The ‘Forests’ of Owings Mills:

Past, Present and Future

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I. Introduction

Population growth can be a serious issue in urban areas, thus managing development is an important part of growth management. When planning urban development, the impact of development on stormwater management, wildlife conservation, and pollution must be considered. A Smart Growth planning model can be used to control many of these issues. Smart Growth can be defined as designating the most suitable areas to accommodate urban growth by mixing residential and commercial development, promoting dense development, and minimizing sprawled infrastructure. Since Smart Growth focuses on protecting natural resources, it provides opportunities to preserve forest parcels. Forests are critical for slowing stormwater run-off, since they reduce erosion, create a refuge for wildlife, and filter pollution before it reaches the streams.

In the northern areas of Baltimore County, some of the land is much the same as it was thirty years ago whereas other areas, such as Owings Mills, have changed dramatically. Northern Baltimore County remains primarily agricultural with sparse residential developments. Development in Northern Baltimore County has been carefully controlled. On Interstate 83 near Shawan Road, a contrast in landscape is readily apparent. To the West, the land is composed of forests and farms, while to the East lay densely developed business parks. This abrupt change in land use is a result of the County"s zoning policies, and in particular the Urban-Rural Demarcation Line (URDL). This line was intended to restrict growth into a designated area.

As the population of the County grew throughout the 1950s and 1960s, demand for residential development skyrocketed. There was a clear need for preserving open space and agriculture. In order to keep some parts of the County agricultural, the area north of the URDL was zoned for land preservation and agriculture. Locations south of the URDL were set aside for commercial and high-density residential development. The County would provide infrastructural support, such as water and sewer, strictly for the development zone within the URDL.

Owings Mills is designated as a growth area of Baltimore County. Owings Mills has highly concentrated commercial and residential development as the result of a regulated, planned, and monitored process controlled by Baltimore County. Although dense development is more environmentally sound than sprawl, there are still environmental impacts.

Owi

Riparian forests provide food and habitat for all trophic levels of the food web, from microbes to top consumers (Naiman et al., 1997). Species richness is generally high in riparian forests, as they provide shelter from predation and access to drinking water (Naiman et al., 1997). Leaf litter that falls into the stream provides food for microbes, such as bacteria and invertebrate larvae, as well as necessary nutrients for biological processes (Naiman et al., 1997). Some macro-invertebrates will also feed on this leaf litter, and these organisms serve as food for fish and other aquatic organisms.

II. B. Determinants of species composition in forests

II. B. 1. The Vertical Organization of Forests

Forests are arranged vertically, from the bedrock up through the canopy (Smith and

Jewelweed (*Impatiens bidens)* are likely to be found in the wettest areas that are not continually submerged (USDA NRCS, 1993).

The soil characteristics and species composition change within a forest as the distance from water and elevation increases (USDA Plants, 2007). Sycamores require soil with higher moisture content and are more likely to be found in more lowland areas and in closer proximity to water (USDA Plants, 2007). In contrast, White Oaks are much more tolerant of low moisture and drought and would likely be found in more upland environments (USDA Plants, 2007). Red Maples prefer soils that are higher in moisture content (USDA Plants, 2007).

The chemical structure of the soils, such as the amounts of sodium chloride and calcium carbonate present, can be predictors of species found in an area. Salinity is a chemical property

precipitation, which tend to be more acidic than acid rain such as snow and fog (Eubanks et al., 2006). Prevailing winds carry the acidic gases released into the atmosphere from the Mid-western regions of the United States to the Northeastern regions of the country (Eubanks et al., 2006). As precipitation occurs in these Northeastern areas, the transported acidic gases, as well as gases released within the Northeastern area, are responsible for acid rain and acid deposition.

Acid rain may impair the survival of Maryland forest vegetation in many ways because it can cause serious problems for vegetation with restricted soil pH tolerance or that require specific soil conditions. Soil changes are induced as acid rain leaches calcium and magnesium from soil, creating more acidic conditions. This is unhealthy for trees because basic elements such as calcium and magnesium are necessary nutrients for proper tree growth. Both calcium (Ca) and magnesium (Mg) can act as soil buffers but their loss can result in acidification of the soil and water of the area (Boyer et al., 2003). Acid rain also harms aquatic organisms in forest streams (Pheiffer, 2007).

Two common tree species in the Owings Mills area are White Oak and Red Maple (Johnson, 1999). White Oaks grow, reproduce, and thrive in a soil having a pH of 6.5-7.5 while Red Maples thrive best in soils that have a pH of 4.5-7.5 (Johnson, 1999). Acid rainfall may alter the soil pH out of the optimum pH range which allows normal and healthy tree growth.

the ability to affect vegetation in Maryland. Salt is placed onto roadway surfaces to melt snow and ice. Excess salt runs off into streams and storm-water retention ponds and can eventually infiltrate groundwater. Salinity of fresh water has salinity less than 0.5% and seawater has salinity of about 3.5 % (Garrison, 2004). Increased exposure to salt can have a dehydrating effect on plants (TRB, no date). Salt disrupts normal vegetation growth, damages foliage, limbs, and roots, prevents plants from flourishing, and may lead to death (TRB, no date). American Linden (*Tilia americana*), Black Walnut (*Juglans nigra*), Sugar Maple (*Acer saccharum*), and Red Maple are Maryland trees that are most susceptible to damage by salt (TRB, no date).

Chloride ions cause more harm to vegetation than sodium ions. Chloride is absorbed through the roots of vegetation. After reaching plant tissues, chloride remains present for a significant amount of time (TRB, no date). As a result of excess chloride in plant tissue, osmotic stress may be induced which leads to vegetation dehydration. Maryland trees that are affected the most by salt are American Linden, Black Walnut, Sugar Maple, and Red Maple (TRB, no date). Trees with a higher tolerance of salt are Oaks, Birch, White Ash, Scotch Broom (*Cytisus scoparius)*, and Jack Pine (*Pinus banksiana)* (TRB, no date).

II. C. 3. Ground Level Ozone

Ground-level ozone is another predisposing stressor that can impact Maryland"s forests. Ground-level ozone is created when nitrogen oxides and volatile organic compounds react with

II. C. 4. Non-point Source Pollution and Heavy Metals

Non-point source pollution (NPS) is pollution from a number of different sources, that can not necessarily be pin-pointed, such as runoff from impervious surfaces, yards, and roof tops (EPA, 2006). Urban NPS pollution, especially nutrient pollution in the form of nitrogen, phosphorous, and heavy metals, is a predisposing stressor that can seriously impact the trees and landscape in Maryland. Excessive nutrients are harmful to streams (Polyakov et al, 2005). A stream with a functioning riparian buffer is able to maintain more natural inputs of nitrogen and phosphorous within the stream (Polyakov et al, 2005).

