SDSU-RSI-83-05

Land Classification/Soil Survey Project of the

SYRIAN ARAB REPUBLIC

VOLUME 4

Detailed Soil Survey of the Tartous Area
1:25,000 scale

October 1982

Prepared for

United States Agency for
International Development
and the
Syrian Arab Republic

Prepared by

Louis Berger International, Inc.
East Orange, New Jersey, U.S.A.

Remote Sensing Institute
South Dakota State University
Brookings, South Dakota , U.S.A.

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Ministry of Agriculture and Agrarian Reform
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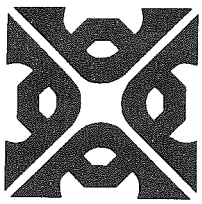

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FOREWORD

The Soil Survey of the Tartous-Safita area at the scale of 1:25,000 is one of the main objectives of the "Syria Land Classification/Soil Survey Project". It is one of the major soil studies undertaken in accordance with the guidelines put forward by the Grant Agreement between the Government of the Syrian Arab Republic (SARG) and the United States Agency for International Development (USAID), and according to the agreement reached during the subsequent annual meetings between all interested parties. This survey is a model study, the primary purpose of which is to establish procedures and criteria for the future semi-detailed soil surveys to be performed by the Directorate of Soils of the Ministry of Agriculture and Agrarian Reform.

The area chosen for this model study is in the northwestern part of Syria; one of the most important agricultural regions of the country. The reasons for selecting this particular area were mainly the presence of diverse geomorphic, geologic, and soil characteristics of the area, as well as the availability of the aerial photographs, topographic maps, and other natural resources information, and the accessibility. This survey shows how to classify, map, and describe the nature of soils with the particular attention to the interpretation of soils according to their physical and chemical properties.

In this study, the soils of the Tartous-Safita area are classified according to the new comprehensive soil classification system of the United States Department of Agriculture, which is now universally accepted. The soil mapping was done by the aid of black and white aerial photographs of approximately 1:40,000 scale. The final soil map was prepared by using the 1:25,000 scale topographic map as the base. Although the preliminary mapping of the entire survey area was done in the field, only one map sheet was prepared in final form due to the unavailability of the aerial photographs at the final stage of the project. This report, which accompanies the soil map of the Tartous-Safita area, presents descriptions and data on physical and climatic features of the survey area, and on the origins, mode of formation, classification, capabilities, and limitations of soils according to their physical and chemical properties.

This soil survey contains much information useful in any land-planning program in the Tartous area. Of prime importance are the predictions of soil behavior for selected land uses. Also important are limitations or hazards to land uses that are inherent in the soil, improvements needed to overcome these limitations, and the effect that selected land uses will have on the environment.

The soil survey has been prepared for many different users. Farmers and agronomists can use it to determine the potential of the soil and the management practices required for food and fiber production. Planners, community officials, engineers, and builders can use it to plan land use, select sites for

construction, develop soil resources, and identify special practices needed to insure the best performance. Conservationists, teachers, students and specialists in recreation, waste disposal and pollution control can use the soil survey to help them understand and protect the environment.

Great differences in soil properties can occur even within short distances. Soils may be seasonally wet or subject to flooding. They may be shallow to bedrock. They may be unstable when used as a foundation for buildings or roads. These and other soil properties that affect land use are described in this report. Broad areas of soils are shown on the general soil map and the locations of soils in more detail are shown on the 1:25,000 map. Each kind of soil is described and much information is given for each soil for specific uses.

HOW TO USE THIS SURVEY

The purpose of any soil survey is primarily to show the distribution of soil in a given area on maps. Individual soils are grouped together into "mapping units" according to their characteristics, properties and mode of formation. Soils found in one mapping unit are related to other soils by their characteristics, environment, evolution or by their position on a given landscape. Mapping units provide a practical approach to the evaluation of soils and their possible utilization. Soil surveys also assist other scientists and planners to select sites for construction, to develop soil resources and to identify special practices needed to insure the best use of the soil.

This soil survey covers the Tartous-Safita area and can be applied in managing farms, ranches, woodlands, grazing land and in judging the suitability of tracks of land for farming, industry and recreation.

All the soils of the Tartous area are shown on the detailed map. This map corresponds to one 1:25,000 scale topographic map titled Tartous. The detailed map outlines and identifies the soil areas by symbol. All areas are marked with the same symbol are the same kind of soil. The symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

The "Index to Mapping Units" can be used to find information. This index lists all the soils of the survey area in alphabetical order and shows the page where each soil is described.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Following is the step by step procedure to show the user how to obtain all the necessary information on a given area:

1. Locate your area of interest on the soil map.

2. List the map unit symbols that are in your area.

3. Turn to "Index to Map Units" which lists the name of each map unit and the page where the map unit is described.

4. See "List of Tables" for location of additional data on a specific soil use.

5. Consult "Table of Contents" for parts of the publication that will meet your specific needs.

This survey contains useful information for many different users. Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the capability units. Engineers and builders can find, under "Engineering" and "Soil Properties" tables that contain analytical data, estimates of soil properties and information about soil features that affect engineering practices. Scientists and others can read about how the soils formed and how they are classified in the section titled "Formation and Classification of Soils". Other users may be interested in the section titled "General Soil Map" where broad patterns of soils are described. They may also be interested in the information about the area given in the section titled "General Nature of the Tartous-Safita Area".

VOLUME 4

Detailed Soil Survey of the Tartous Area
1:25,000 scale

SOIL SURVEY OF THE TARTOUS-SAFITA AREA *

(1:25,000 SCALE)

The survey area is in the northwestern part of Syria (Figure 4-1) which covers two 1:25,000 scale topographic map sheets, namely Tartous and Safita. The area is located between 34 45' 00'' and 34 52' 30'' N latitude, and 35 52' 0'' and 36 07' 30'' E longitude. The western side is the Mediterranean Sea.

The survey area covers 272 square kilometers or 27,200 hectares of land. According to the 1981 estimates, the population is 182,100. Tartous and Safita are the two major towns in the survey area with the population of 82,784 and 68,810, respectively. Other important towns and villages are Yazidiyeh, Beit Sheikh el Younes, Bamra, Tarkoub, Beit Khammouni, Yahmour, and Mintar.

About 84 percent of the survey area is cropland, out of which 11 percent is irrigated. About 10 percent is rangeland and pastures, and 6 percent is under forest and low bush. Vegetables, legumes, fruits, citrus, and olives are the main crops. Livestock and livestock products are also a main income source.

1 GENERAL NATURE OF THE SURVEY AREA

This section gives general information concerning the survey area. It describes climate, physiography, natural vegetation, and sociological and economic features of the area.

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1.1 CLIMATE

Mediterranean climate prevails in the Tartous-Safita area. It is characterized by a rainy winter and a hot dry summer. The two transitional seasons are short. December and January are the coldest months, and July and August are the hottest. Annual precipitation is irregular. Total annual rainfall is normally adequate for most of the crops grown in the region. Tables 4-1 and 4-2 give data on temperature, precipitation, relative humidity, and evaporation for the Tartous and Safita regions, respectively.

The average yearly temperature is 19.7 °C for the Tartous area. The average daily minimum is 15.4 °C and the average daily maximum is 23.6 °C. The coldest months are January and February with an average temperature of 9.1 °C, and the hottest month is August with an average temperature of 30.2 °C. The lowest temperature on record is -1 °C in January and the highest is 41 °C in June. For the Safita region, the yearly temperature is 18.2 °C. The average daily minimum is 14.2 °C, and the average daily maximum is 22.4 °C. The coldest month is January with an average temperature of 9.7 °C and the hottest month is August with an average temperature of 30.1 °C. The lowest temperature on record is -3.7 °C in January, and the highest temperature is 40.8 °C in June.

The annual precipitation is 862 mm in the Tartous area and 1,112 mm in the Safita area, all of which occurs as rainfall. The highest precipitation is received in December and January. The driest period is May through September in both areas. Almost 95 percent of the total precipitation is received between November and April.

The average relative humidity in midafternoon is about 62 and 67 percent in Safita and Tartous, respectively. Its distribution is relatively regular throughout the year. The lowest amount of humidity occurs in November and the highest in July and August.

The potential water loss from soils and crops is indicated by the loss of water from an evaporation pan. The total annual evaporation for the Tartous area is 1425 mm, and for the Safita area is 1346 mm. The lowest evaporation occurs between December and March, and the highest in September and October. An average of about 600 mm evaporates during the growing season. The water loss during this period greatly exceeds the rainfall.

Figures 4-2 and 4-3 give the average rainfall, mean monthly air temperatures, and mean monthly evaporation for Tartous and Safita, respectively.

1.2 PHYSIOGRAPHY AND RELIEF

The Tartous-Safita area is in two major physiographic regions. It is dominantly in the Jebel Ansariyeh range, but a few areas in the western part is on the marine aggradation plains. The generalized physiographic and relief features of the survey area are shown in Figure 4-4. The generalized geology for the survey area is shown in Figure 4-5.

The Jebel Ansariyeh range covers the eastern part of the area near Safita. It is formed generally by block structures, characterized by hilly and low

mountainous relief. This relief is typically represented by transverse, mostly V-shaped, deeply cut valleys, and gently undulating to rolling, slightly terraced summits. This part can be divided into two major sections. The first section is found at the altitude of 250 to 300 meters, and the second at the altitude of 450 to 500 meters near Safita. In places where the limestone is fractured, a karst relief was developed, represented mainly by small and shallow sinkholes. The valleys are characterized by narrow bottoms and steep side slopes. The valley sides flatten out to some degree at the footslopes, due to the accumulation of slopewash deposits. Recent talus and alluvial fan deposits are also found in these areas. The longitudinal profiles of the valleys are characterized by a considerable slope which greatly intensifies the riverbed erosion process. The depth of the valleys increases upstream, ranging from 50 to 250 meters. Aggradation in the river valleys is observed only in the lower portion of the valleys, and in the foothills where low alluvial terraces and narrow floodplains can be seen. The majority of these formations are very gravelly on the surface and throughout the soil profile.

The marine aggradation plains occupy only a small portion of the survey area near Tartous. They extend as a narrow band along the Mediterranean Sea, and are bounded in the east by the foothills of the western slope of the Ansariyeh Mountains. They are characterized by a slightly dissected surface which is terraced in places. The relative height of such terraces increases towards the west. Slopes are gentle and are generally towards the sea. The greater part of the plain consists of Quaternary terraces, which, nearer to its eastern edge, are buried under the Quaternary deposits. The higher marine terraces extend beyond the marine plains, and are seen only in the western foothills of the Ansariyeh Mountains as small, slightly sloping surfaces. The relative height of the plains ranges from sea level to 50 meters. A very narrow marine beach extends between the Mediterranean Sea and the marine aggradation plains.

1.3 NATURAL VEGETATION

The survey area includes the Mediterranean Cedar and Alpine plant zones. It can support non-irrigated crops successfully, although much of the area is either too steep or too rocky for farming. While the forests are state-owned, non-irrigated crops are grown on privately owned lands in the foothills and narrow valleys. Tree crops are common, including fruits, nuts, citrus, and olives. Cereals and vegetables are grown among the fruit and nut trees, and on separate small fields. Crop residues provide grazing for local livestock following harvest. The natural grazing lands are found generally on steep slopes where soils are thin and stony.

The natural vegetation of the survey area is characterized by lower stages of the forests of subhumid climates. The dominant type is a degraded oak forest (Quercus calliprinos and infectoria, Pyria, Fraximus spp., Amygdalus, Cenatonia, and Graminaceae).

1.4 SOCIOLOGICAL FEATURES OF THE AREA

1.4.1 SETTLEMENT AND POPULATION

Tartous and Safita are among the oldest towns in Syria. Tartous was established during the Roman Empire, and prospered throughout the Muawiyeh and Ottoman period. The Crusaders were also in this area between 1097 and 1144. The castle and the cathedral built during that period are still a point of interest.

Today, modern Tartous is a continuously progressive town with a population of 82,784. It has the biggest port in the country, which handles most of the national import and export cargo. The cement factory, which has just recently started production, is among the most important industrial complexes in Syria. Safita is the second major town in the survey area with a population of 68,810.

1.4.2 EDUCATION

The school system in the survey area consists of tuition-free public schools. Schooling is divided into six years of compulsory primary education, three years of upper secondary education, and three years of lower secondary (preparatory) education. The upper secondary education offers academic courses and prepares for university entrance. The survey area is being served by two main school districts. The Tartous area has 127 elementary schools, 17 lower secondary schools, and 13 upper secondary schools. The Safita area has 93 elementary, 18 preparatory, and 10 upper secondary schools. According to the 1981 figures, 148,474 students attend the primary schools, 55,865 attend the preparatory schools, and 22,990 attend the upper secondary schools in both districts. In addition, there is a private school in Tartous for the preparatory and upper secondary education.

The trade school in Tartous provides lower and upper secondary education and prepares students for carpentry, electronics, auto repair, and welding.

1.4.3 HEALTH

The Tartous General Hospital with 169 beds is located within the survey area. In addition, there are many local clinics and health centers distributed throughout the survey area, the most important of which is in Safita. There is also a private hospital in Tartous. There are many private clinics and laboratories, located mostly in Tartous. The nursing school has just been completed and started its first year of education. An additional hospital is presently under construction, and scheduled to be completed in 1984.

1.4.4 ELECTRIFICATION

Since 1970, an extensive electrification program has been carried out to bring electricity to almost every village and town in the survey area. Today, all rural villages with at least a population of 100 has electricity. The power is provided from the Euphrates hydroelectric site. It is quite stable and highly reliable.

1.4.5 COMMUNICATIONS

Domestic telephone service is good and connection to the rest of the country and the world is reliable. Postal services are handled by the General Directorate of the P.T.T. (Post-Telegram-Telephone). It has main centers in Tartous and Safita, and local offices in most of the major towns and villages throughout the survey area. Local and international calls are usually made at local post office centers, but automatic dialing is available in Tartous for local and international calls.

1.5 ECONOMIC FEATURES

1.5.1 INDUSTRIES

Manufacturing and handicrafts are the main income source along with agriculture. Development of industry is based primarily on processing agricultural products because the area has few other natural resources. There are a few olive-pressing mills which operate only a few months a year. Local auto repair shops and small welding shops are numerous. There are many flour mills and peanut processing plants, distributed throughout the survey area. The most important addition to the economy, however, is the cement factory located just a short distance from Tartous. It is the biggest factory of its kind in Syria and has just begun operation.

1.5.2 TRANSPORTATION

The survey area is connected to the main population and economic areas of the country by various forms of transport. The majority of the freight and passenger transport, however, is provided by trucks and buses on the highways. The main Lattakia-Homs highway traverses the survey area and provides the main link between the survey area and the rest of Syria. This is a two-lane, paved highway, and is barely adequate for the recently increased traffic. A new four-lane highway, which will connect the coastal cities and ports to the inland, is under construction. A network of secondary roads, which are also mostly paved, provide access to most of the small villages and towns. In addition, there are many all-weather, gravel and earth surface roads to the farms and fields.

Of the three ports in Syria which serve domestic and transit trade, Tartous is the most important. Opened in 1965, it now handles over 2.5 million tons of cargo each year, excluding oil. It handles mostly general cargo imports, Syrian export of phosphates and crude oil. The standard gauge Northern railway provides the freight services between the survey area and the inland. No commercial airline service is available in the survey area.

1.5.3 AGRICULTURE

Farming is the main occupation in the Tartous-Safita area. Approximately 84 percent of the survey area is cropland, out of which 11 percent is irrigated. The irrigated lands are mostly in the Tartous area. Private wells are the main source for irrigation water. About 10 percent of the area is used as rangeland, of which 7 percent is mostly very steep, highly eroded, rocky sideslopes. Approximately 6 percent of the area is under natural forest and low bush.

The main crops grown in the survey area include vegetables, legumes, grains, fruits and nuts, citrus, and olives. Cash crops, like tobacco, are also grown in small scale. Vegetables include cucurbits (melons, squash, etc.), solaneceae crops (tomatoes, eggplants, etc.), cauliflowers, green peppers, and okra. They are grown mostly on non-irrigated fields, but irrigated fields are also common, especially in the Tartous area. Legumes include chick peas, haricot beans, and

vetches. Small grains include mostly wheat and barley. Tuber/bulb crops are onions, potatoes, and garlic. Oil crops are also grown, which include peanuts, sesame, and sunflower. Apples, pears, peaches, apricots, figs, and grapes are the main fruits of the region. Olives are one of the main income sources, especially in the Safita area. According to the 1979 estimates, the yield was over 20,000 tons. Citrus is another important crop, grown mostly in the Tartous area on irrigated orchards. According to the 1979 figures, the yield was close to 10,000 tons for all the citrus crops.

Fertilizers are used mostly for orchards and vegetables. In 1981, almost 3,900 tons of nitrogen, 1,000 tons of phosphates (as P2O5), 330 tons of potassium, and 950 tons of compound fertilizers were applied for crops, out of which over 80 percent was used during spring or early summer. Fertilizers are also used heavily for fruit trees. In 1981, about 1,500 tons of nitrogen, 400 tons of phosphorus, 200 tons of potassium and 200 tons of compound fertilizers were used for orchards.

Most of the cultivated fields are under rotation. Currently the method being used is to plant half of the field with potatoes, wheat, cucumber, and squash, followed by peanuts or autumn potatoes while the other half is planted with vegetables, lentils, corn, and tuber/bulb crops, followed by autumn tomatoes, cucumber, vegetables, and potatoes. According to the local agricultural extension offices, however, the recommended rotation is to plant half of the field in wheat, corn, oats, then peanuts; and the second half in legumes followed by summer and winter vegetables, potatoes, and corn. In the mountainous areas, it is suggested to plant one-third of the land in barley, wheat, and oats; one-third in legumes and lentils; and one-third in millet, corn, spring potatoes, and vegetables.

In 1980, the estimated number of livestock in the Tartous-Safita area included 15,850 milk cows, 6,500 non-milk cows, 10,700 calves, 3,600 oxen, 12,700 sheep, and 7,000 goats. Meat products produced were about 1,100 tons, out of which only about 100 tons were imported. Total milk products reached about 14,000 tons, which included cheese, butter, and yogurt. The total wool production was about 40 tons.

2 HOW THIS SURVEY WAS MADE

This soil survey was done to learn what kinds of soil are in the Tartous-Safita area, where they are, and how they can be used. The soil scientists went into the area knowing they likely would locate many soils they already knew something about and perhaps identify some they had never seen before. They observed steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of plants and crops grown in the area; the kinds of rock; and many other facts about the soils. They dug many holes to expose soil profiles in order to study the soil characteristics. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material, which has been changed very little by leaching or by the action of plant roots.

The soil scientists recorded the characteristics of the profiles they studied, and compared those profiles with others in the area nearby and in places

more distant. Thus, through correlation, they classified and named the soils.

After a guide for classifying and naming the soils was worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. These photographs show woodlands, buildings, field boundaries, roads and other details that help in drawing boundaries accurately. The soil map at the back of this report was prepared from aerial photographs.

The areas shown on a soil map are called soil map units. Some map units are made up of one kind of soil, others are made up of two or more kinds of soil, and a few have little or no soil material. Map units are discussed in the sections "General Soil Map for Broad Land Use Planning " and "Soil Maps for Detailed Planning".

While this soil survey was in progress samples of soils were taken as needed for laboratory measurements to determine physical and chemical characteristics of soils. The soils were examined in the field, and interpretations of their behavior are modified as necessary during the course of the survey. New interpretations were added to meet local needs, mainly through field observations of different kinds of soil in different uses under different levels of management. Also data were assembled from other sources, such as previous soil surveys in the area, test results, records, field experience, and information available from specialists which is related to the soil survey work in the area. Data were also collected and assembled for climate, geology, geomorphology and other important features of the area that affect soil formation.

Only part of a soil survey is done, however, when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it is readily available to different groups of users, among them farmers, engineers, agronomists, planners, developers and builders, home buyers and those seeking recreation.

3 GENERAL SOIL MAP FOR BROAD LAND USE PLANNING

The general soil map at the back of this report (Figure 4-6) shows map units that have a distinct pattern of soils and of relief and drainage. Each map unit is a unique natural landscape. Typically, a map unit consists of one or more of the major soils and some minor soils. It is named for major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map provides a broad perspective of the soils and landscapes in the survey area. It provides a basis for comparing the potential of large areas for general types of land use. Areas that are, for the most part, suited to certain types of farming or to other land use can be identified on the map. Likewise, areas of soils having properties that are distinctly unfavorable for certain land use can be located.

The map does not show the kind of soil at a specific site because of its small scale. Thus, it is not suitable for planning the management of a farm or field or for selecting a site for a road, building or other structure. The kinds of soil in any one map unit differ from place to place in slope, depth,

stoniness, drainage and other characteristics that affect their management.

The units on the general soil map of the Tartous area are described on the pages that follow.

3.1 ARIDA-MINTAR-BASSA ASSOCIATION: Deep, nearly level to gently rolling, excessively drained sandy soils on marine beaches.

This map unit is on a marine aggradation plain that has been reworked by water and wind and has a sandy profile throughout. It is characterized by gentle slopes on marine sand, and isolated individual very low eroded hills on weakly consolidated material. Slopes are long and concave on the marine plain and very short and convex on the isolated hills. The drainage pattern generally is poorly defined, but it is well defined in the areas near the highly eroded hills. Rare flooding occurs in areas close to the drainageways.

This map unit covers approximately 1400 ha of land and makes up about 5.2 percent of the survey area. It is about 40 percent Arida soils, 30 percent Mintar soils, 10 percent Bassa soils, and 20 percent minor soils.

Arida soils are excessively drained and are on level to gently undulating beaches along the Mediterranean coast. Slopes range from 0 to 5 percent. Typically the surface layer is light brownish gray sand. The subsoil and the underlying material is gray to light gray sand.

Mintar soils are deep, excessively drained and are on level to gently undulating marine aggradation plains. Slopes range from 0 to 5 percent. Typically, the surface layer is dark brown to brown sand. The subsoil and the underlying material are yellowish brown to pale brown sand. These soils have a somewhat higher water holding capacity than the Arida soils.

Bassa soils are very shallow, are excessively drained and are on gently rolling to rolling low eroded hills. Slopes range from 5 to 45 percent. Typically, the surface layer is brown to dark brown sandy loam. The weakly consolidated sedimentary rock usually is within 20 cm of the surface.

Minor in this map unit are Tartous, El Hishi, Yahmour and Jaferiyeh soils. Tartous and El Hishi soils are well drained and moderately fine to fine textured. They are on gently undulating plains. Yahmour and Jaferiyeh soils are in drainageways. Yahmour soils are very gravelly and Jaferiyeh soils are fine to moderately fine textured.

Permeability is very rapid throughout the profile in Arida and Mintar soils. Available water holding capacity is very low, but Mintar soil has a somewhat higher moisture content due to fine sand in the profile. Fertility is low in Mintar soils and very low in Arida and Bassa soils.

Only some of the Mintar soils are used for irrigated crops. Arida soils generally are barren and subject to overblowing. Mintar soils are used for rangeland. Conserving moisture, maintaining fertility, and controlling soil blowing are the main management concerns. The major problems of range management are to control the blowing soil and to protect

the present vegetative cover. Because these soils are droughty, reestablishing vegetation is difficult in overgrazed areas.

This map unit has little or no potential for crops. Only the Mintar soils have some potential for tree crops and rangeland. Arida and Bassa soils have severe limitations for building sites and recreational developments. The Mintar soil is fairly well suited for building sites and water management practices.

3.2 TARTOUS-EL HISHI ASSOCIATION: Deep, nearly level to gently rolling, well drained clayey soils of marine aggradation plains.

This map unit is on a slightly elevated marine aggradation plain. It is characterized by gentle slopes and enclosed depressions in some areas. Most soils have a fine loamy mantle over clayey material. Slopes generally are gentle, long, and concave. The drainage pattern generally is poorly defined, but it is well defined in the areas where entrenched drainageways occur. Rare flooding occurs in low lying areas and in drainageways in winter or in early spring.

This map unit covers approximately 3480 ha of land and makes up about 12.7 percent of the survey area. It is about 50 percent Tartous soils, 20 percent El Hishi soils and 30 percent minor soils.

Tartous soils are well drained and are on level to gently undulating plains. Slopes range from 0 to 5 percent. Typically the surface layer is dark reddish brown to reddish brown clay loam. The subsoil is reddish brown clay. It has some angular limestone fragments. The underlying material is reddish brown to yellowish red clay.

El Hishi soils are well drained and are on level to gently undulating plains. Slopes range from 0 to 5 percent. Typically the surface layer is very dark gray clay loam. The subsoil is very dark grayish brown clay. The underlying material is dark brown to yellowish brown clay.

Minor in this map unit are Mintar, Bassa, Semka, Kilmaho, Beit Khammouni and Kissara soils. Excessively drained sandy Mintar soil is in transitional areas to the marine beaches. Bassa soils are shallow and are found on small, isolated, low, eroded hills. Semka and Kilmaho soils are well drained reddish clay soils on limestone. Beit Khammouni soils are well drained reddish fine loamy soils on limestone. They are on gently undulating to rolling plains. Kissara soils are imperfectly to poorly drained clayey soils in small isolated depressions.

Permeability is moderately slow in Tartous soils, and is slow in El Hishi soils. Available water holding capacity is high. Fertility is moderate. Runoff is slow. The water erosion hazard is low and the wind erosion hazard is very low in both soils.

Most of this map unit is used extensively for rainfed and irrigated crops. Few areas are used as rangeland. The main concerns of management are providing an adequate surface drainage system, removing excess water from the El Hishi soils, maintaining fertility, to provide good tilth and

avoid puddling, and controlling erosion in sloping areas.

Tartous and El Hishi soils are highly suitable to irrigated and rainfed agriculture. They have few limitations for crops that are climatically adapted to the region. They have good potential for tree crops and rangeland. They have no limitations for building site development, and for recreational and sanitary facilities. They are highly suitable for water management practices. They are a poor source for construction material because of excess clay.

3.3 KILMAHO-EL BOUSTAN-BMALKEH ASSOCIATION: Moderately deep to shallow, steep to very steep, well to moderately excessively drained loamy and clayey stony soils on uplands.

This map unit is on rolling plains and footslopes of the Ansariyeh mountain range. It is a transitional area from the mountainous landscape to the gently undulating to rolling Tartous plains. It is dissected by many well defined drainageways. Narrow bottomland and terraces are along the drainageways. Slopes are generally long and convex. The unit generally is very gravelly and stony throughout.

This map unit covers approximately 5790 ha of land and makes up about 21.8 percent of the survey area. It is about 40 percent Kilmaho soils, 30 percent El Boustan soils, 10 percent Bmalkeh soils and 20 percent minor soils.

Kilmaho soils are deep, and well drained, and are on undulating to rolling plains. Slopes range from 5 to 15 percent. Typically the surface layer is dark grayish brown to dark yellowish brown clay loam. The subsoil is dark brown to dark yellowish brown clay. It has a few angular limestone fragments. The underlying material is yellowish brown clay. It contains many angular limestone fragments.

El Boustan soils are moderately deep and well drained, and are on the shoulders and backslopes of the low hills adjacent to the Ansariyeh mountain system. Slopes range from 30 to 50 percent. Typically the surface layer is very dark gray loam. The subsoil is dark grayish brown clay loam. The underlying material is dark yellowish brown clay loam. It contains many angular limestone fragments. The bedrock usually is between 50 to 100 cm of the surface. They have very gravelly and stony surfaces.

Bmalkeh soils are shallow and moderately excessively drained, and are on steep side slopes of low eroded hills. Slopes range from 30 to 75 percent and more. Typically the surface layer is dark brown gravelly clay. The subsoil is dark yellowish brown to dark brown clay. The bedrock generally is found within 50 cm of the surface. They are very gravelly and stony on the surface.

Minor in this map unit are Besmakah, Drykish, Kansebba, El Keshfi, Kadmous, Jozeriyeh and Sinn soils. The dark colored, excessively drained Besmakah soils are extremely gravelly and are on footslopes. Drykish and Kansebba soils are shallow to very shallow and are excessively drained. El Keshfi soils are developed in colluvium and have extremely gravelly subsoil.

Jozeriyeh and Kadmous soils are extremely gravelly on the surface and throughout the profile. The well drained Sinn soils have a subsoil of reddish clay.

Permeability is moderate in Kilmaho and Bmalkeh soils and slow in El Boustan soils. Available water holding capacity is moderate. Fertility is moderate in Kilmaho soils and low to very low in El Boustan and Bmalkeh soils. Runoff is rapid to very rapid. The water erosion hazard is very high and the wind erosion hazard is low in all of the soils.

Some of this map unit is used for rainfed agriculture but the yields are low. Most areas are terraced and used for orchards, particularly for olives. A few are used as rangeland. Kilmaho soils have some potential for crops and good potential for tree crops and rangeland. El Boustan and Bmalkeh soils are not suitable for crops due to steep slopes, shallow profile to bedrock, and extreme stoniness. They have some potential for tree crops and rangeland. Maintaining an adequate vegetative cover, maintaining fertility and controlling erosion are the main concerns of management.

Kilmaho soils have good potential for recreational facilities. They have moderate to severe limitations for building sites and water management practices due to steep slope and excessive fines. El Boustan and Bmalkeh soils are too steep and shallow for building sites, recreational facilities, and water management practices.

3.4 DRYKISH-KANSEBBA-EL BOUSTAN ASSOCIATION: Shallow to very shallow, very steep to mountainous, excessively drained loamy soils on uplands.

This map unit is on very steep to mountainous landscape of the southern Ansariyeh range. It is dissected by many well defined drainageways. Narrow bottom lands and terraces are along the drainageways. Slopes are generally long and convex. Limestone boulders and rock outcrops are on the surface throughout much of the map unit.

This map unit covers approximately 11,700 ha of land and makes up about 42.4 percent of the survey area. It is about 40 percent Drykish soils, 20 percent Kansebba soils, 20 percent El Boustan soils and 20 percent minor soils.

Drykish soils are shallow, somewhat excessively drained, and are on crests and steep shoulders of high hills and low mountains. Slopes range from 15 to 30 percent. Typically, the surface layer is very dark grayish brown clay. The subsoil is grayish brown, very firm clay. The bedrock is found within 50 cm of the surface. The surface is very gravelly and marked with many limestone outcrops.

Kansebba soils are very shallow and excessively drained, and are on very steep shoulders and backslopes of medium-height mountains. Slopes are usually more than 75 percent. Typically, the surface layer is dark grayish brown clay loam. The bedrock is generally within 20 cm of the surface. These soils are extremely stony and rocky.

El Boustan soils are moderately deep and well drained, and are on steep shoulders and backslopes of high hills. Slopes range from 5 to 30 percent. Typically, the surface layer is very dark gray loam. The subsoil is dark grayish brown, firm clay loam. The underlying material is dark yellowish brown clay loam and clay with many angular limestone gravel. The bedrock is usually within 1 m of the surface. These soils are very gravelly and stony.

Minor in this map unit are Bmalkeh, Reyhaniyeh, Beit Khammouni, Sinn, Kadmous and El Keshfi soils. Bmalkeh soils are similar to Drykish soils, but have well developed horizons. Reyhaniyeh and Beit Khammouni soils are deep and are on gently undulating crests. Reyhaniyeh soils are brown and moderately fine textured. Beit Khammouni soils are red to reddish brown and fine textured. Sinn soils are on steep footslopes. They are fine textured and gravelly. Kadmous and El Keshfi soils are very gravelly and stony throughout their profile. They are on steep footslopes of high hills.

Permeability is slow in Drykish and El Boustan soils, and moderate to rapid in Kansebba soils. Available water holding capacity is low in Drykish and Kansebba soils and moderate in El Boustan soils. Fertility is medium in El Boustan soils and low to very low in Drykish and Kansebba soils.

Most of this map unit is terraced and used for rainfed agriculture. Olives and wheat are the main crops. Some of the steeper areas bordering the larger creeks and drainageways support native grass and are used as rangeland. Controlling erosion, maintaining fertility and conserving moisture are the main management concerns.

This map unit has severe limitations for crops due to steep slopes. It has some potential for rangeland, but overgrazing should be avoided on steep slopes to maintain the natural vegetation. All of the soils in this unit have severe limitations for recreational and building site development, sanitary facilities and water management practices, due to steep slopes and shallow and stony profiles. They are a poor source for construction material.

3.5 BAHLULIYEH-BAMRA-YAZIDIYEH ASSOCIATION: Shallow to moderately deep, rolling to very steep, well to moderately excessively drained, loamy soils on uplands.

This map unit is on very steep to hilly landscape near the town of Yazidiyeh, southwest of Safita. It is dissected by many well defined drainageways. Narrow bottom land and terraces are along the drainageways. Slopes are generally long and slightly convex. Scattered limestone boulders and marl outcrops are on the surface throughout much of the map unit.

This map unit covers approximately 1460 ha of land and makes about 9.1 percent of the survey area. It is about 30 percent Bahluliyeh soils, 20 percent Bamra soils, 20 percent Yazidiyeh soils and 30 percent minor soils.

