Palestine Polytechnic University

College of Engineering and Technology
Civil & Architecture Engineering Department

Project Title

Design Of Wastewater Collection system And Storm Water Drainage system For Sourif Town

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Hebron – Palestine

December, 2011

Design Of Waste water Collection system And Storm Water Drainage system For Sourif Town

BY

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A PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF THE

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IN

CIVIL & ARCHITECTURAL ENGINEERING DEPARTMENT

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COLLEGE OF ENGINEERING AND TECHNOLOGY

PALESTINE POLYTECHNIC UNIVERSITY

HEBRON- WEST BANK

PALESTINE

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CERTIFICATION

Palestine Polytechnic University

(PPU)

Hebron- Palestine

The Senior Project Entitled:

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In accordance with the recommendations of the project supervisor, and the acceptance of all examining committee members, this project has been submitted to the Department of Civil and Architectural Engineering in the College of Engineering and Technology in partial fulfillment of the requirements of the department for the degree of Bachelor of Science in Engineering.

Project Supervisor **Department Chairman**

December; 2011

إهــداء

إلى اقرب من في الوجود إلى نفسي ... والدي الحبيبين .

إلى أغلى من في الحياة على قلبي ... إخوتي الأعزاء .

إلى من أهدتني بهم السماء ... أصدقائي الأحباء .

إلى المنارات التي أضاءت لي الدرب ... أساتذتي الأجلاء .

إلى كل اللحظات السعيدة التي قضيناها داخل اسوار هذه الجامعة الغراء .

إلى أرواح كل الشهداء ... إلى فلسطين الإباء .

إلى كل شيء طاهر جميل في هذا الوطن المعطاء .

إلى كل هؤلاء ... أهدي ما جنيت بعناء .

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We would like to express our thanks and gratitude to Allah, the Most Beneficent, the most Merciful who granted us the ability and willing to start and complete this project. We pray to his greatness to inspire us the right path to his content and to enable us to continue the work started in this project to the benefits of our country.

We wish to express our deep and sincere thanks and gratitude to Palestine Polytechnic University, the Department of Civil & Architectural Engineering, College of Engineering & Technology. We wish to express our thanks to Eng.Samah Al-Jabari, for a valuable help, encouragement, supervision and guidance in solving the problems that we faced from time to time during this project.

We can find no words to express our sincere, appreciation and gratitude to our parents, sisters and brothers, for their endless support and encouragement, we are deeply indebted to you and we hope that we may someday reciprocate it in someway.

Work Team

ABSTRACT

Design Of Waste water Collection system And Storm Water Drainage system For Sourif Town

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The disposal of raw waste water and storm water without treatment creates major potential health and environmental problems. in Hebron rural areas, the sewage facilities do not exist.

The people disposal sanitary waste in cesspits, laterains and open drains , the waste water has been seeping into the ground through the overflows of the deteriorated cesspits and laterains causing serious environmental and health problem . also water accumulate on the streets as a result of precipitation, population growth and development of the area causing storm water collection low areas and flood streets and walk ways.

Sourif like other towns in the Hebron district has no drainage system for waste water and storm water. the people disposal sanitary waste in cesspit, laterains and open drain , these laterains and cesspit are deteriorating and they are in very bad condition , adding to this the increasing in water consumption and consequently increasing in waste water production, resulting in over flows from the cesspits and excessive recharges of ground water in Sourif area. Also rapid growth of the area has decrease the open area available for percolation of rain water and has greatly increased the runoff to low lying areas .

The present study considered the annual population growth and their water consumption for the coming 25 years that will be the design period for the waste water collection system , also estimation of the accumulated areas , rainfall intensity and the quantity of storm water for the storm water drainage system and the necessary hydraulic simple calculation .

The study shows a number of important conclusions . absence of drainage system in Sourif town cause problems to the peoples, subsequently there is a big need for design and construction of waste water collection system and storm water drainage system . gravity flow sewer were proposed for Sourif town to minimize the cost of construction and excavations .

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BILL OF QUANTITY

5.1 BILL OF QUANTITY FOR THE PROPOSED WASTEWATER COLLECTION SYSTEM

No.	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A1	Excavation of pipes trench in all kind of soil for one pipe diameter 8 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2000				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 10 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2800				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 12 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	4370				

A4	Excavation of pipes trench in all kind of soil for one pipe diameter 15 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2410				
A5	Excavation of pipes trench in all kind of soil for one pipe diameter 18 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	1015				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 24 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	7230				
A4	Excavation of pipes trench in all kind of soil for one pipe diameter 28 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2410				

A5	Excavation of pipes trench in all kind of soil for one pipe diameter 32 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	1015				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 36 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	7230				

5.2 BILL OF QUANTITY FOR THE PROPOSED STORM WATER DRAINAGE SYSTEM

No.	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A1	Excavation of pipes trench in all kind of soil for one pipe diameter 10 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	500				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 15 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	450				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 18 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	105				
A4	Excavation of pipes trench in all kind of soil for one pipe diameter 28 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	366				

A5	Excavation of pipes trench in all kind of soil for one pipe diameter 36 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	118.5				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 65 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	293				

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1.1 General

Drainage is the term applied to systems for dealing with excess water. It is importante for the disposal of surplus irrigation water, storm water, and waste water.Water drainage is a natural phenomenon which takes place naturaly and depends on the geomorphological and hydrological features, water drainage is often considered as minor problem, but with rapid increase in population and concequent in all round activities of man, the problem has been accentuated.

The wide expansion and accelerated development of Sourif Town had led to change in the hydrological and geomorphological features and the drainage system had become more complex, hence the amount of waste water and running water has increased. At the same time waste water collection system and storm water draiage are not exist.

In view of this prevailing condition, the drainage system in Sourif Town would have a new characteristics and the development of new water drainage is very necessary to drainage waste water and excess water from streets. This study is conducted to design a waste water collection system and storme water drainage system for Sourif Town.

Sourif like other town in Palestine have no sewerge facility. The people are using latrines, cesspits and few of them use septic tanks, which are emptied by cesspit emptier and tankers from time to time. These latrines and cesspits are deteriorating and they are in very bad condition, adding to this the increasing water consumption and consequently increasing in waste water production resulting in over flows from the cesspits and excessive recharge of ground water in Sourif area. For all the reasons mentioned above and since a waste water treatment plant will be erected, this evaluation and design of waste water collection system and storm water collection system study for Sourif have been conducted.

1.2 Problem Definition

The acceleration expansion and developed of Sourif has resulted in increasing of water consumption and consequently in generation of large quantities of waste water from various sources such as residential areas, commercial establishments and different industries. Due to the absence of waste water collection system, the waste water has been seeping into the ground through the overflows of the deteiorated cesspits and latrines that are commonly used in Sourif. Moreover, in some areas waste water is flows to the wadis through open drains in different routes causing serious environmental and health problems.

The main damaging consequences of these waste water routes are offensive adors and smells, proper media for breeding of mosquitoes, soil contamination and polluting of the existing aquifers. The municipality of Sourif is receiving on daily bases complains from the people asking a comprehensive solution for the waste water problems in the town.Also water drainage is very important due to water a ccumulation on the sheets as a result of heavy preciption (running water).

In view of these bad conditions, and since there is no seweage or storm water networks exist, along with fast increasing of the environmental and health problem. The design of waste water collection system and storm water drainage system study become a pressing necessity so as to solve all problems that were mentioned above. This study will consider the annual growth of the people and their water consumption for the coming 25 years, which will be the design period, along with the commercial industrial development in the area and the amounmt of rainfall intensity also will consider.

1.3 Objecives Of The Project

The main objectives of this project are:

1. Division of Sourif area into catchment and sub-catchment areas according to existing situation and the topographic maps and classifying them into classes.
2. Estimation of population and their densities for the design period for each catchment area.
3. Determination of the water consumption and consequently the waste water production from the different sources for each catchment area.

4. Evaluation of the collected data, propose collection system of the town and design of the main trunks of the network.
5. Estimation of rainfall intensity and then quantities of strom water for each catchment.
6. Showing the proposed waste water network and strom water network its parts on different maps for different purposes.
7. Preparation of Bill of Quantities for the main trunks.

1.4 Methadology

1. Many site visits to Sourif town and Municipality were done.
2. All needed maps and the previous studies that contain different information about Sourif were obtained.
3. The amounts of water consumption for different purposes and consequently the amounts of waste water production for each area were obtained.
4. The amount of storm water for each area.
5. The different layouts of the proposed waste water collection system and storm water drainage system are ploted.
6. The necssary hydraulic calculation for the two systems and other design reqirements will be carried out in the next semester.
7. Bill of quantity of the designed waste water main trunks will be prepared with needed recommendations.
8. Finalizing of the project that will contain the report and the needed maps and drawings.

1.5 Phases Of The Project

The project will consist of the four phases and will be completed by Jan 2011 as shown in (Table 1.1)

TABLE 1.1:- PhasesOf The ProjectWithTheirExpectedDuration

Phase No.	Title	Duration								
		02/ 11	03/ 11	04/ 11	05/ 11	06/ 11	09/ 11	10/ 11	11/ 11	12/ 11
One	Data collection and survey									
Two	Preparing layout for two networks and calculate the amount of waste water and storm water									
Three	Design of waste water and storm water collection systems									
four	Writing the report and other related jobs									

1.5.1 First phase:- Data Collection And Survey

In this phase, available data and information were collected from different sources. Moreover, many site visits to both the town and the municipality were done. This phase include the following tasks.

1. Collecting of aerial and topographical maps for all the area.
2. Collecting of meteorological and hydrological data(temperature, wind speed, rainfall, evapoeration…etc) from different sources.

3. Evaluation of town population densities in each zone of the town with their waterconsumption and predicting their numbers, densities and their water consumption in year 2036.

1.5.2 Second Phase:-Preparing Layout For Two Networks And Calculate The Amount Of Waste WaterAnd Storm Water

In this phase layout will prepared and put in its final shape and then quantities of waste water and storm water will determine.

This phase include the following tasks:

1. Draw the layout of the two networks and compare it with the real setuation in Sourif twon then make adjusment and last draw the final layout this task is the most improtant.
2. Evaluation of the contour maps and matching it with actual ground levels in the town
3. Determination of the stormwater quantities
4. Determination of the waste water quantities and projection of the waste water production in year 2036.

1.5.3 Third Phase:- Design Of Waste WaterAnd Storm Water Collection Systems

In this phase the necessary hydraulic calculation needed for the design of the main trunks will be carried out. This phase include the following tasks:

1. Establish a system layout, which includes the areas that are going to be served, existing streets and roads, topography…etc.
2. Establish the catchments and sub-catchments areas and routes of the sewers.
3. Establish the design criteria and conducting the needed sewer diameter hydraulic calculations.

4. Preparing needed different drawings for the designed sewers.

1.5.4 Fourth Phase:- Writing The Report And Other Needed Jobs

After finishing the design calculation of the main trunks the project team prepared the specifications drawing, bill of quantities and preliminary maps.Final report of the project was prepared and submitted to the Department of civil and Architectural Engineering at Palestine Polytechnic University.

1.6 Organization Of The Project

The study report has been prepared in accordance with the objectives and scope of work. The report consist of six chapters. The first chapter entitled "Introduction" outlines the problem, project objectives, and phase of the project.

Chapter two entitled "Chataristics of the project area" presents basic background data and information on the object area, water supply, and waste water disposal.

Chapter three entitled " Drainage Systems" deals with municipal sewage systems , types of waste water collection systems, storm system, rainfall intensities, sewer appurtenances, flow in sewer, design of sewer systems and sewer construction and maintenance.

Chapter four entitled "Design Criteria" presents information about population and their densities, the actual water consumption, land use, time of concentration, rainfall intensity, quantity of storm water, and design criteria applicable to the sewerage networks.

Chapter five "Bill of Quantities" deals with the item of the project estimated quantity of each item.

Chapter six "Conclusions " discusses the conclusions of the study.

2.1 General

In this chapter, the basic data of Sourif town will be briefly discussed. The topography, population water consumption, and waste water production will be briefly presented.

2.2 Project Area

Sourif is situated 18 Km to the north east of Hebron town, as shown on the project location plan (Fig2.1), the average hight of the town is 600 m with respect to sea level. The total area of the town is about 4960 donum.

The population within the municipal administrative borders in year 2009 is around 16000 persons. This population is expected to grow substantially up to the year 2036 planning horizon of this project.

The town is composed of several hills and mountains. The heights of these mountains are range between 460 m and 825 m.The topography of Sourifarea is illustrated in Drawing D1 (Apendex B). Sourif town lies on the coordinate lines: 115330.88 – 118779.42 longitude lines . 155246.78 –157003.24 latitude lines.

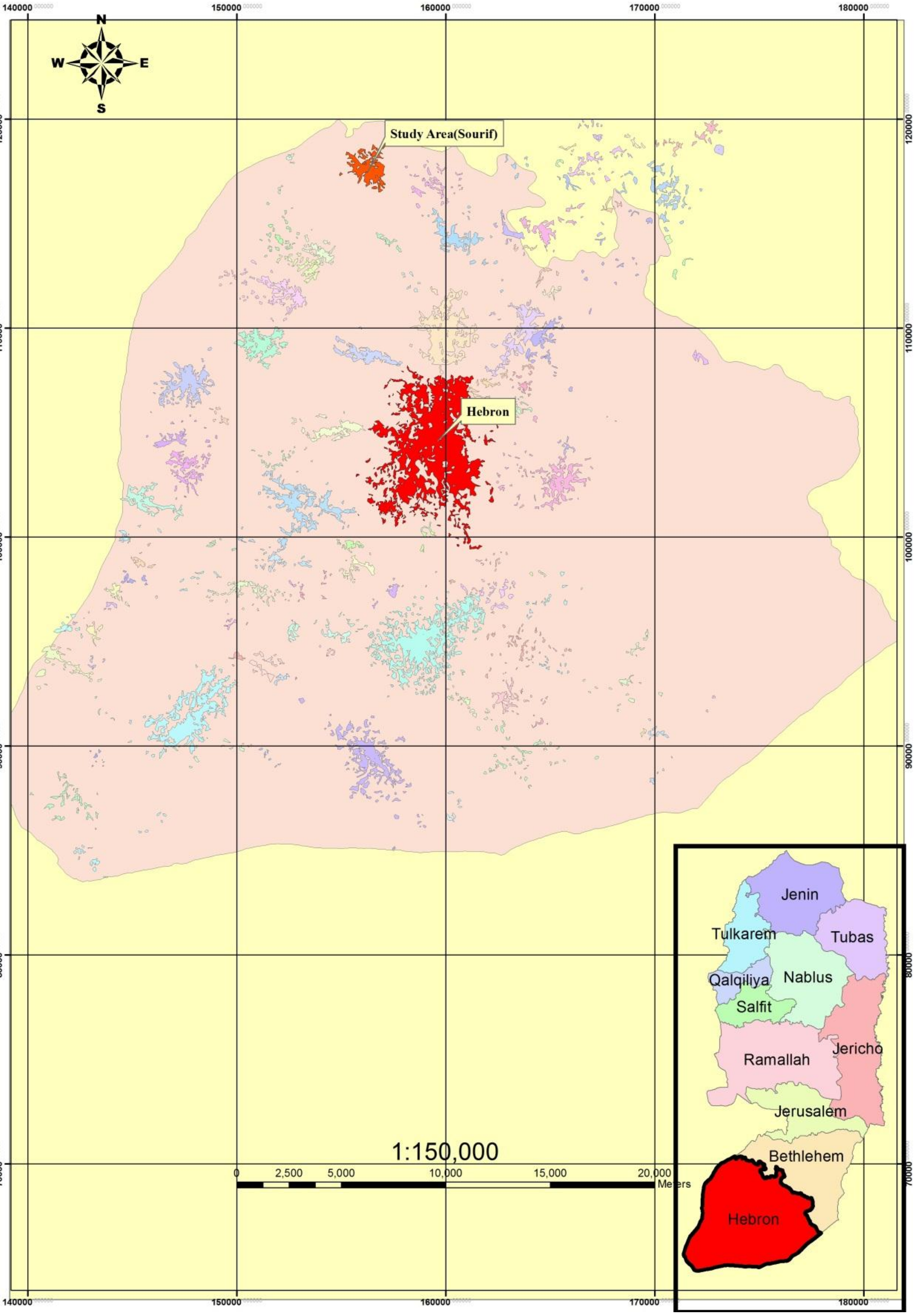

Fig 2.1 Location Plan For Sourif Town

2.3 Land Use

As mentioned earlier, the land area of Sourif town is approximately 4960 donum. There is no clear town plan defining land use in the various zones of Sourif. The land use can be distributed as follows:-

1. Old town : This area is consists of old buildings which have a historical importance, these buildings are used as resedinces, workshops, public building, and cemetry. Some of these buildings are very old and to be maintained.
2. Old town surrounding: The land use of Sourif town(shown in Fig 2.2) is distributed as follow :-
    1. Habitation area, food stories, workshop building, public buildings.
    2. Agricultural areas.
    3. Roads.

Fig 2.The land use of Sourif town

2.4 Road Network

There are two main roads link the town with neighbour towns and villages:

The road link the town with road number 60 (Jerusalem-Hebron road).The road that link the town with neighbour villags Kharas, Noba….etc.

These roads need to be repaired, expanded or modified. The expansion sometimes become impossible due to the buildings that surround these roads. The best alternatives is to find an external roads network that links between the two entrances of the town and between those entrances and internal roads. The town has poor internal roads network.

2.5 Meteorological Data

The hydrology of the region depends primarily on its climate, and secondarily on its topography. Climate is largely dependent on geographical position of the earth surface; humidity, temperature, and wind. These factors affect are affecting evaporation and transpiration. So this study will include needed data about these factors, since they play big role in the determination of water demand.

The climate of Sourif tends to be cold in winter with limited amount of rain, and warm in summer with relative humid.

2.5.1 Rainfall

The average annual rainfall in Sourif town for the last five year is approximately 300-400 mm. The maximum annual rainfall in the period from 2005 to 2010 is 330.1 mm. This was in year 2005/2006.The minimum annual rainfall is 268.8mm, which was in the year 2009/2010 Table (2.1) shows the monthly rainfall and number of raining days during the period from 2005-2010.

Table 2.1 Monthly Rainfall AndNumber Of Raining Days During The Period From 2005-2010

Year / Month	2005/2006		2006/2007		2007/2008		2008/2009		2009/2010		5- Years Average Rainfall mm
	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	
September	0	0	0	0	0	0	0	0	0	0	0
October	5	1	4.5	1	5.5	2	5	1	6	1	5.2
November	6	2	4	2	5	1	0	0	0	0	3
December	85	7	80	6	73.5	5	70	5	63.9	4	74.48
January	79.5	10	75.5	6	72.3	6	70.1	7	70.5	8	73.58
February	75.5	9	75.1	8	75.5	7	73.1	8	72.4	8	74.32
March	39.5	5	35.2	3	30.3	2	26.9	3	26.6	4	31.7
April	35.6	2	31.8	3	29.6	2	31.2	3	29.4	2	31.52
May	4	1	3	2	2	1	0	0	0	0	1.8
Total	330.1	37	309.1	31	293.7	26	276.3	27	268.8	27	295.6

2.5.2 Temperature

The temperature is characterized by considerable variation between summer and winter times. The mean temperature values at Sourif town for the period 1995 to 2000 are given in below.

- The Mean maximum temperature: 31˚C
- The Mean minimum temperature: 8˚C
- The Mean Maximum temperature record: 30˚C
- The Mean Minimum temperature record: 4.4˚C

2.5.3 Relative Humidity

Since Sourif is situated at considerable distance from the sea in a mountains region on the outskirts of the desert, Sourif has low values of relative humidity compared to those in the plains. the relative humidity in Sourif town range from 54-78%, it reaches the maximum value in January(78%).

2.5.4 Wind

The directions and velocities of wind vary depending on the season of the year. In winter, the wind blows in the morning from the southwest a rounds noon from southwest and west, and at night from west and northwest. In summer, northeasterly wind blows all day long. According to data obtained from Meteorological Station, average wind in winter is about 9.8km/h and in summer 5.4km/h.

3.1 WASTE WATER COLLECTION SYSTEM DESIGN

3.1.1 General

Once used for its intended purposes, the water supply of a community is considered to be waste water. The individual conduits used to collect and transport waste water to the treatment facilities or to the point of disposal are called sewers.

There are three types of sewers: sanitary, storm, and combined. Sanitary sewers are designed to carry waste water from residential, commercial, and industrial areas, and a certain amount of infiltration /inflow that may enter the system due to deteriorated conditions of sewers and manholes. Storm sewers are exclusively designed to carry the storm water. Combined sewers are designed to carry both the sanitary and the storm flows.

The network of sewers used to collect waste water from a community is known as waste water collection system. The purpose of this chapter is to define the types of sewers used in the collection systems, types of waste water collection systems that are used, the appurtenances used in conjunction with sewers, the flow in sewers, the design of sewers, and the construction and maintenance of sewers.

3.1.2 Municipal Sewerage System

Types Of Sewers

The types and sizes of sewers used in municipal collection system will vary with size of the collection system and the location of the waste water treatment facilities. The municipal or the community sewerage system consists of (1) building sewers (also called house connections), (2) laterals or branch sewers, (3) main and submain sewers, (4) trunk sewers.

House sewers connect the building plumbing to the laterals or to any other sewer lines mentioned above. Laterals or branch sewers convey the waste water to the main sewers. Several main sewers connect to the trunk sewers that convey the waste water to large intercepting sewers or the treatment plant.

The diameter of a sewer line is generally determined from the peak flow that the line must carry and the local sewer regulations, concerning the minimum sizes of the laterals and house connections. The minimum size recommended for gravity sewer is 200 mm (8 inch).

Sewer Materials

Sewers are made from concrete, reinforced concrete, vitrified clay, asbestos cement, brick masonry, cast iron, ductile iron, corrugated steel, sheet steel, and plastic or polyvinylchloride or ultra polyuinyl chloride. Concrete and ultra polyvinyl chlorides are the most common materials for sewer construction.

3.1.3 Types Of Waste Water Collection Systems

Gravity Sewer System

Collecting both waste water and storm water in one conduit (combined system) or in separate conduits (separate system). In this system, the sewers are partially filled. A typical characteristic is that the gradients of the sewers must be sufficient to create self-cleansing velocities for the transportation of sediment. These velocities are 0.6 to 0.7 m/s minimum when sewers are flowing full or half-full. Manholes are provided at regular intervals for the cleaning of sewers.

Pressure Type System

Collecting waste water only. The system, which is entirely kept under pressure, can be compared with a water distribution system. Sewage from an individual house connection, which is collected in manhole on the site of the premises, is pumped into the pressure system. There are no requirements with regard to the gradients of the sewers.

Vacuum Type System

Collecting waste water only in an airtight system. A vacuum of 5-7 m is maintained in the system for the collection and transportation of the waste water. There is no special requirement for the gradients of the sewers.

Pressure and vacuum–types systems require a comparatively high degree of mechanization, automation and skilled manpower. They are often more economical than gravity system, when applied in low population density and unstable soil conditions. Piping with flexible joints has to be used in areas with expansive soils.

3.1.4 Sewer Appurtenances

Manholes

Manholes should be of durable structure, provide easy access to the sewers for maintenance, and cause minimum interference to the sewage flow. Manholes should be located at the start and at the end of the line, at the intersections of sewers, at changes in grade, size and alignment except in curved sewers, and at intervals of 35-50 m in straight lines.

The general shapes of the manholes are square, rectangular or circular in plan, the latter is common. Manholes for small sewers are generally 1.0-1.2 m in diameter. For larger sewers larger manhole bases are provided. The maximum spacing of manholes is 35-50 m depending on the size of sewer and available size of sewer cleaning equipment (Qasim, 1985).

Standard manholes consist of base, risers, top, frame and cover, manhole benching, and step-iron. The construction materials of the manholes are usually precast concrete sections, cast in place concrete or brick. Frame and cover usually made of cast iron and they should have adequate strength and weight.

Drop Manholes

A drop manhole is used where an incoming sewer, generally a lateral, enters the manhole at a point more than about 0.6 m above the outgoing sewer. The drop pipe permits workmen to enter the manhole without fear of being wetted, avoid the splashing of sewage and corrosion of manhole bottom (Hammer 1977).

House Connections

The house sewers are generally 10-15 cm in diameter and constructed on a slope of 2% m/m. house connections are also called, service laterals, orservice connections. Service connections are generally provided in the municipal sewers during construction. While the sewer line is under construction, the connections are conveniently located in the form of wyes or tees, and plugged tightly until service connections are made. In deep sewers, a vertical pipe encased in concrete is provided for house connections.

3.1.5 Design Parameters

Population

The ideal approach for population forecasting is by the evaluation and using the previous census records, which cover along period. The longer the period, and the more comprehensive census data, the more accurate will be the result which will be obtained. In the analysis of these data demographical, economic and political factors should be considered in order to develop a method of forecasting which will predict the expected growth rate , future population and their distribution in the different zones of the area.

In the town of Sourif, as well as other Palestinian cities and towns, there is great uncertainty in the political future.

Due to the unstable condition of the area during the last 50 years, it would be very difficult to develop a statistical interpretation to extrapolate future population. some reasonable assumption have therefore been made to project the future population of the town of Sourif over next 25 year.

Population Forecast

Prediction of the future population of Sourif is very difficult due to the lack of reliable historic data, and the political uncertainties which will greatly influence future social and economic development. at the same time, the available data on past population growth do not.

Constitute a reliable basis for projecting the future population growth in Sourif. The base for the forecasting is the 2009 population for Sourif obtained from PCBS of 16000 inhabitants. The rate of population growth for the purpose of our study was based on estimation used for other towns of similar population composition and characteristics.

The rate of population growth in other town in West Bank is 3.5%. A grater rate of growth was assumed for the town of Gaza.

Therefore the rate of 3.5% per year was used for the future growth of the population of Sourif town.

To calculate the population for the end of the design period (year 2036), a geometric increase is assumed, represented by the following equation:

$$\boldsymbol{P = P_0 * (1 + R)^n} \qquad \textbf{(3.1)}$$

In which, P is future population, P_0 is present population, R is annual population growth rate, and n is the period of projection.

Using the above assumption and equation, Table 3.1 presents the population projection up to the design horizon of 2036. The data show that the population of Sourif is estimated to be 52512 in year 2036.

Table3.1Population Forecasts For Sourif

Year	**2009**	**2011**	**2016**	**2021**	**2026**	**2031**	**2036**
Population	**16000**	**17472**	**21773**	**27134**	**33814**	**42138**	**52512**

2. Flow Rate Projections

The total waste water flow in sanitary sewers for municipal area is made up of two components:

(1) Residential area (2) infiltration. Sanitary sewers are designed for peak flows from residential and peak infiltration allowance for the entire service area. Theflow rateprojections are necessary to determine the required capacities of sanitary sewers.

3. The Peak Coefficient

In general, this coefficient increases when the average flow decrease, it will be determined from the practice and experience of the designer. The following relation has been used commonly by the designer and gives satisfactory results:

$$Pf = 1.5 + 2.5 / \sqrt{q} \qquad (3.2)$$

Where, q (in l/s) is the daily average flow rate of the network branch under consideration and Pf is the peak factor.

4. Hydraulic Design

As mentioned earlier and according to usual practice, the sewers will be designed for gravity flow using Manning's formula:

$$V = (1/n)\, R^{2/3}\, S^{1/2} \qquad (3.3)$$

Depending on pipe materials, the typical values of n is 0.015

5. Minimum And Maximum Velocities

To prevent the settlement of solid matter in the sewer ,the literature suggested that the minimum velocity at half or full depth – during the peak flow period – should not be less than 0.6 m/s , Usually, maximum sewer velocities are limited to about 3 m/s in order to limit abrasion and avoid damages which may occur to the sewers and manholes due to high velocities.

6. Pipes And Sewers

Experience indicates a minimum diameter of 200 mm (8 in) for sewer pipes. For house connections.

Pipe Materials: Different pipe materials may be recommended for the sewers. Polyvinyl chloride, vitrified clay or polyethylene material for small size pipes(approximately up to the size 400 mm in diameter).

Centrifugal cast reinforced concrete pipes may be used for larger diameter.

7. Manholes

Manholes should be located at changes in size, slope direction or junction with secondary sewer. Manholes spacing generally does not exceed 50 m.

8. Sewer Slope

For a circular sewer pipe, the slope must be between the minimum and maximum slope, the minimum and maximum slope is determined from minimum and maximum velocity. Generally the natural ground slope is used because it is the technical and economic solution, the solution is therefore recommended.

9. Depth of Sewer Pipe

The depth of sewers is generally 1.5 m below the ground surface. Depth should be enough to receive the sewage by gravity, avoid excessive traffic loads, and avoid the freezing of the sewer. It is recommended that the top of sewer should not be less than 1.5 m below basement floor (Qasim, 1985).

Important Numbers

- Maximum velocity = 3 m/s
- Minimum velocity = 0.6 m/s
- Maximum slope = 15%
- Minimum slope = 0.5%
- H/D = 50%
- Minimum diameter 200 mm
- Maximum diameter 600 mm
- Minimum cover 1.5 m
- Maximum cover 5 m

After the preliminary sewer layout plan is prepared, the design computations are accomplished. Design computations for sewers are repetitious and therefore, are best performed in a tabular format. Table 3.2 is typical of the way in which data can be organized to facilitate computations for closed system.

Table 1 (Main Trank S1 West Water Collection System) Cont'd

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
98	S 1	98	99	25.4	0.17	35.93	1970.42	821.25	1.59	1303.52	82.13	3439.03	24.62
99	S 1	99	100	50	0.17	4.34	1974.76	823.06	1.59	1306.32	82.31	3442.00	2.97
100	S 1	100	101	50	0.17	10.45	1985.21	827.42	1.59	1313.04	82.74	3449.16	7.16
101	S 1	101	102	17.51	0.17	7.98	1993.19	830.74	1.59	1318.17	83.07	3454.63	5.47
102	S 1	102	103	50	0.17	2.04	1995.23	831.59	1.59	1319.48	83.16	6638.10	3183.48
103	S 1	103	104	58.7	0.17	9.91	2005.14	835.72	1.59	1325.86	83.57	6644.89	6.79
104	S 1	104	105	50	0.17	8.53	2013.67	839.28	1.59	1331.35	83.93	6650.73	5.84
105	S 1	105	106	50	0.17	8.35	2022.02	842.76	1.59	1336.72	84.28	6656.45	5.72
106	S 1	106	107	38.57	0.17	6.31	2028.33	845.39	1.59	1340.77	84.54	6660.77	4.32

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	3.543	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

3.2 STORM WATER DRAINAGE SYSTEM DESIGN

3.2.1 General

Rapid effective removal of storm runoff was a luxury not found in many cities in the early nineteenth century. Today, the modern city dweller has come to think of this as an essential service. Urban drainage facilities have progressed from crude ditches and stepping stones to the present intricate coordinates systems of curbs, gutters, inlets, and underground conveyance.

The design must consider meteorological factors, geomorphologic factors, and the economic value of the land, as well as human value considerations such as aesthetic and public safety aspects of the design. The design of storm water detention basins should also consider the possible effects of inadequate maintenance of the facility

3.2.2 Storm Water Runoff

Storm water runoff is that portion of precipitation which flows over the ground surface during and a short time after a storm. The dependence parameters that controlled the quantity of the storm water which carried by a storm or combined sewer are the surface of the drainage area (A, ha), the intensity of the rainfall (i, l/s.ha), and runoff coefficient C dimensionless (the condition of the surface). There are many methods and formulas to determine the storm flow, and in all of them above parameters show up. One of the most common methods is Rational method which will be discussed below.

Rational Method

The rational method has probably been the most popular method for designing storm systems. It has been applied all over the world and runoff is related to rainfall intensity by the formula,

$$Q = C \cdot i \cdot A \qquad 3.4$$

Where

Q = peak runoff rate (l/sec)

C = runoff coefficient, which is actually the ratio of the peak runoff rate to the average rainfall for a period known as the time of concentration.

i = average rainfall intensity, mm/min, for period equal to the time of concentration

A = drainage area, hectar

For small catchments areas, it continues to be a reasonable method, provided that it is used properly and that results and design concepts are assessed for reasonableness. This procedure is suitable for small systems where the establishment of a computer model is not warranted.

The steps in the rational method calculation procedure are summarised below:

1. The drainage area is first subdivided into sub-areas with homogeneous land use according to the existing or planned development.

2. For each sub-area, estimate the runoff coefficient *C* and the corresponding area *A*.

3. The layout of the drainage system is then drawn according to the topography, the existing or planned streets and roads and local design practices.

4. Inlet points are then defined according to the detail of design considerations. For main drains, for example, the outlets of the earlier mentioned homogeneous sub-areas should serve as the inlet nodes. On the other hand in very detailed calculations, all the inlet points should be defined according to local design practices.

5. After the inlet points have been chosen, the designer must specify the drainage sub-area for each inlet point A and the corresponding mean runoff coefficient *C*. If thesub-area for a given inlet has non-homogeneous land use, a weighted coefficient may be estimated.

6. The runoff calculations are then done by means of the general rational method equations for each inlet point, proceeding from the upper parts of the watershed to the final outlet. The

peak runoff, which is calculated at each point, is then used to determine the size of the downstream trunk drain using a hydraulic formula for pipes flowing full.

7. After the preliminary minor system is designed and checked for its interaction withthe major system, reviews are made of alternatives, hydrological assumptions areverified, new computations are made, and final data obtained on street grades and elevations. The engineer then should proceed with final hydraulic design of the system.

Runoff Coefficient, C

Runoff coefficient is a function of infiltration capacity, interception by vegetation, depression storage, and evapotranspiration. It is requires greatest exercise of judgment by engineer and assumed constant, actually variable with time. It is desirable to develop composite runoff coefficient (weighted average) for each drainage area as:

$$C = \frac{\sum Ci.Ai}{\sum Ai} \qquad \textbf{(3.5)}$$

Where Ai = i^{th} area.

Ci = i^{th} runoff coefficient.

The range of coefficients with respect to general character of the area is given in the following tables (Table 3.2 and Table 3.3).

Table 3.3 The Range Of Coefficient With Respect to General Character Of The Area (Sarikaya, 1984)

Description of Area	Runoff Coefficients
Business	
Down town	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	

Single-Family Multi-unit, detached Multi-unit, attached	0.30 to 0.50 0.40 to 0.60 0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light Heavy	0.50 to 0.80 0.60 to 0.90
Parks, Cemeteries	0.10 to 0.25
Playground	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved	0.10 to 0.30

Table 3.4The Range of Coefficient With Respect to Surface Type of the Area (Sarikaya, 1984)

Character of Surface	Runoff Coefficients
Pavement	
Asphalt and concrete Brick	0.70 to 0.95 0.70 to 0.85
Lawns, Sandy soil	
Flat, 2 percent Average,2to7percent Steep, 7 percent	0.05 to 0.10 0.10 to 0.15 0.15 to 0.20
Roofs	0.75 to 0.95
Lawns, heavy soil	

Flat, 2 percent	0.13 to 0.17
Average,2 to 7percent	0.18 to 0.22
Steep, 7 percent	0.25 to 0.35

Rainfall Intensity, i

In determining rainfall intensity for use in rational formula it must be recognized that the shorter the duration, the greater the expected average intensity will be. The critical duration of rainfall will be that which produces maximum runoff and this will be that which is sufficient to produce flow from the entire drainage area. Shorter periods will provide lower flows since the total area is not involved and longer periods will produce lower average intensities. The storm sewer designer thus requires some relationship between duration and expected intensity. Intensities vary from place to another and curves or equations are specified for the areas for which they were developed.

The rainfall intensity depends on many factors through which we can do our calculations; we can list these factors as follow:

1. Average frequency of occurrence of storm (1/n) or (f).

Average frequency of occurrence is the frequency with which a given event is equaled or exceeded on the average, once in a period of years. Probability of occurrence, which is the reciprocal of frequency, (n) is preferred by sum engineers. Thus, if the frequency of a rain once a 5-year (1/n=5), then probability of occurrence n=0.20. Selection of storm design rain frequency based on cost-benefit analysis or experience. There is range of frequency of often used:

a. Residential area: f = 2 to 10 years (5 year most common).
b. Commercial and high value districts: f = 10 to 50 (15 year common).
c. Flood protection: f = 50 year.

2. Intensity, duration and frequency characteristics of rainfall.

Basic data derived from gage measurement of rainfall (Point rainfall) over a long period can be used to obtain a rainfall height diagram that show the relation between the height of rain (mm) and time (min). The slope of the curve or rain height per unit time is defined as rain intensity:

i= (Δ height of rain / Δ time) $\left[\frac{mm}{\min}\right]$

The rain intensity in liter per second . hectare is equal:

$$i(\frac{l}{s.ha}) = 166.7i\left[\frac{mm}{\min}\right]$$

in order to drive intensity-duration-frequency curves long-term observation of rainfall is needed. Analysis of such observation is given in any text in sanitary engineering.

3. Time of Concentration

The time of concentration is the time required for the runoff to become established and flow from the most remote part (in time) of the drainage area to the point under design.

$$t_c = t_i + t_f \quad \textbf{(3.6)}$$

Where t_c: time of concentration.

t_i: inlet time.

t_f: flow time.

Time of flow in storm, $t_f = \frac{\text{Length of pipeline (L)}}{\text{Velocity of flow (v)}}$

Inlet time (t_i): is the time required for water to flow over ground surface and along gutters to drainage inlet. Inlet time is function of rainfall intensity, surface slope, surface roughness, flow distance, and infiltration capacity and depression storage.

3.2.3 Hydraulic Consideration

Waste water systems and (storm water) are usually designed as open channels except where lift stations of the flows, and the fact that an unconfined or free surface exists. The driving are required to overcome topographic barriers. The hydraulic problems associated with these flows are complicated in some cases by the quality of the fluid, the highly variable nature force for open-channel flow and sewer flow is gravity. For the hydraulic calculations of sewers, it is usually assumed uniform flow in which the velocity of flow is constant, and steady flow condition in which the rate discharge at any point of a sewer remains constant (Metcalf,1982).

Hydraulic design equations

In principle all open channel flow formulas can be used in hydraulic design of sewer pipes. The following are the most important formulas:

1. Chezy's formula:

$$\textbf{(3.7)}\, V = C\sqrt{RS}$$

Where V: the velocity of flow (m/s).

C: the Chezycoefficient; where m = 0.35 for concrete pipe or 0.25 for vitrified clay pipe

$$C = \frac{100\sqrt{R}}{m+\sqrt{R}}$$

R: the hydraulic radius (m)

S: the slope of the sewer pipe (m/m).

2. Darcy-Weisbach formula: It is not widely used in waste water collection design and evaluation because a trial and error solution is required to determine pipe size for a given flow and head loss, since the friction factor is based on the relative roughness which involves the pipe diameter, making it complicated. Darcy-Weishbach formula states that

$$\textbf{(3.8)}\, H = \lambda \frac{L \times V^2}{D \times 2g}$$

Where H: the pressure head loss (mwc).

L: the length of pipe (m).

