REVIEW OF FLOOD HAZARDS OF RAWHIDE WASH

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for

FLOOD CONTROL DISTRICT OF MARICOPA COUNTY

FCD 99-01
#2

The following is a brief synopsis of a review of the severity of flooding in the Rawhide Wash watershed. Tributary and distributary flow areas upstream and downstream of the hydrographic and topographic apices associated with Rawhide Wash are included. This review is based on the methodology outlined in the draft Piedmont Assessment Manual and USGS publications to determine the degree and severity of flooding of Rawhide Wash.

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Scope of review

Application of methods in the "Manual" is of a reconnaisance nature where stages 1 and 2 of the Manual are applied but detailed 100-year flood boundaries for Rawhide Wash are not defined. This synopsis includes the type of landform and an assessment of activity or landform stability. Flood processes and the 100-year peak discharge, volume and sediment yield also are be briefly described to quantify the severity of the hazard. The reader is reminded that this synopsis is of a reconnaisance nature.

The manual

A manual has been developed for engineers to use to determine whether an area is subject to alluvial fan flooding as defined by FEMA and the National Research Council. The manual uses a three-stage method developed by the National Research Council that shows how flood hazards on piedmonts in Maricopa County are related to geomorphologic processes. The three-stage method progressively focuses on the definition of flood hazard zones by first recognizing and characterizing the kind and extent of piedmont landforms and showing these landforms on a map. The second stage is the definition of the nature of the piedmont landform environment and identifying unstable and stable components of the piedmont and showing those areas subject to various flood hazards on a map. The third stage identifies and applies methods for defining and characterizing areas affected by the 100-year flood and showing those areas on a map. The intent of the County is to adopt the manual for the assessment and management of flood hazards on piedmonts, which include alluvial fans, to meet the Guidelines and Specifications for Study Contractors (FEMA 37, 1995) and County requirements.

Overview

This synopsis is in five parts as follows:

1. Identification of the landforms. Methods given in Chapter 2 (STAGE 1) of the Manual are used. The four major landforms - pediments, relict fans, alluvial fans and alluvial plains - on piedmonts are considered.
2. Stable and unstable areas are examined. Methods given in Chapter 3 (STAGE 2) of the Manual are used.
3. Soil types from the soil survey by Camp (1986) are given.
4. 100-year peak discharge, volume and sediment yield for Rawhide Wash are estimated.
5. The severity of the flood hazard is summarized in both general and specific terms.

Type of Landform

Upstream of Section 1, T. 4 N., R. 4 E. (Figure 1), the channel of Rawhide Wash typically is confined to channels and flood plains. The network of drainage channels generally is tributary. An exception is the small distributary fork in the pediment along the northwestern drainage divide located in the SW1/4 of section 19, T. 5N., R. 5 E.. There may be floodflow across the drainage divide at other locations.

The landform below Section 1, T. 4 N., R. 4 E. (Figure 1) appears to be an alluvial fan based on the convex elevation contours on the U. S. Geological Survey Currys Corner 7-1/2 minute topographic map. The hydrographic apex appears to be about 1/4 mile below Jomax Rd. There is also a small distributary channel about 1/4 mile to the east that parallels the main channel. About 1/2 mile below Jomax Rd. there is little confinement of floodwater in the main channel area. The NRCS soil type changes from 122 to 90 at the apex. There is also a distinct network of distributary channels below the apex for about 2 miles down the apparent alluvial fan.

Is the landform an alluvial fan?

An alluvial fan is *"a sedimentary deposit at a topographic break, such as the base of a mountain front, escarpment, or valley side, that is composed of fluvial and/or debris flow sediments and which has the shape of a fan either fully or partly extended."*(NRC, 1996).

The following steps for recognizing and characterizing alluvial fans based on the National Research Council (1996) report *Alluvial Fan Flooding*.

Composition

Surrounding area: Inset in older Momoli gravelly sandy loam (Camp, 1986) is the much younger Carrizo and Maripo soil. The NRCS classes the unit as Soil Type 90 Momoli that includes small areas of Carrizo and Maripo soils on flood plains (See Figure 2). The surrounding older soil is deep and well drained on fan terraces. It formed in alluvium derived dominantly from acid and basic igneous rock. Elevation is 1,400 to 2,200 feet. The average annual precipitation is 7 to 10 inches, and the average annual air temperature is 70 to 73 degrees F. Typically, the surface layer is strong brown gravelly sandy loam about 3 inches thick. The subsoil is strong brown very gravelly sandy loam about 23 inches thick. The substratum to a depth of 60 inches or more is brown, calcareous very gravelly sandy loam.

Alluvial fan: The flood plains and alluvial fan in the Rawhide Wash area formed during the Holocene Epoch. Flood plains are characterized by low undulating bars and broad channels that are the result of periodic flooding. The soils in this area on flood plains are mostly Carrizo soils (Typic Torriorthents). These deep, calcareous, moderately coarse and coarse textured soils contain appreciable amounts of rock fragments. They have little or no horizon development. High velocity floodwaters carry and deposit rock fragments in these areas, but much of the fine sediment is not deposited. The fan-like area clearly is

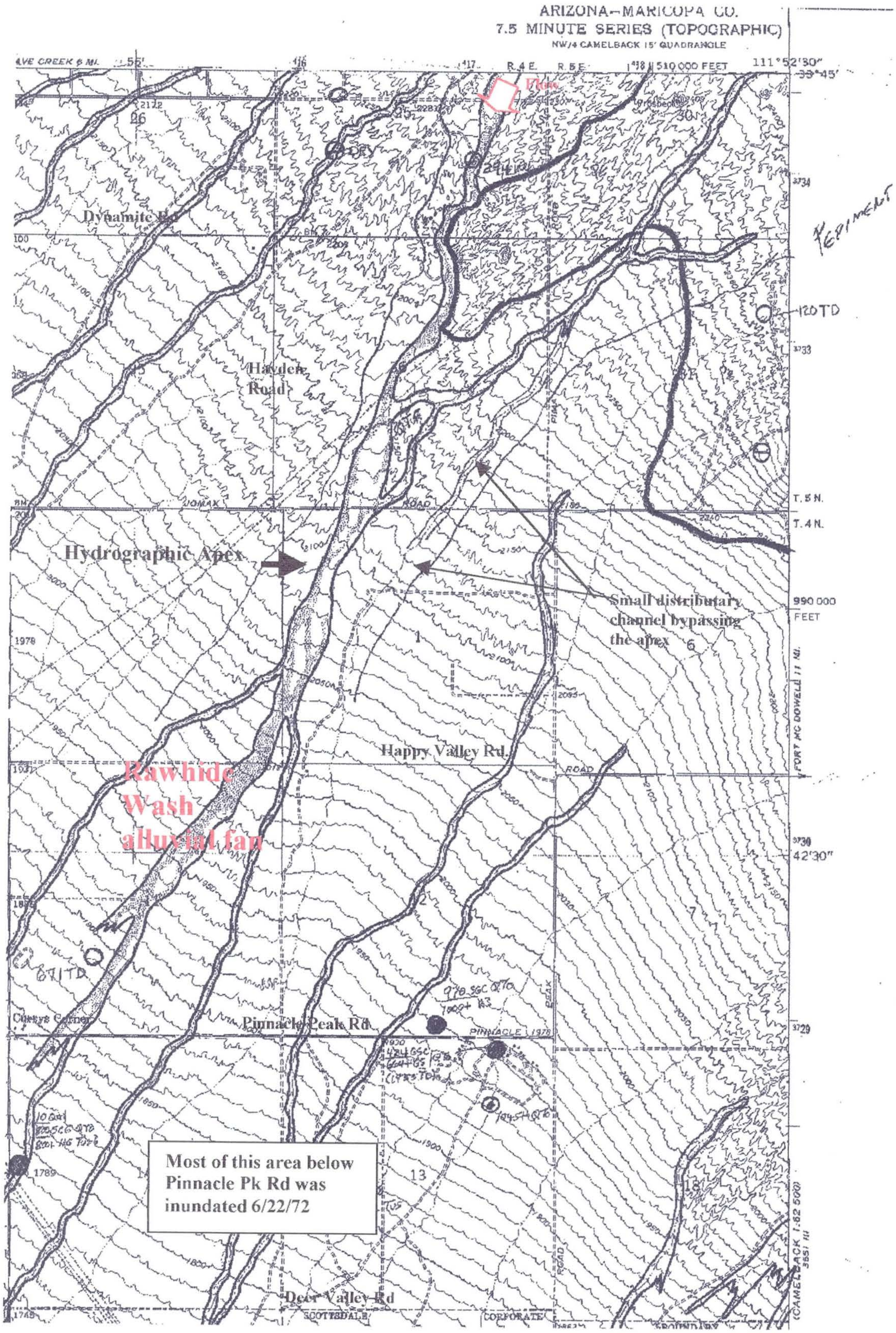


Figure 1. Map of topography and surface geology. Rawhide Wash recon. assessment. HWH 5/99