Bahluliyeh soils are shallow and well drained, and are on rolling to steep crests and shoulders of high hills. Slopes range from 15 to 50 percent. Typically, the surface layer is grayish brown clay loam. The subsoil is brown, firm clay loam. The bedrock is usually within 50 cm of the surface. They are gravelly on the surface.

Bamra soils are moderately deep and well drained. They are on undulating to rolling crests and shoulders of high hills. Slopes range from 5 to 15 percent. Typically, the surface layer is dark brown clay loam. The subsoil is dark grayish brown, firm clay loam. The underlying material is brown, very gravelly loam. The bedrock is usually found within 1 m of the surface.

Yazidiyeh soils are deep and well drained. They are on gently undulating to rolling crests. Slopes range from 5 to 15 percent. Typically, the surface layer is grayish brown clay. The subsoil is yellowish brown, firm silty clay loam and clay loam. The underlying material is dark yellowish brown to yellowish brown, firm clay loam.

Minor in this map unit are Bamra, Kferiyeh, Jozeriyeh, El Keshfi, and Yahmour soils. Moderately deep, well drained Bamra soils are usually associated with Yazidiyeh soils, and are on gently undulating to rolling crests. Kferiyeh, Jozeriyeh and El Keshfi soils are on gravelly colluvium, and are found on steep footslopes of high hills. Kferiyeh soils are deep, well drained and have less gravel than the Jozeriyeh and El Keshfi soils. Jozeriyeh soils are excessively drained, and are extremely gravelly throughout the profile. Yahmour soils are on narrow floodplains and terraces of the drainageways. They are extremely gravelly throughout, and are excessively drained.

Permeability is moderately rapid in Bahluliyeh soils, moderate in Yazidiyeh soils and moderately slow in Bamra soils. Available water holding capacity is moderate in Bamra and Yazidiyeh soils and low in Baluliyeh soils. Fertility is moderate in Bamra and Yazidiyeh soils and low in Bahluliyeh soils. The water erosion hazard is high to very high in all major soils.

Most of the map unit is terraced and used for olives and rainfed wheat. Some of the steeper areas bordering the larger creeks and drainageways support native grass and are used as rangeland. Controlling erosion, maintaining fertility and conserving moisture are the main concerns of management if the major soils are continued to be used for crops.

This map unit generally has a low potential for crops, except Yazidiyeh soils which have medium to high potential for most of the crops that are adapted to the region. Bamra soils can also be cultivated successfully if erosion control measures are taken. All major soils have good potential for rangeland, but overgrazing should be avoided to conserve the natural vegetation thus to prevent accelerated water erosion. The Bamra and Yazidiyeh soils have moderate potential for building sites while Bahluliyeh soils have severe limitations due to shallow profile and steep slope. The Bahluliyeh and Bamra soils have severe limitations and Yazidiyeh soils have moderate limitations for most of the building site developments, sanitary facilities and water management practices. All major soils are a poor source for construction material.

3.6 SAFSAFI-SHALOUH-TARKOUB ASSOCIATION: Deep to shallow, rolling to mountainous, well to moderately excessively drained, loamy and clayey soils on uplands.

This map unit is on undulating crests and very steep side slopes of mountainous landscape near the town of Tarkoub, southwest of Safita. It is dissected by many well defined, deeply cut drainageways. Narrow bottomlands and terraces of the soil association G are along the drainageways. Slopes are long, very steep and slightly convex. Scattered basaltic rocks and boulders are on the surface throughout much of the map unit.

This map unit covers approximately 2460 ha of land and makes about 9.1 percent of the survey area. It is about 30 percent Safsafi soils, 30 percent Shalouh soils, 10 percent Tarkoub soils, and 30 percent minor soils.

Safsafi soils are shallow, excessively drained and are on the moderately steep to very steep sideslopes of high hills. Slopes range from 15 to 50 percent. Typically, the surface layer is dark grayish brown loam. The subsoil is very dark brown, friable loam. It has much angular basalt fragments. The bedrock is within 50 cm of the surface. The surface is very gravelly and stony.

Shalouh soils are shallow, well to moderately excessively drained and are on gently to strongly sloping shoulders of high hills. Slopes range from 5 to 30 percent. Typically, the surface layer is very dark grayish brown gravelly clay. The subsoil is very dark grayish brown, very firm gravelly clay. The bedrock is found 50 cm of the surface. The surface is very gravelly and stony.

Tarkoub soils are deep, well drained and are on gently to strongly sloping summits of high hills. Slopes range from 0 to 9 percent. Typically, the surface layer is reddish brown clay loam. The subsoil is yellowish red, very firm clay. The underlying material is yellowish red, very firm clay.

Minor in this map unit are Em Harten, Kferro, Sinn and Jozeriyeh soils. The dark colored, very shallow, excessively drained Em Harten soils are on steep side slopes. Kferro soils are similar to Shalouh soils but they are more rocky and stony than the Shalouh soils. Sinn soils are deep and are on steep footslopes. They are developed on gravelly colluvium. Jozeriyeh soils are deep, excessively drained, and are extremely gravelly. They are found on steep footslopes of high hills.

Permeability is moderate in Safsafi soils and slow in Shalouh and Tarkoub soils. Available water holding capacity is high in Tarkoub soils and low in Safsafi and Shalouh soils. Fertility is high in Tarkoub soils and low in Safsafi and Shalouh soils. The runoff is very rapid to rapid and the water erosion hazard is high to very high in all major soils.

Most of this map unit is terraced and used for olives and rainfed wheat. Some of the less sloping areas, especially on Tarkoub soils, are under intensive rainfed agriculture. Almost all of the steeper areas bordering the drainageways support native grass and are used as rangeland. Controlling erosion, maintaining fertility and conserving moisture are the main concerns of management. Terracing and contour farming help to control erosion on Tarkoub soils. Safsafi and Shalouh soils are too shallow and too steep for successful farming. They should be used for rangeland, but

overgrazing should be avoided to preserve the native vegetation.

The majority of this map unit has low to very low potential for crops due to steep slopes and shallow profiles. All of the major soils have medium to good potential for rangeland. Safsafi and Shalouh soils have severe limitations and Tarkoub soils have slight limitations for recreational development, building site development, sanitary facilities and water management practices. All major soils are a poor source for construction material.

3.7 JAFERIYEH-YAHMOUR-ZARQA ASSOCIATION: Deep, level to gently undulating, well drained, loamy and clayey soils on floodplains and drainageways.

This map unit is on bottomlands. It consists of narrow floodplains, terraces of larger streams and drainageways, and steep footslopes of high hills. Also included are small, isolated alluvial fans at the end of many small, short erosional cuts. The relief is low on the floodplains, but is somewhat higher on the footslopes. The unit is dissected, especially on side slopes, by numerous small erosional cuts. Some parts of the unit are subject flooding after the heavy rains.

This map unit covers approximately 910 ha of land and makes up about 3.4 percent of the survey area. It is about 30 percent Jaferiyeh soils, 20 percent Yahmour soils, 20 percent Zarqa soil and 30 percent minor soils.

Jaferiyeh soils are deep, well drained, and are on level to gently undulating narrow floodplains and terraces. Slopes range from 0 to 5 percent. Typically, the surface layer is very dark grayish brown clay loam and clay. The subsoil is very dark grayish brown, very firm clay. The underlying material is dark gray to dark grayish brown, very firm clay.

Yahmour soils are deep, excessively drained, and are on level to gently undulating bottomlands and terraces. Slopes range from 0 to 5 percent. Typically, the surface layer is dark brown gravelly loam. The subsoil is dark brown to dark yellowish brown very gravelly clay loam. The underlying material consists entirely of rounded and flat limestone gravel. These soils are extremely gravelly on the surface and throughout the profile.

Zarqa soils are deep, well to moderately excessively drained, and are on level to gently undulating bottomlands and terraces. Slopes range from 0 to 5 percent. Typically, the surface layer is dark brown to brown clay loam. The subsoil is dark yellowish brown gravelly clay loam. The underlying material is dark yellowish brown to yellowish brown gravelly clay loam. It has abundant rounded and flat limestone fragments. This soil is very gravelly on the surface and throughout the substratum.

Minor in this map unit are Em Hosh, Maisarat, Jozeriyeh, Kadmous and El Keshfi soils. Em Hosh soils are less gravelly and have very dark colored surface horizons. Maisarat soils are on gently undulating piedmont plains adjacent to the floodplains. They are fine textured and very stony on the surface and throughout the profile. Jozeriyeh, Kadmous and El Keshfi soils are on steep footslopes of the high hills bordering the unit. Jozeriyeh soils are excessively drained and are extremely gravelly throughout the

profile. Kadmous soils are similar to Jozeriyeh soils but they have a better developed B horizon. El Keshfi soils are well to moderately excessively drained. They have very gravelly substratum.

Permeability is moderate to moderately slow in Jaferiyeh and Zarqa soils and rapid in Yahmour soils. Available water holding capacity is high in Jaferiyeh soils and low to very low in Yahmour and Zarqa soils. Fertility is high in Jaferiyeh soils and low in Yahmour and Zarqa soils. The surface runoff is slow to very slow and the water erosion hazard is low in all major soils.

Most of this map unit is used for crops. Jaferiyeh soils are under intensive rainfed agriculture. Yahmour and Zarqa soils are mostly used for orchards, particularly for olives. In some places, Zarqa soils are used for rainfed wheat. Some of the minor soils found on steeper areas bordering the unit support native grass and used for rangeland. Conserving moisture and maintaining fertility are the main concerns of management.

This map unit generally has good potential for crops, orchards and rangeland. Jaferiyeh soils have slight limitations for most of the recreational development, sanitary facilities and water management practices. They are not suitable for most of the building site development because of occasional floods. Yahmour soils and Zarqa soils have severe limitations for all kinds of development projects because of extreme stoniness. Jaferiyeh soils are a poor source for construction material but Yahmour and Zarqa soils are a good source for roadfill and gravel.

4 SOIL MAPS FOR DETAILED PLANNING

The map units shown on the detailed soil map represent the kinds of soil in the Tartous-Safita area. They are described in this section. The descriptions together with the soil map can be useful in determining the potential of a soil and in managing it for food and fiber production; in planning land use and developing soil resources; and in enhancing, protecting and preserving the environment. More information for each mapping unit, or soil, is given in the section "Use and Management of Soils".

Preceeding the name of each map unit is the symbol that identifies the soil on the detailed soil map. Each soil description includes general facts about the soil and a brief description of the soil profile. In each description, the principal hazards and limitations are indicated, and the management concerns and practices needed are discussed.

The map units on the soil map represent an area on the landscape made up mostly of the soil or soils for which the unit is named. Most of the delineations shown on the detailed soil map are phases of soil series.

Soils having profiles that are similar make up a soil series. Except for allowable differences in texture of the surface layer or of the underlying substratum all the soils of a series have major horizons that are similar in composition, thickness, and arrangements in the profile. A soil series commonly is named for a town or geographic feature near the place where a soil of that

series was first observed and mapped. The Tartous series, for example, is named for the town of Tartous where this particular soil is found.

Soils of one series can differ in texture of the surface layer or in the underlying substratum and in slope, erosion, stoniness, salinity, wetness or in other characteristics that affect their use. On the basis of such differences, a soil series is divided into phases. The name of a soil phase commonly indicates a feature that affects use or management. For example, Tartous 2 to 5 percent slope is one of the several phases within the Tartous series.

Some map units are made up of two or more dominant kinds of soils. Such map units are called soil complexes, soil associations and undifferentiated soil groups.

A soil complex consists of areas of two or more soils that are so intricately mixed or so small in size that they cannot be shown separately on the soil map. Each area includes some of each of the two or more dominant soils, and the pattern and proportion are somewhat similar in all areas. Gindireye-Bahluliyeh 9 to 15 percent slope is an example.

A soil association is made up of soils that are geographically associated and are shown as one unit on the map because it is not practical to separate them. A soil association has considerable regularity in geographic pattern and in the kinds of soil that are a part of it. The extent of the soils can differ appreciably from one delineation to another; nevertheless, interpretations can be made for use and management of the soils.

Most map units include small, scattered areas of soils other than those that appear in the name of the map unit. Some of these soils have properties that differ substantially from those of the dominant soil or soils and this could significantly affect use and management of the map unit. These soils are described in the map unit description. Some of the more unusual or strongly contrasting soils that are included are identified by a special symbol on the soil map.

Some mapped areas include places that have little or no soil material and support little or no vegetation. Such places are called miscellaneous areas; they are delineated on the soil map and given descriptive names. If some of these areas are too small to be delineated, they can be identified by a special symbol on the soil map.

The hectarage and proportionate extent of each map unit are given in Table 4-3, and additional information on properties, limitations, capacities, and potentials for many soil uses is given for each kind of soil in other tables in this survey.

Aa- ANNABIYEH CLAY LOAM

These deep, imperfectly drained, level to depressional soils are on uplands. They cover approximately 50 ha of land or 0.2 percent of the survey area.

Typically, the Annabiyeh soil has a surface layer of dark grayish brown clay loam about 11 cm thick. The subsoil is dark brown to brown calcareous clay and has many prominent dark grayish mottles on ped faces. The underlying material to a depth of 100 cm and more is brown, mottled calcareous clay.

Included with these soils in mapping are small areas of Tartous soils. These included soils make up less than 10 percent of any one mapped area. Tartous soils are well drained, deep, fine textured, reddish brown, gravelly clay soils of gently undulating uplands. They generally are on the edges of the slightly depressional areas.

Permeability is slow throughout the Annabiyeh soil. Available water holding capacity is high. Organic matter content is low and fertility is low. Runoff is slow. The water erosion hazard is low and the wind erosion hazard is very low.

Almost all of the area is being utilized as rangeland. With an adequate drainage network, these soils have good potential for cultivated crops, rangeland, and tree crops. They have fair to poor potential for most building sites, and recreational and sanitary facilities.

These soils are well suited for most crops if they are artificially drained. They have a good potential for wheat, barley, millet and tree crops and a fair potential for tobacco, vegetables and peanuts. The main limiting factors are slow permeability, heavy texture and imperfect drainage. The main concerns of management are providing an adequate drainage system, controlling the water table, and maintaining fertility. Returning crop residues to the soil improves fertility and tilth, and increases infiltration rate.

These soils are well suited for grazing. The native vegetation is mainly a mixture of mid and short grasses. Rangeland rotation and timely deferment of grazing keeps rangeland in good condition.

These soils are a good source for topsoil for areas where vegetation is to be established and maintained. They are a fair source for roadfill but a poor source for sand and gravel. Capability unit: IIIw-1.

Ab- ARIDA SAND

These deep, excessively drained, level to gently undulating soils are on marine aggradation plains and beaches. They cover approximately 560 ha of land or 2.1 percent of the survey area.

Typically, the Arida soil has a surface layer of light brownish gray sand about 12 cm thick. The subsoil and the underlying material is gray to light gray sand.

Included with these soils in mapping are small areas of Mintar and Bassa soils. These included soils make up less than 15 percent of any one mapped area. The Mintar soil is sandy but has a somewhat higher moisture holding capacity than the Arida soil due to fine sandy textures. The Bassa

soils are shallow over weakly consolidated marine deposits. They are found on small, isolated, low, eroded hills.

Permeability is very rapid throughout the Arida soil. Available water holding capacity is very low. Organic matter content and fertility are both very low. Surface runoff is slow to very slow. The water erosion hazard is low and the wind erosion hazard is very high.

Almost all of the Arida soils are barren with sparse vegetation. They have no potential for cultivated crops and have severe limitations for recreational and building site development.

These soils have a very low potential for agricultural crops due to coarse textures, excessive drainage and a very low water holding capacity. Their natural fertility is also very low.

These soils are not suited for grazing due to severe soil limitations. The present natural vegetation should be preserved to prevent wind erosion.

These soils are a fair source for roadfill and a good source for sand and gravel. They are not suitable to be used as topsoil for areas where vegetation is to be established.

These soils have severe limitations for most of the water management practices, except drainage. They can easily be drained if necessary. Capability unit: VIIIs-3.

Ba- BAHLULIYEH CLAY LOAM

These shallow, well drained, rolling to steep soils are on uplands. Slopes are moderately long and complex, and drainageways are well defined. These soils cover approximately 440 ha of land or 1.6 percent of the survey area.

Typically, the Bahluliyeh soil has a surface layer of grayish brown clay loam about 20 cm thick. The subsoil is firm clay loam about 25 cm thick. Soft marl bedrock is found within 50 cm of the surface.

Included with these soils in mapping are small areas of Bamra and Kferiyeh soils, and a few outcrops of marl. These included soils make up less than 15 percent of any one mapped area. Bamra soils are deeper then the Bahluliyeh soils and are found on undulating crests of low hills. Kferiyeh soils are deep soils on stony and gravelly colluvium. They are found on very steep footslopes.

Permeability is moderately rapid throughout the Bahlulieh soil. Available water holding capacity is low. Organic-matter content and fertility are low. Runoff is rapid. The water erosion hazard is very high and the wind erosion hazard is low.

Most areas of these soils are in rangeland. They are not suitable for the production of rainfed and irrigated crops due to steep slopes, shallow soil profile to bedrock and high amounts of gravel. They have fair

potential for tree crops but special management practices, such as stone clearing and terracing, are required.

These soils are poorly suited to grazing due to steep slopes, high gravel content and a very high water erosion hazard. Overgrazing should be avoided to preserve the native vegetation, thus preventing any further soil loss by runoff.

These soils have moderate limitations for most of the recreational and building site development, and severe limitations for small commercial buildings, local roads and streets. They are, however, highly suitable for development of paths and trails for recreational purposes.

These soils are a poor source for roadfills. They are not suitable for use as topsoil for areas where vegetation is to be established and maintained. They are a fair source of gravel. Capability unit: IVe-1.

Bb- BAMRA CLAY LOAM

These moderately deep, well drained undulating to rolling soils are on uplands. Slopes are moderately long and complex, and drainage ways are not well defined. These soils cover approximately 250 ha of land or 1.1 percent of the survey area.

Typically, the Bamra soil has a surface layer of dark grayish brown clay loam about 15 cm thick. The subsoil is dark grayish brown firm clay loam 45 cm thick. The underlying material is very gravelly clay loam. The soft marl bedrock is usually found within 100 cm of the surface.

Included with these soils in mapping are small areas of Yazidiyeh, Bahluliyeh and Kferiyeh soils. These included soils make up less than 20 percent of any one mapped area. Yazidiyeh soils are deeper than the Bamra soils and are found on gently undulating crests and shoulders of low hills. The well to excessively drained Bahluliyeh soils are shallower than the Bamra soils. Their position on the landscape is similar to that of the Bamra soils. The well drained Kferiyeh soils are deeper than the Bamra soils and are found on gravelly and stony colluvium of steep footslopes.

Permeability is moderately slow. Available water holding capacity is moderate. Organic matter content and fertility are low. The runoff is rapid and the water erosion hazard is high.

Most areas of these soils are farmed or under orchards, particularly olives. Most of the cultivated areas are terraced. These soils have fair to low potential for most of the crops and rangeland. They have fair potential for some building sites, and for recreational and sanitary facilities.

These soils are not well suited to some of the cultivated crops. They have low potential for wheat, barley and millet, and fair potential for tree crops. They are not suitable for tobacco, vegetables and peanuts. The main limiting factors are steep slope, depth to bedrock and the high amount of gravel in the profile. The major concerns of management are controlling the erosion and maintaining fertility. Returning crop residue to the soil helps

maintain fertility, improves tilth, and increases the infiltration rate, thus reducing runoff. Terracing is required to prevent erosion.

These soils are fairly well suited to rangeland. Steep slopes and erosion hazard are the main management concerns. Overgrazing should be avoided to preserve the native vegetation thus preventing further soil loss by runoff. Capability unit: IVe-2.

Bc- BASSA SANDY LOAM

These shallow, well to excessively drained level to rolling soils are on uplands. They are developed on weakly consolidated marine deposits. Slopes are short and complex. These soils cover approximately 310 ha of land or 1.1 percent of the survey area.

Typically, the Bassa soil has a surface layer of brown to dark brown sandy loam less than 10 cm thick. The underlying material is hard, weakly consolidated rock. The surface is very gravelly and stony.

Included with these soils in mapping are small areas of Tartous soils. These included soils make up less than 10 percent of any one mapped area. Tartous soils are deep, well drained soils of marine aggradation plains. They are found on gentle slopes of the transitional areas between the Bassa and Tartous soils.

Permeability is rapid. Available water holding capacity is very low. Organic matter content is low and natural fertility is very low. Runoff is rapid to very rapid and water erosion hazard is high.

All of the Bassa soils are being used as rangeland or are barren. They are not suitable for agriculture. They have low potential for grazing. They have severe limitations for building site development, and recreational and sanitary facilities.

These soils are poorly suited to crops because of steep slopes and shallow profile.

These soils are best suited for rangeland, but special management practices should be applied to avoid overgrazing, thus preventing further soil loss by runoff.

These soils generally are poorly suitable as building sites in places where the slope is excessive. Capability unit: VIIs-1.

Bd- BEIT KHAMMOUNI CLAY LOAM

These deep, well drained, undulating to gently rolling soils are on upland, developed on limestone. Slopes are moderately long and complex, and drainageways are poorly defined. These soils cover approximately 560 ha of land or 2.1 percent of the survey area.

Typically, the Beit Khammouni soil has a surface layer of dark reddish brown clay loam about 9 cm thick. The subsoil is dark reddish brown very

firm clay about 40 cm thick. The underlying material is yellowish red clay. They are very stony on the surface.

Included with these soils in mapping are small areas of Reyhaniyeh, Kilmaho and El Boustan soils. These included soils make up less than 20 percent of any one mapped area. The well drained, deep Reyhaniyeh soils are brown colored clayey soils, found on similar physiographic positions as the Beit Khammouni soils. Kilmaho soils have redder subsoil than the Beit Khammouni soils. The well drained El Boustan soils are shallower than the Beit Khammouni soils and are found on steep shoulders of low hills.

Permeability is slow. Available water holding capacity is high. Organic matter content and fertility are moderate. The runoff is medium. The water erosion and the wind erosion hazards are both moderate.

Almost all Beit Khammouni soils are farmed or are under orchards, particularly olives. Cultivated areas on steeper slopes are terraced. These soils have fair potentials for crops, building site development and recreational and sanitary facilities.

These soils are highly suitable for cultivated crops. They have high potential for tree crops, medium potential for wheat, barley and millet, and low potential for tobacco, vegetables and peanuts. The main limiting factors are slope and stoniness. The major concerns of management are controlling erosion, maintaining fertility and improving the infiltration rate. Returning crop residue to the soil helps maintain fertility, improves tilth and increases infiltration rate, thus reducing runoff. Terracing is required to prevent erosion on steeper slopes.

These soils are highly suited for rangeland, but very few areas are used as rangeland. If they are used as rangeland, uniform grazing distribution, timely deferment of grazing and a planned grazing system help keep the range in good condition.

These soils are moderately suitable for camp and picnic areas, and playgrounds. They have moderate potential for all types of building site development, and for local roads and streets. They are highly suitable for paths and trails. They have fair potential for water management practices and are highly suitable for irrigation if stones are cleared. They are fair source for roadfill and topsoil, but are poor source for sand and gravel. Capability unit: IIIs-1.

Be- BESMAKAH CLAY

These deep, well drained, gently undulating to rolling gravelly soils are on uplands, developed on limestone. Slopes are moderately long and complex, and drainageways are not well defined. These soils cover approximately 170 ha of land or 0.6 percent of the survey area.

Typically, the Besmakah soil has a surface layer of dark reddish brown gravelly clay about 14 cm thick. The subsoil is yellowish red very firm gravelly clay about 32 cm thick. The underlying material is yellowish red extremely firm gravelly clay. They are extremely stony on the surface.

Included with these soils in mapping are small areas of Semka, Kilmaho, Beit Khammouni and Kadmous soils. The well drained, fine textured Semka soils have less gravel in the subsoil then the Besmakah soils. The well drained, deep Kilmaho soils have browner subsoil than the Besmakah soils and are less gravelly. The Beit Khammouni soils are less gravelly than the Besmakah soils and have moderately fine textured subsoils. Kadmous soils are similar to the Besmakah soils but are developed on gravelly colluvium derived from limestone. They are found on steep footslopes of the low hills.

Permeability is very slow. Available water holding capacity is high. Runoff is moderate to rapid. The water erosion hazard is very high and the wind erosion hazard is moderately low.

Almost all Besmakah soils are farmed or are under orchards, particularly olives. In cultivated areas stones are usually cleared and used to build terrace walls. Although cultivated, these soils have poor to very poor potentials for crops and fair to poor potential for tree crops and rangeland because of extreme stoniness. They have severe limitations for development for almost all kinds of building site development, and for recreational and sanitary facilities.

These soils have low potential for grazing due to extreme stoniness. Uniform grazing distribution, timely deferment of grazing and a planned grazing system help keep the range in good condition.

These soils are a poor source for roadfill and for topsoil for areas where the vegetation is to be maintained. They are a fair source for sand and gravel. Capability unit: VIs-6.

Bf- BMALKEH CLAY

This shallow, well to moderately excessively drained soil is on uplands. It is developed on hard Cretaceous limestone. Slopes are simple and fairly long. This soil generally occupies the steep side slopes of low eroded hills. Drainageways are well defined in the landscape. These soils cover approximately 870 ha of land or 3.2 percent of the survey area.

Typically, the Bmalkeh soil has a surface layer of dark brown gravelly clay about 3 cm thick. The subsoil is about 35 cm of dark yellowish brown to dark brown, extremely firm gravelly clay. The bedrock is within 50 cm of the surface. These soils are very gravelly and stony on the surface.

Included with this soil in mapping are small areas of El Boustan and Kilmaho soils. These included soils make up less than 15 percent of any one mapped area. The El Boustan soil is deeper than the Bmalkeh soil. The bedrock usually is within 50 to 100 cm of the surface. The Kilmaho soil is deeper than the Bmalkeh soil. It is on gently undulating crests.

Permeability is moderately slow. Available water holding capacity is moderate. Organic matter content is low. Fertility is low to very low. Runoff is very rapid. The water erosion hazard is very high and the wind erosion hazard is low.

The majority of this soil is used as rangeland, and some areas are terraced and used for orchards. This soil has no potential for cultivated crops, and is poorly suited to tree crops and rangeland due to severe limitations. It is not suitable to building sites, recreational development, and sanitary facilities.

This soil has no potential for rainfed and irrigated agriculture. Although it has some potential for tree crops, orchards should be established on areas where terraces can be established to help control erosion.

This soil is best suited to rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Overgrazing should be avoided to protect the vegetative cover, thus to control soil loss by runoff. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff. If grazing continues on this soil, the size of bare areas and the risk of erosion and runoff increases. Because this soil is somewhat droughty, reestablishing vegetation is difficult on overgrazed areas.

This soil has severe limitations for all kinds of building sites, recreational development, and sanitary facilities due to shallow profiles, steep slopes and excessive stones. It is a poor source for construction material and for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: VIe-1.

Bg- EL BOUSTAN CLAY LOAM

This moderately deep, well drained, moderately steep soil is on uplands. It is developed on hard Cretaceous limestone. Slopes are both simple and complex, and moderately long. It is generally on steep shoulders and backslopes of medium-height hills. Drainageways are well defined in the landscape. These soils cover approximately 4,070 ha of land or 14.9 percent of the survey area.

Typically, the El Boustan soil has a surface layer of very dark gray loam about 11 cm thick. The subsoil is about 24 cm of dark grayish brown, firm clay loam. The underlying material to a depth of 72 cm is dark yellowish brown clay loam and clay. It contains many angular limestone gravel. The bedrock is within 50 to 100 cm of the surface. These soils are very gravelly and stony on the surface.

Included with this soil in mapping are small areas of Bmalkeh, Reyhanieh and Kilmaho soils. These included soils make up less than 15 percent of any one mapped area. The well to moderately excessively drained Bmalkeh soil is shallower than the El Boustan soil. It occurs on steep slopes. The Reyhanieh soil is deeper than the El Boustan soil, and has a subsoil of brown clay loam. The Kilmaho soil is deeper than the El Boustan soil. It has a subsoil of reddish brown clay. It is on gently undulating to rolling crests.

Permeability is slow. Available water holding capacity is moderate. Organic matter content is low. Fertility is low. Runoff is rapid to very rapid. Water erosion hazard is very high and wind erosion hazard is low.

Most of this soil is under low bush and natural vegetation. Most areas are used as rangeland. It has no potential for cultivated crops, and low potential for tree crops and rangeland. It has severe limitations for all kinds of building sites, recreational development, and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture due to severe limitations, such as shallow profile, steep slopes, low water holding capacity, and high erosion hazard. On gentle slopes this soil is cultivated, particularly for wheat, but the yield is quite low. Although it has some potential for tree crops, orchards should be established on areas where terraces can be established to help to control erosion.

This soil is best suited to rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover.

A planned grazing system that includes proper grazing use and deferred grazing may help maintain or improve the range condition and control erosion. Overgrazing should be avoided to protect the vegetative cover, thus to control soil loss by the runoff.

Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing runoff rate.

This soil has severe limitations for building sites, recreational development, and sanitary facilities due to shallow profiles, steep slope and excessive stoniness. It has no potential for water management practices.

This soil is a poor source for construction material and for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: VIe-1.

Da- DRYKISH CLAY

This shallow, somewhat excessively drained, moderately steep to very steep soil is on uplands. It is developed on hard Cretaceous limestone. Slopes are both simple and complex, and fairly long. It occurs, generally, on steep shoulders and back slopes of medium-height hills and low mountains. Drainageways are well defined in the landscape. These soils cover approximately 4,360 ha of land or 16.0 percent of the survey area.

Typically, the Drykish soil has a surface layer of very dark grayish brown clay about 13 cm thick. The subsoil is about 15 cm of dark grayish brown, very firm clay. It contains many angular limestone fragments. The bedrock is within 50 cm of the surface. This soil is very gravelly on the surface and throughout the profile.

Included with this soil in mapping are small areas of Kansebba, Bmalkeh, and El Boustan soils. These included soils make up less than 20

percent of any one mapped area. The Kansebba soil is somewhat shallower than the Drykish soil, and has very rocky and stony surface. The Bmalkeh soil has a well developed B horizon. It is less stony than the Drykish and Kansebba soils and has gentle topography. The El Boustan soil is deeper and less stony than both Drykish and Kabsebba soils. The bedrock is found within 50 to 100 cm of the surface.

Permeability is low. Available water holding capacity is low to very low. Organic matter content is low. Fertility is very low. Runoff is very rapid. Water erosion hazard is very high and wind erosion hazard is low.

Most of this soil is used as rangeland. Some areas occurring on smooth slopes are cultivated mainly for rainfed wheat and olives. This soil has low potential for tree crops, and medium to low potential for tree crops and rangeland. It has low potential for building sites, recreational development, and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture due to severe limitations, such as steep slopes, shallow profiles to bedrock and excessive stoniness. Orchards should be established on areas with gentle slopes to help control erosion.

This soil is best suited for rangeland.

The major problems of range management are to control erosion and to maintain the present vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Overgrazing should be avoided to protect the vegetative cover, and thus control soil loss by runoff. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate. If grazing continues on this soil, the size of the bare areas and the risk of erosion and runoff increases. Because this soil is somewhat droughty, reestablishing vegetation is difficult on overgrazed areas.

This soil is not suited to building sites, recreational development, and sanitary facilities because of steep slopes, shallow profile and excessive stones. It has severe limitations for water management practices. It is not a good source for construction material and for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: VIs-1.

Ea- EM HARTEN LOAM

This very shallow, excessively drained, undulating to rolling soil is on uplands. It is developed on Neogene basalt. Slopes are smooth and complex, and very long. It is generally on undulating to rolling elevations and plains. Drainageways are poorly defined in the landscape. These soils cover approximately 190 hectares of land or 0.7 percent of the survey area.

Typically, the Em Harten soil has a surface layer of very dark grayish brown loam about 15 cm thick. It contains much stone and gravel on the surface and throughout the profile. The bedrock generally is within 50 cm of the surface.

Included with this soil in mapping are small areas of Safsafi, Kferro, and Shalouh soils. These included soils make up less than 20 percent of any one mapped area. The Safsafi soil is somewhat deeper than the Em Harten soil. The Kferro and Shalouh soils both have a well developed B horizon. All these soils are less stony and less gravelly than the Em Harten soil.

Permeability is rapid. Available water holding capacity is low to very low. Organic matter content is low. Fertility is very low. Runoff is rapid. Water erosion hazard is very high and wind erosion hazard is low.

The majority of this soil is used for rangeland. This soil has no potential for cultivated crops, and low potential for tree crops and rangeland.

This soil is not suited to rainfed and irrigated agriculture because of severe limitations. The main limiting factors are very shallow profiles to bedrock, very low water holding capacity, and a high erosion danger.