Trace metals, such as zinc (Zn), copper (Cu), lead (Pb), chromium (Cr), and nickel (Ni) are absorbed by plant roots and are stored in plant tissues (Sebastiani, 2004). These elements interfere with a plant"s ability to photosynthesize at varying degrees of severity for different plants. In addition, heavy metals negatively alter soil microbial activity and fertility (Sebastiani, 2004). Most of these metals come from tire wear on road- ways and roof runoff and enter a forest system during a rainfall (NSPS, 2003). The typical concentrations of some trace metals in soils are as follows: zinc at 108ppm, lead at 37ppm, copper at 19ppm, chromium at 45ppm, and nickel

surface runoff causes erosion and carries pollutants such as nutrients and heavy metals (Science Daily, 2007).

Forest edges are another potential impact of fragmentation. A forest edge is an area where two separate types of landscapes intersect, such as between forest and meadow, forest and stream, or forest and a backyard. (OLC, 1996). It is common to see intersection of forest and private property in new growth forests, forest fragments, parcels, and urban forests, like in Owings Mills. There are two types of forest edges, inherent and induced, which are defined by how the edges were created (OLC, 1996). An inherent forest edge is created by natural conditions and the evolution of plant communities, whereas an induced forest edge is created by human interactions like development, logging, planting crops, and grazing livestock (Patton, 1992). In each case, an intersection of two landscapes produces an area that is different from the original landscape, which in turn has a series of effects on the surrounding environment (Patton, 1992). These effects are known as edge effects, and they can have both positive and negative effects on the long-term characteristics of both habitats and sustainability of both habitats (OLC, 1996).

Negative edge effects, resulting from clear-cutting have many impacts on Maryland forests. Interior forest habitats have been estimated to take hundreds of years to regenerate into a mature, interior type forest (Raines, 2007). As these interior habitats are destroyed, animals may be unable to move across forest edges as a result of the extreme temperatures and humidity (OLC, 1996). These same induced edges do not provide enough protection against wind for the surrounding trees. During periods of high wind, trees can be blown down like a domino effect (Little, 1995). Edge effects that result in future tree deaths are known as residual tree death

stressor in Maryland. Gypsy moths are a huge problem in Maryland forests. Gypsy moth larvae have defoliated trees, mostly Oaks, throughout the Eastern forest states (Leibhold, 2003). When larvae density is high, complete defoliation of forests can occur which can kill trees (Leibhold, 2003). Efforts to eradicate this species have been extensive and include spraying infested forests with pesticides and the introduction of numerous insect parasitoids from Eurasia (Leibhold, 2003).

Invasive organisms" especially novel pathogens can be categorized as mortal stressors

III. Creating and Fostering Communities that Preserve Forests

Anthropogenic effects of development can be devastating for forests, thus Baltimore County has attempted to minimize these effects by curbing sprawl and promoting Smart Growth development. Smart Growth has many environmental and economic benefits for the Baltimore County area.

III. A. Impacts of Urban Sprawl

Since the beginning of the 1970"s, urban sprawl has destroyed agricultural lands, natural habitats, and recreational areas and has become a critical issue for developed countries (Berlin, 2002). The term sprawl generally refers to development that decreases population density and increases vehicle use (Berlin, 2002). Sprawl can be considered as random development that is characterized by little forethought or consideration of the benefits of connecting components of a community such as housing, employment, schools, and hospitals (Schmidt, 1998). The full impact of sprawl can be understood with the consideration of several factors such as leapfrog development, commercial strip development, single-use development, poor accessibility and automobile dependency, fragmented open space between scattered developments, lack of functional open space, high edge contrast, lack of nearby conveniences, and an increase of expenditures on infrastructure (Berlin, 2002).

Housing characteristics, land-use patterns, transportation choices, and poorly executed or ignored architectural or urban-design decisions, cause ecosystems to fail and communities to collapse (Schmidt, 1998). The negative health impacts associated with sprawl are also of growing concern. These impacts, which are exacerbated by automobile dependence, include poor air quality and its impact on respiratory health, as well as limited physical activity from driving to work, home, school, and shopping which can lead to obesity (Jackson and Kochtitzky, 2001). Sprawl also has deleterious effect on both human and non-humans; it destroys natural habitats atiftats

A **B**

Figure III. 1: Urban Rural Demarcation Line. A) Urban Rural Demarcation Line: area outside the pink line is intended to remain as agricultural land. B) Map B represents the changes that have occurred to the URDL since its inception in 1967. The current URDL is colored gray while the original line is green. Image A from http://www.neighborspacebaltimorecounty.org/urdlccamap.gif. Image B from D. Outen"s presentation, August 2007.

III. B. Policies

In the face of a booming suburban population, Baltimore County realized that planned development policies were necessary to reduce the growing impacts of suburban sprawl (Gwynn"s Falls Watershed Association, 1999). Smart Growth policies and environmental laws have shaped the Owings Mills area into a mixed-use, densely populated area interspersed with forested sections (Jack Dillon, personal communication October 2007).

standards [of the FCA…]" (DNR, 2003). These plans provide the state with the amount of land that is protected and replanted with trees, as well as protection during and after development has occurred (Howell, 1997).

benefits of Smart Growth (Wheeler, 2007). If a Smart Growth community does not track its public spending, then it is impossible to gauge whether the Smart Growth program is economically efficient. Cost and benefits drive community decisions; therefore, it is critical that cost and benefits be analyzed to curb sprawl-like growth.

