ENVIRONMENTAL ASSESSMENT FOR AL-DAHRYIA OLD CITY

By

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ABSTRACT

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Project Team

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The architectural heritages of the region reflect the identity, culture, and the link between past and present and clear evidence of original and authenticity.

Old Cities make a connection with ancestor and give a sense and understanding of history that no other documents or evidence exist.

Old Cities should to keep them and rehabilitate of architectural heritage to protect it and to develop it to suit the circumstances of the times and cultural transformations ongoing. Preservation and reuse of historic buildings serve resource and reduce material consumption and consumes less energy than demolishing buildings and constructing new ones.

Palestine has many oldest historical cities which having an important value for national and international sector.

Al-Dahriya old city is one of the most important areas in Palestine that has a historical and religious value .it is located in the southern part of Hebron city.

This study make an environmental assessment for Al-Dahriya old city by studying the current situation of the area then making an evaluation and assessment of all environmental parameters including parts of infrastructure then making a designs for the waste water and storm water systems , this study also make the design of a suitable septic tank for the study area and it engineering solution for some environmental problems.

إهداء

لابد لنا ونحن نخطو خطواتنا الأخيرة في الحياة الجامعية من وقفة نعود إلى أعوام قضيناها في رحاب الجامعة مع أساتذتنا الكرام الذين قدموا لنا الكثير باذلين بذلك جهودا كبيرة في بناء جيل الغد لتبعث الأمة من جديد.

وقبل أن نمضي نهدي عملنا هذا

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

الى الأسرى البواسل .... يا من تقبعون خلف قضبان الحديد...في زنازين الغدر والقهر والجلادين

الى روح الشهداء العظام الذين تتوشح فلسطين اليوم بأثواب اجسادهم

إلى الذين مهدوا لنا طريق العلم والمعرفة .... إلى جميع أساتذتنا الأفاضل ونخص بالذكر مشرفة المشروع المهندسة سماح الجعبري على الجهد الذي بذلته معنا .

وكذلك نشكر كل من ساعد على إتمام هذا البحث وقدم لنا العون ومد لنا يد المساعدة وزودنا بالمعلومات اللازمة لإتمام هذا البحث ونخص بالذكر

المهندس احمد الحرباوي, مؤسسة رواق , بلدية الظاهرية, شعبة المعماري لعام 2015, الاستاذ لبيب ابو حمدية.

إلى أبي النور الذي ينير لي درب النجاح الذي لم يبخل علي يوماً بشيء ..

إلى أمي الحبيبة ....من بها أكبر وعليه أعتمد .... إلى شمعة متقدة تنير ظلمة حياتي .... إلى من بوجودها أكتسب قوة ومحبة لا حدود لها..

إلى اخوتي وخواتي .... طالبات وطلاب هندسة تكنولوجيا البيئة .... إلى من تحلو بالإخاء وتميزوا بالوفاء والعطاء إلى ينابيع الصدق الصافي الى من معهم سعدت ، وبرفقتهم في دروب الحياة الحلوة والحزينة سرت إلى من كانوا معي على طريق النجاح والخير .... إلى من عرفت كيف أجدهم وعلموني أن لا اضيعهم

إلى اختي توأم روحي ورفيقة دربي .... إلى صاحبة القلب الطيب والنوايا الصادقة .... إلى من رافقتني منذ أن حملنا حقائب صغيرة ومعك سرت الدرب خطوة بخطوة وما تزال ترافقني حتى الآن

إلى اخي من أرى التفاؤل بعينه .... والسعادة في ضحكته .... إلى شعلة الذكاء والنور ..

فريق العمل

حنين ابوصبحة

ساجدة الدراويش

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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, College of Engineering, the Department of Mechanical Engineering . 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.

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Work Team

TABLE OF CONTENT

CHAPTER 1 : INTRODUCTOIN

CHAPTER 2 : CHARACTERISTICS OF THE PROJECT AREA

CHPTER 3 : CURRENT SITUATION OF AL-DAEHRIYA OLD CITY

CHPTER 4 : DESIGN PARAMETERS

CHPTER 5 : ANALYSIS AND ASSESSMENT

CHPTER 6 : Bill of Quantity

CHPTER 7 : Conclusions and Recommendations

Appendix

References

LISTS OF TABLES

LISTS OF FIGURES

FIGURE#	DISCRIPTION	PAGE

Chapter One

Introduction

1.1 General

Before the First World War, rapid industrialization and urbanization in western countries was causing rapid loss of natural resources. This continued to the period after the Second World War giving rise to concerns for pollution, quality of life and environmental stress. In early 60s, investors and people realized that the natural environment and the projects they were under taking were affecting the environment, resources, raw materials and people must be study, evaluation and analysis. As a result of this, experience groups formed with the aim of getting a tool that can be used to safeguard the environment in any development this will be done by environmental assessment [1] .

Environmental assessment implies the determination of the environmental consequences, or impact, of current natural environment or proposed projects or activities. An environmental assessment is, therefore, a study of the probable changes in the various socioeconomic and biophysical characteristics of the environment which may results from proposed or impending action [1].

The USA decided to respond to these issues and established a National Environmental Policy Act in 1970 to consider its goal in terms of environmental protection. The USA became the first country to enact legislation on Environmental Impact Assessment (EIA). This was the first time that EIA became the official tool to be used to protect the environment. The United Nations Conference on the Environment in Stockholm in 1972 and subsequent conventions formalized EIA, So comparison between Environmental Impact Assessment and Environmental Assessment must be considered.

EIA is a tool designed to identify and predict the impact of a project impact means change any change, positive or negative-from a desirability standpoint on the bio-geophysical environment and on man's health and well-being, to interpret and communicate information about the impact, to analyze site and process alternatives and provide solutions to mitigate the negative consequences on man and the environment.

An EA is : "A management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing in the aim of helping to safeguard the environment by :

-facilitating management and control of environmental practices,

• Assessing compliance with company policies, which would include meeting regulatory requirements".

Environmental assessment encompasses varied disciplines, and consequently requires the expertise of personal knowledgeable in various technical areas.

Environment attribute consisting of both natural and human caused factor .The environment is admittedly difficult to characterize because of its many attribute and complex interrelationship among them.

So it's better to create a set of attribute before we began to prepare environmental documentation as shown in Table (1.1).

Table (1.1):Example of environmental attribute. [1]

Air	Water	Ecology	Sound
Diffusion factor	Flow variation	Large animals	Physical effects
Particulate	Suspended solid	Small game	Communication effects
Sulfur oxide	Acid &Alkali	Aquatic plants	Performance effects
Nitrogen oxide	Biological oxygen demand (BOD)	Natural and vegetation	Sound behavior effect
Carbon monoxide	Chemical oxygen demand COD	Field crops	
Odors	Dissolved solid	Threatened species	
Hazardous toxicants	Fecal coliforms		

Human aspects	Economic	Resources	Land
Life styles	Regional economic Stability	Fuel resources	Soil stability
Community needs	Public sector review	Nonfuel resources	Natural hazards
Psychological needs		aesthetics	Land use patterns

lany methodologies have developed which allow the user to have more accurate iformation. Depending upon the specific needs of the user and type of project being ndertaken .One particular methodology may be more useful than another.

.2 Problem Definition

he old city (historic center) in any city of the world is considered as a famous site from rchaeological, cultural, religious, and historical side.

here are many historic centers in Palestinian cities that has recently been suffering from ignificant environmental problems such as water shortages, air pollution, soil pollution, nd lots of other problems as a result of leaving these areas and largely neglected.

ne of the most historic centers in Palestine is Al-Dahriya City.

l-Dahriya Old City located in the center of Al-Dahriya and represents the cultural and istorical side of city .It suffers from a series of environmental problem such as nconsciousness of the value of heritage building, Shortage of water resources and reatment where there is no sanitary networks and bad management of the solid waste.

.3 Project Objectives

his project includes the following main objectives:

. Make an environmental study for the current satiation in Al-Dahriya Old City this done y studying the following points:

a) Infrastructure.

b) Water.

. Make an analysis for the environmental study throughout comparison between the arameter current situation and the international parameter.

. Make an environmental assessment for the whole area.

. Making a complete design for some parts of infrastructure or making redesign for parts hat are need rehabilitation.

. Design of primary treatment of the collected waste water.

1.4 Phases of Project

The project consists of four phases, which are designed to be completed in accordance with time schedule shown below .The description of each of the four phases of the project and tasks involved are listed below:

Table (1.2): phases of the project with their expected duration

Title	Duration "year 2015"							
	1/2	1/3	1/4	1/5	1/9	1/10	1/11	1/12
Data collection and survey	■	■	■	■				
Field work		■	■	■				
Study and analysis			■	■	■	■		
Analysis and design parameter					■	■	■	■
Assessment and writing and preparing the report					■	■	■	■

1.4.1 First phase: Data collection and survey

During this phase available data and information were collected from different sources.

Moreover many site visits were done. This phase includes the following activates:

1. All needed maps for the area were collected.
2. Metrological data were collected from different source.
3. Collecting Infrastructure data.

1.4.2 Second phase: Field work

Many site visits to evaluate the environmental condition of Al-Dahriya Old City, visits were done for:

a) Studying area to assess the environmental factors and samples of soil and water were collected.

b) Visiting the municipality of Al-Dahriya city to get more information about the old city there.

c) Visit Riwaq Institution to get required maps and information.

1.4.3 Third phase: Study and Analysis

During third phase certain task were done as following:

1. Define the requirement activities.
2. Define the affected attribute.
3. Evaluate environmental impact and summarize them.

1.4.4 Fourth phase: Assessment, design and/or redesign, and preparing the report

During this phase the final estimation of the last stage, the project team prepared a complete design for some parts of infrastructure.

Final report prepared and submitted to the department of Environmental Technology Engineering at Palestine Polytechnic University.

1.5 Organization of the study

The study report has been prepared in accordance with the objectives and of work.

The report consists of seven chapters.

The first chapter entitled "Introduction" introduce basic concept associated with environmental assessment also the comparison between environment assessment and environment impact assessment, then talk about environment assessment elements and methodologies.

Chapter two entitled "Characteristics of the Project Area" which deals with history, socio-economic, geographic data, and climate characterization of site.

Chapter three entitled "Current Situation" which deals with the environmental condition of Al-Dahriya Old City.

Chapter four entitled "Design Parameters" which deals with quantity and volumes of the solution described in chapter four.

Chapter five entitled "Analysis and Assessment" which deals with analysis the result and find solution for present environmental problems.

Chapter six "Bill of Quantity " which deals with numbers required of pipe, manholes for both waste water collection system and drainage system, and containers' for solid management.

Chapter seven entitled "Conclusions and recommendations" which deals with the conclusions of the study and provide recommendation for mitigation of the potential negative impacts and enhancement of the positive ones.

Chapter two

Characteristics of the Project Area "Al- Dahriya Old City"

2.1. General

In this chapter, basic data of Al-Dahriya City will be discussed. Topography, meteorological data, Population data, water consumption, and wastewater production.

2.2. Project Area

Al-Dahriya City is located to the northwest of the main street connecting between the cities of Hebron and Beersaba, extending from the beginning of the valley Ghemari south to the north east area of Abu Alroazin. Figure (2.1) below show general view of Al-Dahriya Old City.

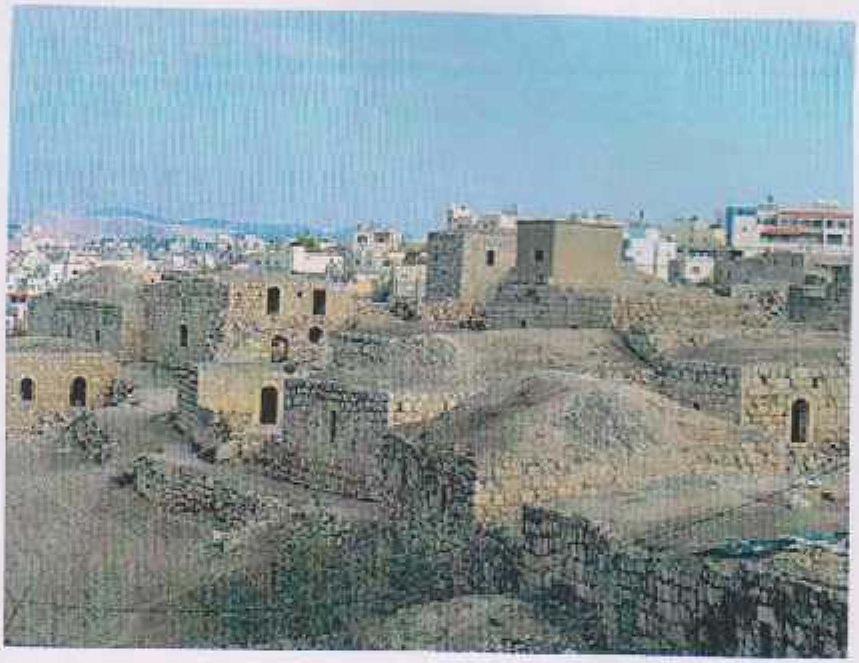

Figure (2. 1) General View of the of AL-Dahriya Old City[2].

It is twenty three kilometers south-west of Hebron. It surrounding from north Dura city, Samu from east, Berg and Ramadeen from west, and Beersaba from south. Figure (2.2) show the location of Al-Dahriya Old City.

Palestine Polytechnic University
College of Engineering and Technology

Al Dahiriya	
West Bank	

Project Title:
Enviromental Assessment Of Al Dahiriya Old City

Created by:

Haneen Abu Subha
Sajida Al Daraweesh

Project Supervisor:
Eng.Samah Al-Jabari

Coordinate System:Palestine_1923_Palestine_Grid
Projection: Cassini

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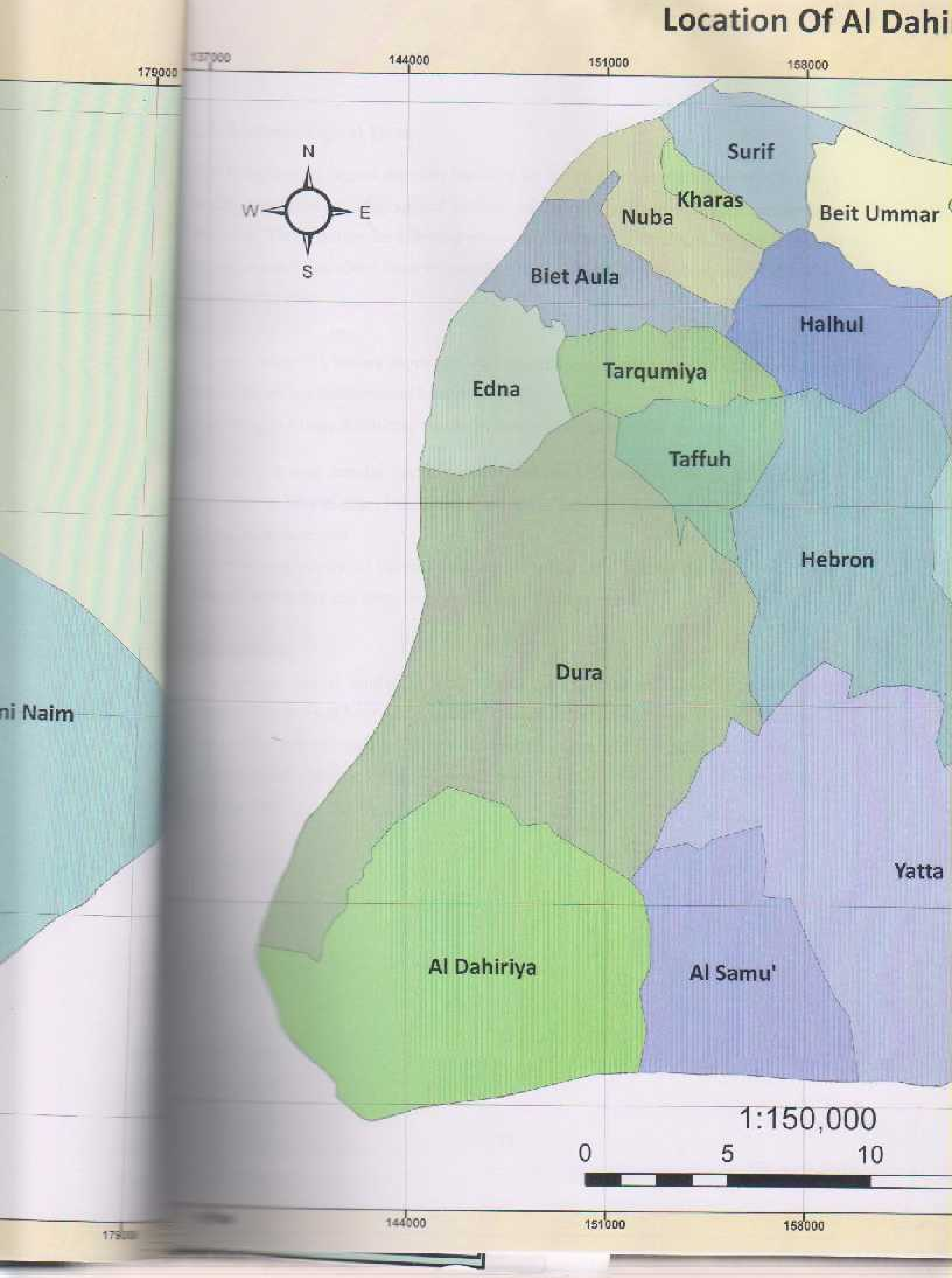
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2.3. Meteorological Data

The hydrology of region depends basically on its climate, and topography. Climate is largely dependent on geographical position of the earth surface, humidity, temperature, and wind. These factors are affecting on evaporation and transpiration. So this study will include needed data about these factors. Figure (2.3) show Digital Elevation Model of Al-Dahriya Old City.

The city rising 651 meters above sea level which means medium height characterized by semi – desert to Mediterranean basin climate [3].
According to Riwaq Institution climate in general can split to two seasons:

a) Rainfall season ,usually start in October and reach its peak in February then decrease gradually in May month .This climate consist of two seasons went season, and part of spring, autumn season.
b) Dry season consist of summer and part of spring, and autumn seasons .It start from May till September and sometimes continue to October month.

2.3.1 Rainfall

The average annual rainfall at area reaches approximately 337 mm .Rainfall occurs between October and May while it rarely rains in the summer season .The driest month is June, with 0 mm of rainfall. The greatest amount of precipitation occurs in January, with an average of 250 mm.. Figure 2.4 and table 2.1 show the amount of rainfall in Al-Dahriya City.

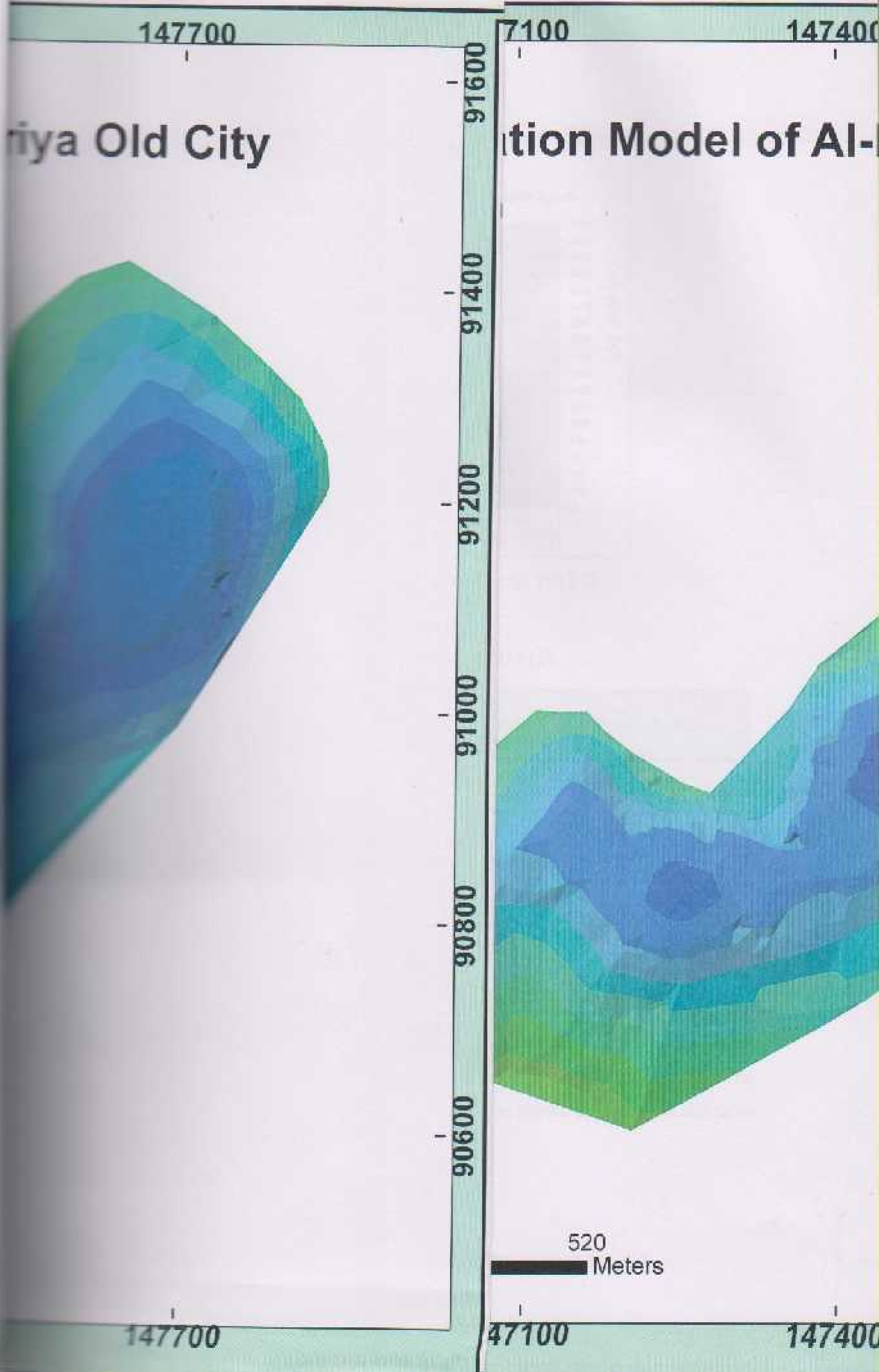
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Figure (2.4): Rainfall in Al-Dahriya City till 2013 [2].

Table(2.1):Al-Dahriya Rainfall 2013 [2].

Station	Accumulative Rainfall	General rate	Percent Ratio
Dahriya	155.9	336.5	46

Temperature

The climate here is classified as Subtropical Dry Arid (Desert) (BWh)by the Köppen-Geiger system. The annual average Annual rate is (17-19 c°) .Rate of colder temperatures ranging from 6 to 14 c°, while the highest temperature (26-34 °C).The warmest month of the year is August, with an average temperature of 26.7 °C. The lowest average temperatures in the year occur in January, when it is around 12.3 °C. The variation in temperatures throughout the year is 14.4 °C, as shown in figure 2.6 and table 2.2 below.

Table (2.2):Al-Dahriya climate [4].

month	1	2	3	4	5	6	7	8	9	10	11	12
mm	14	11	6	3	2	0	0	0	0	3	8	12
°C	12.3	13.1	15.8	19.0	22.9	25.6	26.6	26.7	24.7	22.6	18.7	14.2
°C (min)	8.1	6.6	8.8	11.3	14.9	18.1	19.5	19.6	17.8	15.7	12.6	8.1
°C (max)	18.6	19.7	22.8	26.8	30.9	33.2	33.8	33.9	31.7	29.5	24.8	20.4
°F	54.1	55.6	60.4	66.2	73.2	78.1	79.9	80.1	76.5	72.7	65.7	57.6
°F (min)	43.0	43.9	47.8	52.3	58.8	64.6	67.1	67.3	64.0	60.3	54.7	46.6
°F (max)	65.5	67.5	73.0	80.2	87.6	91.8	92.8	93.0	89.1	85.1	76.6	68.7

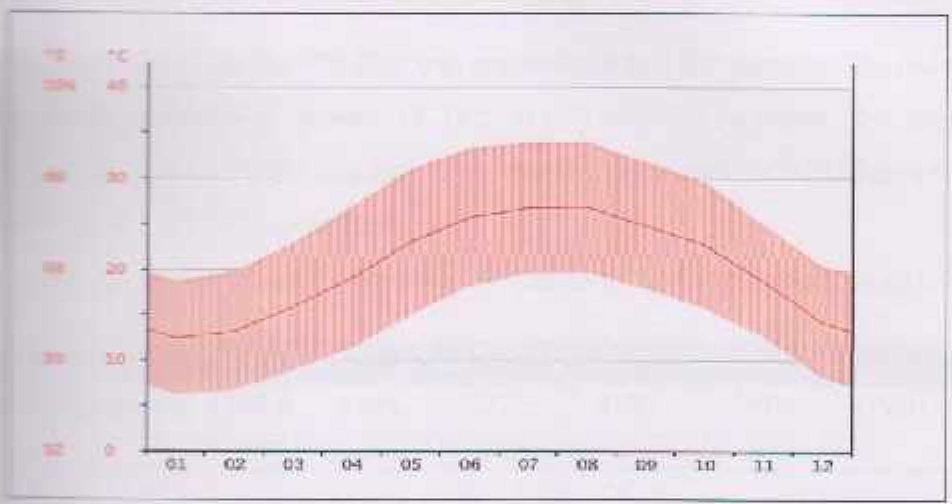


Figure (2.5): Temperature graph in Al-Dahriya City[4].

