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O A L S BULLETIN 1

GENERAL SOIL MAP
LOWER PANTANO WASH AREA
PIMA COUNTY, ARIZONA

by

M.L. Richardson

A report of work performed under
NASA grant No. NGL 03-002-313
in cooperation with the United States
Department of Agriculture, Soil Conservation
Service, and the City of Tucson, Dept. of Planning

OFFICE OF ARID LANDS STUDIES
College of Earth Sciences
University of Arizona
Tucson, Arizona

June 1972

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FOREWORD

This Bulletin is published in furtherance of the purposes of NASA grant NGL 03-002-313 entitled "Research for Application of Remote Sensing to State and Local Governments." The purpose of the grant is to assist with the use of NASA high-altitude photography and satellite imagery, state and local agencies whose responsibioity lies in planning, zoning, and environmental monitoring and/or assessment.

This report is the first in a series of publications designed to present information bearing on remote sensing research and applications in Arizona. In the present investigation, high-altitude color photography (Mission 101, August 71) was used to determine soil type variation over large areas at a contact print scale of 1:125000. It was found that color variation and land form could be used as a basis for assigning seven SCS soil mapping units to the area as depicted on stereoscopic pairs of the color photography. A unit is assigned by soil scientists on the basis of similarity of soil features in the area to pre-determined physical and chemical characteristics of the same soil type.

GENERAL SOIL MAP

LOWER PANTANO WASH AREA

PIMA COUNTY, ARIZONA

INTRODUCTION

This General Soil Map and certain interpretations for soils in the Lower Pantano Wash drainage system, Pima County, Arizona, was made by soil scientists of the Soil Conservation Service, U.S.D.A. in cooperation with the Office of Arid Lands Studies, University of Arizona. Purpose of the survey was to determine the distribution and characteristics of the major soils in the area, using standard methods, and comparing their distribution to the pattern depicted on high altitude, small scale color photographs. The study hopes to determine the feasibility of using high altitude, small scale photography for indicating the distribution and characteristics of major soils in an area and their suitability for residential, commercial, industrial and recreational development. The soil information is part of a broader environmental protection study entitled "Application of Remote Sensing to an Urban Environmental Plan" which is a joint study between the Office of Arid Lands Studies and the Planning Division, City of Tucson. The study is part of a NASA funded project to explore the potential of remote sensing as a problem-solving tool for state and local governments. It is intended to provide basic guidance for future land use planning along Pantano Wash with consideration being given to soil and hydrological limitations, together with esthetic factors as determined from high altitude and space photography.

METHODS AND LIMITATIONS OF THE SURVEY

In making General Soil Maps, soil scientists utilize their knowledge of the interaction of climate and time upon parent materials in various physiographic positions to predict kinds of soil that may be expected on a given land form. The type of vegetation may also give some clues as to the kind of soil. Photos show drainage patterns, and by use of stereo pairs the topography and relief is readily discernible. In this survey stereo pairs of 1970 high altitude color transparencies were used and compared with stereo pairs of photos of the same area flown in 1936 to detect changes in drainage patterns.

In this rapidly urbanizing area many road cuts and excavations were available for examination of soil profiles. The major soils were identified by comparison with known soils from detailed surveys of nearby areas. Representative areas of the various patterns depicted on both color and black and white photos were examined in an attempt to correlate soils with photo imagery.

The General Soil Map in the back of this report shows the major soil associations in the Lower Pantano Wash area. Seven mapping units - 6 soil associations and one miscellaneous land type - are delineated on a 2 inch = 1 mile, half-tone, August 1971 aerial photo mosaic. The same delineations are also shown on a ½ inch = 1 mile milar overlay for use with the color photo mosaics of that scale. The mapping units contain one of more properties such as texture, slope, depth, carbonate content, rock fragment content, or natural drainage.

The text of this report describes the 7 mapping units delineated on the soil map in numerical order. It gives the setting in which the soils occur, the approximate proportions of the major soils, and a brief description of the major soil series. It should be noted that there are other minor kinds of soils -- soils that may be fairly extensive locally, that are not rated in this report. 1/ The soil association descriptions are followed by a table classifying the named soil series in the National Classification System and three interpretative tables. Table A lists estimated soil properties and suitability for various uses. Tables B and C give soil limitation ratings and soil features affecting various engineering interpretations for urbanization, and recreational uses. The appendix describes some of the criteria used in determining the soil limitation and suitability ratings and gives a glossary of terms used in the report. The results of percolation tests on four representative soils in the area are also given in this section that emphasize the variability of results that might be obtained under varying conditions.

General soil maps are intended to give only a very broad picture of the kinds of soils and landscapes in an area. The map therefore is suitable only for broad planning purposes. On-site investigation should be made to obtain specific information for any intended use of a specific site. In general, interpretations in the tables apply only to depths of 60 inches; however, observations of underlying materials to greater depths may be stated where observed.

GENERAL DESCRIPTION OF THE AREA

The area covered by this General Soil Map and report is approximately 13 square miles or about 8300 acres. It lies on the east edge of the City of Tucson and borders Pantano Wash from Irvington Road on the south, to River Road north of the confluence of Pantano Wash and Tanque Verde Creek. The area ranges in width from 1 to 2 miles. It includes the floodplains of lower Pantano Wash and Tanque Verde Creek and portions of the terrace breaks and mesa-like terrace tops on either side of the floodplains. Slopes on terrace breaks are mainly 5 to 15 percent but short slopes are as much as 50 percent. The terrace tops have slopes of about 1 to 5 percent. Vertical relief from the floodplain to the tops of the terrace remnants is from 25 to 75 feet. Elevation ranges from about 2500 feet on the north to 2800 feet on the south. Both the Pantano Wash and Tanque Verde Creek are intermittent streams that drain large watersheds to the east and southeast. The stream channels are entrenched to depths of 5 to 15 feet in most areas and are from

1/ More information about the soil series and the mentioned, but not described, minor included soils can be obtained from most SCS offices.

200 to about 700 feet in width. High density housing developments and a few commercial developments have been, or are being built, on private lands within the area. These are mainly on the terrace tops but several trailer parks as well as permanent housing are on the floodplain. At least 3 golf courses are in the area. Several sand and gravel quarries are on the floodplain and in the stream channel. A few of these have been refilled with a variety of materials -- mostly refuse from construction such as boards, concrete, and asphalt material. In several areas these materials are dumped immediately adjacent to the stream channel where lightweight materials will ultimately be washed downstream.

GEOLOGY

No bedrock was noted in the area. The floodplain is composed of comparatively recent alluvium derived from a variety of parent rocks. The terraces and terrace breaks are composed of older alluvium from the nearby mountains and is gravelly in most areas. The alluvium and rock fragments are derived mainly from granite and gneiss with considerable material from limestone in some areas. Much of the gravel is in the 2 mm. to ½ inch size range. The landforms range in age from Recent on the floodplain to probable Pleistocene age on the terraces.

HYDROLOGY

The portion of Pantano Wash within the study area has undergone man-made changes that have tended to stabilize the wash into a narrower and deeper channel. This appears to have been accomplished in three ways:

1) Sand and gravel companies have used the wash as a material source and have excavated large holes and trenches within the channel;

2) Stream banks have been stabilized in a few places where urbanization has occurred adjacent to the channel. The stabilization is in the form of rip-rap or banks shoved up by bulldozer from within the channel which has tended to straighten and deepen it. Wildcat dumping and filling with miscellaneous materials along the stream banks has defined and increased the depth of the channel in places.

3) Although a gauging station does not exist on the lower end of the Pantano to substantiate increased runoff, urbanization along the channel has undoubtedly led to increased local runoff which may have aided the channelizing effect.

CLIMATE

The climate is warm and semi-arid. Average annual precipitation ranges from about 10 to 12 inches with about one-half of the total falling as thundershowers in July, August and September. Most of the remainder falls in October through April as gentle rains. May and June are usually dry and hot. Mean annual air temperature is 67°F. with the mean maximum 83°F. and the mean minimum 50°F. The frost-free season is approximately 241 days. This data is from the U. S. Coast and Geodetic Magnetic Observatory in the northern part of the study area where the elevation is 2526 feet.

DESCRIPTIONS OF THE MAPPING UNITS

Unit 1. Pima-Grabe association

This association consists of deep, dark colored moderately fine, medium, and moderately coarse textured soils formed in recent alluvium from mixed sources. They are on the floodplain of Pantano Wash and Tanque Verde Creek. Slopes are less than 1 percent. They could be subject to overflow from rare major storms but present entrenchment of the stream channels should handle normal runoff. Stream bank erosion and local flooding from side drainages are probable unless precautionary measures are taken. Native vegetation is mainly creosotebush with some desert broom and paloverde and a few mesquite and cottonwood trees along Tanque Verde Creek. This association covers about 24 percent of the area.

Pima soils make up about 50 percent of the association, Grabe soils 25 percent, and Comoro soils 15 percent. The remaining 10 percent consists of small intermixed bodies of sandier soils or soils shallow over sand and gravel.

Pima soils have dark brown loam, silt loam or light silty clay loam surface and sub-surface layers to 40 inches or more. Grabe soils are similar but range in texture from loam to very fine sandy loam. Comoro soils are also dark brown but have dominant texture of fine sandy loam or sandy loam to 40 inches or more and may be stratified with slightly finer or coarser textured materials. The Comoro, Grabe, and sandy included soils are commonly near the stream channels or where the channel has meandered in the past. As evidenced by the gravel pits in the area, the soils in this association are underlain at varying depths by sand and gravel.

Soils in this association serve as sites for residential and commercial housing. Several trailer parks are on these soils. A few areas are vacant. The Tucson Country Club and Dorado Park golf courses are partially on these soils in the north part of the area. Several areas were formerly irrigated cropland but are now vacant or used for housing.

Unit 2. Torrifluvents association[1/]

This association consists of Riverwash in the stream channels and stratified sandy to loamy mixed alluvial soils in the lower positions adjacent to the stream channels. Some of the larger side drainage

1/ A term used in Soil Taxonomy of the National Cooperative Soil Survey, Dec. 1970, meaning roughly, recent, stratified, water laid deposits in an arid climate.

channels are included. Slopes are dominantly less than 1 percent. These soils are subject to frequent seasonal overflow in the stream channels and occasional overflow on the adjacent low-lying floodplains. Stream bank erosion is a potential hazard in many places. Natural vegetation is mainly mesquite, creosotebush, desertbroom, and annual grasses, with many desert willow, mesquite, and cottonwood trees along Tanque Verde Creek. The stream channels are nearly barren. This association covers about 15 percent of the area.

Mixed stratified sandy to loamy soils make up about 60 percent of the unit and Riverwash makes up about 35 percent. The remainder is small bodies of Comoro, Grabe, and Pima series.

