Sewage Solutions
4321 Poplar Street
Macon, GA 30107

May 4, 2021

Carol Hodges
Superintendent of Grounds
Physical Plant
1937 College Drive
Macon, Georgia 31201

Dear Mrs. Carol Hodges

We are pleased to deliver our proposal, Drainage Solution for The Sidewalk on Adams Street in response to the present drainage problem. Ideally the sidewalk between the Greek Village Dumpsters and Shorter Hall on Adams Street would not flood, but the lack of proper drainage causes flooding to occur. The problem causes distress for students on days when there is unideal weather. Our solution is cost effective and sustainable.

Contact us by email at sewagesolutions@sewagesolutions.com or call us at 123-456-7890 when you would like to start working on Drainage Solutions for The Sidewalk on Adams Street.

Sincerely,

Mo Baldwin

Mo Baldwin

Sewage Solutions Project Manager

Enclosure

Drainage Solution for The Sidewalk on Adams Street

Sewage Solutions
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Executive Summary

When rain falls in Macon, nowhere else is it felt more than in the parking lot on Adams St. by Mercer Hall. The flooding causes many issues to the students as they cannot go to class without becoming soaked by the flooding. Our solution is to place a drain and pipe system to alleviate and remove the flooding altogether. This will make the area look more appealing during and after rainfall as well as improve student morale. Sewage Solutions, LLC is a team of experienced engineers that are dedicated to the construction and design of this project and the communications between your organization, Sewage Solutions, and the general student body.

Sewage Solutions shows that this method will accomplish our goals of providing a drain that removes the excess water while being completed in less than 5 days and costing less than $1000. Out of all of the alternative solutions, we have determined that the drainpipe solution is going to be the most cost effective and sustainable over time.

Our solution requires a stretch of grass to be dug up for a pipe to be placed below the surface. Then a crosspipe will be placed from the drain to the main storm line at an incline to prevent backwater from flooding back to the surface or not draining to the city line. This solution fulfills all of our professional goals for this project, and this is ensured by an evaluation plan for each goal that provides the most effective solution and prevents us from exceeding our time and budget.

Our management and operations plan includes the timeline of completing the project as well as the proposed budget for this project. This project will be overseen by the grounds superintendent Carol Hodges. This project will be carried out by Brightview which is contracted through Mercer. This contracting will make the project cost effective as Brightview employees are already employed through Mercer. Equipment for digging and replacing soil has already been purchased and is owned by Mercer University which limits the need for outside funds. Our solution is simple, sustainable, and cost effective and will positively impact students by keeping their shoes dry.

Introduction

Background and Purpose

Mercer University is a private university in Macon, Georgia. On the Macon campus there are many residential halls that house undergraduate students and a few faculty. Mercer University is built upon a hill and has a flooding problem when it rains as a result of the variety of inclines around the campus. Usually the flooding problems and other drainage issues are dealt with by Physical Plant, the maintenance organization that pairs with Mercer University. Physical Plant's mission statement is as follows,

> "The Physical Plant is a team dedicated to supporting Mercer University by providing quality services to the medical school, law school, and campus community. Customer service, through improved communications, will enable the Physical Plant to meet the needs of the University's students, faculty, staff, and the visitors to our campus."

Physical Plant has several departments: Grounds Maintenance, Events Setups Moves, Custodial Services, and Building Maintenance. Grounds Maintenance includes repairing parking lots and since our proposed solution includes drilling into the parking lot, maintenance is an integral group for this problem.

Ideally, the sidewalk between the Greek Village Dumpsters and Shorter Hall would not flood, but the lack of proper drainage causes flooding to occur. The problem causes distress for students on rainy days. This causes the sidewalk to flood which causes students to have to take alternate paths in order to avoid getting their shoes and clothes wet. The rain water quickly builds up even after only a few minutes of heavy rain and creates deceptively deep puddles.

Physical Plant can remedy this problem for the Mercer community by implementing our solution. We are proposing that a drain be implemented to redirect the water so that it does not flood onto the walkway. The drain will be linked to the storm drainage line through a series of PVC pipes to prevent further flooding.

Credibility

Sewage Solutions, LLC. is a team of dedicated engineers and designers that produce innovative solutions for any drainage and erosion issues indoor or outdoor in company settings. Our experience with design and problem solving in the engineering field makes our company the clear answer for all of your sewage-related problems.