Population

Population projection

The base for the forecast is the 2007 population for Al-Dahriya City obtained from Palestine Central Bureau of Statistics (PCBS) of 28776 parsons. The annual growth rates [illegible]% in the west bank [1].

To calculate the population for the coming 25 year, a geometric increase is assumed, represented by the following equation:

$$P = P_0 * (1 + r)^n \quad (2.1)$$

Where:

P: Future population.

P0: Current population.

n: Time period.

r: Population growth.

2.2.2 Population Forecast for Al-Dahriya Old City

The population of Al-Dahriya Old City was approximately 1300 parsons. The old city has annual average population growth of (3.5 %). Table 2.3 presents the population projection up to the year 2036. The data show that the population of Al-Dahriya Old City estimated to be 3693.8 in year 2036.

Table (2.3) Population Forecast for Al-Dahriya Old City [Project Team].

Year	2007	2011	2015	2020	2025	2030	2036
Population(capita)	1300.0	1544	1772	2105	2500	2970	3651

2.3 Importance of the Area(capital)

Historical importance of a city can be measured of how much the city have historical monuments, and cultural heritage. Al-Dahriya City have a particular importance because line of communication between the two natural environments are the Hebron mountains and the Negev desert .The figure 2.6 show famous site in Al-Dahriya Old City archeological site. Also the city have within it many of historical monuments which eight hundred and eighty one historical buildings as Rawq Institution Statistics like:

- Qisaria.
- Omari Mosque.
- Om Al- Fadel.
- Al-Shohda.

5. Maqbara and Maqam Abu-Dabor.

6. Maqam Abu-Hashim.

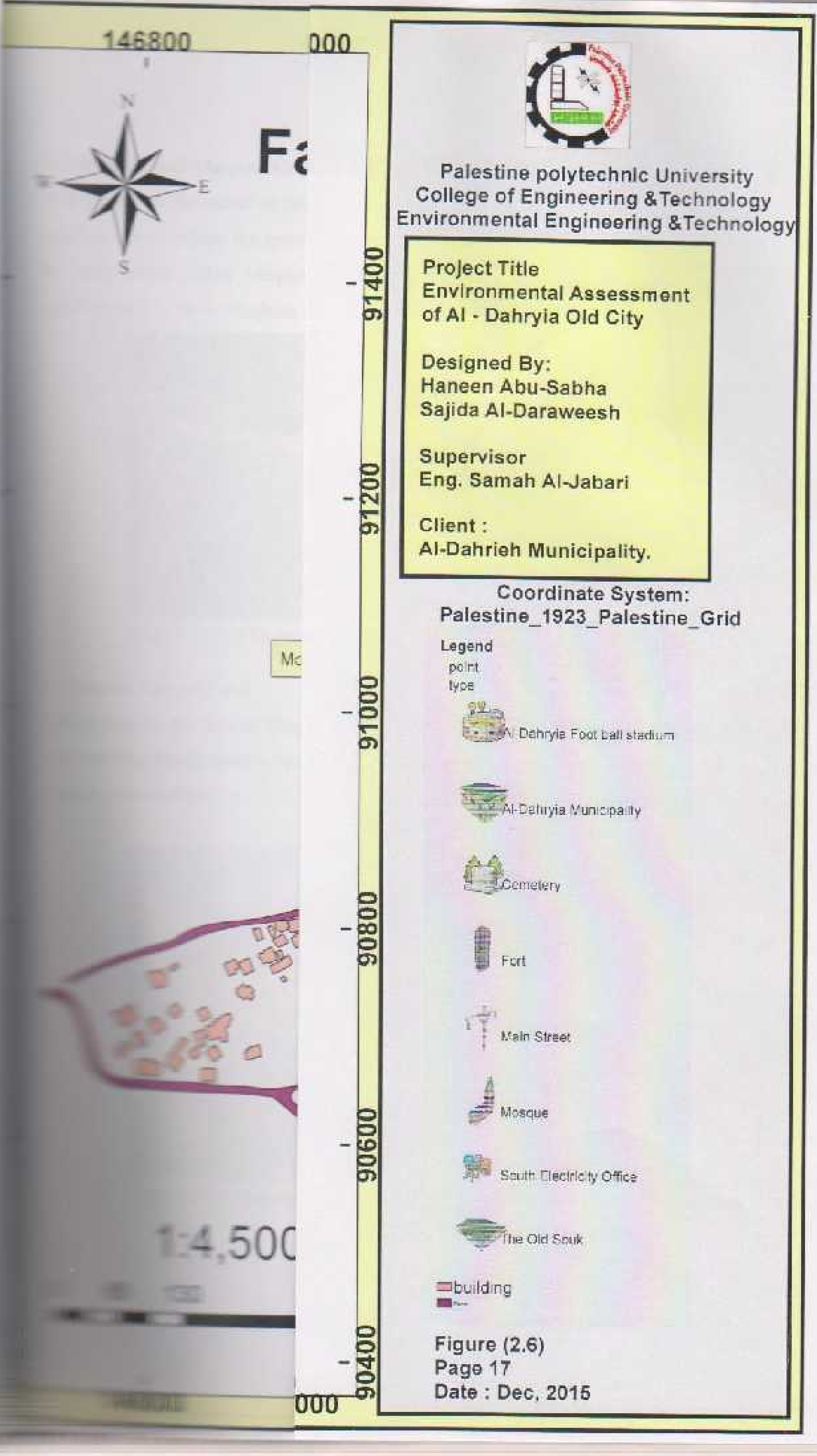
7. Maqam Al-Gamaree.

Some of the important buildings discussed below:

a. Hisen Qisaria

It is located in the center of the Old City, it is a huge stone wall, and seems that it is a wall of old castle. Figure(2.7) show Hisen Qisaria building.

Figure (2.7): Hisen Qisaria [Project Team].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Environmental Engineering &Technology
Project Title
Environmental Assessment
of Al - Dahryia Old City
Designed By:
Haneen Abu-Sabha
Sajida Al-Daraweesh
Supervisor
Eng. Samah Al-Jabari
Client :
Al-Dahrieh Municipality.
Coordinate System:
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Al-Dahryia Foot ball stadium
Al-Dahryia Municipality
Cemetery
Fort
Main Street
Mosque
South Electricity Office
The Old Souk
building
Figure (2.6)
Page 17
Date : Dec, 2015

2- Maqbara and Maqam Abu-Dabor

It is located in the center of the Old City, and opposite to the Hisen from the west. It is a small cemetery where the great Tomb painted with weigh color and have a place to put the wax which called Maqam Abu-Dabor, and it is a shrine to the man from the city.Figure(2.8) show Maqbara and Maqam Abu-Dabor.

Figure (2.8): Maqbara and Maqam Abu-Dabor [Project Team].

3- Maqam Abu Al-Fasel

It is located on the side of Maqbara Abu-Dabor ,and exactly opposite to Hisen site. It is one building blocks have a very small square window to put the wax. Figure (2.9) show Maqam Abu Al-Fasel.

Figure (2.9): Maqam Abu Al-Fasel [Project Team].

4- Al-Omaree Mosque

Mosque is located on the edge of the Old City in the south east. It is a large room where ... and are around with modern cement additives. It is believed that the mosque dates back to the Mamluk period Baibars days. Figure(2.10) show Al-Omaree Mosque.

Figure (2.10): Al-Omaree Mosque [Project Team].

5- Qisaria Castel

Located in the centre of the old town, and the old market area. The site features have several large rooms and Al-Ahawash contains many distinctive architectural details. Figure (2.11) show Qisaria Castel.

Figure (2.11): Qisaria Castel [Project Team].

6- Maqam Abu-Karoba

The place is situated by the highway leading to Arab Al-ramadin, about 1 km west of the Old City. It consists of a large square room with a dome and a niche, and has some modern planting seedlings. Figure (2.12) show Maqam Abu-Karoba.

Figure (2.12): Maqam Abu-Karoba [5].

2.6. Structure of the buildings in Al-Dahriya Old City

The structures of the old buildings in Al-Dahriya Old City is classified according to :

2.6.1 Uses of buildings in Al-Dahriya Old City

Through the doing form of the same existing buildings within the Old City by municipality, the types of uses are divided into eight types:

a. Type number one

Residential use; it was found that the number of residential buildings in the area around "[illegible]" building, and these accounted for 52 percent of total buildings. Figure (2.13) show a building for residential use [6].

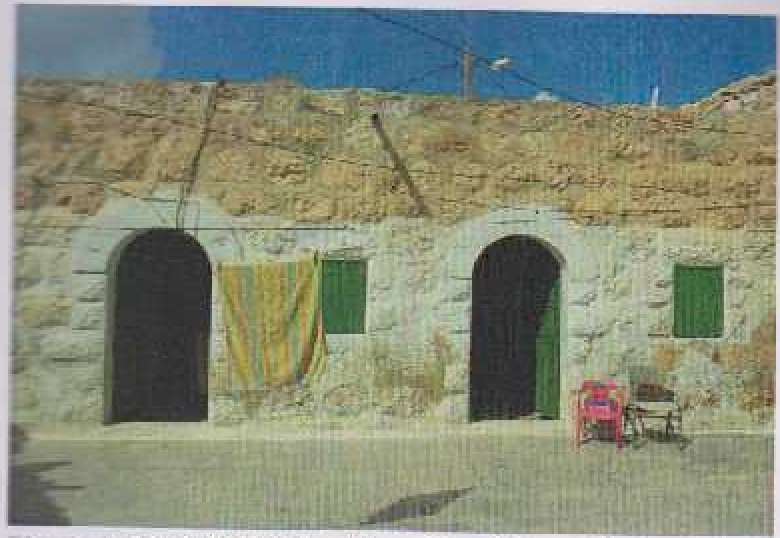


Figure (2.13): Old building for residential use [Project Team].

2. Type number two

The number of buildings used for business purposes was found "28" building. Figure (2.14) show old building for commercial use [6].

Figure (2.14): Old building for commercial use [Project Team].

3. Type number three

Buildings used for industrial purposes was found "4" building and represent 1.1% of the total buildings, these are light industries, such as: a factory for packing liquid soap, toilet paper packaging factory, as well as solar water heaters factory [6].

4. Type number four

The educational use where there is a school of Andalusia and some nearby buildings, and four buildings in percentage 0.8%. Figure (2.15) show school in Al-Dahriya Old City [6].

Figure (2.15): Old building for educational use (Al-Dahriya School)[Project Team].

5. Type number five

Social, which is a single building used as a dewan to Qisia.

6. Type number six

The religious buildings and mosques, its two building within study area, namely the Al-Omari mosque and Al-Atqia mosque. Figure (2.16) show Al-Omari mosque [5].

Figure (2.16): Old religious building (Al-Omari mosque) [Project Team].

7. Type number seven

The buildings which are used for several purposes its number is "16" building, with 4 percent, where it was used the buildings for housing, but are now used for storage purposes, especially for agricultural products, such as grain, hay and others, as well as using part of sheds for animals, and various other uses. Figure (2.17) show old building used for storing food, also figure(2.18) show old building used for livestock breeding and animals [6].

Figure (2.17): Old building for storing [Project Team].

Figure (2.18): Old building for livestock breeding and animals[Project Team].

... abandoned sight

... abandoned buildings and an estimated "118" building 32.8%, and the currently ... buildings not used, they are clustered in the Central old town adjacent to the ... cemetery .And it is Rabaa Hosh ,part of Al-Weradat,also part of ... Abu-Allan.All these Al-ahwash had not been subjected to deliberate ... and left after the departure of the owners to their new homes, which have ... services, and modern kind of life. Figure (2.19) show abandoned old building [6].

Figure (2.19): Abandoned old building [Project Team].

... Number of Floors

... Part one

... composed of one-story buildings, where it is found that "249" building, the ... is estimated at 69 percent, of the total buildings, this is a great majority of the ... in the old city. Figure (2.20) show one-story buildings [6].

Figure (2.20): One-story buildings [Project Team].

2. Part Two

A two-storey buildings and number "98" building, with 27 percent, these buildings are with, may reflect physical and social situation characteristic for the owners. Figure (2.21) show two-story buildings [6].

Figure (2.21): Two-story buildings [Project Team].

3. Part Three

It's composed of three-story buildings, the "12" building; the percentage is 3.3%, and the buildings around the commercial market. Figure (2.22) show three-story buildings [6].

Figure (2.22): Three-story buildings [Project Team].

4. Part Four

It's composed of five floors, its one building in Wadi Al-Gamaree area.

[illegible] Buildings Frame

We analyzing the situation existing in the old construction found that buildings are divided into three sections:

1. First Part:

Buildings that are under construction. Figure (2.23) show building under construction.

Figure (2.23): Building under construction [Project Team].

2. Second Part:

Buildings containing expansion. Figure (2.24) show Building containing expansion.

Figure (2.24): Building containing expansion [Project Team].

3. Third Part:

Completed buildings. Figure (2.25) show completed building.

Figure (2.25): Completed building [Project Team].

Quality of the buildings

Through the analysis of existing buildings within the study area were found to be grouped into the four categories:

1. First Part:

The buildings are in a good construction. Figure (2.26) show buildings in a good construction.

Figure (2.26): buildings in a good construction [Project Team].

2. Second Part:

[illegible] moderate condition, as shown in figure (2.27).

Figure (2.27): Building in moderate condition [Project Team].

c) Third Part

Buildings in poor condition as shown in figure (2.28) show Buildings in poor condition.

Figure (2.28): Buildings in poor condition [Project Team].

d) Fourth Part

Destroyed buildings, as shown in figure (2.29).

Figure (2.29): Destroyed buildings [Project Team].

[illegible] The nature of the building and its design

The old city characterized of cave under old building and little, small window at high level and same to the door, so the polluted air will transfer out of building and deccased the humidity in the building .But the ignorance of this benefits of design they cover the window and so increase *the humidity in the buildings . Figures below shows* The nature of the building and its design.

Figure(2.30):Window design in Al-Dahriya Old City buildings [Project team].

Figure(2.31):Doors and windows design in Al-Dahriya Old City [Project team].

Figure(2.32):Nature building in Al-Dahriya Old City [Project team].

2.7 Water

Water Quantity

According to Al-Dahriya municipality the water resources is 12% covered by Israeli water company distributed by municipality net ,36% by collection of rainwater wells ,40% by water tanks, and 19% other resources .So the city suffer from pollution and shortage of water to different causes .

Water Consumption

Water demand in Al-Dahriya, like other West Bank towns, is continuously increasing due to the increasing in population. The population of is estimated about 28776 parsons for year 2007 and 81762.9 for year 2036. The result of all this is obvious, the total water requirement is ever on the increase, and per capita water consumption is also on increase. Water consumption is not constant, yearly, monthly, weekly, daily and hourly variations in water consummations are observed. it is range from 18 to 22 liter per day. Certain dry years cause more consumption. In hot months water is consumed in drinking, bathing, and watering lawns and gardens. On holidays and weekends the water consumption may be high.

Even during day water use various with high use during morning hours and low use at night. Maximum daily demand or maximum daily consumption usually occurs during summer months Forecast water consumption.

Wastewater Quantity

Sanitary sewage is mostly the spent water of the community draining into the sewer system. It has been observed that a small portion of spent water is lost in evaporation, seepage in ground, leakage, etc. Usually 80% of the water supply may be expected to reach the sewers.

Overall the amount of Domestic wastewater produced per capita per day is usually 80% of water consumption.

Unfortunately the city have no sewerage system ,they collect the sewage from houses by cesspits and letrains then thrown it to the wadis.

2.7.4 Storm Water

There was no storm water drainage system in the Al-Dahriya Old City; some people collect the storm water and use it when there is shortage of water from municipality.

Chapter Three

Current Situation of

A "Al-Dahriya Old City"

3.1. General

In this chapter, a discussion of the environmental issues will be done. Also an explanation of the positive and negative points in environmental evaluation of AL-Dahriya Old City.

3.2. Environmental condition in Al-Dahriya Old City

Environmental analysis is a systematic process to find the environmental effects of positive and negative, direct and indirect, current and future in order to avoid adverse impacts and enhance positive impacts in addition achieved sustainable development as compatible with the Palestinian environmental standards.

Analysis and understand the environmental situation of the old city through the study of the following points:

3.2.1. Infrastructure in Al-Dahriya Old City

Infrastructure of any city is defined as all activities and engineering systems, which provides for the residents of the place of urban life so that these people can work various daily activities easily and without problems. Infrastructure consist of water supply networks, sewerage and storm water networks, electricity networks, telecommunications networks, road networks ,schools, gardens, methods of solid waste disposal, and all other constructions.

Infrastructure has high importance to study and evaluate that to preservation the old city of historical and religious value ,and to provide sustainable services to the residents of the old city and to encourage them to settle in this important place.

Infrastructure services in the old city include the following:

Water network

[illegible] the old city area available as the old network to a Al-Dahriya been, and [illegible] emerging mostly from the old city alleys despite its narrow and the lack of [illegible], but the minor roads in Alahowash region there is no water network.

2- Sewage system network

Sewerage net work is very *important system to avoid ground water, soil, air pollution,* and prevent the disease of human. Unfortunately the city have no sewerage system ,they collect the sewage from houses by cesspits and letrains then thrown it to the wadis .

When they have accumulation of waste they spread insecticide to avoid the smelt, insects, rodents, and flies that adverse near communities. Table 3.1 shows more details about impact of absence of sewerage system. This service could cause a major problem such:

1- Ground water pollution.

2- Soil pollution.

3- Dispersed the insects, rodents, flies in the area ,which cause a sever diseases to human.

4- Decrease tourism because of bad smelt.

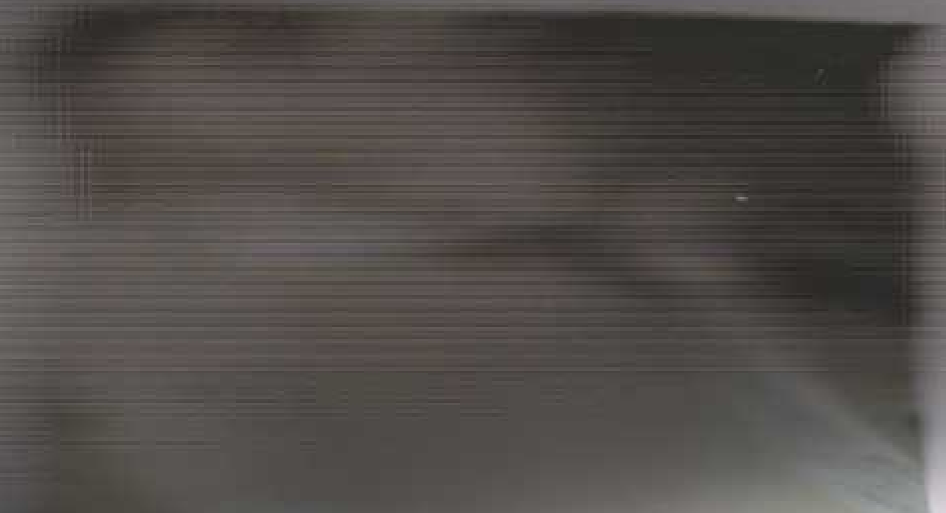
5- Distortion of aesthetic view.

Table 3.1 Environmental *parameter affected by* absence of sewerage system [Project team].

NO.	Environmental Parameter	Description
1	Water Pollution	As the soil polluted by wastewater, if this soil is permeable and have sensitive ground water below it. And so the main source of water will be polluted.

2	Soil Pollution	When the wastewater is in contact with the soil the salinity and hazardous solid material content in soil will contaminate the soil and loss their fertility. Also the septic tank which are impermeable to soil then street or near agricultural area, or neighbors, and may cause swamps full of wastewater ,and rodent ,insects exist.
3	Air pollution	They dispose wastewater in wadi open to atmosphere which increases the pungent smelt from the inorganic compounds, ammonia and hydrogen sulfide which are considered to be the main causes of odor when the sewage comes from mainly households.Also the municipality use inseticed to avoid rodent insect near there but pesticides may suspended in the air as particles and carried by wind to other areas till it reach receptor and contaminating them.
4	Land Use	Use the land as a place to dispose wastewater ,the land lose its value, and structure of the top soil.
5	Public Health	Whether air pollution, soil pollution, water pollution, all of that will cause a severe problem to humans and may cause death.
6	Economic	When population increase ,the wastewater consumption will

	increase too, the improper disposal of waste will increase diseases so we need more money to treat this problem.
Social	The waste flow in wad cause problem to neighbor or owner of agricultural area there and may cause them emigrate from their
Heritage	The people will emigrate from there and also the tourism will decrease sue to pollution there. Also the aesthetic and heritage view loss their value



... of sewerage net work [Project team].

[illegible] (3.2): Effects of sewage discharge on soil [Project team].

[illegible] water network

[illegible] include water accumulated in the streets during and after the incident [illegible]

[illegible] storm water collection systems in old city except a small area called Faouqa [illegible] institution in cooperation with the municipality set up a network to collect [illegible]

[illegible]

[illegible] four main entrance each entrance have branch street which are also [illegible] narrow, dirty, and not qualified street. The road network of the old city have [illegible] as show in figure (3.3), its wide range maximum from 2.5 to 3 meter . [illegible] the street type of Al-Dahriya Old City.

Figure(3.3):Roads condition in Al-Dahriya Old City [Project team].

...network and telecommunication network

...network and telecommunication network: The electricity service in the old ... available but it is not exist in Alahowash

...communication service is available in the areas surrounded by the old city but in ... there was no telecommunication.

...waste

...waste in the city involve the domestic, commercial, light industries. People who ... collect their waste in plastic bags then disposed it throw in streets, alleys, old ... and some of them in container which will then collect by worker cleaner and ... the waste in random sites. All these improper ways in collecting and ... solid waste will create severe environmental problem in area. The table 3.2 ...environmental parameter affected by solid waste.

Palestine polytechnic University
College of Engineering &Technology
Environmental Engineering &Technology

Project Title
Environmental Assessment of Al - Dahryia Old City

Designed By:
Haneen Abu-Sabha
Sajida Al-Daraweesh

Supervisor
Eng. Samah Al-Jabari

Client :
Al-Dahrieh Municipality.

Coordinate System:
Palestine_1923_Palestine_Grid

Legend

- building

Street type

- Asphalt Road
- Concrete Tile Road
- Entrance of Al-Dahriya Old City
- Pedestrian Road
- Stone Tile Road

Fig (3.4)
Page 40
Date : Dec, 2015

Major impacts of absence of good management of the solid waste:

1- The final step of disposal the solid material by dumping it or firing in certain area will pollute the sensitive ground water, soil, and air below if there is.

2- Hazardous gaseous dispersed in the atmosphere.

3- Proliferation of rodents, insects, and diseases.

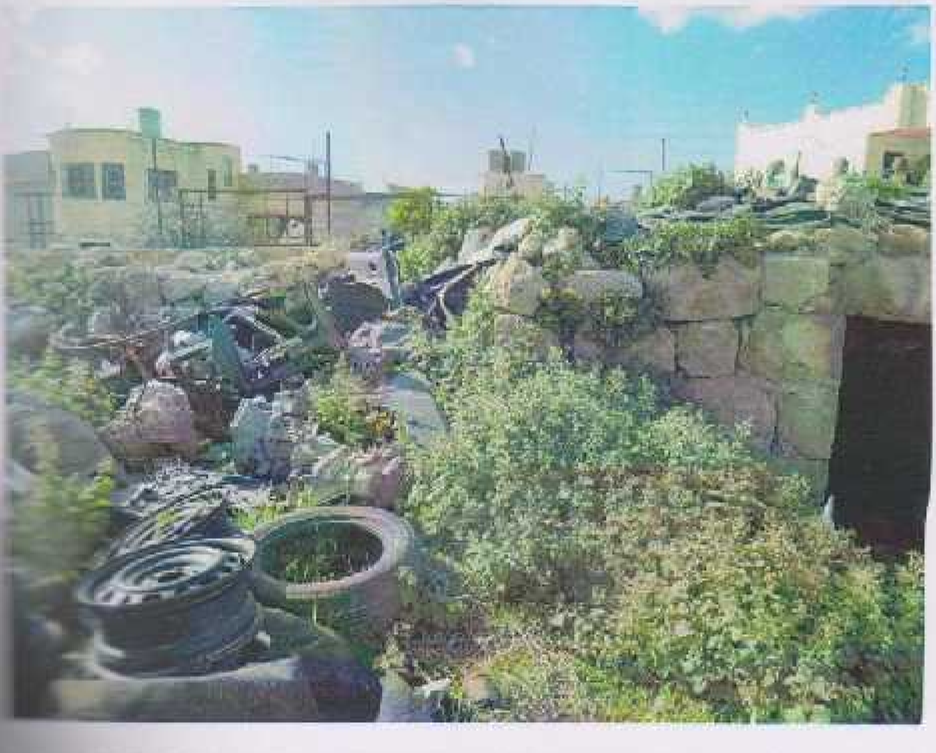
Table (3.2) Environmental parameter affected by solid waste [Project team].

NO.	Environmental Parameter	Description
[illegible]	Water Pollution	The leachate of waste will penetrate to ground water and pollute it.
[illegible]	Soil Pollution	Firing hazards material will accumulate the hazards on soil ,and loosing there top soil
[illegible]	Air pollution	Whether leave the domestic waste degrade or firing it or dumping in a certain site. All these will cause air pollution.
[illegible]	Land Use	The quality and value of land will decrease, and it is hard to treat it
[illegible]	Public Health	As the soil, air, and water polluted the disease will increase too.
[illegible]	Economic	We need more money to treat this pollution.
[illegible]	Social	Neighbor of disposal site will affect, and this may cause emigration or fight.
[illegible]	Heritage	The heritage building will abandoned.

