CAPSTONE RESTORATION DESIGN PROJECT

FOR

ROBBINS PARK

Keith Maung-Douglass
Monitoring Workshop
Spring 2013

MONITORING PLAN

MONITORING PLAN FOR ROBBINS PARK IN AMBLER, PA

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Introduction

The Robbins Park restoration project is entirely contained within the 38 acre Robbins Park Environmental Education Center property (Figure 1) located off of Butler Pike in Ambler, PA. Roughly 35 of these acres will be within the restoration area. Not included in the restoration is the portion of land at the Butler Pike entrance that contains the education center, maintenance buildings, parking and space for other human use activities. A majority of the park's forests are heavily invaded with exotic invasive plant species that, along with excessive deer browsing pressure, has greatly reduced the native plant diversity of the park. A main goal of this restoration project is to greatly reduce the presence of these exotic invasive plants, while increasing the native diversity of plants and animals.

Rose Valley Creek, which runs through the center of the park (Figure 1) has also been greatly degraded and is in need of much restoration. Historical farm run-off, combined with the more recent suburban development, has funneled and piped much of the surrounding storm water directly into this small tributary of the Wissahickon watershed. All of this stormwater runoff has caused the stream bed to be incised and the streambanks to be badly eroded. All of this erosion has lowered the water table, disconnected the stream from the natural floodplain and has reduced wildlife habitat both on the stream bed and along the banks. Another main goal of this restoration is to restore Rose Valley Creek to its original and natural floodplain level and, while also stabilizing and re-vegetating the streambanks.

Another big component of the restoration plan is to incorporate the restoration efforts into the environmental educational nature of the park. With this educational component in mind, the immediate goal of the restoration is not to do a total restoration on the entire park right off, but rather do a gradual restoration that allows the park visitors to both learn about and participate in the restoration efforts. This site monitoring plan will also incorporate this public involvement to both help in the monitoring process and also use to the collected data better educate the public on the benefits of the restoration efforts.

The planned restored conditions for the site can be seen on the map in Figure 2. This map show the different forest succession stages, the larger and more mature forest area, the planned warm season grass meadow, restored wetlands, and the installed reed bed systems. This map also highlights the stream corridor, which will consist of all of the streambank stabilization, re-vegetation and sill installations.

Monitoring Plan Overview

This restoration monitoring plan is part a larger project that also includes an invasive removal plan and an overall restoration design plan. If these documents are not currently attached to this document both of them are can be made available by contacting Keith Maung-Douglass at keithd@temple.edu.

All of the data collected during the monitoring process will be made directly available to the public at the education center of the park, as well as through the park's website: htttp://robbinspark.wikispaces.com. This data will not only be a great tool to educate the public about the benefits of restoration, but it will also be very useful to keep track of how well the restoration process is going and will allow for on the fly adjustments to the restoration plan to better improve on things that do not seem to be progressing as planned. The data collected is also very beneficial when trying to give irrefutably evidence on the many benefits of ecological restoration to government and private organizations that might create laws and provide funding that could create future restoration projects around the world. The long term success of any restoration project will only occur when there is a solid monitoring and maintenance plan put in place from the start of the project. With that in mind here is a list of some of the monitoring that will be highlighted in this plan.

- Documenting changes with 120° panoramic photographs at specific locations throughout the park on a consisted bases at the same location each time.
- Surveying the park for invasive species on a regular schedule during different seasons to ensure that all exotic and/or invasive species are dealt with as soon as possible.
- Collecting and testing water chemistry to document any improvements that are seen from the restoration efforts.
- Collecting data on stream flow rates to both get good information about the stream to better make restoration design choices and to also document how the restoration efforts might improve retention and infiltration of stormwater.
- Keeping track of all wildlife that is seen within the park.
- Examining the macro-invertebrate species that are within the creek and see if the species diversity increases with water quality improvements.
- Installing piezometers perpendicular to the stream and measure depth to water table to see how it changes as the restoration progresses in the attempt to return the stream to the natural historic floodplain.
- Doing vegetation plots in select habitat areas of the park to examine how species diversity changes over time.

