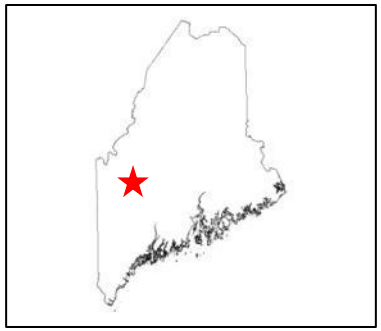
Geologic Site of the Month

February, 2001

Engineered Solutions to Stream Bank Erosion: A Case Study



44 53‘ 15.04“ N, 70 31‘ 54.23“ W

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Introduction

Streams and their flood plains are dynamic geologic systems. Ever-changing patterns of erosion and deposition occur during the evolution of a river, especially when it begins to meander and shift its course across the cut bank of the bend, while deposition of sediment builds point bars on the inside of the meander (Figure 1). The shifting of meander paths occurs at varying rates, but it is generally most rapid during periods of high water. Erosion of the cut bank may attain a magnitude of centimeters or even meters per day, and streams occasionally shorten their courses dramatically by cutting across the necks of meanders. Therefore, it is unwise to build homes on surficial materials close to an active stream meander, even though the building sites may be higher than the flood plain.

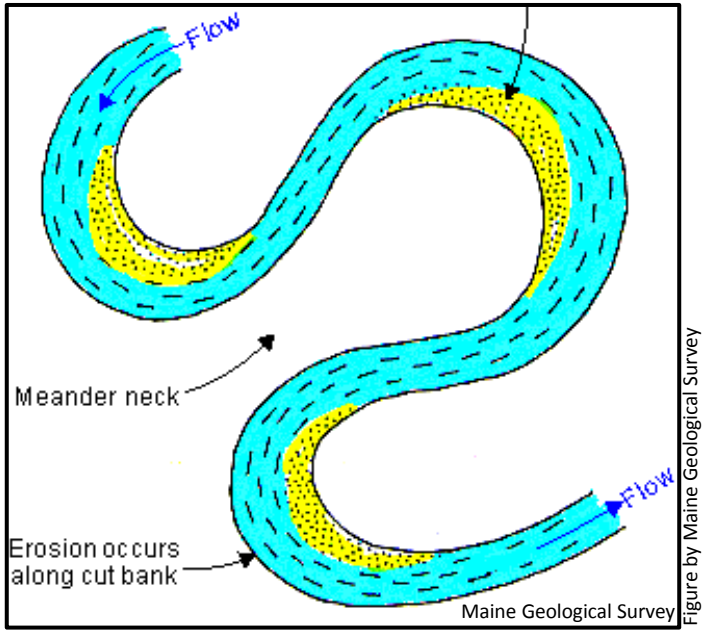

Figure 1. Plan view of stream meanders showing zones of erosion and deposition.

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In October 1998, the Maine Geological Survey (MGS) was asked by the Maine Department of Environmental Protection (MDEP) to provide written comment on a proposal to excavate approximately 19,000 cubic yards of sand and gravel from three point bars in an attempt to lessen erosion along the adjacent cut banks of a river in Maine (Figure 2).