D: the diameter of pipe (m)

λ : the dimensionless friction factor generally varying between 0.02 to 0.075.

3. The Manning formula: Manning’s formula, though generally used for gravity conduits like open channel, it is also applicable to turbulent flow in pressure conduits and yields good results, provided the roughness coefficient n is accurately estimated. Velocity, according to Manning’s equation is given by:

$$\mathbf{V = (1/n)\ R^{2/3} S^{1/2}} \quad \mathbf{(3.9)}$$

Where n: the Manning's roughness coefficient [$1/n\ (k_{str}) = 75\ m/s^{1/3}$].

R: the hydraulic radius = area /wetted perimeter (R = A/P)

- For circular pipe flowing full, R= (D/4).
- For open channel flowing full, R= [(b*d)/ (b+2d)].

The Manning's roughness coefficient depends on the material and age of the conduit. Commonly used values of n for different materials are given in Table (3.4).

Table 3.5 Common Values Of Roughness Coefficient Used In The Manning Equation (Sarikaya, 1984)

Material	Commonly Used Values of n
Concrete	0.013 and 0.015
Vitrified clay	0.013 and 0.015
Cast iron	0.013 and 0.015
Brick	0.015 and 0.017
Corrugated metal pipe	0.022 and 0.025
Asbestos cement	0.013 and 0.015
Earthen channels	0.025 and 0.003
PVC	0.015

Hydraulics Of Partially Field Section

The filling rate of a sewer is an important consideration, as sewers are seldom running full, so storm water sewers designed for 70% running full, that is means only 70% of the pipe capacity should be utilized to carry the peak flow.

Partially filled sewers are calculated by using partial flow diagram and tables indicating the relation between water depth, velocity of flow and rate flow .The hydraulic characteristics are similar as for open channels, but the velocity of flow is reduced by increased air friction in the pipe with increasing water level, particularly near the top of the pipe. The velocity of flow and the flow rate are reduced at filling rates between 60% and 100%; the water level in the pipe is unstable at filling rates above 90% or 95%.

3.2.4 Storm Water Sewers Design

Designing a community storm system is not a simple task. It requires considerable experience and a great deal of information to make proper decisions concerning the layout, sizing, and construction of a storm network that is efficient and cost-effective. The design engineer needs to generally undertake the following tasks (Qasim, 1985, Peavy, 1985):

1. Define the service area.
2. Conduct preliminary investigations.
3. Develop preliminary layout plan and profile.
4. Selection of design parameters.
5. Review construction considerations.
6. Conduct field investigation and complete design and final profiles

Service Area

Service area is defined as the total area that will eventually be served by the drainage system. The service area may be based on natural drainage or political boundaries, or both. It is important that the design engineers and project team become familiar with the surface area of the proposed project.

Preliminary Investigation

The design engineer must conduct the preliminary investigations to develop a layout plan of the drainage system. Site visits and contacts with the city and local planning agencies and state officials should be made to determine the land use plans, zoning regulations, and probable future changes that may affect both the developed and undeveloped land. Data must be developed on topography, geology, hydrology, climate, ecological elements, and social and economic conditions. Topographic maps with existing and proposed streets and other utility lines provide the most important information for preliminary flow routing (Qasim, 1985).

If reliable topographic maps are not available, field investigations must be conducted to prepare the contours, place bench marks, locate building, utility lines, drainage ditches, low and high areas, stream, and the like. All these factors influence the sewer layout.

Layout Plan

Proper storm sewer layout plan and profiles must be completed before design flows can be established. The following is a list of basic rules that must be followed in developing a sewer plan and profile.

1. Select the site for disposal of the storm water at the end of the network, generally the lowest elevation of the entire drainage area.
2. The preliminary layout of storm sewers is made from the topographic maps. In general, sewers are located on streets, or on available right-of-way; and sloped in the same direction as the slope of the natural ground surface.
3. The trunk storm sewers are commonly located in valleys. Each line is started from the intercepting sewer and extended uphill until the edge of the drainage area is reached, and further extension is not possible without working downhill.
4. Main storm sewers are started from the trunk line and extended uphill intercepting the laterals.
5. Preliminary layout and routing of storm sewage flow is done by considering several feasible alternatives. In each alternative, factors such as total length of storm sewers, and cost of

construction of laying deeper lines versus cost of construction, operation, and maintenance of lift station, should be evaluated to arrive at a cost- effective drainage system.

6. After the preliminary storm sewer layout plan is prepared, the street profiles are drawn. These profiles should show the street elevations, existing storm sewer lines, and manholes and inlets. These profiles are used to design the proposed lines.

Finally, these layout plans and profiles are revised after the field investigations and storm sewer designs are complete (Viessman, 1985).

Selection of Design Parameters

Many design factors must be investigated before storm sewer design can be completed. Factors such as design period; peak, average, and minimum flow; storm sewer slopes and minimum velocities; design equations …etc. are all important in developing storm sewer design. Many of the factors are briefly discussed below.

1. Design Flow Rate

Storm water sewers should be designed to carry the largest storm that occurred in the period of design; commonly it is 5 years because of consideration of the cost and the frequently factors.

2. Minimum Size

The minimum storm sewer size recommended is 250mm (10″) for closed system, and for open channel depend on the type of profile that selected.

3. Minimum and Maximum Velocities

In storm water sewers, solids tend to settle under low-velocity conditions. Self-cleaning velocities must be developed regularly to flush out the solids. Most countries specify minimum velocity in the sewers under low flow conditions. The minimum allowable velocity is 1 m/s is desirable. This way the lines will be flushed out at least once or twice a day. The maximum velocity for storm water system is5 m/s. The maximum velocity is limited to prevent the erosion of sewer inverts.

4. **Slope**

For closed systemminimum slopes determined from minimum velocities, for minimum velocity 0.9 m/s, the slopes are shown in Table (3.5).

Table 3.6 Minimum Recommended Slopes Of Storm Sewer (n = 0.015) (Sarikaya, 1984)

Pipe Diameter (D)		Slope (min)	Slope (max) =1/D
Mm	**Inch**	**Mm**	**Cm**
250	10	0.00735	0.04
300	12	0.00576	0.033
450	18	0.00336	0.0222
600	24	0.00229	0.0167

Note: for a velocity of 0.75m/s the slopes shown above should be multiplied by 1.56

Maximum slopes determined from maximum velocities, 1/D (cm) can be used as a guide. For open channel, the slope also depends on the profile type, and generally used as the slope of the road.

5. Depth

The depth of storm sewers when using closed system is generally just enough to receive flow but not less than 1 m below the ground surface. Depth depends on the water table, lowest point to be served, topography, and the freeze depth. But for the open channel it is at the ground surface.

6. Appurtenances

Storm Sewer appurtenances include manholes, inlets, outlets and outfall, and others. Appropriate storm sewer appurtenances must be selected in design of storm water sewers.

7. Design Equations and Procedures

Storm water sewers are mostly designed to flow partially full. Once the peak, average, and minimum flow estimates and made general layout and topographic features for each line are established, the design engineer begins to size the sewers. Design equations proposed by Manning, Chezy, Gangullet, Kutter, and Scobey have been used for designing sewers and drains. The Manning equation, however, has received most widespread application. This equation is expressed below:

$$V = (1/n)\ R^{2/3} S^{1/2} \quad (3.10)$$

And as mentioned earlier, the runoff flow is calculated using the following formula:

$$Q = C.i.A \quad (3.11)$$

Various types of nomographs have been developed for solution of problems involving sewers flowing full. Nomographs based on Manning's equation for circular pipe flowing full and variable n values are provided in Fig 3.1. Hydraulic elements of circular pipes under partially-full flow conditions are provided in Fig 3.2. It may be noted that the value of n decreases with the depth of flows Fig 3.1. However, in most designs n is assumed constant for all flow depths. Also, it is a common practice to use d, v, and q notations for depth of flow, velocity, and discharge under partial flow condition while D, V, Q notations for diameter, velocity, and discharge for sewer flowing full.

Use of equations 3.3 and 3.8 and Figs 3.1 and 3.2, one can design the drainage system.

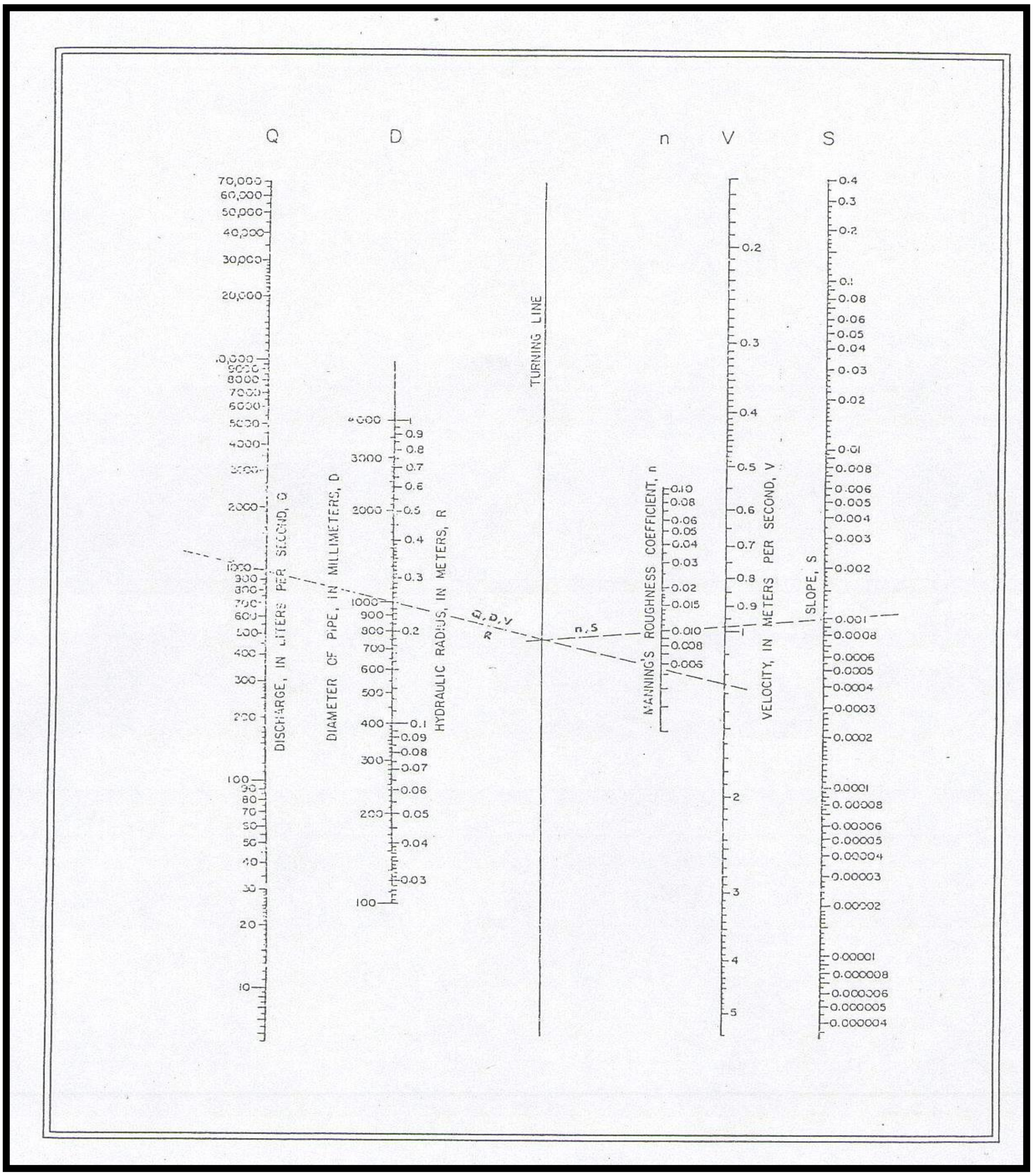

Fig 3.1 NomographFor Solution Of MainingFormula

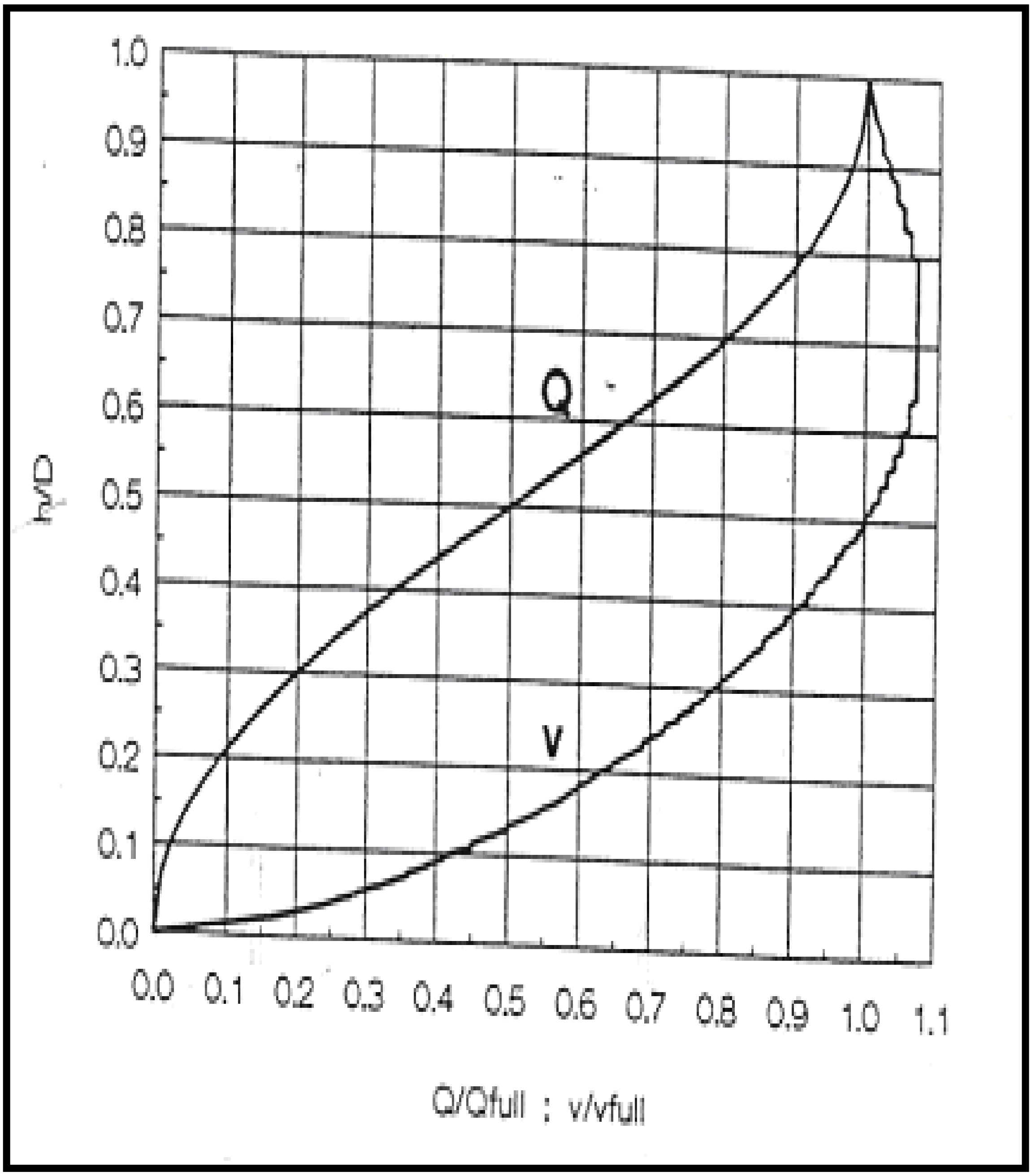

Fig 3.2 Hydraulic Properties Of Circular Sewer

Design Computations

After the preliminary sewer layout plan and profile are prepared, the design computations are accomplished. Design computations for sewers are repetitious and therefore, are best performed in a tabular format. Table 3.7 is typical of the way in which data can be organized to facilitate computations for closed system.

Preparation of Maps and Profile

It is important that the detailed drawings be prepared and specifications completed before the bide can be requested. The contract drawings should show (1) surface features, (2) depth and character of material to be excavated, (3) the existing structures that are likely to be encountered, and (4) the details of sewer and appurtenances to be constructed.

Important Numbers

- Maximum velocity = 5 m/s
- Minimum velocity = 1 m/s
- Maximum slope = 15%
- Minimum slope = 0.5%
- H/D = 70%
- Minimum Diameter 250-300 mm
- Minimum cover 1 m
- Maximum cover 5 m

Table 16.1(Main Trunk N2 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N2 a	1	2	100	100.00	2.56	0.2	0.51	0.51	9.67	202.32	103.59	103.59
2	N2 a	2	3	99.91	199.91	2.56	0.2	0.51	1.02	11.33	199.63	204.42	100.84
3	N2 a	3	4	98.72	298.63	2.46	0.2	0.49	1.52	12.98	197.01	298.67	94.25
4	N2 a	4	5	99.89	398.52	2.45	0.2	0.49	2.01	14.64	194.39	389.95	91.29
5	N2 a	5	6	100	498.52	2.70	0.2	0.54	2.55	16.31	191.81	488.35	98.39
6	N2 a	6	7	99.02	597.54	2.70	0.2	0.54	3.09	17.96	189.28	584.13	95.78
7	N2 a	7	8	99.49	697.03	2.76	0.2	0.55	3.64	19.62	186.78	679.50	95.37
8	N2 a	8	9	100	797.03	2.92	0.2	0.58	4.22	21.28	184.30	778.09	98.59
9	N2 a	9	10	100	897.03	2.83	0.2	0.57	4.79	22.95	181.84	870.67	92.58
10	N2 a	10	11	100	997.03	2.33	0.2	0.47	5.25	24.62	179.43	942.71	72.03
11	N2 a	11	12	99.94	1096.97	1.43	0.2	0.29	5.54	26.28	177.04	980.81	38.11
12	N2 a	12	16	71.81	1168.78	0.30	0.2	0.06	5.60	27.48	175.35	981.95	1.14

Design Assamptions and data
Chock Load

4.1 WASTE WATER COLLECTION SYSTEM

4.1.1 GENERAL

In this project, design of waste water collection system for Sourif town is made, and develop a future plans for construction of the collection system, corresponding to the vision of Sourif municipality about their future plan zone, in order to reduce the problem causes by missing this important part.

In this section, the layout of the system established is presented, and the computation procedures and tables are given along the drawings of layout and profiles for all the lines designed.

4.1.2 Layout of the System

The first step in designing a sewerage system is to establish an overall system layout that includes a plan of the area to be sewered, showing roads, streets, buildings, other utilities, topography, and the lowest floor elevation or all buildings to be drained.

In establishing the layout of waste water collection system for Sourif town, the following basic steps were followed:

1. Obtain a topographic map of the area to be served.
2. Visit the location
3. Locate the drainage outlet. This is usually near the lowest point in the area and is often along a stream or drainage way. In Sourif town, the lowest point is in the North-west part of the zone.
4. Sketch in preliminary pipe system to serve all the contributors.
5. Pipes are located so that all the users or future users can readily tap on. They are also located so as to provide access for maintenance and thus are ordinarily placed in streets or other rights-of-way.

6. Sewers layout is followed natural drainage ways so as to minimize excavation and pumping requirements. Large trunk sewers are located in low-lying areas closely paralleling streams or channels.
7. Revise the layout so as to optimize flow-carrying capacity at minimum cost. Pipe lengths and sizes are kept as small as possible, pipe slopes are minimized, and followed the ground surface slope to minimize the depth of excavation, and the numbers of appurtenances are kept as small as possible.
8. The pumping is avoided across drainage boundaries. Pumping stations are costly and add maintenance problems.

The final layout of waste water collection system for Souriftown is illustrated in (Fig 4.1), (Fig 4.2) and drawing D1, D2 in (Appendix B).

Four main trunks are located on the layout and each has catchment and sub catchment area.

Fig 4.1 A3 sanitary

1. Layout Of Waste Water Collection System (With Contour Lines) Fig4.1
2. Layout Of Waste Water Collection System (Without Contour Lines) Fig4.2

4.1.3 Quantity Of Waste Water

The detailed design of sanitary sewers involves the selection of appropriate pipe sizes and slopes to transport the quantity of waste water expected from the surroundings and upstream areas to the next pipe in series, subject to the appropriate design constrains. The design computations in the example given below.

After preparing the layout of the waste water collection system the quality of waste water that the system must carry it will be calculated using the data collected about the area.

Example: Design a gravity flow trunk sanitary sewer for the area to outfall (line S2a) in (Fig 4.3). The following data will collect and analyzed.

1. For current water consumption uses 60 l/c.day.
2. For future water consumption 120 l/c.day.
3. For current population.
4. For Population growth rate 3.5%.
5. For design period 25 year.
6. The waste water calculates as 80% of the water consumption.
7. For infiltration allowance use 10% of the domestic sewerage flow.
8. Peaking factor depending on the formula :

$$\mathbf{Pf = 1.5 + (2.5/\sqrt{q})}$$

Table 1.5 (Main Trank S1 West Water Collection System)

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**18**	**20**	**21**	**22**	**24**	**25**
1	S1 e	1	2	50	0.051	8.66	8.66	1.09	3.00	3.26	0.11	3.37	3.37
2	S1 e	2	3	27.85	0.051	4.86	13.52	1.70	3.00	5.09	0.17	5.26	1.89
3	S1 e	3	4	50	0.051	15.23	28.75	3.61	2.82	10.15	0.36	10.52	5.26
4	S1 e	4	5	57.74	0.051	17.41	46.16	5.79	2.54	14.70	0.58	15.28	4.76
5	S1 e	5	6	30.24	0.051	3.57	49.73	6.24	2.50	15.60	0.62	16.22	0.94
6	S1 e	6	7	36.76	0.051	4.24	53.97	6.77	2.46	16.66	0.68	17.33	1.11
7	S1 e	7	8	50	0.051	5.54	59.51	7.46	2.42	18.02	0.75	18.77	1.44
8	S1 e	8	S1-37	31.86	0.051	3.82	63.33	7.94	2.39	18.96	0.79	19.75	0.98

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	1.07	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Solution

1. Lay out the trunk sewer. Draw a line to represent the proposed sewer Fig 4.3.
2. Locate and number the manholes. Locate manholes at (1) change in direction, (2) change in slope, (3) pipe junctions, (4) upper ends of sewers, and (5) intervals from 35 to 50 m or less. Identify each manhole with a number.
3. Prepare a sewer design computation table. Based on the experience of numerous engineers, it has been found that the best approach for carrying out sewer computations is to use a computation table. The necessary computations for the sanitary sewer are presented in Table 4.3. The data in the table are calculated as follow:
   a. The entries in columns 1 and 2 are used to identify the line numbers and street sewer name.
   b. The entries in columns 3 through 5 are used to identify the sewer manholes, their numbers and the spacing between each two manholes.
   c. The entries in column 6 used to identify unit sewage. Unit sewage = 80% multiplied bythe current consumption density divided area in dounm.
   d. The entries in columns 7 and 8 are used tributary area, column 7 used incremental area, column 8 used total area in dounm.
   e. To calculate municipal maximum flow rates columns 9, 10, 11 are used. Column9is municipal average sewage flow (unit sewage *total area), the peak factor column 10 is calculated using equation 3.2 as: $P_f = 1.5 + 2.5/ \sqrt{q}$, where q = Average industrial sewage flow (Column 9). Column 10 represents the actual Pf that we are taken in the project.
   f. Column 12 used to calculate the Q max in year 2036, the value of it comes from multiply column 10* column 9. Column 12 calculate the infiltration which equal to 10% $fQ_{average}$ (10% * column 9).Column 13 used to calculate total average which is equal to column 11 + column 12. Column 13 and column 14 used to show the maximum flow design for year 2036 which is come from column 12 + column 13.

In this section the quantity of waste water for the four main trunks is calculated and it's shown on tables in (Appendix A)

4.1.4 The Proposed Waste Water Collection System

In the proposed study for the WasteWater Collection System for Sourif Town, the trial is made to design the main trunks of the collection system. This section deals with the results of the wastewater collection system.

Manholes number , pipes lengths, water consumption, areas, wastewater quantities are found doing the calculations given in the previous section and are given in tables (1 -4) in appendix A**.**
The appropriate pipe diameters, lengths and slopes, and location of the manholes are found doing the calculations on the sewerCAD software program. During and once the sewer design computations have been completed, alternative alignments have be examined, and the most cost and energy effective alignment has Collection System for the area, slopes ,lengths of the pipes ,the calculated velocities and flow rates are given in Tables (5-14) in Appendix-A.

4.1.5 Profiles Of Waste water Pipes

The profiles of sewer area assist in the design and are used as the basis of construction drawings. The profile is usually prepared for pipe sewer line at a horizontal and vertical scale. The profile shows the ground or street surface, inlets locations, elevation of street surface, pipe surface, pipe basement.

After all the calculation is completed and all the maps of the proposed waste water collection system are prepared, detailed profile for sewer pipe line is drawn. The profile of sewer pipe line is shown in Drawing in Appendix-B. This profile has shown the ground elevation, the proposed sewer pipe line.

4.2 STORM WATER DRAINAGE SYSTEMDESIGN

4.2.1 General

In this project, design of storm water drainage system for the Sourif town, in order to solve the problem causes by the cumulative flooded storm water in the streets.

In this chapter, the layout of the system established will be presented followed by discussion of detailed design computations and the final design and profile of the suggested storm water drainage system.

4.2.2 Layout Of The System

The first step in designing a storm water drainage system is to establish an overall system layout that includes a plan of the area, showing roads, streets, buildings, other utilities, topography.
In suggesting the layout of storm water drainage system for the Sourif town, the following basic steps were followed:

1. Obtain a topographic map of the area to be served.
2. Visit the location
3. Locate the catchment of the site and determine the area of this catchment.
4. Sketch in preliminary closed pipe system to serve the area.
5. Sewer layout is followed natural drainage ways so as to minimize
6. Excavation and pumping requirements.
7. Establish preliminary pipe diameter that can drain the required water runoff.
8. Revise the layout so as to optimize flow-carrying capacity at minimum cost.

The final layout of storm water drainage system for Sourif town is illustrated in the (Fig 4.4) and (Fig 4.5) and drawing (D1), (D2) in Appendix B.

Fig A3 4.2 storm

1. Layout Of Storm Water Collection System
   (With Contour Line) (Fig 4.4)
2. Layout Of Storm Water Collection System
3. (WithoutContour Line)(Fig 4.5)

4.2.3 Quantity Of Storm Water

After preparing the layout of storm water drainage system the quality of storm water that the system must carry it will be calculated using the data collected about the area.

Example:Design a gravity flow storm water drainage pipe for the area Sourif town shown in the accompanying (Fig 4.6). Assume that the following design criteria have been developed and adopted based on an analysis of local conditions and codes.

1. For weighted Runoff coefficient (C) uses 0.65
2. For Inlet time (Ti) use 5 minutes
3. For Concentration time (T_c) use equations

$$T_c = t_i + t_f \quad (4.2)$$

4. For Runoff rate depending on the formula:

$$Q = C.i.A \quad (4.3)$$

5. For Rainfall intensity use (Fig 4.7).

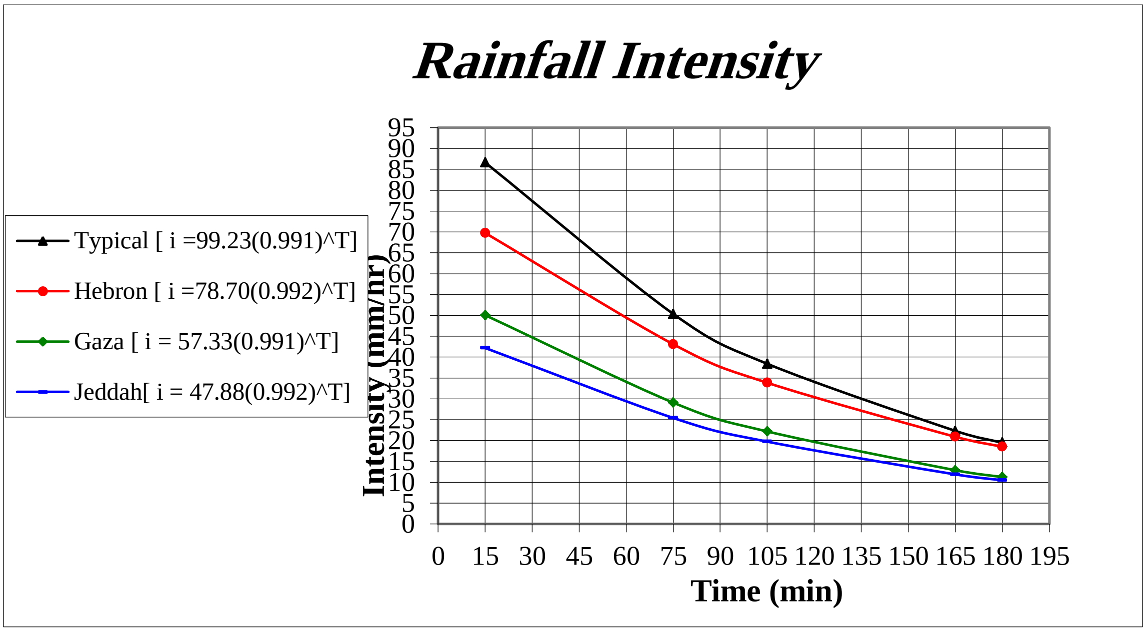

Fig 4.7 The Rainfall Intensity-Duration Curve For Several Areas

Table 16.1(Main Trunk N2 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N2 a	1	2	100	100.00	2.56	0.2	0.51	0.51	9.67	202.32	103.59	103.59
2	N2 a	2	3	99.91	199.91	2.56	0.2	0.51	1.02	11.33	199.63	204.42	100.84
3	N2 a	3	4	98.72	298.63	2.46	0.2	0.49	1.52	12.98	197.01	298.67	94.25
4	N2 a	4	5	99.89	398.52	2.45	0.2	0.49	2.01	14.64	194.39	389.95	91.29
5	N2 a	5	6	100	498.52	2.70	0.2	0.54	2.55	16.31	191.81	488.35	98.39
6	N2 a	6	7	99.02	597.54	2.70	0.2	0.54	3.09	17.96	189.28	584.13	95.78
7	N2 a	7	8	99.49	697.03	2.76	0.2	0.55	3.64	19.62	186.78	679.50	95.37
8	N2 a	8	9	100	797.03	2.92	0.2	0.58	4.22	21.28	184.30	778.09	98.59
9	N2 a	9	10	100	897.03	2.83	0.2	0.57	4.79	22.95	181.84	870.67	92.58
10	N2 a	10	11	100	997.03	2.33	0.2	0.47	5.25	24.62	179.43	942.71	72.03
11	N2 a	11	12	99.94	1096.97	1.43	0.2	0.29	5.54	26.28	177.04	980.81	38.11
12	N2 a	12	16	71.81	1168.78	0.30	0.2	0.06	5.60	27.48	175.35	981.95	1.14

Design Assamptions and data	
	Chock Load

Solution

a. Lay out the storm water sewer. Draw a line to represent the proposed sewer(See Fig 4.6).

b. Locate and number the upper and lower points of the line N1a.

c. The necessary computations for the storm water sewer shown in Fig presented in the Table 4.2. The data in the table are calculated as follow:

d. The entries in columns 1 through 6 are used to identify the point locations, their numbers and the length between them.

e. The entries in columns 7 used to identify the sewer area; column 7 shows the partial sewered area in hectare.

f. The entries in columns 8 through 14 are used to calculate the design flow. Runoff coefficient (C) is entered in column 8. The partial sewered area in hectare is multiplied by runoff coefficient (C) and the result is given in column 9. The cumulative multiplication of the sewered area in hectare is multiplied by runoff coefficient (C) are given in column 10. The concentration time is shown in column 11 and rainfall intensity (L/s.ha) is shown in column 12. Column 14 shows the quantity of storm water separately between two inlets.

Two main trunks is proposed and located on the layout of the area and the quantity of storm water for each is illustrated in table in Appendix A

4.2.4 The Proposed Storm Water Drainage System

In the proposed study for the Storm Water Drainage System for Jericho industrial zone, the trial is made to design the main trunks of the collection system. This section deals with the results of the storm water drainage system.

Manholes number, pipes lengths, water consumption, areas, industrial wastewater quantities are found doing the calculations given in the previous section and are given in tables (15-16) in appendix A**.**

The appropriate pipe diameters, lengths and slopes, and location of the manholes are found doing the calculations on the sewer CAD software program. During and once the sewer design computations have been completed, alternative alignments have be examined, and the most cost and energy effective alignment has Collection System for the area, slopes ,lengths of the pipes ,the calculated velocities and flow rates are given in Tables (17-18) in Appendix-A.

4.2.5 Profiles Of Drainage Pipes

The profiles of sewer area assist in the design and are used as the basis of construction drawings. The profile is usually prepared for pipe sewer line at a horizontal and vertical scale. The profile shows the ground or street surface, in lets locations, elevation of street surface, pipe surface, pipe basement.

After all the calculation is completed and all the maps of the proposed storm water drainage system are prepared, detailed profile for sewer pipe line is drawn. The profile of sewer pipe line is shown in Drawings in Appendix-B. This profile has shown the ground elevation, the proposed sewer pipe line.

BILL OF QUANTITY

5.1 BILL OF QUANTITY FOR THE PROPOSED WASTEWATER COLLECTION SYSTEM

No.	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A1	Excavation of pipes trench in all kind of soil for one pipe diameter 8 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2000				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 10 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2800				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 12 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	4370				

A4	Excavation of pipes trench in all kind of soil for one pipe diameter 15 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2410				
A5	Excavation of pipes trench in all kind of soil for one pipe diameter 18 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	1015				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 24 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	7230				
A4	Excavation of pipes trench in all kind of soil for one pipe diameter 28 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2410				

A5	Excavation of pipes trench in all kind of soil for one pipe diameter 32 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	1015				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 36 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	7230				

5.2 BILL OF QUANTITY FOR THE PROPOSED STORM WATER DRAINAGE SYSTEM

No.	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A1	Excavation of pipes trench in all kind of soil for one pipe diameter 10 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	500				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 15 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	450				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 18 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	105				
A4	Excavation of pipes trench in all kind of soil for one pipe diameter 28 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	366				

A5	Excavation of pipes trench in all kind of soil for one pipe diameter 36 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	118.5				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 65 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	293				

CHAPTER SIX

CONCLUSION

In this project, the trial is made to design waste water collection system and storm water drainage system for Sourif town considering the annual growth of the people and their water consumption for the coming 25 years, the water runoff, and catchment area. The result brought out many important conclusions. The main conclusions drawn from the present study are summarized below:

1. Sourif town has no sewage facility. The people are using laterains cesspits and septic tanks. The waste water has been seeping into the ground through the over flow of the deteriorated cesspits and laterains, causing series environmental and health problem also storm water collect in law areas and flood streets and walk ways, rapid growth has decreased the open areas available for percolation of the rainwater and has greatly increased the runoff to low lying areas.

2. The present population of Sourif Town is 16000 person prediction of the future population of Sourif Town is estimated depending on 4.58 % growth rate.

3. The present water consumption of Sourif Town is 60 L/c.dayand the future water consumption is estimated to be 111 L/c.day depending on 2.5 % increase use rate.

4. The slopes of sewer in the proposed waste water, collection system and storm water drainage system are followed the slope of the ground to decrease the cost of construction.

5. For the waste water collection system it is found that there are 4 main catchments in the area and each main catchments consists of many sub-catchments.

6. For the storm water drainage system it is found that there are 2 main catchments in the area, and each main catchment consists of many sub-catchments.

7. For the storm water drainage system we used runoff coefficient(c) equal 0.65 because some of the area is agricultural areas.

8. the proposed waste water collection system and storm water drainage system for Sourif Town covers most of the areas of the Town.

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1.1 General

Drainage is the term applied to systems for dealing with excess water. It is importante for the disposal of surplus irrigation water, storm water, and waste water.Water drainage is a natural phenomenon which takes place naturaly and depends on the geomorphological and hydrological features, water drainage is often considered as minor problem, but with rapid increase in population and concequent in all round activities of man, the problem has been accentuated.

The wide expansion and accelerated development of Sourif Town had led to change in the hydrological and geomorphological features and the drainage system had become more complex, hence the amount of waste water and running water has increased. At the same time waste water collection system and storm water draiage are not exist.

In view of this prevailing condition, the drainage system in Sourif Town would have a new characteristics and the development of new water drainage is very necessary to drainage waste water and excess water from streets. This study is conducted to design a waste water collection system and storme water drainage system for Sourif Town.

Sourif like other town in Palestine have no sewerge facility. The people are using latrines, cesspits and few of them use septic tanks, which are emptied by cesspit emptier and tankers from time to time. These latrines and cesspits are deteriorating and they are in very bad condition, adding to this the increasing water consumption and consequently increasing in waste water production resulting in over flows from the cesspits and excessive recharge of ground water in Sourif area. For all the reasons mentioned above and since a waste water treatment plant will be erected, this evaluation and design of waste water collection system and storm water collection system study for Sourif have been conducted.

1.2 Problem Definition

The acceleration expansion and developed of Sourif has resulted in increasing of water consumption and consequently in generation of large quantities of waste water from various sources such as residential areas, commercial establishments and different industries. Due to the absence of waste water collection system, the waste water has been seeping into the ground through the overflows of the deteiorated cesspits and latrines that are commonly used in Sourif. Moreover, in some areas waste water is flows to the wadis through open drains in different routes causing serious environmental and health problems.

The main damaging consequences of these waste water routes are offensive adors and smells, proper media for breeding of mosquitoes, soil contamination and polluting of the existing aquifers. The municipality of Sourif is receiving on daily bases complains from the people asking a comprehensive solution for the waste water problems in the town.Also water drainage is very important due to water a ccumulation on the sheets as a result of heavy preciption (running water).

In view of these bad conditions, and since there is no seweage or storm water networks exist, along with fast increasing of the environmental and health problem. The design of waste water collection system and storm water drainage system study become a pressing necessity so as to solve all problems that were mentioned above. This study will consider the annual growth of the people and their water consumption for the coming 25 years, which will be the design period, along with the commercial industrial development in the area and the amounmt of rainfall intensity also will consider.

1.3 Objecives Of The Project

The main objectives of this project are:

1. Division of Sourif area into catchment and sub-catchment areas according to existing situation and the topographic maps and classifying them into classes.
2. Estimation of population and their densities for the design period for each catchment area.
3. Determination of the water consumption and consequently the waste water production from the different sources for each catchment area.

4. Evaluation of the collected data, propose collection system of the town and design of the main trunks of the network.
5. Estimation of rainfall intensity and then quantities of strom water for each catchment.
6. Showing the proposed waste water network and strom water network its parts on different maps for different purposes.
7. Preparation of Bill of Quantities for the main trunks.