The mixed alluvial soils are in intricate mixed patterns and include such soil series as Anthony, Gila, Arizo 2/, Vinton, Brazito 2/, and Agua. 3/ In general, all of these soils are very sandy throughout or are loams overlying sandy or sandy and gravelly materials at shallow to moderate depths. They occur adjacent to the larger stream channels or in the channels and on the stream deltas of the side drainages. Riverwash consists of the very sandy to gravelly materials in the stream channels. Periodic flooding precludes growth of most vegetation.

Soils in this mapping unit area are mostly vacant land. A small area is part of the Tucson Country Club Golf Course. A few amall areas have been farmed and a few buildings are on the unit or are being elevated by landfill for building sites. Several sand and gravel pits lie within or adjacent to the area.

Unit 3. Anthony association

This unit consists mainly of deep, light colored sandy loam or gravelly sandy loam or loamy sand soils on the alluvial fans and floodplains of the side drainages. Slopes are 0 to 3 percent. Parent alluvium is dominantly from granitic materials with considerable amounts of fine gravel, 2 mm. to ½ inch, in the profile. These areas are subject to local seasonal flooding in many areas but can usually be protected by dikes and diversion channels under present building programs. Continued construction on upstream watersheds, with increased runoff and natural channel diversion, may cause flooding problems in the future. Natural vegetation is mainly creosotebush and mesquite, with some whitethorn and annual grasses. This association occupies about 10 percent of the surveyed area.

Anthony sandy loam is estimated to make up about 50 percent of the mapping unit, Anthony gravelly sandy loam or gravelly loamy sand, 40 percent, and Comoro soils, 5 percent. The remaining 5 percent is intermixed small bodies of sandier soils and Riverwash.

2/ Arizo is a Torriorthent and Brazito is a Torripsamment and technically would be inclusions in the association as named.

3/ See footnote, page 2.

Anthony sandy loam has surface and subsurface layers of brown to reddish brown sandy loam or fine sandy which may be stratified with slightly finer or coarser textured material and contain small amounts of gravel. This soil is usually on the lower fans or intermixed in the floodplains. Slopes are 0 to 2 percent. Anthony gravelly sandy loam and gravelly loamy sand are similar but contain an average of 15 to 35 percent gravel by volume and are more likely to be stratified with coarser textured layers. This soil is commonly higher on the fans or on the floodplains of the smaller side drainages where slopes are 1 to 3 percent. In places on the upper fans, Anthony soils overlie older reddish brown finer textured soils, such as those in Unit 4. The included Comoro soils are similar to Anthony but are darker in color and contain more organic matter.

Soils in this unit are being used as construction sites for residential housing, trailer courts, and small suburban ranchettes. Small areas have been farmed in the past.

Unit 4. Mohave-Tres Hermanos association

Soils in this association occupy the nearly level to gently sloping or undulating old terrace tops on either side of the Pantano floodplain. The terraces are partially dissected by shallow drainageways. Slopes are dominantly 1 to 5 percent but range from 0 to 7 percent. These soils are formed in old alluvium dominantly from granitic rocks but including some limestone. Natural vegetation is creosotebush, mesquite, cholla and a few saguaro cacti, burroweed and a few paloverde and annual grasses. The mapping unit makes up about 21 percent of the study area.

Mohave soils comprise about 50 percent of the association and Tres Hermanos soils 35 percent. The remainder is made up of intermixed bodies of Latene and Rilloso and other minor soils.

Mohave soils have reddish brown loam or fine sandy loam surface layers and reddish brown heavy loam or light clay loam subsoils and substrata. They usually have many white lime (calcium carbonate) mottles below about 20 inches. Tres Hermanos soils are similar to Mohave but have 15 to 35 percent gravel by volume throughout the profile and in places are weakly cemented by lime below 20 to 30 inches with texture of gravelly sandy loam or loam. Latene and Rilloso soils are light brown to pinkish gray and strongly calcareous throughout with numerous lime mottles and nodules in the lower subsoil. They lack subsoil development. Latene soils are dominantly of loam texture with little gravel. Rilloso soils are sandy loam to light loam in texture and contain 15 to 35 percent gravel, by volume, throughout the profile. Mohave soils are usually on the more level areas and in slight swales. The Tres Hermanos, Latene and Rilloso soils are on low ridges or edges of the terrace breaks.

The soils in this association are being used for residential and light commercial construction. The Rolling Hills and part of the Dorado golf courses are on these soils. The U. S. Coast and Geodetic Survey Magnetic Observatory is mostly on these soils in the NW¼ of section 5, T. 14 S., R. 15 E. There is also one cemetery and several schools on this association.

Unit 5. Continental association

This association occurs only in the $W\frac{1}{2}$ of section 34, T. 14 S., R. 15 E., within the surveyed area. It is near the end of a nearly level terrace top with slopes less than 2 percent. The soils are formed in old alluvium from granite, quartzite, rhyolite, andesite, and other rocks apparently transported from the southeast. Natural vegetation is creosotebush, cholla and prickly pear cacti, a few mesquite and paloverde, and three-awn and annual grasses. This association covers about 2 percent of the area.

Continental soils make up about 90 percent of the unit. The remainder is small intermixed bodies of Mohave, Tres Hermanos, or closely related soils.

The Continental soils in this area have thin reddish brown gravelly loam or clay loam surface layers 2 to 6 inches thick which overlie reddish brown or dark red clay subsoils. They become calcareous and gravelly below about 20 inches with textures ranging from clay loam to gravelly or very gravelly sandy clay loam. The surface is covered with 20 to 35 percent gravel and a few cobble.

This area is presently unfenced desert range land with many "wildcat" trash dumps.

Unit 6. Pinaleno-Nickel-Rough broken land association

This association consists principally of very gravelly, moderately fine to moderately coarse textured soils on narrow ridges formed by dissection of the old terraces adjacent to and above the Pantano and Tanque Verde floodplains. Slopes are dominantly 5 to 15 percent but short slopes up to 30 percent are included. Vertical relief is mostly 10 to 25 feet, but a few small areas, described below as Rough broken land, have slopes of 15 to 50 percent and vertical relief up to about 75 feet. The soils are formed in old alluvium from granite, gneiss, schist, quartzite and limestone. In places, erosion has exposed older buried soils. Vegetation consists of paloverde, whitethorn, creosotebush, mesquite, catclaw, bursage, prickly pear and a few saguaro and cholla cacti, fluffgrass and annual grasses. This association comprises about 22 percent of the surveyed area.

Pinaleno soils make up about 40 percent of the association, Nickel soils 35 percent, Rough broken land about 15 percent, and miscellaneous soils such as Palos Verdes, Latene, Rilloso, Tres Hermanos and sandy soils in the drainageways make up the remaining 10 percent.

Pinaleno soils have reddish brown, very gravelly sandy loam surface layers and reddish brown gravelly to very gravelly sandy clay loam subsoils that grade to very gravelly sandy loam or loamy sand substrata. Lime content in the subsoils and substrata is variable but it is common for the lower subsoils to be weakly cemented by lime or by lime and silica in places. Nickel soils have strongly calcareous pale brown or light brown gravelly to very gravelly sandy loam profiles and may also be weakly cemented with lime in the subsoils and substrata. Both

Pinaleno and Nickel soils contain from 35 to about 75 percent gravel, by volume, throughout the profile. These soils are predominantly on rolling 5 to 15 percent slopes with a few short slopes up to 30 percent. When smoothed by construction machinery, as has been done in several places, e.g. the N½ NE¼ section 27, T. 14 S., R. 15 E., the over all gradient is about 5 percent. Areas steeper than about 30 percent and more than 50 foot high relief are considered to be a Rough broken land component of this association. Three small areas occur as follows: The area immediately above the floodplain in the NE¼ of section 26 near the intersection of Houghton and Escalante Roads; a near-escarpment on the west side of Pantano Wash just north of 22nd Street and east of Prudence Road; and a small area on the southwest side of the Rolling Hills Golf Course. Soils on the Rough broken land component are similar to the other very gravelly soils in the association. Palos Verdes soils which outcrop in a few places, mainly on the north and east sides, have thin reddish brown gravelly sandy clay loam subsoils and are shallow (9 to 20 inches) to weakly to strongly cemented gravelly old alluvium or agglomerate.

Soils in this association are being used for housing construction, light commercial structures and vacant land.

Unit 7. Gravel pits and Landfills

This miscellaneous land type includes several operating sand and gravel pits or quarries and a few areas that have been refilled with a variety of materials. With the exception of a pit in the SW¼ of section 5, T. 14 S., R. 15 E., all of the pits and fills are in the floodplain on the west side of Pantano Wash south of Speedway Blvd. Two areas, one in the NE¼ SW¼ section 8, and one in the NW¼ NW¼ SW¼ of section 35, T. 14 S., R. 15 E., appear to be true landfills.[4] A few areas have been refilled and smoothed from materials excavated from the adjacent terraces (Unit 6) or are filled with relatively clean soil material or solid building debris such as concrete slabs, bricks, etc. Unfortunately, several vacant pits as well as gullies and stream banks have been littered or partially filled with miscellaneous junk, much of which will eventually be washed downstream or will cause land subsidence if it is covered and eventually decays. Properly constructed landfills can also be expected to settle to some degree over a period of years as materials decay. At present, the landfill areas are vacant. Most of the sand and gravel pits are still being quarried in some parts. This mapping unit covers about 6 percent of the study area.

4/ See discussion of landfills in the appendix, page

CLASSIFICATION[1] OF THE SOILS

Lower Pantano Wash Area

Pima County, Arizona

June 1972

(by alphabetical order of Soil Series)

Soil Series	Map Symbol(s)	Family	Subgroup
Agua	2	coarse-loamy over sandy or sandy-skeletal, mixed, (calcareous), thermic	Typic Torrifluvents
Anthony	3	coarse-loamy, mixed, (calcareous), thermic	Typic Torrifluvents
Arizo	2 (i)[2]	sandy-skeletal, mixed, thermic	Typic Torriorthents
Brazito	2 (i)	mixed, thermic	Typic Torripsamments
Comoro	1, (3i)	coarse-loamy, mixed, thermic	Cumulic Haplustolls
Continental	5	fine, mixed, thermic	Typic Haplargids
Grabe	1 (2i)	coarse-loamy, mixed, thermic	Cumulic Haplustolls
Gravel pits	7	not classified	
Landfills	7	not classified	
Latene	4, 6(i)	coarse-loamy, mixed, thermic	Typic Calciorthids
Mohave	4, (5i)	fine-loamy, mixed, thermic	Typic Haplargids
Nickel	6	loamy-skeletal, mixed, thermic	Typic Calciorthids
Palos Verdes	6 (i)	fine-loamy, mixed, thermic	Typic Haplargids
Pima	1, (2i)	fine-silty, mixed, thermic	Cumulic Haplustolls
Pinaleno	6	loamy-skeletal, mixed, thermic	Typic Haplargids
Rilloso	4, 6 (i)	coarse-loamy, mixed, thermic	Typic Calciorthids
Riverwash	2	not classified	
Rough broken land	6	not classified	
Tres Hermanos	4, (5,6i)	fine-loamy, mixed, thermic	Typic Haplargids
Vinton	2	sandy, mixed, thermic	Typic Torrifluvents

1/ This section is primarily information for soil scientists. The classification is based on Soil Taxonomy of the National Cooperative Soil Survey as of the date of this report. Since some local classifications were then pending, further checking is advised.

