HOLY CROSS ABBEY

reinhabiting place

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2010

ABSTRACT

As a monastery living under the Rule of St. Benedict and as part of the 900-year-old Order of Cistercians of the Strict Observance (OCSO), the monks of Holy Cross Abbey (HCA) are pursuing sustainability not only to ensure that their traditions and spiritual way of life persevere, but also to foster a deeper stewardship of the land as "lovers of the brethren and of the place." As part of this move toward economic and environmental sustainability, HCA solicited the assistance of a team of graduate students from the University of Michigan's School of Natural Resources and Environment ("Michigan Team") under the guidance of Professor Andrew Hoffman. The Michigan Team used a systems perspective with the intention of encouraging a more holistic, integrative, and telescopic view of the monastery in its local, regional, and global contexts. To this end, the Team evaluated HCA's community sustainability as it specifically applies to the following topic areas: land use, energy, water, solid waste, toxics, economies, food, and buildings. Subsequently, synergistic recommendations were provided to help HCA become more sustainable. These suggested guidelines may also assist other monasteries and religious institutions as they initiate, evaluate, and/or modify their own sustainability efforts, thereby enhancing environmental stewardship throughout numerous communities and maximizing positive impact on society.

ACKNOWLEDGEMENTS

The Michigan Team would like to acknowledge all of those who assisted in the completion of our sustainability study, including: the HCA community, Fr. James Orthmann, Fr. Robert Barnes, Br. Michael Desilets, Br. Benedict Simmonds, Mary Cay Harrington, Carol Hensley, Ronnie & Marty Hope, Ernie Polanskas, Professor Andrew J. Hoffman, University of Michigan's School of Natural Resource and Environment, and University of Michigan's Frederick A. and Barbara M. Erb Institute for Global Sustainable Enterprise.

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EXECUTIVE SUMMARY

In early 2008, the monks of Holy Cross Abbey (HCA) in Berryville, Virginia began to evaluate their unique position in the local, regional, and global environment and to envision a more sustainable ecology, community, and economy. As a monastery living under the Rule of St. Benedict and as part of the 900-year-old Order of Cistercians of the Strict Observance (OCSO), the monks began to pursue sustainability not only to ensure that their traditions and spiritual way of life persevere, but also to foster a deeper stewardship of the land as "lovers of the brethren and of the place." As part of this sustainability initiative, HCA solicited the assistance of a team of graduate students from the University of Michigan's School of Natural Resources and Environment ("Michigan Team") under the guidance of Professor Andy Hoffman.

The methodology, analysis, and options proposed in this report were conceived from a systems perspective with the intention of encouraging a more holistic, integrative, and telescopic view of the monastery in its local, regional, and global contexts. However, while recognizing that HCA is part of a complex and inter-related system, we considered community sustainability as it specifically applies to the following topic areas: land use, energy, water, solid waste, toxics, economies, food, and buildings.

LAND USE

Property owned by HCA encompasses approximately 1,200 acres of karst terrain in the Shenandoah Watershed and includes three intermittent streams that drain to the Shenandoah River. A variety of ecosystem types and land uses exist on the property, such as farmland, forest, floodplain and the built environment. Each ecosystem type requires different management techniques, and each land use accomplishes a different objective.

Methodology

The Michigan Team evaluated HCA's land use to evaluate the community's impact on its physical environment. Data collection efforts and analysis involved historical research; literature review; water quality testing; a review of previous soil tests and a visual, spatial analysis using GIS data from the Natural Resource Conservation Service, Clarke County, the US Geological Survey, and the US Fish and Wildlife Service. In addition, a community map-survey was issued to gather information about community relationship to place, wildlife habitat, and places of interest.

Results

The land use analysis resulted in the following key findings:

- Current agricultural practices at the HCA property contribute to the degradation of soil integrity, soil biodiversity, and ground and surface water quality. Sinkholes located on parts of the property exacerbate these problems because they act as direct conduits of contaminants to the water table.

- Agricultural contaminants that threaten the property include nitrates from excess manure and fertilizer, heavy metals and bacteria from municipal sewage sludge, and harmful herbicides such as atrazine.

- The Shenandoah shoreline and streambanks suffer from erosion and sedimentation due to cattle grazing.

- Run-off of agricultural contaminants and eroded sediment occurs to the river. This run-off may harm the aquatic habitat in HCA's streams, the Shenandoah River, and, ultimately, the Chesapeake Bay. The 100-year floodplain is susceptible to contamination from HCA's septic systems, as well as from dilapidated structures containing contaminants such as lead paint.

