Palestine Polytechnic University
College of Engineering and Technology
Civil & Architecture Engineering Department

Project Title

Infrastructure Assessment And Design for Al-Samou' Down Town

Project Team
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Hebron – Palestine

May - 2017

Infrastructure Assessment And Design for Al-Samou‘ Down Town

Abstract

The down town of Al-Samou' is located in the center of the town, which has a great historical and archaeological value, as it is many archeological sites and Canaanite monuments.

This area faces many problems in its infrastructure such as roads, buildings and networks, this has become worse in the last years, so study and assess for the current situation of the existing infrastructure , problems analysis and designing for some parts of infrastructure must be fixed to keep down town in good status .

The current project concern in studying and evaluating the main parts of infrastructure in the most important area in Al-Samou' down town , then analyze the problems and solving it through making a design for the most important part of infrastructure .

After making an evaluation of Al-Samou' down town **,** the study shows that the absence of waste water collection system is the worst problem which must solve through making design for waste water collection system using gravity system to minimize the cost , the system is contain three main trunks , seven sub main trunks and one lateral trunks .

إهداء

الى...صاحب الفردوس الاعلى وسراج الامة المنير وشفيعها النذير البشير

محمد (صلى الله عليه وسلم)

الى ...من سهر الليالي ... ونسي الغوالي ... وظل سندي الموالي ... وحمل همي غير مبالي ىبدر التمام ... والدي الغالي

الى ...من اثقلت الجفون سهرا ... وحملت الفؤاد هما ... وجاهدت الايام صبرا ... وشغلت البال فكرا ... ورفعت الايادي دعاءا ... وايقنت بالله املا

اغلى الغوالي واحب الاحباب ... امي العزيزة الغالية

الى من علمتنا أن للنجاح قيمة و معنى ...و علمتنا كيف يكون التفاني والإخلاص في العمل ...و من معها آمنا أن لا مستحيل في سبيل الإبداع والرقي ...

المهندسة سماح الجعبري

الى ...ورود المحبة ... وينابيع الوفاء ... الى من رافقوني في السراء والضراء

الى اصدق الاصحاب ... اخوتي واخواتي

الى ...القلعة الحصينة التي الجأ اليها عند شدتي ...اصدقائي الاعزاء

الى من ضحوا بحريتهم من اجل حرية غيرهم......... الاسرى والمعتقلين

الى من هم اكرم منا مكانة........ شهداء فلسطين

إلى هذه الصرح العلمي الفتي والجبار........ جامعة بوليتكنك فلسطين

الى من احتضنتني كل هذا الكم من السنين .... فلسطين الحبيبة

ACKNOWLEDGEMENT

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

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

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

Work Team

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CHAPTER ONE

INTRODUCTION

1.1 General

Old cites in Palestine have a great value, makes a link between past and present , have a historical and religions value, so it must keep in a good statues .

Palestinian cities does not have a complete infrastructure , since it is now in a building , rebuilding and reconstructed stage , at least many Palestinian cities does not have drainage system , water network , and roads which is the most important part of infrastructure.

Infrastructure is the basic physical systems of a countries or communities, it is including roads, utilities, networks, school , building , shops etc., these systems are considered as an essential part for enabling productivity and sustainability.

Developing infrastructure often requires large initial investment, high engineering skills, board institutional cooperation and public and individual contribution.

1.2 Problem Definition

The most important part of Al-Samou' town is the downtown which located in the middle part of Al-Samou' town, this area has an historical value, so Palestine authority and Al-Samou' municipality give this area concern.

The most real problem for Al-Samou' downtown that there is no wastewater collection system, people use cesspits under the ground, then the sewage flow under Al-Samou' town surface .Which is dangerous on the groundwater and the environment around.

There's a water distribution network covering 97% of Al-Samou' town , but more than 50% of the water which enter the network lost in the pipes , that makes people who lives there suffering from lack of water.

The very crowded area, without expending in the boundary of the downtown, and large quantity of cesspits underground make the downtown in serious environmental and infrastructure problem.

1.3 Objectives and Goals

The project team looking to make an evaluation for the existing infrastructure and facilities of Al-Samou' down town. The most important goal of the study is to evaluate and assess the situation of the existing infrastructure in the downtown and then making design or redesign for some part of it.

The objectives can be explained as:-

1. Evaluate and assess the existing situation of the downtown infrastructure

This will be done by making many visits to the down town to take deep study for the existing situation, and to discuss the problem with those who are living there and with those who serve that area like Al-Samou' municipality, also a review of previous studies, workshops conclusions, and taking an opinion of some people who are having a good vision for Al-Samou' downtown future situation.

These steps will be done by taking all of infrastructure components into account, so that all networks such as water, wastewater, storm water, roads will be evaluated, a fast view of the cultural, economical, environmental aspects will discuss and the infrastructure network will have the main concern.

2. Design some parts of the down town infrastructure

After making an evaluation for the down town, project team will take a decision by making a design for some parts and giving their recommendation to give it a good and complete facility of infrastructure.

1.4 Importance of the project

It is simply known that the old parts of any city is the most important part of it because old parts always having a historical worth and in many cases religious values , this is concern as worthy heredity .

Al-Samou' down town was built in third millennium BC by the Canaanites many civilizations were live there , which has a great historical and archaeological value, as it is many archeological sites and Canaanite monuments , all of these things giving Al-Samou' down town a great value.

1.5 Methodologies

1. Site visits to Al-Samou' down town and Al-Samou' municipality was done.

2. All needed maps and photos was obtained.

3. All previous studies, statistical studies for down town was obtained.

4. Quantities such as water consumption, waste water production, rain water depth was obtained.

5. Infrastructure evaluation was done after study and discussion of the existing situation.

6. Design some parts of infrastructure specially those which causes a big problem in down town.

7. All calculations and drawings for the selected parts.

8. Finalizing the project by writing a complete report showing the outcomes of evaluation and design.

1.6 Phases of the project

The project will consist of four phases as shown in table 1.1:-

Table 1.1: Phases and duration of the project

Title	Duration							
	9/2016	10/2016	11/2016	12/2016	2/2017	3/2017	4/2017	5/2017
Data collection								
Infrastructure evaluation								
Design of some parts of infrastructure								
Writing the reports								

1.6.1 First phase: Data collection

In this phase available data information maps ,drawings, statistical studies and previous studies from different sources was collected.

This phase includes the following tasks:-

1. Visits to the project area.

2. Collecting of maps and drawings.

3. Collecting of meteorological and hydraulic data.

4. Review the statistical data.

5. Review the previous studies.

1.6.2 Second phase: Infrastructure evaluation

After study the previous data in the first phase, an evaluation and assessment for the existing infrastructure was done.

1.6.3 Third phase: Design of some parts of infrastructure

After making an evaluation of the down town infrastructure decision is making to make a design for some part of infrastructure which causes a serious problem for the project area. In this phase calculations, analysis, design, drawing profiles, maps will be prepared.

1.6.4 Fourth phase: Writing the reports

After finishing all of the above three phases, project team prepare a complete report.

1.7 Organization Of The Project

The study report has been prepared in accordance with the objectives and scope of work. The report consists of five chapters. The first chapter entitled “Introduction” outlines the problem, project objectives, and phases of the project.

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

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

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

Chapter five entitled “Bill Of Quantities “ show some calculations.

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

Chapter Two

Project Area

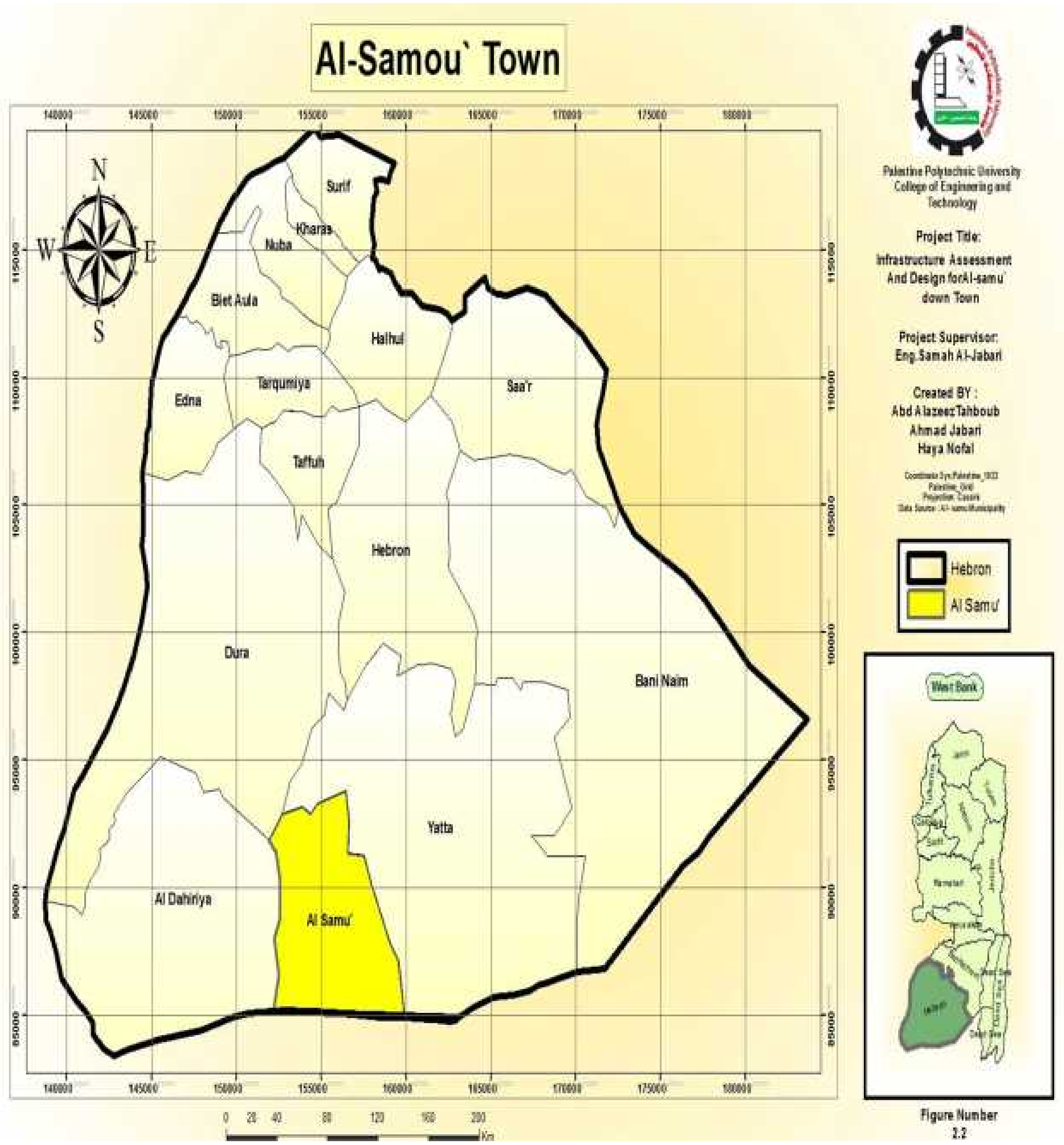
2.1 General

In this chapter, basic data of Al-Samou’ town will be discussed. Topography meteorological data, population data, water consumption, wastewater production and roads situation.