The implementation of public water and sewer works can be quite often a burden on the tax base. Therefore, the benefits of having sewer and water lines must be analyzed in detail in order to develop the best possible development plan; lack of study of a development plan can lead to inefficient sewer placement (Bagi, 2002). The Economic Development Administration, a federal entity under the United States Department of Commerce, worked with several prestigious academic universities to find the key financial differences between the

number of household shopping trips jumped from 341 per year in 1990 to 496 per year in 2001 and the overall length of the average trip increased from 5.1 miles to 7.02 miles (Hakim and Peters, 2005). This increase occurred even though the cost of gasoline had been on the rise during those years (Hakim and Peters, 2005). By implementing walkable communities, these costs of living are decreased. The cost of speeding, which is also associated with increased driving, is around $40.4 billion annually nation wide (Hakim and Peters, 2005). The cost arises from enforcement of speed laws and emergency response to crashes caused by speeding (Hakim and Peters, 2005). Local governments in walkable communities will save money, but the additional indirect benefits to these communities, such as healthier lifestyles from increased walking and decreased car accidents, are a priceless benefit.

The analysis of economic data can help communities to decide what to do and what not to do, in terms of development. If done correctly, it often drives society towards the conservation of natural resources. If it is used as part of the decision making process regarding how to develop land properly and wisely, problems such as infrastructure cost exceeding tax revenue gained will be avoided.

IV. The Forests of Owings Mills

The existing forests in Owings Mills are fragments surrounding streams. Our research aimed to determine the composition of these buffers and their sustainability. Tallies of seedlings and saplings were conducted to gauge the appearance of regeneration in the individual sampling sites. Soil analysis, to determine the impacts of trace and heavy metal contamination, was performed to assess how the soils in the area might affect the vegetation present.

IV.A. Site Selection

Small groups of students preliminarily assessed 14 possible sampling sites in Owings

quarter sampling

of the genera Oak (*Quercus)* and Hickory (*Carya)* dominate Maryland forests, as well as Maple (*Acer)*, Gum (*Nyssa)*, Ash (*Fraxinus)*, Cherry (*Prunus)*, and Beech (*Fagus)* (Gurevitch, et al., 2002). The most common species found in Maryland forests are Oak, Hickory, Tulip Poplar (*Liriodendron tulipifera*), and Red Maple (*Acer rubrum*) (Pywell, 2003).

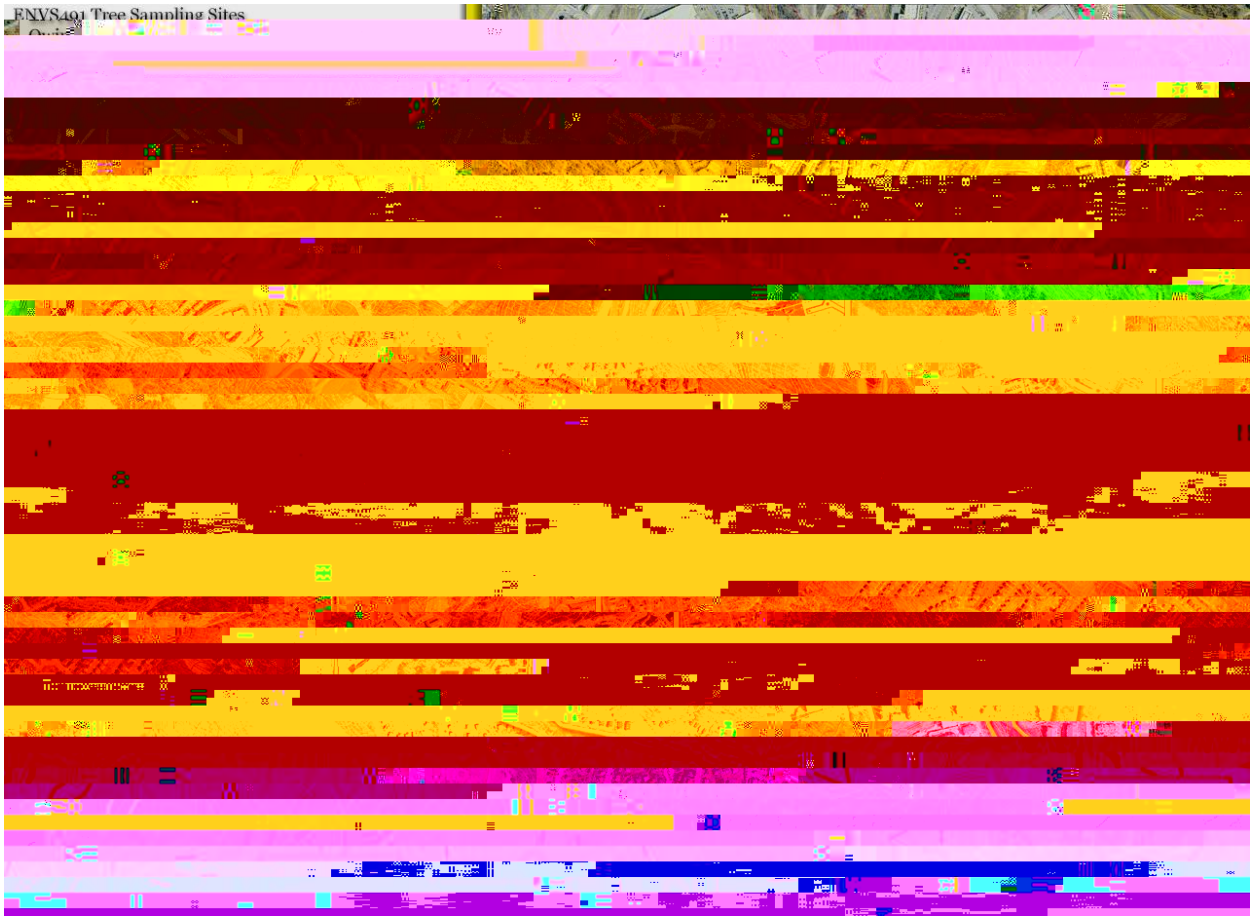

Figure IV. 1: Map of Sampling Sites. Map of the four sampling sites selected by the class to sample trees and soil. Each site represents a fragmented forest, or a forest "finger." Map adapted from DEPRM 2007.

Formerly, American Chestnut (*Castanea dentate)* was a fairly dominant tree in Maryland and elsewhere in the Eastern United States, but the effects of Chestnut Blight have nearly eliminated the trees from the east coast; Oak species have moved into the Chestnut"s vacated ecological niche and replaced them (Gurevitch, et al., 2002). Specimens of American Chestnut still exist in Maryland as small branches arising from the stump of a former adult tree, but the

Chestnut Blight prevents these branches from surviving long enough to become reproductive adults, effectively preventing the Chestnut population from recovery (Gurevitch, et al., 2002).