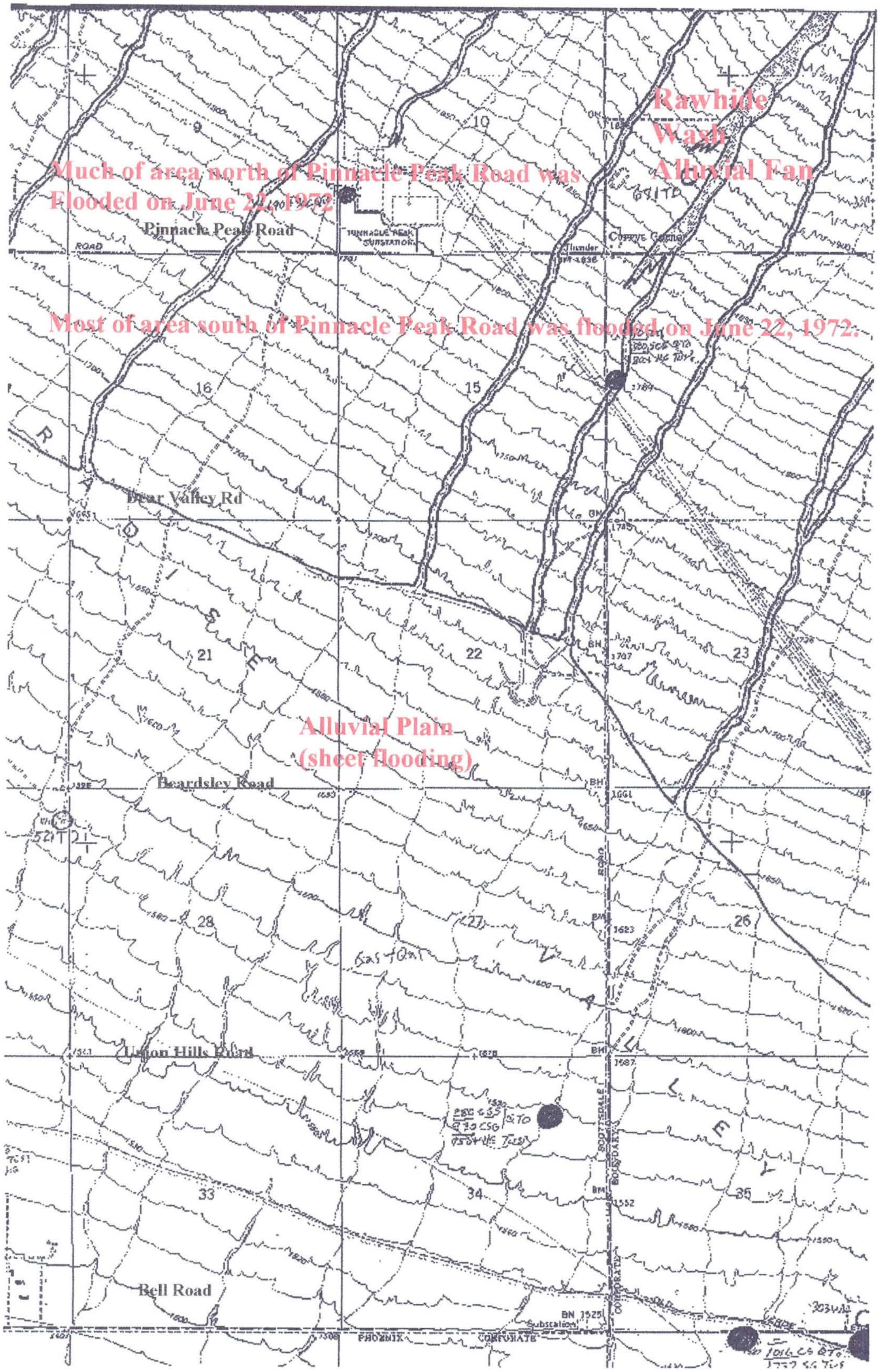


Figure 1 (cont.). Rawhide Wash. Hjalmarson, PE May 1999

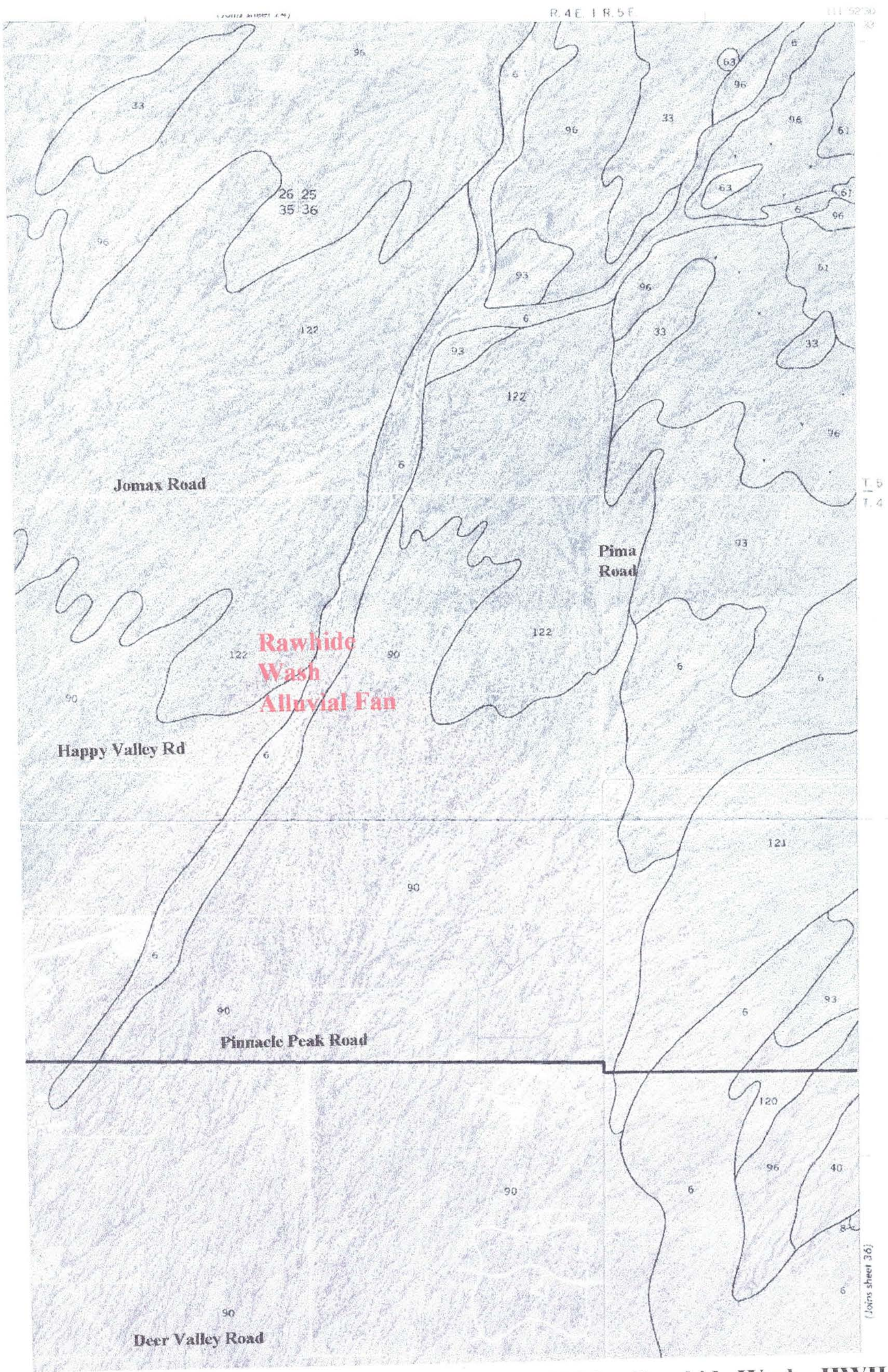


Figure 2. NRCS soil map (Sheet 35 of Camp, 1986). Rawhide Wash. HWH 5/99

a sedimentary deposit of loose, unconsolidated or weakly consolidated sediments. The finer sediment is deposited downslope in sheetflow areas classed as soil type 55.