1.4 Methadology

1. Many site visits to Sourif town and Municipality were done.
2. All needed maps and the previous studies that contain different information about Sourif were obtained.
3. The amounts of water consumption for different purposes and consequently the amounts of waste water production for each area were obtained.
4. The amount of storm water for each area.
5. The different layouts of the proposed waste water collection system and storm water drainage system are ploted.
6. The necssary hydraulic calculation for the two systems and other design reqirements will be carried out in the next semester.
7. Bill of quantity of the designed waste water main trunks will be prepared with needed recommendations.
8. Finalizing of the project that will contain the report and the needed maps and drawings.

1.5 Phases Of The Project

The project will consist of the four phases and will be completed by Jan 2011 as shown in (Table 1.1)

TABLE 1.1:- PhasesOf The ProjectWithTheirExpectedDuration

Phase No.	Title	Duration								
		02/11	03/11	04/11	05/11	06/11	09/11	10/11	11/11	12/11
One	Data collection and survey									
Two	Preparing layout for two networks and calculate the amount of waste water and storm water									
Three	Design of waste water and storm water collection systems									
four	Writing the report and other related jobs									

1.5.1 First phase:- Data Collection And Survey

In this phase, available data and information were collected from different sources. Moreover, many site visits to both the town and the municipality were done. This phase include the following tasks.

1. Collecting of aerial and topographical maps for all the area.
2. Collecting of meteorological and hydrological data(temperature, wind speed, rainfall, evapoeration…etc) from different sources.

3. Evaluation of town population densities in each zone of the town with their waterconsumption and predicting their numbers, densities and their water consumption in year 2036.

1.5.2 Second Phase:-Preparing Layout For Two Networks And Calculate The Amount Of Waste WaterAnd Storm Water

In this phase layout will prepared and put in its final shape and then quantities of waste water and storm water will determine.

This phase include the following tasks:

1. Draw the layout of the two networks and compare it with the real setuation in Sourif twon then make adjusment and last draw the final layout this task is the most improtant.
2. Evaluation of the contour maps and matching it with actual ground levels in the town
3. Determination of the stormwater quantities
4. Determination of the waste water quantities and projection of the waste water production in year 2036.

1.5.3 Third Phase:- Design Of Waste WaterAnd Storm Water Collection Systems

In this phase the necessary hydraulic calculation needed for the design of the main trunks will be carried out. This phase include the following tasks:

1. Establish a system layout, which includes the areas that are going to be served, existing streets and roads, topography…etc.
2. Establish the catchments and sub-catchments areas and routes of the sewers.
3. Establish the design criteria and conducting the needed sewer diameter hydraulic calculations.

4. Preparing needed different drawings for the designed sewers.

1.5.4 Fourth Phase:- Writing The Report And Other Needed Jobs

After finishing the design calculation of the main trunks the project team prepared the specifications drawing, bill of quantities and preliminary maps.Final report of the project was prepared and submitted to the Department of civil and Architectural Engineering at Palestine Polytechnic University.

1.6 Organization Of The Project

The study report has been prepared in accordance with the objectives and scope of work. The report consist of six chapters. The first chapter entitled "Introduction" outlines the problem, project objectives, and phase of the project.

Chapter two entitled "Chataristics of the project area" presents basic background data and information on the object area, water supply, and waste water disposal.

Chapter three entitled " Drainage Systems" deals with municipal sewage systems , types of waste water collection systems, storm system, rainfall intensities, sewer appurtenances, flow in sewer, design of sewer systems and sewer construction and maintenance.

Chapter four entitled "Design Criteria" presents information about population and their densities, the actual water consumption, land use, time of concentration, rainfall intensity, quantity of storm water, and design criteria applicable to the sewerage networks.

Chapter five "Bill of Quantities" deals with the item of the project estimated quantity of each item.

Chapter six "Conclusions " discusses the conclusions of the study.

2.1 General

In this chapter, the basic data of Sourif town will be briefly discussed. The topography, population water consumption, and waste water production will be briefly presented.

2.2 Project Area

Sourif is situated 18 Km to the north east of Hebron town, as shown on the project location plan (Fig2.1), the average hight of the town is 600 m with respect to sea level. The total area of the town is about 4960 donum.

The population within the municipal administrative borders in year 2009 is around 16000 persons. This population is expected to grow substantially up to the year 2036 planning horizon of this project.

The town is composed of several hills and mountains. The heights of these mountains are range between 460 m and 825 m.The topography of Sourifarea is illustrated in Drawing D1 (Apendex B). Sourif town lies on the coordinate lines: 115330.88 – 118779.42 longitude lines . 155246.78 –157003.24 latitude lines.

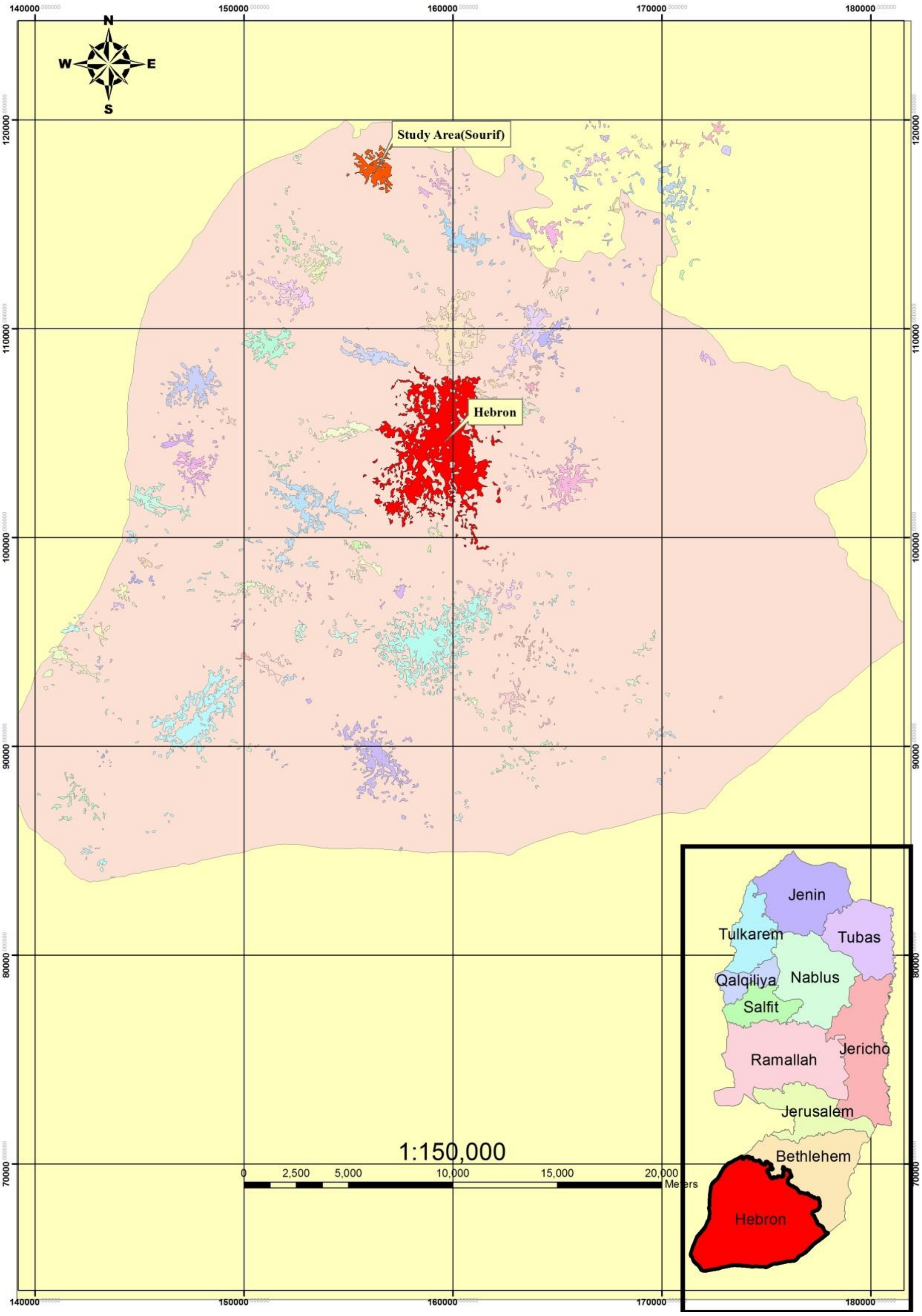

Fig 2.1 Location Plan For Sourif Town

2.3 Land Use

As mentioned earlier, the land area of Sourif town is approximately 4960 donum. There is no clear town plan defining land use in the various zones of Sourif. The land use can be distributed as follows:-

1. Old town : This area is consists of old buildings which have a historical importance, these buildings are used as resedinces, workshops, public building, and cemetry. Some of these buildings are very old and to be maintained.
2. Old town surrounding: The land use of Sourif town(shown in Fig 2.2) is distributed as follow :-
    1. Habitation area, food stories, workshop building, public buildings.
    2. Agricultural areas.
    3. Roads.

Fig 2.The land use of Sourif town

2.4 Road Network

There are two main roads link the town with neighbour towns and villages:

The road link the town with road number 60 (Jerusalem-Hebron road).The road that link the town with neighbour villags Kharas, Noba….etc.

These roads need to be repaired, expanded or modified. The expansion sometimes become impossible due to the buildings that surround these roads. The best alternatives is to find an external roads network that links between the two entrances of the town and between those entrances and internal roads. The town has poor internal roads network.

2.5 Meteorological Data

The hydrology of the region depends primarily on its climate, and secondarily on its topography. Climate is largely dependent on geographical position of the earth surface; humidity, temperature, and wind. These factors affect are affecting evaporation and transpiration. So this study will include needed data about these factors, since they play big role in the determination of water demand.

The climate of Sourif tends to be cold in winter with limited amount of rain, and warm in summer with relative humid.

2.5.1 Rainfall

The average annual rainfall in Sourif town for the last five year is approximately 300-400 mm. The maximum annual rainfall in the period from 2005 to 2010 is 330.1 mm. This was in year 2005/2006.The minimum annual rainfall is 268.8mm, which was in the year 2009/2010 Table (2.1) shows the monthly rainfall and number of raining days during the period from 2005-2010.

Table 2.1 Monthly Rainfall AndNumber Of Raining Days During The Period From 2005-2010

Year / Month	2005/2006		2006/2007		2007/2008		2008/2009		2009/2010		5- Years Average Rainfall mm
	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	Monthly Rainfall mm	No. Of Raining Days	
September	0	0	0	0	0	0	0	0	0	0	0
October	5	1	4.5	1	5.5	2	5	1	6	1	5.2
November	6	2	4	2	5	1	0	0	0	0	3
December	85	7	80	6	73.5	5	70	5	63.9	4	74.48
January	79.5	10	75.5	6	72.3	6	70.1	7	70.5	8	73.58
February	75.5	9	75.1	8	75.5	7	73.1	8	72.4	8	74.32
March	39.5	5	35.2	3	30.3	2	26.9	3	26.6	4	31.7
April	35.6	2	31.8	3	29.6	2	31.2	3	29.4	2	31.52
May	4	1	3	2	2	1	0	0	0	0	1.8
Total	330.1	37	309.1	31	293.7	26	276.3	27	268.8	27	295.6

2.5.2 Temperature

The temperature is characterized by considerable variation between summer and winter times. The mean temperature values at Sourif town for the period 1995 to 2000 are given in below.

- The Mean maximum temperature: 31˚C
- The Mean minimum temperature: 8˚C
- The Mean Maximum temperature record: 30˚C
- The Mean Minimum temperature record: 4.4˚C

2.5.3 Relative Humidity

Since Sourif is situated at considerable distance from the sea in a mountains region on the outskirts of the desert, Sourif has low values of relative humidity compared to those in the plains. the relative humidity in Sourif town range from 54-78%, it reaches the maximum value in January(78%).

2.5.4 Wind

The directions and velocities of wind vary depending on the season of the year. In winter, the wind blows in the morning from the southwest a rounds noon from southwest and west, and at night from west and northwest. In summer, northeasterly wind blows all day long. According to data obtained from Meteorological Station, average wind in winter is about 9.8km/h and in summer 5.4km/h.

3.1 WASTE WATER COLLECTION SYSTEM DESIGN

3.1.1 General

Once used for its intended purposes, the water supply of a community is considered to be waste water. The individual conduits used to collect and transport waste water to the treatment facilities or to the point of disposal are called sewers.

There are three types of sewers: sanitary, storm, and combined. Sanitary sewers are designed to carry waste water from residential, commercial, and industrial areas, and a certain amount of infiltration /inflow that may enter the system due to deteriorated conditions of sewers and manholes. Storm sewers are exclusively designed to carry the storm water. Combined sewers are designed to carry both the sanitary and the storm flows.

The network of sewers used to collect waste water from a community is known as waste water collection system. The purpose of this chapter is to define the types of sewers used in the collection systems, types of waste water collection systems that are used, the appurtenances used in conjunction with sewers, the flow in sewers, the design of sewers, and the construction and maintenance of sewers.

3.1.2 Municipal Sewerage System

Types Of Sewers

The types and sizes of sewers used in municipal collection system will vary with size of the collection system and the location of the waste water treatment facilities. The municipal or the community sewerage system consists of (1) building sewers (also called house connections), (2) laterals or branch sewers, (3) main and submain sewers, (4) trunk sewers.

House sewers connect the building plumbing to the laterals or to any other sewer lines mentioned above. Laterals or branch sewers convey the waste water to the main sewers. Several main sewers connect to the trunk sewers that convey the waste water to large intercepting sewers or the treatment plant.

The diameter of a sewer line is generally determined from the peak flow that the line must carry and the local sewer regulations, concerning the minimum sizes of the laterals and house connections. The minimum size recommended for gravity sewer is 200 mm (8 inch).

Sewer Materials

Sewers are made from concrete, reinforced concrete, vitrified clay, asbestos cement, brick masonry, cast iron, ductile iron, corrugated steel, sheet steel, and plastic or polyvinylchloride or ultra polyuinyl chloride. Concrete and ultra polyvinyl chlorides are the most common materials for sewer construction.

3.1.3 Types Of Waste Water Collection Systems

Gravity Sewer System

Collecting both waste water and storm water in one conduit (combined system) or in separate conduits (separate system). In this system, the sewers are partially filled. A typical characteristic is that the gradients of the sewers must be sufficient to create self-cleansing velocities for the transportation of sediment. These velocities are 0.6 to 0.7 m/s minimum when sewers are flowing full or half-full. Manholes are provided at regular intervals for the cleaning of sewers.

Pressure Type System

Collecting waste water only. The system, which is entirely kept under pressure, can be compared with a water distribution system. Sewage from an individual house connection, which is collected in manhole on the site of the premises, is pumped into the pressure system. There are no requirements with regard to the gradients of the sewers.

Vacuum Type System

Collecting waste water only in an airtight system. A vacuum of 5-7 m is maintained in the system for the collection and transportation of the waste water. There is no special requirement for the gradients of the sewers.

Pressure and vacuum–types systems require a comparatively high degree of mechanization, automation and skilled manpower. They are often more economical than gravity system, when applied in low population density and unstable soil conditions. Piping with flexible joints has to be used in areas with expansive soils.

3.1.4 Sewer Appurtenances

Manholes

Manholes should be of durable structure, provide easy access to the sewers for maintenance, and cause minimum interference to the sewage flow. Manholes should be located at the start and at the end of the line, at the intersections of sewers, at changes in grade, size and alignment except in curved sewers, and at intervals of 35-50 m in straight lines.

The general shapes of the manholes are square, rectangular or circular in plan, the latter is common. Manholes for small sewers are generally 1.0-1.2 m in diameter. For larger sewers larger manhole bases are provided. The maximum spacing of manholes is 35-50 m depending on the size of sewer and available size of sewer cleaning equipment (Qasim, 1985).

Standard manholes consist of base, risers, top, frame and cover, manhole benching, and step-iron. The construction materials of the manholes are usually precast concrete sections, cast in place concrete or brick. Frame and cover usually made of cast iron and they should have adequate strength and weight.

Drop Manholes

A drop manhole is used where an incoming sewer, generally a lateral, enters the manhole at a point more than about 0.6 m above the outgoing sewer. The drop pipe permits workmen to enter the manhole without fear of being wetted, avoid the splashing of sewage and corrosion of manhole bottom (Hammer 1977).

House Connections

The house sewers are generally 10-15 cm in diameter and constructed on a slope of 2% m/m. house connections are also called, service laterals, orservice connections. Service connections are generally provided in the municipal sewers during construction. While the sewer line is under construction, the connections are conveniently located in the form of wyes or tees, and plugged tightly until service connections are made. In deep sewers, a vertical pipe encased in concrete is provided for house connections.

3.1.5 Design Parameters

Population

The ideal approach for population forecasting is by the evaluation and using the previous census records, which cover along period. The longer the period, and the more comprehensive census data, the more accurate will be the result which will be obtained. In the analysis of these data demographical, economic and political factors should be considered in order to develop a method of forecasting which will predict the expected growth rate , future population and their distribution in the different zones of the area.

In the town of Sourif, as well as other Palestinian cities and towns, there is great uncertainty in the political future.

Due to the unstable condition of the area during the last 50 years, it would be very difficult to develop a statistical interpretation to extrapolate future population. some reasonable assumption have therefore been made to project the future population of the town of Sourif over next 25 year.

Population Forecast

Prediction of the future population of Sourif is very difficult due to the lack of reliable historic data, and the political uncertainties which will greatly influence future social and economic development. at the same time, the available data on past population growth do not.

Constitute a reliable basis for projecting the future population growth in Sourif. The base for the forecasting is the 2009 population for Sourif obtained from PCBS of 16000 inhabitants. The rate of population growth for the purpose of our study was based on estimation used for other towns of similar population composition and characteristics.

The rate of population growth in other town in West Bank is 3.5%. A grater rate of growth was assumed for the town of Gaza.

Therefore the rate of 3.5% per year was used for the future growth of the population of Sourif town.

To calculate the population for the end of the design period (year 2036), a geometric increase is assumed, represented by the following equation:

$$\boldsymbol{P = P_0 * (1 + R)^n} \qquad \textbf{(3.1)}$$

In which, P is future population, P_0 is present population, R is annual population growth rate, and n is the period of projection.

Using the above assumption and equation, Table 3.1 presents the population projection up to the design horizon of 2036. The data show that the population of Sourif is estimated to be 52512 in year 2036.

Table3.1Population Forecasts For Sourif

Year	2009	2011	2016	2021	2026	2031	2036
Population	16000	17472	21773	27134	33814	42138	52512

2. Flow Rate Projections

The total waste water flow in sanitary sewers for municipal area is made up of two components:

(1) Residential area (2) infiltration. Sanitary sewers are designed for peak flows from residential and peak infiltration allowance for the entire service area. Theflow rateprojections are necessary to determine the required capacities of sanitary sewers.

3. The Peak Coefficient

In general, this coefficient increases when the average flow decrease, it will be determined from the practice and experience of the designer. The following relation has been used commonly by the designer and gives satisfactory results:

$$Pf = 1.5 + 2.5 / \sqrt{q} \qquad (3.2)$$

Where, q (in l/s) is the daily average flow rate of the network branch under consideration and Pf is the peak factor.

4. Hydraulic Design

As mentioned earlier and according to usual practice, the sewers will be designed for gravity flow using Manning's formula:

$$V = (1/n)\, R^{2/3}\, S^{1/2} (3.3)$$

Depending on pipe materials, the typical values of n is 0.015

5. Minimum And Maximum Velocities

To prevent the settlement of solid matter in the sewer ,the literature suggested that the minimum velocity at half or full depth – during the peak flow period – should not be less than 0.6 m/s , Usually, maximum sewer velocities are limited to about 3 m/s in order to limit abrasion and avoid damages which may occur to the sewers and manholes due to high velocities.

6. Pipes And Sewers

Experience indicates a minimum diameter of 200 mm (8 in) for sewer pipes. For house connections.

Pipe Materials: Different pipe materials may be recommended for the sewers. Polyvinyl chloride, vitrified clay or polyethylene material for small size pipes(approximately up to the size 400 mm in diameter).

Centrifugal cast reinforced concrete pipes may be used for larger diameter.

7. Manholes

Manholes should be located at changes in size, slope direction or junction with secondary sewer. Manholes spacing generally does not exceed 50 m.

8. Sewer Slope

For a circular sewer pipe, the slope must be between the minimum and maximum slope, the minimum and maximum slope is determined from minimum and maximum velocity. Generally the natural ground slope is used because it is the technical and economic solution, the solution is therefore recommended.

9. Depth of Sewer Pipe

The depth of sewers is generally 1.5 m below the ground surface. Depth should be enough to receive the sewage by gravity, avoid excessive traffic loads, and avoid the freezing of the sewer. It is recommended that the top of sewer should not be less than 1.5 m below basement floor (Qasim, 1985).

Important Numbers

- Maximum velocity = 3 m/s
- Minimum velocity = 0.6 m/s
- Maximum slope = 15%
- Minimum slope = 0.5%
- H/D = 50%
- Minimum diameter 200 mm
- Maximum diameter 600 mm
- Minimum cover 1.5 m
- Maximum cover 5 m

After the preliminary sewer layout plan is prepared, the design computations are accomplished. Design computations for sewers are repetitious and therefore, are best performed in a tabular format. Table 3.2 is typical of the way in which data can be organized to facilitate computations for closed system.

Table 1 (Main Trank S1 West Water Collection System) Cont'd

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
98	S 1	98	99	25.4	0.17	35.93	1970.42	821.25	1.59	1303.52	82.13	3439.03	24.62
99	S 1	99	100	50	0.17	4.34	1974.76	823.06	1.59	1306.32	82.31	3442.00	2.97
100	S 1	100	101	50	0.17	10.45	1985.21	827.42	1.59	1313.04	82.74	3449.16	7.16
101	S 1	101	102	17.51	0.17	7.98	1993.19	830.74	1.59	1318.17	83.07	3454.63	5.47
102	S 1	102	103	50	0.17	2.04	1995.23	831.59	1.59	1319.48	83.16	6638.10	3183.48
103	S 1	103	104	58.7	0.17	9.91	2005.14	835.72	1.59	1325.86	83.57	6644.89	6.79
104	S 1	104	105	50	0.17	8.53	2013.67	839.28	1.59	1331.35	83.93	6650.73	5.84
105	S 1	105	106	50	0.17	8.35	2022.02	842.76	1.59	1336.72	84.28	6656.45	5.72
106	S 1	106	107	38.57	0.17	6.31	2028.33	845.39	1.59	1340.77	84.54	6660.77	4.32

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	% (Chock Load)
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5	
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015	
7)dinsity of line=	3.543	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d

3.2 STORM WATER DRAINAGE SYSTEM DESIGN

3.2.1 General

Rapid effective removal of storm runoff was a luxury not found in many cities in the early nineteenth century. Today, the modern city dweller has come to think of this as an essential service. Urban drainage facilities have progressed from crude ditches and stepping stones to the present intricate coordinates systems of curbs, gutters, inlets, and underground conveyance.

The design must consider meteorological factors, geomorphologic factors, and the economic value of the land, as well as human value considerations such as aesthetic and public safety aspects of the design. The design of storm water detention basins should also consider the possible effects of inadequate maintenance of the facility

3.2.2 Storm Water Runoff

Storm water runoff is that portion of precipitation which flows over the ground surface during and a short time after a storm. The dependence parameters that controlled the quantity of the storm water which carried by a storm or combined sewer are the surface of the drainage area (A, ha), the intensity of the rainfall (i, l/s.ha), and runoff coefficient C dimensionless (the condition of the surface). There are many methods and formulas to determine the storm flow, and in all of them above parameters show up. One of the most common methods is Rational method which will be discussed below.

Rational Method

The rational method has probably been the most popular method for designing storm systems. It has been applied all over the world and runoff is related to rainfall intensity by the formula,

$$Q = C \cdot i \cdot A \qquad 3.4$$

Where

Q = peak runoff rate (l/sec)

C = runoff coefficient, which is actually the ratio of the peak runoff rate to the average rainfall for a period known as the time of concentration.

i = average rainfall intensity, mm/min, for period equal to the time of concentration

A = drainage area, hectar

For small catchments areas, it continues to be a reasonable method, provided that it is used properly and that results and design concepts are assessed for reasonableness. This procedure is suitable for small systems where the establishment of a computer model is not warranted.

The steps in the rational method calculation procedure are summarised below:

1. The drainage area is first subdivided into sub-areas with homogeneous land use according to the existing or planned development.

2. For each sub-area, estimate the runoff coefficient *C* and the corresponding area *A*.

3. The layout of the drainage system is then drawn according to the topography, the existing or planned streets and roads and local design practices.

4. Inlet points are then defined according to the detail of design considerations. For main drains, for example, the outlets of the earlier mentioned homogeneous sub-areas should serve as the inlet nodes. On the other hand in very detailed calculations, all the inlet points should be defined according to local design practices.

5. After the inlet points have been chosen, the designer must specify the drainage sub-area for each inlet point A and the corresponding mean runoff coefficient *C*. If thesub-area for a given inlet has non-homogeneous land use, a weighted coefficient may be estimated.

6. The runoff calculations are then done by means of the general rational method equations for each inlet point, proceeding from the upper parts of the watershed to the final outlet. The

peak runoff, which is calculated at each point, is then used to determine the size of the downstream trunk drain using a hydraulic formula for pipes flowing full.

7. After the preliminary minor system is designed and checked for its interaction withthe major system, reviews are made of alternatives, hydrological assumptions areverified, new computations are made, and final data obtained on street grades and elevations. The engineer then should proceed with final hydraulic design of the system.

Runoff Coefficient, C

Runoff coefficient is a function of infiltration capacity, interception by vegetation, depression storage, and evapotranspiration. It is requires greatest exercise of judgment by engineer and assumed constant, actually variable with time. It is desirable to develop composite runoff coefficient (weighted average) for each drainage area as:

$$C = \frac{\sum Ci.Ai}{\sum Ai} \qquad \textbf{(3.5)}$$

Where Ai = i^{th} area.

Ci = i^{th} runoff coefficient.

The range of coefficients with respect to general character of the area is given in the following tables (Table 3.2 and Table 3.3).

Table 3.3 The Range Of Coefficient With Respect to General Character Of The Area (Sarikaya, 1984)

Description of Area	Runoff Coefficients
Business	
Down town	0.70 to 0.95
Neighborhood	0.50 to 0.70
Residential	

Single-Family Multi-unit, detached Multi-unit, attached	0.30 to 0.50 0.40 to 0.60 0.60 to 0.75
Residential (suburban)	0.25 to 0.40
Apartment	0.50 to 0.70
Industrial	
Light Heavy	0.50 to 0.80 0.60 to 0.90
Parks, Cemeteries	0.10 to 0.25
Playground	0.20 to 0.35
Railroad yard	0.20 to 0.35
Unimproved	0.10 to 0.30

Table 3.4The Range of Coefficient With Respect to Surface Type of the Area (Sarikaya, 1984)

Character of Surface	Runoff Coefficients
Pavement	
Asphalt and concrete Brick	0.70 to 0.95 0.70 to 0.85
Lawns, Sandy soil	
Flat, 2 percent Average,2to7percent Steep, 7 percent	0.05 to 0.10 0.10 to 0.15 0.15 to 0.20
Roofs	0.75 to 0.95
Lawns, heavy soil	

Flat, 2 percent	0.13 to 0.17
Average,2 to 7percent	0.18 to 0.22
Steep, 7 percent	0.25 to 0.35

Rainfall Intensity, i

In determining rainfall intensity for use in rational formula it must be recognized that the shorter the duration, the greater the expected average intensity will be. The critical duration of rainfall will be that which produces maximum runoff and this will be that which is sufficient to produce flow from the entire drainage area. Shorter periods will provide lower flows since the total area is not involved and longer periods will produce lower average intensities. The storm sewer designer thus requires some relationship between duration and expected intensity. Intensities vary from place to another and curves or equations are specified for the areas for which they were developed.

The rainfall intensity depends on many factors through which we can do our calculations; we can list these factors as follow:

1. Average frequency of occurrence of storm (1/n) or (f).

Average frequency of occurrence is the frequency with which a given event is equaled or exceeded on the average, once in a period of years. Probability of occurrence, which is the reciprocal of frequency, (n) is preferred by sum engineers. Thus, if the frequency of a rain once a 5-year (1/n=5), then probability of occurrence n=0.20. Selection of storm design rain frequency based on cost-benefit analysis or experience. There is range of frequency of often used:

a. Residential area: f = 2 to 10 years (5 year most common).
b. Commercial and high value districts: f = 10 to 50 (15 year common).
c. Flood protection: f = 50 year.

2. Intensity, duration and frequency characteristics of rainfall.

Basic data derived from gage measurement of rainfall (Point rainfall) over a long period can be used to obtain a rainfall height diagram that show the relation between the height of rain (mm) and time (min). The slope of the curve or rain height per unit time is defined as rain intensity:

i= (Δ height of rain / Δ time) $\left[\frac{mm}{\min}\right]$

The rain intensity in liter per second . hectare is equal:

$$i(\frac{l}{s.ha}) = 166.7i\left[\frac{mm}{\min}\right]$$

in order to drive intensity-duration-frequency curves long-term observation of rainfall is needed. Analysis of such observation is given in any text in sanitary engineering.

3. Time of Concentration

The time of concentration is the time required for the runoff to become established and flow from the most remote part (in time) of the drainage area to the point under design.

$$t_c = t_i + t_f \quad \textbf{(3.6)}$$

Where t_c: time of concentration.

t_i: inlet time.

t_f: flow time.

Time of flow in storm, $t_f = \dfrac{\text{Length of pipeline (L)}}{\text{Velocity of flow (v)}}$

Inlet time (t_i): is the time required for water to flow over ground surface and along gutters to drainage inlet. Inlet time is function of rainfall intensity, surface slope, surface roughness, flow distance, and infiltration capacity and depression storage.

3.2.3 Hydraulic Consideration

Waste water systems and (storm water) are usually designed as open channels except where lift stations of the flows, and the fact that an unconfined or free surface exists. The driving are required to overcome topographic barriers. The hydraulic problems associated with these flows are complicated in some cases by the quality of the fluid, the highly variable nature force for open-channel flow and sewer flow is gravity. For the hydraulic calculations of sewers, it is usually assumed uniform flow in which the velocity of flow is constant, and steady flow condition in which the rate discharge at any point of a sewer remains constant (Metcalf,1982).

Hydraulic design equations

In principle all open channel flow formulas can be used in hydraulic design of sewer pipes. The following are the most important formulas:

1. Chezy's formula:

$$\textbf{(3.7)}\, V = C\sqrt{RS}$$

Where V: the velocity of flow (m/s).

C: the Chezycoefficient; where m = 0.35 for concrete pipe or 0.25 for vitrified clay pipe

$$C = \frac{100\sqrt{R}}{m+\sqrt{R}}$$

R: the hydraulic radius (m)

S: the slope of the sewer pipe (m/m).

2. Darcy-Weisbach formula: It is not widely used in waste water collection design and evaluation because a trial and error solution is required to determine pipe size for a given flow and head loss, since the friction factor is based on the relative roughness which involves the pipe diameter, making it complicated. Darcy-Weishbach formula states that

$$\textbf{(3.8)}\, H = \lambda \frac{L \times V^2}{D \times 2g}$$

Where H: the pressure head loss (mwc).

L: the length of pipe (m).

D: the diameter of pipe (m)

λ : the dimensionless friction factor generally varying between 0.02 to 0.075.

3. The Manning formula: Manning's formula, though generally used for gravity conduits like open channel, it is also applicable to turbulent flow in pressure conduits and yields good results, provided the roughness coefficient n is accurately estimated. Velocity, according to Manning's equation is given by:

$$V = (1/n)\ R^{2/3} S^{1/2} \quad (3.9)$$

Where n: the Manning's roughness coefficient [$1/n\ (k_{str}) = 75\ m/s^{1/3}$].

R: the hydraulic radius = area /wetted perimeter (R = A/P)

- For circular pipe flowing full, R= (D/4).
- For open channel flowing full, R= [(b*d)/ (b+2d)].

The Manning's roughness coefficient depends on the material and age of the conduit. Commonly used values of n for different materials are given in Table (3.4).

Table 3.5 Common Values Of Roughness Coefficient Used In The Manning Equation (Sarikaya, 1984)

Material	Commonly Used Values of n
Concrete	0.013 and 0.015
Vitrified clay	0.013 and 0.015
Cast iron	0.013 and 0.015
Brick	0.015 and 0.017
Corrugated metal pipe	0.022 and 0.025
Asbestos cement	0.013 and 0.015
Earthen channels	0.025 and 0.003
PVC	0.015

Hydraulics Of Partially Field Section

The filling rate of a sewer is an important consideration, as sewers are seldom running full, so storm water sewers designed for 70% running full, that is means only 70% of the pipe capacity should be utilized to carry the peak flow.

Partially filled sewers are calculated by using partial flow diagram and tables indicating the relation between water depth, velocity of flow and rate flow .The hydraulic characteristics are similar as for open channels, but the velocity of flow is reduced by increased air friction in the pipe with increasing water level, particularly near the top of the pipe. The velocity of flow and the flow rate are reduced at filling rates between 60% and 100%; the water level in the pipe is unstable at filling rates above 90% or 95%.

3.2.4 Storm Water Sewers Design

Designing a community storm system is not a simple task. It requires considerable experience and a great deal of information to make proper decisions concerning the layout, sizing, and construction of a storm network that is efficient and cost-effective. The design engineer needs to generally undertake the following tasks (Qasim, 1985, Peavy, 1985):

1. Define the service area.
2. Conduct preliminary investigations.
3. Develop preliminary layout plan and profile.
4. Selection of design parameters.
5. Review construction considerations.
6. Conduct field investigation and complete design and final profiles

Service Area

Service area is defined as the total area that will eventually be served by the drainage system. The service area may be based on natural drainage or political boundaries, or both. It is important that the design engineers and project team become familiar with the surface area of the proposed project.

Preliminary Investigation

The design engineer must conduct the preliminary investigations to develop a layout plan of the drainage system. Site visits and contacts with the city and local planning agencies and state officials should be made to determine the land use plans, zoning regulations, and probable future changes that may affect both the developed and undeveloped land. Data must be developed on topography, geology, hydrology, climate, ecological elements, and social and economic conditions. Topographic maps with existing and proposed streets and other utility lines provide the most important information for preliminary flow routing (Qasim, 1985).

If reliable topographic maps are not available, field investigations must be conducted to prepare the contours, place bench marks, locate building, utility lines, drainage ditches, low and high areas, stream, and the like. All these factors influence the sewer layout.

Layout Plan

Proper storm sewer layout plan and profiles must be completed before design flows can be established. The following is a list of basic rules that must be followed in developing a sewer plan and profile.

1. Select the site for disposal of the storm water at the end of the network, generally the lowest elevation of the entire drainage area.
2. The preliminary layout of storm sewers is made from the topographic maps. In general, sewers are located on streets, or on available right-of-way; and sloped in the same direction as the slope of the natural ground surface.
3. The trunk storm sewers are commonly located in valleys. Each line is started from the intercepting sewer and extended uphill until the edge of the drainage area is reached, and further extension is not possible without working downhill.
4. Main storm sewers are started from the trunk line and extended uphill intercepting the laterals.
5. Preliminary layout and routing of storm sewage flow is done by considering several feasible alternatives. In each alternative, factors such as total length of storm sewers, and cost of

construction of laying deeper lines versus cost of construction, operation, and maintenance of lift station, should be evaluated to arrive at a cost- effective drainage system.

6. After the preliminary storm sewer layout plan is prepared, the street profiles are drawn. These profiles should show the street elevations, existing storm sewer lines, and manholes and inlets. These profiles are used to design the proposed lines.

Finally, these layout plans and profiles are revised after the field investigations and storm sewer designs are complete (Viessman, 1985).

Selection of Design Parameters

Many design factors must be investigated before storm sewer design can be completed. Factors such as design period; peak, average, and minimum flow; storm sewer slopes and minimum velocities; design equations …etc. are all important in developing storm sewer design. Many of the factors are briefly discussed below.

1. Design Flow Rate

Storm water sewers should be designed to carry the largest storm that occurred in the period of design; commonly it is 5 years because of consideration of the cost and the frequently factors.

2. Minimum Size

The minimum storm sewer size recommended is 250mm (10″) for closed system, and for open channel depend on the type of profile that selected.

3. Minimum and Maximum Velocities

In storm water sewers, solids tend to settle under low-velocity conditions. Self-cleaning velocities must be developed regularly to flush out the solids. Most countries specify minimum velocity in the sewers under low flow conditions. The minimum allowable velocity is 1 m/s is desirable. This way the lines will be flushed out at least once or twice a day. The maximum velocity for storm water system is5 m/s. The maximum velocity is limited to prevent the erosion of sewer inverts.

4. **Slope**

For closed systemminimum slopes determined from minimum velocities, for minimum velocity 0.9 m/s, the slopes are shown in Table (3.5).

Table 3.6 Minimum Recommended Slopes Of Storm Sewer (n = 0.015) (Sarikaya, 1984)

Pipe Diameter (D)		Slope (min)	Slope (max) =1/D
Mm	**Inch**	**Mm**	**Cm**
250	10	0.00735	0.04
300	12	0.00576	0.033
450	18	0.00336	0.0222
600	24	0.00229	0.0167

Note: for a velocity of 0.75m/s the slopes shown above should be multiplied by 1.56

Maximum slopes determined from maximum velocities, 1/D (cm) can be used as a guide. For open channel, the slope also depends on the profile type, and generally used as the slope of the road.

5. Depth

The depth of storm sewers when using closed system is generally just enough to receive flow but not less than 1 m below the ground surface. Depth depends on the water table, lowest point to be served, topography, and the freeze depth. But for the open channel it is at the ground surface.

6. Appurtenances

Storm Sewer appurtenances include manholes, inlets, outlets and outfall, and others. Appropriate storm sewer appurtenances must be selected in design of storm water sewers.

7. Design Equations and Procedures

Storm water sewers are mostly designed to flow partially full. Once the peak, average, and minimum flow estimates and made general layout and topographic features for each line are established, the design engineer begins to size the sewers. Design equations proposed by Manning, Chezy, Gangullet, Kutter, and Scobey have been used for designing sewers and drains. The Manning equation, however, has received most widespread application. This equation is expressed below:

$$\mathbf{V = (1/n)\ R^{2/3} S^{1/2}} \quad \textbf{(3.10)}$$

And as mentioned earlier, the runoff flow is calculated using the following formula:

$$\mathbf{Q = C.i.A} \quad \textbf{(3.11)}$$

Various types of nomographs have been developed for solution of problems involving sewers flowing full. Nomographs based on Manning's equation for circular pipe flowing full and variable n values are provided in Fig 3.1. Hydraulic elements of circular pipes under partially-full flow conditions are provided in Fig 3.2. It may be noted that the value of n decreases with the depth of flows Fig 3.1. However, in most designs n is assumed constant for all flow depths. Also, it is a common practice to use d, v, and q notations for depth of flow, velocity, and discharge under partial flow condition while D, V, Q notations for diameter, velocity, and discharge for sewer flowing full.

Use of equations 3.3 and 3.8 and Figs 3.1 and 3.2, one can design the drainage system.