2/ (i) - included soil in minor amounts.

ESTIMATED SOIL PROPERTIES SIGNIFICANT TO ENGINEERING INTERPRETATIONS FOR RESIDENTIAL, INDUSTRIAL, AND RECREATIONAL USES 1/

GENERAL SOIL MAP - LOWER PANTANO WASH AREA

PIMA COUNTY, ARIZONA

TABLE A

Map Symbol and Major Soil Components	Estimated Properties of the Soils: Permeability Inches/hr.	Available Water Capacity Inches/in.	Shrink-Swell Potential	Reaction	Corrosivity (uncoated steel)	Suitability as a Source of: Roadfill	Sand and/or Gravel	Topsoil	Other Features: Hydrologic Soil Group	Flooding Hazard	Erosion Hazard
1. Pima loam, silt loam or silty clay loam, 0 to 1 percent slopes (50% of unit)	Moderately slow .20 to .60	High .16 to .21	Moderate	pH 7.9 to 8.4	Moderate to high	Fair. ML or CL material	Poor - excessive fines. Overlies sand and/or gravel in many places	Fair to good - entire profile. Silty clay loam only fair	B	Slight to moderate. Occasional to frequent in local areas. Usually very brief	Slight to moderate. Subject to piping and gullying
Grabe loam, silt loam or very fine sandy loam, 0 to 1 percent slopes (25% of unit)	Moderate .60 to 2.0	High .15 to .21	Low	pH 7.9 to 8.4	Low to moderate	Fair. ML material	Poor - excessive fines. Overlies sand and/or gravel in many areas	Good - entire profile	B	Slight to moderate. Occasional to frequent in local areas. Usually very brief	Slight to moderate. Subject to piping and gullying
Comoro fine sandy loam, 0 to 1 percent slopes (15% of unit)	Moderately rapid 2.0 to 6.0	Moderate .10 to .13	Low	pH 6.6 to 8.4	Low	Good. SM material	Poor - excessive fines. Overlies sand and/or gravel in many areas	Good - entire profile. Moderate water holding capacity	B	Slight to moderate. Occasional to frequent in local areas. Usually very brief	Slight
2. Mixed stratified sandy to loamy soils, 0 to 1 percent slopes, subject to occasional overflow (60% of unit)	Moderate to rapid 2.0 to 20.0	Low .04 to .09	Low	pH 7.0 to 8.0	Low	Fair to good. ML to SM material or ML or SM over SP, GP or GM material	Fair to good in lower profile. Commonly overlies sand and/or gravel	Poor to fair. Some part usually has low water-holding capacity. Poor where gravelly	A and B	Moderate to severe. Occasional to frequent in local areas - usually brief	Moderate. Usually in a position where stream bank cutting is a hazard

1/ See Appendix for explanation of terms and column headings. See Tables B and C for soil limitation ratings based on soil properties in this table.

TABLE A

Map Symbol and Major Soil Components	Estimated Properties of the Soils: Permeability Inches/hr.	Available Water Capacity Inches/in.	Shrink-Swell Potential	Reaction	Corrosivity (uncoated steel)	Suitability as a Source of: Roadfill	Sand and/or Gravel	Topsoil	Other Features: Hydrologic Soil Group	Flooding Hazard	Erosion Hazard
2. (cont'd)											
Riverwash (35% of unit)	Very rapid. Usually >20.0	Low to very low <.04 to .07	Low	pH 7.0 to 8.0	Low	Good. SM, SP material	Good for sand. Fair to good for gravel	Poor	A	Severe. Frequent seasonal overflow	Slight. Possible deposition
3. Anthony sandy loam, 0 to 2 percent slopes (50% of unit)	Moderately rapid 2.0 to 6.0	Moderate .09 to .13	Low	pH 7.9 to 8.4	Low	Good. SM material	Poor. Excessive fines. May overlie sand and/or gravel	Fair. Moderate water-holding capacity. May be slightly gravelly	B	Generally slight. Occasional to frequent in local areas from side drainages. Short duration	Slight
Anthony gravelly sandy loam or loamy sand, 1 to 3 percent slopes (40% of unit)	Rapid 6.0 to 20.0	Low .05 to .09	Low	pH 7.4 to 8.4	Low	Good. SM or GM material	Poor. Excessive fines. May overlie sand and/or gravel	Poor. Excessive gravel. Low water-holding capacity	B or A	Generally slight. Occasional to frequent in local areas from side drainages. Short duration	Slight
4. Mohave loam or fine sandy loam, 0 to 5 percent slopes (50% of unit)	Moderately slow. .20 to .60 May be moderate in substratum	High .16 to .20	Moderate	pH 7.9 to 8.4 Strongly calcareous in lower subsoil	Moderate	Fair. CL materials	Poor. Excessive fines	Fair. Clay loam texture. May have high lime in lower subsoil	B	Slight	Slight to moderate
Tres Hermanos gravelly loam or fine sandy loam, 1 to 7 percent slopes (35% of unit)	Moderately slow .20 to .60 May be moderate to moderately rapid in substratum .6 to 6.0	High in upper 24 to 30 inches .13 to .17 May be moderate below 24 to 30 inches .09 to .13	Moderate	pH 7.9 to 8.4 Strongly calcareous in substrata	Moderate	Fair. SC or SM materials	Poor. Excessive fines. May overlie gravel	Poor. Excessive gravel. High lime in substrata	B	Slight	Slight

TABLE A

Map Symbol and Major Soil Components	Estimated Properties of the Soils: Permeability Inches/hr.	Available Water Capacity Inches/in.	Shrink-Swell Potential	Reaction	Corrosivity (uncoated steel)	Suitability as a Source of: Roadfill	Sand and/or Gravel	Topsoil	Other Features: Hydrologic Soil Group	Flooding Hazard	Erosion Hazard
5. Continental gravelly loam or clay loam, 0 to 2 percent slopes (90% of unit)	Slow .06 to .20 May be moderate in substratum .6 to 2.0	High .13 to .16	High	pH 7.4 to 8.4	High	Poor. CH material in subsoil	Poor. Excessive fines	Poor. Clayey material	C	Slight	Slight
6. Pinaleno very gravelly sandy loam, 5 to 15 percent slopes (Short slopes up to 30%) (40% of unit)	Moderate .60 to 2.0 May be moderately rapid to rapid in substratum 2.0 to 20.0	Low .06 to .09	Low to moderate	pH 7.9 to 8.4	Moderate	Good. GM, SM or GC material	Poor for sand. May be fair for gravel	Poor. Excessive gravel	B	Slight	Slight
Nickel very gravelly sandy loam, 5 to 15 percent slopes (Short slopes up to 30%) (35% of unit)	Moderately rapid 2.0 to 6.0 May be rapid in substratum 6.0 to 20.0	Low .06 to .09	Low	pH 7.9 to 8.4 Calcareous	Moderate	Good. GM or SM material	Poor. Excessive fines. May be fair for gravel	Poor. Excessive gravel and usually high in lime	B	Slight	Slight
Rough broken land, 15 to 50 percent slopes (15% of unit)	Moderate to moderately rapid .6 to 6.0	Usually low .04 to .09	Usually low	pH 7.9 to 8.4	Moderate	Fair to good. Mostly SM to GM	Poor. Excessive fines	Poor. Excessive gravel in most areas	Mostly B	Slight	Usually slight. Severe if natural vegetation is disturbed
7. Gravel pits (about 75% of unit)	Rapid to very rapid 6.0 to >20.0	Very low < .04	Low	Variable	Low	GP to SP material	Good	Poor	A	Variable. Most are in floodprone areas	Slight
Landfills (about 25% of unit)	Variable	Variable	Variable	Variable	Usually high	Variable	Variable	Variable	Variable	Variable	Severe on stream banks

SOIL LIMITATIONS RATINGS AND FEATURES AFFECTING ENGINEERING INTERPRETATIONS FOR RESIDENTIAL AND INDUSTRIAL USES 1/

FOR THE GENERAL SOIL MAP - LOWER PANTANO WASH AREA - PIMA COUNTY, ARIZONA

TABLE B

Map Symbol and Major Soil Components	Soil Limitations and Soil Features Affecting Residential and Light Industrial Uses:							
	Septic tank Absorption Fields	Shallow Excavations	Dwellings without basements (Foundation Support)	Sanitary Landfill	Local Roads and Streets	Water Areas (Ponds, Sewage, Lagoons, etc.)	Embankments, Dikes and Levees	Irrigation - Cropland, Golf Fairways, Lawns, and Similar Uses
1. Pima loam, silt loam or silty clay loam, 0 to 1 percent slopes (50% of unit)	Severe. Moderately slow permeability. Possible occasional flooding	Slight to moderate. Severe where subject to flooding	Moderate. Moderate shrink-swell potential. Severe if subject to flooding	Slight. Moderate where subsoils are clay loam. Severe if subject to flooding or if underlain by sand & gravel. Fair cover material	Moderate. ML or CL materials. Severe if subject to flooding more than once in 5 years	Slight to moderate. Substratum may have moderate permeability	Moderate. Poor to medium stability; high to medium susceptibility to piping. Medium to low shear strength. Moderate shrink-swell potential	Moderate to slight. Moderately slow permeability
Grabe loam, silt loam or very fine sandy loam, 0 to 1 percent slopes (25% of unit)	**Moderate to severe. Moderate permeability. Severe where flooding may occur**	Slight. Severe where subject to flooding	Slight. Severe where subject to flooding	Slight. Severe where subject to flooding or if underlain by sand & gravel. Good cover material	Moderate. ML material. Severe if subject to flooding more than once in 5 years	Moderate. Moderate permeability. Severe for sewage lagoons if subject to flooding or if underlain by sand & gravel	Moderate. High susceptibility to piping. Medium to low compacted permeability. Medium to low shear strength. Good to poor compaction characteristics	None to slight.
Comoro fine sandy loam, 0 to 1 percent slopes (15% of unit)	Slight. Severe where subject to flooding	Slight. Severe where subject to flooding	Slight. Severe where subject to flooding	Slight. Severe where subject to flooding or if underlain by sand & gravel. Good cover material	Slight. SM materials. Severe if subject to flooding more than once in 5 years	Severe. Moderately rapid permeability (may be rapid if underlain by sand and gravel. Possible flooding	Slight to moderate. Medium to high susceptibility to piping. Medium to low compacted permeability. Medium shear strength	Slight to moderate. Moderate water holding capacity

1/ See table A and text of report for soil characteristics upon which these interpretations are based.
See the appendix for an explanation of terms used and criteria for limitation ratings.