Below alluvial fan: The toe of the Rawhide Wash alluvial fan transitions to soil type 55-Gilman loams. According to the NRCS, these deep and well drained are on flood plains and alluvial fans. They formed in alluvium derived dominantly from acid and basic igneous rock. Slope is 0 to 3 percent. Most of the areas used as cropland have slopes of less than 1 percent. Elevation is 1,100 to 2,200 feet. The average annual precipitation is 7 to 10 inches, and average annual air temperature is 70 to 73 degrees F.
About 40 percent of this unit is Gilman loam that is noncalcareous in the upper 5 inches and is calcareous below, and 40 percent is Gilman loam that is calcareous throughout. The noncalcareous (younger) areas are below the more active washes where there is recent deposition of fine sediment as floodwater spreads over wide areas. The NRCS mapped this as one unit because the components are so intricately intermingled that it was not practical to map them separately at the scale used. Included in this unit are small areas of Antho and Carrizo soils in throughflow channels. Also included are small areas of soils that are similar to these Gilman soils but are underlain by very gravelly sand at a depth of less than 40 inches. The included areas make up about 20 percent of the total acreage. The percentage varies from one area to another. Runoff is slow, and the hazard of water erosion is slight. Where unprotected, the soils are subject to rare periods of flooding.

According to the NRCS (Camp, 1986), if this unit is used as sites for buildings, main limitation is the hazard of flooding. The unit is subject to localized flooding from overland flow, particularly during high intensity thunderstorms of short duration. Foundations built on this unit should be placed on elevated fill material, and yards should be graded away from the foundations so that surface water will flow away from the buildings. Clearly, the area is subject to sheetflooding.

Shape

The landform has a shape of a partly extended fan with an angle of nearly 40°. Modern and old flow paths radiate outward to the perimeter of the fan toe. The elevation contours are convex upward in the transverse direction for more than 2 miles below the apex. This transverse convexity with the wide-shallow channels suggests the fan is young. Some of the fan shape has been lost by coalescence with adjacent alluvial fans.

Topographic break

The stream widens and corresponding flow depths decrease resulting in less sediment transporting power below the hydrographic apex (Figure 1) a topographic break. This is a locus of markedly more channel migration and sedimentation. The topographic apex is where the stream widens and corresponding flow depths decrease resulting in less sediment transporting power. The hydrographic apex is the highest location of an active alluvial fan and the topographic apex is the highest point on the alluvial fan. For the Rawhide Wash fan, both apexes are at the same location.

This apex also has a small distributary channel about 1/4 mile to the east. This channel is is stable developed soil.

Summary

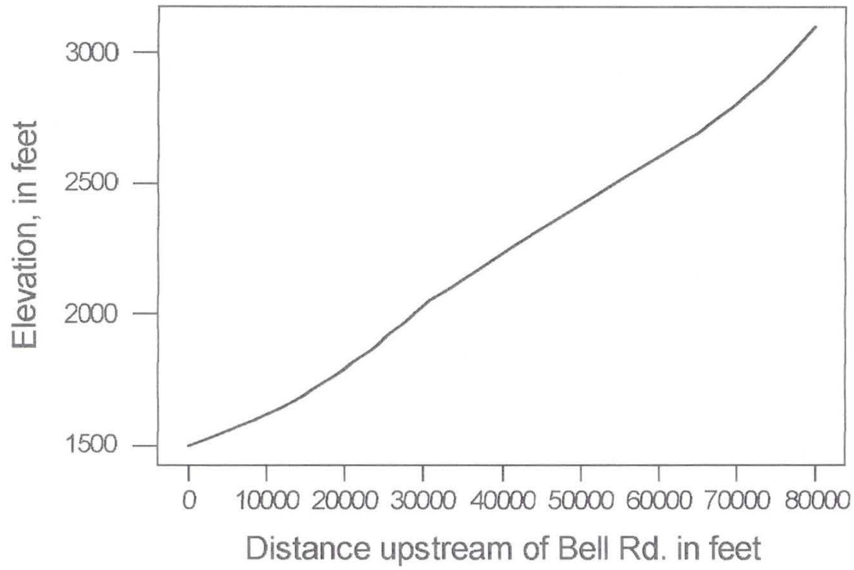
The landform below Jomax Rd. is a small alluvial fan bounded by smaller alluvial fans and older sediment deposits. Some of the fan shape has been lost by coalescence with the adjacent fans. There is some channel incision near the toe (See the slope profile of Rawhide Wash) near Deer Valley Road. Below the toe there are fewer channels separated by wide-flat-silty areas several hundred feet wide in places. A tributary drainage network has developed below the toe.

The landform is a pediment upstream of Dynamite and Jomax Rds (the boundary is irregular). Below Jomax Rd for about 3 miles to about 3 mile north of Bell Rd the landform is an alluvial fan inset in a relict fan. Between Deer Valley and Bell Rds the landform is an alluvial plain with both young and old sediment deposits

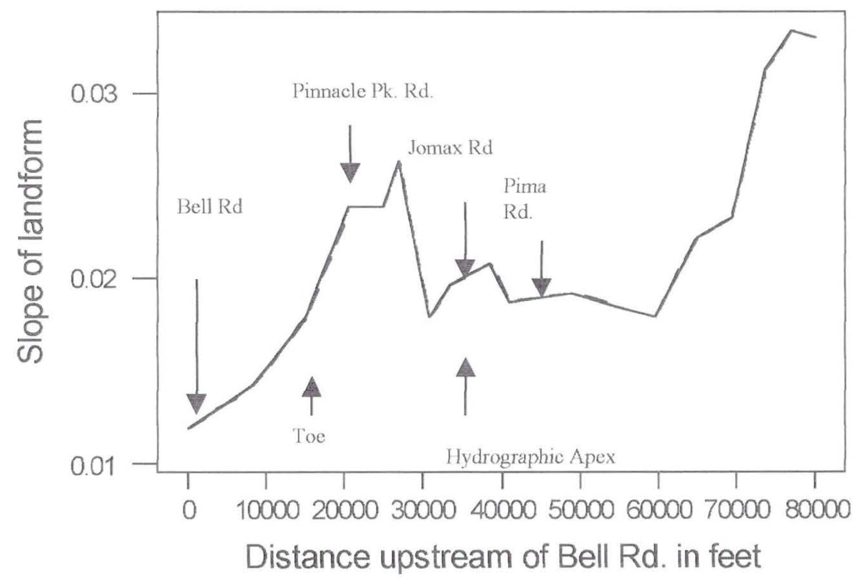
The profiles on the next page are from U. S. Geological Survey 7-1/2 minute topographic maps and are for pre-development. The profiles of the wash show a slight flattening and then a steepening below the apex. Above the apex the slope is about 0.02. At such a slope the floodflow velocities will be supercritical in the main channels where there is little vegetation to offer resistance to the flow. The slope profile suggests channel incision above the apex with deposition below the apex. There is a significant decrease of slope down the alluvial fan suggesting a lessening of flow velocity and spreading of floodwater and some fine sediment deposition.

The general particle size of the sediments reflects the aggrading environment down the fan. For example, about 30% of the Momoli soil is smaller than 0.074 mm while nearly 70% of the noncalcareous Gilman soil is smaller than 0.074 mm.

Elevation profile of Rawhide Wash



Slope profile of Rawhide Wash



2.--Stable and unstable areas

Areas are classed as either stable or unstable flow paths. Unstable areas, which include active alluvial fans and some wide-flat braided alluvial channels, are subject to changes in geometry. These changes are such that the errors of a conventional flood hazard assessment are so large as to render the assessment unreliable. Stable areas along Rawhide Wash include the defined channels of relict fans and the upslope pediment. Flow paths of stable areas are predictable using geomorphic methods based on channel shape, surface geology, soil development and landform morphology. Flood boundaries for these stable areas are predictable using classic engineering methods based on hydraulic factors of roughness, grade and channel cross section geometry.

