Designing a System of Trails in the Smith-Crisler Nature Preserve

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The Red-tail Conservancy is a non-profit land trust which acquires properties through donations and grants and then works to protect them from development and disturbance. The Smith-Crisler Nature Preserve is just such a property which the Red-tail Conservancy purchased in the summer of 2009. Their goal for this property is to turn it into a useable nature preserve with trails, signs, benches, a parking lot, etc. It is the goal of this project to supply the Red-tail Conservancy with all the information they need to make an informed decision as to what sort of infrastructure to install at the property. Specifically, I cover in this report types of trail surfaces, types of trail markers, and types of benches. I also discuss some more general concepts, such as where trails should be built, what the main problems trail builders (and maintainers) face are, and the role of trails in a park/preserve. Hopefully through the information in this report, the Red-tail Conservancy will be able to craft the Smith-Crisler Nature Preserve into a real top-notch environmental education facility.
Acknowledgements

Special thanks to Barry Banks from the Red-tail Conservancy for his guidance and support with this project. Special thanks also to Dr. Amy Gregg and her Outdoor Recreation class for giving me the idea for this project in the first place and introducing me to Barry Banks. Thanks also to Ball State University and the Natural Resources and Environmental Management department for providing me with an assistantship during my time at Ball State, which allowed me to be here in the first place.
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Chapter 1: Introduction

Smith-Crisler Nature Preserve (previously called Mechanicsburg Woods) is a 40-acre property acquired in the summer of 2009 by the Red-tail Conservancy. It is located in Henry County, just south of Muncie, IN. It is a mix of old-growth forest land, newer early successional forest, and an old field that is now in the very first stages of succession. Red-tail Conservancy is a non-profit group dedicated to preserving nature in Indiana. Their mission statement is as follows:

Figure 1 – Red-tail Conservancy Mission Statement from http://www.fortheland.org/
In keeping with their mission, the Red-tail Conservancy’s goals for the property are to turn it into a nature preserve, with trails, benches, a parking lot, and other amenities which would help enable visitors to experience and enjoy the marvels that can be found in Indiana’s woodlands.

There is a need for such facilities in this area. According to the latest Indiana SCORP (Statewide Comprehensive Outdoor Recreation Plan), Henry County does have
the recommended amount of land devoted to outdoor recreation; however, most counties in Indiana (including neighboring Delaware County) are severely lacking in natural areas (IDNR 2007). Thus, Henry County can help make up for this deficit. My project deals with determining how to best go about putting in the trails and other amenities in Smith-Crisler Nature Preserve. My role in the development of the nature preserve is to research types of trails, trail signage, benches, etc. and try to determine, by weighing the benefits and drawbacks of the various options. Specifically, I will help determine what types of trails (trail surfaces) should be installed, what types of trail markers should be used, and what types of benches should be installed.
Chapter 2: The Need for Trails

Is it any wonder that nearly every nature preserve, park, recreational area, national forest, or any other natural area used for recreation has some sort of system of trails, paths, or roads through it? Without such infrastructure, visitors would be unable (or at least impaired in their ability) to participate in the outdoor recreational opportunities the area presents. According to the Indiana SCORP, the most popular outdoor recreational activities in Indiana include such things as walking, camping, and photography (Indiana Department of Natural Resources 2007). In addition, according to Outdoor Recreation in America, since the early 1980’s: “[birdwatching] has been the fastest growing of the traditional activities” (Jensen and Guthrie 2006). All of these activities require or at least benefit from a trail system. On the other hand, they also all benefit from a more natural setting, so one must make sure that we don’t put in too much artificial infrastructure.

If people aren’t able to use and enjoy a park, preserve, etc., then they won’t experience for themselves all the great reasons why we need to preserve our natural areas. This will breed apathy and a lack of caring for our natural areas, making it increasingly difficult to protect them. This is probably one of the biggest roadblocks to preserving our natural spaces today. If everyone was of the opinion that we need to preserve our natural places, it would be easy to do so. Therefore, we need to increase people’s appreciation for nature, thus hopefully increasing how much they care about it.
This will hopefully in turn lead to all sorts of pro-environmental behavior in the future (for a definition of and a discussion about “pro-environmental behavior” see Kollmuss and Agyeman 2002).

