Horn Lake Creek Stabilization Plan

Appendix C. Memphis Metropolitan Stormwater – North DeSoto Count Feasibility Study

One of the primary goals of this project is to minimize channel degradation, channel erosion, and sedimentation to support aquatic ecosystem form and function. This assessment addresses the channel stabilization, erosion control and sedimentation aspects of these goals. The preliminary field investigations along Horn Lake Creek suggest that the long-term stability of the creek is a directly dependent on the continued functionality of the existing grade control structures along the channel. Figure 1 is a 2016 Lidar profile of Horn Lake Creek. As shown in Figure 1, the Horn Lake Creek profile is controlled by numerous grade control type structures. Most of these structures are components of bridges and culverts along the stream, while there are few that appear to be associated with pipeline crossings. While these structures are currently controlling the grade of the channel system, many of these appear to have been designed without adequate regard for engineering and geomorphic considerations. As a result, many are endanger of failure, which could be catastrophic to the geomorphic and environmental character of the channel system. Therefore, the primary recommendations for Horn Lake Creek should include rehabilitation or replacement of these existing structures. Stabilization of meanders that could endanger these structures should also be an important feature of the Horn Lake Creek Plan. Unless otherwise stipulated, all grade control structures described herein will be assumed to be sloping riprap structures, and bank stabilization structures will be assumed to longitudinal stone toe protection with tiebacks.

The following is a brief description of the recommended structures. The location of all structures is shown in the attached kmz file. A total of 5 new structures and the rehabilitation of 9 structures is proposed, as well as about 20,000 feet of bank stabilization. A summary of these structures is shown in Table 1.

NOTE: This effort only extends up to the Hwy 302 bridge. As we get additional Lidar we can move further upstream if needed.