TABLE B

Map Symbol and Major Soil Components	Soil Limitations and Soil Features Affecting Residential and Light Industrial Uses: Septic tank Absorption Fields	Shallow Excavations	Dwellings without basements (Foundation Support)	Sanitary Landfill	Local Roads and Streets	Water Areas (Ponds, Sewage, Lagoons, etc.)	Embankments, Dikes and Levees	Irrigation - Cropland, Golf Fairways, Lawns, and Similar Uses
2. Mixed stratified sandy to loamy soils, 0 to 1 percent slopes, subject to occasional overflow (65% of unit)	Severe. Subject to flooding. Possible contamination of ground water	Severe. Subject to flooding. Sandy and gravelly materials subject to slumping	Severe. Subject to flooding	Severe. Subject to flooding. Possible ground water contamination due to rapid percolation rate. Poor cover material	Slight to severe depending upon frequency of flooding. SM to ML materials or SM or ML over SP, GP, or GM materials	Severe. Porous substrata Sewage lagoons may contaminate ground water or flood	Severe. Most soils have high compacted permeability. Medium to poor stability	Severe. Low waterholding capacity. Subject to seasonal flooding
Riverwash (35% of unit)	Unsuitable for all uses due to frequent seasonal flooding.							
3. Anthony sandy loam, 0 to 2 percent slopes (50% of unit)	Slight. Severe if subject to flooding	Slight. Severe if subject to flooding	Slight. Severe where subject to flooding	Slight. Severe where subject to flooding or where leachate may contaminate ground water. Good cover material	Slight. SM materials. Severe if flooded more than once in 5 years	Severe. Permeability > 2.0 inches per hour	Slight to moderate. Good compaction characteristics. Medium shear strength. Medium to low compacted permeability. Medium to high susceptibility to piping	Moderate. Moderate waterholding capacity
Anthony gravelly sandy loam or loamy sand, 1 to 3 percent slopes (40% of unit)	Slight. Severe if subject to flooding. Caution: possible ground water contamination. Rapid permeability	Severe. Sandy and gravelly materials subject to slumping. Possible flooding	Slight. Severe where subject to flooding	Severe. Moderately rapid to rapid permeability Possible ground water contamination. Fair cover material - gravelly	Slight. SM or GM materials. Severe if flooded more than once in 5 years	Severe. Permeability > 2.0 inches per hour	Moderate. Medium compacted permeability. High to medium shear strength. Fair to good compaction characteristics	Moderate to severe. Low waterholding capacity. Gravelly profiles (mostly fine)

TABLE B

Map Symbol and Major Soil Components	Soil Limitations and Soil Features Affecting Residential and Light Industrial Uses: Septic tank Absorption Fields	Shallow Excavations	Dwellings without basements (Foundation Support)	Sanitary Landfill	Local Roads and Streets	Water Areas (Ponds, Sewage, Lagoons, etc.)	Embankments, Dikes and Levees	Irrigation - Cropland, Golf Fairways, Lawns, and Similar Uses
4. Mohave loam or fine sandy loam, 0 to 5 percent slopes (50% of unit)	Severe. Moderately slow permeability	Slight.	Moderate. Moderate shrink-swell potential.	Slight to moderate. Loam or clay loam subsoils. Clay loam is only fair cover material	Moderate. CL material. Moderate shrink-swell potential	Slight.	Slight. Medium to low shear strength. Medium to low compacted permeability. Medium compressibility. Fair to good compaction characteristics	None to slight. High waterholding capacity. Calcareous subsoils and substrata
Tres Hermanos gravelly loam or fine sandy loam, 1 to 7 percent slopes (35% of unit)	Severe. Moderately slow permeability. May be slight to moderate if substrata is more porous	Moderate. Gravelly subsoils and substrata	Moderate. Moderate shrink-swell potential	Slight to moderate. Gravelly loam or clay loam subsoils. Fair cover - gravelly clay loam	Moderate. SC or SM materials. Moderate shrink-swell potential	Slight to moderate. Substratum may be porous. Investigate before excavating deep ponds	Slight. Medium shear strength. Good to fair compaction characteristics. Low to medium compressibility. Low to medium compacted permeability	Moderate. 20 to 50 percent gravel. Moderate to high waterholding capacity. Calcareous subsoils and substrata
5. Continental gravelly loam or clay loam, 0 to 2 percent slopes (90% of unit)	Severe. Slow permeability. May be more porous in substratum-Investigate	Severe. Poor workability due to clayey materials.	Severe. High shrink-swell potential in subsoils	Severe. Clayey subsoils - poor workability. Substrata may be gravelly. Poor cover material	Severe. CH material. High shrink-swell potential	Slight. Slow permeability. Substratum may be gravelly and porous. Investigate before excavating deep ponds	Moderate. Low shear strength. High compressibility Fair to poor compaction characteristics. Subject to cracking	Moderate. Slow permeability. High waterholding capacity. 20 to 35 percent gravel on surface
6. Pinaleno very gravelly sandy loam, 5 to 15 percent slopes (40% of unit)	Slight on slopes <8%. Moderate on 8 to 15% slopes	Severe. Very gravelly soils - slump hazard, poor workability	Slight on slope <8%. Moderate on 8 to 15% slopes. Low to moderate shrink-swell potential	Severe. Very gravelly material - poor workability. Poor cover material due to gravel. Possible ground water contamination due to porous substrata	Slight — <8% slopes. Moderate 8 to 15% slopes. SM, GM, or GC material	Severe. Porous gravelly substrata. Slopes >7% excessive for sewage lagoons	Moderate. Medium to low compacted permeability. May be pervious if uncompacted. High shear strength. Fair to good compaction characteristics	Severe. Excessive gravel. Low water holding capacity

TABLE B

Map Symbol and Major Soil Components	Soil Limitations and Soil Features Affecting Residential and Light Industrial Uses: Septic tank Absorption Fields	Shallow Excavations	Dwellings without basements (Foundation Support)	Sanitary Landfill	Local Roads and Streets	Water Areas (Ponds, Sewage, Lagoons, etc.)	Embankments, Dikes and Levees	Irrigation - Cropland, Golf Fairways, Lawns, and Similar Uses
Nickel very gravelly sandy loam, 5 to 15 percent slopes (short slopes up to 30%) (35% of unit)	Slight on slopes <8%. Moderate on 8 to 15% slopes. Possible ground water contamination due to rapid percolation in substrata	Severe. Very gravelly soils - slump hazard, poor workability	Slight on slope <8%. Moderate on 8 to 15% slopes. Low to moderate shrink-swell potential	Severe. Very gravelly material - poor workability. Poor cover material due to gravel. Possible ground water contamination due to porous substrata	Slight - <8% slopes. Moderate-8 to 15% slopes. SM, GM, or GC material	Severe. Porous gravelly substrata. Slopes >7% excessive for sewage lagoons	Moderate. Medium to low compacted permeability. May be pervious if uncompacted. High shear strength. Fair to good compaction characteristics	Severe. Excessive gravel. Low water holding capacity. Usually strongly calcareous — May cause chlorosis
Rough broken land, 15 to 50 percent slopes (15% of unit)	Severe. Excessive slopes	Severe. Excessive slopes - poor workability due to gravel	Generally severe due to steep slopes. Selected sites on <15% slopes may be suitable	Severe. Usually gravelly. Poor workability. Slope >25% is excessive. Poor to fair cover material due to gravel	Severe. Slopes >15% is excessive. Usually SM or GM material	Severe. Excessive slopes. Permeability moderate to rapid	Moderate to severe. Medium to high compacted permeability. Steep slopes	Severe. Excessive slopes. Usually has low water holding capacity
7. Gravel pits (about 75% of unit)	Severe. Possible ground water contamination due to porous material. Possible flooding hazard	Severe. Very sandy and gravelly - slump hazard	Slight if topography is suitable. Severe if subject to flooding	Severe. Excessive gravel. Possible ground water contamination due to rapidly permeable materials. Possible flooding some areas	Slight where topography is suitable and flood hazard is low.	Severe. Rapid permeability	Severe. High compacted and uncompacted permeability	Severe. Very low water holding capacity. Excessive gravel
Landfills (about 25% of unit)	Severe. Variable permeability. Possible ground water contamination	Generally severe. Variable fill materials	Severe. Possible subsidence unless properly compacted earthy materials have been used as fill	Variable. Soil filled areas may be suitable. Most areas appear to contain excessive gravel or have been used in the past for garbage disposal	Generally severe. May be suitable for light traffic	Severe. Variable permeability. Possible leaching of undesirable material into ground water	Generally severe. Variable compaction and permeability characteristics	Severe. Variable water holding capacity. May be suitable if covered with 2 feet or more of good soil material

SOIL LIMITATION RATINGS AND SOIL FEATURES AFFECTING RECREATIONAL USES

GENERAL SOIL MAP - LOWER PANTANO WASH AREA, PIMA COUNTY, ARIZONA

TABLE C

Map Symbol and Major Soil Components	Camp Areas	Playgrounds	Paths & Trails	Picnic Areas
1. Pima loam, silt loam or silty clay loam, 0 to 1 percent slopes (50% of unit)	Moderate. Moderately slow permeability. Silty clay loam surface in some areas. Severe if subject to flooding during period of use	Moderate. Moderately slow permeability. Silty clay loam surface in some areas. Severe if subject to flooding during period of use	Slight Moderate where surface is silty clay loam	Slight. Moderate where surface is silty clay loam. Severe if subject to flooding during period of use
Grabe loam, silt loam or very fine sandy loam, 0 to 1 percent slopes (25% of unit)	Slight. Severe if subject to flooding during period of use	Slight. Severe if subject to flooding during period of use	None to slight	Slight. Severe if subject to flooding during period of use
Comoro fine sandy loam, 0 to 1 percent slopes (15% of unit)	Slight. Severe if subject to flooding during period of use	Slight. Severe if subject to flooding during period of use	None to slight	Slight. Severe if subject to flooding during period of use
2. Mixed stratified sandy to loamy soils 0 to 1 percent slopes (65% of unit)	Severe. Subject to seasonal flooding. Loose sandy or gravelly surface	Severe. Subject to seasonal flooding. Loose sandy or gravelly surface	Severe. Loose sandy or gravelly surface	Severe. Loose sandy or gravelly surface. Subject to seasonal flooding

TABLE C

Map Symbol and Major Soil Components	Camp Areas	Playgrounds	Paths & Trails	Picnic Areas
2. (cont'd)				
Riverwash (35% of unit)	Severe. Frequent seasonal flooding	Severe. Frequent seasonal flooding	Severe. Loose surface	Severe. Frequent seasonal flooding
3. Anthony sandy loam, 0 to 2 percent slopes (50% of unit)	Slight. Possible dust problem. Severe if subject to flooding during period of use	Slight. Possible dust problem. Severe if subject to flooding during period of use	None to slight	None to slight. Severe if subject to flooding during period of use
Anthony gravelly sandy loam or loamy sand, 1 to 3 percent slopes (40% of unit)	Moderate. Gravelly, loose surface. Severe if subject to flooding during period of use	Severe. Gravelly, loose surface. Possible flooding	Moderate. Loose, gravelly surface	Moderate. Gravelly loose surface. Severe if subject to flooding during use period
4. Mohave loam or fine sandy loam, 0 to 5 percent slopes (50% of unit)	Moderate. Moderately slow permeability	Moderate. Moderately slow permeability	None to slight	None to slight
Tres Hermanos gravelly loam or fine sandy loam, 1 to 7 percent slopes (35% of unit)	Moderate. Gravelly surface. Moderately slow permeability	Severe. Gravelly surface. Moderately slow permeability	Moderate. Gravelly surface	Moderate. Gravelly surface

