures will not be provided since, the pumping stations will be designed for the emergency storage to retain two hours peak dry weather flow to provide an adequate response time to a pump station failure. In addition, pumping stations will be provided with an Emergency bypass mechanism for use during pump station service and maintenance.

5.4 Connections to the Sewer System

5.4.1 Residential Connections

All premises will be connected to the sewer main with uPVC pipe of 110mm OD gravity sewer laid at a minimum grade of 1.5-2.5% to facilitate the flow of solids. A pre-fabricated corrugated uPVC inspection chamber of 315mm OD will be placed at the boundary of each residential connection prior to downstream connection with a 'Y' fixture, lateral connection.

5.5 Preliminary hydraulic design of Sewers Network

5.5.1 Design Criteria

The following parameters are taken into consideration for the design of the sewers network.

Table 9: Design Criteria

	15 Years	30 Years
Parameter	**Design Value / Unit**	**Design Value / Unit**
Design Population	1583	1973
Average daily flow (ADF)	120 lpcd	120 lpcd
Utilization %	**90 %**	**90 %**
Infiltration	10 %	10 %
Other flows	**4 %**	**4 %**
Peak factor (PF)	4	4
Pipe size	**160mm OD**	**160mm OD**
Pipe material	uPVC	uPVC
Pipe slope	**1:250**	**1:250**
Min. depth of pipe	0.6m	0.6m
Max. depth of pipe	**2.52m**	**2.52m**
Max. depth of excavation	3.0 - 3.5m	3.0 - 3.5m
Length of sewer mains	**9734 m**	**9734 m**
Peak Wet Flow (PWWF)	825 m^3/day	999 m^3/day

5.5.2 Concept hydraulic design of various components of sewer network

The average flow taken for the hydraulic design of the system is 120 lites per capita per day. In addition to this institutional demands are calculated based on the EPA guidelines. The estimate of 120 LPCD is a reasonable value appropriate for small islands of Maldives and 90 percent utilization is considered for the design. The entire island will be divided

into three catchments in order to effectively service the network based on the design criteria and specifications. Each pumping station will have 2 pumps, each capable of pumping peak flow and pumps will be selected for the 15 year design flow. The minimum diameter of the pump well will be 2.0m and depth limited to a maximum of 3.5m as recommended in the guideline.

5.5.3 Design Material

All the design materials and fittings will comply with EPA published standards and are given in Table 8.

Table 10 – Design materials of pipes and fittings

Pipes and Fittings	Material	Class
Main Wastewater collection network	uPVC (160mm OD min)	SN4 (SDR 41)
Household lateral connection	uPVC (110mm OD)	SN4 (SDR 41)
Manhole	PE/PP (DN600 min)	BS EN1610
Household inspection chamber	uPVC (DN315)	BS 1758
Wastewater pumping main	HDPE (110mm OD min)	PE100, PN16
Sea outfall	HDPE (160mm OD min)	PE100, PN16

6 GENERAL DESIGN CONSIDERATIONS FOR PUMP STATIONS AND RISING MAINS

The pumping station will be comprised of a wet well, submersible sewage pumps (one duty and one standby) and an adjacent valve chamber/discharge chamber. The pumping station will be below ground level with an adjacent weatherproof and vandal proof cabinet housing the pump controls. Locations of the pumping stations were decided after a meeting with the Island Council and approved pumping station.

Three zonal pumping stations are required to effectively service the entire network based on the design criteria and specifications. Each pumping station will have 2 pumps (one duty and one standby) each capable of pumping peak flow.

6.1 Reticulation Pumping Stations & Valve Chambers

Three zonal pumping stations are required to effectively service the entire network based on the design criteria and specifications. Each pumping station will have 2 pumps each capable of pumping peak flow. Since the pump life is 5 years, pumps will be selected for the 15 year design flow. An external valve chamber will service each of the pump stations. Locations of the pumping stations were decided after a meeting with the Island Council.

6.1.1 Wet Well Design Requirements

The minimum diameter of the wet well will be 2.5m and depth limited to a maximum of 3.6m. The pump well floor is to be shaped to avoid retention of waste water and material entering the pump well. Where this is achieved through placement of mass concrete, the concrete is to be sloped towards the well pump sump. The design will allow pumps and personnel can pass through the pump well opening. The Details of the well is provided in the Annex I. With the drawings.

6.1.2 General Arrangement

The pump well will be capable of accommodating two submersible pumps, associated pipe work, electrical wiring and access equipment and personnel access as shown in Annex II.

6.1.3 Construction requirements

Pump stations will be constructed using reinforced concrete and internal surface will be provided a double mat GRP lining with gel coat in accordance with the manufacturer's instructions. An Epoxy coating of the internal surfaces to 500 micron is also acceptable.

6.2 Rising Mains

Rising Mains or Pressure Mains used for the network will be of HDPE/PE and a diameter of 110mm and 160mm OD pipe with a specified wall thickness and stiffness to satisfy PE100 PN16, SDR11 classification for resistance to abrasion and ease of jointing using fusion butt welding.

6.2.1 Discharge Pipework Velocities

Velocities in the rising mains shall be maintained at a minimum value of 1.50m/s to facilitate the removal of sedimentation from valves and a maximum value of 3.50m/s to avoid scouring of pipe walls. Thrust blocks will be provided for the discharge pipes at not less than 1.0m intervals in any direction.

6.2.2 Isolation & Control Valves

An isolation and control valves will be placed at upstream of the rising main intersection inside the valve chamber and at downstream end of pump well in order to isolate the connection in case of pipe failure or maintenance.

6.3 Pump Selection for pump stations

The initial sizing of pumps is based on the 15 year demand. However the pump sizing for the 30 year are also provided in the table below. Details of the pump selection is provided in the Annex II. Pump curves are also provided. It should be noted that two pumps will be installed in one station.

Table 11 -Pump Selection

	15 Year Period		30 Year Period	
Pump station	Design Flow (l/s)	Design Head (m)	Design Flow (l/s)	Design Head (m)
PS1	6.8	19.9	8.2	19.9
PS2	5.8	17.5	7.0	17.5
PS2	8.5	23.9	10.3	23.9

6.3.1 Control Levels

Normal pump operation will be controlled through float-switches. The pump control system will consist of the following components for float switches:

- Low level to signal pump OFF,
- High level to signal duty pump ON,
- Maximum level alarm and,
- Standby pump ON.

The pumps specifications will be as follows:

- Pump type: Submersible grinder capable of handling solids up to 75mm
- Impeller: SS ASTM A743 CF 8 M
- Shaft: SS BS 970 Gr 304 S11
- Casing: IS 210 Gr.FG 260 with 1.5-2% Ni
- Start/Stops: restricted to6 per hour
- Motor: [as per engineering design], IP 68 protection with Class F insulation
- Guiderail pipe & Chain: SS BS 970 Gr 304 S11

All equipment such as the inlet chamber, pump wells, valves, pumps, control cabinets/panels, control cables, instrument protection, indicator meters, switches, lights, control system, ultra sensors/switches, float switches, pump controllers and related accessories will be in conformance with the published guidelines in Maldives.

7 SEWAGE TREATMENT FACILITY

Sewerage Treatment Plant will be installed in this project. For the discharged water quality, the limits defined by the European Normative 91/271/EEC and by the Water and Sanitation Unit of Maldives EPA guideline, Design criteria and technical specifications for conventional gravity sewerage systems, are as follows:

Table 12: Influent and Effluent Standards

Influent Data		*Effluent Data*	
pH	6.8 – 8.5		
BOD_5	300 mg/l	*BOD_5*	20 mg/l
COD	500 mg/l	*COD*	125 mg/l
TSS	250 mg/l	*TSS*	20 mg/l
TKN	50 mg/l	*TKN*	15 mg/l
Total phosphorus	7 mg/l	*Total phosphorus*	2 mg/l
Oils and fats	15 – 30 mg/l	*Oils and fats*	2 mg/l

7.1 Activated Sludge Treatment Plant

Preliminary capacity of Conventional Activated sludge system proposed will be 275 m^3/day. The overall process associated with the treatment plant are as follows.

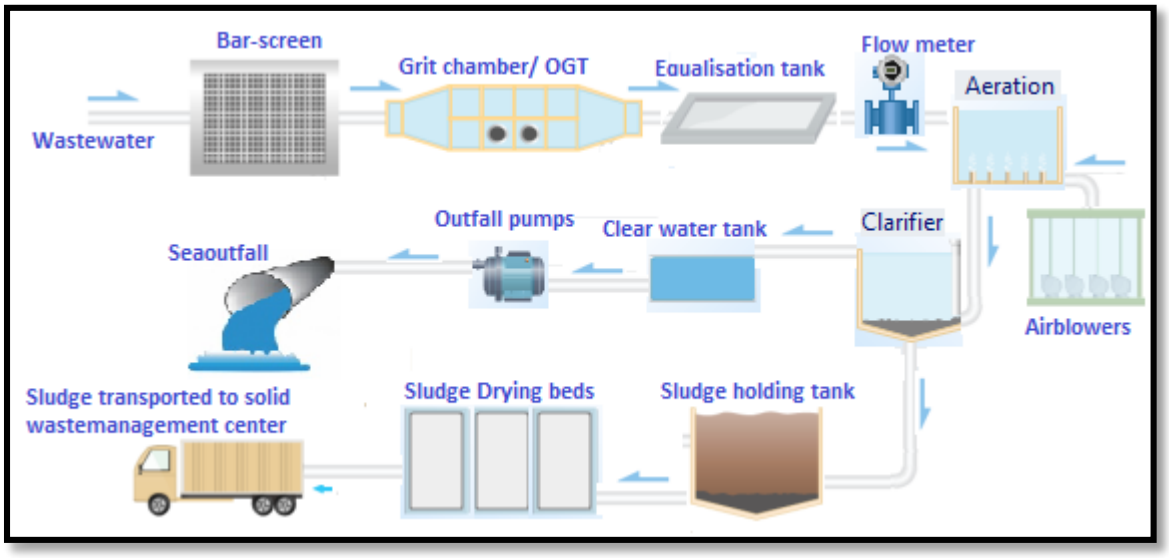


Figure 1: Activated Sludge process diagram

7.1.1 Bar screen and the oil and grease trap.

Wastewater will be pumped from pump stations in to the oil separator tank after passing through coarse bar screen. The bar screen will have a manually cleanable screen, a walk way to facilitate the operator to reach the bar screen, remove and replace the screens when necessary, and the system shall be divided into two equal units which can be isolated separately for maintenance. The oil and grease will be separated from the OG trap by manual scooping of the free floating oil and grease layer. The grease trap will house a submersible pump to transport the sludge accumulated at the bottom to the equalization tank.