Tulip Poplar is generally considered to be an early to mid-successional tree and its

and Matthews, 1976). The water table is generally high in this soil type and native vegetation consists of water tolerable hardwoods. Tulip Poplar, Sweetgum, Ash, Red Oak, and Red Maple grow well in this soil type. There can also be significant erosion present in this soil type (Reybold III and Matthews, 1976).

Table IV. 2: Selected soil characteristics of the soil types at each sampling site. Note the two soils that are not very fertile for hardwoods, the Baile soil and Edgemont soils. Mod refers to moderate and Slight-mod refers to Slightly-Moderate Modified from Reybold III and Matthews, 1976.

Runnymeade	**Erosion Hazard**	**Seed Mortality**	**Hardwood Competition**	**Soil Depth(ft)**	**Water Table(ft)**	**Drainage**
Glenville GnB	Slight	Slight	Moderate	4-10	1-3	Poor
Manor MbC2	Mod	Slight-Moderate	Moderate	3.5-10	>5	Good
Manor Forge						
Manor McD2	Severe	Slight-Moderate	Moderate	3.5-10	>5	Good
Codorus Cu	Slight	Slight	Severe	6-20	1.5-2	Poor
Lyons Gate						
Edgemont EdC2	[redacted]	[redacted]	Slight	[redacted]	>5	Good
Edgemont EgE	Slight-M[redacted]		[redacted]	3.5-5	>5	Good
Codorus Cu	Slight	Slight	Severe	6-20	1.5-2	Poor

IV. B. 2b Manor Forge

The Manor Forge site lies to the east of the other three sites. Based on the 1987-1989 aerial photographs, Manor Forge had a significant amount of disturbance before any development had taken place. In the aerial photograph, there is an agricultural field, along with a sewer line and a road, Owings Mills Blvd, all located where the forest presently lies. Development here was the most recent of the four sites. In 2001, an apartment complex was built to the west of the forest where the agricultural fields had previously been located. In 2005, a development of town homes was built to the east of the forest, establishing a buffer on each side.

This site also has two soil types. The first type is McD2 of the Manor series. This occurs on the sloped areas of the forest. Slopes here range between 15% and 25% and moderate erosion is evident, though this area has fairly low erosion levels because of its high plant

densities (Reybold III and Matthews, 1976).

Therefore, the distance of the transect and the spacing interval of the points will vary depending on how densely forested the sampling area is. At each sample point along the transect, one person determines the cardinal directions, North, West, East, and South, ultimately creating four quadrants, Northwest, Southwest, Southeast, and Northeast (Mitchell, 2007). For each quadrant the distance to the nearest tree larger than 4 centimeters diameter of the trunk at breast height is measured and recorded, along with the Diameter at Breast Height (DBH) and the species of the tree (Mitchell, 2007). Due to difficulties in identification of Black Oaks and Red Oaks, these were

running through each forest fragment and a fifth sample was taken in the closest retention pond; there were a total of five core samples from each study site. Along the transect, one core sample was taken on each side of the stream within the floodplain, and one sample was taken 50 feet from each side of the stream. The core samples taken from each retention pond were located within the wetted perimeter of the pond.

A group of students obtained the samples by driving a core sampler six to eight inches

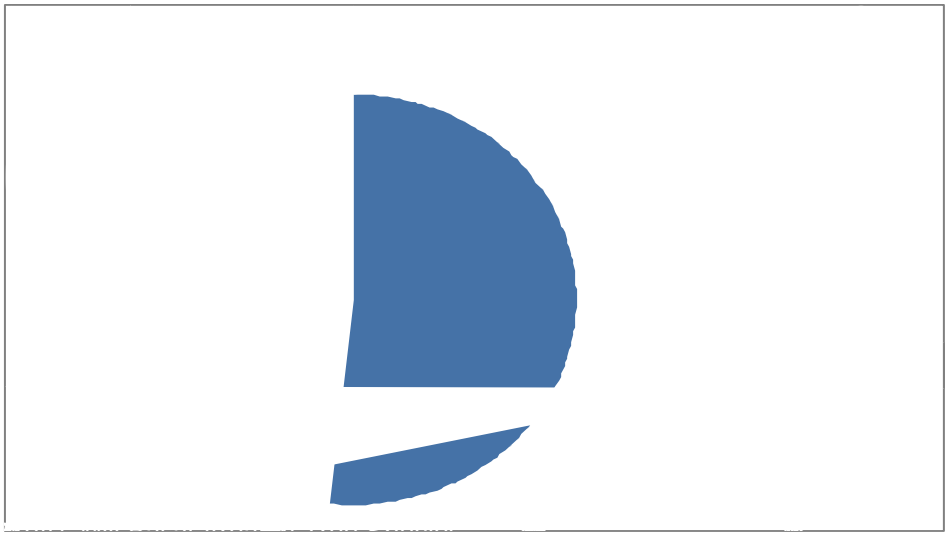

Figure IV. 5: Basal Area: Groffs Mill This site is dominated by Tulip Poplar, Chestnut Oak, and White Oak.

Simpson"s Diversity Index (SDI) is used to quantify and compare the diversity of the four sites. Lyons Gate exhibited the highest levels of diversity with twenty species recorded and an SDI of 0.99 (see Table IV. 3). In contrast, Groffs Mill, which is dominated by Tulip Poplar (52% of total basal area), scored comparatively low at 0.666 (see Table IV. 3) with only 12 tree species recorded. Non-native species such as Tree of Heaven, Bradford Pear, and Norway Maple were present in only two of the four sample areas at very low densities, at less than 2.5% of total basal area per species.

Tree density is similar for all sites with the exception of Lyons Gate, which is significantly less dense in regards to mature trees over the sample area. In the Lyons Gate stand, the average distance from sample point to adjacent trees was 7.511 meters and tree density per 100 meters squared is significantly lower than other sites at 1.772 (see Table IV. 3). The remaining sites were comparable to each other; mean distances ranging from 4.5 to 5 meters and densities of 3.9 to 4.6 trees per 100 meters squared.

Diameter at Breast Height measurements indicate a wide range of tree sizes present in each sample site, however, these measurements are closely related to the species of tree sampled. In all sample sites, members of the Oak family tend to have higher DBH measurements,

followed by Tulip Poplar and members of the Hickory family. The average DBH measurements for each site are available for reference in Table IV. 4.

listing the actual value for metal concentration in the sample known as the certified value. Dividing the measured concentration by the certified concentration will give us the percent recovery. An acceptable recovery for XRF analysis is 85-105%. Some elements, sodium (Na), aluminum (Al), phosphorus (P), copper (Cu), and lead (Pb) all fell outside the predetermined accuracy range and therefore results from these elements must be treated with caution (see Tables IV. 5 and IV. 6).

