OptiFacts

Officer Wastewater Network Optimization

Design and optimization of Officer Sewerage Catchment wastewater system

THE Officer wastewater project in South East Melbourne is typical of the needs of new development. By using the Optimatics Genetic Algorithm, a more efficient design was identified, saving both time and money while also enhancing the overall performance of the system.

KEY POINTS

- Staged design
- Cost savings of 14%
- Improved performance
- Detailed cost analysis

Background

The Officer Sewerage Catchment being designed by South East Water, one of three retail water authorities in Melbourne, was elected to trial the Optimizer software in order to assess the technology for future use on wastewater networks.

Optimatics was provided with an existing master plan to use as the baseline solution. In order to identify a solution which had a reduced project cost and improved hydraulic performance, staging and flow path options were assessed.

The catchment had a small amount of existing development but was predominantly green field (typical of any new development area in Australia). Future development will be a combination of industrial and residential and will be staged over a period of 15 years.

The Project

Design Considerations

- Five year design storm event with a six hour critical duration
- Dry and wet weather flow conditions modelled for ultimate and interim design horizons
- 1500L/s peak flow in ultimate design horizon.

Performance Criteria

- One metre minimum freeboard in gravity sewer
- Minimum PDWF velocity of 0.7m/s in gravity sewers
- Maximum velocity in rising main of 2m/s
- 2 hours pump station contingency storage in PDWF.

Detailed Cost Analysis

The set up of the cost function was extensive and included:

- Depth dependent sewer main costs;
- Location specific sewer main costs;
- Micro tunnel costs for highway and railway crossings;
- Pump station capital costs, electrical costs (using green-energy tariffs) and maintenance costs; and
- NPV of capital and operating costs based on construction schedule and 30 year design life.

Performance Criteria	Baseline Solution	Optimized Baseline Solution	Final Optimization Solution
Total Project Cost (NPV)	$35,786,519	$34,582,744	$30,662,365
Saving on baseline	-	3.4%	14.3%
Total overflow volume (ML)	1.42	0	0
N° GS with < 1 m PWWF freeboard	28	23	0
N° RM with v > 2 m/s	2	0	0
N° RM with PDWF v < 1.2 m/s	1	1	0
N° GS with DWF surcharge	3	0	0
N° GS with PDWF v < 0.7 m/s	5	7	4
N° GS with PWWF v > 3.0 m/s	0	0	0

Final solution with the benefit of optimization

Optimatics

Water Systems Optimization

Australia
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United States

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"The limitation of traditional methods is now a thing of the past as OGA is able to develop and analyze any number of desktop sewerage transfer system options and select the most suitable and cost effective concept design solution."

