DESIGN EXAMPLES—SECTION 6

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6.0 CASE STUDY— GOLDSMITH GULCH

Goldsmith Gulch flows through Bible Park in southeast Denver. Bible Park is located between Monaco Parkway and Quebec Street and south of Yale Avenue. The Highline Canal flows around the perimeter of the park. Bible Park has active recreational areas that include ball fields, tennis courts and playgrounds. The park has a significant trail system that connects the active recreational components of the park and allows for enjoyment of the passive areas. The channel in Bible Park had become deeply incised and very linear. The average slope of the existing channel in Bible Park prior to the drainageway maintenance project was approximately 0.5 percent. The channel bottom elevation at the upstream and downstream ends of the park was controlled but the channel in the park had become very incised with sloughing banks. The incised channel and unstable banks greatly reduced the potential for enjoyment of the channel by park users and presented a definite safety issue. The Urban Drainage and Flood Control District, the Denver Wastewater Management Division and the Denver Parks Department undertook a rehabilitative maintenance project for the Goldsmith Gulch channel in Bible Park in 1996. Sellards & Grigg, Inc. and Wenk Associates performed the design. Dames & Moore provided environmental consultation. The rehabilitative maintenance of the Goldsmith Gulch channel was undertaken with the primary goals of stabilizing the channel in a manner that was environmentally sensitive and that enhanced the wildlife habitat in the park. A secondary goal was to enhance the passive and active enjoyment of the park. Bioengineering techniques were combined with traditional methods of channel stabilization to accomplish the project goals.

6.1 Design

Inherent in all of the alternatives that were considered for channel stabilization was the concept of reducing the channel slope by the construction of drop structures. As a result of the extensive public involvement process that was undertaken during the design phase of the project, it was decided that there would be two drop structures that would divide Bible Park into three distinctly different channel reaches.

6.1.1 Channel Reaches

The lower reach of the channel was constructed with boulder walls to protect a large area of trees that was adjacent to the channel. An island was created around the area of trees. The development of the island resulted in a new channel adjacent to the trail that connects to the below-grade crossing under Yale Avenue. The island in the lower channel reach provides for a more interesting and aesthetic experience for the park trail user. The reduced velocity and constant inundation in the widened low-flow channel upstream and downstream of the island has resulted in flourishing wetland vegetation.

The middle channel reach was the most deeply incised and linear. The middle channel reach is located in the passive area of the park. The width of the park in the middle reach was sufficient to allow for the redevelopment of a new meandering channel. The new meandering channel was designed with sweeping oxbows that would be frequently flooded to sustain wetland vegetation. Sand blankets were installed in the low-lying overbank areas on the inside of bends in an attempt to provide a direct hydraulic connection to the wetland vegetation during low-flow conditions. The low-flow channel banks for the middle reach of the channel were protected with soil riprap that was vegetated with wetland species. Over the course of time, the vegetation in the low-flow channel bank has obscured the soil riprap. A foot path constructed with crusher fines follows close to the constructed meandering channel in the middle portion of the park. The footpath allows for passive enjoyment of the tranquil meandering channel and the enhanced wildlife habitat.

The upper channel reach was not as severely incised as the middle channel reach. There were a significant number of trees in close proximity to the channel. For the most part, the existing channel alignment was maintained in the upper portion of the park. The moderately degraded channel in the upper channel reach was stabilized by the design of the upper drop with a crest elevation somewhat above the existing channel bottom. The channel bottom in the upper third of the park was allowed to fill in by natural sedimentation processes in the pool area behind the drop. There is a very large five-cell box culvert at the upstream end of Bible Park. The channel immediately downstream of the five-cell box culvert was protected from erosion using bioengineering techniques. Soil riprap was planted with wetland species that have become very prolific in this area.

6.1.2 Drop Structures

The lower drop structure has significant drop and provides an interesting overlook for park users by combining the drop with a pedestrian crossing. There are significant structural elements to the lower drop

structure. A concrete cutoff wall was integrated with the upstream edge of the trail crossing and the intermediate crests of the rock walls on the downstream face of the drop structure were stabilized with concrete walls that are hidden from view. The upper drop was constructed of boulders and was intended to provide a separation between the meandering channel portion of the park and the existing channel portion of the park. The drop structures have reduced the longitudinal slope of the channel to 0.21 percent.