In order to have good data comparison at least a full year of monitoring data should be collected before the restoration begins. This can be a difficult task to plan out given the unknowns of the final design changes and the need to be forward thinking in how the data will be collecting following the many changes to the environment following the different restoration efforts. Since this plan is being pro-actively written along with the design plan, the ability exists to blend them together as seamlessly as possible to ensure good base line data can be collected before the project is fully funded and set into motion. Some of the future data collection will require that some of the restoration and design modification are in place first, so baseline data for those items will either not be possible or can be gathered in an alternative, but similar method. These modifications will be noted in the proceeding sections when they arise.

Location Map

Legend

Site Coordinates
+40° 10' 8.71", -75° 12' 8.56"

Figure 1: Location map showing the park boundary, Rose Valley Creek and the surround roads and neighborhoods

Figure 2: A map highlighting what the restored conditions of the park will look like after implementing the restoration plan.

Monitoring Staff Qualifications and Training

Before many of the monitoring items can have data collected for them, the person that will be collecting the data will go through a mini training session to ensure that the data is collected correctly and consistently between collectors. Some of the training sessions will be very short and only require a quick demonstration on how to take a quick measurement. Other training sessions might require some botany and chemistry training to ensure that plants are identified correctly and that the water chemical analysis is done in an accurate and safe manner. The combined effort to monitor and remove invasive species will require good plant identification and also proper herbicide and plant removal training. Some of the monitoring data will be soft data and will rely on the public and other non-trained individuals to gather it. This data will not have the same scientific merit as the other data, but can be equally as important. Other monitoring data will be collected strictly for educational purposes and will not be logged within the main dataset.

Monitoring Methods

A map showing the locations of site specific monitoring methods is shown in Figure 3. These monitoring methods shown on this map will be conducted many times a year and over the entire course of the restoration process. A yearly calendar breakdown of the different monitoring techniques and during which months they will be conducted is shown in Figure 4. Many of the methods life collecting water samples and doing vegetation plots will done on a repeatable cycle that should be consistent from year to year, while methods like invasive species and wildlife monitoring can occur on a wider time frame and can even be done during a non-scheduled time. Some species of plants are only present for a limited time of the year or can only be easily identified during certain seasons, so the need to at least follow the months listed in Figure 4 is very important to ensure all of the exotic invasive are noticed and dealt with at their optimal time. Details on invasive plant detection and removal will be discussed more later in this document and is discussed in even greater detail in the Invasive Species Removal documented that is paired with this document.

	January	February	March	April	May	June	July	August	September	October	November	December
Invavise Species			X		X	X			X	X		
Wildlife	X	X	X	X	X	X	X	X	X	X	X	X
Water Sample Collection	X			X			X			X		
Photographs	X			X			X			X		
Vegetation Plots					X		X		X			
Piezometer Data Collection			X			X	X	X		X		
Weir Depth Measurements	X*	X*	X	X*	X*	X	X*	X*	X	X*	X*	X*

* Measurements will be taken if measurement possible during and directly following a major storm event

Figure 4: A yearly calendar for when each monitoring activity will take place.

Wildlife

General wildlife can be monitored throughout the entire year. The limited size of the site and its location in the middle of a suburban landscape greatly limits the amount of wildlife that enter and successfully live within the park. For this reason, a major wildlife survey will not be necessary. Instead of hiring professional wildlife experts, data collection on wildlife will mostly be done accomplished on the fly during any site visit. The public will also have the opportunity to document wildlife that see at the park via a wildlife documentation book permanently located at the park, as well as a submittal form on the park's' website. The public data will be taken only as soft data and will not be used for any publication work, without some form of verification or strict disclaimers. Given the randomness of seeing wildlife, crowd sourcing is a great way to get a much wider dataset, even though some of the data may be inaccurate. An example of a typical data set form for wildlife data can be seen in Figure 5.

One exemption to this wildlife data collection will be for amphibian and creek life. To minimize damage to the creek and amphibian habitats, the public will bot be encouraged to go searching in these place. Instead park staff will periodically conduct random searches within these habitats to look for life. In amphibian habitats rocks and logs will be carefully turned over and leaf litter will be combed through in search for different amphibian species. The use of a field guide book will help in the identification of anything not known by the park staff member or highly trained and experienced volunteer. Nets will be used in the creek to collect some samples of the different fish that are present. One that can not be quickly identified in the net will be taken back to the education center for examination under a dissecting scope and quickly returned to the stream. Marcroinvertebrates will be surveyed by using a D-net along the bottom of the creek after lifting up rocks and leafy debris. Some rocks will also be carefully brushed off into a collection bucket. These organisms will also be examined under a microscope and carefully examined to try and identify them. Organisms that are not easily identified will be photographed using a scope camera attachment and those pictures will be sent to an expert for some identification help. These type of wildlife surveys will only be done a few times before restoration starts and then periodically in the years following the restoration and only if there is a noticeable difference in water quality and habitat formation. Over doing these surveys could do more damage to the ecosystem and not be worth the potential information gained.