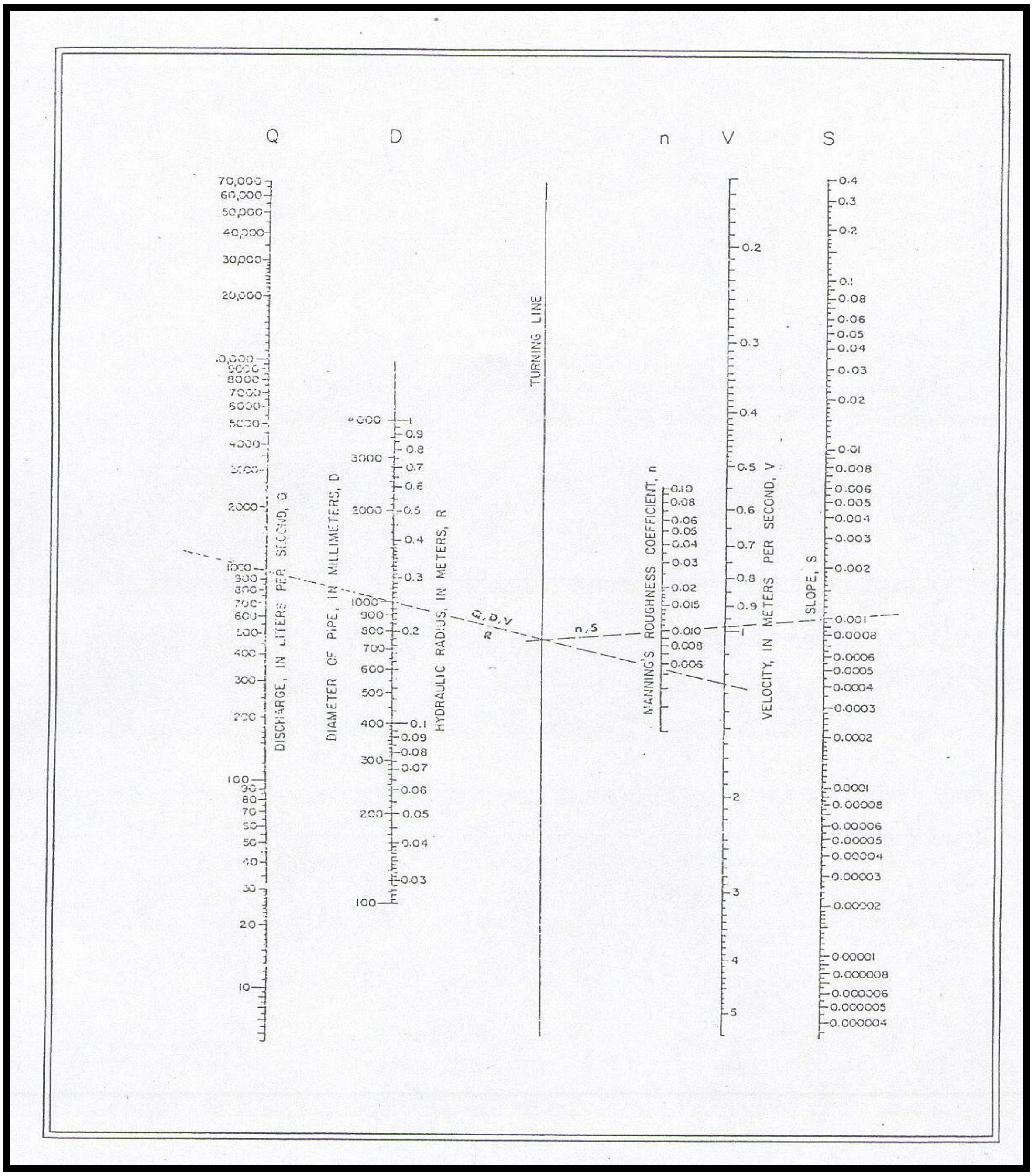

Fig 3.1 NomographFor Solution Of MainingFormula

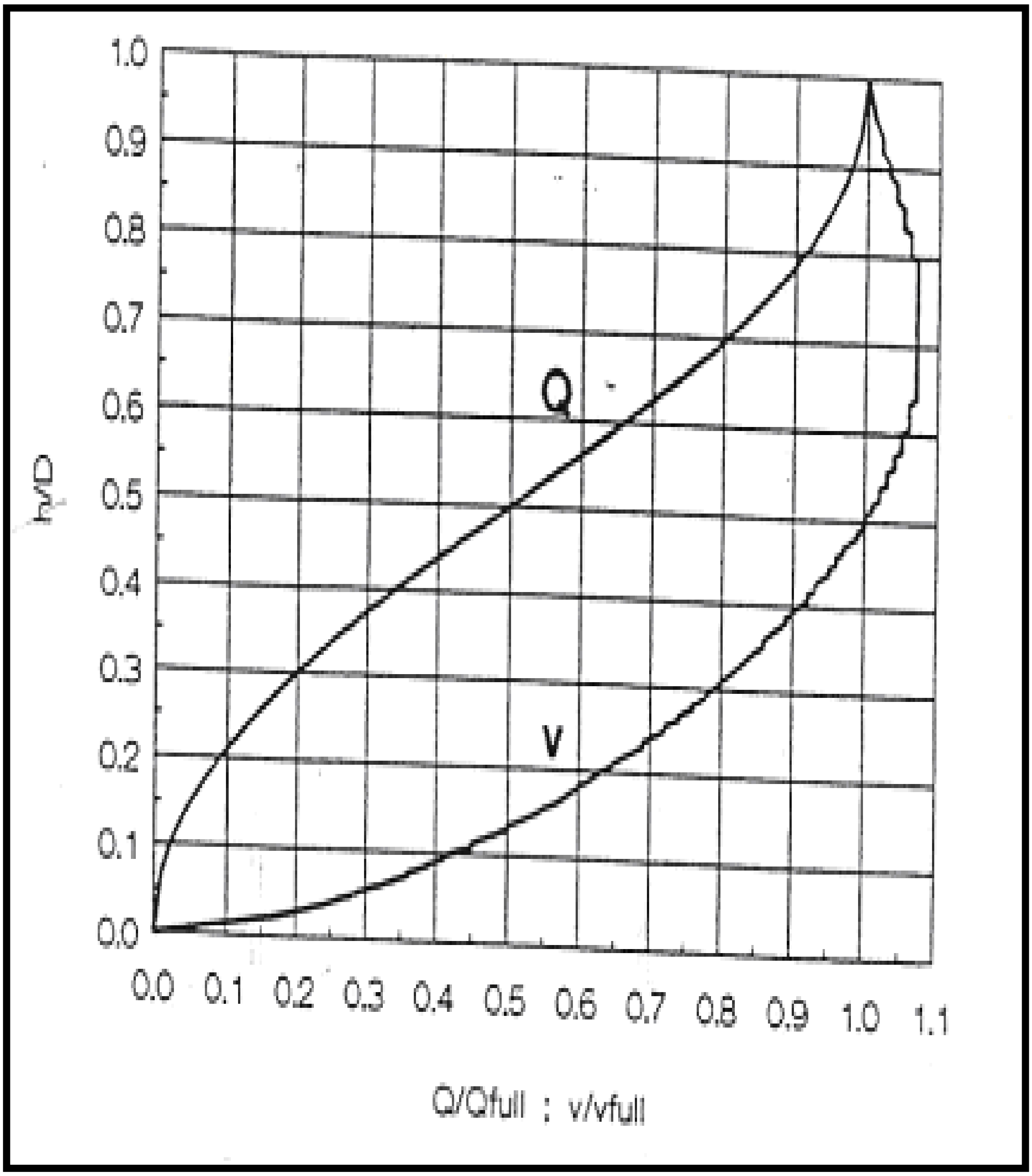

Fig 3.2 Hydraulic Properties Of Circular Sewer

Design Computations

After the preliminary sewer layout plan and profile are prepared, the design computations are accomplished. Design computations for sewers are repetitious and therefore, are best performed in a tabular format. Table 3.7 is typical of the way in which data can be organized to facilitate computations for closed system.

Preparation of Maps and Profile

It is important that the detailed drawings be prepared and specifications completed before the bide can be requested. The contract drawings should show (1) surface features, (2) depth and character of material to be excavated, (3) the existing structures that are likely to be encountered, and (4) the details of sewer and appurtenances to be constructed.

Important Numbers

- Maximum velocity = 5 m/s
- Minimum velocity = 1 m/s
- Maximum slope = 15%
- Minimum slope = 0.5%
- H/D = 70%
- Minimum Diameter 250-300 mm
- Minimum cover 1 m
- Maximum cover 5 m

Table 16.1(Main Trunk N2 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N2 a	1	2	100	100.00	2.56	0.2	0.51	0.51	9.67	202.32	103.59	103.59
2	N2 a	2	3	99.91	199.91	2.56	0.2	0.51	1.02	11.33	199.63	204.42	100.84
3	N2 a	3	4	98.72	298.63	2.46	0.2	0.49	1.52	12.98	197.01	298.67	94.25
4	N2 a	4	5	99.89	398.52	2.45	0.2	0.49	2.01	14.64	194.39	389.95	91.29
5	N2 a	5	6	100	498.52	2.70	0.2	0.54	2.55	16.31	191.81	488.35	98.39
6	N2 a	6	7	99.02	597.54	2.70	0.2	0.54	3.09	17.96	189.28	584.13	95.78
7	N2 a	7	8	99.49	697.03	2.76	0.2	0.55	3.64	19.62	186.78	679.50	95.37
8	N2 a	8	9	100	797.03	2.92	0.2	0.58	4.22	21.28	184.30	778.09	98.59
9	N2 a	9	10	100	897.03	2.83	0.2	0.57	4.79	22.95	181.84	870.67	92.58
10	N2 a	10	11	100	997.03	2.33	0.2	0.47	5.25	24.62	179.43	942.71	72.03
11	N2 a	11	12	99.94	1096.97	1.43	0.2	0.29	5.54	26.28	177.04	980.81	38.11
12	N2 a	12	16	71.81	1168.78	0.30	0.2	0.06	5.60	27.48	175.35	981.95	1.14

Design Assamptions and data

Chock Load

4.1 WASTE WATER COLLECTION SYSTEM

4.1.1 GENERAL

In this project, design of waste water collection system for Sourif town is made, and develop a future plans for construction of the collection system, corresponding to the vision of Sourif municipality about their future plan zone, in order to reduce the problem causes by missing this important part.

In this section, the layout of the system established is presented, and the computation procedures and tables are given along the drawings of layout and profiles for all the lines designed.

4.1.2 Layout of the System

The first step in designing a sewerage system is to establish an overall system layout that includes a plan of the area to be sewered, showing roads, streets, buildings, other utilities, topography, and the lowest floor elevation or all buildings to be drained.

In establishing the layout of waste water collection system for Sourif town, the following basic steps were followed:

1. Obtain a topographic map of the area to be served.
2. Visit the location
3. Locate the drainage outlet. This is usually near the lowest point in the area and is often along a stream or drainage way. In Sourif town, the lowest point is in the North-west part of the zone.
4. Sketch in preliminary pipe system to serve all the contributors.
5. Pipes are located so that all the users or future users can readily tap on. They are also located so as to provide access for maintenance and thus are ordinarily placed in streets or other rights-of-way.

6. Sewers layout is followed natural drainage ways so as to minimize excavation and pumping requirements. Large trunk sewers are located in low-lying areas closely paralleling streams or channels.
7. Revise the layout so as to optimize flow-carrying capacity at minimum cost. Pipe lengths and sizes are kept as small as possible, pipe slopes are minimized, and followed the ground surface slope to minimize the depth of excavation, and the numbers of appurtenances are kept as small as possible.
8. The pumping is avoided across drainage boundaries. Pumping stations are costly and add maintenance problems.

The final layout of waste water collection system for Souriftown is illustrated in (Fig 4.1), (Fig 4.2) and drawing D1, D2 in (Appendix B).

Four main trunks are located on the layout and each has catchment and sub catchment area.

Fig 4.1 A3 sanitary

1. Layout Of Waste Water Collection System (With Contour Lines) Fig4.1
2. Layout Of Waste Water Collection System (Without Contour Lines) Fig4.2

4.1.3 Quantity Of Waste Water

The detailed design of sanitary sewers involves the selection of appropriate pipe sizes and slopes to transport the quantity of waste water expected from the surroundings and upstream areas to the next pipe in series, subject to the appropriate design constrains. The design computations in the example given below.

After preparing the layout of the waste water collection system the quality of waste water that the system must carry it will be calculated using the data collected about the area.

Example: Design a gravity flow trunk sanitary sewer for the area to outfall (line S2a) in (Fig 4.3). The following data will collect and analyzed.

1. For current water consumption uses 60 l/c.day.
2. For future water consumption 120 l/c.day.
3. For current population.
4. For Population growth rate 3.5%.
5. For design period 25 year.
6. The waste water calculates as 80% of the water consumption.
7. For infiltration allowance use 10% of the domestic sewerage flow.
8. Peaking factor depending on the formula :

$$\mathbf{Pf = 1.5 + (2.5/\sqrt{q})}$$

Table 1.5 (Main Trank S1 West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area		Flow Rates 2036					
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**18**	**20**	**21**	**22**	**24**	**25**
1	S1 e	1	2	50	0.051	8.66	8.66	1.09	3.00	3.26	0.11	3.37	3.37
2	S1 e	2	3	27.85	0.051	4.86	13.52	1.70	3.00	5.09	0.17	5.26	1.89
3	S1 e	3	4	50	0.051	15.23	28.75	3.61	2.82	10.15	0.36	10.52	5.26
4	S1 e	4	5	57.74	0.051	17.41	46.16	5.79	2.54	14.70	0.58	15.28	4.76
5	S1 e	5	6	30.24	0.051	3.57	49.73	6.24	2.50	15.60	0.62	16.22	0.94
6	S1 e	6	7	36.76	0.051	4.24	53.97	6.77	2.46	16.66	0.68	17.33	1.11
7	S1 e	7	8	50	0.051	5.54	59.51	7.46	2.42	18.02	0.75	18.77	1.44
8	S1 e	8	S1-37	31.86	0.051	3.82	63.33	7.94	2.39	18.96	0.79	19.75	0.98

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	1.07	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Solution

1. Lay out the trunk sewer. Draw a line to represent the proposed sewer Fig 4.3.
2. Locate and number the manholes. Locate manholes at (1) change in direction, (2) change in slope, (3) pipe junctions, (4) upper ends of sewers, and (5) intervals from 35 to 50 m or less. Identify each manhole with a number.
3. Prepare a sewer design computation table. Based on the experience of numerous engineers, it has been found that the best approach for carrying out sewer computations is to use a computation table. The necessary computations for the sanitary sewer are presented in Table 4.3. The data in the table are calculated as follow:
   a. The entries in columns 1 and 2 are used to identify the line numbers and street sewer name.
   b. The entries in columns 3 through 5 are used to identify the sewer manholes, their numbers and the spacing between each two manholes.
   c. The entries in column 6 used to identify unit sewage. Unit sewage = 80% multiplied bythe current consumption density divided area in dounm.
   d. The entries in columns 7 and 8 are used tributary area, column 7 used incremental area, column 8 used total area in dounm.
   e. To calculate municipal maximum flow rates columns 9, 10, 11 are used. Column9is municipal average sewage flow (unit sewage *total area), the peak factor column 10 is calculated using equation 3.2 as: $P_f = 1.5 + 2.5/\sqrt{q}$, where q = Average industrial sewage flow (Column 9). Column 10 represents the actual Pf that we are taken in the project.
   f. Column 12 used to calculate the Q max in year 2036, the value of it comes from multiply column 10* column 9. Column 12 calculate the infiltration which equal to 10% $fQ_{average}$ (10% * column 9).Column 13 used to calculate total average which is equal to column 11 + column 12. Column 13 and column 14 used to show the maximum flow design for year 2036 which is come from column 12 + column 13.

In this section the quantity of waste water for the four main trunks is calculated and it's shown on tables in (Appendix A)

4.1.4 The Proposed Waste Water Collection System

In the proposed study for the WasteWater Collection System for Sourif Town, the trial is made to design the main trunks of the collection system. This section deals with the results of the wastewater collection system.

Manholes number , pipes lengths, water consumption, areas, wastewater quantities are found doing the calculations given in the previous section and are given in tables (1 -4) in appendix A**.**
The appropriate pipe diameters, lengths and slopes, and location of the manholes are found doing the calculations on the sewerCAD software program. During and once the sewer design computations have been completed, alternative alignments have be examined, and the most cost and energy effective alignment has Collection System for the area, slopes ,lengths of the pipes ,the calculated velocities and flow rates are given in Tables (5-14) in Appendix-A.

4.1.5 Profiles Of Waste water Pipes

The profiles of sewer area assist in the design and are used as the basis of construction drawings. The profile is usually prepared for pipe sewer line at a horizontal and vertical scale. The profile shows the ground or street surface, inlets locations, elevation of street surface, pipe surface, pipe basement.

After all the calculation is completed and all the maps of the proposed waste water collection system are prepared, detailed profile for sewer pipe line is drawn. The profile of sewer pipe line is shown in Drawing in Appendix-B. This profile has shown the ground elevation, the proposed sewer pipe line.

4.2 STORM WATER DRAINAGE SYSTEMDESIGN

4.2.1 General

In this project, design of storm water drainage system for the Sourif town, in order to solve the problem causes by the cumulative flooded storm water in the streets.

In this chapter, the layout of the system established will be presented followed by discussion of detailed design computations and the final design and profile of the suggested storm water drainage system.

4.2.2 Layout Of The System

The first step in designing a storm water drainage system is to establish an overall system layout that includes a plan of the area, showing roads, streets, buildings, other utilities, topography.

In suggesting the layout of storm water drainage system for the Sourif town, the following basic steps were followed:

1. Obtain a topographic map of the area to be served.
2. Visit the location
3. Locate the catchment of the site and determine the area of this catchment.
4. Sketch in preliminary closed pipe system to serve the area.
5. Sewer layout is followed natural drainage ways so as to minimize
6. Excavation and pumping requirements.
7. Establish preliminary pipe diameter that can drain the required water runoff.
8. Revise the layout so as to optimize flow-carrying capacity at minimum cost.

The final layout of storm water drainage system for Sourif town is illustrated in the (Fig 4.4) and (Fig 4.5) and drawing (D1), (D2) in Appendix B.

Fig A3 4.2 storm

1. Layout Of Storm Water Collection System
   (With Contour Line) (Fig 4.4)
2. Layout Of Storm Water Collection System
3. (WithoutContour Line)(Fig 4.5)

4.2.3 Quantity Of Storm Water

After preparing the layout of storm water drainage system the quality of storm water that the system must carry it will be calculated using the data collected about the area.

Example:Design a gravity flow storm water drainage pipe for the area Sourif town shown in the accompanying (Fig 4.6). Assume that the following design criteria have been developed and adopted based on an analysis of local conditions and codes.

1. For weighted Runoff coefficient (C) uses 0.65
2. For Inlet time (Ti) use 5 minutes
3. For Concentration time (T_c) use equations

$$T_c = t_i + t_f \quad (4.2)$$

4. For Runoff rate depending on the formula:

$$Q = C.i.A \quad (4.3)$$

5. For Rainfall intensity use (Fig 4.7).

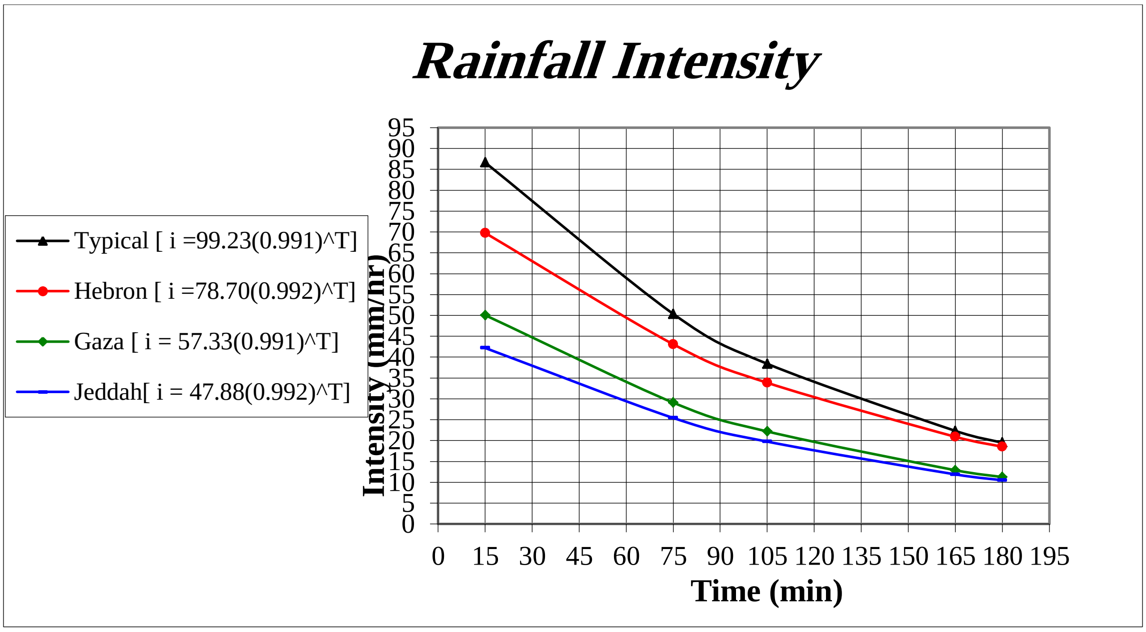

Fig 4.7 The Rainfall Intensity-Duration Curve For Several Areas

Table 16.1(Main Trunk N2 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N2 a	1	2	100	100.00	2.56	0.2	0.51	0.51	9.67	202.32	103.59	103.59
2	N2 a	2	3	99.91	199.91	2.56	0.2	0.51	1.02	11.33	199.63	204.42	100.84
3	N2 a	3	4	98.72	298.63	2.46	0.2	0.49	1.52	12.98	197.01	298.67	94.25
4	N2 a	4	5	99.89	398.52	2.45	0.2	0.49	2.01	14.64	194.39	389.95	91.29
5	N2 a	5	6	100	498.52	2.70	0.2	0.54	2.55	16.31	191.81	488.35	98.39
6	N2 a	6	7	99.02	597.54	2.70	0.2	0.54	3.09	17.96	189.28	584.13	95.78
7	N2 a	7	8	99.49	697.03	2.76	0.2	0.55	3.64	19.62	186.78	679.50	95.37
8	N2 a	8	9	100	797.03	2.92	0.2	0.58	4.22	21.28	184.30	778.09	98.59
9	N2 a	9	10	100	897.03	2.83	0.2	0.57	4.79	22.95	181.84	870.67	92.58
10	N2 a	10	11	100	997.03	2.33	0.2	0.47	5.25	24.62	179.43	942.71	72.03
11	N2 a	11	12	99.94	1096.97	1.43	0.2	0.29	5.54	26.28	177.04	980.81	38.11
12	N2 a	12	16	71.81	1168.78	0.30	0.2	0.06	5.60	27.48	175.35	981.95	1.14

Design Assamptions and data

Chock Load

Solution

a. Lay out the storm water sewer. Draw a line to represent the proposed sewer(See Fig 4.6).

b. Locate and number the upper and lower points of the line N1a.

c. The necessary computations for the storm water sewer shown in Fig presented in the Table 4.2. The data in the table are calculated as follow:

d. The entries in columns 1 through 6 are used to identify the point locations, their numbers and the length between them.

e. The entries in columns 7 used to identify the sewer area; column 7 shows the partial sewered area in hectare.

f. The entries in columns 8 through 14 are used to calculate the design flow. Runoff coefficient (C) is entered in column 8. The partial sewered area in hectare is multiplied by runoff coefficient (C) and the result is given in column 9. The cumulative multiplication of the sewered area in hectare is multiplied by runoff coefficient (C) are given in column 10. The concentration time is shown in column 11 and rainfall intensity (L/s.ha) is shown in column 12. Column 14 shows the quantity of storm water separately between two inlets.

Two main trunks is proposed and located on the layout of the area and the quantity of storm water for each is illustrated in table in Appendix A

4.2.4 The Proposed Storm Water Drainage System

In the proposed study for the Storm Water Drainage System for Jericho industrial zone, the trial is made to design the main trunks of the collection system. This section deals with the results of the storm water drainage system.

Manholes number, pipes lengths, water consumption, areas, industrial wastewater quantities are found doing the calculations given in the previous section and are given in tables (15-16) in appendix A**.**

The appropriate pipe diameters, lengths and slopes, and location of the manholes are found doing the calculations on the sewer CAD software program. During and once the sewer design computations have been completed, alternative alignments have be examined, and the most cost and energy effective alignment has Collection System for the area, slopes ,lengths of the pipes ,the calculated velocities and flow rates are given in Tables (17-18) in Appendix-A.

4.2.5 Profiles Of Drainage Pipes

The profiles of sewer area assist in the design and are used as the basis of construction drawings. The profile is usually prepared for pipe sewer line at a horizontal and vertical scale. The profile shows the ground or street surface, in lets locations, elevation of street surface, pipe surface, pipe basement.

After all the calculation is completed and all the maps of the proposed storm water drainage system are prepared, detailed profile for sewer pipe line is drawn. The profile of sewer pipe line is shown in Drawings in Appendix-B. This profile has shown the ground elevation, the proposed sewer pipe line.

BILL OF QUANTITY

5.1 BILL OF QUANTITY FOR THE PROPOSED WASTEWATER COLLECTION SYSTEM

No.	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A1	Excavation of pipes trench in all kind of soil for one pipe diameter 8 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2000				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 10 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2800				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 12 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	4370				

A4	Excavation of pipes trench in all kind of soil for one pipe diameter 15 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2410				
A5	Excavation of pipes trench in all kind of soil for one pipe diameter 18 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	1015				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 24 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	7230				
A4	Excavation of pipes trench in all kind of soil for one pipe diameter 28 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2410				

A5	Excavation of pipes trench in all kind of soil for one pipe diameter 32 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	1015				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 36 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	7230				

5.2 BILL OF QUANTITY FOR THE PROPOSED STORM WATER DRAINAGE SYSTEM

No.	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A1	Excavation of pipes trench in all kind of soil for one pipe diameter 10 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	500				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 15 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	450				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 18 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	105				
A4	Excavation of pipes trench in all kind of soil for one pipe diameter 28 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	366				

A5	Excavation of pipes trench in all kind of soil for one pipe diameter 36 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	118.5				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 65 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	293				

CHAPTER FIVE

CONCLUSION

In this project, the trial is made to design waste water collection system and storm water drainage system for Sourif town considering the annual growth of the people and their water consumption for the coming 25 years, the water runoff, and catchment area. The result brought out many important conclusions. The main conclusions drawn from the present study are summarized below:

1. Sourif town has no sewage facility. The people are using laterains cesspits and septic tanks. The waste water has been seeping into the ground through the over flow of the deteriorated cesspits and laterains, causing series environmental and health problem also storm water collect in law areas and flood streets and walk ways, rapid growth has decreased the open areas available for percolation of the rainwater and has greatly increased the runoff to low lying areas.

2. The present population of Sourif Town is 16000 person prediction of the future population of Sourif Town is estimated depending on 4.58 % growth rate.

3. The present water consumption of Sourif Town is 60 L/c.dayand the future water consumption is estimated to be 111 L/c.day depending on 2.5 % increase use rate.

4. The slopes of sewer in the proposed waste water, collection system and storm water drainage system are followed the slope of the ground to decrease the cost of construction.

5. For the waste water collection system it is found that there are 4 main catchments in the area and each main catchments consists of many sub-catchments.

6. For the storm water drainage system it is found that there are 2 main catchments in the area, and each main catchment consists of many sub-catchments.

7. For the storm water drainage system we used runoff coefficient(c) equal 0.65 because some of the area is agricultural areas.

8. the proposed waste water collection system and storm water drainage system for Sourif Town covers most of the areas of the Town.

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Table 1 (Main Trank S1 West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area		Flow Rates 2036					
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S 1	1	2	50	0.17	9.98	9.98	4.16	2.73	11.34	0.42	11.75	11.75
2	S 1	2	3	29.88	0.17	3.67	13.65	5.69	2.55	14.50	0.57	15.07	3.31
3	S 1	3	4	50	0.17	7.79	21.44	8.94	2.34	20.88	0.89	21.77	6.71
4	S 1	4	5	50	0.17	7.44	28.88	12.04	2.22	26.73	1.20	27.93	6.16
5	S 1	5	6	28.51	0.17	4.38	33.26	13.86	2.17	30.10	1.39	31.49	3.56
6	S 1	6	7	50	0.17	7.24	40.50	16.88	2.11	35.59	1.69	37.28	5.79
7	S 1	7	8	50	0.17	6.72	47.22	19.68	2.06	40.61	1.97	42.58	5.30
8	S 1	8	9	27.13	0.17	26.76	73.98	30.83	1.95	60.13	3.08	63.22	20.64
9	S 1	9	10	46.84	0.17	21.49	95.47	39.79	1.90	75.46	3.98	79.44	16.22
10	S 1	10	11	50	0.17	6.94	102.41	42.68	1.88	80.36	4.27	84.63	5.19
11	S 1	11	12	50	0.17	8.20	110.61	46.10	1.87	86.13	4.61	90.74	6.11
12	S 1	12	13	50	0.17	9.35	119.96	50.00	1.85	92.67	5.00	97.67	6.94
13	S 1	13	14	50	0.17	6.94	126.90	52.89	1.84	97.52	5.29	102.81	5.13
14	S 1	14	15	33.7	0.17	19.38	146.28	60.97	1.82	110.97	6.10	117.07	14.26
15	S 1	15	16	50	0.17	20.84	167.12	69.65	1.80	125.35	6.97	166.53	49.46
16	S 1	16	17	50	0.17	5.24	172.36	71.84	1.79	128.95	7.18	170.35	3.82
17	S 1	17	18	13.6	0.17	11.95	184.31	76.82	1.79	137.14	7.68	179.04	8.69
18	S 1	18	19	50	0.17	24.57	208.88	87.06	1.77	153.92	8.71	196.84	17.80
19	S 1	19	20	58.07	0.17	2.21	211.09	87.98	1.77	155.42	8.80	198.44	1.60
20	S 1	20	21	44.71	0.17	37.13	248.22	103.46	1.75	180.61	10.35	257.92	59.48
21	S 1	21	22	50	0.17	41.30	289.52	120.67	1.73	208.47	12.07	287.49	29.58
22	S 1	22	23	25.81	0.17	21.40	310.92	129.59	1.72	222.84	12.96	302.76	15.27
23	S 1	23	24	50	0.17	41.23	352.15	146.77	1.71	250.45	14.68	332.08	29.32
24	S 1	24	25	50	0.17	41.10	393.25	163.90	1.70	277.86	16.39	361.21	29.13
25	S 1	25	26	50	0.17	40.77	434.02	180.90	1.69	304.97	18.09	390.02	28.81
26	S 1	26	27	35.9	0.17	28.94	462.96	192.96	1.68	324.16	19.30	410.42	20.40
27	S 1	27	28	50	0.17	40.47	503.43	209.83	1.67	350.95	20.98	438.89	28.47
28	S 1	28	29	50	0.17	40.12	543.55	226.55	1.67	377.45	22.65	467.06	28.17
29	S 1	29	30	50	0.17	39.80	583.35	243.14	1.66	403.68	24.31	494.96	27.89
30	S 1	30	31	50	0.17	39.39	622.74	259.55	1.66	429.61	25.96	522.52	27.56
31	S 1	31	32	50	0.17	39.11	661.85	275.85	1.65	455.30	27.59	549.85	27.33
32	S 1	32	33	50	0.17	39.01	700.86	292.11	1.65	480.90	29.21	577.07	27.22
33	S 1	33	34	50.04	0.17	9.68	710.54	296.15	1.65	487.24	29.61	583.82	6.75
34	S 1	34	35	50	0.17	16.61	727.15	303.07	1.64	498.13	30.31	595.39	11.58
35	S 1	35	36	19.96	0.17	6.67	733.82	305.85	1.64	502.50	30.58	600.04	4.65
36	S 1	36	37	50	0.17	10.24	744.06	310.12	1.64	509.20	31.01	607.17	7.13
37	S 1	37	38	57.65	0.17	10.31	754.37	314.41	1.64	515.95	31.44	638.11	30.94
38	S 1	38	39	51.1	0.17	13.26	767.63	319.94	1.64	524.63	31.99	647.34	9.23
39	S 1	39	40	60	0.17	15.64	783.27	326.46	1.64	534.86	32.65	658.23	10.88

Table 1 (Main Trank S1 West Water Collection System) Cont'd

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
40	S 1	40	41	50	0.17	11.32	794.59	331.18	1.64	542.26	33.12	666.10	7.87
41	S 1	41	42	50	0.17	14.08	808.67	337.05	1.64	551.47	33.70	675.89	9.79
42	S 1	42	43	50	0.17	14.18	822.85	342.96	1.63	560.73	34.30	685.75	9.86
43	S 1	43	44	57.04	0.17	16.30	839.15	349.75	1.63	571.38	34.98	697.07	11.33
44	S 1	44	45	50	0.17	14.32	853.47	355.72	1.63	580.73	35.57	707.02	9.95
45	S 1	45	46	50	0.17	14.42	867.89	361.73	1.63	590.14	36.17	717.03	10.01
46	S 1	46	47	50	0.17	14.52	882.41	367.78	1.63	599.61	36.78	727.11	10.08
47	S 1	47	48	55.08	0.17	16.10	898.51	374.49	1.63	610.12	37.45	738.28	11.17
48	S 1	48	49	44.92	0.17	12.34	910.85	379.63	1.63	618.16	37.96	746.85	8.56
49	S 1	49	50	50	0.17	13.37	924.22	385.21	1.63	626.88	38.52	756.12	9.27
50	S 1	50	51	50	0.17	14.08	938.30	391.07	1.63	636.05	39.11	765.88	9.76
51	S 1	51	52	24.25	0.17	9.26	947.56	394.93	1.63	642.08	39.49	772.30	6.42
52	S 1	52	53	57.22	0.17	15.63	963.19	401.45	1.62	652.26	40.14	783.13	10.83
53	S 1	53	54	46.77	0.17	5.93	969.12	403.92	1.62	656.13	40.39	787.24	4.11
54	S 1	54	55	49.79	0.17	10.88	980.00	408.46	1.62	663.21	40.85	794.77	7.54
55	S 1	55	56	50	0.17	17.08	997.08	415.57	1.62	674.33	41.56	806.60	11.83
56	S 1	56	57	50	0.17	21.64	1018.72	424.59	1.62	688.40	42.46	821.58	14.98
57	S 1	57	58	57.14	0.17	23.56	1042.28	434.41	1.62	703.73	43.44	837.89	16.30
58	S 1	58	59	50	0.17	12.68	1054.96	439.70	1.62	711.97	43.97	846.66	8.77
59	S 1	59	60	19.36	0.17	4.83	1059.79	441.71	1.62	715.11	44.17	850.00	3.34
60	S 1	60	61	50	0.17	22.36	1082.15	451.03	1.62	729.64	45.10	865.46	15.46
61	S 1	61	62	35.89	0.17	16.63	1098.78	457.96	1.62	740.44	45.80	876.96	11.50
62	S 1	62	63	50	0.17	9.13	1107.91	461.77	1.62	746.37	46.18	883.27	6.31
63	S 1	63	64	18.33	0.17	3.50	1111.41	463.23	1.62	748.65	46.32	885.69	2.42
64	S 1	64	65	50	0.17	9.59	1121.00	467.22	1.62	754.87	46.72	1194.87	309.19
65	S 1	65	66	50	0.17	10.60	1131.60	471.64	1.62	761.75	47.16	1202.20	7.32
66	S 1	66	67	45.04	0.17	9.80	1141.40	475.73	1.61	768.12	47.57	1208.97	6.77
67	S 1	67	68	50	0.17	16.25	1157.65	482.50	1.61	778.66	48.25	1220.19	11.22
68	S 1	68	69	14.79	0.17	4.26	1161.91	484.27	1.61	781.43	48.43	1223.13	2.94
69	S 1	69	70	50	0.17	16.94	1178.85	491.33	1.61	792.42	49.13	1234.83	11.70
70	S 1	70	71	50	0.17	17.23	1196.08	498.52	1.61	803.59	49.85	2792.79	1557.96

Table 1 (Main Trank S1 West Water Collection System) Cont'd

Line No	Location			Length	Unit Sewage	Tributary area		Flow Rates 2036					
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
71	S 1	71	72	52.43	0.17	18.38	1214.46	506.18	1.61	815.51	50.62	2805.48	12.68
72	S 1	72	73	50	0.17	27.92	1242.38	517.81	1.61	833.61	51.78	2824.74	19.26
73	S 1	73	74	15.4	0.17	8.57	1250.95	521.38	1.61	839.16	52.14	2830.65	5.91
74	S 1	74	75	50	0.17	27.92	1278.87	533.02	1.61	857.25	53.30	2849.90	19.25
75	S 1	75	76	50	0.17	28.17	1307.04	544.76	1.61	875.49	54.48	2869.32	19.42
76	S 1	76	77	50	0.17	32.18	1339.22	558.17	1.61	896.33	55.82	2891.49	22.17
77	S 1	77	78	45.33	0.17	21.78	1361.00	567.25	1.60	910.42	56.73	2906.50	15.00
78	S 1	78	79	54.7	0.17	17.71	1378.71	574.63	1.60	921.88	57.46	2918.69	12.20
79	S 1	79	80	50	0.17	22.74	1401.45	584.11	1.60	936.59	58.41	2934.35	15.66
80	S 1	80	81	50	0.17	5.57	1407.02	586.43	1.60	940.19	58.64	2938.18	3.83
81	S 1	81	82	50	0.17	4.41	1411.43	588.27	1.60	943.04	58.83	2941.22	3.04
82	S 1	82	83	51.7	0.17	3.70	1415.13	589.81	1.60	945.44	58.98	2943.77	2.55
83	S 1	83	84	50	0.17	27.14	1442.27	601.13	1.60	962.98	60.11	3076.47	132.71
84	S 1	84	85	49.37	0.17	25.28	1467.55	611.66	1.60	979.32	61.17	3093.87	17.39
85	S 1	85	86	50	0.17	34.38	1501.93	625.99	1.60	1001.54	62.60	3117.51	23.65
86	S 1	86	87	50	0.17	36.18	1538.11	641.07	1.60	1024.90	64.11	3142.39	24.88
87	S 1	87	88	50	0.17	37.98	1576.09	656.90	1.60	1049.43	65.69	3168.50	26.10
88	S 1	88	89	50	0.17	113.80	1689.89	704.33	1.59	1122.84	70.43	3246.66	78.16
89	S 1	89	90	13.71	0.17	8.47	1698.36	707.86	1.59	1128.31	70.79	3252.47	5.81
90	S 1	90	91	50	0.17	15.54	1713.90	714.34	1.59	1138.32	71.43	3263.14	10.67
91	S 1	91	92	50	0.17	26.06	1739.96	725.20	1.59	1155.12	72.52	3281.02	17.88
92	S 1	92	93	36.5	0.17	28.70	1768.66	737.16	1.59	1173.62	73.72	3300.72	19.69
93	S 1	93	94	50	0.17	12.80	1781.46	742.50	1.59	1181.87	74.25	3309.50	8.78
94	S 1	94	95	44.3	0.17	31.54	1813.00	755.64	1.59	1202.19	75.56	3331.13	21.63
95	S 1	95	96	50	0.17	28.28	1841.28	767.43	1.59	1220.40	76.74	3350.52	19.39
96	S 1	96	97	50	0.17	32.19	1873.47	780.85	1.59	1241.13	78.08	3372.59	22.07
97	S 1	97	98	50	0.17	61.02	1934.49	806.28	1.59	1280.40	80.63	3414.41	41.82