Our lead engineer, Jarod Miller, has worked on similar projects before, designing fundamental drainage solutions for parks and other public spaces throughout middle Georgia. He has a strong sense of deadlines and perfectionism. His attention to detail, precision, and accuracy is unmatched in the industry, and he brings a well-respected team of

designers and engineers who are equally as adept in their fields.

Mo Baldwin, our communications expert and project manager, has worked with engineering firms for over 10 years, and has played an integral role in the process of internal and external communications. They are well-versed in composing documentation and other records for projects and professionally communicating with the public and with private organizations.

Our head designer, Kathryn Chunn, has had previous work with an assortment of digital designs. She adds creativity and design elements to many of our digital and physical productions. Kathryn has produced documents for various organizations throughout the technical field, for example engineering conferences, public works, and university projects.

Organization

We will be detailing our technical approach as well as our operation plan. Our technical approach will detail our goals and objectives for the drainage solution. It will also detail our solution feasibility study. In this section we will go over all the criteria created to get to this being our top and most logical solution. We will also be including our evaluation plan where we will go over how we intend to reach our goals.

Our operation plan will detail how we intend to manage and organize this project including how we intend to organize our Human Resources and labor. Our plan for implementing the solution will include a detailed schedule which will give dates for any and all major events. We will also detail our budget plan and test for quality control.

Technical Approach

Optimally, the strip of sidewalk between the Greek Dumpsters and Shorter Hall would not flood due to rainfall, but the lack of proper drainage in the parking lot causes flooding to occur. Sewage Solutions aims to propose a solution to this problem.

Goals and Objectives

In the process of the completion of this project we aim to complete the following goals:

1. The main goal of this project is to prevent flooding of the sidewalk between Shorter Hall and Greek Row over the height of 1.5 inches at the lowest point on the road.
2. The drainage flow rate should exceed 90% or the average rainwater production rate.
3. Total cost should not exceed $1000.
4. Construction should not exceed 5 business days.

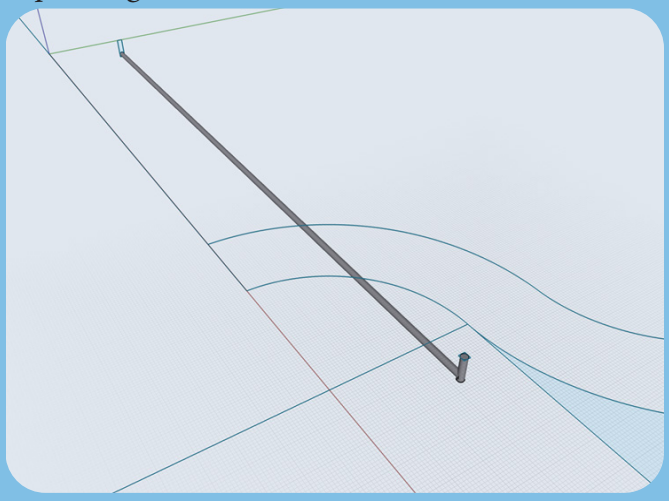
Alternative Solution

Our other original solutions were the Gutter Solution and the Porous Sidewalk Solution. The Gutter Solution included adding gutters to help redirect the flow of water. These gutters would have redirected the water so that it would flow into a previously existing storm drain. The Porous Sidewalk Solution included ripping up the existing sidewalks and adding a drain under a new porous sidewalk that would empty into a pipeline to the existing sewage line.

Solution Analysis

The criteria used to evaluate the solutions included: the construction time, cost, and how aesthetically pleasing the solution would be. The less time it took to implement the solution the better and the lower the cost the better. The solution should be as aesthetically pleasing as possible to blend in with Mercer's campus. The Porous Sidewalk Solution was determined to cost over the budget and therefore is infeasible. The gutters would require tearing up bricks and concrete to add a gutter kit across the walkway that would empty into the already existing drain about 20ft away from where it floods, impacting Mercer University's aesthetics. Gutter kits cost about $175 for a 10ft gutter at Lowes, and manual labor to install it would take 2-4 days. This option was looked over because overall the Drain Solution scored higher than the Gutter Solution in the Merit Analysis based on the fact that the Drain Solution was overall cheaper and has a smaller impact on the campus.