Stable areas also include sheet flow at and below the fan toe. Some split flow areas have an uncertain distribution of flow where the hydraulic geometry, grade and roughness are relatively stable but small obstructions or small amounts of scour or fill associated with the generally shallow flow depths can alter the distribution of floodflow. The uncertainty of the flow distribution for these stable areas may or may not be set aside depending on site conditions.

Areas with *uncertain flow paths* where the flow path uncertainty *"is so great that this uncertainty cannot be set aside in realistic assessments of flood risk or in the reliable mitigation of the hazard"* (NRC, 1996) are called unstable areas. The unstable area of Rawhide Wash is the active alluvial fan below the hydrographic apex just below Jomax Road. The urban development near Jomax Road and on the alluvial fan between Happy Valley Road and Dear Valley Road confounds this assessment of stability because the flood control works are considered minor and piecemeal. A relevant characteristic of fans like the Rawhide Wash Alluvial Fan, according to the National Research Council, is that predevelopment fan topography influences the location of major flooding even after fans are urbanized and minor flood control structures are in place. In other words, major flood control works are necessary to mitigate flood hazards.

The definition of Alluvial Fan Flooding (NRC, 1996) gives insight on the nature of the flood hazard as follows:

> Alluvial fan flooding is a type of flood hazard that occurs only on alluvial fans. It is characterized by flow path uncertainty so great that this uncertainty cannot be set aside in realistic assessments of flood risk or in the reliable mitigation of the hazard. An alluvial fan flooding hazard is indicated by three related criteria: (1) flow path uncertainty below the hydrographic apex, (2) abrupt deposition and ensuing erosion of sediment as a stream or debris flow loses its competence to carry material eroded from a steeper, upstream source area, and (3) an environment where the combination of sediment availability, slope, and topography creates an ultrahazardous condition for which elevation on fill will not reliably mitigate the risk.

This ultrahazardous condition pertains to much of the Rawhide Wash Alluvial Fan.

Upstream of the hydrographic apex, the main channel of Rawhide Wash and the major tributary from the east have braided channels that divide and combine over wide areas between defined ridges. Both classic hydraulic methods and geomorphic methods should be considered to define the level and boundaries of the 100-year flood in these areas. In other words, the flow paths generally are stable but the distribution of flow may change because of changes of channel geometry roughness. Changes in channel geometry may be both slow and progressive or sudden. The large area classed as Zone AO between Jomax and Dynamite Roads should be examined using geomorphic methods (See Figure 3).

The flood plains in the Rawhide Wash area formed during the Holocene Epoch. Flood plains are characterized by low undulating bars and broad channels that are the result of periodic flooding. The soils in this area on flood plains include the Antho soils (Typic Torrifluvents) and Carrizo soils (Typic Torriorthents). These deep, calcareous, moderately coarse and coarse textured soils contain appreciable amounts of rock fragments. They have little or no horizon development. High velocity floodwaters carry and deposit rock fragments in these areas, but fine sediment is not deposited. These channels and floodplains are subject to scour and fill during floods but the general flow paths are stable because the areas are bounded by pediment of relict fan material.

