The Optimatics Letter

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Water Infrastructure Needs $24B/yr

On Capitol Hill on March 27-28, the topic of infrastructure funding shared center stage in Senate and House committee meetings. EPA Administrator Christie Whitman reportedly stated that to tackle infrastructure funding "we need strong commitments from state and local governments" to partner with federal government. However, "there's not enough money to do it all. Within the parameters of the president's budget, we need to do more to address infrastructure" and look for creative solutions.

Rep. John Duncan (R-Tenn.), chairman of the House Subcommittee on Water Resources and Environment, also emphasized efficiency, so that infrastructure projects "don't cost 3 or 4 times more than they should." (Source: Nancy Pontius in Water Online, 3/26/01.)

All this talk about "creative solutions" and "efficiency" to keep costs down gives us a perfect opening to once again promote formal optimization analysis as an invaluable step to include in water distribution studies. Genetic algorithm (GA) optimization, for example, can be applied to develop superior, low-cost solutions for capital improvement plans (CIPs), main replacement plans, and more. Cost savings of 20% or higher are not uncommon for both small and large distribution systems. (To apply the optimization does require a hydraulic model of the system.)

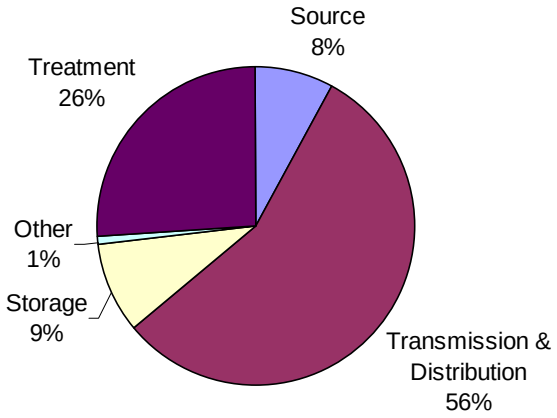
Optimization Could Save $2B per Year

On pages 2-3 is reprinted a letter we are sending to key Senators, Congressmen, and Mayors, as well as contacts at the member organizations of Water Infrastructure Now (WIN). The letter refers to the April 2000 WIN report that estimates infrastructure funding needs for U.S. drinking water systems of $24 billion per year over the next 20 years. The current "gap" in funding amounts to about $11 billion per year.

While some argue the funding gap estimates from WIN (or the EPA) are too high and others say they're too low, everyone agrees that significant increases in infrastructure funding are needed. The funding needs are being driven by large numbers of aging pipes reaching the end of their design life in water systems nationwide, as well as increasingly tough clean water standards.

Our letter points out that improved planning and design practices could have a real impact in reducing infrastructure costs. Optimization analysis can help utilities reduce transmission, distribution and storage improvement costs, which amount to more than 60% of total infrastructure costs (see chart). Assuming that cost savings of 25% can be achieved on just over half of all projects, the potential savings comes to $2 billion per year.

Optimization analysis could potentially save U.S. water utilities $2 billion per year



Percent of Infrastructure Funding Needs by Area

(Source: EPA's 1997 Drinking Water Infrastructure Needs Survey)

Our letter goes on to propose several concrete steps that could be taken promote the use of formal optimization analysis in distribution system studies. One idea is for AWWA and others to sponsor workshops to educate water utilities on the proper use of optimization techniques.

Albuquerque Chooses GA Optimization

The City of Albuquerque has engaged Optimatics/Frey Water Engineering and CH2M HILL to perform a GA optimization study of the transmission system improvements needed to meet year 2040 demand conditions. The GA study will focus on how best to move water from the City's new surface water treatment plant (going on-line in 2004) to serve areas on both sides of the Rio Grande.

Albuquerque currently relies on groundwater pumping from 22 well fields to supply its 460,000 customers with 100 MGD (average day demand). The GA study will identify near-optimal alternatives for new transmission mains and possibly new equalization storage. The study will also consider options for treating high-arsenic wells and specific operations to supply aquifer storage and recovery (ASR) wells with excess treatment plant flows in winter.

Published jointly by Frey Water Engineering, Inc., USA and Optimatics Pty Ltd, Australia, consultants specializing in OGA optimization.

An Open Letter to the Water Infrastructure Purse-String Holders

April 2, 2001

Subject: **Water Utilities Are Achieving Savings of 20%+ in Capital Costs Using Optimization Analysis**

Dear Sir/Madam:

At a press conference on Capitol Hill on February 13th, a coalition of local government and industry groups called for federal aid to help repair aging water infrastructure across the country. The Water Infrastructure Network (WIN) report *Clean and Safe Water for the 21st Century* (April 2000) warns of huge funding shortfalls for replacement of drinking water infrastructure and needed improvements to meet federal water regulations. The required capital investment for drinking water systems alone is estimated to be $24 billion per year for the next 20 years—this amount dwarfs the $13 billion per year that water systems currently invest for infrastructure capital needs.

