Stormwater Study using Optimizer City of Belvidere



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Overview – Belvidere, IL







Study Objectives

- Analysis of existing drainage system capacity, performance
- Evaluate extent of flooding, focused on problem areas
- Develop improvement plan to reduce flooding impacts and increase operational capacity of south side infrastructure



Existing Conditions





Known Problem Areas





Existing Conditions Assessment



Detention Volume Required to Meet Current City Requirements

Drainage Basin	Area (ac)	Allowable Release Rate (cfs)	Required Detention Vol. (ac-ft)
А	382.47	57.4	105.1
A-1	82.04	12.3	24.6
В	360.98	54.1	99.1
С	143.34	21.5	41.5
D	78.49	11.8	22.0
D-1	80.88	12.1	22.7
Е	30.96	4.6	9.3
F	113.09	17.0	26.8
F-1	26.87	4.0	7.8
Total	1,299.12	194.9	358.8



Modeling Plan

- Started with XPSWMM modeling
- Had been interested in trying Optimizer for quite a while
- Decided that this would be a good pilot project because of:
 - Size
 - Scope of improvement scenarios



Optimizer Overview

- Infrastructure Planning Tool
- Acts as an extension to traditional hydraulic modeling
- Analyses thousands of planning options to optimize for cost and performance
- Input the full range of possible improvements and let optimizer site and size needed upgrades



Model Development





Model

- Must have base hydraulic model first
- XP must be converted to EPA
- Model cannot be edited in Optimatics





Formulate

- Input costs, planning decisions, and design criteria that is used to optimize the system
- Most complex part of using Optimizer

Size (ft)	Construction depth < 12ft	Construction depth 12-16ft	Construction depth 16-20ft	Construction depth > 20ft
1	260	350	460	560
1.5	320	410	520	680
2	450	530	680	900
2.5	600	830	1,050	1,350
3	830	1,130	1,430	1,800
3.5	980	1,350	1,800	2,100
4	1,200	1,650	2,250	2,550
4.5	1,580	2,180	2,550	2,850
5	2,100	2,550	2,850	3,150
6	2,480	2,930	3,300	3,750
7	3,300	3,600	3,900	4,500
8	4,050	4,500	4,800	5,250



Formulate

Design Criteria Example: Freeboard

Anything more than 3 ft = no penalty 0-3 ft = small penalty Less than 0 = large penalty

Penalties should roughly equal costs



Plan

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Optimize

- Cloud-based
- Run times vary from a couple of hours to days
- The faster your model, the faster your optimization



Results





Optimizer Strengths

- Utilizes cost in the design process
- Highly defensible solutions for stakeholders
- Improve transparency
- Improve quality of design solutions



Optimizer Weaknesses

- Not necessarily time-saving
- Some solutions have to be tweaked to be constructible
- Effectiveness depends on the size and type of job



Conceptual Improvement Plan



Planning Level Cost Estimate

Overview of Engineer's Estimate of Probable Cost



Questions?

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