Figure (3.5): Burning container in Al-Dahriya Old City [Project team].

Figure (3.6):Solid waste inside Al-Dahriya Old City buildings [Project team].

Figure(3.7):Solid waste beside Al-Dahriya Old City buildings [Project team].



Figure(3.8):Solid waste in Al-Dahriya Old City [Project team].

[illegible] Livestock and animals

[illegible] long time ago, the city known of livestock breeding, so the livestock breeding is [illegible] corner. All of these things are benefit point, but the negative point here is [illegible] the heritage old building a place for livestock breeding, this will threat [illegible] heritage of old building by increasing the strong pungent odors from animal [illegible]. Figure (3.9) below show the livestock breading in the city.

Figure (3.9): Livestock breeding in Al-Dahriya Old City [Project team].

[illegible] Vegetation

[illegible] in this city are very low because of different reason:

- The climate in the old city classified with semi arid region which receives [illegible] below potential evapotranspiration , and low vegetation index.
- Lack of awareness about cultivation and irrigation.

[illegible] show the land use of Al-Dahriya City .

Table(3.3): Land use of Al-Dahriya city [7].

[illegible]	Arable Area (Dounm)		Residential Area (Dounm)	Forest Area (Dounm)	Area of Open Grasslands (Dounm)
	Planted	Non Planted			
[illegible]	22928	25572	16000	300	33200

Chapter Four

Design Parameter

[illegible] Wastewater Collection System Design

[illegible] General

[illegible] purposes, the water supply of community is considered to be [illegible]. The individual conduits used to collect and transport wastewater to the [illegible] the point of disposal are called sewers.

[illegible] types of sewers: sanitary, storm, and combined. Sanitary sewers are [illegible] wastewater from residential, commercial, and industrial areas, and a [illegible] of infiltration/inflow that may enter the system due to deteriorated [illegible] and manholes. Storm sewers are exclusively designed to carry the [illegible]. Combined sewers are designed to carry both the sanitary and the storm [illegible].

[illegible] of sewers used to collect wastewater from a community is known as [illegible] collection system. The purpose of this chapter is to define the types of sewers [illegible] collection systems, types of wastewater collection systems that are used, the [illegible] used in conjunction with sewers, the flow in sewers, the design of sewers, [illegible] and maintenance of sewers.

[illegible] Municipal Sewerage System

[illegible]

[illegible] of sewers used in municipal collection system will vary with size of [illegible] system and the location of the wastewater treatment facilities. The [illegible] community sewage system consist of:

[illegible] called house connections).

[illegible] branch sewers.

[illegible] main sewers.

[illegible]

[illegible] sewer connect the building plumbing to the laterals or to any other sewer lines [illegible] above. Laterals or branch sewers convey the wastewater to the main sewers. [illegible] main sewers connect to the trunk sewers that convey the wastewater to large [illegible] sewers or the treatment plant.

[illegible] of a sewer line is generally determined from the peak flow that the line [illegible] and the local sewer regulations, concerning the minimum size of the laterals [illegible] connections. The minimum size recommended for gravity sewer is 200 mm [illegible]

[illegible] Sewer Material

[illegible] made from concrete, reinforced concrete, vitrified clay, asbestos cement, brick [illegible] cast iron, corrugated steel, sheet steel, and plastic or polyvinyl chloride or ultra [illegible] chloride. Concrete and ultra polyvinyl chorides are the most common materials [illegible]

[illegible] Types Of Wastewater Collection Systems

[illegible] System

[illegible] wastewater and storm water in one conduct(combined system) or in [illegible] (separate system). In this system , the sewers are partially filled. A [illegible] is that the gradients of the sewers must be sufficient to create self-[illegible] for the transportation of sediment. These velocities are 0.6 to 0.7 m/s [illegible] sewers are flowing full or half-full. Manholes are provided at regular [illegible] cleaning of sewers.

[illegible] System

[illegible] only. The system, which is entirely kept under pressure , can be [illegible] water distribution system. Sewage from an individual house connection

, which is 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

Conveys 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-type 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.

[illegible] 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 provided at the start and at the end of the line, at the intersections of sewers, at changes in direction and alignment except in curved sewers, and at intervals of 40-60 m in straight lines.

The common shapes of the manholes are square, rectangular or circulation in plan , the circular is the most common. Manholes for small sewers are generally 1.0-1.2 m in diameter. For [illegible] 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 [13].

[illegible] consist of base, risers, top, frame and cover manholes benching , and [illegible] The construction materials of the manholes are usually precast concrete section, 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 manholes 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 manholes without fear of being wetted, avoid the splashing of sewage and corrosion of manhole bottom.

[illegible] 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. The flow rate projection are necessary to determine the required capacities of *sanitary sewers.*

Peak flow coefficient

Generally, the coefficient increases when the average flow decrease, it will be estimated 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 (L/s) is the daily average flow rate of the network branch under consideration and Pf: peak factor.

Important Numbers

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

Storm Design System Design

General

Most 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, inlet, 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.

4.2.2 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 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,

$$Q=C.i.A \qquad (4.2)$$

Where:

Q= peak runoff rate(L/s)

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 intensity, mm/min, for period equal to the time concentration

A= drainage area, hectar.

For small catchments areas, it continues to be a reasonable method, provided that it is applied properly and that results and design concepts are for reasonableness.

This procedure is suitable for small systems where the establishment of a computer model is not warranted.

Steps in the rational method calculation procedure are summarized 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 derange system is then drawn according to the topography, the existing or planned streets and roads and local deign practices.

4.Inlet points are then defined according to the detail of design considerations. For main mains, 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 the sub-area for a given inlet has non-homogeneous land use, a weighted coefficient may be estimated.

6.The runoff calculation 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.

7.After the preliminary minor system is designed and checked for its interaction with the major system, reviews are made of alternative , hydrological assumptions are verified computations are made, and final data obtained on street grades and elevations. The designer 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:

$$C = \frac{\sum Ci.Ai}{\sum Ai} \qquad (4.3)$$

Where:

Ai= ith area

Ci= ith runoff coefficient.

The range of coefficient with respect to general character of the area is given in the following tables (Table 4.1 and Table 4.2).

Table 4.1: The range of coefficient with respect to general character of the area [18].

Description of Area	Runoff coefficient
Business	
Down town	0.7 to 0.95
Neighborhood	0.5 to 0.7
Residential	
Single family	0.3 to 0.5
Multi-unit, detached	0.4 to 0.6
Multi-unit, attached	0.6 to 0.75
Residential (suburban)	0.25 to 0.4
Apartment	0.5 to 0.7
Industrial	

Light	0.5 to 0.8
Heavy	0.6 to 0.9
Parks, Cemeteries	0.1 to 0.25
Playground	0.2 to 0.35
Railroad yard	0.2 to 0.35
Unimproved	0.1 to 0.3

Table (4.2):The range of coefficient with respect to surface type of the area [18].

Character of surface	Runoff Coefficient
Pavement	
Asphalt and concrete	0.7 to 0.95
Brick	0.7 to 0.85
Lawns, Sandy soil	
Flat, 2 %	0.05 to 0.1
Average, 2-7 %	*0.1 to 0.15*
Steep, 7%	0.15 to 0.2
Roofs	0.75 to 0.95
Lawns, heavy soil	
Flat, 2 %	0.13 to 0.17
Average, 2-7 %	0.18 to 0.22
Steep, 7%	0.25 to 0.35

Rainfall intensity, i

[illegible] rainfall intensity for use in rational formula it must be recognized that the [illegible] duration , the greater the expected average intensity will be . The critical [illegible] of rainfall will be that which 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 [illegible].

[illegible] intensity depended on many factors through which we can do our [illegible] we can list these factors as follow:

[illegible] frequency of occurrence of storm (1/n) or (f).

[illegible] frequency of occurrence is the frequency with which a given event is equaled or [illegible] average , once in a period of years. Probability of occurrence, which is the [illegible] of frequency, (n) is preferred by sum engineers. Thus , if the frequency of a [illegible] 5 year (1/n) =5), then probability of occurrence n=0.2. Selection of storm [illegible] frequency based on cost-benefit analyses or experience. There is range of [illegible] often used:

[illegible] area: f=2 to 10 years(5 year most common).

[illegible] and high value districts: f=10 to 50 (15 year common).

[illegible]: f=50 year.

[illegible] duration and frequency characteristics of rainfall.

[illegible] from gage measurement of rainfall (point rainfall) over a long period [illegible] obtain a rainfall height diagram that show the relation between the height [illegible] and time (min). The slope of the curve or rain height per unit time is [illegible] intensity:

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

[illegible] intensity in liter per second . hectare is equal:

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

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

[illegible] of concentration.

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

$$t_c = t_i + t_f \qquad (4.4)$$

[illegible] time of concentration.

[illegible] inlet time.

[illegible] flow time.

[illegible] flow in storm, $t_f = \frac{Length\ of\ pipe\ line\ (L)}{Velocity\ of\ flow\ (v)}$

[illegible] it is the time required for water to flow over ground surface and along [illegible] inlet. Inlet time is function of rainfall intensity, surface slope, surface [illegible] flow distance, and infiltration capacity and depression storage.

[illegible] of Design Parameters

[illegible] must be investigated before storm sewer design can be completed. [illegible] peak, average , and minimum flow; storm sewer slope and [illegible] etc. are all important in developing storm sewer design. Many of [illegible] discussed below.

[illegible]

[illegible] should be designed to carry the largest storm that occurred in the [illegible] commonly it is years because of consideration of the cost and the [illegible]

[illegible]

[illegible] storm sewer recommended is 250 to 300 mm for closed system, and [illegible] on the type of profile that selected.

[illegible] Velocities

[illegible] solids tend to settle under low-velocity conditions. Self-cleaning [illegible] developed regularly to flush out the solids. Most countries specify [illegible] in the sewer under low flow conditions. The minimum allowable [illegible] and 0.9 m/s is desirable. This way the lines will be flushed out at [illegible] day. The maximum velocities for storm water system are between 4 [illegible] velocity is limited to prevent the erosion of sewer inverts.

[illegible]

[illegible] minimum slopes determined from minimum velocities, for minimum [illegible] slopes are shown in Table (4.3).

[illegible] Minimum recommendation slopes of storm sewer (n=0.015) [18].

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 0.75 m/s the slope shown above should be multiplied by 1.56

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

[illegible] 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.

[illegible] Appurtenances

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

Important Numbers

- Maximum velocity=5m/s
- Minimum velocity = 1 m/s
- Maximum slope =15%
- Minimum slope =0.5%

- H/D =100%
- Minimum diameter 250-300 mm
- Minimum cover 1 m
- Maximum cover 5 m

4.3 Septic Tank Design

4.3.1 General

The term "septic" refers to the anaerobic bacterial environment that develops in the tank which decomposes or mineralizes the waste discharged into the tank. In which Wastewater flows from the waste water collection system to the septic tank through the sewer pipe. The septic tank treats the wastewater naturally by holding it in the tank long enough for solids and liquids to separate. The wastewater forms three layers inside the tank. Solids lighter than water (such as greases and oils) float to the top forming a layer of scum. Solids heavier than water settle at the bottom of the tank forming a layer of sludge. This leaves a middle layer of partially clarified wastewater.

So we have three distinct layers of sewage in the septic tank that will describe below. Figure(4.1) show the layer in septic tank.

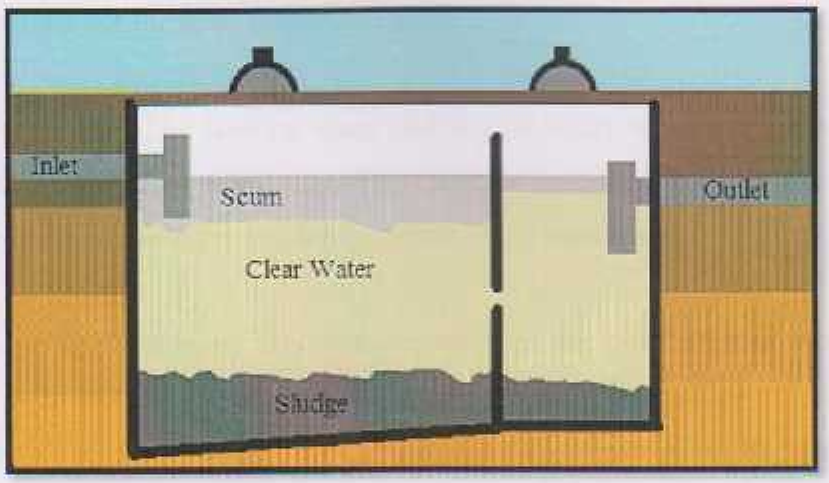


Figure (4.1): Different layers of septic tank

a) Sludge Layer: All solids that are heavier than water settle at the bottom of the tank to make up the sludge layer. The anaerobic bacteria breakdown and digest the biodegradable solids in the sludge. During the process, the solids become lighter and migrate upwards to the middle of the tank or the clear zone.

b) Clear Zone: The clear zone in the septic tank holds grayish or brown colored water that contains fine and microscopic biodegradable and non-biodegradable materials suspended in the liquid. It is in this liquid environment that the bacteria further break down most of the remaining biodegradable solids. The clarified liquid then flows into the soak pit.

c) Scum Layer: The scum layer at the top of the septic tank contains grease, oils, soap films and other materials that are lighter than water. The sludge and scum that cannot be broken down are retained in the tank until the tank is pumped.

The baffle wall and outlet TEE prevent any of the scum on the top layer from exiting the septic tank before being treated. The inlet, outlet and the baffle wall are designed and constructed to allow only the liquid from clear zone to exit into the soak pit.

[illegible] must have a design parameter that classified it. Septic tank system has many [illegible] parameter but the main parameters are:

[illegible] volume: The floating scum and sludge layers take up the top and bottom [illegible] the septic tank respectively. The effective volume is the liquid volume in the [illegible] between the scum and sludge layers in the septic tank.

[illegible] time: This is the time that elapses from the entry point of sewage into the [illegible] the time of exit of the sewage from the clear zone of the septic tank. This is [illegible] parameter for the design of septic tank, as each molecule of the incoming [illegible] enters and exits the clear zone under the design retention time period. The retention time is the function of the effective volume and the daily household wastewater flow.

3. Organic flow rate: One of the principal parameters used in wastewater system design is the organic flow rate which also called hydraulic loading rate. It defines as a unit volume of filter or per unit area per day of treated wastewater water.

The tank must have configuration on these points:

1. Base
The base is usually constructed of plain concrete with the thickness of about 100-150 millimeters. This is the minimum thickness required to withstand the uplift pressure when the tank is empty. The base also acts as a foundation for the side walls. A designer may also reinforce the base slab in larger tanks.

2. Side Walls
The side walls of the septic tank are made of brick, stone masonry or concrete. The septic tank must be watertight.
3. Inlet and Outlet
The correct installation of the inlet and outlet are critical in the performance of the septic tank.

4. Ventilation
The decomposition of the organic wastes produce gases and the safe exit of the gases must be provided in the septic tank. The simplest option is to install a vent pipe with a [illegible] on the roof slab of the septic tank. The gases coming out of septic tank has a strong stench and so the height of the vent pipe should be higher than the normal height of a person.

[illegible]. Maintains

Adequate care must be taken to design, construct, operate and maintain the septic system so that it can provide years of reliable service. A poorly designed and maintained septic system can be a source of pollution, which causes disease outbreaks and other environmental problems. Therefore, it is important to understand the consequences of a poorly designed and maintained septic system and to take necessary precautions.

To assess the system you must compare between the advantages and disadvantages of the system.

- Advantages of Septic Tanks

1. Needs little maintenance
2. Anaerobic system will break down solids faster so less solids will reach the draining field and groundwater.
3. For cement septic tanks, they last much longer The lifespan of a properly installed septic tank is usually between 20-40 years, but can be much longer with proper maintenance and care.
4. Septic systems provide simple, effective wastewater treatment for low-density urban and rural areas.
5. Septic systems are also simple in design, which make them generally less expensive to install and maintain.
6. Provide a storage space for the separated solids (sludge and scum).
7. Serves as a sedimentation tank. As the sewage enters the tank, the rate of flow is reduced so that the larger solids in the sewage sink to the bottom of the tank.

- Disadvantages of Septic Tanks

1. Bad odors caused by poor maintenance or clogged septic systems
2. Groundwater contamination is also another problem that can manifest when poor maintenance [illegible] the septic system

3. There is a risk in rainy seasons that the septic system overflows bringing sewage to the urface.

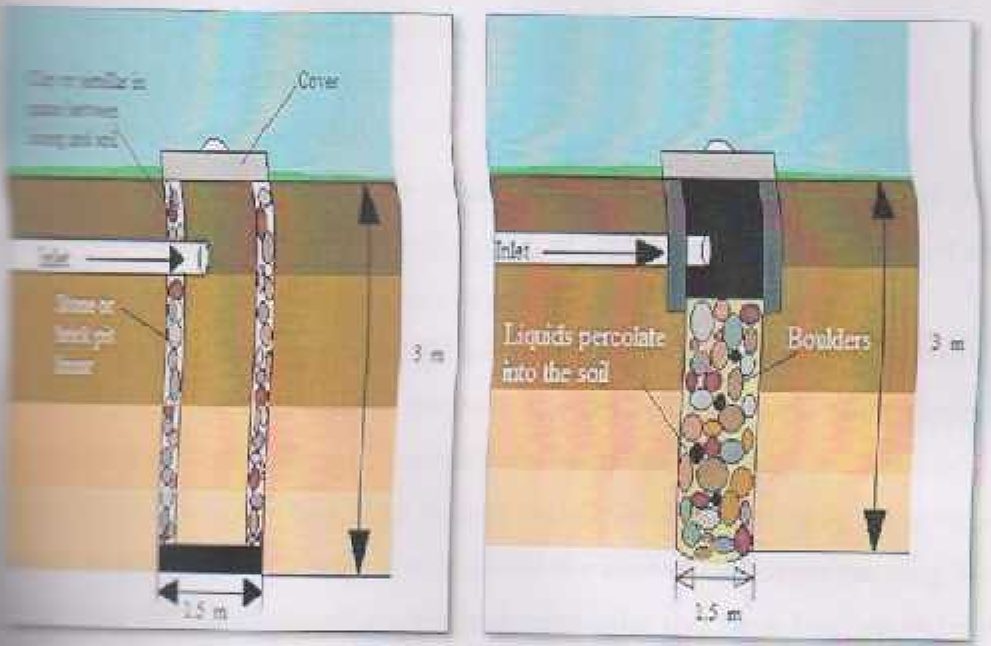
4. Clogged drains by oil, grease, fats, and other materials that may be thrown into toilets, nks, and showers causing obstruction.

5. Requires more responsibility and regular maintenance.

Figure (4.2): Collapse of Septic Tank due to lack of maintenance

tic tank is designed to minimize pollution, but must follow with Soak for the natural process in the soil.

k pit or seepage pit is a vertical leach line consisting of either a deep hole with walls or a hole filled with gravel or brickbats. Septic tanks should always be ed to a suitable soak pit or a sewer line. The soak pit can be constructed of pre- crete-rings (with holes) or a dry cylindrical wall made of brick, block or stone as Figure (4.3)The minimum diameter of the pit is 1.5 meters with a minimum 3 meters. It must be located at least 10 meters away from any waterways in soil conditions.



A lined soak pit An unlined soak pit

of the tank must be in an area where it will not experience vehicular traffic, point of the.

produced from the treatment of waste water. This is inherently because a wastewater treatment is removing solids from the wastewater. In addition, substances are converted to bacterial cells, and the latter is removed from So needing of sludge treatment is important for:

- organic ingredients.
- odor.
- volume and weight.
- hygiene by removing of pathogen organisms.
- sludge for further utilization or disposal.

ways of handling the sludge treatment such as:

- the sludge.

2. Aerobic/anaerobic sludge digestion.
3. Mechanical drying of sludge.
4. Natural drying tank for sludge.

The most efficient way in our case is natural drying tank for sludge, due to high temperature of the city; also make sure the death of fly larvae and fermentation of organic material, and so increasing the efficiency of outlet sewage.

This can be done by installing a shallow basin, having area range from 100- 200 m^2

It made from Concrete resistance to sulphate and the bottom of this basin supply with pipes to collect the waste water and it cover with 30 cm of gravel.

The sludge spread along the basin less than or equal 10 cm depth to dray for seven days, then spread another layer of sludge and so on till the total sludge depth reaching 30 cm . After that cover the final layer of sludge with sand after five days from spread the last layer.

The sludge treated can be used in different ways such as:

1. Agricultural Use as compost material, but our religion have constrain in this side so e eliminate this use.
2. Incineration, and use its energy for powering system.
3. Land filling, but It is important consider to whether the sludge is consistent enough to be land filled.

4.3.2 Design Parameter of Septic Tank

Characteristics of manual septic tank:

I. The inlet pipe shall be fixed inside the tank, with top limb rising above scum level and the bottom limb extending about 300 mm below the top water level.

II. The final outlet for tanks should be by 100 mm pipe diameter, the bottom limb extending to about 1/3 of the liquid depth below top water level.

III. Free-Board: A minimum free board of 300 mm should be provided.

IV. Ventilating Pipe: Every septic tank shall be provided with ventilating pipe of at least 50 mm diameter. The ventilating pipe shall extend to a height which would cause no smell nuisance to any building in the area. Generally the ventilating pipe may extend to a height of about 2 m when the septic tank is at least 20 m away from the nearest building and to a height of 2 m above the top of the building when it is located closer than 20 meters.

5. Floor

The floor may be of cement concrete of minimum slope of 1 : 10 may be provided towards the sludge outlet to facilitate desludging.

6. Walls

The walls should be of such thickness as to provide adequate strength and water tightness.

7. BOD removal = 25 - 35 % (4.5)

8. Removal of suspended solid (SS) = 40 - 60 % (4.6)

The equations used in the design of septic tank are:

a) $Volume = Flow\ rate * Hydraulic\ retention\ time$

$$V = Q * HRT \tag{4.7}$$

b) $Surface\ area = Flow\ rate * Organic\ flow\ rate$

$$As = Q * OFR \tag{4.8}$$

c) $Depth = \frac{Volume}{Surface\ area}$

$$D = \frac{V}{As} \tag{4.9}$$

d) $Surface\ area = Width * Length$

$$As = W * L \tag{4.10}$$

4.4 Solid Waste Management

Solid waste is the collecting, treating, and disposing of solid material that is discarded because it has served its purpose or is no longer useful. While solid waste management systematic control of generation, collection, storage, transport, source separation, processing, treatment, recovery, and disposal of solid waste [19].

By cooperation of architectural and environmental engineering we make a design of small park that located near grave which have large quantity of solid waste in random distribution way, also we make a waste collection and transportation of solid waste of the city by finding the number of container needed and capacity of compactor and transportation for each trip.

To make an analysis of solid waste management for Al- Dahriya city, required data was obtained from different source, majority from the Land, history and human heritage in Al-Dahriya city book [20].

Chapter Five

Analysis and Assessment

[illegible] Wastewater Collection System

[illegible] General

In this project, design of wastewater collection system for Al-Dahriya Old City is made, and develop a future plans for construction of the collection system, corresponding to the [illegible] of Al-Dahriya municipality about their future plan, in order to reduce the problem [illegible] missing this important part.

In this section, the layout of the system established is presented, and the computation [illegible] and tables are given along the drawings of layout.

[illegible] of the System

[illegible] designing a sewerage system is to establish an overall system layout that [illegible] of the area to be sewered, showing roads, streets, buildings, other utilities, [illegible] and the lowest floor elevation or all buildings to be drained.

[illegible] the layout of wastewater collection system for Al-Dahriya Old City, the [illegible] were followed:

[illegible] map of the area to be served.

[illegible]

[illegible] outlet. This is usually near the lowest point in the area and is often [illegible] drainage way. In Al-Dahriya City, the lowest point which is located at [illegible]

[illegible] pipe system to serve all the contributors.

[illegible] so that all the users or future users can readily tap on. They are also [illegible] access for maintenance and thus are ordinarily placed in streets [illegible]

[illegible] followed natural drainage ways so as to minimize excavation and [illegible]. Large trunk sewers are located in low-lying areas closely [illegible] 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 Al-Dahriya Old City is illustrated in Figures (5.1, 5.2).
Three main trunks, five sub main lines are located on the layout.

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Technology and engineering college
civil and Architecture department
Architectural Engineering

Environmental Assessment of Al-Dahrieh Old City.

Notes:-

All contour line in meter.

LEGEND

Main Road
Sub Main Road
Catchment Area
Flow Direction
Contour Line

Drawing Title:
Layout for Al-Dahrieh Old City.

Designed By:
Haneen Abu-Sabha.
Sajida Al-Daraweesh.

Supervisor:
Eng:Samah AL-Jabary.

Client:
Al-Dahrieh Municipality.

V Scale 1 :50
H Scale 1 : 500

# of Figure : 5.1

Page : 72

Date : Dec, 2015

Quantity Of Wastewater

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

... the layout of the wastewater collection system the quality of wastewater ... must carry it will be calculated using the data collected about the area.

... Design a *gravity flow sanitary sewer*

... flow main *sanitary sewer for the area to outfall (line M1) shown in Figure* ... data is collected and analyzed.

