Office of Structures
Chapter 14: Stream Morphology and Channel Crossings

Appendix C
Example of a Preliminary Stream Morphology Report

Note: Some of the field methods, analytical methods, and reporting guidelines in Chapter 14 have been modified since this example was submitted to OBD. Where differences occur, the manual guidance supersedes the example. The example is intended only to provide an indication of the length, detail, and general organization of a preliminary study letter report.

September 2007

Crossing of Catoctin Creek at MD 464 (Structure 10091)

Preliminary Stream Morphology Report

Prepared For:

SHA

Maryland State Highway Administration
Structure Hydrology and Hydraulics Unit
Bridge Design Division
707 North Calvert Street
Baltimore, Maryland 21202

Prepared By:

LandStudies

315 North Street
Lititz, Pa 17543
(717)-627-4440

www.landstudies.com

AUGUST 2007

August 29, 2007

Mr. Andrzej J. Kosicki, M.S., P.E.
Maryland State Highway Administration
Bridge Design Division
707 N. Calvert St.
Baltimore, MD 21202

RE: Preliminary Stream Morphology Report, Bridge 10091, MD Route 464 over Catoctin Creek

Dear Andy,

What follows is our preliminary stream morphology report for Bridge 10091. Based on the information obtained from the visual assessment, I recommend that further studies and assessments be undertaken. Detailed information concerning the visual assessment is included in Attachment A; photo documentation of the visual assessment is included in Attachment B.

The study site is located in Bells Mill, about 12 miles southwest of Frederick, at the MD Route 464 crossing of Catoctin Creek in Frederick County, Maryland (see Attachment A, Figures 1, Vicinity Map, and 1A, Location Map). This bridge, built in 1933, is to be replaced because it is nearing the end of its design life. In general, Catoctin Creek flows north to south. The bridge crossing is about 2.5 miles downstream of MD Route 340, about 3,000 feet upstream of an unnamed tributary, about two miles upstream of Boss Arnold Road, and about 3 miles upstream of Catoctin Creek's confluence with the Potomac River. The drainage area is approximately 113 square miles.

The MD Route 464 bridge crossing and the entire associated watershed are located within the Blue Ridge Province (see Attachment A, Figure 2, Physiographic Provinces and Their Subdivisions in Maryland). The stream flow is perennial, driven by rainfall and occasionally by snowmelt. The largest floods in the region are driven by rain or snow events, hurricanes, and tropical storms. Bankfull flows may occur as a result of a variety of rain events including rain or snow, frontal storm events, and tropical storms.

Catoctin Creek powered many mills within the watershed in the 18th, 19th, and 20th centuries. As observed in the field assessment, the banks along the Catoctin Creek consist mostly of fine, laminated sediments (Photo 70), consistent with mill dam deposits, that are now being eroded. The linear pattern of the Creek shown in the 1808 Map of Frederick County differs significantly from its current path. There appears to be significant relocation of the Creek, with the majority of its length located along the east and west valley walls (Photo 109). This relocation possibly occurred as a result of the construction of the mill dams and/or roads.   Bore or blast holes were found in the bedrock downstream of the bridge (Photo 37). The bank sediments represent mill pond or dam sediments. The stream is currently going through vertical degradation and, in some locations, severe lateral movement. Using Rosgen Stream Classification and based on the thick, high banks of fine laminated sediments (mill pond sediments) and the low, recent depositional features (Photo 121), the stream is classified as an F-4 channel type.

The purpose of this preliminary study is to evaluate the existing channel morphology and the interaction of the channel with the existing MD Route 464 bridge, and to determine the scope of additional studies, if need

SUMMARY OF GENERAL FINDINGS

The existing stream channel was found to be degraded, unstable, and undergoing significant change. Effects of past channel straightening, damming, and relocation efforts have contributed to past and current channel degradation. The stream is moving laterally away from its previously straightened alignment. There is evidence of the potential for long-term channel degradation and abutment scour. In addition, a number of other problems are present at the existing bridge including lateral channel movement and bar development, aggradation and deposition within the bridge spans (Photo 83), pier scour, backwater flooding and flow obstructions (Photos 67 and 101), tributary confluence at the bridge, and debris accumulation. Of particular importance are two bends that form an offset (i.e. abruptly bending out of line) channel reach within 1,000 feet of the crossing (Photos 59 and 133). Based on the vegetation, the movement is recent.

The old bridge plans, dated 1933, show a stone mill dam (Photo 96) extending from the west hillside to a land feature between the easternmost pier (Pier D) and the east abutment of the proposed bridge. That land feature has since eroded away, leaving the two retaining walls that tied the concrete gates to Pier D and the east abutment. The mill race went over concrete gates along the east abutment to the mill building (Photo 56) approximately 1,000 feet downstream. Portions of the retaining wall have collapsed, as have the concrete gates. The remnants are located immediately upstream of Pier D (Photo 91). Scour around the existing crossing is primarily due to the partial breach of the stone mill dam. This partial breach occurred on the left side, while the remaining 60 to 70 percent of the stone mill dam encroaches on the west side of the channel, redirecting low and moderate flows (flows up to 6 feet) to the extreme left of the channel. Pier D is placed directly in the center of the opening in the stone mill dam, causing a substantial amount of scour around the pier. Grout bags have been placed around Pier D and a scour pool 4 feet deep currently exists Photo 89). There is a scour hole more than 5.5 feet deep at the old bridge abutment downstream (Photo 69).

Existing conditions of the channel in the vicinity of the bridge are exacerbated by the mill dam. However, because of the height of and erosive soils in the banks and the existing location of the channel, the greatest threat to the structure will be from lateral movement of the channel to the east. The channel will continue to move east, in the direction of the east abutment, or Abutment E. Over time, this lateral movement may increase scour or encroach on the roadway embankment or bridge substructure units.

There are some signs of pier scour within the deposition at Piers B and C (Photo 83). This is likely due to the steep gradient of the high flows overtopping the 6-foot-high dam. It is difficult to determine the actual scour depths because fine material surrounds the piers to an unknown depth. Farther downstream on the left bank is an old abutment from the previous bridge that has never been removed. A scour hole around the abutment has formed to a depth of more than 5.5 feet. This, too, is caused by the location of the breach in the dam and by flows being directed through the existing bridge to the old bridge abutment.

RECOMMENDATIONS

Based on the assessment of the morphological processes summarized above and the information presented in Attachments A and B, additional studies and evaluations are recommended to provide greater detail and accuracy in determining:

1. Long term degradation;
2. Lateral channel movement, particularly in the vicinity of the replacement structure;
3. Measurements and observations of floodplain soils and channel bed load materials for the purpose of scour evaluation and analysis;
4. The removal of flow obstructions immediately upstream and downstream of the bridge that may reduce conveyance, cause deposition, or increase the risk of scour at the crossing.

I will be pleased to meet with you at your convenience to discuss the findings of this preliminary stream morphology report and to make arrangements for conducting the recommended studies and evaluations.

Sincerely,

Ward Oberholtzer, P.E.
Vice President