Table 13-Screening Parameters

Raking Mechanism	**Manual**
Number of Screens	2 (I per unit)
Screen Perforations	6-10 mm
Encasement	Stainless Steel

7.1.2 Equalization Tank (EQT)

Once the oil and grease has been screened the wastewater will flow into equalization tank. The equalization tank will have the capacity to hold the flow of 15mins of peak flow which is equal to about an hour of AWWF. Each compartment of the EQT will have a submersible pump which will pump water into the aeration tank. Flow meters will be placed between equalization tank and the aeration tank and actuator valve will help to control the flow from EQT to aeration tank.

7.1.3 Aeration tank

From EQT wastewater will be pumped to the Aeration tank through a Flow Controller mechanism which can be monitored from the control room. The aeration tanks will have a retention time of 18- 20 hours.

The aeration tanks will be equipped with fine bubble generation system. Ceramic fine bubble diffusers will be fitted to base of the aeration tank. Air will be supplied with the help of air blowers which will be housed in the administration building. Air blowers will be twin lobe design coupled with motor, pulleys, filter, silencer and baseplate as Design Criteria and Technical Specification for Conventional Gravity Systems (EPA, MEE, and Water and sanitation unit). Blowers with sufficient power will be used to provide the necessary aeration which will help in bacterial growth. The purpose of aeration is to provide the desired effects for biological treatment. The process is based on extended aeration enable the volume of sludge produced to be considerably restricted and efficiency of biological treatment caters to large buffer capacity and cope with peak flows encountered. The foul odor or smell will be kept at the minimum possible as the system has large amount of bacteria growth and oxygen presence in the system.

7.1.4 Sedimentation tank (clarifier tank)

The aerated effluent from the aerator is let into clarifier unit by gravity. The sludge at a bottom level is sent back in to the sludge sump and finally into the drying beds for disposal. The system is designed such a way that any excess sludge can be diverted in to aeration tank. Sedimentation tank will have a minimum of 4 hour retention.

7.1.5 Sludge holding tank

The sludge collected at the bottom of the clarifier is passed to sludge holding tanks. Sludge holding tanks are constructed below ground level. The sludge holding tanks have pumps to recirculate the sludge into aeration tank to attain the sludge retention time (SRT)

required. Once the SRT is attained the waste activated sludge will be transported to sludge drying beds.

7.1.6 Clear water tank

The clear water that overflows into effluent launder will flow by gravity into the clear water tank. The clear water tank holds the effluent before being discharged via sea outfall.

7.1.7 Sludge drying beds

The waste activated sludge is dried using drying beds and the sludge cake produced will be sent to solid waste management facility. The effluent from the sludge drying beds will be collected to an effluent tank, which will have pumps to recirculate the effluent back into aeration tank.

7.1.8 Sea outfall pump.

Two sea outfall pumps will provide the necessary pressure to discharge the effluent into sea. These will be housed in the administration building.

	15 Year Period		30 Year Period	
	Design Flow (l/s)	Design Head (m)	Design Flow (l/s)	Design Head (m)
Outfall pumps	21	15.6	25.5	15.6

7.2 Outfall Pipeline and Diffuser

7.2.1 Outfall Pipeline

The length of the sea outfall is approximately 280 m. The diameter of the black PE100 pipes used will be 160mm OD. Outfall pipe will be laid to depth of 0.6 m on land and place on the natural sea bed using concrete ballast blocks anchored to the seabed to prevent the movement of the pipeline during heavy wave activity. The pipe joints will be HDPE fusion welded.

7.2.2 T-Head Diffuser Arrangement

Outfall 'T' diffuser will be fixed at end of pipe outside of the reef which is at a minimum depth of 6m below lowest tide level. However, it is expected that the end of the outfall pipe to be at 15m depth below the lowest tide level to ensure maximum environmental benefit.

7.2.3 Shoreline Stability

For the purpose of minimum impact on shoreline, the depth of pipe portion laid up to beach toe will be placed on same level as the seabed level. Pipe installed on the sea portion will be using concrete ballast blocks anchored to the seabed.

8 ADMINISTRATION BUILDING

8.1 Administrative Building

An administration building will be located at the site to facilitate the maintenance and operational works. The administration building will also serve as a storage facility with sufficient covered vehicle parking space for service vehicle. Administrative building will be separated with masonry wall. Land area required for the administrative building and the drawings are attached in Annex III.

8.2 Power Supply & Upgrade Requirements

8.2.1 Existing Power Infrastructure

Th.Veymandoo has electricity for 24 hours generated from the powerhouse. The powerhouse has three generators to power the island with a total Power Generation capacity of 793 KW.

8.2.2 Power Supply Upgrades & Connection Requirements

Estimated power consumption for the sewerage system will be 80 kW. No upgrades to the system are envisaged to cater for the sewerage system as current power supply system has the capacity to provide for the pump stations. However the utility provider has informed at the EIA stage that it will be difficult to provide the power with the existing systems to reduced efficiency of the engines. As such, power upgrade might be necessary for the island which should be coordinated by Ministry of Environment and Energy.

8.2.3 General Electrical Arrangement

The pumping stations are supplied with electricity from the existing island power supply. Provisions for a mobile backup generator is provided. In addition if the STP is to be built additional backup generator for the plant should also be supplied to cater for the electrical demands of the plant.

9 OPERATION AND MAINTENANCE

9.1 Operation and Maintenance Requirements

9.1.1 Sewer Cleaning

Difficulties arising due to low velocities observed and its resulting tendency for deposition are tackled in two ways; the high density of population and the close proximity of incoming house laterals leads in flushing pipe system. Annual hydro jetting of the network is recommended for further cleansing of the network.

9.1.2 Sewer System Maintenance Tools

All necessary maintenance tools such as squeegees, wrenches, valve keys, rakes, shovels, spare parts, etc. will be provided. A sewer jetting machine is desirable. Readily accessible storage space and workbench facilities will be provided and consideration will be given to provision of a garage for large equipment storage, maintenance and repair.

Maintenance tools and spare parts for the wastewater system will be provided by the Contractor for the operation period of one year.

Table 14 - Sewer System Maintenance Tools & Spare Parts

Maintenance Tools	**Qty**
Trailer mounted sewer jetting machine	1 nos
Adjustable wrench made up of carbon steel with standard pattern of size 200mm	2 nos
Double ended open jaw spanner set of sizes (mm): 6x7, 8x9, 10x11, 12x13, 14x15, 16x17, 18x19, 20x21, 22x23, 24x25, 26x27, 28x29, 30x31, 32x33	1 nos
Screw driver set consisting of various sizes (6", 8", 12")	1 nos
Cutting Plires 12"	1 nos
Hacksaw frame with blade	1 nos
Mechanical components	
Spare parts of each pump	2 sets
Float Switch	2 nos
Electrical components	
Contactor MN16	1 nos
Contactor MN12	1 nos
230 –V-AC Coil for Contactors	2 nos
Overload Relay MN2	2 nos
1-0-2 Change Over switch 16 Amps	2 nos
Panel Board indicator	5 nos
Single phase preventer	1 nos

Table 15-Safety tools

Safety Tools	Qty
5 kg capacity dry chemical powder type Fire Extinguisher	2 nos
Wooden First Aid Box	2 nos
Fire Bucket sand with 3 nos. of round bottom buckets	2 nos
Rubber mat of 1.1kV grade of size 6mm thick	2 nos
Fire Safety Rules chart	2 nos
Shock Treatment Chart	2 nos
Manuals and Catalogues	2 nos

9.2 Training of Personnel

As per technical specification, training will be provided by the Contractor as follows:

1. A 3 months comprehensive training program facilitated by a skilled operator will be provided for local operations and maintenance personnel following the signing of handing over Certificates. The training will include practical training on all aspects of the operation, maintenance and routine repair of the whole sewerage collection and pumping network, sewage pumping stations, equipment and facilities under normal and special operating conditions. The training will include but is not limited to training related to process, mechanical, electro-mechanical, electrical, instrumentation and control equipment supplied and installed.

2. For the purpose of training to maintain the said facilities and equipment, proper training manuals based on operation and maintenance manual and checklists will be provided.

3. An awareness and training program for the Island community, Island Office staff, utility company staffs and other personnel that may be in-directly involved with the maintenance of the household sanitation and public sewers will be provided. The awareness program would include aspects related to community participation during the construction since most of the work will be executed within or close to the houses and properties to be connected.