... *consumption uses 18-20L/c.day.*

... *consumption uses 100L/c.day.*

... *= 1752 capita.*

... : using the formula $P = P_o(1+R)^n$. Where P_o is a current population

... growth rate 3.5 %.

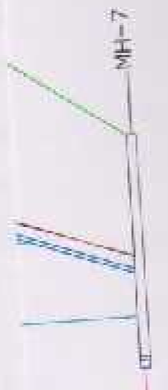
... use 25 years as a design period.

... calculates as 80% of the water *consumption.*

... use 10% of the domestic sewerage flow.

... depending on the formula :

... *(2.5*√*q).*



Point Numbe	7
Manhole Nu	MH7
Station	2+20
Ground Elev	636.25
Depth of M	2.80
Distances	219.5
Dstance of M	
Pipe Diamete	
Pipe Slope	

Palestine Polytechnic University
Technology and engineering college
Mechanical department
Environmental Technology and Engineering

Environmental Assessment of Al-Dahriya Old City.

Notes:-
1- All Pipe Diameter are Millimeter.
2-All Pipe Depth are in Meter.
3-Depth of Excavation up to 1.5 m.

Legend
- Ground Elevation
- Sewer Line
- Manholes

Designed By:
Haneen Abu-Sabha.
Sajida Al-Darawsesh.

Supervisor :
Eng:Samah AL-Jabary.

Client :
Al-Dahrieh Municipality.

Drawing Title :
The Profile Of Sanitry Line (Main #1) (From Manholes 1 to 7)

H.Scale 1:500

V.Scale 1:50

No.of Figure : 5.3

Page : 75

Date : Dec.2015

Solution

1. Lay out the trunk sewer. Draw a line to represent the proposed sewer Figure (5.3).
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 (5.1) for year 2036. The data in the tables 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 by the current water consumption multiplying by density.
   d. The entries in columns 7 and 8 are used tributary area, column 7 used incremental area, column 8 used total area in donum.
   e. To calculate municipal maximum flow rates columns 9, 10 are used. Column 9 is *municipal average sewage flow (unit sewage* total area), the peak factor column 10 is calculated as: $PF = 1.5 + 2.5/\sqrt{q}$ where q = Average industrial sewage flow (Column 9).*

Column 11 used to calculate the Qmax in year 2036, the value of it comes from [illegible] column 10 column 9. Column 12 calculate the infiltration which equal to [illegible] (10% * column 9). Column 13 is used to show the maximum flow* [illegible] come from column 11+ column 12.

[illegible] the maximum flow in each manhole separately.

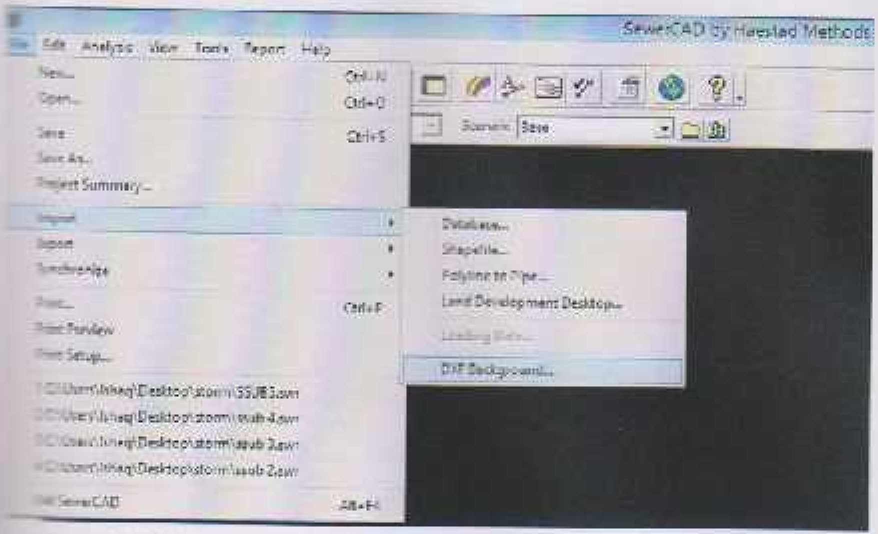
	Name			m	unit sewage m³/d.dounm	dounm	dounm	Average m³/day		Maximum m³/day	m³/day	Total Average m³/day	Total Maximum m³/day	Q max m³/day
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	main 1	1	2	30.26	36.34	0.06	0.06	2.18	3.00	6.54	0.22	2.40	6.76	6.76
2	main 1	2	3	49.36	36.34	0.40	0.46	16.55	2.11	35.00	1.66	18.21	175.00	168.24
3	main 1	3	4	24.25	36.34	0.17	0.62	22.55	2.03	45.70	2.26	24.81	186.29	18.06
4	main 1	4	5	25.10	36.34	0.31	0.93	33.82	1.93	65.27	3.38	37.20	344.95	326.89
5	main 1	5	6	40.39	36.34	0.54	1.47	53.44	1.84	98.44	5.34	58.79	380.09	53.19
6	main 1	6	7	49.28	36.34	1.04	2.51	91.24	1.76	160.74	9.12	100.37	446.17	392.97
7	main 1	7	8	48.86	36.34	0.92	3.43	124.79	1.72	215.12	12.48	137.27	617.79	224.82
8	main 1	8	9	50.22	36.34	1.09	4.52	164.45	1.69	278.73	16.44	180.89	685.36	460.55
9	main 1	9	10	49.43	36.34	1.89	6.42	233.21	1.66	387.99	23.32	256.53	801.50	340.96
10	main 1	10	11	49.12	36.34	1.54	7.96	289.25	1.65	476.39	28.93	318.18	895.51	554.55
11	main 1	11	12	50.49	36.34	1.46	9.42	342.24	1.64	559.61	34.22	376.46	984.02	429.47
12	main 1	12	13	46.21	36.34	0.82	10.23	371.90	1.63	606.06	37.19	409.09	1033.44	603.97
13	main 1	13	14	49.36	36.34	1.72	11.95	434.41	1.62	703.72	43.44	477.85	1361.36	757.39
14	main 1	14	15	42.90	36.34	1.72	13.67	496.92	1.61	801.11	49.69	546.61	1465.00	707.61
15	main 1	15	16	34.30	36.34	1.20	14.87	540.42	1.61	868.75	54.04	594.47	1537.00	829.39
16	main 1	16	17	41.64	36.34	1.37	16.24	590.07	1.60	945.83	59.01	649.08	1619.04	789.65

Design Assamptions and data

1) Water commsumption is	3.5	m3/d.d which	80% return to sewer
3) Infiltration is equal	10	% of the average industrial wastewater flow.	
4) Minimum pipe diameter=	200	mm	
5) Minimum velocity Vmin =	0.6	m/sec	
6) Maximum velocity Vmax =	3	m/sec	
7) Minimum slope Smin =	0.5	%	
8) Maximum slope Smax =	15	%	
9) Maximum manhole spacing =	60	m	
10) Minimum depth of sewer	1.5	m	
11) Design depth of flow h/d<	0.5		
12) Maining coefficient n=	0.01		

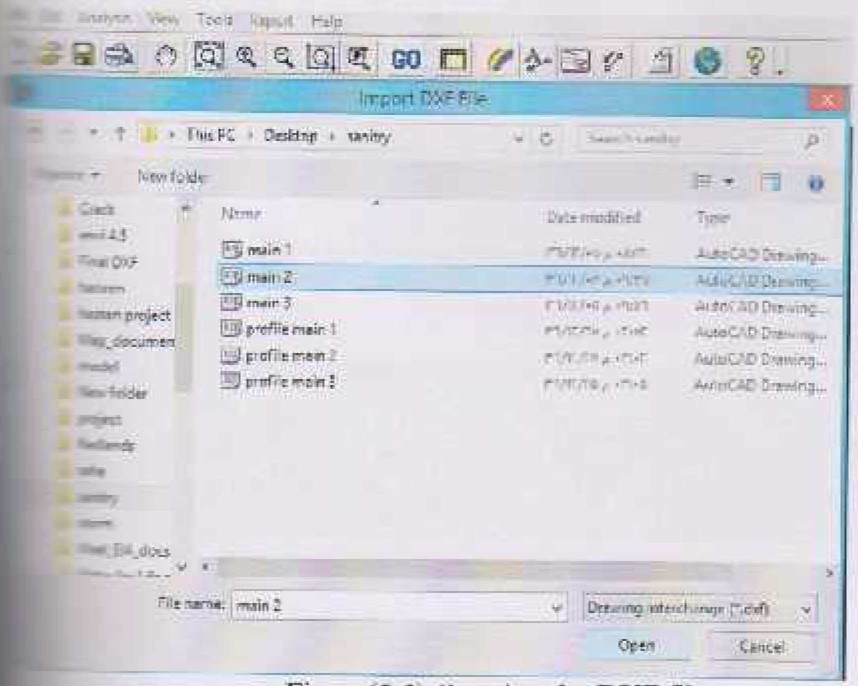
SewerCAD program works

Open SewerCAD ,select file → import → DXF Background to import the DXF file , figure (5.4) below shows this step.

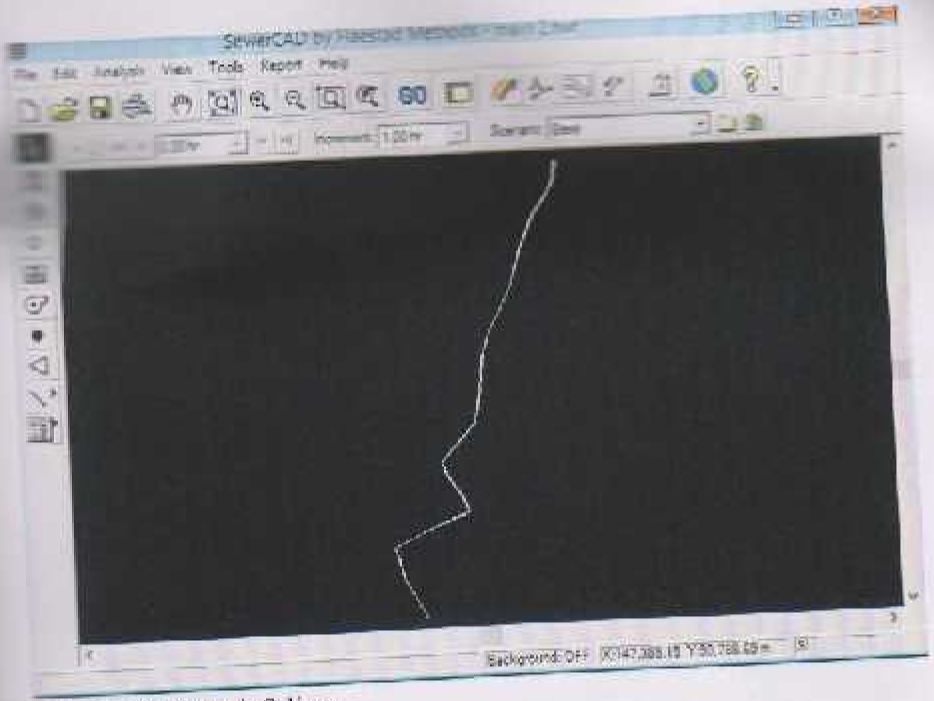


Figure(5.4): Importing DXF file

…ify file location is then press open ,figure(5.5) below shows this step. And figure … shows line(main 2).

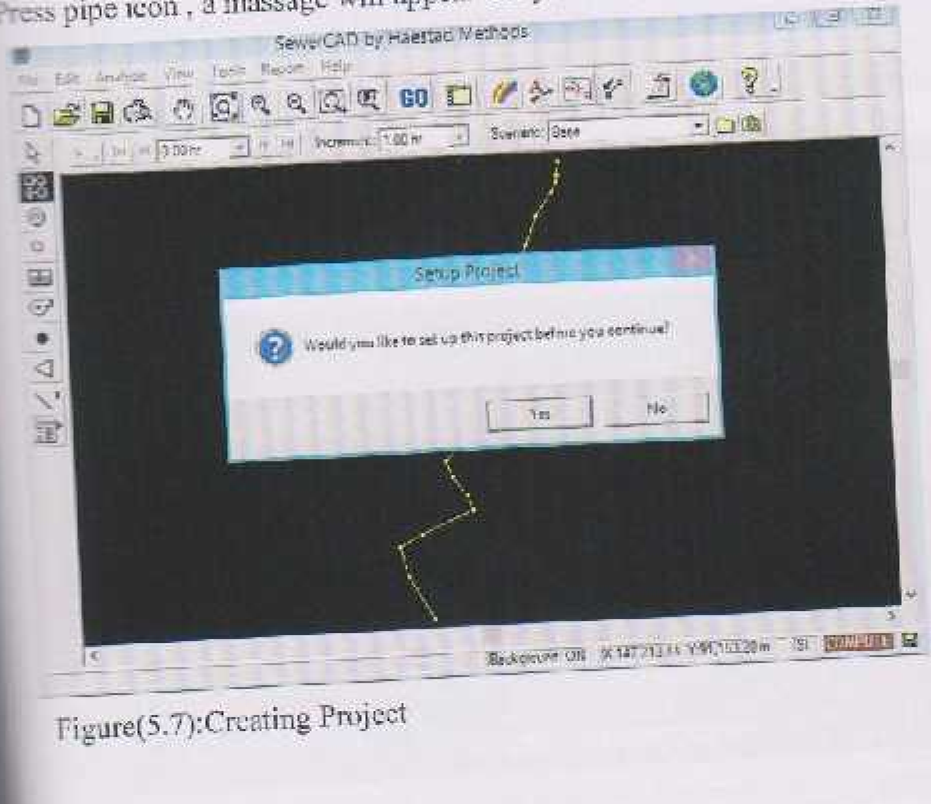


Figure(5.5):Opening the DXF file



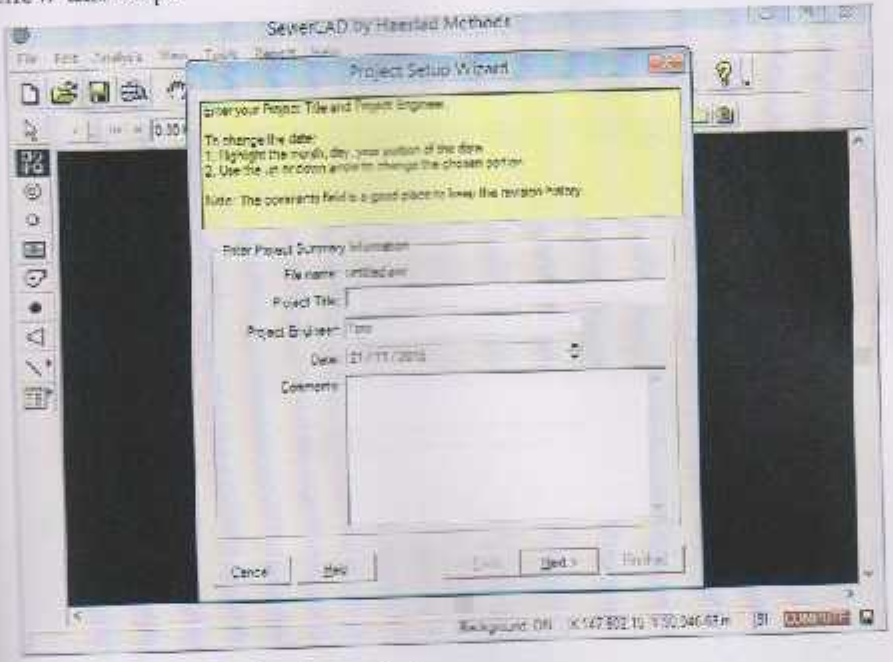
Figure(5.6):main2 line

Press pipe icon , a massage will appear tell you to create a project see figure(5.7).



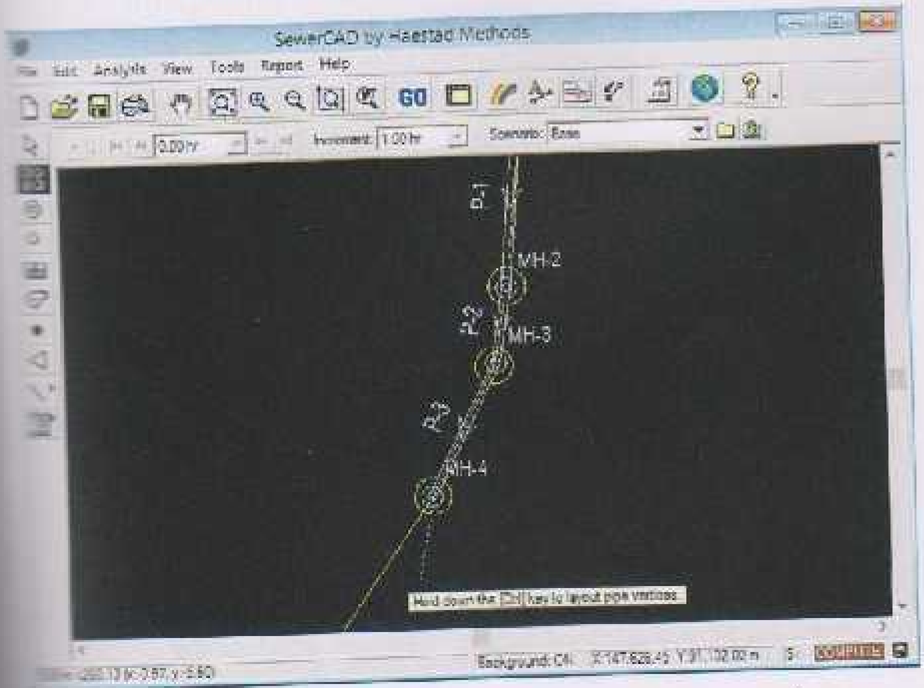
Figure(5.7):Creating Project

4. Press yes and define the project then press next twice , then select finish, the figure(5.8) below show this step.



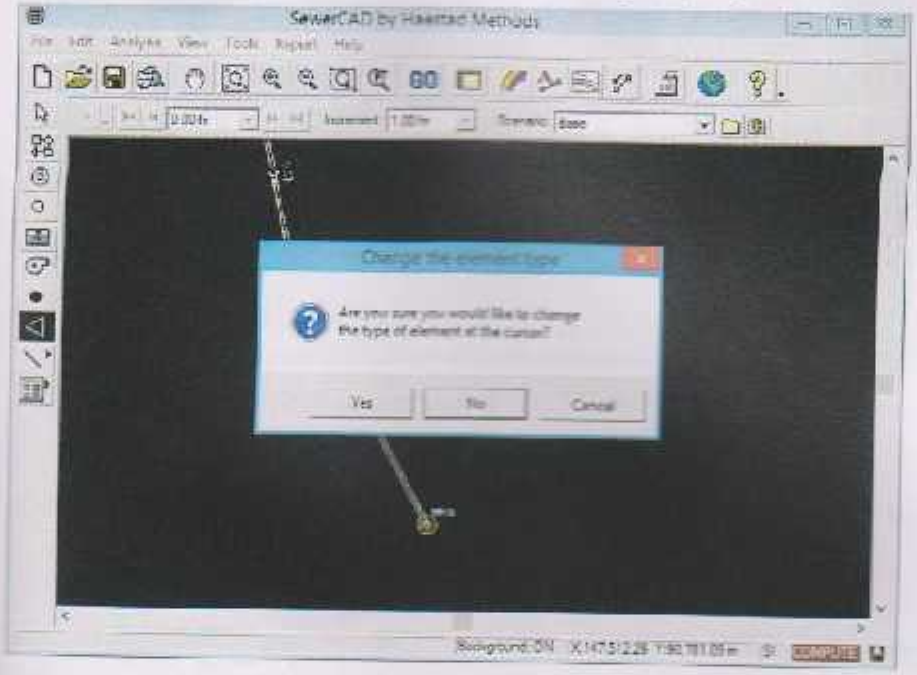
Figure(5.8): Defining the project

Press pipe icon and connect between manholes , figure(5.9) below show this step.



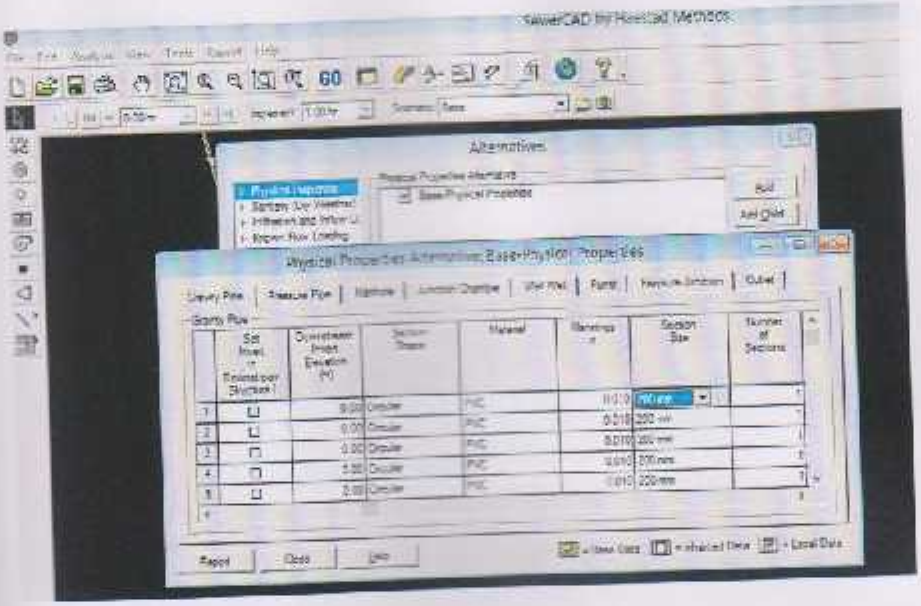
Figure(5.9): Creating a pipe network

E. After you connect all manholes , press on the out let icon and click on the last manhole , then press yes to replace the manhole with outlet , the figure(5.10) below shows the step.



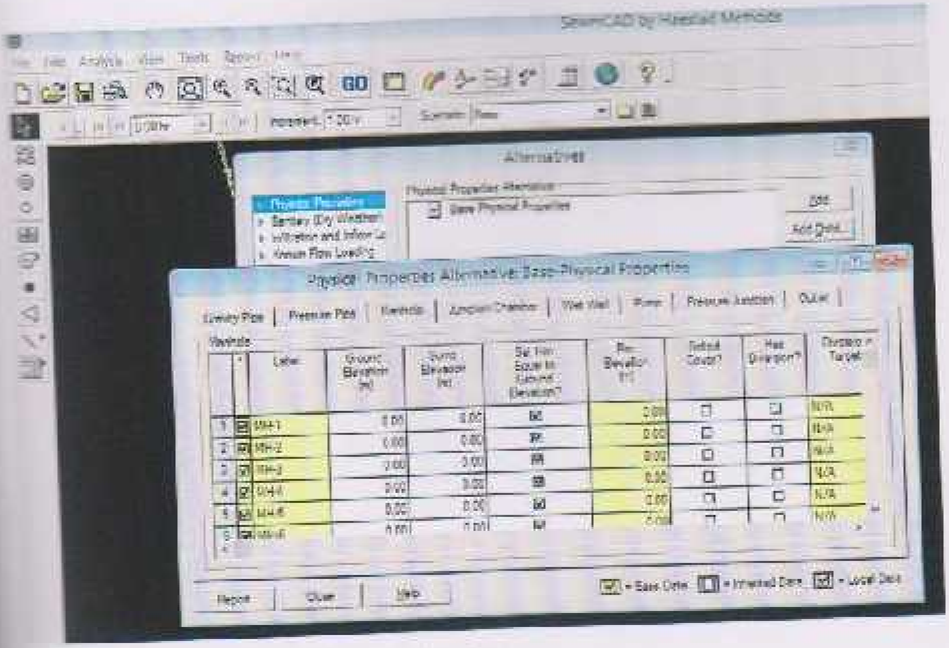
Figure(5.10): Creating outlet

Save your project , then select analysis→ alternatives→ physical properties→ edit, then start editing gravity pipe , see figure(5.11).



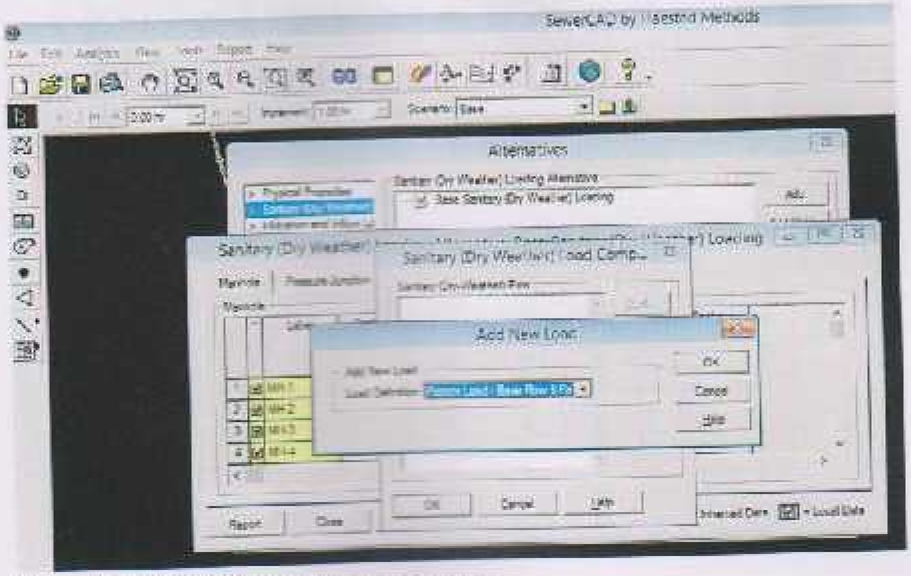
Figure(5.11): Editing design parameter

Select manhole to enter the ground elevations of manholes, then select out let to enter its elevation. Then press close. Figure (5.12) below shows the step.



