

EPICS®

Design Document

Team: Water Resource Management

Project: Happy Hollow Park

Date: Fall 2013 -Present

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2 Revision History

Date	Author	Revisions Made
9/13/13	Douglas Milani	Title Page (N/A)
9/18/13	Douglas Milani	Semester Documentation (Sec. 6)
9/25/13	Douglas Milani	Overall Project Design (Sec. 5.6)
9/25/13	Ashley Ancil	Project Charter (Sec. 4)
9/26/13	Ashley Ancil	Design Status and Overall Project Design (Sec 6.2)
11/14/13- 11/19/13	Douglas Milani	Resetting Template Format, (Entire Document) Updated Design Phase and Semester Documentation (5.5-5.6 and Sec. 6)
12/5/13	Douglas Milani	Minor Spelling and Grammar Edits (Sec. 4.1-4.2 and Sec. 5.6)
1/24/14	Douglas Milani	New Semester Update (Sec.6 and Sec. 7)
2/14/14	Douglas Milani	Update of Design Status and General Comments (Sec. 3, Sec. 4.2-4.5, Sec. 5.5-5.6, and Sec. 6.1-6.5)
2/22/14	Douglas Milani	Update Project Charter and Overall Project Design (Sec. 3, Sec. 4.3-4.5, Sec.5.5-5.6, and Sec. 6.3-6.5)
4/19/14	Douglas Milani	Update Project Charter, Overall Project Design, and Semester Documentation (Sec. 4.2, Sec. 4.5, Sec.5.4-5.6, Sec.6.2, Sec. 6.4, and Sec.6.6)
9/26/14	Sabre Jones	Update Team members' contact information and update "Brainstorm several possible solutions" status. (Sec.5.4, 6.1)
9/26/2014	Sabre Jones	Updated the Project Budget for this semester, Fall 2014, as well as the predicted budget for spring 2015. (Sec. 6.5)
9/26/14	Sabre Jones	Update of Project Objectives and Outcomes to include public education. (Sec. 4.3 and 4.4)
9/27/14	Meiyi Guo	Update of public education project outcome
9/27/14	Meiyi Guo	Update of description of overall project timeline (Sec 4.5)
9/27/14	Meiyi Guo	Changes to location of documents (Sec 5.4, Sec 5.5)
11/17/14	Sabre Jones, Meiyi Guo	Fix the format of Design Document (N/A)
11/19/14	Meiyi Guo	Update of project progress (Sec 5.4)

		Update of semester plan (Sec 6.4)
12/07/14	Meiyi Guo	Update of Design Status Summary (Sec 3) Update of Outcomes/Deliverables (Sec 4.4) Update of Phase Three (Sec 5.4) Update of Phase Two (Sec 5.5) Update of Current Status and Location on Overall Project Timeline and Semester Timeline (Sec 6.2, Sec 6.4) Update of Transition Report (Sec 6.6) Update of Past Semester Archive (Sec 7)
12/07/14	Sabre Jones	Spelling, grammar and content edits (Sec 5.4, Sec 6.2, Sec 6.3, Sec 6.4 and Sec 6.6) Update of semester expenses in Semester Budget (Sec 6.5)
2/11/15	Andrew Huang	Update of project progress (Sec. 5.4) Update of Phase Three (Sec 5.4), Update of Phase 1 (Sec 5.6) Updated Semester Documentation (Sec. 6.1, Sec. 6.2, Sec. 6.3, Sec. 6.4, Sec. 6.5) Created Past Documentation file (Sec. 7.3)
2/14/15	Andrew Huang	Update of project progress (Sec. 5.4) Update of Semester Documentation (Sec. 6.1, 6.2, 6.3)
3/2/15	Andrew Huang	Updated Phase 1, 2, 3 (Sec 5.4-5.6)
3/27/15	Robert Bays	Updated all properties of conceptual design since it was completed (Sec 5.4) Updated Design Status Summary (Sec 5.4) Revised Stakeholders to Reflect Current Stakeholders Updated Revision Dates Updated Confirmation to Detailed Design (Sec 5.3)
4/3/15	Robert Bays	Updated Detailed Design (Sec 5.3) Updated Semester Documentation (Sec 7)
4/10/15	Robert Bays	Updated Semester Documentation (Sec 7) Updated Logo
4/16/15	Robert Bays	Updated transition documentation (Sec 6.6.1) Updated budget (Sec 6.5)
4/17/15	Andrew Huang	Updated Semester Documentation (Sec 7) Updated Phase 4 (Sec 5.3) Minor spelling/grammar edits
4/30/15	Andrew Huang	Minor File Naming edits Edits to Phase 4 (Sec 5.3)

5/1/15	Andrew Huang	Updated Stakeholders Updated Phase 4 (Sec 5.3) Updated Phase 3 (Sec 5.4) Updated Project Timeline Location (Sec 4.5) Updated the entirety of Current Semester Documentation (Section 6)
9/26/15	Scott Quillen Callum Wayman	Updated Phase 4 (Sec 5.3) Updated Past Semester Documentation (Section 7) Updated Project Timeline Location (Sec 4.5) Updated the entirety of Current Semester Documentation (Section 6) Updated Semester Budget (Sec 6.5)
9/28/15	Scott Quillen	Updated Transition Document (Sec 6.6.1) Updated Semester Timeline Location (Sec 6.4)
11/09/15	Pablo Schwiep	Updated Current Status (Sec 6.2) Updated Phase 4 (Sec 5.3)
11/20/15	Pablo Schwiep Callum Wayman	Updated Phase 3 (Sec 5.4) Updated Current Status and Location on Overall Project Timeline (Sec 6.2) Updated Goals for the Semester (Sec 6.3) Updated Semester Timeline (Sec 6.4)
12/1/15	Andrew Huang	Updated Phase 4 (Sec 5.3) Updated Current Status of Semester Plan (Sec 6.2) Updated Goals for the Semester (Sec 6.3)
2/13/16	Andrew Huang	Updated Project Charter (Sec 4) Updated the entirety of Semester Documentation (Sec 6) Updated Project Timeline Location (Sec 4.5) Updated Phase 4 (Sec 5.3) Updated Section 7 (moved old semester over)
4/16/16 - 4/17/16	Monica Moran, Andrew Huang	Updated Phase 4 (Sec 5.3) Updated the entirety of Semester Documentation (Sec 6)
09/23/16	Blaire Coleman	Updated Phase 4 (Section 5.3)
12/02/16	Matt Springer, Monica Moran, Stephanie Verhoff, Andrew Huang, Blaire Coleman	Updated Entire Section 6 Updated Phase 4 (Sec 5.3) Updates Section 7 (moved old semester over)
12/16/16	Andrew Huang	Updated Project Charter (Sec 4) Updated Phase 5 (Sec 5.2) Updated Entire Section 6 Fixed Headings and Table of Contents
2/16/17	Benjamin Eaton	Updated Semester Documentation (Section 6) Updated Section 7 (moved previous semester)