10 ANNEX I – DETAILED DRAWINGS

11 ANNEX II – PUMPING MAIN CALCULATIONS

PUMPING STATION FLOW

	q pk	Inlet Depth	Legth riser
	(l/s)	m	m
PS1	4.1	2.1	602
PS2	3.5	2.3	388
PS3	5.1	2.5	770
SO	12.7	1.0	281

SEWERAGE PUMPING STATION DESIGN

PS	Length p.main	Diameter p.main	Inlet depth	Diameter well	Area	q	Depth req.	v	Design depth
	m	m	m	m	m2	l/s	m	m/s	m
PS1	602	0.09	2.1	2.5	4.9	8.2	3.1	2.6	3.2
PS2	388	0.09	2.3	2.5	4.9	7.0	3.3	2.2	3.4
PS3	770	0.09	2.5	2.5	4.9	10.3	3.6	3.2	3.6

SEWERAGE PUMPING STATION PUMP SELECTION (30 YEARS)

	Factor	Diameter p. main	Length p.main	Q	Q	H
	k	mm	m	m3/min	l/s	m
PS1	0.163	110	602	0.5	8.2	19.9
PS2	0.163	110	388	0.4	7.0	17.5
PS3	0.163	110	770	0.6	10.3	23.9
SO	0.163	160	281	1.5	25.5	15.6

CUMULATIVE HEAD LOSS (30 YEARS)

PS1				
Peak Flow, q (l/s)	8.24			
Pipe Diameter ID (mm)	90			
Description	Unit	No.	Factor	HL
Static head	m	3.1	1	9.92
90 deg Elb.	nos.	6	0.05	0.15
Reflux Valve	nos.	2	0.2	0.4
T' Junction	nos.	1	0.1	0.1
Pipe Run to 'T'	m	6	0.004	0.02
Pipe Run After 'T'	m	602	0.015	9.03
90 deg Elb.	nos.	6	0.05	0.3
TOTAL				19.92

PS2				
Peak Flow, q (l/s)	6.96			
Pipe Diameter ID (mm)	90			
Description	Unit	No.	Factor	HL
Static head	m	3.3	1	10.56
90 deg Elb.	nos.	6	0.05	0.15
Reflux Valve	nos.	2	0.2	0.4
T' Junction	nos.	1	0.1	0.1
Desity factor	m	6	0.03	0.18
Pipe Run After 'T'	m	388	0.015	5.82
90 deg Elb.	nos.	6	0.05	0.3
TOTAL				17.51

PS3				
Peak Flow, q (l/s)	10.26			
Pipe Diameter ID (mm)	90			
Description	Unit	No.	Factor	HL
Static head	m	3.5	1	11.2
90 deg Elb.	nos.	6	0.05	0.15
Reflux Valve	nos.	2	0.2	0.4
T' Junction	nos.	1	0.1	0.1
Desity factor	m	6	0.03	0.18
Pipe Run After 'T'	m	770	0.015	11.55
90 deg Elb.	nos.	6	0.05	0.3
TOTAL				23.88

PUMPING STATION FLOW

	q pk	Inlet Depth	Legth riser
	(l/s)	m	m
PS1	3.4	2.1	603
PS2	2.9	2.3	388
PS3	4.2	2.5	770
SO	10.5	1.0	281

SEWERAGE PUMPING STATION DESIGN

PS	Length p.main	Diameter p.main	Inlet depth	Diameter well	Area	q	Depth req.	v	Design depth
	m	m	m	m	m2	l/s	m	m/s	m
PS1	603	0.09	2.1	2.5	4.9	6.8	3.1	2.1	3.2
PS2	388	0.09	2.3	2.5	4.9	5.8	3.3	1.8	3.4
PS3	770	0.09	2.5	2.5	4.9	8.5	3.5	2.7	3.6

SEWERAGE PUMPING STATION PUMP SELECTION (15 YEARS)

	Factor	Diameter p. main	Length p.main	Q	Q	H
	k	mm	m	m3/min	l/s	m
PS1	0.163	110	603	0.4	6.8	19.9
PS2	0.163	110	388	0.3	5.8	17.5
PS3	0.163	110	770	0.5	8.5	23.9
SO	0.163	140	281	1.3	21.0	15.6

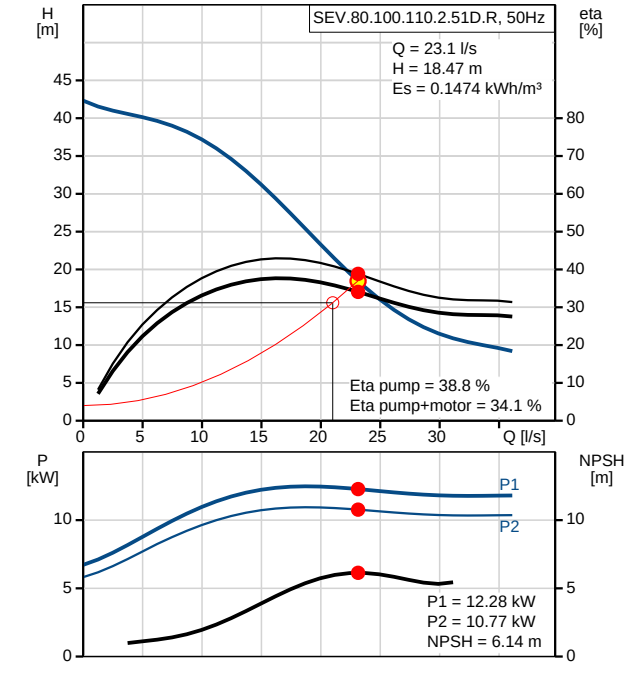
CUMULATIVE HEAD LOSS (15 YEARS)

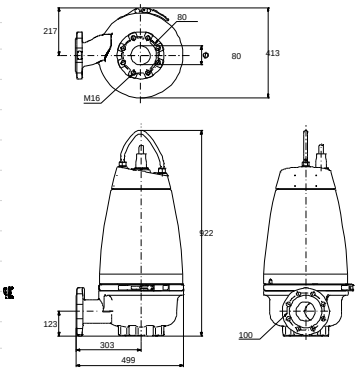
PS1				
Peak Flow, q (l/s)	6.80			
Pipe Diameter ID (mm)	90			
Description	Unit	No.	Factor	HL
Static head	m	3.1	1	9.92
90 deg Elb.	nos.	6	0.05	0.15
Reflux Valve	nos.	2	0.2	0.4
T' Junction	nos.	1	0.1	0.1
Pipe Run to 'T'	m	6	0.004	0.02
Pipe Run After 'T'	m	602	0.015	9.03
90 deg Elb.	nos.	6	0.05	0.3
TOTAL				19.92

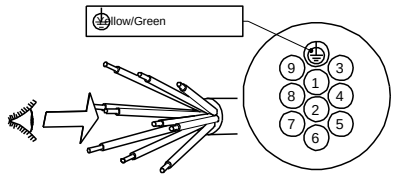
PS2				
Peak Flow, q (l/s)	5.76			
Pipe Diameter ID (mm)	90			
Description	Unit	No.	Factor	HL
Static head	m	3.3	1	10.56
90 deg Elb.	nos.	6	0.05	0.15
Reflux Valve	nos.	2	0.2	0.4
T' Junction	nos.	1	0.1	0.1
Desity factor	m	6	0.03	0.18
Pipe Run After 'T'	m	388	0.015	5.82
90 deg Elb.	nos.	6	0.05	0.3
TOTAL				17.51

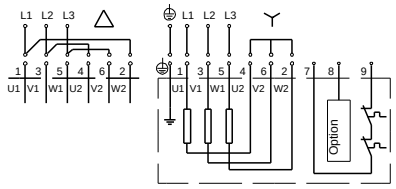
PS3				
Peak Flow, q (l/s)	8.48			
Pipe Diameter ID (mm)	90			
Description	Unit	No.	Factor	HL
Static head	m	3.5	1	11.2
90 deg Elb.	nos.	6	0.05	0.15
Reflux Valve	nos.	2	0.2	0.4
T' Junction	nos.	1	0.1	0.1
Desity factor	m	6	0.03	0.18
Pipe Run After 'T'	m	770	0.015	11.55
90 deg Elb.	nos.	6	0.05	0.3
TOTAL				23.88

Description	Value
General information:	
Product name:	SEV.80.100.110.2.51D.R
Product No:	96889342
EAN number:	5700312864585
Price:	On request
Technical:	
Actual calculated flow:	23.1 l/s
Max flow:	36.1 l/s
Resulting head of the pump:	18.47 m
Head max:	42.1 m
Type of impeller:	SUPER VORTEX
Maximum particle size:	80 mm
Primary shaft seal:	SIC/SIC
Secondary shaft seal:	CARBON/CERAMICS
Max. hydraulic efficiency:	43 %
Approvals on nameplate:	EN12050-1
Curve tolerance:	ISO9906:2012 3B
Cooling jacket:	with cooling jacket
Materials:	
Pump housing:	EN 1.4408
Impeller:	Stainless steel
Installation:	
Maximum ambient temperature:	40 °C
Maximum operating pressure:	6 bar
Flange standard:	DIN
Pump outlet:	DN 100
Pressure stage:	PN 10
Maximum installation depth:	20 m
Inst dry/wet:	DRY/SUBMERGED
Installation:	horizontal or vertical
Liquid:	
Pumped liquid:	Any Newtonian liquid
Liquid temperature range:	0 .. 40 °C
Density:	998.2 kg/m³
Electrical data:	
Power input - P1:	12.6 kW
Rated power - P2:	11 kW
Mains frequency:	50 Hz
Rated voltage:	3 x 380-415 V
Voltage tolerance:	+6/-10 %
Max starts per. hour:	20
Rated current:	22,7-21,4 A
Rated current at 3/4 load:	16.2 A
Rated current at 1/2 load:	12.3 A
Starting current:	162 A
Rated current at no load:	7.2 A
Cos phi - power factor:	0,88
Cos phi - p.f. at no load:	0,15
Cos phi - p.f. at 3/4 load:	0,84
Cos phi - p.f. at 1/2 load:	0,75
Rated speed:	2935 rpm
Locked-rotor torque:	85 Nm
Breakdown torque:	118 Nm
Moment of inertia:	0.0368 kg m²
Motor efficiency at full load:	87.7 %
Motor efficiency at 3/4 load:	88.1 %
Motor efficiency at 1/2 load:	86.4 %
Number of poles:	2
Start. method:	star/delta
Enclosure class (IEC 34-5):	IP68