In order to make this goal a reality, we must work to bring people and nature together. In order to accomplish this, one of the first steps that must be taken when developing a new nature preserve is to make it open and accessible to visitors. In most cases, this means that trails, parking lots, and other “visitor-friendly” infrastructure must be built. Such infrastructure should be optimized so that they maximize visitor opportunity while minimizing destructive effects on the ecosystem.
Chapter 3: A Slippery Slope

When creating trails, they should not just be put in randomly here and there but should follow a well thought out plan. Much care should be taken when considering where to put the trails in order to minimize their impact on the ecology of the area. For example, it would be a mistake to put a trail right through the only patch of pink ladyslippers in the forest, or across a delicate quivering bog. Instead, a path should be chosen that goes through a relatively clear, open area with an ecosystem that could withstand the disturbance of a trail without being destroyed or irreparably damaged.

Trails are not just meant to ease the passage of pedestrians through a forest, but also to help protect the surrounding ecosystem by steering damaging foot traffic along paths where it will do the least amount of harm.

Another big factor in determining where to put trails is erosion and how it may affect the trail. It would be foolish to put in a trail that will suffer from chronic erosion problems. After all, erosion is the most common and most powerful destructive force for trails (Building Sustainable Trails: Volume One 2008, Lanza 2002). Slopes present exceptional opportunities for erosion. Since erosion in temperate zones is generally caused by moving water, slopes allow water to pick up speed and thus increase the chance the water will pick up and move soil (Lanza 2002). Thus, building trails on slopes should be avoided whenever possible. If a trail must be built on a slope, Best
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Management Practices For Erosion Control During Trail Maintenance and Construction recommends it not be greater than a 5% slope (2004) (also see Rathke and Baughman 2009). Optimally, trails should follow elevation changes wherever practical instead of trying to cut across them.

Lack of vegetation can also exacerbate erosion problems. Plants help to slow the passage of water and hold soil in place, thus combating erosion. In an area cleared of vegetation, water is free to sweep across the surface, carrying away soil particles and eroding the area. When constructing a trail therefore, care should be taken so that as little of the surrounding vegetation is disturbed as possible. Once trail construction has been completed, it is advantageous to replant vegetation along the trails if needed (Best Management Practices For Erosion Control During Trail Maintenance and Construction 2004). This helps prevent erosion problems from becoming too severe.

Luckily, there are various ways of dealing with erosion problems. These include the use of sediment barriers (such as straw-bale barriers), silt fencing, retaining walls/revetments/cribbing, filter strips, outsloping/insloping, swales/dips/berms, water bars, reverse grades, deflectors, or culverts (Best Management Practices For Erosion Control During Trail Maintenance and Construction 2004, Mittenthal 2000, Building Sustainable Trails: Volume One 2008, Riter and Riter no date given, accessed 22 Nov 2009, Rathke and Baughman 2009). All of these work to divert the flow of water (and water-borne sediments) so that the soil is not carried away. Another option in chronically wet areas is to use one of various “geosynthetics” to improve the trail (Monlux 1995). These are synthetic materials that can be purchased and placed underneath the trail surface material. They work to allow water to flow freely through the soil beneath the
trail, helping to protect the trail itself and control erosion. Figure 3 shows an example diagram of how a trail can be constructed using geosynthetics to help facilitate draining.