2/19/17	Andrew Huang	Updated Phase 5 (Sec 5.2) Updated Section 6
4/6/17	Benjamin Eaton	Updated Semester Documentation (Section 6)

3 Design Status Summary

Phase 6: Service / Maintenance	Status:
<i>Gate 6: Project Partner and Advisor approve continued fielding of project. If not, retire or redesign.</i>	
Date of Advisor approval:	

Phase 5: Delivery	Status: In Progress
<i>Gate 5: Continue if Project Partner, Advisor and EPICS Admin agree that project is ready for delivery!</i>	
Date of Advisor approval:	

Phase 4: Detailed Design	Status: Complete
<i>Gate 4: Continue if can demonstrate feasibility of solution (is there a working prototype?). Project Partner and advisor approval required.</i>	
Date of Advisor approval:	

Phase 3: Conceptual Design	Status: Complete
<i>Gate 3: Continue if project partner and advisor agree that solution space has been appropriately explored and the best solution has been chosen.</i>	
Date of Advisor approval:	3/13/15

Phase 2: Specification Development	Status: Complete
<i>Gate 2: Continue if project partner and advisor agree that you have identified the “right” need, specification document is completed and no existing commercial products meet design specifications.</i>	
Date of Advisor approval:	12/12/14

Phase 1: Project Identification	Status: Complete
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Gate 1: Continue if have identified appropriate EPICS project that meets a compelling need for the project partner.

Date of Advisor approval:

2/14/14

4 Project Charter

4.1 Description of the Community Partner

The community partner for this project is the Parks and Recreation Department for the City of West Lafayette. Dan Dunten is the Director of the Lilly Nature Center at the Parks and Recreation Department and is in charge of maintaining Happy Hollow Park. The Parks Department is in need of a way to improve Happy Hollow because of the erosion that is beginning to impact the look and functionality of the park. Dead trees at risk of falling in the park pose potential liabilities to users of the park. This can cause people to complain to the Parks Department and potential injuries could even arise from this issue.

It is the goal of the project partner to implement measures to mitigate erosion that could affect park goers. Mr. Dunten has requested that the team determine in what order the problems should be addressed and work on proposals to address small projects as opposed to larger projects that can be costly to implement. Any solutions to the problem presented to the Parks department will address the issue of erosion and benefit multiple parties. The primary beneficiary will be the project partner. By reducing erosion and sediment build up on the trails and stream bed, there will be less maintenance needed on the park by the employees of the parks department. This will provide a more enjoyable experience for visitors to the park and should ultimately make the park look more aesthetically pleasing.

4.2 Stakeholders

West Lafayette Parks and Recreation Department for the City of West Lafayette

West Lafayette Parks and Recreation Department is the primary stakeholder for the Happy Hollow Park project. Dan Dunten is our primary contact with the Parks Department and is in charge of managing Happy Hollow Park from an educational standpoint. Dan is concerned with the team finding which erosion problem in the park is the one that we should focus on and tackle first. He is our contact who approves whatever solution is delivered to apply for grants and fix the erosion problem within the park.

Residents of West Lafayette and Tippecanoe County

Local citizens are important stakeholders because they are the primary users of the park and the residents of West Lafayette pay fees that contribute to the maintenance of the park. Residents need a solution to the erosion problem that will not limit how they can use the park, but simply make it safe and still aesthetically pleasing place once the erosion issues have been tackled. It is important to avoid tearing down trees or negatively affecting wildlife that is important to residents who want the park to be preserved.

Additionally, there are stakeholders who live on the outer edges of the park who will be affected if the erosion problem worsens. These homes are contributing to the current problem by not employing practices that could reduce run off from their homes into the park. These residents and users are not concerned with a specific approach and would be most affected by any educational practices implemented to provide information about the problems in the park.

Happy Hollow Park's Adjoining Communities

The residents of Happy Hollow Park will be impacted by our project because it will help protect their home from future damage. Although it would take a long time for the soil to degrade to the point where it threatens the foundation of the housing, the erosion is still impacting their property and still is a concern. The aesthetics of the surrounding areas will be compromised if we allow this problem to continue. The residents of Happy Hollow need to be informed with regards to the solution that we are implementing on site. Many Happy Hollow residents also put their gutter drains directly into the park, exacerbating erosion issues within the park during rain events.

Happy Hollow Park Users

There are many ways to use Happy Hollow Park. The park serves as a fantastic opportunity for recreational activities like hiking, biking, walking, etc. Those who utilize the trails of the park for such activities could be impacted by the erosion because the erosion is slowly destroying the possibility of even having trails. Without quality trails, the users of Happy Hollow will become dissatisfied. We as a team need to keep the users of Happy Hollow Park in mind when designing our solutions so that those who use the trails can continue to do so.

Wildlife

The animals living in the park, including insects, deer, and squirrels will be affected by any possible solutions. The main interest of the animals is to have a proper environment to live in. When trying to solve the erosion problem we have to take into consideration where the animals would stay and how we plan on preserving the vegetation that grows there. Certain animals, such as deer, could be a much more important focus of our project because they may eat the vegetation that could be placed in the park as a solution.

4.3 Project Objectives

EPICS has partnered with the City of West Lafayette in order to reduce erosion at Happy Hollow Park and create public awareness of the problem. The erosion of the stream banks as well as the hills around the trail is greatly affecting the park from both an environmental and an aesthetic standpoint. Sediment from the park is being sent to the Wabash River and affecting the quality of the water. This is a great concern for the Wabash River Enhancement Corporation as well as the Parks department.

Additionally, the erosion of the hillside is a significant problem. Currently, water is carrying sediment down the hillside, onto the trail, and eventually into the stream. This causes safety concerns for users of the park and for homeowners on the hillside.

The park, as well as those who take care of the park, will benefit from reduced erosion in many ways. There will be less frequent maintenance and clean up on the trails, the hillside will be able to hold more vegetation, tree roots will remain undisturbed, reducing the likelihood of fallen trees, and there will be less sediment carried to the stream.

4.4 Outcomes/Deliverables

The main outcome is to reduce erosion around Happy Hollow Park. Our project seeks to do this by providing a solution that focuses on reversing the processes of hill slope erosion. Our vision is a design solution that is cost-effective, easily implemented, and effective at reducing runoff on hill slopes and provides public education of the issue. Our final deliverables for this solution are as follows:

1. Testing Methods of Solution
2. Information Regarding the Limits and Abilities of the Solution
3. Plan for Constructing and Implementing the Solution
4. Develop Information to Educate the Public about Erosion and our Project

We plan on achieving these outcomes through the implementation of an erosion solution on three hills that are uniquely positioned to better the park goes of Happy Hollow Park. One hill directly overlooks the parking lot, which during large rain events will be able to inundate the parking lot with sediment. The other two hills are close to where the park trail exits the park near the playground. These hills have had soil creep and gully erosion happening and can sometimes wash lots of sediment onto the trail. This is an issue for hikers and bikers who use said trail.