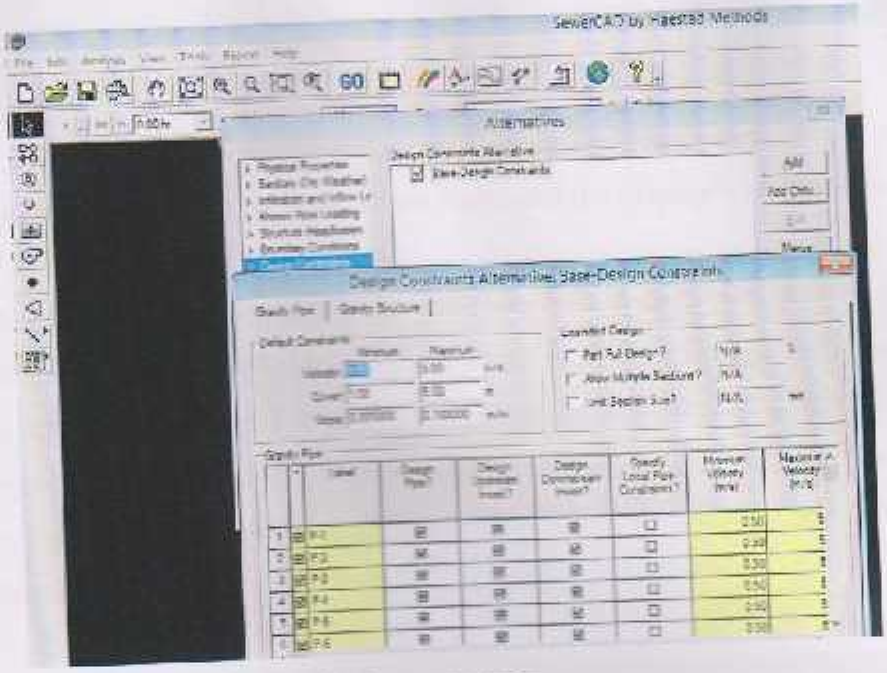
Figure(5.12): Editing design parameter

5. Select sanitary (dry weather)→ edit→ manhole to select the type of load and to enter the load for each manhole , figure (5.13) below shows the step.



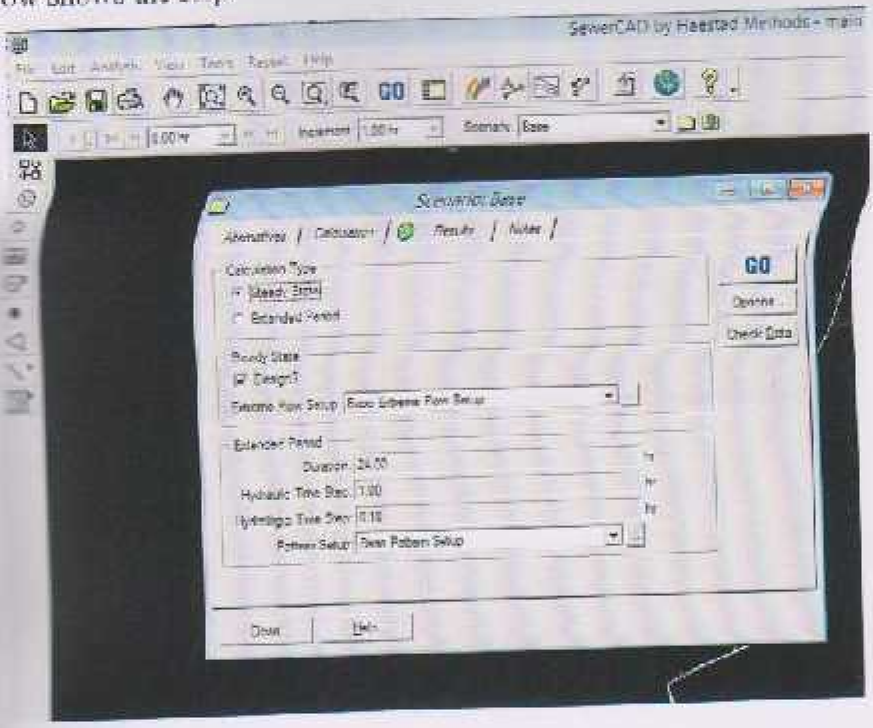
Figure(5.13): Editing design parameter

6. After doing this for each manhole press close , then select design constrains → edit to enter the design specifications , figure (5.14) below shows the step.



Figure(5.14): Editing design parameter

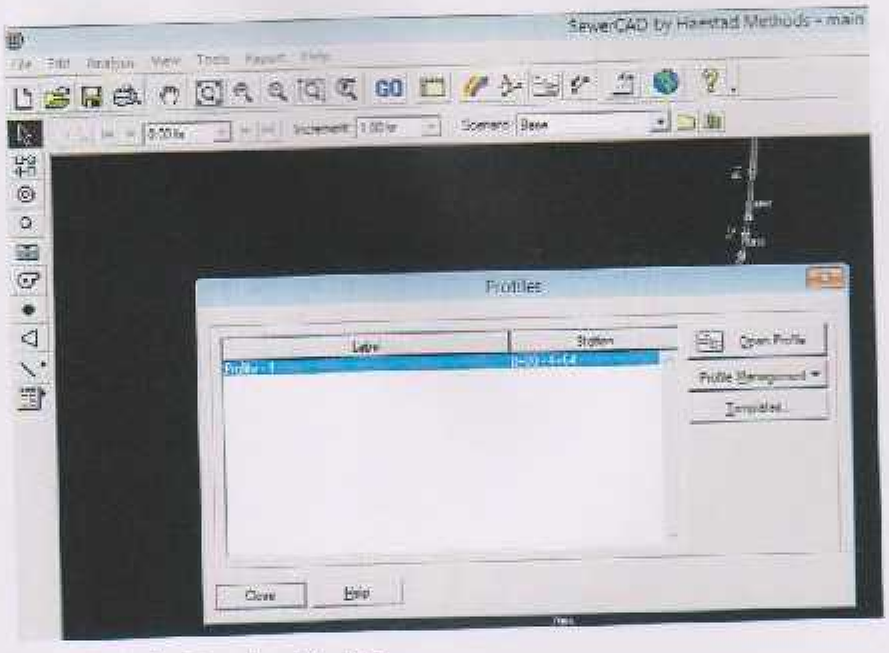
Last step press save , press GO button to start design then press on GO , figure(5.15)below shows the step.



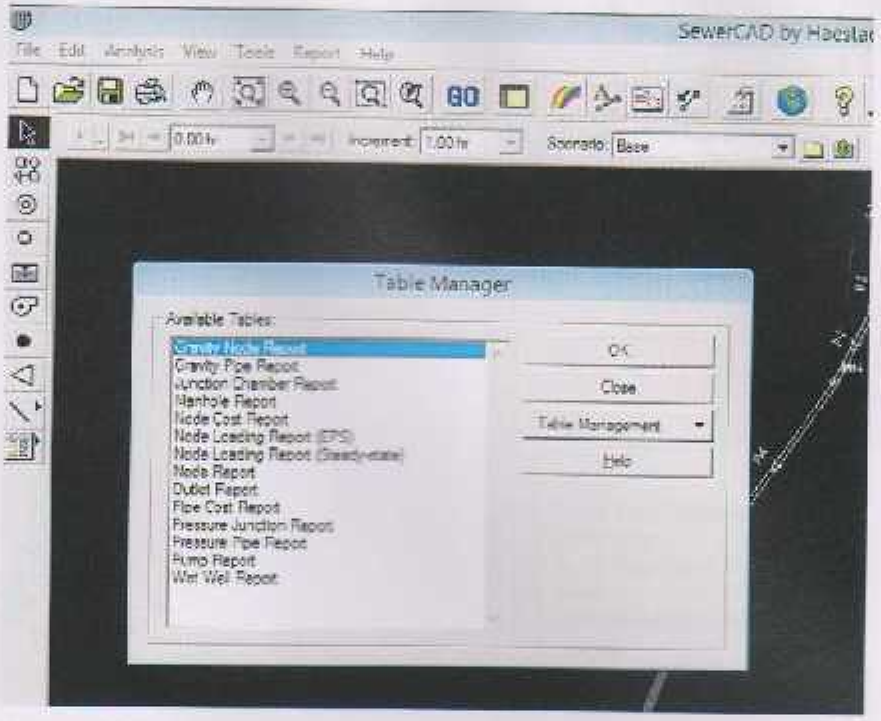
Figure(5.15): Checking the design

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 , gravity pipe report and gravity node report .Press profile button to make the profile see figure (5.16) , have we should put the scale of the profile. The profile for this project are attached in appendix. We can get the required tables by pressing tabular report button see figure (5.17), and then choose gravity pipe report and gravity node report . The required reports for this project are attached in appendix.

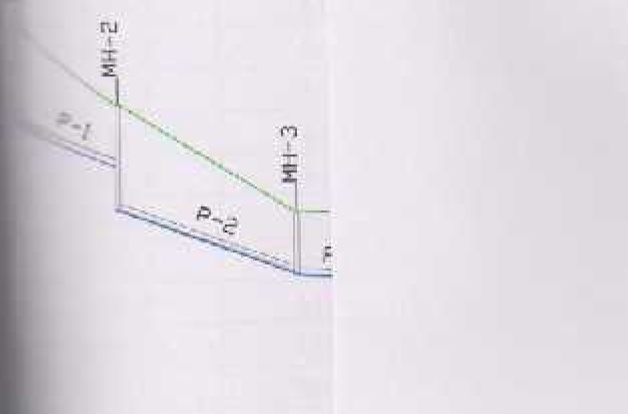


Figure(5.16): Creating Profile



Figure(5.17): Creating Tables

Figure(5.18) shows the profile of sanitary main 1 , and gravity pipe report and gravity node report for the same profile presented in tables(5.2, 5.3).



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Environmental Assessment of Al-Dahriya Old City.

Notes:-
1- All Pipe Diameter are Millimeter.
2-All Pipe Depth are in Meter.
3-Depth of Excavation up to 1.5 m.

Designed By:
Haneen Abu-Sabha.
Sajida Al-Daraweesh.

Supervisor :
Eng:Samah AL-Jabary.

Client :
Al-Dahrieh Municipality.

Drawing Title :
The Profile Of Sanitry Line (Main #1)

H.Scale 1:500

V.Scale 1:50

No.of Figure : 5.18

Page : 87

Date : Dec.2015

…5.2): Gravity pipe Report for sanitary main 1

Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
MH-1	MH-2	200 mm	Circular	0.40	0.035
MH-2	MH-3	200 mm	Circular	1.08	0.035
MH-3	MH-4	200 mm	Circular	0.60	0.006054
MH-4	MH-5	200 mm	Circular	0.75	0.005
MH-5	MH-6	200 mm	Circular	1.53	0.034572
MH-6	MH-7	200 mm	Circular	1.79	0.035
MH-7	MH-8	200 mm	Circular	1.90	0.035
MH-8	MH-9	200 mm	Circular	2.08	0.035
MH-9	MH-10	200 mm	Circular	2.19	0.035
MH-10	MH-11	200 mm	Circular	2.35	0.035
MH-11	MH-12	200 mm	Circular	2.19	0.026119
MH-12	MH-13	200 mm	Circular	2.56	0.035
MH-13	MH-14	200 mm	Circular	2.69	0.035
MH-14	MH-15	250 mm	Circular	2.77	0.034449
MH-15	MH-16	250 mm	Circular	2.90	0.035
MH-16	O-1	300 mm	Circular	1.42	0.005

Table(5.3): Gravity Node Report for sanitary main 1

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	6+83	644.94	1.2	6.76	0.22
MH-2	6+52	642.86	1.2	175	0.50
MH-3	6+03	639.9	1.2	193.06	0.51
MH-4	5+78	639.79	1.2	519.95	0.68
MH-5	5+53	639.71	1.2	573.14	0.70
MH-6	5+13	639.53	1.2	966.11	0.82
MH-7	4+63	636.25	1.2	1190.93	0.87
MH-8	4+14	633.36	1.2	1651.48	0.98
MH-9	3+64	630.98	1.2	1992.44	1.05
MH-10	3+14	628.61	1.2	2546.99	1.17
MH-11	2+65	626.37	1.2	2976.46	1.26
MH-12	2+15	624.99	1.2	3580.43	1.41
MH-13	1+69	622.32	1.2	4337.82	1.62
MH-14	1+19	620.1	1.2	5045.43	1.39
MH-15	0+76	619.07	1.2	5874.82	1.52
MH-16	0+42	617.34	1.2	6664.47	1.40
O-1		617.34		6664.47	0.00

5.2 Storm Water

5.2 .1 General

In this project, design of storm water drainage system for Al-Dahriya Old City , in order to solve problem causes by the commutative flooded storm water in the streets will be prepared.

In this section, the computation procedures and tables are given along the drawings of layout.

5.2.2 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 date collected about the area.

Example:

Design a gravity flow storm water drainage pipe for the area of Al-Dahriya Old City use line sub- main 1 as example this is line down in figure (5.19). 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 (t_i)use 10 minutes.

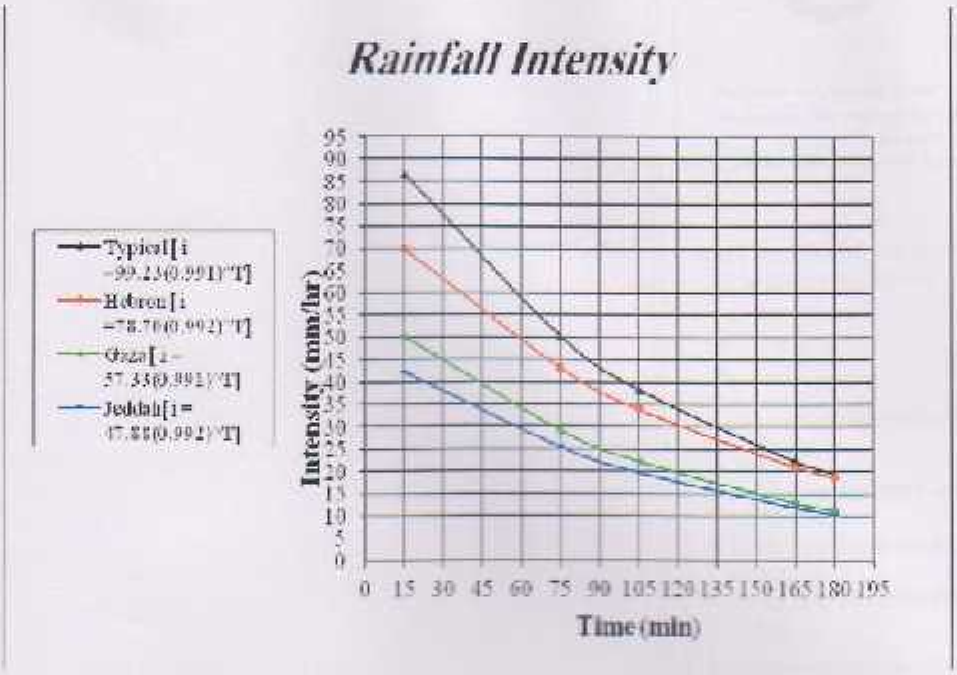
3. for concentration time (t_c) use equations:

$$t_c = t_i + t_f \qquad (4.4)$$

4. for runoff rate depending on the formula:

$$Q=C.i.A \qquad (4.2)$$

5. for runoff intensity use Figure(5.20).



Figure(5.20)The rainfall intensity-duration curve for several areas.

Point
Manhc
Statior
Groun
Depth
Distar
Dstan
Pipe I
Pipe S

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Al-Dahriya Old City.

Notes:-
1- All Pipe Diameter are Millimeter.
2-All Pipe Depth are in Meter.
3-Depth of Excavation up to 1.5 m.

Legend
Ground Elevation
Sewer Line
Manholes

Designed By:
Haneen Abu-Sabha.
Sajida Al-Daraweesh.

Supervisor :
Eng:Samah AL-Jabary.

Client :
Al-Dahrieh Municipality.

Drawing Title :
The Profile Of Storm Line
(Sub main #1)
(From Manholes 1 to 9)

H.Scale 1:500

V.Scale 1:50

No.of Figure : 5.19

Page : 92

Date : Dec. 2015

Solution:

1. Lay out the storm water sewer. Draw a line to represent the proposed sewer Figure (5.19).
2. Locate and number the upper and lower points of the line(sum-main1).
3. The necessary computations for the storm water sewer are presented in Table (5.4) for year 2036. The data in the tables are calculated as follow:
   a. The entries in columns 1 through 6 are used to identify the point location, their numbers and the length between them.
   b. The entries in column 7 used to identify the sewer area, column 7 shows the partial sewered area in hectare.
   c. The entries in columns 8 through 14are used to calculate the design flow .Runoff coefficient (C) is entered in column 8. The partial sewer 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 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

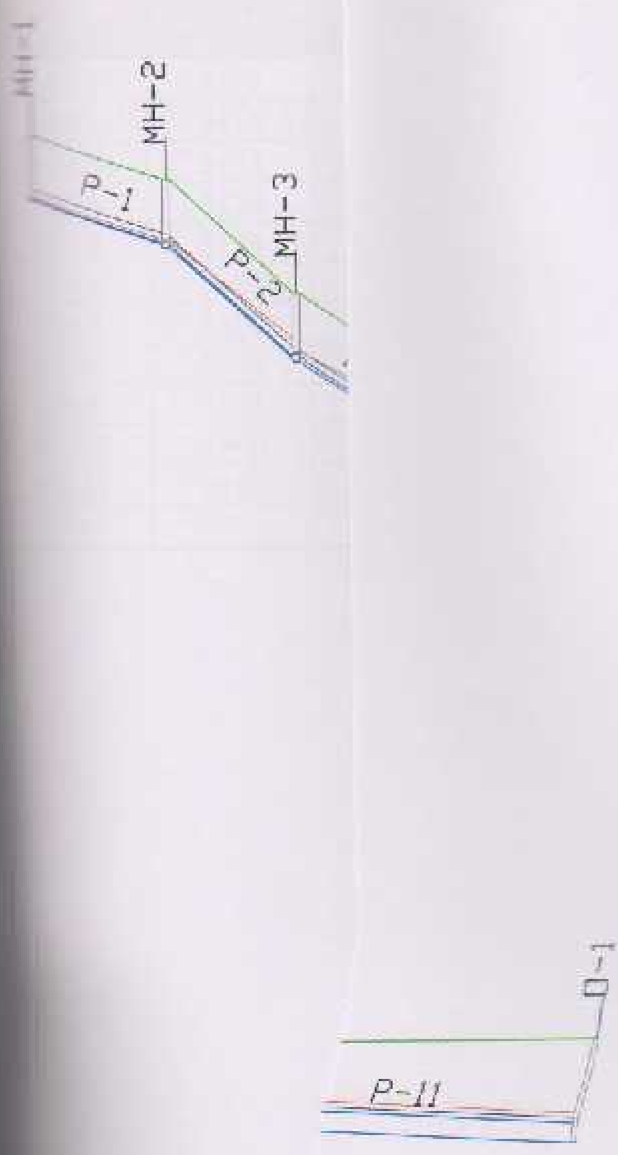
Sub 1

NUMBER	LOCATION			LENGTH	LENGTH COMULATIVE	AREA of Street and industry	C FACTOR Street and industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(i)	Q	Qi
	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	sub1	1	2	26.27	26.27	0.02	0.65	0.014	0.014	10.438	201.191	2.785	2.785
2	sub1	2	3	24.26	50.52	0.07	0.65	0.047	0.061	10.842	200.539	12.266	9.480
3	sub1	3	4	22.26	72.78	0.09	0.65	0.057	0.118	11.213	199.943	23.536	11.270
4	sub1	4	5	22.41	95.19	0.10	0.65	0.062	0.180	11.586	199.343	35.905	12.369
5	sub1	5	6	27.40	122.59	0.17	0.65	0.114	0.294	12.043	198.614	58.353	22.448
6	sub1	6	7	14.36	136.96	0.10	0.65	0.063	0.357	12.283	198.232	70.739	12.386
7	sub1	7	8	28.09	165.05	0.21	0.65	0.139	0.496	12.751	197.488	97.996	27.256
8	sub1	8	9	18.04	183.08	0.06	0.65	0.040	0.536	13.051	197.012	105.622	7.626
9	sub1	9	10	61.23	244.31	0.47	0.65	0.304	0.840	14.072	195.404	164.202	58.580
10	sub1	10	11	131.66	375.96	0.76	0.65	0.491	1.331	16.266	191.990	255.552	91.350
11	sub1	11	12	73.23	449.19	0.12	0.65	0.079	1.410	17.487	190.117	268.073	12.521

StormCAD program works

This program works at the same steps in the SewerCAD program, figure(5.21) shows the profile of *storm sub main 1* , and *gravity pipe* report and gravity node report for the same profile presented in tables(5.5, 5.6).

The required reports and profiles for this project are attached in appendix.



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Technology and engineering college
Mechanical department
Environmental Technology and Engineering

Environmental Assessment of Al-Dahriya Old City.

Notes:-
1- All Pipe Diameter are Millimeter.
2-All Pipe Depth are in Meter.
3-Depth of Excavation up to 1.5 m.

Designed By:
Haneen Abu-Sabha.
Sajida Al-Daraweesh.

Supervisor :
Eng:Samah AL-Jabary.

Client :
Al-Dahrieh Municipality.

Drawing Title :
The Profile Of Storm Line (Sub main #1)

H.Scale 1:500

V.Scale 1:50

No.of Figure : 5.21

Page : 96

Date : Dec. 2015

Table(5.5): Gravity Node Reportfor storm sub main 1

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	4+42	659.8	1.2	240.67	0.55
MH-2	4+16	659	1.2	1,059.78	0.84
MH-3	3+92	656.88	1.2	2,033.53	1.06
MH-4	3+70	655.47	1.2	3,102.17	1.29
MH-5	3+48	651.65	1.2	5,041.67	1.84
MH-6	3+21	649.81	1.2	6,111.86	2.2
MH-7	3+07	646.95	1.2	8,466.81	1.99
MH-8	2+79	645.81	1.2	9,125.73	1.41
MH-9	2+61	645.81	1.2	14,187.01	1.72
MH-10	2+00	643.99	1.2	22,079.68	1.87
MH-11	0+68	643.1	1.2	23,161.54	1.9
O-1		643.1		23,161.54	0

Table(5.6): Gravity Node Report for storm sub main 1

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	4+42	659.8	1.2	240.67	0.55
MH-2	4+16	659	1.2	1,059.78	0.84
MH-3	3+92	656.88	1.2	2,033.53	1.06
MH-4	3+70	655.47	1.2	3,102.17	1.29
MH-5	3+48	651.65	1.2	5,041.67	1.84
MH-6	3+21	649.81	1.2	6,111.86	2.2
MH-7	3+07	646.95	1.2	8,466.81	1.99
MH-8	2+79	645.81	1.2	9,125.73	1.41
MH-9	2+61	645.81	1.2	14,187.01	1.72
MH-10	2+00	643.99	1.2	22,079.68	1.87
MH-11	0+68	643.1	1.2	23,161.54	1.9
O-1		643.1		23,161.54	0

5.3 Septic Tank Design

5.3.1 Septic tank

Assume that:

- HRT=2 hr
- Organic flow rate=35 m3/m2/d
- Depth =3 Width (D = 3W)
- 2 tank (L_1=2L_2), Slope of tank nearly 1:10
- The suspended solid concentration and BOD concentration of the influent discharge are 450 ppm, 300 ppm respectively.
- Removal ratio of BOD and suspended solid is 33 %, 60 % respectively.

$$= 6664.47 * \frac{2}{24}$$

=555.4 m^3

$$= 6664.47 \times 35$$

190.41 m^2

$$= \frac{555.4}{190.41}$$

…4 m ≈ 3m

$$= W * L$$

$As = W*D = W*3W$

$W=7.9m=8$, and $L=24$ m

Suppose that we have two septic tanks.

$L = L_1 + L_2$

$L = L_1 + 2L_1$

Then $L_1 = 16$ m, and $L_2 = 8$ m

c) The SS concentration in effluent=200 ppm

d) The BOD concentration in effluent =180 ppm

Figure(5.22) show the dimension of the septic tank.

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Technology and engineering college
Mechanical department
Environmental Technology and Engineering

Environmental Assessment of Al-Dahrieh Old City.

Notes:-
All Diamention are meter.

Designed By: Haneen Abu-Sabha. Sajida Al-Daraweesh.
Supervisor : Eng:Samah AL-Jabary.
Client : Al-Dahrieh Municipality.

Drawing Title :
Septic Tank Plan and Section

Page : 101
No.of Figure : 5.22
Date : Dec. 2015

5.4 Solid waste management

[illegible]:

- 38864 capita in Al-Dahriya city
- 8000 student in school and kindergartens
- 11 public service office
- 5 Entertainment centers
- 700 commercial markets
- [illegible] patient beds (Health care centers)

[illegible] number of container assuming that:

[illegible] 1 time /day

[illegible] container of type 240 L.

