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RESEARCH SUMMARY

LONG-TERM BED DEGRADATION IN WESTERN MARYLAND STREAMS

Problem

Estimation of potential long-term down-cutting of the stream bed is necessary for evaluation and design of bridges for scour and culverts for fish passage. Existing guidelines for assessing this potential long-term bed degradation (LTBD) in Maryland streams require expertise that may not be available and/or field studies that, depending on the project budgets, may be cost prohibitive, especially for replacement of county structures. The morphological techniques recommended by these guidelines also lack verification data and may lead to overly conservative estimates, unnecessarily large foundation depths, and consequently, significantly higher costs.

Objectives

The purpose of this study was to improve predictions of long-term bed degradation in Maryland streams through the measurement and analysis of stream bed and waterway structure survey data and bridge plans.

Description

The study was conducted in three western Maryland counties: Garret, Allegany and Washington. These three counties contain all of the Maryland portion of the Appalachian Plateau and the Ridge and Valley physiographic provinces and a portion of the Blue Ridge province. A total of 26 sites—15 bridges, 9 culverts, 1 utility crossing, and 1 concrete ford—were selected for data collection. Drainage areas of these sites ranged from 1.5-55 mi^2. At 18 of the sites, LTBD was rapidly estimated using a pocket rod and hand level. At the 8 other sites, more detailed surveys were conducted using a theodolite and an electronic distance meter.

Results

The possibility of developing regional relations between watershed area and LTBD was evaluated for each physiographic province. Data for the Appalachian Plateau and the Ridge and Valley provinces, however, did not indicate strong trends in the variation of LTBD with watershed area, and the data from the Blue Ridge province was inadequate to draw any conclusions. Therefore, the development of regional relations was not pursued. Instead, equations based on risk factors were developed.

Six factors that may influence a site's risk of LTBD in the three western Maryland provinces were identified. These include (1) the valley slope, (2) the effective valley width, (3) discharge, (4) bed material size, (5) downstream channel entrenchment, and (6) downstream grade controls. Three relations between LTBD and these factors were examined: LTBD and valley slope; LTBD and an index combining Factors 1-3; and LTBD and an index combining Factors 1-4.

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A comparison of the resulting equations revealed that valley slope was as good a predictor of the susceptibility of a site to LTBD as the two indices that required additional data and considered more parameters. The relation between valley slope and LTBD was recommended to estimate LTBD for streams with slopes of less than 0.027 ft/ft.

The development of rate relationships between LTBD and the age of the structure was also considered. The analysis of data indicated only a weak correlation between LTBD and the age of the structure; however, the data was insufficient to develop a rate relation.

Additional field data would be required to develop parameters and indices that would capture the influence of Factors 5 and 6. Future research on LTBD in Maryland should include some measure of channel entrenchment and the effectiveness of downstream bed controls in limiting degradation. The development of a rate relation should be explored further in future phases of this research.

Report Information

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