Policy Analysis

“The problem is that the city sprayed chemicals in the water and damaged fragile riverbank ecosystems”

Cody Zaccagnino, Kelsy Wright,
Maddie Peabody, Anne Kaplan, Amos Han

Introduction to Policy Studies
Professor Nicodemus
December 7, 2012
Executive Summary:

The major objective of our study was to find the best way to restore the ecosystem in the city of Easton along the Delaware River. As a result of the city spraying a round of an herbicide, AquaNeat, the entire riverbank was swept clean of vegetation, damaging the naturally occurring ecosystem. Our main concern was how to combat the invasive species Japanese knotweed, which was one reason for the spraying in the first place. We decided to place our focus on re-growing native plants while simultaneously restoring the ecosystem around Riverside and Scott Parks.

In our research we were able to come up with five possible causes the city decided to spray the riverside. The first was to expose the retaining wall that was being covered by vegetation, in order to examine the wall for needed maintenance and repairs. The second possible cause was that the riverbank was not easily accessible to fishers who wanted easier access to the water without being limited to a dock or boat to fish in the Delaware. Another cause we believe lead to the spraying was possibly an overwhelmed government. Easton's small city government may not have the sufficient resources that a bigger city might boast and therefore may not be able to deal with something such as this. The government does not have a specific department or agency to focus solely on the health of the city’s park systems, so this responsibility falls into departments with a wider range of responsibilities. It may have been that the city was overwhelmed with the issue and acted without a fully researched or informed long-term decision. As mentioned previously, another cause for spraying was to rid the riverbank of the invasive species Japanese knotweed, which became out of control and blocked the riverbank from use. It also inhibited different species from staying in the area, therefore disrupting the local ecosystem. A less important but still crucial motivation for the spraying could have been to clean up the park, improving aesthetics. The knotweed and other overgrown vegetation was not pleasing to see from the parks.

Through evaluation of these causes we came up with four policy alternatives to address what has been done to the riverbank. The first was to plant small plants, grass, and shrubs to combat erosion and to start the process of revitalizing the damaged ecosystem. The second, more long-term alternative we proposed was large growth, in which trees and large bushes would be planted to provide canopy cover and shade which is needed in a healthy riparian zone. The third alternative we explored was no action. This would mean the city would leave things as they currently are. This would be very cost efficient but in the long run not an effective alternative in an attempt to restore the ecosystem. The final alternative we proposed was to bring goats onto the riverbank to eat the stems of the knotweed and completely remove them from the ecosystem, allowing the ecosystem to return to its natural, non-intruded state.

To rate these policies we chose five criteria. Effectiveness was split into two groups: how effective the policy was at controlling the knotweed and how effective it was at restoring the riparian buffer. We also chose social acceptability, how the public would react to the policy, and efficiency, concerned with the cost of each criterion. Finally we chose administrative feasibility, knowing that the city government may have some limitations. This criterion focused on how able the government would be to fulfill the policy we proposed. Based on the importance of each criterion, we decided to weight them according to which we thought were most vital in deciding the best policy alternative possible for the City of Easton. From this weighting we were able to assign a score one through five to each criteria within each policy to get our final solution of the best alternative for the city.
Through our evaluative criteria we were able to score each alternative and concluded that small growth would be the best policy for the City of Easton to implement. It takes maintenance, but would not be overwhelming. Small growth can be cost efficient and effective at ridding the area of knotweed as well as restoring a healthy riparian buffer. We thought it was fitting to choose this alternative because the city has already taken steps towards creating a healthy river ecosystem by planting rye grass on the riverbank this winter in an attempt to ready the area for small planting in the spring when it is the correct growing season.
Problem Analysis:

The general problem is the spraying of chemicals along Easton’s riverbanks, which is causing damage to the ecosystem. As demonstrated in Figure 1, the yellow signifies where there is a lack on one side of a healthy riparian buffer along a river in the city of Easton, while the red signifies two unhealthy sides. Figure 2 represents more specifically the riverbank along the Delaware and the two areas we focused on, Riverside and Scott parks.

This problem can be further divided into potential reasons why the city of Easton sprayed the chemicals including: protecting the ecosystem, containing invasive species, allowing river access for fishing, lack of expertise, accessing the retaining wall for repairs and maintenance, and making the parks more aesthetically pleasing.

One issue that may have led the city of Easton to spray chemicals along the Delaware’s riverbank is the problem of maintaining the retaining wall.

Figure 1: Riparian Zones in Easton

Figure 2: Riparian Zones along Riverside and Scott parks
The chemicals, specifically glyphosate (the active ingredient in AquaNeat), were primarily used to get rid of the invasive Japanese knotweed plants, which were overgrown along the riverbank. Japanese knotweed is known to grow in extremely dense mats, which can dominate riverbanks, critically erode soil, and cause structural damage to nearby infrastructure, such as roads, buildings, or the retaining wall (Donald). Knotweed’s dense colonies can also damage hydrological processes (Sprankle, Meggitt, & Penner). The vegetation on the riverbed was so dense that it also blocked access to portions of the retaining wall, making inspection and maintenance difficult. Although the Japanese knotweed was removed from the riverbanks, the use of glyphosate could potentially damage the retaining walls. Overuse of glyphosate can reduce vegetation and increase soil erosion, which might harm the retaining walls.

Another cause of spraying could possibly be the fact that the riverbank did not allow easy access for fishers. The spraying of glyphosate and removal of invasive species made the river much more accessible to fishers. It is very likely that the local government wanted to provide this for fishers, as this area is commonly used for fishing. The local government could have looked into Pennsylvania’s Fishing and Boating Access Strategy, which discusses the definition of walk-in fishing access. According to the Pennsylvania’s Fishing and Boating Access Strategy, walk-in fishing access should provide “a way for anglers to reach the waterway and walk for some distance along the stream bank or in the stream bed” (PA’s Fishing & Boating Access Strategy). This strategy allows for enhanced “fishing, boating and other water-oriented recreational opportunities in Pennsylvania” (PA’s Fishing & Boating Access Strategy). The local government could have looked into this strategy as a way to use the Delaware River more recreationally. Although this strategy may not affect the city of Easton and the Delaware directly, it is very possible the local government used this or
something like it to identify a current problem, which would be their inability to have proper fishing access along the Delaware River.