- Waste deposited in streams and near Cool Spring inhibits natural hydrology and poses risks of water contamination.
- The Cool Spring infrastructure is old and rundown and, therefore, inhibits community appreciation and enjoyment of this special life-giving feature of the landscape.
- Invasive plants on the property threaten biological diversity and ecosystem functioning.
- Many areas of lawn are unused and yet demand energy inefficient maintenance practices (such as mowing). These lawn areas reduce overall plant, insect, bird, and mammal biodiversity on the property.
- Many native woody trees and shrubs are located on the property, but there are relatively few native herbaceous perennials on the site.
- Overall, there is a small proportion of remnant forest habitat (13%) to developed land (87%), and poor habitat connectivity between existing forest patches. In addition, the floodplain forest is degraded due to cattle grazing and erosion caused by cattle traffic.
- The monastery lacks a formal enclosed cloister garden/fountain.
- Accessibility to the river and spring is limited by poorly maintained or non-existing trails.
- Agricultural biodiversity is poor due to use of monocultural production methods and the use of genetically modified corn.
- There are many underutilized spaces on the monastery grounds that could otherwise greatly enhance community well-being and enjoyment of the landscape.
- Proper stewardship of the entire acreage is beyond the current capabilities of the HCA community alone.

Options

Based on the land use analysis and research conducted on possible alternatives, the Michigan Team proposes the following recommendations for sustainable land use at HCA:

- <u>Restore the Shenandoah shoreline</u>. Prohibit cattle access to this area, revegetate eroded banks, create a riparian buffer at least 300’ wide, and monitor restoration progress to restore the natural Shenandoah shoreline.
- <u>Restore the natural hydrology of streams</u>. Remove waste, prohibit cattle access, revegetate eroded banks, create a stream buffer at least 100’ wide, and monitor restoration progress.
- <u>Trail construction</u>. Construct a simple yet more formal trail along the shoreline, with access from the Bishop’s House, the Retreat House, and the Westwood House. Construct a more pedestrian-friendly trail that loops around Cool Spring and the adjacent pond. Pave the trail with ADA accessible paving material (such as crushed, decomposed granite).
- <u>Create buffers around sink holes</u>. Construct wide vegetated buffers around sinkholes with native perennial grasses to help filter pollutants directly en route to the water table, as well as to make them visible as a safety precaution. Treat surrounding land as ecologically sensitive areas.

- Restore Cool Spring. Resurrect Cool Spring as a critically important feature of the landscape, and beautify the human experience of it.

- Protect the water quality of Cool Spring. Protect the water quality of Cool Spring by constructing a wetland upgrade where there used to be a pond, and by designating surrounding land as an ecologically sensitive groundwater "recharge zone" where the use of toxics and/or septic discharge are strictly prohibited.

- Divert rainwater. Divert rainwater from all buildings, but especially from the Retreat House, into raingardens (depressed gardens lined with gravel beneath a layer of topsoil to promote on-site drainage, planted with native plant species which are both drought and flood tolerant).

- Prohibit the use of contaminants on the farm. Strictly prohibit the use of pesticides, herbicides, sewage sludge, excess artificial fertilizer and excess manure in current and future farm leases. Nitrogen applied—in the form of fertilizer or manure—should not exceed Virginia Cooperative Extension Service recommendations based on annual soil tests.

- Limit the use of traffic in the floodplain. Limit the use of vehicular or ATV traffic in the 100-year floodplain to prevent compaction on soil whose function of infiltrating floodwaters is ecologically significant.

- Use and promote organic farming techniques. Require current/future farm tenant to practice organic food production methods, which also strive to protect and/or enhance biodiversity and water quality through the use of best management practices. When the lease with the current farm tenant expires, consider providing a rare and valuable vocational opportunity for innovative, ecologically conscious young farmers by offering prospective tenants an affordable, yet fairly priced, lease.

- Create a new vegetable garden. Create a new vegetable garden maintained by organic agricultural methods that focus on improving soil organic content and biodiversity. (Compost produced at HCA can be used for this endeavor.)

- Control invasive species. Remove and/or control the spread of invasive species on the property, especially Tree-of-Heaven, along the path to Cool Spring (which is aggressively outcompeting native plants and depleting valuable groundwater reserves in the spring recharge zone), and the Japanese honeysuckle that is scaling the large spring-fed sycamore near the main road.

- Create wildflower meadows. Convert some areas of lawn into no-mow wildflower meadows (which would only have to be mowed once a year, or maintained through annual or bi-annual prescribed burns).

- Use native plants. Use native plants adapted to the Shenandoah Valley ecosystem in all future plantings.

- Plant trees and construct a "greenbelt". Plant more trees, especially along the road towards (and surrounding) the Retreat House, along the main road, and the road to Westwood House. In considering where to replant hardwood forest for the purpose of ecological restoration and/or sustainable forestry, increase the width of riparian and stream buffers first, then construct a "greenbelt" which will act as a habitat corridor to and from the floodplain forest.