4.5 Overall Project Timeline

The current overall timeline of the project is located:

The WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “Design Process Documentation.” It is the file labeled “HHProjectTimelineAKH20160201.”

5 Overall Project Design

5.1 Phase Six

Phase 6: Service / Maintenance	Status:	Evidence can be found:
<ul style="list-style-type: none">• Evaluate performance of fielded project		
<ul style="list-style-type: none">• Determine what resources are necessary to support and maintain the project		
<i>Gate 6: Project Partner and Advisor approve continued fielding of project. If not, retire or redesign.</i>	Decision:	Rationale summary:
Advisor approval:	Yes / No	Date:

Narrative of Service/Maintenance:

5.2 Phase Five

Phase 5: Delivery	Status:	Evidence can be found:
<p>Goal is to refine detailed design so as to produce a product that is ready to be delivered! In addition, the goal is to develop user manuals and training materials.</p>		
<ul style="list-style-type: none"> Complete deliverable version of project including Bill of Materials 	<p>In Progress</p>	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “4 Detailed Design”, in the sub-folder "Working". It’s the document labeled:</p> <p>“HHPBOMAKH20160417”</p> <p>SLG Grant (Detailed Design and Delivery): “HHPDuntenSupportAKH20160417” “HHPEngelSupportAKH20160417” “HHPEngelSupportSignedAKH20160417” “HHPSLGGrantBudgetAKH20160417” “HHPSLGMainGrantAKH20160417” “HHPSLGTimelineAKH20160417” “HHPTest2LayoutAKH20160319”</p>
<ul style="list-style-type: none"> Complete usability and reliability testing 		<p>WRM Team Page of EPICS SharePoint site under “Semester Documentation” in the folder “Happy Hollow Park” in the sub-folder “Dumping,” It’s the document labeled: PlantDecisionWriteup_Delivery</p>
<ul style="list-style-type: none"> Complete user manuals/training material 		
<ul style="list-style-type: none"> Complete delivery review 		

<ul style="list-style-type: none"> Project Partner, Advisor, and EPICS Admin Approval 		
<i>Gate 5: Continue if Project Partner, Advisor and EPICS Admin agree that project is ready for delivery!</i>	Decision:	Rationale summary:
Advisor approval:	Yes / No	Date:

Narrative of Delivery phase:

Spring 2016:

We applied for the SLG Grant in Spring 2016, which can be used for large-scale implementation across Happy Hollow Park.

Fall 2016:

During Fall 2017, we outlined the scope of our delivery by sitting down with the project partner to determine exactly what was to be delivered. We've decided that there will be implementation onto three hills within the park. The team is looking into what plants to procure for the site and are looking into a combination of methods of not only temporary structures like berms to help allow plants to re-establish, but are also looking into "harder" manmade materials like gutters to place plants to allow them to grow. The team is looking into delivery of an education component, which includes outreach to the residents around the park and allows visitors at the Lilly Nature Center to understand what we're doing, what the West Lafayette Parks and Recreation Department is doing, and how citizens can help.

5.3 Phase Four

Phase 4: Detailed Design	Status: In Progress	Evidence can be found:
Goal is to design working prototype which meets functional specifications.		
<ul style="list-style-type: none"> Bottom-Up Development of component designs 	Completed	WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “4 Detailed Design”, in the sub-folder “Working”. It’s the document labeled: “HHPBottomUpDesignRLB20150306”
<ul style="list-style-type: none"> Develop Design Specification for components 	Completed	WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “4 Detailed Design”, in the sub-folder “Working”. It’s the document labeled: "HHPLoadingLayoutAKH20150407" " HHPLThiaDataAKH20150331" "HHPProjectProposalAKH20150417" " HHPSolutionReasoningAKH20150430" "HHPProposedTest2LayoutAKH20160213" "HHPSampleMonolithsCoresAKH20160213" "HHPPotentialPlantsMM20160213" All files in "Sampling_OriginalMethods"
<ul style="list-style-type: none"> Design/analysis/evaluation of project, sub-modules and/or components (freeze interfaces) 	Completed	WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “4 Detailed Design”, in the sub-folder “Working”. It’s the document labeled: "HHPLoadingLayoutAKH20150407" "HHPProjectProposalAKH20150417" "HHPLThiaDataAKH20150331" " HHPExperimentalSignBOS20150416"
<ul style="list-style-type: none"> Design for Failure Mode Analysis (DFMEA) 	Completed	WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “4 Detailed Design”, in the sub-folder “Working”. It’s the document labeled: "HHPDFMEA AKH20150417" "HHPDFMEA AKH20160213"

<ul style="list-style-type: none"> • Prototyping of project, sub-modules and/or components 	<p>Complete</p>	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “4 Detailed Design”, in the sub-folder "Working". It’s the document labeled: “HHPDesignEducationFlyerBOS20150306” and “HHPDesignEducationSignBOS20150306” “HHPLoadingLayoutAKH20150407” “HHPProposedTest2LayoutAKH20160213”</p>
<ul style="list-style-type: none"> • Test Plot Analysis Methods 	<p>In Progress</p>	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “4 Detailed Design”, in the sub-folder "Working". It’s the document labeled: “HHPWeightAnalysisRLB20150313” “HHPProjectProposalAKH20151117” “HHPFollowUpAKH20150501” “HHPQuantificationDiagramAKH20151120” “HHPTestPlotsCRW20151120” “HHPWEPPAnalysisAKH20151201” “HHPManningsEquation20151201” “HHPManningEqnGuideAKH20151026” “HHPNRCStandardsandSpecificationsPHS20151109” “HHPNrcsStandPass-FailPHS151109” “HHPWEPPCatchmentAKH20151201” “HHPLayoutWEPPFinalModelAssumptionsAKH20160417” HHPTestingProcedureFinalizedAKH20160417</p>
<p><i>Gate 4: Continue if can demonstrate feasibility of solution (is there a working prototype?). Project Partner and advisor approval required.</i></p>	<p>Decision:</p>	<p>Rationale summary:</p>
<p>Advisor approval:</p>	<p>Yes / No</p>	<p>Date:</p>

Spring 2015

After transitioning from conceptual design phase to detailed design phase halfway through the semester, we have delivered our first "prototype" on our test plot. We have three tests running. One test implements all of the solutions that we tried to implement. The second test implements just plain seeding of the hill-slope, to measure the amount of soil that would just be held by plants without any aid. The third test just measures the amount of soil that would be trapped behind the log. Andrew has worked heavily on optimizing our design to ensure that the placement between logs and other intricacies are all calculated and measured. We have our detailed design specifications, with a rough schematic of how everything is assumed to work together.