Table IV. 5: Trace metal percent recovery for SRM 2709

Sample	**Ti (%)**	**V (PPM)**	**Cr (PPM)**

were significantly greater in concentration of lead from the Groffs Mill and Manor Forge sites (see Figure IV. 14). The only other significant difference was in copper concentrations between Lyons Gate and Groffs Mill, in which Groffs Mill was greater (see Figure IV. 11).

The cores from each storm water retention pond were next compared to the previously established trace metal concentrations for each site to determine if there was a statistical difference between them. Vanadium, titanium (Ti), and nickel, were not found to be significantly

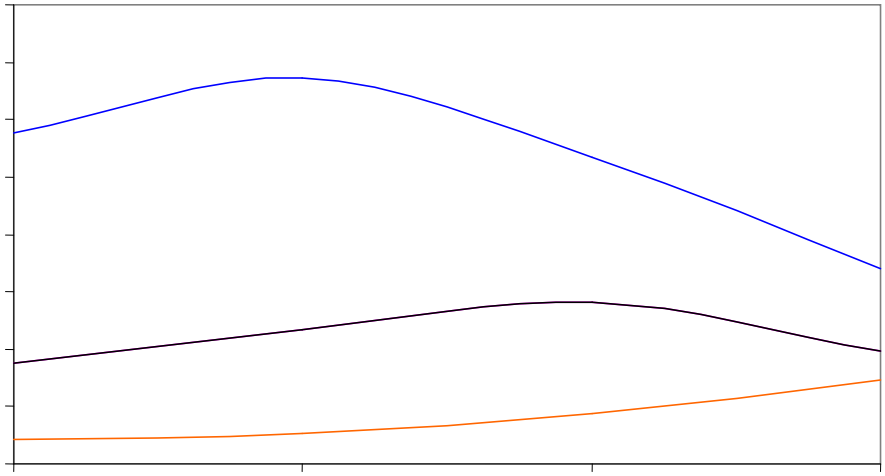

Figure IV. 6: Trace Metal Concentration: Runnymeade Points 2 and 3 are two meters from the stream. Measurements in parts per million (PPM).

Figure IV. 7: Trace Metal Concentration: Manor Forge Points 2 and 3 are 2 meters from the stream. Measurements in parts per million (PPM).

Figure IV. 8: Trace metal concentration: Lyons Gate Points 2 and 3 are 2 meters from the stream. Measurements in parts per million (PPM).

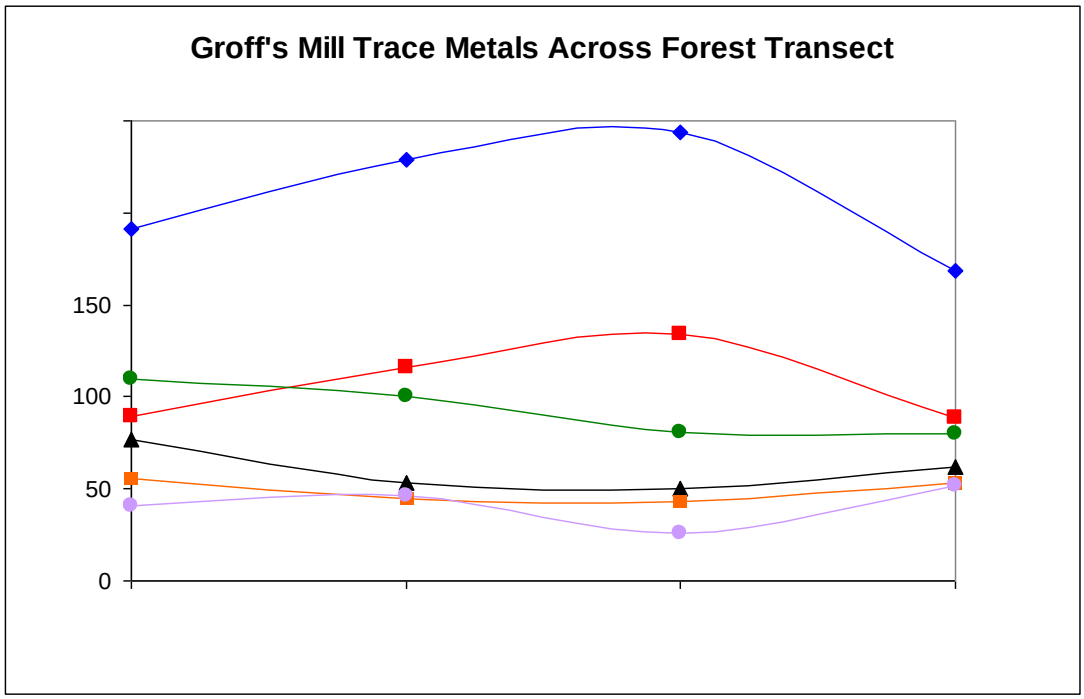

Figure IV. 9: Trace metal concentration: Groffs Mill Points 2 and 3 are 2 meters from the stream. Measurements in parts per million (PPM).

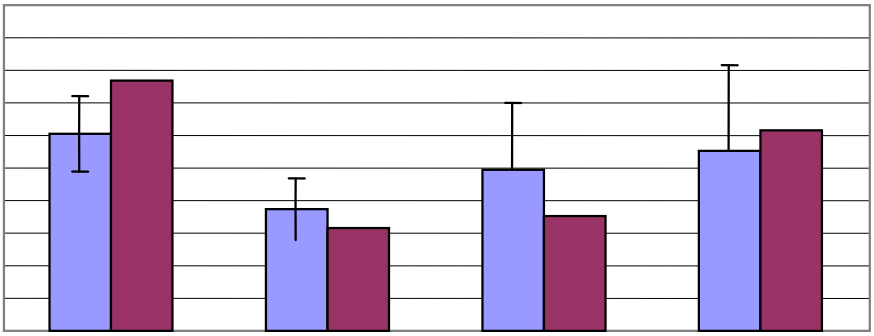

Figure IV. 10: Nickel Concentration Comparison: between sites and their nearest neighboring storm water pond. Forest transect represents the average of four samples taken within each site, while storm water pond samples are representative of a single sample taken in each pond. Error Bars denote the 95% confidence level.

