channel is elevated through deposition and becomes part of the floodplain. Also, the stream channel is lengthened and the slope is further reduced. The upstream streambed is filled in and average flood elevations are increased. As the stream works across the stream valley, deposition causes the total floodplain to raise in elevation. Hence, even old streams are far from static. Old rivers meander, and they are affected by changes in sea level, influenced by movements of the earth's crust, changed by delta formations or glaciation, and subject to modifications due to climatological changes and as a consequence of man's development.

2.3.7 Natural Levees

Natural levees form during floods as the stream stage exceeds bankfull conditions. Sediment is then deposited on the floodplain due to the reduced velocity and transporting capacity of the flood in these overbank areas. The natural levees formed near the stream are rather steep because coarse material drops out quickly as the overbank velocity is smaller than the stream velocity. Farther from the stream, the gradients are flatter and finer materials drop out. Swamp areas are found beyond the levees.

Classification based on natural levees is illustrated in Figure 2.6. Streams with well-developed natural levees tend to be of constant width and have low rates of lateral migration. Well-developed levees usually occur along the lower courses of streams or where the floodplain is submerged for several weeks or months a year. If the levee is breached, the stream course may change through the breach. Areas between natural levees and the valley sides may drain, but slowly. Streams tributary to streams with well-developed natural levees may flow approximately parallel with the larger stream for long distances before entering the larger stream.

2.3.8 Apparent Incision

The apparent incision of a stream channel is judged from the height of its banks at normal stage relative to its width. For a stream whose width is about 30 m (100 ft), bank heights in the range of 1.8 to 3.0 m (6 to 10 ft) are about average, and higher banks indicate probable incision. For a stream whose width is about 300 m (1,000 ft), bank heights in the range of 3.0 to 5.0 m (10-15 ft) are about average, and higher banks indicate probable incision. Incised streams tend to be fixed in position and are not likely to bypass a bridge or to shift in alignment at a bridge. Lateral erosion rates are likely to be slow, except for western arroyos with high, vertical, and clearly unstable banks.

2.3.9 Channel Boundaries and Vegetation

Although no precise definitions can be given for alluvial, semi-alluvial, or non-alluvial streams, some distinction with regard to the erosional resistance of the earth material in channel boundaries is needed. In geology, bedrock is distinguished from alluvium and other surficial materials mainly on the basis of age, rather than on resistance to erosion. A compact alluvial clay is likely to be more resistant than a weakly cemented sandstone that is much older. Nevertheless, the term "bedrock" does carry a connotation of greater resistance to erosion, and it is used here in that sense. An alluvial channel is in alluvium, a non-alluvial channel is in bedrock or in very large material (cobbles and boulders) that do not move except at very large flows, and a semi-alluvial channel has both bedrock and alluvium in its boundaries. The bedrock of non-alluvial channels may be wholly or partly covered with sediment at low stages, but is likely to be exposed by scour during floods.