Table 1 (Main Trank S1 West Water Collection System) Cont'd

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
98	S 1	98	99	25.4	0.17	35.93	1970.42	821.25	1.59	1303.52	82.13	3439.03	24.62
99	S 1	99	100	50	0.17	4.34	1974.76	823.06	1.59	1306.32	82.31	3442.00	2.97
100	S 1	100	101	50	0.17	10.45	1985.21	827.42	1.59	1313.04	82.74	3449.16	7.16
101	S 1	101	102	17.51	0.17	7.98	1993.19	830.74	1.59	1318.17	83.07	3454.63	5.47
102	S 1	102	103	50	0.17	2.04	1995.23	831.59	1.59	1319.48	83.16	6638.10	3183.48
103	S 1	103	104	58.7	0.17	9.91	2005.14	835.72	1.59	1325.86	83.57	6644.89	6.79
104	S 1	104	105	50	0.17	8.53	2013.67	839.28	1.59	1331.35	83.93	6650.73	5.84
105	S 1	105	106	50	0.17	8.35	2022.02	842.76	1.59	1336.72	84.28	6656.45	5.72
106	S 1	106	107	38.57	0.17	6.31	2028.33	845.39	1.59	1340.77	84.54	6660.77	4.32

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	3.543	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 1.1 (Main Trank S1 West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area		Flow Rates 2036					
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S1 a	1	2	50	0.044	9.77	9.77	1.06	3.00	3.19	0.11	3.30	3.30
2	S1 a	2	3	50	0.044	9.50	19.27	2.10	3.00	6.29	0.21	6.50	3.20
3	S1 a	3	4	50	0.044	8.08	27.35	2.98	2.95	8.78	0.30	9.07	2.57
4	S1 a	4	5	50	0.044	7.90	35.25	3.84	2.78	10.65	0.38	11.03	1.96
5	S1 a	5	6	50	0.044	7.80	43.05	4.68	2.66	12.44	0.47	12.91	1.87
6	S1 a	6	7	30.56	0.044	4.73	47.78	5.20	2.60	13.50	0.52	14.02	1.11
7	S1 a	7	8	50	0.044	0.55	48.33	5.26	2.59	13.62	0.53	14.15	0.13
8	S1 a	8	9	36.03	0.044	9.93	58.26	6.34	2.49	15.80	0.63	16.44	2.29
9	S1 a	9	10	46.57	0.044	13.34	71.60	7.79	2.40	18.66	0.78	19.44	3.01
10	S1 a	10	11	50	0.044	16.87	88.47	9.63	2.31	22.20	0.96	23.16	3.72
11	S1 a	11	12	50	0.044	19.19	107.66	11.72	2.23	26.13	1.17	27.30	4.14
12	S1 a	12	13	5.29	0.044	2.21	109.87	11.96	2.22	26.58	1.20	27.77	0.47

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	0.925	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 1.2 (Main Trank S1 West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area		Flow Rates 2036					
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**18**	**20**	**21**	**22**	**24**	**25**
1	S1 b	1	2	50	0.044	5.35	5.35	0.58	3.00	1.73	0.06	1.79	1.79
2	S1 b	2	3	50	0.044	6.69	12.04	1.30	3.00	3.90	0.13	4.03	2.24
3	S1 b	3	4	50	0.044	8.66	20.70	2.23	3.00	6.70	0.22	6.93	2.90
4	S1 b	4	5	50	0.044	9.09	29.79	3.22	2.89	9.31	0.32	9.63	2.70
5	S1 b	5	6	50	0.044	9.84	39.63	4.28	2.71	11.59	0.43	12.02	2.39
6	S1 b	6	7	50.42	0.044	10.86	50.49	5.45	2.57	14.01	0.55	14.56	2.54
7	S1 b	7	8	50	0.044	10.52	61.01	6.59	2.47	16.30	0.66	16.96	2.40
8	S1 b	8	9	50	0.044	8.07	69.08	7.46	2.42	18.02	0.75	18.76	1.81
9	S1 b	9	10	50	0.044	11.91	80.99	8.74	2.35	20.51	0.87	21.38	2.62
10	S1 b	10	11	39.72	0.044	7.49	88.48	9.55	2.31	22.06	0.96	23.01	1.63
11	S1 b	11	12	50	0.044	9.02	97.50	10.53	2.27	23.90	1.05	24.95	1.94
12	S1 b	12	13	50	0.044	11.16	108.66	11.73	2.23	26.16	1.17	27.33	2.38
13	S1 b	13	14	18.01	0.044	4.54	113.20	12.22	2.22	27.07	1.22	28.30	0.96

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	0.92	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 1.3 (Main Trank S1 West Water Collection System)

	Location					Tributary area		Flow Rates 2036					
Line No	Street Sewer Name	Upper Mh No	Lower Mh No	Length	Unit Sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**18**	**20**	**21**	**22**	**24**	**25**
1	S1 c	1	2	60	0.49	14.12	14.12	17.11	2.10	36.00	1.71	37.71	37.71
2	S1 c	2	3	54.66	0.49	32.35	46.47	56.31	1.83	103.22	5.63	108.85	71.13
3	S1 c	3	4	50	0.49	22.95	69.42	84.11	1.77	149.10	8.41	157.51	48.66
4	S1 c	4	5	50	0.49	22.31	91.73	111.14	1.74	193.07	11.11	204.19	46.68
5	S1 c	5	6	21.01	0.49	4.59	96.32	116.71	1.73	202.07	11.67	213.74	9.55
6	S1 c	6	7	50	0.49	6.21	102.53	124.23	1.72	214.21	12.42	226.63	12.90
7	S1 c	7	8	50	0.49	6.10	108.63	131.62	1.72	226.11	13.16	239.28	12.64
8	S1 c	8	9	21.39	0.49	1.66	110.29	133.63	1.72	229.35	13.36	242.71	3.44
9	S1 c	9	10	53.43	0.49	1.16	111.45	135.04	1.72	231.61	13.50	245.11	2.40

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	10.3	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 1.4 (Main Trank S1 West Water Collection System)

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**18**	**20**	**21**	**22**	**24**	**25**
1	S1 d	1	2	26.54	0.051	12.98	12.98	1.63	3.00	4.88	0.16	5.05	5.05
2	S1 d	2	3	50	0.051	26.51	39.49	4.95	2.62	12.99	0.50	13.49	8.44
3	S1 d	3	4	50	0.051	27.07	66.56	8.35	2.37	19.74	0.83	20.58	7.09
4	S1 d	4	5	47.04	0.051	25.98	92.54	11.60	2.23	25.92	1.16	27.08	6.51
5	S1 d	5	6	50	0.051	28.21	120.75	15.14	2.14	32.44	1.51	33.96	6.87
6	S1 d	6	7	50	0.051	35.95	156.70	19.65	2.06	40.56	1.97	42.52	8.57
7	S1 d	7	8	50	0.051	29.79	186.49	23.39	2.02	47.17	2.34	49.51	6.98
8	S1 d	8	9	50	0.051	29.23	215.72	27.05	1.98	53.58	2.71	56.29	6.78
9	S1 d	9	10	36.75	0.051	21.17	236.89	29.71	1.96	58.19	2.97	61.16	4.87
10	S1 d	10	11	55.13	0.051	29.88	266.77	33.45	1.93	64.64	3.35	67.99	6.83
11	S1 d	11	12	50	0.051	26.52	293.29	36.78	1.91	70.33	3.68	74.01	6.02
12	S1 d	12	13	39.79	0.051	20.82	314.11	39.39	1.90	74.78	3.94	78.71	4.71
13	S1 d	13	14	59.41	0.051	23.08	337.19	42.28	1.88	79.68	4.23	83.91	5.20
14	S1 d	14	15	50	0.051	24.50	361.69	45.36	1.87	84.87	4.54	89.41	5.50
15	S1 d	15	S1-83	32.66	0.051	16.24	377.93	47.39	1.86	88.30	4.74	93.04	3.63

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	1.07	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 1.5 (Main Trank S1 West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area		Flow Rates 2036					
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**18**	**20**	**21**	**22**	**24**	**25**
1	S1 e	1	2	50	0.051	8.66	8.66	1.09	3.00	3.26	0.11	3.37	3.37
2	S1 e	2	3	27.85	0.051	4.86	13.52	1.70	3.00	5.09	0.17	5.26	1.89
3	S1 e	3	4	50	0.051	15.23	28.75	3.61	2.82	10.15	0.36	10.52	5.26
4	S1 e	4	5	57.74	0.051	17.41	46.16	5.79	2.54	14.70	0.58	15.28	4.76
5	S1 e	5	6	30.24	0.051	3.57	49.73	6.24	2.50	15.60	0.62	16.22	0.94
6	S1 e	6	7	36.76	0.051	4.24	53.97	6.77	2.46	16.66	0.68	17.33	1.11
7	S1 e	7	8	50	0.051	5.54	59.51	7.46	2.42	18.02	0.75	18.77	1.44
8	S1 e	8	S1-37	31.86	0.051	3.82	63.33	7.94	2.39	18.96	0.79	19.75	0.98

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	1.07	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 2 (Main Trank S2West Water Collection System)

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S2	1	2	45	0.06	13.53	13.53	2.51	3.00	7.53	0.25	7.78	7.78
2	S2	2	3	40.44	0.06	20.93	34.46	6.39	2.49	15.91	0.64	16.55	8.77
3	S2	3	4	49.55	0.06	16.46	50.93	9.45	2.31	21.86	0.94	22.80	6.25
4	S2	4	5	45	0.06	13.27	64.20	11.91	2.22	26.49	1.19	27.69	4.88
5	S2	5	6	33.63	0.06	12.33	76.53	14.20	2.16	30.72	1.42	32.14	4.45
6	S2	6	7	56.36	0.06	12.15	88.68	16.45	2.12	34.82	1.65	36.47	4.33
7	S2	7	8	45	0.06	14.77	103.46	19.19	2.07	39.74	1.92	41.66	5.20
8	S2	8	9	45	0.06	15.95	119.41	22.15	2.03	45.00	2.22	47.21	5.55
9	S2	9	10	45	0.06	10.21	129.62	24.05	2.01	48.33	2.40	50.74	3.52
10	S2	10	11	45	0.06	9.91	139.53	25.89	1.99	51.55	2.59	54.14	3.40
11	S2	11	12	46.71	0.06	9.76	149.29	27.70	1.98	54.70	2.77	57.47	3.33
12	S2	12	13	57.82	0.06	6.64	155.92	28.93	1.96	56.84	2.89	59.73	2.26
13	S2	13	14	57.82	0.06	6.54	162.47	30.14	1.96	58.94	3.01	61.95	2.22
14	S2	14	15	38.75	0.06	6.55	169.02	31.36	1.95	61.04	3.14	64.17	2.22
15	S2	15	16	44.71	0.06	5.20	174.22	32.32	1.94	62.70	3.23	65.93	1.76
16	S2	16	17	44.71	0.06	5.20	179.42	33.29	1.93	64.36	3.33	67.69	1.75
17	S2	17	18	36.78	0.06	5.20	184.62	34.25	1.93	66.01	3.43	69.44	1.75
18	S2	18	19	48.35	0.06	5.20	189.82	35.22	1.92	67.66	3.52	71.19	1.75
19	S2	19	20(s)	55.9	0.06	5.20	195.02	36.18	1.92	69.31	3.62	72.93	1.75
20	S2	20	21	55.39	0.06	5.20	200.22	37.15	1.91	70.96	3.71	120.84	47.91
21	S2	21	22	53.01	0.06	5.20	205.43	38.11	1.90	72.60	3.81	122.58	1.74
22	S2	22	23	45	0.06	5.20	210.63	39.08	1.90	74.24	3.91	124.32	1.74
23	S2	23	24	45	0.06	6.20	216.83	40.23	1.89	76.20	4.02	126.39	2.07
24	S2	24	25	45	0.06	7.20	224.03	41.56	1.89	78.46	4.16	128.79	2.40
25	S2	25	26	45	0.06	8.20	232.23	43.09	1.88	81.04	4.31	131.52	2.73
26	S2	26	27	45	0.06	9.20	241.43	44.79	1.87	83.92	4.48	134.57	3.05
27	S2	27	28	45	0.06	10.20	251.63	46.69	1.87	87.11	4.67	137.95	3.38
28	S2	28	29	45	0.06	11.20	262.83	48.76	1.86	90.60	4.88	141.65	3.70
29	S2	29	30	45	0.06	12.20	275.03	51.03	1.85	94.40	5.10	145.67	4.02
30	S2	30	31	45	0.06	13.20	288.23	53.48	1.84	98.50	5.35	150.01	4.34
31	S2	31	32	45	0.06	14.20	302.43	56.11	1.83	102.89	5.61	154.67	4.66
32	S2	32	33	45	0.06	15.20	317.63	58.93	1.83	107.59	5.89	159.65	4.98
33	S2	33	34	45.3	0.06	16.20	333.83	61.94	1.82	112.58	6.19	164.94	5.29
34	S2	34	35	40.93	0.06	17.20	351.03	65.13	1.81	117.87	6.51	170.55	5.61
35	S2	35	36(s)	45.16	0.06	18.20	369.23	68.50	1.80	123.45	6.85	176.47	5.92
36	S2	36	37	9.81	0.06	19.20	388.43	72.07	1.79	129.32	7.21	1808.52	1632.05
37	S2	37	38	21.6	0.06	20.20	408.63	75.81	1.79	135.49	7.58	1815.06	6.54
38	S2	38	39	38.21	0.06	21.20	429.83	79.75	1.78	141.95	7.97	1821.91	6.85
39	S2	39	40	52.81	0.06	22.20	452.03	83.87	1.77	148.69	8.39	1829.07	7.16

Table 2 (Main Trank S2West Water Collection System) Cont'd

Line No	Location			Length	Unit Sewage	Tributary area							
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
40	S2	40	41	60.2	0.06	23.20	475.23	88.17	1.77	155.73	8.82	1836.54	7.47
41	S2	41	42	47.78	0.06	24.20	499.43	92.66	1.76	163.06	9.27	1844.31	7.77
42	S2	42	43	39.3	0.06	25.20	524.64	97.34	1.75	170.67	9.73	1852.39	8.08
43	S2	43	44	48.86	0.06	26.20	550.84	102.20	1.75	178.57	10.22	1860.78	8.39
44	S2	44	45	45	0.06	27.20	578.04	107.24	1.74	186.76	10.72	1869.47	8.69
45	S2	45	46	59.69	0.06	28.20	606.24	112.48	1.74	195.23	11.25	1878.47	9.00
46	S2	46	47	60.8	0.06	29.20	635.44	117.89	1.73	203.99	11.79	1887.76	9.30
47	S2	47	48(s)	38.35	0.06	30.20	665.64	123.50	1.72	213.03	12.35	1897.37	9.60
48	S2	48	49	55.86	0.06	31.20	696.84	129.29	1.72	222.35	12.93	2049.17	151.81
49	S2	49	50	55.18	0.06	32.20	729.04	135.26	1.71	231.97	13.53	2059.38	10.21
50	S2	50	51	44.32	0.06	33.20	762.24	141.42	1.71	241.86	14.14	2069.89	10.51
51	S2	51	52	53.9	0.06	34.20	796.44	147.76	1.71	252.04	14.78	2080.70	10.81
52	S2	52	53	35.63	0.06	35.20	831.64	154.30	1.70	262.50	15.43	2091.82	11.11
53	S2	53	54	28.6	0.06	36.20	867.84	161.01	1.70	273.24	16.10	2103.23	11.41
54	S2	54	55	31.53	0.06	37.20	905.04	167.91	1.69	284.27	16.79	2114.95	11.72
55	S2	55	56	31.53	0.06	38.20	943.24	175.00	1.69	295.57	17.50	2126.96	12.02
56	S2	56	57	28.28	0.06	39.20	982.44	182.27	1.69	307.16	18.23	2139.28	12.32
57	S2	57	58	58.9	0.06	40.20	1022.64	189.73	1.68	319.03	18.97	2151.90	12.62
58	S2	58	59	50.22	0.06	41.20	1063.84	197.38	1.68	331.19	19.74	2164.82	12.92
59	S2	59	60	36.78	0.06	42.20	1106.04	205.21	1.67	343.62	20.52	2178.03	13.22
60	S2	60	61	36.78	0.06	43.20	1149.24	213.22	1.67	356.34	21.32	2191.55	13.52
61	S2	61	62	39.9	0.06	44.20	1193.44	221.42	1.67	369.33	22.14	2205.37	13.82
62	S2	62	63	34.67	0.06	45.20	1238.64	229.81	1.66	382.61	22.98	2219.48	14.12
63	S2	63	64	34.67	0.06	46.20	1284.84	238.38	1.66	396.17	23.84	2233.90	14.41
64	S2	64	65	40.53	0.06	47.20	1332.05	247.14	1.66	410.01	24.71	2248.61	14.71
65	S2	65	66(s)	40.45	0.06	48.20	1380.25	256.08	1.66	424.13	25.61	2263.62	15.01
66	S2	66	67	39.46	0.06	49.20	1429.45	265.21	1.65	438.52	26.52	2443.71	180.08
67	S2	67	68	39.36	0.06	50.20	1479.65	274.52	1.65	453.20	27.45	2459.32	15.61
68	S2	68	69	59.33	0.06	51.20	1530.85	284.02	1.65	468.16	28.40	2475.23	15.91
69	S2	69	70	58.25	0.06	52.20	1583.05	293.71	1.65	483.40	29.37	2491.43	16.21
70	S2	70	71	34.89	0.06	53.20	1636.25	303.58	1.64	498.92	30.36	2507.94	16.51
71	S2	71	72	34.89	0.06	54.20	1690.45	313.63	1.64	514.72	31.36	2524.75	16.81
72	S2	72	73	53.73	0.06	55.20	1745.65	323.87	1.64	530.80	32.39	2541.85	17.10
73	S2	73	74	51.97	0.06	56.20	1801.85	334.30	1.64	547.16	33.43	2559.25	17.40
74	S2	74	75	40.1	0.06	57.20	1859.05	344.91	1.63	563.80	34.49	2576.95	17.70
75	S2	75	76(s)	40.08	0.06	58.20	1917.25	355.71	1.63	580.72	35.57	2594.95	18.00
76	s2	76	77	38.55	0.06	59.20	1976.45	366.69	1.63	597.92	36.67	2653.65	58.71
77	S2	77	78	45.03	0.06	60.20	2036.65	377.86	1.63	615.39	37.79	2672.25	18.59
78	S2	78	79	40.68	0.06	61.20	2097.85	389.22	1.63	633.15	38.92	2691.14	18.89
79	S2	79	80	56.06	0.06	62.20	2160.05	400.76	1.62	651.19	40.08	2710.33	19.19
80	S2	80	81	50.81	0.06	63.20	2223.25	412.48	1.62	669.50	41.25	2729.82	19.49
81	S2	81	82	50.81	0.06	64.20	2287.45	424.40	1.62	688.10	42.44	2749.60	19.79
82	S2	82	83	59.05	0.06	65.20	2352.65	436.49	1.62	706.97	43.65	2769.69	20.08

Table 2 (Main Trank S2West Water Collection System) Cont'd

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Tributary area: Average	Tributary area: Peak Factor	Tributary area: Maximum	Tributary area: Infiltration	Tributary area: Total Maximum	Tributary area: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
83	S2	83	84	45	0.06	66.20	2418.85	448.77	1.62	726.12	44.88	2790.07	20.38
84	S2	84	85	31.18	0.06	67.20	2486.05	461.24	1.62	745.55	46.12	2810.75	20.68
85	S2	85	86	33.55	0.06	68.20	2554.25	473.90	1.61	765.27	47.39	2831.73	20.98
86	S2	86	87	40.46	0.06	69.20	2623.46	486.73	1.61	785.26	48.67	2853.00	21.27
87	S2	87	88	29.79	0.06	70.20	2693.66	499.76	1.61	805.53	49.98	2874.57	21.57
88	S2	88	89	37.5	0.06	71.20	2764.86	512.97	1.61	826.08	51.30	2896.44	21.87
89	S2	89	90	39.42	0.06	72.20	2837.06	526.36	1.61	846.90	52.64	2918.61	22.17
90	S2	90	91	39.42	0.06	73.20	2910.26	539.95	1.61	868.01	53.99	2941.07	22.46
91	S2	91	92	63.64	0.06	74.20	2984.46	553.71	1.61	889.40	55.37	2963.84	22.76
92	S2	92	93	50.93	0.06	75.20	3059.66	567.66	1.60	911.06	56.77	2986.90	23.06
93	S2	93	94	39.06	0.06	76.20	3135.86	581.80	1.60	933.00	58.18	3010.25	23.36
94	S2	94	95	45	0.06	77.20	3213.06	596.12	1.60	955.23	59.61	3033.91	23.65
95	S2	95	96	45	0.06	78.20	3291.26	610.63	1.60	977.73	61.06	3057.86	23.95
96	S2	96	97	45	0.06	79.20	3370.46	625.33	1.60	1000.51	62.53	3082.11	24.25
97	S2	97	98	45.86	0.06	80.20	3450.66	640.21	1.60	1023.57	64.02	3106.66	24.55
98	S2	98	99	34.74	0.06	81.20	3531.86	655.27	1.60	1046.90	65.53	3131.50	24.84
99	S2	99	100	54.39	0.06	82.20	3614.06	670.52	1.60	1070.52	67.05	3156.64	25.14
100	S2	100	101	54.51	0.06	83.20	3697.26	685.96	1.60	1094.42	68.60	3182.08	25.44

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	1.26	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 2 .1(Main Trank S2West Water Collection System)

	Location					Tributary area							
Line No	Street Sewer Name	Upper Mh No	Lower Mh No	Length	Unit Sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S2a	1	2	45	0.012	6.67	6.67	0.24	3.00	0.71	0.02	0.73	0.73
2	S2a	2	3	60	0.012	9.30	15.97	0.56	3.00	1.69	0.06	1.75	1.02
3	S2a	3	4	34.32	0.012	3.59	19.55	0.69	3.00	2.07	0.07	2.14	1.12
4	S2a	4	5	34.32	0.012	3.79	23.34	0.82	3.00	2.47	0.08	2.55	1.43
5	S2a	5	6	42.07	0.012	7.51	30.85	1.09	3.00	3.26	0.11	3.37	1.94
6	S2a	6	7	42.07	0.012	8.56	39.40	1.39	3.00	4.17	0.14	4.31	2.37
7	S2a	7	8	45.66	0.012	13.45	52.85	1.86	3.00	5.59	0.19	5.78	3.41
8	S2a	8	9	45.66	0.012	11.66	64.51	2.28	3.00	6.83	0.23	7.05	3.64
9	S2a	9	10	50.19	0.012	19.33	83.85	2.96	2.95	8.74	0.30	9.03	5.39
10	S2a	10	11	45	0.012	19.55	103.40	3.65	2.81	10.24	0.36	10.61	5.22
11	S2a	11	12	38.96	0.012	21.18	124.58	4.39	2.69	11.83	0.44	12.27	7.05
12	S2a	12	13	44.76	0.012	21.52	146.11	5.15	2.60	13.41	0.52	13.92	6.87
13	S2a	13	14	44.76	0.012	15.48	161.59	5.70	2.55	14.52	0.57	15.09	8.22
14	S2a	14	15	53.31	0.012	21.76	183.35	6.47	2.48	16.06	0.65	16.70	8.49
15	S2a	15	16	53.31	0.012	23.34	206.68	7.29	2.43	17.68	0.73	18.41	9.93
16	S2a	16	17	41.31	0.012	22.58	229.26	8.09	2.38	19.24	0.81	20.05	10.12
17	S2a	17	18	45.86	0.012	21.76	251.02	8.85	2.34	20.72	0.89	21.60	11.48
18	S2a	18	19	52.06	0.012	24.14	275.17	9.71	2.30	22.35	0.97	23.32	11.83
19	S2a	19	20	56.29	0.012	23.96	299.12	10.55	2.27	23.95	1.06	25.00	13.17
20	S2a	20	21	53.29	0.012	25.49	324.61	11.45	2.24	25.63	1.14	26.78	13.61
21	S2a	21	22	46.25	0.012	6.78	331.39	11.69	2.23	26.08	1.17	27.25	13.64
22	S2a	22	23	47.2	0.012	11.44	342.83	12.09	2.22	26.83	1.21	28.04	14.40
23	S2a	23	24	52.56	0.012	13.46	356.28	12.57	2.21	27.71	1.26	28.97	14.57
24	S2a	24	25	45	0.012	12.81	369.09	13.02	2.19	28.55	1.30	29.85	15.28
25	S2a	25	26	43.69	0.012	15.13	384.21	13.55	2.18	29.53	1.36	30.89	15.60
26	S2a	26	27	46.3	0.012	14.56	398.77	14.07	2.17	30.47	1.41	31.88	16.28
27	S2a	27	28	45	0.012	16.12	414.89	14.63	2.15	31.51	1.46	32.98	16.70
28	S2a	28	29	56.11	0.012	17.37	432.26	15.25	2.14	32.63	1.52	34.16	17.45
29	S2a	29	30	48.38	0.012	15.91	448.17	15.81	2.13	33.65	1.58	35.23	17.78
30	S2a	30	31	40.94	0.012	3.83	452.00	15.94	2.13	33.90	1.59	35.49	17.71

Table 2 .1(Main Trank S2West Water Collection System) Cont'd

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Tributary area: Average	Tributary area: Peak Factor	Tributary area: Maximum	Tributary area: Infiltration	Tributary area: Total Maximum	Tributary area: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
31	S2a	31	32	40.94	0.012	6.78	458.79	16.18	2.12	34.33	1.62	35.95	18.23
32	S2a	32	33	46.13	0.012	4.52	463.30	16.34	2.12	34.62	1.63	36.25	18.02
33	S2a	33	32	46.13	0.012	8.56	471.86	16.64	2.11	35.16	1.66	36.83	18.81
34	S2a	34	35	41.13	0.012	7.61	479.46	16.91	2.11	35.65	1.69	37.34	18.53
35	S2a	35	36	41.13	0.012	8.74	488.21	17.22	2.10	36.20	1.72	37.93	19.40
36	S2a	36	33	44.07	0.012	9.95	498.16	17.57	2.10	36.83	1.76	38.59	19.19
37	S2a	37	38	45	0.012	10.04	508.19	17.92	2.09	37.47	1.79	39.26	20.07
38	S2a	38	39	45	0.012	9.50	517.69	18.26	2.09	38.07	1.83	39.90	19.83
39	S2a	39	40	45	0.012	6.96	524.66	18.51	2.08	38.51	1.85	40.36	20.53
40	S2a	40	41	18.97	0.012	0.65	525.30	18.53	2.08	38.55	1.85	40.41	19.87

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	% (Chock Load)
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5	
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015	
7)dinsity of line=	0.24	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d

Table 2.2 (Main Trank S2West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area							
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S2b	1	2	45	0.027	54.95	54.95	4.58	2.67	12.22	0.46	12.68	12.68
2	S2b	2	3	45	0.027	54.14	109.09	9.09	2.33	21.18	0.91	22.09	9.41
3	S2b	3	4	45	0.027	81.52	190.62	15.89	2.13	33.80	1.59	35.39	13.30
4	S2b	4	5	62	0.027	96.60	287.22	23.94	2.01	48.15	2.39	50.54	15.15
5	S2b	5	6	54.1	0.027	58.27	345.49	28.80	1.97	56.61	2.88	59.49	8.95
6	S2b	6	7	45.55	0.027	58.62	404.11	33.69	1.93	65.04	3.37	68.41	8.91
7	S2b	7	8	52.69	0.027	51.62	455.73	37.99	1.91	72.39	3.80	76.19	7.78
8	S2b	8	9	45	0.027	41.10	496.83	41.41	1.89	78.21	4.14	82.35	6.16
9	S2b	9	10	51.51	0.027	42.59	539.42	44.96	1.87	84.21	4.50	88.71	6.36
10	S2b	10	11	45.47	0.027	29.96	569.38	47.46	1.86	88.42	4.75	93.16	4.45
11	S2b	11	12	54.54	0.027	36.69	606.07	50.52	1.85	93.55	5.05	98.60	5.44
12	S2b	12	13	55.17	0.027	45.42	651.49	54.31	1.84	99.88	5.43	105.31	6.71
13	S2b	13	14	56.06	0.027	45.82	697.31	58.12	1.83	106.25	5.81	112.06	6.75
14	S2b	14	15	52.21	0.027	38.17	735.48	61.31	1.82	111.54	6.13	117.67	5.61
15	S2b	15	16	45	0.027	11.26	746.74	62.25	1.82	113.09	6.22	119.32	1.65
16	S2b	16	17	38.2	0.027	8.46	755.20	62.95	1.82	114.26	6.30	120.56	1.24
17	S2b	17	18	51.79	0.027	6.32	761.52	63.48	1.81	115.13	6.35	121.48	0.93
18	S2b	18	19	54.3	0.027	9.40	770.92	64.26	1.81	116.43	6.43	122.86	1.38
19	S2b	19	20	59.22	0.027	12.36	783.29	65.29	1.81	118.14	6.53	124.67	1.81
20	S2b	20	21	59.22	0.027	41.70	824.99	68.77	1.80	123.88	6.88	130.76	6.09
21	S2b	21	22	52.23	0.027	28.86	853.85	71.17	1.80	127.85	7.12	134.97	4.21
22	S2b	22	23	45	0.027	20.82	874.67	72.91	1.79	130.71	7.29	138.00	3.03
23	S2b	23	24	45	0.027	15.21	889.88	74.18	1.79	132.80	7.42	140.22	2.21
24	S2b	24	25	39.36	0.027	11.56	901.44	75.14	1.79	134.38	7.51	141.90	1.68

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	0.57	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 2 .3(Main Trank S2West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area							
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S2c	1	2	37.41	0.04	13.53	13.53	1.68	3.00	5.03	0.17	5.20	5.20
2	S2c	2	3	53.79	0.04	20.93	34.46	4.27	2.71	11.58	0.43	12.00	6.80
3	S2c	3	4	44.6	0.04	16.46	50.93	6.31	2.50	15.75	0.63	16.38	9.58
4	S2c	4	5	35.47	0.04	13.27	64.20	7.96	2.39	18.99	0.80	19.79	10.21
5	S2c	5	6	35.47	0.04	12.33	76.53	9.49	2.31	21.93	0.95	22.88	12.67
6	S2c	6	7	49.72	0.04	12.15	88.68	10.99	2.25	24.78	1.10	25.88	13.21
7	S2c	7	8	57.75	0.04	14.77	103.46	12.82	2.20	28.19	1.28	29.47	16.27
8	S2c	8	9	59.45	0.04	15.95	119.41	14.80	2.15	31.82	1.48	33.30	17.04
9	S2c	9	10	39.48	0.04	10.21	129.62	16.07	2.12	34.12	1.61	35.73	18.69
10	S2c	10	11	56.18	0.04	9.91	139.53	17.30	2.10	36.34	1.73	38.07	19.38
11	S2c	11	12	56.18	0.04	9.76	149.29	18.51	2.08	38.51	1.85	40.36	20.99
12	S2c	12	13	31.49	0.04	6.64	155.92	19.33	2.07	39.98	1.93	41.92	20.93
13	S2c	13	14	31.49	0.04	6.54	162.47	20.14	2.06	41.43	2.01	43.44	22.51
14	S2c	14	15	41.43	0.04	6.55	169.02	20.95	2.05	42.87	2.10	44.97	22.45
14	S2c	15	16	34.71	0.04	5.20	174.22	21.60	2.04	44.01	2.16	46.17	23.72

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	0.84	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 2.4 (Main Trank S2West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area							
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S2d	1	2	45	0.14	13.53	13.53	5.67	2.55	14.46	0.57	15.03	15.03
2	S2d	2	3	45	0.14	20.93	34.46	14.45	2.16	31.18	1.44	32.62	17.59
3	S2d	3	4	32.98	0.14	16.46	50.93	21.35	2.04	43.58	2.13	45.71	28.12
4	S2d	4	5	39.94	0.14	13.27	64.20	26.91	1.98	53.34	2.69	56.03	27.91
5	S2d	5	6	39.94	0.14	12.33	76.53	32.08	1.94	62.29	3.21	65.49	37.58
6	S2d	6	7	42.38	0.14	12.15	88.68	37.18	1.91	71.01	3.72	74.73	37.15
7	S2d	7	8	42.38	0.14	14.77	103.46	43.37	1.88	81.52	4.34	85.86	48.71
8	S2d	8	9	31.82	0.14	15.95	119.41	50.06	1.85	92.78	5.01	97.78	49.07
9	S2d	9	10	31.82	0.14	10.21	129.62	54.34	1.84	99.94	5.43	105.37	56.30
10	S2d	10	11	33.27	0.14	9.91	139.53	58.50	1.83	106.86	5.85	112.71	56.41
11	S2d	11	12	33.27	0.14	9.76	149.29	62.59	1.82	113.66	6.26	119.92	63.51
12	S2d	12	13	39.69	0.14	6.64	155.92	65.37	1.81	118.27	6.54	124.80	61.30
13	S2d	13	14	37.83	0.14	6.54	162.47	68.11	1.80	122.80	6.81	129.61	68.32
14	S2d	14	15	23.84	0.14	6.55	169.02	70.86	1.80	127.33	7.09	134.42	66.10
15	S2d	15	16	50.68	0.14	5.20	174.22	73.04	1.79	130.93	7.30	138.23	72.13
16	S2d	16	17	50.68	0.14	5.20	179.42	75.22	1.79	134.51	7.52	142.03	69.91
17	S2d	17	18	54.41	0.14	5.20	184.62	77.40	1.78	138.09	7.74	145.83	75.93
18	S2d	18	19	56.38	0.14	5.20	189.82	79.58	1.78	141.67	7.96	149.63	73.70
19	S2d	19	20	53.23	0.14	5.20	195.02	81.76	1.78	145.25	8.18	153.42	79.72
20	S2d	20	21	49.22	0.14	5.20	200.22	83.94	1.77	148.82	8.39	157.21	77.49
21	S2d	21	22	47	0.14	5.20	205.43	86.12	1.77	152.38	8.61	160.99	83.50
22	S2d	22	23	30.9	0.14	5.20	210.63	88.30	1.77	155.94	8.83	164.77	81.27

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	2.85	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 3 (Main Trank S3 West Water Collection System)

	Location					Tributary area		Flow Rates 2036					
Line No	Street Sewer Name	Upper Mh No	Lower Mh No	Length	Unit Sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S3	1	2	40	0.028	16.25	16.25	1.11	3.00	3.33	0.11	3.44	3.44
2	S3	2	3	40	0.028	16.73	32.98	2.25	3.00	6.75	0.23	6.98	3.54
3	S3	3	4	40	0.028	17.20	50.18	3.42	2.85	9.76	0.34	10.10	3.13
4	S3	4	5	40	0.028	17.67	67.85	4.63	2.66	12.32	0.46	12.79	2.68
5	S3	5	6	45.6	0.028	20.73	88.58	6.04	2.52	15.21	0.60	15.82	3.03
6	S3	6	7	34.4	0.028	16.84	105.42	7.19	2.43	17.49	0.72	18.21	2.40
7	S3	7	8	40	0.028	19.99	125.41	8.56	2.35	20.15	0.86	21.00	2.79
8	S3	8	9	40	0.028	20.41	145.82	9.95	2.29	22.81	0.99	23.80	2.80
9	S3	9	10	27.3	0.028	14.16	159.98	10.92	2.26	24.63	1.09	25.72	1.92
10	S3	10	11	12.7	0.028	5.34	165.32	11.28	2.24	25.32	1.13	26.44	0.72
11	S3	11	12	40	0.028	16.97	182.29	12.44	2.21	27.47	1.24	28.72	2.27
12	S3	12	13	40	0.028	16.51	198.80	13.56	2.18	29.55	1.36	30.91	2.19
13	S3	13	14	35.5	0.028	14.55	213.35	14.56	2.16	31.37	1.46	32.83	1.92
14	S3	14	15	44.5	0.028	13.85	227.20	15.50	2.13	33.10	1.55	34.65	1.82
15	S3	15	16	40	0.028	12.41	239.61	16.35	2.12	34.63	1.63	36.27	1.62
16	S3	16	17	18.3	0.028	5.67	245.28	16.74	2.11	35.33	1.67	37.00	0.74
17	S3	17	18	21.7	0.028	9.93	255.21	17.41	2.10	36.55	1.74	38.29	1.29
18	S3	18	19	40	0.028	18.24	273.45	18.66	2.08	38.78	1.87	40.65	2.36
19	S3	19	20	40	0.028	18.16	291.61	19.90	2.06	41.00	1.99	42.99	2.34
20	S3	20	21	40.8	0.028	18.43	310.04	21.15	2.04	43.23	2.12	45.34	2.36
21	S3	21	22	39.2	0.028	17.51	327.55	22.35	2.03	45.34	2.23	47.58	2.23
22	S3	22	23	40	0.028	17.42	344.97	23.54	2.02	47.43	2.35	49.79	2.21
23	S3	23	24	48.4	0.028	20.95	365.92	24.97	2.00	49.94	2.50	52.44	2.65
24	S3	24	25	31.6	0.028	14.11	380.03	25.93	1.99	51.62	2.59	54.22	1.78
25	S3	25	26	25.6	0.028	11.39	391.42	26.71	1.98	52.98	2.67	55.65	1.43
26	S3	26	27	25.6	0.028	8.20	399.62	27.27	1.98	53.95	2.73	56.68	1.03
27	S3	27	28	28.7	0.028	12.24	411.86	28.10	1.97	55.40	2.81	58.21	1.53
28	S3	28	29	30.5	0.028	12.93	424.79	28.98	1.96	56.93	2.90	59.83	1.62