- Conserve land. Place more land in conservation easement. Consider the option of a conservation burial ground to help protect land.

- Identify zones of ecological significance. Hire appropriate local ecologists/botanists/biologists to perform comprehensive botanical and habitat surveys of the property to identify zones of ecological significance.

- Enlist volunteers. Enlist the help of local volunteer or environmental groups to perform restoration work, as well as to conduct annual monitoring of biodiversity and water quality.

- Construct several gardens. Construct a prayer/healing garden in the footprint of the old sheep barn to be enjoyed by residents of the infirmary who may not be able to get very far outside. Construct a more formal cloister garden as a central, ceremonial gathering place. Enlist the help of lay Cistercians, volunteers, and/or local environmental groups to perform this work. Otherwise, consider donating land/conservation easements which HCA cannot manage adequately to a land trust/conservancy such as The Nature Conservancy.

- Use the landscape for education. Include educational and interpretive information in the landscape to educate guests, visitors, and community members about the history of the land, as well as sustainable land stewardship practices taking place at HCA.

Following these recommendations will provide significant environmental benefits. These efforts would help to protect and enhance ground and surface water quality, and would promote (unpolluted) groundwater recharge and protect and enhance biodiversity. These efforts also would protect soil fertility--soil is a virtually irreplaceable natural resource considering the time it takes for organic content and tilth (i.e., nutrients) to regenerate. HCA would reduce its energy footprint and sequester additional carbon to help offset global climate change. HCA would be able to grow its own food and even generate economic gain. The property would be protected from development and would become more beautiful and accessible to the community, which would increase the human connection to and enjoyment of the land and possibly even opportunities for relaxation and mental well-being. By sharing the principles and practices of land stewardship, HCA would be able to educate community members and visitors about the importance of sustainability.

HCA can implement these recommendations in phases. Many of the efforts will require ongoing effort and attention.

ENERGY

Current global energy consumption is unsustainable. Total global energy use has been rising at increasing rates since the industrial revolution and, in recent years, this trend has exploded. According to the International Energy Agency (IEA), an autonomous body charged with implementing an international energy program, the current consumption of energy resources by humans is heading towards a systematic crash. The IEA's report states that "the world's energy system is at a crossroads. Current global trends in energy supply and consumption are patently unsustainable—environmentally, economically, socially."[1] While HCA is a small and isolated community, its consumption of energy resources connects the community to unsustainable energy practices around the world.

Methodology

The Team evaluated HCA's energy consumption and energy impact in three steps. First, we calculated HCA's aggregated energy consumption baseline by (1) aggregating the energy footprints of each Unit (i.e. residential, Retreat House, business, and farm); (2) disaggregating those footprints by fuel type and building area (not

[1] International Energy Agency. *World Energy Outlook, 2008*. Pg 3. International Energy Agency, http://www.worldenergyoutlook.org/docs/weo2008/WEO2008_es_english.pdf (Accessed October 3, 2009).

applicable to the consumption of gasoline); and (3) estimating the energy consumption by activity (not applicable to the consumption of gasoline). Second, we inventoried HCA's major: 1) electronics and appliances; 2) heating, ventilation and air condition (HVAC) units; and 3) building structures to estimate the energy used for specified activities within particular areas of the property. Finally, we assigned pollutant emission levels to each activity by using emission factors published by the US Environmental Protection Agency (EPA).

Results

The energy analysis resulted in the following key findings.

- In total, the community consumes an average of about 428,000 kWh of electricity, 2,300 gallons of propane, 18,600 gallons of heating oil and 1,100 gallons of gasoline per year. The total variable costs for these fuels equate to roughly $73,500 a year.
- In total, the community is responsible for average emissions of 570 tons of CO_2eq, 2.82 tons of SO_2 and 0.76 tons of NO_X per year.
- These emissions negatively impact social welfare and result in estimated soft costs that range from $5,000 to $32,500 each year.
- The space heating system for the Monastic Enclosure is extremely inefficient for two reasons: 1) the community's boilers are old and energy inefficient; and 2) the building envelope has low insulating capabilities and contains leaks throughout.
- HCA often purchases fuel (i.e. electricity and heating oil) for processes that could be carried out any time during the year (i.e. bakes and honey production) during months when input energy prices are typically high.