An attractive alternative to address the funding shortfall is to significantly reduce the cost of water infrastructure renewal. Some water utilities have already taken advantage of powerful new analysis techniques to save 20% or more on their infrastructure renewal and improvement costs. Most utilities, however, are unaware that these proven techniques exist. Given the tremendous cost burden we are facing, it makes sense to inform and educate the water industry about new techniques that could potentially reduce the water infrastructure funding shortfall by $2 billion per year.*

Formal Optimization Analysis Can Achieve Cost Savings

Reducing the capital cost of water infrastructure improvements is definitely possible through the use of new innovative technologies. Genetic algorithm (GA) optimization analysis, for example, is gaining recognition as a proven means to minimize pipe replacement costs, infrastructure improvement costs and system operating costs. Rather than rely on a system planner to develop improvement plans by trial-and-error analysis, the GA technique directs an intelligent computer search of hundreds of thousands of trial solutions to identify acceptable plans that are often 20%-50% less costly. Near-optimal solutions literally "evolve" during the GA search.

A computer hydraulic model of the water system is required to apply GA optimization, but many medium and large utilities already have their systems modeled. For example, the City of Grand Prairie, Texas (population 117,000) applied GA optimization after updating its hydraulic model during a Comprehensive Water Master Plan study. The GA identified five alternative near-optimal plans that minimized capital improvement and system lifetime operating costs. Public Works Director Ron McCuller believes the GA optimization will save the City millions of dollars in capital costs as it implements needed improvements.

GA optimization is proving its value on other water system studies as well. A GA review of the Fort Collins-Loveland Water District (Colorado) improvement plan identified an optimized plan with just 18.8 miles of new pipe compared to 29.4 miles in the original plan, resulting in a 49% capital cost savings. At present, Sierra Pacific Power Company is using GA optimization to help cut costs on needed water system improvements for the Reno-Sparks area. San Diego Water is using GA to minimize costs for a major main replacement. The City of Albuquerque is applying GA to optimize its transmission system improvements to incorporate a new surface water treatment plant and to revise its operating plans in the event that more stringent arsenic standards come into effect. The City of Toronto and Region of York are applying GA to minimize future capital and operating costs under their Joint Optimization Study.

What More Can be Done to Promote Cost Savings?

WIN's reporting on 21st century water infrastructure funding needs underlines the urgency of improving all aspects of the infrastructure renewal process. Unfortunately, the water industry has been slow to adopt the latest planning and design techniques. The following ideas would complement the on-going efforts of many engineering consultants to promote the use of formal optimization techniques for water planning, design and operations problems:

1. National associations and agencies could sponsor workshops to educate water utilities on the use of formal optimization techniques to prepare hydraulically superior, low-cost system improvement and main replacement plans.
2. State regulatory commissions could recommend or require that optimization techniques be utilized to limit needed capital expenditures and minimize water rate increases, much like the Nevada Public Utilities Commission did in hearings with Sierra Pacific Power Company in 1997.
3. A value engineering (VE) review step using a formal optimization technique could be required before a water system infrastructure project is approved to receive federal funds above a specified dollar amount (if appropriate).

These steps would help ensure that Congress, the water utility and its customers are getting the most for their money. The steps would also help keep everyone's water rates lower in the future.

In recent years, a number of water utilities, consultants and software vendors have begun using formal optimization techniques to minimize system improvement and main replacement costs. The results we have seen reinforce our opinion that today hundreds of millions of dollars are being committed and spent unnecessarily on non-optimized improvement and replacement plans. Water utility managers need to realize that much of this money could be saved by improving current engineering planning and design practices.

Please feel free to contact me if you would like to talk about cutting water system renewal costs as a means to help close the investment "gap" that concerns all water users.

Sincerely,

Jeffery Frey

Jeffery Frey, P.E.
President, Frey Water Engineering, Inc.

* Assumes 60% of $24 billion per year spending can be optimized (e.g., transmission, distribution and some storage costs), 55% of that spending need is actually subjected to optimization analysis, and the average cost savings is 25%. These percentages seem reasonable based on EPA's 1997 needs survey of 4,000 water systems and past GA optimization study results.

The Optimatics Letter

Advances in optimization for water utilities and consultants

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Please pass this newsletter on to key staff involved in distribution system planning and operations.

Also, please call, fax or e-mail us to update names and addresses or to be removed from the mailing list.

The Optimatics Letter *Advances in Optimization for Water Distribution System Design & Operations*

Can Optimization Help Reduce the Water Infrastructure Funding Gap?

- ***Estimate***—Drinking water infrastructure funding needs will amount to $24 billion per year or $480 billion over the next 20 years
- ***Fact***—AWWA and others are calling for federal funding to help rehabilitate the national water infrastructure and limit necessary customer rate increases
- ***Fact***—AWWA MainStream asks "*Will your utility need to more than triple water rates or require outside help to meet infrastructure requirements over the next 20 years?*" (March 2001 issue)
- ***Fact***—Infrastructure renewal costs could be significantly reduced by improving current planning and design practices
- ***Estimate***—Adopting formal optimization techniques for water system studies could save U.S. water utilities $2 billion per year