

# GROUNDWATER GEOLOGY OF FORT VALLEY, COCONINO COUNTY, ARIZONA

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Fort Valley is an alluvial basin which lies approximately five miles northwest of Flagstaff. The basin is bounded by Tertiary volcanic features which are A-1 Mountain and Observatory Mesa on the south, Wing Mountain on the west, and the San Francisco Mountains on the north and on the east. Surface water drainage enters the area from the north, the northwest, and the south and leaves the valley to the southeast via Rio de Flag.

## ROCK UNIT DESCRIPTIONS

### PALEOZOIC AND MESOZOIC ROCKS

The subsurface sedimentary sequence consists of nearly flat-lying Paleozoic and Mesozoic rocks. The uppermost Paleozoic formation of interest in this study is the Supai Formation of Pennsylvanian and Permian age. The Supai Formation is composed, for the most part, of alternating siltstone and fine-grained sandstone. The Supai Formation is overlain by the Coconino Sandstone of Permian age. The Coconino Sandstone is very fine to fine-grained, is cross-bedded, and consists of well-sorted, rounded to sub-angular, clear, stained, and frosted quartz grains. The Coconino Sandstone is overlain by the Kaibab Limestone of Permian age. The Kaibab Limestone is a thick to thin-bedded, jointed, cherty, and sandy dolomitic limestone. In Fort Valley the Paleozoic rocks are penetrated by a single well which lies in the east central portion of the area. This well was drilled in 1938 for the City of Flagstaff but was unproductive and abandoned.

The Kaibab Limestone is disconformably overlain by the Moenkopi Formation of Triassic age. This Mesozoic rock unit is generally reddish-brown and consists of flat, very thin to thick layers of siltstone, mudstone, and sandstone. The Moenkopi Formation is encountered in all of the Fort Valley wells drilled to depths beyond 230 feet. The depth to the top of the Moenkopi ranges from 140 to 226 feet and the elevation at the top of the Moenkopi ranges from 7090 to 7180 feet. The 90 feet of relief on the top of the Moenkopi reflects an erosion surface and possibly structural offsets by faults now covered by the more recent volcanics.

## VOLCANIC ROCKS AND INTERFLOW ZONES

The volcanics in the Fort Valley area range in age from late Miocene to Pleistocene (Cooley, 1960). Fort Valley is a focal point for volcanic flows which were derived from A-1 Mountain, Wing Mountain, and San Francisco Mountain. Interflow zones which comprise paleosols, cinders, and conglomerates occur between individual lava flows in the subsurface.

## ALLUVIAL ROCKS

Three alluvial units which overlie the volcanic rocks were distinguished by Cooley (1960) range in age from Pleistocene to Recent. The alluvial rocks comprise soil, cinders, clay, and boulders.

## HYDROGEOLOGIC FEATURES

### FENCE DIAGRAM

At present (1973) data are available for 24 wells which are located in the alluvial portion of the valley. The wells throughout the valley yield from 0-20 gallons per minute. An analysis of drillers logs of 10 of these wells was used to construct Figure 1, a hydrogeological fence diagram of Fort Valley. The rock units shown in Figure 1 are generalized.

Alluvial rocks. The unit at the top of each section represents alluvium which ranges in thickness from 7 to 123 feet.

Volcanic rocks and interflow zones. The second units in descending order represents volcanic rocks which range in thickness from 4 to 70 feet. The wells penetrate from 1 to 4 volcanic units. Correlation of the volcanic units is difficult due to similar lithology, multiple source areas, and abrupt pinch outs. The volcanic rocks encountered in wells in the southeast portion of Fort Valley may be derived from A-1 Mountain, those in the north from San Francisco Mountain, and those in the west from Wing Mountain. Interflow zones are also shown on Figure 1. The thickness of these zones ranges from 6 to 54 feet.

Moenkopi Formation. The lowermost unit shown on Figure 1 represents the Moenkopi Formation which is penetrated by 6 of the 10 wells used in construction of the diagram. Wells in the western portion of Fort Valley are of insufficient depth to penetrate the Moenkopi Formation. The drillers log from the City of Flagstaff well drilled in 1938 indicates that the total thickness of the Moenkopi is 270 feet.