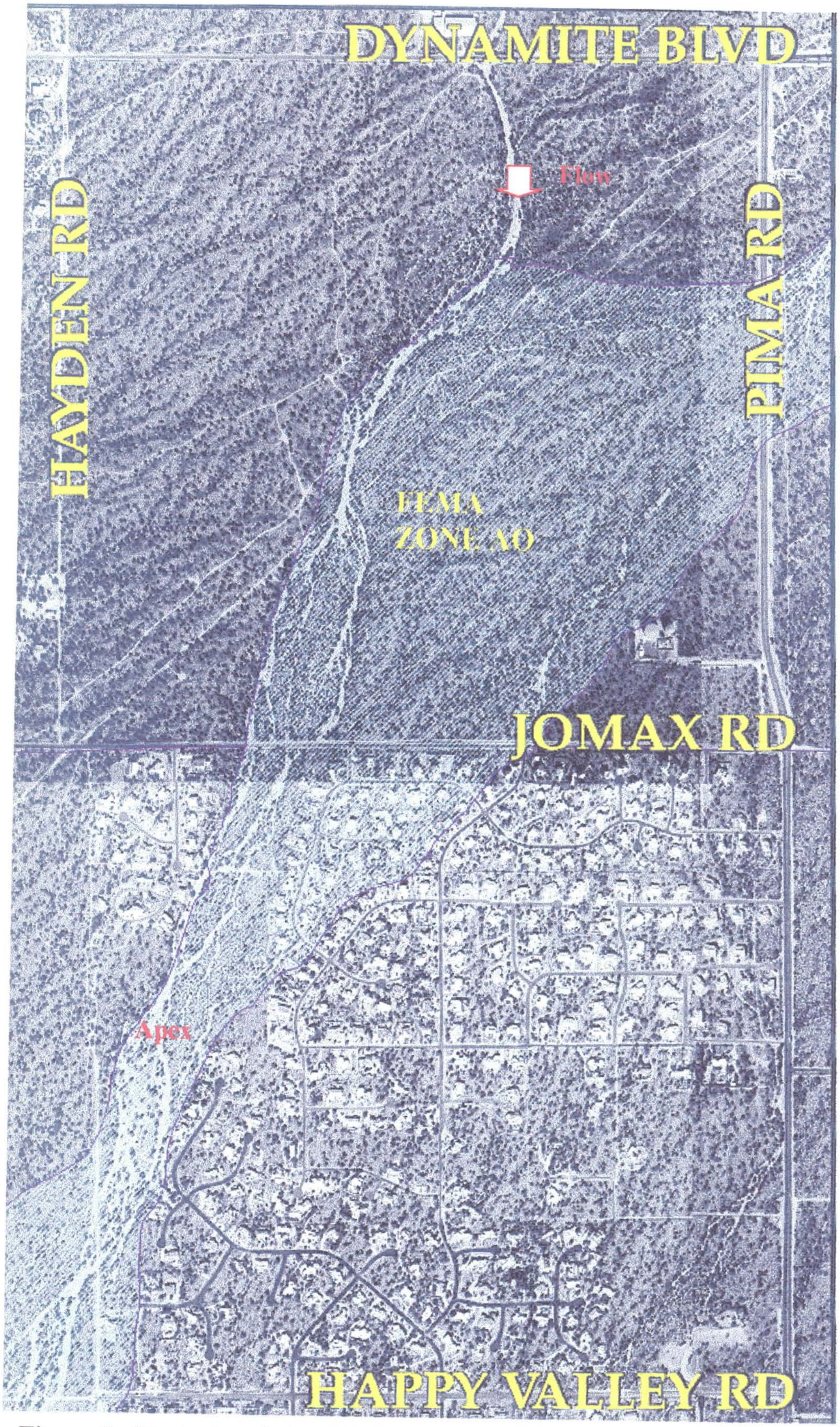


Figure 3. Photo date 3 Dec 96. From FCDMC. Rawhide Wash. Hjalmarson, PE

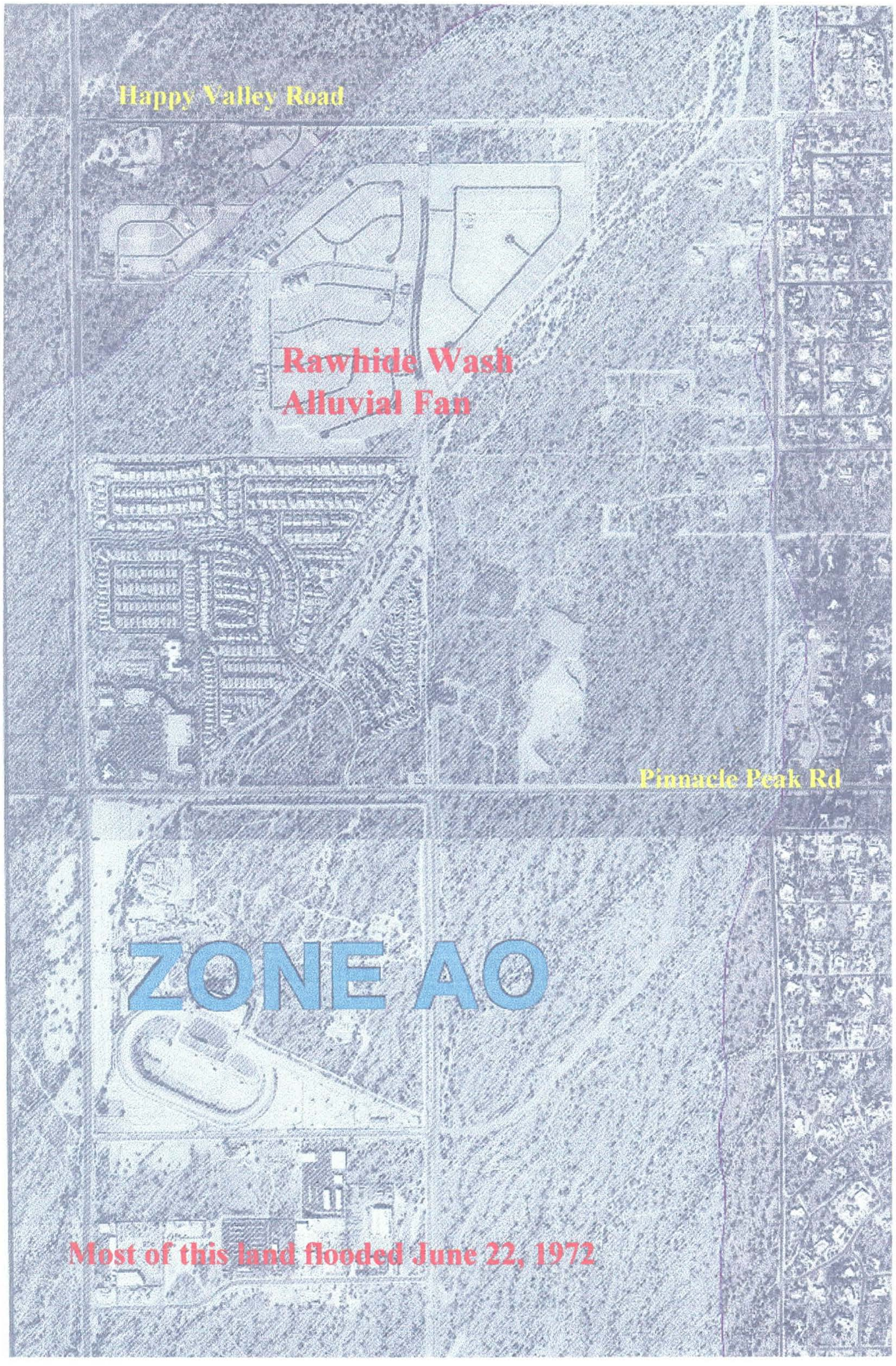


Figure 3. (continued)

3.--Soil in and adjacent to Rawhide Wash

The following soils (See Figure 2) are from the Natural Resources Conservation Service soil survey report by Phil Camp (1986, Soil survey of Aguila-Carefree area, parts of Maricopa and Pinal counties, Arizona: U.S. Soil Conservation Service Report, 306 p.):

Location of soil	Type	General characteristics
Drainageways	6-Arizo	Gravelly sandy loam. Channeling, deposition, and streambank erosion occur during periods of flooding.
Floodplains	6-Anthony	Hazard of water erosion is moderate. Where unprotected, this soil is subject to rare periods of flooding.
Alluvial plains	55-Gilman	Main limitation for buildings is the hazard of flooding. The unit is subject to localized flooding from overland flow, particularly during high intensity thunderstorms of short duration. Foundations built on this unit should be placed on elevated fill material, and yards should be graded away from the foundations so that surface water will flow away from the buildings.
Relict fans and inactive fans	90-Momoli	Hazard of water erosion is slight.
	122-Vado	Runoff is slow, and the hazard of water erosion is slight.

Specific characteristics of soils 6, 55, 90, and 122 follow:

<u>6-Anthony-Arizo complex.</u>

This map unit is on flood plains and in drainageways. Slope is 0 to 3 percent. Elevation is 1,800 to 3,000 feet. The average annual precipitation is 10 to 12 inches, and the average annual air temperature is 66 to 70 degrees F.

This unit is about 40 percent Anthony sandy loam and 40 percent Arizo gravelly sandy loam. The Anthony soil is on flood plains adjacent to drainageways, and the Arizo soil is in drainageways. The components of this unit are so intricately intermingled that it was not pracitical to map them separately at the scale used.

Included in this unit are small areas of sandy soils that are similar to the Arizo soil but are nongravelly. The included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

The Anthony soil is deep and well drained. It formed in alluvium derived dominantly from acid and basic igneous rock. Typically, the surface layer is light brown sandy loam about 2 inches thick. The upper 38 inches of the underlying material is light brown and brown, calcareous gravelly sandy loam, and the lower part to a depth of 60 inches or more is light reddish brown, calcareous loam. In some areas this soil is noncalcareous to a depth of 10 inches or more.

Permeability of the Anthony soil is moderately rapid. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is moderate. Where unprotected, this soil is subject to rare periods of flooding.

The Arizo soil is deep and excessively drained. It formed in alluvium derived dominantly from acid and basic igneous rock. Typically, the surface layer is pink gravelly sandy loam about 1 inch thick. The upper 7 inches of the underlying material is light brown very gravelly sandy loam, and the lower part to a depth of 60 inches or more is reddish yellow and pink, calcareous very gravelly loamy sand.

Permeability of the Arizo soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of water erosion is severe. Where unprotected, this soil is subject to occasional periods of flooding. Channeling, deposition, and streambank erosion occur during periods of flooding.

This unit is used as rangeland and wildlife habitat.

The Anthony soil has moderate potential for producing forage. It responds well to rangeland management. This soil can produce forage year round. It is easily traversed by livestock. Resting pastures during alternate growing seasons helps to maintain or improve the vegetation. Fencing and developing watering facilities help to control grazing. To control erosion, extra care must be taken to maintain a good plant cover. In a few areas this soil is calcareous in the surface layer and is therefore less productive than in most other areas of the soil.

The Arizo soil is one of the most productive rangeland soils in the survey area. It receives extra moisture from runoff, which increases production. The soil responds well to rangeland management. Extra care in management is needed to protect the soil from gullying and channeling. This soil can produce forage year round, and it is easily traversed by cattle. Because of the availability of water, ease of access, and abundance of feed, some areas of this soil are overgrazed.

The riparian habitat in some areas of the Arizo soil is extremely important to wildlife.

55-Gilman loams.

These deep and well drained are on flood plains and alluvial fans. They formed in alluvium derived dominantly from acid and basic igneous rock. Slope is 0 to 3 percent. Most of the areas used as cropland have slopes of less than 1 percent. Elevation is 1,100 to 2,200 feet. The average annual precipitation is 7 to 10 inches, and average annual air temperature is 70 to 73 degrees F.

About 40 percent of this unit is Gilman loam that is noncalcareous in the upper 5 inches and is calcareous below, and 40 percent is Gilman loam that is calcareous throughout. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Typically, the upper 5 inches of these Gilman soils is reddish yellow loam. The next 38 inches is reddish yellow loam and very fine sandy loam. Below this to a depth of 60 inches or more is reddish yellow fine sandy loam. Included in this unit are small areas of Antho and Carrizo soils in drainageways; Estrella, Glenbar, Maripo, Valencia, and Vint soils scattered throughout the unit; and Denure, Momoli, and Carrizo soils on fan terraces. Also included are small areas of soils that are similar to these Gilman soils but are underlain by very gravelly sand at a depth of less than 40 inches. The included areas make up about 20 percent of the total acreage. The percentage varies from one area to another.

Permeability of these Gilman soils is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. Where unprotected, the soils are subject to rare periods of flooding.