TABLE C

Map Symbol and Major Soil Components	Camp Areas	Playgrounds	Paths & Trails	Picnic Areas
5. Continental gravelly loam or clay loam, 0 to 2 percent slopes (90% of unit)	Moderate. Slow permeability. Gravelly surface	Severe. Slow permeability. Gravelly surface	Moderate. Gravelly loam or clay loam surface	Moderate. Gravelly loam or clay loam surface
6. Pinaleno very gravelly sandy loam, 5 to 15 percent slopes (40% of unit)	Severe. 50 to 75 percent gravel on surface	Severe. 50 to 75 percent gravel on surface. Slopes >6% are excessive	Severe. 50 to 75 percent gravel on surface	Severe. 50 to 75 percent gravel on surface
Nickel very gravelly sandy loam, 5 to 15 percent slopes (short slopes up to 30%) (35% of unit)	Severe. 50 to 75 percent gravel on surface	Severe. 50 to 75 percent gravel on surface. Slopes >6% are excessive	Severe. 50 to 75 percent gravel on surface	Severe. 50 to 75 percent gravel on surface
Rough broken land, 15 to 50 percent slopes (15% of unit)	Severe. Excessive slopes and gravel on surface	Severe. Excessive slopes and gravel on surface	Severe. Excessive slopes and gravel on surface. Slope >25 percent is excessive	Severe. Excessive slopes and gravel on surface
7. Gravel pits (about 75% of unit)	Severe. Excessive gravel	Severe. Excessive gravel	Severe. Excessive gravel	Severe. Excessive gravel
Landfills (about 25% of unit)	Severe if excessive gravel and other materials are on surface. May be suitable if covered with good soil material	Severe if excessive gravel and other materials are on surface. May be suitable if covered with good soil material	Slight to severe, depending on surface cover	Slight to severe, depending on surface cover

APPENDIX

EXPLANATION OF ENGINEERING INTERPRETATION TABLE HEADINGS

The first column of tables A and B lists the map symbol that appears on the General Soil Map and the major components of each mapping unit that is described in the text. The approximate proportion is also given. Definitions of the following headings in Table A are given in the glossary and will not be repeated here: Permeability, available water-holding capacity, shrink-swell (potential), alkalinity (reaction), and hydrologic soil group. Explanations of the remaining headings for Table A are discussed below followed by those in Tables B and C.

Corrosivity - On-the-surface structural materials, such as steel and concrete corrode when buried in or placed on soils. A given material will corrode in some soils more rapidly than in others. Corrosivity ratings are given on two different structural materials as follows:

(a) Uncoated Steel Pipe - Steel will corrode in some soils more rapidly than in others. Soil corrosivity differs with the characteristics of the soil. Corrosion of uncoated steel pipe is a physical-biochemical process converting iron into its ions. Soil moisture is needed to form solutions with soluble salts before the process can operate. This constitutes a corrosion cell. Any factors influencing the soil solution or oxidation-reduction reactions taking place in the soil will influence the operation of the corrosion cell. Soil properties such as total acidity, electrical resistivity, or resistance to flow of current, soil drainage, and soil texture are considered. The metal pipe is usually located in the subsoil or substratum of the soil.

(b) Concrete materials placed in some soils deteriorate to varying degrees. In this area only soils with high amounts of sulfates present in the soil appear to cause deterioration and only the soils having this characteristic are noted in the table.

Soil Suitability as a Source of Roadfill--The purpose of this interpretation is to provide ratings of soils as sources of road fill. This purpose requires predictions of how well the soil will perform after it has been moved from its original location and placed in a road embankment; and, it also requires evaluation of soil characteristics, such as slope, that affect the ease or difficulty of getting the soil out.

Roadfill is soil material used for making embankments for roads. As low embankments, or the upper part of high embankments, serve as the subgrade (foundation) for the road. The material good for road fill also needs to be good for subgrade.

If the thickness of suitable material is less than about three feet, due to shallow depth of bedrock or to other unsuited or poorly suited material, the entire soil is rated poor regardless of the quality of the material less than three feet thick.

Soil Suitability as a Source of Sand and Gravel--The principal purpose of this interpretation is to provide guidance about where to look for sand and gravel. Ratings are based on the probability that soils contain sizeable quantities of sand or gravel, excluding soft materials such as shale or siltstone. To qualify as either a good or fair probable source, the layer should be at least about three feet thick. All of this, however, need not be in the top five or six feet--the soil that we classify and map.

Soil Suitability as a Source of Topsoil--The purpose of this interpretation is to provide information for use by engineers, landscapers, nurserymen, planners, and others who make decisions about selection, stockpiling and use of topsoil. Whether to save and stockpile surface soil at a construction site, for example, ought to depend on how good it is for topsoil and the relative availability of other topsoil in the immediate vicinity.

Good topsoil has physical, chemical, and biological characteristics favorable for the establishment and growth of adapted plants. It is friable and easy to handle and spread. While a high content of plant nutrients in good balance is desirable, it is less important than responsiveness to fertilization, or to soil amendments, if pH adjustments are necessary.

A soil that qualifies as a good source not only has material with these favorable characteristics, but also has characteristics such that, with material stripped off for topsoil, the remaining soil is reclaimable. Some damage to a borrow area is to be expected, but if the damage is great enough so that revegetation and erosion control become major problems, the soil should be rated as a poor source of topsoil regardless of the quality of the surface materials.

Flooding Hazard--Flooding hazard is defined in the glossary. Frequency and duration are noted in the tables.

Erosion Hazard--As defined in the glossary. Soil properties that influence water erosion are: (1) Those that affect infiltration rate, movement of water through the soil, and water storage capacity; (2) those that affect dispersion, detachability, abrasion, and mobility of soil particles by rainfall and runoff. Some of the most important properties are soil texture and organic matter content of the exposed layer, size and stability of structural aggregates, permeability of the subsoil, depth to impermeable layers, amount of rock fragments, and slope. Ratings are slight, moderate, and severe.

TABLE B -- SOIL LIMITATION CLASSES AND SOIL FEATURES AFFECTING:

Septic Tank Absorption Fields--The septic tank filter field is a part of the septic tank absorption system for on-site sewage disposal. It is a subsurface tile system laid in such a way that effluent from the septic tank is distributed with reasonable uniformity into the natural soil. Criteria and standards used for rating soils are made on the basis of limitations of the soils to absorb effluent.

Three degrees of limitations are used: slight, moderate, and severe. These are based on factors such as soil depth, slope, permeability, percolation rate, water table, and overflow or flooding hazards. Within the soil profile, that portion below depths of 24 inches is most critical. State law requires on-site percolation tests meeting certain criteria before approval to construct is given. Percolation rate below 30 inches is highly variable and is not given in these tables. 1/

Assumptions

Minimum depth earth cover over lines	-	12 inches
Minimum diameter of lines	-	4 inches
Minimum filter material over lines	-	2 inches
Minimum filter material under lines	-	12 inches

Limitations for sewage lagoons are given under the heading of water areas.

Shallow Excavations--Shallow excavations are those that require excavating or trenching to a depth of five or six feet or less. Such uses include underground utility lines (pipelines, sewers, cables), cemeteries, sanitary landfills, basements, and open ditches, although some supplemental criteria are needed to establish limitation ratings for pipelines and cemeteries and other uses. Most of the anticipated uses involve backfilling, but some, such as basements and open ditches, do not. Desirable soil qualities and characteristics are good workability, moderate resistance to slumping, gentle slopes, absence of rock outcrops and big stones, and flooding.

Dwellings Without Basements--Ratings are for undisturbed soils that are evaluated for single-family dwellings and other structures with similar foundation requirements. Excluded are buildings of more than three stories and other buildings with foundation loads in excess of those equal to three-story dwellings. The emphasis for rating soils for dwellings is on foundations; but soil slope, and susceptibility to flooding and other hydrologic conditions, such as seasonal wetness, that have effects beyond those related exclusively to foundations, are considered too. The properties affecting the foundation support are those that affect bearing capacity and settlement under load and those that affect excavation and construction cost. The properties affecting bearing strength and settlement of the natural soil are density, wetness, flooding, plasticity, texture, and shrink-swell behavior. Texture and plasticity (Atterberg limits) are inferred from the Unified soil group. Properties influencing the ease and amount of excavation are wetness, slope, depth to bedrock, stoniness, and rockiness. Also considered are soil properties, particularly depth to bedrock, that influence installation of utility lines, such as those between the dwellings and the trunk lines.

Sanitary Landfill--Soil limitations for sanitary landfills consider the trench type, area type, and cover material.

1/ See example of variability on six test sites within the area, page

(a) Trench Type Landfill--The trench type sanitary landfill is a dug trench in which refuse is buried. The refuse is covered with at least a six-inch layer of compacted soil material daily, or more frequently if necessary. Soil material excavated in digging the trench is used for this purpose. A final cover of soil material at least two feet thick is placed on the landfill when the trench is full.

Because routine soil investigations are normally confined to depths of about five or six feet and many landfill operations use trenches as deep as 15 or more feet, there is need for a geological investigation of the area to determine the potential for pollution of ground water as well as to obtain the design of the sanitary landfill. Such investigations include the kind of stratification, rock formations, and the like that can conduct leachate to water sources such as aquifers, wells, and water courses. The presence of hard, nonrippable bedrock, creviced bedrock, sandy or gravelly strata within or immediately underlying the proposed trench bottom is undesirable from the standpoint of excavation and from the standpoint of the potential for pollution of underground water.

The size and character of landfills are such that it would not be practical to remove the refuse if a pollution problem should develop. Consequently, a thorough evaluation of site hydrology is essential to landfill design.

(b) Area Type Landfill--In the area method of landfill operations, refuse is placed in successive layers on the surface of the soil. Daily and final cover material must be imported because no trenches are dug unless it is for the purpose of obtaining cover material. A final cover of soil material at least two feet thick is placed over the fill when it is completed.

The soil under the proposed site for an area landfill should be investigated to determine the potential for leachates produced by percolating water from the landfill to penetrate and pollute ground water supplies. The size and character of landfills are such that it would not be practical to remove the refuse if a pollution problem should develop. Consequently, a thorough evaluation of site hydrology is essential to landfill design.

(c) Cover Material for Area-Type Landfill--As cover material for area-type landfills must be obtained from sources away from the landfill sites themselves, the soils in an area may need to be rated for suitability for cover. Soil characteristics relevant to both daily and final cover materials are nearly enough alike for one rating to suffice for both uses.