This soil is best suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Maintaining proper stocking rates, practicing pasture rotation, and timely deferment of grazing help keep the rangeland in good condition. Overgrazing should be avoided to protect the vegetative cover, preventing soil loss by runoff. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate. Because this soil is somewhat droughty, reestablishing vegetation is difficult on overgrazed areas.

This soil has severe limitations for building sites, recreational development, and sanitary facilities due to steep slopes, shallow profile, and excessive stoniness. It is not suited for most of the water management practices.

This soil is a poor source for construction material and for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: VIs-1.

Eb- EM HOSH CLAY

This deep, well drained, gently sloping to moderately sloping soil is on uplands. It is developed on gravelly colluvium, derived mainly from basalt. Slopes are simple and very long. It generally occurs on gently to moderately sloping toe slopes and valley bottoms between low hills. Drainageways are well defined in the landscape. These soils cover approximately 60 ha of land or 0.2 percent of the survey area.

Typically, the Em Hosh soil has a surface layer of very dark gray clay about 20 cm thick. The subsoil is about 23 cm of very dark grayish brown, firm clay. It contains much gravel. The underlying material to a depth of 110 cm is dark grayish brown to dark yellowish brown, firm clay. It contains abundant gravel throughout.

Included with this soil in mapping are small areas of Kferiyeh and El Keshfi soils. These included soils make up less than 15 percent of any one mapped area. The Kferiyeh soil has less gravel than the Em Hosh soil. It has moderately fine texture throughout. The El Keshfi soil has somewhat coarser texture and redder color than the Em Hosh soil. It is very gravelly on the surface as well as throughout the profile.

Permeability is moderately slow. Available water holding capacity is moderate. Organic matter content is high. Fertility is medium. Runoff is medium to rapid. Water erosion hazard is slight to moderate and wind erosion hazard is high.

The majority of this soil is cultivated. It has fair to low potential for cultivated crops, and good to fair potential for tree crops and rangeland. The main limiting factors are high amounts of gravel, surface stoniness and slope. The main concerns of management are to conserve moisture, to maintain fertility to prevent sheet erosion, and to clear stones. Erosion control measures include minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases infiltration rate.

This soil is well suited for rangeland. The major problems of range management are to control erosion and to preserve the vegetative cover. A planned grazing system that includes proper grazing use and deferred grazing helps maintain or improve the range condition and control erosion. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing runoff rate. Overgrazing should be avoided to protect the vegetative cover, thus helping to control soil loss by runoff.

This soil has moderate limitations for shallow excavations and dwellings without basements. It is not suitable for dwellings with basements or small commercial buildings due to excessive gravel in the subsoil and steep slope. It is highly suitable for recreational development, and sanitary facilities. This soil is well suited to most of the water management practices except embankments, dikes, and levees due to excessive gravel in the subsoil.

This soil is a poor source for road fill material, and a fair source for sand and gravel. It is well suited for use as a source for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: IVs-8.

Ha- EL HISHI CLAY

This deep, well drained, level to gently undulating soil is on marine aggradation plains. It is developed on marine deposits, weakly consolidated deposits, and some colluvium. Slopes are simple and smooth, and very long. It is generally on gently undulating elevations and plains. Drainageways are poorly defined in the landscape. These soils cover approximately 790 ha of land or 2.9 percent of the survey area.

Typically, the El Hishi soil has a surface layer of very dark gray clay loam about 6 cm thick. The subsoil is about 60 cm of very dark grayish brown, firm clay. The underlying material, to a depth of 120 cm, is dark brown to dark yellowish brown, firm clay.

Included with this soil in mapping are small areas of Tartous and Semka soils. These included soils make up less than 15 percent of any one mapped area. The Tartous soil is redder than the El Hishi soils. It has somewhat more undulating topography than the El Hishi soils. The Semka soil is similar to El Hishi soil but is on steeper slopes. It is developed on hard limestone. The Semka soil is more stony than the El Hishi soil and is found in areas adjacent to low hills.

Permeability is moderate to moderately slow. Available water holding capacity is moderate to high. Organic matter content is medium. Fertility is medium. Runoff is slow to medium. Water erosion hazard is very low and wind erosion hazard is low.

The majority of this soil is cultivated. It has a high potential for cultivated crops, and a high potential for tree crops and rangeland. It is highly adapted for all kinds of building sites, recreational development, and sanitary facilities.

This soil has no limitations for rainfed and irrigated agriculture. It is highly suited to all kinds of cultivated crops that are climatically adapted to the region. The main concerns of management are to provide adequate surface drainage, to improve infiltration rate, and to maintain fertility. Avoiding field work when the soil is wet helps maintain good tilth. Planting and harvesting may be delayed during wet periods. Providing adequate drainage helps overcome the slow surface runoff. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is highly suited for rangeland. The major problems of range management are to provide adequate surface drainage and to maintain present vegetative cover. If rangeland is grazed during wet periods, the soil puddles and vegetation deteriorates. A planned grazing system that includes proper grazing use and deferred grazing helps maintain or improve the range condition and control erosion.

This soil has no limitations for building sites, recreational development, and sanitary facilities. It is well suited to all kinds of water management practices. This soil is good source for roadfill, and for topsoil for areas where adapted vegetation is to be established and maintained. It is a poor source for sand and gravel. Capability unit: IIs-2.

Ja- JAFERIYEH CLAY LOAM

This deep, well drained, level to gently undulating soil is on narrow flood plains and terraces. It is developed on alluvium. Slopes are simple and smooth, and very long. It generally occurs on level alluvial plains and terraces. Drainageways are poorly defined in the landscape. These soils cover approximately 380 ha of land or 1.4 percent of the survey area.

Typically, the Jaferiyeh soil has a surface layer of very dark grayish brown clay to clay loam which is about 15 cm thick. The subsoil is about 53 cm of very dark grayish brown, very firm clay. It contains some rounded gravel. The underlying material to a depth of 135 cm is dark gray to dark grayish brown, very firm clay. It has some rounded gravel throughout.

Included with this soil in mapping are small areas of Yahmour, Zarqa, Kadmous and El Keshfi soils. These included soils make up less than 20 percent of any one mapped area. The Yahmour soil is extremely gravelly on the surface and throughout the profile. The Zarqa soil is similar to Jaferiyeh soil, but has an extremely gravelly subsoil and moderately fine textured topsoil. The Yahmour and Zarqa soils have physiographic position on the landscape similar to the Jaferiyeh soil. The Kadmous and El Keshfi soils are on gently sloping to strongly sloping colluvium. They are on footslopes of the adjacent hilly landscape. They are also very gravelly on the surface and in the profile.

Permeability is moderately slow. Available water holding capacity is high. Organic matter content is moderate. Fertility is medium. Runoff is slow. The water erosion hazard is very low and the wind erosion hazard is low.

The majority of this soil is cultivated although some is used for orchards and rangeland.

This soil has excellent potential for cultivated crops, tree crops and rangeland. It has no limitations for building sites, recreational development, and sanitary facilities.

This soil has no limitations for rainfed and irrigated agriculture. It is well suited to all kinds of cultivated crops that are climatically adapted to the region. The main concerns of management are to provide an adequate drainage system, to improve the surface drainage and to maintain fertility. Avoiding field work when the soil is wet helps maintain good tilth. Timely field work is necessary to avoid puddling of the soil during wet periods. Planting and harvesting may be delayed during wet periods. Providing adequate drainage helps overcome the slow surface runoff. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is well suited for rangeland. Grazing should be avoided during wet periods to prevent puddling of the surface soil. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil has no limitations for building sites, recreational development, and sanitary facilities. It is well suited to all kinds of water management practices.

This soil is a fair source for roadfill and topsoil material. It is a poor source for sand and gravel. Capability unit: I.

Jb- JINDIRIYEH CLAY LOAM

This shallow, excessively drained, moderately steep to very steep soil is on uplands. It is developed on soft limestone and marl. Slopes are both simple and complex, and fairly long. It is generally on rolling summits and very steep shoulders and back slopes of medium-height hills and low mountains. Drainageways are well defined in the landscape. These soils cover approximately 90 ha of land or 0.3 percent of the survey area.

Typically, the Jindiriyeh soil has a surface layer of very dark grayish brown clay loam about 11 cm thick. The subsoil is about 18 cm of very dark grayish brown to grayish brown, firm clay loam. It has some angular limestone fragments. The bedrock is within 50 cm of the surface. These soils are very stony and rocky on the surface.

Included with this soil in mapping are small areas of rock outcrops, and Bahluliyeh, Bamra, and Yazidiyeh soils. These included soils make up less than 20 percent of any one mapped area. The Bahluliyeh soils are somewhat deeper than the Jindiriyeh soils. The Bamra soils are deeper than both Jindiriyeh and Bahluliyeh soils, and are less stony and rocky. They are on more gentle slopes than the Jindiriyeh soils. The Yazidiyeh soils are deep. They are on gently undulating crests, and are less stony than the Jindiriyeh soils.

Permeability is moderate. Available water holding capacity is very low. Organic matter content is low. Fertility is very low. Runoff is very rapid. Water erosion hazard is very high and wind erosion hazard is low.

This soil is not suited to cultivated crops. It has a low potential for tree crops and rangeland. It has severe limitations for building sites, recreational development, and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture. The main limiting factors are very shallow profiles to bedrock, very steep slope, excessive stoniness and rockiness, and a high erosion hazard. It has low potential for tree crops. Orchards should be established on areas with gentle slopes where terraces can be constructed to help control erosion.

This soil has low potential for rangeland. The major problems of range management are to control erosion and to maintain and preserve vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Because of this, reestablishing vegetation is difficult in overgrazed areas. Overgrazing should be avoided to protect the vegetative cover, thus helping to control soil loss by runoff. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing runoff rate. If grazing

continues on this soil, the size of the bare areas and the risk of erosion and runoff increases.

This soil has severe limitations for all kinds of building sites, recreational development, and sanitary facilities due to steep slopes, shallow profile to bedrock, and excessive stoniness. It is a poor source for all kinds of construction material. Capability unit: VIs-1.

Jc- JOZERIYEH CLAY

This deep, excessively drained, gravelly soil is on uplands. It is developed on colluvium derived mainly from limestone. Slopes are simple, and fairly long. It is generally on gently sloping to steeply sloping back slopes of low and medium-height hills. Drainageways are not well defined in the landscape. These soils cover approximately 440 ha of land or 1.6 percent of the survey area.

Typically, the Jozeriyeh soil has a surface layer of very dark gray gravelly clay about 13 cm thick. It is very gravelly. The underlying material to a depth of more than 100 cm is dark brown to dark yellowish brown gravelly clay. It has much subrounded gravel, which constitutes up to 90 percent of the soil volume. This soil has an extremely gravelly and stony surface.

Permeability is rapid. Available water holding capacity is low. Organic matter content is low and fertility is low. Runoff is rapid. Water erosion hazard is high and wind erosion hazard is low.

Some areas are used for rainfed agriculture but the yield is very low. The majority of the soil is used for rangeland. This soil has a very low potential for cultivated crops, and low potential for tree crops and rangeland. It has severe limitations for all kinds of building sites, recreational development, and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture due to severe limitations, such as very gravelly surfaces and subsoils, and low water holding capacity. Although it has some potential for tree crops, orchards should be established on areas where terraces can be established to help control erosion. The main concerns of management are to control erosion, to provide enough moisture to plants, and to maintain fertility. This soil is too droughty for most crops. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is fairly well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate. A planned grazing system that includes proper grazing use and deferred grazing helps maintain or improve the range condition and control erosion. Because this soil is somewhat droughty, reestablishing

vegetation is difficult on overgrazed areas.

This soil has severe limitations for all kinds of building sites, recreational development, and sanitary facilities due to excessive gravel throughout the profile. It is not suited to most of the water management practices except for terraces and diversions.

This soil is a poor source for roadfill, and for topsoil material to be used for areas where adapted vegetation is to be established and maintained. It is a good source for sand and gravel. Capability unit: VIs-7.

Ka- KADMOUS CLAY LOAM

This deep, well drained, steep to very steep soil occurs on uplands. It is developed on gravelly colluvium, derived mainly from limestone. Slopes are simple and smooth, and very long. It is generally on very steep shoulders and back slopes of high hills and medium-height mountains. Drainageways are well defined in the landscape. These soils cover approximately 610 ha of land or 2.2 percent of the survey area.

Typically, the Kadmous soil has a surface layer of dark brown to brown clay loam about 18 cm thick. The subsoil is about 38 cm of dark brown to yellowish brown, firm gravelly clay. The underlying material to a depth of 110 cm is dark brown to brown, firm to very firm clay. It contains much subrounded gravel which constitutes approximately 30 percent of the soil volume. This soil is extremely stony and gravelly on the surface.

Included with this soil in mapping are small areas of Jozeriyeh, Drykish, Bmalkeh and El Boustan soils. These included soils make up less than 20 percent of any one mapped area. The deep, excessively drained Jozeriyeh soil is extremely gravelly on the surface and throughout the profile. The Drykish soil is shallow, stony and rocky, and the bedrock is within 50 cm of the surface. The Bmalkeh soil is shallower than the Kadmous soil, and has a well developed B horizon. The El Boustan soil is shallower than the Kadmous soil, but somewhat deeper and less stony than the Drykish soil.

Permeability is moderate. Available water holding capacity is moderate. Organic matter content is low. Fertility is medium to low. Runoff is very rapid. The water erosion hazard is very high and the wind erosion hazard is low.

The majority of this soil is used for rangeland. Some areas with gentle slope are terraced and used for orchards. This soil has severe limitations for cultivated crops, tree crops and rangeland. It is not suited to building sites, recreational development, and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture because of severe limitations, such as very steep slope and excessive gravel in the profile and on the surface. This soil generally is too steep and too stony for crops.

This soil is best suited for rangeland but it has a low grazing potential. The major problems of range management are to control erosion and to maintain present vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Overgrazing should be avoided to protect the vegetative cover, thus to control soil loss by runoff. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing runoff rate. If grazing continues on this soil, the size of the bare areas and the risk of erosion and runoff increases. Because this soil is somewhat droughty, reestablishing vegetation is difficult on overgrazed areas.

This soil is not suited to building sites, recreational development, and sanitary facilities due to excessive slope and excessive gravel content of the soil. It has no potential for water management practices.

This soil is a poor source for roadfill material, and for topsoil for areas where adapted vegetation is to be established and maintained. It is a fair source for sand and gravel. Capability Unit: VIIe-1.

Kb- KANSEBBA CLAY LOAM

This very shallow, excessively drained, very steep to mountainous soil is on uplands. It is developed on hard Cretaceous limestones. Slopes are both simple and complex, and very long. It is generally on very steep shoulders and back slopes of low and medium-height mountains. Drainageways are well defined in the landscapes. These soils cover approximately 2,260 ha of land or 8.3 percent of the survey area.

Typically, the Kansebba soil has a surface layer of dark grayish brown clay loam, about 7 cm thick. It has some angular limestone fragments. The bedrock generally is within 20 cm of the surfaces. These soils are extremely stony and rocky.

Included with this soil in mapping are small areas of Drykish, Bmalkeh, El Boustan and Kilmaho soils. These included soils make up less than 20 percent of any one mapped area. The shallow, well to excessively drained Drykish soil is somewhat deeper than the Kansebba soil. The Bmalkeh soil is deeper than the Kansebba soil and it has a well developed B horizon. The bedrock is within 50 cm of the surface in Bmalkeh soils. The El Boustan soil is less stony and rocky than the Kansebba soil and is also deeper. The Kilmaho soil is deep. It has a subsoil of reddish brown clays. It is on gently undulating crests.

Permeability is rapid. Available water holding capacity is low to very low. Organic matter content is very low. Fertility is very low. Runoff is very rapid. Water erosion hazard is very high and wind erosion hazard is low.

This soil has no potential for cultivated crops, and low potential for tree crops and rangelands. It is not suitable for building sites, recreational development, and sanitary facilities.

This soil has no potential for rainfed or irrigated agriculture due to severe limitations, such as very shallow profiles, very steep slopes, and excessive stoniness. Although it has some potential for tree crops, orchards should be planted on areas where terraces can be established to help control erosion.

This soil has low potential for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Overgrazing should be avoided to protect the vegetative cover, thus to control soil loss by runoff. Management that maintains an adequate vegetative cover helps prevent excessive soil loss by runoff. Overgrazing reduces the protective vegetative cover and causes deterioration of the plant community. If grazing continues on this soil, the size of the bare areas and the risk of erosion and runoff increases. Because this soil is somewhat droughty, reestablishing vegetation is difficult on overgrazed areas.

This soil has no potential for building sites, recreational development, and sanitary facilities due to very steep slopes and excessive stoniness. It is not suitable to water management practices. This soil is a poor source for construction material, and for topsoil for areas where adapted vegetation is to be established and maintained. It is a poor source for sand and gravel. Capability unit: VIIe-1s.

Kc- EL KESHFI CLAY LOAM

This deep, well drained, very gravelly, gently rolling to rolling soil is on uplands. It is developed on gravelly colluvium and alluvium, derived mainly from limestone. Slopes are simple and fairly long. It is generally on gently sloping to strongly sloping toe slopes of low hills and on plains. Drainageways are poorly defined in the landscape. These soils cover approximately 560 ha of land or 2.1 percent of the survey area.

Typically, the El Keshfi soil has a surface layer of dark grayish brown clay loam about 25 cm thick. The subsoil is about 65 cm of dark grayish brown to dark brown clay and clay loam. It has some subangular gravel. The underlying material to a depth of 125 cm is almost 100 percent gravel and stones. It has very little fine particles between the coarse fragments. This soil is extremely gravelly on the surface.

Included with this soil in mapping are small areas of Joseriyeh, Kferiyeh and Kadmous soils. These included soils make up less than 20 percent of any one mapped area. The deep, excessively drained Jozeriyeh soils are extremely gravelly on the surface and throughout the profile. The subsoil of this soil is more gravelly than the El Keshfi soil. The Kferiyeh soil is deep and less gravelly than the El Keshfi soil. It occupies similar physiographic positions as the El Keshfi soil. The deep, well drained Kadmous soil is on very steep sideslopes. It is less gravelly than the El Keshfi soil.

Permeability is moderately slow. Available water holding capacity is medium. Organic matter content is low. Fertility is low. Runoff is rapid

to very rapid. The water erosion hazard is high to very high and the wind erosion hazard is low.

Most of this soil is cultivated. Some areas are planted to orchards and a few areas are utilized for rangeland. This soil has low potential for cultivated crops, and medium potential for tree crops and rangeland. It has severe limitations for most building sites, recreational development, and sanitary facilities.

This soil is poorly suited to rainfed and irrigated agriculture due to excessive gravel and stones in the subsoil, and steep slope. It has low potential for wheat, barley, and millet. It is not suitable for tobacco, vegetables and peanuts. The main concerns of management are to provide adequate moisture to the plants, to control erosion, and to maintain fertility. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help to control erosion. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate. Although it has some potential for tree crops, orchards should be planted on areas where terraces can be established to help to control erosion.

This soil is fairly well suited for rangeland. A planned grazing system that includes proper grazing use and deferred grazing help maintain or improve the range condition and control erosion. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil has severe limitations for most building sites, recreational development, and sanitary facilities except it has fair potential for picnic areas, playgrounds and paths and trails. It has severe limitations for most water management practices. It is fairly well suited for the construction of terraces and diversions.

This soil is a poor source for construction material, and for topsoil for areas where adapted vegetation is to be established and maintained. It is a good source for sand and gravel. Capability unit: VIs-8.

Kd- KFERIYEH LOAM

This deep, well drained, moderately steep to steep, stony soil is on uplands. It is developed on gravelly colluvium derived mainly from marl and soft limestone. Slopes are simple and fairly short. It generally occurs on steep back slopes and footslopes of low to medium height hills. Drainageways are well defined in the landscape. These soils cover approximately 140 ha of land or 0.5 percent of the survey area.

Typically, the Kferiyeh soil has a surface layer of very dark grayish brown loam about 11 cm thick. The subsoil is about 65 cm of very dark grayish brown to dark brown, firm clay loam. It has some angular limestone

and marl fragments. The underlying material to a depth of 115 cm is very dark gray, firm clay loam. It has some angular gravel throughout. This soil has a very stony and gravelly surface.

Permeability is moderately slow. Available water holding capacity is moderate. Organic matter content is low. Fertility is low. Runoff is very rapid. Water erosion hazard is very high and wind erosion hazard is low.

Most areas are terraced and used for orchards, particularly for olives. Some areas on gentle slopes are used for rainfed wheat, but the yield is quite low and soil loss is too great under present farming practices. This soil is not suited to cultivated crops, but is fairly well suited to tree crops and rangeland. It has no potential for building sites, recreational development, and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture due to severe soil limitations, particularly very steep slope. This soil generally is too steep and too stony for crops. Although it has some potential for tree crops, orchards should be established on areas where terraces can be planted to help to control erosion.

This soil is fairly well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. Management that maintains an adequate vegetative cover helps prevent excessive soil loss by runoff. Overgrazing should be avoided to protect the vegetative cover, and thus control soil loss by runoff. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing runoff rate. If grazing continues on this soil, the size of the bare areas and the risk of erosion and runoff increases.

This soil has no potential for building sites, recreational development, and sanitary facilities due to steep slopes and excessive coarse fragments. It has no potential for water management practices except it has some potential for the establishment of embankments, dikes and levees.

This soil is a poor source for construction material, and for sand and gravel. It is not suited for use as topsoil material due to excessive stones. Capability unit: IVe-1.

Ke- KFERRO LOAM

This shallow, well to moderately excessively drained, gently rolling to rolling soil is on uplands. It is developed on Neogene basalt. Slopes are complex and fairly long. It is generally on gently rolling elevations and plains. Drainageways are poorly defined in the landscape. These soils cover approximately 180 ha of land or 0.7 percent of the survey area.

Typically, the Kferro soil has a surface layer of very dark grayish brown loam about 7 cm thick. The subsoil is about 31 cm of very dark grayish brown, firm clay loam. It is gravelly throughout. The bedrock is found within 50 cm of the surface. This soil is moderately gravelly on the

surface.

Included with this soil in mapping are small areas of Shalouh, Tarkoub and Tartous soils. These included soils make up less than 30 percent of any one mapped area. The Shalouh soil is similar to the Kferro soil except it has a subsoil of dark brown clay. It is more stony than the Kferro soil. The Tarkoub soil is deep and fine textured. It is found on gently undulating plains. It is less stony and gravelly than the Kferro soil. The deep, well drained Tartous soil is developed on limestone. It has a subsoil of reddish brown clay. It is found on areas transitional to the marine aggradation plains.

Permeability is moderate. Available water holding capacity is moderate. Organic matter content is medium. Fertility is low. Runoff is rapid. Water erosion hazard is high to very high and wind erosion hazard is low.

Although the majority of this soil is used for cultivation it has low potential for cultivated crops, and medium potential for tree crops and rangeland. It is fairly well suited to some building sites, and well suited for most of the recreational development and sanitary facilities.

This soil has low potential for rainfed and irrigated agriculture. The main limiting factors are shallow profiles to bedrock, steep slopes, and excessive gravel on the surface. It is suited only to wheat, barley and millet. The main concerns of management are to control erosion, to preserve moisture, and to maintain fertility. Erosion control measures include minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases infiltration rate. Although it has some potential for tree crops, orchards should be established on areas where terraces can be established to help control erosion.

This soil is well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate. A planned grazing system that includes proper grazing use and deferred grazing help maintain or improve the range condition and control erosion. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil will permit shallow excavations and has potential for buildings without basements. It is not suitable for buildings with basements due to shallow depth to bedrock. This soil is fairly well suited to most of the water management practices. The main limiting factor is the shallow profile to bedrock and excessive coarse fragments on the surface.

This soil is a poor source for construction material, and for topsoil for areas where adapted vegetation is to be established and maintained. It is a poor source for sand and gravel. Capability unit: IVs-1.

Kf- KILMAHO CLAY LOAM

This deep, well drained, gently sloping to strongly sloping soil is on uplands. It is developed on hard Cretaceous limestone. Slopes are complex and very long. It is generally on undulating to rolling plains. Drainageways are poorly defined in the landscape. These soils cover approximately 2,470 ha of land or 9.1 percent of the survey area.

Typically, the Kilmaho soil has a surface layer of dark grayish brown to dark yellowish brown clay loam, about 14 cm thick. The subsoil is about 34 cm of dark brown to dark yellowish brown, very firm clay. It has some angular limestone fragments. The underlying material to a depth of 102 cm is yellowish brown, very firm clay. It contains some angular limestone fragments, which constitute approximately 15 to 25 percent of the soil volume. This soil is free of surface stoniness.

Included with this soil in mapping are small areas of Semba, Beit Khammouni, Reyhaniyeh and El Boustan soils. These included soils make up less than 20 percent of any one mapped area. The deep, well drained Semka soil has a subsoil of reddish brown clay. It is more stony than the Kilmaho soil. The Beit Khammouni soil has a moderately fine textured subsoil. It is more stony than the Kilmaho soil. The deep, well drained Reyhaniye soil has a coarser textured subsoil than the Kilmaho soil. The El Boustan soil is shallower than the Kilmaho soil. It is very stony on the surface. It is found on steep slopes of the transitional areas to the adjacent hilly landscape.

Permeability is moderate to moderately slow. Available water holding capacity is moderate to high. Organic matter content is medium to low. Fertility is moderate. Runoff is medium. Water erosion hazard is high and wind erosion hazard is low.

The majority of this soil is cultivated. Some areas are used for orchards, particularly for olives. This soil has high potential for tree crops and rangeland. This soil is well suited for building sites, recreational development, and sanitary facilities. This soil has moderate limitations for rainfed and irrigated agriculture. It is fairly well suited to wheat, barley and millet. It has however, severe limitations for tobacco, vegetables and peanuts. The main limiting factor is steep slopes. The main concerns of management are to control erosion and to maintain fertility. Timely field work is necessary to avoid puddling of the soil during wet periods. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control erosion. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases infiltration rate. This soil has few limitations for tree crops. Orchards should be planted on areas where terraces can be established to help to control erosion.

This soil is highly suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. Grazing should be avoided during wet periods to prevent puddling of the surface soil. Maintaining an adequate vegetative cover helps prevent

excessive soil loss and improves the moisture supplying capacity by reducing runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil is highly suited to building sites and sanitary facilities. It is not suitable for dwellings with basements, due to the fine texture of the subsoil. It is highly suitable for the development of all kinds of recreational facilities. This soil has few limitations for most of the water management practices.

This soil has moderate limitations to use for construction material due to excessive amounts of coarse fragments and a fine textured subsoil. It is a fair source for sand and gravel. It is not suitable for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: IIIe-1.

Kg- KISSARA CLAY

This deep, poorly drained, level to depressional soil is on uplands. It is developed on Cretaceous limestone. Slopes are smooth, slightly concave and fairly short. It is generally on level crests of low eroded hills. Drainageways are poorly defined in the landscape. These soils cover approximately 170 ha of land or 0.6 percent of the survey area.

Typically, the Kissara soil has a surface layer of very dark grayish brown clay about 9 cm thick. The subsoil is about 50 cm of dark yellowish brown, very firm clay. It has many grayish mottles on ped faces. The underlying material to a depth of 120 cm is yellowish brown, very firm clay. It has many grayish spots on ped faces. It contains some gravel which comprises less than 35 percent of the soil volume. This soil is stone free.

Included with this soil in mapping are small areas of Kilmaho, Semka, and Beit Khammouni soils. These included soils make up less than 20 percent of any one mapped area. The well drained, deep Kilmaho soil has a subsoil of reddish clay. The Semka soil is better drained than the Kissara soil. It has a subsoil of reddish brown clay. The Beit Khammouni soil is deep and better drained than the Kissara soil. It has a subsoil of yellowish brown clay loam. All these soils have a more stony surface than the Kilmaho soil.

Permeability is slow. Available water holding capacity is high. Organic matter content is moderate. Fertility is low to very low. Runoff is very slow. This soil usually is ponded during the winter months. Water erosion hazard is very low and wind erosion hazard is low.

The majority of this soil is used as rangeland. Some areas are barren especially in depressional areas where water accumulates. Although it is poorly drained, this soil is well suited for crops if an adequate surface drainage is provided. It has moderate potential for cultivated crops, and high potential for tree crops and rangeland. It has moderate limitations for building sites, recreational development, and sanitary facilities.

This soil has moderate limitations for rainfed and irrigated agriculture due to very slow surface runoff because the water accumulates on

the surface for a considerable time each year. If an adequate drainage system is provided, this soil is moderately suitable for wheat, barley and millet, and highly suitable to tobacco, vegetables and peanuts. It has high potential for tree crops. The main limiting factors are slow surface runoff and level to depressional topography. The main concerns of management are to provide adequate surface drainage to prevent ponding during the winter months, and to maintain fertility. Undrained areas are poorly suited to crops. Timely field work is necessary to avoid puddling of the soil during wet periods. Planting and harvesting may be delayed during wet periods. Surface drainage systems remove excess water in most places. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is well suited for rangeland. The major problems of range management are to protect the present vegetation. If rangeland is grazed during wet periods, the soil puddles and vegetation deteriorates. Use of proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil has moderate limitations for most of the building sites, except dwellings with basements and small commercial buildings, due to poor drainage. It is highly suitable for all kinds of recreational development. It has severe limitation for the construction of local roads and streets due to poor drainage. This soil has high potential for water management practices except for the construction of grassed waterways.

This soil is a fair source for construction material and a poor source for sand and gravel, and for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: IIIw-1.

Ma- MAISARAT CLAY

This deep, well drained, level to gently undulating soil is on toe slopes and on terraces. It is developed on gravelly and stony slopewash and terrace deposits derived from Cretaceous limestone. Slopes are simple, smooth, and long. It is generally on level to gently sloping toe slopes of the low hills and terraces of the Abrash River. Drainageways are poorly defined in the landscape. These soils cover approximately 80 ha of land or 0.3 percent of the survey area.

Typically, the Maisarat soil has a surface layer of dark red clay about 21 cm thick. The subsoil is about 25 cm of dark red, very firm, gravelly and stony clay. The underlying material to a depth of more than 100 cm is yellowish red, very firm extremely gravelly and stony clay. The coarse fragments of stones and gravel constitute approximately 90 percent of this layer. This soil has a very stony surface.

Included with this soil in mapping are small areas of El Keshfi, Kadmous and Semka soils. These included soils make up less than 15 percent of any one mapped area. The El Keshfi soil has a gravelly subsoil but it is less stony than the Maisarat soil. It has subsoil of yellowish brown clay to clay loam. The Kadmous soil is very gravelly throughout, but it is less stony than the Maisarat soil. It is found on steep footslopes of adjacent

low hills. The deep, well drained Semka soil has a subsoil of dark yellowish brown to reddish brown clay. It is less stony than the Maisarat soil.

Permeability is very slow in the topsoil and slow to moderately slow in the subsoil. Available water holding capacity is high in the subsoil, and low in the underlying material due to the high amount of coarse fragments. Organic matter content is moderate. Fertility is moderate. Runoff is slow. Water erosion hazard is low and wind erosion hazard is very low.

Most areas are under cultivation and some are used as rangeland. This soil is poorly suited for cultivated crops, and has a fair potential for tree crops and rangeland. It has severe limitations for building sites, recreational development, and sanitary facilities.

This soil is too stony for rainfed and irrigated agriculture. It is poorly suited to wheat, barley and millet, and not suitable for tobacco, vegetables and peanuts due to extreme stoniness on the surface and in the subsoil. It has fair potential for tree crops. The main limiting factors are extreme stoniness, a very fine textured surface soil and very slow permeability. Avoiding field work when the soil is wet helps maintain good tilth. Contour farming and terraces help control erosion in the moderately sloping areas. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate. Stone clearing is essential. Deep rooted crops should be avoided due to stony subsoil. Although it has some potential for tree crops, orchards should be established on areas where terraces can be planted to help control erosion.

This soil is fairly well suited for rangeland. The major problems of range management are to maintain present vegetative cover and control erosion in moderately sloping areas. Grazing should be avoided during wet periods to prevent puddling of the surface soil. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition. Overgrazing should be avoided to protect the vegetative cover to control soil loss by runoff.

This soil has severe limitations for building sites, recreational development, and sanitary facilities due to extreme stoniness. It has fair potential for camp and picnic areas. It is not suited to all kinds of water management practices due to the stony surface and subsoil.

This soil is a poor source for construction material and for sand and gravel. It is not suited for use as topsoil due to excess fines in the surface layer. Capability unit: VIs-7.

Mb- MINTAR SAND

This deep, excessively drained, level to gently undulating soil is on marine aggradation plains adjacent to beaches. It is developed on marine sand. Slopes are both simple and complex, smooth, and long. Drainageways are poorly defined in the landscape. These soils cover approximately 610 ha of land or 2.2 percent of the survey area.

Typically, the Mintar soil has a surface layer of dark brown to brown loose sand about 12 cm thick. The subsoil is about 28 cm of yellowish brown, loose sand. The underlying material to a depth of more than 100 cm is pale brown, loose sand.