![Geotextile with Encapsulated Free Draining Rock](image)

*Figure 3 – Geotextile with Encapsulated Free Draining Rock (Monlux 1995)*

The best prevention, however, is planning ahead for any problems (Lanza 2002). For instance, when scoping out a site to determine what erosion issues one may run into when putting in a trail, it is best to do so during the wettest part of the year (Best Management Practices For Erosion Control During Trail Maintenance and Construction 2004). Here in Indiana, average rainfall is approximately 40 inches per year with the majority of this rainfall occurring in April – September (United States Soil Survey of Henry County 1987). Coupled with spring snow melt, generally the wettest time of year for our trails is April-May; therefore this would be the optimal time to scout out future trail conditions for the site in question. It is best to see the worst that the area can throw at you before you decide where to put the trail or how to construct it. It would make no
sense to put a trail through an area that is seasonally under water. Many such mistakes can be avoided by careful preparation and planning.
Chapter 4: A Trail to Somewhere

One of the most important things to consider when putting in a trail, however, is the aesthetics involved (Hudson *no date, accessed 22 Nov 2009*). Trails should be designed so that walking along them is an aesthetically pleasing and learning experience (Building Sustainable Trails: Volume One 2008, Martin 2009). If it is not, then the
visitor receives no satisfaction from the experience and so fails to benefit recreationally. Most trails are not hiked solely to get to a place, but for the benefits and enjoyment of the hiking itself. Thus, possibly more important than where the trail goes to is how it gets there. In considering aesthetics, one should try to ensure that there are sights along the trail worth looking at (Lanza 2002). These should be far enough from the trail to protect their destruction by careless hikers, erosion, etc., but close enough so that hikers do not need to go off trail to get a better look.

Researchers in Acadia National Park have examined why people walk off the trails and what methods of stopping this are most effective (Park et. al. 2008). One of the biggest reasons why people go off-trail is because the trail does not go where they want to get to, such as a certain overlook or point of interest (Park et. al. 2008, Building Sustainable Trails: Volume One 2008). This can be avoided by properly planning ahead where to put the trail. If you put the trail where people want to go, there will be no need for them to get off it.

Figure 5 shows one of these highlights of the woods; some ground pine (an unusual plant in this area). Any trail system through Smith-Crisler Nature Preserve should include a jaunt past this interesting and rather unique feature of these woods.
A proper trail usually benefits from some sort of marking which clearly denotes where the trail is. This is especially helpful in areas of the country where during parts of the year the trail may be obscured by fallen leaves or snow. These trail markings can take many forms, including blazes painted on trees, trail marker signs affixed to trees or posts, flagging tape tied to tree branches, stone cairns, marks carved into trees, or even some sort of lining along the trail edges such as logs, railroad ties, etc. (“Trail Blazing – Types of Blazes” 2009, Rathke and Baughman 2009). All of these help make the trail more visible and also help people distinguish between the official trail and unofficial trails or “short-cuts” made by visitors.

Seeing as the goal at Smith-Crisler Nature Preserve is to create a very natural sort of site that focuses on the ecological health of the forest, we can probably rule out immediately any trail blazes that are destructive in nature, such as carvings on trees. We also need something fairly permanent, so we will ignore the possibility of flagging tape as an option (other than to initially mark where the trail is to be built). What is needed is something that will 1) stand out without detracting from the aesthetics, and 2) last for a fairly long time without a lot of maintenance.

The best option may be a two-fold solution. First, the trail could be lined with logs and branches from the area. This would require no additional materials and very
little work as all that would need to be done is for branches and logs to be scavenged from the woods and placed along the trails. Lining trails in this way could potentially cause problems with increased erosion at times as the logs/railroad ties/boards/etc. can help to channel water along the trail instead of off of it (IMBA “10 Most Common Trailbuilding Mistakes” 2009); but this should not be a problem if random branches and bits of wood are used as they will not act as a solid wall to water.

Secondly, since these branches may be covered up in the fall and winter by leaves and snow, something more prominent may be called for. Small painted wooden trail blazes affixed to trees along the path may be the perfect solution. Painted trail markers last longer than simply painting blazes on trees (“Trail Blazing – Types of Blazes” 2009) and are more professional-looking. Also, if the routes of the trails ever need to be altered, it is easier to change the locations of the signs than some other trail marker types. It is hard to “un-paint” a marker painted directly on a tree, but quite easy to remove a small wooden sign and put it back up elsewhere. This also highlights an inherent possible weakness to trail markers signs, however. They could be prone to vandalism since they could be removed and stolen, unlike a mark painted directly on a tree.