In the trench type landfill it is assumed that the material excavated can be used for cover material.

Suitability for cover is based on soil properties which reflect workability; the ease of digging, moving, and spreading the soil material over the refuse daily during both wet and dry periods; soil slope, wetness and thickness of material.

A soil rated as a good source not only has favorable properties but the remaining material or borrow area must be reclaimable. Some damage to the borrow area is to be expected, but if revegetation and erosion control are major problems, the soil should be rated as a poor source of daily cover.

Local Roads and Streets--The following factors are considered in evaluating soils for the construction and maintenance of local roads and streets. These are improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete, and are expected to carry automobile traffic all year. They consist of: (1) underlying local soil material (either cut or fill) called the subgrade; (2) the base material of gravel, crushed rock, or lime--or soil cement--stabilized soil called the subbase; and (3) the actual road surface or pavement, either flexible or rigid. They also are graded to shed water and have ordinary provisions for drainage. With the probable exception of the hardened surface layer, the roads and streets are built mainly from the soil at hand, and cuts and fills are limited, usually less than six feet. Excluded from consideration in this guide are highways designed for fast-moving heavy trucks.

Properties that affect design and construction of roads and streets are: (1) those that affect the load supporting capacity and stability of the subgrade, and (2) those that affect the workability and amount of cut and fill. The AASHO and Unified Classification, and the shrink-swell potential give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope. depth of hardrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill to reach an even grade.

Water Areas (including sewage lagoons, ponds, and other small water impoundment areas)--A sewage lagoon is a shallow lake used to hold sewage for the time required for bacterial decomposition. Soil requirements for basin floors of lagoons are: (1) slow rate of seepage, (2) even surface of low gradient and low relief, and (3) little or no organic matter. Slope and relief must be low enough so that smoothing required to obtain the specified uniformity in depths of the liquid body is practical. Surface runoff and floodwater must be kept from entering the lagoon. Soils that flood have severe limitations as sites for lagoons. Soil limitations for other water impoundments are similar, except that shape and depth of the floor of the impounded area is not a requirement.

Embankments, Dikes and Levees--The factors considered for embankments are those features and qualities of disturbed soils that affect their suitability for constructing earth fills. Both the subsoil and substratum are evaluated where they have significant thickness for use as borrow.

These ratings apply to low height structures designed to impound or divert water. Factors to be considered are stability after compaction, compaction characteristics, compressibility, permeability when compacted and resistance to piping.

Irrigation--Cropland, Golf Fairways, Lawns and Similar Uses--The soil is classified in relation to the qualities and factors affecting suitability for irrigation. Factors are water-holding capacity, depth of root zone, permeability, salt and alkali, presence of gravel and cobble, and slope. Most of these same factors also affect watering of golf fairways, lawns, and other landscaping uses in residential areas and are so listed in the column heading.

TABLE C - SOIL LIMITATION CLASSES AFFECTING RECREATIONAL USES:

Camp Areas--Primarily those used intensively for tents and small camp trailers and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and leveling for tent and parking areas. Suitability for growing and maintaining vegetation is not considered here but it is an item to consider in the final evaluation of a site. The major soil characteristics to consider are drainage, flooding, slope, percent of surface covered by rock fragments and surface texture.

Playgrounds--Areas used intensively for playgrounds for baseball, football, badminton, and other similar organized games. The most desirable soils have nearly level surfaces, good drainage, and are free of rock outcrops and fragments. Suitability for growing and maintaining vegetation is not considered here but should be considered in the final evaluation of a site.

Paths and Trails--Are areas used for local and cross-country footpaths and trails and for bridle paths. It is assumed that these areas will be used as they occur in nature and that little or no soil will be moved. The features that affect trafficability, dust, design and maintenance of trafficways are given special emphasis.

Picnic Areas--Are areas for intensive use as park-type picnicking. It is assumed that most vehicular traffic will be confined to access roads. The most desirable soils are free from flooding, well drained, nearly level and free of rock fragments.

A horizon--A mineral soil horizon at or near the surface, usually containing an accumulation of organic matter and which may have lost clay, iron, or aluminum by eluviation (leaching).

Alkali soil--1. A soil with a high degree of alkalinity (pH of 8.5 or higher) or with a high exchangeable sodium content (15 percent or more of the exchange capacity) or both.
2. A soil that contains sufficient alkali (sodium) to interfere with the growth of most crop plants.

Alluvial fan--A sloping, fan-shaped mass of sediment deposited by a stream where it emerges from an upland onto a plain.

Alluvial soils--Soils formed in recently deposited alluvium and exhibiting essentially no horizon development or modification from the parent alluvium.

Association--See Soil associations.

Available water-holding capacity--The capacity to store water available for use by plants, usually expressed in linear depths of water per unit depth of soil. In this survey four classes are used, and are defined as follows:

	Inches per Inch	Inches per foot
High	More than .13	>1.5
Moderate	.09-.13	1.0-1.5
Low	.04-.09	.5-1.0
Very low	Less than .04	> .5

B horizon--A subsurface horizon, often used, synonymously with subsoil, that has accumulated clay, iron & aluminum by leaching from overlying horizons.

Calcareous soil--Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

Caliche--A layer, usually parallel to the surface, more or less cemented by secondary carbonates of calcium or magnesium precipitated from the soil solution. It may occur as thin accumulations of soft to hard nodular material, or as thick beds at shallow depths of strongly cemented gravels with an indurated, nearly continuous, laminar capping. This layer is sometimes exposed at the surface by erosion.

Clay--A mineral soil separate consisting of particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt. Clayey--having properties similar to those of clay.

Cobble--Rock fragments, generally rounded, between 3 and 10 inches in diameter.

Depth, effective soil--The depth of soil material that plant roots can penetrate readily to obtain water and plant nutrients. Limiting layers may consist of bedrock, silica and/or calcium cemented hardpans or dense clay pans. Under natural conditions the effective rooting depth is determined by the depth of moisture penetration. Four depth classes were used in this survey as follows:

<u>Deep</u>--More than 40 inches deep.
<u>Moderately deep</u>--20 to 40 inches.
<u>Shallow</u>--10 to 20 inches.
<u>Very shallow</u>--Less than 10 inches deep.

Drainage, natural--As a condition of the soil, refers to the frequency and duration of periods when the soil is free of saturation or partial saturation. Drainage may be altered either naturally by channel deepening or blocking, or artifically by the application of irrigation water or the construction of artificial drains. Three drainage classes are recognized as follows:

<u>Well drained</u>--Water is removed from the soil readily but not rapidly. Normally these are medium textured soils but finer or coarser textured soils may fall in this class.

<u>Moderately well drained</u>--Water is removed from the soil slowly, so that the profile is wet for a small but significant part of the time. These soils commonly have a slowly permeable layer within or immediately underneath the solum.

<u>Somewhat poorly drained</u>--Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time.

Erosion--The wearing away of the land surface by wind, running water, and other geological agents.

Erosion hazard--The susceptibility of a soil to accelerated erosion resulting from disturbance or destruction of the vegetation. Causes may be mechanical such as construction machinery, overgrazing or other misuse, or fire.

Flooding hazard--The susceptibility of a soil, generally due to its position of occurence, to overflow or inundation, usually damaging, from streams or other flood channels.

Floodplain--Nearly level land situated on either side of a channel which is subject to overflow flooding.

Gravelly--Containing significant amounts of gravel. Rock fragments, generally rounded or subrounded, 2mm to 3 inches in diameter. In amounts, gravelly infers about 20 to 50 percent by volume of the soil mass. Very gravelly infers 50 to 90 percent by volume of the soil mass.

Hardpan--A hardened or cemented soil layer. The soil material may be sandy or clayey, and it may be cemented by silica or calcium carbonate. The hardness does not change appreciably with changes in moisture content, and pieces of the hard layer do not slake in water.

Hydrologic group--A grouping of soils for estimating the runoff potential on watersheds. The classification indicates the minimum rate of infiltration obtained from a bare soil at the end of individual storms occurring after the soil has had prolonged wetting and opportunity for swelling. Four groups are used:

Group A--Soils having high infiltration rates even when thoroughly wetted, consisting chiefly of deep, well to excessively drained sands and/or gravel. These soils have a high rate of water transmission and have a low runoff potential.

Group B--Soils having moderate infiltration rates when thoroughly wetted, consisting chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of transmission.

Group C--Soils having slow infiltration rates when thoroughly wetted, consisting chiefly of (1) soils with a layer that impedes the downward movement of water, or (2) soils with moderately fine to fine texture and a slow infiltration rate. These soils have a slow rate of water transmission.

Group D--Soils having very slow infiltration rates when thoroughly wetted, consisting chiefly of (1) clay soils with a high swelling potential, (2) soils with a high permanent water table, (3) soils with a claypan or clay layer at or near the surface, and (4) shallow soils over nearly impervious materials. These soils have a very slow rate of water transmission.

Indurated--A condition that exists in material that has become hardened by heat, pressure, and/or cementation. The indurated material cannot be softened by prolonged soaking in water.

Intake rate--The rate, usually expressed in inches per hour, at which rain or irrigation water enters the soil.

Lime (limy)--Chemically, lime is calcium oxide, but as the term is commonly used, it is also calcium carbonate and calcium hydroxide. When present in visible amounts it is also sometimes called "caliche" locally.

Mapping unit (unit, soil unit)--A kind of soil, a combination of kinds of soil, or land types, that can be shown at the scale of mapping for the defined purposes and objectives of the survey. Mapping units are generally designed to reflect significant differences in use and management.

Percent slope--The gradient of any particular slope expressed as the difference in elevation in feet between two points 100 feet apart horizontally. See slope classes.

Permeability, soil--The quality of a soil layer that enables water or air to move through it. The permeability of a soil may be limited by the presence of one nearly impermeable layer even though the others are permeable. Terms used to describe permeability are:

	Inches per hour
Very slow - - - - - - - - - - -	< 0.06
Slow- - - - - - - - - - - - - -	0.06-0.20
Moderately slow - - - - - - - -	0.20-0.6
Moderate- - - - - - - - - - - -	0.6-2.00
Moderately rapid- - - - - - - -	2.00-6.0
Rapid - - - - - - - - - - - - -	6.0-20.0
Very rapid- - - - - - - - - - -	> 20.0

Piping--Removal of soil material through subsurface flow channels or "pipes" developed by seepage of water.

Profile, soil--A vertical section of the soil from the surface through all its layers, including C horizons. Unless otherwise stated in this report it is the section from the surface to 60 inches or to bedrock.