[illegible] container of type 1100 L.

[illegible] container of type 4 m^3

[illegible] student is 1 houschold

[illegible] patient beds is 1 houschold

[illegible] generation = 4L/Cap.Day, and 24L/Unit.Day

[illegible] of solid in compaction truck = 0.7 ton / m3

[illegible] = 90%

[illegible] rate = 86%

[illegible] of solid in container = 0.25 ton / m3

[illegible] per container = 6 min

[illegible] 6.5 hr

[illegible] for household, student, public service office, Entertainment centers, and [illegible] centers, are 1.5, 1.5, 1.5, 3, 3, and 1.5 respectively.

[illegible] Volume of Waste Generated Daily =Number of Unit * Waste Generation *Safety [illegible]

[illegible] Capacity of Compactor = Volume Of Truck * Density Of Solid In Compaction [illegible] Operating Rate* Loading Rate

Effective Capacity of Compactor = Volume Of Container * Density Of Solid In Container *Operating Rate

For each unit apply below equation:

The Total Volume of Waste Generated Daily =Number of Unit * Waste Generation *Safety Factor

–The Total Volume of Waste Generated Daily of household = 38864 Cap*4L/Cap.Day* 1.5

= 233184 L /day

- We have 8000 student and every 50 student is 1 household so we have 160 hh

  The Total Volume of Waste Generated Daily of student in school and kindergartens

  = 160hh*24L/Cap.Day* 1.5

  = 5760 L /day

- The Total Volume of Waste Generated Daily of student in public service office

  = 11 *24L/Cap.Day* 1.5

  = 396 L /day

- The Total Volume of Waste Generated Daily of student Entertainment centers

  = 5 *24L/Cap.Day* 3

  = 360 L /day

- The Total Volume of Waste Generated Daily of commercial markets

  = 700 *24L/Cap.Day* 3

  = 50400 L /day

- *We have 600 patent bed and every 2 bed is 1 household so we have 300 hh*

  The Total Volume of Waste Generated Daily of Health care centers

  *= 300hh*24L/Cap.Day* 1.5*

  = 10800 L /day

- The Total Volume of Waste Generated Daily

  =233184+5760+396+360+50400+10800

= 300900 L/day

- 10% container of type 240 L = 10%*(300900/240) = 125 container of type 240 L
- 60% container of type 1100 L =60%*(300900/1100) = 164 container of type 1100 L
- 30% container of type 4 m^3 =30%*(300900/4000) = 23 container of type 4 m^3

Table(5.7):Capacity per trip

Number	nominal capacity for container		Loading Rate	Operating Rate	Effective Capacity
/	m3	ton/m3	(%)	(%)	ton
1	5	0.7	90	86	2.7
2	8	0.7	90	86	4.33
3	12	0.7	90	86	6.5
4	21	0.7	90	86	11.4

- Effective Capacity of Compactor = Volume of Truck * Density Of Solid In Compaction Truck *Operating Rate* Loading Rate

= 5 m3* 0.7 ton/m3 *.9*.86 = 2.7 ton

Table(5.8): number of container

Type of compactor	nominal capacity for container		Operating Rate	Effective Capacity	number of container per trip
m2	m3	ton/m3	(%)	Ton	/
5	1.1	0.25	80	0.22	12
8	1.1	0.25	80	0.22	20
12	1.1	0.25	80	0.22	30
21	4.3	0.25	80	0.86	13

- Effective Capacity of Compactor = Volume Of Container * Density Of Solid In Container *Operating Rate

= 1.1 m3 *.25 ton /m3 *.8 *.22 ton

= 12 container

Table(5.9):Transportation

Number	Type of compactor	number of container per trip	hauling time per container	1 trip in minute				average trip per shift	average capacity per shift in ton
				time for collection	time for transportation	total time	total time		
	m2		Min	min	min	Min	hr	/	/
1	5	12	6	73.9	40	113.9	1.9	3.4	9.3
2	8	20	6	118.2	40	158.2	2.6	2.5	10.7
3	12	30	6	177.3	40	217.3	3.6	1.8	11.7
4	21	13	6	79.4	40	119.4	2.0	3.3	37.2

- Total time(min) − time for collection + time for transportation

  = 40 + 73.9

  = 113.9 min

- Total time(hr) − 113.9 min *(1 min / 60 hr)

  = 1.9 hr

- Average trip per shift = Shift working / total time

  = 6.5 / 1.9

  =3.4 trip

- Average capacity per shift – Average trip per shift * effective capacity of compactor

  − 2.7*3.4

  −9.3 ton

5.5Park design

The idea of park was by cooperation between us as an environmental engineering and student from architectural student working at the same project, but in architectural view.

Landscapes are more than just pretty views. They can provide economic benefits and create more appealing places to live

If you are looking for ways to make our landscape design more sustainable, we must take in consideration these points:

First we look to the sustainable sites; the site oversees a unique view of historical place, in addition to place which has a large quantity of solid waste by converting it to a place suitable for children to play in it, figure (5.23) show the bad condition for the site, and figure(5.24) show the landscape of small park.

Figure (5.23): Parking site prior implementation and the bad condition there

[illegible] number of container for landscape distributed to limit solid waste on ground.

[illegible] storm water quality and quantity, by making storm water collection system and [illegible] gradient in each part of park.

Wheels can be used for residential purposes and in children's play areas, picnic tables, park benches, and lots of thing can be built by these wheel.

Figure (5.25): Reuse cans, wheel for agricultural use

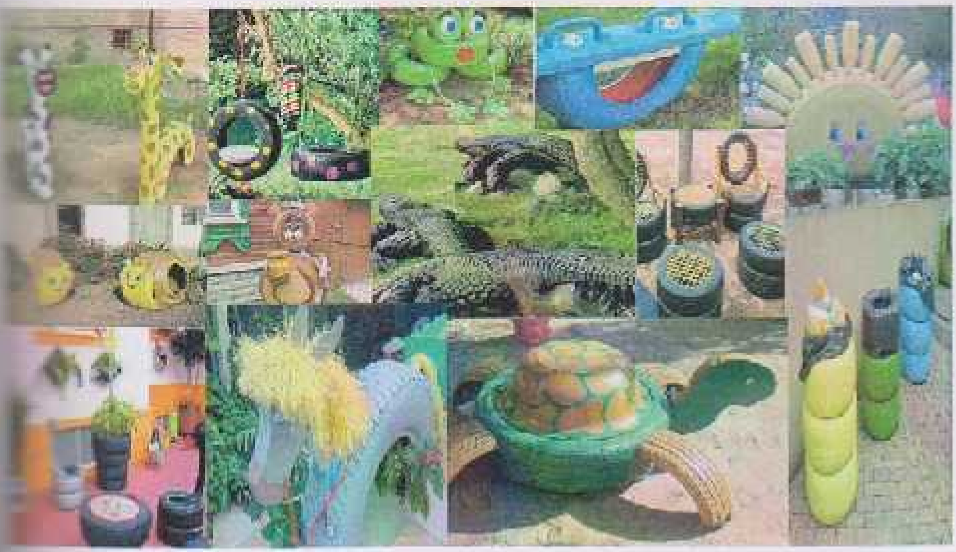


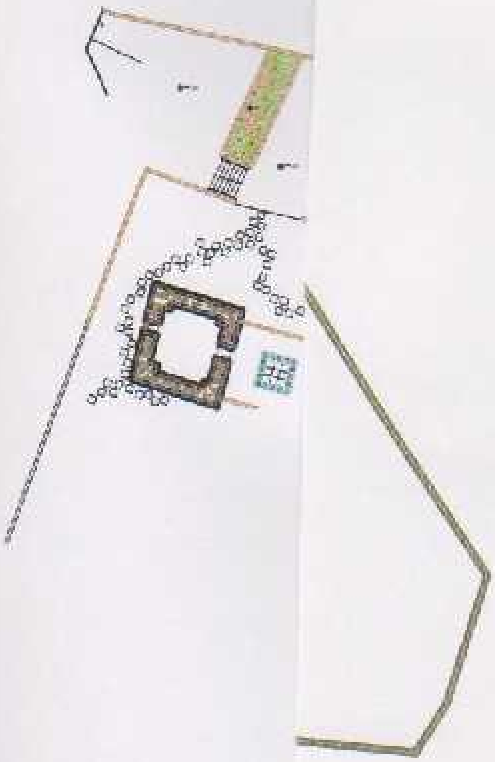
Figure (5.25): Use wheel for different uses.

Create direct, comfortable and safe pedestrian routes .Generally; main footpaths should be wide enough to allow two wheelchairs to pass comfortably.

Provide shade and high-quality landscaping and enhancing Wildlife Habitat

Provide children's play areas that should be safe for them.

Landscapes need to be maintained and managed to conserve investment.



Palestine Polytechnic University
Technology and engineering college
civil and Architecture department
Architectural Engineering

Environmental Assessment of Al-Dahrieh Old City.

Drawing Title:
Landscape of Small Park in Al-Daheryia Old City.

Designed By:
Deema Alamllah.
Haneen Abu-Sabha.
Leena Abu- Reesh.
Sajida Al-Daraweesh.

Supervisor:
Eng:Samah AL-Jabary.

Client:
Al-Dahrieh Municipality.

V.Scale 1 :50
H Scale 1 : 500

# of Figure : 5.24

Page : 109

Date : Dec, 2015

Chapter Six
Bill of Quantity

Chapter Six
Bill of Quantity

1. 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 200 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	2685				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 250 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	128				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 300 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	92				
	Sub-Total						
B	**PIPE WORK**						
	Supplying, storing and installing of uPVC	LM	2905				
	Sub-Total						

No.	BACKFILLING	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
[illegible]	PIPE BEDDING AND BACKFILLING Dimension and material						

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	2685				
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	128				
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	92				
	Sub-Total						
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	85				
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	26				
	Sub-Total						
E	**Concrete Surround**						
E1	Supplying and cast iron (B200) surround for sewer.	M^3	109				
	Sub-Total						

No	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
F	**Air And Water Leakage Test**						
[illegible]	Air leakage test for sewer pipe lines 8,10,12,and 14inch according to specifications, including for all t emporary works.	LM	2905				

F2	Water leakage tests for manholes, depth up to 1.5 meter according to specifications.	NR	85				
F3	Water leakage test for manholes , depth up to 2.5 meter according to specification	NR	26				
	Sub-Total						
G	**Rode reinstatment**						
G1	Removing and dispose of the asphalt anf repaaviing and re-Asphalting after BACKFILL, road structure layers compacted basecoarse 125+125 mm, MCO layer 1l/m2, asphalt layer 50mm(3/4").	LM	2905				
	Sub-Total						
H	**Survey work**						
H1	Topographical survey required for shop drawings and as built DWGS using absoluet Elev. And coordinate system	LM	2905				
	Sub-Total						

2.For The Proposed Storm water 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 200 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	561				
A2	Excavation of pipes trench in all kind of soil for one pipe diameter 250 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	212				
A3	Excavation of pipes trench in all kind of soil for one pipe diameter 300 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	236				
A4	Excavation of pipes trench in all kind of soil for one pipe diameter 375 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	281				
A5	Excavation of pipes trench in all kind of soil for one pipe diameter 450 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	507				
A6	Excavation of pipes trench in all kind of soil for one pipe diameter 600 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	406				

A7	Excavation of pipes trench in all kind of soil for one pipe diameter 750 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	96				
A8	Excavation of pipes trench in all kind of soil for one pipe diameter 900 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	94				
A9	Excavation of pipes trench in all kind of soil for one pipe diameter 1050 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	24				
A10	Excavation of pipes trench in all kind of soil for one pipe diameter 375 mm depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	28				
	Sub-Total						
B	**PIPE WORK**						
	Supplying, storing and installing of uPVC	LM	2445				
	Sub-Total						

No.	BACKFILLING	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
C	**PIPE BEDDING AND BACKFILLING** **Dimension and material**						
[illegible]	Supplying and embedment of sand for one pipe diameter 200 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	561				

C2	Supplying and embedment of sand for one pipe diameter 250 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	212				
C3	Supplying and embedment of sand for one pipe diameter 300 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	236				
C4	Supplying and embedment of sand for one pipe diameter 375 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	281				
	Supplying and embedment of sand for one pipe diameter 450 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	507				
	Supplying and embedment of sand for one pipe diameter 600 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	406				
	Supplying and embedment of sand for one pipe diameter 750 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	96				
	Supplying and embedment of sand for one pipe diameter 900 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	94				

C9	Supplying and embedment of sand for one pipe diameter 1050 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	24				
C10	Supplying and embedment of sand for one pipe diameter 1200 mm, depth up to 1.5 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	28				
	Sub-Total						
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	35				
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	45				
	Sub-Total						
	Concrete Surround						
	Supplying and cast iron (B200) surround for sewer.	M^3	221				
	Sub-Total						

	EXCAVATION	**UNIT**	**QTY**	**UNIT PRICE**		**TOTAL PRICE**	
	Air And Water Leakage Test						
	Air leakage test for sewer pipe lines 8,10,12,and 14inch according to specifications, including for all t emporary works.	LM	2445				
	Water leakage tests for manholes, depth up to 1.5 meter according to specifications.	NR	35				
	Water leakage test for manholes , depth up to 2.5 meter according to specification	NR	45				
	Sub-Total						
	Rode reinstatment						

[illegible]	Removing and dispose of the asphalt anf repaving and re-Asphalting after BACKFILL, road structure layers compacted basecoarse 125+125 mm, MCO layer 1l/m2, asphalt layer 50mm(3/4").	LM	2445				
	Sub-Total						
[illegible]	**Survey work**						
[illegible]	Topographical survey required for shop drawings and as built DWGS using absoluet Elev. And coordinate system	LM	2445				
	Sub-Total						

3. For the Proposed Septic tank:

No.		UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A	**Septic Tank**						
A1	Volume of septic tank	M^3	555.4				

4. For the Proposed Solid Waste management:

No.		UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A	**Container**						
A1	Type 240 L	NR	125				
A2	Type 1100 L	NR	164				
A3	Type 4 m^3	NR	23				

Chapter Seven

"Conclusions and Recommendations"

CONCLUSIONS

In this project, the trial is done make an environmental assessment for Al-Dahriya Old City in addition to make a design for wastewater and storm water collection systems for the coming 25 years . The main conclusions drown from the present study are summarized below:

1.The environmental condition in Al-Dahriya Old City is assessed in bad condition, an absence of sanitary systems, and an absence of solid waste management.

2. Al-Dahriya Old City like other city in Palestine has no sewage facilities. The people are using latrines, and cesspits . The wastewater has been seeping into the ground through the over flow of the deteriorated cesspits and latrines, causing series environmental and health problems.

3. The proposed wastewater and storm water systems covered all of the areas of Al-Dahriya Old City and the two systems are done by gravity.

4.The septic tank for whole area is with volume equal 555.4 m^3 and it design in order to save environment.

5.Making a solid waste management to avoid random landfilling, and design small park at the old damping site in order to save environment, heritage and vegetation land.

RECOMMENDATIONS

1. This study was done for Al-Dahriya Old City and we recommend to make a complete study for all old cities in Palestine.
2. A cooperation with architectural and civil engineers is in high need and very use fall to make a good assessment.

APPENDIX

(A)

- **WASTE WATER QUANTITY TABLES**
- **STORM WATER QUANTITY TABLE**

First: Waste water quantity calculation

Example on calculation of waste water quantity for manhole number 1 to manhole number 2:

- Unit sewage = $waste\ water * Pop\ density$
- Waste water = 0.8* water consumption

= 0.8* 100/1000

* Waste water = 0.08 $m^3/_{c.day}$

- Pop density = $\frac{population}{Area}$

- Population growth= 3. 5 %

$$P_f = P_p\left(1 + \frac{r}{100}\right)^n$$

Pop 2040 = 1772 $\left(1 + \frac{3.5}{100}\right)^{25}$

Pop 2040 =4188 Cap

- Area of Old City = 44.82 dounum.

- Pop Present density = $\frac{No\ of\ floor * No\ of\ House * avg\ individual}{Total\ Area}$

Pop density = $\frac{2*718*6}{44.82}$

Pop density = 192.24 $Cap\ /dounm$

- Pop Future density

$$D_f = D_p\left(1 + \frac{r}{100}\right)^n$$

Pop Future density =

$$D_f = 192.24\left(1 + \frac{3.5}{100}\right)^{25}$$

$Df = 454.31\ Cap/\ dounm$

Unit sewage = $0.08 * 454.3 = 36.34 m^3/day.dounum$

The incremental area is the expected area for each manhole.

Total area is the sum of all previous manholes area.

- Q Average = Unit sewage * Total Area

  = 36.34 * 0.06

- Q Average = $2.18 m^3/day$

- Peak factor = $1.5 + \frac{2.5}{\sqrt{Qavg}}$

Peak factor = $1.5 + \frac{2.5}{\sqrt{2.18}}$

Peak factor = 3

Peak factor should be less than 3

Maximum Q= Peak factor * Qavg

= 3*2.18

= $6.54\ m^3/day$

Infiltration = 0.1 * Qavg

= 0.1 * 2.18

Infiltration = $0.22\ m^3/day$

Total Average = Infiltration + Qavg

= 0.22 + 2.18

Total Average = $2.4\ m^3/day$

Total Max = Infiltration + Qmax

= 0.22 + 6.54

Total Max = $6.76\ m^3/day$

Second: Storm water quantity calculation:

Example on calculation of storm water quantity for manhole number 1 to manhole number 2:

- Pipe length =103.67 m.
- Tributary area = 0.64 m^2.
- Runoff coefficient = 0.65.
- C.A= 0.416 ha.
- ∑C.A= 0.416 ha.
- Concentration time (Tc) = ti +tf
- ti = 10 min.
- $tf = \frac{\text{Distance}}{\text{Velocity}}$.

$tf = \frac{103.67}{1*60} = 1.728$ min.

- Tc = 10+1.73=11.728 min.
- Rain Fall intensity = 71.62 $\frac{mm}{hr}$.

  Rain Fall intensity = 199.117 $\frac{l}{s.h}$.

  Qmax =C.I.A

  Qmax = 0.416 * 199.117 *

  $=82.83\frac{l}{s}$

Line No	Sewer Name	Mh No	Mh No	L	unit sewage	[illegible]	Total	Average	Peak Factor	Maximum	Infiltration	Total Average	Total Maximum	Q max
				m	m³/d.dounm	dounm	dounm	m³/day		m³/day	m³/day	m³/day	m³/day	m³/day
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	main 1	1	2	30.26	36.34	0.06	0.06	2.18	3.00	6.54	0.22	2.40	6.76	6.76
2	main 1	2	3	49.36	36.34	0.40	0.46	16.55	2.11	35.00	1.66	18.21	175.00	168.24
3	main 1	3	4	24.25	36.34	0.17	0.62	22.55	2.03	45.70	2.26	24.81	186.29	18.06
4	main 1	4	5	25.10	36.34	0.31	0.93	33.82	1.93	65.27	3.38	37.20	344.85	326.89
5	main 1	5	6	40.39	36.34	0.54	1.47	53.44	1.84	98.44	5.34	58.79	380.09	53.19
6	main 1	6	7	49.26	36.34	1.04	2.51	91.24	1.76	160.74	9.12	100.37	446.17	392.97
7	main 1	7	8	48.86	36.34	0.92	3.43	124.79	1.72	215.12	12.48	137.27	617.79	224.82
8	main 1	8	9	50.22	36.34	1.09	4.52	164.45	1.69	278.73	16.44	180.89	685.36	460.55
9	main 1	9	10	49.43	36.34	1.89	6.42	233.21	1.66	387.99	23.32	256.53	801.50	340.96
10	main 1	10	11	49.12	36.34	1.54	7.96	289.25	1.65	476.39	28.93	318.18	895.51	554.55
11	main 1	11	12	50.49	36.34	1.46	9.42	342.24	1.64	559.61	34.22	376.46	984.02	429.47
12	main 1	12	13	46.21	36.34	0.82	10.23	371.90	1.63	606.06	37.19	409.09	1033.44	603.97
13	main 1	13	14	49.36	36.34	1.72	11.95	434.41	1.62	703.72	43.44	477.85	1361.36	757.39
14	main 1	14	15	42.90	36.34	1.72	13.67	496.92	1.61	801.11	49.69	546.61	1465.00	707.61
15	main 1	15	16	34.30	36.34	1.20	14.87	540.42	1.61	868.75	54.04	594.47	1537.00	829.39
16	main 1	16	17	41.64	36.34	1.37	16.24	590.07	1.60	945.83	59.01	649.08	1619.04	789.65

Design Assamptions and data

1) Water comnsumption is 3.5 m3/d.d which 80% return to sewer

3) Infiltration is equal 10 % of the average industrial wastewater flow.

4) Minimum pipe diameter= 200 mm

5) Minimum velocity Vmin = 0.6 m/sec

6) Maximum velocity Vmax = 3 m/sec

7) Minimum slope Smin = 0.5 %

8) Maximum slope Smax = 15 %

9) Maximum manhole spacing = 60 m

10) Minimum depth of sewer 1.5 m

11) Design depth of flow h/d< 0.5

12) Maining coefficient n= 0.01

Line No	Street Sewer	Upper Mh No	Lower Mh No	L	unit sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Average	Total Maximum	Q max
	Name			m	m^3/d.dounm	dounm	dounm	m^3/day		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	15
1	main2	1	2	12.34	36.34	0.10	0.10	3.63	2.81	10.22	0.36	4.00	10.58	10.58
2	main2	2	3	5.40	36.34	0.03	0.13	4.68	2.66	12.44	0.47	5.15	12.91	2.33
3	main2	3	4	9.65	36.34	0.05	0.18	6.50	2.48	16.13	0.65	7.15	16.78	14.45
4	main2	4	5	24.49	36.34	0.13	0.31	11.15	2.25	25.08	1.12	12.27	26.20	11.74
5	main2	5	6	26.05	36.34	0.16	0.46	16.90	2.11	35.62	1.69	18.59	37.31	25.57
6	main2	6	7	35.69	36.34	0.17	0.64	23.11	2.02	46.69	2.31	25.42	49.00	23.43
7	main2	7	8	45.07	36.34	0.11	0.75	27.17	1.98	53.79	2.72	29.89	56.50	33.08
8	main2	8	9	22.27	36.34	0.03	0.77	28.12	1.97	55.44	2.81	30.93	58.25	25.17
9	main2	9	10	25.40	36.34	0.08	0.85	30.85	1.95	60.15	3.08	33.93	63.24	38.06
10	main2	10	11	28.03	36.34	0.19	1.04	37.86	1.91	72.17	3.79	41.65	75.96	37.89
11	main2	11	12	43.11	36.34	0.23	1.27	46.11	1.87	86.14	4.61	50.72	90.75	52.86
12	main2	12	13	14.65	36.34	0.09	1.36	49.44	1.86	91.74	4.94	54.39	96.69	43.83
13	main2	13	14	19.97	36.34	0.14	1.50	54.80	1.84	100.37	5.46	60.06	105.83	62.00
14	main2	14	15	13.62	36.34	0.08	1.58	57.57	1.83	105.32	5.76	63.33	111.08	49.08
15	main2	15	16	47.89	36.34	0.17	1.76	63.85	1.81	115.75	6.38	70.23	122.13	73.05
16	main2	16	17	21.49	36.34	0.09	1.85	67.07	1.81	121.07	6.71	73.77	127.78	54.73
17	main2	17	18	26.69	36.34	0.10	1.95	70.74	1.80	127.14	7.07	77.81	134.21	79.49
18	main2	18	19	41.35	36.34	0.06	2.01	72.88	1.79	130.67	7.29	80.17	137.96	58.47

Design Assamptions and data

1) Water comnsumption is 3.5 m3/d.d which 80% return to sewer
3) Infiltration is equal 10 % of the average industrial wastewater flow.
4) Minimum pipe diameter= 200 mm
5) Minimum velocity Vmin = 0.6 m/sec
6) Maximum velocity Vmax = 3 m/sec

7) Minimum slope Smin = 0.5 %
8) Maximum slope Smax = 15 %
9) Maximum manhole spacing = 60 m
10) Minimum depth of sewer 1.5 m
11) Design depth of flow h/d< 0.5
12) Maining coefficient n= 0.01

Line No	Street Sewer	Upper Mh No	Lower Mh No	Length	Unit sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Average	Total Maximum	Q max
	Name			m	m^3/d.dounm	dounm	dounm	m^3/day		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	15
1	main3	1	2	8.92	36.34	0.14	0.14	5.09	2.61	13.27	0.51	5.60	13.78	13.78
2	main3	2	3	18.28	36.34	0.23	0.37	13.49	2.18	29.43	1.35	14.84	30.77	16.99
3	main3	3	4	23.57	36.34	0.28	0.65	23.67	2.01	47.67	2.37	26.04	50.04	33.04
4	main3	4	5	21.9	36.34	0.26	0.91	33.08	1.93	64.01	3.31	36.39	67.31	34.27
5	main3	5	6	33.18	36.34	0.48	1.39	50.42	1.85	93.38	5.04	55.46	98.42	64.15
5	main3	5	6	48.95	36.34	0.48	1.86	67.76	1.80	122.21	6.78	74.53	231.12	166.97
7	main3	7	8	47.67	36.34	0.16	2.02	73.50	1.79	131.68	7.35	80.85	241.16	74.19
8	main3	8	9	49.91	36.34	0.94	2.96	107.66	1.74	187.43	10.77	118.43	300.33	226.14
9	main3	9	10	47.55	36.34	0.42	3.38	122.93	1.73	212.11	12.29	135.22	326.53	100.39
10	main3	10	11	49.82	36.34	0.68	4.06	147.53	1.71	251.66	14.75	162.28	368.55	268.15
11	main3	11	12	47.82	36.34	0.67	4.73	171.85	1.69	290.54	17.18	189.03	409.85	141.70
12	main3	12	13	43.68	36.34	0.55	5.28	191.83	1.68	322.38	19.18	211.02	443.69	301.99
13	main3	13	14	50.34	36.34	1.24	6.51	236.72	1.66	393.54	23.67	260.39	825.02	523.03
14	main3	14	15	55.88	36.34	1.75	8.26	300.25	1.64	493.69	30.02	330.27	931.52	408.49
15	main3	15	16	50.44	36.34	1.60	9.86	358.25	1.63	584.70	35.83	394.08	1028.32	619.84
16	main3	16	17	50.03	36.34	1.30	11.16	405.43	1.62	658.48	40.54	445.97	1106.82	486.99
17	main3	17	18	50.21	36.34	2.25	13.41	487.20	1.61	785.98	48.72	535.92	1242.50	755.52