Water Sampling

Water sampling will be done 4 times a year and the samples will be taken just upstream of each of the 6 weir structures. Taking the samples at these locations will give a good overall breakdown of how nutrients move through the stream system within the park and whether or not some of th restoration methods are helping to reduce some of the pollution at certain locations. The schedule for this sampling is shown in Figure 4. Taking water samples at least once during each season will help to show any seasonality changes in water quality. These seasonal water samples should be taken during normal stream flows and not after a recent storm event. Water samples should also be taken during large storm events in order to see how much pollution is being put into the stream system during rain events, but that data should be listed separately from the typical water sampling data. This data would be useful to see which of the different restoration techniques helped to improve the water quality the most. An example of a water sampling data sheet is shown in Figure 5.

Salinity

Salinity measurements can be taken using a conductivity meter. On top of the normal data collection, salinity measurements would also be useful after snow storm events when salt has been used on the

Monitoring Map

Figure 3: A map highlighting the locations of the important monitoring areas.

Vegetation Plot Plant List Data Sheet

Plot Location: Plot 2
Name: Keith Maung-Douglass
Date: October 20, 2012

	Species Name	Native Status	Estimated Count (1, 10, 50+)	ID Feature	Phenology Notes	Removed? (If exotic/invasive)
1	Acer Rubrum	Native	10	Leaves	Leaves Changing to Red	No - Native
2						

Water Chemistry Data Sheet

Sample Location	Date	Time of Collection	Time of Full Analysis	Water Temperature (°C)	Salinity (PPT)	pH	[Phospherous] (mg/L)	[Nitrate] (mg/L)	[Nitrite] (mg/L)	Turbinity (%)	Initials
Pond	3-Dec-12	2:00 PM	2:30pm	11	0	6.8	1	2	1	90%	KAMD

Water Flow Rate Data Sheet

Weir Number	Date	Time	Weather Conditions	Air Temperature (°C)	Was Weir clogged?	Depth of Water in Weir (cm)	Initials	Notes
1	3-Mar-13	10:30 AM	Calm and Sunny	6	No	4	KAMD	Left side of Weir needs some repairs

Wildlife Data Sheet

	Date	Initials	Animal Seen	Identifying features	Location of Sighting	Time of day	Weather Conditions	Notes
1	10-May-12	KAMD	Painted Turtle	Yellow line on head	Pond	Mid Day	Sunny	Was sunning on a log

Piezometer Data Sheet

Well Number	Date	Time	Weather Conditions	Air Temperature (°C)	Depth to Water (cm)	Initials	Notes
3B	3-Mar-13	10:30 AM	Calm and Sunny	6	20	KAMD	

Figure 5: Examples of some other data sheets that would be used for the monitoring of this site.

roads. This will help to show what happens to all the salt that is sprayed and dumped onto the roads and doing multiple collections during these snow storm events will help to show if the salt concentrations get to harmful levels for wildlife. If the levels do get an unsafe level for long periods of time, this data could be used to argue against using salt on the roads that drain into creek systems. This data would also be useful to know in case the plantings within some the stormwater wetlands needs to be adapted to select for more salt tolerant plants or even modify how stormwater is collected following snow events.

pH

Analyzing the pH of a water sample in a stream is not all that informative on its owns, especially since this value could change constantly by slight variations. Yet as a standard practice it will be good to have the pH value in case it effects some of the other chemical analysis.

Nutrients

Phosphorous, Nitrate and Nitrite will all be tested on each water sample. The standard EPA reduction method along with a spectrophotometer will be used to test the levels of these nutrient pollutants in the water samples and will be reported in mg/L. Nutrient levels will be very useful when comparing water samples before and after different natural water treatment areas within the restored areas. Its will be useful to know how much the natural systems are reducing the nutrient load downstream. This data could potentially show that one type of system works better or worse than another and could also provide some every useful data to support the use of ecological restoration within stream systems to help reduce nutrification.