6.2 Criteria

For the most part, the District criteria were followed for this project. The channel slope has been reduced to approximately 0.2 percent through the construction of grade control structures. The low-flow channel has been constructed for 100 cfs, which is approximately 3 percent of the 100-year flow of 3570 cfs. The lower drop structure is unique. There are three intermediate pools between the upper channel and the lower channel. The areas lateral to the low-flow throat of the lower drop structure have been armored with loose boulders. Subsequent to the completion of construction, the crevices between the loose boulders have become vegetated. The intermediate pools on the downstream side of the pedestrian crossing provide for an interesting sound effect that often captures the attention of the trail user. There is an interesting view of the island and the wetland area upstream of the island from the pedestrian crossing of the lower drop structure.

6.3 Construction

L&M Enterprises was the General Contractor for the rehabilitative maintenance in Bible Park. The project included substantial earthwork, structural concrete, placement of boulders and soil riprap, trail construction, and the establishment of vegetation. Getting the wetland species established was probably the biggest challenge of the project. The significant flood events that were experienced during construction and immediately after construction made it difficult to establish the wetland vegetation.

Replanting the wetland areas was necessary in the first growing season after the completion of the project.

6.4 Success

The rehabilitative maintenance project in Bible Park has been well received by the public and has attained the goals set by the sponsors and the design team. The experience of the design team and the project sponsors demonstrated that patience and perseverance are required when bioengineered solutions are employed for erosion protection in a drainageway that is subject to frequent flooding. It took approximately two years for the wetlands to become well established and provide for their intended erosion protection. Ultimately, the approach of combining armoring with bioengineered solutions resulted in a successful project. The project has stabilized the Goldsmith Gulch channel and has provided for enhanced enjoyment by the people who use the park.

