Design Of Waste water collection system

For BeitUmmer City

BY

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A PROJECT REPORT SUBMITTED IN PARTIAL FULFILLMENT OF

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IN

CIVIL & ARCHITECTURAL ENGINEERING DEPARTMENT

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PALESTINE POLYTECHNIC UNIVERSITY

HEBRON- WEST BANK

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<u>CERTIFICATION</u>

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**

٢٠١٥ , DEC

إهـــــــــداء

بدأنا بأكثر من يد وقاسينا أكثر من هم وعانينا الكثير من الصعوبات وهانحن اليوم والحمد لله نطوي سهر الليالي وتعب الأيام وخلاصة مشوارنا بين دفتي هذا العمل المتواضع.

الكريم سيدنا إلى منارة العلم والامام المصطفى إلى الأمي الذي علم العالمين إلى سيد الخلق إلى رسولنا محمد صلى الله عليه وسلم.

إلى الينبوع الذي لا يمل العطاء الي من حاكت سعادتي بخيوط منسوجة من قلبها إلى والدتي العزيزة.

إلى من سعى وشقى لأنعم بالراحة والهناء الذي لم يبخل بشيء من أجل دفعي في طريق النجاح إلى الذي علمني أن ارتقي سلم الحياة بحكمة وصبر إلى والدي العزيز.

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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 WASTEWATER COLLECTION SYSTEM FOR BEIT UMMER CITY

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The disposal of raw wastewater without treatment creates major potential health and environmental problems. in BeitUmmur city.

The infrastructure do not exist , The people disposal sanitary waste in cesspits, latrines and open drains. The wastewater has been seeping into the ground through the overflows of the deteriorated cesspits and latrines causing serious environmental and health problems , These latrines and cesspits are deteriorating and they are in bad condition, adding to this the increasing in water consumption and consequently increasing in wastewater production , resulting in over flows from the cesspits and recharges of ground water in BeitUmmer city , for this reasons This study is conducted to design wastewater collection system for BeitUmmer city.

The present study considered the annual population growth and their water consumption for the coming 25 years that will be the design period the necessary

hydrulic calculation needed for the design of the main trunks was carried out by simple calculation .

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CHAPTER ONE

INTRODUCTION

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 wastewater.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 Exacerbated.

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

Beit ummer like other Cities 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 wastewater production resulting in over flows from the cesspits and excessive recharge of ground water in beit ummerarea. For all the reasons mentioned, this evaluation and design of wastewater collection system for beit ummer have been conducted.

1.2 Problem Definition

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

The main damaging consequences of these wastewater routes are offensive adors and smells, proper media for breeding of mosquitoes, soil contamination and polluting of the existing aquifers. The municipality of Beit ummer is receiving on daily bases complains from the people asking a comprehensive solution for the wastewater problems in the city.

In view of these bad conditions, and since there is no seweage networks exist, along with fast increasing of the environmental and health problem. The design of wastewater collection 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 .

1.3 Objecives Of The Project

The main objectives of this project are:-

1. Estimation of population and their densities for the design period for each catchment area.
2. Determination of the water consumption and consequently the wastewater production from the different sources for each catchment area.
3. Evaluation of the collected data, propose collection system of the city and design of the main trunks of the network.
4. Showing the proposed wastewater network its parts on different maps for different purposes.
5. Preparation of Bill of Quantities for the main trunks.
6. Preparation the profiles of pipes .

1.4 Methadology

1. Many site visits to beit ummer city and Municipality were done.
2. All needed maps and the previous studies that contain different information about beit ummer were obtained.
3. The amounts of water consumption for different purposes and consequently the amounts of wastewater production for each area were obtained.
4. The different layouts of the proposed wastewater collection system were ploted.

5. The necssary hydraulic calculation for the systems and other design reqirements will be carried out in the next semester.

6. Bill of quantity of the designed wastewater main trunks will be prepared with needed recommendations.

7. Finalizing of the project that will contain the report and the needed maps and drawings.

1.5 Phases Of The Project

The project was consist of the four phases as shown in (Table 1.1)

	Duration							
	2/15	3/15	4/15	5/15	9/15	10/15	11/15	12/15
Data collection and survey								
Preparing layout for wastewater collection system and collect the amount of wastewater								
Design of wastewater collection system								
Writing the report and preparing maps								

Table 1.1:- Phases of The ProjectWithTheirExpectedDuration

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 city and the municipality were done. This phase include the following tasks.

1. Collecting of 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 population densities in each zone of the city with their waterconsumption and predicting their numbers, densities and their water consumption in year2039.

1.5.2 Second Phase:-Preparing Layout For The Network And Calculate The Amount OfWasteWater.

In this phase layout was prepared and put in its final shape and then quantities of wastewater will determine.

This phase include the following tasks:

1. Draw the layout of the network and compare it with the real setuation in Beit ummer city 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 city.
3. Determination of the wastewater quantities.
4. Determination of the wastewater quantities and projection of the wastewater production in year 2039.

1.5.3 Third Phase:- Design Of WasteWaterCollection Systems

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

1. Establish a system layout, which includes the areas that are going to be served, 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 consists of five chapters. The first chapter entitled “Introduction” outlines the problem, project objectives, and phases of the project.

Chapter two entitled “ The Project Area” presents basic background data and information on the project area, water supply, wastewater disposal.

Chapter three entitled “Design parameters” deals with municipal sewage system, types of wastewater collection systems, sewer appurtenances, flow in sewers, design of sewer system, and sewer construction and maintenance.

Chapter four entitled “Analysis And Design” presents the design calculations and maps of the system.

Chapter five Bill of quantities deals with the quantities of pipes manhole excavation, backfilling and…etc.

Chapter six entitled “Conclusions” discusses the conclusions of the study.

CHAPTER TWO

PROJECT AREA

2.1 General

In this chapter, the basic data of Beit ummer city will be briefly discussed. The topography, population water consumption, and wastewater production will be briefly presented.

2.2 Project Area

The town of Biet ummar is located about 12 km to the north of the Hebron city, and is surrounded by a number of smaller towns as shown in figure2.1, The town is hilly with ground elevations from about 600 m to 970 m above the sea level as shown in figure 2.2. The highest point in the whole Biet Ommar is actually at the center part of the town as shown in figure2.3, Biet ummar occupies an area of about 3300 hectare. The population of the 8k town is about 17000 people for year 2015.[Beit ummer Municipality]

2.3 population

Prediction of the future population of Biet Ummar 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 Biet Ommar.

The base for the forecast is the 2004 population for Biet Ummar obtained from PCBS of 15000 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 towns in the West Bank is 2 %. A similar rate of growth was assumed for the towns of Gaza, Therefore, the rate of 2% per year was used for the future growth of the population of Biet ummar town .

Using the above assumption and equation (0.1 + X)^n / n+1 , Table 3.1 presents the population projection up to the design horizon of 2035. The data show that the population of Biet ummar is estimated to be 38540 in year 2040.

Table2.1: Population Forecasts for Biet Ommar Town

Year	2004	2010	2015	2020	2025	2030	2035	2040
Population	15000	15998	16811	22154	26125	30841	35243	38540

2.4 Population Density

When determining the density of population, it is either related to the total municipal area (gross density) or to the built–up area only (net density). The gross density related to the municipal area includes large industrial areas, agricultural areas, un-built areas, public parks, large water surfaces, forests …etc. The net density is related to the built up urban area, but it includes small-scale industries, schools, public and commercial buildings, small parks for local use and roads.

2.5 Land Use

The overall area of the town is distributed among the following:

1. **The Old Town:** The old town is famous for its old buildings, two stories high, and its old passageways.
2. **Residential Area:** Residential buildings are scattered all over the town of Beitummar. There is no apparent system for organizing residential distribution or establishing a clear distinction between land use.