Table 3 (Main Trank S3 West Water Collection System) Cont'd

	Location					Tributary area		Flow Rates 2036					
Line No	Street Sewer Name	Upper Mh No	Lower Mh No	Length	Unit Sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
29	S3	29	30	25.3	0.028	6.07	430.86	29.40	1.96	57.65	2.94	60.59	0.76
30	S3	30	31	27.3	0.028	6.57	437.43	29.85	1.96	58.43	2.98	61.41	0.82
31	S3	31	32	37	0.028	7.26	444.69	30.34	1.95	59.28	3.03	62.32	0.91
32	S3	32	33	38.6	0.028	7.57	452.26	30.86	1.95	60.17	3.09	63.26	0.94
33	S3	33	34	41.4	0.028	18.74	471.00	32.14	1.94	62.38	3.21	65.59	2.33
34	S3	34	35	40	0.028	18.52	489.52	33.40	1.93	64.55	3.34	67.89	2.30
35	S3	35	36	48.2	0.028	22.83	512.35	34.96	1.92	67.22	3.50	70.71	2.83
36	S3	36	37	31.8	0.028	15.50	527.85	36.02	1.92	69.03	3.60	72.63	1.91
37	S3	37	38	40	0.028	19.73	547.58	37.36	1.91	71.32	3.74	75.06	2.43
38	S3	38	39	40	0.028	20.01	567.59	38.73	1.90	73.65	3.87	77.52	2.46
39	S3	39	40	49.8	0.028	25.23	592.82	40.45	1.89	76.57	4.04	80.62	3.10
40	S3	40	41	30.2	0.028	14.55	607.37	41.44	1.89	78.25	4.14	82.40	1.78
41	S3	41	42	40	0.028	19.50	626.87	42.77	1.88	80.51	4.28	84.78	2.39
42	S3	42	43	40	0.028	19.75	646.62	44.12	1.88	82.78	4.41	87.20	2.41
43	S3	43	44	40	0.028	20.00	666.62	45.48	1.87	85.09	4.55	89.63	2.44
44	S3	44	45	42.8	0.028	21.68	688.30	46.96	1.86	87.58	4.70	92.27	2.64
45	S3	45	46	37.2	0.028	20.01	708.31	48.33	1.86	89.87	4.83	94.70	2.43
46	S3	46	47	40	0.028	21.82	730.13	49.82	1.85	92.37	4.98	97.35	2.65
47	S3	47	48	40	0.028	22.09	752.22	51.32	1.85	94.90	5.13	100.03	2.68
48	S3	48	49	47.6	0.028	26.65	778.87	53.14	1.84	97.94	5.31	103.25	3.22
49	S3	49	50	32.4	0.028	17.50	796.37	54.34	1.84	99.93	5.43	105.37	2.11
50	S3	50	51	40	0.028	21.70	818.07	55.82	1.83	102.40	5.58	107.98	2.62
51	S3	51	52	40	0.028	21.63	839.70	57.29	1.83	104.86	5.73	110.59	2.61
52	S3	52	53	40	0.028	21.55	861.25	58.76	1.83	107.31	5.88	113.19	2.59
53	S3	53	54	31.7	0.028	17.01	878.26	59.92	1.82	109.24	5.99	115.23	2.05
54	S3	54	55	48.3	0.028	15.12	893.38	60.96	1.82	110.95	6.10	117.05	1.82
55	S3	55	56	40	0.028	12.69	906.07	61.82	1.82	112.39	6.18	118.57	1.52

Table 3 (Main Trank S3 West Water Collection System) Cont'd

Line No	Location			Length	Unit Sewage	Tributary area		Flow Rates 2036					
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
56	S3	56	57	40	0.028	7.13	913.20	62.31	1.82	113.20	6.23	119.43	0.86
57	S3	57	58	40	0.028	7.70	920.90	62.83	1.82	114.07	6.28	120.35	0.92
58	S3	58	59	40	0.028	7.69	928.59	63.36	1.81	114.94	6.34	121.27	0.92
59	S3	59	60	39.2	0.028	7.53	936.12	63.87	1.81	115.79	6.39	122.17	0.90
60	S3	60	61	40.8	0.028	15.84	951.96	64.95	1.81	117.58	6.50	124.07	1.90
61	S3	61	62	27.5	0.028	10.64	962.60	65.68	1.81	118.78	6.57	125.35	1.27
62	S3	62	63	24.2	0.028	9.35	971.95	66.32	1.81	119.83	6.63	126.46	1.12
63	S3	63	64	28.4	0.028	13.79	985.74	67.26	1.80	121.39	6.73	128.11	1.65
64	S3	64	65	40	0.028	19.40	1005.14	68.58	1.80	123.57	6.86	130.43	2.32
65	S3	65	66	40	0.028	19.37	1024.51	69.90	1.80	125.76	6.99	132.75	2.31
66	S3	66	67	39.9	0.028	23.45	1047.96	71.50	1.80	128.39	7.15	135.54	2.80
67	S3	67	68	15.9	0.028	9.30	1057.26	72.14	1.79	129.44	7.21	136.65	1.11
68	S3	68	69	24.2	0.028	14.42	1071.68	73.12	1.79	131.06	7.31	138.37	1.72
69	S3	69	70	40	0.028	24.03	1095.71	74.76	1.79	133.76	7.48	141.23	2.86
70	S3	70	71	38.9	0.028	23.48	1119.19	76.36	1.79	136.39	7.64	144.03	2.79
71	S3	71	72	41.2	0.028	23.26	1142.45	77.95	1.78	139.00	7.79	146.79	2.77
72	S3	72	73	40	0.028	22.74	1165.19	79.50	1.78	141.54	7.95	149.49	2.70
73	S3	73	74	40	0.028	22.86	1188.05	81.06	1.78	144.10	8.11	152.21	2.71
74	S3	74	75	28	0.028	16.07	1204.12	82.16	1.78	145.90	8.22	154.11	1.91
75	S3	75	76	12	0.028	6.34	1210.46	82.59	1.78	146.60	8.26	154.86	0.75
76	S3	76	77	40	0.028	21.08	1231.54	84.03	1.77	148.96	8.40	157.36	2.50
77	S3	77	78	48.9	0.028	25.93	1257.47	85.80	1.77	151.85	8.58	160.43	3.07
78	S3	78	79	31.1	0.028	18.94	1276.41	87.09	1.77	153.96	8.71	162.67	2.24
79	S3	79	80	28.8	0.028	17.65	1294.06	88.29	1.77	155.93	8.83	164.76	2.09
80	S3	80	81	10.9	0.028	5.43	1299.49	88.66	1.77	156.54	8.87	165.40	0.64
81	S3	81	82	40	0.028	19.52	1319.01	90.00	1.76	158.71	9.00	167.71	2.31
82	S3	82	83	40	0.028	19.61	1338.62	91.33	1.76	160.89	9.13	170.03	2.32
83	S3	83	84	24.6	0.028	12.09	1350.71	92.16	1.76	162.24	9.22	171.45	1.43
84	S3	84	85	15.4	0.028	9.01	1359.72	92.77	1.76	163.24	9.28	172.52	1.06

Table 3 (Main Trank S3 West Water Collection System) Cont'd

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m³/day		m³/day	m³/day	m³/day	m³/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
85	S3	85	86	40	0.028	23.44	1383.16	94.37	1.76	165.85	9.44	175.28	2.77
86	S3	86	87	17.1	0.028	10.08	1393.24	95.06	1.76	166.97	9.51	176.47	1.19
87	S3	87	88	32.4	0.028	17.56	1410.80	96.26	1.75	168.92	9.63	178.54	2.07
88	S3	88	89	49.3	0.028	28.72	1439.52	98.22	1.75	172.10	9.82	181.93	3.38
89	S3	89	90	33.2	0.028	15.93	1455.45	99.31	1.75	173.87	9.93	183.80	1.88
90	S3	90	91	28	0.028	15.75	1471.20	100.38	1.75	175.62	10.04	1416.94	1233.13
91	S3	91	92	40	0.028	43.62	1514.82	103.36	1.75	180.45	10.34	1422.07	5.13
92	S3	92	93	40	0.028	39.32	1554.14	106.04	1.74	184.80	10.60	1426.69	4.62
93	S3	93	94	40	0.028	39.31	1593.45	108.72	1.74	189.15	10.87	1431.30	4.61
94	S3	94	95	27.3	0.028	26.70	1620.15	110.54	1.74	192.10	11.05	1434.43	3.13
95	S3	95	96	12.8	0.028	16.61	1636.76	111.68	1.74	193.93	11.17	1436.38	1.95
96	S3	96	97	40	0.028	51.93	1688.69	115.22	1.73	199.66	11.52	1442.47	6.08
97	S3	97	98	40	0.028	51.77	1740.46	118.75	1.73	205.37	11.88	1448.53	6.06
98	S3	98	99	40	0.028	51.61	1792.07	122.27	1.73	211.05	12.23	1454.56	6.04
99	S3	99	100	40	0.028	51.44	1843.51	125.78	1.72	216.71	12.58	1460.57	6.01
100	S3	100	101	18.2	0.028	23.29	1866.80	127.37	1.72	219.27	12.74	1463.29	2.72
101	S3	101	102	21.9	0.028	28.12	1894.92	129.29	1.72	222.36	12.93	1466.57	3.28
102	S3	102	103	40	0.028	51.35	1946.27	132.79	1.72	228.00	13.28	1472.56	5.99
103	S3	103	104	40	0.028	51.19	1997.46	136.29	1.71	233.62	13.63	1478.52	5.96
104	S3	104	105	24.1	0.028	30.77	2028.23	138.39	1.71	236.99	13.84	1482.11	3.58
105	S3	105	106	15.9	0.028	10.83	2039.06	139.12	1.71	238.18	13.91	1483.37	1.26
106	S3	106	107	36.2	0.028	24.68	2063.74	140.81	1.71	240.88	14.08	1486.24	2.87

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	0.58	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 3.1 (Main Trank S3 West Water Collection System)

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S3a	1	2	40.17	0.1	10.82	10.82	2.69	3.00	8.06	0.27	8.33	8.33
2	S3a	2	3	15.14	0.1	16.62	27.44	6.81	2.46	16.74	0.68	17.42	9.10
3	S3a	3	4	42.6	0.1	14.00	41.44	10.29	2.28	23.45	1.03	24.48	7.05
4	S3a	4	5	40	0.1	14.71	56.15	13.94	2.17	30.24	1.39	31.63	7.16
5	S3a	5	6	40	0.1	15.43	71.58	17.77	2.09	37.19	1.78	38.97	7.33
6	S3a	6	7	40	0.1	7.52	79.10	19.63	2.06	40.53	1.96	42.49	3.53
7	S3a	7	8	18.8	0.1	2.84	81.94	20.34	2.05	41.78	2.03	43.82	1.33
8	S3a	8	9	21.6	0.1	17.67	99.61	24.72	2.00	49.52	2.47	51.99	8.17
9	S3a	9	10	41.7	0.1	15.40	115.01	28.55	1.97	56.18	2.85	59.03	7.04
10	S3a	10	11	37.9	0.1	15.70	130.71	32.44	1.94	62.91	3.24	66.15	7.12
11	S3a	11	12	40	0.1	15.20	145.91	36.22	1.92	69.37	3.62	72.99	6.84
12	S3a	12	13	40	0.1	14.70	160.61	39.87	1.90	75.58	3.99	79.57	6.58
13	S3a	13	14	40	0.1	14.20	174.81	43.39	1.88	81.55	4.34	85.89	6.32
14	S3a	14	15	40	0.1	13.70	188.51	46.79	1.87	87.29	4.68	91.97	6.07
15	S3a	15	16	40	0.1	7.80	196.31	48.73	1.86	90.54	4.87	95.41	3.45
16	S3a	16	17	23.3	0.1	4.90	201.21	49.94	1.85	92.58	4.99	97.58	2.16
17	S3a	17	18	16.8	0.1	11.40	212.61	52.77	1.84	97.32	5.28	102.60	5.02
18	S3a	18	19	40	0.1	10.80	223.41	55.45	1.84	101.80	5.55	107.34	4.74
19	S3a	19	20	40	0.1	64.80	288.21	71.54	1.80	128.45	7.15	135.61	28.26
20	S3a	20	21	27.1	0.1	31.40	319.61	79.33	1.78	141.27	7.93	149.20	13.59
21	S3a	21	22	13	0.1	10.10	329.71	81.84	1.78	145.38	8.18	153.56	4.36
22	S3a	22	23	40	0.1	10.00	339.71	84.32	1.77	149.44	8.43	157.87	4.31
23	S3a	23	24	40	0.1	10.00	349.71	86.80	1.77	153.50	8.68	162.18	4.31
24	S3a	24	25	20.6	0.1	5.13	354.84	88.08	1.77	155.58	8.81	164.39	2.21
25	S3a	25	26	38.6	0.1	2.74	357.58	88.76	1.77	156.69	8.88	1184.99	1020.61
26	S3a	26	27	38.3	0.1	3.82	361.40	89.71	1.76	158.24	8.97	1186.64	1.64
27	S3a	27	28	22.5	0.1	1.91	363.31	90.18	1.76	159.01	9.02	1187.46	0.82
28	S3a	28	29	40	0.1	2.96	366.27	90.91	1.76	160.21	9.09	1188.73	1.27
29	S3a	29	30	40	0.1	2.39	368.66	91.51	1.76	161.18	9.15	1189.76	1.03
30	S3a	30	31	25.3	0.1	1.22	369.88	91.81	1.76	161.67	9.18	1190.28	0.52
31	S3a	31	32	14.7	0.1	0.52	370.40	91.94	1.76	161.88	9.19	1190.50	0.22
32	S3a	32	33	40	0.1	1.13	371.53	92.22	1.76	162.34	9.22	1190.99	0.49
33	S3a	33	34	45.5	0.1	0.79	372.32	92.42	1.76	162.66	9.24	1191.33	0.34
34	S3a	34	35	46.2	0.1	0.27	372.59	92.48	1.76	162.77	9.25	1191.44	0.12

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	2.11	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 3.2 (Main Trank S3 West Water Collection System)

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Flow Rates 2036: Average	Flow Rates 2036: Peak Factor	Flow Rates 2036: Maximum	Flow Rates 2036: Infiltration	Flow Rates 2036: Total Maximum	Flow Rates 2036: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S3b	1	2	40	0.63	6.79	6.79	10.51	2.27	23.87	1.05	24.92	24.92
2	S3b	2	3	40	0.63	7.60	14.39	22.28	2.03	45.22	2.23	47.44	22.52
3	S3b	3	4	40	0.63	9.10	23.49	36.37	1.91	69.62	3.64	73.26	25.82
4	S3b	4	5	40	0.63	10.00	33.49	51.85	1.85	95.77	5.18	100.96	27.70
5	S3b	5	6	26	0.63	7.10	40.59	62.84	1.82	114.07	6.28	120.36	19.40
6	S3b	6	7	14	0.63	13.30	53.89	83.43	1.77	147.98	8.34	156.32	35.96
7	S3b	7	8	40	0.63	37.30	91.19	141.17	1.71	241.46	14.12	255.58	99.26
8	S3b	8	9	40	0.63	14.90	106.09	164.24	1.70	278.40	16.42	294.82	39.24
9	S3b	9	10	40	0.63	17.00	123.09	190.56	1.68	320.35	19.06	339.40	44.58
10	S3b	10	11	40	0.63	18.60	141.69	219.35	1.67	366.05	21.94	387.99	48.59
11	S3b	11	12	40	0.63	20.40	162.09	250.93	1.66	416.00	25.09	441.10	53.11
12	S3b	12	13	40	0.63	20.40	182.49	282.52	1.65	465.79	28.25	494.05	52.95
13	S3b	13	14	40	0.63	20.70	203.19	314.56	1.64	516.18	31.46	547.64	53.59
14	S3b	14	15	40	0.63	20.60	223.79	346.45	1.63	566.21	34.65	600.86	53.22
15	S3b	15	16	40	0.63	18.60	242.39	375.25	1.63	611.30	37.52	648.82	47.97
16	S3b	16	17	40	0.63	17.70	260.09	402.65	1.62	654.14	40.26	694.40	45.58
17	S3b	17	18	40	0.63	16.70	276.79	428.50	1.62	694.50	42.85	737.35	42.95
18	S3b	18	19	40	0.63	15.70	292.49	452.81	1.62	732.41	45.28	777.69	40.34
19	S3b	19	20	40	0.63	13.10	305.59	473.09	1.61	764.01	47.31	811.32	33.63
20	S3b	20	21	12.5	0.63	3.90	309.49	479.13	1.61	773.41	47.91	821.32	10.01

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	13.16	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 4 (Main Trank S4 West Water Collection System)

Line No	Location			Length	Unit Sewage	Tributary area							
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S4	1	2	40	0.25	20.14	20.14	12.37	2.21	27.34	1.24	28.58	28.58
2	S4	2	3	40	0.25	20.44	40.58	24.92	2.00	49.86	2.49	52.35	23.78
3	S4	3	4	40	0.25	20.44	61.02	37.48	1.91	71.52	3.75	75.27	22.91
4	S4	4	5	31.4	0.25	20.44	81.47	50.03	1.85	92.73	5.00	97.74	22.47
5	S4	5	6	48.6	0.25	29.09	110.56	67.90	1.80	122.45	6.79	129.24	31.50
6	S4	6	7	40	0.25	23.64	134.20	82.42	1.78	146.32	8.24	154.56	25.33
7	S4	7	8	46.2	0.25	26.94	161.14	98.96	1.75	173.31	9.90	183.21	28.65
8	S4	8	9	33.8	0.25	15.15	176.29	108.27	1.74	188.41	10.83	199.24	16.03
9	S4	9	10	32.2	0.25	14.29	190.58	117.04	1.73	202.61	11.70	214.31	15.08
10	S4	10	11	47.8	0.25	26.72	217.30	133.45	1.72	229.06	13.35	242.40	28.09
11	S4	11	12	40	0.25	22.04	239.34	146.99	1.71	250.79	14.70	265.49	23.09
12	S4	12	13	40	0.25	21.78	261.12	160.36	1.70	272.20	16.04	288.24	22.75
13	S4	13	14	40	0.25	21.51	282.63	173.57	1.69	293.30	17.36	310.66	22.41
14	S4	14	15	40	0.25	21.25	303.88	186.62	1.68	314.09	18.66	332.75	22.10
15	S4	15	16	13.3	0.25	6.94	310.82	190.89	1.68	320.87	19.09	339.96	7.21
16	S4	16	17	26.7	0.25	21.25	332.07	203.94	1.68	341.61	20.39	362.00	22.04
17	S4	17	18	40	0.25	18.43	350.50	215.26	1.67	359.56	21.53	381.09	19.09
18	S4	18	19	33.6	0.25	15.21	365.71	224.60	1.67	374.36	22.46	396.82	15.73
19	S4	19	20	46.4	0.25	19.39	385.10	236.51	1.66	393.21	23.65	416.86	20.03
20	S4	20	21	45	0.25	18.20	403.30	247.68	1.66	410.87	24.77	435.64	18.78
21	S4	21	22	32.9	0.25	13.24	416.54	255.81	1.66	423.71	25.58	449.29	13.65
22	S4	22	23	57.1	0.25	26.30	442.84	271.97	1.65	449.18	27.20	476.38	27.09
23	S4	23	24	45	0.25	20.14	462.98	284.34	1.65	468.66	28.43	497.09	20.72
24	S4	24	25	45	0.25	19.61	482.59	296.38	1.65	487.61	29.64	517.25	20.15
25	S4	25	26	53.8	0.25	22.60	505.19	310.26	1.64	509.42	31.03	540.45	23.20
26	S4	26	27	37.6	0.25	15.30	520.49	319.66	1.64	524.18	31.97	556.15	15.70
27	S4	27	28	37.9	0.25	14.60	535.09	328.62	1.64	538.25	32.86	571.11	14.97
28	S4	28	29	22.1	0.25	8.15	543.24	333.63	1.64	546.10	33.36	579.47	8.35
29	S4	29	30	20.5	0.25	8.87	552.11	339.07	1.64	554.65	33.91	588.55	9.09
30	S4	30	31	30.4	0.25	10.71	562.82	345.65	1.63	564.96	34.57	599.52	10.97
31	S4	31	32	33.8	0.25	11.47	574.29	352.70	1.63	575.99	35.27	611.26	11.74
32	S4	32	33	43.9	0.25	13.52	587.81	361.00	1.63	589.00	36.10	625.10	13.83
33	S4	33	34	22.7	0.25	6.61	594.42	365.06	1.63	595.35	36.51	631.86	6.76
34	S4	34	35	31.3	0.25	8.73	603.15	370.42	1.63	603.75	37.04	640.79	8.93
35	S4	35	36	34.9	0.25	5.70	608.85	373.92	1.63	609.22	37.39	646.62	5.83
36	S4	36	37	35.1	0.25	3.55	612.40	376.10	1.63	612.64	37.61	650.25	3.63
37	S4	37	38	35.4	0.25	8.80	621.20	381.51	1.63	621.09	38.15	659.24	8.99

Table 4 (Main Trank S4 West Water Collection System) Cont'd

Line No	Location			Length	Unit Sewage	Tributary area							
	Street Sewer Name	Upper Mh No	Lower Mh No			Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
38	S4	38	39	31.4	0.25	6.30	627.50	385.37	1.63	627.14	38.54	665.68	6.44
39	S4	39	40	35.7	0.25	7.84	635.34	390.19	1.63	634.67	39.02	673.69	8.01
40	S4	40	41	43.3	0.25	8.64	643.98	395.50	1.63	642.96	39.55	682.51	8.82
41	S4	41	42	35.2	0.25	6.28	650.26	399.35	1.63	648.99	39.94	688.92	6.41
42	S4	42	43	40.3	0.25	6.85	657.11	403.56	1.62	655.56	40.36	695.92	6.99
43	S4	43	44	49.9	0.25	21.52	678.63	416.78	1.62	676.20	41.68	997.78	301.86
44	S4	44	45	31.6	0.25	13.54	692.17	425.09	1.62	689.18	42.51	1011.59	13.81
45	S4	45	46	41.6	0.25	17.37	709.54	435.76	1.62	705.83	43.58	1029.30	17.71
46	S4	46	47	38.8	0.25	13.94	723.48	444.32	1.62	719.18	44.43	1043.51	14.21
47	S4	47	48	41.8	0.25	14.67	737.26	452.78	1.62	732.37	45.28	1057.55	14.04
48	S4	48	49	39.6	0.25	13.78	748.91	459.94	1.62	743.52	45.99	1069.42	11.87
49	S4	49	50	33	0.25	11.65	761.68	467.78	1.62	755.74	46.78	1082.42	13.00
50	S4	50	51	35.7	0.25	12.77	778.20	477.93	1.61	771.54	47.79	1099.24	16.82
51	S4	51	52	43.5	0.25	16.52	789.26	484.72	1.61	782.12	48.47	1110.49	11.25
52	S4	52	53	28.8	0.25	11.06	803.92	493.72	1.61	796.13	49.37	1125.41	14.91
53	S5	53	37	37.7	0.25	14.66	803.92	493.72	1.61	796.13	49.37	1125.41	14.90

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	5.22	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 4.1 (Main Trank S4 West Water Collection System)

	Location					Tributary area							
Line No	Street Sewer Name	Upper Mh No	Lower Mh No	Length	Unit Sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Maximum	Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S4a	1	2	40	0.25	0.11	0.11	0.07	3.00	0.20	0.01	0.21	0.21
2	S4a	2	3	21.6	0.25	0.06	0.17	0.10	3.00	0.31	0.01	0.32	0.11
3	S4a	3	4	18.44	0.25	5.09	5.26	3.17	2.90	9.20	0.32	9.52	9.20
4	S4a	4	5	40	0.25	11.32	16.58	9.99	2.29	22.88	1.00	23.88	14.36
5	S4a	5	6	40	0.25	11.85	28.43	17.12	2.10	36.03	1.71	37.74	13.86
6	S4a	6	7	40	0.25	12.32	40.75	24.54	2.00	49.20	2.45	51.65	13.91
7	S4a	7	8	12.9	0.25	4.05	44.79	26.98	1.98	53.45	2.70	56.15	4.50
8	S4a	8	9	39.2	0.25	13.53	58.33	35.13	1.92	67.51	3.51	71.03	14.88
9	S4a	9	10	39.2	0.25	13.52	71.85	43.27	1.88	81.36	4.33	85.68	14.66
10	S4a	10	11	28.8	0.25	9.85	81.69	49.20	1.86	91.34	4.92	96.26	10.58
11	S4a	11	12	40	0.25	13.55	95.24	57.36	1.83	104.98	5.74	110.72	14.46
12	S4a	12	13	40	0.25	13.41	108.65	65.44	1.81	118.38	6.54	124.93	14.21
13	S4a	13	14	13.3	0.25	4.43	113.08	68.11	1.80	122.80	6.81	129.61	4.68
14	S4a	14	15	26.7	0.25	8.91	121.99	73.48	1.79	131.64	7.35	138.99	9.38
15	S4a	15	16	42.7	0.25	14.09	136.08	81.96	1.78	145.58	8.20	153.77	14.78
16	S4a	16	17	37.3	0.25	11.65	147.73	88.98	1.77	157.05	8.90	165.95	12.18
17	S4a	17	18	21.6	0.25	6.68	154.41	93.00	1.76	163.61	9.30	172.91	6.96
18	S4a	18	19	31.4	0.25	2.86	157.27	94.73	1.76	166.42	9.47	175.89	2.98
19	S4a	19	20	27.05	0.25	8.60	165.87	99.91	1.75	174.85	9.99	184.84	8.94
20	S4a	20	21	40	0.25	12.60	178.47	107.49	1.74	187.16	10.75	197.91	13.07
21	S4a	21	22	26.3	0.25	8.20	186.67	112.43	1.74	195.15	11.24	206.40	8.49
22	S4a	22	23	33.5	0.25	10.34	197.01	118.66	1.73	205.22	11.87	217.09	10.69
23	S4a	23	24	22.3	0.25	4.48	201.49	121.36	1.73	209.57	12.14	221.71	4.63
24	S4a	24	25	43.2	0.25	5.53	207.02	124.69	1.72	214.95	12.47	227.42	5.70
25	S4a	25	26	36.5	0.25	4.52	211.54	127.41	1.72	219.33	12.74	232.07	4.66
26	S4a	26	27	32.5	0.25	0.67	212.21	127.81	1.72	219.98	12.78	232.76	0.69
27	S4a	27	28	28.1	0.25	6.81	219.02	131.91	1.72	226.59	13.19	239.78	7.01
28	S4a	28	29	29.4	0.25	6.30	225.32	135.71	1.71	232.69	13.57	246.26	6.48
29	S4a	29	30	47.2	0.25	9.82	235.14	141.62	1.71	242.19	14.16	256.35	10.09
30	S4a	30	31	43.4	0.25	9.30	244.44	147.23	1.71	251.17	14.72	265.89	9.54
31	S4a	31	32	40	0.25	8.80	253.23	152.52	1.70	259.66	15.25	274.91	9.02
32	S4a	32	33	40	0.25	4.84	258.07	155.44	1.70	264.32	15.54	279.87	4.95
33	S4a	33	43	26.9	0.25	0.04	258.11	155.46	1.70	264.36	15.55	279.90	0.04

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which 80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3		10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.	11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm	12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec	13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec	14) Maining coefficient n=	0.015		
7)dinsity of line=	5.12	Captal/donum	15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d	16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table 4 .2(Main Trank S4 West Water Collection System)

Line No	Location: Street Sewer Name	Location: Upper Mh No	Location: Lower Mh No	Length	Unit Sewage	Tributary area: Incremental	Tributary area: Total	Tributary area: Average	Tributary area: Peak Factor	Tributary area: Maximum	Tributary area: Infiltration	Tributary area: Total Maximum	Tributary area: Q max
				m	m3/d. dou	dounm	dounm	m^3/day		m^3/day	m^3/day	m^3/day	m^3/day
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
1	S4 b	1	2	40.6	0.14	18.06	18.06	6.42	2.49	15.96	0.64	16.60	16.60
2	S4 b	2	3	42	0.14	18.23	36.30	12.89	2.20	28.32	1.29	29.61	13.01
3	S4 b	3	4	42	0.14	17.77	54.06	19.21	2.07	39.76	1.92	41.69	12.08
4	S4 b	4	5	42	0.14	17.27	71.33	25.34	2.00	50.59	2.53	53.13	11.44
5	S4 b	5	6	42	0.14	16.72	88.05	31.28	1.95	60.90	3.13	64.03	10.90
6	S4 b	6	7	42	0.14	16.27	104.32	37.06	1.91	70.81	3.71	74.52	10.49
7	S4 b	7	8	43.5	0.14	5.03	109.35	38.85	1.90	73.85	3.88	77.74	3.22
8	S4 b	8	9	47.5	0.14	5.96	115.30	40.96	1.89	77.45	4.10	81.54	3.80
9	S4 b	9	10	40	0.14	3.05	118.36	42.05	1.89	79.28	4.20	83.49	1.95
10	S4 b	10	11	47.4	0.14	5.11	123.47	43.86	1.88	82.35	4.39	86.74	3.25
11	S4 b	11	12	47.4	0.14	4.76	128.23	45.55	1.87	85.20	4.56	89.76	3.02
12	S4 b	12	13	37.3	0.14	3.19	131.42	46.69	1.87	87.11	4.67	91.78	2.02
13	S4 b	13	14	37.3	0.14	2.47	133.89	47.56	1.86	88.59	4.76	93.35	1.56
14	S4 b	14	15	24.4	0.14	1.34	135.23	48.04	1.86	89.39	4.80	94.19	0.85
15	S4 b	15	m	24.4	0.14	2.68	137.91	48.99	1.86	90.99	4.90	95.89	1.69

Design Assamptions and data

1) Water comnsumption is	3.2	m3/d.d which	80% return to sewer	9) Min slope Smin =	0.5	%	Chock Load
2) Peak coefficient equal	1.5+2.5/(Qavg^0.5)<3			10) Max slope Smax =	15	%	
3) Infiltration is equal	10	% of the average industrial wastewater flow.		11) Max manhole spacing =	60	m	
4) Min pipe diameter=	200	mm		12) Min depth of sewer	1.5	m	
5) Min velocity Vmin =	0.6	m/sec		13) Design depth of flow h/d<	0.5		
6) Max velocity Vmax =	4	m/sec		14) Maining coefficient n=	0.015		
7)dinsity of line=	3.02	Captal/donum		15)dinsity of line after 25 years=	10.85393183	Captal/donum	
8) water consmbtion=	60	L/s.d		16) water consmbtion after 25 years=	111.2366459	L/s.d	

Table (5) Waste Water Design Report For (Line S2 main)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	38+58	615.4	1.2	0.58	135.648	P-1	MH-1	MH-2	Circular	200 mm
MH-2	38+18	614.2	1.2	0.73	271.2961	P-2	MH-2	MH-3	Circular	200 mm
MH-3	37+78	613	1.2	0.77	406.9441	P-3	MH-3	MH-4	Circular	200 mm
MH-4	37+38	612.3	1.2	0.66	542.5922	P-4	MH-4	MH-5	Circular	200 mm
MH-5	37+98	611.7	1.2	0.94	678.2402	P-5	MH-5	MH-6	Circular	200 mm
MH-6	37+58	610.2	1.2	0.81	813.8883	P-6	MH-6	MH-7	Circular	200 mm
MH-7	37+18	609.5	1.2	0.8	949.5363	P-7	MH-7	MH-8	Circular	200 mm
MH-8	36+78	609.1	1.2	0.85	1085.184	P-8	MH-8	MH-9	Circular	200 mm
MH-9	36+38	608.65	1.2	0.9	1220.832	P-9	MH-9	MH-10	Circular	200 mm
MH-10	35+98	608.2	1.2	0.78	1356.48	P-10	MH-10	MH-11	Circular	250 mm
MH-11	35+58	607.95	1.20	0.91	1492.129	P-11	MH-11	MH-12	Circular	250 mm
MH-12	35+18	607.42	1.20	0.97	1627.777	P-12	MH-12	MH-13	Circular	250 mm
MH-13	34+78	606.7	1.20	1.22	2077.057	P-13	MH-13	MH-14	Circular	250 mm
MH-14	34+38	605.5	1.20	1.62	2526.337	P-14	MH-14	MH-15	Circular	250 mm
MH-15	33+98	603.1	1.20	1.61	2975.617	P-15	MH-15	MH-16	Circular	250 mm
MH-16	33+58	599.7	1.2	1.44	3424.897	P-16	MH-16	MH-17	Circular	250 mm
MH-17	33+18	598	1.2	1.54	3874.177	P-17	MH-17	MH-18	Circular	250 mm
MH-18	32+78	596.3	1.2	1.4	4323.458	P-18	MH-18	MH-19	Circular	300 mm
MH-19	32+38	595.2	1.2	1.14	4772.738	P-19	MH-19	MH-20	Circular	375 mm
MH-20	31+98	594.75	1.2	1.31	5222.018	P-20	MH-20	MH-21	Circular	375 mm
MH-21	31+58	594	1.2	1.63	5671.298	P-21	MH-21	MH-22	Circular	375 mm
MH-22	31+18	592.25	1.2	1.72	6120.578	P-22	MH-22	MH-23	Circular	375 mm
MH-23	30+78	590.2	1.2	1.23	6569.858	P-23	MH-23	MH-24	Circular	375 mm
MH-24	30+38	589.8	1.2	1.31	7019.138	P-24	MH-24	MH-25	Circular	375 mm
MH-25	29+98	589.2	1.2	1.52	7468.419	P-25	MH-25	MH-26	Circular	375 mm
MH-26	29+58	588.1	1.20	1.47	7917.699	P-26	MH-26	MH-27	Circular	375 mm
MH-27	29+18	587.35	1.20	1.49	8366.979	P-27	MH-27	MH-28	Circular	375 mm
MH-28	28+78	586.5	1.20	1.46	8816.259	P-28	MH-28	MH-29	Circular	375 mm
MH-29	28+38	585.8	1.20	1.56	9265.539	P-29	MH-29	MH-30	Circular	375 mm
MH-30	27+98	585	1.20	1.2	9597.315	P-30	MH-30	MH-31	Circular	375 mm
MH-31	27+58	585	1.2	1.21	9929.091	P-31	MH-31	MH-32	Circular	375 mm
MH-32	27+18	585	1.2	1.22	10260.87	P-32	MH-32	MH-33	Circular	375 mm
MH-33	26+78	585	1.2	1.23	10592.64	P-33	MH-33	MH-34	Circular	375 mm
MH-34	26+38	585	1.2	1.24	10924.42	P-34	MH-34	MH-35	Circular	375 mm
MH-35	25+98	585	1.2	1.25	11256.2	P-35	MH-35	MH-36	Circular	375 mm
MH-36	25+58	584.95	1.2	1.26	11587.97	P-36	MH-36	MH-37	Circular	375 mm
MH-37	25+18	582.93	1.2	1.27	11919.75	P-37	MH-37	MH-38	Circular	375 mm
MH-38	24+78	582.92	1.2	2.74	12251.52	P-38	MH-38	MH-39	Circular	375 mm
MH-39	24+38	580	1.2	1.5	12583.3	P-39	MH-39	MH-40	Circular	375 mm

Table (5) Waste Water Design Report For (Line S2 main) Cont'd

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-40	23+98	580	1.2	1.52	12915.08	P-40	MH-40	MH-41	Circular	375 mm
MH-41	23+58	580	1.20	1.53	13246.85	P-41	MH-41	MH-42	Circular	375 mm
MH-42	23+18	580	1.20	1.54	13578.63	P-42	MH-42	MH-43	Circular	375 mm
MH-43	22+78	580	1.20	1.55	13910.4	P-43	MH-43	MH-44	Circular	375 mm
MH-44	22+38	580	1.20	1.56	14242.18	P-44	MH-44	MH-45	Circular	375 mm
MH-45	21+98	580	1.20	1.57	14573.96	P-45	MH-45	MH-46	Circular	375 mm
MH-46	21+58	580	1.2	1.58	14905.73	P-46	MH-46	MH-47	Circular	375 mm
MH-47	21+18	580	1.2	1.59	15237.51	P-47	MH-47	MH-48	Circular	375 mm
MH-48	20+78	580	1.2	1.6	15569.29	P-48	MH-48	MH-49	Circular	375 mm
MH-49	20+38	580	1.2	1.61	15901.06	P-49	MH-49	MH-50	Circular	375 mm
MH-50	19+98	580	1.2	1.62	16232.84	P-50	MH-50	MH-51	Circular	375 mm
MH-51	19+58	579.57	1.2	1.4	16564.61	P-51	MH-51	MH-52	Circular	375 mm
MH-52	19+18	579.57	1.2	1.4	16896.39	P-52	MH-52	MH-53	Circular	375 mm
MH-53	18+78	577.1	1.2	2.68	17228.17	P-53	MH-53	MH-54	Circular	375 mm
MH-54	18+38	575	1.2	1.66	17559.94	P-54	MH-54	MH-55	Circular	375 mm
MH-55	17+98	575	1.2	1.67	17891.72	P-55	MH-55	MH-56	Circular	375 mm
MH-56	17+58	574	1.2	1.68	18223.49	P-56	MH-56	MH-57	Circular	375 mm
MH-57	17+18	574	1.2	1.69	18555.27	P-57	MH-57	MH-58	Circular	375 mm
MH-58	16+78	574	1.2	1.69	18887.05	P-58	MH-58	MH-59	Circular	375 mm
MH-59	16+38	575	1.2	1.7	19218.82	P-59	MH-59	MH-60	Circular	375 mm
MH-60	15+98	575	1.2	1.71	19550.6	P-60	MH-60	MH-61	Circular	375 mm
MH-61	15+58	575	1.2	1.72	19882.37	P-61	MH-61	MH-62	Circular	375 mm
MH-62	15+18	574.8	1.2	1.73	20214.15	P-62	MH-62	MH-63	Circular	375 mm
MH-63	14+78	573.5	1.2	1.74	20545.93	P-63	MH-63	MH-64	Circular	375 mm
MH-64	14+38	572.1	1.2	1.75	20877.7	P-64	MH-64	MH-65	Circular	375 mm
MH-65	13+98	571.6	1.2	1.75	21209.48	P-65	MH-65	MH-66	Circular	375 mm
MH-66	13+58	571.5	1.2	1.76	21541.26	P-66	MH-66	MH-67	Circular	375 mm
MH-67	13+18	571.4	1.2	1.77	21873.03	P-67	MH-67	MH-68	Circular	375 mm
MH-68	12+78	571.3	1.2	1.78	22204.81	P-68	MH-68	MH-69	Circular	375 mm
MH-69	12+38	571.5	1.2	1.79	22536.58	P-69	MH-69	MH-70	Circular	375 mm
MH-70	11+98	571.5	1.2	1.79	22868.36	P-70	MH-70	MH-71	Circular	375 mm
MH-71	11+58	571.5	1.2	1.8	23200.14	P-71	MH-71	MH-72	Circular	375 mm
MH-72	11+18	571.4	1.2	1.81	23531.91	P-72	MH-72	MH-73	Circular	375 mm
MH-73	10+78	571.3	1.2	1.82	23863.69	P-73	MH-73	MH-74	Circular	375 mm
MH-74	10+38	571.5	1.2	1.82	24195.46	P-74	MH-74	MH-75	Circular	375 mm
MH-75	9+98	571.4	1.2	1.83	24527.24	P-75	MH-75	MH-76	Circular	375 mm
MH-76	9+58	571	1.2	1.53	24859.02	P-76	MH-76	MH-77	Circular	375 mm
MH-77	9+18	571.2	1.2	1.55	25190.79	P-77	MH-77	MH-78	Circular	375 mm
MH-78	8+78	571.4	1.2	1.56	25522.57	P-78	MH-78	MH-79	Circular	375 mm