Because we were unsure whether we were going to deliver a prototype, we created a Project Proposal which was going to set the next team up for future success. Because we have delivered a prototype, the project proposal will serve as a great place for the future team to transition. It details what the park is and what we have done to get a prototype onto the hill. It also creates a place for the future team to quantify the amount of change that we have made. The rest of the hillside will serve as a "control", while the three tests that we run will allow us to see the amount of change that we have made due to the sediment buildup behind our logs/berms and the amount of growth from the grass we have seeded the hillside with. There are excess materials located within the EPICS lab that is for us, including the giant erosion berms, the erosion mats, and extra stakes. The future team should look into purchasing more compost, stakes, and grass seed in case something goes wrong (like if seeds do not take, etc). The DFMEA should be the first thing that needs to get edited, as it lacks in some eventualities.

Fall 2015

This semester we continued work in the detailed design phase. We completed a DFMEA for failure analysis of last semester's prototype as well as our prototype. After observing last semester's prototype, our group has decided to make amendments to the design plan in order to try and fix the issues with last semester's prototype. We have researched past methods used to help farmers, ranchers, and forest landowners with plots of land in conjunction with nature called the NRCS Standards. We compared our methods to the NRCS Standards to see if we were using standard methods for hill-slope erosion.

We developed a testing procedure to analyze test plots on the hill-slope and compare the effectiveness of prototype components. The procedure for analyzing the components provides data on the test plot being analyzed, showing its ability to withstand degradation, and its ability to capture soil. We took measurements at the site that reflected the parameters we had created, and created graphical representations of our findings so that relative comparisons of effectiveness could and can be made to test plots that have and will be implemented.

The quantitative analysis was documented so that others can replicate the procedure and continue to refine the test prototypes on the hill to find the most efficient and effective method for mitigating hill slope erosion. We also wrote a proposal for the next three test sites that should be implemented and tested next semester. The test sites use three different combinations of components that will slow erosion. The testing procedure will judge how effective these test plots were, and what components are the most useful for capturing sediment. The comparison of future test plots with previous ones will allow for the streamlining of a final deliverable prototype that can be implemented throughout the park. Additionally, we've

done more analysis with regards with site specifics, including using models and other analysis tools from governmental organizations.

Spring 2016

This semester, we completed the site layout. We are doing additional testing of the site by implementing seven differing layouts of similar materials to those of last semester, so that we have a better understanding of the layout of potential factors on the hill-slopes that we may be dealing with. From observation, our site has started to have both soil erosion factors like soil creep (where the entirety of the hillside moves down) as well as gullying (where large amounts of water travel down the hillside and wash away soil in a concentrated channel). Due to recommendations from last semester's design review, we decided to revisit the types of plants and soil mixture to use on the hillside to help ensure growth, as this was likely the issue with last year's design. These now include a combination of grasses and perennial herbs as well as compost. This will allow nature to select the best plants to succeed on the hillslope.

Fall 2016

This semester, we have selected and ordered saplings for the hillslope based on the list of native plants formed last semester, analyzed the water flow down the hill-slope to find the best erosion preventative methods, found ways to prevent park users from tampering with the hill-slope, and formulated the best method for informing the neighboring homes about the project and what they can do to prevent future damage to the park, and their homes.

The three plants that we have ordered and implemented are: Spicebush, Flowering Dogwood, and Allegheny Serviceberry. Our team is also planning on ordering plants next semester for better prices. The plants ordered next semester will be planted and monitored on the original North Hill as well as our newly chosen Middle Hill and South Hill.

In addition to planting saplings, our team also used Arc-GIS (the Arc-Hydro toolbox) to analyze water flow down the hill and identified the flow of the water. We also gathered soil samples to be analyzed to see the health of the hill and predict solutions that would improve the likelihood of plant survival on the hill. We have sent two samples to A&L laboratories and have done a more detailed pH analysis in a lab on our own. We found that our pH levels in all three of the hills are higher than would be acceptable for our plant species we have implemented.

One of the indicators we noticed on the hill was the presence of litter, which indicated the presence of park users on the hill, which could harm the fragile environment and make it difficult to establish new plants. Our team has designed signs to discourage park users from disturbing the hill, and there are currently three signs installed on the original North Hill.

Finally, to share the importance of the project and inform users on how they can help slow erosion by reducing runoff, our team has designed a pamphlet and a door hanger to share with the public. These items give a brief description of the problem and the results of leaving the problem as it is. Then it informs the public about the results of finding solutions to slow erosion, and how they can help the park and the EPICS team, solve the problem and improve overall park health. We plan to deliver these once they go through the final review process.

5.4 Phase Three

Phase 3: Conceptual Design	Status: Completed	Evidence can be found on:
<p>Goal is to expand the design space to include as many solutions as possible. Evaluate different approaches and selecting “best” one to move forward. Exploring “how”.</p>		
<ul style="list-style-type: none"> Complete functional decomposition 	Completed	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “3 Conceptual Design”, in the sub-folder “Final”. It’s the document labeled “HHPFunctionalDecompositionAKH20150211Final”</p>
<ul style="list-style-type: none"> Brainstorm several possible solutions 	Completed	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “3 Conceptual Design”, in the sub-folder “Final”. Click the folder labeled “Prior Art.” It is the document labeled “HHPContextPriorArtBrainstormingAKH20150217Final”</p>
<ul style="list-style-type: none"> Prior Artifacts Research 	Completed	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “3 Conceptual Design”, in the sub-folder “Final” and are all the files in the sub-subfolder “Prior Art”</p> <p>More information can be found on the WRM Team Page of EPICS SharePoint under “Project Documentation” in the folder “1 Happy Hollow Park” in the subfolder “3 Conceptual Design” in the subfolder “Final.” It includes the documents “HHPPriorArtifactsBiomassAKH20150217Final”, “HHPPriorArtifactsErosionPlantsAKH20150217Final” “HHPPriorArtifactsHydroSlurryAKH20150217Final” “HHPCostCalculationsRLB20150221Final” “HHPLThiaDataAKH20150301Final” “HHPSoilTestingXDL20150214Final” “HHP ErosionPlantResearchXDL20150221Final” And “HHPTestPlotSoilDataXDL20150217Final”</p>
<ul style="list-style-type: none"> Create prototypes of multiple concepts, get feedback from users, refine specifications 	Completed	<p>WRM Team Page of EPICS SharePoint under “Project Documentation” in the folder “1 Happy Hollow Park” in the subfolder “3 Conceptual Design” in the subfolder “Final” It includes the documents “HHPEducationalFlyerBOS20150221Final” “HHPEducationalSignBOS20150222Final” “HHPPrototypeDiagramAKH20150217Final” “HHPPrototypingProposalAKH20150303Final”</p>