Included with this soil in mapping are small areas of Arida, Tartous, and Bassa soils. These included soils make up less than 15 percent of any one mapped area. The Arida soil is similar to the Mintar soil, but it has somewhat lower water holding capacity. The deep, well drained Tartous soil is on transitional areas between the marine beaches and marine aggradation plain. It has reddish brown, clay to clay loam textured subsoils. The Bassa soil is shallow. It is found on small isolated hills of weakly consolidated material.

Permeability is very rapid. Available water holding capacity is low. Organic matter content is low. Fertility is very low. Runoff is slow. Water erosion hazard is slight and wind erosion hazard is very high.

Most of this soil is cultivated because it has somewhat better water holding capacity than the Arida soil. Some areas are used as rangeland, and some areas are barren, especially in transitional zones to the Arida soil. This soil has very low potential for cultivated crops, and low potential for tree crops and rangeland. It is well suited for building sites, recreational development, and sanitary facilities.

This soil has severe limitations for agriculture. The main limiting factors are coarse texture, low water holding capacity and susceptibility to wind erosion. This soil is too droughty for most crops. Maintaining adequate vegetative cover during dry periods helps to control soil blowing. A cropping system in which grasses and legumes are grown during most years also helps to control soil blowing and conserve moisture. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is poorly suited for rangeland. The major problems of range management are to maintain the present vegetative cover and to avoid soil blowing. The Mintar soil is droughty and has a sparse vegetation cover. The bare areas also are subject to overblowing. Species that are suited to sandy soils low in fertility and droughty resistance should be grown. Because this soil is somewhat droughty, reestablishing vegetation is difficult in overgrazed areas. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil has moderate limitations for most building sites, and a fairly high potential for all kinds of recreational development and sanitary facilities. It has few limitations for water management practices except that the soils are not very suitable to pond reservoir areas and grassed waterways.

This soil is a good source for construction material. It is also a good source for sand and gravel. It is however, not suited to be used as a source for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: IVs-3.

Ra- REYHANIYEH CLAY LOAM

This deep, well drained, gently sloping to steeply sloping soil is on uplands. It is developed on Cretaceous limestone. Slopes are simple and complex, smooth, and fairly long. It is generally on gently undulating to rolling elevations and plains. Drainageways are fairly well defined in the landscape. These soils cover approximately 390 ha of land or 1.4 percent of the survey area.

Typically, the Reyhaniyeh soil has a surface layer of very dark grayish brown clay loam about 12 cm thick. The subsoil is about 48 cm of very dark grayish brown to brown, firm clay loam. The underlying material to a depth of 126 cm is brown to light yellowish brown, firm clay loam. It has few angular limestone fragments.

Included with this soil in mapping are small areas of Kilmaho, Beit Khammouni, and El Boustan soils. These included soils make up less than 20 percent of any one mapped area. The deep, well drained Kilmaho soil has a subsoil which is finer texture than the Reyhaniyeh soil. The Beit Khammouni soil is deep. It has a subsoil which is redder and finer textured than the Reyhaniyeh soil. It also has a fairly stony surface. The El Boustan soil is shallower than the Reyhaniyeh soil. The bedrock is usually found within 100 cm of the surface. It has more stony and gravelly surface than the Kilmaho soil.

Most of this soil is cultivated. Some is used as rangeland. This soil is well suited to cultivated crops, tree crops and rangeland. It has few limitations for building sites, recreational development, and sanitary facilities.

This soil has high potential for rainfed and irrigated agriculture. The main limiting factor is moderate slope. The main concerns of management are to keep sheet erosion under control, and to maintain fertility. Because slopes are long and smooth, terraces can be constructed to help control erosion. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is well suited for rangeland. The major problems of range management are to control erosion and to protect the present vegetative cover. Grazing should be avoided during wet periods to prevent puddling of the surface soil. A planned grazing system that includes proper grazing use and deferred grazing help maintain or improve the range condition and control erosion. Overgrazing should be avoided to protect the vegetative cover, thus helping to control soil loss by runoff.

This soil is well suited for most of the building sites, recreational development, and sanitary facilities except it has moderate limitations for dwellings with basement and small commercial buildings because of fine textured subsoils. This soil has no limitations for water management practices.

It is a fair source for construction material but a poor source for sand and gravel. It is not suitable for topsoil material for areas where adapted vegetation is to be established and maintained. Capability unit: IIe-1

Sa- SAFSAFI LOAM

This shallow, excessively drained, moderately steep to very steep soil is on uplands. It is developed on basalt. Slopes are simple and complex, and fairly long. It is generally on steep shoulders and backslopes of low and medium-height hills. Drainageways are well defined in the landscape. These soils cover approximately 750 ha of land or 2.8 percent of the survey area.

Typically, the Safsafi soil has a surface layer of very dark grayish brown loam to sandy loam about 6 cm thick. The subsoil is about 26 cm of very dark brown, friable loam. It has many angular basalt fragments. This soil has a very gravelly and stony surface.

Included with this soil in mapping are small areas of Em Harten, Kferro and Shalouh soils. These included soils make up less than 20 percent of any one mapped area. The Em Harten soil is shallower than the Safsafi soil. The bedrock usually is within 20 cm of the surface. The Kferro soil is like the Safsafi soil, but has a well developed B horizon. The Shalouh soil has a well developed B horizon and has a subsoil finer textured than the Safsafi soil.

Permeability is moderately slow. Available water holding capacity is low. Organic matter content is low. Fertility is very low. Runoff is very rapid. Water erosion hazard is very high and wind erosion hazard is low.

Most of this soil is used as rangeland. A few areas support orchards on terraces in moderately steep areas. This soil has severe limitations for tree crops, and is poorly suited to tree crops and rangeland. It has no potential for building sites, recreational development, and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture. The main limiting factors are steep slopes, shallow profiles to bedrock, gravelly and stony profiles, and low fertility. This soil generally is too steep and too stony for crops. Although it has some potential for tree crops, orchards should be planted on areas where terraces can be established to help control erosion.

This soil is poorly suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. This soil tends to be droughty because of rapid runoff and low water holding capacity. Overgrazing reduces the protective vegetative cover and causes deterioration of the plant community. Overgrazing should be avoided to protect the vegetative cover, and thus control soil loss by runoff. If grazing continues on this soil, the size of the bare areas and the risk of erosion and runoff increases. Because this soil is somewhat droughty, reestablishing vegetation is difficult in overgrazed areas.

This soil has no potential for building sites, recreational development, and sanitary facilities except that it may be used for paths and trails for recreational purpose. This soil is not suitable to any kinds of water management practices.

This soil is a poor source for construction material and sand and gravel. It is not suited to be used as a topsoil source for areas where adapted vegetation is to be established and maintained. Capability unit: VIs-1.

Sb- SEMKA CLAY LOAM

This deep, well drained, undulating to rolling soil is on uplands. It is developed on Cretaceous limestone. Slopes are both simple and complex, and fairly long. It is generally on gently sloping to strongly sloping summits and shoulders of low and medium-height hills. Drainageways are fairly well defined in the landscape. These soils cover approximately 170 ha of land or 0.6 percent of the survey area.

Typically, the Semka soil has a surface layer of dark brown to brown clay loam about 11 cm thick. The subsoil is about 43 cm of dark brown to brown, firm clay loam and clay. It has few angular limestone fragments, which constitute 10 to 20 percent of the subsoil. The underlying material to a depth of 105 cm is strong brown to brown, firm clay. It has few angular limestone fragments. It has a few, soft, irregularly shaped, black manganese concretions. This soil has an extremely gravelly surface.

Included with this soil in mapping are small areas of Besmakah, Kilmaho, and Kadmous soils. These included soils make up less than 20 percent of any one mapped area. The deep, well drained Besmakah soil is less gravelly on the surface, but its subsoil has more coarse fragments than the Semka soil. The Kilmaho soil is similar to the Semka soil, but is less gravelly and stony on the surface and throughout the profile. The Kadmous soil is gravelly throughout the profile. It is developed on colluvium.

Permeability is moderately slow. Available water holding capacity is moderate. Organic matter content is low. Fertility is moderate. Runoff is rapid. Water erosion hazard is high and wind erosion hazard is low.

The majority of this soil is cultivated. Some areas are planted as orchards on terraces, especially in areas with steep slopes. This soil has severe limitations for cultivated crops, and moderate limitations for tree crops and rangeland. It is not suited to building sites, recreational development, and sanitary facilities.

This soil has severe limitations for rainfed and irrigated agriculture. It is poorly suited to wheat, barley and millet, and not suited to other crops that are climatically adapted to the region. The main limiting factors are steep slopes and stoniness. The main concerns of management are to control erosion, to maintain fertility, and to provide enough moisture to plants. This soil generally is too steep and too stony for crops. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control

erosion. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate. Although it has some potential for tree crops, orchards should be established on areas where terraces can be established to help control erosion.

This soil is fairly well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. Overgrazing reduces the protective vegetative cover and causes deterioration of the plant community. Overgrazing should be avoided to protect the vegetative cover, thus helping to control soil loss by runoff. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate.

This soil has severe limitations for building sites, recreational development, and sanitary facilities because of steep slopes and excessive coarse fragments. It can be used for paths and trails for recreational purpose. This soil has no potential for water management practices. This soil is a poor source for construction material and for sand and gravel. It is a fair source for topsoil for areas where adapted vegetation is to be established and maintained. Capability unit: VIs-8.

Sc- SHALOUH CLAY

This shallow, well drained, gently sloping to strongly sloping soil is on uplands. It is developed on basalt. Slopes are simple and complex, smooth, and fairly long. It is generally on gently undulating to rolling elevations and plains. Drainageways are not very well defined in the landscape. These soils cover approximately 740 ha of land or 2.7 percent of the survey area.

Typically, the Shalouh soil has a surface layer of very dark grayish brown gravelly clay about 12 cm thick. The subsoil is about 33 cm of very dark grayish brown, very firm gravelly clay. It has abundant angular basalt fragments. The bedrock is usually found within 50 cm of the surface. These soils are very stony and gravelly on the surface.

Included with this soil in mapping are small areas of Tarkoub, Kferro and Safsafi soils. These included soils make up less than 20 percent of any one mapped area. The Tarkoub soil is deep. It has a fine textured subsoil. It is less stony and gravelly than the Shalouh soil. The Kferro soil is similar to Shalouh soil, except it has a subsoil of clay loam or coarser texture. The Safsafi soil is similar to Shalouh soil, but it does not have a well developed B horizon. It is less stony than the Shalouh soil.

Permeability is slow. Available water holding capacity is low. Organic matter content is low. Fertility is low. Runoff is moderately slow to rapid. The water erosion hazard is moderate to high and the wind erosion hazard is low to very low.

Most of this soil is cultivated. Some areas are planted as orchards, mainly olives. This soil has severe limitations for cultivated crops, and a poor potential for tree crops and rangeland. It is not suited to most

building sites, and it has moderate limitations for recreational development and sanitary facilities.

This soil is not suited to rainfed and irrigated agriculture. The main limiting factors are steep slopes, shallow profiles to bedrock, stony surfaces and profiles, and low fertility. Although it has some potential for tree crops, orchards should be established on areas where terraces can be planted to help control erosion

This soil is fairly well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. The soil tends to be droughty because of rapid runoff and low water holding capacity. Management that maintains an adequate vegetative cover helps prevent excessive soil loss by runoff. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition. Because this soil is somewhat droughty, reestablishing vegetation is difficult on overgrazed areas.

This soil is not suited to building site development because of steep slopes, shallow profiles, and excessive amounts of coarse fragments. It has a moderate potential for shallow excavations. This soil has some potential for recreational development and a high potential for paths and trails. This soil has severe limitations for irrigation, and for construction of terraces and diversions. It has a moderate potential for other types of water management practices.

This soil is a poor source for roadfill material because of excessive amounts of coarse fragments in the profile. It is a fair source of sand and gravel. It is not suited for a topsoil source due to excessive clay and the high amount of gravel in the profile. Capability unit: IVs-1.

Sd- SINN CLAY LOAM

This deep, well drained, gently undulating to rolling soil is on uplands. It is developed on colluvium derived mainly from limestone. Slopes are simple, smooth, and fairly short. It is generally on gently sloping to strongly sloping back slopes and toe slopes of low hills. Drainageways are fairly well defined in the landscape. These soils cover approximately 750 ha of land or 2.8 percent of the survey area.

Typically, the Sinn soil has a surface layer of dark reddish brown gravelly clay about 18 cm thick. The subsoil is about 53 cm of dark reddish gray to dark reddish brown, firm clay. It has some angular limestone fragments. The underlying material to a depth of 120 cm is yellowish red, firm clay. It has some angular limestone fragments. This soil is fairly stony and gravelly on the surface.

Included with this soil in mapping are small areas of Kadmous, El Keshfi, Semka and Kilmaho soils. These included soils make up less than 15 percent of any one mapped area. The Kadmous soil is more gravelly and stony than the Sinn soil. It is on steep backslopes. The deep, well drained El Keshfi soil has a subsoil more gravelly than the Sinn soil. The Semka soil has a subsoil of reddish clay. It is more stony on the surface than the

Sinn soil. The Kilmaho soil is similar to Sinn soil, except it developed on different parent material. It is also less stony and gravelly than the Sinn soil.

Permeability is moderate to slow. Available water holding capacity is moderate to high. Organic matter content is low. Fertility is moderate. Runoff is medium to rapid. The water erosion hazard is high to very high and the wind erosion hazard is very low.

Most of this soil is cultivated. Some areas are planted as orchards, mainly olives. This soil has fair potential for cultivated crops, and good potential for tree crops and rangeland. It is well suited to most of the recreational developments and sanitary facilities. It has moderate to severe limitations for building site development.

This soil is well suited to rainfed and irrigated agriculture. It has good potential for wheat, barley and millet. It is moderately well suited for tobacco, vegetables and peanuts due to steep slopes and high gravel contents of the subsoil. The main concerns of management are to control erosion, to maintain fertility, and to provide an adequate drainage system in areas with gentle slopes. Planting and harvesting may be delayed during wet periods. Avoiding field work when the soil is wet helps maintain good tilth. Surface drainage systems remove excess water in most places. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control erosion. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate. Although it has some potential for tree crops, orchards should be planted on areas where terraces can be established to help control erosion.

This soil is well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. If rangeland is grazed during wet periods, the soil puddles and vegetation deteriorates. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate. Proper stocking rates, pasture rotation, and timely deferment of grazing helps keep rangeland in good condition.

This soil has moderate to severe limitations for building sites because of steep slopes and fine textured subsoils. It is fairly well suited to shallow excavations and dwellings without basements. It is not suited to dwellings with basements, small commercial buildings, and for local roads or streets due to excess clay in the subsoil. It is well suited to all kinds of recreational development projects, like camp and picnic areas, play grounds, and paths and trails. This soil is fairly well suited for most of the water management practices and has a high potential for grassed waterways.

This soil is a fair source for construction material. It is a poor source for sand and gravel. It is not suitable for use as topsoil due to excess clay in the surface layer. Capability unit: IIIe-1.

Ta- TARKOUB CLAY LOAM

This deep, well drained, gently undulating to rolling soil is on uplands. It is developed on basalt. Slopes are both simple and complex, smooth and long. It is generally on gently sloping to strongly sloping summits of high hills. Drainageways are well defined in the landscape. These soils cover approximately 240 ha of land or 0.9 percent of the survey area.

Typically, the Tarkoub soil has a surface layer of reddish brown clay loam about 20 cm thick. The subsoil is about 45 cm of yellowish red, very firm clay. The underlying material to a depth of 120 cm is yellowish red, very firm clay. It has a few angular basalt fragments.

Included with this soil in mapping are small areas of Shalouh and Kferro soils. These included soils make up less than 20 percent of any one mapped area. The Shalouh soil is shallower than the Tarkoub soil. It has a very gravelly and stony surface. The Kferro soil is shallower than the Tarkoub soil. The bedrock usually is within 50 cm of the surface. It is also more gravelly and stony than the Tarkoub soil.

Permeability is moderately slow. Available water holding capacity is high. Organic matter content is moderate. Fertility is medium. Runoff is medium to rapid. Water erosion hazard is moderate to high, and wind erosion hazard is low.

The majority of this soil is cultivated. Some areas are terraced and used for orchards, particularly olives. Few areas are used as rangeland. This soil is highly suitable for all kinds of crops that are climatically adapted to the region. It has no limitations for tree crops and rangeland. It has moderate to severe limitations for building sites, and good potential for recreational development and sanitary facilities.

This soil is well suited to rainfed and irrigated agriculture. It has few limitations. The main concern of management is to control erosion in areas with steep slopes, to maintain fertility and to provide an adequate drainage system for areas with gentle slopes. Timely field work is necessary to avoid puddling of the soil during wet periods. Planting and harvesting may be delayed during wet periods. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control erosion. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate.

This soil is well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. If rangeland is grazed during wet periods, the soil puddles and vegetation deteriorates. A planned grazing system that includes proper grazing use and deferred grazing helps maintain or improve the range condition and control erosion. Using proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil is well suited for some of the building sites. It has no limitations for small excavations. It has moderate limitations for dwellings without basements and severe limitations for dwellings with basement and small commercial buildings due to excess clay in the subsoil. It is well suited for most of the recreational development projects, like camp and picnic areas. This soil is highly suited for all kinds of water management practices.

This soil is a fair source for construction material. It is a poor source of sand and gravel. It is not a good source for topsoil due to excess clay in the surface layer and in the subsoil. Capability unit: IIs-1.

Tb- TARTOUS CLAY LOAM

This deep, well drained, level to gently sloping soil is on gentle elevations and level plains. It is developed on marine continental deposits. Slopes are simple, smooth and very long. It is generally on level to gently undulating marine aggradation plains. Drainageways are poorly defined in the landscape. These soils cover approximately 1,740 ha of land or 6.6 percent of the survey area.

Typically, the Tartous soil has a surface layer of dark reddish brown to reddish brown clay loam about 15 cm thick. The subsoil is about 60 cm of reddish brown, firm clay. It has few angular limestone fragments. The underlying material to a depth of 125 cm is reddish brown to yellowish red, firm clay. It has few angular limestone fragments. This soil has some gravel on the surface, but it is generally free of large stones.

Included with this soil in mapping are small areas of El Hishi, Bassa, and to a limited extent, Mintar soils. These included soils make up less than 15 percent of any one mapped area. The El Hishi soil is deep, and its surface layer is finer textured than the Tartous soil. It also has large cracks during the dry summer months. The Bassa soil is shallower than the Tartous soil. It is found on small isolated low hills of weakly consolidated marine deposits. This soil is very stony and rocky on the surface. The Mintar soil is found in transitional areas near marine beaches. It is coarse textured throughout the profile.

Permeability is moderately slow. Available water holding capacity is moderate to high. Organic matter content is medium. Fertility is moderate. Runoff is slow. The water erosion hazard is low and the wind erosion hazard is very low.

Presently, this soil is under intensive rainfed and irrigated agriculture. It has high potential for all the crops that are climatically adapted to the region. It is highly suitable to tree crops and rangeland. It has no limitations for building sites, recreational development, and sanitary facilities except for local roads and streets.

This soil has no limitations for rainfed and irrigated agriculture. The main concerns of management are to maintain fertility and to provide an adequate surface drainage system for low-lying areas. Avoiding field work

when the soil is wet helps maintain good tilth. Planting and harvesting may be delayed during wet periods. Providing adequate drainage helps overcome the slow surface runoff. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate. This soil is highly suitable to all kinds of tree crops that are adapted to the region.

This soil is well suited for rangeland. The major problems of range management are to maintain the vegetative cover. If rangeland is grazed during wet periods, the soil puddles and vegetation deteriorates. Application of proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil is well suited to all kinds of building sites, except local roads and streets due to excess fines in the subsoil. It has high potential for all kinds of recreational development projects. This soil has no limitations for water management practices.

This soil is not suited to construction material due to excess clay in the subsoil. It is poor source for sand and gravel. It is not suitable to be used as a topsoil source for areas where adapted vegetation is to be established and maintained. Capability unit: I.

Ya- YAHMOUR GRAVELLY LOAM

This deep, moderately excessively to excessively drained, level soil is on valley floors. It is developed on very gravelly recent alluvium. Slopes are simple, smooth and very long. It is generally on narrow alluvial plains and terraces. Drainageways are poorly defined in the landscape. These soils cover 350 ha of land or 1.3 percent of the survey area.

Typically, the Yahmour soil has a surface layer of dark brown gravelly loam about 21 cm thick. The subsoil is about 60 cm of dark brown to dark yellowish brown very gravelly clay loam. The rounded gravel constitutes up to 80 percent of this layer. The underlying material to a depth of 150 cm consists entirely of rounded and flat gravel. This soil is extremely gravelly and stony on the surface.

Included with this soil in mapping are small areas of Zarqa, Jaferiyeh and Kadmous soils. These included soils make up less than 20 percent of any one mapped area. The Zarqa soil is deep. Its subsoil is less gravelly than the Yahmour soil. It has higher water holding capacity than the Yahmour soil. Jaferiyeh soil is deep. It is less gravelly and stony than the Yahmour soil. It is found on older alluvial deposits where the gravelly substratum is usually deeper than 100 cm beneath the surface. The Kadmous soil is found on footslopes and toe slopes of adjacent low hills. It is very gravelly on the surface and throughout the profile.

Permeability is rapid. Available water holding capacity is very low. Organic matter content is low. Fertility is very low. Runoff is slow. The water erosion hazard is low and the wind erosion hazard is very low.

Most of this soil is used for rainfed agriculture and orchards, but the crop yield is very poor. Some areas are used for rangeland. This soil is

not suitable to cultivated crops, and poorly suited to tree crops and rangeland. It has no potential for building sites, recreational development, and sanitary facilities.

This soil is not suited for rainfed and irrigated agriculture. The main limiting factors are low fertility, very low water holding capacity, and an extremely high percentage of coarse fragments on the surface and throughout the profile. This soil is too gravelly and stony for crops.

This soil is best suited to rangeland, but the grazing capability is low. The major problems of range management are to provide enough moisture for the plants and to maintain present vegetative cover. This soil is droughty and has a sparse vegetation cover. The bare areas are also subject to blowing. Species that are suited to sandy soils that are low in fertility and drought-resistant should be grown. Because this soil is somewhat droughty, reestablishing vegetation is difficult in overgrazed areas. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil has no potential for building sites, recreational development, and sanitary facilities due to high percentage coarse fragments throughout. It is not suited to water management practices. This soil is a poor source for construction material, and for topsoil source for areas where adapted vegetation is to be established and maintained. It is good source for sand and gravel. Capability unit: VIIs-7.

Yb- YAZIDIYEH CLAY LOAM

This deep, well drained, gently undulating to rolling soil is on uplands. It is developed on marl and soft limestone. Slopes are both simple and complex, slightly convex, and fairly long. It is generally on gently sloping to steeply sloping summits and shoulders of low and medium-height hills. Drainageways are fairly well defined in the landscape. These soils cover approximately 290 ha of land or 1.1 percent of the survey area.

Typically, the Yazidiyeh soil has a surface layer of grayish brown clay loam about 30 cm thick. The subsoil is about 45 cm of dark yellowish brown silty clay loam and clay loam. It contains a few angular limestone fragments. The underlying material to a depth of 110 cm is dark yellowish brown to yellowish brown clay loam. It has a few angular limestone fragments which constitute approximately 10 percent of the soil volume.

Included with this soil in mapping are small areas of Bamra, Bahluliyeh and Reyhaniyeh soils. These included soils make up less than 20 percent of any one mapped area. The Bamra soil is shallower than the Yazidiyeh soil. It has a gravelly surface. The Bahluliyeh soil is shallower than the Yazidiyeh soil. The bedrock usually is within 50 cm of the surface. It has more gravel on the surface than the Yazidiyeh soil. The deep, well drained Reyhaniyeh soil is developed on hard Cretaceous limestone. It is on gentle slopes and has a surface less gravelly than the Yazidiyeh soil.

Permeability is moderate. Available water holding capacity is moderate. Organic matter content is low. Fertility is medium to low. Runoff is medium to rapid. The water erosion hazard is moderate to high and the wind erosion hazard is low.

The majority of this soil is cultivated. Some areas are terraced and used for orchards, mainly for olives. Few are under pasture. This soil has severe limitations for cultivated crops mainly because of steep slopes. It is well suited to tree crops and rangeland. It has moderate potential for building sites, recreational development, and sanitary facilities.

This soil is poorly suited to rainfed and irrigated agriculture. It has some potential for wheat, barley and millet. The main limiting factor is unfavorable topography. The main concerns of management are to control erosion and to maintain fertility. These soils are too steep for cultivated crops. Soil loss is excessive under present farming practices. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control erosion. Because slopes are long and smooth, terraces can be constructed to help control erosion. Returning crop residue to the soil improves tilth and fertility and increases the infiltration rate. Although it has some potential for tree crops, orchards should be planted on areas where terraces can be established to help control erosion.

This soil is fairly well suited for rangeland. The major problems of range management are to control erosion and to maintain present vegetative cover. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate. Overgrazing should be avoided to protect the vegetative cover, thus helping to control soil loss by runoff. If grazing continues on this soil, the size of the bare areas and the risk of erosion and runoff increases. Proper stocking rates, pasture rotation, and timely deferment of grazing help keep rangeland in good condition.

This soil has moderate limitations for all kinds of building site development. The main limiting factor is slope. It is fairly well suited to recreational developments, such as camp and picnic areas and playground. The main limiting factor is the steep slope. This soil has fair potential for water management practices.

This soil is a poor source for construction material, and for sand and gravel. It is not suited to be used as a topsoil source for areas where adapted vegetation is to be established and maintained. Capability unit: IVe-1.

Za- ZARQA CLAY LOAM

This deep, well to moderately excessively drained, level to gently sloping soil is on bottom lands. It is developed on recent alluvium. Slopes are simple, smooth and long It is generally on recent alluvial plains and terraces. Drainageways are well defined in the landscape. These soils cover 180 ha of land or 0.7 percent of the survey area.

Typically, the Zarqa soil has a surface layer of dark brown to brown clay loam about 15 cm thick. The subsoil is about 60 cm of dark yellowish brown gravelly clay loam. It contains abundant rounded and flat gravel. The underlying material to a depth of 120 cm is dark yellowish brown to yellowish brown gravelly clay loam. It contains abundant rounded and flat gravel, which constitutes up to 80 percent of the soil volume. This soil has a very gravelly surface.

Included with this soil in mapping are small areas of Yahmour, Jaferiyeh, Kadmous, El Keshfi and Joseriyeh soils. These included soils make up less than 20 percent of any one mapped area. The Yahmour soil has a more gravelly surface and subsoil than the Zarqa soil. The Jaferiyeh soil is deep and almost free of surface and subsurface gravel. It is on older alluvium and terraces. The Kadmous soil is developed on colluvium. It has a more gravelly surface and subsoil than the Zarqa soil. It is found on steep footslopes of adjacent hills. The El Keshfi soil is similar to Zarqa soil, except it is developed on colluvium. It has a gravelly surface. It is found on steep footslopes and toe slopes of low to medium-height hills. The Jozeriyeh soil has extremely gravelly surface and profile. It is found on colluvium on adjacent footslopes.

Permeability is moderate in the topsoil and subsoil, and is rapid to very rapid in the underlying material. Available water holding capacity is moderate in the subsoil and is low to very low in the substratum. Organic matter content is low. Fertility is low. Runoff is slow. The water erosion hazard is moderate and the wind erosion hazard is low.

Most of this soil is used for orchards. Some areas are under rainfed agriculture, with wheat the principal crop. This soil has severe limitations for cultivated crops, and is fairly well suited to tree crops and rangeland. It has moderate limitations for building sites, recreational development, and sanitary facilities.

This soil is poorly suited to rainfed and irrigated agriculture. The main limiting factors are excessive amounts of coarse fragments on the surface and in the profile, steep slopes, low water holding capacities, and low fertility. It is poorly suited to wheat, barley and millet. This soil is too droughty for most crops. Minimum tillage, contour farming, crop residue management, grassed waterways, and inclusion of grasses and legumes in the cropping system help control erosion. Returning crop residue to the soil improves tilth and fertility and increases infiltration rate. Although it has some potential for tree crops, orchards should be established on areas where terraces can be established to help to control erosion.

This soil is well suited for rangeland. The major problems of range managements are to control erosion and to maintain present vegetative cover. A planned grazing system that includes proper grazing use and deferred grazing helps maintain or improve the range condition and control erosion. Maintaining an adequate vegetative cover helps prevent excessive soil loss and improves the moisture supplying capacity by reducing the runoff rate.

This soil has moderate limitations for building site development due to excessive amounts of coarse fragments on the surface and in the subsoil. It

is fairly well suited to all kinds of recreational development, including camp and picnic areas and play grounds. This soil has fair potential for most of the water management practices except it is not suited to embankments, dikes and levees. It is not suited for irrigation because of excessive amounts of coarse fragments.

This soil is a poor source for construction material due to the high amount of coarse fragments. It is a fair source for sand and gravel. The limiting factor is excess clay throughout the profile. It is not suited as topsoil source for areas where adapted vegetation is to be established and maintained. Capability unit: IVs-7.

5 USE AND MANAGEMENT OF SOILS

The soil survey is an inventory and an evaluation of the soils of the survey area. It is useful in adjusting land use to the limitations and potentials of the soils. Its use can also avoid soil-related failures in uses of the land.

During the course of a survey, the soil surveyors keep detailed notes about the nature of the soils and about unique aspects of soil behavior. These notes include data on erosion, drought damage, agricultural yields, flooding, and other factors that affect the productivity, potential and limitations of the soils. These notes are combined with profile descriptions and data on soil properties measured in the laboratory as the basis for predicting soil behavior.

Information in this section is useful in planning use and management of the soils for crops, vegetables, pasture, orchards, as sites for buildings, highways and other transportation systems, recreation facilities and water management. From the data presented the potential of each soil for specific land uses can be determined, soil limitations to these land uses can be identified and failures caused by unfavorable soil properties can be avoided. A site where soil properties are favorable can be selected or practices that will overcome the limitation can be planned.

5.1 GENERAL SOIL PROPERTIES

Table 4-4 lists important soil characteristics of the soil mapping units. The data are presented in digital form so that thematic maps can more easily be produced from the soil maps. Thematic maps, as the name suggests, show one feature or theme per map such as slope class, soil depth and the like. Thematic maps generally are produced by an information system utilizing the computer after the soil maps have been digitized.

Table 4-5 presents the class limits of the characteristics listed in Table 4-4. The two tables should be used simultaneously.

The soil characteristics listed in Table 4-4 are features that can be measured or observed in the field. They include the slope, depth, drainage and texture of the soils, as well as their degree of stoniness, the amount of gravel and the rock outcrop characteristics of the map units.

Other soil characteristics not listed in Table 4-4 include depth to a water table, possibility of flooding (inundation), salinity, presence of alkali, and wind and water erosion. These characteristics are not presented in table form since, with the exception of water erosion, the soils all rate about the same. All soils of the survey area have water tables deeper than 100 cm. Only two soils, Kissara and Zarqa may flood and even for these soils the likelihood of inundation is rare. None of the soils have any more than slight salinity and none are affected by alkali. Only three soils, Arida, Kansebba, and Mintar have suffered more than slight wind erosion damage and wind erosion on these soils has been moderate. Water erosion has been widespread in the survey area, however, and is most severe on the steep soils. Two soils, Kadmous and Kansebba, have had very severe erosion and both occupy slopes in excess of 75 percent. Six soils have had severe erosion, Bahluliyeh, Bamra, Bmalkeh, Semka, Yazidiyeh, and Zarqa, and the slopes of these soils, except for Zarqa, with 5-9 percent slopes, all were on slopes of 9-50 percent. The rest of the soils have had slight or moderate erosion and generally the slopes of these are less than 9 percent.

The major limitations of each soil can be determined by examining Table 4-4 and noting in Table 4-5 the class limits for each characteristic. Slopes generally are limiting because of high runoff and erosion if they are steeper than 5-9 percent (slope class 3). Eleven of the soils have slopes that exceed this, some by a considerable margin. Depending upon the crop grown soil depth can be limiting because of a reduced root zone and water storage reservoir. Generally depth classes 3 and 4 are limiting (less than 50 cm). Nine soils have depth classes of 3 or 4.

Soil drainage can be limiting if it is either poor or excessive. One soil, Arida, has excessive drainage (due to coarse texture) and one soil has very poor drainage, Kissara. The other soils mostly are well drained.

Soil texture can be limiting if it is too coarse. Coarse textures generally consist of quartz of sand size which lacks minerals that could weather into elements needed by plants. Therefore most sands have a very low fertility potential. Two soils - Arida and Mintar - are coarse textured. The ideal soil texture for most purposes is medium to moderately fine corresponding to numbers 3 and 4 in Table 4-4. Six soils have finer surface soil textures than this which means that these soils would have slow permeability and because of stickiness may be difficult to till. These fine textured soils are Bassa, Besmakah, Bmalkeh, Drykish, Jozeriyeh and Kissara.