Flow Rates

Design Assamptions and data

1) Water comnsumption is 3.5 m3/d.d which 80% return to sewer
3) Infiltration is equal 10 % of the average industrial wastewater flow.
4) Minimum pipe diameter= 200 mm
5) Minimum velocity Vmin = 0.6 m/sec
6) Maximum velocity Vmax = 3 m/sec

7) Minimum slope Smin = 0.5 %
8) Maximum slope Smax = 15 %
9) Maximum manhole spacing = 60 m
10) Minimum depth of sewer 1.5 m
11) Design depth of flow h/d< 0.5
12) Maining coefficient n= 0.01

[illegible]	[illegible]	[illegible]	[illegible]	m	m³/d.dounm	dounm	dounm	Average m³/day	Peak Factor	Flow Rates Maximum m³/day	Infiltration m³/day	Total Avarage m³/day	Total Maximum m³/day	Q max m³/day
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	sub1	1	2	20.26	36.34	0.02	0.02	0.73	3.00	2.18	0.07	0.80	2.25	2.25
2	sub1	2	3	13.4	36.34	0.03	0.05	1.82	3.00	5.45	0.18	2.00	5.63	3.38
3	sub1	3	4	24.25	36.34	0.09	0.14	4.94	2.62	12.97	0.49	5.44	13.47	10.09
4	sub1	4	5	11.39	36.34	0.05	0.19	6.76	2.46	16.64	0.68	7.44	17.32	7.23
5	sub1	5	6	20.55	36.34	0.08	0.27	9.67	2.30	22.27	0.97	10.63	23.24	16.01
6	sub1	6	7	26.06	36.34	0.16	0.43	15.48	2.14	33.06	1.55	17.03	34.61	18.60
7	sub1	7	8	14.78	36.34	0.11	0.53	19.41	2.07	40.13	1.94	21.35	42.07	23.47
8	sub1	8	9	25.03	36.34	0.20	0.74	26.71	1.98	52.99	2.67	29.38	55.66	32.19
9	sub1	9	10	18.75	36.34	0.05	0.79	28.53	1.97	56.15	2.85	31.38	59.00	26.81
10	sub1	10	11	39.25	36.34	0.24	1.03	37.25	1.91	71.14	3.73	40.98	74.86	48.05
11	sub1	11	12	24.77	36.34	0.22	1.25	45.25	1.87	84.69	4.52	49.77	89.21	41.16
12	sub1	12	13	48.51	36.34	0.35	1.60	57.97	1.83	105.99	5.80	63.77	111.78	70.62
13	sub1	13	14	37.4	36.34	0.14	1.74	63.23	1.81	114.72	6.32	69.55	121.04	50.42
14	sub1	14	15	49.53	36.34	0.16	1.90	68.93	1.80	124.16	6.89	75.83	131.05	80.63
15	sub1	15	16	39.34	36.34	0.09	1.99	72.38	1.79	129.83	7.24	79.61	137.07	56.44
16	sub1	16	17	30.81	36.34	0.02	2.01	73.10	1.79	131.03	7.31	80.41	138.34	81.90

Design Assamptions and data

1) Water comnsumption is	3.5	m3/d.d which 80% return to sewer		7) Minimum slope Smin =	0.5	%
3) Infiltration is equal	10	% of the average industrial wastewater flow.		8) Maximum slope Smax =	15	%
4) Minimum pipe diameter=	200	mm		9) Maximum manhole spacing =	60	m
5) Minimum velocity Vmin =	0.6	m/sec		10) Minimum depth of sewer	1.5	m
6) Maximum velocity Vmax =	3	m/sec		11) Design depth of flow h/d<	0.5	
				12) Maining coefficient n=	0.01	

Line No	Sewer Name	Upper Mh No	Lower Mh No	Length m	unit sewage m³/d.dounm	Incremental dounm	Total dounm	Flow Rates Average m³/day	Peak Factor	Maximum m³/day	Infiltration m³/day	Total Average m³/day	Total Maximum m³/day	Q max m³/day
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	sub 2	1	2	37.47	36.34	0.19	0.19	6.91	2.45	16.93	0.69	7.60	17.62	17.62
2	sub2	2	3	12.17	36.34	0.06	0.25	9.09	2.33	21.16	0.91	9.99	22.07	4.46
3	sub 2	3	4	29.24	36.34	0.03	0.28	10.18	2.28	23.24	1.02	11.19	24.26	19.80
8	sub 2	8	9	20.51	36.34	0.13	0.41	14.80	2.15	32.00	1.49	16.39	33.49	13.69
9	sub 2	9	10	33.71	36.34	0.34	0.75	27.26	1.98	53.94	2.73	29.98	56.67	42.97
10	sub 2	10	11	22.95	36.34	0.18	0.93	33.80	1.93	65.23	3.38	37.18	68.61	25.64
11	sub 2	11	12	18.19	36.34	0.27	1.20	43.61	1.88	81.93	4.36	47.97	86.29	60.65
12	sub 2	12	13	21.09	36.34	0.34	1.54	55.86	1.83	102.48	5.59	61.45	108.06	47.41
13	sub 2	13	14	35.40	36.34	0.09	1.63	59.16	1.83	107.98	5.92	65.08	113.89	68.48

Design Assamptions and data

1) Water comnsumption is 3.5 m3/d.d which 80% return to sewer

3) Infiltration is equal 10 % of the average industrial wastewater flow.

4) Minimum pipe diameter= 200 mm

5) Minimum velocity Vmin = 0.6 m/sec

6) Maximum velocity Vmax = 3 m/sec

7) Minimum slope Smin = 0.5 %

8) Maximum slope Smax = 15 %

9) Maximum manhole spacing = 60 m

10) Minimum depth of sewer 1.5 m

11) Design depth of flow h/d< 0.5

12) Maining coefficient n= 0.01

Line No	Street Sewer	Upper Mh No	Lower Mh No	Length	unit sewage	Tributary area Incremental	Tributary area Total	Flow Rates Average	Peak Factor	Maximum	Infiltration	Total Average	Total Maximum	Q max
	Name			m	m^3/d.dounm	dounm	dounm	m^3/day		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	15
1	sub 3	1	2	42.25	36.34	0.32	0.32	11.63	2.23	25.97	1.16	12.79	27.13	27.13
2	sub 3	2	3	27.61	36.34	0.31	0.63	22.90	2.02	46.31	2.29	25.19	48.60	21.46
3	sub 3	3	4	16.02	36.34	0.03	0.66	24.00	2.01	48.24	2.40	26.40	50.64	29.18
4	sub 3	4	5	34.82	36.34	0.22	0.88	32.02	1.94	62.17	3.20	35.22	65.38	36.20
5	sub 3	5	6	25.63	36.34	0.26	1.14	41.29	1.89	77.99	4.13	45.42	82.12	45.93
6	sub 3	6	7	35.2	36.34	0.53	1.67	60.55	1.82	110.28	6.05	66.60	116.33	70.41
7	sub 3	7	8	39.5	36.34	0.07	1.74	63.09	1.81	114.50	6.31	69.40	120.81	50.40
8	sub 3	8	9	24.82	36.34	0.04	1.78	64.55	1.81	116.91	6.45	71.00	123.36	72.96
9	sub 3	9	10	39.21	36.34	1.60	3.38	122.70	1.73	211.74	12.27	134.97	224.01	151.05

Design Assamptions and data

1) Water comnsumption is 3.5 m3/d.d which 80% return to sewer
3) Infiltration is equal 10 % of the average industrial wastewater flow.
4) Minimum pipe diameter= 200 mm
5) Minimum velocity Vmin = 0.6 m/sec
6) Maximum velocity Vmax = 3 m/sec

7) Minimum slope Smin = 0.5 %
8) Maximum slope Smax = 15 %
9) Maximum manhole spacing = 60 m
10) Minimum depth of sewer 1.5 m
11) Design depth of flow h/d< 0.5
12) Maining coefficient n= 0.01

Line No	Street Sewer	Upper Mh No	Lower Mh No	L	unit sewage	Tributary area Incremental	Total	Flow Rates Average	Peak Factor	Maximum	Infiltration	Total Average	Total Maximum	Q max
	Name			m	m^3/d.dounm	dounm	dounm	m^3/day		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	15
1	sub 4	1	2	39.28	36.34	0.11	0.11	4.00	2.75	11.00	0.40	4.40	11.40	11.40
2	sub 4	2	3	12.52	36.34	0.13	0.24	8.58	2.35	20.19	0.86	9.43	21.05	9.65
3	sub 4	3	4	47.2	36.34	0.37	0.61	22.09	2.03	44.88	2.21	24.30	47.09	37.44
4	sub 4	4	5	17.42	36.34	0.19	0.80	29.10	1.96	57.14	2.91	32.01	60.05	22.60
5	sub 4	5	6	37.8	36.34	0.27	1.07	38.98	1.90	74.07	3.90	42.87	77.97	55.36
6	sub 4	6	7	13.54	36.34	0.15	1.22	44.51	1.87	83.44	4.45	48.96	87.90	32.53
7	sub 4	7	8	13.56	36.34	0.09	1.31	47.78	1.86	88.95	4.78	52.56	93.73	61.20
8	sub 4	8	9	20.82	36.34	0.13	1.44	52.51	1.85	96.87	5.25	57.76	102.13	40.93

Design Assamptions and data

1) Water comnsumption is 3.5 m3/d.d which 80% return to sewer

3) Infiltration is equal 10 % of the average industrial wastewater flow.

4) Minimum pipe diameter= 200 mm

5) Minimum velocity Vmin = 0.6 m/sec

6) Maximum velocity Vmax = 3 m/sec

7) Minimum slope Smin = 0.5 %

8) Maximum slope Smax = 15 %

9) Maximum manhole spacing = 60 m

10) Minimum depth of sewer 1.5 m

11) Design depth of flow h/d< 0.5

12) Maining coefficient n= 0.01

Line No	Street Sewer Name	Upper Mh No	Lower Mh No	Length	unit sewage	Incremental	Total	Average	Peak Factor	Maximum	Infiltration	Total Average	Total Maximum	Q max
				m	m^3/d.dounm	dounm	dounm	m^3/day		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	15
1	sub 5	1	2	49.99	36.34	0.59	0.59	21.44	2.04	43.74	2.14	23.59	45.89	45.89
2	sub 5	2	3	9.25	36.34	0.09	0.68	24.86	2.00	49.75	2.49	27.35	52.24	6.35
3	sub 5	3	4	49.48	36.34	0.68	1.59	57.79	1.83	105.68	5.78	63.57	111.46	105.11
4	sub 5	4	5	40.94	36.34	0.69	2.28	82.94	1.77	147.17	8.29	91.23	155.47	50.36
5	sub 5	5	6	34.00	36.34	0.31	2.59	94.13	1.76	165.45	9.41	103.54	174.86	124.51
6	sub 5	6	7	21.41	36.34	0.44	3.03	110.12	1.74	191.42	11.01	121.13	202.43	77.92
7	sub 5	7	8	28.12	36.34	0.07	3.59	130.47	1.72	224.27	13.05	143.52	237.32	159.39
8	sub 5	8	9	36.24	36.34	0.11	3.70	134.47	1.72	230.70	13.45	147.92	244.15	84.75
9	sub 5	9	10	33.69	36.34	0.08	4.59	166.82	1.69	282.52	16.68	183.50	299.20	214.45
10	sub 5	10	11	44.52	36.34	0.11	4.70	170.64	1.69	288.61	17.06	187.70	305.67	91.23

Design Assamptions and data

1) Water comnsumption is 3.5 m3/d.d which 80% return to sewer

3) Infiltration is equal 10 % of the average industrial wastewater flow.

4) Minimum pipe diameter= 200 mm

5) Minimum velocity Vmin = 0.6 m/sec

6) Maximum velocity Vmax = 3 m/sec

7) Minimum slope Smin = 0.5 %

8) Maximum slope Smax = 15 %

9) Maximum manhole spacing = 60 m

10) Minimum depth of sewer 1.5 m

11) Design depth of flow h/d< 0.5

12) Maining coefficient n= 0.01

Main 1

NUMBER	LOCATION			LENGTH	LENGTH COMULATIVE	AREA of Street and Industry	C FACTOR Street and Industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(i)	Q	Qi
	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	main 1	1	2	103.67	103.67	0.64	0.65	0.416	0.416	11.728	199.117	350.906	350.906
2	main 1	2	3	57.47	161.14	0.80	0.65	0.520	0.936	12.686	197.591	666.214	315.308
3	main 1	3	4	62.45	223.58	1.23	0.65	0.800	1.736	13.726	195.946	821.333	155.119
4	main 1	4	5	147.21	370.79	3.73	0.65	2.425	4.160	16.180	192.123	1493.863	672.530
5	main 1	5	6	109.14	479.94	3.02	0.65	1.963	6.123	17.999	189.336	1853.937	360.074
6	main 1	6	7	33.01	512.95	0.73	0.65	0.475	6.598	18.549	188.501	1938.268	84.331
7	main 1	7	8	77.68	590.63	3.74	0.65	2.431	9.029	19.844	186.551	2789.329	851.061
8	main 1	8	9	90.10	680.73	2.82	0.65	1.833	10.862	21.346	184.314	3106.984	317.655

Main 2

NUMBER	LOCATION			LENGTH	LENGTH COMULATIVE	AREA of Street and industry	C FACTOR Street and industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(i)	Q	Qi
	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	main 2	1	2	17.73	17.73	0.12	0.65	0.078	0.078	10.296	201.421	15.711	15.711
2	main 2	2	3	13.10	30.83	0.09	0.65	0.059	0.137	10.514	201.068	27.446	11.735
3	main 2	3	4	22.07	52.90	0.12	0.65	0.078	0.215	10.882	200.475	43.002	15.556
4	main 2	4	5	51.26	104.16	0.27	0.65	0.176	0.390	11.736	199.104	77.651	34.649
5	main 2	5	6	62.79	166.96	0.18	0.65	0.117	0.507	12.783	197.437	100.101	22.450
6	main 2	6	7	34.05	201.01	0.09	0.65	0.059	0.566	13.350	196.540	111.143	11.042
7	main 2	7	8	28.76	229.77	0.19	0.65	0.124	0.689	13.830	195.784	134.895	23.752
8	main 2	8	9	49.05	278.82	0.24	0.65	0.156	0.845	14.647	194.503	164.355	29.460
9	main 2	9	10	49.88	328.69	0.24	0.65	0.156	1.001	15.478	193.209	193.402	29.047
10	main 2	10	11	71.71	400.40	0.03	0.65	0.020	1.021	16.673	191.363	195.286	1.884
11	main 2	11	12	69.49	469.89	0.16	0.65	0.104	1.125	17.832	189.591	213.195	17.909

Main 3

NUMBER	LOCATION			LENGTH	LENGTH COMULATIVE	AREA of Street and industry	C FACTOR Street and industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(I)	Q	Qi
	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	main 3	1	2	34.13	34.13	0.44	0.65	0.286	0.286	10.569	200.980	57.480	57.480
2	main 3	2	3	16.92	51.05	0.22	0.65	0.143	0.429	10.851	200.525	86.025	28.545
3	main 3	3	4	30.57	81.62	0.41	0.65	0.267	0.696	11.360	199.706	138.896	52.870
4	main 3	4	5	24.48	106.10	0.33	0.65	0.215	0.910	11.768	199.053	181.138	42.242
5	main 3	5	6	95.95	202.05	0.30	0.65	0.195	1.105	13.367	196.512	217.146	36.008
6	main 3	6	7	86.68	288.73	1.31	0.65	0.852	1.957	14.812	194.245	380.040	162.895
7	main 3	7	8	56.64	345.37	0.75	0.65	0.488	2.444	15.756	192.778	471.149	91.108
8	main 3	8	9	16.27	361.64	0.31	0.65	0.198	2.642	16.027	192.358	508.259	37.110
9	main 3	9	10	17.87	379.51	0.31	0.65	0.198	2.841	16.325	191.899	545.088	36.829
10	main 3	10	11	92.04	471.55	1.59	0.65	1.034	3.874	17.859	189.549	734.312	189.224
11	main 3	11	12	106.35	577.90	3.37	0.65	2.191	6.065	19.632	186.869	1133.269	398.957
12	main 3	12	13	100.17	678.07	3.33	0.65	2.165	8.229	21.301	184.380	1517.265	383.996

Sub 1

NUMBER	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	LENGTH (m)	LENGTH COMULATIVE (m)	AREA of Street and industry (ha)	C FACTOR Street and industry	C.A STREET (ha)	SUM(AC) COMULATIVE (ha)	Tc (min)	(I) (l/s.ha)	Q (l/s)	QI (l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	sub1	1	2	26.27	26.27	0.02	0.65	0.014	0.014	10.438	201.191	2.785	2.785
2	sub1	2	3	24.26	50.52	0.07	0.65	0.047	0.061	10.842	200.539	12.266	9.480
3	sub1	3	4	22.26	72.78	0.09	0.65	0.057	0.118	11.213	199.943	23.536	11.270
4	sub1	4	5	22.41	95.19	0.10	0.65	0.062	0.180	11.586	199.343	35.905	12.369
5	sub1	5	6	27.40	122.59	0.17	0.65	0.114	0.294	12.043	198.614	58.353	22.448
6	sub1	6	7	14.36	136.96	0.10	0.65	0.063	0.357	12.283	198.232	70.739	12.386
7	sub1	7	8	28.09	165.05	0.21	0.65	0.139	0.496	12.751	197.488	97.996	27.256
8	sub1	8	9	18.04	183.08	0.06	0.65	0.040	0.536	13.051	197.012	105.622	7.626
9	sub1	9	10	61.23	244.31	0.47	0.65	0.304	0.840	14.072	195.404	164.202	58.580
10	sub1	10	11	131.66	375.96	0.76	0.65	0.491	1.331	16.266	191.990	255.552	91.350
11	sub1	11	12	73.23	449.19	0.12	0.65	0.079	1.410	17.487	190.117	268.073	12.521

Sub 2

NUMBER	LOCATION			LENGTH	LENGTH COMULATIVE	AREA of Street and industry	C FACTOR Street and industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(i)	Q	Qi
	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	sub2	1	2	20.87	20.87	0.14	0.65	0.091	0.091	10.348	201.337	18.322	18.322
2	sub2	2	3	45.74	66.61	0.18	0.65	0.117	0.208	11.110	200.108	41.622	23.301
3	sub2	3	4	29.45	96.06	0.03	0.65	0.020	0.228	11.601	199.320	45.345	3.723
4	sub2	4	5	51.49	147.55	0.39	0.65	0.254	0.481	12.459	197.951	95.214	49.869
5	sub2	5	6	22.95	170.50	0.23	0.65	0.150	0.631	12.842	197.344	124.425	29.211
6	sub2	6	7	41.66	212.16	0.62	0.65	0.403	1.034	13.536	196.246	202.821	78.395
7	sub2	7	8	32.75	244.91	0.09	0.65	0.059	1.092	14.082	195.388	213.364	10.543

Sub 3

NUMBER	LOCATION			LENGTH	LENGTH COMULATIVE	AREA of Street and industry	C FACTOR Street and industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(i)	Q	Qi
	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	sub 3	1	2	27.85	27.85	0.23	0.65	0.150	0.150	10.464	201.149	30.072	30.072
2	sub 3	2	3	28.65	56.50	0.22	0.65	0.143	0.293	10.942	200.379	58.611	28.539
3	sub 3	3	4	28.02	84.53	0.21	0.65	0.137	0.429	11.409	199.628	85.640	27.030
4	sub 3	4	5	36.53	121.06	0.22	0.65	0.143	0.572	12.018	198.654	113.630	27.990
5	sub 3	5	6	26.66	147.72	0.26	0.65	0.169	0.741	12.462	197.947	146.679	33.048
6	sub 3	6	7	34.87	182.58	0.68	0.65	0.442	1.183	13.043	197.025	233.080	86.402
7	sub 3	7	8	39.69	222.28	0.17	0.65	0.111	1.294	13.705	195.981	253.501	20.421
8	sub 3	8	9	24.42	246.70	0.05	0.65	0.033	1.326	14.112	195.341	259.022	5.521
9	sub 3	9	10	40.61	287.31	1.21	0.65	0.787	2.113	14.788	194.282	410.421	151.398

Stormwater Design Computations

Sub 4

NUMBER	LOCATION: LINE NAME	LOCATION: UPPER MH. NO.	LOCATION: LOWER MH. NO.	LENGTH	LENGTH COMULATIVE	AREA of Street and industry	C FACTOR Street and industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(i)	Q	Qi
				(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	sub 4	1	2	50.66	50.66	0.13	0.65	0.085	0.085	10.844	200.535	16.945	16.945
2	sub 4	2	3	26.53	77.19	0.25	0.65	0.163	0.247	11.287	199.824	49.357	32.411
3	sub 4	3	4	37.60	114.79	0.31	0.65	0.202	0.449	11.913	198.821	89.171	39.815
4	sub 4	4	5	48.72	163.51	0.42	0.65	0.273	0.722	12.725	197.529	142.517	53.346
5	sub 4	5	6	15.26	178.77	0.14	0.65	0.091	0.813	12.980	197.125	160.164	17.648
6	sub 4	6	7	14.00	192.77	0.09	0.65	0.059	0.871	13.213	196.756	171.375	11.210
7	sub 4	7	8	19.12	211.89	0.12	0.65	0.078	0.949	13.532	196.253	186.244	14.870

Sub 5

NUMBER	LOCATION			LENGTH	LENGTH COMULATIVE	AREA of Street and Industry	C FACTOR Street and Industry	C.A STREET	SUM(AC) COMULATIVE	Tc	(I)	Q	QI
	LINE NAME	UPPER MH. NO.	LOWER MH. NO.	(m)	(m)	(ha)		(ha)	(ha)	(min)	(l/s.ha)	(l/s)	(l/s)
1	2	3	4	5	6	7	9	11	14	15	16	17	18
1	sub 5	1	2	60.50	60.50	0.69	0.65	0.449	0.449	11.008	200.271	89.822	89.822
2	sub 5	2	3	97.94	158.44	1.57	0.65	1.021	1.469	12.641	197.663	290.367	200.545
3	sub 5	3	4	21.39	179.83	0.20	0.65	0.130	1.599	12.997	197.098	315.159	24.792
4	sub 5	4	5	51.82	231.65	0.52	0.65	0.338	1.937	13.861	195.735	379.139	63.980
5	sub 5	5	6	35.42	267.07	0.07	0.65	0.046	1.983	14.451	194.809	386.209	7.070
6	sub 6	6	7	79.60	346.67	0.20	0.65	0.130	2.113	15.778	192.744	407.172	20.963

Sanitary main 1

Gravity Node Report

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	6+83	644.94	1.2	6.76	0.22
MH-2	6+52	642.86	1.2	175	0.50
MH-3	6+03	639.9	1.2	193.06	0.51
MH-4	5+78	639.79	1.2	519.95	0.68
MH-5	5+53	639.71	1.2	573.14	0.70
MH-6	5+13	639.53	1.2	966.11	0.82
MH-7	4+63	636.25	1.2	1190.93	0.87
MH-8	4+14	633.36	1.2	1651.48	0.98
MH-9	3+64	630.98	1.2	1992.44	1.05
MH-10	3+14	628.61	1.2	2546.99	1.17
MH-11	2+65	626.37	1.2	2976.46	1.26
MH-12	2+15	624.99	1.2	3580.43	1.41
MH-13	1+69	622.32	1.2	4337.82	1.62
MH-14	1+19	620.1	1.2	5045.43	1.39
MH-15	0+76	619.07	1.2	5874.82	1.52
MH-16	0+42	617.34	1.2	6664.47	1.40
O-1		617.34		6664.47	0.00

ravity pipe Report

abel	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	0.40	0.035
P-2	MH-2	MH-3	200 mm	Circular	1.08	0.035
P-3	MH-3	MH-4	200 mm	Circular	0.60	0.006054
P-4	MH-4	MH-5	200 mm	Circular	0.75	0.005
P-5	MH-5	MH-6	200 mm	Circular	1.53	0.034572
P-6	MH-6	MH-7	200 mm	Circular	1.79	0.035
P-7	MH-7	MH-8	200 mm	Circular	1.90	0.035
P-8	MH-8	MH-9	200 mm	Circular	2.08	0.035
P-9	MH-9	MH-10	200 mm	Circular	2.19	0.035
-10	MH-10	MH-11	200 mm	Circular	2.35	0.035
-11	MH-11	MH-12	200 mm	Circular	2.19	0.026119
-12	MH-12	MH-13	200 mm	Circular	2.56	0.035
-13	MH-13	MH-14	200 mm	Circular	2.69	0.035
-14	MH-14	MH-15	250 mm	Circular	2.77	0.034449
-15	MH-15	MH-16	250 mm	Circular	2.90	0.035
-16	MH-16	O-1	300 mm	Circular	1.42	0.005