This unit is used as rangeland, wildlife habitat, irrigated cropland, and urban development.
In areas where the soils in this unit are noncalcareous in the upper 5 inches, they have moderate potential for producing forage and respond well to rangeland management. Where the range is in good or excellent condition, it produces forage year round. The soils are easily traversed by livestock. Resting pastures during alternate growing seasons helps to maintain or improve e the vegetation. Fencing and developing watering facilities help to control grazing. To control erosion, extra care must be taken to maintain a good plant cover.
In areas where the soils are calcareous throughout, they have moderate potential for producing forage and respond slowly to rangeland management. Most of the vegetation is produced following rainfall in winter and spring. In favorable winters, the production of annual grasses and forbs can Support grazing for about 2 to 3 months. Little forage is available during the rest of the year.

A few areas of this unit are in lower positions that receive extra moisture from runoff. These areas are far more productive than is typical for the unit. A few small areas west of the White Tank Mountains receive less precipitation than is typical for the unit. These areas are somewhat less productive than most other areas of the unit.
If this unit is used as sites for buildings, main limitation is the hazard of flooding. The unit is subject to localized flooding from overland flow, particularly during high intensity thunderstorms of short duration. Foundations built on this unit should be placed on elevated fill material, and yards should be graded away from the foundations so that surface water will flow away from the buildings.

If this unit is used for septic tank absorption fields, the main limitation is the hazard of flooding. In areas that are subject to flooding, sewerlines should be connected to a community sewage system to minimize the Possibility of contaminating ground water and creating a hazard to health. Onsite investigation is needed to determine the most suitable alternatives and the best design of buildings, roads, and septic tank absorption fields.

NOTE: The NRCS classes some soils as those of alluvial fans. Some of these "alluvial fans" may not meet the three criteria set by the Committee on Alluvial Fan Flooding to be classed as alluvial fans.

90-Momoli gravelly sandy loam, 1 to 5 percent slopes.

This deep and well drained soil is on fan terraces. It formed in alluvium derived dominantly from acid and basic igneous rock. Elevation is 1,400 to 2,200 feet. The average annual precipitation is 7 to 10 inches, and the average annual air temperature is 70 to 73 degrees F.

Typically, the surface layer is strong brown gravelly sandy loam about 3 inches thick. The subsoil is strong brown very gravelly sandy loam about 23 inches thick. The substratum to a depth of 60 inches or more is brown, calcareous very gravelly sandy loam.

Included in this unit are small areas of Carrizo and Maripo soils on flood plains and Pinamt and Denure soils on fan terraces. The included areas make up about 30 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Momoli soil is moderately rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight.

Most areas of this unit are used as rangeland and wildlife habitat. A few areas are used for urban development.

The soil in this unit has moderate potential for producing forage. It responds moderately well to rangeland management. Where the range is in good or excellent condition, it produces forage year round. The soil is easily traversed by livestock. Resting pastures during alternate growing seasons helps to maintain or improve the vegetation. Fencing and developing watering facilities help to control grazing. To control erosion, extra care must be taken to maintain a good plant cover.

If this unit is used as sites for buildings, roads, or septic tank absorption fields, it has few limitations. Onsite investigation is needed to determine the most suitable alternatives and the best design of buildings, roads, and septic tank absorption fields.

In areas of this unit that have been invaded by woody species, the productivity of the soils can be improved by prescribed burning or by chemical or mechanical treatment of the brush. Other types of land uses should be considered in selecting a method of brush control.
The riparian habitat in some areas of this unit is extremely important to wildlife.

122-Vado gravelly sandy loam, 1 to 5 percent slopes.

This deep and well drained soil is on fan terraces. It formed in alluvium derived dominantly from acid and basic igneous rock. Elevation is 1,800 to 2,500 feet. The average annual precipitation is 10 to 12 inches, and the average annual air temperature is 66 to 70 degrees F.

Typically, the surface layer is yellowish brown gravelly sandy loam about 2 inches thick. The subsoil is brown very gravelly sandy loam about 26 inches thick. The substratum to a depth of 60 inches or more is brown and strong brown, calcareous very gravelly sandy loam.
Included in this unit are small areas of Anthony and Arizo soils in drainageways and Pinaleno and Tres Hermanos soils on fan terraces. The included areas make up about 25 percent of the total acreage. The percentage varies from one area to another.

Permeability of this Vado soil is moderately rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of water erosion is slight. Most areas of this unit are used as rangeland or wildlife habitat. A few areas are used for urban development.

The soil in this unit has high potential for producing forage. It responds well to rangeland management. The soil can produce forage year round. It is easily traversed by livestock. Resting pastures during alternate growing seasons helps to maintain or improve the vegetation. Fencing and developing watering facilities help to control grazing. To control erosion, extra care must be taken to maintain a good plant cover.

If the soil in this unit is used as sites for buildings, roads, or septic tank absorption fields, it has few limitations.

Onsite investigation is needed to determine the most suitable alternatives and the best design of buildings, roads, and septic tank absorption fields. □

4.--100-year peak discharge, runoff and sediment

The 100-year flood peak discharge is estimated using methods in *Thomas, B.E., Hjalmarson, H.W., and Waltemeyer, S.D., 1997, Methods for estimating magnitude and frequency of floods in the southwestern United States: U.S. Geological Survey Water-Supply Paper 2433, 195 p.* From Table 16 of the report for flood region 12, the 100-year peak Q is as follows:

$$Q_{100} = 10^{(6.55-3.17AREA^{-0.11})}(ELEV/1{,}000)^{-0.454}$$

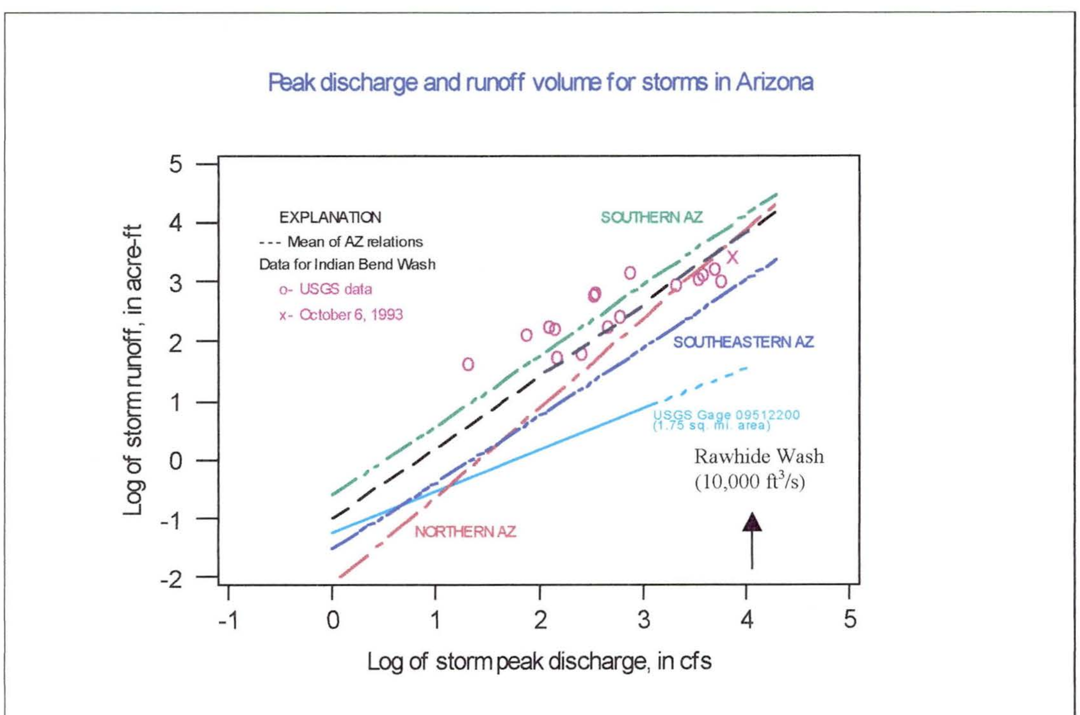
Where the area upstream of the hydrographic apex of Rawhide Wash is about 14.6 mi^2 and the mean elevation of the drainage basin is about 2,600 ft. The standard error of prediction is 39 percent. Thus, the peak is

Q_{100}= (15,475)(.648) = 10,000 ft^3/s +/- 3,900 ft^3/s

Or, the estimate of Q_{100} is expected to be between 6,100 and 13,900 ft^3/s.

The capacity of throughflow channels is about 1/10 of the 100-year peak discharge and floodwater will spread over wide areas. Because of the flood spreading the peak discharge will attenuate especially below the apex. The regional relation for region 12 may not reflect this attenuation. This attenuation, however, may be offset by rapid runoff in the steep-smooth throughflow channels.