Although there were already some specific areas to fish at like the boat ramp and the area alongside the riverbank, there could potentially have been a complaint about not having enough areas to fish. This problem is more of an immediate cause because it is likely that someone complained about the lack of fishing space available along the riverbank. The city could have potentially become involved in the matter because they would not want to lose business of people coming into the city in order to fish in these specific areas.

Another potential cause is the lack of expertise and personnel within the city government. In a small city government, each employee has many responsibilities, and he or she may not have expertise in every area he or she has to make decisions about. There are multiple different types of organizations whose expertise in the public problem is necessary for the creation of a successful public policy. These organizations include the local government, residents, and departments of the city government including public works and planning, and business owners. The problem is how to determine if these specific people are experts on the public problem.

The local government should have some expertise on the problem. Of the Easton City Council Members, only Vice-Mayor Elinor Warner has experience in environmental policy. According to Neighbors of Easton, Warner proposed the establishment of the Easton Environmental Action Committee. The EAC “is a body, separate from council, empowered to provide opinions on anything that goes before the planning commission, and on anything environmental on which city council requests an opinion” (Jones). Unfortunately, the EAC does not publicize its members, so with the exception of Vice-Mayor Warner, Kate Brandes of the Nurture and Nature center, Tess Mondelo and Chot Elliot, the backgrounds of the
other committee members could not be found.

Easton has small city government; meaning that in general, departments are not as large and resources are not as abundant as those of a larger city. If the EAC can advise the city council on policies related to the environment, then the EAC may serve as Easton’s primary resource for advice on environmental problems. Under this assumption, the City should have consulted the EAC on its decision to spray or not. Larger cities have extensive Parks and Recreation departments and Public Works departments. Easton’s Public Works Department consists of only 100 employees, who work on highways, garbage, and engineering, among other fields. A department that has so few employees but has such various responsibilities suggests that the employees are not experts in each division of the department they may have to make decisions on. Larger cities have more experts and personnel from government departments and organizations than smaller cities like Easton do.

Residents who spend a lot of time in Riverside and Scott parks are also important in deciding policies. From a resident’s perspective, they know how the defoliation in the riverbank is noticeably changing the physical aspects of the ecosystems. These residents could describe the wildlife they noticed while taking their children to the park, or walking their dogs along the river. They could comment on the differences they observe in wildlife patterns on the riverbanks before and after the addition of the glyphosate. The residents include Anne Nicodemus who represented the “Concerned Citizens of Easton” group at a City Council meeting. According to Nepalinks.com, Nicodemus stated that, “...the use of the chemical by the city and the state Department of Transportation and the defoliation of the riverbanks was ‘alarming and needless’” (Nepalink.com). Resident perspectives like Anne’s are imperative to successful policies because the policies must be accepted and followed by those who reside in Easton.
One of the most important causes that prompted the city of Easton to take action along the riverbank of the Delaware River came from a need to clear out invasive species, especially Japanese hop vine and Japanese knotweed. Hop vine is a prickly plant with tendrils, which if left untreated can grow up to ten feet and cover everything in its path. Japanese knotweed was introduced to the United States in the late 1800s as a form of erosion control because of its height. Japanese knotweed can grow four to eight feet and it has stalks almost like bamboo. According to the Marine Resource Management Program at Oregon State, the plant itself “out competes neighboring plants and vegetation” (Gianou) and can affect the ecosystem it grows in by “changing the nutrients cycle through food webs in waterways” (Gianou). This invasion of Japanese knotweed could have been choking out native species along the riverbank and affecting the overall ecosystem.

An important question to ask could be why the city is putting such an emphasis on restoring a healthy riparian buffer. Part of the problem comes from the importance that natural occurring plants help to keep a healthy riparian buffer. According to a report published by Penn State College of Agricultural Sciences, Cooperative Extension, “riparian buffers protect water quality by intercepting sediment and pollution from agricultural fields, residential lawns, roadways, and other sources. This improves habitat for aquatic wildlife while providing food, cover, water, and breeding areas for many other kinds of wildlife.” These are not the only benefits to a healthy riparian buffer, but it also helps provide clean water for humans in rivers that are used as the major source for human consumption. In a report specific to reestablishing the riparian buffers along the Delaware River, it suggests, “Corridor municipalities should provide stream corridor protection through preserving buffers” to help assist the areas surrounding rivers develop a stronger ecosystem.
The city's solution to rid the riverbank of knotweed was to spray it with AquaNeat, an herbicide that contains the chemical glyphosate. According to a case study on the Hoh River in Washington, chemical control is the most effective method to control knotweed; they suggest the use of glyphosate and imazapyr. Between these two chemicals they are able to control more than 80% of the invasive knotweed. Glyphosate is most effective when applied between the months of August and October, which the city followed. The report on the Hoh River did say that if glyphosate is applied through a spray that it is able to leak out of the rhizomes of the knotweed and can enter the water source close to the riverbank. They may have sprayed a surfactant, which would have helped the AquaNeat stay in the knotweed rather than leaking into the soil or running off into the river. AquaNeat also has a non-aquatic formula so it is possible that the city used this formula. There are other methods such as injection into stalks in a small area and air dropping used to cover a larger area than the city worked with. Glyphosate and imazapyr both have the ability to harm and affect non-target vegetation surrounding knotweed. This may have been the case in Easton, it might not have been the intention of the city to kill everything on the riverbank, but this side effect happened in this situation. Depending on the severity, knotweed might need multiple treatments or chemicals to completely remove or heavily deplete the amount of knotweed on the riverbank, which could take many years to see the total effect of the herbicide because of the season of the year it must be sprayed in.