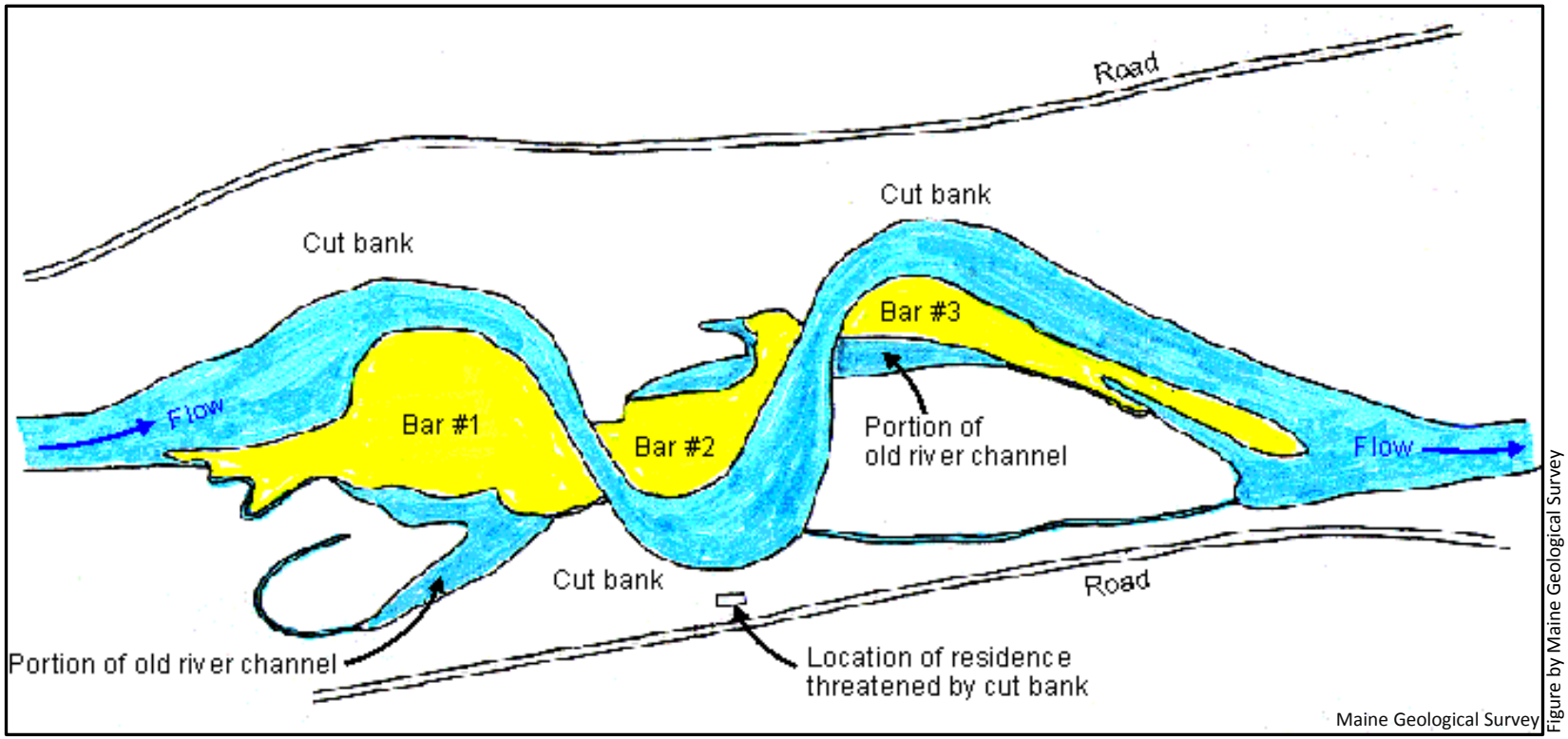

Figure 2. Locations of gravel bars proposed to be excavated in Maine DEP permit application.

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A factor which made this proposal of particular importance was the fact that a home was situated adjacent to a cut bank and the home appeared in imminent danger of falling into the river. The original proposal called for excavation down to the low water level. The theory behind this proposal was that the cross-sectional area of the river channel would effectively be increased during periods of high flow in the areas of the excavations. While this approach would lessen erosion on the cut banks, the applicant would be faced with having to return to the MDEP after a few years with new requests for gravel removal since the river would quickly replace the excavated material. In other words, the proposed "fix" was not likely long-term in nature. Another problem that we saw with this proposal was the fact that material would be removed from the river system and there was no easy way of quantifying actual long-term impact.

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In preparing our comments, we decided to include an alternative to what was proposed. Essentially, we proposed that the applicant leave gravel bar #1 intact. At gravel bar #2, we proposed that a channel partly in the footprint of an older river channel be dredged (Refer to Figure 3) down to the level of the thalweg (deepest part of the river channel) starting at location A on Figure 3.