3. **Public Properties:** There is twelve schools which are located within the residential areas in one site of the town. The existing schools do not meet the educational and schooling needs of the town. Public building such as the municipality is located in the center of the town.
4. **The Industrial Zone:** Adding to the industry area which is about 80 donums at the residential areas in one site of the town, and that will be raised to 250 donums in the future at Safa as an indusrial zone, there is several manufacturing business have started in different places of the town.
5. **Agricultural Area:** It is about 70% - 80% of total area of Bietummartown .
6. **Roads.**

   The overall area of the town is distributed in figure 2.4

2.6 Town Master Plan

As a result of the long period of occupation, the town lacks well studied and prepared master plan for land use, town planning and the design of utilities. Town master plan prepared by municipality conclude and suggested the following:

1. The existing interior roads serve the needs of the people, and take into account the boundary and ownership of land parcels.The proposalsfor future interior roads are indicative only the require detailed study to determine land ownership and road alignment.

2. Some of the existing interior roads are agricultural roads. All the building are constructed around these roads without any plan which cause to insufficient roads without any plan which cause to insufficient roads network for the needs of the people.

3. Public buildings, schools and their lands are needed to be increase to meet the current demand.

4. The old town must be protected in its current form and no new roads will be constructed within it.

5. Zone for industry should be determined and serviced by good roads and all necessary utilities to encourage industries scattered in different places to transfer the industrial zone.

The future plan has been developed based on these proposals and taking into account the existing situation.

2.7 Meteorological Data

2.7.1 Temperature

Based on information obtained from Beitummermunicipality ,The temperature is characterized by considerable variation between summer and winter times. The mean temperature values at Beitummer for the period 2000 to 2005 are given in below.[4]

The Mean maximum temperature:	30˚C
The Mean minimum temperature:	5˚C
The Mean Maximum temperature record:	30˚C
The Mean Minimum temperature record:	4.4˚C

And show the average monthly temprture in Palestine in table(3.2)

Month	Ramallah	Nablus	Jerusalem	Jericho	Jenin	Bethlehem	Hebron	Tularemia	Gaza
	C°	C°	C°	C°	C°	C°	C°	C°	°C
January	5,10	6,9	7,8	3,13	1,12	1,11	1,7	11,0	13,6
February	5,9	6,10	9,9	6,14	7,12	5,9	0,8	3,11	5,13
March	5,12	0,13	4,12	4,17	1,15	8,11	5,10	8,13	6,15
April	8,16	1,17	6,15	7,21	8,19	5,20	8,14	7,17	8,18
May	2,23	3,20	0,20	6,25	5,22	6,20	4,18	3,20	6,20
June	4,24	6,22	5,22	5,28	1,25	7,23	8,20	3,23	8,23
July	7,25	2,24	6,23	0,30	6,26	9,24	1,22	6,25	6,25
August	9,25	5,24	8,23	0,30	7,27	1,27	1,22	2,26	2,26
September	8,24	5,23	8,22	6,28	5,26	7,25	0,21	7,24	3,25
October	8,19	0,21	4,20	1,25	4,23	2,23	6,18	0,23	9,23
November	8,17	2,16	5,15	7,19	4,18	5,15	7,13	6,17	3,19
December	8,10	2,11	7,10	7,14	8,13	2,14	9,8	3,13	15,2
Annual rate	**18,5**	**17,8**	**17,1**	**22,4**	**20,3**	**19,0**	**15,5**	**18,9**	**20,1**

Table (2.2): grades monthly rates of heat in the West Bank and Gaza Strip [WitanWeather]

2.7.2 Relative Humidity

Since Beitummer is situated at considerable distance from the sea in a mountains region, Beitummer has low values of relative humidity compared to those in the plains. The relative humidity in Beitummer city range from 25-85%, it reaches the maximum value in January (78%).

2.7.3 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.

2.7.4 Rainfall

Based on information obtained from Beitummer municipality ,The average annual rainfall in city Beitummer for the last five year is approximately 400-500 mm. The maximum annual rainfall in the period from 2005 to 2010 is 482.6 mm. This was in year 2005/2006.[Beitummer Municipality]

CHPTER THREE

DESIGN PARAMETERS

3.1 WASTEWATER COLLECTION SYSTEM DESIGN

3.1.1 General

Once used for its intended purposes, the water supply of a community is considered to be wastewater. The individual conduits used to collect and transport wastewater 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 wastewater 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 wastewater from a community is known as wastewater collection system. The purpose of this chapter is to define the types of sewers used in the collection systems, types of wastewater 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 wastewater 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 wastewater to the main sewers. Several main sewers connect to the trunk sewers that convey the wastewater 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 in).

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 Wastewater Collection Systems

Gravity Sewer System:

Collecting both wastewater 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 wastewater 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 intothe pressure system. There are no requirements with regard to the gradients of thesewers.

Vacuum Type System:

Collecting wastewater only in an airtight system. A vacuum of 5-7 m is maintained in the system for the collection and transportation of the wastewater. 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 40-60 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 40-60 m depending on the size of sewer and available size of sewer cleaning equipment.

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 pipepermits workmen to enter the manhole without fear of being wetted, avoid the splashing of sewage and corrosion of manhole bottom .

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, or service 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.

Inverted Siphons

An inverted siphon is a section of sewer, which is dropped below the hydraulic grade line in order to avoid an obstacle such as a railway or highway cut, a subway, or a stream. Such sewers will flow full and will be under some pressure; hence they must be designed to resist low internal pressures as well as external loads. It is also important that the velocity be kept relatively high (at least 0.9 m/s) to prevent deposition of solids in locations, which would be very difficult or impossible to clean.

Since sewage flow is subject to large variation, a single pipe will not serve adequately in this application. If it is small enough to maintain a velocity of 0.9 m/s at minimum flow, the velocity at peak flow will produce very high head losses and may actually damage the pipe. Inverted siphons normally include multiple pipes and an entrance structure designed to divide the flow among them so that the velocity in those pipes in use will be adequate to prevent deposition of solids .

3.1.5 Design Parameters

Flow Rate Projections:

The total wastewater flow in sanitary sewers for industrial area is made up of two components:

(1) Domestic

(2) Infiltration.

Sanitary sewers are designed for peak flows from domestic, and peak infiltration allowance for the entire service area. Theflow rateprojections are necessary to determine the required capacities of sanitary sewers.

- 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:

$$Pf = 1.5 + 2.5 / \sqrt{q} \qquad (4.1)$$

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

Hydraulic Design:

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

$$V = (1/n)\, R^{2/3}\, S^{1/2} \qquad (4.2)$$

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

1. 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.

2. 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.

3. Manholes and Covers

Manholes should be located at changes in size, slope direction or junction with secondary sewer. Manholes spacing generally does not exceed 60 m.

4. 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.

5. 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.

Important Numbers:

- Maximum velocity = 3 m/s
- Minimum velocity = 0.6 m/s
- Maximum slope = 15%
- Minimum slope = 0.5%
- H/D = 70%
- Minimum diameter 200 mm
- Minimum cover 1.5 m
- Maximum cover 5 m

CHAPTER FOUR

ANALYSIS& DESIGN

4.1General

In the previous chapters, the problem of the study area has been defined and the objectives of the project have been listed. The characteristics of the project area (Bietummar town) have been described. Wastewater collection systems and design of sewer system were explained. In this chapter, basis for planning and design will be discussed including present population, population forecasting, projected water consumption, town structure plan, and the design and planning criteria of the project.

4.2 Population

4.2.1 Introduction

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

In the town of Beitummar, as well as other Palestinian cities and towns, there is great uncertainty in the political and economical future. Additionally, there were no accurate population data since the occupation of the West Bank in 1967, until 1997 when the Palestinian Central Bureau of Statistic (PCBS) conducted comprehensive census covering the West Bank and Gaza Strip. The final results of this census show that the total population of Beitummar town is 15000 inhabitants.

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 assumptions have, therefore, been made to project the future population of the town of BeitUmmar over the next 25 years.

4.2.2 Population Forecast

Prediction of the future population of Beitummar 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 Beitummar.

The base for the forecast is the 2004 population for Beitummar obtained from PCBS of 15000 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 towns in the West Bank is 2 %. A similar rate of growth was assumed for the towns of Gaza, Therefore, the rate of 2 % per year was used for the future growth of the population ofBeitummartown .

To calculate the population at the end of the design period (year 2040), a geometric increase is assumed, represented by the following equation:

$$P = P_\circ * (1+ r)^n$$

Where, P is the future population, $P_\circ$ is the present population, r is the annual population growth rate, and n is the period of projection.