Figure IV. 11: Copper Concentration Comparison: between sites and their nearest neighboring storm water pond. Forest transect represents the average of four samples taken within each site, while storm water pond samples are representative of a single sample taken in each pond. Error Bars denote the 95% confidence level.

Figure IV. 12: Chromium Concentration Comparison: between sites and their

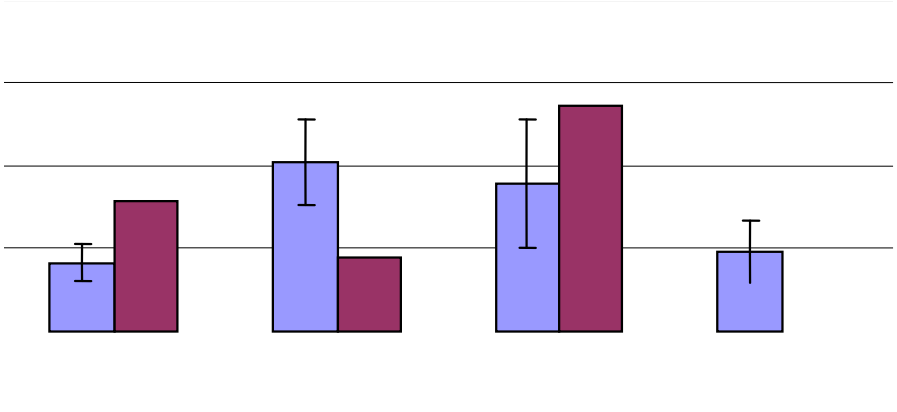

Figure IV. 14: Lead Concentration Comparison: between sites and their nearest neighboring storm water pond. Forest transect represents the average of four samples taken within each site, while storm water pond samples are representative of a single sample taken in each pond. Error Bars denote the 95% confidence level.

Figure IV. 15: Titanium Concentration Comparison: between the sites sampled. Forest transect represents the average of four samples taken within each site. Error Bars denote the 95% confidence level.

Figure IV. 16: Potassium Concentration Comparison

mostly Oaks and Hickories. This suggests either a disturbance has taken place in the northern half or succession has not occurred as in the southern half of the forest.

We also sampled the seedlings and saplings of the forest. From our sampling, we found that Runnymeade has the most seedlings overall with a count of 39, but has the lowest number of saplings with 14. Of these, we found 23 Oak seedlings and only two Oak saplings in our sampling set. This could be due to the high canopy cover which would restrict light that is necessary for sapling growth. The Oak seedlings we found may be waiting for more sunlight in order to grow at a proper rate. Additionally, the northern section, which consists primarily of poplars and also has less seedlings and saplings, is covered by thick underbrush, primarily Multiflora Rose, which could out-compete the seedlings and saplings.

The southern half has more seedlings and saplings and is also more diverse. Along with the Oaks, we found Mockernut Hickory, Shagbark Hickory, and Ironwood. The northern half is predominantly Poplar seedlings and may not survive with the thick underbrush and dense canopy since Poplar seedlings need more light than most other species.

Soil samples of the Runnymeade forest were taken to assess the amount of heavy metals as well as minor nutrients in the soil. Overall, there is nothing out of the ordinary in the soil and minor nutrients, such as zinc and potassium, are around typical levels for this area and not different from the other three sites. In conclusion, we found this forest to be half sustainable. The southern half looks to be very healthy for an urban forest being both diverse and numerous in both adult and juvenile tree species. The northern half of this forest, on the other hand, seems to be trapped in early succession. It consists of mostly Poplar with few seedlings and saplings, most of which are Poplar. The northern half does not appear to be sustainable, possibly because of smothering underbrush, dense canopy cover, and possibly an unknown disturbance.

IV. E. 2. Manor Forge

The next site to be discussed is Manor Forge. This site consists of two soils according to the 1976 USDA Soil Survey of Baltimore County, Maryland. Based on the Codorus flood plain soil and Manor upland soil at this site, one would expect to find a lot of Tulip Poplar, especially in the flood plain, and Oaks more upland. One would also expect to find Red Maple and Ash species here. The trees observed were expected. This forest site consists mostly of Poplar, Red Maple,

Oak, Hickories, and Sweetgum. This forest has the highest density of trees with 4.6 per square 100 meters. Also, the trees here are the largest, with a mean basal area of 1400 square centimeters. This is particularly good to see considering that there was a farm, pipeline, and road

expected since the Baile soil has high seedling mortality, heavy erosion, and is usually inundated with water.

There is significant evidence of erosion near the stream here. There is also noticeable disturbance from a sewer line in the forest. A

like today to preferences of the soil types located in each forest, possible stressors such as runoff and erosion, and past disturbances that could have altered the succession or structure of the forest. Given this information, the only forest that appears not to be sustainable is the Lyons Gate site. A larger study would be needed to fully assess and determine what these forests will look like in 20 or 30 years from now.

An important feature to consider is the presence of storm water retention ponds in Owings Mills. These ponds have been installed over the past 10 to 15 years to collect storm water from roadways. The objective of these ponds is to lower discharge rates into streams to reduce erosion, but the ponds are also known to collect and store urban pollutants, which can effectively keep these out of the forests. Research on these ponds is still ongoing and such information along with forest data will be beneficial for protecting streams in Owings Mills.

V. Recommendations

This project primarily focused on assessing forest sustainability. In completing it, we researched the history, policies, economic impacts, and environmental benefits of Smart Growth development in the Owings Mills area. As we studied the New Town area of Owings Mills, we became aware of future research and public education opportunities. These recommendations will hopefully help Baltimore County in its efforts to protect the riparian areas in Owings Mills.

V. A. Future Research

Further research is necessary to properly assess and monitor the conditions of the forest fragments in Owings Mills. In order for Baltimore County and the Owings Mills area to continue to responsibly develop the land, more information about the health of the forests, streams, and condition of the soils is essential. Our project can be used as a stepping-stone for future research projects.

Examination of a regional vegetation diversity and structure allows scientists to determine which forest types are most prone to invasion by non-native species (Schulz, 2003). Assessments of the classification of forest community types for both canopy and understory plant species, which are interconnected with ecosystem properties such as productivity, response to disturbance, and use by wildlife, can be made (Schulz, 2003). Vegetation can also be used to study trends over time in relation to other forest health indicators, examine response of forests to disturbance and stresses such as pollution (Schulz, 2003).