One lesser reason the city had for spraying the herbicide was for aesthetic purposes. There could have been complaints from citizens about the riverbanks seeming untidy and overgrown. As a result the city may have formed a plan to remove the unappealing vegetation and accidently killed the rest of the plants surrounding the riverbank. Another possibility is that the city intentionally removed all growth to start fresh. It could have been
easier to remove all plant life and replant rather than attempt to alter the already existing environment.

After researching and analyzing the situation, the problem can be redefined as not only the act of spraying chemicals onto the riverbanks of the Delaware River, but also including that the city of Easton does not have the ability or government structures and personnel to properly make decisions which call for a specialized field of expertise. Maybe the city should look to outsource more of its projects; at least to consult on what the appropriate action or lack of action should be taken.

List of Terms:

- Aquaneat: the chemical that was sprayed along the riverbank of the Delaware River;
  
  AquaNeat is considered very effective due to its wide range of use and low toxicity, relative to other herbicides

- Glyphosate: the active ingredient in Aquaneat, glyphosate inhibits amino acid synthesis in plants and as such is only effective on plants that are already growing, it will not prevent germination; glyphosate is approved by many agencies worldwide, but concerns about health and the environment endure

- Riparian zone: a buffer area between land and flowing water; riparian zones are significant because of their facilitation of soil conservation

- Soil erosion: the process by which soil gets displaced and deposited elsewhere; loss of soil can degrade the integrity of land

- Retaining walls: structures used to contain soil and shape the landscape, allowing engineering of paths, roadways, flat parks, and help with containing floods

- Pennsylvania’s Fishing and Boating Access Strategy: an agency that provides the Pennsylvania Fish & Boat Commission (PFBC), the Pennsylvania Department of
Conservation & Natural Resources (DCNR), and many important partners, such as local governments and conservation organizations with the necessary tools to make sound decisions on the discovery and selection of priority access points, acquisitions of key properties, and the design and development of new or improvements to existing facilities, and on the identification and allocation of financial resources for fishing and boating access.

- Walk-in fishing access: a way for anglers to reach the waterway and walk for some distance along the stream bank or in the streambed.
- Mitigation plan: a plan to reduce the severity of something.
- Mechanical control: the process or method of removing or controlling something, in this case the removal of the invasive species.
- Surfactant: a compound sprayed on plants after herbicide to hold the herbicide in the plant and avoid it leaking into the soil.
- Half-life: the time it takes for a quantity or concentration of something to degrade to half its original value.
- Aesthetic: having an intrinsic value from beauty.

**Policy Alternatives:**

**Policy Alternative 1: Small plants and seeding**

The current policy the city of Easton has decided to possibly use is the idea of replanting. Currently, the idea is to replant small bushes and plants and place matting like grass over the area sprayed with glyphosate. The grass seed and matting have already been purchased by the city in order to begin moving forward with this policy. Also just recently, the grass seed and the matting have now been put down along the riverside.
With replanting of any kind, many factors need to be addressed before actually proceeding. A study on replanting in a forest in southwestern Ohio, after a form of glyphosate was used to remove the invasive shrub Amur Honeysuckle, points out potential benefits replanting can have on any type of environment. One of the key points the study makes is that “replanting may inhibit further invasion, because native individuals can preempt space and acquire resources, which makes reestablishment by invasives more difficult” (Hartman). However, an important factor in replanting is time and this is a problem the city of Easton is going to face. Replanting at exactly the right time can aid in success of the growth rate. In order to replant successfully, the city is going to have to wait until after the winter to maximize the survival rate of small bushes and seeds. Waiting until after winter could potentially cause some of the knotweed to return. Another factor with replanting small bushes and seeds can be that small plants need constant and heavy maintenance, which could potentially be difficult for the city of Easton to provide.

Although it may be more difficult, replanting seeds and smaller plants or bushes after the winter season could potentially be a very successful way to begin regrowth in the areas sprayed. Also, the ecosystem has the potential to become more successful by producing new plants naturally. In the Amur honeysuckle research, the study shows that successful regrowth after the spraying of glyphosate and has the potential to rebalance the ecosystem. There are many different types of grass and small plants that could potentially be very successful on Easton’s riverbanks.

As far as recommendations go, the black chokeberry (Photinia (Aronia) melanocarpa) can tolerate many different growing seasons and blooms in the months of April and May. It attracts songbirds and other animals with its black fruit. Another suggestion would be the bee-balm (Monarda), which works well with other small plants and
is extremely colorful and pleasing to the eye. It can be useful because its color attracts hummingbirds, pollinating insects, and predatory/parasitic insects that hunt common pests.

This policy alternative is a type of government management because the government intervened on a problem and is currently attempting to fix it. Also, the government is needed in order to fund the policy alternative. Many of the areas affected by the spraying are public parks or walking areas. These particular areas are a resource that the government must manage because they are publicly owned. In order to fully implement the replanting plan, the Easton government would need to hire gardeners or train the current maintenance crew. Additionally, Easton could choose to hire private contractors to handle the replanting and maintenance. Hiring private contractors will still allow the citizens of Easton to see the benefits of a newly replanted riverbank.

**Policy Alternative 2: Large growth**

One strategy the city of Easton could implement in order to deal with the lack of vegetation along the riverbank is to plant large growth and create a partial canopy cover. Planting trees and creating a canopy that shades 50% of low growth from the sun has been shown to drastically reduce and prevent Japanese Knotweed growth (Skinner). A canopy cover that extends fifty feet from the riverbank can also help to improve soil structure and reduce the growth of invasive species (Donald). However, fifty feet of canopy cover may not be possible considering the parks and roadways so close to the riverbank. If trees are planted along the riverbank in the upper sections behind the retaining walls, including along the bike path and in the park, an effective canopy can still be provided, as exists further north along the Delaware River, where the riparian buffers are stronger.