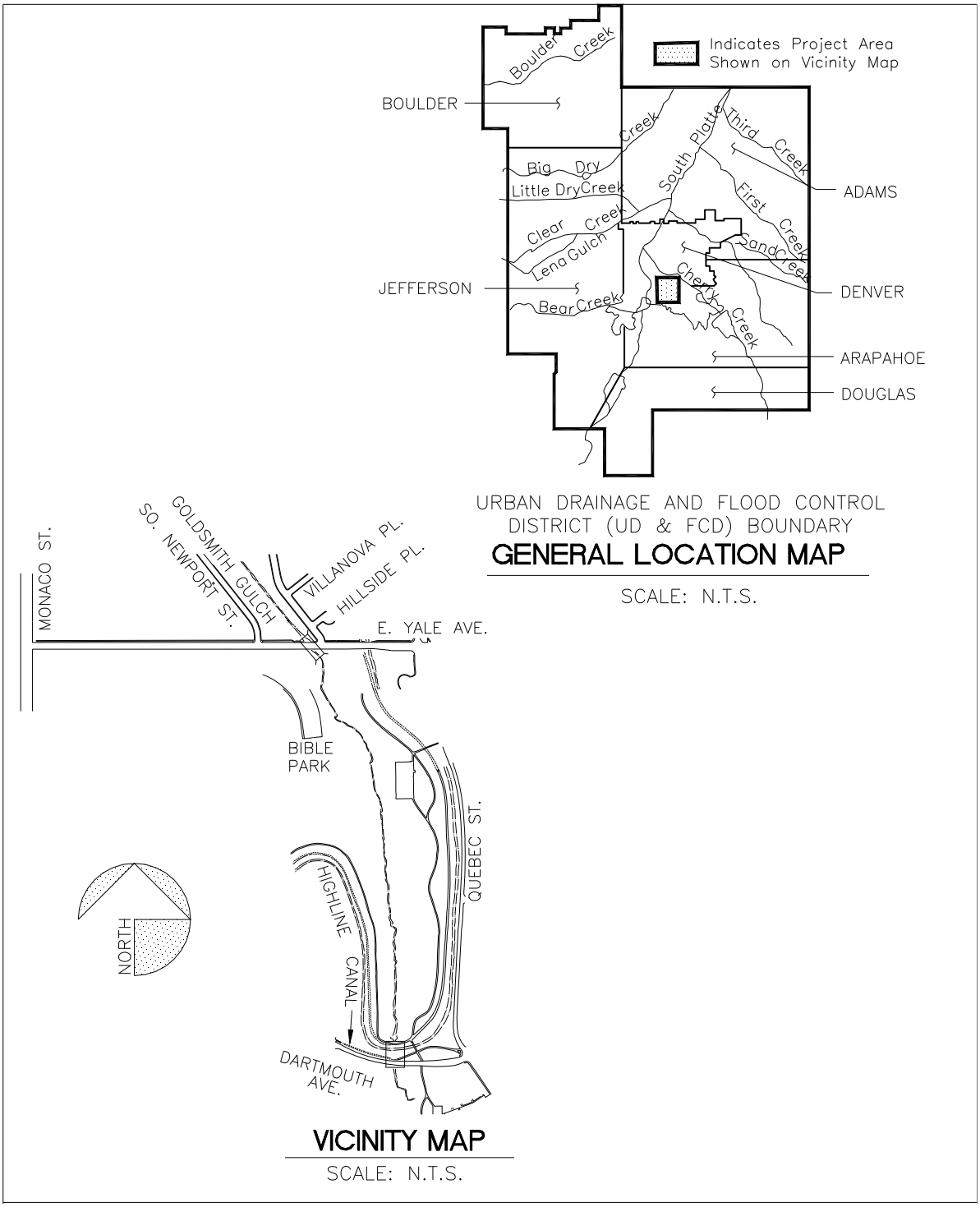

Figure 1—Location and Vicinity Map