According to data from the World Resources Institute (WRI) and the Energy Information Agency (EIA), the average American consumes about 334 MMBtu per year. By contrast, the average HCA resident consumes about 269 MMBtu per year. It is not surprising that HCA members consume less energy because they lead a considerably different lifestyle than the average American when it comes to general activities involving consumption, like energy. However, this comparison could be misleading because the national statistic aggregates across all related activities (e.g. residential, commercial, industrial, etc.). In contrast, HCA fares worse when considering only residential activities. In fact, the average HCA member consumes about 110 MMBtu per year for household related activities (e.g. space heating and cooling, electronics, appliances, etc.), whereas the average Virginian resident averages about 42 MMBtu per year. In terms of carbon dioxide emissions, each HCA resident is accountable for 19.67 tons of CO_2eq annually, which is still higher than the national average (19.64 tons of CO_2eq per year).

Options

Based on the results of HCA's energy consumption baseline, the team concluded that there were numerous opportunities for reducing the community's energy use and the costs associated with that use. This section offers the HCA community various options for reducing the amount of energy consumed on the property. These options are categorized by the type of action taken and ordered from least to most capital intensive within each category. In addition to estimating energy and emission reductions for each option, the Team also estimated the total financial savings that the community would realize over the appropriate lifespan of each option. Notably, some of these options may never pay off, but the options nevertheless are attractive due to large reductions in the soft costs imposed on society from negative environmental impacts. These options include:

- Energy conservation behaviors. Adopt/continue energy conservation behaviors.
- Improve lighting systems. Improve lighting systems by converting to compact fluorescent lamps, installing occupancy sensors, increasing daylight in HCA's buildings, and/or installing daylighting controls.
- Increase appliance efficiency. Improve the use of appliances and electronics by installing smart power strips to reduce phantom loads and/or replacing old appliances with ENERGYSTAR® certified units according to recommended replacement schedules outlined in Chapter 2.
- Increase water heating efficiency. Improve water heating systems by insulating and/or replacing water heating units with more efficient units that use less energy.
- Increase heating/cooling efficiency. Improve heating and cooling systems by installing programmable thermostats to better control indoor climate (especially in low/no occupancy areas), switching to a forced air heating system for greater flexibility in climate control, replacing or retrofitting older boilers, and/or retrofitting buildings to better utilize free and clean energy by using passive solar design.
- Improve the building envelope. Improve the building envelope through weatherization (e.g., weather-stripping, caulking, etc.), improving roof and/or exterior wall insulation, and/or replacing single pane windows with double pane, low E windows (except the novitiate, where the glass dominated eastern wall should be replaced by triple pane, low E windows).
- Use renewable energy. Install on-site renewable energy (e.g. wind power and/or solar power).

WATER

The Earth's supply of fresh water is finite. While 70% of the Earth's surface is covered by water, only 2.5% of the water is fresh water. Of that 2.5%, nearly 70% is frozen in the polar icecaps and much of the remaining 30% is otherwise inaccessible to humans. Fresh water also is scarce in many areas of the world. While areas like Virginia have access to plentiful fresh water in most years, they are still susceptible to drought. Even so, globally, 1.2 billion people live in areas where water scarcity is a constant concern. Water supplies are further limited by pollution which can come from a variety of sources, including wastewater treatment systems, agricultural runoff, storm water runoff, and others.

At HCA, water used by the community is drawn from private wells. Because HCA draws its water from private wells, it does not pay for water access. Nevertheless, there is a strong environmental and economic rationale for encouraging the HCA community to conserve water. In sum, HCA should consider implementing water conservation measures for the following reasons:

- To avoid the financial cost of septic system replacement
- To avoid the environmental cost of septic system pollution
- To avoid the cost of unnecessary energy expenditures related to hot water use
- To increase community resilience in anticipation of drought
- To take a leadership position, within the broader religious community, on an issue integral to sustainability

Methodology

In order to complete a full assessment of water use and water quality at HCA, the Team compiled inventories of all the components of HCA's water system, including wells, septic systems, water treatment systems, indoor fixtures and appliances, and outdoor fixtures. In addition, the Team collected flow rate data for indoor and outdoor appliances. This data was used in combination with data from a weeklong assessment of HCA community water use to estimate total, annual community water use. In addition, information about the location and purpose of specific wells and septic systems was used in conjunction with data on threats to water quality in order to create a plan for on-site water testing. This data was used to identify areas where the HCA community could reduce their water use.

Results

- There are nine wells on HCA's property supply water to HCA's facilities.
- Ultraviolet (UV) treatment systems are currently being used to treat water for the Bakery, Monastic Enclosure, Retreat House, and Westwood House.
- After use, wastewater is generally deposited into one of 11 septic systems onsite.
- HCA has a total of 256 indoor appliances and fixtures and 14 outdoor appliances and fixtures.
- The team calculated that the HCA community uses a total of 558,139 gallons of water per year. This level of use translates to 46,512 gallons of water per month, 10,733 gallons per week, and 1,529 gallons per day.
- Of the 558,139 total gallons of water used by the community annually, HCA residents are estimated to use 534,134 gallons (approximately 96%).