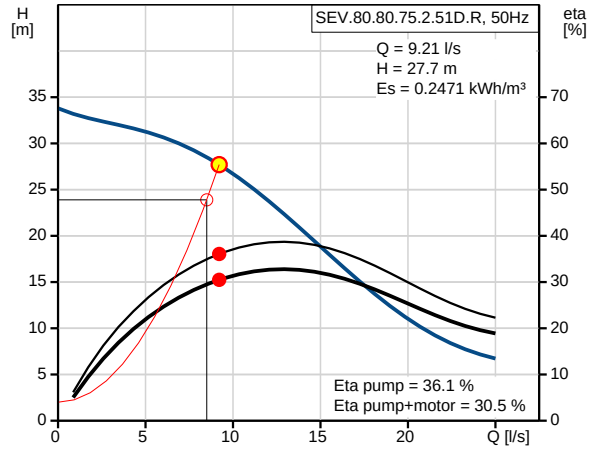


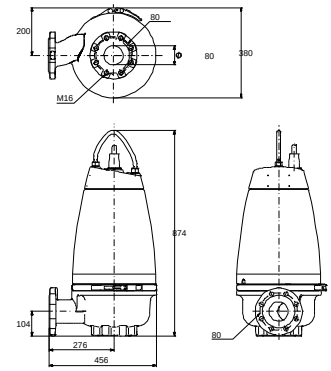


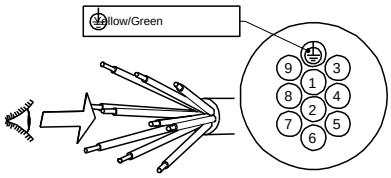


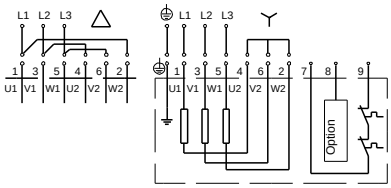
Description	Value
Insulation class (IEC 85):	F
Explosion proof:	no
Motor protec:	THERMAL SWITCH
Thermal protec:	internal
Length of cable:	10 m
Cable type:	LYNIFLEX
Type of cable plug:	NO PLUG
Controls:	
Control box:	not included
Moisture sensor:	without moisture sensors
Water-in-oil sensor:	without water-in-oil sensor
Temp. sensor:	N
Others:	
Net weight:	196 kg

Description	Value
General information:	
Product name:	SEV.80.80.75.2.51D.R
Product No:	96889330
EAN number:	5700312864462
Price:	On request
Technical:	
Actual calculated flow:	9.21 l/s
Max flow:	25 l/s
Resulting head of the pump:	27.7 m
Head max:	33.8 m
Type of impeller:	SUPER VORTEX
Maximum particle size:	80 mm
Primary shaft seal:	SIC/SIC
Secondary shaft seal:	CARBON/CERAMICS
Max. hydraulic efficiency:	39 %
Approvals on nameplate:	EN12050-1
Curve tolerance:	ISO9906:2012 3B2
Cooling jacket:	with cooling jacket
Materials:	
Pump housing:	EN 1.4408
Impeller:	Stainless steel
Installation:	
Maximum ambient temperature:	40 °C
Maximum operating pressure:	6 bar
Flange standard:	DIN
Pump outlet:	DN 80
Pressure stage:	PN 10
Maximum installation depth:	20 m
Inst dry/wet:	DRY/SUBMERGED
Installation:	horizontal or vertical
Liquid:	
Pumped liquid:	Any Newtonian liquid
Liquid temperature range:	0 .. 40 °C
Density:	998.2 kg/m³
Electrical data:	
Power input - P1:	8.9 kW
Rated power - P2:	7.5 kW
Mains frequency:	50 Hz
Rated voltage:	3 x 380-415 V
Voltage tolerance:	+6/-10 %
Max starts per. hour:	20
Rated current:	16,5-16,2 A
Rated current at 3/4 load:	12.7 A
Rated current at 1/2 load:	10.4 A
Starting current:	152 A
Rated current at no load:	7.8 A
Cos phi - power factor:	0,83
Cos phi - p.f. at no load:	0,14
Cos phi - p.f. at 3/4 load:	0,76
Cos phi - p.f. at 1/2 load:	0,65
Rated speed:	2940 rpm
Locked-rotor torque:	80 Nm
Breakdown torque:	112 Nm
Moment of inertia:	0.0215 kg m²
Motor efficiency at full load:	84.8 %
Motor efficiency at 3/4 load:	83.8 %
Motor efficiency at 1/2 load:	80.1 %
Number of poles:	2
Start. method:	star/delta
Enclosure class (IEC 34-5):	IP68



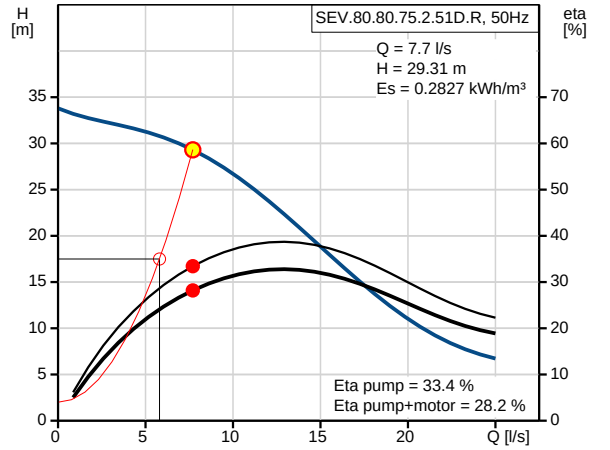


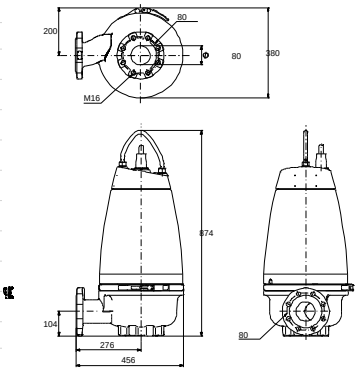


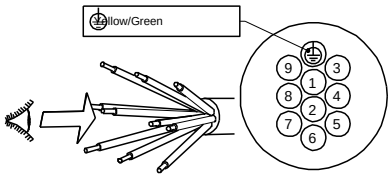


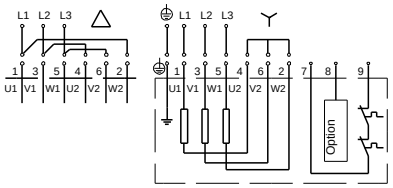
Description	Value
Insulation class (IEC 85):	F
Explosion proof:	no
Motor protec:	THERMAL SWITCH
Thermal protec:	internal
Length of cable:	10 m
Cable type:	LYNIFLEX
Type of cable plug:	NO PLUG
Controls:	
Control box:	not included
Moisture sensor:	without moisture sensors
Water-in-oil sensor:	without water-in-oil sensor
Temp. sensor:	N
Others:	
Net weight:	142 kg

Description	Value
General information:	
Product name:	SEV.80.80.75.2.51D.R
Product No:	96889330
EAN number:	5700312864462
Price:	On request
Technical:	
Actual calculated flow:	7.7 l/s
Max flow:	25 l/s
Resulting head of the pump:	29.31 m
Head max:	33.8 m
Type of impeller:	SUPER VORTEX
Maximum particle size:	80 mm
Primary shaft seal:	SIC/SIC
Secondary shaft seal:	CARBON/CERAMICS
Max. hydraulic efficiency:	39 %
Approvals on nameplate:	EN12050-1
Curve tolerance:	ISO9906:2012 3B2
Cooling jacket:	with cooling jacket
Materials:	
Pump housing:	EN 1.4408
Impeller:	Stainless steel
Installation:	
Maximum ambient temperature:	40 °C
Maximum operating pressure:	6 bar
Flange standard:	DIN
Pump outlet:	DN 80
Pressure stage:	PN 10
Maximum installation depth:	20 m
Inst dry/wet:	DRY/SUBMERGED
Installation:	horizontal or vertical
Liquid:	
Pumped liquid:	Any Newtonian liquid
Liquid temperature range:	0 .. 40 °C
Density:	998.2 kg/m³
Electrical data:	
Power input - P1:	8.9 kW
Rated power - P2:	7.5 kW
Mains frequency:	50 Hz
Rated voltage:	3 x 380-415 V
Voltage tolerance:	+6/-10 %
Max starts per. hour:	20
Rated current:	16,5-16,2 A
Rated current at 3/4 load:	12.7 A
Rated current at 1/2 load:	10.4 A
Starting current:	152 A
Rated current at no load:	7.8 A
Cos phi - power factor:	0,83
Cos phi - p.f. at no load:	0,14
Cos phi - p.f. at 3/4 load:	0,76
Cos phi - p.f. at 1/2 load:	0,65
Rated speed:	2940 rpm
Locked-rotor torque:	80 Nm
Breakdown torque:	112 Nm
Moment of inertia:	0.0215 kg m²
Motor efficiency at full load:	84.8 %
Motor efficiency at 3/4 load:	83.8 %
Motor efficiency at 1/2 load:	80.1 %
Number of poles:	2
Start. method:	star/delta
Enclosure class (IEC 34-5):	IP68



