3.6.2 Local Stability Prevents Incision and Protects Infrastructure

The organizing principle for local stability is, like systemic stability, energy management. The goal is to manage energy throughout the intervention so that neither scour nor deposition is induced in the adjoining reaches. This implies managing hydraulic roughness, focusing flows and achieving an equilibrium channel shape. Sugar Creek's incision threatens sanitary pipes near the flow line and protecting those pipes should be a high priority.

Similarly, some culverts such as that at W. Magnolia Drive cause incision. Widening a channel to achieve the desired conveyance often causes more problems than it solves. At W. Magnolia Drive, the channel was widened to roughly twice its equilibrium width. In response, the channel incised upstream and deposited the material it generated immediately upstream of the culvert to recreate its stable shape. In doing so, the capacity of the culvert is reduced.

Culverts and bridges can be designed or retrofitted to provide any desired level of service while protecting stream stability. The installation of new drainage structures should take into account the natural channel configuration at the location of the improvement. Long-term observations of stream channels and structures have shown that natural channels once modified will return to their original size and shape without routine maintenance. This phenomenon occurs at the W. Magnolia Street culvert. Therefore, by accounting for this natural tendency during design, long-term maintenance cost can be reduced.

Typically, natural channels have a two-stage configuration. The first stage handles flows up to the 1.5- to 2-year flood. This stage is typically referred to as the primary channel or flow-way. The second stage handles flows from larger flood events and is better known as the floodway.

Accounting for the natural channel configuration in the design of improvements translates to the construction of nonsymmetrical structures. Using the traditional approach, a culvert designed with three parallel box culverts would be designed around all three culverts being constructed with the same invert, requiring the channel bed to be artificially widened to match the new opening width. **Figure 3.6.2** shows an example of a typical traditional installation. Typically, structures constructed with this approach have siltation problems that either require a significant amount of maintenance and/or a significant reduction in the flow capacity of the structure.

This problem can be avoided by accommodating the stable channel shape in the design. Through this approach, the inverts and shape of parallel culverts would be adjusted to match the shape of the natural channel. The primary culvert would be set at the natural channel invert and any secondary culverts would be set at a higher elevation, matching the flow line of the flood channel. This type of configuration is