4.2.3 Population Density

When determining the density of population, it is either related to the total municipal area (gross density) or to the built–up area only (net density). The gross density related to the municipal area includes large industrial areas, agricultural areas, un-built areas, public parks, large water surfaces, forests …etc. The net density is related to the built up urban area, but it includes small-scale industries, schools, public and commercial buildings, small parks for local use and roads.

Sewer design, however, is based on the net densities of population, because the provision of sewers is limited to the built-up areas. The net density of population varies considerably from town to town as well as within a town from district to district. It is between 50 –1000 capita / dounm.as shown in figure (4.1)

4.3 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 wastewater collection system forBeitummer 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.InBeitummer city, there are two points of the first towardsAl-Aroob and the second point towardstowards thewest .
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.as shown in figure (4.2) .
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 paralleled with 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 wastewater collection system of Beitummercityis illustrated in Figure (4.3).

4.4 Quantity Of Wastewater

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

After preparing the layout of the wastewater collection system the quantity of wastewater that the system must carry will be calculated using the data collected about the area.

Design example: Design a gravity flow sanitary sewer

Design a gravity flow main sanitary sewer for the area to outfall (submain connected to sureef) shown in Figure(4.4). The following data will be collected and analyzed.

1. For current water consumption uses 70L/c.day.
2. For future water consumption uses 150L/c.day.
3. For current population
4. For future population : using the equation(4.1).
5. For population growth rate 2 %.

6. For design period use 25 years as a design period.

7. The wastewater calculates as 80% of the water consumption.

8. For infiltration allowance use 10% of the domestic sewerage flow.

9. Peaking factor depending on the formula :

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

Where q = average industrial sewage flow.

10. For the hydraulic design equation use the Manning equation with an n value of 0.01.

To simplify the computations, we use the tables.

11. Minimum pipe size: The building code specifies 200 mm (8 in) as the smallest pipe size permissible for this situation.

12. Minimum velocity: To prevent the deposition of solids at low wastewater flows, use minimum velocity of 0.6 m/s during the peak flow conditions.

13. Minimum cover (minimum depth of cover over the top of sewer). The minimum depth of cover is 1.5 m.

Solution :-

1. Lay out the sewer. Draw a line to represent the proposed sewer Figure (4.4).

2. Locate and number the manholes. Locate manholes at

(a) change in direction,

(b) change in slope,

(c) pipe junctions,

(d) upper ends of sewers,

(e) intervals from 50 to 60 m or less.

Identify each manhole with a number.

3. Prepare a sewer design computation table4.1 . 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 data in the table are calculated as follow:

4. The entries in columns 1 and 2 are used to identify the line numbers and street sewer name.

5. The entries in columns 3 through 5 are used to identify the sewer manholes, their numbers and the spacing between each two manholes.

6. The entries in column 6 used to identify unit sewage. Unit sewage = 80% multiplied bythe current consumption density divided area in dounm.

7. The entries in columns 7 and 8 are used tributary area, column 7 used incremental area, column 8 used total area in dounm.

8. To calculate municipal maximum flow rates columns 9, 10, are used. Column9 is 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).

9. Column 11 used to calculate the Q max ,the value of it comes from multiply column 10* column 9.

10. Column 12 calculate the infiltration which equal to 10% $Q_{average}$ (10% * column 9). Column 13 and column 15 used to show the maximum flow design which is come from column 11+ column 1

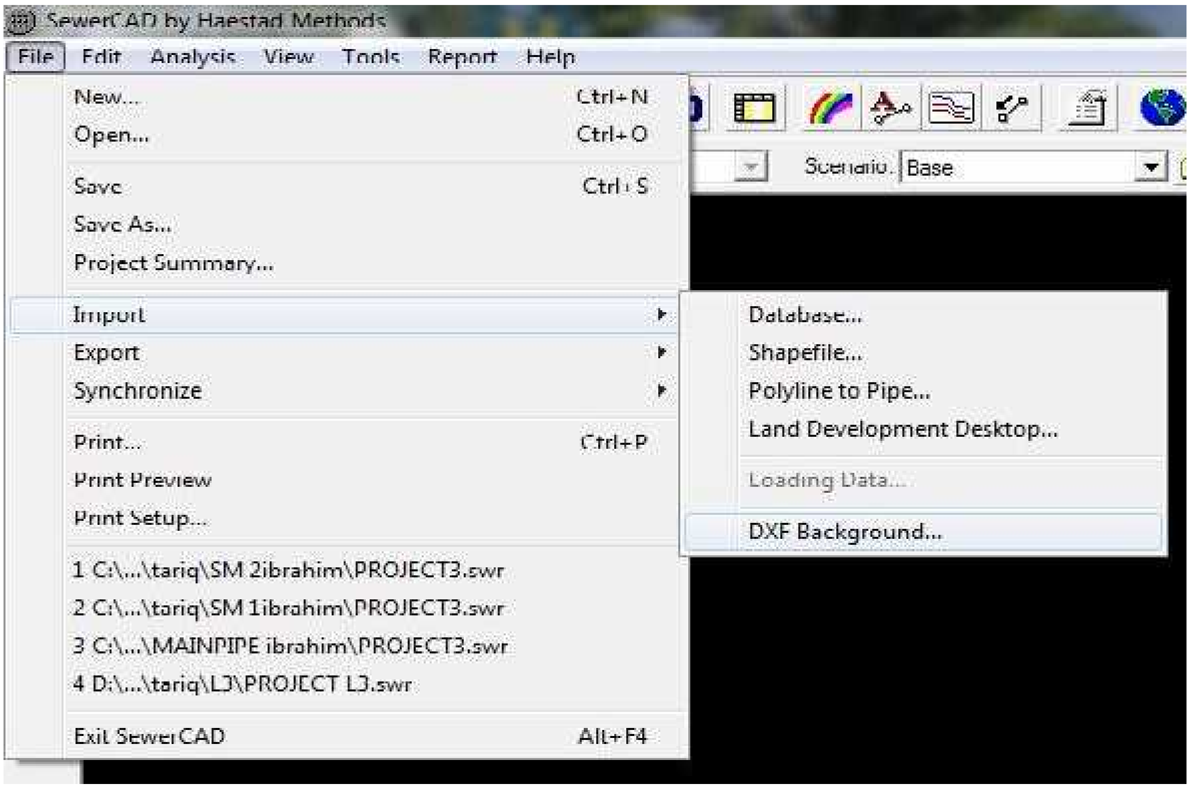
Table 4.1 shows a sample calculation for computing the quantity of waste water in on line of the system .

To making design for all pipes a software program (sewer CAD) was used to calculate the pipe size , slope , velocity and cover of the pipe section 4.5 is showing the basics of working on sewer CAD program .