2.2 Project Area

Al-Samou’ town is twenty two kilometers south of Hebron, surrounding from north by Yatta town and Al-Reheiah village, and also Yatta town surrounding it from east, Al-Dahriya from west and the Green line from south .Al-Samou’ down town located in the center of Al-Samou’ town and has a great value to contain some of historical places. See Fig 2.1, 2.2 and 2.3

Figure 2.1: Al-Samou’ Down Town.


Al-Samou` Town
Palestine Polytechnic University
College of Engineering and Technology
Project Title:
Infrastructure Assessment And Design forAl-samu` down Town
Project Supervisor:
Eng.Samah Al-Jabari
Created BY :
Abd Alazeez Tahboub
Ahmad Jabari
Haya Nofal
Hebron
Al Samu'
West Bank
Figure Number
2.2
Surif
Kharas
Nuba
Biet Aula
Halhul
Edna
Tarqumiya
Saa'r
Taffuh
Hebron
Dura
Bani Naim
Yatta
Al Dahiriya
Al Samu'
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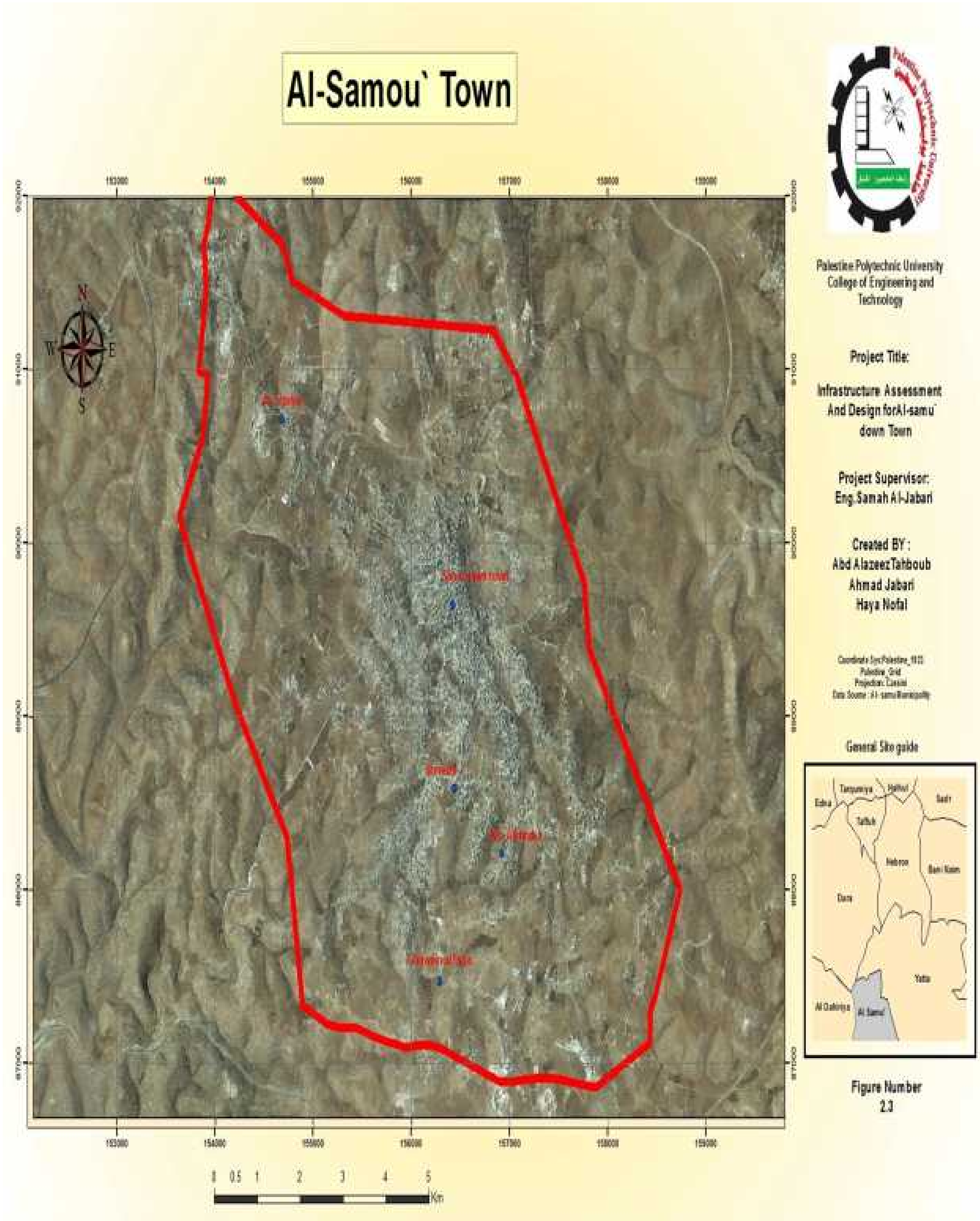

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Ahmad Jabari
Haya Nofal
General Site guide
Figure Number
2.3
0 0.5 1 2 3 4 5 Km

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.

The down town rising 710 meters above sea level which means medium height characterized by semi – desert to Mediterranean basin climate. The highest point called Al-Ellieh has an elevation equal 718m.The lowest point called Al-Sail has an elevation equal 678 m.See Fig 2.4,2.5 and 2.6

Climate in Al-Samou' can be spilt to two seasons:

a) Rainfall season, usually start in October and reach its peak in February then decrease gradually in May month. This climate consists two seasons, winter and part of spring, autumn season.

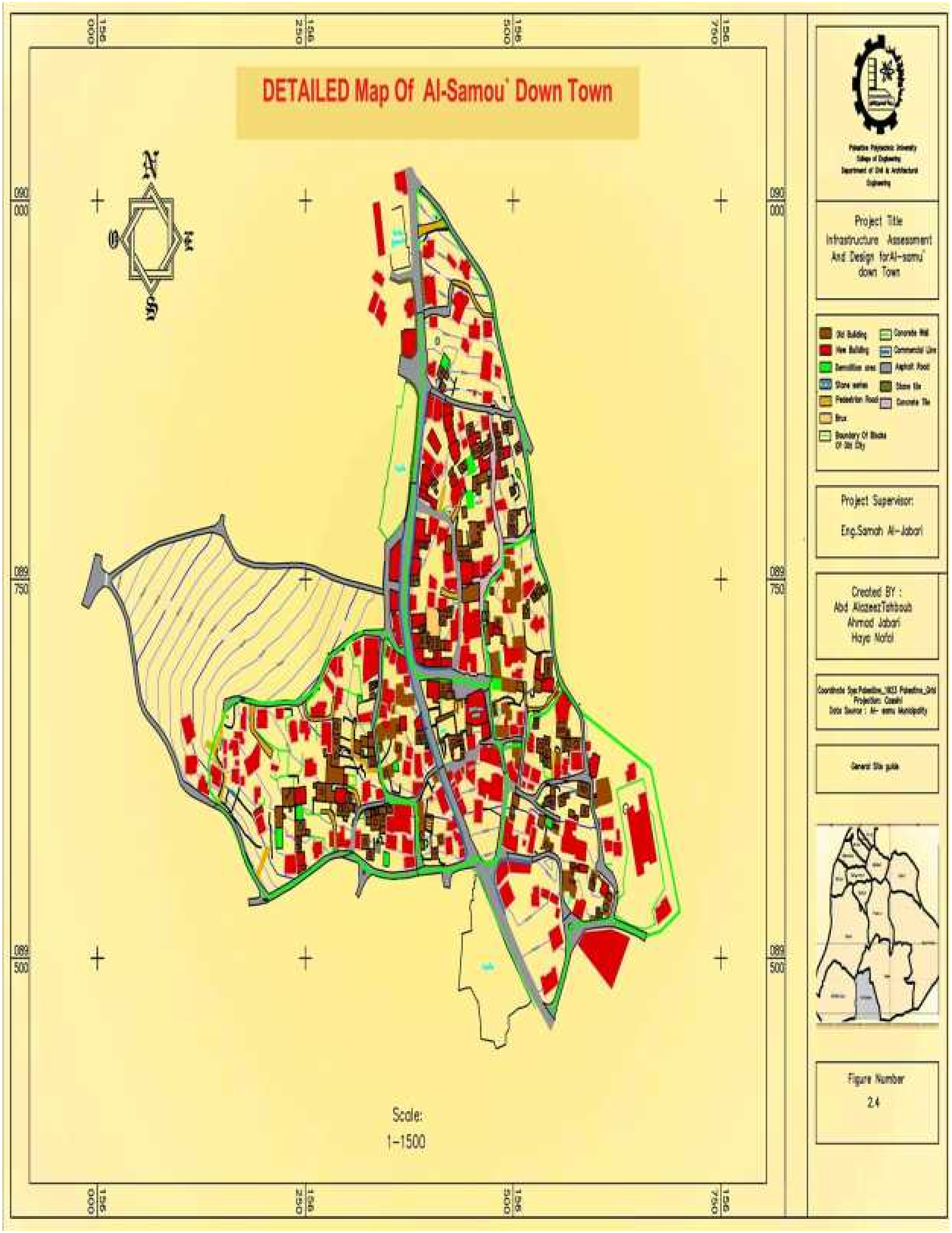
b) Dry season consist of summer and part of spring, and autumn seasons. It starts from May till September and sometimes continues to October month.

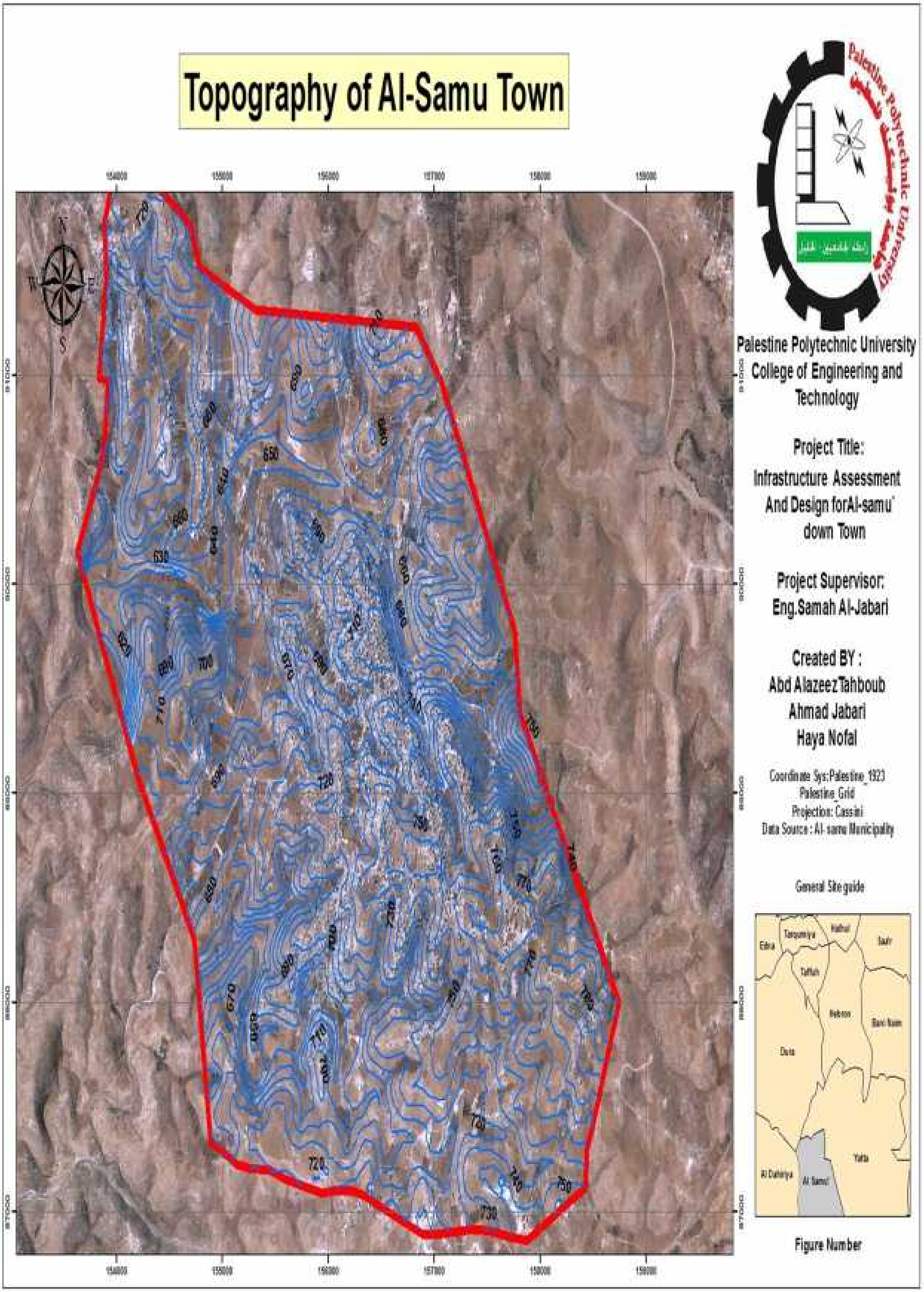
2.3.1 Rainfall:

The average annual rainfall at area reaches approximately 306 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. See Fig 2.7

2.3.2 Temperature:

The climate here is classified as subtropical Dry Arid (Desert) .The annual average 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 temperature in the year occur in January, when it is around 12.3°C, the variation in temperatures throughout a year is 14.4 °C. See Fig 2.7


DETAILED Map Of Al-Samou' Down Town
Project Title
Infrastructure Assessment And Design forAl-samu' down Town
Old Building
New Building
Concrete Wall
Project Supervisor:
Eng.Samah Al-Jabari
Created BY :
Abd AlazeezTahboub
Ahmad Jabari
Haya Nofal
Figure Number
2.4
Scale:
1-1500


Topography of Al-Samu Town
Palestine Polytechnic University
College of Engineering and Technology
Project Title:
Infrastructure Assessment And Design forAl-samu' down Town
Project Supervisor:
Eng.Samah Al-Jabari
Created BY :
Abd Alazeez Tahboub
Ahmad Jabari
Haya Nofal
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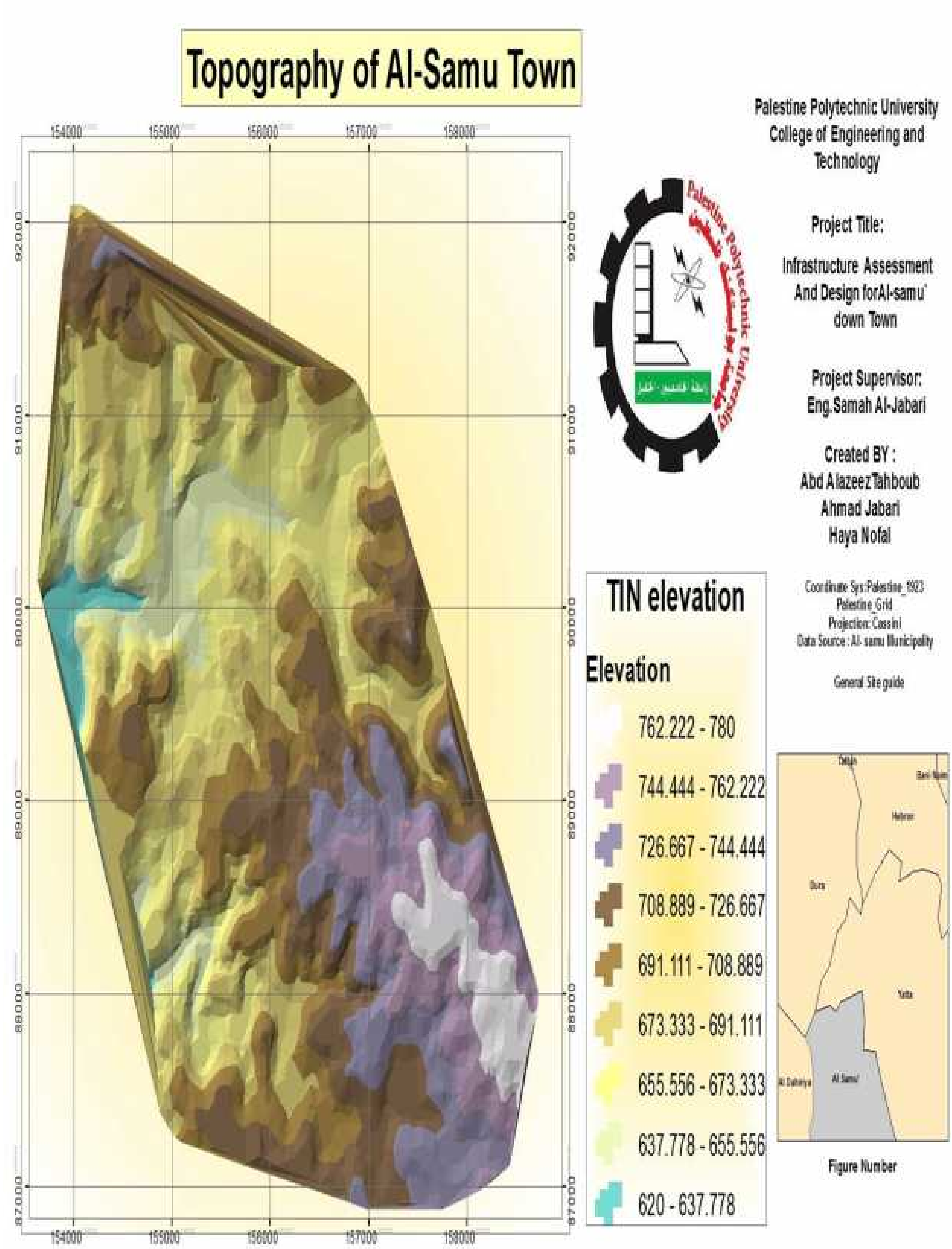
Projection: Cassini
Data Source : Al-samu Municipality
General Site guide
Figure Number


Topography of Al-Samu Town
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Coordinate Sys:Palestine_1923
Palestine_Grid
Projection: Cassini
Data Source : Al- samu Municipality
General Site guide
TIN elevation
Elevation
762.222 - 780
744.444 - 762.222
726.667 - 744.444
708.889 - 726.667
691.111 - 708.889
673.333 - 691.111
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620 - 637.778
Dura
Yatta
Al Samu'
Figure Number

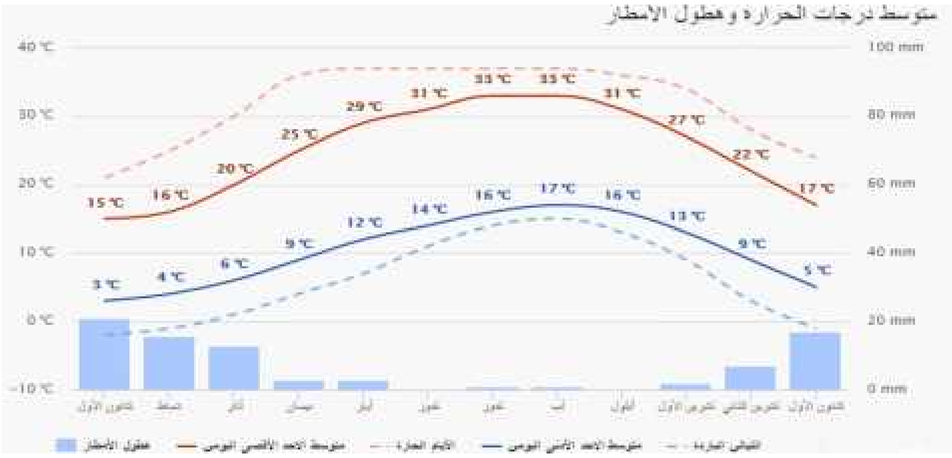


Figure 2.7: The average temperatures and rainfall of Al-Samou'Town.

2.4 population

2.4.1 Population projection

The 2007 population for Al-Samou' town obtained from Palestine central bureau of statistics (PCBS) of 19154. The annual growth rate is 3.21% in the west bank. To calculate the population for the coming 25 year, a geometric increase is assumed represented by the following equation:

$P = P_o * (1 + x)^n$

Where:

P: future population

P_o : current population

x: population growth

n: time period

Table 2.1: The population of Al-Samou'Town.

Year	2011	2016	2020	2025	2030	2035	2041
Population(capita)	21979	25527	28966	33923	39729	46528	56240

2.5 Roads:

The length of the roads network is 68 kilometers, only 10 kilometers in a good status which is the main roads of the city : Semia road in the west of Al-Samou' town.a road between Yatta town and Al-Samou' town to the north from it. The southern road to the green line.

58 kilometers of the roads network are in a bad status, some of it just agriculture roads Now Al-samou' town municipality working to develops the roads network. See Fig (2.8)

Figure 2.8: The municipality working to develops the roads network

Al-Samou' down town roads network made from stones, it is all in a good status and there is no need to develop it. See fig (2.9)

Figure 2.9: road in Al-Samou' down town

Streets in Al-Samou' down town is narrow but cars can passes through it , according to al Samou' natural the street's slopes is good and there is no pools of rain water in it .

2.6 Solid waste

Municipality worker gathering the solid waste from streets ,houses and shops , then they put it in waste containers , and the municipality take it to the landfill according to this Al-Samou' down town is clean and there is no rubbish in it .See figure (2.10)

Figure 2.10: road in Al-Samou' down town .

2.7 Buildings

There is many type of building :

old buildings , the area of this buildings is small and there's a few windows in it , those building not fit with the human requirements and not healthy .

new buildings , people in Al-Samou' down town build some new building over the old buildings , the area also small , sunshine can enter to it also there is good air , we can say its in a good conditions

2.8 Social Situation

1- Education

85% of children in Al-Samou' down town learning in schools , 40% of them complete their university studies , 15% of them left the schools at small age according to their bad situations where they have to work to help their families , there is two schools in Al-Samou' Down town for boys and girls located in the center of down town .

2- Health

There's a one health care facility in Al-Samou' down town and it serve the people in down town .

2.9 Economic situation

Population worked in several jobs to secure income in order to provide the requirements of life for them and for their children .

1- Shops :

Many of people in Al-Samou' Down Town have shops there , and use it to conduct their business , some of these shops are restaurant , clothing shops , markets , super markets

2- Tourism

There are many archeological sites in down town, so the tourists to visit and identify critical areas in the town, which is beneficial for The owners of the shops .

3- Animal Husbandry

Some of people in al samou' down town rears animals like sheep and chickens to sell its products And they rear the animal in the lower grand in their houses .