In terms of indoor water use, specifically, HCA residents actually use more water per capita than residents living in North American single-family homes on average (68.7 gallons per capita per day versus 59.8 gallons per capita per day). This finding suggests that there is ample room for HCA to reduce its water use.

Options

Based on the results of the water use and quality analysis, the Team offers the following options for conserving water, as well as monitoring and enhancing water quality.

- <u>Install new showerheads</u>. 2.0 gallon-per-minute (gpm) rated showerheads provide a relatively low cost way to conserve a substantial amount of water. In two locations, replacing showerheads provides a positive net present value.
- <u>Install sink faucet aerators</u>. 1.5 gpm rated sink faucet aerators provide a low cost way to conserve a substantial amount of water. In three locations, retrofitting faucet aerators provides a positive net present value.
- <u>Install low-flow toilets</u>. 1.28 gallon-per-flush (gpf) toilets have the potential to provide substantial water savings in a number of HCA locations.

- Install composting toilets. Composting toilets are an option to consider if new buildings are being designed. These systems can provide substantial water savings and nutrient recycling. However, they are not generally a good retrofit option due to design constraints.

- Install new urinals. 0.5 gpf urinals have the potential to provide substantial water savings in two HCA locations. Waterless urinals have the potential to provide even greater water savings than low flow urinals. However, before retrofitting waterless urinals, the HCA community should verify that the existing plumbing infrastructure is appropriate to accommodate the urinals.

- Install a high efficiency clothes washer. A modern, high efficiency clothes washer has the potential to provide moderate to substantial water and energy savings. However, new commercial clothes washers are quite expensive and residential washers may not have the load capacity that HCA requires.

- Install a high efficiency dishwasher. A high efficiency dishwasher has the potential to save a substantial amount of water in the refectory dishwashing room. The installation of a high efficiency dishwasher should also save the community a substantial amount of time.

- Install a graywater system. Graywater systems keep water out of septic systems. One type of graywater system uses graywater (wash water) for plant irrigation. Another type of system reuses graywater to flush toilets.

- Install drip irrigation systems. Drip irrigation systems are substantially more water efficient than sprinklers because they distribute water directly to the plant roots. A drip irrigation could effectively replace the sprinkler system now in use at the butterfly garden.

- Install flow meters. Flow metering would allow HCA to monitor the progress of its water conservation strategy.

- Adopt the following behavioral strategies for water conservation. 1) Watch out for leaking fixtures and fix leaks immediately when they are found. 2) Take short showers rather than baths. To encourage community members to adopt shorter showers, it may be useful to place a timer or sign in or near each shower as a reminder. 3) Turn the sink faucet off while brushing teeth, shaving, and scrubbing dishes. 4) Wash full loads of laundry or choose appropriate load-size setting. 5) Wash laundry with cold water.

- Develop a drinking water monitoring program. A regular drinking water monitoring program would give the HCA community better information about the quality of its drinking water over time.

- Investigate septic system siting. Poor septic system siting can be a cause of water quality problems. The team's analysis indicates that one or more of HCA's septic systems could be located in a floodplain. HCA should consult a plumbing professional to determine whether current siting poses any risk to water quality.

- Develop a septic system maintenance program. A regular septic system maintenance program can help to increase the useful life of HCA's septic systems and help protect water quality.

SOLID WASTE

Most experts believe that humans generate roughly two billion tons of global municipal solid waste (MSW) every year, and annual worldwide production of MSW (i.e. trash) is predicted to grow to more than three billion tons within the next twenty years due to rises in global population and consumption. To manage this garbage, most countries primarily rely on incineration and/or landfilling, which are unfortunately connected to a number of environmental issues, such as the loss of resources, the pollution of groundwater and soil, and the production of greenhouse gases (GHGs).

A specific MSW management program at the national, regional, and even the local community level can be evaluated with regard to sustainability, based on whether its practices reflect the prioritized activities of integrated solid waste management (ISWM) and move a community toward "Zero Waste" status (a 90% or greater recovery/recycling rate). The ultimate goal is to eliminate waste by first maximizing waste prevention efforts, which is then followed by reuse and recycling/composting to the extent possible. Disposal is the last resort and should only incorporate non-recyclable and non-compostable items. If a waste management system, such as HCA's program, follows this framework, a relatively small amount of MSW will actually be placed in a landfill or incinerated, and the impacts to the environment and public health will be minimal.