4.5 Sewer CAD Program Works:

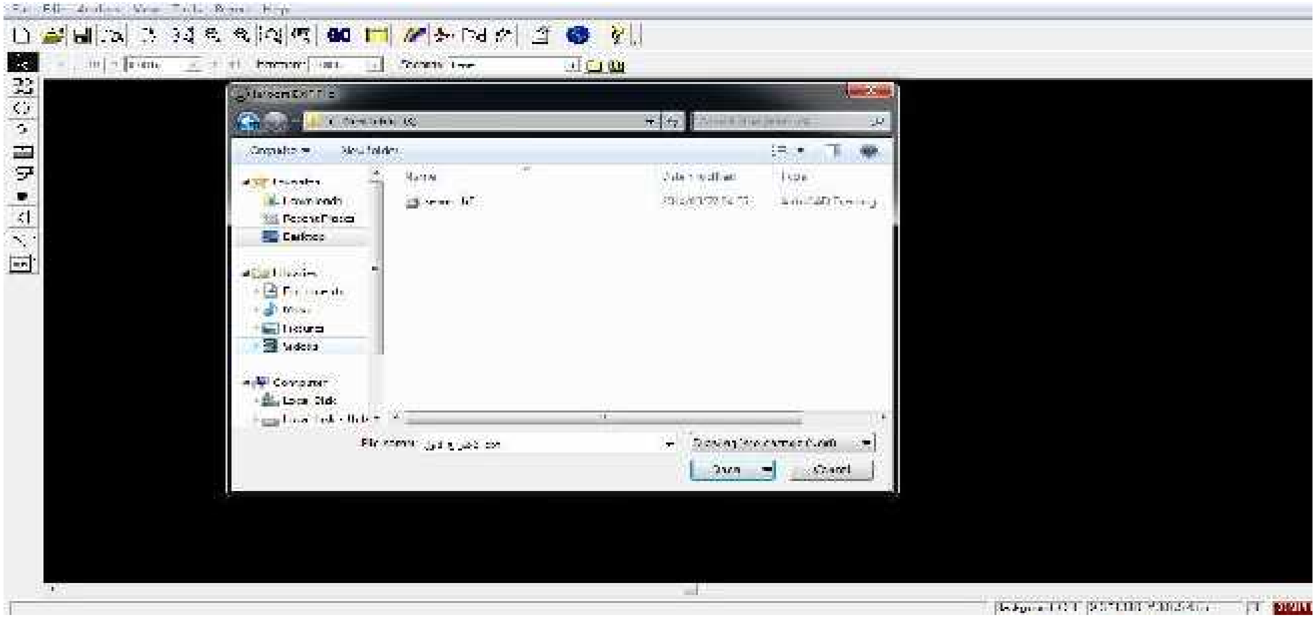
a. Open Sewer CAD, select file → import → DXF Background to import the DXF file,

Fig (4.5) below shows thisstep.



Fig(4.5)

b. Specify file location is then press open, Fig (4.6) below shows this step. And Fig (4.7) shows line (Soreef line).



Fig(4.6)

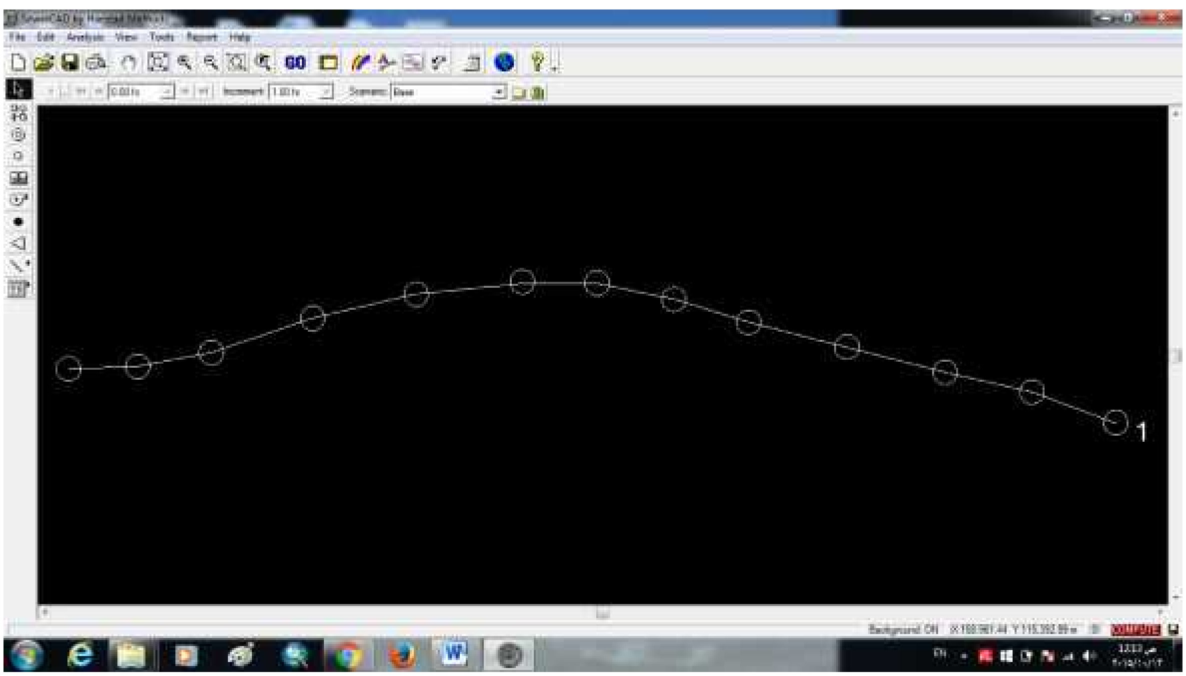


Fig (4.7)(soreef line)

c. Press pipe icon, a massage will appear tell you to create a project .

d. Press yes and define the project then press next twice, then select finish, the Fig (4.8) below show thisstep.

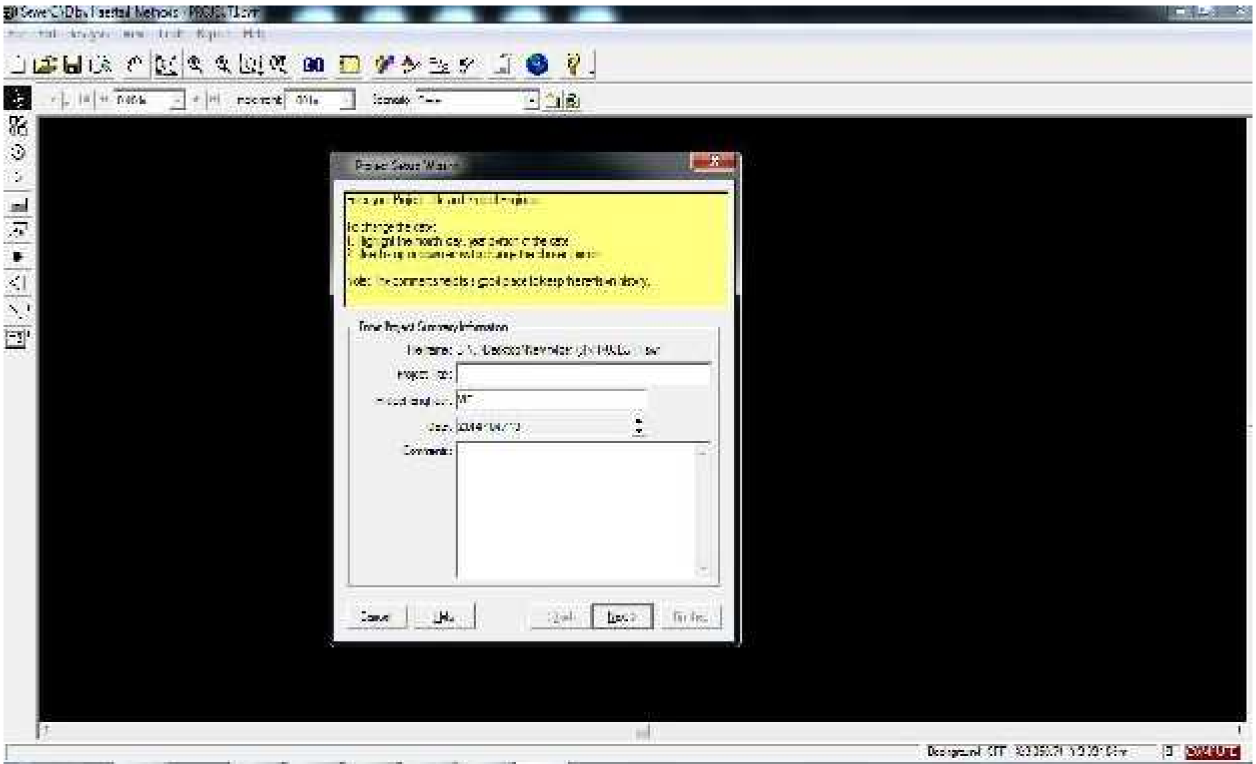


Fig (4.8)

e. Press pipe icon and connect between inlets, Fig (4.9) below shows thestep.