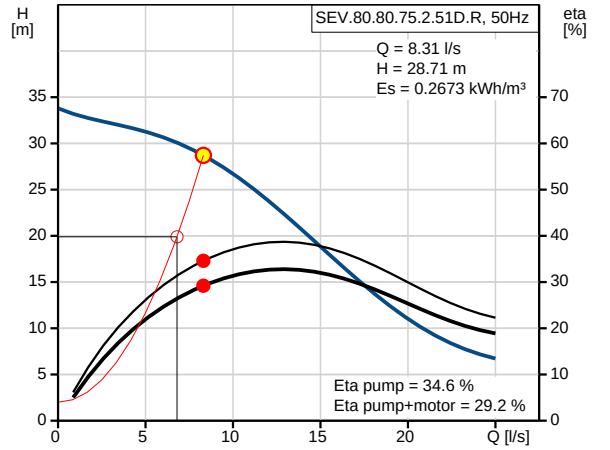


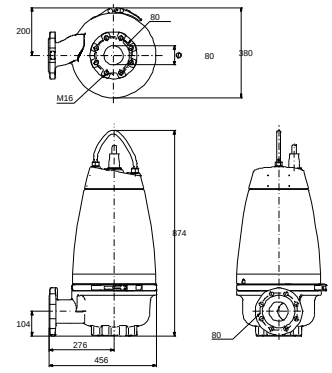


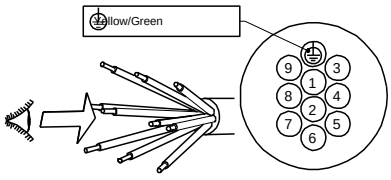


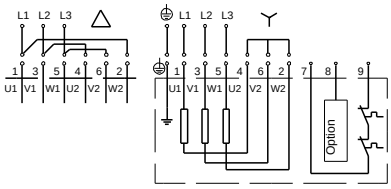
Description	Value
Insulation class (IEC 85):	F
Explosion proof:	no
Motor protec:	THERMAL SWITCH
Thermal protec:	internal
Length of cable:	10 m
Cable type:	LYNIFLEX
Type of cable plug:	NO PLUG
Controls:	
Control box:	not included
Moisture sensor:	without moisture sensors
Water-in-oil sensor:	without water-in-oil sensor
Temp. sensor:	N
Others:	
Net weight:	142 kg

Description	Value
General information:	
Product name:	SEV.80.80.75.2.51D.R
Product No:	96889330
EAN number:	5700312864462
Price:	On request
Technical:	
Actual calculated flow:	8.31 l/s
Max flow:	25 l/s
Resulting head of the pump:	28.71 m
Head max:	33.8 m
Type of impeller:	SUPER VORTEX
Maximum particle size:	80 mm
Primary shaft seal:	SIC/SIC
Secondary shaft seal:	CARBON/CERAMICS
Max. hydraulic efficiency:	39 %
Approvals on nameplate:	EN12050-1
Curve tolerance:	ISO9906:2012 3B2
Cooling jacket:	with cooling jacket
Materials:	
Pump housing:	EN 1.4408
Impeller:	Stainless steel
Installation:	
Maximum ambient temperature:	40 °C
Maximum operating pressure:	6 bar
Flange standard:	DIN
Pump outlet:	DN 80
Pressure stage:	PN 10
Maximum installation depth:	20 m
Inst dry/wet:	DRY/SUBMERGED
Installation:	horizontal or vertical
Liquid:	
Pumped liquid:	Any Newtonian liquid
Liquid temperature range:	0 .. 40 °C
Density:	998.2 kg/m³
Electrical data:	
Power input - P1:	8.9 kW
Rated power - P2:	7.5 kW
Mains frequency:	50 Hz
Rated voltage:	3 x 380-415 V
Voltage tolerance:	+6/-10 %
Max starts per. hour:	20
Rated current:	16,5-16,2 A
Rated current at 3/4 load:	12.7 A
Rated current at 1/2 load:	10.4 A
Starting current:	152 A
Rated current at no load:	7.8 A
Cos phi - power factor:	0,83
Cos phi - p.f. at no load:	0,14
Cos phi - p.f. at 3/4 load:	0,76
Cos phi - p.f. at 1/2 load:	0,65
Rated speed:	2940 rpm
Locked-rotor torque:	80 Nm
Breakdown torque:	112 Nm
Moment of inertia:	0.0215 kg m²
Motor efficiency at full load:	84.8 %
Motor efficiency at 3/4 load:	83.8 %
Motor efficiency at 1/2 load:	80.1 %
Number of poles:	2
Start. method:	star/delta
Enclosure class (IEC 34-5):	IP68









Description	Value
Insulation class (IEC 85):	F
Explosion proof:	no
Motor protec:	THERMAL SWITCH
Thermal protec:	internal
Length of cable:	10 m
Cable type:	LYNIFLEX
Type of cable plug:	NO PLUG
Controls:	
Control box:	not included
Moisture sensor:	without moisture sensors
Water-in-oil sensor:	without water-in-oil sensor
Temp. sensor:	N
Others:	
Net weight:	142 kg

12 ANNEX III – GRAVITY PROFILE TABLES

TH.VEYMANDOO									Meters	KM	
PS 1				Total Lengths of Catchment (Sewer Main)					3149.53	3.15	
Inlet 1											

Profile 1

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-1	MH1-1	60.000	0.004	160	1.472	1.087	0.712	0.327	0.760	0.760	0.006
MH1-1	MH1-2	60.000	0.004	160	1.087	0.967	0.327	0.087	0.760	0.880	0.004
MH1-2	MH1-3	52.000	0.004	160	0.967	0.735	0.087	-0.121	0.880	0.856	0.004
MH1-3	MH1-4	52.000	0.004	160	0.735	0.703	-0.121	-0.329	0.856	1.032	0.004
MH1-4	MH1-5	36.000	0.004	160	0.703	0.771	-0.329	-0.473	1.032	1.244	0.004
MH1-5	MH1-6	36.120	0.004	160	0.771	0.692	-0.473	-0.617	1.244	1.309	0.004
MH1-6	PS1-1	45.910	0.004	160	0.692	0.822	-0.617	-0.801	1.309	1.623	0.004
TOTAL		**342.03**									

Profile 2

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-2	MH1-7	51.000	0.004	160	1.093	0.900	0.333	0.129	0.760	0.771	0.004
MH1-7	MH1-8	51.000	0.004	160	0.900	0.750	0.129	-0.075	0.771	0.825	0.004
MH1-8	MH1-4	44.500	0.004	160	0.750	0.703	-0.075	-0.253	0.825	0.956	0.004
TOTAL		**146.50**									

Profile 3

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-3	MH1-9	50.000	0.004	160	1.100	0.900	0.340	0.140	0.760	0.760	0.004
MH1-9	MH1-8	50.000	0.004	160	0.900	0.750	0.140	-0.060	0.760	0.810	0.004
TOTAL		**100.00**									

Profile 4

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-4	MH1-10	60.000	0.004	160	0.800	0.750	0.040	-0.200	0.760	0.950	0.004
MH1-10	MH1-11	60.000	0.004	160	0.750	0.700	-0.200	-0.440	0.950	1.140	0.004
MH1-11	MH1-6	43.820	0.004	160	0.700	0.692	-0.440	-0.615	1.140	1.307	0.004
TOTAL		**163.82**									

Profile 5

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-5	MH1-11	65.000	0.004	160	0.750	0.700	-0.010	-0.270	0.760	0.970	0.004
TOTAL		**65.00**									

Profile 6

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-6	MH1-11	65.000	0.004	160	0.750	0.700	-0.010	-0.270	0.760	0.970	0.004
TOTAL		**65.00**									

Profile 7

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	

CO1-7	MH1-6	60.000	0.004	160	0.801	0.692	0.041	-0.199	0.760	0.891	0.004
TOTAL		**60.00**									

Inlet 2

Profile 8

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-8	MH1-12	50.000	0.004	160	0.700	0.700	-0.060	-0.260	0.760	0.960	0.004
MH1-12	MH1-13	50.000	0.004	160	0.700	0.725	-0.260	-0.460	0.960	1.185	0.004
MH1-13	MH1-14	50.000	0.004	160	0.725	0.750	-0.460	-0.660	1.185	1.410	0.004
MH1-14	MH1-15	45.000	0.004	160	0.750	0.892	-0.660	-0.840	1.410	1.732	0.004
MH1-15	MH1-16	44.820	0.004	160	0.892	0.665	-0.840	-1.019	1.732	1.684	0.004
MH1-16	MH1-17	34.050	0.004	160	0.665	0.862	-1.019	-1.155	1.684	2.017	0.004
MH1-17	PS1-2	34.050	0.004	160	0.862	0.822	-1.155	-1.292	2.017	2.114	0.004
TOTAL		**307.92**									

Profile 9

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-9	MH1-14	53.000	0.004	160	0.600	0.750	-0.160	-0.372	0.760	1.122	0.004
TOTAL		**53.00**									

Profile 10

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-10	MH1-18	40.000	0.004	160	0.600	0.606	-0.160	-0.320	0.760	0.926	0.004
MH1-18	MH1-15	51.000	0.004	160	0.606	0.892	-0.320	-0.524	0.926	1.416	0.004
TOTAL		**91.00**									

Profile 11

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-11	MH1-19	38.000	0.004	160	0.606	0.890	-0.154	-0.306	0.760	1.196	0.004
MH1-19	MH1-16	52.600	0.004	160	0.890	0.665	-0.306	-0.516	1.196	1.181	0.004
TOTAL		**90.60**									