Surface stoniness is a limiting factor since it interferes with tillage operations as well as use of the soil for roads, buildings and other structures. Eleven of the soils have no or negligible surface stoniness. In referring to Tables 4-4 and 4-5 it is seen that three soils are in stoniness class 2, six are in class 3, three are in class 4 and five are in class 5 in which 60 percent or more of the surface consists of stones.

Rock outcrop refers to bedrock exposures. While stones usually can be picked up and removed from the soil, bedrock is a permanent limitation where it outcrops. Six of the soils have rock outcropping in percentages greater than 25 and in one of these - Kadmous - 50-90 percent of the area consists of rock outcrop.

Surface and subsoil gravel is limiting if excessive since this part of the soil volume is inert in terms of supplying elements and water to plants. All of the soils in the area have some gravel on the surface and in the subsoil. When the class is above 3 gravel becomes limiting. Seven soils have surface gravel present above the class 3 level and seven soils have subsoil gravel present exceeding the class 3 limit. Besmakeh has 60-80 percent gravel in the surface while Jozeriyeh and El-Keshfi have above 80 percent gravel in the subsoil.

5.2 AGRICULTURAL POTENTIAL OF SOILS

Table 4-6 gives the agricultural potential of the soils of the survey area. The first column in Table 4-6 is a listing of the map symbol and name of the soil. Column 2 lists the capability class, subclass and unit of each soil. The next seven columns give suitability ratings for important crops grown in the area. Column ten gives the grazing suitability for the soils. Column eleven lists the principal features limiting use of the soils. The suitability ratings are good, fair, poor, and very poor.

The capability classes and subclasses show in a general way the suitability of soils for most kinds of field crops. The soils are classified according to their limitations when they are used for field crops, the risk of damage when they are used and the way they respond to treatment. The grouping does not take into account major and generally expensive land farming that would change slope, depth, stoniness, or other characteristics of soils, does not take into consideration possible but unlikely major reclamation projects, and does not apply to horticultural crops or other crops that require special management. The capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for forest trees or for engineering purposes.

In the capability system all kinds of soils are grouped at three levels: class; subclass; and unit. These levels are defined below.

Capability classes are the broadest groups and are desigreated by the Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have few limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants, or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants, or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, usually wetness, that make them generally unsuitable for cultivation.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and landforms have limitations that nearly preclude their use for commercial crop production.

Capability subclasses are soil groups within one class. They are designated by adding a lower case letter, e, w, s or c to the class numeral, for example IIe. The letter e shows that the main limitation is risk of erosion unless close-growing plant cover is maintained. The letter w shows that water in or on the soil interferes with plant growth or cultivation. The letter s shows the soil is limited mainly because it is shallow, droughty, stony, rocky or saline or alkali. The letter c shows that the chief limitation is climate that is too dry.

In class I there are no subclasses because the soils in this class have few limitations. Class V contains only the subclasses w, s or c.

The capability unit is identified in the description of each soil mapping unit. The unit is identified by an arabic numeral and the soils in one capability unit are enough alike to be suited to the same crops and feature plants, to require similar management, or to have similar productivity. A system and general guidelines to assign soils into capability units are presented in detail in seminar notes (17). In this system, capability unit symbols are standardized for Syria, thus providing a great uniformity for the establishment of capability units by different surveyors in different parts of the country. For example, capability unit (S-1) always shows a depth limitation.

The crop suitability ratings are arrived at by a consideration of the soil characteristics. Soils that occur on gentle slopes, are deep, well drained, medium textured, and free of stones, rocks, gravel, alkali and salts and that have a favorable climate are suitable for all crops. As slopes increase or soils become shallower or poorly or excessively drained, or stony, or rocky, or saline or alkali, or have less favorable climate they are less suitable for crops. Some crops such as tobacco and vegetables are more demanding in terms of the soil environment while tree crops and pasture usually are less demanding. The final column in Table 4-6 lists what are considered to be the most limiting of the soil factors.

5.3 RECREATIONAL DEVELOPMENT

The soils of the survey area are rated in Table 4-7 according to limitations that affect their suitability for recreation uses and as building sites.

The ratings for recreation uses are based on such restrictive soil features as slope, texture of the soil surface, wetness, and flooding. Not considered in these ratings, but important in evaluating a site, are location and accessibility of the area, size and shape of the area and its scenic quality, the ability of the soil to support vegetation, access to water, and either access to public sewer lines or capacity of the soil to absorb septic tank effluent. Onsite

assessment is essential before final selection of sites.

The degree of limitation is expressed as slight, moderate, and severe. Slight means the soil properties are generally favorable and that limitations are minor and easily overcome. Moderate means that the limitations can be overcome or alleviated by planning, design or special maintenance. Severe means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design or intensive maintenance.

Camp areas require such site preparation as shaping and leveling for tent and parking areas, stabilizing roads and intensely used areas and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils for this use have mild slopes and are not wet or subject to flooding during periods of use. The surface has few or no stones or boulders, absorbs water readily, but remains firm and is not dusty when dry. Strong slopes or boulders greatly increase the cost of construction.

Picnic areas are subject to heavy foot traffic. The best soils for this use are firm when wet, not dusty when dry, are not subject to flooding and do not have slopes, stones or boulders.

Playgrounds require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding. These soils should be free of stones and boulders and depth of soil over bedrock should be deep enough to allow for necessary grading.

Paths and trails for walking, bicycling, or horseback riding should require little or no cutting or filling. The best soils for this use are not wet, are firm after rains, are not dusty when dry and are not subject to flooding. They have moderate slopes and few stones or boulders.

5.4 ENGINEERING

This section provides information about the use of soils for building sites, sanitary facilities, construction material, and water management. Among those who can benefit from this information are engineers, landowners, community planners, town and city managers, land developers, builders, contractors, and farmers and ranchers.

The ratings in the engineering tables are based on test data and estimated data in the "Soil Properties" section. The ratings were determined jointly by soil scientists and engineers of the Soil Conservation Service using known relationships between the soil properties and the behavior of soils in various engineering uses.

Among the soil properties and site conditions identified by a soil survey and used in determining the ratings in this section were grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock that is within 5 or 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure or aggregation, in-place soil density, and geologic origin of the soil material.

Where pertinent, data about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of absorbed cations were also considered.

On the basis of information assembled about soil properties, ranges of values can be estimated for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, compressibility, slope stability, and other factors of expected soil behavior in engineering uses. As appropriate, these values can be applied to each major horizon of each soil or to the entire profile.

These factors of soil behavior affect construction and maintenance of roads, airport runways, pipelines, foundations for small buildings, ponds and small dams, irrigation projects, drainage systems, sewage and refuse disposal systems and other engineering works. The ranges of values can be used to (1) select potential residential, commercial, industrial, and recreational uses; (2) make preliminary estimates pertinent to construction in a particular area; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for location of sanitary landfills, onsite sewage disposal systems, and other waste disposal facilities; (5) plan detailed onsite investigations of soils and geology; (6) find sources of gravel, sand, clay, and topsoil; (7) plan farm drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; (8) relate performance of structures already built to the properties of the kinds of soil on which they are built so that performance of similar structures on the same or a similar soil in other locations can be predicted; and (9) predict the trafficability of soils for cross-country movement of vehicles and construction equipment.

Data presented in this section are useful for land-use planning and for choosing alternative practices or general designs that will overcome unfavorable soil properties and minimize soil-related failures. Limitations to the use of these data, however, should be well understood. First, the data are generally not presented for soil material below a depth of 5 feet. Also, because of the scale of the detailed map in this soil survey, small areas of soil that differ from the dominant soil may be included in mapping. Thus, these data do not eliminate the need for onsite investigations, testing, and analysis by personnel having expertise in the specific use contemplated.

The information is presented mainly in tables. Table 4-8 shows, for each kind of soil, the degree and kind of limitations for building site development; Table 4-9 for sanitary facilities; and Table 4-11 shows the kind of limitations for water management. Table 4-10 shows the suitability of each kind of soil as a source of construction materials.

The information in the tables, along with the soil map, the soil descriptions, and other data provided in this survey, can be used to make additional interpretations and to construct interpretive maps for specific uses of land.

5.4.1 BUILDING SITE DEVELOPMENT

Building site development ratings are given in Table 4-8 along with the ratings for recreation development. Limitations are indicated as slight, moderate, and severe. A slight limitation indicates that soil properties generally are favorable and any limitation can be easily overcome. A moderate limitation indicates that the soil properties and site features are unfavorable but the limitations can be overcome or minimized by special planning. A severe limitation indicates one or more soil properties or site features are so unfavorable or difficult to overcome that a major increase in construction effort is needed.

Shallow excavations are made for pipelines, sewer lines, communications and power transmission lines, basements, open ditches and cemeteries. Such digging is influenced by soil wetness, texture and consistence of soils, the tendency of soils to cave in or slough and the presence of very firm dense layers, bedrock or large stones. Ratings do not apply to soil horizons below a depth of about one meter and a half.

Dwellings and small commercial buildings referred to in Table 4-8 are built on undisturbed soil and have foundation loads of a dwelling no more than three stories high. For these structures soils should be sufficently stable so that cracking or subsitence of the structure from settling or shear failure of the foundation does not occur. The ratings were determined from estimating compressibility and shrink-swell potential of the soil. Soil texture, plasticity, wetness and depth to a water table also were considered. Depth to bedrock, slope and large stones are additional factors.

Local roads and streets referred to in Table 4-8 have an all-weather surface that can carry light to medium traffic all year. They consist of a subgrade of the underlying soil material, a base of gravel or crushed rock and a surface of asphalt or concrete. The texture of the soil and its shrink- swell potential are indicators of the traffic supporting capacity used in making the ratings. In addition, soil wetness, flooding, slope, depth to bedrock and presence of large stones affect stability and ease of excavation.

5.4.2 SANITARY FACILITIES

Favorable soil properties and site features are needed for proper functioning of septic tank absorption fields, sewage lagoons, and sanitary landfills. The nature of the soil is important in selecting sites for these facilities and in identifying limiting soil properties and site features to be considered in design and installation. Also, those soil properties that affect ease of excavation or installation of these facilities will be of interest to contractors and local officials. Table 4-9 shows the degree and kind of limitations of each soil for such uses and for use of the soil as daily cover for landfills. It is important to observe local ordinances and regulations.

If the degree of soil limitation is expressed as slight, soils are generally favorable for the specified use and limitations are minor and easily overcome; if moderate, soil properties or site features are unfavorable for the specified use, but limitations can be overcome by special planning and design; and if

severe, soil properties or site features are so unfavorable or difficult to overcome that major soil reclamation, special designs, or intensive maintenance is required. Soil suitability is rated by the terms good, fair, or poor, which, respectively, mean about the same as the terms slight, moderate, and severe.

Septic tank absorption fields are subsurface systems of tile or perforated pipe that distribute effluent from a septic tank into the natural soil. Only the soil horizons between depths of 45 and 180 cm are evaluated for this use. The soil properties and site features considered are those that affect the absorption of the effluent and those that affect the construction of the system.

Properties and features that affect absorption of the effluent are permeability, depth to seasonal high water table, depth to bedrock, and susceptibility to flooding. Stones, boulders, and shallowness to bedrock interfere with installation. Excessive slope can cause lateral seepage and surfacing of the effluent. Also, soil erosion and soil seepage are hazards if absorption fields are installed on sloping soils.

In some soils, loose sand and gravel or fractured bedrock is less than 120 cm below the tile lines. In these soils the absorption field does not adequately filter the effluent, and groundwater in the area may be contaminated.

On many of the soils that have moderate or severe limitations for use as septic tank absorption fields, a system to lower the seasonal water table can be installed or the size of the absorption field can be increased so that performance is satisfactory.

Sewage lagoons are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons have a nearly level floor and cut slopes or embankments of compacted soil material. Aerobic lagoons generally are designed to hold sewage within a depth of 60 to 150 cm. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of groundwater. Soils that are very high in content of organic matter and those that have cobbles, stones, or boulders are not suitable. Unless the soil has very slow permeability, contamination of groundwater into the lagoon can seriously reduce the lagoon's capacity for liquid waste. Slope, depth to bedrock, and susceptibility to flooding also affect the suitability of sites for sewage lagoons or the cost of construction. Shear strength and permeability of compacted soil material affect the performance of embankments. These limitations do not apply to anaerobic lagoons.

Sanitary landfill is a method of disposing of solid waste by placing refuse in successive layers either in excavated trenches or on the surface of the soil. The waste is spread , compacted, and covered daily with a thin layer of soil material. Landfill areas are subject to heavy vehicular traffic. Risk of polluting groundwater and trafficability affect the suitability of a soil for this use. The best soils have a loamy or silty texture, have moderate to slow permeability, are deep to a seasonal water table, and are not subject to flooding. Clayey soils are likely to be sticky and difficult to spread. Sandy or gravelly soils generally have rapid permeability, which might allow noxious liquids to contaminate groundwater. Soil wetness can be a limitation, because operating heavy equipment on a wet soil is difficult. Seepage into the refuse increases the risk of pollution of groundwater.

Ease of excavation affects the suitability of a soil for the trench type of landfill. A suitable soil is deep to bedrock and free of large stones and boulders. If the seasonal water table is high, water will seep into trenches.

Unless otherwise stated, the limitations in Table 4-9 apply only to the soil material within a depth of about 180 cm. If the trench is deeper, a limitation of slight or moderate may not be valid. Site investigation is needed before a site is selected.

Daily cover for landfill should be soil that is easy to excavate and spread over the compacted fill in wet and dry periods. Soils that are loamy or silty and free of stones or boulders are better than other soils. Clayey soils may be sticky and difficult to spread; sandy soils may be subject to soil blowing.

The soils selected for final cover of landfills should be suitable for growing plants. Of all the horizons, the A horizon in most soils has the best workability, more organic matter, and the best potential for growing plants. Thus, for either the area- or trench-type landfill, stockpiling material from the A horizon for use as the surface layer of the final cover is desirable.

Where it is necessary to bring in soil material for daily or final cover, thickness of suitable soil material available and depth to a seasonal high water table in soils surrounding the sites should be evaluated. Other factors to be evaluated are those that affect reclamation of the borrow areas. These factors include slope, erodibility, and potential for plant growth.

5.4.3 SOURCE FOR CONSTRUCTION MATERIALS

The suitability of the soil as a source of roadfill, sand, gravel and topsoil is indicated in Table 4-10 by ratings of good, fair, and poor. The texture, thickness and organic matter content of the soils are important factors in rating soils for use as construction materials. Each soil is rated based on a depth of about 150 cm.

Roadfill is soil material used for embankments for roads. Soils are evaluated as a source of roadfill for low embankments which usually are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the base of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained.

Soils rated good for roadfill are coarse grained. They have low shrink-swell potential and few cobbles and stones. They are well drained and have slopes of 15 percent or less. Soils rated fair have moderate shrink-swell potential, moderately steep slopes, some wetness or many stones. If the thickness of suitable material is less than a meter the soil is rated poor.

Sand and gravel ratings provide guidance as to where to look for probable sources and are based on the probability that soils in the area contain sizable quantities of sand or gravel.

Topsoil is used in areas where vegetation is to be established and maintained. Soils rated good have at least 40 cm of friable loamy material at

their surface. They are free of stones and cobbles, low in gravel and have gentle slopes. Soils rated fair are loose sandy soils or firm loamy or clayey soils 20-40 cm thick that have appreciable amounts of gravel, stones or soluble salt. Soils rated poor are very sandy or clayey; soils with suitable layers less than 20 cm thick; soils with large amounts of gravel, stones or soluble salt; steep soils; and poorly drained soils.

5.4.4 WATER MANAGEMENT

In Table 4-11 soil mapping units are rated for the soil and site features that affect water management. The suitability is indicated as good, fair, and poor. The soil mapping units are evaluated for the following uses: pond reservoir areas; embankments, dikes and levees; drainage, irrigation, terraces and diversions; and grassed waterways.

Soils best suited for pond reservoirs have a low seepage potential which is estimated from the soil permeability and depth to permeable material.

Embankments, dikes and levees require soil material that is resistant to seepage and erosion and has favorable stability, shrink-swell potential, shear strength and compaction characteristics. Large stones downgrade the soil for this purpose.

Drainage of soil is affected by permeability, texture, depth to bedrock, depth to water table, slope, salinity and alkali and availability of a drainage outlet.

Irrigation is affected by slope, susceptibility to flooding, water erosion hazard, texture, permeability of the soil below the surface, available water capacity, need for drainage and depth to the water table.

Terraces and diversions are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for this purpose are uniformity and steepness of slope, depth to bedrock, large stones, permeability, ease of establishing vegetation and resistance to erosion.

Grassed waterways are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the soil for this purpose are slope, permeability, erodability wetness and suitability for permanent vegetation.

5.5 SOIL PROPERTIES

Extensive data about soil properties are summarized on the following pages. The two main sources of these data are the many hundreds of soil borings made during the course of the survey and the laboratory analyses of selected soil samples from typical profiles.

In making soil borings during field mapping, soil scientists identify several important soil properties. They note the seasonal soil moisture

condition or the presence of free water and its depth. For each horizon in the profile, they note the thickness and color of the soil material; the texture, or amount of clay, silt, sand, and gravel or other coarse fragments; the structure, or the natural pattern of cracks and pores in the undisturbed soil; and the consistence of the soil material in place under the existing soil moisture conditions. They record the depth of plant roots, determine the pH or reaction of the soil, and identify any free carbonates.

Samples of soil material are analyzed in the laboratory to verify the field estimates of soil properties and to determine the major properties of key soils, especially properties that cannot be estimated accurately by field observation. Laboratory analyses are conducted for all soil series in the survey area, and laboratory data for all soil series are presented in the appendix.

The available field and laboratory data are summarized in tables. The tables give the estimated range of engineering properties, the engineering classifications, and the physical and chemical properties of each major horizon of each soil in the survey area. They also present data about pertinent soil and water features.

5.5.1 ENGINEERING PROPERTIES

Table 4-12 gives estimates of some engineering properties and classifications for the soils of the study area. The data are recorded digitally for easy preparation of thematic maps. Table 4-13 gives the class limits for the properties and classifications given in Table 4-12.

Texture is described in Tables 4-12 and 4-13 in standard terms. The data are for combined surface and subsoil horizons, The terms are defined according to percentages of sand, silt and clay in soil material that is less than 2 millimeters in diameter.

The two systems commonly used to classify soils for engineering use are the Unified Soil Classification System and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO).

The unified system classifies soil according to properties that affect their use as construction materials. Soils are classified according to grain size distribution, plasticity index, liquid limit and organic matter content. Soils are grouped into 15 classes - eight for coarse grained soils identified as GW, GP, GM, GC, SW, SP, SM and SC; six classes for fine grained soils, identified as ML, CL, OL, MH, CH and OH; and one class of organic soils identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, ML-CL. No organic soils were mapped in the study area and not all classes are recognized in the study area.

The AASHTO system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A1 through A7 on the basis of grain size distribution, liquid limit and plasticity index. Soils in A1 are coarse grained and low in content of fine material. At the other extreme, in group A7, are fine grained soils. Highly organic soils are classified in group

A8 on the basis of visual inspection.

Liquid limit and plasticity index indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems.

5.5.2 PHYSICAL AND CHEMICAL PROPERTIES AND EROSION HAZARDS

Table 4-14 shows estimated values for several soil characteristics and features. The data are recorded digitally for easy preparation of thematic maps. Table 4-15 gives the class limits for the properties given in Table 4-14

Permeability is estimated on the basis of known relationships among soil characteristics observed in the field - particularly soil structure, porosity and texture - that influence the downward movement of water in the soil. The estimates are for vertical water movement when the soil is saturated.

Available water holding capacity is rated on the basis of soil characteristics that influence the ability of the soil to hold water and make it available to plants. Important characteristics are content of organic matter, soil texture, and soil structure.

Soil reaction is expressed as a range of pH values. The figures are based on field checks that have been verified by laboratory analyses.

Water erosion hazard is based on the behavior of bare unprotected soil. It considers soil texture, organic matter content, structure, permeability and slope.

The wind erosion hazard is assigned on the basis of surface soil texture assuming an unprotected surface. Sands are most likely to blow while medium textured soils are moderately erodable. Very stony and gravelly and wet soils are the least susceptible to wind erosion.

6 SOIL SERIES AND MORPHOLOGY

In this section, each soil series recognized in the survey area is described in detail. Descriptions are arranged in alphabetical order by series name, and are presented in the appendix along with the physical and chemical analysis.

Characteristics of the soil and the material in which it formed are discussed for each series. A pedon, a small three-dimensional area of soil that is typical of the soil series in the survey area, is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (12). Unless otherwise noted, matrix colors described are for dry soil. Phases, or map units, of each soil series are described in the section "Soil Maps for Detailed Planning".

7 FORMATION OF SOILS

In this section, five factors of soil formation are related to the soils in the Tartous-Safita area. These factors determine the characteristics of the soil at any given point. They are: (1) the physical and mineralogical composition of the parent material, (2) the climate under which the soil material has accumulated and existed since accumulation, (3) the plant and animal life on and in the soil, (4) the relief, and (5) the length of time that the forces of soil formation have acted on the soil material.

Climate and plant and animal life, chiefly plants, are active factors of soil formation. They act on the parent material that has accumulated through the weathering of rocks and slowly change it to a natural body that has genetically related horizons. The effects of climate and plant and animal life are conditioned by relief. The parent material also affects the kind of soil profile that forms and, in extreme cases, determines it almost entirely. Finally, time is needed for changing the parent material into a soil. Some time is always required for the differentiation of soil horizons. Usually, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on soil that few generalizations can be made regarding the effect of any factor unless conditions are specified for the other four.

7.1 PARENT MATERIAL

Parent material is the unconsolidated mass of material in which soils form. In the Tartous-Safita area several kinds of parent material were recognized (Figure 4-5). Neogene and Cretaceous sedimentary rocks cover most of the survey area. Basic extrusive rocks of Neogene era are found near the town of Tarkoub.

Quaternary marine aggradation material covers a narrow strip of land between the Mediterranean sea in the west and the low limestone hills in the east. Weakly consolidated sandstone is also found in this area as small, isolated, low hills. The marine sands form a very narrow beach between the marine aggradation plains and the Mediterranean sea. Quaternary and recent alluvium is deposited by numerous creeks and streams are found as very narrow bands along the waterways. Gravelly colluvium of Quaternary and more recent era is deposited at the footslopes of high hills and low mountains in the eastern part of the survey area.

Sedimentary rocks belong to different geological times and cover large areas in the Tartous-Safita area. Cretaceous sedimentary rocks are mostly hard limestones, dolomites, sandstones, clays and flints. They are widely exposed in the mountainous part of the survey area in the east. In the remaining areas, they are present almost everywhere but hidden under other sediments. Neogene sedimentary rocks consist of limestone and marl, with inclusions of clays, conglomerates, sandstones and siltstones. They occupy fairly large areas in areas south and southwest of Safita.

Basic extrusive rocks, which consist of Neogene basalt, are widely spread in the southeastern corner of the survey area. Those rocks consist of dark gray to

gray colored, massive, partly porous basalts of varying grain sizes. They generally form highly dissected plateaus with remnant volcanic cones, arranged either in volcanic chains or scattered.

Alluvial sediments form the narrow terraces and valley fills of the numerous creeks and streams. The most important of such deposits are the Maisarat valley in the southeast corner and the valley in the north of Safita. These consist of medium to moderately fine textured deposits with well rounded gravelly interbeds.

Quaternary and recent continental deposits are widely spread in the eastern part of the survey area, forming slope wash deposits, colluvium and few alluvial fan deposits. Almost all of these deposits are confined to the sides of the intermontane basins and footslopes of the high hills and medium-height mountains. These deposits are composed mainly of fine to moderately fine textured deposits with a high amount of rounded and subrounded pebbles with varying sizes. The surface of such areas is also very gravelly and stoney.

Marine deposits occupy relatively small areas. They occur as a group of terraces of Upper Quaternary era with different elevation and degree of preservation. They stretch as a narrow band along the western coast of the survey area. In some places the terrace looks like a rock bench, and is made up mostly of compact sandy and calcarerous formations. These deposits consist of compact, gray to light gray, fine grained conglomerates with numerous marine Quaternary fossils and well rounded limestone pebbles. Recent marine deposits form the first marine terrace in the form of sand beaches stretching as a narrow, fairly low band of land along the sea shore. It is very narrow near Tartous and widens towards the southwest corner of the survey area. These deposits are composed of light yellowish, well rounded sands which contain frequent inclusions of well rounded small flint and limestone pebbles.

7.2 CLIMATE

Climate is one of the most important factors of soil formation. It influences the rate of chemical and physical weathering. The Tartous-Safita area has a Mediterranean climate. The taxonomic term used to describe the moisture regime of Mediterranean climates is xeric. In this moisture regime winters are moist and cool and summers are warm and dry. The moisture, coming in winter when potential evapotranspiration is at a minimum, is particularly effective for leaching. Thus the soils formed in this environment are relatively highly weathered considering the total annual precipitation. The annual precipitation throughout the Tartous- Safita area is between 862 and 1112 mm. The soils in these areas on gentle slopes, then, are more deeply developed than those areas receiving less rainfall.

7.3 PLANT AND ANIMAL LIFE

Living organisms play an important part in soil formation. These include plants, animals, insects, earthworms, bacteria and fungi. In the Tartous-Safita area, the soils in the mountains have developed under trees and brush and some grass. In the depressions and on the plains south of Tartous grass was the dominant vegetation except on rock outcrops which are barren. The organic matter

produced by grass accumulates at the surface which is evident in the dark surface layers of the Mollisols and some Inceptisols. Iron has remained in an oxidized state in most of the upland soils which tends to mask the dark colors of some soils with red hues. Microorganisms help decompose plant residues thus releasing nutrients for plant food. Earthworms, burrowing insects, moles and other animals that live in the soil mix the soil material.

7.4 RELIEF AND TOPOGRAPHY

Relief influences soil formation through its effect on drainage, runoff, erosion, plant cover and soil temperature. On the Entisols in the mountains, for example, much of the rainfall is lost through runoff. Where these soils are terraced the rainfall loss is reduced. As a result of runoff, less water is taken in the soil and more soil is lost through erosion. These soils have very thin layers in which organic matter accumulates and if the parent material is calcareous, the soils are calcareous at the surface. Often these soils are stony and stoniness increases proportionally as finer clay, silt and sand particles erode.

More moisture enters the gently undulating Inceptisols and Mollisols so that horizons in which organic matter accumulates are thicker and calcium carbonate occurs deeper in the profile.

In swales and depressions extra moisture is received by runoff from adjacent soils. The horizons where organic matter accumulates are thicker. If drainage is impeded soils may be wet during rainy periods. Sometimes salts accumulate under poor drainage and saline soils form. Irrigation without adequate drainage also will cause salinity which retards plant growth.

7.5 TIME

The length of time that soil material is exposed to the other four factors of soil formation is reflected in the Tartous-Safita area. In the survey area, no highly weathered soils, such as Ultisols and Oxisols, occur. Both of these soils are highly weathered and formed under moist conditions where weathering is intense. Of the soils present, the Inceptisols and Mollisols have undergone some weathering while the Fluvents are young soils on active food plains. The Orthents are kept youthful by erosion. The soils that belong to the Vertic subgroup are fine textured so little water percolates through the profiles to cause leaching.

8 CLASSIFICATION OF THE SOILS

8.1 TAXONOMIC CLASSIFICATION OF SOILS

The system of soil classification currently used was adopted by the National Cooperative Soil Survey in 1965. Readers interested in further details about the system should refer to "Soil Taxonomy".

The system of classification has six categories. Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. In this system the classification is based on the different soil properties that can be observed in the field or those that can be inferred either from other properties that are observable in the field or from the combined data of soil science and other disciplines. The properties selected for the higher categories are the result of soil genesis or of factors that affect soil genesis. In Table 4-16, the soils of the survey area are classified according to the system. Categories of the system are discussed in the following paragraphs.

ORDER. Ten soil orders are recognized as classes in the system. The properties used to differentiate among orders are those that reflect the kind and degree of dominant soil-forming processes that have taken place. Each order is identified by a word ending in 'sol'. An example is Mollisol.

SURBORDER. Each order is divided into suborders based primarily on properties that influence soil genesis and are important to plant growth or that are selected to reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Ustoll (Ust, meaning intermittent dryness, plus oll, from Mollisol).

GREAT GROUP. Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of expression of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and a prefix that suggests something about the properties of the soil. An example is Haplustolls (Hapl, meaning simple horizons, plus ustolls, the suborder of Mollisols that have an ustic moisture regime).

SUBGROUP. Each great group may be divided into three subgroups : the central (typic) concept of the great groups, which is not necessarily the most extensive subgroup; the intergrades, or transitional forms to other orders, suborders, or great groups; and the extragrades which have some properties that are representative of the great groups but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective Typic identifies the subgroup that is thought to typify the great group. An example is Typic Haplustolls.

FAMILY. Families are established within a subgroup on the basis of similar physical and chemical properties that affect management. Among the properties considered in horizons of major biological activity below plow depth are particle-size distribution, mineral content, temperature regime, thickness of the soil penetrable by roots, consistence, moisture equivalent, soil slope, and permanent cracks. A family name consists of the name of a subgroup and a series of adjectives. The adjectives are the class names for the soil properties used as family differentiate An example is fine-loamy, mixed, mesic Typic Haplustolls.

SERIES. The series consists of soils that formed in a particular kind of material and have horizons that, except for texture of the surface soil or of the underlying substratum, are similar in differentiating characteristics and in arrangement in the soil profile. Among these characteristics are color, texture,

structure, reaction, consistence, and mineral and chemical composition. It is the lowest category in the taxonomy.

It is not easy to establish a strict rule for the establishment of soil series. The criteria used for series are mostly the same as those used for classes of other categories in the soil taxonomy, but the range permitted is somewhat narrower than the soil families. A series may have the full range of characteristics of the family to which it belongs, but in one or more characteristics the range is restricted.

In general, the following rules can be used to differentiate between the series:

1- The distinction between families and higher classes are also the distinction between series. In other words, a series cannot range across the limits between the two families or higher categories.

2- The distinction between similar series within a family are restriction in one or more, but not necessarily all of the ranges in properties of the family.

3- Properties used as criteria for separating series should be observed or should be inferred easily.

4- Properties used must create soil series with distinct characteristics which can be measured, observed or estimated.

5- Properties used should have some relation to the horizon differentiation if horizons are present.

As can be seen from the above criteria, it is difficult to establish general guidelines to establish soil series. This will create a serious problem in coordinating soil studies if investigators use different criteria or personal bias. The situation is even more complicated if the soils personnel do not have significant experience in soil survey.

8.2 MORPHOLOGICAL GROUPING OF SOILS

The author has developed a system which forms a base to establish soil series (17). This system depends purely on morphological characteristics of soils and has been very successfully used in a number of countries in Africa, South America and Central America. It tries to organize soils into natural morphological groups according to the characteristics that can be observed in the field. The majority of the criteria adopted here are in agreement with the criteria of FAO and the Soil Taxonomy, therefore the correlation between the international systems is also relatively easy. In addition, since the system permits soils that look similar morphologically in the field to be grouped together, it is compatible with general rules 3, 4 and 5 mentioned above. Lastly, since the morphological grouping is done after the taxonomic classification of that particular soil, it also is compatible with the general rules 1 and 2 mentioned in the same section. This morphological grouping can also be incorporated with the land use capability classification of soils, so

that there will be a uniformity and consistence in interpretation of soil characteristics.

8.2.1 GENERAL CRITERIA

8.2.1.1 GEOLOGY

The following geological material and symbols were used in the Tartous-Safita area:

A- Alluvium (Quaternary to recent)
B- Neogene Basalt
C- Colluvium (Quaternary to recent)
Lc- Cretaceous limestone
Ln- Neogene marl and limestone
M- Marine sand
Mc- Continental marine deposits (Quaternary)
S- Weakly consolidated sandstone

8.2.1.2 DEPTH

This is the depth to the soft or hard bedrock. The following depth classes are used:

- Less than 20 cm
- 20 to 50 cm
- 50 to 100 cm
- more than 100 cm

8.2.1.3 COARSE FRAGMENTS

This is considered only if it occurs as a layer having 35 percent or more coarse fragments and at least 25 cm thick. If this layer occurs within 50 cm of the surface then the texture and the color of the B horizon (or subsoil) is not considered. If it occurs below 50 cm of the surface, then the texture and color criteria for the B horizon are used for the grouping.

8.2.1.4 DRAINAGE

The following drainage classes are used:

- Well drained: Includes excessively and well drained soils.
- Imperfectly drained: Includes moderately well and imperfectly drained soils.
- Poorly drained: Includes poorly and very poorly drained soils.

8.2.1.5 TEXTURE

The following texture groups are used:

- Coarse textured: S-LS
- Medium textured: SL-SiL-Si
- Moderately fine textured: CL-SCL-SiCL
- Fine textured: C-SC-Sic

8.2.1.6 COLOR

The following color criteria are used:

- Brown: Soil with hue 7.5 and chroma 4 or darker; hues 10 YR or yellower.
- Chromic: Soils with hue 7.5 YR and chroma higher than 4; and all hues of 5 YR.
- Red: Soils with hue 2.5 YR or redder.