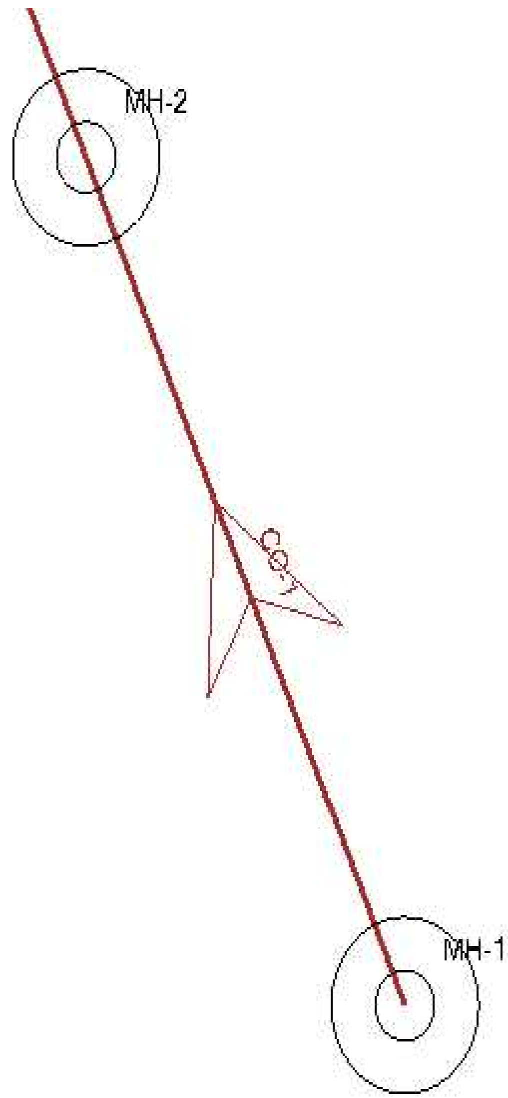


figure (4.9) :pipe network

F. After you connect between all inlets, press on the out let icon and click on the last inlet, then press yes to replace the inlet with outlet, the Fig (4.10) below shows the step

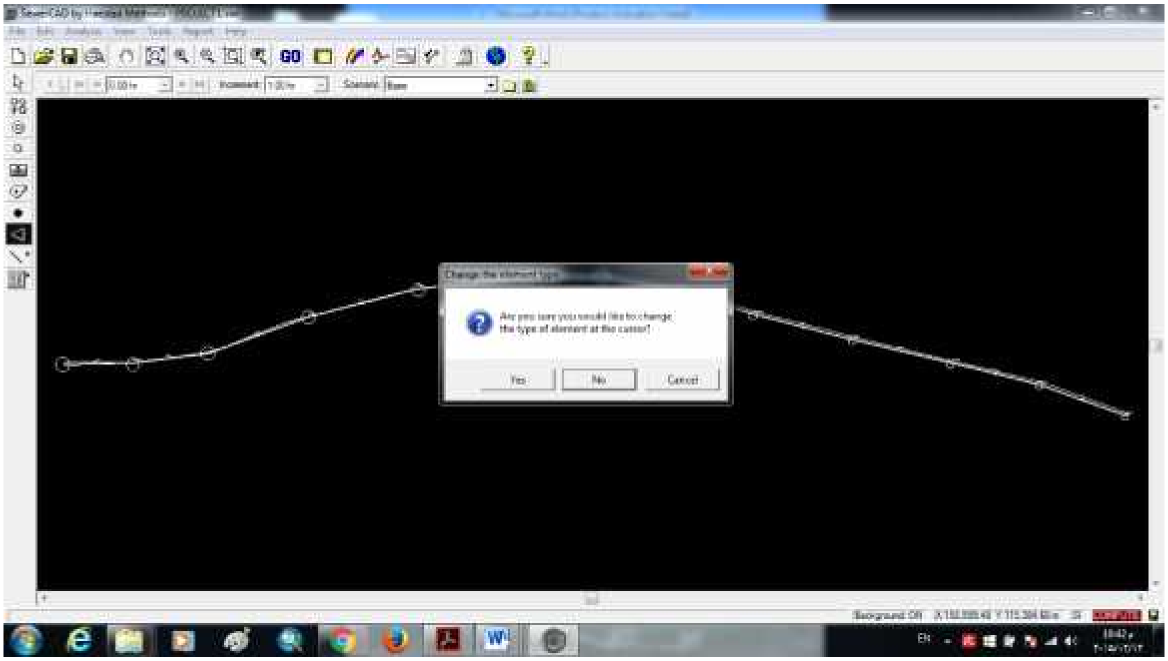


figure (4.10)

g. Save your project, then select analysis → alternatives → physical properties → edit,

then start editing gravity pipe, see Fig(4.11).

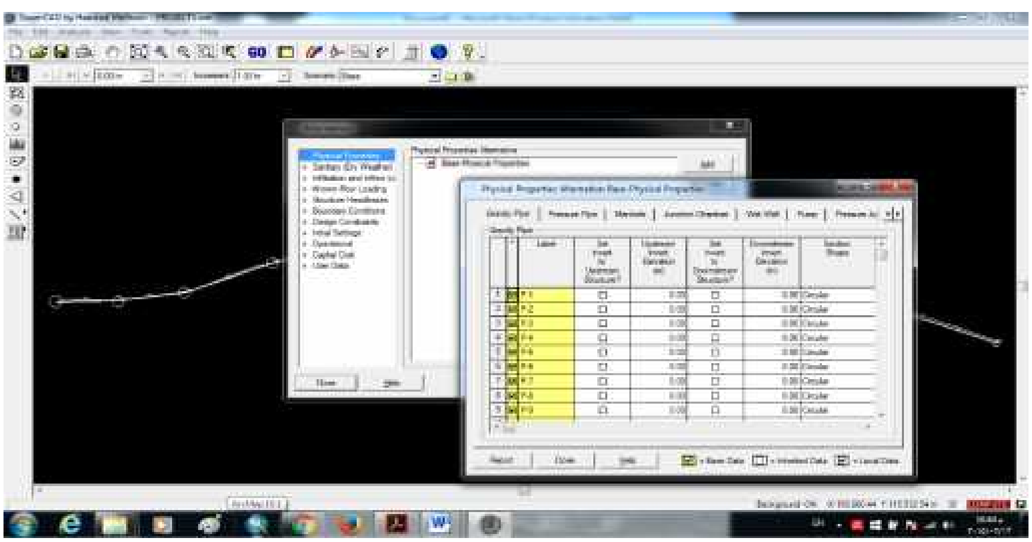


figure (4.11)

h. Select inlet to enter the ground elevations of inlets, then select out let to enter its elevation. Then press close. Fig (4.12) below shows thestep.

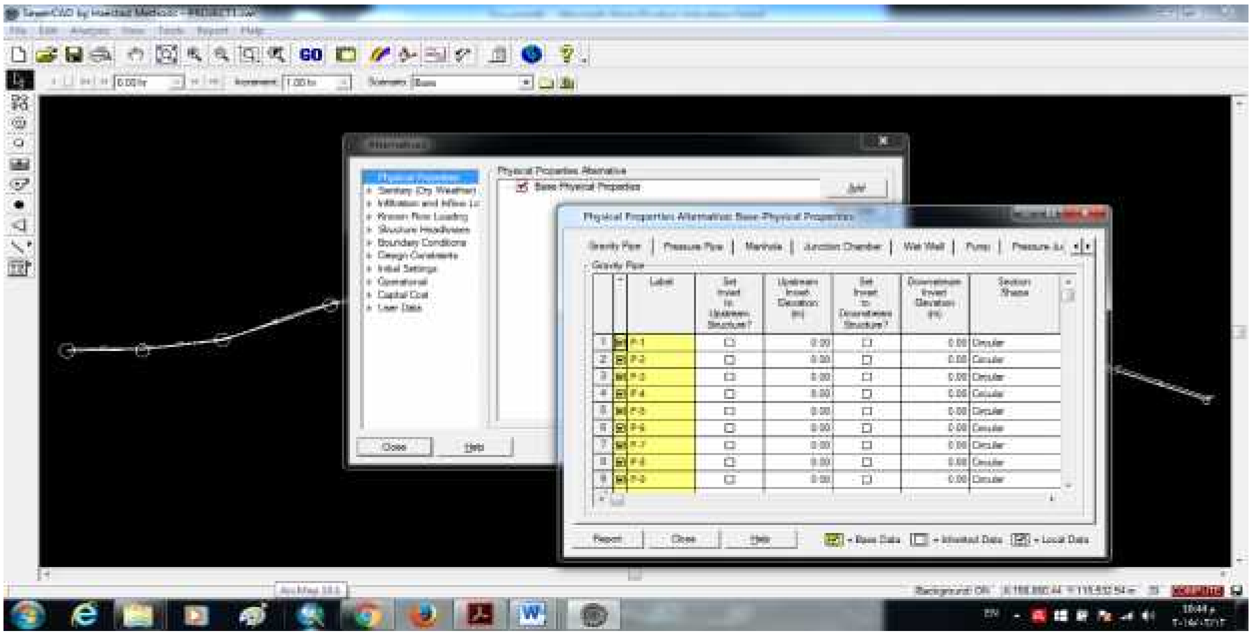


figure (4.12)

i. Select sanitary → edit → manhole to select the type of load and toenter the load for each inlet, Fig (4.13) below shows thestep.