Figure 1: CAD Drawing of The Proposed Drain Pipe Design



Solution Description

Our solution involves adding a drain beside the walkway in the parking lot, in order to help with drainage. The water from the parking lot floods to the sidewalk, so adding the drain to the parking lot will reduce flooding. The drain will be connected to a line of PVC pipe which will connect to a preexisting storm line to redirect the flow of water so that it does not flood the walkways further (see Figures 1, 2, and 3). The materials needed are PVC, the NDS 3" Round Grate, a construction/ installation crew to be provided by Mercer University/Physical Plant, and a detailed time table to keep the process on track.

To obtain the solution, the drain would require laying down piping which would entail digging up a small strip of grass along the side of the sidewalk and connecting the pipe to the storm system. We plan to use PVC pipe because of its affordability, versatility, and durability under adverse weather conditions. Assuming the storm system runs perpendicular to our drainpipe we would need about 20ft of pipe to connect the drain.

After the drain is connected, the pipe needs to be buried at least a foot underground to prevent any damages from above. Sod would then be placed to maintain the aesthetic qualities of the area. The pipe will empty into the storm drain at the top in order to prevent any backwater from filling our drain pipe and overflowing onto the street. The PVC pipe will be cut to form a ditch for the water to enter the drain and collect at the bottom to flow directly to the storm drain. This buried stretch of PVC pipe will have a slight incline to prevent any backwater from the rain we are flowing into the existing drain system.

Equation 1 shows a model for the flow rate in storm drain systems. When applied to this system with our measurements, we get a total flow rate of 0.747 cubic feet of water per second, which is a good amount for the small area where the water accumulates. This

Figure 2: Graphic That Shows Sidewalk Before Rain

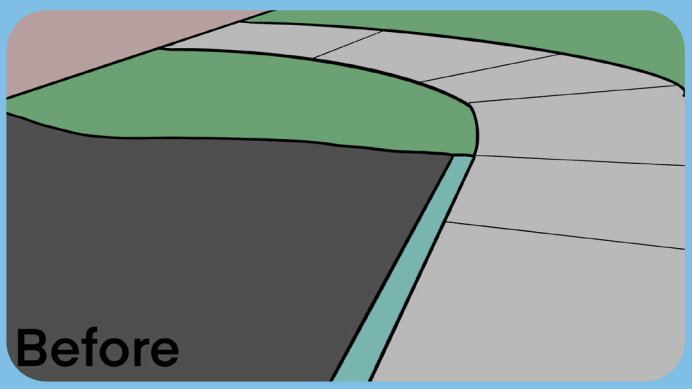
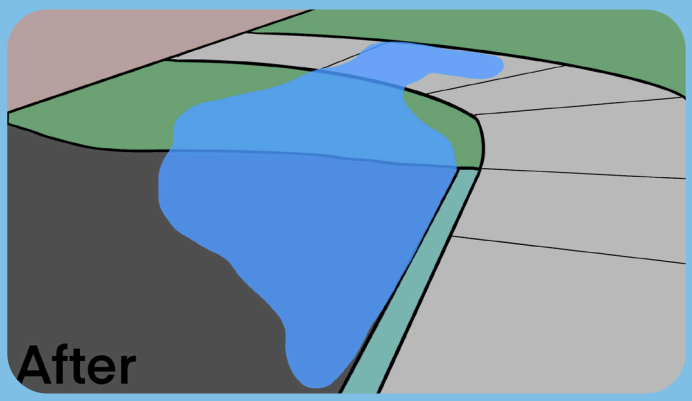


Figure 3: Graphic That Shows Flooding



Equation 1: Flow Rate Model Equation

$$Q_f = \frac{1.49}{n} A_f R_f^{2/3} S_o^{1/2}$$

Q_f = flow rate = .747 ft^3/s

n = Manning Roughness Coefficient =.01

A_f = cross sectional flow area ($\pi D^2/4$) = 0.049 ft^2

R_f = flow radius =.125 ft

S_0 = flow slope (h/d) = 0.167 ft/ft

theoretical flow rate will reduce flooding and keep the water levels to a minimum.

Evaluation Plan

The completion of our project will depend on the fulfillment of each of our goals set forth in this proposal.

1.The Main goal of this project is to prevent flooding of the sidewalk between Shorter Hall and Greek Row over the height of 1.5 inches at the lowest point on the road.

To complete this goal, we must get approval from maintenance, buy the necessary supplies, hire a team to implement the drain and PVC. We must also fix upturned landscaping to improve aesthetics.
To measure this goal, we will measure the water height over a period of time with rain and calculate the height difference to compare to the theoretical flow rate calculated in Equation 1.

