

OptiFacts



Optimatics

Water Systems Optimization

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“I would like to commend the entire team on the tremendous job you’ve done with the Final Solutions Memo... I’ve been involved in engineering planning and analysis of water systems since 1986 and this is the best water model analysis document I have had the pleasure of holding in my hands... We are very proud of our association with Optimatics and CH2M Hill on this project.”

Client Reference:

Dan Preston, P.E.
Facilities Director
North Penn Water Authority
P.O. Box 1659
Lansdale, PA 19446
Telephone: 215-855-3617

Water Distribution Master Plan Optimization

Rehabilitation and augmentation of system

NORTH PENN WATER AUTHORITY and consultants CH2M HILL engaged Optimatics to undertake the optimization of the North Penn Water Distribution System Master Plan. New infrastructure was required to meet growth to 2030, while replacement of aging assets was also considered.

KEY POINTS

- Year 2030 Master Plan
- Maximum day demand of 19 MGD
- New pipeline, pump station, storage and zone boundary options
- Sensitivity analysis

Background

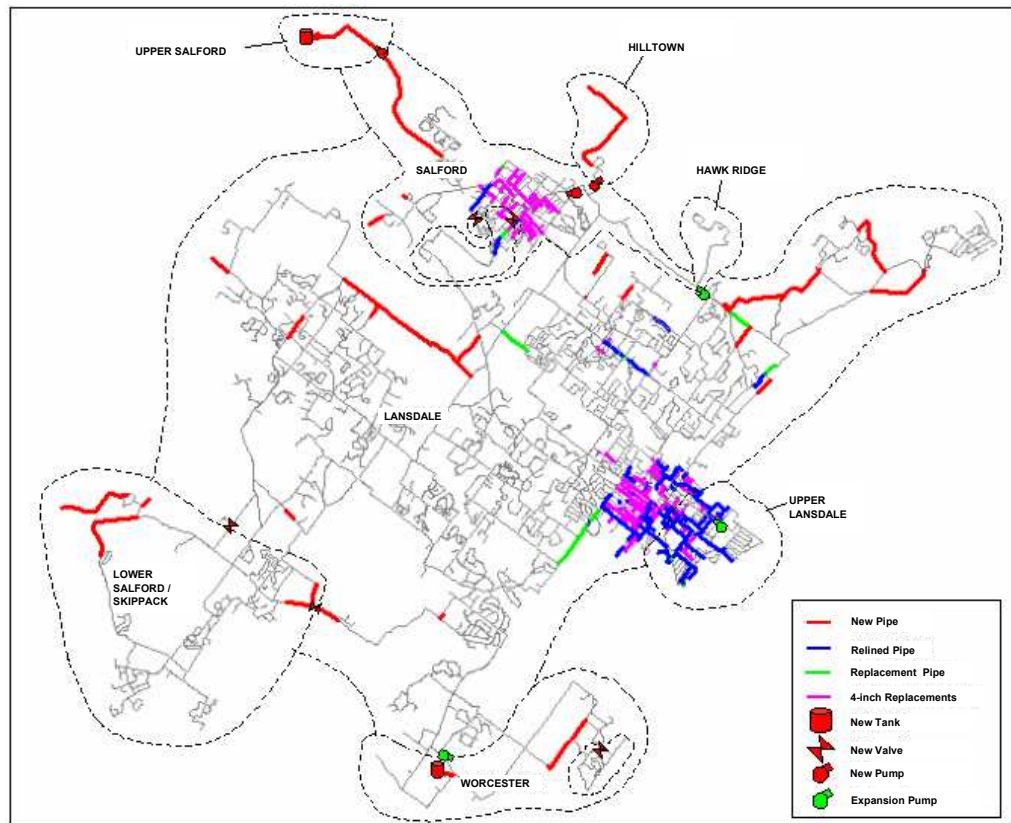
North Penn Water Authority (NPWA), located in Bucks and Montgomery Counties, Pennsylvania, serves approximately 27,000 customers. The Authority oversees a system containing 435 miles of water mains. The distribution system is set up with five pressure zones that receive water from 23 production well sources and a surface water treatment plant.

Facilities also include seven tanks and five booster pump stations. In total, the system is required to meet an average daily demand of 9MGD.

The Project

North Penn Water Authority (NPWA) is anticipating significant growth with estimated average and maximum day demands of 13MGD and 19MGD at build-out (assumed to be year 2030).

NPWA determined that a formal optimization approach could assist them in identifying the most cost-effective set of capital improvements and operational changes as they progressed to develop a new system-wide water master plan.



New infrastructure options for the North Penn system

Study Objective

The objective of the GA analysis was to optimize both capital improvements and system operations in order to minimize project life-cycle costs while meeting projected year, 2030, maximum day demands. As lead consultant, CH2M HILL first prepared an extended period simulation (EPS) hydraulic model utilizing available GIS and other data. Optimatics' Genetic Algorithm (OGA) was then formulated to consider a range of options, including:

- new pipes;
- replacement or relining of selected existing pipes;
- new storage or expanding existing storage at the same location;
- new pump stations or expanding existing pump stations; and
- new pressure zones or adjusting existing pressure zones.

The OGA also considered a range of operational settings for the existing control valves as well as possible new control valves and pumping facilities.

Key Outcomes

A sensitivity analysis was performed to observe the effect of different planning horizons on the system designs.

A planning horizon of 30 years was selected and a series of preliminary and interim OGA runs were carried out with the promising solutions discussed in detail with NPWA and CH2M Hill staff.

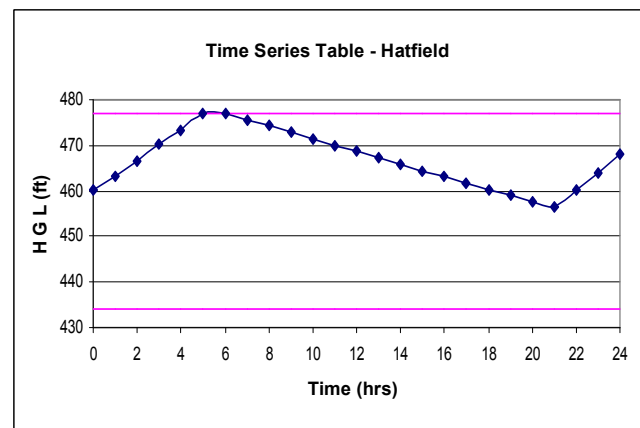
A final 2030 optimized solution for the North Penn system was then prepared and refined. This solution utilized new pipe alignments and replaced and relined some existing pipe alignments. New pump stations, new storages and new PRVs

were included, and pump station expansions or replacements were recommended for some existing pump stations. Zone boundaries were also adjusted in some areas to reduce high-pressures and improve overall system operations.

Benefits

The total capital cost of improvements identified for the system was \$24.95 million.

Operating costs over the 30 year planning horizon amounted to \$27.56 million for pumping at the water treatment plant, pump stations and wells. NPWA later estimated that the optimized solution will save them 25% in capital costs alone, compared to their previous capital facilities planning.



Level in the Hatfield storage over the 24 hour maximum day period



Elevated tank in the North Penn system