The runoff volume for a peak discharge of 10,000 ft^3/s is roughly estimated as 10,000 acre-ft using U. S. Geological Survey data and relations shown below.



This reconnaissance analysis brings forward potentially useful U.S. Geological Survey information for peak discharge, runoff and sediment yield estimation in central Arizona. Little channel trenching is evident in the subareas to the east of Pima Road. Near stationarity of average annual soil loss appears likely. Stationarity is important if useful estimates of sediment yield are made using soil loss methods such as RUSLE and sediment yield equations of Flaxman (see references below). There also is no evidence of runoff or peak discharge trends for small streams in the area (Thomas, Hjalmarson, and Waltemeyer, 1994). Accordingly, these computations of sediment yield from the hillslopes of the area do not include sediment derived from significant gullying and channel bed and bank cutting. The relations below use information from the following:

Flaxman, E. M., 1972, Predicting sediment yield in Western United States: Proceedings of the American Society of Civil Engineers, Journal of the Hydraulics Division, HY 12, p. 2073-2085.

Flaxman, E. M., 1974, Progress report on development of sediment yield predictive equations: Soil Conservation Service, TSC Advisory ENG-PO-32, Portland, Oregon, 14p.

Soil and Water Conservation Society, 1995, RUSLE user guide, Revised universal soil loss equation version 1.04, 145 p.

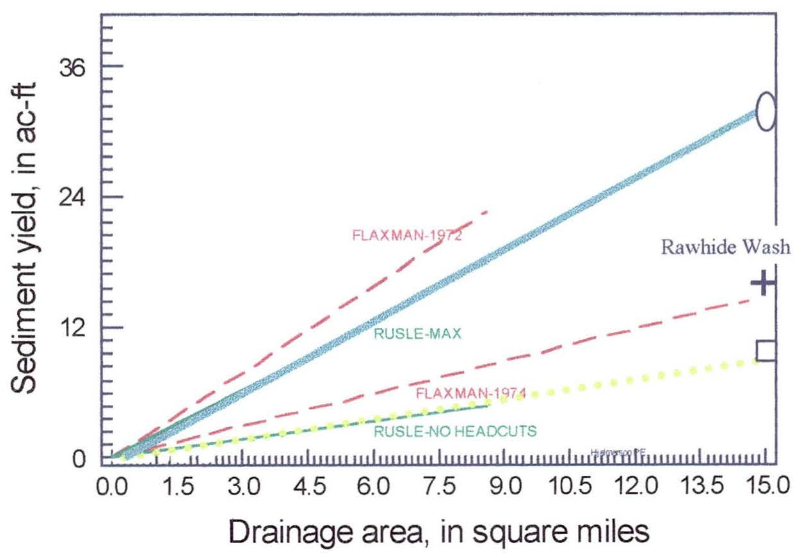


Figure 5. Sediment yield for 100-Year storm along Pima Road

The 1974 Flaxman relation gives 14 acre-ft of sediment transported to the hydrographic apex of the Rawhide Wash alluvial fan. The RUSLE computer program gives a minimum of 9 acre-ft and a maximum of 31 acre-ft of sediment transported to the alluvial fan. These estimates are based on poorly defined water runoff-sediment yield relations and do not reflect any engineering factor of safety.

5.--Summary

A: Rawhide Wash heads on a pediment where stream channels are separated by defined ridges and flow paths are stable. There is at least one diffluence along the northwestern drainage divide where flow can cross to or from the adjacent drainage. This sharing of drainage can be ignored in this assessment.

B: Below Jomax Road the flow becomes unconfined and there is an active alluvial fan. The fan is not large and may be entirely inundated during the 100-year flood. Much of the active fan is covered with urban development that is not protected by major engineering works such as a floodwater and sediment detention reservoir or an engineered channel down the entire fan. The natural and present hazard is severe where sediment erosion and deposition are likely and flow velocities will be high and supercritical in open channels.

C: The toe of the fan is near Deer Valley Road where the drainage pattern becomes tributary. Near and below the fan toe the channels are small and most of the floodwater in sheetflow. Nearly the entire sheetflow area was inundated during the flood of June 22, 1972. Based on the developed tributary drainage on the toe, the area is considered stable. It is assumed that such a network of tributary channels could not form where sediment deposition was significant.

D: The flood plains along Rawhide Wash are characterized by young-low undulating bars and broad channels that are the result of periodic flooding. There is little or no soil horizon development. High velocity floodwaters carry and deposit rock fragments in these areas, but fine sediment is not deposited. Because of the unstable geometry, both hydraulic and geomorphic methods should be used to define the extent of the flood hazard.

E: The hazard on the active alluvial fan and the throughflow channels is severe and associated with erosion, deposition and high flow velocities. The 100-year peak discharge may inundate the entire fan. Below the fan toe wide areas will be covered with sheetflow. A few tens of acre-feet of sediment will be deposited below the fan apex. The sediment transported to the active alluvial fan is equivalent to about three thousand large dump truck loads of sediment. Simple elevation of finished floors will not mitigate the hazard because of the sediment deposition, erosion of sediment and changing paths of flow.

F: The committee on alluvial fan flooding for the National Academy of Science visited sites to the north and south of Rawhide Wash. These sites are on pages 34 and 102 to 111 of the report (NRC, 1996). Thus, the conclusions of the committee clearly pertain to the Rawhide Wash site as follows: (A) Floodwater surface elevations computed using preflood topography are not a comprehensive indicator of the true hazard for alluvial fan flooding situations as they are for riverine flooding and (B) The fan environment where the combination of sediment availability, slope, and topography creates an ultrahazardous condition for which elevation on fill will not reliably mitigate the risk.

The following reports describe flood hazards of nearby sites:

Hjalmarson, H. W., 1978, Delineation of flood hazards in the Cave Creek quadrangle, Maricopa County, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-843-B, 2 sheets.

Hjalmarson, H. W.,1994, Potential flood hazards and hydraulic characteristics of distributary-flow areas in Maricopa County, Arizona: U.S. Geological Survey Water-Resources Investigations Report 93-4169, 56 p.

Hjalmarson, H. W., and Kemna, S. P., 1992, Flood hazards of distributary-flow areas in southwestern Arizona: U.S. Geological Survey Water Resources Investigations Report 91-4171, 68 p.

Photo 3. Looking downstream and southwest from Pinnacle Peak Road at one of Rawhide Wash channels. Channel is 0.1 mile east of Scottsdale Road. Soil along banks has eroded. Photo taken on June 22, 1972 shortly after the flood peak.

Photo 4. Floodwater of flood of June 22, 1972 at Pinnacle Peak Road about 0.5 mile west of Scottsdale Road. Site is about 1/2 mile west of Scottsdale Road next to APS Pinnacle Peak Substation. Looking northeast at sheetflow with small headcut. Landslope is about 2.0 percent. Some of this flow may be from Rawhide Wash but most of flow probably is from area to the west of Rawhide Wash.

Photo 1. View looking south across Rawhide Wash channel at deposited sediment and floodwater in dip crossing at Scottsdale Road. Site is about 0.6 mile south of Pinnacle Peak Road. Photo is of recession of large flood on June 22, 1972.

Photo 2. View looking southeast and across channel at dip crossing on Scottsdale Road about 0.1 mile north of Jomax Road. Deposited sediment is about 6 inches deep and several tens of feet wide. Photo taken on June 22, 1972 shortly after the flood peak.

Field inspection of 5/26/99 by Hjalmarson

Inspection focused of landforms and stability upstream of Scottsdale Road to Dynamite Road. Comments are referenced to aerial photo 3 Dec 96 unless otherwise noted.