Materials required include

- PVC, NDA 3" Round Grate
- PPE: safety glasses, respirator, gloves
- Cleaning and Prep: Steel wool, sandpaper, acetone, rags
- Measuring and Clamping: measuring tape, clamps, marker
- Cutting: ratcheting pipe cutter, hacksaw, recurring tool, rotary tool, spade bits, drill
- Gluing: PVC clear cement, PVC primer

2.The drainage flow rate should exceed 90% or the average rainwater production rate.

To complete this goal we will be adding in the drain and measuring the water flow rate using a change over time equation. This goal will be supervised by the Sewage Solutions Teams. To see if this is a feasible way to achieve the goal we will need to measure the flow rate both in and out over a specified amount of time. For this goal we will need the personnel, the PVC pipe, the drain, and water to measure the flow rate.

3. Not exceed a budget of $1000 dollars total.

To complete this goal, we will need to hire a maintenance crew and ensure that their time is used efficiently. We will also need to purchase reliable but inexpensive materials preferably from local stores in order to avoid high shipping costs. This process will be overseen by the Sewage Solutions Team. At the time of material purchase a budget needs to be created. The budget can be created at a time of year when prices are on average lower (such as November due to black friday). If the budget needs to be recalculated for a higher cost point in the year such as July the materials purchased must be budgeted to be the cheapest supplies that are still reliably in quality. This goal will need the management personnel, the materials such as the PVC pipe and Drain cover.

4. The solution needs to be completed within a 5 day window (One business week).

To complete this goal, the process for construction should be closely monitored and possible problems with installation should be taken into account to avoid further delays. The personnel needed to complete this task are the management crew and a project manager. The work crew foreman should

complete daily evaluations of work completed and make judgements on foreseeable problems and methods of mitigation. Adequate work materials and tools should be used to maximize efficiency and production, as well as forms and methods for work leaders to follow. A schedule and time table should be made prior to the desired work week.

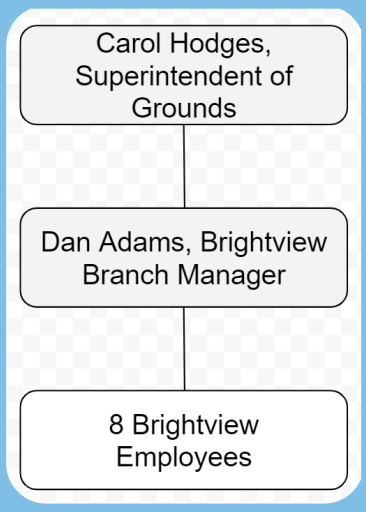
Operations Plan

If we were awarded the contract, the activities would progress as such:

Management and Operations Plan

Physical Plant Grounds Maintenance including Brightview Landscape Services, Inc., who is contracted to work with the Grounds Department, will be involved in the implementation of the solution. This project will be managed and overseen by Carol Hodges as she is the Superintendent of Grounds at Mercer University. This plan will also be carried out by Brightview's branch manager assigned to Mercer, Dan Adams, who would work in conjunction with Carol Hodges. Dan Adams will lead 8 employees, employed through Brightview, that are assigned to Mercer to complete the plan. See Figure 4 to see how the implementation team is related to one another.

Figure 4: Organization Chart



Plan Implenentation

To start off the project, the land will be surveyed to find the storm drain line and the best placement of the drain. From there the crew will be hired. Once the crew is hired and the land is surveyed the ground will be dug in preparation for the PVC pipe placement. The PVC pipe will then be placed. After this the dirt will be replaced over the PVC line and the drain cover will be attached. The final steps will be to add the drain cover, do a new land survey, and then write up the closing reports. For a visual representation of the process see Appendix A. The implementation of our solution would occur over 5 days, see Figure 5.

Figure 5: Gantt Chart

Task	10-May	11-May	12-May	13-May	14-May	15-May
Purchase Materials						
Schedule Workers for Site						
Locate and Measure Start and End for Drainpipe						
Digging Out Trench for Pipeline Lay						
PVC Pipe is assembled and placed						
Pipe is buried						
Pour replacement asphalt and concrete						
Sod is placed						

Cost Analysis Budget

A detailed budget breakdown has been created to show the cost of each individual item as well as the quantity needed (see Table 1). The maintenance crew will be hired through Mercer so their cost can be deducted from the final budget. This project has a budget of $1000 but only approximately $89.16 with the cost of the maintenance team being negligible and assuming that Mercer already owns all of the tools needed to implement the solution. Which would leave a $8.92 contingency fund. The cost analysis shows how cost efficient our solution is.