<ul style="list-style-type: none"> Evaluate feasibility of potential solutions (proof-of-concept prototypes) 	Completed	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “3 Conceptual Design”, in the sub-folder "Final" and are all the files in the sub-subfolder "Prior Art"</p> <p>More information can be found on the WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "3 Conceptual Design" in the subfolder "Final" It includes the document "HHPProofofConceptAKH20150217Final"</p>
<ul style="list-style-type: none"> Choose "best" solution 	Completed	<p>WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "3 Conceptual Design" in the subfolder "Final" It includes the documents "HHPBestSolutionRationaleAKH20150217Final" and "HHPBestSolution-WDMAKH20150217Final"</p>
<p><i>Gate 3: Continue if project partner and advisor agree that solution space has been appropriately explored and the best solution has been chosen.</i></p>	Decision: Move to Detailed Design Phase	<p>Rationale summary: The team has appropriately explored and chose the best possible solution for Happy Hollow Park. We have confirmed this with our project partner and our advisor.</p>
Advisor approval:	Yes / No	Date: 3/13/15

Spring 2015

So far this semester, due to poor transitioning from last semester, we struggled with what we needed to do on this project, so we spent a lot of time reviewing the project. We plan on dividing the team up into two teams, with one large group concerned with the actual implementation of our solution, and with one small group working on the educational component that Dan Dunten wanted us to provide for our project. For our plan, we plan on using vegetation, erosion mats, and retention logs as our prototype this semester to determine what the best solution would be. We hope to implement this by the end of the semester. We finished conceptual design and moved the project to detailed design on 3/14/2015. For a more current status on what we have done for the rest of the semester (a vast majority of our work is from the second half of the semester), look at the summary for Spring 2015 in Detailed Design.

Fall 2014

Followed by the prior art research that the team completed in Spring 2014, the Happy Hollow Park Project decided to go to the City of Lafayette Park Board to present our conceptual ideas to receive

permission to test the ideas on site. We divided the team into 3 subgroups. Group 1 and group 2 focused on brainstorming different solutions to prevent the hill slope erosion problems Group 3 focused on brainstorming ideas to educate the public about erosion and to prevent further damage and erosion in the park.

We asked their approval for a minimum experimental plot area with 100 square feet and briefly explained our brainstorming solutions. The West Lafayette Park Board agreed with our idea and Happy Hollow Park project could start to run testing prototypes in the early spring of 2015. The park board also advised that it was possible for the team to run different solutions instead of testing the “best” solution, so we had three different phases for our “best” solution to adjust the changes of hill slope development. Once we were granted permission to prototype on the hillside, we began finalizing our solution. Our proposed solution requires the collection of data in order to calculate the peak flow on the hill. To obtain this and other data, we visited the park to conduct a land survey, collect soil samples and document various pictures. This data will be used to create a site profile for future reference and use with the L-THIA software. A Power Point Presentation on the L-THIA software can be found on the WRM Team Page of EP-ICS SharePoint site under “Semester Documentation” in the folder “Fall 2014” and is the document labeled “L-THIA Presentation.”

5.5 Phase Two

Phase 2: Specification Development	Status: Completed	Evidence can be found:
<p>Goal is to understand “what” is needed by understanding the context, stakeholders, requirements of the project, and why current solutions don’t meet need, and to develop measurable criteria in which design concepts can be evaluated.</p>		
<ul style="list-style-type: none"> Understand and describe context (current situation and environment) 	<p>Completed</p>	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “2 Specification Design”, in the sub-folder "Final" and are all the files in the sub-subfolder "Prior Art"</p> <p>More information can be found on the WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the sub-folder "2 Specification Design" in the subfolder "Final." It includes the documents "HHPCContextStakeholdersAKH20150217Final", "HHPCContextTaskAnalysisAKH20150217Final"</p>
<ul style="list-style-type: none"> Create stakeholder profiles 	<p>Completed</p>	<p>WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "2 Specification Design" in the subfolder "Final." It is the document "HHPCContextStakeholdersAKH20150217Final"</p>
<ul style="list-style-type: none"> Create mock-ups and simple prototypes: quick, low-cost, multiple cycles incorporating feedback 	<p>Completed</p>	<p>WRM Team Page of EPICS SharePoint site under “Project Documentation” in the folder “1 Happy Hollow Park” in the sub-folder “2 Specification Design”, in the sub-folder "Final" and are all the files in the sub-subfolder "Prior Art"</p> <p>More information can be found on the WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the sub-folder "2 Specification Design" in the subfolder "Final." It includes the documents "HHPCContextStakeholdersAKH20150217Final", "HHPCContextTaskAnalysisAKH20150217Final"</p>
<ul style="list-style-type: none"> Develop a task analysis and define how users will interact with project (user scenarios) 	<p>Completed</p>	<p>WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "2 Specification Design" in the subfolder "Final." It is the document "HHPCContextTaskAnalysisAKH20150217Final"</p>

<ul style="list-style-type: none"> Identify other solutions to similar needs and identify benchmark products (prior art) 	Completed	WRM Team Page of EPICS SharePoint site under "Project Documentation" in the folder "1 Happy Hollow Park" in the sub-folder "2 Specification Design", in the sub-folder "Final" and are all the files in the sub-subfolder "Prior Art"
<ul style="list-style-type: none"> Define customer requirements in more detail; get project partner approval 	Completed	WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "2 Specification Design" in the subfolder "Final." It is the document "HHPContextCriteriaConstraintsAKH20150217Final"
<ul style="list-style-type: none"> Develop specifications document 	Completed	WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "2 Specification Design" in the subfolder "Final." It includes the documents "HHPSpecificationPlotDataAKH20150217Final", "HHPContextCriteriaConstraintsAKH20150217Final" and "HHPSpecificationSurveyAKH20150217Final"
<ul style="list-style-type: none"> Establish evaluation criteria 	Completed	WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "2 Specification Design" in the subfolder "Final." It is the document "HHPContextCriteriaConstraintsAKH20150217Final"
<p><i>Gate 2: Continue if project partner and advisor agree that you have identified the "right" need, specification document is completed and no existing commercial products meet design specifications. [This includes their agreeing that you have captured and documented the critical requirements and specifications for this project]</i></p>	Decision: Move to Conceptual Design Phase	Rationale summary: The team established a good understanding on current situation and environment and was able to develop customer specifications and evaluation criteria after communicating with the project partner and doing prior art search.
Advisor approval:	Yes / No	Date: 12/12/2014

Spring 2014:

We began the Specification Design Phase in Spring 2014. After visiting Happy Hollow and seeing the erosion more closely, we began to conceptualize how erosion was occurring in two ways. The first was our task analysis which we completed. This document focused on understanding the physical

methods by which erosion occurred. Because there is no true user for our solution, we focused on making the document focus on how stakeholders would interact with our solution. Given that our solution will most likely be incorporated into the hill slopes, we identified these interactions as those between the stakeholders and the current hill slopes. After completing this document, we began to work on researching Prior Art solutions as well as macroscopic erosion processes. We began to outline a document that summarizes each of the types of prior solutions used and what their positives and negatives were. We also began to outline what we thought the criteria and constraints would be for our design and conceptualize what each one was with examples as well as how it affected our project. We also created an excel document that will become a design matrix rating these prior art solutions in various weighted criterion categories to see how they are rated in our situation. We will also check to see how many of our constraints they meet and thus whether there are immediate red flags with using any particular prior art solution in our situation.