Methodology

The Team conducted two MSW characterization studies, multiple qualitative interviews, and personal observations as part of this waste analysis. An open-ended sustainability questionnaire, which included inquiries about conservation behaviors, also was administered to HCA community members and full-time employees. The information was used to identify opportunities for the community to reduce its production of MSW.

Results

The Team's analysis revealed the following key findings:

- HCA generated 21,320 pounds of MSW in 2009, which is significantly lower than the amount of MSW produced by the equivalent number of "average" Americans in one year.
- From the total amount of MSW produced, HCA recovered 37 percent of it (7,878 pounds) through various recycling and diversion activities.
- HCA's recovery rate exceeded the national average (33%), but it fell short of meeting the recycling rates for the state of Virginia (38.5%) and Frederick/Clarke Counties (45%).
- Of the 13,442 pounds of MSW that HCA discarded (into a landfill), 68% of it was recyclable or compostable.
- There are over seven different, informal dump sites located on HCA's property.
- HCA has not adopted an official procedure for responsibly storing and disposing of electronic waste.
- The farm tenant burns some MSW (e.g. tire inner tubes and plastic buckets), which has serious, negative environmental implications.

- As a result of its current recovery activities, HCA avoided producing a net total of 8,670 pounds of carbon dioxide equivalents (CO_2eq).

Options

Based on the results of the analysis and research conducted on possible alternatives, the Michigan Team proposes the following options related to the sustainable management of solid waste at HCA:

- Contract for comprehensive recycling collection services. Contract with Waste Management to provide comprehensive (i.e., single-stream) recycling collection services on a weekly basis using an eight-yard dumpster (the same size as the current AWS dumpsters). This option would also entail discontinuing the existing cardboard recycling service while retaining AWS as the provider for monthly trash collection services.

- Implement a composting system. Build a three-bin composting system and compost all food waste and compostable materials produced on the property. The composting bin system could be built by HCA maintenance staff or local volunteers (e.g., the Boy Scout troop from the Shenandoah Area Council), primarily using second-hand materials. The Virginia Cooperative Extension (Clarke County office) will provide education regarding composting and any needed support.

- Discontinue burning trash at the farm headquarters. HCA should request that the farm tenant refrain from burning MSW at the farm headquarters and instead place recyclables and MSW in the appropriate dumpsters. As part of this option, HCA is encouraged to adopt an official policy prohibiting the burning of trash anywhere on its property. (This policy could also be written into a new lease with the current or future farm tenant.)

- Adopt/continue various waste prevention practices to limit total MSW produced. These practices include, but are not limited to: reducing the consumption of disposable goods by using and buying durable (or compostable) products, reusing paper and other packaging materials, buying in bulk, and repairing appliances and other products rather than replacing them.

- Develop a formal management system for electronic waste ("e-waste"). HCA should select a spacious indoor storage room that could temporarily house e-waste in a safe manner and that would limit the chance of damaging items and exposing harmful materials contained within the units. HCA is also encouraged to adopt an official policy that e-waste items be removed from the property after a certain span of time (e.g., every 3 months) by volunteers or the maintenance staff and donated or recycled.

- Develop a formal management system for pharmaceutical waste. Unused pharmaceuticals that have not yet expired can be taken to the Free Medical Clinic of Northern Shenandoah Valley, which can legally redistribute the medication to needy patients who cannot afford prescription drugs. Expired medication should be taken to the Leesburg Pharmacy, where it is picked up by a certified recycler who incinerates pharmaceutical waste—the most preferred disposal method for this type of waste according to the FDA and EPA.

- Remove and recycle waste from informal dump sites located on the property. HCA should work with local scrap collection companies and/or volunteers to assist with the removal, recycling, and appropriate disposal of all waste items contained at the known dump sites.

If all of these options are implemented, HCA could potentially divert up to 90% of its MSW from entering the Frederick County Landfill, thus achieving Zero Waste status and fully embodying the concept of sustainable waste management as espoused by the US Environmental Protection Agency's ISWM principles. In addition, HCA would avoid producing a total of 26,675 pounds of CO_2eq per year (possibly more depending on the waste prevention activities that are adopted), which is equivalent to avoiding the amount of carbon dioxide produced by consuming 1,235 gallons of gasoline.

TOXICS

It is impossible to know all of the effects that chemicals have on humans. Many of the chemicals that are commonly used in the home or found in surrounding landscapes are potentially harmful to humans and the environment. In addition to impacting the health of people indoors, the use of chemicals in the indoor environment can have environmental health impacts once they enter the outdoor environment. Chemicals improperly disposed of down the drain or in storm drains/sewers, can contaminate water supplies and be toxic to humans and animals. Other chemicals can disrupt endocrines (important hormones) in fish and amphibians.