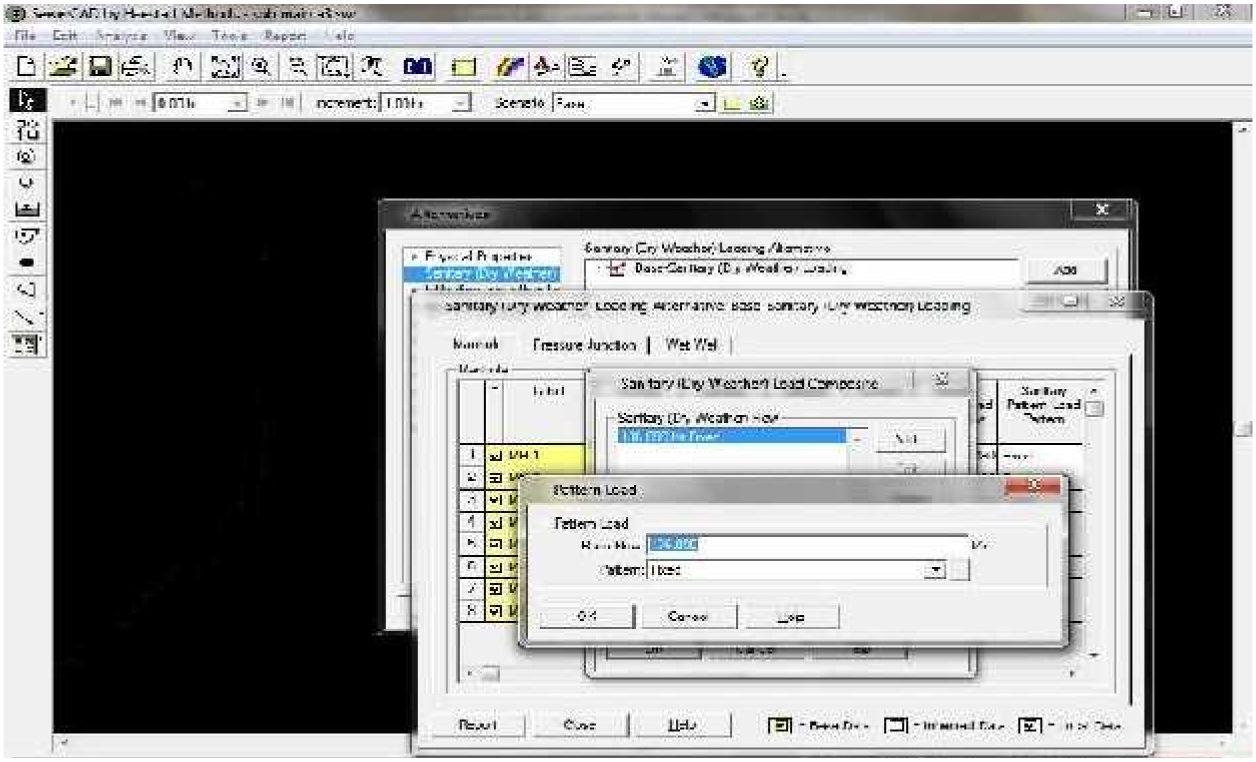


figure (4.13)

j. Afterdoingthisforeachinletpressclose,thenselectdesignconstrains→editto enter the design specifications, Fig(4.14) below shows thestep.

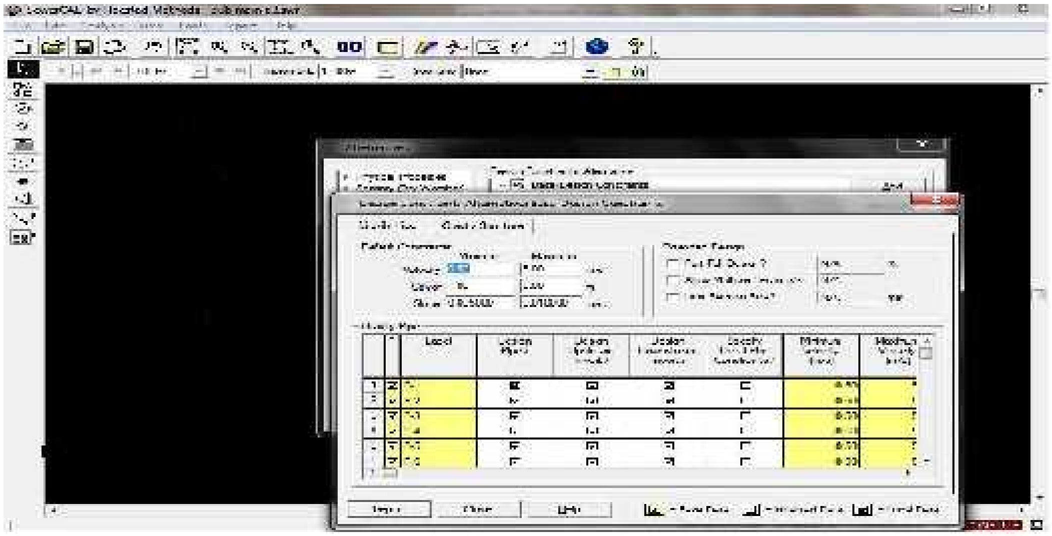


figure (4.14)

k. Last step press save, press GO button to start design then press on GO, Fig (4.15) below shows thestep.

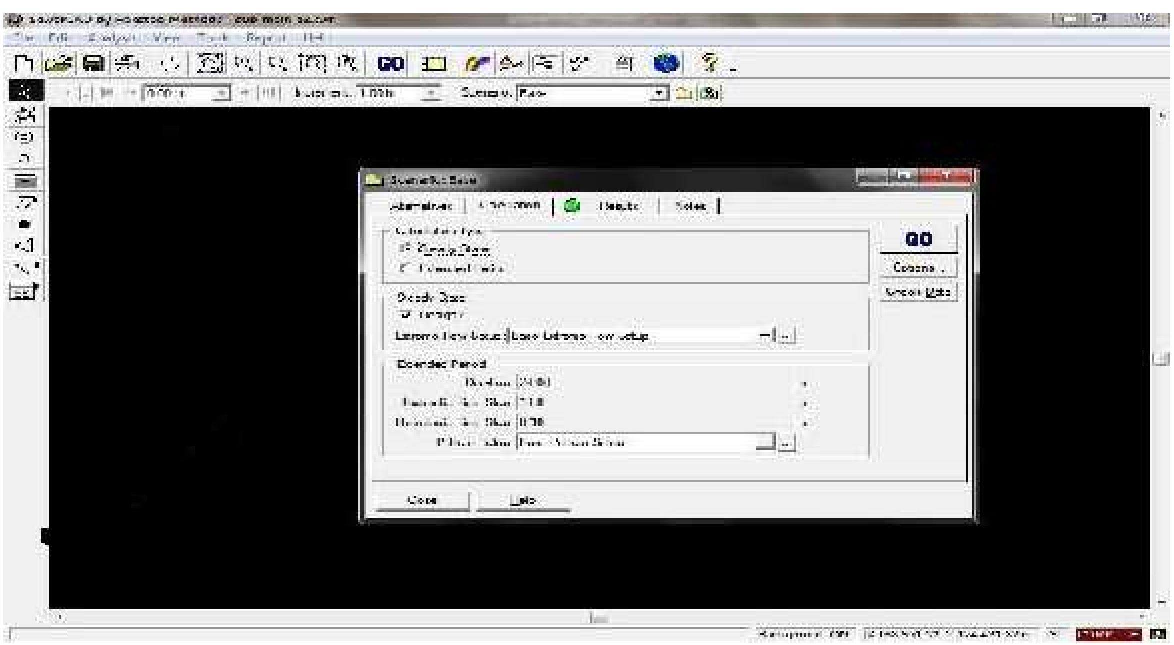


figure (4.15)

L. If you have green light that mean there is no problems in the design work, but if you have yellow or red light that’s mean there is problem, read the massages and fix these problems.

m. After finishing design work we need to show the pipe line profile and the profile, gravity pipe report and manhole report. Press profile button to make the profile see Fig (4.16), here we should put the scale of the profile. The profiles for this project are attached in appendix C.We can get the required tables by pressing tabular report button see Fig (4.17), and then choose gravity pipe report and manhole report. The required reports for this project are attached in appendix B.

