DEPTH TO RIVER GRAVEL
TEMPE QUADRANGLE, MARICOPA COUNTY, ARIZONA

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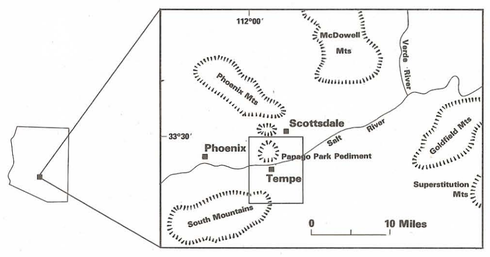

INTRODUCTORY STATEMENT

The ancient and modern deposits created by a stream are of great interest to land-use planners, as well as a guide to interpret geologic history. The deposits of the Salt River consist of alternating layers of rounded cobbles (greater than 80 mm in diameter), gravel (2 to 80 mm), sand (0.05 to 2 mm), silt (0.002 to 0.05 mm), and clay (less than 0.002 mm).* Not only are there frequent vertical variations in grain size, but there are also lateral variations. The coarser material is deposited as bedload in the channels, whereas the silt and clay accumulate as overbank deposits on the floodplain. As the channel becomes choked with cobbles and gravel, the stream gradually shifts, depositing coarser bedload over previously deposited fine-grained sediments. In turn, silt and clay slowly accumulate over the sand and gravel of the abandoned channel. As the river swings from side to side across the valley, sand and gravel beds record its ancient courses.

The modern Salt River is a typical braided stream in an arid environment. To interpret the distribution of sand and gravel deposits, it is necessary to understand the processes of deposition and erosion presently occurring in the Salt River, and to assume that the conditions of climate, sediment load, and discharge were similar in the past. A braided stream is one that divides into several channels which successively meet and redivide. The interwoven channels diverge around islands or mid-channel gravel bars, which separate the river at low flow but are often submerged at high flow. Large braided rivers are characterized by wide channels, rapid shifting of bed material, and continuous shifting of the position of the river course.

Streams are constantly adjusting to create a balance between erosion and deposition. As the banks of the river are eroded, deposition occurs downstream. The largest particles are the first to be deposited since they are the most difficult to transport. Velocities required to keep large particles in motion are less than those required to reinitiate movement after the particles have come to rest. Once concentrated, large particles act as a locus for continued deposition. As the deposit grows surfaceward, the current is deflected against the sides of the channel, causing scouring of the banks and enlargement of the cross-sectional area of the stream. As a result, the water surface becomes increasingly shallow over the mid-channel bar, and deposition of finer-grained sediment occurs. Vegetation eventually covers and stabilizes the bar as it emerges as an island.

Rivers in flood exhibit tremendous eroding and transporting abilities. During flood stage there is a vertical accretion of sediment. As the waters rise, velocities increase, and abundant sediment is picked up and carried along. When the river overtops the channel, there is a rapid spreading out of the water, with an immediate decrease in velocity, resulting in the deposition of the coarsest material; gravel and cobbles, in the channel, and sand across the floodplain. As the waters continue to rise, velocities again increase, causing local scour of the newly deposited sediments. During the falling stages of the flood, the velocity gradually decreases, resulting in sorting of the sediments. Silt is deposited across the floodplain, and clay eventually settles out of standing water, usually in depressions.

The balance of erosion and deposition in a stream system does not remain constant through time. On some occasions dissection (degradation) has been prominant throughout the Salt River system, while during other times alluviation (aggradation) has proceeded. Although changes in climate or vegetative cover are commonly responsible for a change in stream regimen, tectonic deformation is associated with changes in the Salt River.

Alluvial terraces result from stream erosion and are formed when a river cuts into the floodplain which it had deposited previously. A terrace consists of a flat area or bench bounded by a front and back scarp. It is above the present stream so the river no longer flows across it, except in the case of extremely large floods. The terraces of the Salt River in the Tempe Quadrangle are paired alluvial terraces, meaning they occur on both sides of the modern channel and are cut into the river's own deposits.