These trail markers could be marked to differentiate different trails in the woods if applicable, or could simply have the Red-tail Conservancy’s logo on them. These markers should be approximately 4” x 4” and should be affixed to the trees with galvanized or aluminum nails (so they don’t rust and deteriorate) (Koehler 2000, Rathke and Baughman 2009). When attaching them to the trees, care must be taken so that a gap (about ½”-1”) is left between the tree and the marker (Koehler 2000, Rathke and Baughman 2009). This allows the tree space to grow. If this gap is not left, as the tree
grows it will quickly grow around the nails, absorbing them and pushing the marker off ("Trail Blazing – Types of Blazes" 2009). These markers will then need to be checked and loosened as necessary every few years to prevent this from happening. Optimally, the markers should be placed so that when someone is standing at one marker, he or she should be able to see the next marker in line in both directions (Rathke and Baughman 2009). With these two marker systems in place, any visitors should be able to easily tell where the trail is at any time of the year.
Chapter 6: Types of Trail Surfaces

There are many different materials that can be used to build a trail. These can range from natural substances, such as wood chips or gravel, to artificial substances, such as asphalt, ground up old car tires, or even fake wood chips made from plastic (National Center on Accessibility 2007, Hudson no date, accessed 22 Nov 2009). One option of course is the simplest – just leave the trail unaltered as a simple packed-earth trail. These various substances all have their benefits and drawbacks, and one may be better for some situations, while another may be better in other situations. At Smith-Crisler Nature Preserve the goal is to keep the area as natural as possible, and to focus on the ecology of the forest. Since this is the case, it would probably be best to choose a trail material that is more natural and has little effect on the surrounding ecosystem. In this case, there are three viable options: packed earth, gravel (or “crusher fines”), and wood chips.

Packed earth is the easiest and cheapest to install, since you aren’t actually bringing in any outside materials. All that must be done is to clear the trail and then perhaps do a little work to smooth out the trail and make sure it is even and reasonably level. Optionally, the trail could be packed down with some sort of heavy machinery. If the trail is packed down however, the result may be the creation of a trail-shaped “trench” which will channel water and lead to erosion problems. To prevent this, extra soil could be brought in to add to the trail before packing so that the resulting trail is at least as
elevated as the surrounding ground, or better yet, slightly higher than the surrounding terrain. This then negates one of the advantages of the packed-earth trail, however (namely, its not needing any extra material brought in from outside).

The drawbacks to a packed-earth trail are that since it is just soil, if water is added it can easily turn into mud. Thus, these sorts of trails work best in places with sandy, well-drained soils which don’t get large amounts of precipitation. The soils under Smith-Crisler Nature Preserve are primarily LeD2 (Losantville silt loam, 12-18 percent slopes, eroded) and MmB2 (Miamian silt loam, 2-6 percent slopes, eroded) (US Soil Survey of Henry County 1987). These soils are not overly prone to flooding as they are well drained but they are easily eroded and water percolates through them moderately to slowly (US Soil Survey of Henry County 1987). The Henry County Soils Survey also says that while MmB2 soils have only slight limitations for paths and trails, LeD2 soils have severe limitations due to high potential for erosion. If packed-earth trails were installed in Smith-Crisler Nature Preserve, care would have to be taken in construction and location of the trails to try to prevent erosion problems before they start.