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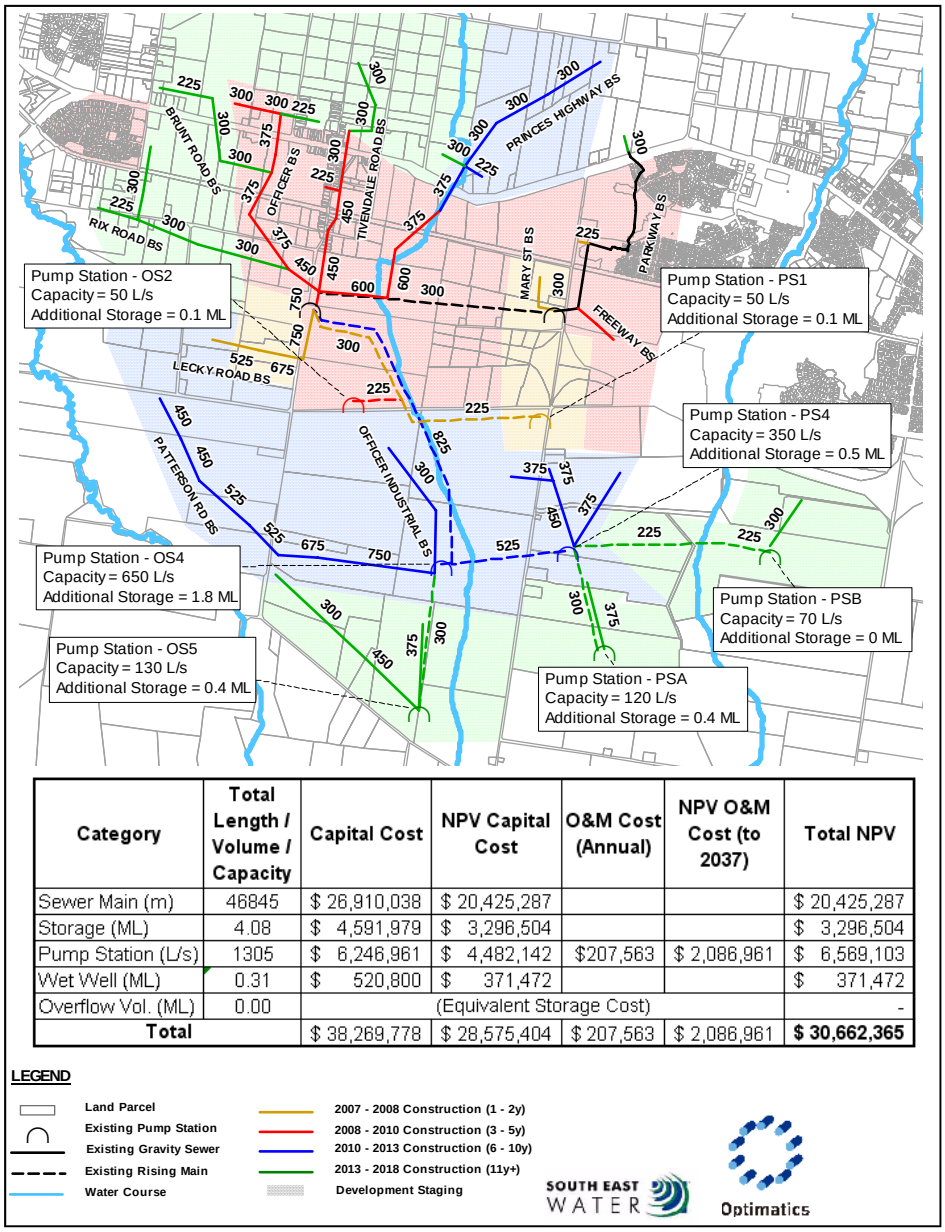
Key Outcomes

A total saving of 14.3% was achieved by:

- Including two additional local pump stations to:
  - offset construction of a regional pump station
  - reduce the life-cycle operating costs
  - reduce pump station additional contingency storage requirements.
- Selecting pump station capacities less than PWWF to:
  - moderate rising main velocities
  - minimize rising main diameters
  - utilize existing storage in upstream system.
- Selecting three additional micro-tunnel highway crossings to:
  - allow the flow path to follow the natural, north-south drainage rather than traversing the highway and railway to a common crossing.
- Selecting large diameter mains, upstream of pump stations which surcharge in wet weather, to:
  - reduce head-loss in sections where the surface slope is mild and surcharge behind the pump station which would otherwise cause minimum freeboard violations.
- Selecting additional storage to attenuate PWWF
- Selecting gravity sewer main depths which helped to achieve minimum velocity requirements.



Category	Total Length / Volume / Capacity	Capital Cost	NPV Capital Cost	O&M Cost (Annual)	NPV O&M Cost (to 2037)	Total NPV
Sewer Main (m)	46845	$ 26,910,038	$ 20,425,287			$ 20,425,287
Storage (ML)	4.08	$ 4,591,979	$ 3,296,504			$ 3,296,504
Pump Station (L/s)	1305	$ 6,246,961	$ 4,482,142	$207,563	$ 2,086,961	$ 6,569,103
Wet Well (ML)	0.31	$ 520,800	$ 371,472			$ 371,472
Overflow Vol. (ML)	0.00	(Equivalent Storage Cost)				-
Total		$ 38,269,778	$ 28,575,404	$ 207,563	$ 2,086,961	**$ 30,662,365**

Master Plan Optimization Solution - Total Capital Cost $30.66M