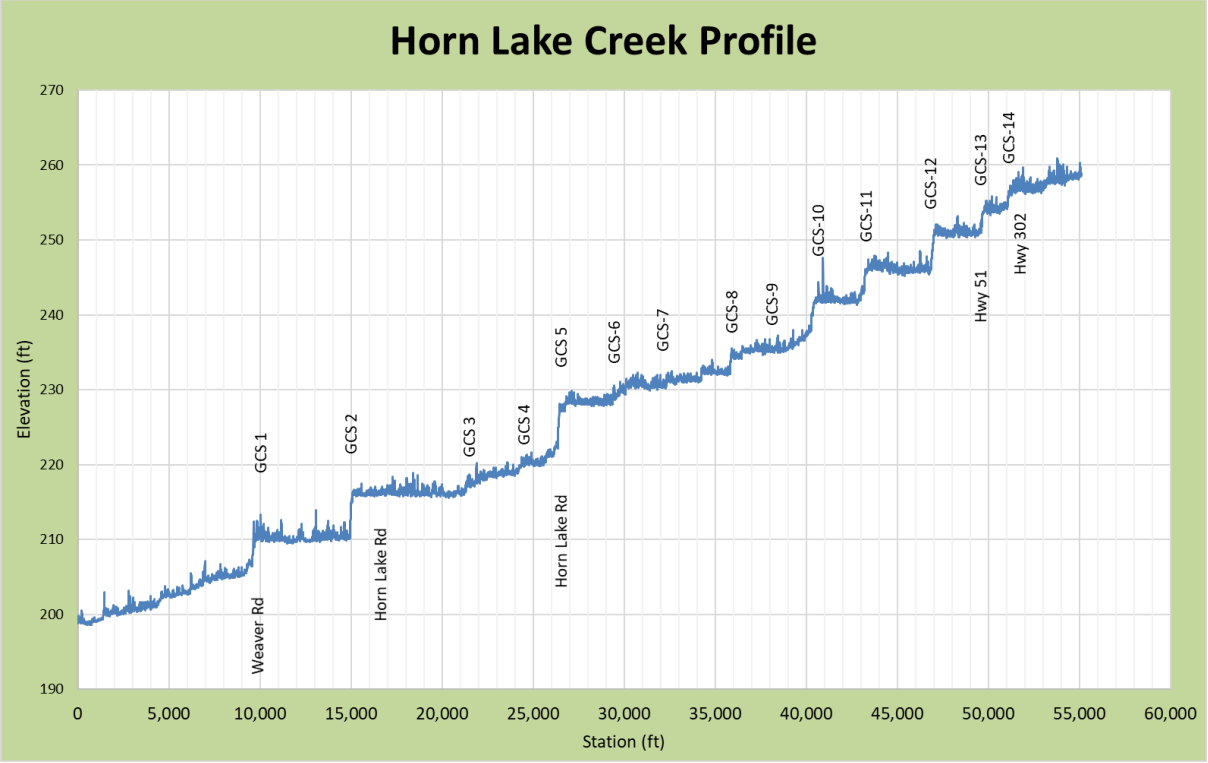

Figure 1. Horn Lake Creek LiDAR Profile with grade control locations

GCS-1 (Weaver Rd). Google Earth imagery indicates that there is a riprap structure through the bridge section (Figure 2). As shown in Figure 1, there is about a 4 to 6 foot drop through this structure. Although no field investigation was conducted here, it appears that a large scour hole has developed downstream of the structure (Figure 2). Consideration should be given to providing protection of this scour hole. Although no direct observations are available for the riprap structure itself, it is likely, based on inspections of similar structures in the system that repairs would be needed.

Figure 2. GCS-1 at Weaver Road

GCS-2 (Downstream of Stateline Rd). There is an existing riprap structure about 2,000 feet downstream of the Stateline Road. According to Figure 1, there is about 6 to 7 feet of drop at this structure. Unfortunately, there is severe erosion both upstream and downstream that is threatening to flank this structure (Figure 3). Failure of this structure would significantly destabilize the upstream channel system. Therefore, this structure needs to be repaired or probably replaced entirely. For this assessment it will be assumed that the structure should be replaced with a new structure. The final location of the proposed grade control structure is not known at this time, but, regardless of the location, it is likely that several of the actively migrating meander bends in this reach will need to be stabilized as part of the rehabilitation effort. Approximately 2,000 feet of bank stabilization is estimated for this site.

Figure 3. GCS-2 downstream of Stateline Road.

GCS-3, 4, and 5. There is a sloping riprap grade control structure under the Horn Lake Rd bridge with a huge scour hole downstream. This will be designated GCS-5. While there is some riprap along this scour hole, this structure need to be extended by about 150 to 200 feet downstream. Additional stone may also be needed along the sloping rock structure itself.

There is also another sloping rock type structure about 200 feet upstream of the bridge. There is a huge unprotected scour hole downstream of this structure. This scour hole need to be stabilized to ensure the integrity of the road. The existing sloping rock structure also appears to be in danger of being flanked. Therefore, this structure needs to be repaired, or replaced. For this assessment it will be assumed that the structure should be replaced with a new structure, which will be called GCS-5a. Additionally, about 800 feet of bank stabilization may be required upstream of the structure to ensure its integrity.

According to Google Earth imagery, there are no existing structures between GCS-2 and GCS-5. However, according to the Lidar survey there does appear to be a somewhat oversteepened zones in this reach which could be degradational. Inspection of Google Earth imagery revealed that there are numerous areas with significant bank instability. For this reason, two additional grade control structures (GCS-3 and GCS-4) are recommended in order to provide stability for this reach, and to help protect GCS-6. The drop heights at these two structures will likely be in the 3 foot range. A more detailed field and geomorphic assessment will be required to site GCS-3 and GCS-4, but approximate locations of these structures, as well as for GCS-5 are shown in Figure 3. Approximately 3,000 feet of bank stabilization may be required as part of the GCS-3 and GCS-4 efforts.

Figure 3. GCS- 3, 4, and 5

GCS-6, 7 and 8. There is an existing rock structure at the GCS-8 site that is holding about 2 to 3 feet of grade. It is not clear as to the exact function of this structure, but it may be a low water crossing built by locals. There is considerable bank erosion both upstream and downstream of this structure that needs to be stabilized in order to prevent the total loss of this structure. This structure needs to be rehabilitated, or more likely completely replaced with an engineered grade control structure. For this assessment it will be assumed that the structure should be replaced with a new structure. Approximately 2,200 feet of bank stabilization will be required to protect this structure.

