

### Problem Definition

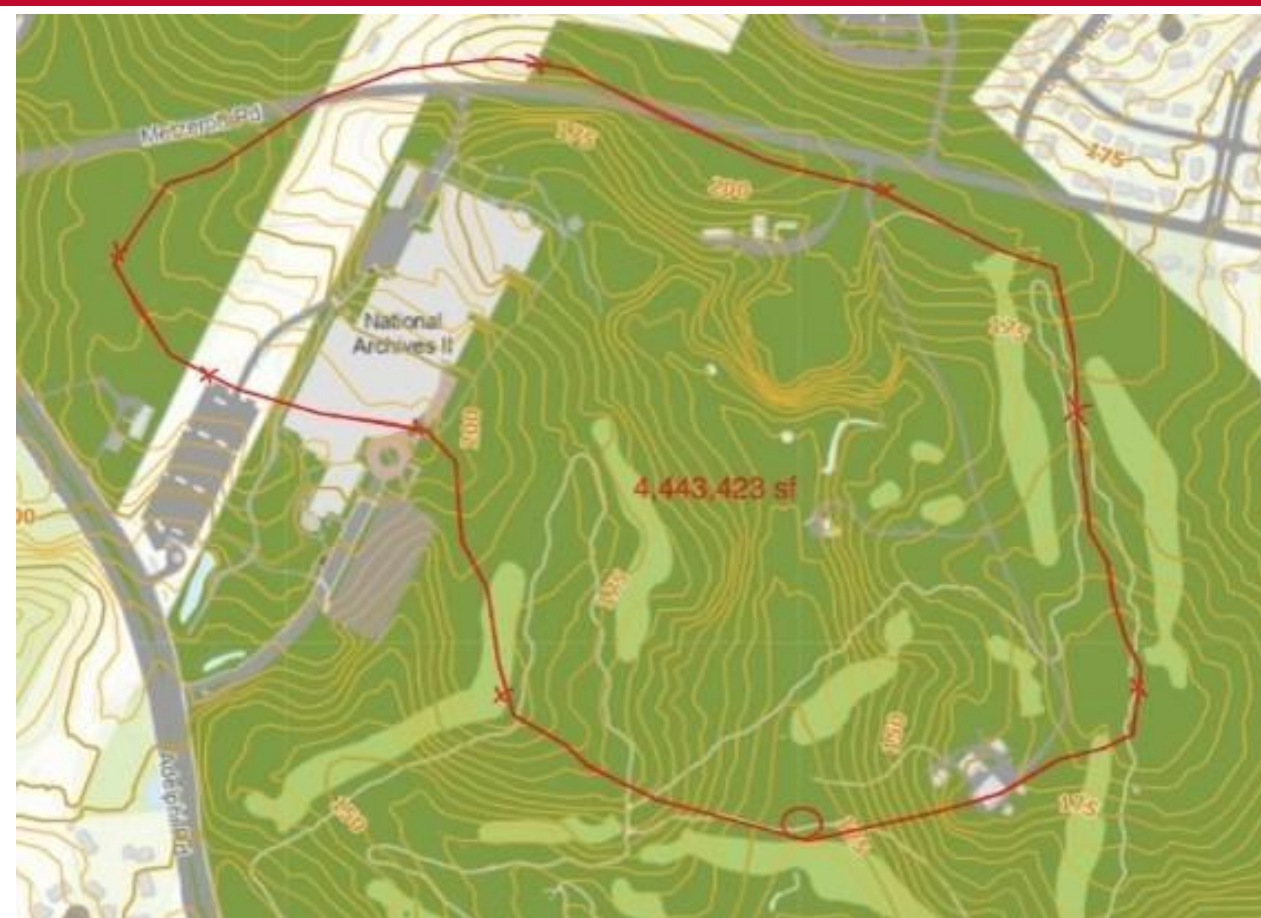
The second fairway at The UMD Golf Course experiences significant flooding and erosion due to an inadequate and collapsing culvert.

Our team is tasked with designing an improved stormwater solution to mitigate flooding, improve sustainability, and preserve pace of play.

A survey was conducted to understand community preference on type of stormwater management solution i.e. open stream or culvert.



### Stormwater Calculations



Drainage area delineated.