CHAPTER THREE

DESIGN PARAMETERS

3.1 Wastewater Collection System Design

3.1.1 General

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

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

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

3.1.2 Municipal Sewerage System

Type of Sewers

The types and sizes of sewers used in municipal collection system will vary with size of the collection system and the location of the wastewater treatment facilities. The municipal or the community sewage system consist of:

1. Building sewers (also called house connections).

2. Laterals or branch sewers.

3. Main and sub main sewers.

4. Trunk sewers.

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

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

Sewer Material

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

3.1.3 Types of Wastewater Collection Systems

- **Gravity Sewer System**

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

- **Pressure Type System**

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

- **Vacuum Type System**

Collection 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.

3.1.4 Sewer Appurtenances

❖ **Manholes**

Manholes should be of durable structure, provide easy access to the sewers for maintenance, and cause minimum interference to the sewage flow. Manholes should be located at the start and at the end of the line, at the intersections of sewers, at changes in grade, size and alignment except in curved sewers, and at intervals of 40-60 m in straight line.

The general shapes of the manholes are square, rectangular or circulation in plan, the latter is common. Manholes for small sewers are generally 1.0-1.2 m in diameter. For larger manhole bases are provided. The maximum spacing of manholes is 40-60 m depending on the size of sewer and available size of sewer cleaning equipment

Slandered manholes consist of base, risers, top, and frame and cover manholes benching, and step-iron. 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.

3.1.5 Design Parameters

Flow Rate Projections

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

1. Domestic

2. Infiltration.

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

- The peak coefficient

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

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

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

Important Numbers

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

3.2 Storm water Collection System Design

3.2.1 General

Rapid effective removal of storm runoff was a luxury not found in many cities in the early nineteenth century. Today, the modern city dweller has come to think of this as 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.

3.2.2 Storm Water Runoff

Storm water runoff is that portion of precipitation which flows over the ground surface during and a short time after a storm. The dependence parameters that controlled the quantity of the storm water which carried by a storm or combined sewer are the surface of the drainage area (A, ha), the intensity of 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 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, hectare.

For small catchments areas, it continues to be a reasonable method, provided that it is used 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.

The step 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 drains, for example,the outlets of the earlier mentioned homogeneous sub-areas should serve as the inlet

nodes. On the other hand in very detailed calculations all the inlet points should be defined according to local design practices.

5. After the inlet points have been chosen, the designer must specify the drainage sub-area for each inlet point A and the corresponding mean runoff coefficient C. If 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 engineer then should proceed with final hydraulic design of the system.

Runoff Coefficient, C

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

$$C = \frac{\sum Ci.Ai}{\sum Ai}$$

Where:

Ai = I the area

Ci = I the runoff coefficient.

The range of coefficient with respect to general character of the area is given in the following tables (Table 3.1 and Table (3.2).

Table (3.1): The range of coefficient with respect to general character of the area.

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 (3.2): The range of coefficient with respect to surface type of the area.

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

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

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

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

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

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

2. Intensity, duration and frequency characteristics of rainfall.

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

$$i = (\Delta \text{ height of rain} / \Delta \text{ time}) \ \frac{mm}{min}$$

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

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

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

3. Time of concentration.

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

$t_c = ti + t_f$

Where tc: time of concentration.

t_i: inlet time.

t_f: flow time.

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

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

3.3 Selection of Design Parameters

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

1. Design Flow Rate

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

2. Minimum Size

The minimum size storm sewer recommended is 250 to 300 mm for closed system, and for open channel depended on the type of profile that selected.

3. Minimum and Maximum Velocities

In storm water sewers, solids tend to settle under low-velocity conditions. Self-cleaning velocities must be developed regularly to flush out the solids. Most countries specify minimum velocity in the sewer under low flow conditions. The minimum allowable velocity is 0.75 m/s, and 0.9 m/s is desirable. This way the lines will be flushed out at least once or twice a day. The maximum velocities for storm water system are between 4 to 6 m/s. The maximum velocity is limited to prevent the erosion of sewer inverts.

4. Slope

For closed system minimum slopes determined from minimum velocities, for minimum velocity 1 m/s, the slopes are shown in Table (3.3).

Table (3.3): Minimum recommendation slopes of storm sewer (n=0.015).

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.

5. Depth

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

6. Appurtenances

Storm sewer appurtenances include manholes, 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

CHAPTER FOUR

ASSESSMENT ,ANALYSIS AND DESIGN

4.1Assessment:

4.1.1 Importance Of The Area

Old cities make a connection which ancestor and give a sense and understanding of history that no other documents or evidence exist, and Al-Samou' town has many heritage places ,there are 21 mosques in the town. But for the archaeological places there are a lot of it, Including: Building Old Roman Church, archeological prison, they can be used as sites for tourism. "Tower and the remains of a synagogue, dilapidated buildings, foundations, higher thresholds in large Used Again, pieces carved in the village, landfills, and seductive ".Like Al-Burj, Al-Elleieh, Al-kaaber mosque, and a lot of caves.

Some of important building discussed below:

Al_Burj :Building dating back to the fourth century AD and has been used as a place of worship for several religions, at the end of the twelfth century the place was converted to a mosque, large part of Al-Burj destroyed after Samou' battle in 1996. See Fig 4.1

Al-Elleieh**:** It is a house has a huge stone wall, and in Al-Elleieh there is a monument back to Roman era. See Fig 4.2

Figure4.1: Al-Burj

Figure 4.2: Al-Elleieh

4.1.2Water Quantity and consumption:

1-Water Quantity:

Accordingt to Al-Samou' town municipality the water resources are coming from: Water line from Bani Nae'm town pours in to Al-Safi reservoir which is 850 cubic meters volume but the water volume comes just 480 cubic meters, A water line from Dura town pours in to Al-Semia reservoir which is 30 cups between Al-Samou' town and Al-Dahreieh for 15 cups each one has. The most important source in Al-Samou' is rainwater collection walls which covered 40% of water consumption for the town. Water network reach to 95% of Al-Samou', people gets the water by subscription from the municipal to have a water line .

2-Water Consumption:

Water demand in Al-Samou' town, like other West Bank towns, is continuously increasing due to the increasing in population. The population of it is estimated about 25527 parsons for year 2016 and it is increasing. The result of all this is obvious, the total water requirement is ever on increase, 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, current range from 40-50 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.

3-Wastewater Quantity:

The amount of Domestic wastewater produced per capita per day is usually 80% of water consumption. Unfortunately there is no waste water collection system in Al-Samou' town, they depend on cesspits to disposal it. Then the sewage flow to caves under Al-Samou' town surface ,that's affects the soil and the ground water around.

4-Storm water Quantity:

There is no storm water drainage system in the Al-Samou' town. According to Al-Samou' town topography there's no need to a storm water collection system .They depend on surface disposal for it, then all of the water moved by gravity to Al-sail area which is the lowest area in Al-Samou' town.

4.1.3 infrastructure in Al-Samou' down town:

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 activities easily and without problems. Infrastructure consist of water supply networks sewerage and storm water collection systems, electricity networks, telecommunications network, road networks, schools, methods of solid waste disposal, and all other constructions.

Infrastructure has high importance to study and evaluate that to preservation the old city as a 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 down town include the following:

1-water network

Water network in Al-Samou’ down town available as the old network in Al-Samou’ town been, and it’s covers 97% of Al-Samou’ town and the hole area of Al-Samou’ down town.

The network is old but in a good status and serve all the people who lives there.

2-sewage collection system

Sewerage collection system is very important system to avoid ground water, soil, air pollution, also to avoid the disease of human. Unfortunately Al-Samou’ town have no sewerage system, they collect the waste water from the houses using cesspits then the waste water seeps to a caves under the ground of the town.

When they have accumulation of waste they spread insecticide to avoid the smell, insects, rodents and flies that adverse near communities. Table 3.1 shows more details for the impact of absence of sewerage system. This service could cause a major problem such ground water pollution, soil pollution, and decrease tourism because of bad smell.

3-storm water network:

There is no storm water drainage system in the Al-Samou’ town. According to Al-Samou’ town topography there’s no need to a storm water collection system .They depend on surface disposal for it, then all of the water moved by gravity to Al-sail area which is the lowest area in Al-Samou’ town .

4-Roads

Al-Samou’ down town roads network made from stones, asphalt and it is all in a good status and there is no need to develop it. See fig (4.3)

Figure 4.3: road in Al-Samou' down town

5-Electricity network and telecommunication network

The electricity and telecommunications service in the down town is available and serve all of the people who lives there and registered in the municipality.

6-Solid waste:

Solid waste in Al-samou' down town involve the domestic, commercial, light industries. people who lives there collect their waste in plastic bags the disposed it throw in streets, old buildings, and some of them in container which will the collect by worker cleaner then they take it to the landfill, there is 8 container in Al-Samou' down town . See fig 4.4

Figure 4.4: container in down town

4.1.4 Building

The structure of the old building in Al-Samou' down town is classified according to :

1- Uses of building in Al-Samou' down town

Through the doing from of the same existing buildings within down town by municipality, the types of uses are divided into seven Types:

1. Type Number one

Residential use; it was found that the number of residential building in the area around "163" building, and these accounted for 48 percent of total building. See fig 4.5

Figure 4.5: Old building for residential use

2. Type Number two

The number used for business purpose was found 45 building .See Fig (4.6)

Figure 4.6: buildings for commercial use.

3. Type Number three

Building used for industrial purposes was found “4” building and represent 1.1% of the total buildings, these are light industries like carpentry. See fig 4.7

Figure 4.7: building for industrial purposes .

4. Type number four

The educational use where there is four schools in Al-Samou’ down town for boys and girls those schools is

Al-Samou secondary school for girls

Mo’ta s primary school for girls

Al-Samou’ primary school for girls

and these accounted for 1.1% . see fig 4.8

Figure 4.8: Al-Samou’ secondary school for girls

5.Type number 5

Social , which is a single building use as a dewan to jawaadeh .

6.Type number 6

The religious building and mosques , its two building within study area , namely the Al-kaaber mosque and Al-Omari mosque . see fig 4.9 , 4.10

Figure 4.9: Al-Kaaber Mosque

Figure 4.10: Al-Omari Mosque

7. Type number 7

The building which are used for several purpose its number is “14” building with 4 percent, where it was used the building for housing, but now used for storage purpose and various activities like animal husbandry. See fig 4.11

Figure 4.11: old building use for animal husbandry .

2- Number of floor

1. Part one

It is composed of one-storey building, what's it is found 227 building, the percentage is estimated at 66 percent, of total of buildings .see fig 4.12

Figure 4.12: one-storey buildings

2.Part two

The number of two-storey is 84 building with 25 percent. See fig 4.13

Figure 4.13 :two-storey buildings

3. Part three

It is composed of three-storey, the number of it is 29 building with 8 percent, the municipality in al Samou' prevent build more than 3 floors in Al-Samou' down town. See fig 4.14

Figure 4.14: collection of three-storey building

3- Quality of buildings

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

1. First part

The buildings are in good construction. See fig 4.15

Figure 4.15:building in good construction

2. Part two

Building in moderate condition. See fig 4.16

Figure 4.16 : building in moderate condition.

3.Part three

Building in poor condition .See fig 4.17

Figure 4.17 : building in poor condition.

4.Part four

Destroyed building .See fig 4.18

Figure 4.18 : destroyed building.

4.1.5 Vegetation

In the past people in Al-Samou' town was depend on planting and vegetation and its was a traditional career for a lots of them, now the vegetation in Al-Samou town is very low because of different reasons:

1- The climate in the town is semi-desert.
2- The lake of water in the town.
3- There is no space because of overcrowding of buildings.