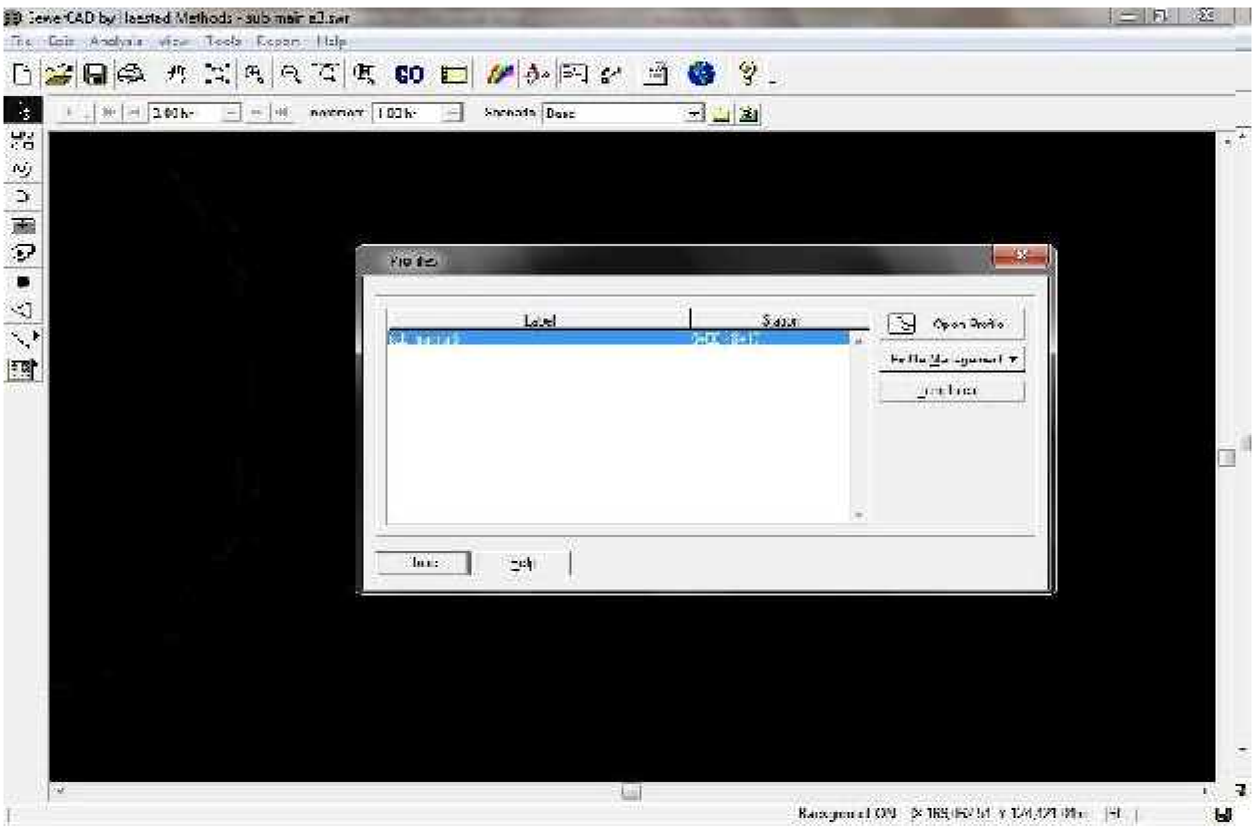


fig (4.16)

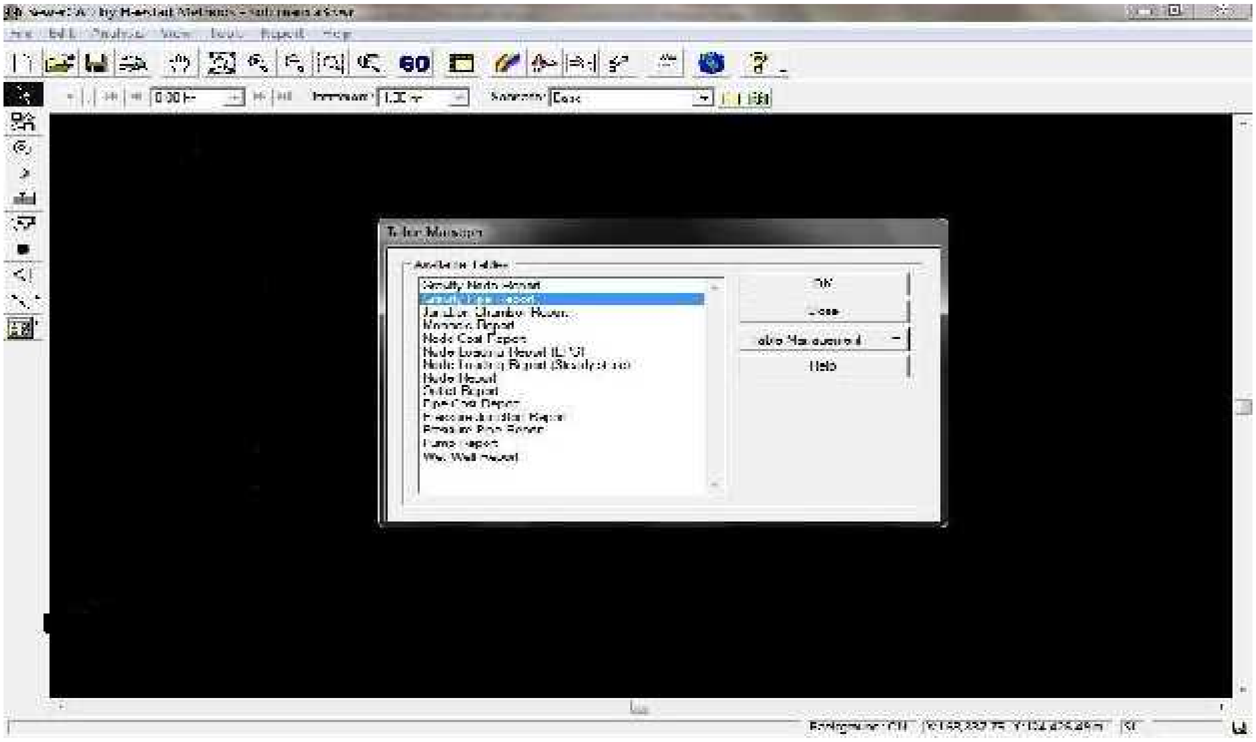


fig (4.17)