Reaction, soil--The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that has a pH of 7.0 is neutral in reaction because it is neither acid nor alkaline. In words, the degrees of acidity or alkalinity are expressed thusly:

	pH
Extremely acid - - - - - - - - - - -	Below 4.5
Very strongly acid - - - - - - - -	4.5 to 5.0
Strongly acid- - - - - - - - - - -	5.1 to 5.5
Medium acid- - - - - - - - - - - -	5.6 to 6.0
Slightly acid- - - - - - - - - - -	6.1 to 6.5
Neutral- - - - - - - - - - - - - -	6.6 to 7.3
Mildly alkaline- - - - - - - - - -	7.4 to 7.8
Moderately alkaline- - - - - - - -	7.9 to 8.4
Strongly alkaline- - - - - - - - -	8.5 to 9.0
Very strongly alkaline - - - - - -	9.1 and higher

Rough broken land--Land with very steep topography and numerous intermittent drainage channels, usually covered with vegetation.

Runoff, surface--Refers to the relative rate water is removed by flow over the surface of the soil. Rates are referred to as slow, medium and rapid.

Saline soil--A nonalkali soil that contains sufficient soluble salts to impair the growth of plants but that does not contain excess exchangeable sodium.

Saline-alkali soil--A soil having a combination of harmful quantities of salts and either a high alkalinity or high content of exchangeable sodium, or both, so distributed in the profile that the growth of most crop plants is reduced.

Sand--Individual rock or mineral fragments in soils having diameters ranging from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Sediment yield--The quantity of solid materials, both mineral and organic, removed from its original site and transported, usually by water, but also by wind, ice, or gravity and deposited in another location.

Semiarid--A term applied to regions or climates where moisture is normally greater than under arid conditions but still limits the growth of most plants. Irrigation is usually required for crop production. The average annual precipitation in the area of this survey is from about 10 to 16 inches.

Shear strength--The internal resistance offered to shearing stresses. It is measured by the maximum shear stress, based on original area of cross section, that can be sustained without failure.

Shrink-swell (potential)--Susceptibility to volume change due to loss or gain in moisture content.

Silica--A constituent composed of silicon and oxygen. The essential material of the mineral quartz.

Silt--Individual mineral particles in a soil that ranges in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and has less than 12 percent clay.

Slope classes--Groupings of slope gradients into named classes as follows:
Nearly level-0 to 2 percent; gently sloping-2 to 5 percent; moderately sloping-5 to 8 percent; strongly sloping-8 to 15 percent; moderately steep-15 to 30 percent; steep-30 to 60 percent; very steep-more than 60 percent.

Soil--The unconsolidated mineral and organic material on the immediate surface of the earth that serves as a natural medium for the growth of land plants.

Soil profile--A vertical section of the soil from the surface through all its horizons (layers). Thickness as usually mapped in the soil survey is to 60 inches or to bedrock.

Soil series--A subdivision of soils within a soil family having horizons similar in differentiating characteristics and arrangement in the soil profile except for texture of the surface horizon.

Soil associations--A group of defined and named soil units occurring together in a characteristic pattern over a geographic region.

Stones--Rock fragments larger than 10 inches in diameter.

Subsoil--The B horizon of soils with distinct profiles. In soils with weak profile development the subsoil can be defined as the soil below the plowed soil (or its equivalent of surface soil) in which roots normally grow.

Substratum--Technically, the part of the soil below where the processes of soil formation are active; the parent materials. Generally, the characteristics of the material in this part of the profile are unlike those of the overlying material.

Surface soil or layer--The uppermost part of the soil ordinarily moved in tillage or its equivalent in uncultivated soil, about 3 to 8 inches in thickness. The plowed layer. The A horizon(s).

Swale--A slight depression in an area generally nearly level. These depressions are usually slightly more moist than the adjacent higher land and often have ranker vegetation due to additional water and the enrichment resulting from the washing down of the finer and richer part of the soil of the higher land about them.

Terrace (geological)--A nearly level or undulating plain, commonly rather narrow and usually with a steep front, bordering a river or lake.

Texture, soil--The relative proportions of sand, silt, and clay particles in a mass of soil. The different texture classes are commonly referred to in general terms as listed below:

Texture		
Sands Loamy sands	coarse textured soils	
Sandy loam Fine sandy loam	moderately-coarse textured soils	sandy soils
Very fine sandy loam Loam Silt loam Silt	medium textured soils	loamy soils
Clay loam Sandy clay loam Silty clay loam	moderately-fine textured soils	loamy soils
Sandy clay Silty clay Clay	fine textured soils	clayey soils

PERCOLATION RATE STUDIES [1/]

Percolation rates in the lower subsoils and substrata of soils similar to those in the study area are highly variable. Arizona state law requires on-site percolation tests that meet certain minimum requirements to pass State and County Health Codes before construction permits are given that require septic tanks for sewage disposal. [2/] As stated in the introduction of Engineering Bulletin No. 12 "There are many advantages in using community sewerage facilities instead of individual systems. One of these is cost. Another is the degree of effectiveness to be expected, especially as individual systems become inoperative when neglected or if not properly located or installed in the first place, resulting in the overflow of waste water on the surface of the ground."

Experience has shown that soils having percolation rates: (1) faster than 45 minutes per inch function satisfactorily, (2) between 45 and 60 minutes per inch have moderate limitations, and (3) slower than 60 minutes per inch have severe limitations when used as absorption fields for septic tanks. These rates are those obtained by the auger-hole method.

Field percolation tests made by local health departments and private soil engineering firms are usually conducted under a wide range of soil moisture conditions and, therefore, the results should be interpreted with caution. <u>Results are reliable only if the moisture is at or near field capacity when the test is run</u>. In fact, nearly impermeable soils on which absorption fields have failed can give high percolation test results after periods of drought. In addition to soil properties that influence percolation rates, changes in the micro-organisms in the soil may also help or hinder the functioning of the absorption field after it is in operation. Because the methods of measuring percolation and permeability are different, the correlation between the two values is imperfect.

In this study, percolation tests were made at 6 sites on four soils using standard methods [3/]. Site locations are indicated on the General Soil Map in the back of this report as P1, P2, etc. Six holes of six inch diameter were dug to depths of 24 inches at each site. The holes were spaced 20 to 40 feet apart over a simulated absorption field and were soaked for about 26 hours prior to measurement. The following results in inches per hour illustrate the variability of percolation rates in soils of these types:

P1 - Mohave loam - 5.5, 7.5, 4.0, 10.0, 7.0, 4.0 - average rate 6.3

P2 - Mohave loam - 4.0, 10.0, 6.5, 7.0, 8.25, 5.75 - average rate 6.9

P3 - Nickel very gravelly sandy loam - 26.0, 26.0, 25.5, 29.0, 28.0, 24.5 - average rate 26.5

P4 - Anthony very gravelly loamy sand - 24.0, 23.0, 37.0, 32.0, 35.0, 29.0 - average rate 30.0

P5 - Continental gravelly loam - 3.5, 3.5, 5.5, 4.0, 7.5, 2.25 - average rate 4.4

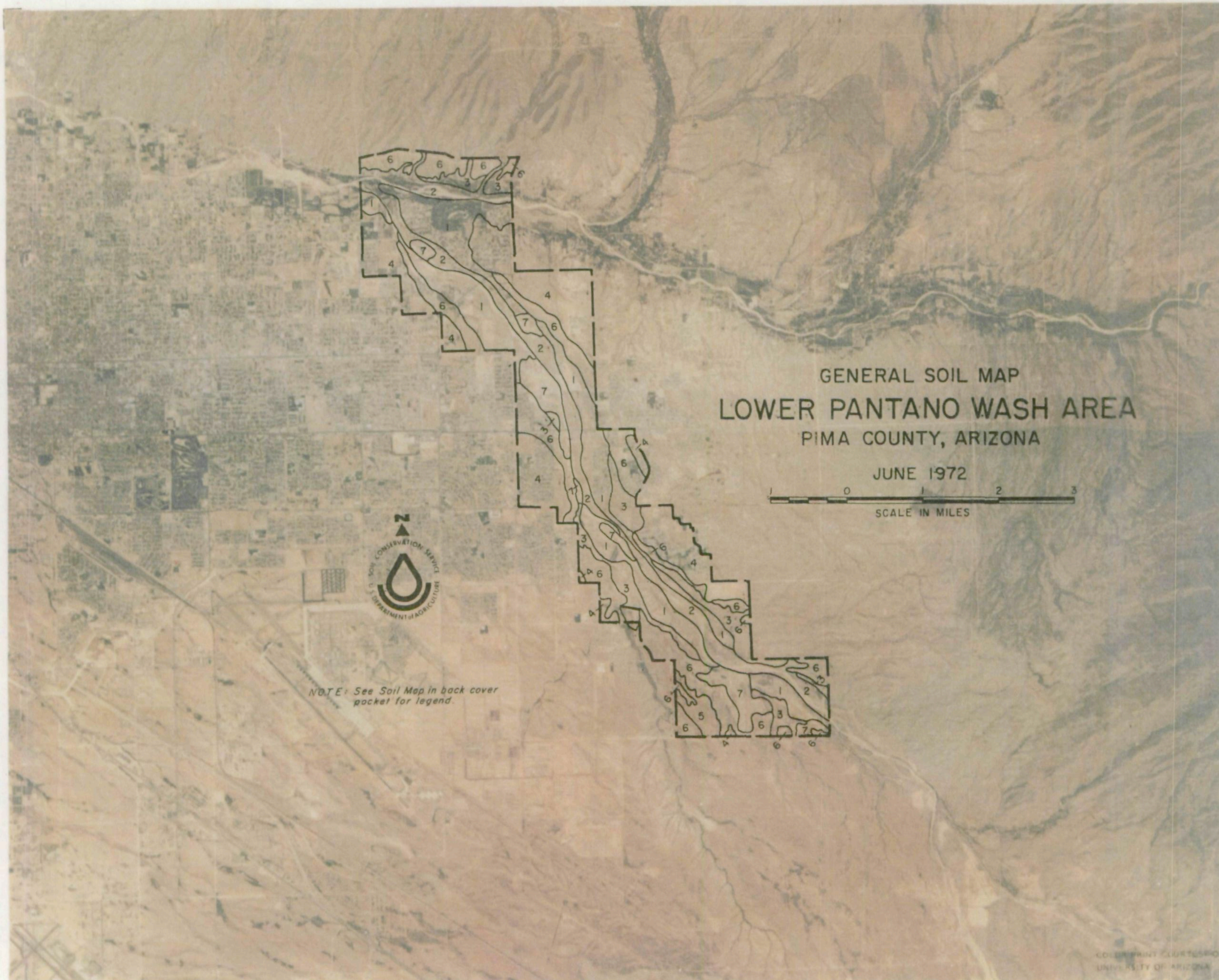
P6 - Continental gravelly loam - 3.0, 9.0, 5.0, 8.0, 7.5, 7.5 - average rate 6.7

The above test results are given as an example only. <u>They should not be construed as typical percolation rates of the soils named in this report</u>. These percolation rates are considerably higher than would be expected theoretically. This is probably because there had been no precipitation in the prior 5 months and the soils were extremely dry. To simulate a saturated filter field in soils as dry as these would probably require prior soaking for a much longer time than specified in the standard instructions.