4.2 Analysis and Design

4.2.1General

After studying and assessing the situation of the down town of Al-Samou' town, the project team find that the absence of the waste water collection system is the most dangerous problem that affects the ground water, soil and environmental so the first part is to design a waste water collection system for Al-Samou' down town .

4.2.2 Layout of the System

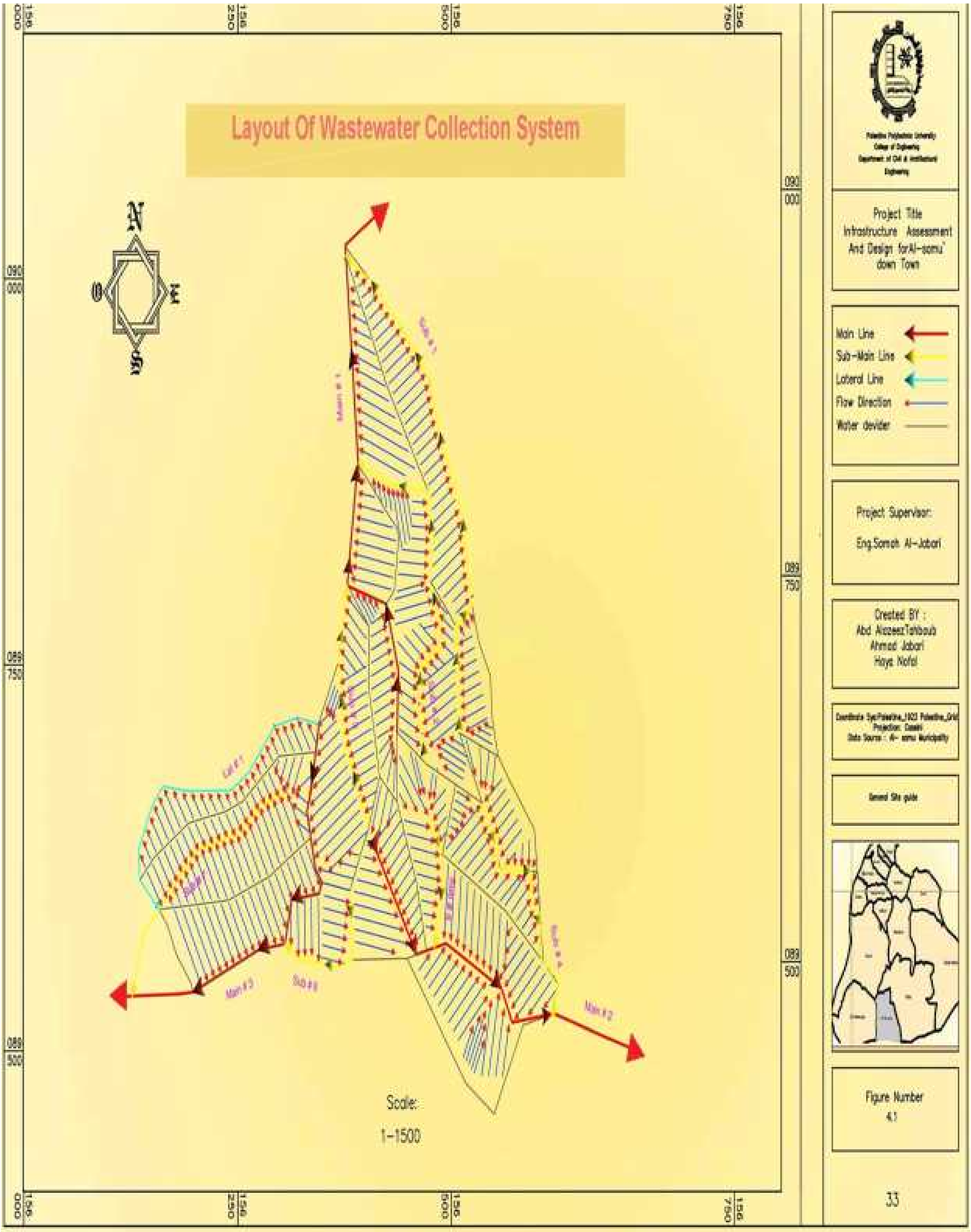
The first step in designing a sewerage system is to establish an overall system layout that includes a plan of the area to be sewer showing roads, streets, buildings, other utilities, topography, and the lowest floor elevation or all buildings to be drained.

In establishing the layout of wastewater collection system for Al-Samou' downtown. The following basic steps were followed:-

1. Obtain a topographic map of the area to be served.
2. Visit the location.
3. Locate the drainage outlet. This is usually near the lowest point in the area and is often along a stream or drainage way. In Al-Samou' down town, towards to Al-Sail torrent.
4. Sketch in preliminary pipe system to serve all the contributors.
5. Pipes are located so that all the users or future users can readily tap on. They are also located so as to provide access for maintenance and thus are ordinarily placed in streets or other rights-of-way.
6. Sewers layout is followed natural drainage ways so as to minimize excavation and pumping requirements. Large trunk sewers are located in low-lying areas closely paralleled with streams or channels.
7. Revise the layout so as to optimize flow-carrying capacity at minimum cost. Pipe lengths and sizes are kept as small as possible, pipe slopes are minimized, and followed the ground surface slope to minimize the depth of excavation, and the numbers of appurtenances are kept as small as possible.
8. The pumping is avoided across drainage boundaries. Pumping stations are costly and add maintenance problems.

The final layout of waste water collection system of Al-Samou' down town is illustrated in Figure (4.19),

Three main trunks, seven sub-main and one lateral are located on the layout.



4.2.3 Quantity of Wastewater

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

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

Design example: Design a gravity flow sanitary sewer

The following data will be collected and analyzed.

1. For current water consumption uses 40L/c.day.
2. For future water consumption uses 150L/c.day.
3. For current population.
4. For future population: using the equation (4.1).
5. For population growth rate 3.21%.
6. For design period use 25 years as a design period.
7. The wastewater calculates as 80% of the water consumption.
8. For infiltration allowance use 10% of the domestic sewerage flow.
9. Peaking factor depending on the formula :

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

Where q = average industrial sewage flow.

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

To simplify the computations, we use the tables.

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

Permissible for this situation.

12. Minimum velocity: To prevent the deposition of solids at low wastewater flows, use

Minimum velocity of 0.6 m/s during the peak flow conditions.

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

Of cover is 1.5 m.

Solution:-

1. Layout the sewer. Draw a line to represent the proposed sewer Figure (4.1).
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 of Q for the sanitary sewer are presented in Table (4.1) , The data in the table are calculated as follow:
4. The entries in columns 1 and 2 are used to identify the line numbers and street sewer name.
5. The entries in columns 3 through 5 are used to identify the sewer manholes, their numbers and the spacing between each two manholes.
6. The entries in column 6 used to identify unit sewage. Unit sewage = 80% multiplied by the current consumption density divided area in dounm.
7. The entries in columns 7 and 8 are used tributary area, column 7 used incremental area, and column 8 used total area in dounm.
8. To calculate municipal maximum flow rates columns 9, 10, are used. Column9 is municipal average sewage flow (unit sewage *total area), the peak factor column 10 is calculated using equation 3.2 as: $P_f = 1.5 + 2.5/ \sqrt{q}$, where q = Average industrial sewage flow (Column 9).
9. Column 11 used to calculate the Q max, the value of it comes from multiply column 10* column 9. Column 12 calculate the infiltration which equal to 10% $Q_{average}$ (10% * column 9). Column 13 and column 15 used to show the maximum flow design which is come from column 11+ column 1The calculation and design tables for the wastewater collection system of Al-Samou' downtown are shown in Appendix.

Table 4.1: quantities of waste water for main trunk #3

MAIN #3														
Line No	Location			Length	unit sewage	Tributary area		Flow Rates						
	Street Sewer Name	Upper Mh No	Lower Mh No			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	main 3	1	2	41	14.84	1.40	1.40	20.78	2.05	42.57	2.08	22.86	44.64	44.64
2	main 3	2	3	15	14.84	0.86	2.26	33.56	1.93	64.82	3.36	36.92	68.18	23.53
3	main 3	3	4	39	14.84	2.30	4.57	67.76	1.80	122.21	6.78	74.53	128.99	60.81
4	main 3	4	5	12	14.84	0.31	4.87	72.28	1.79	129.68	7.23	79.51	136.91	7.92
5	main 3	5	6	8	14.84	0.44	5.31	78.76	1.78	140.32	7.88	86.63	148.20	11.29
6	main 3	6	7	32	14.84	0.84	6.14	91.18	1.76	160.64	9.12	100.30	169.76	21.56
7	main 3	7	8	30	14.84	1.91	8.05	119.50	1.73	206.58	11.95	131.45	376.89	207.13
8	main 3	8	9	31	14.84	1.26	9.31	138.19	1.71	236.67	13.82	152.00	408.85	31.96
9	main 3	9	10	50	14.84	1.75	11.06	164.16	1.70	278.27	16.42	180.58	453.05	44.20
10	main 3	10	11	32	14.84	1.05	12.11	179.75	1.69	303.14	17.97	197.72	479.47	26.42
11	main 3	11	12	15	14.84	0.91	13.02	193.25	1.68	324.63	19.33	212.58	502.32	22.85
12	main 3	12	13	29	14.84	1.94	14.96	222.08	1.67	370.37	22.21	244.29	1060.68	558.36

4.2.4 Sewer CAD Program Works

- Open Sewer CAD, select file → import →DXF Background to import the DXF file, figure (4.20) below shows this step.

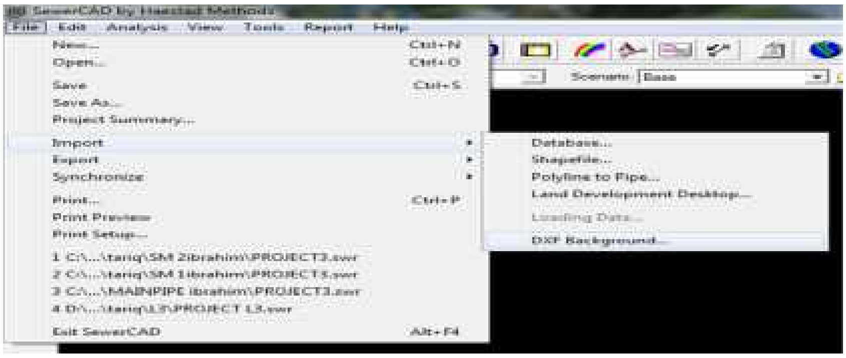


Figure 4.20 : Importing Dxf File

- Specify file location and then press open, figure (4.21) below shows this step.