This method, though it may take a long time and a lot of effort to implement, would be one of the most effective long-term strategies for containing the invasive species,
providing a healthy riverbank ecosystem, and minimizing chemical use. Since the problem being focused on is the actual spraying of the chemicals, the most important strategic goal is to minimize or avoid chemical use. After the trees and large growth are planted, the low growth would still require some maintenance in the short-term, but this maintenance would require no chemical use. It would also involve checking for and eliminating Japanese knotweed and other invasive plants.

Though the canopy strategy may be very effective in the long-term, there are a few negative effects of planting large trees along the riverbank. The biggest problem is that the trees would have to be planted in the park, which would partially block off the view of the Delaware River from people in the parks. Another problem is that if trees are planted close to the retaining walls, they could disable access. One of the major reasons that chemicals were originally sprayed was to allow for check-up and maintenance of the retaining wall. This problem needs to be addressed if the city wants to avoid spraying and de-vegetation in the future. The trees would also need to be planted strategically so as to provide an adequate canopy without major gaps, but also to not be too close to major features of the park, including the bike path and the retaining walls.

The following information is from the Pennsylvania Department of Conservation and Natural Resources. As far as recommendations go, one tree that could be especially beneficial is the black gum tree (Nyssa sylvatica), which is native to the Easton region. The tree is noted for its durability and its ability to attract birds and other wildlife. Other suggestions are the chestnut oak, pin oak, red maple, and eastern white pine, all native to the Lehigh Valley. The benefit of the white pine is that it provides shade year-round. One recommendation for a high shrub to plant is the highbush blueberry. This blueberry plant is noted for its durability and ability to attract birds and other animals. The Pennsylvania
DCNR’s guide to landscaping with native plants is an excellent source of information for information about specific plants and their ecological impact (PA DCNR).

Policy Alternative 3: No action

The policy alternative of no-action is another option the city of Easton could utilize to help with their knotweed invasion problem on the riverbank of the Delaware in Riverside and Scott parks. This does not necessarily mean that the city will not do anything to solve the problem, rather “keeping present policies or programs ... may be a viable option” (Kraft and Furlong 171). Currently the city has stopped doing anything to the riverbank because they are unsure of what is the correct solution is. Also, in our discussion with Tess Mondello, she suggested that the city has not pushed for a solution because it is at the end of a fiscal year and there is not much money to be put towards a project such as the revitalization of the riverbank because it is not a dire need for the city. Applying this alternative might be the case because the barrenness of the riverbank is a policy problem that is not a pressing issue that must be fixed right this moment (Rushefsky, 93).

This policy of no-action could also give the city a base line of how effective the herbicide was. If come spring there is the same amount or more of the knotweed, which grows back during that season, the city can conclude that the spraying of herbicide was an ineffective solution to the knotweed problem. If there is a reduced amount of knotweed in the spring, it can suggest that the spraying of herbicide was the correct option and can be repeated to ultimately eliminate or at least keep the knotweed in a manageable amount. According to a study done by a student at the Oregon State University on knotweed control in a riparian area, “it often takes multiple growing seasons to eradicate this species” (Gianou 87).
No action might be economically beneficial because chemicals such as glyphosate used to kill knotweed are effective in the time period between July and October. If the city would like to continue to use the option of herbicide as the form of control for knotweed, they would have to wait until July to use the same chemical of AquaNeat so it would be better to let the riverbank return to its original state to see the same effects.

**Policy Alternative 4: Goats**

One potential policy alternative could be the use of goats to manage weeds, specifically knotweed, and therefore assist in the replanting process. If the presence of Japanese knotweed in Riverside or Scott Park is still a large problem, goats could possibly help to remove its presence. According to an article by Lani Lamming, owner of the Goat Grazing Business, goats can successfully control weeds. Lamming is also a "beyond Pesticides" board member and received her M.S. in weed science from Colorado State University. In her article published by “Pesticides and You”, she states, “the goats are used as a tool in intensive grazing and short duration schemes under holistic resource management principles” (Lamming). Lamming emphasizes that using goats eliminates the need for pesticides, is more cost-efficient and is also less likely to require additional treatments.

Lamming argues that using goats to control weeds is effective because the goats prefer weeds to grass. Thus, she explains that the goats are able to successfully control weeds because they naturally eat the weeds instead of the grass present, and “…everything they eat is then recycled as fertilizer and laid back down on the grasses” (Lamming). In a more detailed explanation of the process, Lamming claims, “once the goats graze the weed, it cannot go to seed because it has no flower and it cannot photosynthesize to build a root system because it has no leaves” (Lamming). This illustrates that one treatment is sufficient.
While it may be necessary to spray pesticides in the same area multiple times, once a goat grazes an area of land, those plants can no longer grow back. This means that using goats could be more cost-effective and time-effective than future pesticide spraying.

In Prince George’s County, Maryland, an invasive plant species is “threatening a forest... in Upper Marlboro” (WJLA). According to Susan Hubbard, of the Prince George County Department of Public Works and Transportation, when comparing traditional herbicide use to goat grazing she stated, that using herbicides “...to get rid of some vines can be ineffective and require repeat treatments”, whereas “...the goats get down much further and get down to the roots of the plant” (weedsnetwork). She also noted “the method has proven effective in other jurisdictions in Maryland” (weedsnetwork). Gaitherburg's Environmental Project Coordinator, Meredith Strider, stated Gaitherburg's intention to replant native species in the area in the coming spring, just as it seems the city of Easton does. Strider continued, “the goats were effective and were a more environmentally friendly alternative to using herbicide, since the parcel bordered a stream” (weedsnetwork). The proximity of the area to a stream complicated the use of herbicides, leading Prince George’s County to bring over 72 goats into the country to eat the invasive plant species. According to an article about Prince George County’s use of goats, “twenty-five goats can clear about a quarter of an acre per day. These two herds will eat up the problem plants in about a week” (WJLA).