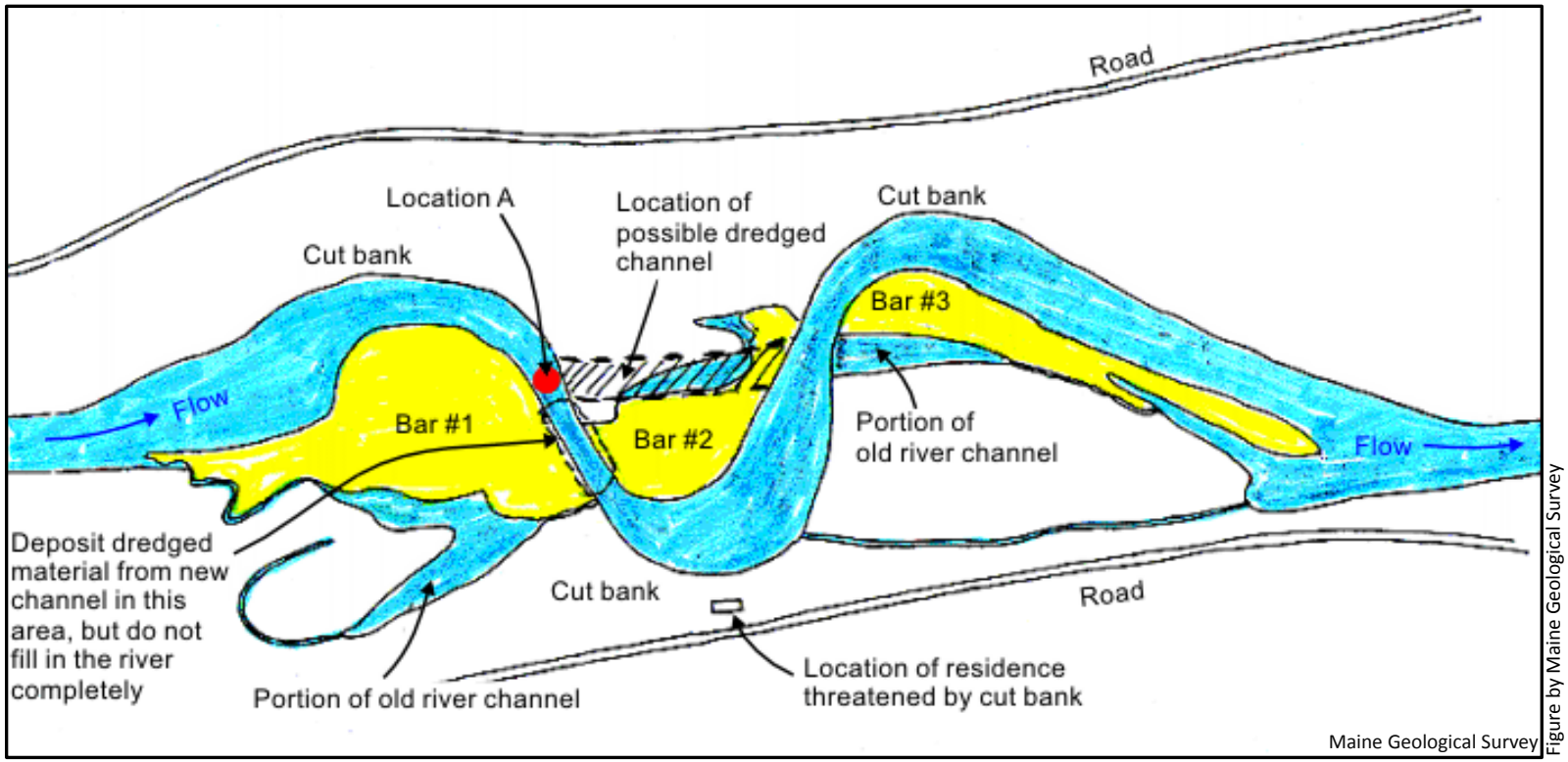

Figure 3. Location of possible dredged channel.

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All or a portion of the dredgings from the channel would then be placed just downstream of location A so as to make the river more shallow. It was our intent that the river would choose this new route and that the channel near the residence would evolve into an oxbow. The effect would also be a decrease in the amplitude of the river meandering. This amplitude decrease would result in a decrease in the energy exerted upon the bank opposite gravel bar #3. We also stated that some gravel could be removed from the upstream portion of gravel bar #3, but that it was believed that some of this bar would be eroded anyway if the river adopted the new dredged channel as its own.

In making these recommendations, we believe that our alternative proposal would involve the removal of a smaller amount of gravel from the river system. In addition, the activity would simulate a natural process which likely would occur anyway at some point in the future. The best part of this approach is that we believe it constitutes a much more long term "fix" to the problem (especially for the homeowner) than what was proposed.

UPDATE: In the spring of 2005, the Sandy River took back the old river channel it once occupied and bypassed the meander! See Natural Processes Affecting Stream Bank Erosion for more information.