V. A. 1e. Impact of Wildlife

The impact of wildlife such as deer, foxes, birds, and squirrels may affect the health, functioning, and regenerating ability of the forests. For example, deer browsing was evidenced at all of the sites we studied and could greatly affect vegetation growth, seed dispersal, and pollination. Foxes act as predators of squirrels and birds and the abundance of these predators and prey species could ultimately affect the health of the forest. Squirrels and birds are critical seed dispersers and their presence could greatly impact the health of the forest.

V. A. 1f. Impact of human disturbance

The impacts of human disturbance on the forests, especially those of road salt, can greatly

plant species regeneration and may be altering the functioning capabilities of the forest. Of course great care would have to be taken to prevent erosion after the invasive plants are removed and before native plantings get established.

V. B. 2. Community Involvement

Elementary or middle school students could become involved with the regeneration of their forests by creating and supporting nurseries, in their school yards, of seedlings of trees that are successionally important for the local forests. The trees could be planted in areas where invasive species were removed in order to prevent erosion, future growth of other invasive species, and boost forest regeneration of native plants.

V. B. 3. Replanting

Using the soil analysis (pH, grain size, moisture, etc.), forest fragments could be enhanced by transplanting saplings that are the correct successional stage, prefer the specific soil conditions, and can control erosion and absorb pollutants effectively. Areas that are choked with invasive species should be cleared of them and saplings planted at random in accordance to the density of the surrounding area. That is, saplings should be planted at least 20 meters apart, if that is the average distance between trees in the area. The replanted areas must be kept clear of invasive species, such as stilt grass. These replanting activities could be important supplements to improve forest regeneration.

V. B. 4. Trash Removal

Many of the sites we visited were littered with construction debris, scrap metal, and trash. Construction materials that had been left years after development, such as silt barriers, were observed to be restricting stream flow in some instances. They can also pose a threat to wildlife that can become entangled in them or ingest them. Trash such as metal scraps, appliances, and other discarded materials tarnish the forests and do not motivate efforts to keep areas clean. Trash could also inhibit vegetation growth and leach harmful chemicals into soils. Community clean-ups could coincide with tree plantings to beautify the forests and to create functional habitats for the vegetation and wildlife of the area.

the different species of trees that are present in these forests, predominant wildlife, and their essential functions. In addition, residents should be informed about the conditions that may potentially cause stress to the health of the forests and their effects, such as heavy metal pollution, road salt sources, invasive species, and nutrient runoff from fertilizer use. Local high school students or Boy Scout/Girl Scout troops could create these pamphlets or booklets and the managerial staff of the Owings Mills condominiums should be asked to distribute these information sources to the residents. In addition, DEPRM, or other environmental organizations knowledgeable about the surrounding forests, should request that the managerial staff of the Owings Mills condominiums conduct meetings with their employees and residents to inform them about the current state of the forests.

V. D. 2. Creation of Red Run Watershed Association

A Red Run Watershed Association could be created in the community. Such an organization could mirror the activities and organization of other local community organizations, like the Gwynn"s Fall Watershed Association (GFWA). The GFWA participates in education and community activities related to the watershed as well as restore streams and advocated stream health (Gwynn"s Fall Watershed Association, 2004). More information on the GFWA can be found online at http://www.Gwynn"s Falls Watershed Associationfalls.net/home/.

V. D. 3. BayScape

Residents need to be aware that riparian buffers need to be 100 feet on either side of the stream. These residents should be informed of their impact on the buffers and aware of the consequences of infiltrating these buffers. Individual homeowners and landscape managers could be educated about the various landscape options that promote native plant species and reduce the need for excessive watering and fertilizer use. Programs such as BayScape offer resources for homeowners. If homeowners understand the purpose and functioning abilities of riparian buffers, they may be more cautious of their habits. More information on BayScape can be found at http://www.fws.gov/chesapeakebay/ bayscapes.htm.

V. D. 4. Promoting Ownership and Forest stewardship

Activities that help residents to develop a sense of ownership of the forests will help improve and maintain the forest buffers. The local elementary school could design an “Adopt a

Forest” program where a fifth grade, or appropriate grade level, science class is assigned a forest fragment to keep clean. The forest could serve as an extension of the classroom and students could leTJ C(l)5ts

Works Cited

Alban M. L, Miller K. E., Rabaglia R.t, Riley J., Schwaab C. E., (no date) Maryland"s forests, a health report. Maryland Department of Natural Resource Forest Service. 48pp.

Albico, N., Pelley, J. (1997). Maryland: Sierra Club. Sprawl Cost to us All.

Anagnostakis, S. L.. 2000. Revitalization of the Majestic Chestnut: Chestnut Blight Disease. (9 October, 2007; http://www.apsnet.org/online/feature/chestnut/)

Armstrong, M. 2004. Example Outling - Eastern Deciduous Forest. (9 October 2007;

Chesapeake Bay Field Office FWS (no date) BayScaping. (December 2, 2007; http://www.fws.gov/chesapeakebay/bayscapes.htm)

Cub Hill Ranger Station. 1987-1989 aerial photographs. Retrieved October 2007.

[DEPRM] Department of Environmental Protection and Resource Management. 2007. OwingsMills_NewTown_Forestbuffer_Aerial.pdf. Published July 5, 2007.

[DEPRM] Department of Environmental Protection and Resource Management. (November 26. 2002). Article IX Protection of Water quality, streams, wetlands, and floodplains. (

Gurevitch, J., Scheiner, S.M., Fox, G.A. 2002. The Ecology of Plants. Sinauer Assoc. Inc., MA.

Gwynn"s Falls Watershed Association (© 2001-2004) Gwynn"s Fall Watershed Association. (December 2, 2007; http://www.Gwynn"s Falls Watershed Associationfalls.net/home/)

Gwynn"s Falls Watershed Association Falls Watershed Association. 1999. "The Gwynn"s Falls Watershed Association Falls Watershed Atlas," United States Forestry Service. (September 30, 2007; http://www.beslter.org/gfatlasr/gfatlaslr.pdf)

Hakin, D., Peters, J. September 25, 2005. New York Times. Go Ahead and Drive.

Horton, T. (2003). Turning the Tide: Saving the Chesapeake Bay. 46, 362.