Goat grazing could help control the Japanese knotweed in Scott and Riverside parks. According to Bob O’ Brien, Invasive Species Control Field Director for New York State Parks, goats “... like the stuff.... Three or four goats can clear a quarter acre of knotweed in a day. They love knotweed" (Rowley). However, the goats will also eat other types of bushes. According to “Sound Native Plants,” goats are not selective with their diets. Therefore, they suggest that the best practice for goat management is to hire a 24-hour herder and also to
erect a fence around the area. The “Sound Native Plants” advise that if “… the area also contains desirable plants, each plant must be temporarily fenced off with chicken wire or hardware cloth to prevent damage” (Sound Native Plants) from the goats. This policy alternative could most closely be categorized as government management. The Easton City government would pay a private company to bring these goats to Easton and have them graze the riverbanks. Once the private company does this, the City is then directly able to provide its citizens with public use of both Scott and Riverside parks.

**Evaluative Criteria:**

We thought that one of the most important criterion for evaluating the city of Easton’s policy on revitalizing the riverbank ecosystem along the Delaware River was effectiveness. Effectiveness, according to Kraft and Furlong, is the “likelihood of achieving policy goals and objectives of demonstrated achievement of them.” Also, effectiveness cannot evaluate more than one objective at a time, and our policies have more than just one objective included in them. It would be better to take two measures of effectiveness to accurately assess the success of the policy. The first would look at how effective the city was at controlling the knotweed growth, and the second would focus on evaluating the revival of a healthy riparian buffer zone.

The current tactic used to remove the knotweed from the riverbank with the spraying of AquaNeat seems to have worked so far, because it killed everything. The true success of this must be measured in the spring to see if the knotweed comes back. If it doesn’t come back, it also must be viewed that there is nothing left to the riverbank, which is not a desirable outcome. It takes time to project results and to see if these results actually happen. In this case, time is not too big of an issue because it can be dealt with in the spring and the summer when it is a better growing season for vegetation. The measure of health of
the riparian zone would also ideally be taken in the spring or summer, when the ecosystem is the liveliest.

The second evaluative criterion we selected was social acceptability. We chose this because our original problem concerned how the spraying of pesticides along the river negatively impacted the surrounding ecosystem. The problem arose from a concerned citizen about the physical health of the ecosystem and the aesthetic quality of the riverbank. People want a healthy riverbank to enjoy while at the park. Part of this includes the appearance of the riverbank. Some of our strategies are maintenance heavy, and may require closing portions of the parks for hours or days at a time. When deciding which policy to implement, the City should also consider what effect closing the park would have on its citizens.

Cost is always a factor when multiple options are being considered. Often, cost is the most important factor; however, in analyzing our policy alternatives, we deemed cost efficiency a less important criterion, lower than effectiveness and social acceptability. There is a problem that needs to be solved, and the people of Easton need to agree and accept a solution. Only then will cost be a major concern.

Efficiency considers all costs, including labor, training, resources, supplies, and maintenance. Labor is one of the primary costs, since the city of Easton would be hiring contractors or employees in many of our strategic options. Training is more of an issue if volunteers are selected instead of hired contractors, but can still apply if contractors are used. Resources include the seeds, plantings, maintenance equipment, and potentially more chemicals. Lifetime costs need to be considered for all options to make comparison easier.

The last evaluative criterion we will use to determine which is the best policy alternative is administrative feasibility. Administrative feasibility in this case refers to if the Easton City Government has the capacity, through its organizations and workers, to
potentially implement the policy alternatives. It is imperative to know if a policy alternative is practical before implementing it. Thus, we want to ensure that the City has the manpower, departments, and the organizations that a policy alternative would demand.

Easton is a small city with a small government; therefore, it has fewer resources than a large city can boast. Easton has a public works department of about 100 workers; however, the department’s responsibilities span over many parts of Easton. The public works department is responsible for highways and roads, parks and recreation, garbage and recycling, and traffic lights, among many other responsibilities. The City also has a Department of Planning; however this department only has five employees.

The limited number of employees and departments should be taken into account when determining policy alternatives; however, it is not the most important criterion. Administrative feasibility is listed last out of the evaluative criteria selected because it is less important than the effectiveness, efficiency, or social acceptability of a policy alternative.

Assessing the Alternatives:

While the five criteria selected are all important, we felt that their level of significance in determining a policy alternative differed, as shown in Table 1. The effectiveness on controlling knotweed was weighted as times one and a half because controlling the knotweed in Riverside and Scott parks is one of the main public problems this policy should be addressing. Another public problem the policy we chose should respond to is the lack of a healthy riparian buffer; therefore, the policy’s effectiveness in creating a healthy riparian buffer was also weighted by one and a half. Social acceptability also held a large share of the problem and was weighted as one and a half its score.
The citizens of Easton were annoyed and uninformed by the spraying near the Delaware River. Many were also not pleased by the now unpleasing look of the waterfront.

We decided that efficiency, while important, was not as important as the other three; therefore, it has less weight in the final score, and is only weighed as one. Finally, we concluded that administrative feasibility should be considered, but should not be the deciding factor for a policy. Administrative feasibility is a criterion that can work with many solutions; therefore, administrative feasibility's score is only weighted by half.

The first policy alternative we suggested was the planting of small growth, including grasses, flowers, and brushes. This policy would include putting down grass seed and matting in all the areas sprayed for the winter, and then adding additional smaller plants and bushes at a later date. We gave this policy alternative a score of twenty-three and a half, which was largest score out of the four policy alternatives.

