DESIGN EXAMPLES—SECTION 8

CONTENTS

8.0 CASE STUDY—LENA GULCH DROP STRUCTURE

8.1 Background

Lena Gulch is a major drainageway that flows through Jefferson County in Colorado. The drainage basin area is approximately 13.9 square miles and is almost completely developed. At one point, Lena Gulch flows into and out of Maple Grove Reservoir, which serves as a water storage facility operated by the Consolidated Mutual Water Company. The water level of the reservoir is controlled by an inflatable fabridam. Downstream of the reservoir, Lena Gulch flows from a flat, wide channel into a steep, narrow dumped-concrete and sheet-pile drop structure, which was severely undercut and in danger of complete failure. Downstream of the drop structure, scour and bank erosion were endangering a home and a pedestrian bridge over Lena Gulch. Because of these safety and drainage concerns, the City of Wheat Ridge requested assistance from the District to replace this structure.

Photo 1.

The existing failing drop structure was situated on a jurisdictional boundary that required the involvement of three different local government sponsors in addition to the District, the City of Lakewood, the City of Wheat Ridge, and the Consolidated Mutual Water Company. The lower end of the drop structure and channel were situated on private property, which required the close involvement of the affected homeowner. The District needed both permanent and temporary construction easements to construct the project, so addressing their needs was critical. The project team interviewed several consultants and chose Taggart Engineering Associates to design the drop structure and channel improvements.

8.2 Design Considerations

Since there were five different participants on the project team, each with their own design considerations and concerns, the initial meetings were critical to the success of the design. Consolidated Mutual Water's concerns were the efficient transportation of water through their property and the removal of some existing ponding just upstream of the failing drop structure. The City of Lakewood, which is responsible for the trail in the area and bridge over the drop structure, was concerned about trail access during construction and placement of the bridge on a new alignment. The City of Wheat Ridge, which

represents the homeowners downstream of the drop, was primarily concerned with reducing the flood hazard to their constituents.

The District had two primary issues that needed to be addressed with the new drop structure. First was the ability of the new drop structure to funnel the 100- year flood from a wide floodplain into a deep, narrow flow. The second was the possibility of failure of the inflatable fabridam upstream at Maple Grove Reservoir. If the fabridam stayed intact during the 100-year flood, the design flow at the drop structure was approximately 1725 cfs. If the fabridam failed in the flood event, the flow downstream increased to approximately 3800 cfs. The project team believed that it was imperative that the new drop structure be designed for the 1725 cfs flow, but be able to handle the 3800 cfs in the event of fabridam failure.

In addition to the local government concerns were the concerns of the homeowners immediately downstream of the failing drop structure. They would have to grant a significant permanent easement in their backyard where the pool of the new drop structure was to be constructed. Their property had been designated as a Backyard Wildlife Habitat, and they were concerned that the disturbance caused by the project would adversely affect this habitat. In order to keep the wildlife habitat designation, the final design would have to replace food-bearing bushes and trees lost during construction, provide habitat for aquatic and terrestrial life, and improve the creek aeration. The property owner was also concerned with the aesthetic aspects of the project since the project would severely impact most of their backyard.

After reviewing several different design alternatives, a final design was chosen that addressed all of the project requirements. A four-stage drop structure was designed which alternatively funnels the water and dissipates energy with an upstream curved, grouted, stacked boulder drop, a deep grouted boulder-lined transition pool, a lower cascade drop, and a lower stilling pool (Figures 1 and 2). The resulting drop structure looked natural, but the size and location of every drop and rock in the waterway and on the banks were strategically sized and placed for flood control and habitat. Below the curved entrance, a sheet pile cutoff wall was installed, and the joints were sealed with a water sensitive expansive product.

Adjacent to the drop structure, an overflow spillway was designed to handle the additional flow in the event of failure of the fabridam. This area was shaped to direct flow back into the main channel at the stilling basin. The spillway was lined with boulders and riprap to prevent scour and vegetated with trees and shrubs.