Figure 6 – An example of a simple earthen trail (photo by Joshua Hapner)
A second option would be to build the trails out of gravel or other types of crushed-rock trails such as “crusher fines”. These types of trails are popular in more urban natural areas, such as nature preserves located inside city limits. They require a fair amount of work to be installed, since large amounts of gravel must be trucked to the site and spread along the trails. For best results, the trails should be dug out a bit first, so that the gravel is actually sitting in a small “trench” rather than just being heaped on the ground (Bachensky 2007). This helps to keep the gravel in place so that erosion by water doesn’t just carry it away to other places. This is especially important because gravel or “crusher fines” trails are highly susceptible to erosion by water (Bachensky 2007). This method can also be a bit expensive, as the gravel must be purchased and then delivered (with cost of delivery sometimes exceeding the actual cost of the material) (Bachensky 2007). In addition, there will be a fair amount of man-hours involved to install it along the trails. These types of trails, once installed, do have their benefits, however. Fine gravel trails, if constructed properly, can be ADA approved for wheelchair access (Bachensky 2007, Boone 2004, Rathke and Baughman 2009). In addition, these trails can last for quite a long time with minimal maintenance. Weighing the options, this would probably be the second-best option for a trail surface at Smith-Crisler Nature Preserve.
A third option for a trail surface would be trails made out of wood chips. These are fairly cheap and easy to install. They basically just involve clearing the trail and then spreading a coat of wood chips several inches thick along the trail. This requires nothing more complex than some wheelbarrows, rakes, and shovels, and plenty of people to do the job. The wood chips themselves can generally be obtained free of charge or at least very cheaply from local municipalities, as long as you are able to load and transport the wood chips yourself (Rathke and Baughman 2009). Another option would be to create the wood chips on site using a wood chipper, but this would require a large amount of branches/logs on-site. In either case, these would not be high-quality wood chips like one would buy bagged in a store, granted, but will do just fine for a trail surface. As far as manpower goes, this could be handled by a team of volunteers coming out to help for a day. Thus, this type of trail could be installed for next to nothing if you have some volunteers, pickup trucks, and tools.

Benefits of a wood chip trail include that it is easy to install, it’s cheap, and it has nice aesthetic value. Since it is made of all-natural materials, this type of trail does not detract very much at all from the surroundings. Anytime you can use all-natural materials (preferably ones available right at the site in question) it will increase the
sustainability (sustainability in trails means it will last a long time with minimal upkeep) and aesthetic value of the trail (Spring 2006, Riter and Riter no date given, accessed 22 Nov 2009). There is also no problem if some of the wood chips are washed away by water, kicked off the trail by visitors, etc. since they are all-natural and biodegradable. The material will simply decompose and turn to soil.

One big drawback however is that this material is, as just mentioned, biodegradable. Because of this, the trail will gradually decompose and turn to soil, which then means that more wood chips must be brought in and placed on the trail. Thus, this trail surface needs more upkeep than perhaps any other option. Every several years it would need a new layer of wood chips put down (Hudson no date, accessed 22 Nov 2009, Rathke and Baughman 2009). If you have the manpower (whether paid or volunteer) to maintain it, however, the benefits of this type of trail surface outweigh the drawbacks in my opinion. Thus, for a wild, all-natural, rural area such as Smith-Crisler Nature Preserve, simple wood chip trails seems to be the best choice so long as the Red-tail Conservancy can devote the needed manpower to keeping up the trails. One issue, however, is that wood chips as a trail surface are not handicap accessible, so if this is a requirement of the Red-tail Conservancy, another option will have to be considered (NCA 2007, Hudson no date, accessed 22 Nov 2009).
Chapter 7: Trails, Trails Everywhere, but Not a Spot to Sit

No matter how well built a trail system is, eventually your visitors will want to stop and take a rest. Indeed, if you have designed the path of your trail properly, so that it goes to somewhere people want to get to, once they get there they will not just say “That’s nice” and then turn around and leave. They will want to stop and admire the view and soak in the beauty of nature. To this end, it is good to design suitable rest stops with benches to sit on. Barry Banks has specifically mentioned that he wants one or two of these rest stops built, with benches placed there. As a result, I have researched various types of benches and will report my findings here.