Table (5) Waste Water Design Report For (Line S2 main) Cont'd

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-79	8+38	570.6	1.2	1.58	25854.35	P-79	MH-79	MH-80	Circular	375 mm
MH-80	7+98	569.5	1.2	1.73	26186.12	P-80	MH-80	MH-81	Circular	375 mm
MH-81	7+58	566.9	1.2	2.45	26517.9	P-81	MH-81	MH-82	Circular	375 mm
MH-82	7+18	565	1.2	2.19	26849.67	P-82	MH-82	MH-83	Circular	375 mm
MH-83	6+79	563.9	1.2	2.81	27181.45	P-83	MH-83	MH-84	Circular	375 mm
MH-84	6+40	560.6	1.2	1.88	27513.23	P-84	MH-84	MH-85	Circular	375 mm
MH-85	6+01	560	1.2	2.24	27845	P-85	MH-85	MH-86	Circular	375 mm
MH-86	5+60	558.9	1.2	2.65	28176.78	P-86	MH-86	MH-87	Circular	375 mm
MH-87	5+18	556.8	1.2	2.3	28508.55	P-87	MH-87	MH-88	Circular	375 mm
MH-88	4+76	555.55	1.2	2.09	28840.33	P-88	MH-88	MH-89	Circular	375 mm
MH-89	4+34	554.77	1.2	1.88	29172.11	P-89	MH-89	MH-90	Circular	375 mm
MH-90	3+92	554.3	1.2	2.02	29503.88	P-90	MH-90	MH-91	Circular	375 mm
MH-91	3+50	553.8	1.2	1.7	29835.66	P-91	MH-91	MH-92	Circular	375 mm
MH-92	3+07	553.6	1.2	1.69	30167.43	P-92	MH-92	MH-93	Circular	375 mm
MH-93	2+59	553.4	1.2	2.32	30499.21	P-93	MH-93	MH-94	Circular	375 mm
MH-94	2+19	551.98	1.2	2.32	30830.99	P-94	MH-94	MH-95	Circular	375 mm
MH-95	1+72	550.83	1.2	2.1	31162.76	P-95	MH-95	MH-96	Circular	375 mm
MH-96	1+24	550.05	1.2	1.73	31494.54	P-96	MH-96	MH-97	Circular	375 mm
MH-97	0+87	550.4	1.2	1.74	31826.32	P-97	MH-97	MH-98	Circular	375 mm
MH-98	0+49	550.8	1.2	1.75	32158.09	P-98	MH-98	MH-99	Circular	375 mm
MH-99	0+25	550.3	1.2	1.75	32489.87	P-99	MH-99	MH-100	Circular	375 mm
MH-100	0+1	550	1.2	1.76	32821.64	P-100	MH-100	O-1	Circular	375 mm

Table (6) Waste Water Design Report For (Line S2 b)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/d	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	9+58	622.15	1.2	0.43	18.144006	P-1	MH-1	MH-2	Circular	200 mm
MH-2	9+18	620.26	1.2	0.59	36.288013	P-2	MH-2	MH-3	Circular	200 mm
MH-3	8+78	615.41	1.2	0.57	54.432019	P-3	MH-3	MH-4	Circular	200 mm
MH-4	8+38	612.87	1.2	0.57	72.576026	P-4	MH-4	MH-5	Circular	200 mm
MH-5	7+98	610.99	1.2	0.58	90.720032	P-5	MH-5	MH-6	Circular	200 mm
MH-6	7+58	609.58	1.2	0.43	108.86404	P-6	MH-6	MH-7	Circular	200 mm
MH-7	7+18	609.98	1.2	0.45	127.00804	P-7	MH-7	MH-8	Circular	200 mm
MH-8	6+79	609.22	1.2	0.46	145.15205	P-8	MH-8	MH-9	Circular	200 mm
MH-9	6+40	609.4	1.2	0.47	163.29606	P-9	MH-9	MH-10	Circular	200 mm
MH-10	6+01	610	1.2	0.5	181.44006	P-10	MH-10	MH-11	Circular	200 mm
MH-11	5+60	610	1.2	0.51	199.58407	P-11	MH-11	MH-12	Circular	200 mm
MH-12	5+18	610	1.2	0.52	217.72808	P-12	MH-12	MH-13	Circular	200 mm
MH-13	4+76	609.56	1.2	0.7	235.87	P-13	MH-13	MH-14	Circular	200 mm
MH-14	4+34	607.03	1.2	0.84	254.02	P-14	MH-14	MH-15	Circular	200 mm
MH-15	3+92	605	1.2	0.53	272.16	P-15	MH-15	MH-16	Circular	200 mm
MH-16	3+50	605	1.2	0.54	291.17	P-16	MH-16	MH-17	Circular	200 mm
MH-17	3+07	604.55	1.2	0.98	310.18	P-17	MH-17	MH-18	Circular	200 mm
MH-18	2+59	601.38	1.2	0.82	329.18	P-18	MH-18	MH-19	Circular	200 mm
MH-19	2+19	600.09	1.2	0.7	348.19	P-19	MH-19	MH-20	Circular	200 mm
MH-20	1+72	599.46	1.2	0.89	367.20	P-20	MH-20	MH-21	Circular	200 mm
MH-21	1+24	597.47	1.2	0.85	386.21	P-21	MH-21	MH-22	Circular	200 mm
MH-22	0+87	596.41	1.2	0.58	405.22	P-22	MH-22	MH-23	Circular	200 mm
MH-23	0+49	597.12	1.2	0.58	424.22	P-23	MH-23	MH-24	Circular	200 mm
MH-24	0+25	597.85	1.2	0.59	443.23	P-24	MH-24	MH-25	Circular	200 mm
MH-25	0+1	596.78	1.2	0.6	462.24	P-25	MH-25	0-1	Circular	200 mm

Table (7) Waste Water Design Report For (Line S2 c)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/d	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	5+60	618.14	1.2	0.81	158.1121	P-1	MH-1	MH-2	Circular	200 mm
MH-2	5+18	616.6	1.2	1.03	316.2241	P-2	MH-2	MH-3	Circular	200 mm
MH-3	4+76	613.1	1.2	1.19	474.3362	P-3	MH-3	MH-4	Circular	200 mm
MH-4	4+34	609.02	1.2	1.26	632.4482	P-4	MH-4	MH-5	Circular	200 mm
MH-5	3+92	605.69	1.2	1.32	790.5603	P-5	MH-5	MH-6	Circular	200 mm
MH-6	3+50	602.59	1.2	1.33	948.6723	P-6	MH-6	MH-7	Circular	200 mm
MH-7	3+07	599.95	1.2	1.43	1106.784	P-7	MH-7	MH-8	Circular	200 mm
MH-8	2+59	596.85	1.2	1.31	1264.896	P-8	MH-8	MH-9	Circular	200 mm
MH-9	2+19	595	1.2	1.5	1423.009	P-9	MH-9	MH-10	Circular	200 mm
MH-10	1+72	592.4	1.2	1.58	1581.121	P-10	MH-10	MH-11	Circular	200 mm
MH-11	1+24	589.4	1.2	1.83	1739.233	P-11	MH-11	MH-12	Circular	200 mm
MH-12	0+87	582.54	1.2	1.88	1897.345	P-12	MH-12	MH-13	Circular	200 mm
MH-13	0+49	575.31	1.2	1.93	2,055.46	P-13	MH-13	MH-14	Circular	200 mm
MH-14	0+25	570.19	1.2	1.94	2,213.57	P-14	MH-14	MH-15	Circular	200 mm
MH-15	0+1	566.01	1.2	1.06	2,371.68	P-15	MH-15	0-1	Circular	250 mm

Table (8) Waste Water Design Report For (Line S2 d)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/d	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	8+78	581.86	1.2	0.28	15.20641	P-1	MH-1	MH-2	Circular	200 mm
MH-2	8+38	581.35	1.2	0.31	30.41281	P-2	MH-2	MH-3	Circular	200 mm
MH-3	7+98	581.2	1.2	0.35	45.61922	P-3	MH-3	MH-4	Circular	200 mm
MH-4	7+58	580.89	1.2	0.36	60.82562	P-4	MH-4	MH-5	Circular	200 mm
MH-5	7+18	580.84	1.2	0.43	76.03203	P-5	MH-5	MH-6	Circular	200 mm
MH-6	6+79	579.88	1.2	0.55	91.23843	P-6	MH-6	MH-7	Circular	200 mm
MH-7	6+40	578.77	1.2	0.6	106.4448	P-7	MH-7	MH-8	Circular	200 mm
MH-8	6+01	577.29	1.2	0.69	121.6512	P-8	MH-8	MH-9	Circular	200 mm
MH-9	5+60	575.14	1.2	0.51	136.8576	P-9	MH-9	MH-10	Circular	200 mm
MH-10	5+18	574.68	1.2	0.79	152.0641	P-10	MH-10	MH-11	Circular	200 mm
MH-11	4+76	571.9	1.2	0.74	167.2705	P-11	MH-11	MH-12	Circular	200 mm
MH-12	4+34	570	1.2	0.5	182.4769	P-12	MH-12	MH-13	Circular	200 mm
MH-13	3+92	570	1.2	0.52	197.68	P-13	MH-13	MH-14	Circular	200 mm
MH-14	3+50	570	1.2	0.53	212.89	P-14	MH-14	MH-15	Circular	200 mm
MH-15	3+07	570	1.2	0.77	267.32	P-15	MH-15	MH-16	Circular	200 mm
MH-16	2+59	567.73	1.2	0.96	321.75	P-16	MH-16	MH-17	Circular	200 mm
MH-17	2+19	565	1.2	0.97	376.19	P-17	MH-17	MH-18	Circular	200 mm
MH-18	1+72	562.85	1.2	1.04	430.62	P-18	MH-18	MH-19	Circular	200 mm
MH-19	1+24	560.17	1.2	0.9	485.05	P-19	MH-19	MH-20	Circular	200 mm
MH-20	0+87	558.99	1.2	1.01	539.48	P-20	MH-20	MH-21	Circular	200 mm
MH-21	0+49	557.29	1.2	1.03	593.91	P-21	MH-21	MH-22	Circular	200 mm
MH-22	0+25	555.64	1.2	0.91	648.35	P-22	MH-22	MH-23	Circular	200 mm
MH-23	0+1	554.75	1.2	1.13	702.78	P-23	MH-23	0-1	Circular	200 mm

Table (9) Waste Water Design Report For (Line S3)

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Manhole	Downstream Manhole	Section Shape	Section Size (mm)
MH-1	821	36+83	1.2	0.18	3.43708	P-1	MH-1	MH-2	Circular	200 mm
MH-2	816	36+43	1.2	0.22	6.9757	P-2	MH-2	MH-3	Circular	200 mm
MH-3	811	36+03	1.2	0.24	10.10391	P-3	MH-3	MH-4	Circular	200 mm
MH-4	806.18	35+63	1.2	0.26	12.78606	P-4	MH-4	MH-5	Circular	200 mm
MH-5	800	35+23	1.2	0.27	15.81614	P-5	MH-5	MH-6	Circular	200 mm
MH-6	793.51	34+77	1.2	0.28	18.21334	P-6	MH-6	MH-7	Circular	200 mm
MH-7	787.83	34+43	1.2	0.29	21.00372	P-7	MH-7	MH-8	Circular	200 mm
MH-8	783.67	34+03	1.2	0.3	23.8045	P-8	MH-8	MH-9	Circular	200 mm
MH-9	781.27	33+63	1.2	0.31	25.72431	P-9	MH-9	MH-10	Circular	200 mm
MH-10	781	33+36	1.2	0.31	26.44399	P-10	MH-10	MH-11	Circular	200 mm
MH-11	779.71	33+23	1.2	0.31	28.71698	P-11	MH-11	MH-12	Circular	200 mm
MH-12	772.72	32+83	1.2	0.32	30.90996	P-12	MH-12	MH-13	Circular	200 mm
MH-13	765.15	32+43	1.2	0.32	32.82935	P-13	MH-13	MH-14	Circular	200 mm
MH-14	760	32+07	1.2	0.33	34.64605	P-14	MH-14	MH-15	Circular	200 mm
MH-15	752.57	31+63	1.2	0.33	36.26608	P-15	MH-15	MH-16	Circular	200 mm
MH-16	752.57	31+23	1.2	0.34	37.00396	P-16	MH-16	MH-17	Circular	200 mm
MH-17	752.57	31+05	1.2	0.34	38.29296	P-17	MH-17	MH-18	Circular	200 mm
MH-18	752.57	30+83	1.2	0.34	40.65055	P-18	MH-18	MH-19	Circular	200 mm
MH-19	752.57	30+43	1.2	0.35	42.98585	P-19	MH-19	MH-20	Circular	200 mm
MH-20	752.57	30+03	1.2	0.35	45.3448	P-20	MH-20	MH-21	Circular	200 mm
MH-21	752.57	29+62	1.2	0.36	47.57657	P-21	MH-21	MH-22	Circular	200 mm
MH-22	752.3	29+23	1.2	0.36	49.78848	P-22	MH-22	MH-23	Circular	200 mm
MH-23	749.63	28+83	1.2	0.37	52.43841	P-23	MH-23	MH-24	Circular	200 mm
MH-24	747.71	28+34	1.2	0.37	54.21733	P-24	MH-24	MH-25	Circular	200 mm
MH-25	747.01	28+03	1.2	0.37	55.65012	P-25	MH-25	MH-26	Circular	200 mm
MH-26	747	27+77	1.2	0.37	56.67992	P-26	MH-26	MH-27	Circular	200 mm
MH-27	745.46	27+52	1.2	0.38	58.21455	P-27	MH-27	MH-28	Circular	200 mm
MH-28	743.54	27+23	1.2	0.38	59.83251	P-28	MH-28	MH-29	Circular	200 mm
MH-29	741.4	26+98	1.2	0.38	60.59098	P-29	MH-29	MH-30	Circular	200 mm
MH-30	740.17	26+79	1.2	0.38	61.41117	P-30	MH-30	MH-31	Circular	200 mm
MH-31	737.15	26+59	1.2	0.38	62.3166	P-31	MH-31	MH-32	Circular	200 mm
MH-32	734.04	26+22	1.2	0.38	63.25972	P-32	MH-32	MH-33	Circular	200 mm
MH-33	731.18	25+94	1.2	0.39	65.59033	P-33	MH-33	MH-34	Circular	200 mm
MH-34	722.86	25+56	1.2	0.39	67.88806	P-34	MH-34	MH-35	Circular	200 mm
MH-35	714.1	25+16	1.2	0.4	70.71344	P-35	MH-35	MH-36	Circular	200 mm
MH-36	705.7	24+68	1.2	0.4	72.62746	P-36	MH-36	MH-37	Circular	200 mm
MH-37	699.86	24+36	1.2	0.4	75.05917	P-37	MH-37	MH-38	Circular	200 mm
MH-38	692.01	23+96	1.2	0.41	77.52032	P-38	MH-38	MH-39	Circular	200 mm
MH-39	682.95	23+56	1.2	0.41	80.61664	P-39	MH-39	MH-40	Circular	200 mm

Table (9) Waste Water Design Report For (Line S3) Con'd

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Manhole	Downstream Manhole	Section Shape	Section Size (mm)
MH-40	674.71	23+06	1.2	0.41	82.39897	P-40	MH-40	MH-41	Circular	200 mm
MH-41	668.37	22+76	1.2	0.42	84.78406	P-41	MH-41	MH-42	Circular	200 mm
MH-42	661.39	22+36	1.2	0.42	87.19568	P-42	MH-42	MH-43	Circular	200 mm
MH-43	653.41	21+96	1.2	0.42	89.63389	P-43	MH-43	MH-44	Circular	200 mm
MH-44	646.44	21+56	1.2	0.43	92.27263	P-44	MH-44	MH-45	Circular	200 mm
MH-45	640.39	21+13	1.2	0.43	94.70433	P-45	MH-45	MH-46	Circular	200 mm
MH-46	634.57	20+76	1.2	0.43	97.35204	P-46	MH-46	MH-47	Circular	200 mm
MH-47	631.27	20+36	1.2	0.43	100.0285	P-47	MH-47	MH-48	Circular	200 mm
MH-48	626.54	19+96	1.2	0.44	103.2523	P-48	MH-48	MH-49	Circular	200 mm
MH-49	619.93	19+49	1.2	0.44	105.3664	P-49	MH-49	MH-50	Circular	200 mm
MH-50	615.61	19+17	1.2	0.44	107.9847	P-50	MH-50	MH-51	Circular	200 mm
MH-51	608.43	18+77	1.2	0.44	110.5913	P-51	MH-51	MH-52	Circular	200 mm
MH-52	599.93	18+37	1.2	0.45	113.1852	P-52	MH-52	MH-53	Circular	200 mm
MH-53	593.97	17+97	1.2	0.45	115.2304	P-53	MH-53	MH-54	Circular	200 mm
MH-54	590.21	17+65	1.2	0.45	117.0469	P-54	MH-54	MH-55	Circular	200 mm
MH-55	584.08	17+17	1.2	0.45	118.5704	P-55	MH-55	MH-56	Circular	200 mm
MH-56	579.43	16+77	1.2	0.45	119.426	P-56	MH-56	MH-57	Circular	200 mm
MH-57	574.36	16+37	1.2	0.45	120.3496	P-57	MH-57	MH-58	Circular	200 mm
MH-58	568.28	15+97	1.2	0.45	121.2716	P-58	MH-58	MH-59	Circular	200 mm
MH-59	561.9	15+57	1.2	0.46	122.1742	P-59	MH-59	MH-60	Circular	200 mm
MH-60	555.77	15+18	1.2	0.46	124.0718	P-60	MH-60	MH-61	Circular	200 mm
MH-61	552.99	14+77	1.2	0.46	125.3456	P-61	MH-61	MH-62	Circular	200 mm
MH-62	551.47	14+49	1.2	0.46	126.4645	P-62	MH-62	MH-63	Circular	200 mm
MH-63	550.13	14+25	1.2	0.46	128.1138	P-63	MH-63	MH-64	Circular	200 mm
MH-64	547.96	13+97	1.2	0.46	130.4324	P-64	MH-64	MH-65	Circular	200 mm
MH-65	546.43	13+57	1.2	0.47	132.7456	P-65	MH-65	MH-66	Circular	200 mm
MH-66	545.58	13+16	1.2	0.47	135.5434	P-66	MH-66	MH-67	Circular	200 mm
MH-67	545.58	12+76	1.2	0.47	136.6523	P-67	MH-67	MH-68	Circular	200 mm
MH-68	540.27	12+60	1.2	0.47	138.3708	P-68	MH-68	MH-69	Circular	200 mm
MH-69	538.84	12+36	1.2	0.47	141.2324	P-69	MH-69	MH-70	Circular	200 mm
MH-70	536.76	11+96	1.2	0.48	144.0261	P-70	MH-70	MH-71	Circular	200 mm
MH-71	534.84	11+57	1.2	0.48	146.7912	P-71	MH-71	MH-72	Circular	200 mm
MH-72	533.05	11+16	1.2	0.48	149.4922	P-72	MH-72	MH-73	Circular	200 mm
MH-73	531.31	10+77	1.2	0.48	152.2054	P-73	MH-73	MH-74	Circular	200 mm
MH-74	529.55	10+37	1.2	0.48	154.1114	P-74	MH-74	MH-75	Circular	200 mm
MH-75	529.01	10+09	1.2	0.49	154.8631	P-75	MH-75	MH-76	Circular	200 mm
MH-76	528.33	9+97	1.2	0.49	157.3614	P-76	MH-76	MH-77	Circular	200 mm
MH-77	526.64	9+57	1.2	0.49	160.4321	P-77	MH-77	MH-78	Circular	200 mm
MH-78	523.53	9+08	1.2	0.49	162.6735	P-78	MH-78	MH-79	Circular	200 mm

Table (9) Waste Water Design Report For (Line S3) Con'd

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Manhole	Downstream Manhole	Section Shape	Section Size (mm)
MH-79	523	8+77	1.2	0.4	164.7611	P-79	MH-79	MH-80	Circular	200 mm
MH-80	523	8+48	1.2	0.49	165.4031	P-80	MH-80	MH-81	Circular	200 mm
MH-81	522.31	8+37	1.2	0.5	167.7102	P-81	MH-81	MH-82	Circular	200 mm
MH-82	520.54	7+97	1.2	0.5	170.0266	P-82	MH-82	MH-83	Circular	200 mm
MH-83	518.99	7+57	1.2	0.5	171.4541	P-83	MH-83	MH-84	Circular	200 mm
MH-84	517.16	7+32	1.2	0.5	172.5176	P-84	MH-84	MH-85	Circular	200 mm
MH-85	516.46	7+17	1.2	0.5	175.2832	P-85	MH-85	MH-86	Circular	200 mm
MH-86	515.22	6+77	1.2	0.5	176.4719	P-86	MH-86	MH-87	Circular	200 mm
MH-87	513.81	6+60	1.2	0.5	178.542	P-87	MH-87	MH-88	Circular	200 mm
MH-88	513	6+27	1.2	0.51	181.9257	P-88	MH-88	MH-89	Circular	200 mm
MH-89	509.82	5+78	1.2	0.51	183.8015	P-89	MH-89	MH-90	Circular	200 mm
MH-90	507.63	5+45	1.2	0.91	1,326.87	P-90	MH-90	MH-91	Circular	200 mm
MH-91	505	5+17	1.2	0.91	1,332.00	P-91	MH-91	MH-92	Circular	200 mm
MH-92	501.39	4+77	1.2	0.71	1,336.62	P-92	MH-92	MH-93	Circular	200 mm
MH-93	501.39	4+37	1.2	0.71	1,341.23	P-93	MH-93	MH-94	Circular	200 mm
MH-94	501.39	3+97	1.2	0.71	1,344.36	P-94	MH-94	MH-95	Circular	200 mm
MH-95	501.39	3+70	1.2	0.71	1,346.31	P-95	MH-95	MH-96	Circular	200 mm
MH-96	501.39	3+57	1.2	0.91	1,352.40	P-96	MH-96	MH-97	Circular	200 mm
MH-97	499.36	3+17	1.2	0.91	1,358.46	P-97	MH-97	MH-98	Circular	200 mm
MH-98	496.32	2+77	1.2	0.91	1,364.49	P-98	MH-98	MH-99	Circular	200 mm
MH-99	494.14	2+37	1.2	0.92	1,370.50	P-99	MH-99	MH-100	Circular	200 mm
MH-100	491.12	1+97	1.2	0.92	1,373.22	P-100	MH-100	MH-101	Circular	200 mm
MH-101	489.85	1+79	1.2	0.92	1,376.50	P-101	MH-101	MH-102	Circular	200 mm
MH-102	489.09	1+57	1.2	0.92	1,382.49	P-102	MH-102	MH-103	Circular	200 mm
MH-103	487.69	1+17	1.2	0.92	1,388.45	P-103	MH-103	MH-104	Circular	200 mm
MH-104	486.28	0+77	1.2	0.92	1,392.04	P-104	MH-104	MH-105	Circular	200 mm
MH-105	485.44	0+53	1.2	0.71	1,393.30	P-105	MH-105	MH-106	Circular	200 mm
MH-106	485.44	0+37	1.2	0.92	1,396.17	P-106	MH-106	O-1	Circular	200 mm
O-1	485	0	1.2	0	1,396.17					

Table (10) Waste Water Design Report For (Line S3)

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Manhole	Downstream Manhole	Section Shape	Section Size (mm)
MH-1	624.06	11+50	1.2	0.23	8.32566	P-1	MH-1	MH-2	Circular	200 mm
MH-2	622.37	11+10	1.2	0.28	17.42217	P-2	MH-2	MH-3	Circular	200 mm
MH-3	620.55	10+95	1.2	0.3	24.47568	P-3	MH-3	MH-4	Circular	200 mm
MH-4	617.86	10+52	1.2	0.32	31.6329	P-4	MH-4	MH-5	Circular	200 mm
MH-5	611.86	10+12	1.2	0.34	38.96549	P-5	MH-5	MH-6	Circular	200 mm
MH-6	603	9+72	1.2	0.35	42.49174	P-6	MH-6	MH-7	Circular	200 mm
MH-7	594.74	9+32	1.2	0.35	43.81674	P-7	MH-7	MH-8	Circular	200 mm
MH-8	589.41	9+13	1.2	0.37	51.99067	P-8	MH-8	MH-9	Circular	200 mm
MH-9	585.84	8+92	1.2	0.38	59.03312	P-9	MH-9	MH-10	Circular	200 mm
MH-10	579.94	8+50	1.2	0.39	66.15086	P-10	MH-10	MH-11	Circular	200 mm
MH-11	578.07	8+12	1.2	0.4	72.99267	P-11	MH-11	MH-12	Circular	200 mm
MH-12	572.08	7+72	1.2	0.41	79.57041	P-12	MH-12	MH-13	Circular	200 mm
MH-13	565.08	7+32	1.2	0.41	85.89289	P-13	MH-13	MH-14	Circular	200 mm
MH-14	560.86	6+92	1.2	0.43	91.96691	P-14	MH-14	MH-15	Circular	200 mm
MH-15	556.96	6+52	1.2	0.43	95.41485	P-15	MH-15	MH-16	Circular	200 mm
MH-16	552.48	6+12	1.2	0.43	97.57732	P-16	MH-16	MH-17	Circular	200 mm
MH-17	549.52	5+89	1.2	0.44	102.5984	P-17	MH-17	MH-18	Circular	200 mm
MH-18	547.85	5+72	1.2	0.44	107.3431	P-18	MH-18	MH-19	Circular	200 mm
MH-19	546.25	5+32	1.2	0.47	135.6064	P-19	MH-19	MH-20	Circular	200 mm
MH-20	544.2	4+92	1.2	0.48	149.1988	P-20	MH-20	MH-21	Circular	200 mm
MH-21	539.35	4+65	1.2	0.48	153.5591	P-21	MH-21	MH-22	Circular	200 mm
MH-22	536.63	4+52	1.2	0.49	157.871	P-22	MH-22	MH-23	Circular	200 mm
MH-23	530.29	4+04	1.2	0.49	162.1779	P-23	MH-23	MH-24	Circular	200 mm
MH-24	527.69	3+72	1.2	0.49	164.3854	P-24	MH-24	MH-25	Circular	200 mm
MH-25	526.2	3+52	1.2	0.82	986.884	P-25	MH-25	MH-26	Circular	200 mm
MH-26	521.87	3+13	1.2	0.82	988.5266	P-26	MH-26	MH-27	Circular	200 mm
MH-27	519.15	2+75	1.2	0.82	989.3476	P-27	MH-27	MH-28	Circular	200 mm
MH-28	517.69	2+52	1.2	0.82	990.6197	P-28	MH-28	MH-29	Circular	200 mm
MH-29	516.73	2+12	1.2	0.82	991.6465	P-29	MH-29	MH-30	Circular	200 mm
MH-30	512.76	1+72	1.2	0.82	992.1706	P-30	MH-30	MH-31	Circular	200 mm
MH-31	509.89	1+47	1.2	0.82	992.3939	P-31	MH-31	MH-32	Circular	200 mm
MH-32	509.32	1+32	1.2	0.82	992.8792	P-32	MH-32	MH-33	Circular	200 mm
MH-33	508.61	0+92	1.2	0.82	993.2185	P-33	MH-33	MH-34	Circular	200 mm
MH-34	507.64	0+47	1.2	0.66	993.3344	P-34	MH-34	O-1	Circular	200 mm
O-1	507.63	0	1.2	0	993.3344					

Table (11) Waste Water Design Report For (Line S3)

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Manhole	Downstream Manhole	Section Shape	Section Size (mm)
MH-1	581.62	4+93	1.2	0.58	294.8221	P-1	MH-1	MH-2	Circular	200 mm
MH-2	580.16	4+53	1.2	0.6	339.4025	P-2	MH-2	MH-3	Circular	200 mm
MH-3	576.66	4+13	1.2	0.62	387.9901	P-3	MH-3	MH-4	Circular	200 mm
MH-4	572.61	3+73	1.2	0.65	441.0964	P-4	MH-4	MH-5	Circular	200 mm
MH-5	568.26	3+33	1.2	0.67	494.0451	P-5	MH-5	MH-6	Circular	200 mm
MH-6	563.73	2+93	1.2	0.69	547.6379	P-6	MH-6	MH-7	Circular	200 mm
MH-7	558.95	2+53	1.2	0.71	600.8571	P-7	MH-7	MH-8	Circular	200 mm
MH-8	553.48	2+13	1.2	0.72	648.8242	P-8	MH-8	MH-9	Circular	200 mm
MH-9	547.35	1+73	1.2	0.74	694.4038	P-9	MH-9	MH-10	Circular	200 mm
MH-10	542.67	1+33	1.2	0.75	737.3549	P-10	MH-10	MH-11	Circular	200 mm
MH-11	537.24	0+93	1.2	0.76	777.691	P-11	MH-11	MH-12	Circular	200 mm
MH-12	531.78	0+53	1.2	0.77	811.3177	P-12	MH-12	MH-13	Circular	200 mm
MH-13	527.32	0+13	1.2	0.78	821.3239	P-13	MH-13	O-1	Circular	200 mm
O-1	526.2	0	1.2	0	821.3239					

Table (12) Waste Water Design Report For (Line S4 -main-)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	19+93	627	1.2	0.3	28.58	P-1	MH-1	MH-2	Circular	250 mm
MH-2	19+53	626.5	1.2	0.35	52.36	P-2	MH-2	MH-3	Circular	250 mm
MH-3	19+13	625	1.2	0.39	75.27	P-3	MH-3	MH-4	Circular	250 mm
MH-4	18+73	615	1.2	0.42	97.74	P-4	MH-4	MH-5	Circular	250 mm
MH-5	18+41	610	1.2	0.45	129.24	P-5	MH-5	MH-6	Circular	250 mm
MH-6	17+93	606.4	1.2	0.47	154.57	P-6	MH-6	MH-7	Circular	250 mm
MH-7	17+53	605	1.2	0.49	183.22	P-7	MH-7	MH-8	Circular	250 mm
MH-8	17+07	600	1.2	0.5	199.25	P-8	MH-8	MH-9	Circular	250 mm
MH-9	16+73	595.5	1.2	0.51	214.33	P-9	MH-9	MH-10	Circular	250 mm
MH-10	16+41	594.5	1.2	0.53	242.42	P-10	MH-10	MH-11	Circular	250 mm
MH-11	15+93	590	1.20	0.54	265.51	P-11	MH-11	MH-12	Circular	250 mm
MH-12	15+53	590	1.20	0.55	288.26	P-12	MH-12	MH-13	Circular	250 mm
MH-13	15+13	585	1.20	0.56	310.67	P-13	MH-13	MH-14	Circular	250 mm
MH-14	14+73	585	1.20	0.57	332.77	P-14	MH-14	MH-15	Circular	250 mm
MH-15	14+33	580	1.20	0.58	339.98	P-15	MH-15	MH-16	Circular	250 mm
MH-16	14+20	580	1.20	0.59	362.02	P-16	MH-16	MH-17	Circular	250 mm
MH-17	13+93	575.5	1.20	0.6	381.11	P-17	MH-17	MH-18	Circular	250 mm
MH-18	13+53	575	1.20	0.6	396.84	P-18	MH-18	MH-19	Circular	250 mm
MH-19	13+20	575	1.20	0.61	416.87	P-19	MH-19	MH-20	Circular	250 mm
MH-20	12+73	570	1.20	0.62	435.65	P-20	MH-20	MH-21	Circular	250 mm
MH-21	12+28	565	1.20	0.62	449.3	P-21	MH-21	MH-22	Circular	250 mm
MH-22	11+95	565	1.20	0.63	476.39	P-22	MH-22	MH-23	Circular	250 mm
MH-23	11+38	560	1.20	0.64	497.11	P-23	MH-23	MH-24	Circular	250 mm
MH-24	10+93	560	1.20	0.65	517.26	P-24	MH-24	MH-25	Circular	250 mm
MH-25	10+48	555	1.20	0.66	540.46	P-25	MH-25	MH-26	Circular	250 mm
MH-26	9+94	550	1.20	0.66	556.16	P-26	MH-26	MH-27	Circular	250 mm
MH-27	9+57	550	1.20	0.67	571.13	P-27	MH-27	MH-28	Circular	250 mm
MH-28	9+19	550	1.20	0.67	579.48	P-28	MH-28	MH-29	Circular	250 mm
MH-29	8+97	545	1.20	0.67	588.57	P-29	MH-29	MH-30	Circular	250 mm
MH-30	8+76	545	1.20	0.67	599.54	P-30	MH-30	MH-31	Circular	250 mm

Table (12) Waste Water Design Report For (Line S4 -main-) Con'd

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-31	8+46	545	1.20	0.68	611.28	P-31	MH-31	MH-32	Circular	250 mm
MH-32	8+12	545	1.20	0.68	625.11	P-32	MH-32	MH-33	Circular	250 mm
MH-33	7+68	544.3	1.20	0.68	631.87	P-33	MH-33	MH-34	Circular	250 mm
MH-34	7+45	544	1.20	0.69	640.8	P-34	MH-34	MH-35	Circular	250 mm
MH-35	7+14	543	1.20	0.69	646.63	P-35	MH-35	MH-36	Circular	250 mm
MH-36	6+79	542.5	1.20	0.69	650.26	P-36	MH-36	MH-37	Circular	250 mm
MH-37	6+44	542.9	1.20	0.69	659.25	P-37	MH-37	MH-38	Circular	250 mm
MH-38	6+08	543	1.20	0.69	665.69	P-38	MH-38	MH-39	Circular	250 mm
MH-39	5+77	542.5	1.20	0.7	673.7	P-39	MH-39	MH-40	Circular	250 mm
MH-40	5+41	540	1.20	0.7	682.52	P-40	MH-40	MH-41	Circular	250 mm
MH-41	4+98	536.5	1.20	0.7	688.93	P-41	MH-41	MH-42	Circular	250 mm
MH-42	4+63	536.5	1.20	0.7	695.92	P-42	MH-42	MH-43	Circular	250 mm
MH-43	4+22	527.2	1.20	0.78	997.78	P-43	MH-43	MH-44	Circular	250 mm
MH-44	3+73	517.5	1.20	0.78	1011.5	P-44	MH-44	MH-45	Circular	250 mm
MH-45	3+41	515	1.20	0.79	1025.71	P-45	MH-45	MH-46	Circular	250 mm
MH-46	3+00	515	1.20	0.79	1040.66	P-46	MH-46	MH-47	Circular	250 mm
MH-47	2+61	515	1.20	0.79	1055.61	P-47	MH-47	MH-48	Circular	250 mm
MH-48	2+19	513.5	1.20	0.79	1067.48	P-48	MH-48	MH-49	Circular	250 mm
MH-49	1+79	514.1	1.20	0.8	1080.48	P-49	MH-49	MH-50	Circular	250 mm
MH-50	1+46	512.6	1.20	0.8	1097.3	P-50	MH-50	MH-51	Circular	250 mm
MH-51	1+11	510	1.20	0.8	1108.56	P-51	MH-51	MH-52	Circular	250 mm
MH-52	0+67	503	1.20	0.81	1123.47	P-52	MH-52	MH-53	Circular	250 mm
MH-53	0+38	500	1.20	0.81	1138.37	P-53	MH-53	O-1	Circular	250 mm
O-1	O-1	500		0	1,138.37					

Table (13) Waste Water Design Report For (Line S4 a)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	10+90	616.2	1.2	0.2	5	P-1	MH-1	MH-2	Circular	250 mm
MH-2	10+50	611.5	1.2	0.24	10	P-2	MH-2	MH-3	Circular	250 mm
MH-3	10+28	608.1	1.2	0.27	19.2	P-3	MH-3	MH-4	Circular	250 mm
MH-4	10+10	605.9	1.2	0.32	33.56	P-4	MH-4	MH-5	Circular	250 mm
MH-5	9+70	601.3	1.2	0.34	47.42	P-5	MH-5	MH-6	Circular	250 mm
MH-6	9+30	595	1.2	0.37	61.33	P-6	MH-6	MH-7	Circular	250 mm
MH-7	8+90	590	1.2	0.38	65.83	P-7	MH-7	MH-8	Circular	250 mm
MH-8	8+77	588.3	1.2	0.4	80.71	P-8	MH-8	MH-9	Circular	250 mm
MH-9	8+38	585	1.2	0.41	95.37	P-9	MH-9	MH-10	Circular	250 mm
MH-10	7+99	580	1.2	0.42	105.95	P-10	MH-10	MH-11	Circular	250 mm
MH-11	7+70	580	1.20	0.44	120.41	P-11	MH-11	MH-12	Circular	250 mm
MH-12	7+30	570.9	1.20	0.45	134.62	P-12	MH-12	MH-13	Circular	250 mm
MH-13	6+90	566.8	1.20	0.46	139.3	P-13	MH-13	MH-14	Circular	250 mm
MH-14	6+76	565	1.20	0.46	148.68	P-14	MH-14	MH-15	Circular	250 mm
MH-15	6+50	562.7	1.20	0.48	163.46	P-15	MH-15	MH-16	Circular	250 mm
MH-16	6+07	557	1.20	0.49	175.64	P-16	MH-16	MH-17	Circular	250 mm
MH-17	5+70	552.5	1.20	0.49	182.6	P-17	MH-17	MH-18	Circular	250 mm
MH-18	5+48	550	1.20	0.49	185.58	P-18	MH-18	MH-19	Circular	250 mm
MH-19	5+17	548	1.20	0.5	194.52	P-19	MH-19	MH-20	Circular	250 mm
MH-20	4+90	546.5	1.20	0.51	207.59	P-20	MH-20	MH-21	Circular	250 mm
MH-21	4+50	542.5	1.20	0.51	216.08	P-21	MH-21	MH-22	Circular	250 mm
MH-22	4+23	540	1.20	0.52	226.77	P-22	MH-22	MH-23	Circular	250 mm
MH-23	3+90	540	1.20	0.52	231.4	P-23	MH-23	MH-24	Circular	250 mm
MH-24	3+67	540	1.20	0.52	237.1	P-24	MH-24	MH-25	Circular	250 mm
MH-25	3+24	536.3	1.20	0.53	241.76	P-25	MH-25	MH-26	Circular	250 mm
MH-26	2+88	535	1.20	0.53	242.45	P-26	MH-26	MH-27	Circular	250 mm
MH-27	2+55	535	1.20	0.53	249.46	P-27	MH-27	MH-28	Circular	250 mm
MH-28	2+27	535	1.20	0.53	255.94	P-28	MH-28	MH-29	Circular	250 mm
MH-29	1+98	532.2	1.20	0.54	266.03	P-29	MH-29	MH-30	Circular	250 mm
MH-30	1+51	525	1.20	0.55	275.57	P-30	MH-30	MH-31	Circular	250 mm
MH-31	1+07	525	1.20	0.55	284.59	P-31	MH-31	MH-32	Circular	250 mm
MH-32	0+67	523.2	1.20	0.55	289.54	P-32	MH-32	MH-33	Circular	250 mm
MH-33	0+27	525	1.20	0.55	289.58	P-33	MH-33	O-1	Circular	250 mm
O-1	O-1	527.2		0	289.58					