In addition to the structural components of the drop structure, a number of innovative planting techniques were used to soften the appearance of the rock and provide the required habitat. Adjacent to the main pools of the drop, planted grouted boulders were used (Figure 3). The boulders in these areas were only grouted halfway up the rock's depth, and the remaining depth between the boulders was filled with soil and then planted with native material. Above the main pool areas along the bank, planted riprap was used to provide additional energy dissipation and help anchor the riprap. Below the stilling basin area, a

variety of plants were selected and installed along the water's edge to provide a food source for the birds and cover for the fish. In addition, a number of trees were planted to provide additional habitat and screening for the affected property owner.

8.3 Construction

L & M Enterprises was awarded the contract for construction of this project. Because of the tight site constraints, coordination with the local governments and the affected homeowner was critical. The contractor was required to provide temporary trail access across the drainageway as much as possible during construction. This was accomplished by constructing a temporary channel crossing upstream of the project area and diverting users along the new alignment. Another challenge during construction was effectively handling the constant base flow of the gulch and the occasional storm event, which severely tested the water control. In addition, L & M worked closely with the homeowner to minimize the impacts during construction and allow as much use of the property as possible.

Construction began in the fall of 1997 and was completed in early 1998. The plant material was installed shortly after construction was completed, but before the wet spring season. The homeowners were happy with the appearance and function of the new drop structure. They took real ownership of the completed project and provided all irrigation and maintenance of the newly installed plants, shrubs, and trees. Since the project has been completed, they have installed additional landscaping and plantings to further enhance their backyard habitat.

Photo 2

8.4 Conclusion

The Lena Gulch Drop Structure Project is a real success story. The project started as a complicated design with multiple concerns to address, and finished as an award-winning project with which all project participants are very pleased. It has been several years since the project has been completed, and in that time, it has seen numerous storm events. The drop structure has functioned well, and the revegetation has been established and is thriving (Photos 1 & 2). The homeowner was able to keep the Backyard Wildlife Habitat designation and noted that several species of fish have moved into the pools below the drop structure.