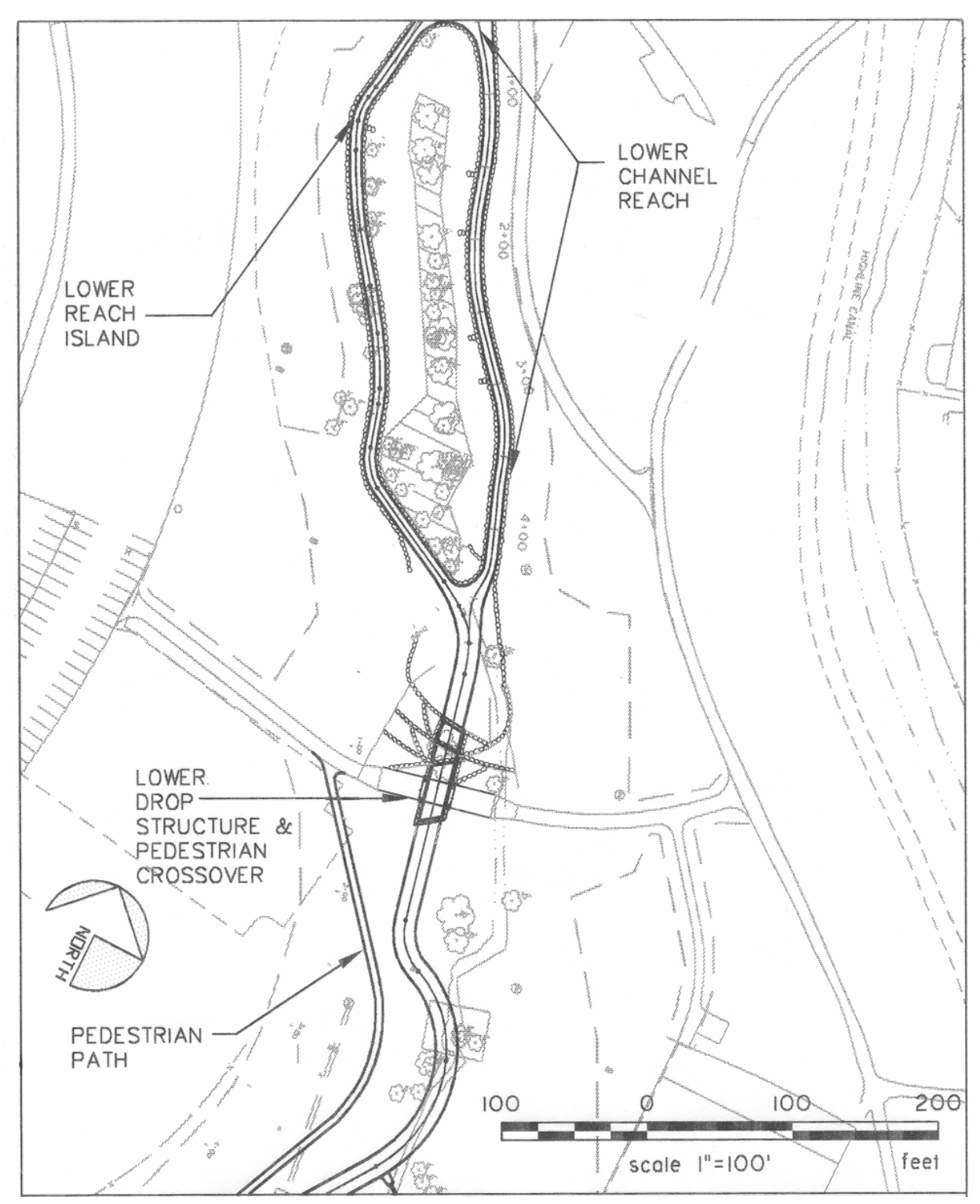

Figure 2—Lower Channel Reach

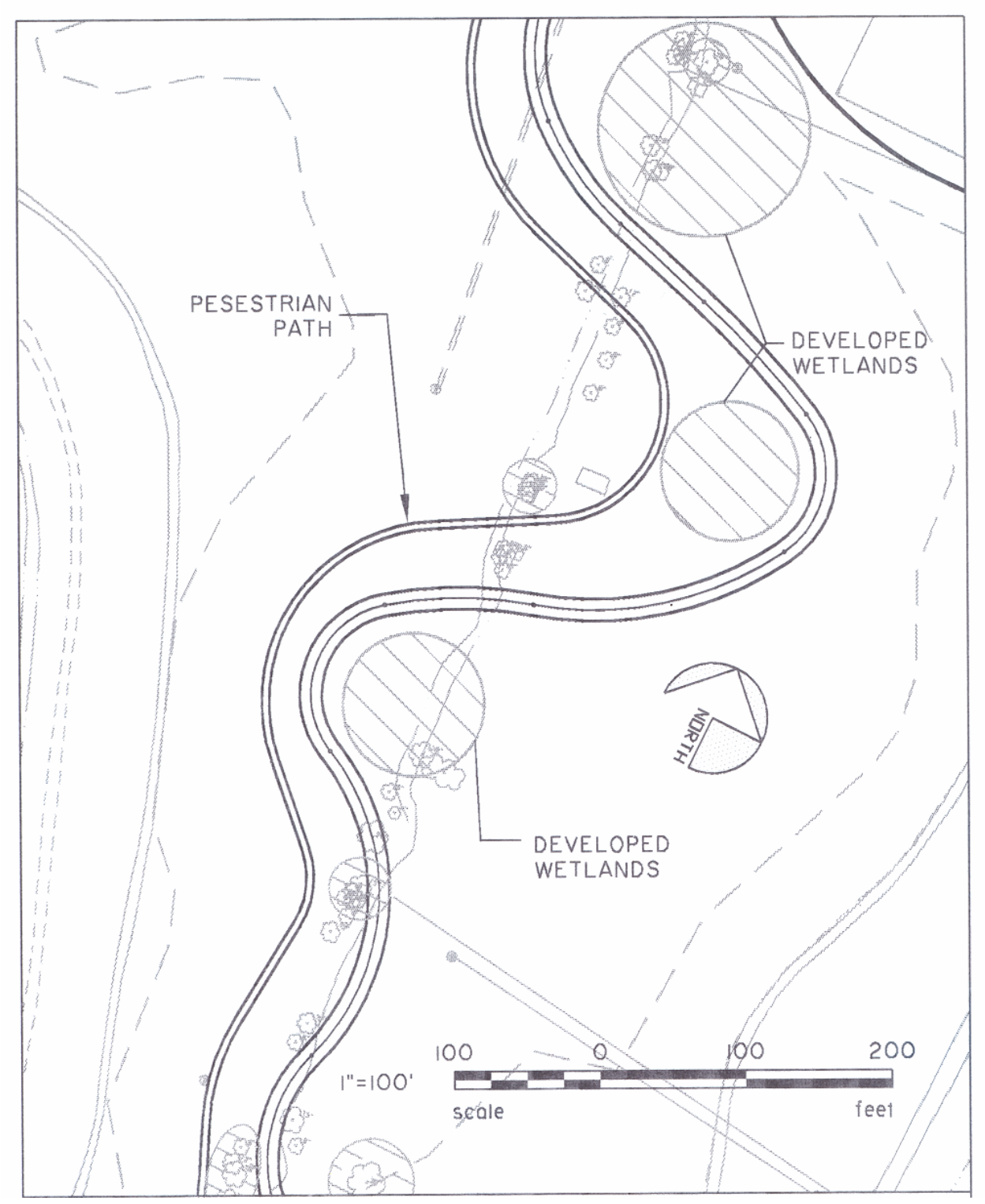