Benches may be built in a number of different materials, and in a number of different styles or designs. Materials range from wood to metal to recycled plastic. Each has its benefits and drawbacks. For placement in Smith-Crisler Nature Preserve, we must consider a few points.
First of all, these benches will be placed deep into the woods, away from the road. This means that the type of bench chosen must be fairly portable (at least, before installation) so that they can be carried all the way out there. For this reason, pre-constructed concrete benches may not be feasible due to the difficulty of hauling a several-hundred pound bench through the woods.

Secondly, these benches will be left out in the woods indefinitely, with little to no upkeep. Therefore, the benches should be of a material that can withstand everything that weather and time throws at it without deteriorating too quickly. It would be foolish to pick benches that would need replacing every few years.

Lastly, the benches must be able to stand up to possibly mischievous visitors. Visitors with a taste for vandalism could move (or even steal) the benches, or carve into them or otherwise deface them. Thus, the design should help limit the mobility of the benches once installed, and the material should be fairly robust to help limit damage from vandals. To fix the former problem, perhaps the best design would be a bench that does not simply sit there, but is sunk into the ground – that is, is mounted in place.
The following table weighs some of the pros and cons of different bench materials.

<table>
<thead>
<tr>
<th>Material</th>
<th>Benefits</th>
<th>Drawbacks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood (various types)</td>
<td>• Lightweight (easy to move into place)</td>
<td>• Will eventually rot</td>
</tr>
<tr>
<td></td>
<td>• Aesthetic value</td>
<td>• Easy to carve into</td>
</tr>
<tr>
<td>Metal (steel, aluminum, wrought iron, etc.)</td>
<td>• May be lightweight (easy to move into place)</td>
<td>• May eventually rust</td>
</tr>
<tr>
<td></td>
<td>• Generally cheaper than other options</td>
<td>• If it breaks, difficult or impossible to fix</td>
</tr>
<tr>
<td></td>
<td>• Difficult to vandalize</td>
<td>• May have low aesthetic value</td>
</tr>
<tr>
<td>Metal frame with wood slats</td>
<td>• One of the cheapest options</td>
<td>• May rot &amp; rust</td>
</tr>
<tr>
<td></td>
<td>• May be lightweight (easy to move into place)</td>
<td>• Slats may warp from moisture &amp; weathering</td>
</tr>
<tr>
<td>Cement/Concrete</td>
<td>• Very resistant to vandalism</td>
<td>• Very heavy (hard to move into place)</td>
</tr>
<tr>
<td></td>
<td>• Lasts a long time</td>
<td>• Expensive</td>
</tr>
<tr>
<td>Recycled Plastic</td>
<td>• Fairly resistant to vandalism</td>
<td>• Not made of natural Materials</td>
</tr>
<tr>
<td></td>
<td>• Lasts a long time</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Generally unaffected by weather, moisture, insects, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• It’s recycled!</td>
<td></td>
</tr>
</tbody>
</table>
As far as bench style/design goes, the benches should be fairly comfortable for people to sit in. To this end, the benches should probably have both arm rests and backs. A bench designed like a bleacher seat, with simply a straight flat surface to sit on, is no better than sitting on a fallen log (and possibly worse).

The benches should also have a good aesthetic value that fits in with their surroundings. A bright pink bench would draw the eye and detract from the beauty of nature surrounding the bench, robbing the rest area of much of its value. A better color for a bench in this setting would be some sort of muted nature tone, such as green or brown, so as to blend right in to the surrounding trees and plants, as if the bench were a part of nature that had always been there, or had simply sprouted up in that spot naturally.

The type of bench that best fits all the requirements that have just been outlined is probably a recycled-plastic bench in a style that would be mounted directly into the ground instead of just set on the ground. Recycled plastic benches are relatively cheap and come in many different styles and colors. Some are even made to resemble wood in appearance – thus you can have the aesthetics of a wood bench with none of the drawbacks (from rot, insects, etc.). They often come pre-assembled or are easily assembled. They are also fairly light and so not difficult to move into place and install. Lastly, recycled plastic is a durable material that holds up well to weather,
vandals, insects, and other causes of wear and tear. Figure 11 shows a recycled plastic bench that was installed in a city park in Fort Wayne, IN approximately twenty years ago yet has never needed repair and shows very little wear.
Chapter 8: Budget

In order to determine an exact dollar estimate for the project, it would be necessary to know exactly which trail surface and marker type(s) will be used. It would also be necessary to know exactly how long the trails will be (a.k.a., where the trails will be placed). Since these are yet to be determined, an exact estimate cannot be developed at this time. What can be done however is to weigh the relative costs of various options.