NOAA atlas 14 was utilized to determine intensity of 25 and 100-year storm.

Time of Concentration was calculated below

	Length (ft)	Average Slope	Time (min)
Sheet Flow	48.1	0.037	9.6
Shallow Concentrated	744.25	0.04	3.84
Open Channel	2533.3	0.024	10.14

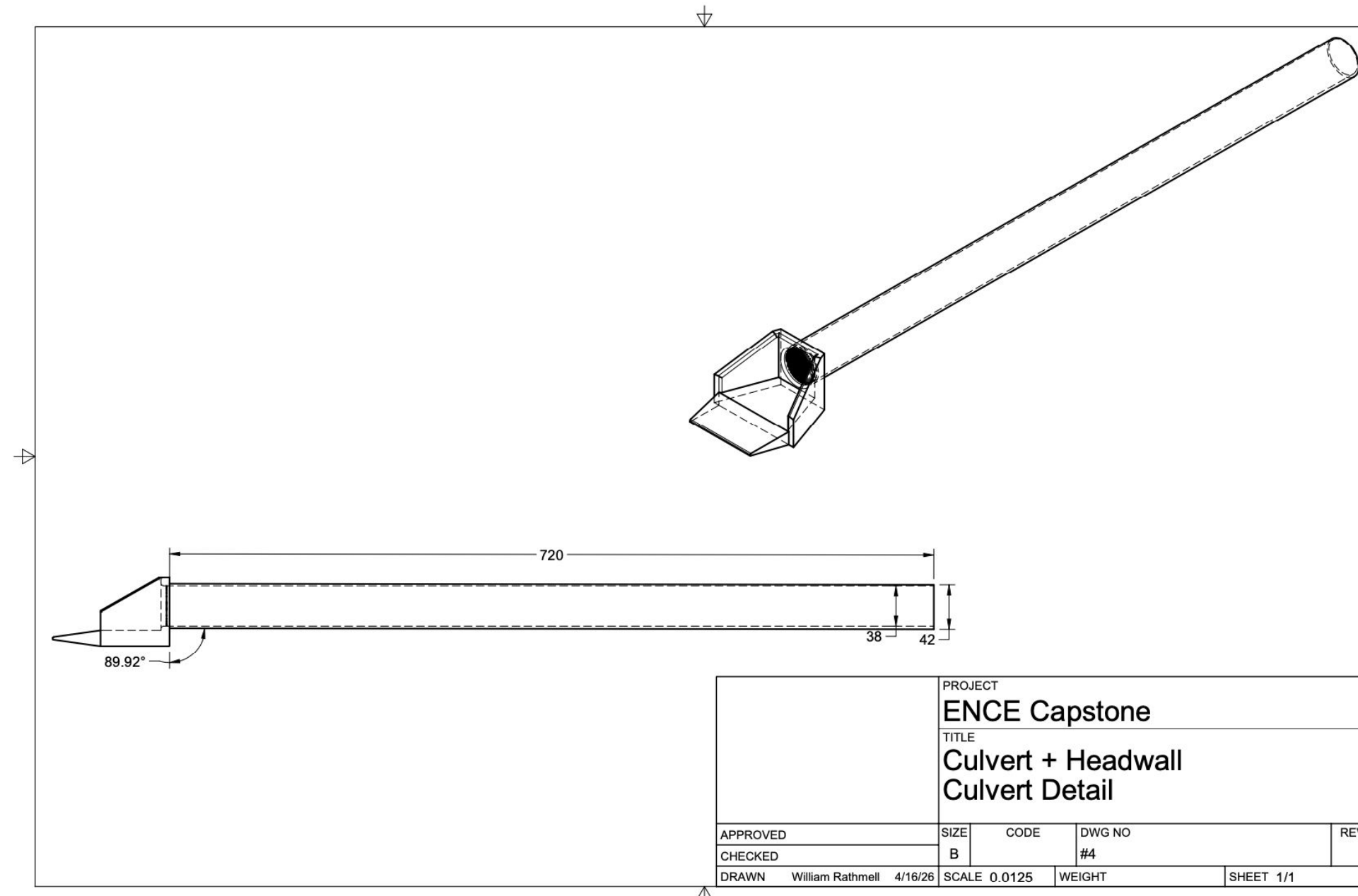
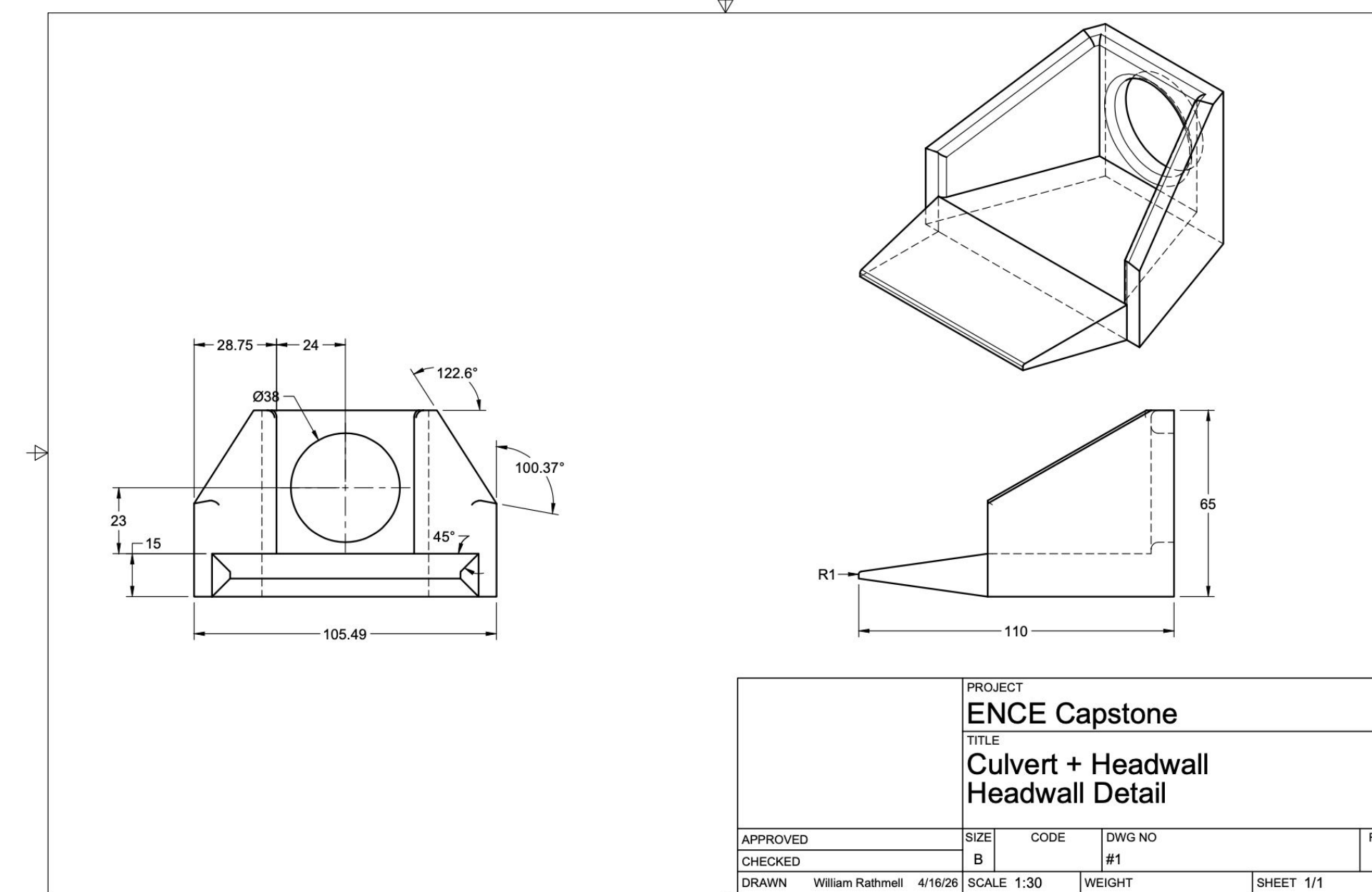
	Intensity (in/hr)	Peak Runoff (ft <sup>3</sup> /s)
25-year Storm	3.74	114.4
100-year Storm	4.51	138