Figure 3—Middle Channel Reach

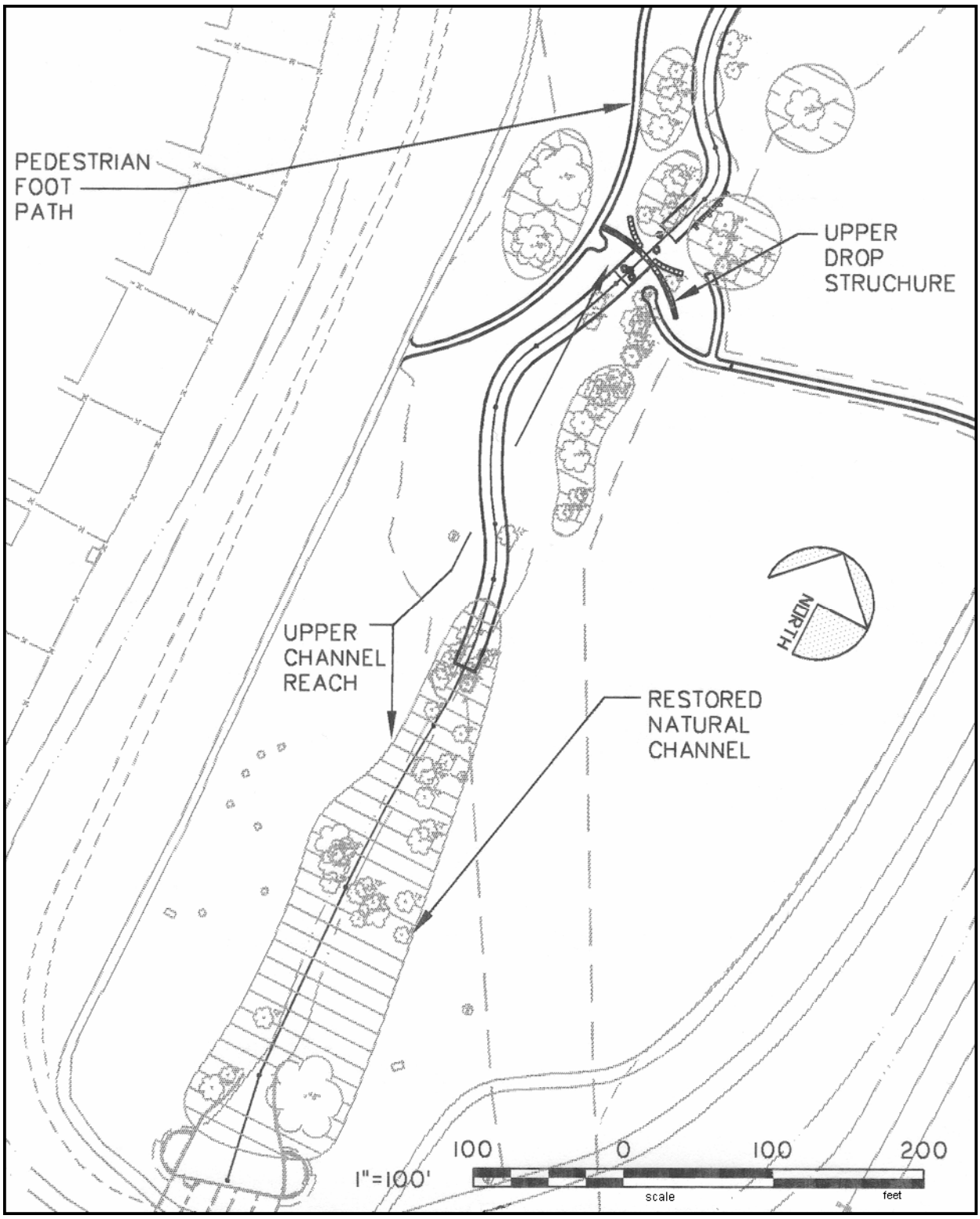

Figure 4—Upper Channel Reach