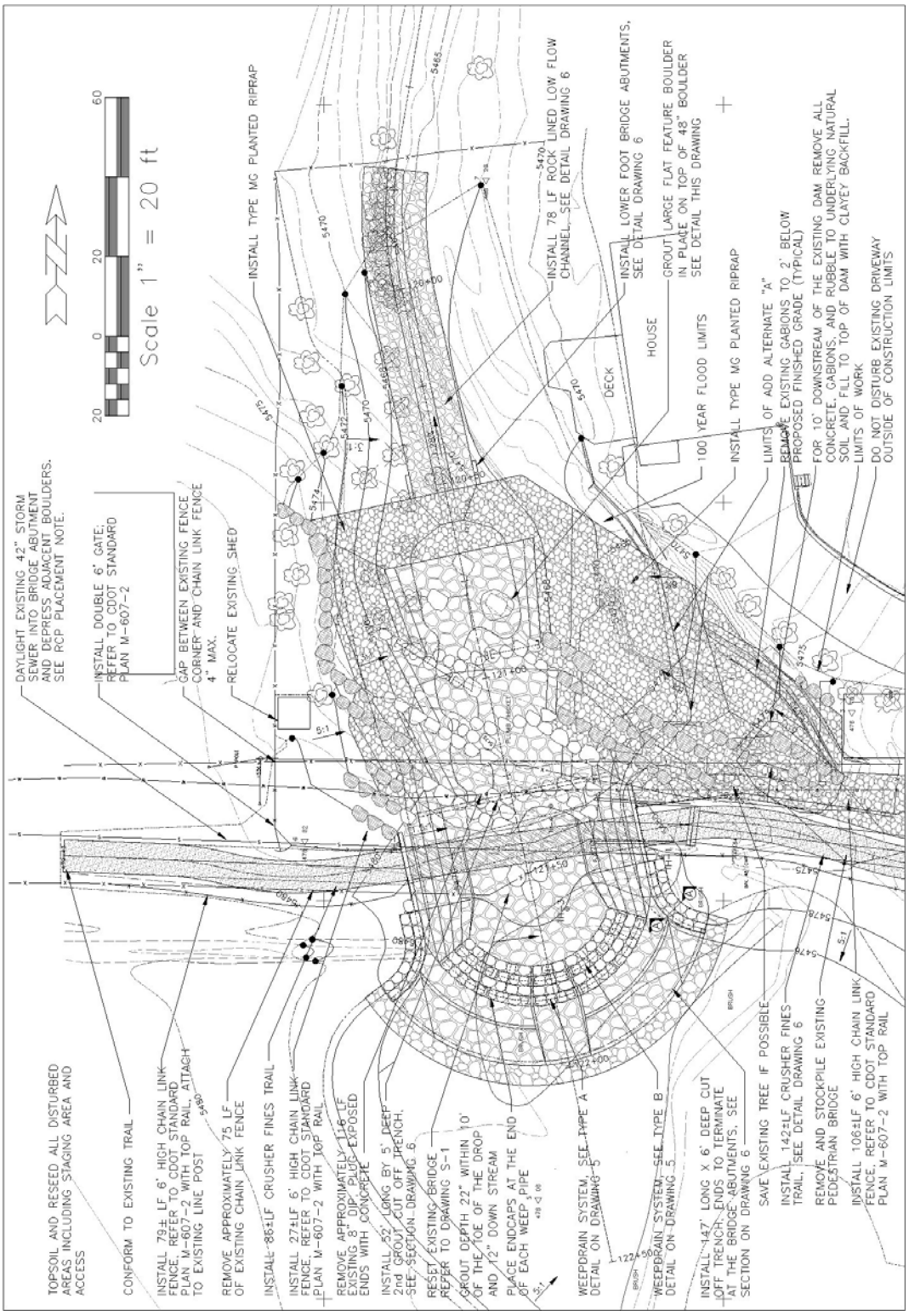

Figure 1—Plan

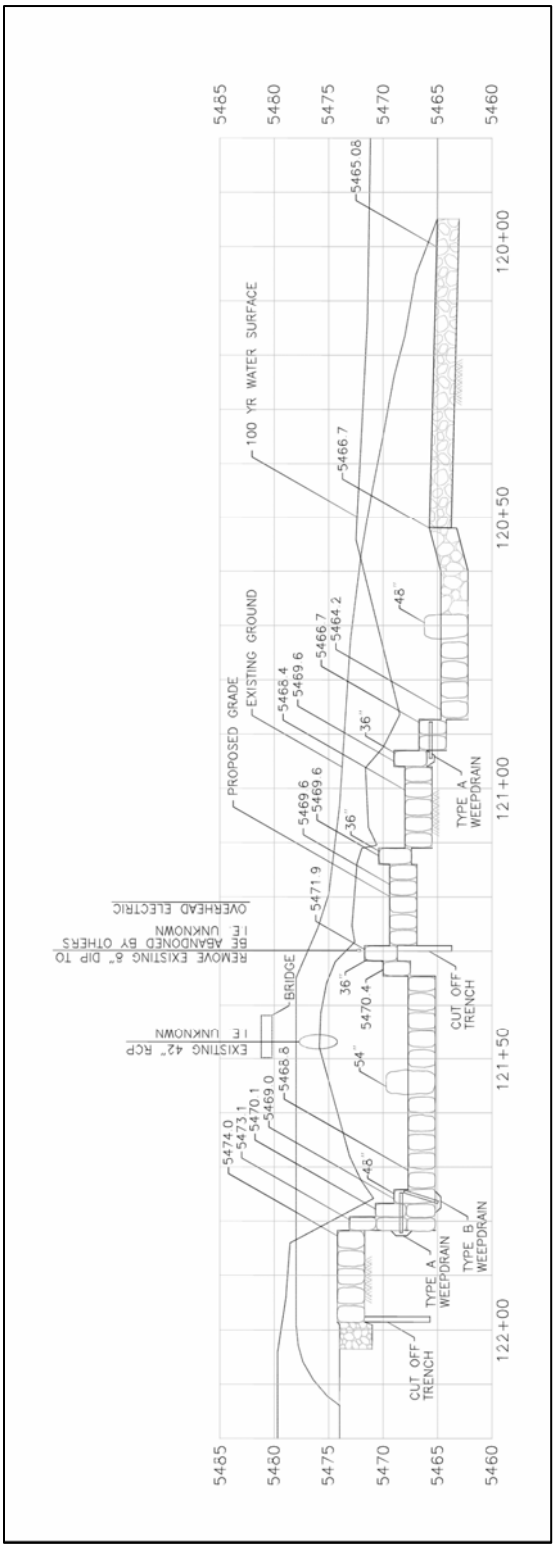