A general key to the morphological grouping of soils in the field is presented in distributed seminar notes in soil classification and mapping (17). Morphological grouping of soils in Tartous-Safita area is given in Table 4-16. The relationship between the morphological groupings, taxonomic classification and the geology is also summarized in Table 4-17. Table 4-18 lists the soil series of the Tartous - Safita area in relation to the Taxonomic classification, Morphological Groupings and Geology.

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Table 4-1- Climatic Data for Tartous Area

Month	Temperature			Precipitation (mm)	Relative Humidity (%)	Evaporation (mm)
	Average Daily Maximum (C)	Average Daily Minimum (C)	Average (C)			
Jan.	15.8	9.1	12.3	186	66	85
Feb.	16.5	9.1	12.9	127	66	88
March	18.5	10.6	14.9	105	68	92
April	21.9	13.1	17.6	50	67	107
May	25.3	15.0	21.0	21	68	122
June	27.9	19.3	24.1	1	70	130
July	29.2	21.0	25.9	0	73	126
Aug.	30.2	22.5	26.2	1	72	134
Sept.	29.4	20.5	25.3	17	67	150
Oct.	27.0	17.2	22.5	51	63	150
Nov.	23.1	14.1	18.6	101	59	140
Dec.	18.2	11.0	14.4	202	64	101
Yearly	23.6	15.4	19.7	862	67	1425

Table 4-2- Climatic Data for Safita Area

Month	Temperature			Precipitation (mm)	Relative Humidity (%)	Evaporation (mm)
	Average Daily Maximum (C)	Average Daily Minimum (C)	Average (C)			
Jan.	13.3	7.5	9.7	231	71	63
Feb.	14.2	7.5	10.7	175	69	71
March	16.8	9.6	13.0	148	68	83
April	20.7	12.8	16.4	87	66	105
May	24.6	15.9	20.0	25	66	124
June	28.1	19.0	23.3	1	66	143
July	29.1	20.9	24.6	1	73	119
Aug.	30.1	21.6	25.3	3	73	123
Sept.	28.9	20.1	24.0	37	67	143
Oct.	26.2	17.5	21.4	69	61	150
Nov.	21.2	14.2	17.3	112	56	142
Dec.	15.4	9.5	12.2	223	68	80
Yearly	22.4	14.2	18.2	1112	62	1346

Table 4-3- Hectarage and Proportionate Extent of Soils in Tartous-Safita Area

Symbol	Soil Series	Coverage	
		Ha	%
Aa	Annabiyeh	50	0.2
Ab	Arida	560	2.1
Ba	Bahluliyeh	440	1.6
Bb	Bamra	290	1.1
Bc	Bassa	310	1.1
Bd	Beit Khammouni	560	2.1
Be	Besmakah	170	0.6
Bf	Bmalkeh	870	3.2
Bg	El Boustan	4,070	14.9
Da	Drykish	4,360	16.0
Ea	Em Harten	190	0.7
Eb	Em Hosh	60	0.2
Ha	El Hishi	790	2.9
Ja	Jaferiyeh	380	1.4
Jb	Jindiriyeh	90	0.3
Jc	Jozeriyeh	440	1.6
Ka	Kadmous	610	2.2
Kb	Kansebba	2,260	8.3
Kc	Keshfi	560	2.1
Kd	Kferiyeh	140	0.5
Ke	Kferro	180	0.7
Kf	Kilmaho	2,470	9.1
Kg	Kissara	170	0.6
Ma	Maisarat	80	0.3
Mb	Mintar	610	2.2
Ra	Reyhaniyeh	390	1.4
Sa	Safsafi	750	2.8
Sb	Semka	170	0.6
Sc	Shalouh	740	2.7
Sd	Sinn	750	2.8
Ta	Tarkoub	240	0.9
Tb	Tartous	1,740	6.6
Ya	Yahmour	350	1.3
Yb	Yazidiyeh	290	1.1
Za	Zarqa	180	0.7
	Rock Outcrops	840	3.1
	Total	27,200	100.0

Table 4-4- Soil Characteristics
(See Table 4.5 for Meaning of Code Digits)

Map Symbol and Soil Name	Slope Class	Soil Depth	Soil Drainage	Surface Texture	Subsoil Texture	Surface Stoniness	Rock Outcrop	Surface Gravel	Subsoil Gravel
Aa---------- Annabiyeh	3	1	5	4	5	1	1	1	1
Ab---------- Arida	1	1	1	2	2	1	1	1	1
Ba---------- Bahluliyeh	6	3	3	4	4	1	1	3	3
Bb---------- Bamra	4	2	3	4	4	3	1	3	4
Bc---------- Bassa	3	4	3	5	-	2	1	1	1
Bd---------- Beit Khamroumi	3	1	3	4	5	3	1	1	1
Be---------- Besmakah	4	2	3	5	5	5	1	5	4
Bf---------- Bmalkeh	6	3	3	5	5	3	1	4	3
Bg---------- El Boustan	5	2	3	4	5	4	2	4	2
Da---------- Drykish	4	3	2	5	5	2	2	3	1
Ea---------- Em Harten	2	4	3	3	-	3	3	3	1
Eb---------- Em Hosh	2	1	5	3	5	5	1	3	3
Ha---------- El Hishi	1	1	5	3	5	1	1	1	1
Ja---------- Jaferiyeh	1	1	3	4	5	3	1	3	2
Jb---------- Jindiriyeh	5	3	2	4	-	3	2	3	-
Jc---------- Jozeriyeh	2	1	1	5	5	4	1	4	6
Ka---------- Kadmous	8	1	3	4	5	4	5	4	4
Kb---------- Kansebba	8	4	3	4	-	4	4	2	-
Kc---------- Keshfi	2	1	3	4	5	5	1	3	6

Table 4-4- Soil Characteristics (continued)

Map Symbol and Soil Name	Slope Class	Soil Depth	Soil Drainage	Surface Texture	Subsoil Texture	Surface Stoniness	Rock Outcrop	Surface Gravel	Subsoil Gravel
Kd---------- Kferiyeh	5	1	3	3	4	3	1	3	3
Ke---------- Kferro	4	3	3	4	5	1	1	4	2
Kf---------- Kilmaho	3	1	3	4	5	1	1	2	3
Kg---------- Kissara	2	1	6	5	5	1	1	1	1
Ma---------- Maisarat	2	1	3	5	5	4	1	4	6
Mb---------- Mintar	1	1	2	2	2	1	1	1	1
Ra---------- Reyhaniyeh	2	1	3	4	4	1	1	1	1
Sa---------- Safsafi	5	4	3	3	3	1	1	4	4
Sb---------- Semka	4	1	4	4	5	5	1	3	2
Sc---------- Shalouh	2	3	3	4	5	3	2	4	4
Sd---------- Sinn	3	1	3	4	5	1	1	3	2
Ta---------- Tarkoub	2	1	3	4	5	3	1	2	1
Tb---------- Tartous	1	1	3	4	5	3	1	3	2
Ya---------- Yahmour	1	1	1	3	4	5	1	6	6
Yb---------- Yazidiyeh	4	1	3	4	4	2	1	2	2
Za---------- Zarqa	3	1	3	4	5	5	1	3	3

Table 4-5
Class Limits for Soil Characteristics

SOIL SLOPE								
Code	1	2	3	4	5	6	7	8
Slope %	0-2	2-5	5-9	9-15	15-30	30-50	50-75	>75

SOIL DEPTH				
Code	1	2	3	4
Depth (cm)	>100	50-100	20-50	<20

SOIL TEXTURE	
Code	Texture
1	Very coarse (cs, gravel)
2	Coarse (Sand, L. sand)
3	Medium (Silt loam, loam, sandy loam)
4	Mod. fine (clay loam, silty clay loam, sandy clay loam)
5	Fine (clay, silty clay, sandy loam)
6	Very fine (clay over 60%)

SOIL DRAINAGE							
Code	1	2	3	4	5	6	7
Class	Excessive	Somewhat Excessive	Well	Moderat-ly well	Imperfect	Poor	Very Poor

SURFACE STONINESS					
Code	1	2	3	4	5
Coverage(%)	None	1-3	3-15	15-60	>60

Table 4-5- Class Limits for Soil Characteristics (Continued)

COARSE FRAGMENTS IN PROFILE						
Code	1	2	3	4	5	6
Coverage %	5	5-15	15-35	35-60	60-80	> 80

ROCK OUTCROP CLASS						
Code	1	2	3	4	5	6
Coverage %	2	2-10	10-25	25-50	50-90	> 90

Table 4-6- Agricultural Potential of Soils

Map Symbol and Soil Name	Capability Class and Subclass and Unit	Crop Suitability Ratings							Grazing Suitability	Features Limiting Use
		Wheat	Barley	Millet	Tobacco	Vegetables	Peanuts	Tree Crops		
Aa---------- Annabiyeh	IIIe-1	good	good	good	fair	fair	fair	good	good	slope
Ab---------- Arida	VIIIs-3	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	coarse texture
Ba---------- Bahluliyeh	IVe-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	slope, depth, gravel
Bb---------- Bamra	IVe-2	poor	poor	poor	v.poo	v.poor	v.poor	fair	fair	slope, depth, gravel
Bc---------- Bassa	VIs-1	v.poor	v.poor	v.poor	v.po	v.poor	v.poor	poor	poor	depth, slope
Bd---------- Beit Khammouni	IIIs-1	fair	fair	fair	poor	poor	poor	good	good	slope, stones
Be---------- Besmakah	VIs-6	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	stones, gravel, slope
Bf---------- Bmalkeh	VIe-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	slope, gravel, depth
Bg---------- El Boustan	VIs-6	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	slope, gravel, depth
Da---------- Drykish	IVs-1	poor	poor	poor	v.poor	v.poor	v.poor	fair	fair	slope, depth, gravel

Table 4-6- Agricultural Potential of Soils (continued)

Map Symbol and Soil Name	Capability Class and Subclass and Unit	Crop Suitability Ratings							Grazing Suitability	Features Limiting Use
		Wheat	Barley	Millet	Tobacco	Vegetables	Peanuts	Tree Crops		
Ea---------- Em Harten	VIIs-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	depth, stones, rock
Eb---------- Em Hosh	IVs-8	poor	poor	poor	poor	poor	poor	fair	fair	stones, gravel, slope
Ha---------- El Hishi	IIs-2	good	good	good	good	good	good	good	good	----------
Ja---------- Jaferiyeh	I	good	good	good	good	good	good	good	good	----------
Jb---------- Jindiriyeh	IVs-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	depth, slope, stones
Jc---------- Jozeriyeh	VIs-7	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	gravel, stones
Ka---------- Kadmous	VIIe-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	slope, rock, stones
Kb---------- Kansebba	VIIe-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	slope, stones, rock
Kc---------- Keshfi	VIs-8	poor	poor	poor	v.poor	v.poor	v.poor	fair	fair	stones, gravel

Potential of Soils (continued)

Table 4-6- Agricultural Potential of Soils (continued)

Map Symbol and Soil Name	Capability Class and Subclass and Unit	Crop Suitability Ratings							Grazing Suitability	Features Limiting Use
		Wheat	Barley	Millet	Tobacco	Vegetables	Peanuts	Tree Crops		
Kd---------- Kferiyeh	IVe-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	fair	fair	slope, stones
Ke---------- Kferro	IVs-1	poor	poor	poor	v.poor	v.poor	v.poor	fair	fair	depth, slope, gravel
Kf---------- Kilmaho	IIIe-1	fair	fair	fair	poor	poor	poor	good	good	slope, gravel
Kg---------- Kissara	IIIw-1	fair	fair	fair	good	good	good	good	good	drainage
Ma---------- Maisarat	VIs-7	poor	poor	poor	v.poor	v.poor	v.poor	fair	fair	stones
Mb---------- Mintar	IVs-3	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	coarse texture
Ra---------- Reyhaniyeh	IIe-1	good	good	good	good	good	good	good	good	slope
Sa---------- Safsafi	VIs-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	slope, gravel
Sb---------- Semka	VIs-8	poor	poor	poor	v.poor	v.poor	v.poor	fair	fair	stones, slope, gravel
Sc---------- Shalouh	IVs-1	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	gravel, stones
Sd---------- Sinn	IIIe-1	fair	fair	fair	poor	poor	poor	good	good	slope, gravel
Ta---------- Tarkoub	IIs-1	good	good	good	good	good	good	good	good	stones, gravel
Tb---------- Tartous	I	good	good	good	good	good	good	good	good	----------
Ya---------- Yahmour	VIIs-7	v.poor	v.poor	v.poor	v.poor	v.poor	v.poor	poor	poor	stones, gravel
Yb---------- Yazidiyeh	IVe-1	poor	poor	poor	v.poor	v.poor	v.poor	fair	fair	slope
Za---------- Zarqa	IVs-7	poor	poor	poor	v.poor	v.poor	v.poor	fair	fair	stones, gravel

Table 4-7- Recreational Development

Soil Name and Map Symbol	Camp Areas	Picnic Areas	Playgrounds	Paths and Trails
Aa---------- Annabiyeh	Moderate: slope	Moderate: slope	Severe: slope	Slight----------
Ab---------- Arida	Severe: too sandy	Severe: too sandy	Severe: too sandy	Severe: too sandy
Ba---------- Bahluliyeh	Severe: slope depth to rock small stones	Severe: slope small stones depth to rock	Severe: slope small stones depth to rock	Severe: slope
Bb---------- Bamra	Moderate: slope small stones	Moderate: slope small stones	Severe: slope small stones	Slight----------
Bc---------- Bassa	Severe: slope depth to rock	Severe: slope depth to rock	Severe: slope depth to rock	Slight----------
Bd---------- Beit Khammouni	Moderate: slope small stones	Moderate: slope small stones	Severe: slope	Slight----------
Be---------- Besmakah	Severe: slope small stones depth to rock	Severe: slope small stones too clayey	Severe: slope small stones too clayey	Severe: too clayey
Bf---------- Bmalkeh	Severe: slope small stones depth to rock	Severe: slope small stones depth to rock	Severe: slope small stones depth to rock	Moderate: slope
Bg---------- El Boustan	Severe: slope small stones	Severe: slope small stones	Severe: slope small stones	Moderate: slope
Da---------- Drykish	Severe: slope large stones depth to rock	Severe: slope large stones depth to rock	Severe: slope large stones depth to rock	Severe: too clayey
Ea---------- Em Harten	Severe: small stones depth to rock	Severe: small stones depth to rock	Severe: small stones depth to rock	Slight----------
Eb---------- Em Hosh	Severe: large stones	Severe: large stones	Severe: large stones	Severe: large stones
Ha---------- El Hishi	Severe: percs slowly	Severe: percs slowly	Severe: percs slowly	Slight----------
Ja---------- Jaferiyeh	Slight----------	Slight----------	Slight----------	Slight----------
Jb---------- Jindiriyeh	Severe: slope large stones depth to rock	Severe: slope large stones depth to rock	Severe: slope depth to rock	Moderate: slope
Jc---------- Jozeriyeh	Severe: large stones small stones too clayey	Severe: large stones too clayey small stones	Severe: large stones small stones too clayey	Severe: large stones too clayey
Ka---------- Kadmous	Severe: slope large stones small stones	Severe: slope large stones small stones	Severe: slope large stones small stones	Severe: slope
Kb---------- Kansebba	Severe: slope large stones depth to rock	Severe: slope large stones depth to rock	Severe: slope large stones depth to rock	Severe: slope

Table 4-7- Recreational Development (continued)

Soil Name and Map Symbol	Camp Areas	Picnic Areas	Playgrounds	Paths and Trails
Kc---------- Keshfi	Severe: large stones	Severe: large stones	Severe: large stones slope	Severe: large stones
Kd---------- Kferiyeh	Severe: slope large stones	Severe: slope large stones	Severe: large stones slope	Moderate: large stones slope
Ke---------- Kferro	Severe: slope small stones depth to rock	Severe: slope small stones depth to rock	Severe: slope small stones depth to rock	Slight----------
Kf---------- Kilmaho	Slight----------	Slight----------	Severe: slope	Slight----------
Kg---------- Kissara	Severe: too clayey percs slowly	Severe: too clayey percs slowly	Severe: too clayey percs slowly	Severe: too clayey
Ma---------- Maisarat	Severe: small stones large stones too clayey	Severe: large stones small stones too clayey	Severe: large stones small stones too clayey	Severe:
Mb---------- Mintar	Severe: too sandy	Severe: too sandy	Severe: too sandy	Severe: too sandy
Ra---------- Reyhaniyeh	Slight----------	Slight----------	Slight----------	Slight----------
Sa---------- Safsafi	Severe: slope small stones depth to rock	Severe: slope small stones depth to rock	Severe: slope small stones depth to rock	Moderate: slope
Sb---------- Semka	Severe: slope large stones	Severe: slope large stones	Severe: large stones slope	Severe: large stones
Sc---------- Shalouh	Severe: large stones small stones depth to rock	Severe: large stones small stones depth to rock	Severe: large stones slope depth to rock	Slight----------
Sd---------- Sinn	Moderate: small stones	Moderate: small stones	Severe: slope	Slight----------
Ta---------- Tarkoub	Slight----------	Slight----------	Moderate: small stones	Slight----------
Ya---------- Yahmour	Severe: large stones small stones	Severe: large stones small stones	Severe: large stones small stones	Severe: large stones small stones
Yb---------- Yazidiyeh	Moderate: slope	Moderate: slope	Severe: slope	Slight----------
Za---------- Zarqa	Severe: slope large stones	Severe: slope large stones	Severe: large stones slope	Severe: large stones

Table 4-8- Building Site Development

Map Symbol and Soil Name	Shallow Excavations	Dwellings without Basements	Dwellings with Basements	Small Commercial Buildings	Local Roads and Streets
Aa---------- Annabiyeh	Moderate: too clayey	Slight----------	Slight----------	Moderate: slope	Severe: low strength
Ab---------- Arida	Severe: cutbanks cave	Slight----------	Slight----------	Slight----------	Slight----------
Ba---------- Bahluliyeh	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: slope depth to rock	Severe; depth to rock slope low strength
Bb---------- Bamra	Severe: depth to rock	Moderate: depth to rock	Severe: depth to rock	Severe: slope depth to rock	Severe: depth to rock slope
Bc---------- Bassa	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock
Bd---------- Beit Khammouni	Moderate: too clayey	Slight----------	Slight----------	Slight----------	Severe: low strength
Be---------- Besmakah	Severe: depth to rock large stones	Severe: depth to rock large stones	Severe: depth to rock large stones	Severe: slope depth to rock large stones	Severe: depth to rock large stones low strength
Bf---------- Bmalkeh	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope low strength
Bg---------- El Boustan	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope
Da---------- Drykish	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: slope depth to rock	Severe: depth to rock
Ea---------- Em Harten	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock
Eb---------- Em Hosh	Severe: large stones	Severe: large stones	Severe: large stones	Severe: large stones	Severe: low strength large stones
Ha---------- El Hishi	Moderate: too clayey	Slight----------	Slight----------	Slight----------	Severe: low strength
Ja---------- Jaferiyeh	Moderate: too clayey	Severe: floods	Severe: floods	Severe: floods	Severe: low strength
Jb---------- Jindiriyeh	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope	Severe: slope depth to rock	Severe: low strength depth to rock slope
Jc---------- Jozeriyeh	Moderate: too clayey large stones	Moderate: large stones	Moderate: large stones	Moderate: large stones	Moderate: large stones
Ka---------- Kadmous	Severe: large stones slope	Severe: slope large stones	Severe: slope large stones	Severe: slope large stones	Severe: low strength slope large stones
Kb---------- Kansebba	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope
Kc---------- Keshfi	Severe: large stones	Severe: large stones	Severe: large stones	Severe: large stones	Severe: low strength large stones

Table 4-8- Building Site Development (continued)

Map Symbol and Soil Name	Shallow Excavations	Dwellings without Basements	Dwellings with Basements	Small Commercial Buildings	Local Roads and Streets
Kd---------- Kferiyeh	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: low strength slope
Ke---------- Kferro	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: slope depth to rock	Severe: depth to rock low strength
Kf---------- Kilmaho	Moderate: too clayey	Slight----------	Slight----------	Moderate: slope	Severe: low strength
Kg---------- Kissara	Moderate: too clayey	Slight----------	Slight----------	Slight----------	Severe: low strength
Ma---------- Maisarat	Moderate: too clayey large stones	Moderate: large stones	Moderate: large stones	Moderate: large stones	Severe: low strength large stones
Mb---------- Mintar	Severe: cutbanks cave	Slight----------	Slight----------	Slight----------	Slight----------
Ra---------- Reyhaniyeh	Slight----------	Slight----------	Slight----------	Slight----------	Severe: low strength
Sa---------- Safsafi	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope	Severe: slope depth to rock	Severe: depth to rock slope
Sb---------- Semka	Severe: large stones	Severe: large stones	Severe: large stones	Severe: slope large stones	Severe: large stones
Sc---------- Shalouh	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: low strength depth to rock
Sd---------- Sinn	Moderate: too clayey	Slight----------	Slight----------	Moderate: slope	Severe: low strength
Ta---------- Tarkoub	Moderate: too clayey	Slight----------	Slight----------	Slight----------	Severe: low strength
Tb---------- Tartous	Moderate: too clayey	Slight----------	Slight----------	Slight----------	Severe: low strength
Ya---------- Yahmour	Severe: cutbanks cave large stones	Severe: large stones	Severe: large stones	Severe: large stones	Severe: large stones
Yb---------- Yazidiyeh	Moderate: slope	Moderate: slope	Moderate: slope	Severe: slope	Moderate: slope
Za---------- Zarqa	Severe: large stones	Severe: large stones	Severe: large stones	Severe: large stones	Severe: low strength large stones

Table 4-9- Sanitary Facilities

Map Symbol and Soil Name	Septic Tank Absorption Fields	Sewage Lagoons	Trench Sanitary Landfill	Area Sanitary Landfill	Daily Cover for Landfill
Aa---------- Annabiyeh	Moderate: percs slowly	Severe: slope	Severe: too clayey	Slight----------	Severe: too clayey
Ab---------- Arida	Slight----------	Severe: seepage	Severe: seepage	Severe: seepage	Severe: too sandy
Ba---------- Bahluliyeh	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: area reclaim slope
Bb---------- Bamra	Severe: depth to rock	Severe: depth to rock slope	Severe: depth to rock	Severe: depth to rock	Severe: area reclaim
Bc---------- Bassa	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: area reclaim
Bd---------- Beit Khammouni	Moderate: percs slowly	Moderate: slope	Severe: too clayey	Slight----------	Severe: too clayey
Bc---------- Besmakah	Severe: depth to rock percs slowly large stones	Severe: depth to rock slope large stones	Severe: depth to rock too clayey large stones	Severe: depth to rock	Severe: area reclaim too clayey large stones
Bf---------- Bmalkeh	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: area reclaim slope
Bg---------- El Boustan	Severe: depth to rock slope	Severe: depth to rock slope large stones	Severe: depth to rock slope large stones	Severe: depth to rock slope	Severe: area reclaim slope
Da---------- Drykish	Severe: depth to rock	Severe: depth to rock slope	Severe: depth to rock	Severe: depth to rock	Severe: area reclaim
Ea---------- Em Harten	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: area reclaim
Eb---------- Em Hosh	Severe: large stones	Severe: large stones	Severe: too clayey large stones	Slight----------	Severe: too clayey large stones
Ha---------- El Hishi	Moderate: percs slowly	Moderate: seepage	Severe: too clayey	Slight----------	Severe: too clayey
Ja---------- Jaferiyeh	Moderate: percs slowly	Moderate: seepage	Severe: too clayey	Slight----------	Severe: too clayey
Jb---------- Jindiriyeh	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: area reclaim slope
Jc---------- Jozeriyeh	Severe: poor filter	Severe: seepage large stones	Severe: seepage large stones	Severe: seepage	Severe: seepage
Ka---------- Kadmous	Severe: slope large stones	Severe: slope large stones	Severe: slope large stones seepage	Severe: slope seepage	Severe: slope seepage
Kb---------- Kansebba	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: area reclaim slope

Table 4-9- Sanitary Facilities (continued)

Map Symbol and Soil Name	Septic Tank Absorption Fields	Coverage Lagoons	Trench Sanitary Landfill	Area Sanitary Landfill	Daily Cover for Landfill
Kc---------- Keshfi	Severe: poor filter large stones	Severe: large stones	Severe: too clayey large stones seepage	Severe: seepage	Severe: seepage large stones
Kd---------- Kferiyeh	Severe: slope	Severe: slope	Severe: slope	Severe: slope	Severe: slope
Ke---------- Kferro	Severe: depth to rock	Severe: depth to rock slope	Severe: depth to rock	Severe: depth to rock	Severe: area reclaim
Kf---------- Kilmaho	Slight----------	Severe: slope	Severe: too clayey	Slight----------	Severe: too clayey
Kg---------- Kissara	Severe: percs slowly	Slight----------	Severe: too clayey	Slight----------	Severe: too clayey
Ma---------- Maisarat	Severe: percs slowsly	Moderate: large stones	Severe: too clayey	Slight----------	Severe: too clayey
Mb---------- Mintar	Severe: poor filter	Severe: seepage	Severe: seepage too sandy	Severe: seepage	Severe: seepage
Ra---------- Reyhaniyeh	Slight----------	Moderate: slope	Slight----------	Slight----------	Slight----------
Sa---------- Safsafi	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe: depth to rock slope	Severe; area reclaim slope
Sb---------- Semka	Severe: large stones	Severe: slope large stones	Severe: too clayey large stones	Moderate: slope	Severe: too clayey large stones
Sc---------- Shalouh	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: depth to rock	Severe: area reclaim
Sd---------- Sinn	Slight----------	Moderate: slope	Severe: too clayey	Slight----------	Severe: too clayey
Ta---------- Tarkoub	Moderate: percs slowly	Moderate: slope	Severe: too clayey	Slight----------	Severe: too clayey
Tb---------- Tartous	Moderate: percs slowly	Slight----------	Severe: too clayey	Slight----------	Severe: too clayey
Ya---------- Yahmour	Severe: poor filter large stones	Severe: seepage large stones	Severe: seepage large stones	Severe: seepage	Severe: seepage small stones large stones
Yb---------- Yazidiyeh	Moderate: slope	Severe: slope	Moderate: slope	Moderate: slope	Moderate: slope
Za---------- Zarqa	Severe: poor filter large stones	Severe: large stones	Severe: seepage large stones	Severe: seepage	Severe: seepage large stones

Table 4-10- Construction Material

Map Symbol and Soil Name	Roadfill	Sand	Gravel	Topsoil
Aa---------- Annabiyeh	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Ab---------- Arida	Good----------	Good----------	Unsuited: too sandy	Poor: too sandy
Ba---------- Bahluliyeh	Poor: area reclaim low strength slope	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey slope
Bb---------- Bamra	Poor: area reclaim low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey
Bc---------- Bassa	Poor: area reclaim	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey
Bd---------- Beit Khammouni	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Fair: too clayey
Be---------- Besmakah	Poor: low strength large stones	Unsuited: small stones excess fines large stones	Unsuited: excess fines large stones	Poor: too clayey large stones small stones
Bf---------- Bmalkeh	Poor: area reclaim low strength slope	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey slope
Bg---------- El Boustan	Poor: area reclaim slope	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey large stones slope
Da---------- Drykish	Poor: area reclaim	Unsuited: excess fines	Unsuited: excess fines	Unsuited: area reclaim too clayey
Ea---------- Em Harten	Poor: area reclaim	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey
Eb---------- Em Hosh	Poor: low strength large stones	Unsuited: excess fines large stones	Unsuited: excess fines large stones	Poor: too clayey large stones small stones
Ha---------- El Hishi	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Ja---------- Jaferiyeh	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Jb---------- Jindiriyeh	Poor: area reclaim	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey
Jc---------- Jozeriyeh	Poor: large stones	Unsuited: small stones large stones	Fair: large stones	Poor: too clayey large stones small stones
Ka---------- Kadmous	Poor: low strength large stones slope	Unsuited: excess fines large stones	Unsuited: excess fines large stones	Poor: too clayey large stones slope

Table 4-10- Construction Material (continued)

Map Symbol and Soil Name	Roadfill	Sand	Gravel	Topsoil
Kb---------- Kansebba	Poor: area reclaim slope	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey slope
Kc---------- Keshfi	Poor: large stones	Unsuited: small stones large stones	Good----------	Poor: large stones small stones
Kd---------- Kferiyeh	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey slope
Ke---------- Kferro	Poor: area reclaim	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey
Kf---------- Kilmaho	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Kg---------- Kissara	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Ma---------- Maisarat	Poor: low strength large stones	Unsuited: small stones excess fines large stones	Unsuited: excess fines large stones	Poor: too clayey large stones small stones
Mb---------- Mintar	Good----------	Good----------	Unsuited: too sandy	Poor: too sandy
Ra---------- Reyhaniyeh	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Fair: too clayey
Sa---------- Safsafi	Poor: area reclaim	Unsuited: Thin layer	Unsuited: too sandy	Poor: area reclaim small stones slope
Sb---------- Semka	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey small stones
Sc---------- Shalouh	Poor: area reclaim low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: area reclaim too clayey
Sd---------- Sinn	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Ta---------- Tarkoub	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Tb---------- Tartous	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Poor: too clayey
Ya---------- Yahmour	Good----------	Unsuited: small stones	Good----------	Poor: small stones
Yb---------- Yazidiyeh	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Fair: too clayey slope
Za---------- Zarqa	Poor: low strength	Unsuited: excess fines	Unsuited: excess fines	Unsuited: too clayey

Table 4-11- Water Management

Map Symbol and Soil Name	Pond Reservoir Areas	Embankments dikes and levels	Drainage	Irrigation	Terraces and diversions	Grassed Waterways
Aa---------- Annabiyeh	Moderate: slope	Moderate: piping	Percs slowly: slope	Percs slowly: slope	Percs slowly-----	Percs slowly-------
Ab---------- Arida	Severe: seepage	Severe: seepage	Cutbanks cave----	Droughty fast intake soil blowing	Too sandy soil blowing	Droughty ----------
Ba---------- Bahluliyeh	Severe: depth to rock slope seepage	Severe: thin layer	Depth to rock: slope	Depth to rock: slope	Slope: depth to rock	Slope: depth to rock
Bb---------- Bamra	Severe: slope seepage	Moderate: thin layer	Depth to rock: slope	Depth to rock: slope	Slope: depth to rock	Slope: depth to rock
Bc---------- Bassa	Severe: depth to rock	Severe: thin layer	Depth to rock: slope	Depth to rock: slope	Depth to rock	Depth to rock
Bd---------- Beit Khammouni	Moderate: slope	Slight----------	Percs slowly: slope	Percs slowly: slope	Percs slowly-----	Percs slowly--------
Be---------- Besmakah	Severe: slope	Severe: large stones	Percs slowly: depth to rock large stones slope	Large stones: slow intake depth to rock slope	Slope: large stones depth to rock percs slowly	Large stones: slope depth to rock percs slowly
Bf---------- Bmalkeh	Severe: depth to rock slope	Severe: thin layer	Depth to rock: slope	Slow intake: depth to rock slope	Slope: depth to rock	Slope: depth to rock

Table 4-11- Water Management (continued)

Map Symbol and Soil Name	Pond Reservoir Areas	Embankments dikes and levels	Drainage	Irrigation	Terraces and diversions	Grassed Waterways
Bg---------- El Boustan	Severe: slope	Severe: thin layer large stones	Percs slowly: depth to rock large stones slope	Large stones: percs slowly depth to rock slope	Slope: large stones depth to rock percs slowly	Large stones: slope depth to rock percs slowly
Da---------- Drykish	Severe: depth to rock slope	Severe: thin layer	Percs slowly: depth to rock slope	Slow intake: percs slowly depth to rock	Slope: depth to rock percs slowly	Slope: depth to rock percs slowly
Ea---------- Em Harten	Severe: depth to rock	Severe: thin layer	Depth to rock----	Depth to rock---	Depth to rock----	Depth to rock------
Eb---------- Em Hosh	Moderate: seepage	Severe: large stones	Large stones-----	Large stones----	Large stones-----	Large stones--------
Ha---------- El Hishi	Slight----------	Slight----------	Favorable--------	Favorable-------	Favorable--------	Favorable----------
Ja---------- Jaferiyeh	Moderate: seepage	Slight----------	Favorable--------	Favorable-------	Favorable--------	Favorable----------
Jb---------- Jindiriyeh	Severe: depth to rock slope seepage	Severe: thin layer	Depth to rock: slope	Depth to rock: slope	Slope: depth to rock	Slope: depth to rock
Jc---------- Jozeriyeh	Severe: seepage	Severe: seepage	Cutbanks cave:	Droughty: fast intake	Erodes easily----	Erodes easily: droughty
Ka---------- Kadmous	Severe: seepage	Severe: large stones	Large stones: slope	Large stones: slope	Slope: large stones	Large stones: slope
Kb---------- Kansebba	Severe: depth to rock slope	Severe: thin layer large stones	Depth to rock: large stones slope	Large stones: depth to rock slope	Slope: large stones depth to rock	Large stones: depth to rock slope
Kc---------- Keshfi	Severe: seepage	Severe: seepage large stones	Large stones-----	Large stones----	Large stones------	Large stones---------
Kd---------- Kferiyeh	Severe: slope	Slight----------	Slope----------	Slope----------	Slope----------	Slope----------