Table 2 on the following page outlines these cost comparisons.
<table>
<thead>
<tr>
<th>Improvement Type</th>
<th>Material Cost(s)</th>
<th>Manpower Cost</th>
<th>Maintenance Needs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packed-earth Trail</td>
<td>None</td>
<td>Low</td>
<td>Very little, barring future trail damage/erosion</td>
</tr>
<tr>
<td>Gravel Trail</td>
<td>Gravel (enough for a 4”-5” layer according to Bachensky 2007 and Matthews et. al. 2005) and transportation of gravel</td>
<td>High</td>
<td>Little, barring future trail damage/erosion, though more gravel may need to be added at times</td>
</tr>
<tr>
<td>Wood-chip Trail</td>
<td>None, other than transport; if free source of wood chips can be found</td>
<td>Medium-high</td>
<td>Wood chips would need to be replaced/supplemented every few years</td>
</tr>
<tr>
<td>Log-lining for Trail</td>
<td>None</td>
<td>Low</td>
<td>May need a little straightening from time to time as branches get kicked out of place</td>
</tr>
<tr>
<td>Painted Wooden Trail Markers</td>
<td>Wood (could re-use scraps of wood rather than buying new)</td>
<td>Low-Medium</td>
<td>Markers may need adjusted periodically, and some may need replacing if they are broken or lost</td>
</tr>
</tbody>
</table>
In general, the gravel trail would represent the largest cost of the options discussed in this paper. A “crusher fines” type gravel trail can cost approximately $4-$10.50 per foot to install when done by a contractor (Bachensky 2007, Boone 2004, Matthews et. al. 2005) (though some money could no doubt be saved if the Red-tail Conservancy can do the project with their own personnel/volunteers). Which option the Red-tail Conservancy decides on will likely depend in part upon how much money they can devote to the project. If they are unable to raise very much money themselves, however, they could apply for a grant or some other type of funding, such as “The National Trails Fund” (see AHS 2007).

As far as manpower goes, since this is a non-profit organization, most likely all work would be done by volunteers. Thus, this would not really represent a cost to the organization, though it could be difficult to find large numbers of people to devote large amounts of time to the project. They could perhaps ask for assistance from Ball State University’s NREM department in this matter, however. Since BSU’s Fall 2009 Outdoor Recreation class assisted by way of technical recommendations, perhaps a future Ball State class could assist with the actual execution of whatever projects the Red-tail Conservancy decides to pursue.

Another option would be to look for assistance from some local trail group(s), such as the Hoosier Hikers Council (http://www.hoosierhikerscouncil.org/index.shtml) or the Indianapolis Hiking Club. There are a number of such groups in this area that may be willing to assist with this project. Larger, more national organizations include such groups as the Appalachian Mountain Club and the American Hiking Society. These may also be amenable to helping with manpower or monetary needs.
The following table outlines the price ranges I have found for benches of different types. I looked at the following companies to find these prices on benches: Belson Outdoors, Walmart, Lowes.