The final product of this process of summarizing and assessing prior solutions through these documents will be a final solution choice for the project. This does not have to be one of the prior art solutions. It could be a hybrid of two solutions that don't meet all the constraints of our project but when combined in some form, exceed the individual solutions they came from. These will be completed in Fall 2014.

Fall 2014:

We continued in the Specification Design Phase and finished it. We recruited new members this semester for Happy Hollow Park project, and we were delighted to have three environmental science students to join our team for providing and sharing their experiences in related area. After meeting with our project partner Dan in Week Two, We updated the previous customer needs development document and finalized the Customer Criteria and Constraints document.

5.6 Phase One

Phase 1: Project Identification	Status: Completed	Evidence can be found:
Goal is to identify a specific, compelling need to be addressed		
<ul style="list-style-type: none"> Conduct needs assessment (if need not already defined) 	Completed	WRM Team Page of EPICS SharePoint under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "1 Project Identification" in the subfolder "Final." It is the document "HHPUserNeedsAssessmentDGM20131009Final"

<ul style="list-style-type: none"> ● Identify stakeholders (customer, users, person maintaining project, etc.) 	Completed	WRM Team Page of EPICS Share-Point under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "1 Project Identification" in the subfolder "Final." It is the document "HHPStakeholderAnalysisDGM20131009Final"
<ul style="list-style-type: none"> ● Understand the Social Context 	Completed	WRM Team Page of EPICS Share-Point under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "1 Project Identification" in the subfolder "Final." It is the document "HHPStakeholderAnalysisDGM20131009Final"
<ul style="list-style-type: none"> ● Define basic stakeholder requirements (objectives or goals of projects and constraints) 	Completed	WRM Team Page of EPICS Share-Point under "Project Documentation" in the folder "1 Happy Hollow Park" in the subfolder "1 Project Identification" in the subfolder "Final." It is the document "HHPStakeholderAnalysisDGM20131009Final"
<ul style="list-style-type: none"> ● Determine time constraints of the project 	Completed	WRM Team Page of EPICS Share-Point site under "Project Documentation" in the folder "1 Happy Hollow Park" in the sub-folder "Design Process Documentation." It is the file labeled "HHPProjectTimelineAKH20150303."
<p><i>Gate 1: Continue if have identified appropriate EPICS project that meets a compelling need for the project partner [This includes a Project Charter]</i></p>	Decision:	Rationale summary:

Advisor approval:	Yes	Date: 2/14/14
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Fall 2013

During this stage in the Fall of 2013, we completed a stakeholder analysis to get a greater idea of the people involved and affected by the current issues. We needed to know how each of their needs must be met when solving the issues. It is important for us to gain this context before deciding on major project or suggesting any soft practices to the project partner because without this knowledge we would be designing a solution that may disrupt a stakeholder unnecessarily and create a new problem for them. From there we created a direct user needs analysis to gain a better understanding of the problem according to the project partner. As the direct user, West Lafayette Parks, the context of the main issue must be thought about from their perspective. Given that other stakeholders are only indirectly related to the issue, their issues are less important (though still necessary) when compared to those of the direct user. Originally, we had worked on a possibly doing a Watershed Analysis to help gain context of the scale of the problem. However, given that we already know that the problem is severe given the lack of topsoil on the hills and the gullies and obvious erosion on the stream banks, we decided the next semester that it was better to just pick a problem and use a more specific assessment later on the area we choose to focus on.

Spring 2014

In Spring 2014, we picked our project after a visit to Happy Hollow and looking at the types of erosion present. This experience helped us choose the type of erosion we wanted to attack first and we chose hill slope erosion. This was because hill slope erosion is the most prevalent type of erosion throughout the park and is the most scalable for any design solution. We summarized the reasons for our decision in our “Project Choice Rationale” document. We also created the overall project timeline that spans more than two years into the future during the initial part of the semester. This helped us scope the estimated time length of our project and what tasks were involved during each stage. It also provided us context on what would be involved in the project over time. We then ended this stage around mid-semester.

6 Semester Documentation (Current Semester)

6.1 Team Members

Monica Moran, Design Lead, moran30@purdue.edu, 317-800-5882

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Alan Gross, Team Member, gross67@purdue.edu

6.2 Current Status and Location on Overall Project Timeline

We are currently in the delivery phase with plans to complete the project during this semester. During January and February, we selected plants, berms, and erosion mats to use and placed orders for these items. The final door hanger design received approval, and the hangers were printed and distributed in the neighborhoods surrounding the park. The educational pamphlets were also printed and delivered to the project partner, who will display them at the Lilly Nature Center. February and March were spent planning for the final delivery of the project and securing the necessary resources, including berms, plants, compost, and erosion mats. There was also a recruitment campaign to attract volunteers for the final installation day in April. Over the course of the first two weekends in April, the team and volunteers completed the final project delivery. The final day of installation focused on planting, and _____ people from the local community were involved.

6.3 Goals for the Semester

Project Vision: To create and implement a long-term solution for the mitigation of hillslope erosion in Happy Hollow Park, while educating the public about our solution and the problem at hand. This semester, the project will be completed. This will include final delivery of educational materials to the area around the park. The final installation of berms, mats, compost, and plants on the three selected hills will also occur. This system will be monitored going forward with the ultimate goal of implementing a similar system throughout the park to control the widespread erosion there.

Goals:

- Distribute educational door hangers to communities around the park
- Deliver educational pamphlets for display at the Lilly Nature Center.
- Install final erosion control system on the three selected hills within the park.

6.4 Semester Timeline

The Project Timeline is located at the WRM Team Page of EPICS SharePoint site under “Semester Documentation” in the folder "Fall 2016" in the sub-folder “Happy Hollow Park”. It is in the “Design Review Documents” folder and is labeled “HHPPProjectTimelineFall2016." The most current version of the semester timeline has been integrated in the project timeline, due to the updates that are continually being made.