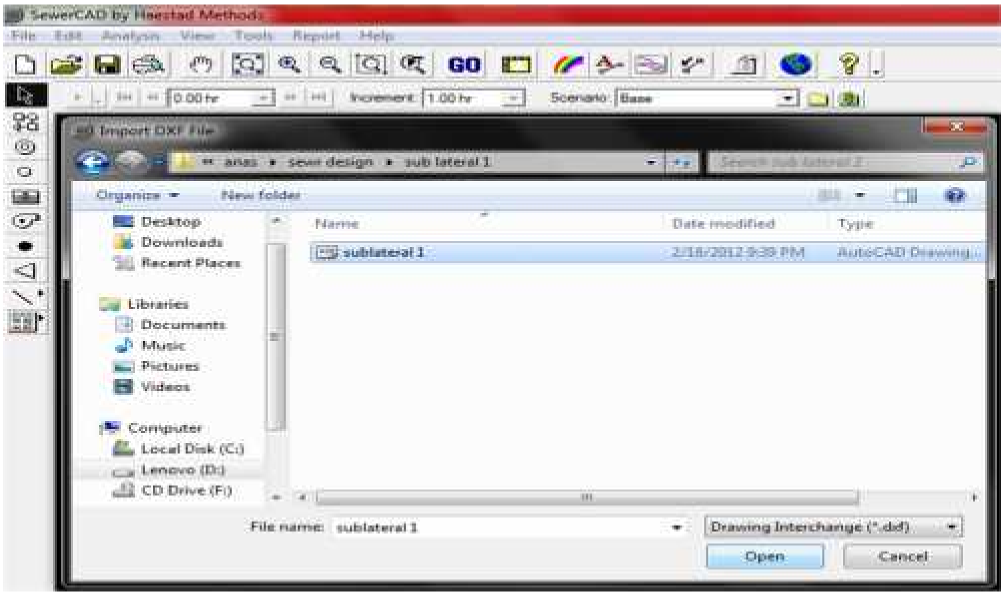


Figure4.21: Opening The Dxf File

- Figure (4.22) shows a line example.

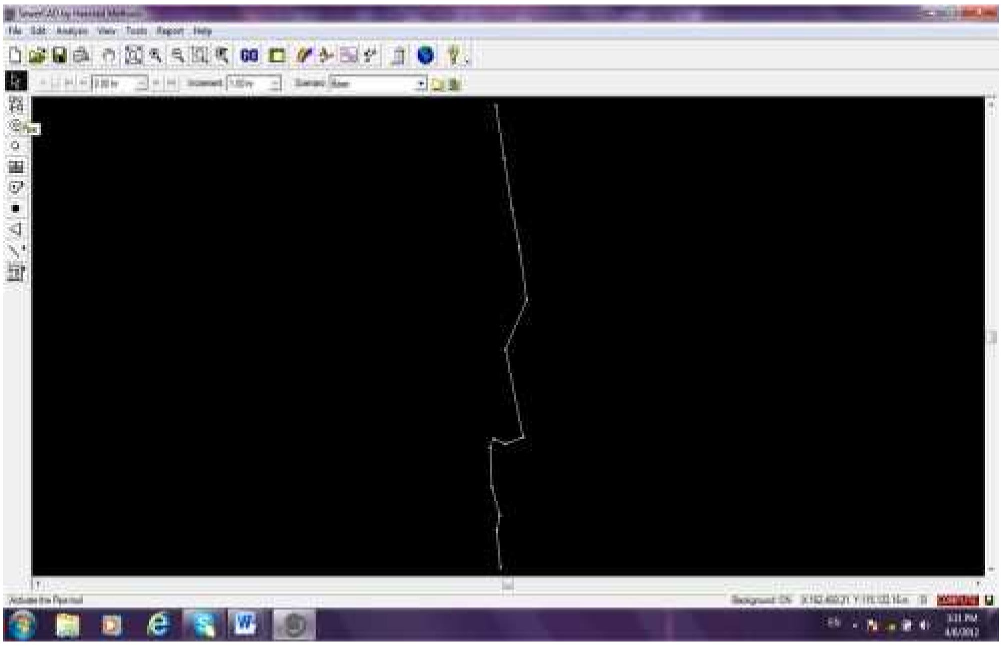


Figure 4.22: Line Example

- Press pipe icon, a massage will appear tell you to create a project see figure (4.23).

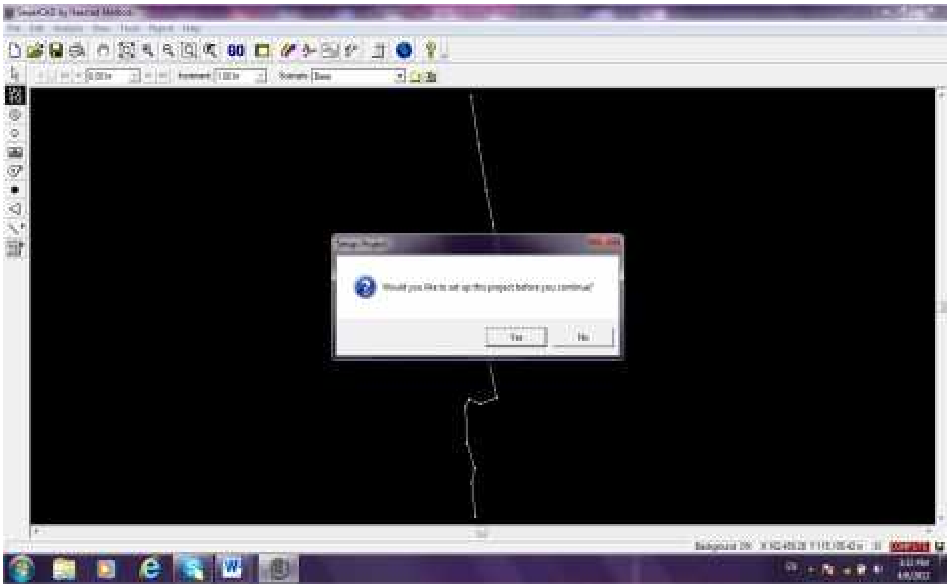


Figure 4.23: Creating project

- Press yes and define the project then press next twice, then select finish, the figure (4.24) below shows this step.

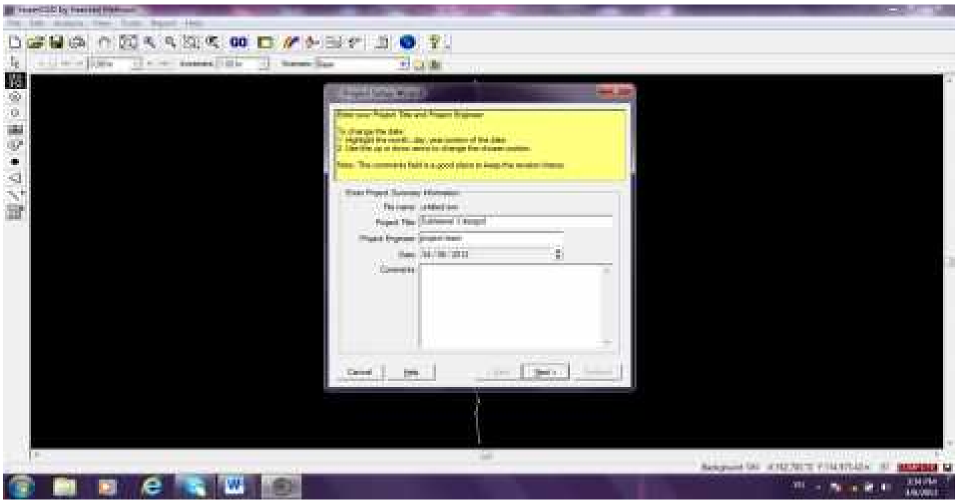


Figure 4.24: Defending Project

- Press pipe icon and connect between manholes, figure (4.25) below shows the step.

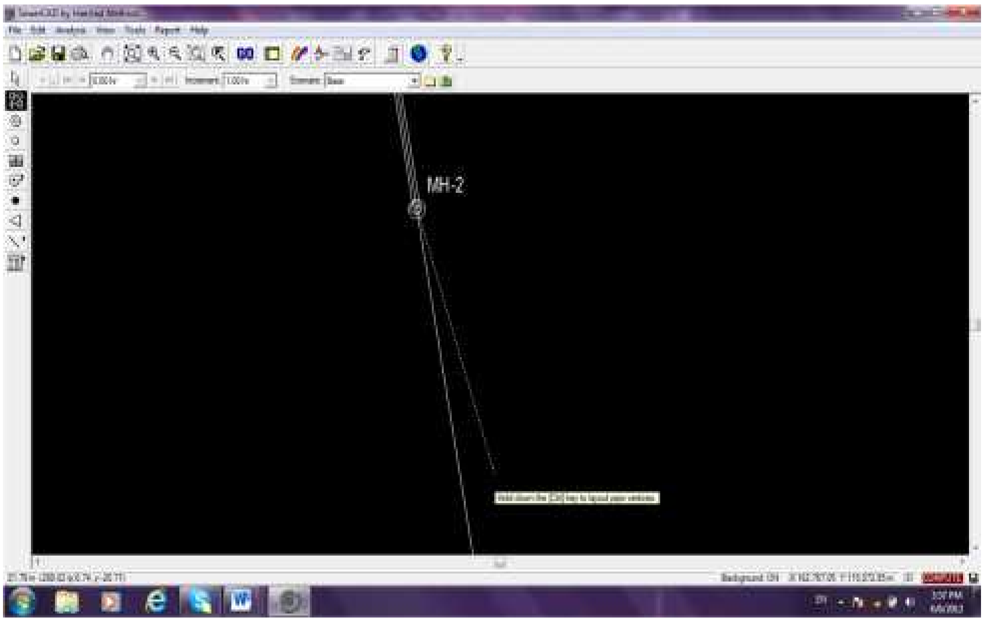


Figure 4.25: Creating A Pipe Network

- After you connect between all manholes, press on the outlet icon and click on the last manhole, then press yes to replace the manhole with outlet, the figure (4.26) below shows the step.

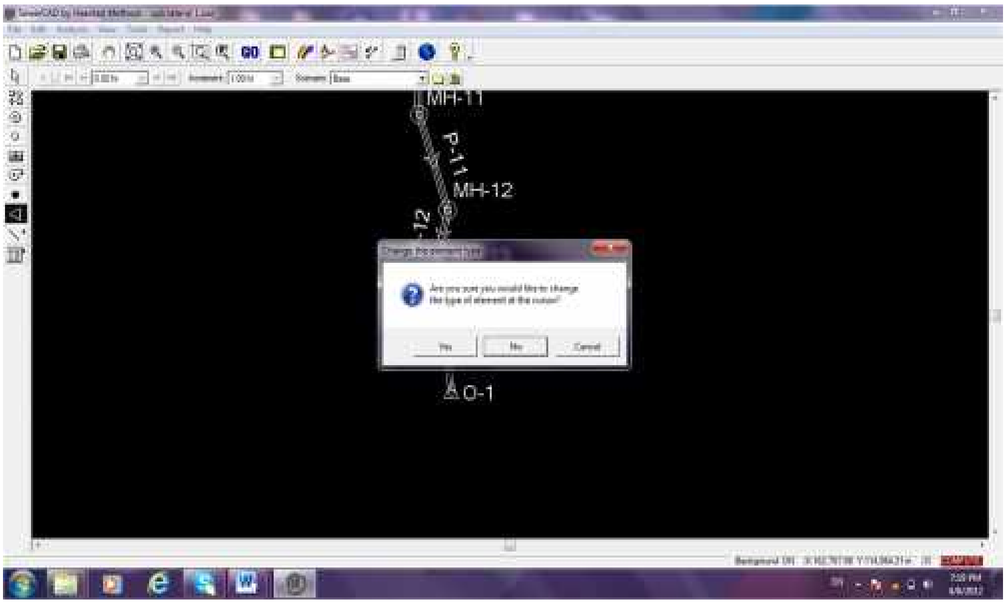


Figure 4.26: Creating Outlet

- Save your project, then select analysis → alternatives → physical properties → edit, then start editing gravity pipe, see figure (4.27).