Temperature

Temperature is a simple thing to collect data on and could be very useful in explaining different things that may come up in the water quality data. It would also be useful to know how the stream temperature changes as you move downstream and you get additional ground water inputs and possible warming or cooling from the air and sun.

Turbidity

Turbidity will also be tested by using the spectrophotometer to measure the percent light transmittance through the water sample. This will give a good indication of how much sedimentation and algae are suspended within the water column. High turbidity could be an indicator of erosion and/or high nutrient levels and could be compliment some of the other water chemistry data. Turbidity data would also be useful during storm events to see how well the different restoration techniques helped to reduce sedimentation within the flowing water. Ideally, some the restoration techniques would help to collect and settle out any sediment that gets dumped into the creek from stormwater runoff.

Water Table

Piezometers will be installed in three sections perpendicular to the stream as shown in Figure 3. The design of the piezometer and how they are installed in shown in Figure 6. One piezometer will be installed on each bank of the creek and then they will be spaced in 50 foot increments from there. The number of piezometers installed varies based on topography and wetland features. The wetland seep area gets more piezometers, so that the water table within it can be studied to a greater degree. The locations of these wells were chosen based on where the historic floodplain existed and because this section of the steam is the most incised compared to the upstream portions. These devices should be installed before any stream work is done in order to get a good solid data set of the typical water table pre-restoration. This data should give a good indication if the stream work is helping to restore the water table to historic conditions. The piezometers in the vernal pool area will help to monitor the water levels there and will allow for modification of the design if the pools end up being either too wet or too dry to support successful amphibian preproduction

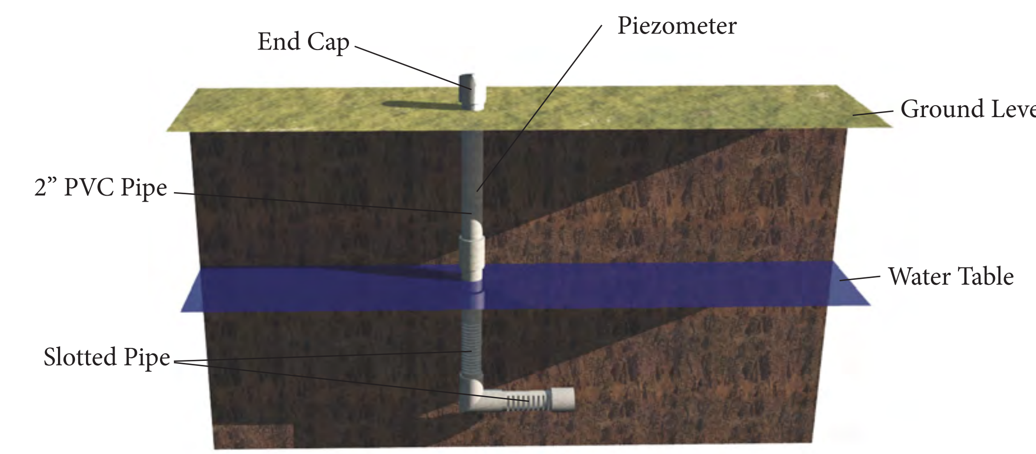


Figure 6: A diagram showing the design of the piezometer and how it is installed in the ground. These piezometers are made using 2" PVC instead of 1". The larger diameter makes it easy to use a variety of tools to measure the water depth, while still minimizing the need to dig large holes and disturb lots of soil. The bottom pipe is slotted to allow ground water to flow into the stand pipe for accurate measurements, while reducing possible clogging. The L-shape design helps keep the piezometer from sinking below ground level, while also reducing the possibility of someone pulling it out. The top end cap ensures that no rain water gets into the stand pipe.

Water Flow

Water flow will be measured using the installed weirs (Figure 3). For the upper portion of the stream that has lower flow, a V-notch weir will be used. A schematic of this is shown in Figure 7. In the lower portions of the stream, which get higher flow volumes, a wider flat bottom weir will be used. By measuring the height of the water coming through the weir one can calculate the flow of water in the stream. Collecting this data in the pond and reed bed system will be useful to see how the water flows are effected by the recirculating system of the reed bed along with the input of spring water from the spring house. It will also be useful to see how the flows vary throughout the stream system as other water inputs enter the system, especially during storm events. Getting a better handle on the flows early on will also help to ensure that restoration work done in the stream is built at the right scale to handle the potential water flows.