1/ These studies were conducted by Kevin Whittaker, University of Arizona graduate student.

2/ Engineering Bulletin No. 12 "The Septic Tank, A Method of Dewage Disposal for Private or Public Buildings", Environmental Health Services, Arizona State Department of Health, adopted August 1962.

3/ "Soils and Septic Tanks", Agriculture Information Bulletin 349, Soil Conservation Service, U.S.D.A.

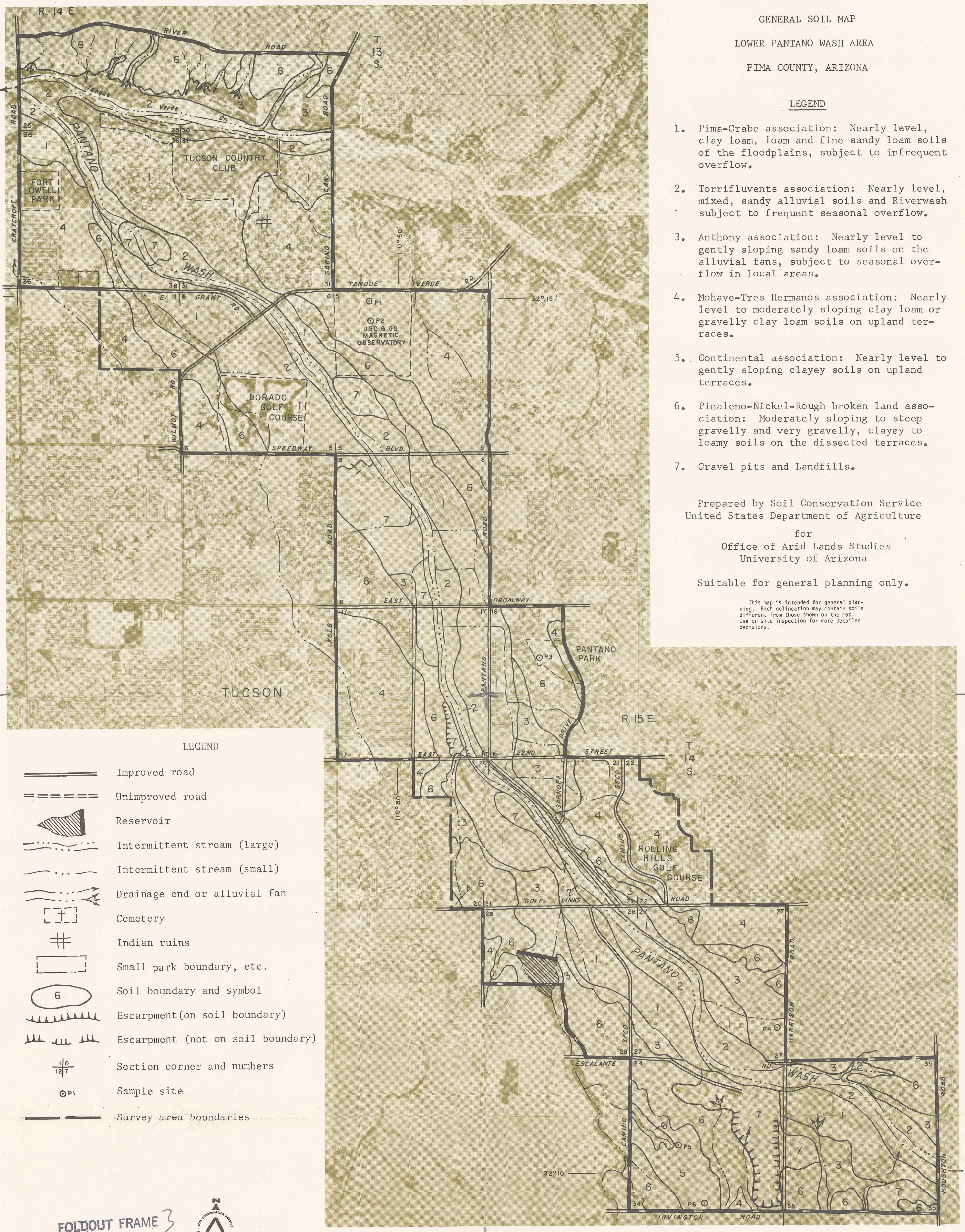

GENERAL SOIL MAP
LOWER PANTANO WASH AREA
PIMA COUNTY, ARIZONA
JUNE 1972
SCALE IN MILES
SOIL CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE
NOTE: See Soil Map in back cover pocket for legend.

FOLDOUT FRAME 1

FOLDOUT FRAME 2

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE



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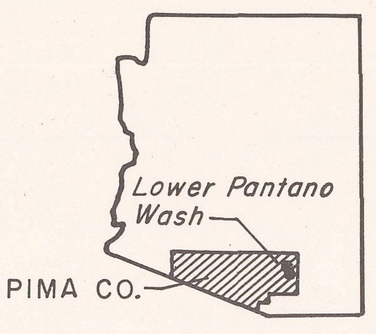

LOCATION MAP

FOLDOUT FRAME 4

GENERAL SOIL MAP
LOWER PANTANO WASH AREA
PIMA COUNTY, ARIZONA
JUNE 1972

1/2 0 1/2 1 1 1/2 MILES

SCALE 1:31,380

USDA-SCS-PORTLAND, OREGON 1972

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U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

GENERAL SOIL MAP
LOWER PANTANO WASH AREA
PIMA COUNTY, ARIZONA

LEGEND

1. Pima-Grabe association: Nearly level, clay loam, loam and fine sandy loam soils of the floodplains, subject to infrequent overflow.

2. Torrifluvents association: Nearly level, mixed, sandy alluvial soils and Riverwash subject to frequent seasonal overflow.

3. Anthony association: Nearly level to gently sloping sandy loam soils on the alluvial fans, subject to seasonal overflow in local areas.

4. Mohave-Tres Hermanos association: Nearly level to moderately sloping clay loam or gravelly clay loam soils on upland terraces.

5. Continental association: Nearly level to gently sloping clayey soils on upland terraces.

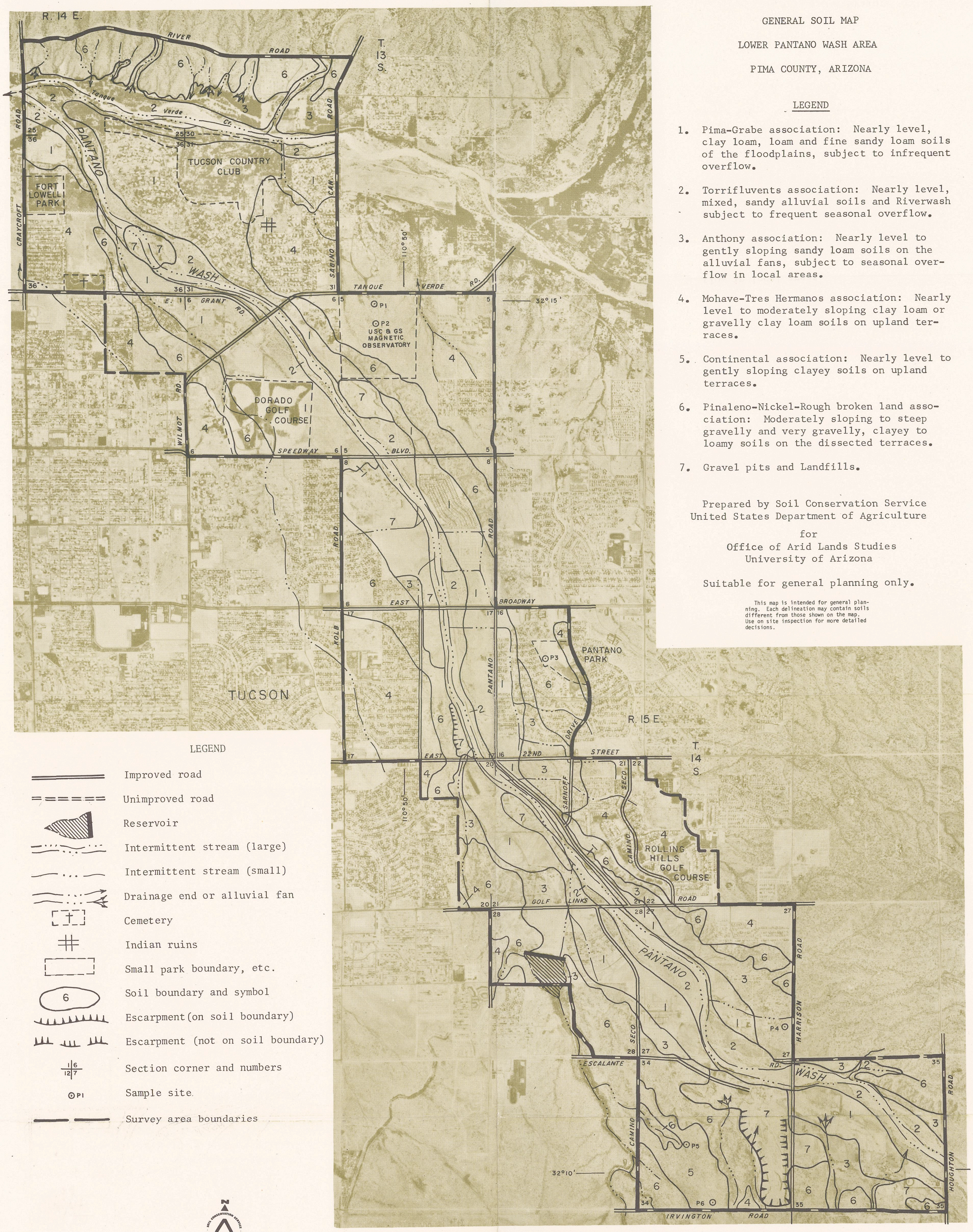
6. Pinaleno-Nickel-Rough broken land association: Moderately sloping to steep gravelly and very gravelly, clayey to loamy soils on the dissected terraces.

7. Gravel pits and Landfills.

Prepared by Soil Conservation Service
United States Department of Agriculture
for
Office of Arid Lands Studies
University of Arizona

Suitable for general planning only.

This map is intended for general planning. Each delineation may contain soils different from those shown on the map. Use on site inspection for more detailed decisions.



LEGEND

	Improved road
	Unimproved road
	Reservoir
	Intermittent stream (large)
	Intermittent stream (small)
	Drainage end or alluvial fan
	Cemetery
	Indian ruins
	Small park boundary, etc.
6	Soil boundary and symbol
	Escarpment (on soil boundary)
	Escarpment (not on soil boundary)
$\frac{1\mid 6}{12\mid 7}$	Section corner and numbers
⊙P1	Sample site
	Survey area boundaries

LOCATION MAP

GENERAL SOIL MAP
LOWER PANTANO WASH AREA
PIMA COUNTY, ARIZONA
JUNE 1972

1/2 0 1/2 1 1 1/2 MILES

SCALE 1:31,380

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