Our group agreed on giving policy one a four on its potential effectiveness of knotweed control. With the additional weighting, the final score for effectiveness came to a six. As quoted earlier, small growth “may inhibit further invasion, because native individuals can preempt space and acquire resources, which makes reestablishment by
invasives more difficult” (Hartman). Small growth has the potential to be very effective in the area of knotweed control because as grass and small plants begin to grow they require a lot of attention, which allows for careful observation and control of knotweed growth. Also, our group looked into finding specific suggestions of small growth that would grow successfully together in the area. Policy one did not receive a perfect score of five because knotweed still has the potential to grow around the newly planted small growth.

For the second criteria, our group decided to give policy one a score of four out of five on the effectiveness of repairing the riparian buffer along the Delaware. This score was multiplied by one point five to receive a final score of six. In order to successfully repair the riparian buffer, the barren area along the buffer needs vegetation. Small growth would add vegetation to this area, which would aid in the return of a successful ecosystem in the area. Also with small growth, there is potential to add many different plants and bushes to the area, which would add to a diverse ecosystem. Small growth also has the potential of protecting the riverbank from erosion. Erosion would only increase the problems along the riverbank, as it would decrease the size of the riverbank.

For the third criterion, social acceptability, we allotted policy one a score of five out of five. Due to the importance of this issue to the city of Easton, we chose to weight this criterion heavily with a one and a half allowing for the total social acceptability for policy one to be a seven and a half. We gave this a high score because we believe adding small growth will be extremely aesthetically pleasing to the community. The people living in Easton originally were unhappy with the overall look of the sprayed area, which was what lead them to make this issue such a high importance. Small growth includes everything from grass, flowers, and bushes. There are many different combinations of these three types of plants that would look very beautiful together. The different plants available with small growth allows for a large variation of options for the community. Also, small growth still
allows for a view of the river and the parks as no large trees would be blocking peoples’ views.

For the fourth criterion, we decided to give policy one a three in efficiency. With the weighting, the final score comes out to a three as well. As the city has already laid down grass, the cost of small growth is not as expensive as other policies. Small plants and bushes are not expensive to purchase; however, they can be expensive to maintain. Maintenance is important because it keeps up the aesthetically pleasing look along with aiding in the control of any reappearance of knotweed.

The final criterion used was administrative feasibility, which represents the city’s ability to implement the policy suggested. We agreed on giving policy one a two and after weighting it received a final score of one. Although the city of Easton has already began to place grass down, it is essential to understand the city would need to be very involved in the success of the small growth policy. This policy requires for the newly planted riverbank to receive a decent amount of attention. The area will need to be carefully maintained, in order to see the successful growth of plants and the return of the ecosystem. Maintenance would require someone to know and understand knotweed, in order to prevent the return of it later on. However, this intensive maintenance would only be necessary until the replanted areas begin to prevent further invasion through successful growth.

Overall, policy alternative four scored the highest of the four policy alternatives.

Among all the alternatives we looked at, planting trees, bushes, and other large vegetation along the Delaware River is the most effective at creating and maintaining a healthy riparian buffer over the long-term. Planting large growth is also very effective at controlling Japanese knotweed. However, large growth is the most expensive strategy we looked at.
Large growth received a weighted score of six for effectiveness at knotweed control, but it didn’t receive the best. Planting trees and high bushes that shade at least fifty percent of low growth along with a healthy native bed of low growth can greatly reduce the expansion of Japanese knotweed and prevent invasive species from being successful (Skinner). Although a fifty percent canopy cover can be very effective, in Easton’s implementation, it would only be effective in the long-term, and the low growth would still need to be maintained and possibly even sprayed while the larger vegetation is growing. After an adequate canopy cover is achieved, the riverbank would require very little maintenance, and the use of chemicals would be unneeded.

Large growth received the best score for effectiveness at creating a healthy riparian buffer zone, a weighted score of seven and a half. According to Donald, a canopy that extends out fifty feet from the riverbank can be very effective at improving soil structure, reducing erosion, aiding in flood control, and facilitating a healthy ecosystem. On the Delaware River in Easton, flooding is a major concern. Though the existing retaining wall was erected as a flood control system, a natural barrier is often as or more effective. In the wake of Hurricane Sandy, many towns and cities like New York are considering a more natural flood control, rather than man-made barriers and gates; often the natural strategies can be less expensive (De Chant). With a combination of low growth and large growth, the Delaware’s riverbank will be much healthier. The trees suggested previously, especially the black gum tree (*Nyssa sylvatica*) are known for their durability, stability during disaster, and ability to facilitate healthy soil. In combination with the brush suggested, the vegetation could attract birds and other wildlife to the Delaware River, which further help with creating a healthy ecosystem.

Large growth scored a low weighted four and a half on social acceptability. The most ideal riparian buffer has a fifty-foot zone of canopy cover. This is difficult directly around
the Northampton Street Bridge (Free Bridge) because Larry Holmes Drive is barely fifty feet away from the Delaware River, but along most of Riverside Park, a fifty-foot zone is available. The problem is that the fifty-foot zone includes the actual park. While there are already a few trees already growing in Riverside Park, creating an effective canopy cover would shade the majority of the park and obstruct the view to the river and visibility around the park. While some may welcome the shade, the obstruction of the view of the river would likely irritate many citizens of Easton. Also, if large bushes grow without sufficient maintenance, there is a possibility that they could partially block access to the retaining walls, a problem that sparked the initial chemical spraying.

The biggest issue with planting large growth is that it is very expensive, the most expensive option we looked at. For this reason, large growth received a weighted score of two at efficiency. Planting large growth would entail all the costs involved with small plants and seeding, plus the additional cost of planting large trees, and maintaining those trees until they can provide an effective canopy cover. While planting large growth is very effective at controlling Japanese knotweed and providing a healthy riparian zone, the effectiveness is very strong over the long-term, and fairly weak over the short-term (relative to goats and seeding).