Howell, G.P, Ericson, T. (eds) 1997. State Forest Conservation Technical Manual, Third Edition. Maryland Department of Natural Resources.

Jackson, R., Kochtitzsky, C. (2001). Creating a healthy environment: The impact of the built environment on public heath. Sprawl Guide. (November 12, 2007; http://www.plannersweb.com/sprawl/prob_health.html)

Johnson R. G. (1999). Protecting trees from construction damage: A homeowner"s guide. (1 October 2007; http://www.extension.umn.edu/distribution/housingandclothing/DK6135.html)

Jones, N. (November 2007). The Country Chronicle pg. 17. Baltimore County Ag. Preservation exceeds 53,000 acre mark.

Liang, S., Seagle S. W. (2002) Browsing and microhabitat effects on riparian forest woody seedling demography

[MISC] Maryland Invasive Species Council. Invaders of the Month, '03, '07, '06. (October 17, 2007; http://www.mdinvasivesp.org/index.html)

Mookherjee, D., Hoerauf, E., Freelan, S., McAuley, M. 2006. Urban growth and metropolitan sprawl in a small metropolitan area. Academic Search Premier. Focus on Geography, 49 (3).

Naiman, R. J., Decamps, H. (1997). The ecology of interfaces: Riparian zones. Annual Review of Ecological Systems 28: 623-658.

[NAPP] National Aerial Photography Program. 1988. USDA FSA NAPP map series, 24005-006, Baltimore County maps 63 and 39.

Office of Planning. 2006 February 14, 2006. Smart Growth. (November 10, 2007; http://www.baltimorecountyonline.info/Agencies/planning/masterplanning/smartgrowth.html)

[OLC] Olympic Leaning Center. 1996. Concepts In Ecosystem Management: Forest Edges. (September 13, 2007; http://www.fs.fed.us/r6/olympic/ecomgt/unecosys/edges.htm)

O'Neill, K., Amacher M. 2003. Soil quality indicator fact sheet. (December 6, 2007; http://www.fia.fs.fed.us)

Outen, D. August 30, 2007. Baltimore County. Towson University Environmental Science Capstone Project . Lecture presented at Towson University.

Pheiffer, T. August 29, 2007. Maryland Biological stream survey. (October 9, 2007; http://www.epa.gov/emap/remap/html/docs/mbsslnt/PDF)

Polyakov, V., Fares, A., Ryder, M. H. 2005. Precision riparian buffers for the control of non-point source pollutant loading into surface water: A review. Environmental Review 13: 129-144.

Pywell, N. 2003. Glossary of Forestry Terms. Maryland Department of Natural Resources. (October 11, 2007; http://www.dnr.state.md.us/forests/gloss.html)

Reybold III, W., Matthews, E. 1976. Soil Survey of Baltimore County, Maryland. USDA Natural Resource Conservation Service.

Sebastiani L. Scebba F,, Tognetti R. (2004) Heavy metal accumulation and growth responses in polar clones Eridano (Populus deltoids x maximowiczii) and I-214 (P. x euramericana) exposed to industrial waste.

Schear, P., Blaine, T. (no date) Conservation easements. (December 4, 2007; http://ohioline.osu.edu/cd-fact/1261.html)

Schmidt, C. June 1998. The Specter of Sprawl. Sprawl Guide. (November 12, 2007; http://www.plannersweb.com/sprawl/focus.html)

Schulz, B. 2003. Vegetation indicator Soil quality indicator fact sheet. (December 6, 2007; http://www.fia.fs.fed.us)

Science Daily. Surface runoff. 2007.(Fall 2007; http://www.sciencedaily.com/articles/s/surface_runoff.htm)

Science Daily. Erosion. 2007. (Fall 2007; http://www.sciencedaily.com/articles/e/erosion.htm)

Slaughnessy, D. 2007. Clemson extension, Maple. (November 1 2007;

Windows to the Universe Team. (2002). Chesapeake Bay. (October 6, 2007; http://www.windows.ucar.edu/tour/link=/earth/Water/chesapeake.html)

Appendix 1 Raw Data from Tree Sampling at each Site.

Runnymeade: October 2, 2007

Point No.	GPS Coordinates	Quadrant	Tree species	Distance to tree (m)	DBH (cm)	Saplings	#	Seedlings	#
1	N 39 23.770' W 76 48.867'	NW	Mockernut Hickory	9.2	23.0			Black Oak	1
		NE	Shingle Oak	4.0	16.0				
		SE	Tulip Poplar	3.5	13.7				

	SW	Tulip Poplar	2.6	10.5

11	N 39 23.897' W 76 47.909"	NW	Tulip Poplar	7.2	25.5

	SE	Red Maple	7.3	51.4				
	SW	Black Gum	1.5	26.4				

20	N 39 23.668' W 76 48.002'	NW	Norway Maple	3.0	58.0				
		NE	Tulip Poplar	3.8	22.3				
		SE	Norway Maple	3.9	34.5				
		SW	Tulip Poplar	3.9	29.8				
Totals				**371.7**	**2926.9**		**31**		**12**

Lyon's Gate: October 1, 2007

Point No.	**GPS Coordinates**	**Quadrant**	**Tree species**	**Distance to tree (m)**	**D.B.H (cm)**	**Saplings**

SW	Box Elder	5.9	23.0

8	N 39 23.768" W 76 48.234"	NW	Tulip Poplar	4.4	44.0

W 76 48.267"								

Groff's Mill: October 1, 2007

	SW	Tulip Poplar	2.6	27.5				

	SE	Black gum	1.3	11.3	Black Cherry	1		
	SW	Black gum	3.0	11.7	Black Gum	1		

Appendix 2: Seedling and sapling count at each sampling site.

Seedlings			**Saplings**		
Site	**Species**	**Number**	**Site**	**Species**	**Number**
Runnymeade	Black Cherry	4	**Runnymeade**	Black Cherry	2
	Black Oak				

				Black Gum	2
				Chestnut Oak	7
				Magnolia	1
				Mulberry	1
				Pignut Hickory	9
				Red Maple	11
				Tulip Poplar	9
				Waterbirch	1
				White Oak	3
				Total	**53**

Appendix 4: Major element data for each site sampled. RP denotes the retention pond for each site.

Sample	Na(%)	Mg(%)	K (%)	Ca (%)	Ti (%)	Al (%)	Si (%)	P (%)