CAPSTONE EXPERIENCE 2014

Restoration of Water Control Structures in Happy Hollow Park

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Objective:

Happy Hollow Park faces multiple water and sediment control issues. High erosion levels are causing sediment build-up in the Wabash River. This project focuses on two failing water control structures, a weir that is next to the main path and a gabion basket that acts as a bridge over the main channel in the park. Both spots initially had drainage pipes, but neither are currently working. Since both structures also have significant sediment build-up behind them, water tends to flow over them, causing the trails to flood. This poses a safety hazard to the public, especially when the water freezes. This project will produce a set of solutions to the problems at Happy Hollow Park that meet the erosion control, the drainage control, and the aesthetic needs of the park. Since funding for construction is currently unavailable, the various solutions also cover a range of costs.

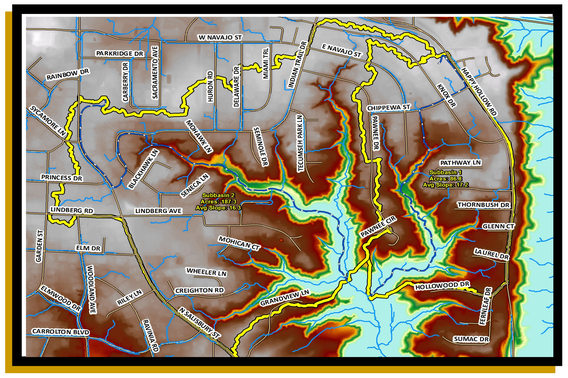
Overflowing weir (left)

Overflowing gabion (right)

Photos taken after a 1-year storm event

Background Research

- RTK GPS survey
- Soil map
- Watershed delineation for weir and gabion using L-THIA, WEPP, USGS StreamStats, NRCS LiDAR tool (see image on right), and hand drawn in Indiana Map
- Peak flow estimation using rational method
- Standards review (NRCS, ASABE, ASCE, ADA)



Watersheds of each site outlined in yellow

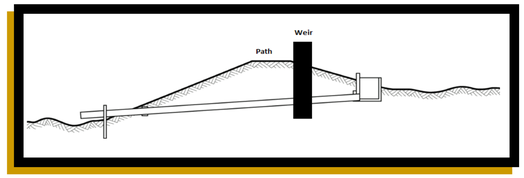
Results:

Gabion

Since the gabion structure is storing so much sediment, it was considered unwise to remove it. In order to prevent the path from flooding, therefore, it was deemed best to build a bridge over the site. A prefabricated bridge was selected in order to reduce costs. The necessary span was estimated to be 55', which was the average between the maximum possible and minimum advisable span. The bridge would meet ADA standards and would be constructed for bicycle and pedestrian traffic.

Weir

The existing structure will be torn out and replaced with a new drop inlet pipe structure and weir spillway. The inlet will be protected with a trash rack and the outlet will have rip rap protection. The storm peak flows are too large to be completely handled by a reasonably sized pipe, so a set pipe size is not specified. A variety of pipe sizes is given in order to present a range of pipe capacities and costs including associated design grade, riser size, trash rack cost, and statistical occurrence that the structure will use the auxiliary spillway (weir). The weir will be 55' wide, 1' thick, and 5' tall above ground. It will also have a 27" footer to prevent undermining.



Pipe Diameter Size (in)	Riser Diameter Size (in)	Pipe Grade (ft/ft)	Pipe Capacity (cfs)	Auxiliary Spillway Use (times/year)	Cost of Pipe (20 ft length) ($)	Cost of Riser ($)	Cost of Trash Guard ($)
12	24	0.078	6.20	9.8	210.00	100.00	518.00
15	30	0.066	10.23	5.9	240.00	160.00	761.00
18	36	0.051	14.74	4.1	300.00	190.00	916.00
21	42	0.042	20.06	3	360.00	305.00	1,035.00
24	48	0.035	26.20	2.3	400.00	345.00	1,163.00
27	54	0.030	30.75	2	500.00	814.00	1,388.00
30	60	0.026	40.94	1.5	640.00	1,000.00	1,595.00
36	72	0.020	58.95	1	770.00	1,400.00	2,061.00

Cost Estimate

Gabion

Component	Cost ($)
Connector Pedestrian Trail Bridge by Contech	30,700
Labor	1,500
Total	**32,200**

Weir (without pipe, riser, or trash guard)

Component	Cost /Unit	Cost ($)
Concrete	$250/cy	7,875
Rip Rap	$80/cy	1,800
Outlet Support	-	200
Labor	1500/task	7,500
Total		**17,375**

Alternatives

- Hydro-seeding hillsides will reduce the peak flows and erosion reaching the sites ($4000/ac).
- Upstream rip rap (rock checks) to reduce peak flows and erosion ($80 /cy).
- Public education on rain gardens and other water retention methods

Sponsor: Dan Dunten, Stewardship Manager for West Lafayette Parks and Recreation
Technical Advisor: Dr. Bernie Engel, Purdue University ABE Department Head