Profile 12

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-12	MH1-19	40.000	0.004	160	0.674	0.890	-0.086	-0.246	0.760	1.136	0.004
TOTAL		**40.00**									

Profile 13

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-13	MH1-20	52.000	0.004	160	0.516	0.724	-0.244	-0.452	0.760	1.176	0.004
MH1-20	MH1-21	43.000	0.004	160	0.724	0.730	-0.452	-0.624	1.176	1.354	0.004
MH1-21	MH1-16	44.010	0.004	160	0.730	0.665	-0.624	-0.800	1.354	1.465	0.004
TOTAL		**139.01**									

Profile 14

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope

From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-14	MH1-22	39.000	0.004	160	0.516	0.674	-0.244	-0.400	0.760	1.074	0.004
MH1-22	MH1-21	52.000	0.004	160	0.674	0.730	-0.400	-0.608	1.074	1.338	0.004
TOTAL		**91.00**									

Profile 15

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-15	MH1-23	53.000	0.004	160	0.984	1.345	0.224	0.012	0.760	1.333	0.004
MH1-23	MH1-20	53.000	0.004	160	1.345	0.724	0.012	-0.200	1.333	0.924	0.004
TOTAL		**106.00**									

Profile 16

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-16	MH1-20	60.000	0.004	160	0.968	0.724	0.208	-0.036	0.760	0.760	0.004
TOTAL		**60.00**									

Inlet 3

Profile 17

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-17	MH1-24	60.000	0.004	160	0.669	0.963	-0.091	-0.331	0.760	1.294	0.004
MH1-24	MH1-25	42.000	0.004	160	0.963	0.803	-0.331	-0.499	1.294	1.302	0.004
MH1-25	MH1-26	47.880	0.004	160	0.803	0.696	-0.499	-0.691	1.302	1.387	0.004
MH1-26	MH1-27	25.110	0.004	160	0.696	0.767	-0.691	-0.791	1.387	1.558	0.004
MH1-27	PS1-3	18.130	0.004	160	0.767	0.822	-0.791	-0.863	1.558	1.685	0.004
TOTAL		**193.12**									

Profile 18

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-18	MH1-28	33.000	0.004	160	1.102	1.091	0.342	0.210	0.760	0.881	0.004
MH1-28	MH1-29	50.000	0.004	160	1.091	0.960	0.210	0.010	0.881	0.950	0.004
MH1-29	MH1-30	32.260	0.004	160	0.960	0.836	0.010	-0.119	0.950	0.955	0.004
MH1-30	MH1-25	57.720	0.004	160	0.836	0.803	-0.119	-0.350	0.955	1.153	0.004
TOTAL		**172.98**									

Profile 19

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-19	MH1-31	31.000	0.004	160	1.240	1.279	0.480	0.356	0.760	0.923	0.004
MH1-31	MH1-28	29.000	0.004	160	1.279	1.091	0.356	0.240	0.923	0.851	0.004
TOTAL		**60.00**									

Profile 20

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-20	MH1-29	33.000	0.004	160	0.927	0.960	0.167	0.035	0.760	0.925	0.004
TOTAL		**33.00**									

Profile 21

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope

From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-21	MH1-30	36.000	0.004	160	0.914	0.836	0.154	0.010	0.760	0.826	0.004
TOTAL		**36.00**									

Profile 22

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-22	MH1-32	49.000	0.004	160	0.678	0.961	-0.082	-0.278	0.760	1.239	0.004
MH1-32	MH1-33	56.370	0.004	160	0.961	0.703	-0.278	-0.503	1.239	1.206	0.004
MH1-33	MH1-27	61.670	0.004	160	0.703	0.767	-0.503	-0.750	1.206	1.517	0.004
TOTAL		**167.04**									

Profile 23

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-23	MH1-34	46.000	0.004	160	0.997	1.237	0.237	0.053	0.760	1.184	0.004
MH1-34	MH1-32	53.880	0.004	160	1.237	0.961	0.053	-0.163	1.184	1.124	0.004
TOTAL		**99.88**									

Profile 24

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-24	MH1-34	33.000	0.004	160	1.341	1.237	0.581	0.449	0.760	0.788	0.004
TOTAL		**33.00**									

Profile 25

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-25	MH1-32	31.000	0.004	160	0.948	0.961	0.188	0.064	0.760	0.897	0.004
TOTAL		**31.00**									

Profile 26

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-26	MH1-33	52.000	0.004	160	0.683	0.703	-0.077	-0.285	0.760	0.988	0.004
TOTAL		**52.00**									

Profile 27

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-27	MH1-35	30.000	0.004	160	0.905	0.989	0.145	0.025	0.760	0.964	0.004
MH1-35	MH1-36	56.360	0.004	160	0.989	0.811	0.025	-0.200	0.964	1.011	0.004
MH1-36	MH1-33	37.280	0.004	160	0.811	0.703	-0.200	-0.350	1.011	1.053	0.004
TOTAL		**123.64**									

Profile 28

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-28	MH1-37	32.000	0.004	160	1.251	1.341	0.491	0.363	0.760	0.978	0.004
MH1-37	MH1-35	53.830	0.004	160	1.341	0.989	0.363	0.148	0.978	0.841	0.004
TOTAL		**85.83**									

Profile 29

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-29	MH1-36	32.000	0.004	160	0.848	0.811	0.088	-0.040	0.760	0.851	0.004
TOTAL		**32.00**									

Profile 30

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-30	MH1-36	50.000	0.004	160	0.785	0.811	0.025	-0.175	0.760	0.986	0.004
TOTAL		**50.00**									

Profile 31

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO1-31	MH1-26	59.160	0.004	160	0.530	0.696	-0.230	-0.467	0.760	1.163	0.004
TOTAL		**59.16**									

TH.VEYMANDOO									Meters	KM
PS 2				Total Lengths of Catchment (Sewer Main)					2662.52	2.66

Inlet 1

Profile 1

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-1	MH2-1	60.000	0.004	160	0.950	0.950	0.190	-0.050	0.760	1.000	0.004
MH2-1	MH2-2	60.000	0.004	160	0.950	0.979	-0.050	-0.290	1.000	1.269	0.004
MH2-2	MH2-3	29.350	0.004	160	0.979	1.159	-0.290	-0.407	1.269	1.566	0.004
MH2-3	MH2-4	28.370	0.004	160	1.159	1.293	-0.407	-0.521	1.566	1.814	0.004
MH2-4	MH2-5	46.490	0.004	160	1.293	1.299	-0.521	-0.707	1.814	2.006	0.004
MH2-5	MH2-6	48.470	0.004	160	1.299	1.338	-0.707	-0.901	2.006	2.239	0.004
MH2-6	PS2-1	39.970	0.004	160	1.338	1.270	-0.901	-1.061	2.239	2.331	0.004
TOTAL		**312.65**									

Profile 2

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-2	MH2-7	44.090	0.004	160	0.903	0.721	0.143	-0.039	0.760	0.760	0.004
MH2-7	MH2-2	44.090	0.004	160	0.721	0.979	-0.039	-0.215	0.760	1.194	0.004
TOTAL		**88.18**									

Profile 3

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-3	MH2-8	18.650	0.004	160	0.803	1.111	0.043	-0.032	0.760	1.143	0.004
MH2-8	MH2-3	53.860	0.004	160	1.111	1.159	-0.032	-0.247	1.143	1.406	0.004
TOTAL		**72.51**									

Profile 4

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-4	MH2-9	23.580	0.004	160	1.225	1.210	0.465	0.371	0.760	0.839	0.004
MH2-9	MH2-10	35.400	0.004	160	1.210	1.270	0.371	0.229	0.839	1.041	0.004
MH2-10	MH2-11	35.210	0.004	160	1.270	1.281	0.229	0.088	1.041	1.193	0.004
MH2-11	MH2-6	34.470	0.004	160	1.281	1.338	0.088	-0.050	1.193	1.388	0.004
TOTAL		**128.66**									

Profile 5

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-5	MH2-9	44.460	0.004	160	1.407	1.210	0.647	0.450	0.760	0.760	0.004
TOTAL		**44.46**									

Profile 6

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-6	MH2-10	45.170	0.004	160	1.481	1.270	0.721	0.510	0.760	0.760	0.005
TOTAL		**45.17**									

Profile 7

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-7	MH2-11	45.350	0.004	160	1.432	1.281	0.672	0.491	0.760	0.790	0.004

TOTAL		45.35									

Profile 8

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-8	MH2-6	43.390	0.004	160	1.422	1.338	0.662	0.488	0.760	0.850	0.004
TOTAL		43.39									

Inlet 2

Profile 9

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-9	MH2-12	55.000	0.004	160	1.000	1.000	0.240	0.020	0.760	0.980	0.004
MH2-12	MH2-13	55.000	0.004	160	1.000	1.154	0.020	-0.200	0.980	1.354	0.004
MH2-13	MH2-14	53.040	0.004	160	1.154	1.300	-0.200	-0.412	1.354	1.712	0.004
MH2-14	MH2-15	47.060	0.004	160	1.300	1.300	-0.412	-0.600	1.712	1.900	0.004
MH2-15	PS2-2	48.640	0.004	160	1.300	1.270	-0.600	-0.795	1.900	2.065	0.004
TOTAL		258.74									

Profile 10

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-10	MH2-13	40.470	0.004	160	0.986	1.154	0.226	0.064	0.760	1.090	0.004
TOTAL		40.47									

Profile 11

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-11	MH2-13	36.830	0.004	160	0.958	1.154	0.198	0.051	0.760	1.103	0.004
TOTAL		36.83									

Profile 12

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-12	MH2-14	36.250	0.004	160	1.252	1.300	0.492	0.347	0.760	0.953	0.004
TOTAL		36.25									