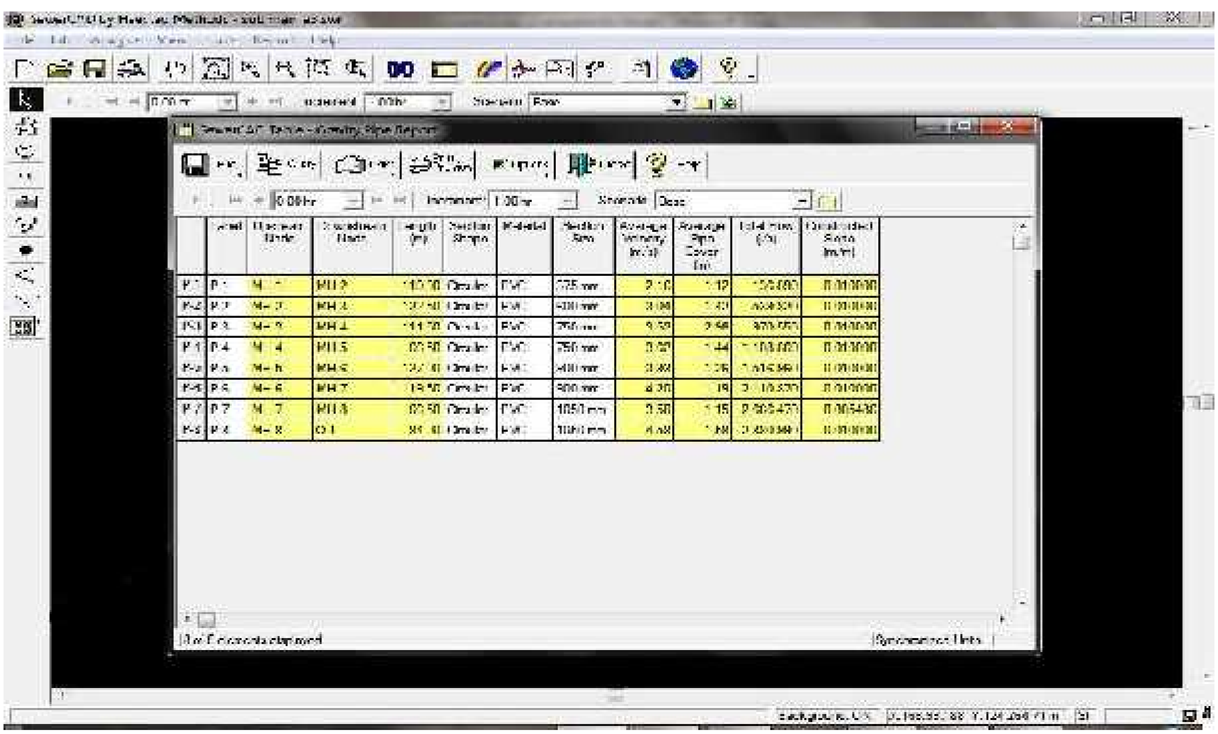


Fig (4.18) Example of waste WaterTable

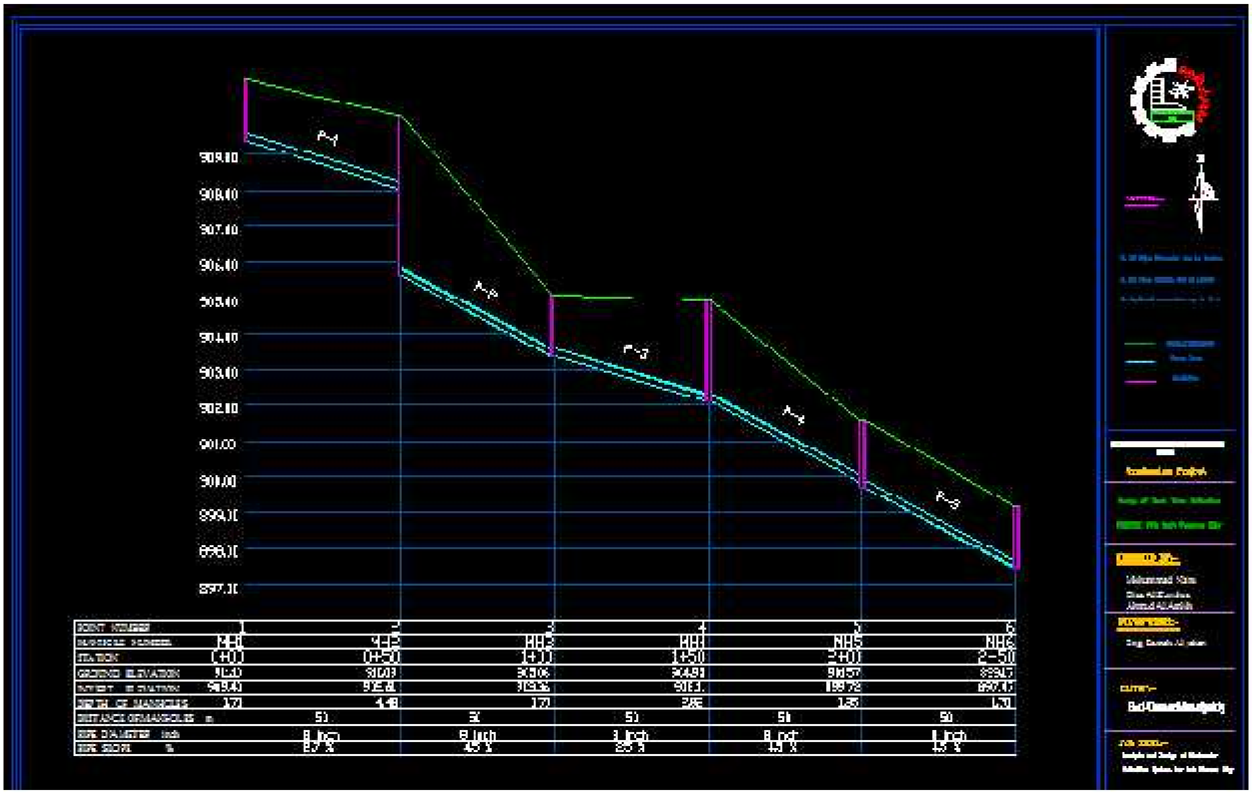


Fig (15) Example of waste waterprofile

Table 4.2 and Table 4.3 showing a sample calculation done by the programe on sewer line of soreef.

All table are in Appendix A

Fig 4.1 showing a sample profile drown by sewer CAD for soreef line

All profile are in Appendix B

CHAPTER FIVE

BILL OF QUANTITES

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 200mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	155618				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 250mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	20				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 300mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	300				
Sub-Total							
B	**PIPE WORK**						
B1	Supplying, storing and installing of PVC	LM	155938				

Sub-Total							
C	**PIPE BEDDING AND BACKFILLING Dimension and material**	LM	155938				
C1	Supplying and embedment of sand for one pipe diameter 8 inch, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	155618				
C2	Supplying and embedment of sand for one pipe diameter 10 inch, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	20				
C3	Supplying and embedment of sand for one pipe diameter 12 inch, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	300				

D	**MANHOLES, Details according to the drawing**						
D1	Supplying and installing of precasted manhole including excavation pipe connection, epoxytar coating, 25-ton cast iron cover and backfill, size 1200mm, depth up to 1.5m.	NR	312				
D2	Supplying and installing of precasted manhole including excavation pipe connection, epoxytar coating, 25-ton cast iron cover and backfill, size 1200mm, depth up to 2.5m.	NR	64				
Sub-Total							
F	**Air And Water Leakage Test**						
F1	Air leakage test for sewer pipe lines and 15 inch according to specifications, including for all temporary works.	LM	155938				
F2	Water leakage tests for manholes, depth up to 1.5 meter according to specifications.	NR	312				
F3	Water leakage test for manholes , depth up to 2.5 meter according to specification	NR	64				

Sub-Total							
G	**Survey work**						
G1	Topographical survey required for shop drawings and as built DWGS using absolute Elev. And coordinate system	LM	155938				

CHAPTER SIX

CONCLUSIONS

6.1 CONCLUSIONS

In this project a trial is made to design a waste water collection system for Beitummer city considering the annual growth of the people and their water consumption for the coming 25 years the main conclusion drown from the present study are summarized below : -

1- The proposed is a waste water collections system for BeitUmmer city is obtained and it will cover all of the area.

2- The senitary system is consisting of five main lines ,All lines in the senitary system are running by gravity, Except two line by pumping , One pump station is created in the southern part of BeitUmmar ,it is located on Main Trunk3 and the other pump in the beginning of main five.

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APPINDEX A

APPINDEX B