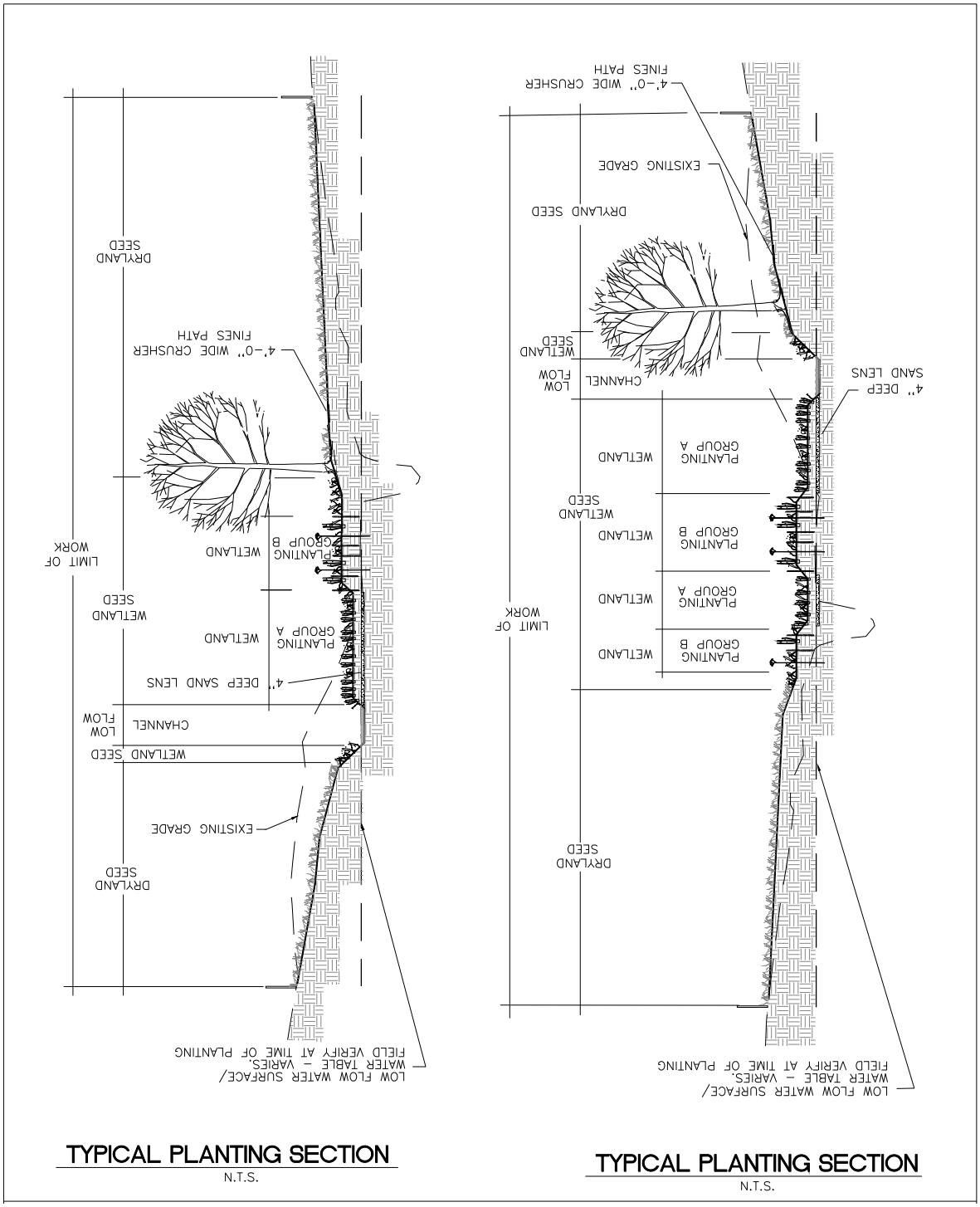

Figure 5—Typical Section for Areas of Wetland Development