Profile 13

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-13	MH2-14	39.780	0.004	160	1.267	1.300	0.507	0.348	0.760	0.952	0.004
TOTAL		39.78									

Profile 14

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-14	MH2-15	37.050	0.004	160	1.299	1.300	0.539	0.391	0.760	0.909	0.004
TOTAL		37.05									

Profile 15

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-15	MH2-15	38.420	0.004	160	1.335	1.300	0.575	0.421	0.760	0.879	0.004

TOTAL	38.42									

Inlet 3

Profile 16

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-16	MH2-16	50.000	0.004	160	0.900	0.900	0.140	-0.060	0.760	0.960	0.004
MH2-16	MH2-17	50.000	0.004	160	0.900	0.994	-0.060	-0.260	0.960	1.254	0.004
MH2-17	MH2-18	49.130	0.004	160	0.994	1.295	-0.260	-0.457	1.254	1.752	0.004
MH2-18	MH2-19	46.830	0.004	160	1.295	1.406	-0.457	-0.644	1.752	2.050	0.004
MH2-19	MH2-20	49.050	0.004	160	1.406	1.511	-0.644	-0.840	2.050	2.351	0.004
MH2-20	PS2-3	42.840	0.004	160	1.511	1.270	-0.840	-1.011	2.351	2.281	0.004
TOTAL		**287.85**									

Profile 17

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-17	MH2-21	60.000	0.004	160	1.600	1.400	0.840	0.600	0.760	0.800	0.004
MH2-21	MH2-22	60.000	0.004	160	1.400	1.200	0.600	0.360	0.800	0.840	0.004
MH2-22	MH2-17	60.000	0.004	160	1.200	0.994	0.360	0.120	0.840	0.874	0.004
TOTAL		**180.00**									

Profile 18

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-18	MH2-23	36.750	0.004	160	1.500	1.500	0.740	0.593	0.760	0.907	0.004
MH2-23	MH2-20	41.080	0.004	160	1.500	1.511	0.593	0.429	0.907	1.082	0.004
TOTAL		**77.83**									

Profile 19

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-19	MH2-24	56.950	0.004	160	1.289	1.644	0.529	0.301	0.760	1.343	0.004
MH2-24	MH2-25	53.400	0.004	160	1.644	1.494	0.301	0.088	1.343	1.406	0.004
MH2-25	MH2-20	40.110	0.004	160	1.494	1.511	0.088	-0.073	1.406	1.584	0.004
TOTAL		**150.46**									

Profile 20

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-20	MH2-25	36.880	0.004	160	1.500	1.494	0.740	0.592	0.760	0.902	0.004
TOTAL		**36.88**									

Inlet 4

Profile 21

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-21	MH2-26	40.680	0.004	160	1.487	1.686	0.727	0.564	0.760	1.122	0.004
MH2-26	MH2-27	35.200	0.004	160	1.686	1.441	0.564	0.423	1.122	1.018	0.004
MH2-27	MH2-28	61.710	0.004	160	1.441	1.466	0.423	0.177	1.018	1.289	0.004
MH2-28	MH2-29	34.260	0.004	160	1.466	1.416	0.177	0.040	1.289	1.376	0.004
MH2-29	MH2-30	35.200	0.004	160	1.416	1.357	0.040	-0.101	1.376	1.458	0.004
MH2-30	MH2-31	12.920	0.004	160	1.357	1.380	-0.101	-0.153	1.458	1.533	0.004
MH2-31	PS2-4	47.550	0.004	160	1.380	1.270	-0.153	-0.343	1.533	1.613	0.004
TOTAL		**267.52**									

Profile 22

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-22	MH2-27	32.760	0.004	160	1.457	1.441	0.697	0.566	0.760	0.875	0.004
TOTAL		**32.76**									

Profile 23

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-23	MH2-32	58.420	0.004	160	1.729	1.850	0.969	0.735	0.760	1.115	0.004
MH2-32	MH2-28	35.290	0.004	160	1.850	1.466	0.735	0.594	1.115	0.872	0.004
TOTAL		**93.71**									

Profile 24

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-24	MH2-33	30.460	0.004	160	1.818	1.535	1.058	0.775	0.760	0.760	0.009
MH2-33	MH2-29	36.050	0.004	160	1.535	1.416	0.775	0.631	0.760	0.785	0.004
TOTAL		**66.51**									

Profile 25

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-25	MH2-34	30.390	0.004	160	1.314	1.225	0.554	0.432	0.760	0.793	0.004
MH2-34	MH2-30	35.700	0.004	160	1.225	1.357	0.432	0.290	0.793	1.067	0.004
TOTAL		**66.09**									

Profile 26

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-26	MH2-34	31.730	0.004	160	1.463	1.225	0.703	0.465	0.760	0.760	0.008
TOTAL		**31.73**									

Profile 27

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-27	MH2-35	16.030	0.004	160	1.451	1.355	0.691	0.595	0.760	0.760	0.006
MH2-35	MH2-36	46.840	0.004	160	1.355	1.413	0.595	0.408	0.760	1.005	0.004
MH2-36	MH2-31	22.500	0.004	160	1.413	1.380	0.408	0.318	1.005	1.062	0.004
TOTAL		**85.37**									

Profile 28

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO2-28	MH2-36	17.900	0.004	160	1.422	1.413	0.662	0.590	0.760	0.823	0.004
TOTAL		**17.90**									

TH.VEYMANDOO									Meters	KM	
PS 3				Total Lengths of Catchment (Sewer Main)					3921.31	3.92	
Inlet 1											
Profile 1											
Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-1	MH3-1	78.000	0.004	160	0.984	0.775	0.224	-0.088	0.760	0.863	0.004
MH3-1	MH3-2	78.000	0.004	160	0.775	0.826	-0.088	-0.400	0.863	1.226	0.004
MH3-2	MH3-3	45.030	0.004	160	0.826	0.773	-0.400	-0.580	1.226	1.353	0.004
MH3-3	MH3-4	37.370	0.004	160	0.773	0.760	-0.580	-0.730	1.353	1.490	0.004
MH3-4	MH3-5	37.370	0.004	160	0.760	0.838	-0.730	-0.879	1.490	1.717	0.004
MH3-5	MH3-6	36.160	0.004	160	0.838	0.864	-0.879	-1.024	1.717	1.888	0.004
MH3-6	MH3-7	36.170	0.004	160	0.864	0.856	-1.024	-1.168	1.888	2.024	0.004
MH3-7	PS3-1	19.880	0.004	160	0.856	0.965	-1.168	-1.248	2.024	2.213	0.004
TOTAL		**367.98**									
Profile 2											
Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-2	MH3-8	32.420	0.004	160	0.783	0.654	0.023	-0.107	0.760	0.761	0.004
MH3-8	MH3-2	34.480	0.004	160	0.654	0.826	-0.107	-0.245	0.761	1.071	0.004
TOTAL		**66.90**									
Profile 3											
Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-3	MH3-8	17.860	0.004	160	1.016	0.654	0.256	-0.106	0.760	0.760	0.020
TOTAL		**17.86**									
Profile 4											
Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-4	MH3-9	43.370	0.004	160	0.654	0.892	-0.106	-0.279	0.760	1.171	0.004
MH3-9	MH3-3	44.840	0.004	160	0.892	0.773	-0.279	-0.459	1.171	1.232	0.004
TOTAL		**88.21**									
Profile 5											
Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-5	MH3-9	24.400	0.004	160	1.233	0.892	0.473	0.132	0.760	0.760	0.014
TOTAL		**24.40**									
Profile 6											
Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-6	MH3-10	35.000	0.004	160	0.926	0.871	0.166	0.026	0.760	0.845	0.004
MH3-10	MH3-11	35.000	0.004	160	0.871	0.795	0.026	-0.114	0.845	0.909	0.004
MH3-11	MH3-12	35.000	0.004	160	0.795	0.849	-0.114	-0.254	0.909	1.103	0.004
MH3-12	MH3-5	34.980	0.004	160	0.849	0.838	-0.254	-0.394	1.103	1.232	0.004
TOTAL		**139.98**									
Profile 7											
Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope

From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-7	MH3-5	68.110	0.004	160	0.836	0.838	0.076	-0.196	0.760	1.034	0.004
TOTAL		**68.11**									

Profile 8

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-8	MH3-7	51.150	0.004	160	0.950	0.856	0.190	-0.015	0.760	0.871	0.004
TOTAL		**51.15**									

Inlet 2

Profile 9

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-9	MH3-13	44.810	0.004	160	0.775	0.724	0.015	-0.164	0.760	0.888	0.004
MH3-13	MH3-14	67.460	0.004	160	0.724	0.793	-0.164	-0.434	0.888	1.227	0.004
MH3-14	MH3-15	63.310	0.004	160	0.793	1.179	-0.434	-0.687	1.227	1.866	0.004
MH3-15	PS3-2	71.000	0.004	160	1.179	0.965	-0.687	-0.971	1.866	1.936	0.004
TOTAL		**246.58**									

Profile 10

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-10	MH3-13	41.000	0.004	160	0.816	0.724	0.056	-0.108	0.760	0.832	0.004
TOTAL		**41.00**									

Profile 11

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-11	MH3-16	60.000	0.004	160	0.783	0.870	0.023	-0.217	0.760	1.087	0.004
MH3-16	MH3-14	44.260	0.004	160	0.870	0.793	-0.217	-0.394	1.087	1.187	0.004
TOTAL		**104.26**									

Profile 12

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-12	MH3-16	41.000	0.004	160	1.023	0.870	0.263	0.099	0.760	0.771	0.004
TOTAL		**41.00**									

