



**US Army Corps
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Construction Engineering
Research Laboratory

Fact Sheet

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WATER PIPER (W-PIPER) ENGINEERED MANAGEMENT SYSTEM

The Problem

Deterioration of underground water distribution systems, particularly those composed of unlined metallic pipe, is a serious and costly problem on military installations as well as in the private sector. Modern construction techniques, such as lining metallic pipes with cement mortar or plastic, have greatly reduced the problem. However, millions of miles of unlined pipe still exist. One of the most severe deterioration processes occurring in unlined metallic pipe is the loss of carrying capacity. This means the system fails to meet fire flow and daily demand requirements. Pipe corrosion, leading to the formation of tubercles, or calcium carbonate scale build-up on the pipe's interior surfaces causes diminished carrying capacity.

Several repair options are possible. Pressure cleaning, replacement, installation of parallel mains, installation of additional pumps, and installation of additional elevated storage are some alternatives. Making maintenance and repair decisions for a water distribution system is a complex process with many variables. The duration and effectiveness of repair alternatives are frequently unknown. Researchers recognized that a tool to determine these unknowns would be extremely valuable in making cost-effective maintenance and repair decisions.

The Technology

The U.S. Army Construction Engineering Research Laboratory (CERL) has developed a microcomputer-based Engineering Management System (EMS) called Water PIPER (W-PIPER). This program will assist the Directorate of Public Works (DPW) in making cost-effective maintenance and repair decisions for underground water distribution systems, particularly in cases where loss of carrying capacity in metallic pipes is the chief failure mode. The system includes a pipe network inventory, a hydraulic model, data analysis reports, and a Hazen-Williams C-factor prediction model. The C-factor is related to the "roughness" of the pipe's interior surface, which can affect the pipe's carrying capacity. The Water Distribution System Analysis and Optimization (WADISO) program, developed by the U.S. Army Engineer Waterways Experiment Station, provides the hydraulic modeling capabilities. These capabilities have been incorporated into the W-PIPER program.

The C-factor model predicts the degradation of the C-factor in each pipe based on water chemistry or field measurements as a function of time. Using the C-factor model in conjunction with the hydraulic model, managers can determine when the piping system, or a certain section of it, will no longer meet fire flow and/or daily demand requirements. Thus, the prediction is used to determine the life of a particular maintenance alternative. Based on this information, a cost-effective maintenance decision can be made. Prediction models for other failure modes are planned.

Benefits/Savings

W-PIPER is a valuable tool for water distribution system design and scenario-building. Knowledge of future Hazen-Williams C-factors and the life of repair alternatives will enable the DPW to

make cost-effective decisions regarding underground water distribution system. W-PIPER can also serve as a valuable design tool.

Status

A user manual and DOS-based software are available for W-PIPER. A Windows 95-based “C factor calculator” which will run the C-Factor Prediction Model for a specific pipe section is also available. Ongoing work on water distribution system condition assessment techniques and failure models is being conducted as part of the Integrated Utilities Engineered Management Systems (EMS) research.

Points of Contact

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