Table 4-11- Water Management (continued)

Map Symbol and Soil Name	Pond Reservoir Areas	Embankments dikes and levels	Drainage	Irrigation	Terraces and diversions	Grassed Waterways
Ke---------- Kferro	Severe: depth to rock slope	Severe: thin layer	Depth to rock: slope	Depth to rock: slope	Slope: depth to rock	Slope: depth to rock
Kf---------- Kilmaho	Moderate: seepage	Slight----------	Slope----------	Slope----------	Favorable---------	Favorable--------
Kg---------- Kissara	Moderate: slope	Slight----------	Percs slowly-----	Slow intake: percs slowly	Percs slowly------	Percs slowly-----
Ma---------- Maisarat	Moderate: slope	Moderate: large stones	Percs slowly: large stones	Large stones: slow intake percs slowly	Large stones: percs slowly	Large stones: percs slowly
Mb---------- Mintar	Severe: seepage	Severe: seepage	Cutbanks cave----	Droughty: fast intake	Too sandy: soil blowing	Droughty---------
Ra---------- Reyhaniyeh	Moderate: seepage	Slight----------	Favorable--------	Favorable-------	Favorable---------	Favorable--------
Sa---------- Safsafi	Severe: depth to rock slope	Severe: thin layer	Depth to rock: slope	Depth to rock: slope	Slope: depth to rock	Slope: depth to rock
Sb---------- Semka	Severe: slope	Severe: slope	Large stones: slope	Large stones: slope	Slope: large stones	Large stones: slope
Sc---------- Shalouh	Severe: depth to rock	Severe: thin layer	Depth to rock----	Depth to rock---	Depth to rock-----	Depth to rock------
Sd---------- Sinn	Slight----------	Slight----------	Slope----------	Slope----------	Favorable---------	Favorable----------
Ta---------- Tarkoub	Slight----------	Slight----------	Favorable--------	Favorable-------	Favorable---------	Favorable----------
Tb---------- Tartous	Slight----------	Slight----------	Favorable--------	Favorable-------	Favorable---------	Favorable----------
Ya---------- Yahmour	Severe: seepage	Severe: seepage	Large stones: cutbanks cave	Large stones:	Large stones: too sandy	Large stones:
Yb---------- Yazidiyeh	Severe: slope seepage	Slight----------	Slope----------	Slope----------	Slope----------	Slope----------
Za---------- Zarqa	Severe: seepage	Severe: seepage large stones	Large stones-----	Large stones---	Large stones------	Large stones-------

Table 4-12- Engineering Soil Characteristics

(See Table 4-13 for meaning of code digits)

Map Symbol and Soil Name	Profile Texture	Classification		Fragments coarser than 7.5 cm	Liquid Limit (%)	Plasticity Index
		Unified	AASHTO			
Aa - Annabiyeh	8	6	4	1	3	3
Ab - Arida	2	1	3	1	1	1
Ba - Bahluliyeh	4	8	4	3	3	3
Bb - Bamra	4	8	4	3	3	3
Bc - Bassa	5	6	1	1	5	5
Bd - Beit Khammouni	8	6	5	1	3	3
Be - Besmakah	5	7	5	4	5	5
Bf - Bmalkeh	5	6	5	3	5	5
Bg - El-Boustan	5	6	6	4	5	5
Da - Drykish	5	7	2	1	5	5
Ea - Em Harten	3	5	2	1	2	2
Eb - Em Hosh	7	6	5	3	5	5
Ha - El Hishi	7	7	5	1	5	5
Ja - Jaferiyeh	5	7	5	2	5	5
Jb - Jindiriyeh	4	6	5	2	5	5
Jc - Jozeriyeh	5	4	2	6	5	5
Ka - Kadmous	8	6	5	4	4	4
Kb - Kansebba	4	6	7	-	3	3
Kc - Keshfi	8	4	5	6	4	4
Kd - Kferiyeh	4	6	5	2	5	2
Ke - Kferro	8	3	4	2	4	4
Kf - Kilmaho	8	6	5	3	4	4
Kg - Kissara	5	6	5	1	5	5
Ma - Maisarat	5	7	5	4	5	5
Mb - Mintar	2	2	6	1	1	1
Ra - Reyhaniyeh	4	6	4	1	3	3
Sa - Safsafi	3	2	6	4	3	3
Sb - Semka	8	6	7	2	4	4

Table 4-12- Engineering Soil Characteristics (continued)

Map Symbol and Soil Name	Profile Texture	Classification		Fragments coarser than 7.5 cm	Liquid Limit (%)	Plasticity Index
		Unified	AASHTO			
Sc - Shalouh	8	6	5	4	4	4
Sd - Sinn	8	6	5	2	4	4
Ta - Tarkoub	8	6	5	1	4	4
Tb - Tartous	4	6	5	2	4	4
Ya - Yahmour	4	4	2	6	4	4
Yb - Yazidiyeh	4	6	7	2	3	3
Za - Zarqa	8	6	8	3	4	4

Table 4-13- Class Limits for Engineering Soil Characteristics

PROFILE TEXTURE	
Class	Class Limits
1	Coarse sand, gravel
2	Sand, loamy, sand
3	Sandy loam, loam, silt loam, silt
4	Clay loam, sandy clay loam, silty clay loam
5	Clay, sandy clay, silty clay
6	> 60% clay
7	Compound -silty over clayey
8	Compound-silty clay loam over clay

UNIFIED SYSTEM								
Class	1	2	3	4	5	6	7	8
Limits	SP	SM	SC	GM-GC	ML	CL	CH	ML-CL

Table 4-13- (Cont.)

AASHTO SYSTEM								
Class	1	2	3	4	5	6	7	8
Limits	A1	A2	A3	A6	A7	A2/A4	A6/A2	A6/A7

COARSE FRAGMENTS						
Class	1	2	3	4	5	6
Coverage (%)	< 5	5-15	15-35	35-60	60-80	> 80

LIQUID LIMIT						
Class	1	2	3	4	5	6
Limits (%)	< 20	20-30	30-40	40-50	50-65	65-90

PLASTICITY INDEX						
Class	1	2	3	4	5	6
Limits	1-5	5-15	15-25	25-35	35-55	> 55

Table 4-14- Physical and Chemical Properties and Erosion Hazards
(See Table 4.15 for meaning of code digits)

Map and Soil Name	Permeability (cm/hour)	Available water holding capacity cm/cm	Soil reaction (pH)	Water erosion hazard	Wind erosion hazard
Aa - Annabiyeh	4	2	1	4	7
Ab - Arida	7	4	1	1	1
Ba - Bahluliyeh	3	3	1	5	7
Bb - Bamra	2	2	1	4	-
Bc - Bassa	3	3	1	5	4
Bd - Beit Khammouni	4	1	1	3	4
Be - Besmakah	5	4	1	4	7
Bf - Bmalkeh	2	2	1	5	4
Bg - El Boustan	4	2	1	5	4
Da - Drykish	4	3	1	5	4
Ea - Em Harten	1	3	1	5	6
Eb - Em Hosh	2	2	1	2	4
Ha - El Hishi	2	1	1	1	1
Ja - Jaferiyeh	2	1	1	1	1
Jb - Jindiriyeh	1	4	1	5	4
Jc - Jozeriyeh	5	3	1	3	4
Ka - Kadmous	1	2	1	5	7
Kb - Kansebba	5	3	1	5	7
Kc - Keshfi	1	3	1	2	4
Kd - Kferiyeh	2	2	1	5	4
Ke - Kferro	1	2	1	5	7
Kf - Kilmaho	1	2	1	5	7
Kg - Kissara	4	1	1	1	1
Ma - Maisarat	6	1	1	1	7
Mb - Mintar	5	1	1	2	1
Ra - Reyhaniyeh	1	1	2	3	7
Sa - Safsafi	2	3	1	5	6
Sb - Semka	2	2	1	4	1
Sc - Shalouh	4	3	1	3	7
Sd - Sinn	1	2	1	4	7

Table 4-14- Physical and Chemical Properties and Erosion Hazards (continued)

Map Symbol and Soil Name	Permeability (cm/hour)	Available water holding capacity (cm/cm)	Soil reaction (pH)	Water erosion hazard	Wind erosion hazard
Ta - Tarkoub	2	1	1	2	4
Tb - Tartous	2	2	1	1	4
Ya - Yahmour	5	4	1	1	7
Yb - Yazidiyeh	1	2	1	4	7
Za - Zarqa	1	3	1	4	7

Table 4-15- Class Limits for Physical and Chemical Properties of Soils

PERMEABILITY							
Class	1-Moderate	2-Moderately slow	3-Moderately Rapid	4-Slow	5-Rapid	6-Very Slow	7-Very Rapid
Limit (cm./h)	2.-6.25	.5-2.0	6.25-12.5	.125-.5	12.5-25	Less than .125	more than 25

WATER HOLDING CAPACITY				
Class	1-High	2-Medium	3-Low	4-Very Low
Limit (cm/cm)	23/150	15-23/150	8-15/150	0-8/150

SOIL REACTION									
Class	1	2	3	4	5	6	7	8	9
Limit (pH)	6.1-7.3	7.4-7.8	5.6-6.0	7.9-8.4	5.1-5.5	8.5-9.0	4.5-5.0	<4.5	>9.0

WATER ERODABILITY FACTOR					
Class	1	2	3	4	5
Limit	Low	Slight	Moderate	High	Very High

Table 4-15- (Cont.)

WIND ERODABILITY GROUP	
Class	Group
1	extremely erodible
2	very highly erodible
3	highly erodible
4	erodible
5	moderately erodible
6	slightly erodible
7	very slightly erodible
8	not subject to blowing

Table 4-16- Taxonomic Classification of Soils

Soil Name	Family or Higher Taxonomic Classes
Annabiyeh -----	Fine, mixed, thermic Aquic Xerochrepts
Arida ---------	Sandy, mixed, thermic Typic Xeropsamments
Bahluliyeh-----	Fine loamy, mixed, thermic Lithic Xerorthents
Bamra----------	Fine loamy, mixed, thermic Typic Xerochrepts
Bassa----------	Coarse loamy, mixed, thermic Lithic Xerorthents
Beit Khammouni-	Fine loamy, mixed, thermic Typic Xerochrepts
Besmakah-------	Loamy skeletal, mixed, thermic Typic Xerochrepts
Bmalkeh--------	Fine loamy, mixed, thermic Lithic Xerochrepts
El Boustan-----	Fine, mixed, thermic Typic Xerochrepts
Drykish--------	Fine, mixed, thermic Lithic Xerorthents
Em Harten------	Fine loamy, mixed, thermic Lithic Xerorthents
Em Hosh--------	Fine loamy, mixed, thermic Typic Haploxerolls
El Hishi-------	Fine, mixed, thermic Vertic Xerochrepts
Jaferiyeh------	Fine loamy, mixed, thermic Typic Xerochrepts
Jindiriyeh-----	Fine loamy, mixed, thermic Lithic Xerorthents
Jozeriyeh------	Fragmental, mixed, thermic Typic Xerorthents
Kadmous--------	Loamy skeletal, mixed, thermic Typic Xerochrepts
Kansebba-------	Fine, mixed, thermic Lithic Xerorthents
El Keshfi------	Fine loamy over fragmental, mixed, thermic Typic Xerochrepts
Kferiyeh-------	Fine loamy, mixed, thermic Typic Xerochrepts
Kferro---------	Fine loamy, mixed, thermic Lithic Xerochrepts
Kilmaho--------	Fine, mixed, thermic Typic Xerochrepts
Kissara--------	Fine, mixed, thermic Aeric Haplaquepts
Maisarat-------	Clayey over fragmental, mixed, thermic Vertic Xerochrepts
Mintar---------	Sandy, mixed, thermic Typic Xeropsamments
Reyhaniyeh-----	Fine loamy, mixed, thermic Typic Xerochrepts
Safsafi--------	Fine loamy, mixed, thermic Lithic Xerorthents
Semka----------	Fine, mixed, thermic Typic Xerochrepts
Shalouh--------	Fine, mixed, thermic Lithic Xerochrepts
Sinn-----------	Fine, mixed, thermic Typic Xerochrepts
Tarkoub--------	Fine, mixed, thermic Typic Xerochrepts
Tartous--------	Fine, mixed, thermic Typic Xerochrepts
Yahmour--------	Fragmental, mixed, thermic Typic Xerorthents
Yazidiyeh------	Fine loamy, mixed, thermic Typic Xerochrepts
Zarqa----------	Fine loamy over fragmental, mixed, thermic Typic Xerofluvents

Table 4-17- Morphological Groupings of Soils in Tartous-Safita Area

Morpho. Group Number	Morphological Characteristics	Series Included	Geology
1	Less than 20 cm deep soils	- Em Harten - Jindiriyeh - Kansebba	B Ln Lc
4	20 to 50 cm deep, well drained, moderately, fine textured soils	- Safsafi - Kferro - Bahluliyeh - Drykish - Bmalkeh - Bassa	B B Ln Lc Lc S
5	20 to 50 cm deep, well drained, fine textured soils	- Shalouh	B
20	50 to 100 cm deep, well drained, moderately fine to fine textured, brown soils with less than 35 percent coarse fragment	- Bamra - El Boustan	Ln Lc
73	More than 100 cm deep, excessively, drained, corase textured, brown soils with less than 35 percent coarse fragments	- Arida - Mintar	M M
79	More than 100 cm deep, well drained, moderately fine textured, brown soils with less than 35 percent coarse fragments	- Jaferiyeh - Kferiyeh - Em Hosh - Yazidiyeh - Reyhaniyeh - El Hishi	A B B Ln Lc Mc
80	More than 100 cm deep, well drained, moderately fine textured, cromic to red soils with less than 35 percent coarse fragments	- Beit Khammouni	Lc

Table 4-17- (Cont.)

Morpho. Group Number	Morphological Characteristics	Series Included	Geology
82	More than 100 cm deep, well drained, fine textured, brown soils with less than 35 percent coarse fragments	- Tarkoub - Sinn - Kilmaho	B C Lc
83/84	More than 100 cm deep, well drained, fine textured, cromic to red soils with less than 35 percent coarse fragments	- Semka - Maisarat - Tartous	Lc Lc Mc
94	More than 100 cm deep imperfectly drained, fine textured, brown soils with less than 35 percent coarse fragments	- Annabiyeh - Kissara	C Lc
101	More than 100 cm deep, well to excessively drained soils with more than 35 percent coarse fragments throughout the profile	- Yahmour - Jozeriyeh - Kadmous - Besmakah	A C C Lc
109	More than 100 cm deep, well drained, moderately fine textured, brown soils with more than 35 percent fragments below the 50 cm of the profile	- Zarqa - El Keshfi	A C

GEOGLOGY

A- Quaternary and recent alluvium
B- Neogene basalt
C- Quaternary and recent colluvium
Ln- Neogene marl and limestone
Lc- Cretaceous limestone
M- Marine sand
Mc- Continental marine deposits
S- Weakly consolidated sandstone

Table 4-18- Soil Series in Tartous-Safita Area in Relation to the Taxonomic Classification, Morphological Grouping and Geology

GEOLOGY	MORPHO-LOGICAL GROUP NUMBER	TAXONOMIC CLASSIFICATION									
		ENTISOLS				INCEPTISOLS					MOLLI.
		Fluv	Psamm	Orth		Aqu	Ochr				Xer
		Xero	Xero	Xer		Hapl	Xer				Hapl
		Typic	Typic	Typic	Lithic	Aeric	Typic	Aquic	Lithic	Vertic	Typic
A- Quaternary and recent alluvium	A-79						Jaferiyeh				
	A-101			Yahmour							
	A-109	Zarqa									
B- Neogene basalt	B-1				Em Harter						
	B-4				Safsafi				Kferro		
	B-5								Shalouh		
	B-82						Tarkoub				
C- Quaternary and recent colluvium	C-79						Kferiyeh				Em Hosh
	C-82						Sinn				
	C-94							Annabiyeh			
	C-101			Jozeriyeh			Kadmous				
	C-109						El Keshfi				
Ln- Neogene marle and limestone	Ln-1				Jindiriyeh						
	Ln-4				Bahluliyeh						
	Ln-20						Bamra				
	Ln-79						Yazidiyeh				
Lc- Cretaceous limestone	Lc-1				Kansebba						
	Lc-4				Drykish				Bmalkeh		
	Lc-23						El Boustan				
	Lc-79						Reyhaniyeh				
	Lc-80						B.Khammouni				
	Lc-82						Kilmaho				
	Lc-83						Semka				
	Lc-94					Kissara					
	Lc-101						Besmakah				
M- Marine sand	M-73		Arida								
	M-73		Mintar								
Mc- Contin. marine deposit	Mc-79									El Hishi	
	Mc-83						Tartous				
S- Weakly cons. sandstone	S-4				Bassa						

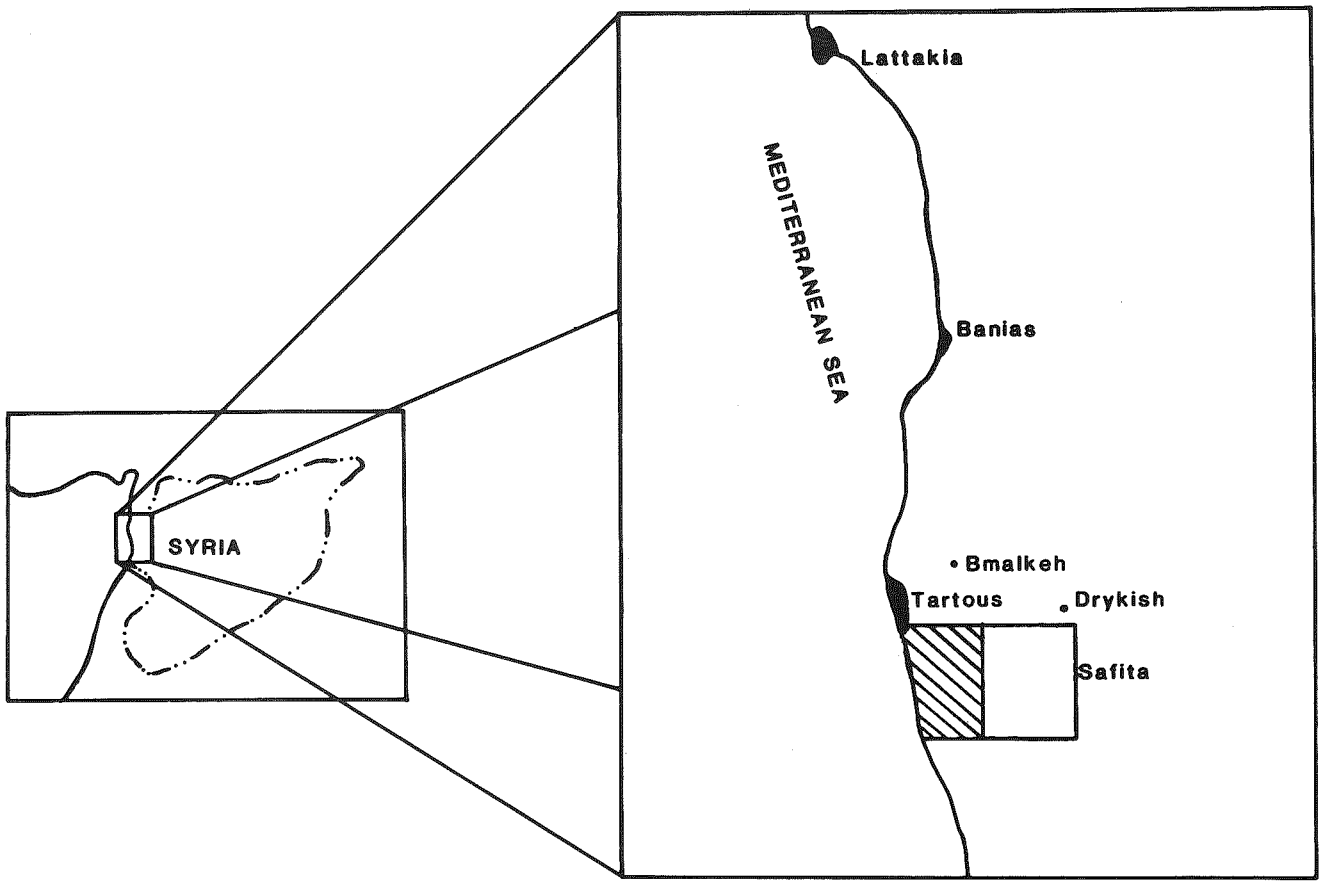

Figure 4-1. Location Map

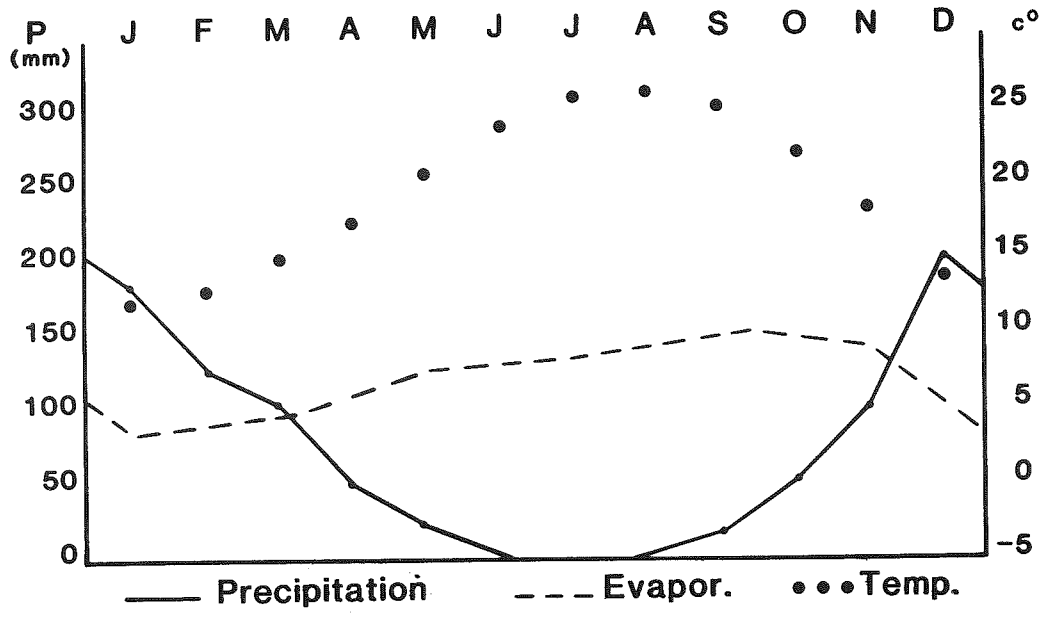

Figure 4-2. Average rainfall, mean monthly air temperatures, and monthly evaporation for Tartous area.

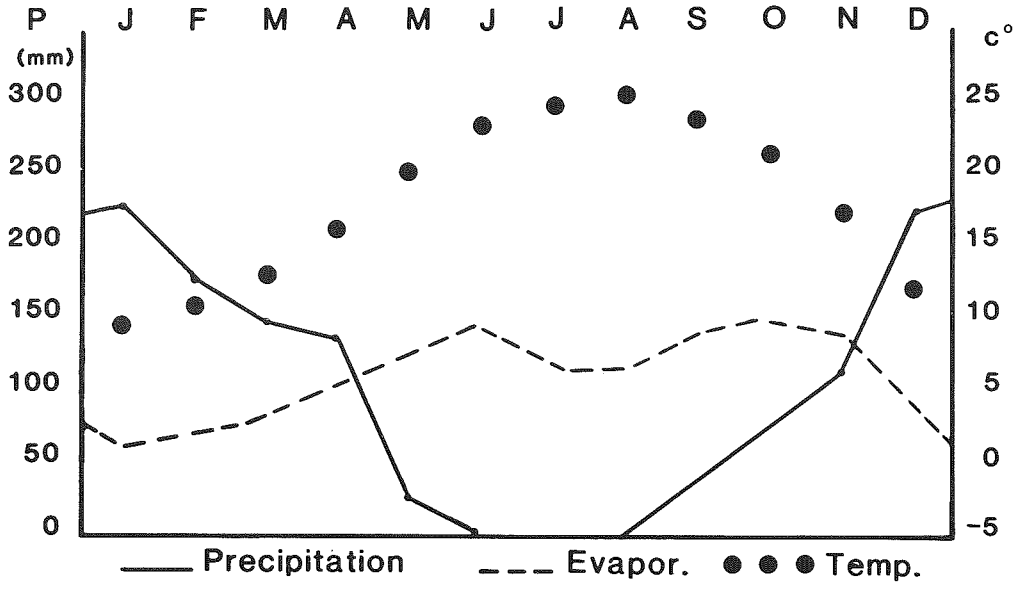

Figure 4-3. Average rainfall, mean monthly air temperatures, and monthly evaporation for Safita area.

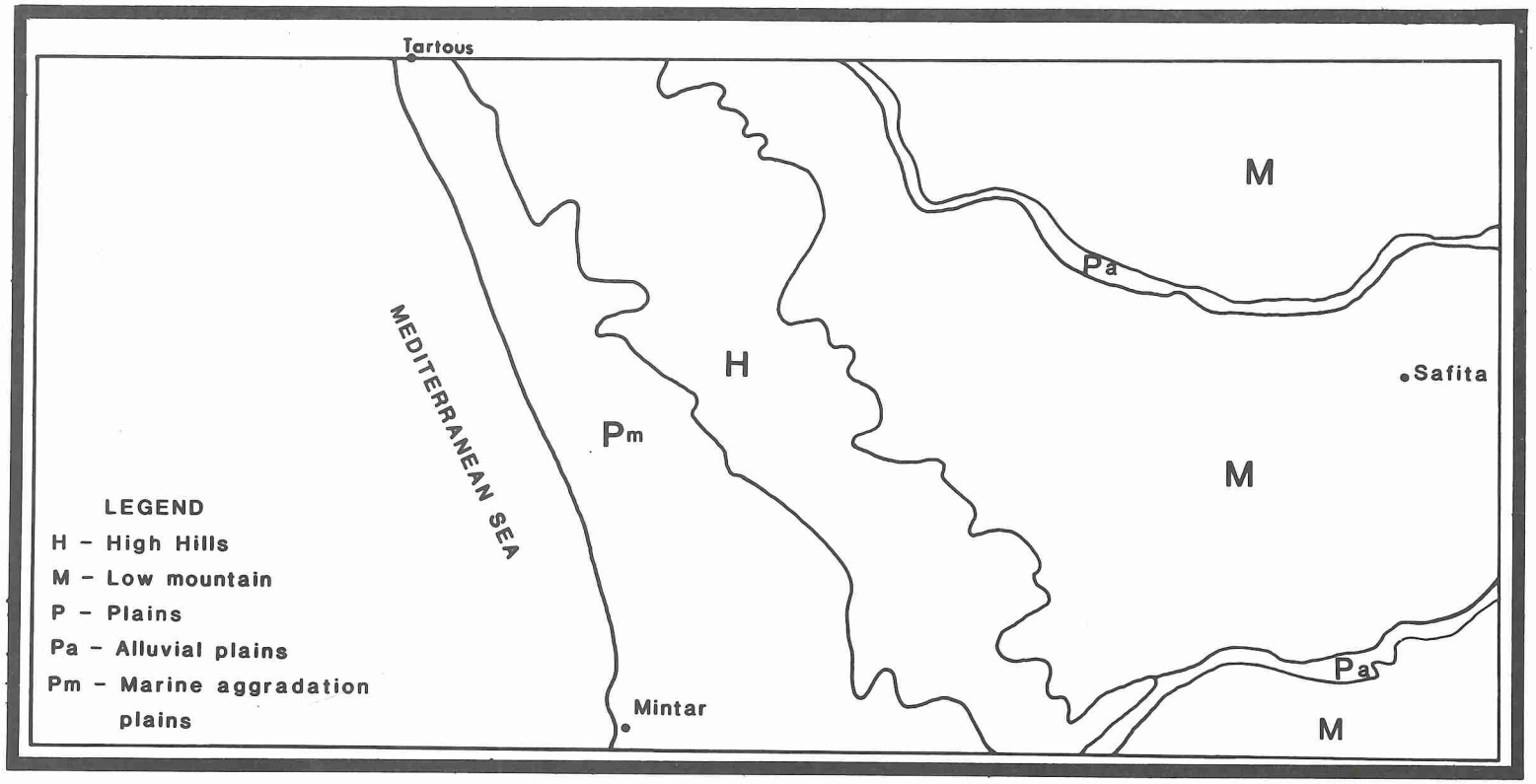

Figure 4-4. Generalized Geomorphology for Tartous-Safita Area.

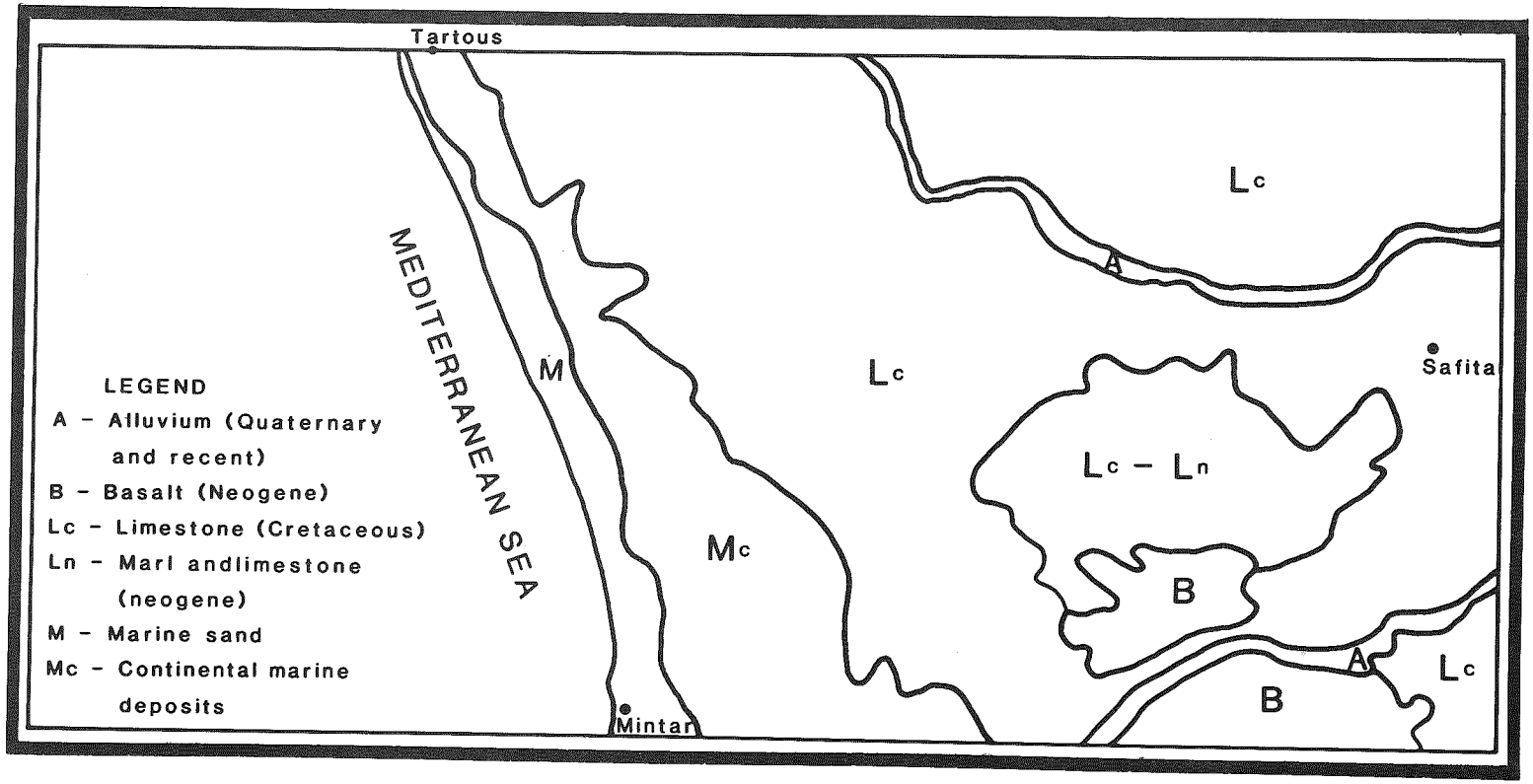

Figure 4-5. Generalized Geology for Tartous-Safita Area.