Profile 13

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-13	MH3-17	36.000	0.004	160	1.237	1.461	0.477	0.333	0.760	1.128	0.004
MH3-17	MH3-18	29.000	0.004	160	1.461	1.390	0.333	0.217	1.128	1.173	0.004
MH3-18	MH3-19	46.500	0.004	160	1.390	0.901	0.217	0.031	1.173	0.870	0.004
MH3-19	MH3-20	31.910	0.004	160	0.901	0.884	0.031	-0.097	0.870	0.981	0.004
MH3-20	MH3-15	55.380	0.004	160	0.884	1.179	-0.097	-0.318	0.981	1.497	0.004
TOTAL		**198.79**									

Profile 14

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-14	MH3-18	33.000	0.004	160	1.165	1.390	0.405	0.273	0.760	1.117	0.004

TOTAL		33.00									

Profile 15

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-15	MH3-19	28.000	0.004	160	0.994	0.901	0.234	0.122	0.760	0.779	0.004
TOTAL		28.00									

Profile 16

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-16	MH3-19	20.980	0.004	160	0.992	0.901	0.232	0.141	0.760	0.760	0.004
TOTAL		20.98									

Profile 17

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-17	MH3-21	51.000	0.004	160	1.229	1.196	0.469	0.265	0.760	0.931	0.004
MH3-21	MH3-22	51.000	0.004	160	1.196	0.914	0.265	0.061	0.931	0.853	0.004
MH3-22	MH3-20	31.780	0.004	160	0.914	0.884	0.061	-0.066	0.853	0.950	0.004
TOTAL		133.78									

Profile 18

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-18	MH3-22	47.350	0.004	160	1.420	0.914	0.660	0.154	0.760	0.760	0.011
TOTAL		47.35									

Profile 19

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-19	MH3-20	50.330	0.004	160	0.963	0.884	0.203	0.002	0.760	0.882	0.004
TOTAL		50.33									

Profile 20

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-20	MH3-23	22.900	0.004	160	1.259	1.310	0.499	0.407	0.760	0.903	0.004
MH3-23	MH3-24	22.900	0.004	160	1.310	1.404	0.407	0.316	0.903	1.088	0.004
MH3-24	MH3-15	60.140	0.004	160	1.404	1.179	0.316	0.075	1.088	1.104	0.004
TOTAL		105.94									

Profile 21

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-21	MH3-23	23.700	0.004	160	1.512	1.310	0.752	0.550	0.760	0.760	0.009
TOTAL		23.70									

Profile 22

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-22	MH3-25	35.000	0.004	160	1.453	1.487	0.693	0.553	0.760	0.934	0.004

MH3-25	MH3-24	38.490	0.004	160	1.487	1.404	0.553	0.399	0.934	1.005	0.004
TOTAL		**73.49**									

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Profile 23

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-23	MH3-26	53.000	0.004	160	1.289	1.272	0.529	0.317	0.760	0.955	0.004
MH3-26	MH3-27	11.170	0.004	160	1.272	1.312	0.317	0.272	0.955	1.040	0.004
MH3-27	MH3-28	24.910	0.004	160	1.312	1.278	0.272	0.173	1.040	1.105	0.004
MH3-28	MH3-29	35.120	0.004	160	1.278	1.329	0.173	0.032	1.105	1.297	0.004
MH3-29	MH3-30	33.970	0.004	160	1.329	1.419	0.032	-0.104	1.297	1.523	0.004
MH3-30	MH3-31	61.750	0.004	160	1.419	1.542	-0.104	-0.351	1.523	1.893	0.004
MH3-31	MH3-32	57.760	0.004	160	1.542	1.299	-0.351	-0.582	1.893	1.881	0.004
MH3-32	MH3-33	37.590	0.004	160	1.299	1.049	-0.582	-0.732	1.881	1.781	0.004
MH3-33	PS3-3	29.770	0.004	160	1.049	0.965	-0.732	-0.851	1.781	1.816	0.004
TOTAL		**345.04**									

Profile 24

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-24	MH3-26	16.250	0.004	160	1.242	1.272	0.482	0.417	0.760	0.855	0.004
TOTAL		**16.25**									

Profile 25

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-25	MH3-27	17.270	0.004	160	1.260	1.312	0.500	0.431	0.760	0.881	0.004
TOTAL		**17.27**									

Profile 26

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-26	MH3-34	25.610	0.004	160	1.260	1.420	0.500	0.398	0.760	1.022	0.004
MH3-34	MH3-28	34.760	0.004	160	1.420	1.278	0.398	0.259	1.022	1.019	0.004
TOTAL		**60.37**									

Profile 27

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-27	MH3-28	60.000	0.004	160	1.323	1.278	0.563	0.323	0.760	0.955	0.004
TOTAL		**60.00**									

Profile 28

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-28	MH3-35	39.380	0.004	160	1.470	1.122	0.710	0.362	0.760	0.760	0.009
MH3-35	MH3-36	35.760	0.004	160	1.122	1.342	0.362	0.219	0.760	1.123	0.004
MH3-36	MH3-29	35.780	0.004	160	1.342	1.329	0.219	0.076	1.123	1.253	0.004
TOTAL		**110.92**									

Profile 29

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope

From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-29	MH3-29	60.000	0.004	160	1.466	1.329	0.706	0.466	0.760	0.863	0.004
TOTAL		**60.00**									

Profile 30

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-30	MH3-37	34.730	0.004	160	1.233	1.220	0.473	0.334	0.760	0.886	0.004
MH3-37	MH3-38	58.520	0.004	160	1.220	1.288	0.334	0.100	0.886	1.188	0.004
MH3-38	MH3-30	37.790	0.004	160	1.288	1.419	0.100	-0.051	1.188	1.470	0.004
TOTAL		**131.04**									

Profile 31

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-31	MH3-38	32.310	0.004	160	1.420	1.288	0.660	0.528	0.760	0.760	0.004
TOTAL		**32.31**									

Profile 32

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-32	MH3-30	60.000	0.004	160	1.977	1.419	1.217	0.659	0.760	0.760	0.009
TOTAL		**60.00**									

Profile 33

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-33	MH3-39	56.600	0.004	160	1.287	1.060	0.527	0.300	0.760	0.760	0.004
MH3-39	MH3-40	58.080	0.004	160	1.060	1.348	0.300	0.068	0.760	1.280	0.004
MH3-40	MH3-31	48.810	0.004	160	1.348	1.542	0.068	-0.128	1.280	1.670	0.004
TOTAL		**163.49**									

Profile 34

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-34	MH3-40	57.450	0.004	160	1.335	1.348	0.575	0.345	0.760	1.003	0.004
TOTAL		**57.45**									

Profile 35

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-35	MH3-31	60.000	0.004	160	1.743	1.542	0.983	0.743	0.760	0.799	0.004
TOTAL		**60.00**									

Profile 36

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-36	MH3-32	46.450	0.004	160	1.090	1.299	0.330	0.144	0.760	1.155	0.004
TOTAL		**46.45**									

Profile 37

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope

From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-37	MH3-32	60.000	0.004	160	1.459	1.299	0.699	0.459	0.760	0.840	0.004
TOTAL		**60.00**									

Profile 38

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-38	MH3-33	60.000	0.004	160	1.275	1.049	0.515	0.275	0.760	0.774	0.004
TOTAL		**60.00**									

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Profile 39

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-39	MH3-41	17.200	0.004	160	1.011	0.965	0.251	0.182	0.760	0.783	0.004
MH3-41	MH3-42	36.620	0.004	160	0.965	1.285	0.182	0.036	0.783	1.249	0.004
MH3-42	MH3-43	52.700	0.004	160	1.285	1.104	0.036	-0.175	1.249	1.279	0.004
MH3-43	MH3-44	19.840	0.004	160	1.104	1.139	-0.175	-0.254	1.279	1.393	0.004
MH3-44	MH3-45	44.820	0.004	160	1.139	0.971	-0.254	-0.434	1.393	1.405	0.004
MH3-45	PS3-4	53.760	0.004	160	0.971	0.965	-0.434	-0.649	1.405	1.614	0.004
TOTAL		**224.94**									

Profile 40

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-40	MH3-42	17.050	0.004	160	1.247	1.285	0.487	0.419	0.760	0.866	0.004
TOTAL		**17.05**									

Profile 41

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-41	MH3-43	32.000	0.004	160	0.865	1.104	0.105	-0.023	0.760	1.127	0.004
TOTAL		**32.00**									

Profile 42

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-42	MH3-46	57.500	0.004	160	0.965	0.869	0.205	-0.025	0.760	0.894	0.004
MH3-46	MH3-47	22.180	0.004	160	0.869	0.978	-0.025	-0.114	0.894	1.092	0.004
MH3-47	MH3-45	51.140	0.004	160	0.978	0.971	-0.114	-0.318	1.092	1.289	0.004
TOTAL		**130.82**									

Profile 43

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-43	MH3-47	65.000	0.004	160	0.923	0.978	0.163	-0.097	0.760	1.075	0.004
TOTAL		**65.00**									

Profile 44

Manholes		Pipe Length	Design Slope	Size	Ground Level (MSL)		Invert Level (MSL)		Pipe Depth (m)		Slope
From	To	m	1 : 250	mm dia (OD)	UG	LG	UI	LI	UI	LI	
CO3-44	MH3-48	51.820	0.004	160	1.023	0.907	0.263	0.056	0.760	0.851	0.004
MH3-48	MH3-49	37.490	0.004	160	0.907	0.950	0.056	-0.094	0.851	1.044	0.004

MH3-49	MH3-45	48.810	0.004	160	0.950	0.971	-0.094	-0.289	1.044	1.260	0.004
TOTAL		**138.12**									

13 ANNEX IV – CONCEPT APPROVAL LETTER