Outdoors, the human and environmental health impacts of exposure to agricultural inputs, such as atrazine, biosolids, artificial fertilizers, and manure, depend on the inputs themselves. Health effects can include nervous system effects, skin or eye irritation, endocrine (hormone) system disruption, and cancer. Ground and surface water quality can be negatively affected by increased pollution levels. For animal species, effects may include mortality, diminished reproductive success, and sterility. Habitat destruction can also occur.

Methodology

To assess the use of chemicals used in the monastic enclosure, bakery, Retreat House and other buildings, the Team took a visual inventory of household cleaners/chemicals, pesticides/herbicides, maintenance products, and automotive products utilized at HCA. In addition to collecting a chemical inventory, the Team visually inspected the facility to identify the location of mold and various disposal areas. To explore what possible indoor pollutants are present, the Team hired a regional company, Hinson & Jung, LLC, to inspect for asbestos, lead paint, mold, and any other potential issues. To evaluate the potential for leakage from the underground storage tanks (USTs), we tested well water downstream of the USTs for oil and gasoline constituents.

Results

The results of our data collection efforts revealed the following:

- At the time of the inventory, HCA had over 100 products that contain potentially harmful ingredients.
- Potentially harmful ingredients can be found all over the property in paints, cleaners, solvents, and adhesives.
- The Monastic Enclosure has tiles and insulation that contain asbestos, a potentially carcinogenic substance.
- Lead paint, which is toxic, is peeling in several locations.
- A mold-like substance can be found in many locations in the Monastic Enclosure.

Options

HCA has several options for handling the toxics. The options include:

- Proper handling/removal of asbestos materials. As long as asbestos-containing products are undamaged, it is best to leave them alone. An initial site assessment should be done to identify all asbestos-containing products. If these products must be removed, a trained contractor should be used and should clean up the site appropriately. As noted in the indoor inspection, there is some damage to the floor tiles, which are likely to contain asbestos. These should be removed or covered up.

- Installation of a carbon monoxide detector. Hire a trained professional to inspect, clean, and tune-up the central heating system annually in order to discover and repair any leaks. To monitor carbon monoxide levels, HCA should install carbon monoxide monitors in various locations around the building, particularly near sleeping areas.

- Reduction of volatile organic carbon (VOC) emissions. First, to reduce formaldehyde levels, avoid purchasing pressed wood products containing phenol resins. Use air conditioning, dehumidifiers and increase ventilation to reduce emissions. When areas are repainted, low VOC paint should be used.

- Proper handling/removal of lead paint. Any paint used before 1978 likely has lead in it. If the paint is damaged and pieces or particles are peeling off, there is the risk that lead is being released into the environment. HCA should hire a trained professional to fix the areas that contain peeling paint.

- Reduction in use of insecticides/pesticides. The development of an integrated pest management (IPM) strategy that uses nonchemical based solutions can reduce the number of pests in HCA's buildings safely. Such a strategy involves implementing sanitation and structural improvements to prevent initial infestation. The next stage is to use mechanical (e.g., traps) or biological controls (e.g., plants) to eradicate the pest. The final stage is to use the least toxic pesticide possible following the application instructions carefully.

- Tests for radon. Radon testing should be done approximately once every 5 years. This can be done by a professional or by purchasing a self-home testing kit.

- Reduction of airborne particles. HCA should hire a trained professional to inspect, clean, and tune-up their central heating system each year and repair all leaks properly. Filters should be changed on central heating and cooling systems and air cleaners per manufacturer's directions.

- Reduction of household chemicals and cleaners. HCA should use all products according to manufacturer's directions and properly ventilate the areas of use. The community should only purchase quantities of chemicals that will be used soon and dispose of old/unneeded chemicals quickly and safely. HCA should also seek out environmentally friendly chemicals and cleaners. Chemicals and cleaners should be consolidated and stored in only a few sites to minimize the risks of accidental spills.

- Removing mold-impacted areas. These areas should be dealt with by cleaning with soap and water. Then, measures should be taken to ensure adequate ventilation which will mitigate mold growth. In some instances, more serious remediation efforts may be needed, including removal and replacement of contaminated areas.

- Replacing underground storage tanks with aboveground storage tanks. One of the best options for mitigating the potential for leakage from USTs would be to install aboveground storage tanks where you can see if any leaks are occurring.

BUSINESS

Sustainable businesses ensure (at a minimum) that their activities cause minimal harm, and do not deplete but rather restore and even enrich the natural environment. Sustainability makes companies viable for the long term by focusing management on principles that strengthen rather than undermine the company's roots in the environment, the social fabric, and the economy.