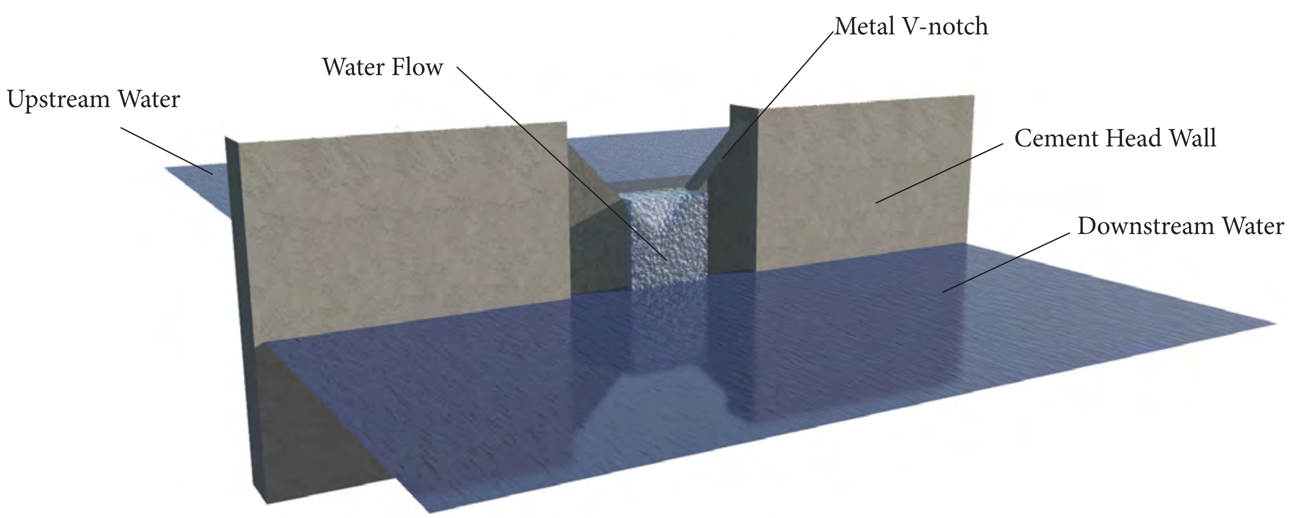
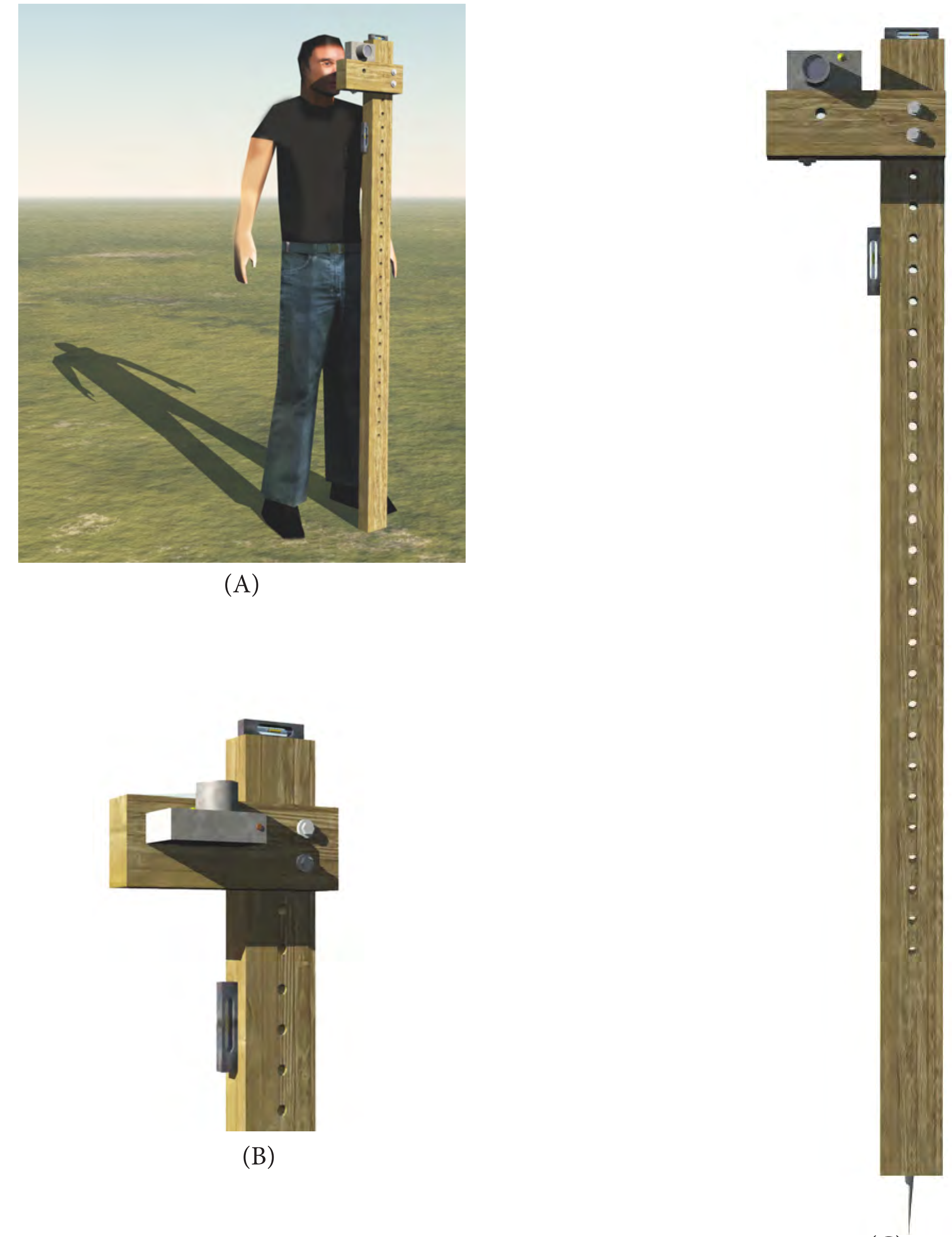