Administrative feasibility was also a low-scoring section for large growth, receiving a weighted score of one. The issues with administrative feasibility are somewhat similar to social acceptability. The idea of planting trees along the park could spark disagreement within Easton’s government and prolong the process of fixing and maintaining the riverbank. Also, since Easton has a small city government, it would have to hire contractors for maintenance, and possibly also landscape architects to re-design the parks with added vegetation. This could be an expensive and difficult process for the city of Easton.
All in all, planting trees, high bushes, and other large vegetation would be the best long-term solution to both control knotweed and create a healthy riparian buffer, but due to its mediocre social acceptability and high cost, it is not the best overall solution.

The third policy we proposed was a policy of no action. This policy would include leaving the riverbank of the Delaware the way that it currently is without any plants or seed on it for the remainder of the winter. This policy earned a final score of twelve and a half out of a possible thirty and was the lowest scoring option out of the four alternatives purposed.

The first criterion we evaluated it on were the effectiveness of controlling the growth of the knotweed on the riverbank. We decided to award it a score of two, and with weighting it came to a three out of five because it is hard at the moment to tell how successful the already sprayed herbicide will be. Right now it seems that the policy of no action would be an achievement because the riverbank is barren. We thought this might change as spring approaches and the knotweed would grow back, and in this case we decided that no action might not be the most effective alternative. As a result of our lack of knowledge of the effects of the spring we decided to give the ranking of three to keep it neutral and reassess this score in the spring after seeing if the knotweed re-grows.

The second criterion we used was the effectiveness of repairing the riparian buffer along the Delaware River. We gave it a score of one because the current state of the riverbank is not ideal for a healthy riparian buffer. Without any vegetation or anything at all on the riverbank it is missing a key component of a riverside ecosystem and could be potentially harmful for the entire river ecosystem. This also raises the concern about erosion. If erosion becomes an issue there will be less of a riverbank to plant vegetation on to help improve the health of the riparian buffer in the future.

The third evaluative criterion we used was social acceptability. We thought this was important because the riverbank runs alongside Riverside Park, which includes a
playground, bike path, and an amphitheater above the riverbank. The aesthetic quality of
the park might not be the number one concern of the city, but we felt it was an important
aspect, especially because the desolate riverbank was an issue a citizen of Easton brought to
the EAC’s attention. Another issue that would impact the public’s opinion would be cost of
the policy; taxpayers care where their money goes and what programs the money is used
for. We gave social acceptability a weighted score of one and a half out of five. We felt that
for those who were concerned with the aesthetic quality of the riverbank, they would not be
pleased with the policy of no action and leaving the riverbank barren and muddy, which is
not the most pleasant view from the river or from the park.

Our fourth evaluative criterion was efficiency. We decided we would approach
efficiency as how economically costly it would be to implement the policy. For no action we
decided to give it a five out of five because it would be the least expensive of all of our
proposed alternatives. It would cost nothing to leave the riverbank as it currently is, muddy
and exposed without any plant growth. We believe that this might increase the social
acceptability as a result of the amount of cost which accompanies this policy, which is
nothing.

Our fifth and final criterion is administrative feasibility. This would include the
ability for the city of Easton to implement our different policy alternatives. For no action it
would not take any action from the government within the city to assign tasks to maintain
the riverbank. For this reason we decided to score no action’s administrative feasibility with
a five out of five, but it finishes weighted as a two and a half. There would be no need to
involve the government because there is nothing to facilitate. They wouldn’t need to make
sure volunteers were trained correctly to plant or remove species from the riverside. They
would not have to look to hire an outside company to spray herbicide to kill unwanted
Japanese knotweed. It would make the government within the city of Easton easier because
they do not have to worry about how they should proceed with a topic they might be unfamiliar with, such as restoring the riverbank alongside the Delaware River. Overall, policy alternative three scored last out of the four policy alternatives.

The fourth policy alternative was goats. After assessing this alternative, we concluded that using goats is a choice that makes a lot of sense in many ways. This alternative scored very well in its effectiveness of controlling the knotweed, effectiveness in creating a healthy riparian buffer, and efficiency. Policy alternative three did not score well on social acceptability or feasibility.

Our group awarded policy alternative four a score of five for its expected effectiveness in controlling knotweed. Due to this criterion’s importance, that score was multiplied to one and a half to have a final score of seven and a half. As explained earlier, when the goats chew on the knotweed, as a result of the way that they chew, the weed “…cannot photosynthesize to build a root system because it has no leaves” (Lamming). Since the weed cannot photosynthesize, it cannot re-grow. Using goats to control knotweed and other weeds is very effective because it hinders the weeds’ abilities to re-grow. This explains why additional or follow-up treatments are not necessary for this policy alternative. This method for controlling weeds has been effective in Prince George’s County and other jurisdictions in the state of Maryland. Due to its successful effectiveness in the past and its rationale for its effectiveness, we deemed using goats to be very effective in controlling the knotweed in Riverside and Scott Parks.

Policy alternative four received a score of four for its expected effectiveness in helping to ensure a healthy riparian buffer. This score was then multiplied by one and a half to become a score of six. The goats would essentially clear the land where knotweed once grew, allowing for new plants to grow. These new plants would contribute to a healthier
and more diverse ecosystem. Eventually, the plants would contribute to a healthy riparian buffer along Riverside and Scott Parks.

The goats earned a score of two for social acceptability for many reasons. This score, because of the criterion’s importance was also multiplied by one and a half, which resulted in a final score of three. No information could be found on how the residents of Prince George’s County, Maryland responded to the goats there. Originally we regarded policy alternative four as highly socially acceptable. Unlike chemicals and long-term methods, goats are not very controversial. At first we assumed that children and parents would find them cute and be pleased by their temporary presence, or unaffected by it. However, goats may cause a few negative externalities for the residents of Easton. Firstly, goats are living organisms that make noise. Goats, like sheep have a “baah” sound. After many hours or days, this sound could potentially irritate many of Easton’s residents. Secondly, living organisms have bodily functions. Along with goats come their feces. While their feces would remain where they are grazing the knotweed, we are not certain as to how residents would feel about this. Lastly, having goats near the Delaware River would seem very bizarre. It could be very unaesthetic and could cause unnecessary commotion. We do not know if the goats would affect the residents in and around Scott and Riverside parks. Due to the negative externalities we predicted that come along with goats, we awarded this policy alternative only a two for social acceptability.