6.5 Semester Budget

Below are the projected and actual expenses of the team this semester,

	Estimated				Actual			
	Cost per item	Number needed	Shipping	total cost	Cost per item	Number needed	Shipping	Total cost
Door Hangers	0.21	500		105	80	1	24	104
Pamphlet	0.2	50	0	10	0.75	50	0	37.5
Erosion Mats	80	2	0	160	85.35	1	0	85.35
Berms	23	37	400	1251	22.5	37	275	1107.5
stakes	4	7	0	28	3.87	2	0	7.74
Staples	30	1	0	30	4.87	12	0	58.44
Compost	4.97	14	0	69.58	4.97	15	0	74.55
Plants	1.5	980	300	1770	1.53	980	445	1944.4
30 inch tube					1.9	55	0	104.5
48 inch tube	2	115		230	2.75	60	0	165
Trees	40.5	1	20	60.5	63.6	1	0	63.6
Miscellaneous								75
			Total:	3714.08			Total:	3827.58

6.6 Transition Report

6.6.1 Summary of Semester Progress

During this semester, the team completed the final delivery of the project at the Happy Hollow Park site. The first step of this process was the distribution of educational materials to the public, which occurred during January and February. The team distributed door hangers in the neighborhoods surrounding the park and created pamphlets that were available to the public within the nature center at Celery Bog. These materials contained information about the park, the process of erosion within the park, and potential actions that can help mitigate erosion. During the rest of the semester, the team secured resources and volunteers in preparation for the final installation of the project. In April, the team and its volunteers installed berms, erosion mats, compost, and plants at the three hill sites within the park. The event received media coverage from _____, satisfying one of the conditions of the project partner. A plan for the future of the three hill sites was also prepared and presented to the project partner.

7 Past Semester Archive

7.1 Fall 2013

During this stage we completed a stakeholder analysis to get a greater idea of the people involved and affected by the current issues. We needed to know how each of their needs must be met when solving the issues. It is important for us to gain this context before deciding on major project or suggesting any soft practices to the project partner because without this knowledge we would be designing a solution that may disrupt a stakeholder unnecessarily and create a new problem for them. From there we created a direct user needs analysis to gain a better understanding of the problem according to the project partner. As the direct user, West Lafayette Parks, the context of the main issue must be thought about from their perspective. Given that other stakeholders are only indirectly related to the issue, their issues are less important (though still necessary) when compared to those of the direct user.

Due to the amount of potential projects at Happy Hollow Park, we will need to conduct a watershed assessment of the park to recognize what projects are beyond our scope viably and feasibly. We have gathered basic information of how to conduct a watershed assessment and these documents are posted under this semester's documentation on the SharePoint site. At the same time we realize our most viable and feasible option for helping the park deal with the erosion throughout the park is the institution of soft practices that will help eliminate or mitigate the causes of erosion throughout the park. Examples include planting better vegetation to improve soil structure and fences to prevent pedestrians from climbing up the eroded slopes, thereby preventing further compaction and detachment of soil in the area. However, until we have the watershed analysis complete, we will not be able to fully identify conditions that allow for these soft practices to be successful.

We are currently working on a plan and requirements of how to do our watershed assessment such that we know when we are gathering data what we are looking for, and how it applies to situations in Happy Hollow Park. This includes getting basic survey data as a baseline for later assessments of the creek bed and hill slopes, as well as gathering possible software tools that we can use to estimate water flows and soil locations. This plan will be given to the next team via SharePoint

7.1.1 Past Team Members

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7.1.2 Past Timeline

Document currently on SharePoint under "Semester Documentation" in the "Historical - Fall 2013" folder under "Happy Hollow". It is name "Semester Plan 1" and is a Microsoft Excel document.

7.2 Spring 2014

In Spring 2014, we picked our project after a visit to Happy Hollow and looking at the types of erosion present. This experience helped us choose the type of erosion we wanted to attack first and we chose hill slope erosion. This was because hill slope erosion is the most prevalent type of erosion throughout the park and is the most scalable for any design solution. We summarized the reasons for our decision in our "Project Choice Rationale" document. We also created the overall project timeline that spans more than two years into the future during the initial part of the semester. This helped us scope the estimated time length of our project and what tasks were involved during each stage. It also provided us context on what would be involved in the project over time. After visiting Happy Hollow and seeing the erosion more closely, we began to conceptualize how erosion was occurring in two ways. The first was our task analysis which we completed. This document focused on understanding the physical methods by which erosion occurred. Because there is no true user for our solution, we focused on making the document focus on how stakeholders would interact with our solution. Given that our solution will most likely be incorporated into the hill slopes, we identified these interactions as those between the stakeholders and the current hill slopes. After completing this document, we began to work on researching Prior Art solutions as well as macroscopic erosion processes. We began to outline a document that summarizes each of the types of prior solutions used and what their positives and negatives were. We also began to outline

what we thought the criteria and constraints would be for our design and conceptualize what each one was with examples as well as how it affected our project. We also created an excel document that will become a design matrix rating these prior art solutions in various weighted criterion categories to see how they are rated in our situation. We will also check to see how many of our constraints they meet and thus whether there are immediate red flags with using any particular prior art solution in our situation. The final product of this process of summarizing and assessing prior solutions through these documents will be a final solution choice for the project. This does not have to be one of the prior art solutions. It could be a hybrid of two solutions that don't meet all the constraints of our project but when combined in some form, exceed the individual solutions they came from. These will be completed in Fall 2014.

7.2.1 Past team Members

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Grant Nice, Project Liaison, niceg@purdue.edu

7.2.2 Past Timeline

Document currently on SharePoint under “Semester Documentation” in the “Spring 2014” folder under “Happy Hollow Park Project Documents”. It is name “Semester Plan 2” and is a Microsoft Project document.

7.3 Fall 2014

In Fall 2014, our team was able to complete the Specification design phase. After our first visit in Happy Hollow Park and talking with our project partner Dan Dunten, we updated the Customer Criteria and Constrains document and discussed the location of testing site for future experiments. We prepared a pitch presentation to ask the West Lafayette Park Board for the use of a minimum of one hundred square feet experimental plot. We were granted permission to use the selected plot area and the future team should start to set up the testing site no later than Spring 2015. Meanwhile, the team also brainstormed several possible solutions for controlling the hill slope erosion in the park. We conducted a Project Choice Rationale Statement and Project Choice Weighted Decision Matrix to develop a “best” solution by applying the Functional Decomposition document. The team then conducted background research in Bio-mass, Plants, and Slurry material to prepare the “best” solution potential prototype. Members of our team took a training session in land surveying using the Sokkia total station and then went to the park and collected required data to measure Peak Flow, Soil Loss and other resources. However, with the end of the semester coming to a close, our team did not have enough time to organize and analyze the collected data. Therefore, the Spring 2015 team should begin to analyze the data.

7.3.1 Past team Members

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Zack Capo, Team Member, zcapo@purdue.edu

7.3.2 Past Timeline

The Semester Timeline is located at the WRM Team Page of EPICS SharePoint site under “Semester Documentation” in the folder “Historical - Fall 2014” in the sub-folder “WRM HHP Fall_2014”, click on the folder labeled “Project Design Process Documents.” It is the document labeled “Happy Hollow Park Semester Plan Fall 2014.”