There are four terraces recognized along the Salt River, three of which extend into the Tempe Quadrangle. The lowest terrace, the Lehi Terrace, is only 5 ft (1.5 m) above the dry river bed near Tempe, and rises to 20 ft (6 m) above the river 25 miles (40.2 km) upstream. A higher terrace, the Blue Point Terrace, is not recognized in this quadrangle. The most prominant terrace is the old and dissected Mesa Terrace. It is 10 to 15 ft (3 to 4.5 m) above the dry river bed at Tempe, and extends toward Stewart Mountain Dam, where it is 220 ft (66 m) above the river, and eastward toward Roosevelt Dam where it is more than 300 ft (90 m) above the river. The oldest and highest terrace, the Sawik Terrace, is the most fragmentary. It is about 45 ft (13.5 m) above the river in Scottsdale, where it becomes buried under alluvial fan deposits from Camelback Mountain and the McDowell Mountains (see GI-2-D). The terraces suggest a periodic regional uplift of the mountains to the north and east, which would cause rejuvenation in the upper parts of the drainage basin and increased alluviation in the lower parts. In this way the terraces come together near the center of the basin (GI-2-G) which is subsiding relative to the uplifting mountains.

Within the Tempe Quadrangle some generalizations can be made concerning the distribution of Salt River Sand and Gravel. Near the scarp of the terraces the depth to gravel is very shallow, for erosion has removed the overlying silt to expose the gravel beneath. The depth to gravel increases away from the modern channel, as the gravel becomes buried by overbank silt of the river, alluvial fan deposits from the surrounding mountains, and the tons of wind-blown dust that are deposited annually in the valley. The depth to river deposits of sand and gravel increases more rapidly than the rise in the surface topography away from the river. How can the older, higher terrace deposits be lower in elevation than the modern channel deposits? The explanation is that the basin is subsiding toward the south and west. In the southwest part of the quadrangle the depth to gravel increases very rapidly as alluvium from South Mountains is carried out and deposited over the river sediments. Some burial of the Mesa and Sawik Terrace gravels has been achieved by the distal ends of alluvial fans from the McDowell Mountains and Camelback Mountain. However, burial alone cannot explain the anomalous depth to gravel west of Indian Bend Wash. It is probable that at some time in the past, Indian Bend Wash occupied a channel somewhat to the west of the present location. At that time the wash was a degrading stream, and incised a deep channel into the Salt River gravels. This channel was subsequently filled with fine-grained silt deposits by the wash itself. River deposits definitely do not exist on or under the bedrock and calichified colluvium (GI-2-A,B,C). However, there remains a questionable area where, according to available subsurface data, river gravel was never deposited.

Sand and gravel are a valuable material resource, and may be useful as decorative stone, concrete aggregate, road construction material and fill material, depending on the grain-size distribution and the development of caliche. The gravel of the Mesa and Sawik Terraces is well calichified at or near the surface, whereas the younger Lehi gravel has weak to no caliche development (GI-2-G). Although deeply buried and calichified gravel may not be economical in terms of quarrying, these deposits provide excellent foundation stability for multistoried buildings. Another value of these permeable river deposits is that they provide a natural receptical for runoff via dry wells (GI-2-J).

This map was prepared from synthesis of data from various sources including U.S. Geological Survey well records, the files of McGuckin Drilling Company, our own drilling project performed in cooperation with Arizona Department of Transportation, and on-site inspection of numerous excavations during the past 20 years.

