

Sacheev Mandhle (ENRE) and Rebecca Werner (ENRE)

Problem Statement

Grace United Methodist Church, located at 615 North 22nd Street in Lafayette, Indiana, is experiencing issues with their parking lot regarding the management of rainwater. They experience heavy flooding and erosion and currently only have a small drain at the low point of the lot to deal with the problem. The Church experiences erosion due to the concentration of water from the downspouts of the roof (Fig. 1), flooding at the entrance of the education building after rain (Fig. 2), and single outlet drain in the northwest corner which consistently gets blocked by leaves and other debris (Fig. 3).



Figure 1: Erosion on side of church



Figure 2: Flooding after small storm



Figure 3: Current drain blocked

The **goal** of this project is to develop a design that would improve stormwater management for the church in a cost effective manner.

Alternative Solutions

- Instead of the outlet redesign, the team initially designed a bioswale to run the entire length of the northern driveway. However, there are electrical poles about 100 feet from the original drain, so this was not a feasible construction option
- The team also considered a large infiltration basin, but we would not be able to adhere to the 10-foot property line setback with this design
- A cistern was considered but rejected as justified below

Criteria	Cistern	Rain Barrels
Volume	500 + gallons	50 gallons/barrel
Location	Excavation and piping required	Flexible location
Pump	Larger pump	Gravity-driven

Project Schedule

Task	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Survey	X							
Conceptual design	X	X	X	X	X			
Cost analysis				X	X	X		
Grant proposal						X	X	
Course deliverables		X		X		X	X	X

Final Design and Process

The team met with Reverend Lore Gibson of Grace Methodist Church to fully understand the problem and to determine the church's needs. After collecting all of the appropriate data, the team ultimately decided on the design displayed below (Fig. 4 and 5).

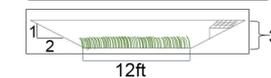


Figure 4: Overarching Site Plan



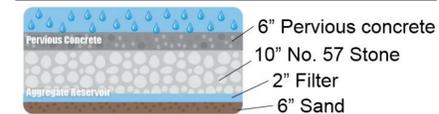
Figure 5: Design Focus Area

Inlet Cross Section



- Base: 12' x 3' rectangle
- 2' square box drain with top grate, 8" below top of basin
- 4" diameter orifice built into box drain, above bottom of basin
- 2:1 side slopes on all sides
- Grass lining on all surfaces

Pervious Concrete Cross Section



4.4" of retention available

Rain Barrels

- 50 gallons each
- Overflow onto permeable pavement

Berm/Speed Bump

Hydrology Calculations

Quantity Calculated	Design component	Method Used and Source	Required Inputs	Assumption
Peak Flow	Inlet size	Rational Method; Lafayette SW Manual	Drainage area, rainfall intensity, slope, land use	10-year, 24-hour storm
Runoff Depth	Basin volume, Permeable pavement depth	SCS Method; NRCS	Rainfall depth, potential max soil moisture retention	10-year, 24-hour storm
Volume sizing	Inlet structure	Chainsaw Routing; Dr. Malcom (NCSU), Stormwater Design	Inflow, outflow, volume, stage-storage relationship	Negligible riser volume and infiltration

Societal Impact

This design, along with the other two projects at Grace Methodist Church, was filed for a grant application with the Wabash River Enhancement Corporation (WREC). In compliance with the proposal, this design will help improve local water quality and can serve as an educational opportunity for the neighboring intermediate school.

Criteria and Constraints

- Reduce erosion
- Increase effective drainage
- Maintain parking space quantity
- Aesthetically pleasing
- Safe for children being around
- Property line setbacks
- Be fundable through the Wabash River Enhancement Corporation

Final Recommendations

1. Speed bump extending across the northern drive way to divert flow into the redesigned inlet
2. Permeable Pavement- 2000 square feet with 2 foot depth
3. 2 Rain Barrels- 50 gallons
4. New outlet with box inlet structure

Cost Analysis

Component	Cost
Berm	\$240
Permeable Pavement	\$8,000
Outlet Structure	\$5,000
Rain Barrels	\$200
Total	\$13,480

Sponsor:
Rev. Lore Gibson
Dr. Laura Bowling

Technical Advisors:
Dr. Keith Cherkauer
Dr. Sara McMillan, P.E.

Instructors:
Dr. Bernard Engel, P.E.
Dr. Robert Stwalley, P.E.

Acknowledgement:
Sara Peel, WREC