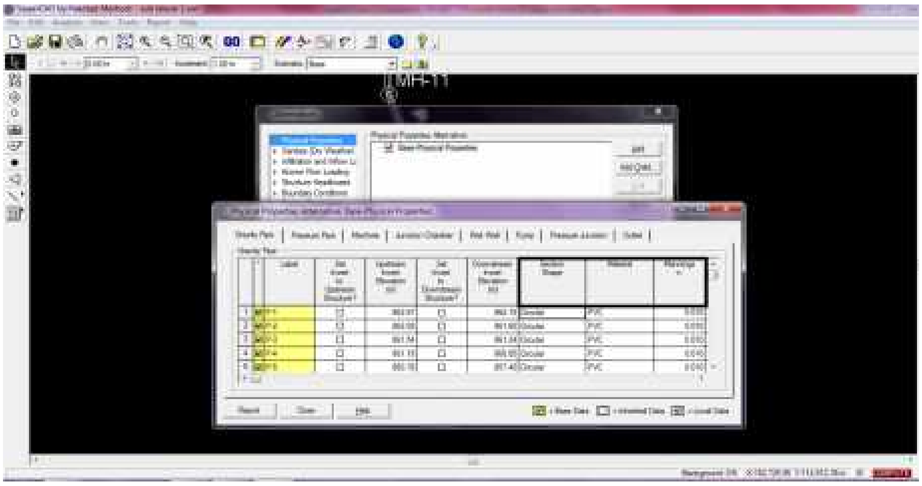


Figure 4.27: Editing Design Parameters – Part1.

- Select manhole to enter the ground elevations of manholes, then select outlet to enter its elevation. Then press close. Figure (4.28) below shows the step.

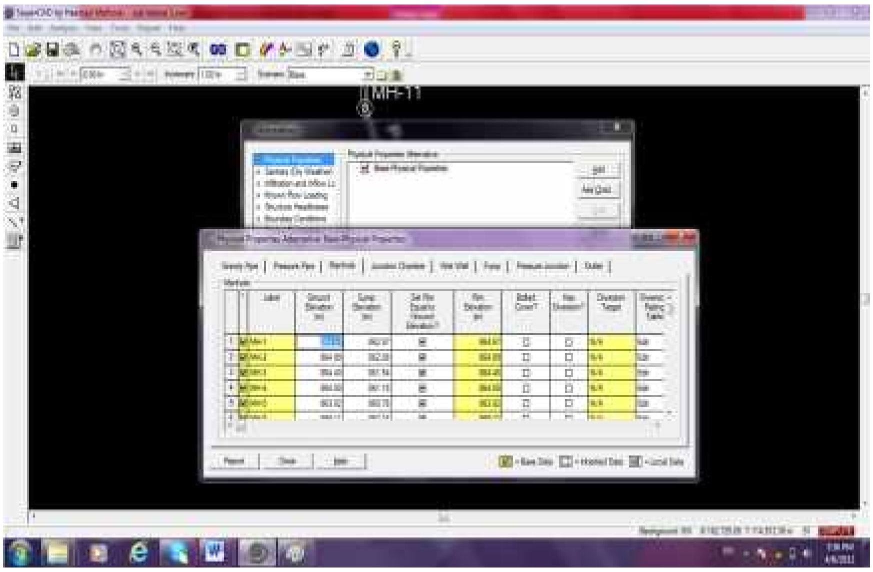


Figure 4.28: Editing Design Parameters– Part2.

- Select sanitary (dry weather) → edit → manhole to select the type of load and to enter the load for each manhole, figure (4.29) below shows the step.

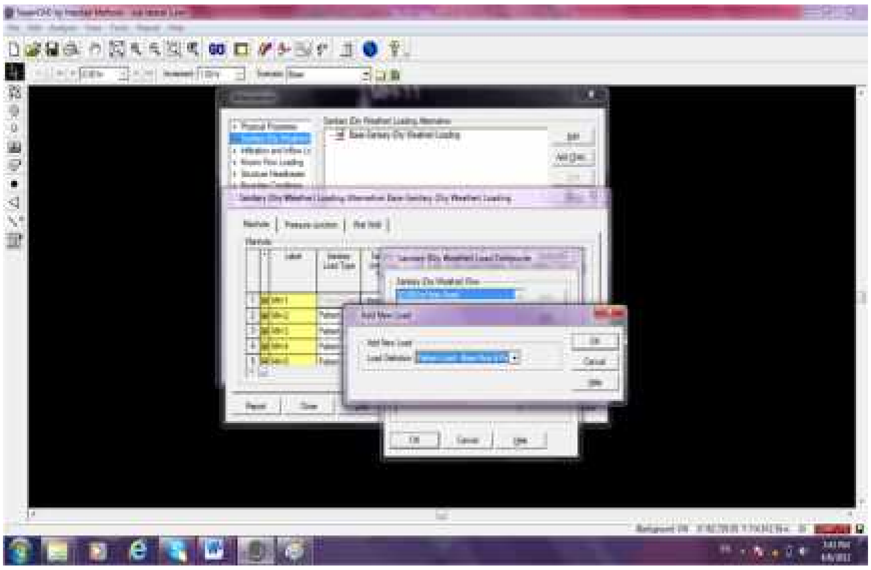


Figure 4.29: Editing Design Parameters– Part3.

- After doing this for each manhole press close, then select design constrains → edit to enter the design specifications, figure (4.30) below shows the step.

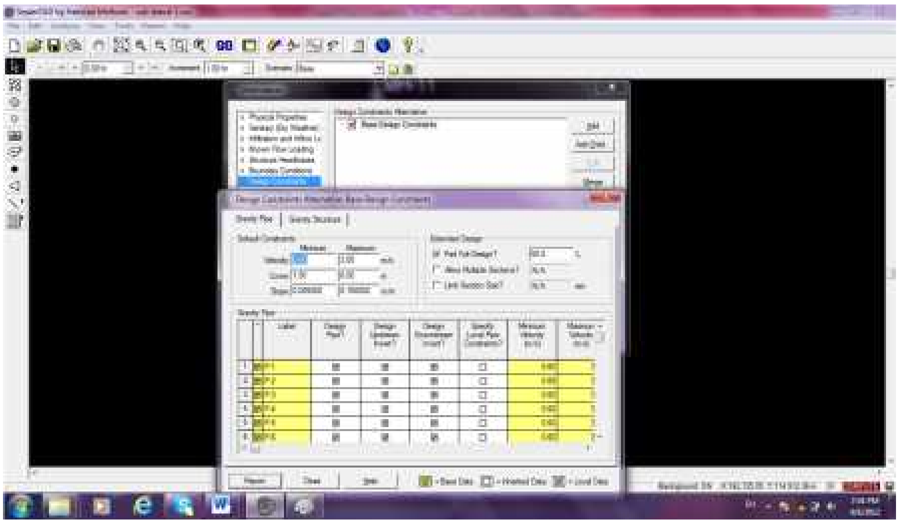


Figure 4.30: Editing Design Parameters– Part4.

- Last step press saves, press GO button to start design then press on GO, figure (4.31) below shows the step.

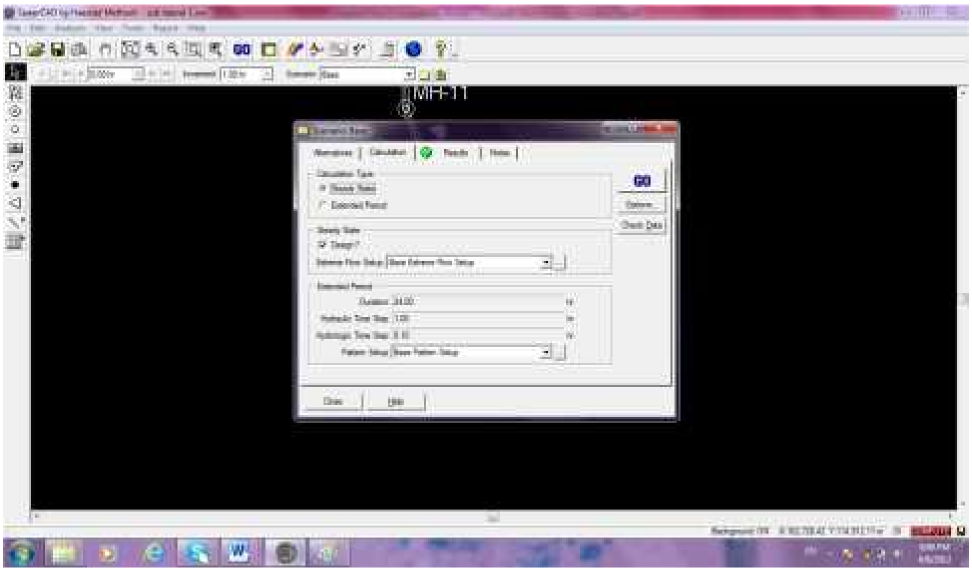


Figure 4.31: Checking The Design.

- 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.
- After finishing design work we need to show the pipe line profile and the profile, gravity pipe report and gravity node report. Press profile button to make the profile see figure (4.32), here we should put the scale of the profile.

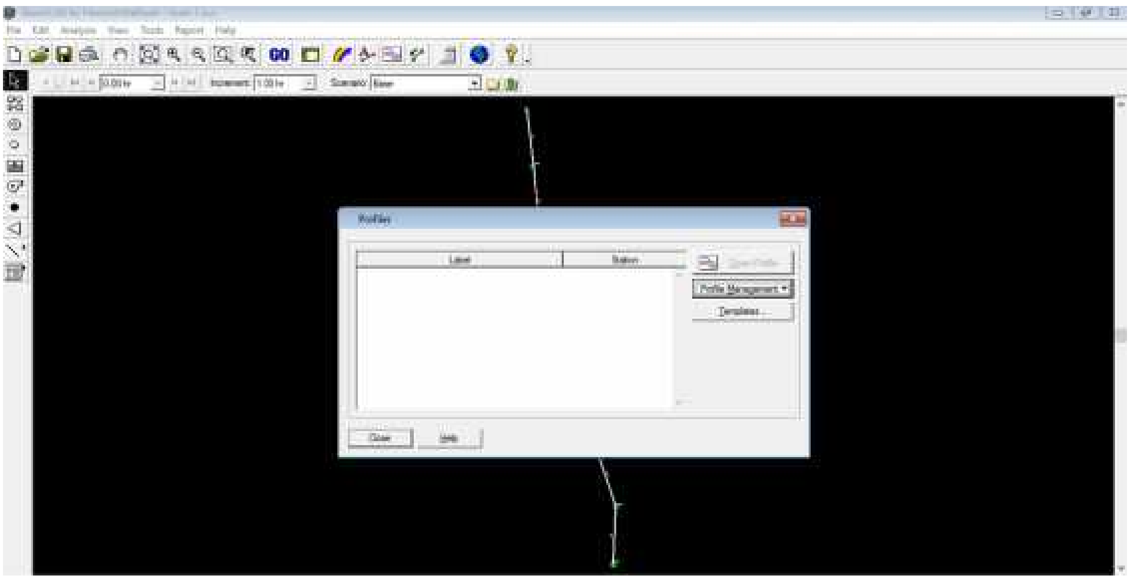


Figure 4.32): Creating Profile .