SELECTED REFERENCES

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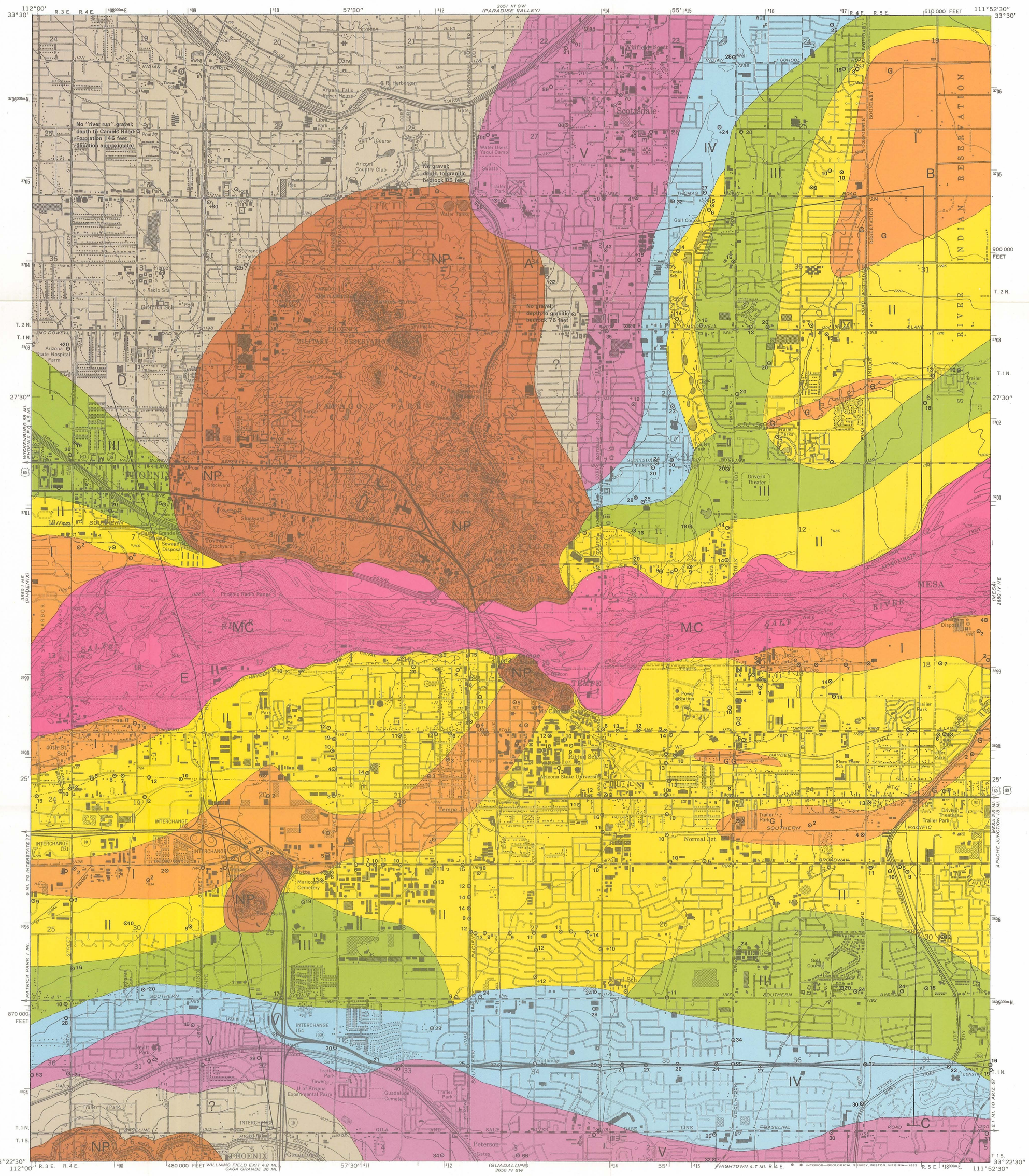
This map involves a general evaluation on a broad scale and does not preclude the necessity of site investigation.

*Size grade divisions according to U.S. Department of Agriculture and Soil Scientists Society of America.

EXPLANATION

I G	0 to 5 feet (0 to 1.5 meters) of fine-grained alluvium over river gravel. G indicates gravel at surface.
II	5 to 15 feet (1.5 to 4.5 meters) of fine-grained alluvium over river gravel.
III	15 to 20 feet (4.5 to 6.0 meters) of fine-grained alluvium over river gravel.
IV	20 to 30 feet (6 to 9 meters) of fine-grained alluvium over river gravel.
V	Greater than 30 feet (9 meters) of fine-grained alluvium over river gravel.
MC	Modern channel, sand and gravel generally at the surface.
NP	Gravel not present under or upon bedrock and calichified colluvium.
?	Questionable area, available data indicates that Salt River never flowed here.
14 +19	Data point, depth to gravel given in feet. Plus symbol means no river gravel was encountered to depth indicated.
A — B	Cross-section.