Table (14) Waste Water Design Report For (Line S4 b)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	6+01	534.6	1.2	0.27	16.6	P-1	MH-1	MH-2	Circular	200 mm
MH-2	5+60	534.2	1.2	0.32	29.61	P-2	MH-2	MH-3	Circular	200 mm
MH-3	5+18	534	1.2	0.34	41.69	P-3	MH-3	MH-4	Circular	200 mm
MH-4	4+76	532.6	1.2	0.37	53.13	P-4	MH-4	MH-5	Circular	200 mm
MH-5	4+34	533	1.2	0.39	64.03	P-5	MH-5	MH-6	Circular	200 mm
MH-6	3+92	532.5	1.2	0.4	74.52	P-6	MH-6	MH-7	Circular	200 mm
MH-7	3+50	531.6	1.2	0.41	77.74	P-7	MH-7	MH-8	Circular	200 mm
MH-8	3+07	528.8	1.2	0.41	81.54	P-8	MH-8	MH-9	Circular	200 mm
MH-9	2+59	525.7	1.2	0.41	83.49	P-9	MH-9	MH-10	Circular	200 mm
MH-10	2+19	522.6	1.2	0.42	86.74	P-10	MH-10	MH-11	Circular	200 mm
MH-11	1+72	517.8	1.20	0.42	89.76	P-11	MH-11	MH-12	Circular	200 mm
MH-12	1+24	511.5	1.20	0.43	91.78	P-12	MH-12	MH-13	Circular	200 mm
MH-13	0+87	505.8	1.20	0.43	93.34	P-13	MH-13	MH-14	Circular	200 mm
MH-14	0+49	500	1.20	0.43	94.19	P-14	MH-14	MH-15	Circular	200 mm
MH-15	0+25	500	1.20	0.43	95.88	P-15	MH-15	O-1	Circular	200 mm
O-1	O-1	500		0	95.88					

Table 15-Part 1(Main Trunk N1 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N1 part 1	1	2	111.62	111.62	8.66	0.65	56.31	56.31	9.86	202.01	11375.09	11375.09
2	N1 part 1	2	3	48.98	160.60	5.00	0.65	32.47	88.78	10.68	200.69	17816.69	6441.59
3	N1 part 1	3	4	40.17	200.77	3.65	0.65	23.74	112.52	11.35	199.61	22459.71	4643.02
4	N1 part 1	4	5	103.46	304.23	7.29	0.65	47.39	159.91	13.07	196.86	31481.12	9021.41
5	N1 part 1	5	6	62.89	367.12	5.29	0.65	34.36	194.28	14.12	195.21	37925.61	6444.49
6	N1 part 1	6	7	100	467.12	5.13	0.65	33.33	227.60	15.79	192.62	43840.38	5914.77
7	N1 part 1	7	8	114.28	581.40	1.59	0.65	10.34	237.95	17.69	189.69	45136.61	1296.23
8	N1 part 1	8	9	41.21	622.61	1.53	0.65	9.92	247.87	18.38	188.65	46759.60	1622.99
9	N1 part 1	9	10	68.33	690.94	3.14	0.65	20.41	268.28	19.52	186.93	50149.35	3389.75
10	N1 part 1	10	11	48.5	739.44	2.86	0.65	18.59	286.86	20.32	185.72	53276.85	3127.49
11	N1 part 1	11	12	100	839.44	4.80	0.65	31.21	318.07	21.99	183.25	58286.87	5010.03
12	N1 part 1	12	13	39.17	878.61	2.67	0.65	17.36	335.43	22.64	182.29	61146.19	2859.32
13	N1 part 1	13	14	55.29	933.90	2.64	0.65	17.13	352.56	23.57	180.95	63795.26	2649.07
14	N1 part 1	14	15	61.66	995.56	2.84	0.65	18.48	371.04	24.59	179.46	66588.12	2792.85
15	N1 part 1	15	16	93.64	1089.20	2.96	0.65	19.27	390.31	26.15	177.23	69173.15	2585.04
16	N1 part 1	16	17	91	1180.20	3.36	0.65	21.86	412.17	27.67	175.08	72162.44	2989.29
17	N1 part 1	17	18	97.51	1277.71	3.66	0.65	23.76	435.93	29.30	172.81	75332.77	3170.33
18	N1 part 1	18	19	100	1377.71	3.47	0.65	22.56	458.49	30.96	170.51	78178.45	2845.68
19	N1 part 1	19	20	90.83	1468.54	2.71	0.65	17.61	476.10	32.48	168.45	80199.71	2021.26
20	N1 part 1	20	21	93.84	1562.38	2.27	0.65	14.73	490.83	34.04	166.35	81648.58	1448.87
21	N1 part 1	21	22	84.59	1646.97	2.48	0.65	16.11	506.94	35.45	164.47	83378.88	1730.29
22	N1 part 1	22	23	115.35	1762.32	3.20	0.65	20.81	527.75	37.37	161.95	85470.97	2092.10
23	N1 part 1	23	24	74.35	1836.67	2.09	0.65	13.56	541.31	38.61	160.35	86798.69	1327.71
24	N1 part 1	24	25	53.52	1890.19	1.55	0.65	10.05	551.35	39.50	159.21	87778.25	979.56
25	N1 part 1	25	26	69.05	1959.24	1.63	0.65	10.57	561.92	40.65	157.74	88637.25	859.00
26	N1 part 1	26	27	80.97	2040.21	2.05	0.65	13.33	575.24	42.00	156.04	89761.22	1123.97
27	N1 part 1	27	28	81.27	2121.48	2.64	0.65	17.17	592.41	43.36	154.35	91439.60	1678.38
28	N1 part 1	28	29	68.08	2189.56	2.51	0.65	16.28	608.69	44.49	152.95	93100.54	1660.93
29	N1 part 1	29	30	128	2317.56	3.57	0.65	23.17	631.87	46.63	150.35	95003.05	1902.52
30	N1 part 1	30	31	28.74	2346.30	1.21	0.65	7.85	639.71	47.11	149.78	95813.25	810.20

Design Assamptions and data	
	Chock Load

Table 15-Part 2(Main Trunk N1 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N1 part 2	1	2	100.08	100.08	3.42	0.65	2.22	2.22	9.67	202.32	250219.58	250219.58
2	N1 part 2	2	3	60.64	160.72	2.51	0.65	1.63	3.85	10.68	200.68	250543.35	323.78
3	N1 part 2	3	4	83.65	244.37	4.34	0.65	2.82	6.68	12.07	198.45	251094.56	551.21
4	N1 part 2	4	5	55.64	300.01	3.72	0.65	2.42	9.09	13.00	196.97	251561.01	466.45
5	N1 part 2	5	6	68.42	368.43	5.52	0.65	3.59	12.68	14.14	195.18	252244.98	683.97
6	N1 part 2	6	7	69.72	438.15	6.22	0.65	4.04	16.72	15.30	193.37	253003.77	758.78
7	N1 part 2	7	8	69.72	507.87	7.23	0.65	4.70	21.42	16.46	191.57	253874.00	870.24
8	N1 part 2	8	9	54.58	562.45	6.58	0.65	4.28	25.70	17.37	190.17	254657.50	783.50
9	N1 part 2	9	10	98.32	660.77	10.57	0.65	6.87	32.57	19.01	187.69	255883.10	1225.60
10	N1 part 2	10	11	100.65	761.42	11.22	0.65	7.29	39.86	20.69	185.18	257151.77	1268.67
11	N1 part 2	11	12	101.18	862.60	10.36	0.65	6.73	46.60	22.38	182.68	258282.65	1130.88
12	N1 part 2	12	13	96.47	959.07	11.45	0.65	7.44	54.04	23.98	180.34	259515.61	1232.95
13	N1 part 2	13	14	100	1059.07	7	0.65	4.55	58.59	25.65	177.94	260195.65	680.04
14	N1 part 2	14	15	100	1159.07	7.03	0.65	4.57	63.16	27.32	175.58	260859.30	663.66
15	N1 part 2	15	16	100.01	1259.08	7.06	0.65	4.59	67.75	28.98	173.24	261506.83	647.52
16	N1 part 2	16	17	51.92	1311.00	3.68	0.65	2.39	70.14	29.85	172.04	261837.05	330.23
17	N1 part 2	17	18	88.97	1399.97	5.39	0.65	3.50	73.65	31.33	170.00	262289.79	452.74
18	N1 part 2	18	19	100	1499.97	5.29	0.65	3.44	77.08	33.00	167.74	262700.09	410.30
19	N1 part 2	19	20	86.46	1586.43	5.55	0.65	3.61	80.69	34.44	165.81	263149.47	449.37
20	N1 part 2	20	21	106.5	1692.93	4.43	0.65	2.88	83.57	36.22	163.47	263430.76	281.30
21	N1 part 2	21	22	107.5	1800.43	3.19	0.65	2.07	85.64	38.01	161.13	305250.69	41819.93
22	N1 part 2	22	23	100	1900.43	4.06	0.65	2.64	88.28	39.67	158.99	305486.75	236.06
23	N1 part 2	23	24	100	2000.43	5.34	0.65	3.47	91.75	41.34	156.87	305844.62	357.86
24	N1 part 2	24	25	100	2100.43	5.03	0.65	3.27	95.02	43.01	154.79	306159.29	314.67
25	N1 part 2	25	26	88.86	2189.29	4.31	0.65	2.80	97.83	44.49	152.96	306413.87	254.58
26	N1 part 2	26	27	111.14	2300.43	0.86	0.65	0.56	98.38	46.34	150.70	7088.11	85.50
27	N1 part 2	27	28	111.27	2411.70	0.85	0.65	0.55	98.94	48.20	148.47	306139.95	84.51
28	N1 part 2	28	29	119.52	2531.22	5.77	0.65	3.75	102.69	50.19	146.11	306454.79	573.67

Design Assamptions and data	
	Chock Load

Table 15.1(Main Trunk N1 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N1a	1	2	52.11	52.11	5.67	0.65	36.88	36.88	8.87	203.62	7509.58	7509.58
2	N1a	2	3	60.02	112.13	7.14	0.65	46.38	83.26	9.87	201.99	16818.05	9308.47
3	N1a	3	4	104.2	216.33	11.01	0.65	71.54	154.80	11.61	199.19	30835.79	14017.74
4	N1a	4	5	88.42	304.75	9.97	0.65	64.83	219.63	13.08	196.85	43233.91	12398.12
5	N1a	5	6	88.42	393.17	11.66	0.65	75.81	295.44	14.55	194.53	57472.34	14238.43
6	N1a	6	7	55.9	449.07	10.74	0.65	69.80	365.24	15.48	193.08	70521.99	13049.65
7	N1a	7	8	112.21	561.28	7.04	0.65	45.74	410.98	17.35	190.20	78169.85	7647.86
8	N1a	8	9	35.75	597.03	5.91	0.65	38.45	449.43	17.95	189.30	85074.59	6904.74
9	N1a	9	10	22.57	619.60	1.42	0.65	9.24	458.67	18.33	188.73	86561.94	1487.35
10	N1a	10	11	20.71	640.31	0.44	0.65	2.85	461.52	18.67	188.20	86859.10	297.16
11	N1a	11	12	72.73	713.04	12.10	0.65	78.66	540.18	19.88	186.38	100678.31	13819.21
12	N1a	12	13	48.34	761.38	7.59	0.65	49.32	589.50	20.69	185.18	109161.89	8483.58
13	N1a	13	14	101.39	862.77	10.09	0.65	65.57	655.07	22.38	182.68	119668.72	10506.83
14	N1a	14	15	90	952.77	9.77	0.65	63.53	718.60	23.88	180.49	129701.87	10033.14
15	N1a	15	16	71.66	1024.43	7.63	0.65	49.57	768.17	25.07	178.77	137325.38	7623.52
16	N1a	16	17	77.92	1102.35	7.68	0.65	49.91	818.08	26.37	176.91	144730.13	7404.75
17	N1a	17	18	101.53	1203.88	7.30	0.65	47.47	865.55	28.06	174.53	151060.32	6330.19
18	N1a	18	19	93.36	1297.24	4.64	0.65	30.17	895.71	29.62	172.36	154383.60	3323.28
19	N1a	19	20	117.11	1414.35	2.48	0.65	16.14	911.85	31.57	169.68	154720.93	337.33
20	N1a	20	21	64.2	1478.55	0.51	0.65	3.33	915.18	32.64	168.23	153956.58	564.52

Design Assamptions and data

Chock Load

Table 16-Part 1(Main Trunk N2 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N2 Part 1	1	2	99.02	99.02	3.57	0.2	0.71	0.71	9.65	202.35	144.48	144.48
2	N2 Part 1	2	3	82.32	181.34	2.97	0.2	0.59	1.31	11.02	200.13	261.77	117.29
3	N2 Part 2	3	4	80.19	261.53	2.86	0.2	0.57	1.88	12.36	197.99	372.22	110.46
4	N2 Part 3	4	5	31.54	293.07	0.53	0.2	0.11	1.99	12.88	197.16	391.56	19.33
5	N2 Part 4	5	6	50.65	343.72	1.42	0.2	0.28	2.27	13.73	195.83	444.52	52.97
6	N2 Part 5	6	7	45.53	389.25	1.80	0.2	0.36	2.63	14.49	194.64	511.89	67.37
7	N2 Part 6	7	8	35.83	425.08	1.16	0.2	0.23	2.86	15.08	193.70	554.38	42.49
8	N2 Part 7	8	9	94.31	519.39	2.50	0.2	0.50	3.36	16.66	191.27	643.06	88.68
9	N2 Part 8	9	10	78.72	598.11	2.89	0.2	0.58	3.94	17.97	189.27	745.72	102.66
10	N2 Part 9	10	11	99.63	697.74	4.51	0.2	0.90	4.84	19.63	186.76	904.30	158.58
11	N2 Part 10	11	12	100.06	797.80	4.90	0.2	0.98	5.82	21.30	184.28	1072.86	168.56
12	N2 Part 11	12	13	100.38	898.18	4.81	0.2	0.96	6.78	22.97	181.82	1233.44	160.59
13	N2 Part 12	13	14	100	998.18	2.94	0.2	0.59	7.37	24.64	179.40	1322.53	89.08
14	N2 Part 13	14	15	100	1098.18	3.59	0.2	0.72	8.09	26.30	177.01	1432.04	109.51
15	N2 Part 14	15	16	103.56	1201.74	3.03	0.2	0.61	8.70	28.03	174.58	1518.11	86.08

Design Assamptions and data	
	Chock Load

Table 16-Part 2(Main Trunk N2 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N2 part 2	16	17	96.44	96.44	3.96	0.2	0.79	0.79	9.61	202.42	2660.21	2660.21
2	N2 part 2	17	18	100	196.44	3.18	0.2	0.64	1.43	11.27	199.72	2785.11	124.89
3	N2 part 2	18	19	98.55	294.99	2.93	0.2	0.59	2.01	12.92	197.11	2896.87	111.77
4	N2 part 2	19	20	91.85	386.84	2.44	0.2	0.49	2.50	14.45	194.70	2987.04	90.16
5	N2 part 2	20	21	62.86	449.70	1.56	0.2	0.31	2.81	15.50	193.07	3043.19	56.15
6	N2 part 2	21	22	99	548.70	2.36	0.2	0.47	3.29	17.15	190.52	3125.96	82.77
7	N2 part 2	22	23	98.32	647.02	3.01	0.2	0.60	3.89	18.78	188.03	3230.97	105.01
8	N2 part 2	23	24	100	747.02	3.2	0.2	0.64	4.53	20.45	185.53	3339.99	109.02
9	N2 part 2	24	25	96.74	843.76	2.84	0.2	0.57	5.10	22.06	183.15	3433.21	93.22
10	N2 part 2	25	26	99.35	943.11	1.68	0.2	0.34	5.43	23.72	180.73	3481.60	48.39
11	N2 part 2	26	27	100.84	1043.95	1.43	0.2	0.29	5.72	25.40	178.30	3519.44	37.83
12	N2 part 2	27	28	100.5	1144.45	1.74	0.2	0.35	6.07	27.07	175.92	3567.03	47.60
13	N2 part 2	28	29	96.25	1240.70	2.72	0.2	0.54	6.61	28.68	173.67	3647.85	80.81
14	N2 part 2	29	30	93.42	1334.12	3.23	0.2	0.65	7.26	30.24	171.51	3744.37	96.53
15	N2 part 2	30	31	98.52	1432.64	2.9	0.2	0.58	7.84	31.88	169.26	3826.24	81.87
16	N2 part 2	31	32	96.53	1529.17	1.98	0.2	0.40	8.23	33.49	167.09	3875.38	49.14
17	N2 part 2	32	33	99.39	1628.56	2.06	0.2	0.41	8.64	35.14	164.88	3925.13	49.75
18	N2 part 2	33	34	100	1728.56	2.06	0.2	0.41	9.06	36.81	162.69	3973.20	48.08
19	N2 part 2	34	35	95.28	1823.84	1.9	0.2	0.38	9.44	38.40	160.63	4015.57	42.37
20	N2 part 2	35	36	92.35	1916.19	2.12	0.2	0.42	9.86	39.94	158.65	4064.22	48.65
21	N2 part 2	36	37	95.7	2011.89	2.39	0.2	0.48	10.34	41.53	156.63	4119.17	54.96
22	N2 part 2	37	38	98.2	2110.09	2.49	0.2	0.50	10.84	43.17	154.59	4175.01	55.84
23	N2 part 2	38	39	98.39	2208.48	3.65	0.2	0.73	11.57	44.81	152.56	4264.46	89.45
24	N2 part 2	39	40	98.84	2307.32	3.58	0.2	0.72	12.28	46.46	150.56	4349.07	84.61
25	N2 part 2	40	41	96.93	2404.25	2.43	0.2	0.49	12.77	48.07	148.62	4397.46	48.39
26	N2 part 2	41	42	100.04	2504.29	3.18	0.2	0.64	13.40	49.74	146.64	4465.48	68.02
27	N2 part 2	42	43	102.41	2606.70	3.96	0.2	0.79	14.20	51.45	144.64	4553.27	87.80
28	N2 part 2	43	21	105.94	2712.64	2.66	0.2	0.53	14.73	53.21	142.61	4600.23	46.95

Design Assamptions and data

Chock Load

Table 16.1(Main Trunk N2 Storm Water Collection System)

Number	LOCATION			Length	Length Comulative	Area Of Street	C Factor Street	C.A Street	Sum (AC) Comulative	Tc	(i)	Q	Qi
	Line Name	Upper Inlet	Lower Inlet	(m)	(m)	(ha)		(ha)	(ha)	(min)	(L/s.ha)	(L/s)	(L/s)
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	N2 a	1	2	100	100.00	2.56	0.2	0.51	0.51	9.67	202.32	103.59	103.59
2	N2 a	2	3	99.91	199.91	2.56	0.2	0.51	1.02	11.33	199.63	204.42	100.84
3	N2 a	3	4	98.72	298.63	2.46	0.2	0.49	1.52	12.98	197.01	298.67	94.25
4	N2 a	4	5	99.89	398.52	2.45	0.2	0.49	2.01	14.64	194.39	389.95	91.29
5	N2 a	5	6	100	498.52	2.70	0.2	0.54	2.55	16.31	191.81	488.35	98.39
6	N2 a	6	7	99.02	597.54	2.70	0.2	0.54	3.09	17.96	189.28	584.13	95.78
7	N2 a	7	8	99.49	697.03	2.76	0.2	0.55	3.64	19.62	186.78	679.50	95.37
8	N2 a	8	9	100	797.03	2.92	0.2	0.58	4.22	21.28	184.30	778.09	98.59
9	N2 a	9	10	100	897.03	2.83	0.2	0.57	4.79	22.95	181.84	870.67	92.58
10	N2 a	10	11	100	997.03	2.33	0.2	0.47	5.25	24.62	179.43	942.71	72.03
11	N2 a	11	12	99.94	1096.97	1.43	0.2	0.29	5.54	26.28	177.04	980.81	38.11
12	N2 a	12	16	71.81	1168.78	0.30	0.2	0.06	5.60	27.48	175.35	981.95	1.14

Design Assamptions and data	
	Chock Load

Table (17) Storm Water Design Report For (Line N1)

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	714.68	48+88	1.2	1.84	5048.049	P-1	MH-1	MH-2	Circular	200 mm
MH-2	703	47+76	1.2	1.79	7472.995	P-2	MH-2	MH-3	Circular	250 mm
MH-3	696.54	47+27	1.2	2.08	8941.655	P-3	MH-3	MH-4	Circular	250 mm
MH-4	690	46+87	1.2	2.69	11738.27	P-4	MH-4	MH-5	Circular	250 mm
MH-5	679.19	45+84	1.2	2.15	13164.75	P-5	MH-5	MH-6	Circular	300 mm
MH-6	671.04	45+21	1.2	2.46	15309.59	P-6	MH-6	MH-7	Circular	300 mm
MH-7	660.73	44+21	1.2	2.56	15998.79	P-7	MH-7	MH-8	Circular	300 mm
MH-8	650.75	43+07	1.2	2.69	16861.72	P-8	MH-8	MH-9	Circular	300 mm
MH-9	644.31	42+66	1.2	2.97	18664.03	P-9	MH-9	MH-10	Circular	300 mm
MH-10	635.97	41+97	1.2	2.17	20326.89	P-10	MH-10	MH-11	Circular	375 mm
MH-11	630	41+49	1.2	2.4	22990.68	P-11	MH-11	MH-12	Circular	375 mm
MH-12	620.83	40+49	1.2	2.54	24510.96	P-12	MH-12	MH-13	Circular	375 mm
MH-13	617.18	40+10	1.2	2.67	25919.45	P-13	MH-13	MH-14	Circular	375 mm
MH-14	611.31	39+55	1.2	2.81	27404.39	P-14	MH-14	MH-15	Circular	375 mm
MH-15	601.79	38+55	1.2	2.95	28778.83	P-15	MH-15	MH-16	Circular	375 mm
MH-16	594.72	37+62	1.2	2.28	30368.21	P-16	MH-16	MH-17	Circular	450 mm
MH-17	592.92	36+71	1.2	2.38	32053.85	P-17	MH-17	MH-18	Circular	450 mm
MH-18	590	35+73	1.2	2.47	33566.88	P-18	MH-18	MH-19	Circular	450 mm
MH-19	583.53	34+70	1.2	2.53	34641.57	P-19	MH-19	MH-20	Circular	450 mm
MH-20	579.07	33+79	1.2	2.58	35411.92	P-20	MH-20	MH-21	Circular	450 mm
MH-21	575.53	32+87	1.2	1.94	36331.91	P-21	MH-21	MH-22	Circular	600 mm
MH-22	573.66	32+08	1.2	1.97	37444.26	P-22	MH-22	MH-23	Circular	600 mm
MH-23	569.66	31+01	1.2	1.99	38150.19	P-23	MH-23	MH-24	Circular	600 mm
MH-24	568.5	30+32	1.2	2	38671.02	P-24	MH-24	MH-25	Circular	600 mm
MH-25	561.05	29+82	1.2	2.01	39127.74	P-25	MH-25	MH-26	Circular	600 mm
MH-26	553	29+14	1.2	2.02	39725.35	P-26	MH-26	MH-27	Circular	600 mm
MH-27	545	28+33	1.2	2.05	40617.73	P-27	MH-27	MH-28	Circular	600 mm
MH-28	537.5	27+51	1.2	2.07	41500.84	P-28	MH-28	MH-29	Circular	600 mm
MH-29	531.64	26+83	1.2	2.09	42512.39	P-29	MH-29	MH-30	Circular	600 mm
MH-30	518.43	25+55	1.2	2.1	42943.17	P-30	MH-30	MH-31	Circular	600 mm
MH-31	512.43	25+26	1.2	4.51	113341.7	P-31	MH-31	MH-32	Circular	600 mm
MH-32	505	24+26	1.2	4.52	113772.1	P-32	MH-32	MH-33	Circular	600 mm
MH-33	498.63	23+66	1.2	4.55	114504.7	P-33	MH-33	MH-34	Circular	600 mm
MH-34	492	22+82	1.2	4.58	115124.8	P-34	MH-34	MH-35	Circular	600 mm
MH-35	485.86	22+27	1.2	4.61	116033.9	P-35	MH-35	MH-36	Circular	600 mm
MH-36	481.29	21+58	1.2	3.11	117042.5	P-36	MH-36	MH-37	Circular	750 mm
MH-37	480	20+89	1.2	3.14	118199.3	P-37	MH-37	MH-38	Circular	750 mm
MH-38	478.62	20+19	1.2	3.16	119240.7	P-38	MH-38	MH-39	Circular	750 mm
MH-39	475.88	19+68	1.2	3.18	120269.8	P-39	MH-39	MH-40	Circular	750 mm

Table (17) Storm Water Design Report For (Line N1)

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-40	473.22	18+80	1.2	3.2	121356.2	P-40	MH-40	MH-41	Circular	750 mm
MH-41	469.75	17+78	1.2	3.24	122859.4	P-41	MH-41	MH-42	Circular	750 mm
MH-42	466.75	16+72	1.2	3.27	124498.3	P-42	MH-42	MH-43	Circular	750 mm
MH-43	460	15+75	1.2	3.29	125402.2	P-43	MH-43	MH-44	Circular	750 mm
MH-44	456.56	14+75	1.2	3.31	126284.3	P-44	MH-44	MH-45	Circular	750 mm
MH-45	451.83	13+75	1.2	3.33	127145	P-45	MH-45	MH-46	Circular	750 mm
MH-46	447.42	12+75	1.2	3.34	127584	P-46	MH-46	MH-47	Circular	750 mm
MH-47	445	12+23	1.2	3.35	128185.8	P-47	MH-47	MH-48	Circular	750 mm
MH-48	441	11+34	1.2	3.37	128731.2	P-48	MH-48	MH-49	Circular	750 mm
MH-49	437.7	10+34	1.2	3.38	129328.5	P-49	MH-49	MH-50	Circular	750 mm
MH-50	432.5	9+48	1.2	3.39	129702.4	P-50	MH-50	MH-51	Circular	750 mm
MH-51	430	8+41	1.2	3.75	527327.1	P-51	MH-51	MH-52	Circular	1500 mm
MH-52	428.5	7+34	1.2	3.45	527640.8	P-52	MH-52	MH-53	Circular	1650 mm
MH-53	427.4	6+33	1.2	3.45	528116.5	P-53	MH-53	MH-54	Circular	1650 mm
MH-54	425.54	5+31	1.2	3.45	528534.8	P-54	MH-54	MH-55	Circular	1650 mm
MH-55	424.27	4+31	1.2	3.46	528873.2	P-55	MH-55	MH-56	Circular	1650 mm
MH-56	422	3+42	1.2	3.46	529054.9	P-56	MH-56	MH-57	Circular	1650 mm
MH-57	420.47	2+31	1.2	3.46	529237.3	P-57	MH-57	MH-58	Circular	1650 mm
MH-58	418	1+20	1.2	3.46	529655.8	P-58	MH-58	O-1	Circular	1650 mm
O-1	415	0	1.2	0	529655.8					

Table (17.1) Storm Water Design Report For (Line N1 -a-)

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	587.63	14+80	1.2	0.94	1,497.30	P-1	MH-1	MH-2	Circular	200 mm
MH-2	582.39	14+28	1.2	1.35	3,353.26	P-2	MH-2	MH-3	Circular	200 mm
MH-3	577.73	13+68	1.2	2.21	6,148.18	P-3	MH-3	MH-4	Circular	200 mm
MH-4	571.04	12+64	1.2	2.02	8,620.18	P-4	MH-4	MH-5	Circular	250 mm
MH-5	567.04	11+75	1.2	2.63	11,459.10	P-5	MH-5	MH-6	Circular	250 mm
MH-6	561.15	10+87	1.2	3.22	14,061.00	P-6	MH-6	MH-7	Circular	250 mm
MH-7	556.14	10+31	1.2	3.56	15,585.87	P-7	MH-7	MH-8	Circular	250 mm
MH-8	545.53	9+18	1.2	2.71	16,962.56	P-8	MH-8	MH-9	Circular	300 mm
MH-9	543.99	8+83	1.2	2.76	17,259.12	P-9	MH-9	MH-10	Circular	300 mm
MH-10	540.9	8+60	1.2	2.76	17,318.37	P-10	MH-10	MH-11	Circular	300 mm
MH-11	537.57	8+40	1.2	3.19	20,073.71	P-11	MH-11	MH-12	Circular	300 mm
MH-12	530	7+67	1.2	3.46	21,765.20	P-12	MH-12	MH-13	Circular	300 mm
MH-13	525	7+18	1.2	3.79	23,860.10	P-13	MH-13	MH-14	Circular	300 mm
MH-14	516.23	6+17	1.2	3.93	24,760.55	P-14	MH-14	MH-15	Circular	300 mm
MH-15	507.77	5+27	1.2	2.71	26,280.56	P-15	MH-15	MH-16	Circular	375 mm
MH-16	506.18	4+55	1.2	2.14	27,756.96	P-16	MH-16	MH-17	Circular	450 mm
MH-17	505	3+77	1.2	2.21	29,019.10	P-17	MH-17	MH-18	Circular	450 mm
MH-18	502.5	2+76	1.2	1.79	29,681.71	P-18	MH-18	MH-19	Circular	600 mm
MH-19	502	1+81	1.2	1.79	29,748.97	P-19	MH-19	MH-20	Circular	600 mm
MH-20	495.5	0+64	1.2	1.79	29,901.37	P-20	MH-20	O-1	Circular	600 mm
O-1	490	0	1.2	0	29,901.37					

Table (17.2) Storm Water Design Report For (Line N1 -b-)

Manhole Report						Pipe Report				
Label	Ground Elevation (m)	Station (m)	Manhole Diameter (m)	Velocity (m/s)	Total Flow (m3/day)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	534.34	9+85	1.2	1.08	2128.896	P-1	MH-1	MH-2	Circular	200 mm
MH-2	529.68	8+85	1.2	1.25	2902.176	P-2	MH-2	MH-3	Circular	200 mm
MH-3	529.17	8+50	1.2	1.42	3607.2	P-3	MH-3	MH-4	Circular	200 mm
MH-4	527.69	8+18	1.2	1.64	4415.04	P-4	MH-4	MH-5	Circular	200 mm
MH-5	525	7+78	1.2	2.19	6089.472	P-5	MH-5	MH-6	Circular	200 mm
MH-6	522.26	7+08	1.2	2.67	7452	P-6	MH-6	MH-7	Circular	200 mm
MH-7	516.99	6+51	1.2	2.26	9758.016	P-7	MH-7	MH-8	Circular	250 mm
MH-8	513.28	5+66	1.2	1.92	11497.25	P-8	MH-8	MH-9	Circular	300 mm
MH-9	511.5	5+01	1.2	2.16	13258.94	P-9	MH-9	MH-10	Circular	300 mm
MH-10	507.93	4+36	1.2	2.36	14651.71	P-10	MH-10	MH-11	Circular	300 mm
MH-11	504.36	3+81	1.2	2.48	15459.55	P-11	MH-11	MH-12	Circular	300 mm
MH-12	502.7	3+42	1.2	2.68	16748.64	P-12	MH-12	MH-13	Circular	300 mm
MH-13	498.34	2+82	1.2	2.92	18296.93	P-13	MH-13	MH-14	Circular	300 mm
MH-14	493.75	1+98	1.2	3.1	19515.17	P-14	MH-14	MH-15	Circular	300 mm
MH-15	491.1	1+13	1.2	3.14	19746.72	P-15	MH-15	MH-16	Circular	300 mm
MH-16	490.51	0+93	1.2	3.28	20657.38	P-16	MH-16	O-1	Circular	300 mm
O-1	482.5	0	1.2	0	20657.38					

Table (18) Storm Water Design Report For (Line N2 -main-)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	39+17	564.8	1.2	1.61	144.48	P-1	MH-1	MH-2	Circular	375 mm
MH-2	38+18	560	1.2	1.9	261.77	P-2	MH-2	MH-3	Circular	450 mm
MH-3	37+35	555	1.2	2.38	372.23	P-3	MH-3	MH-4	Circular	450 mm
MH-4	36+55	550	1.2	1.89	391.56	P-4	MH-4	MH-5	Circular	600 mm
MH-5	36+24	549.2	1.2	1.99	444.53	P-5	MH-5	MH-6	Circular	600 mm
MH-6	35+73	544.64	1.2	2.13	511.9	P-6	MH-6	MH-7	Circular	600 mm
MH-7	35+28	540	1.2	2.23	554.39	P-7	MH-7	MH-8	Circular	600 mm
MH-8	34+92	540	1.2	2.44	643.07	P-8	MH-8	MH-9	Circular	600 mm
MH-9	33+97	535	1.2	2.7	745.77	P-9	MH-9	MH-10	Circular	600 mm
MH-10	33+19	530	1.2	2.4	904.35	P-10	MH-10	MH-11	Circular	750 mm
MH-11	32+19	525	1.20	2.64	1072.91	P-11	MH-11	MH-12	Circular	750 mm
MH-12	31+19	520	1.20	2.9	1233.5	P-12	MH-12	MH-13	Circular	750 mm
MH-13	30+19	515.7	1.20	3.06	1322.58	P-13	MH-13	MH-14	Circular	750 mm
MH-14	29+19	511.62	1.20	3.26	1432.09	P-14	MH-14	MH-15	Circular	750 mm
MH-15	28+19	507.46	1.20	2.72	1518.17	P-15	MH-15	MH-16	Circular	900 mm
MH-16	27+15	505	1.20	3.79	4178.17	P-16	MH-16	MH-17	Circular	1200 mm
MH-17	26+19	500	1.20	3.88	4303.07	P-17	MH-17	MH-18	Circular	1200 mm
MH-18	25+19	495	1.20	3.96	4414.87	P-18	MH-18	MH-19	Circular	1200 mm
MH-19	24+20	490	1.20	3.47	4505.03	P-19	MH-19	MH-20	Circular	1350 mm
MH-20	23+28	490	1.20	3.5	4561.18	P-20	MH-20	MH-21	Circular	1350 mm
MH-21	22+65	485	1.20	3.54	4643.95	P-21	MH-21	MH-22	Circular	1350 mm
MH-22	21+66	485	1.20	3.59	4748.95	P-22	MH-22	MH-23	Circular	1350 mm
MH-23	20+68	480	1.20	3.64	4857.95	P-23	MH-23	MH-24	Circular	1350 mm
MH-24	19+68	480	1.20	3.69	4951.17	P-24	MH-24	MH-25	Circular	1350 mm
MH-25	18+71	475	1.20	3.71	4999.56	P-25	MH-25	MH-26	Circular	1350 mm
MH-26	17+72	472.8	1.20	3.73	5037.39	P-26	MH-26	MH-27	Circular	1350 mm
MH-27	16+71	470	1.20	3.38	5084.99	P-27	MH-27	MH-28	Circular	1500 mm
MH-28	15+70	470	1.20	3.41	5165.8	P-28	MH-28	MH-29	Circular	1500 mm
MH-29	14+74	465	1.20	3.45	5262.33	P-29	MH-29	MH-30	Circular	1500 mm
MH-30	13+80	465	1.20	3.47	5344.2	P-30	MH-30	MH-31	Circular	1500 mm

Table (18) Storm Water Design Report For (Line N2 -main-) Con'd

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-31	12+82	460	1.20	3.49	5393.34	P-31	MH-31	MH-32	Circular	1500 mm
MH-32	11+85	460	1.20	3.51	5443.09	P-32	MH-32	MH-33	Circular	1500 mm
MH-33	10+86	455	1.20	3.53	5491.17	P-33	MH-33	MH-34	Circular	1500 mm
MH-34	9+86	455	1.20	3.54	5533.54	P-34	MH-34	MH-35	Circular	1500 mm
MH-35	8+90	450	1.20	3.56	5582.19	P-35	MH-35	MH-36	Circular	1500 mm
MH-36	7+98	450	1.20	3.58	5637.15	P-36	MH-36	MH-37	Circular	1500 mm
MH-37	7+02	445	1.20	3.6	5692.99	P-37	MH-37	MH-38	Circular	1500 mm
MH-38	6+04	445	1.20	3.63	5782.44	P-38	MH-38	MH-39	Circular	1500 mm
MH-39	5+06	441.01	1.20	3.66	5867.05	P-39	MH-39	MH-40	Circular	1500 mm
MH-40	4+07	440	1.20	3.69	5945.44	P-40	MH-40	MH-41	Circular	1500 mm
MH-41	3+10	437.2	1.20	3.72	6013.46	P-41	MH-41	MH-42	Circular	1500 mm
MH-42	2+10	435	1.20	3.75	6101.26	P-42	MH-42	MH-43	Circular	1500 mm
MH-43	1+07	432.34	1.20	3.77	6148.21	P-43	MH-43	O-1	Circular	1500 mm
O-1	O-1	430		0	6,148.21					

Table (18.1) Storm Water Design Report For (Line N2 -a-)

Gravity Node Report						Gravity Pipe Report				
Label	Calculate Station(m)	Ground Elevation (m)	Stucture Diameter (m)	Velocity In (m/s)	Total Flow (m/s)	Label	Upstream Node	Downstream Node	Section Shape	Section Size (mm)
MH-1	11+70	560	1.2	2.08	103.59	P-1	MH-1	MH-2	Circular	250 mm
MH-2	10+70	555	1.2	1.96	204.43	P-2	MH-2	MH-3	Circular	375 mm
MH-3	9+70	550	1.2	2.66	298.68	P-3	MH-3	MH-4	Circular	375 mm
MH-4	8+71	545	1.2	2.47	389.97	P-4	MH-4	MH-5	Circular	450 mm
MH-5	7+71	538	1.2	3.01	488.35	P-5	MH-5	MH-6	Circular	450 mm
MH-6	6+71	531	1.2	2.29	584.13	P-6	MH-6	MH-7	Circular	600 mm
MH-7	5+72	525	1.2	2.53	679.5	P-7	MH-7	MH-8	Circular	600 mm
MH-8	4+72	520	1.2	2.78	775.09	P-8	MH-8	MH-9	Circular	600 mm
MH-9	3+72	517.2	1.2	3.06	867.67	P-9	MH-9	MH-10	Circular	600 mm
MH-10	2+72	512.1	1.2	3.28	939.7	P-10	MH-10	MH-11	Circular	600 mm
MH-11	1+72	508.7	1.20	3.4	977.81	P-11	MH-11	MH-12	Circular	600 mm
MH-12	0+72	505	1.20	3.4	978.95	P-12	MH-12	O-1	Circular	600 mm
O-1	O-1	500		0	978.95					

APPENDIX-A

CALCULATIONS TABLESFOR

WASTEWATER AND STORM DRAINAGE

1. **WASTEWATER**
2. **STORM DRAINAGE**