<table>
<thead>
<tr>
<th>Material</th>
<th>Size of Bench</th>
<th>Price</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood (various types)</td>
<td>4’-6’</td>
<td>$270 - $840</td>
<td>Price ranges wildly depending on type of wood</td>
</tr>
<tr>
<td>Metal (various types)</td>
<td>4’-4.5’</td>
<td>$58 - $180</td>
<td></td>
</tr>
<tr>
<td>Metal frame with wood slats</td>
<td>4’</td>
<td>$100 - $210</td>
<td></td>
</tr>
<tr>
<td>Cement/Concrete</td>
<td>5’-6’</td>
<td>$500 - $950</td>
<td>Few models to pick from</td>
</tr>
<tr>
<td>Recycled Plastic</td>
<td>4’-6’</td>
<td>$250 - $825</td>
<td>Lots of models to choose from. Some mount directly into the ground.</td>
</tr>
<tr>
<td></td>
<td>(mostly 6’)</td>
<td>(mostly $350-$600)</td>
<td></td>
</tr>
<tr>
<td>Metal coated in plastic</td>
<td>6’</td>
<td>$780</td>
<td>Only 1 model found. Low aesthetic value.</td>
</tr>
</tbody>
</table>
Chapter 9: Goals and Outcomes of the Project

Hopefully, with a trail system in place, Smith-Crisler Nature Preserve will be able to be better used by visitors. Depending on how well the woods is developed and marketed, visitors may come from local communities such as Mechanicsburg, New Castle, and Middletown, and perhaps even from more remote bigger-city areas such as Anderson, Muncie, or even Indianapolis.

One possible use for the woods would be of an educational nature. Local school teachers could bring their students out there for environmental education classes. Teachers from Ball State University could take field trips there for various classes (such as NREM 101’s “Forest Management” lab). Perhaps Red-tail Conservancy members could offer to host free guided hikes and classes for visitors. This last option would be a great way of getting the Red-tail Conservancy some more publicity and local recognition. This could then lead to more people joining or donating to the conservancy, thus allowing them to better care for the woods or perhaps take on yet another natural area sometime in the future. In any case, each of these options would require a system of trails in place to properly facilitate use.

After the trails are installed, it is important to note that the work will not be totally finished. The site should still be evaluated periodically to make sure that the trails are staying in good condition and are not developing chronic problems (such as major
erosion). The locations of the trails should also be evaluated from time to time to ensure they were placed in the optimal locations for users’ enjoyment and for protection of the ecosystem. One way of evaluating this may be to perform some sort of a survey of visitors. Another way would be to look for short-cuts and unofficial trails being made. If these are found in abundance, the trail routes may need to be rethought and altered to better cater to visitor demand (and/or to better protect fragile aspects of the ecosystem).
Chapter 10: Current Status of the Nature Preserve

As of the publication date of this paper, the Smith-Crisler Nature Preserve is still in its infancy. Through my assistance, a tentative set of trails has been marked through the woods with flagging tape. The current path will be reviewed by various members of the Red-tail Conservancy as well as a few other interested parties. Assuming the route is satisfactory to all, the trails will be installed in a more permanent manner. Currently, the plan is to install plain, earthen trails lined with logs and branches to denote the path, though this is still somewhat tentative. No decision has yet been made as to type of benches to install, though tentative rest spot locations have been identified.

That the Smith-Crisler Nature Preserve is not yet totally developed does not mean that my project has failed or is not yet complete. The goal of this project was to assist the Red-Tail Conservancy in making the necessary decisions as to how to go about developing the woods. I have successfully supplied the Red-tail Conservancy with all the information they need to make an informed decision about the trails, trail markers, and benches to be installed in the Smith-Crisler Nature Preserve. That they have yet to make all the decisions and actually complete all the work is immaterial. They now have all the data they need, and may proceed as they see fit.
Conclusion

Smith-Crisler Nature Preserve has the potential to be one of the Red-tail Conservancy’s prime natural areas and a wonderful outdoor recreational and educational site once it gets a little infrastructure set up to meet visitors’ needs. The primary need of this location is a system of trails for visitor use. Hopefully, the ideas proposed in this paper will serve to assist the Red-tail Conservancy as they work to create a much-needed trail system in Smith-Crisler Nature Preserve.
**Works Cited**


<http://www.americantrails.org/resources/trailbuilding/BuildCrushFinesOne.html>.


<http://www.imba.com/resources/trail_building/top_10_mistakes.html>.