According to Google Earth imagery, there are no existing structures between GCS-5 and GCS-8. However, according to the Lidar survey there does appear to be some oversteepened zones in this reach which could be degradational. Additionally, close inspection of Google Earth imagery revealed what appeared to be clay outcrops in this reach. For this reason, two additional grade control structures (GCS-6 and GCS-7) are recommended in order to provide stability for this reach, and to help protect GCS-8. The drop heights at these two structures will likely be in the 3 foot range. A more detailed field and geomorphic assessment will be required to site GCS-6 and GCS-7, but approximate locations of these structures, as well as for GCS-8 are shown in Figure 4. Approximately 3,000 feet of bank stabilization may be required as part of the GCS-6 and GCS-7 efforts.

Figure 4. Approximate locations of GCS- 6, 7, and 8.

GCS-9, and 10. There is an existing rock structure at GCS-10. According to the Lidar profile, there is approximately 4 to 5 feet of drop at this structure. The purpose of this structure is not known, but it appears to be crossing location. There is considerable erosion both upstream and downstream of this structure and there is some potential for this structure to be flanked. For this reason, this structure needs rehabilitated or possible replaced. For this assessment it will be assumed that the structure should be replaced with a new structure. Approximately 2,500 feet of bank stabilization will be required at this site.

Immediately downstream of GCS-10, there appears to be a very steep zone on the Lidar profile, and what appeared to be clay was observed in the bed on Google Earth imagery. For this reason, an additional structure is proposed downstream at GCS-9. The drop height for this structure will likely be in the 3 foot range. The exact location for GCS-9 will require additional studies, but the approximate location is shown in Figure 5, along with GCS-10. Approximately 1,200 feet of bank stabilization will be required in the vicinity of GCS-9.

GCS-11. GCS-11 is located at a railroad crossing about 3,000 feet upstream of GCS-10. (Figure 5). There appears to be a 4 to 5 feet of drop at this structure (Figure 1). Although this site was not inspected as part of the field investigations, it is assumed that some rehabilitation and reinforcement of this structure will be required. An estimated 1,000 feet of bank stabilization may also be required here to protect the integrity of the structure.

Figure 5. Approximate locations of GCS-9, 10, and 11.

GCS-12. There is an existing rock structure at this site (Figure 6). The purpose of this structure is not known, but may be some sort of low water crossing. This structure appears to be in danger of failing, and there is bank erosion both upstream and downstream of the structure. This structure will need to rehabilitated or more likely replaced. For this assessment it will be assumed that the structure should be replaced with a new structure. An estimated 1,500 feet of bank stabilization may also be required here.

Figure 6. GCS-12

GCS-13. There is an existing sloping rock structure at the Hwy 51 bridge with a drop of about 4 feet (Figure 7). There is a large scour hole downstream of the structure that has recently been protected with a longitudinal stone toe and tiebacks. This structure appears to be relatively stable at this time, but a more detailed inspection of the structure may reveal the need for some additional repair work. Additionally, there are some bank erosion sites in this area, including some erosion that appears to be endangering some commercial buildings. that may require stabilization. An estimate of 1,000 feet of bank stabilization will be required.

Figure 7. GCS-13.

GCS-14. There is an existing sloping rock structure at the Hwy 302 bridge with a drop of about 4 feet (Figure 8). Since there was no visual inspection at this site, the integrity of the structure is not known, but it is assumed that some repair will be needed. Additionally, there is a large scour hole downstream of the structure that will need to be stabilized. There also appears to be some bank erosion along the stream both upstream and downstream of the bridge that may be endangering numerous commercial buildings. Approximately 1,500 feet of bank stabilization may be required here in addition to the repairs at the structure.

Figure 8. GCS-14.

Table 1. Summary of grade control and bank stabilization for Horn lake Creek

Grade Control Site	Type of Construction	Linear feet of bank stabilization
GCS-1	Rehab existing structure	0
GCS-2	Replace existing structure	2,000
GCS-3	**New Structure**	1500
GCS-4	**New Structure**	1500
GCS-5	Rehab existing structure	200
GCS-5a	Replace existing structure	800
GCS-6	**New Structure**	1,500
GCS-7	**New Structure**	1,500
GCS-8	Replace existing structure	2,200
GCS-9	**New Structure**	1,200
GCS-10	Replace existing structure	2,500
GCS-11	Rehab existing structure	1,000
GCS-12	Replace existing structure	1,500
GCS-13	Minor rehab of existing structure	1,000
GCS-14	Rehab existing structure	1,500
Total		19,900