1. The Rawhide Wash has an active alluvial fan starting just below Jomax Rd. There is a trib. From the east that crosses Pima Rd. between Jomax and Dynamite Roads that has a small fan like area before it enters the main channel in several places. I did not field inspect this confluence area. The map seem OK for Jomax Road.
2. Appears the map boundary at Happy Valley Rd is incorrect unless there is a major levee upstream that diverts(keeps) flow to the west. The eastern boundary at Happy Valley Rd may be 1/4 too far to the west.
3. On Hayden Rd there was an excavation along the east side from about 0.1 to 0.2 mile north of Pinnacle Pk Rd. The ditch was 8 ft. deep. Took photo looking east at side of ditch showing stratification of sediments. The material is young with no significant carbonate development. The banks sloped some. This is not an area where the surface texture would typically suggest high activity but the soil certainly suggests recent sediment deposition at considerable depth. This is a bigger sand box than I thought. I would include this in the active area as suggested by the pre-development channel shown on aerial photo of 7 Dec. 83 furnished by Joe Tram.
4. I did not examine the source area sediment supply.
5. There is an obvious mound of "sand" that can be seen as you drive west from Pima Road along Happy Valley and Pinnacle Peak Roads. This mound is apparent even with the roads skewed to the fan allignment.
6. At the west side of Happy Valley Rd is a fenced community with a levee extending south from HV Rd about 300 ft to the fence corner. At the entrance to this community (1/2 mile west of Hayden Rd) there is a 300 ft wide bridge at allow floodflow to flow west. This floodwater would be from the west side of Rawhide. Along the east side of the community is a block fence next to Rawhide Wash. This fence will be subject to high floodflow velocity and associated scour. There may be big time scour at the upper fence where the fence veers from the north to the southwest.
7. Opposite the fence described above is another "fence" under construction along the east side of Rawhide. Large rock is being placed along the channel side of this concrete wall.
8. At Pinnacle Peak Rd there is a rock covered berm along the south side that protects "Rawhide" entertainment area. The channel above and below PP Rd is deceptive at this location because it does not appear to have a 15+ square mile drainage upstream. A flood peak of 10,000 ft^3/s+ would be a very serious hazard at this location.
9. My impression of the many fences that are along Rawhide is concern for scour failure along the fences and in the channel. Concentration of floodwater on an active fan into a single channel can have obvious scour problems because the landform basically is a "sand box". Are these fences "engineered"?
10. Except as noted above, the Zone AO generally depicts the active fan that ends about 3 mile below Jomax Rd. There is an alluvial plain below the toe where there is sheetflow on a fairly stable soil. Concentration of flow on the alluvial plain will result in scour of unprotected dirt.

Winn 5/27/99 Several photos taken

Joe & John -

Hope this is what you expected. I included USGS information because it is based on gaged data and measurements in Arizona and in Indian Bend Wash. My estimates of sediment & peak Q are different than HDRs but still very close.

I've spent over 48 hours + travel on this.

W[illegible]

5/28/99

MESSAGE CONFIRMATION

05/27/99 15:34
ID=FLD CTRL CM DIV

SESSION NO. = 452

DATE	TIME	S,R-TIME	DISTANT STATION ID	MODE	PAGES	RESULT	
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FLOOD CONTROL DISTRICT
OF MARICOPA COUNTY

2801 W. Durango, Phoenix, Arizona 85009
Fax: (602) 506-8561
Office: (602) 506-8945

E-mail: ______________________

Date: 5/27/99

COVER SHEET

To: Winn Hjalmarson Fax No. 1-520-567-9578

______________________ Fax No. ______________________

From: J.E. Rodriguez

Number of pages being sent including Cover Sheet: 3

SUBJECT: Scottsdale Tribune / Planning Comm. Mtg.

Comments:

... staff for fitting that they took the tower ... ing out, radio hoisting it from a grease...

Please see TOWER, Page A5

Planning panel delays vote on N. Scottsdale flood plan

Wants more information on Rawhide Wash project

BY JOE KULLMAN
THE TRIBUNE

A $100 million flood-control plan for north Scottsdale has been put in limbo.

The city Planning Commission voted 6-1 Wednesday to delay until at least Sept. 15 a decision that would have paved the way for a major part of the Desert Greenbelt project, requesting more information from project supporters.

The vote came after more than two hours of debate among residents, city officials and representatives from the Flood Control District of Maricopa County.

District officials were requesting an amendment to Scottsdale's general plan that would allow use of a water-retention method for flood control. The city's land-use policy permits only a channelization method.

▶ Please see FLOOD, Page A5

RICK D'ELIA/FOR THE TRIBUNE

Supporting basin: David Mathes, representing members of the Pinnacle Reserve Homeowners Association, speaks in support of the Rawhide Wash Detention Basin at Wednesday's Planning Commission meeting.

To Dan Cowell — Photo is bad
Best copy I could make.
A balanced article, Accurate too in my opinion.
Dave Mathes
506-8501

From Page A1

them. Those hearts represent people who are there. It's a little symbolic. By doing that, we're going to keep David here."

The teens who decorated the home included a football player, a drama student, a friend who walked home from school with Samson and the president of the National Honor Society.

He was a 16-year-old with interests that included dance, color guard and singing. He was a member of the world-renown Phoenix Boys Choir, admired Oprah Winfrey, was inspired by the film *Titanic* and hoped to attend Julliard School in New York.

"I didn't know David Samson very well, but I thought it was a nice thing to do, so I said I'd help out," said Coronado valedictorian Nate Poole. "It's really bad to lose such an involved kid, because he did everything."

Junior Stephanie Noall was in school plays with Samson, whom she last saw in October because

"David has turned out to be my role model because he knew what made him happy and he had the courage to do that."

KAREN SAMSON

she temporarily moved away.

"The last time I saw him, he bulldozed into me, grabbed me," Noall said. "He had this huge, bright smile. It was always really fun to hang with him. That's what I'll remember the most."

Senior David Wylie and juniors Nick Williams and Steve Morrow also helped decorate the Samson home.

"He left a legacy at Coronado," Wylie said. "He made us all proud."

The impromptu remembrance was touching for Karen Samson.

"One of your greatest fears as a parent is that your child will be forgotten and you look out the window and think, 'No, they didn't forget,' " said Samson, who broke into tears the moment she saw the vigil. "With all the things you've been hearing about school-aged children and their problems, it's so nice to see there are some good ones who care about people. Those are the ones you don't hear about."

The memorial couldn't have come at a better time.

"It closes another chapter because he was part of this school year and now with kids graduating, people are moving on and it's another dose of the reality he is gone," Samson said through her tears.

Before his death, David Samson started a journal. Only getting as far as page three, entries do tell a story.

"I love to perform. It is probably the biggest part of who I am. I want to be an actor, that is what I love," he wrote. "I think I like to perform because of the attention and recognition I receive from it. It makes me feel like there is something special and important about me ... applause."

Always ... was Karen ... she will ... in heaven ...

"Anoth... When ...

... want ... what ... I became ... and tha... happy."

She tries ... pie set by h...

"David h... role model ... made him ... courage to ... "The best ... David is to ... life and h... people."

Tribune ... *can be r... proland@az... 970-2336.*

FLOOD: Planning panel delays vote

From Page A1

The district needs the change to its proposed $22 million Rawhide Wash Detention Basin, which would include a 35-foot-high earthen dam on a 110-acre site near Lomax and Hayden roads.

The basin is needed to protect about 1,300 homes in a 6,800-acre flood plain from potentially disastrous flooding that experts predict will occur at least once in a 100-year span, district officials said.

City planners, several area residents and one independent flood expert supported the district's conclusion that the basin is critical for public safety.

Other residents said the Desert Greenbelt is an unwanted, unnecessary scheme designed to open the way for urban sprawl in north Scottsdale. They protested that the Rawhide Wash Basin in particular would do excessive damage to the area's delicate desert environment.

Resident Inge Vairo gave the Planning Commission a copy of a letter signed by 272 north Scottsdale residents opposing the Rawhide Wash Basin. She was followed by David Mathes, representing almost 400 members of the Pinnacle Reserve Homeowners Association who favor the project.

Scientific evidence shows north Scottsdale is "in real danger" of a serious 100-year flood, said Winn Hjalmarson, a hydrologist and civil engineer who told planning commissioners he worked on a flood study for the National Academy of Science.

But the city should not approve any part of the Desert Greenbelt plan until the federal government completes environmental impact studies, said Robert Vairo, representing the Coalition of Pinnacle Peak, a 1,200-member residents group.

Damming water would effectively eliminate the flood plain, a move that could be used as a rationale for allowing high-density development, Vairo said.

The Planning Commission asked flood control district officials and city planners to provide more documentation for the claim that a basin is the most feasible flood-control option for the Rawhide Wash area.

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