Figure 2—Profile

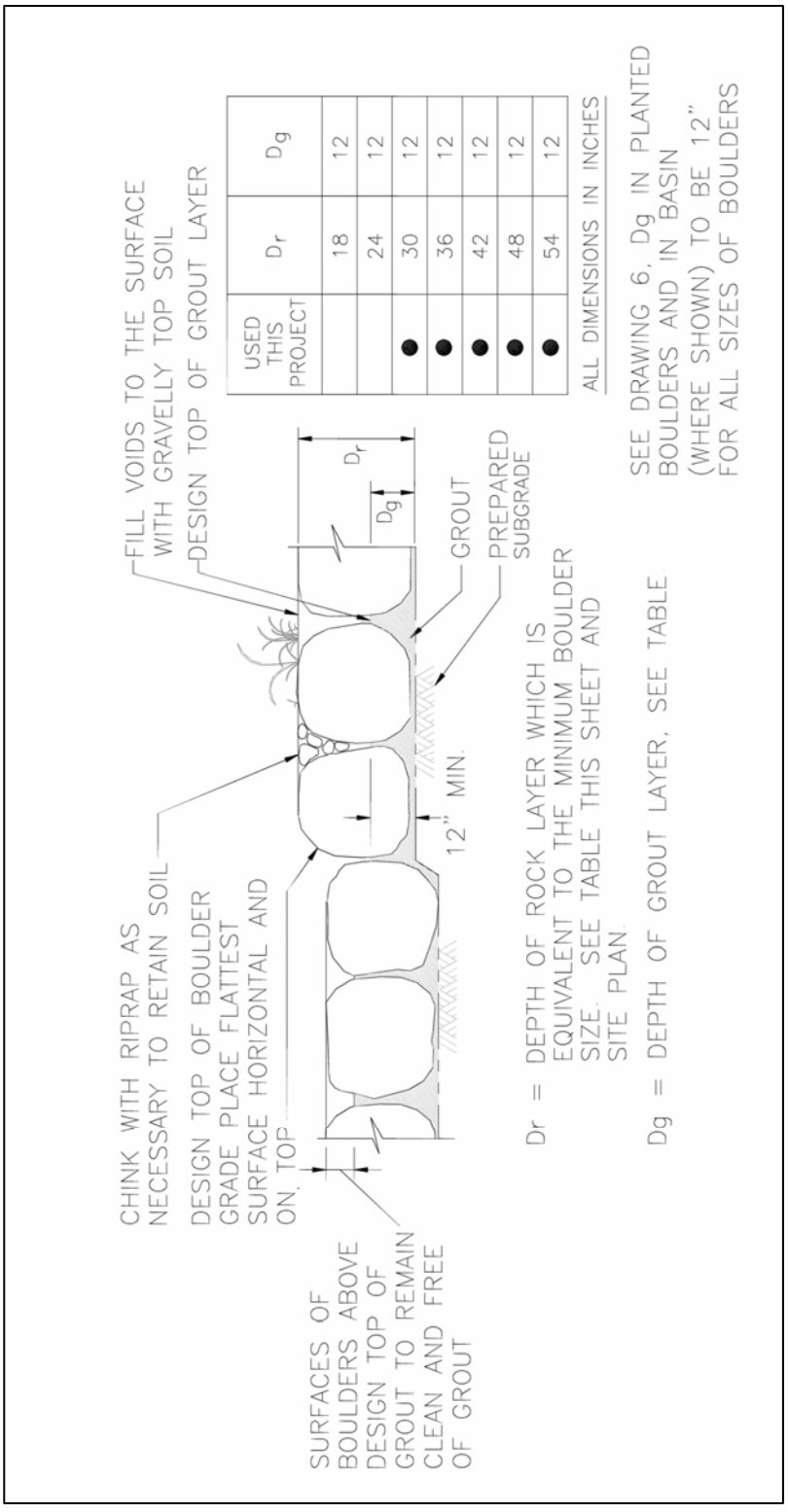

Figure 3—Planted Grouted Boulders