Figure 7: A schematic design of an installed weir. These weirs will control the flow of water over a metal V-notch, which has a measurable surface area at varying water levels pouring over it. This allows for accurate measurements of water volume within creek systems. These weirs can vary greatly in size and shape depending on the size and typical flow rates of a specific waterway.

Photography

The photo points are shown in Figure 3. Each photo point will require taking a 120° panoramic series of photos in order to show a wide area from a single location. This will represent an area when compared to single straight shot of the location. The photos should be taken with the same camera each time using the same settings. This camera should also be mounted on the camera mount shown in Figure 9. This will ensure that no matter who is taking the photograph that they will be from the same height. The camera will swivel on the stand and have the 120° marked off on the swivel base. The base of the stand also has a metal spike, which will be used to place the stand in metal tubes, which will be located at each photo location. This metal tube will also be marked to indicate the centering direction of the camera.

These points were chosen in order to document areas that would show best with images rather than some other form of data collection. Photos of the pond will show a seasonal transition of vegetation growth around th pond as well plant and algae growth within the water. The hope is to see some dramatic changes as the reed bed system begins to filter out excess nutrient from the pond system, which should reduce the algae blooms. Also the removal and regrowth of the invasive water plants should show well in these photos. The photos of the wetlands at locations 2 and 4 will be used to highlight the seasonal changes of a wetland. Photo location 3 will give a nice oblique view down into the stream corridor and should show some of the stream restoration very well. Photos from locations 5 and 6 will be used to monitor the growth progressions of the succession forests as well as the seasonal changes and management practices of the meadow. These photos will also be used in coordination with the panoramic viewing scopes installed on and under the viewing tower. Photo location number 7 will help to document the changes of the vernal pools. These are great for the parks personal records, but also for education displays about vernal pools and the importance of their season-al changes.