Sanitary main 2

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	4+64	656.14	1.2	10.58	0.25
MH-2	4+52	656.09	1.2	12.91	0.26
MH-3	4+46	656.03	1.2	27.36	0.31
MH-4	4+36	655.65	1.2	39.10	0.34
MH-5	4+12	654.46	1.2	64.67	0.39
MH-6	3+86	653.52	1.2	88.10	0.42
MH-7	3+50	652.07	1.2	121.18	0.45
MH-8	3+05	650.13	1.2	146.35	0.48
MH-9	2+83	650	1.2	184.41	0.51
MH-10	2+57	647.58	1.2	222.30	0.54
MH-11	2+29	645.7	1.2	275.16	0.57
MH-12	1+86	645.66	1.2	318.99	0.59
MH-13	1+71	644.98	1.2	380.99	0.62
MH-14	1+51	644.8	1.2	430.07	0.64
MH-15	1+38	644.29	1.2	503.12	0.67
MH-16	0.90	643.45	1.2	557.85	0.69
MH-17	0.68	643.33	1.2	637.34	0.72
MH-18	0.42	640.21	1.2	695.81	0.74
O-1		640.21		695.81	0.00

Gravity pipe Report

Label	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	0.6	0.075587
P-2	MH-2	MH-3	200 mm	Circular	0.6	0.063411
P-3	MH-3	MH-4	200 mm	Circular	0.6	0.0359
P-4	MH-4	MH-5	200 mm	Circular	0.69	0.0359
P-5	MH-5	MH-6	200 mm	Circular	0.79	0.0359
P-6	MH-6	MH-7	200 mm	Circular	0.88	0.0359
P-7	MH-7	MH-8	200 mm	Circular	0.97	0.0359
P-8	MH-8	MH-9	200 mm	Circular	1.03	0.0359
P-9	MH-9	MH-10	200 mm	Circular	1.1	0.0359
P-10	MH-10	MH-11	200 mm	Circular	1.39	0.064725
P-11	MH-11	MH-12	200 mm	Circular	1.25	0.0359
P-12	MH-12	MH-13	200 mm	Circular	1.3	0.0359
P-13	MH-13	MH-14	200 mm	Circular	1.37	0.0359
P-14	MH-14	MH-15	200 mm	Circular	1.43	0.0359
P-15	MH-15	MH-16	200 mm	Circular	1.49	0.0359
P-16	MH-16	MH-17	200mm	Circular	1.54	0.0359
P-17	MH-17	MH-18	200mm	Circular	1.6	0.0359
P-18	MH-18	O-1	200 mm	Circular	1.65	0.0359

Sanitary main 3

Gravity Node Report

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	6+99	633.68	1.2	13.78	0.26
MH-2	6+90	633.27	1.2	30.77	0.32
MH-3	6+71	632.4	1.2	63.81	0.38
MH-4	6+48	632.27	1.2	98.08	0.43
MH-5	6+26	631.72	1.2	162.23	0.49
MH-6	5+93	630.96	1.2	329.2	0.60
MH-7	5+44	630.46	1.2	403.39	0.63
MH-8	4+96	630.39	1.2	629.53	0.72
MH-9	4+46	630	1.2	729.92	0.75
MH-10	3+99	625	1.2	998.07	0.82
MH-11	3+49	620	1.2	1139.77	0.86
MH-12	3+01	615	1.2	1441.76	0.93
MH-13	2+57	612.3	1.2	1964.79	1.05
MH-14	2+07	605	1.2	2373.28	1.13
MH-15	1+51	604	1.2	2993.12	1.27
MH-16	1+00	603.5	1.2	3480.11	1.17
MH-17	0+50	603.2	1.2	4235.63	1.17
O-1		603.2		4235.63	0.00

Gravity pipe Report

Label	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	0.60	0.059866
P-2	MH-2	MH-3	200 mm	Circular	0.65	0.036768
P-3	MH-3	MH-4	200 mm	Circular	0.60	0.015626
P-4	MH-4	MH-5	200 mm	Circular	0.60	0.010775
P-5	MH-5	MH-6	200 mm	Circular	0.86	0.019779
P-6	MH-6	MH-7	200 mm	Circular	0.81	0.008959
P-7	MH-7	MH-8	200 mm	Circular	0.70	.005
P-8	MH-8	MH-9	200 mm	Circular	1.40	0.02479
P-9	MH-9	MH-10	200 mm	Circular	2.21	0.08
P-10	MH-10	MH-11	200 mm	Circular	2.42	0.08
P-11	MH-11	MH-12	200 mm	Circular	2.52	0.08
P-12	MH-12	MH-13	200 mm	Circular	2.44	0.060667
P-13	MH-13	MH-14	200 mm	Circular	2.94	0.08
P-14	MH-14	MH-15	200 mm	Circular	1.76	0.016768
P-15	MH-15	MH-16	200mm	Circular	1.43	0.008693
P-16	MH-16	MH-17	250mm	Circular	1.29	0.005796
P-17	MH-17	O-1	300mm	Circular	1.29	0.005

Sanitary sub main 1

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	1+35	659.78	1.22	2.25	0.16
MH-2	1+29	659.26	1.22	5.63	0.2
MH-3	1+25	657.94	1.22	15.72	0.27
MH-4	1+17	656.04	1.22	22.95	0.3
MH-5	1+14	655.26	1.22	38.96	0.34
MH-6	1+08	651.75	1.22	57.56	0.37
MH-7	1+00	649.82	1.22	81.03	0.41
MH-8	0+95	647.08	1.22	113.22	0.45
MH-9	0+87	645.99	1.22	140.03	0.47
MH-10	0+82	645.92	1.22	188.08	0.51
MH-11	0+70	645	1.22	229.24	0.54
MH-12	0+62	644.24	1.22	299.86	0.58
MH-13	0+48	644	1.22	350.28	0.61
MH-14	0+36	643.9	1.22	430.91	0.64
MH-15	0+21	643.1	1.22	487.35	0.67
MH-16	0+09	642.9	1.22	569.25	0.7
O-1		642.9		569.25	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Shape	Section Size	Average Velocity (m/s)	Hydraulic Slope (m/m)
P-1	MH-1	MH-2	Circular	200 mm	1.58	0.08583
P-2	MH-2	MH-3	Circular	200 mm	0.64	0.150889
P-3	MH-3	MH-4	Circular	200 mm	0.86	0.150822
P-4	MH-4	MH-5	Circular	200 mm	0.97	0.152144
P-5	MH-5	MH-6	Circular	200 mm	1.13	0.151493
P-6	MH-6	MH-7	Circular	200 mm	1.28	0.151504
P-7	MH-7	MH-8	Circular	200 mm	1.42	0.153103
P-8	MH-8	MH-9	Circular	200 mm	1.54	0.143165
P-9	MH-9	MH-10	Circular	200 mm	0.63	0.010375
P-10	MH-10	MH-11	Circular	200 mm	1.44	0.077696
P-11	MH-11	MH-12	Circular	200 mm	1.67	0.100658
P-12	MH-12	MH-13	Circular	200 mm	0.95	0.016275
P-13	MH-13	MH-14	Circular	200 mm	0.77	0.00817
P-14	MH-14	MH-15	Circular	200 mm	1.63	0.054374
P-15	MH-15	MH-16	Circular	200 mm	1.1	0.017052
P-16	MH-16	O-1	Circular	200 mm	0.77	0.005489

Sanitary sub main 2

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	2+31	649.66	1.2	17.62	0.28
MH-2	1+93	648.25	1.2	22.08	0.29
MH-3	1+81	648.25	1.2	41.88	0.34
MH-4	1+52	645.46	1.2	55.57	0.37
MH-5	1+31	644.00	1.2	98.54	0.43
MH-6	0+98	642.00	1.2	124.18	0.46
MH-7	0+75	641.00	1.2	184.83	0.51
MH-8	0+57	639.59	1.2	232.24	0.54
MH-9	0+36	637.72	1.2	298.72	0.58
O-1		637.72		298.72	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Shape	Section Size	Average Velocity (m/s)	Hydraulic Slope (m/m)
-1	MH-1	MH-2	Circular	200 mm	0.64	0.059962
-2	MH-2	MH-3	Circular	200 mm	0.69	0.059605
-3	MH-3	MH-4	Circular	200 mm	0.84	0.059907
-4	MH-4	MH-5	Circular	200 mm	0.92	0.059664
-5	MH-5	MH-6	Circular	200 mm	1.09	0.059893
-6	MH-6	MH-7	Circular	200 mm	1.17	0.059699
-7	MH-7	MH-8	Circular	200 mm	1.32	0.059736
-8	MH-8	MH-9	Circular	200 mm	1.51	0.071152
-9	MH-9	O-1	Circular	200 mm	1.53	0.06067

Sanitary sub main 3

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	2+85	644.97	1.2	27.13	0.31
MH-2	2+42	644.97	1.2	48.59	0.36
MH-3	2+15	642.99	1.2	77.77	0.41
MH-4	1+99	639.49	1.2	113.97	0.45
MH-5	1+64	634.56	1.20	159.9	0.49
MH-6	1+39	634.04	1.20	230.31	0.54
MH-7	1+04	630	1.20	280.71	0.57
MH-8	0+64	625	1.20	353.67	0.61
MH-9	0+39	623.8	1.20	504.72	0.67
O-1		623.8		504.72	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Shape	Section Size	Average Velocity (m/s)	Hydraulic Slope (m/m)
P-1	MH-1	MH-2	Circular	200 mm	0.6	0.033105
P-2	MH-2	MH-3	Circular	200 mm	1	0.066032
P-3	MH-3	MH-4	Circular	200 mm	1.22	0.100603
P-4	MH-4	MH-5	Circular	200 mm	1.37	0.100461
P-5	MH-5	MH-6	Circular	200 mm	1.07	0.037359
P-6	MH-6	MH-7	Circular	200 mm	1.69	0.100661
P-7	MH-7	MH-8	Circular	200 mm	1.79	0.100651
P-8	MH-8	MH-9	Circular	200 mm	1.46	0.046529
P-9	MH-9	O-1	Circular	200 mm	0.74	0.005111

Sanitary sub main 4

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	0+62	649.99	1.22	11.4	0.25
MH-2	0+50	646.74	1.22	21.05	0.29
MH-3	0+46	645.4	1.22	58.49	0.38
MH-4	0+31	641.17	1.22	81.09	0.41
MH-5	0+26	640.47	1.22	136.45	0.47
MH-6	0+15	637.98	1.22	168.98	0.5
MH-7	0+11	636.04	1.22	230.18	0.54
MH-8	0+06	634.23	1.22	271.11	0.57
O-1		634.23		271.11	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Shape	Section Size	Average Velocity (m/s)	Hydraulic Slope (m/m)
P-1	MH-1	MH-2	Circular	200 mm	0.78	0.150416
P-2	MH-2	MH-3	Circular	200 mm	0.94	0.151743
P-3	MH-3	MH-4	Circular	200 mm	1.28	0.150831
P-4	MH-4	MH-5	Circular	200 mm	1.33	0.127173
P-5	MH-5	MH-6	Circular	200 mm	1.66	0.151673
P-6	MH-6	MH-7	Circular	200 mm	1.77	0.155331
P-7	MH-7	MH-8	Circular	200 mm	1.95	0.155839
P-8	MH-8	O-1	Circular	200 mm	0.62	0.005443

Sanitary sub main 5

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	3+47	637.59	1.20	45.89	0.35
MH-2	2+97	636.09	1.20	52.24	0.37
MH-3	2+88	636.04	1.20	157.35	0.49
MH-4	2+38	635	1.20	207.71	0.53
MH-5	1+97	634.98	1.20	332.22	0.6
MH-6	1+63	634.47	1.20	410.14	0.63
MH-7	1+42	630	1.20	569.53	0.7
MH-8	1+15	625	1.2	654.28	0.73
MH-9	0+78	620	1.2	868.73	0.79
MH-10	0+45	615	1.2	959.96	0.81
O-1		615		959.96	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Shape	Section Size	Average Velocity (m/s)	Hydraulic Slope (m/m)
P-1	MH-1	MH-2	Circular	200 mm	0.68	0.03
P-2	MH-2	MH-3	Circular	200 mm	0.6	0.018596
P-3	MH-3	MH-4	Circular	200 mm	0.83	0.018451
P-4	MH-4	MH-5	Circular	200 mm	0.6	0.005693
P-5	MH-5	MH-6	Circular	200 mm	1.73	0.078429
P-6	MH-6	MH-7	Circular	200 mm	2.01	0.1
P-7	MH-7	MH-8	Circular	200 mm	2.22	0.1
P-8	MH-8	MH-9	Circular	200 mm	2.31	0.1
P-9	MH-9	MH-10	Circular	200 mm	2.51	0.1
P-10	MH-10	O-1	Circular	200 mm	0.89	0.005

storm main 1

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	2+08	644.94	1.22	30,318.26	2.28
MH-2	1+76	639.79	1.22	57,560.85	2.49
MH-3	1+58	639.58	1.22	70,963.17	2.92
MH-4	1+39	635.81	1.22	129,069.74	3.37
MH-5	0+94	628.45	1.22	160,180.13	3.07
MH-6	0+61	624.99	1.22	167,466.37	3.17
MH-7	0+51	622.32	1.22	240,998.03	3.37
MH-8	0+27	620.01	1.22	268,443.45	3.13
O-1		620.01		268,443.45	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Shape	Section Size	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	Circular	450 mm	2.67	0.01
P-2	MH-2	MH-3	Circular	600 mm	3.17	0.01
P-3	MH-3	MH-4	Circular	600 mm	3.25	0.01
P-4	MH-4	MH-5	Circular	750 mm	3.77	0.01
P-5	MH-5	MH-6	Circular	900 mm	4.11	0.01
P-6	MH-6	MH-7	Circular	900 mm	4.14	0.01
P-7	MH-7	MH-8	Circular	1050 mm	4.55	0.01
P-8	MH-8	O-1	Circular	1200 mm	3.58	0.005

storm main 2

Gravity Node Report					
Label	**Calculated Station (m)**	**Ground Elevation (m)**	**Structure Diameter (m)**	**Total Flow (m^3/day)**	**Velocity In (m/s)**
MH-1	1+43	656.14	1.22	1,357.42	0.91
MH-2	1+38	656.03	1.22	2,371.32	1.13
MH-3	1+35	655.48	1.22	3,715.37	1.45
MH-4	1+27	654.50	1.22	6,709.01	2.4
MH-5	1+12	652.88	1.22	8,648.71	3.09
MH-6	0+92	650.08	1.22	9,602.77	3.43
MH-7	0+82	648.44	1.22	11,654.96	2.67
MH-8	0+73	645.90	1.22	14,200.27	1.72
MH-9	0+58	645.78	1.22	16,709.92	1.89
MH-10	0+43	644.33	1.22	16,872.69	1.9
MH-11	0+21	643.44	1.22	18,420.04	1.71
O-1		643.44		18,420.04	0

Gravity pipe Report						
Label	**Upstream Node**	**Downstream Node**	**Section Shape**	**Section Size**	**Average Velocity (m/s)**	**Constructed Slope (m/m)**
P-1	MH-1	MH-2	Circular	200 mm	1.61	0.02005
P-2	MH-2	MH-3	Circular	200 mm	3	0.073
P-3	MH-3	MH-4	Circular	200 mm	3.4	0.073
P-4	MH-4	MH-5	Circular	200 mm	3.94	0.073
P-5	MH-5	MH-6	Circular	200 mm	4.15	0.073
P-6	MH-6	MH-7	Circular	200 mm	4.21	0.073
P-7	MH-7	MH-8	Circular	250 mm	4.53	0.073
P-8	MH-8	MH-9	Circular	375 mm	3.39	0.02956
P-9	MH-9	MH-10	Circular	375 mm	4.93	0.073
P-10	MH-10	MH-11	Circular	375 mm	4.06	0.042569
P-11	MH-11	O-1	Circular	450 mm	1.84	0.005

storm main 3

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	6+03	633.68	1.2	45.89	0.35
MH-2	5+85	632.22	1.2	5,012.17	1.24
MH-3	5+62	632.22	1.2	7,478.46	1.48
MH-4	5+40	631.32	1.2	12,046.46	1.59
MH-5	5+07	630.83	1.2	15,696.20	1.6
MH-6	4+45	630.83	1.2	18,807.30	1.73
MH-7	3+85	625	1.2	32,881.39	2.43
MH-8	2+85	620	1.2	40,753.16	2.05
MH-9	2+69	615	1.2	43,959.44	2.13
MH-10	2+51	612.5	1.2	47,141.51	2.21
MH-11	1+57	610	1.2	63,490.43	2.67
MH-12	1+01	605	1.2	97,960.29	2.74
MH-13	0+50	604	1.2	131,137.55	2.72
O-1		604		131,137.55	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Shape	Section Size	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	Circular	200 mm	0.47	0.01
P-2	MH-2	MH-3	Circular	300 mm	1.34	0.005
P-3	MH-3	MH-4	Circular	300 mm	1.92	0.01
P-4	MH-4	MH-5	Circular	375 mm	2.17	0.01
P-5	MH-5	MH-6	Circular	450 mm	1.78	0.005
P-6	MH-6	MH-7	Circular	450 mm	2.42	0.01
P-7	MH-7	MH-8	Circular	450 mm	2.68	0.01
P-8	MH-8	MH-9	Circular	600 mm	2.94	0.01
P-9	MH-9	MH-10	Circular	600 mm	2.99	0.01
P-10	MH-10	MH-11	Circular	600 mm	3.04	0.01
P-11	MH-11	MH-12	Circular	600 mm	3.22	0.01
P-12	MH-12	MH-13	Circular	750 mm	3.63	0.01
P-13	MH-13	O-1	Circular	900 mm	2.98	0.005

Storm sub 1

Gravity Node Report

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	4+42	659.8	1.2	240.67	0.55
MH-2	4+16	659	1.2	1,059.78	0.84
MH-3	3+92	656.88	1.2	2,033.53	1.06
MH-4	3+70	655.47	1.2	3,102.17	1.29
MH-5	3+48	651.65	1.2	5,041.67	1.84
MH-6	3+21	649.81	1.2	6,111.86	2.2
MH-7	3+07	646.95	1.2	8,466.81	1.99
MH-8	2+79	645.81	1.2	9,125.73	1.41
MH-9	2+61	645.81	1.2	14,187.01	1.72
MH-10	2+00	643.99	1.2	22,079.68	1.87
MH-11	0+68	643.1	1.2	23,161.54	1.9
O-1		643.1		23,161.54	0

Gravity pipe Report

Label	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	1.13	0.030769
P-2	MH-2	MH-3	200 mm	Circular	2.52	0.085792
P-3	MH-3	MH-4	200 mm	Circular	2.7	0.061318
P-4	MH-4	MH-5	200 mm	Circular	3.63	0.1
P-5	MH-5	MH-6	200 mm	Circular	3.52	0.064691
P-6	MH-6	MH-7	200 mm	Circular	4.34	0.1
P-7	MH-7	MH-8	250mm	Circular	3.42	0.042707
P-8	MH-8	MH-9	375mm	Circular	1.56	0.005
P-9	MH-9	MH-10	375mm	Circular	3.31	0.02761
P-10	MH-10	MH-11	450mm	Circular	2.17	0.006884
P-11	MH-11	O-1	450mm	Circular	1.9	0.005

Storm sub 2

Gravity Node Report

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m³/day)	Velocity In (m/s)
MH-1	2+45	649.68	1.2	1,582.99	0.96
MH-2	2+24	649.35	1.2	3,596.18	1.41
MH-3	1+79	648.26	1.2	3,917.85	1.5
MH-4	1+49	645.4	1.2	8,226.55	2.94
MH-5	0+98	642	1.2	10,750.37	1.83
MH-6	0+75	641.6	1.2	17,523.73	2.8
MH-7	0+33	637.53	1.2	18,434.64	1.71
O-1		637.53		18,434.64	0

ravity pipe Report

abel	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	1.54	0.015714
P-2	MH-2	MH-3	200 mm	Circular	2.17	0.022615
P-3	MH-3	MH-4	200 mm	Circular	3	0.05
P-4	MH-4	MH-5	200 mm	Circular	3.49	0.05
P-5	MH-5	MH-6	300 mm	Circular	2.68	0.019157
P-6	MH-6	MH-7	300 mm	Circular	4.34	0.05
P-7	MH-7	O-1	450mm	Circular	1.84	0.005

Storm sub 3

Gravity Node Report

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	2+86	645.9	1.2	2,598.26	1.18
MH-2	2+59	645.73	1.2	5,064.03	1.85
MH-3	2+30	644.8	1.2	7,399.40	2.65
MH-4	2+02	639.88	1.2	9,817.72	2.27
MH-5	1+66	634.67	1.2	12,673.08	2.08
MH-6	1+40	633.92	1.2	20,138.20	3.2
MH-7	1+05	630	1.2	21,902.54	3.48
MH-8	0+65	625	1.2	22,379.57	3.55
MH-9	0+41	623.8	1.2	35,460.39	1.92
O-1		623.8		35,460.39	0

Gravity pipe Report

Label	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	1.21	0.006182
P-2	MH-2	MH-3	200 mm	Circular	2.61	0.029966
P-3	MH-3	MH-4	200 mm	Circular	3.45	0.05
P-4	MH-4	MH-5	250mm	Circular	3.76	0.05
P-5	MH-5	MH-6	300 mm	Circular	3.22	0.027917
P-6	MH-6	MH-7	300 mm	Circular	4.46	0.05
P-7	MH-7	MH-8	300mm	Circular	4.52	0.05
P-8	MH-8	MH-9	300mm	Circular	4.39	0.04649
P-9	MH-9	O-1	600mm	Circular	2.34	0.00602

Storm sub 4

Gravity Node Report

Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	2+11	649.99	1.2	1,464.07	0.94
MH-2	1+60	646.48	1.2	4,264.41	1.6
MH-3	1+34	643.79	1.2	7,704.40	2.76
MH-4	0+96	640.74	1.2	12,313.46	2.82
MH-5	0+47	637.6	1.2	13,838.21	3.17
MH-6	0+32	635.71	1.2	14,806.78	3.39
MH-7	0+18	633.82	1.2	16,091.52	1.85
O-1		633.82		16,091.52	0

Gravity pipe Report

Label	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	2.29	0.05
P-2	MH-2	MH-3	200 mm	Circular	3.06	0.05
P-3	MH-3	MH-4	200 mm	Circular	3.47	0.05
P-4	MH-4	MH-5	250 mm	Circular	3.95	0.05
P-5	MH-5	MH-6	250 mm	Circular	4.02	0.05
P-6	MH-6	MH-7	250 mm	Circular	4.05	0.05
P-7	MH-7	O-1	375mm	Circular	1.99	0.007056

Storm sub 4

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity In (m/s)
MH-1	2+11	649.99	1.2	1,464.07	0.94
MH-2	1+60	646.48	1.2	4,264.41	1.6
MH-3	1+34	643.79	1.2	7,704.40	2.76
MH-4	0+96	640.74	1.2	12,313.46	2.82
MH-5	0+47	637.6	1.2	13,838.21	3.17
MH-6	0+32	635.71	1.2	14,806.78	3.39
MH-7	0+18	633.82	1.2	16,091.52	1.85
O-1		633.82		16,091.52	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	200 mm	Circular	2.29	0.05
P-2	MH-2	MH-3	200 mm	Circular	3.06	0.05
P-3	MH-3	MH-4	200 mm	Circular	3.47	0.05
P-4	MH-4	MH-5	250 mm	Circular	3.95	0.05
P-5	MH-5	MH-6	250 mm	Circular	4.02	0.05
P-6	MH-6	MH-7	250 mm	Circular	4.05	0.05
P-7	MH-7	O-1	375mm	Circular	1.99	0.007056

Storm sub 5

Gravity Node Report					
Label	Calculated Station (m)	Ground Elevation (m)	Structure Diameter (m)	Total Flow (m^3/day)	Velocity in (m/s)
MH-1	3+47	637.59	1.2	7,760.60	1.85
MH-2	2+87	636.22	1.2	25,087.67	2.59
MH-3	1+89	634.43	1.2	27,229.73	1.73
MH-4	1+67	634.43	1.2	32,757.57	1.86
MH-5	1+15	625	1.2	33,368.40	1.87
MH-6	0+80	620	1.2	35,179.59	1.92
O-1		620		35,179.59	0

Gravity pipe Report						
Label	Upstream Node	Downstream Node	Section Size Description	Section Shape	Average Velocity (m/s)	Constructed Slope (m/m)
P-1	MH-1	MH-2	250 mm	Circular	2.67	0.023736
P-2	MH-2	MH-3	375 mm	Circular	3.32	0.019976
P-3	MH-3	MH-4	600 mm	Circular	2.05	0.0050
P-4	MH-4	MH-5	600 mm	Circular	4.97	0.049
P-5	MH-5	MH-6	600 mm	Circular	5	0.049
P-6	MH-6	O-1	600 mm	Circular	2.18	0.005

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