Policy alternative four received a score of four for efficiency. While costs for goat grazing vary across the country, it makes sense that this alternative may cost less than the others because the city would not have to pay for repeat treatments and maintenance. According to Sound Native Plants, “one company charges someone for a herd of six goats for three days” (SoundNative). According to an article from WJLA.com, “Prince George’s County is shelling out $5,000 for the week-long job, which is said to be less expensive than other
options to rid the problem” (Doren). While the method would require the hiring of a private firm, it would most likely still be cheaper than using city employees to repeatedly spray or maintain the areas.

For administrative feasibility, this alternative only received a score of three. This is because a herder is recommended to look after the goats while they are grazing. We suspect that the City of Easton does not have a herder, and would therefore have to hire one. The city would also need to hire a private firm to implement the policy. On the other hand, with some of the other alternatives, the City may need to hire additional workers to maintain the area, and it could cost the public works department a lot of time. With goats, it is a one-time treatment that is done externally from the City’s departments. Overall, policy alternative four scored second highest of the four policy alternatives.

**Recommendation:**

Our final recommendation to the city would be policy alternative one, which is adding small growth to the area sprayed with glyphosate. Policy alternative one received the highest score of the four policies. As the city has already begun on this course of action, we would only suggest adding to the current plan. Since rye grass seeding has already been laid down, the next step would be for the city to begin looking into what types of plants to begin putting in the ground. We suggested earlier in the paper two specific plants: the black chokeberry (Photinia (Aronia) Melanocarpa) and the bee-balm (Monarda). These plants are known for attracting butterflies and birds, which would aid in returning the ecosystem into its previous state. However, there are many other potential plants or scrubs that could be planted in this area. We highly suggest the city look at Pennsylvania Department of Conservation and Natural Resources website, as a resource when it begins to plant. As many of the plants bloom in the months from April to May, the planting season is very important,
depending on whether or not the city is purchasing already grown plants or putting in seeds. With small growth, we do suggest heavy maintenance specifically in the first year. As knotweed can return, heavy maintenance will aid in preventing the knotweed from taking over the area as it did before. Thus, it is crucial for the landscapers to fully understand what knotweed is and how to properly remove it from the planted area. With heavy maintenance, the small plants and scrubs will be able to flourish allowing them to use up resources and space, which knotweed needs in order to grow. Overall, we believe small growth will be the best solution to the current problem, as it will help control the Japanese knotweed and will aid in the return of a healthy ecosystem and healthy riparian buffer.

One policy we would definitely not suggest is policy three, entailing no action. This policy alternative has the potential to seriously damage the ecosystem and potentially lead to erosion along the riparian buffer. Although it would be highly cost efficient, there are too many potential problems this policy could lead to in the future.

While policy alternative 2, large growth, and policy alternative 4, goats, may both be effective in controlling the Japanese knotweed, both policies would most likely lack public support and be difficult for the city to implement. Therefore, we concluded that policy alternative one would be the most plausible policy to implement overall.
Annotated Bibliography:


This source provided experts’ perspectives on goat grazing in Prince George County, Maryland.


This magazine article provided information about what makes Japanese knotweed invasive, and the dangers it imposes on the environments it invades.


This source also provides general information and cost information on goat grazing for controlling weeds.


This source explained laws specific to Pennsylvania’s fishing and boating access strategy.


This article provided information about New York City’s plans for flood control.

Doren, Jenny. (18 May 2012). ‘Eco-Goats’ grazing away Prince George’s problem
http://www.wjla.com/articles/2012/05/-eco-goats-grazing-away-prince-george-s-
problem-plants-76109.html.

This source provided an additional perspective on goat grazing in Prince
George County, Maryland.

Donald, W. (2002). Glyphosate effects on ground cover of tall fescue waterways and

This scholarly article provided information about the damaging effects glyphosate
has on soil and the dangers of over spraying glyphosate near waterways.

Hartman, Kurt M. & McCarthy, Brain C. Restoration of a Forest Understory After the
Removal of an Invasive Shrub, Amur Honeysuckle (Lonicera maackii). Forest
Recovery After Shrub Removal. 154 – 165.

I used this study as an example to learn from on planting small shrubs in any
location. Although different ecosystems, the study still provided a good background
on replanting.


*Pesticides and You.*

This source clearly explained why and how goat grazing can control weeds. It
also provided an expert’s input on the method.


We used this source to help gather information on the riparian buffers and the
parks, in order to make our two Arc Gis maps.

Malysa, Matthew. (23 August 2012). Rutherford considers bringing in goats to

National Wild and Scientific Report. Lower Delaware River Management Summary. This report specifically highlighted a plan of action to keep and help restore ecosystems along the Delaware River.

Penn State College of Agricultural Sciences Cooperative Extensions. (2011). Pennsylvania Wildlife, Riparian Buffers for Wildlife (no. 16). University Park, PA. This report gave background information on what makes up a health riparian buffer. It, also, highlights the importance of human interaction with the ecosystem and the benefits humans receive as a result of a health ecosystem.

Pennsylvania Department of Conservation and Natural Resources. (2012). Bureau of Forestry. Retrieved on November 27, from http://www.dcnr.state.pa.us/forestry/index.aspx This website provided a lot of information about plants native to Pennsylvania, their ecological characteristics, and how to maintain them.


This journal article provided scholarly research on the long-term effects of glyphosate in the soil, including data on how glyphosate degrades with differences in pH, phosphate level, and soil type.