(A)

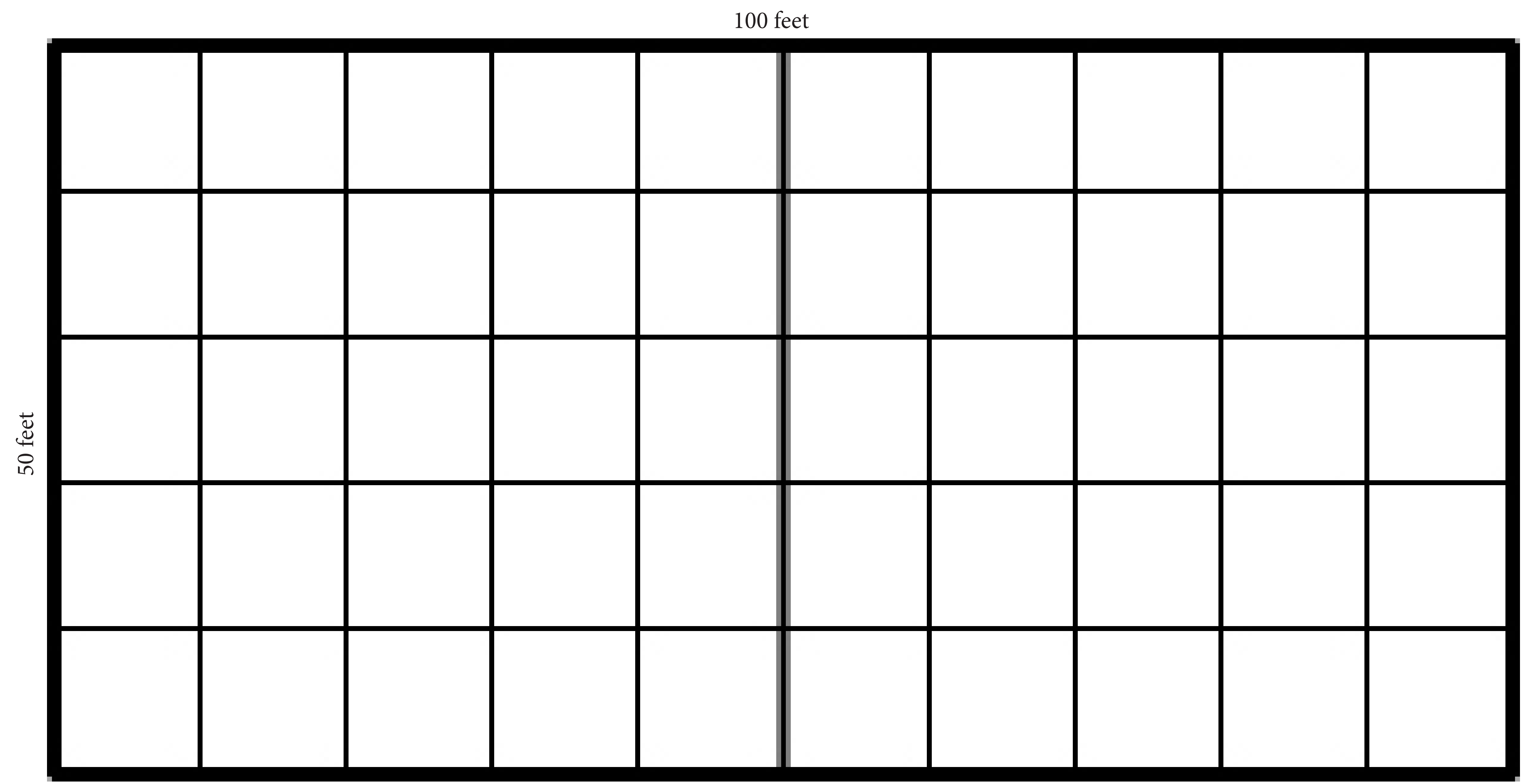
(B)

(C)

Figure 9: Images showing the camera stand built specifically to monitor this site. The stand allows the camera to be locked into a specified height for any location shots, which is easily reproducible no matter who is taking the photograph (A). The stand has two mounting options: a typical forward shot (B) and a sky shot (C) that allows for taking photos of forest canopy. The bottom of the stand has a metal spike that can either be stuck into the ground or placed into a pre-installed metal tube housing. Using a metal tube housing ensures that the shot is taken from the same spot eat time. The stand also has multiple levels attached, so that the stand can be placed in a level position every time.