- We can get the required tables by pressing tabular report button see figure (4.33), and then choose gravity pipe report and gravity node report.

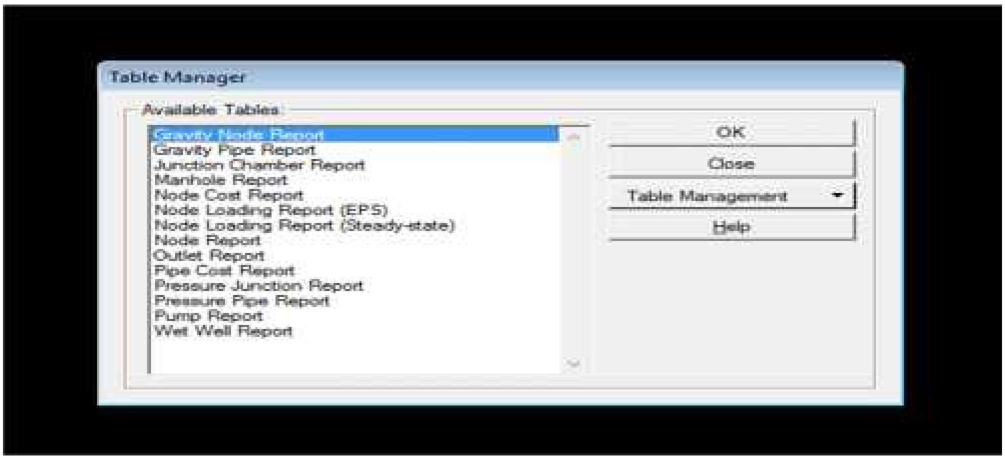


Figure 4.33: Creating Report .

- Sample calculation for pipes diameters, slope, velocities and profile are calculated using sewer cad it's shown on tables (4.2,4.3) and the profile drawing shown in figure (4.34).

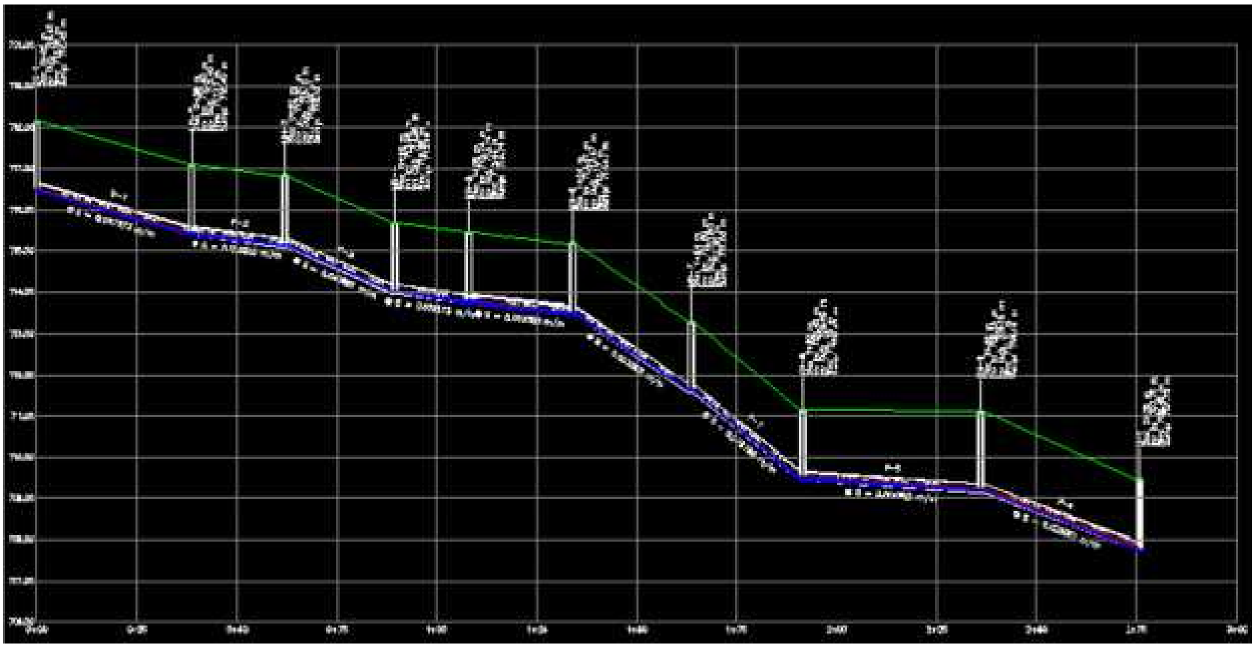


Figure 4.34: Show The Profile .

Table 4.2: Show the gravity node report

Gravity Node Report line main 1				
Label 1	Ground Elevation (m) 2	Structure Diameter (m) 3	Total Flow (m3/day) 4	Velocity in (m/s) 5
MH-1	715.1	1.2	41.8	0.34
MH-2	709.18	1.2	54.16	0.37
MH-3	705.85	1.2	204.96	0.52
MH-4	705.75	1.2	396.16	0.63
MH-5	704.78	1.2	424.01	0.64
MH-6	703.8	1.2	457.77	0.65
MH-7	703.53	1.2	898.07	0.8
MH-8	703.02	1.2	951.71	0.81
O-1	700.59		951.71	0

Table 4.3: Show the gravity pipe report

Gravity pipe Report Line main 1							
Label 1	Upstream Node 2	Down Stream Node 3	Section Shape 4	Section Size (mm) 5	Average Velocity (m/s) 6	Average Pipe Cover (m) 7	constructed slope (m3/day) 8
P-1	MH-1	MH-2	Circular	200 mm	0.6	1.62	0.031575
P-2	MH-2	MH-3	Circular	200 mm	0.89	1.62	0.046823
P-3	MH-3	MH-4	Circular	200 mm	1.52	1.5	0.075532
P-4	MH-4	MH-5	Circular	200 mm	1.11	1.5	0.025941
P-5	MH-5	MH-6	Circular	200 mm	1.11	1.5	0.02375
P-6	MH-6	MH-7	Circular	200 mm	2.17	1.5	0.106
P-7	MH-7	MH-8	Circular	200 mm	2.29	1.5	0.113861
P-8	MH-8	O-1	Circular	200 mm	2.29	1.5	0.09

4.2.5 Profiles

The profiles of sewer area assist in the design and are used as the basis of construction drawing. The profiles are usually prepared for each sewer line at a horizontal and vertical scale. The profiles show ground elevation or street surface, tentative manhole locations, elevation of important subsurface strata such as rock, locations of borings, all underground structures, basement elevations, and cross street. A plan of the line and relevant other structures are usually shown on the same street. Figure (4.35) show apart of line(sub_main#1) profile.

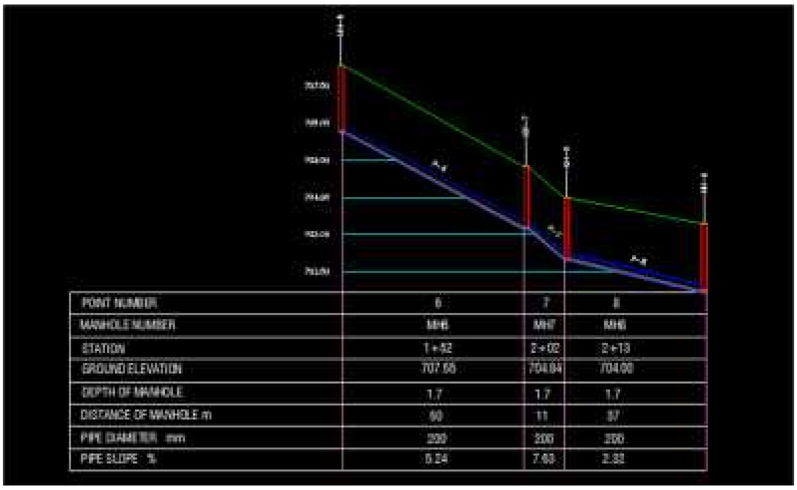


Figure 4.35: show apart of line(sub_main#1) profile .

CHAPTER FIVE

BILL OF QUANTITIES

5.1 Bill of quantity for the proposed wastewater

COLLECTION SYSTEM

No.	EXCAVATION	UNIT	QTY	UNIT PRICE		TOTAL PRICE	
				$	C	$	C
A1	Excavation of pipes trench in all kind of soil for one pipe diameter 8 inch depth and disposing of the debris and the top soil unsuitable for backfill outside the site	LM	**2716**				
Sub-Total							
B	**PIPE WORK**						
B1	Supplying, storing and installing of PVC	LM	**2716**				
Sub-Total							
C	**PIPE BEDDING AND BACKFILLING** **Dimension and material**						
C1	Supplying and embedment of sand for one pipe diameter 8 inch, depth up to 1.50 meter and disposing of the debris and the top soil unsuitable for backfill outside the site.	LM	**2716**				
Sub-Total							
D	**MANHOLES, Details according to the drawing**						

D1	Supplying and installing of precast manhole including excavation pipe connection, epoxy tar coating, 25-ton cast iron cover and backfill, size 200-1350mm, depth up to 2.00m for sewer .	NR	**71**				
D2	Supplying and installing of precastdrop manhole including excavation pipe connection, epoxy tar coating, 25-ton cast iron cover and backfill, size200-1350mm, depth up to 3.00m for sewer .	NR	**10**				
D2	Supplying and installing of precastdrop manhole including excavation pipe connection, epoxy tar coating, 25-ton cast iron cover and backfill, size200-1350mm, depth up to 3.00m for storm water.	NR	**0**				
Sub-Total							
E	**Concrete Surround**						
E1	Supplying and installing of reinforced concrete (B 200) protection concrete encasement for sewer pipe.	LM	**2716**				
Sub-Total							
F	**Air And Water Leakage Test**						

F1	Air leakage test for sewer pipe line: 8inch according to specifications, including for all temporary works.	LM	**2716**				
F2	Waterleakage tests for manholes, depth up to 2.00 meter according to specifications.	NR	**71**				
F3	Water leakage test for manholes , depth up to 3.00 meter according to specification	NR	**10**				
	Sub-Total						
G	**Survey work**						
G1	Topographical survey required for shop drawings and as built DWGS using absolute Elev. And coordinate system	LM	**2716**				

CHAPTER SIX

CONCLUSIONS And RECOMMENDATIONS

CONCLUSIONS:

In this project, the trial is done; make an assessment for Al-Samou' Down Town in addition to make a design for wastewater collection system for the coming 25 years. The main conclusions drawn from the present study are summarized below:

l. The condition in Al-Samou' Down Town is assessed in bad condition, an absence of sanitary systems.

2. Al-Samou' Down Town like other cities in Palestine has no sewage facilities. People using cesspits. The wastewater has been seeping into ground through the over flow of the deteriorated cesspits and latrines, causing series environmental and health problems.

3. The proposed wastewater system covered all of the areas of Al-Samou' Down Town and it's done by gravity.

4. Three main trunks, seven sub-main and one lateral are located on the layout
5. The roads in Al-Samou' Down Town is assessed in good condition.
6. There's no need for storm water collection system for Al-Samou' Down Town because of the existence topography.

RECOMMENDATIONS :

1-This study was done for Al-Samou' down town and we recommend to make complete study for all old cities in Palestine .

2-The people in old cities must take care of them .