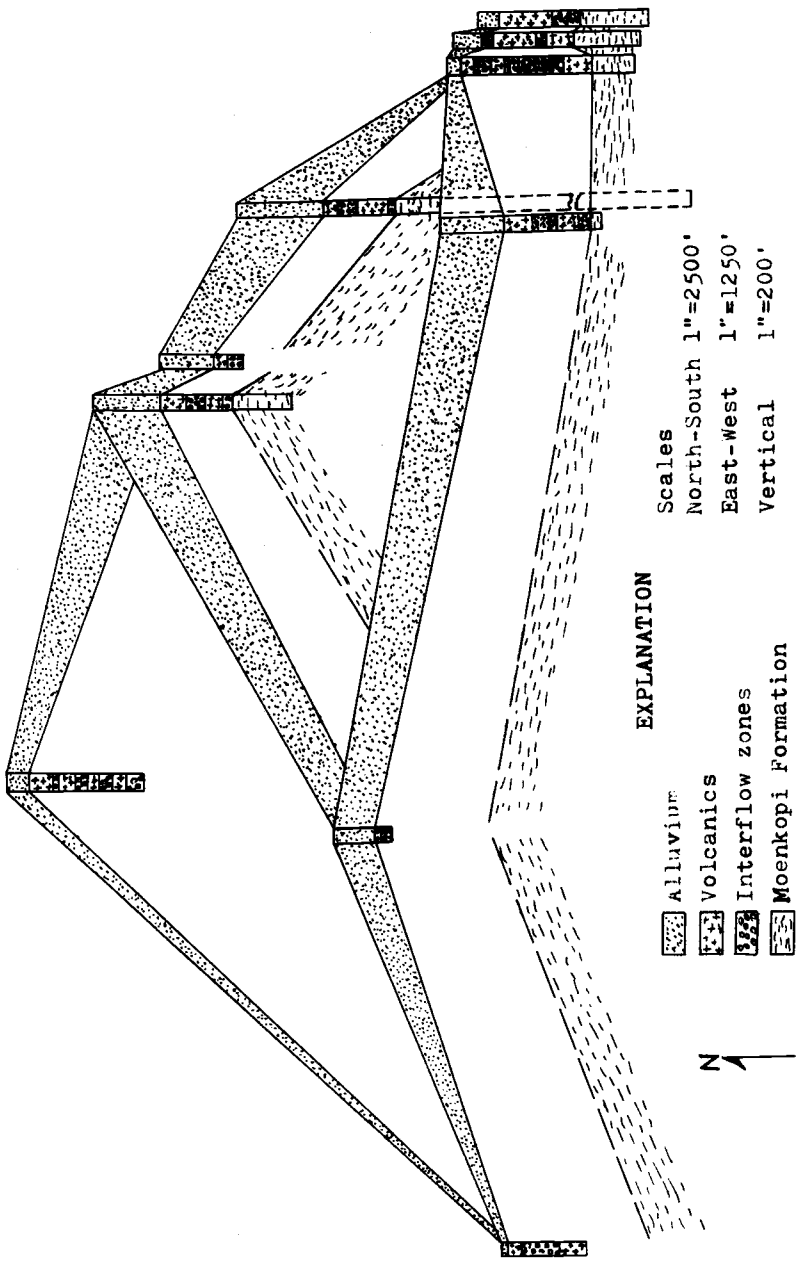


Figure 1 HYDROGEOLOGICAL FENCE DIAGRAM OF FORT VALLEY

## GROUNDWATER FEATURES

All of the groundwater presently developed in Fort Valley is found in perched aquifers. The regional water table in the Fort Valley area is believed to lie at a depth of approximately 1750 feet, a depth which is below the base of the Coconino Sandstone (McGavock, 1968).

Occurrence and flow pattern. Groundwater reservoirs found in the alluvial rocks are perched on impermeable clay zones located at the base of the alluvial units. Groundwater is also found in the volcanics which are locally highly fractured and which also overlie impermeable clay zones. Perched aquifers also occur in interflow zones perched on impermeable clays or on unfractured volcanics. Significant quantities of water are perched on top of the Moenkopi or in sandstone layers in the upper portion of the Moenkopi Formation.

Recharge relations. Groundwater in Fort Valley is derived from infiltration of runoff and from precipitation. Chief sources of runoff are watersheds on San Francisco Mountain, Wing Mountain, and A-1 Mountain. This recharge water infiltrates alluvium or fractured volcanics and percolates downward until it reaches an impermeable zone where it becomes perched groundwater. Under natural conditions water in the perched reservoirs slowly drains into the underlying Paleozoic rocks and is lost to the shallow groundwater system.

## CONCLUSIONS

- The results of this study indicate the following:
1. Local perched groundwater reservoirs occur where an impermeable zone is provided by unfractured basalt or by an impermeable clay zone or by the Moenkopi Formation.
  2. Greatest well yields are derived from fractured volcanic rocks, from alluvial units, and from interflow zones where these rock units are underlain by suitable perching zones.
  3. The reliability of wells in Fort Valley is dependent largely on seasonal precipitation and runoff.
  4. Most wells in Fort Valley supply adequate amounts of water for domestic purposes.

## REFERENCES CITED

- Cooley, M.E., 1960, Physiographic map of the San Francisco Plateau--lower Little Colorado River area, Arizona: Tucson, Univ. Arizona, Geochronology Laboratories.
- McGavock, E.H., 1968, Basic ground-water data for southern Coconino County, Arizona: Ariz. State Land Dept. Water Resources Rept. 33, 49 p.