Location of Plot:_____________________ Date_____________ Names of Surveyors:_________________

After marking out a 50’ x 100’ plot, put flagging at every 10 foot interval and go through the pot and graph out the locations of each tree (along with ID and DBH) and draw in general locations of shrubs and herbs in masses.



Notes:

Figure 10: An example of a vegetation plot data sheet.

Vegetation Plots

Vegetation transects of 100' x 50' will be used to monitor vegetation growth and introduction of new species. The locations of the transects (Figure 3) were chosen to examine the variation in the different stages of the forest succession and along the transition point (Plots 3-5) . Plots 1 and 2 were chosen to have a direct comparison between similar forest systems, but having one be protected from deer while the other is not. This data will be a great educational tool to show which plants might still exist in the seed bank, but get eaten each year by the deer and how much quicker regeneration comes back without deer. Plots 6 and 7 will be used to keep tract of which meadow species are preforming better than others and to examine how well the cut and fire treatments are working to keep out invasive plants. Comparing data between plots 6 and 7 will also show which species do better in a wet (plot 7) vs dry (plot 6) area.

For the forest transects each tree will be identified, mapped on a grid sheet (Figure 10) and have its DBH measured and recorded. Shrub and herb layers will be mapped as clusters and estimated percent cover. Over time this data should show how well the forest are filling in, which species are doing the best and what new recruits are making their way in.

Photographs of the forest canopy will be taken at two selected and marked spots within each forest plot (1-5). The camera mount shown in Figure 9B will be used to ensure the camera is facing directly up into the canopy. These photos then can be process in the freely available ImageJ software (http://rsb.info.nih.gov/ij/)in order to calculate a percent canopy cover. Over time this will help to identify when the forest has reach a point of newer canopy closer by comparing this data to some sample data in more mature forest portions within the park.

Invasive Plants

Monitoring and removal of invasive plants can be a constant on going thing for most of the invasive plants within the park. When time allows the park staff should walk through portions of the park and keep an eye for invasive plants. If they are able to deal with it right then and there then the plant should be removed by the proper method for that species. If they can not remove it then and there then they should make a note of its location so that it can be dealt with at a later date. During the schedule months for monitoring invasive plants (Figure 4) the trained people involved with this monitoring will choose section of the park within a trail and/or boundary border and do a back and forth sweep on 20 foot arcs in order to get a good survey of the entire area. After an area is mostly cleared of invasive, these sweeps should not take very long and multiple section of the park could be done in a day. Depending on the month that this monitoring is being done, different plants might be on the target list because of their limited appearance or ease of identification during that season. A full list of species to look for and how to deal with them can be found in the invasive species management plan that should be accompanying this document. If it is not, then contact Keith Maung-Douglass at keithd@temple.edu for a digital copy.

Restoration Standards

No restoration standards will be required for this restoration project since the end goal is education and not a 100% complete restoration project. As long as Robbins Park is still a environmental education park then the restoration will continue. The important thing will be the data and not any label of what success looks like. In this restoration and monitoring plan a lesson learned is better than an end goal of a perfectly restored forest and meadow system.

List of Monitoring Materials

Below is a list of materials and equipment that should be provided in order to make this monitor plan fully functional.

- Water collection bottles
- Conductivity meter
- pH meter
- Spectrophotometer
- Chemical analysis supplies
- Compound microscope
- Dissecting microscope
- Hand-held GPS device
- Digital camera with field stand
- 100 foot measuring tape
- Plant and animal ID guides
- Hand saw
- Pruners
- Loppers
- Weed wrench
- Glyphosate concentrate (40%)
- Backpack sprayer
- Herbicide painting supplies
- Flagging stakes
- Meter stick
- DBH measuring tape and calipers
- D-net and bug nets

Figure 11: A list highlighting some of the important tools that will be used to do the monitoring for this site.

Monitoring Timeline

The length of any or all of these monitoring methods will depend mostly on the educational and research value that are provided verses the time and monetary cost they cause the park to give up. If they are more costly then they are worth after that particular restoration area has little use for the monitoring, then it might be dropped, but otherwise the educational value of all of the monitoring should require that they all remain in place even if it is just for the use of the exercise by school students to learn the techniques. They will have a huge backlog of data to compare to, so would greatly benefit from using the park in coordination with their different school lectures. For these reasons, no set time frame will be set for any of the monitoring methods.