Q = Peak Discharge (cfs)  
i = Intensity (in/hr)  
C = Runoff Coefficient  
A = Watershed Area (Ac)

$$Q = CiA$$

Watershed Area = 102 acres  
Runoff Coefficient = 0.3

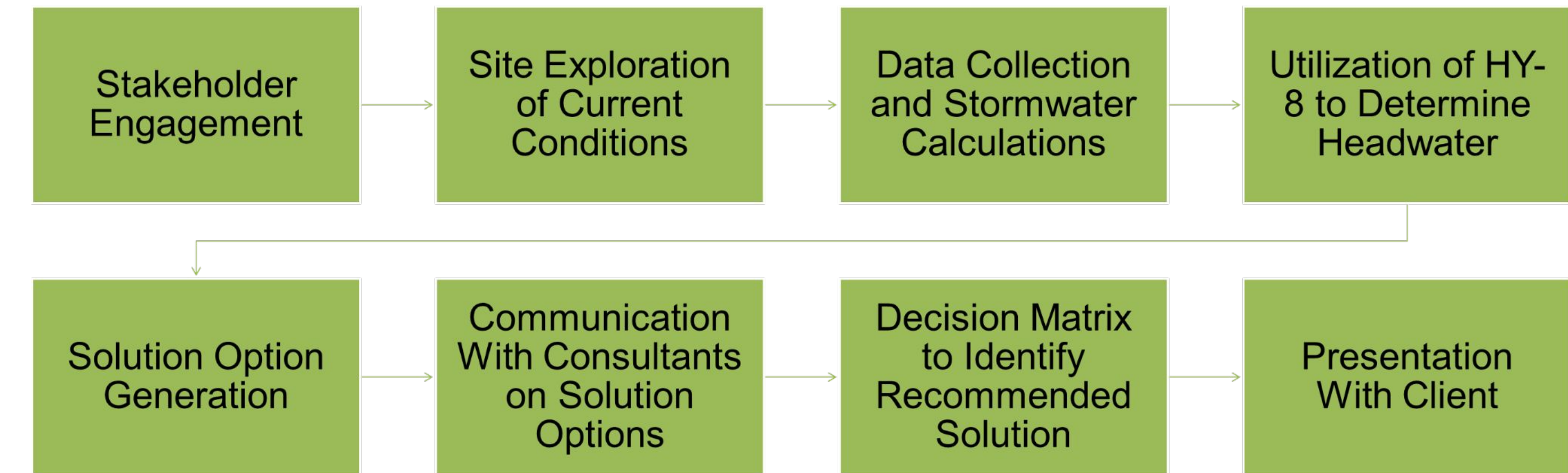
### Final Design



Our final design is a double walled 3.5 ft diameter heavy duty polyurethane (HDPE) plastic culvert that spans 120 ft. This solution is not only one of the cheaper solutions, but it is easier to install and has anti-corrosion properties which should make it a solution that lasts. A headwall is located at the inlet to limit the erosion and guide water into the culvert. Two check dams will be installed at the swale to limit debris that enters the culvert and to reduce the velocity of runoff entering when intense storms occur.

**Estimated Total Cost: \$22,000**

### Methods



### Solution Comparisons

Design	Durability	Cost	Pace of Play	Maintenance	Ease of Installation	Score	Est. Cost
3.5ft Single Concrete Pipe	4	1	5	4	2	16	\$32.5K
3.5ft Single Corrugated Metal Pipe	3	4	5	4	3	19	\$19.5K
3.5ft Single HDPE Pipe	3	4	5	3	4	19	\$18.5K
2.5ft Dual HDPE Pipe	3	1	5	3	4	16	\$31K
Open Stream	5	1	1	3	3	13	\$34.3K

Scored 1-5 with 5 being the best

Utilizing HY8 and our calculated peak runoff values, different sizes and materials of culverts were tested to determine solution options based on a headwater to diameter ratio of roughly 1.50 which was our primary design parameter. Criteria was determined based on clients priorities with solution. Golfer preference was a question on the survey and showed no clear preference thus it was not a factor in the decision matrix. The solution with the highest score was deemed the recommended final design.



Check Dam: Photo taken at UMD Iribe center



Current culvert inlet



Current culvert outlet