



## REMR Technical Note OM-MS-1.6 (Supersedes OM-MS-1.6 1991)

# REMR Management System for Timber Dikes

## Purpose

This technical note provides information about the REMR Management System for timber dikes.

## Background

The research in the Operations Management (OM) problem area of the REMR Research Program centers around the development of REMR Management Systems for civil works structures. A REMR Management System provides tools that can be used to optimize management of REMR activities for a specific type of civil works structure (Yu and Kao 1988; Markow, McNeil, Archarya, and Brown 1989). The types of structure for which REMR Management Systems have been developed (or are being developed) include concrete lock wall, miter gate, steel sheet-pile wall, rubble breakwaters and jetties, and timber dike. The ultimate goal for developing these systems is to achieve the best possible condition for the structures at any funding level.

## Timber Dike Management System

The Timber Dike Management System was developed at the U.S. Army Construction Engineering Research Laboratories and field tested at the Portland District. The system manages a type of pile dike constructed of timber, specifically the timber dikes on the lower Columbia River (Yu and Kao 1989). The system provides objective procedures for condition inspection and evaluation, an automated procedure for maintenance and repair (M&R) quantity estimation and a database manager. The scope of this prototype system presently is limited to a single type of dike to facilitate the development process.

## Timber Dikes

The function of timber dikes is to control the flow in the river so that a favorable channel can be formed in reaches where the channel previously had

been inadequate for navigation (Dodge 1971). Dikes are constructed either parallel or perpendicular to the channel for different purposes. They are used to create more favorable channel alignment for navigation and to help maintain the channel depth by reducing the cross-sectional area of the river. The reduced area increases the flow velocity in the shipping channel, which reduces the sediment buildup. Most of the timber dikes maintained by the U.S. Army Corps of engineers are used to maintain channel depths, and their benefits are usually measured in terms of reduced dredging cost.

The timber dikes on the Columbia River consist of vertical timber piles driven on 2- or 2-1/2-ft centers alternately placed on each side of horizontal spreader timbers. The piles are bolted to the spreaders near the top. The spreader forces the piles to act as a group so that individual piles cannot be pulled out by the dynamic forces from local currents and wave action.

## **Timber Dike Deterioration**

The primary cause of component failure in the timber dikes constructed of untreated timber is rotting caused by wood-destroying fungi (American Society of Civil Engineers 1975). Because these fungi must have air as well as food and moisture, the rotting is limited to the portion of the timber exposed to the air. This is typically the area near the pile-spreader connection. The newly placed piles and spreaders will remain in like-new condition for most of their service life, until the rotting has progressed to a degree that relative movement between the pile and the spreader is possible. From this point on, mechanical wear caused by the relative movement contributes to rapid deterioration to failure (piles breaking loose from the spreader or a break in the spreader). In most cases the piles and the spreaders break at the bore hole for the connector.

The consequence of a component failure depends on the local conditions. In deep waters, the loose piles are most likely to be worked out by the dynamic forces of the current and wave action. A spreader break at such locations has much more serious consequences; a spreader break can lead to a progressive failure, resulting in the loss of a large section of a dike. At the locations where the individual piles can withstand the dynamic forces, since the underwater portion of the piles do not rot, no further deterioration takes place.

## **Dike Condition Index (CI)**

A CI, as used in all REMR Management Systems, is a measure of the ability of the structure to perform its intended function (see REMR Technical Note OM-CI-1.2). The CI allows the objective comparison of the condition of different structures. It also provides a means for monitoring the changes in the condition of individual structures over time. The factors that relate to the

structural integrity, serviceability, and safety of the structure are weighted in the process of determining the CI.

The CI is determined from inspection data and the component age data. The consideration of the component age is important for CI evaluation because the dike components do not show signs of distress over most of their service life and the time span between the detection of distress sign to failure is relatively short.

Three dike components are considered in the CI: Outer Dolphin (cluster of 10 piles that anchors the river end of the dike), dike piles, and spreaders. The CI is obtained by taking a weighted average of the component CI.

## References

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