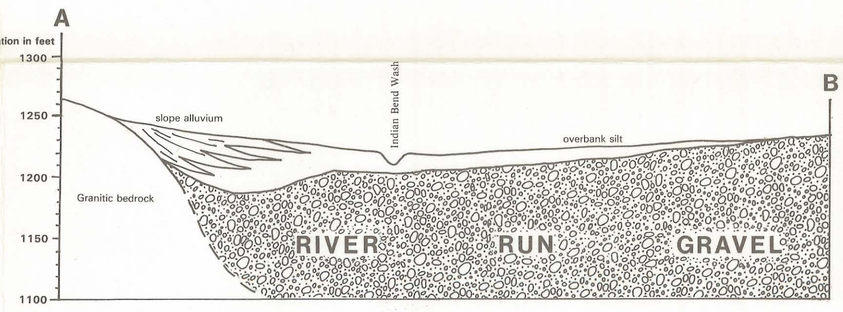
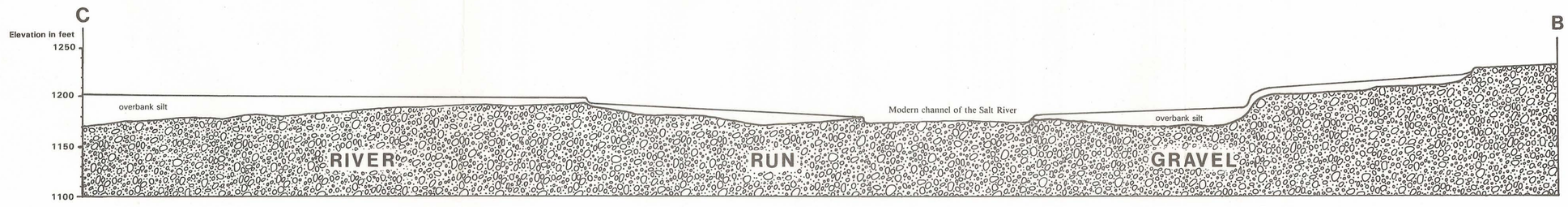
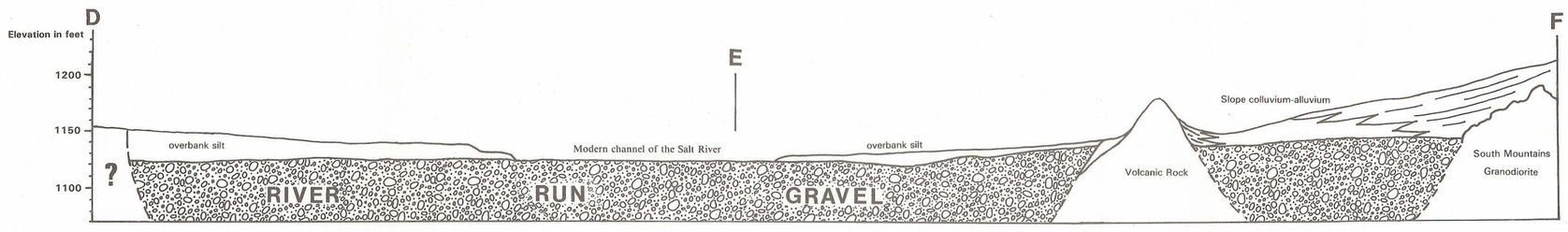


BASE MAP FROM U.S. GEOLOGICAL SURVEY
TOPOGRAPHIC MAP, 1:24,000 SERIES
TEMPE QUADRANGLE (1952, PHOTOREVISED 1967)
Additional revisions compiled by the Geological Survey from aerial photographs taken 1978 and other sources. This information not field checked.
Map edited 1982.

UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

IDEALIZED CROSS-SECTIONS

SHOWING DEPTH TO RIVER GRAVEL
VERTICAL EXAGGERATION — 8X