Table 1: Cost Analysis

Category	Item	Description	Source	Price	Quantity	Cost
Materials	PVC	The piping that will be used to connect and move the water from storm runoff towards the storm line.	The PVC will be coming from Lowes Department store.	10 ft of the PVC pipe will cost $13.76.	We will need an absolute minimum of 20 feets but to ensure that there will be enough 30ft will be purchased.	The total cost of the PVC will equal out to $41.28 excluding shipping and taxes.
Materials	Drain Cover	The drain cover will be used to cover the opening of the PVC piping to make the terrain safe and visually appealing.	The Drain Cover will come from Lowes department store.	One 4” drain cover will cost $3.18.	We will Only Need a singular drain cover.	The total cost of the drain will be $3.18 before shipping and taxes.
Personnel	Maintenace Crew	The maintenance crew will be installing the PVC and Drain cover as well as attaching the piping to the storm line.	The maintenance crew will be hired through Mercer Contracting.	Employees will be paid at an hourly rate.	We will be hiring a team of at least 8 members to be able to complete this project within the original window.	If each employee was paid the minimum wage per hour assuming they worked 8 hours for five days it would cost roughly $300 per person. Making the total labor cost around $2,400.
Materials	Sod	Sod will be used to reestablish the campus aesthetic back to its original potential.	Sod will be purchased from The Home Depot.	A single 2ft square of sod costs $2.98.	We will need a minimum of 20ft of Sod to restore the ground but 30ft will be purchased to ensure there is enough to cover the entire disrupted area.	Given the need for 30 feet of sod the total sod cost will come to $44.70.
						The cost of the maintenance team is negligible.
Subtotal						**$89.16**
Contingency						**$8.92**
Grand Total						**$98.08**

Quality Control Plan

None of these materials are assumed to need replacement other than the sod which may regularly need to be replaced each year. The PVC and drain cover should ideally be a permanent solution that won't need replacement. However, to ensure proper drainage over time the drain cover should be cleaned of debris (such as leaves, dirt, and trash) at least once per month. These cleanings should be a routine process each month that can be implemented simply by power washing the drain cover and returning it to its proper placement.

In the event that parts need to be replaced, the entire process of digging up the PVC pipes and placing them will need to be redone. Plans for this should be conducted in the same manner as the original placement of the piping excluding the costs of extra piping and the drain cover (assuming it's not also damaged.)

Quality control will be conducted by the project manager to ensure there is little need for further renovation of the piping or drain cover.

Conclusion

The sidewalk and road beside Shorter Hall and Greek row (adjacent to Adams Street) has a severe flooding problem that leaves students and staff unable to traverse the path if there is anything more than a short light rain shower. This flooding can reach over an inch in depth if it is caused by a prolonged period of rain.

To solve this problem, we have recommended that a drain and pipe system be implemented to redirect the rain and runoff. This is a relatively simple and cheap solution to a problem that affects all students.

If the cost of the maintenance crew is excluded from our total cost (due to the contacting company already being hired through Mercer's maintenance services our total cost would come out to less than $100 making this a very affordable solution. This also leaves extra room within the budget in case extra supplies need to be purchased or an outside crew needs to be taken on to help finish the construction.

Due to the small nature of the project it can be estimated that the project will take less than five business days but could likely be completed over two days if proper scheduling is done and things move smoothly without much interference.

This is an important issue with a simple and cost effective solution. If this problem helps the general student and staff body it will be worth the time and money to place the pipe and drain. This solution could also be used at other locations on campus if it is effective. Mercer has flooding issues in several places on the campus and if this proves to be an effective solution it could easily be implemented in all the other flooding areas. An example of where this solution could also be effective is on College Street by MEP.

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References

Chapter 28.40 storm DRAIN SYSTEMS. (n.d.). Retrieved March 25, 2021, from https://www.codepublishing.com/CO/GrandJunction/html2/GrandJunction28/GrandJunction2840.html

NDS 3-in or 4-in dia Round Grate. (n.d.). Lowes.Com. Retrieved March 24, 2021, from https://www.lowes.com/pd/NDS-3-in-or-4-in-dia-Round-Grate/50077469

Oxford languages and Google - English. (n.d.). Retrieved March 25, 2021, from https://languages.oup.com/google-dictionary-en/

Appendicies

Appendix A: Phases Plan Layout