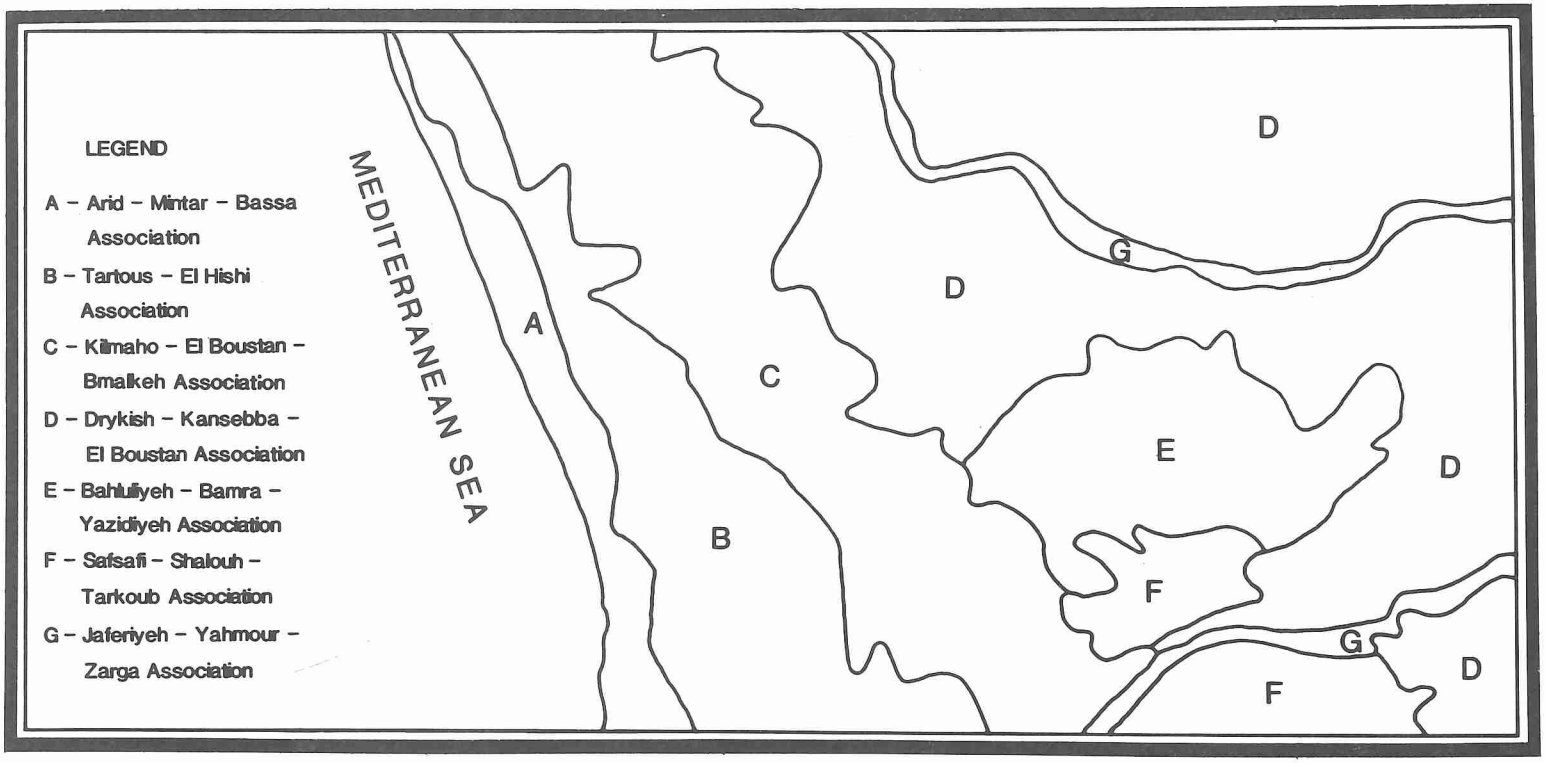

Figure 4-6. General Soil Map of Tartous-Safita Area.

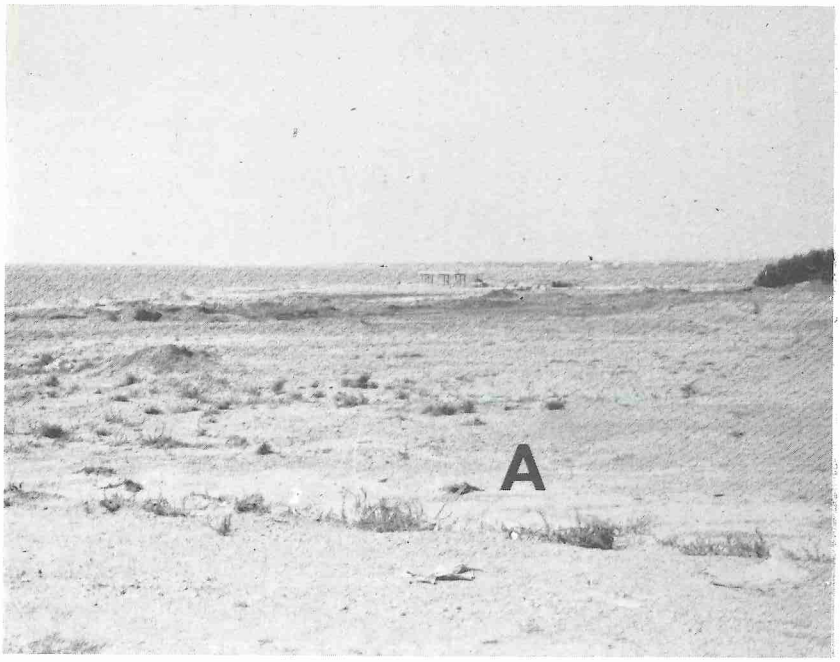

Figure 4-7

Photograph: Arida-Mintar-Bassa Association (soil association A) consists of excessively drained sandy soils of marine beaches. It supports only sparse vegetation due to low water holding capacity and very low natural fertility. It has no potential for agriculture.

Figure 4-8

Photograph: deep, gently undulating soils of the Tartous-El Hishi Association (soil association B; foreground), and shallow, hilly soils of the Kilmaho-El Boustan-Bmalkeh Association (soil association C; background). While the majority of the association B is used for rainfed agriculture, the association C is mostly used for rangeland and for orchards.

Figure 4-9

Photograph: both Drykish-Kansebba-El Boustan Association (soil association D) and Bahluliyeh-Bamra-Yazidiyeh Association (soil association E) consist of shallow and steep soils.

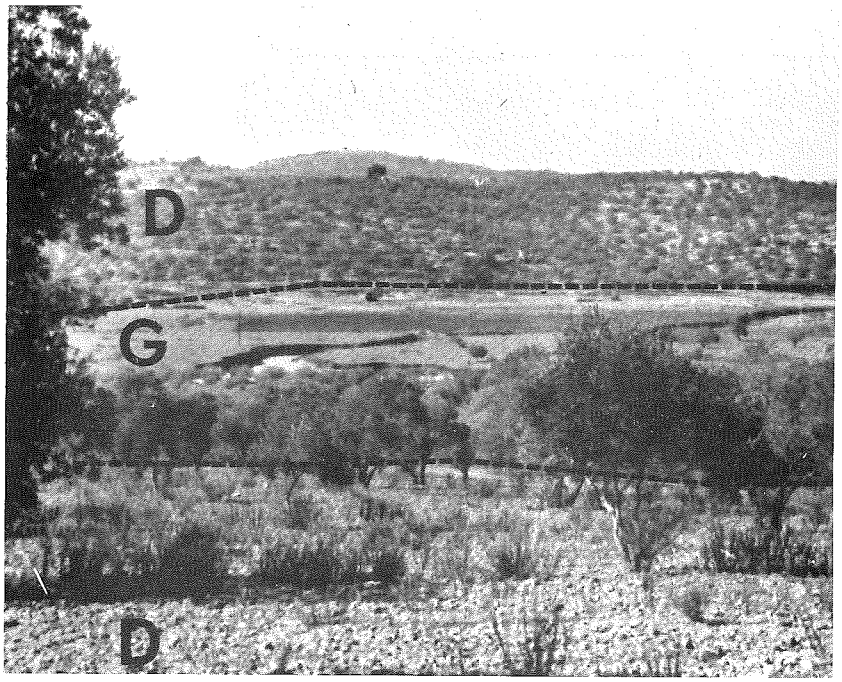

Figure 4-10

Photograph: Drykish-Kansebba-El Boustan Association (soil association D) and Jaferiyeh-Yahmour-Zarga Association (soil association G). The associa- D consists of shallow, very stony, and very steep soils on mountains and high hills, and G includes level, deep, well drained soils of alluvial plains and drainageways.

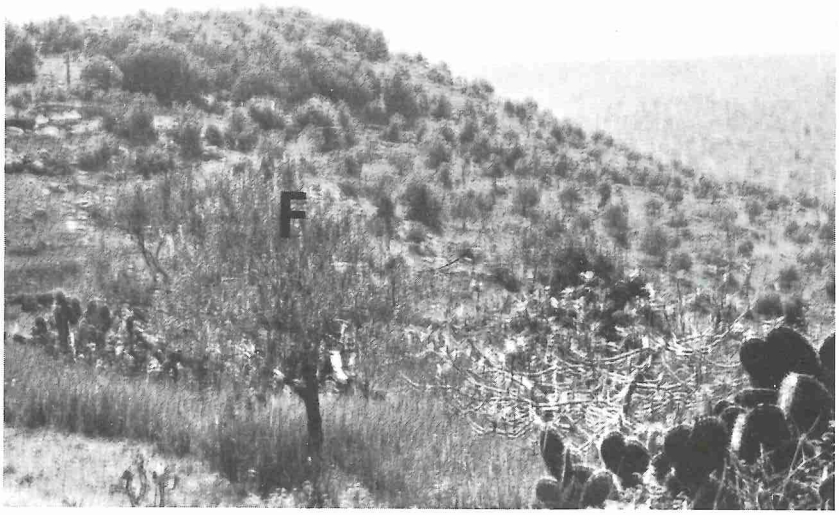

Figure 4-11

Photograph: the Safsafi-Shalouh-Tankoub Association (soil association F) occupies the rolling to hilly landscape on basalt. It consists of deep, clayey soils (Typic Xerochrepts) on summits, and shallow, eroded soils (Lithic Xerochrepts) on steep sideslopes.

Figure 4-12

Photograph; summits of high hills in association F consist of gently undulating to rolling, deep to moderately deep, stony and clayey soils (1). The side slopes (2) are very steep and highly eroded, and often marked with basaltic stones and boulders.

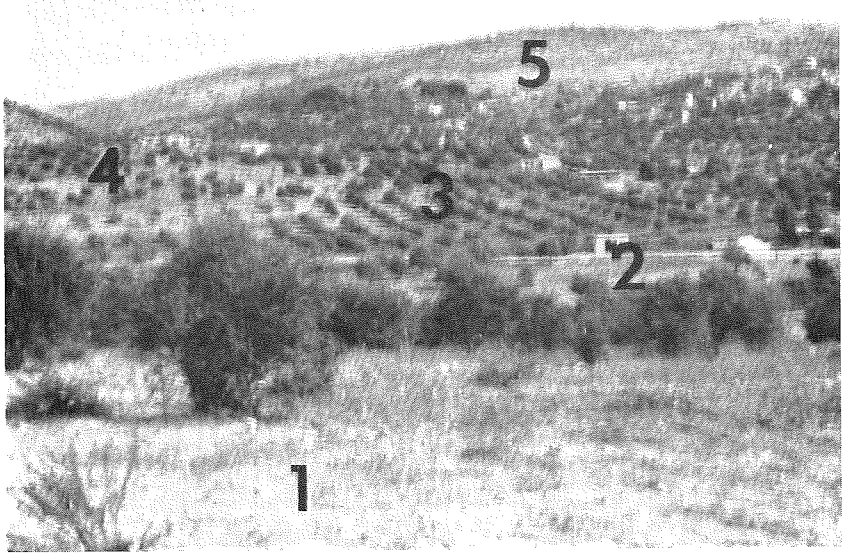

Figure 4-13

Photograph; a complex soilscape unit: (1) shallow and stony Drykish soils (Lithic Xerorthents); (2) deep and gravelly Yahmour soils (Typic Xerorthents); (3) deep Kilmaho soils (Typic Xerochrepts); (4) shallow Bmalkeh soils (Lithic Xerochrepts); and (5) the complex of very shallow Kansebba soils (Lithic Xerorthents) and rock outcrops.

Figure 4-14

Photograph; a complex soil map unit: the shallow and stony Kansebba soils (Lithic Xerorthents) (1) are so intermixed with the rock outcrops (2) that it is impractical to separate them.

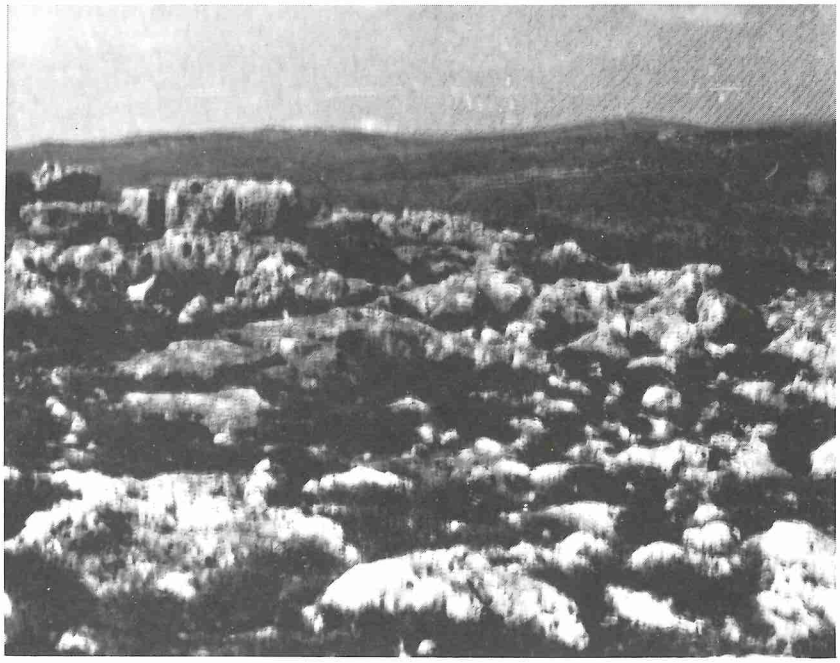

Figure 4-15

Photograph: miscellaneous land types have very little soil material and it is often not feasible to classify them.

Figure 4-16

Photograph; the weakly consolidated marine deposits form rocky benches on marine aggradation plains near Tartous. This formation is usually associated with Bassa soils (Lithic Xerorthents).

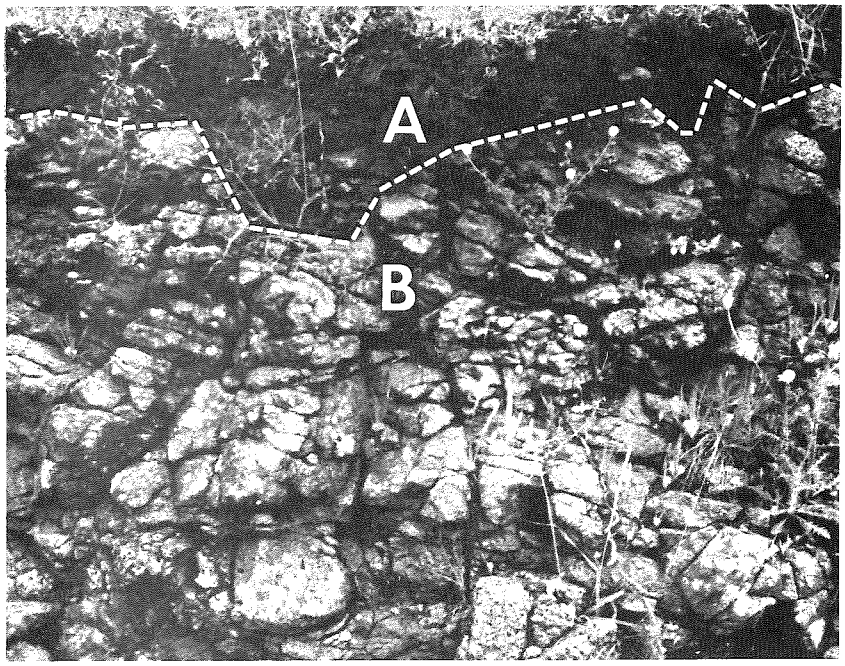

Figure 4-17

Photograph; very shallow Em Harten soils (Lithic Xerorthents) on fractured basalt, where the dark colored (A) horizon is usually found immediately above the bedrock (R).

Figure 4-18

Photograph; the general landscape and typical use of Lithic Xerorthents. The gentle side slopes sometimes are terraced and used for orchards.

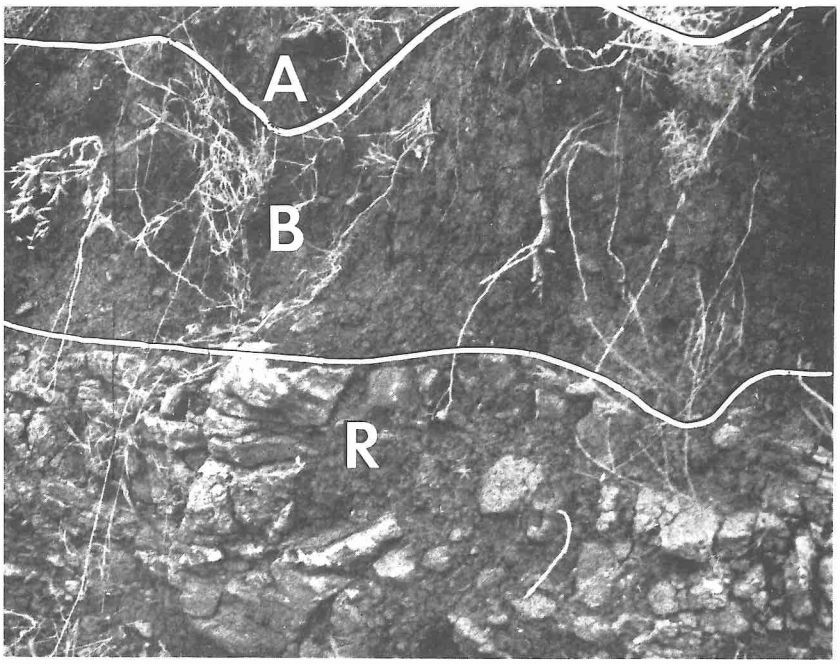

Figure 4-19

Photograph; Lithic Xerochrepts are shallow soils, but they have well developed (A) and (B) horizons. The bedrock (R) is found within 50 cm of the soil surface.

Figure 4-20

Photograph; typical landscape and land use of Lithic Xerochrepts. In spite of the shallow soil body and steep slope, these soils are often terraced and used for orchards because they have better moisture and nutrient supplying power than Lithic Xerorthents.

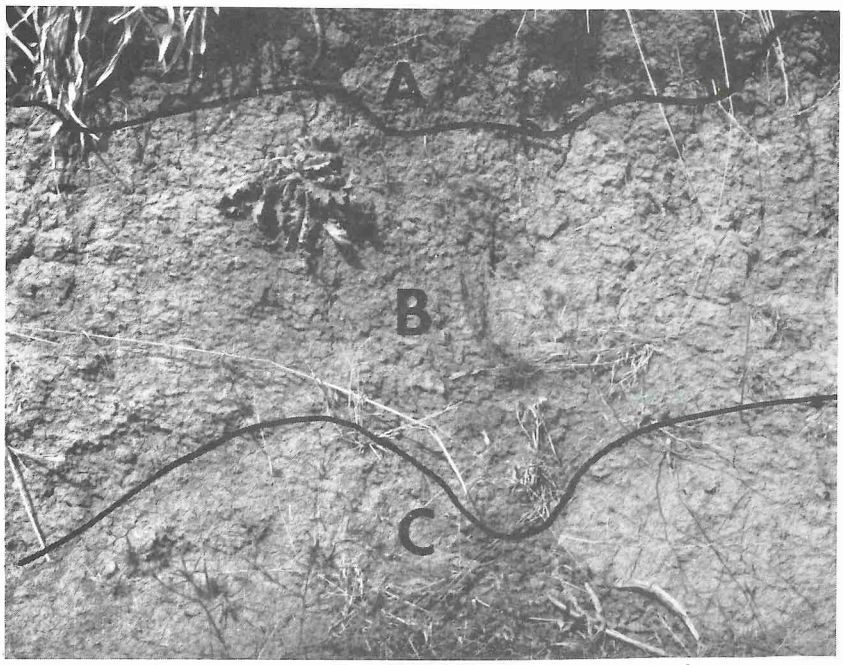

Figure 4-21

Photograph; deep, well developed soils (Typic Xerochrepts) are often found on level to gently undulating landscapes. They have well developed (A) and (B) horizons underlined by the parent material (C). The bedrock is usually deeper than 1 m.

Figure 4-22

Photograph; typical landscape and land use of Typic Xerochrepts. These soils are under intensive agriculture and are highly suitable for both rainfed and irrigated crops.

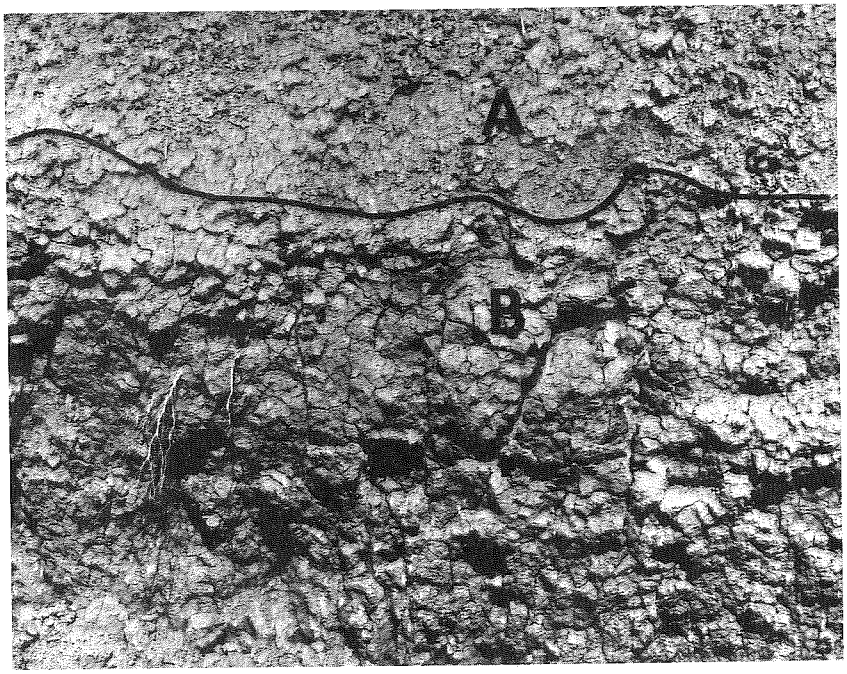

Figure 4-23

Photograph; El Hishi soils have high clay content throughout the profile (Vertic Xerochrepts), and develop cracks during the dry summer months.

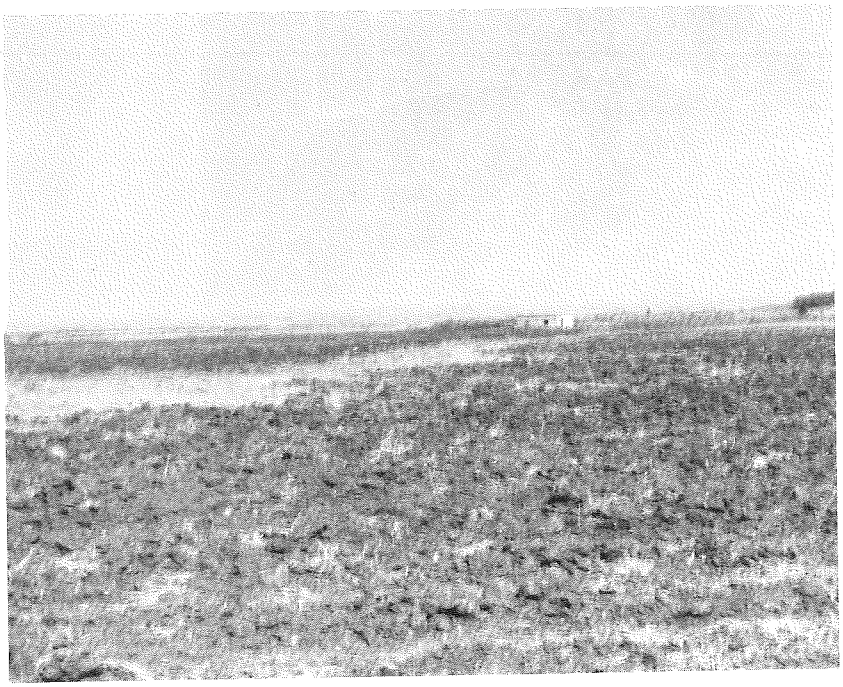

Figure 4-24

Photograph; typical landscape and land use of El Hishi soils. These soils require very careful management due to high clay content and low hydraulic conductivity. It is often necessary to dely planting and harvesting to prevent puddling of the topsoil.

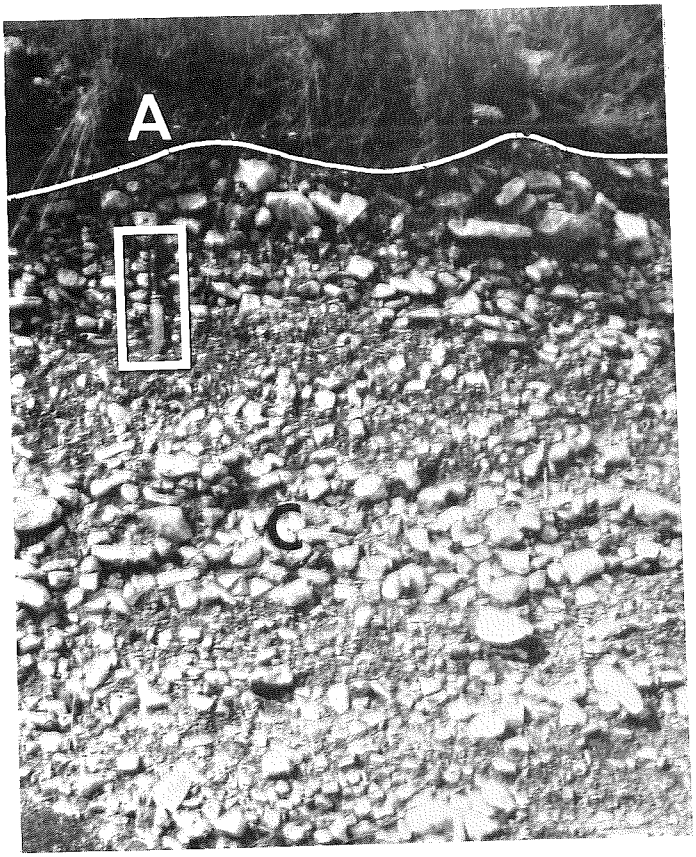

Figure 4-25

Photograph; Yahmour soils (Typic Xerorthents) are extremely gravelly throughout the profile. A very thin topsoil (A) overlies the extremely gravelly deposits (C).

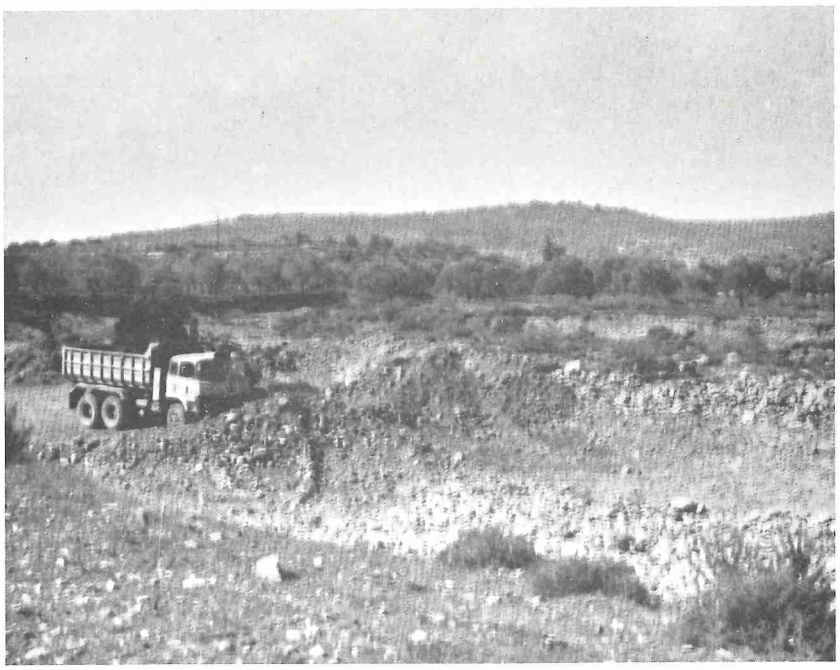

Figure 4-26

Photograph; Yahmour soils are a good source for sand and gravel, and for roadfill material.

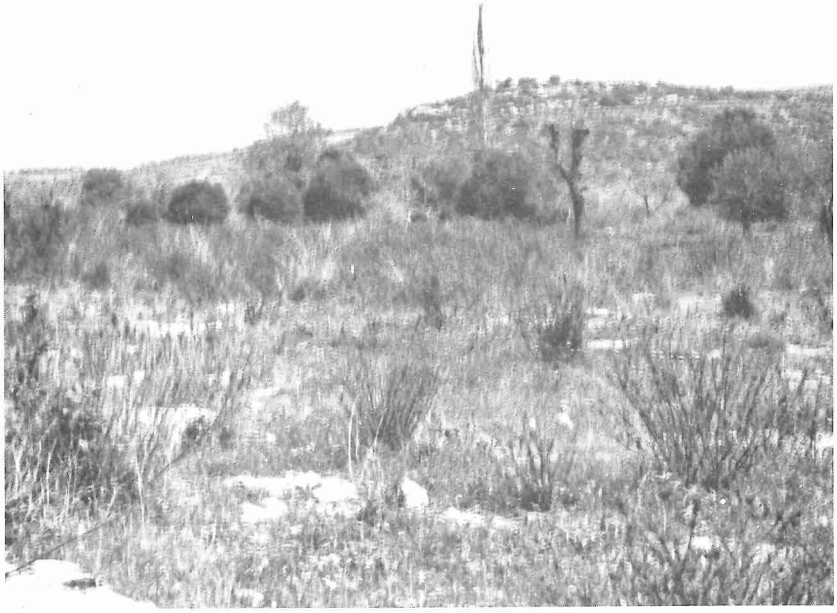

Figure 4-27

Photograph; the use of a soil is very closely associated with its characteristics. This shallow, stony and rocky Kansebba soil is used for rangeland.

Figure 4-28

Photograph; Tarkoub soils (Typic Xerochrepts), although stony like Kansebba soils, are under intensive agriculture because they are deep and highly fertile. Note that the stones are cleared and used to build walls for landmarks.

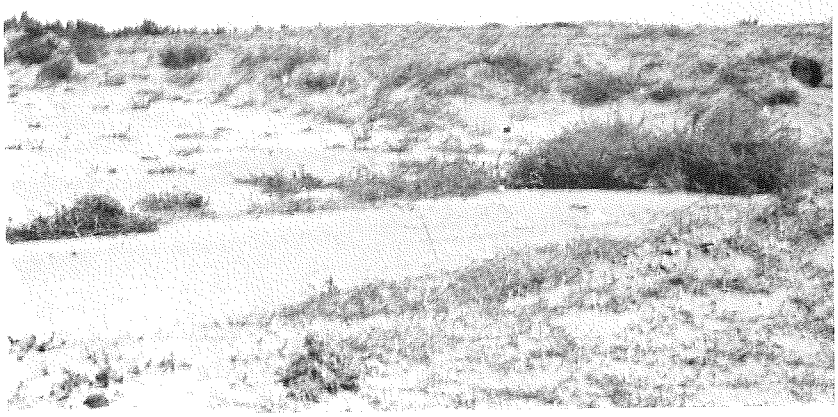

Figure 4-29

Photograph; Arida soils (Typic Xeropsamments) have sandy texture and very rapid permeability. They support very little vegetation because of low water holding capacity and very low fertility, and are subjected to severe wind erosion.

Figure 4-30

Photograph; Mintar soils (Typic Xeropsamments) are similar to the Arida soils, but often are used for irrigated agriculture due to somewhat better water holding capacity than the Arida soils. Note that the pine trees (background) are used as wind break to prevent wind erosion.

Figure 4-31

Photograph; soils of the survey area are sometimes overused. These olive trees are on extremely gravelly and stony soils which have very low water holding capacity and very low nutrient supplying power to the plants.

Figure 4-32

Photograph; these extremely gravelly soils are on 10 percent slope, but are used for irrigated corn and beans. Using soils beyond their capacity often results in total loss of the soil material through erosion.

Figure 4-33

Photograph; the truck-mounted hydraulic probes were used extensively throughout the survey, which greatly accelerated the field work.