7.4 Spring 2015

After transitioning from conceptual design phase to detailed design phase, we have finalized our first prototype design and have implemented the said prototype with its' three tests on the hill slope. We have done extensive calculations to see how much of a change we are making.

This semester, the Happy Hollow Park Project got together and looked for different solutions. After meeting with Dan Duntun, we decided to split the team into two subgroups: One focusing on the actual design of the prototype solution, and one focusing on the design of the educational component that the Parks and Recreation department wanted us to build. We decided on using vegetation, erosion mats, and retention logs for our main prototype this semester. We later decided to add erosion compost berms to help increase the effectiveness of the solution. We analyzed L-THIA data and ran calculations on how to space the retention logs on the site. We also calculated the amount of loading a log could withstand, and decided to design for a 5 year rainstorm on our site (for a Factor of Safety consideration). We plan on implementing very late this semester and allowing next semester's team to record the data from our solution, as we will need numerous iterations to best refine the solutions in our prototype to figure out the best results. As well as a transition document, one should access the document "HHPPProjectProposalAKH20150417" in the Working folder in 4 Detailed Design in Happy Hollow Park under Project Documentation.

7.4.1 Past team Members

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7.4.2 Past Timeline

The Semester Timeline is (currently) the same as the project timeline and needs to be remade for next semester. It is located at the WRM Team Page of EPICS SharePoint site under Project Documentation in the folder “1 Happy Hollow Park” in the subfolder “Design Process Documentation.” The file is called “HHPProjectTimelineRLB20150416.”

7.5 Fall 2015

7.5.1 Past team Members

Callum Wayman, Co-Design Lead, waymanc@purdue.edu

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Loshini Vickneshwaran, Project Partner Liaison, lvicknes@purdue.edu

Pablo Schwiep, Project Archivist, pschwiep@purdue.edu

Andrew Huang, Team Member, huang430@purdue.edu, 240-778-3684

7.5.2 Current Status and Location on Overall Project Timeline

We are currently in the detailed design phase of the project. We reviewed the prototype from last semester and noticed some design flaws that we have since altered to decrease erosion and sediment transport down the hill-slope test site. The primary flaw with the previous prototype is that it focused on stopping erosion on the hill-slope altogether. The issue with this design is that completely stopping the erosion and sediment transport is impossible because of the lack of soil depth, structure, and bulk density along the slope. The weak soil easily erodes, and the addition of soil and plants will not be enough to create a well-developed soil on the hill that can help reduce soil losses to a sustainable amount. Instead, the design should be developed so that the erosion is mitigated, and sediment is allowed less mobility down the hill into the stream across from the test site, with vegetation being introduced as a secondary tool to not only stop erosion, but also create a more natural look in accordance with the demands of the project partner. We have created weighted decision matrices and are now in the process of procuring our supplies, implementing the design, and creating a process by which to test our design next semester. We have also created a DFMEA to test our prototypes for failure in order to see where the prototype failed specifically. We developed the quantitative testing procedure for test plots on the hill slope and have used it to

gather data on the test plots implemented last semester. We analyzed the data and compared the test plots. We used this information in developing a proposal for test plots to be implemented next semester. We created our proposed test plots document to provide suggestions for next semester as they implement new test sites on the hill slope. At this stage we have completed out portion of the project timeline, and the students taking over next semester can segue into their portion of the design process.

7.5.3 Goals for the Semester

Project Vision: To create and implement a long-term prototype for mitigation of hill slope erosion in Happy Hollow Park, while educating the public about our solution and the problem at hand.

Goals:

- Amend previous prototype design
- Implement new prototype on the test plot
- Create quantitative test for prototype
- Complete documentation for final review

7.5.4 Semester Timeline

The Semester Timeline is located at the WRM Team Page of EPICS SharePoint site under “Semester Documentation” in the folder “1 Fall 2015” in the sub-folder “Happy Hollow Park”. It is in the “Design Review Documents” folder labeled “HHP16WeekPlanCRW20151120.” This will need to be re-updated.

7.6 Spring 2016

7.6.1 Past team Members

Andrew Huang, Design Lead, huang430@purdue.edu, 240-778-3684

Monica Moran, Project Partner Liasion, moran30@purdue.edu

Lana Huston, Project Archivist, lhuston@purdue.edu

7.6.2 Current Status and Location on Overall Project Timeline

We are currently in the detailed design phase of the project. We have finished editing last semester's testing procedure, as it lacks the depth and information that we need to help maintain the site and continue measureable success. We have procured items and have a proposed layout of our site, and implementation this semester will be done in the next week. This layout will most likely move us into delivery, as we use concepts from ecological restoration. The concept of "Regenerative Stormwater Conveyance," is one that uses natural in-channel structures to slow water velocity. which should help us implement a prototype that should be able to be quantified in relative terms, where some components of the different implementations that we are trying should allow the test being run (as a delivery) as a success. Regenerative Stormwater Conveyance uses carbon-rich bed material, riffles/pools, and a native plant community to

help increase infiltration rate and support plant, fungal, and microbial material. With the design that we are currently working on, we take aspects (like a modified riffle/pool sequence and native plants) on a gully to remediate the issues on steep hillslopes.

7.7 Fall 2016

7.7.1 Past Team Members

Monica Moran, Design Lead, moran30@purdue.edu, 317-800-5882

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7.7.2 Current Status and Location on Overall Project Timeline

We are currently in the detailed design phase, moving toward delivery. We have added trees and shrubs to our second prototype, as well as installed additional signage on the hill asking park visitors to keep off. Halfway through the semester, we created a contract with our project partner to clarify the project's scope as we prepare for delivery. We have completed a pamphlet and a door hanger to distribute to community members to educate them on erosion in the park, what it means for them, and how they can help reduce erosion in the park. There was not time to distribute these to the public this semester, so this will need to be done next semester. We have also selected and analyzed two new hills to install our solution on for delivery; this will help mitigate erosion in other parts of the park and show that our solution can be implemented in a larger scale. Next semester we will be purchasing all of the materials for the hills (including plants, berms, compost, erosion mats, etc.) and organizing a volunteer day to install everything. We will also have media coverage of the event or showing the final product to further raise awareness.

We are also currently working on the layout of the two hills next semester with regards to different types of plants that may need to go into the hills. After design review, a mobile reviewer mentioned "hardening" of the hill- possibly putting down sections of cut gutter pipes and entrenching them into the hill. This will allow for plants to re-establish because water will not erode away the organic matter or take away as much of the topsoil that we will put down to allow plants to survive on the hill. We are currently looking into this idea as well for next semester in key problem areas that need vegetation to survive and thrive. This idea may be most conducive to areas of the hill that do not have any vegetation on the hillslope.