The main economic reason for business to embrace sustainability is that direct and measurable cost savings are possible. A less obvious economic justification for embracing sustainability is that developing and implementing a sustainability strategy can increase revenues. The market for green goods and services is large and growing. Finally, sustainable businesses often enjoy intangible benefits that may affect financial performance, including a competitive advantage and consumer goodwill.

Even though sustainable business can have significant economic benefits, in the final analysis some businesses adopt the sustainability agenda simply because "it's the right thing to do." Sustainable businesses reverse negative environmental, economic, and social impacts by creating healthy workplaces and reducing resource use and environmental damage.

Methodology

The Team adopted a modified "triple bottom line" (TBL) approach for evaluating the sustainability of HCA's business activities. TBL, which is often referred to as the three "Es" (economic prosperity, environmental quality, social equity) or the three "Ps" (profit, planet, and people), suggests that businesses should measure their success not only by the traditional metric of financial performance, but also by their impact on the environment and on the society in which they operate.

The Team evaluated financial performance by examining HCA's profitability by Unit (i.e. bakery, Retreat House, gift shop, and farm) and the profitability of each of the products produced by the bakery. The Team also evaluated the future profitability of HCA's products by evaluating trends in sales, fixed and/or variable costs, and other key financial indicators. Finally, the Team considered qualitative factors, where relevant, to depict HCA's economic sustainability.

To assess HCA's environmental performance, the Team examined the environmental impact of the inputs and processes required for HCA to generate revenue from the activity. Specifically, the Team calculated the amount of energy required for upstream activities (obtaining ingredients and other inputs), manufacturing (operating appliances and the oven; supplying heat, space cooling, and light), and downstream processes (shipment of product to customers), and then determined the amount of carbon that resulted from the consumption of that energy.

To assess HCA's social performance, we evaluated the degree to which the work required to generate revenues are a drain on its aging population in terms of time and effort.

Results

The key takeaways from the business analysis follow:

- Profits from HCA's economic activities are declining rapidly, from a high of $174,000 in 2005 to just $32,000 in 2009. The Retreat House and the farm consistently generate a net loss. The bakery generates a profit, but bakery profits have declined dramatically over the past five years due primarily to declining fruitcake sales.

- The overall environmental performance “baseline” for HCA’s current bakery products is 94 tons CO_2eq per year.
- HCA’s fruitcakes are responsible for more carbon emissions in a year than any of HCA’s other bakery products.
- Creamed honey also is responsible for a significant portion of HCA’s bakery emissions (30 tons per year).
- Truffles are responsible for the least amount of emissions (less than 5 tons per year).
- At 9.5 to 10 lbs CO_2eq per sales unit, HCA’s fruitcake, honeys, and fraters are more carbon-intensive than many common foods.
- Most of the emissions from HCA’s bakery products result from manufacturing activities (primarily, electricity and heating oil used for lighting, space heating and cooling, operating the cool room and freezer, and to run appliances and the oven).
- With respect to HCA’s social sustainability baseline, the bakery and gift shop demand the vast majority of the community’s time (approximately 1,900 hours per year for each of these activities). The Retreat House and farm demand only a small fraction of the time spent at the bakery and gift shop.

Options

Based on the results of the analysis and research conducted on possible alternatives, the Team proposes the following options related to HCA’s economies:

- <u>Improve overall energy efficiency</u>. At the Retreat House and gift shop, focus on conservation behaviors that address conventional energy uses such as light, heat, and space cooling. Actively invite retreatants to join HCA in these conservation practices by turning room lights off when not in use, keeping thermostats low in the winter and high in the summer, and taking shorter showers.

- <u>Reduce energy consumption in the bakery</u>. Investigate options such as sealing leaks, installing additional roof and wall insulation, eliminating summer bakes (if possible), and insulating the walls and ceiling of the ingredient storage room to reduce the huge amount of energy currently being consumed to heat and cool the bakery building (as discussed in Chapter 2).

- <u>Reduce reliance on fruitcake sales</u>. Prepare for a declining demand for fruitcake by focusing on creamed honey, which has more favorable margins and upward trending sales. Introduce new honey flavors and upgrade packaging to increase competitiveness.

- <u>Introduce new bakery products</u>. Focus on market segments with high growth potential, such as gourmet/specialty, organic, and gluten-free products. Balance the seasonality of fruitcake sales by developing products for events that occur early in the year, such as Easter and Mother’s Day. Develop products that use locally grown and available ingredients (e.g., apples, peaches, tomatoes, and peanuts) to reduce the carbon footprint of the products sold.

- <u>Partner with others to expand and modify economies</u>. Find a partner or hire an employee to develop new products and find ways to more fully utilize the bakery’s assets. Partner with a commercial baker who can use the oven in exchange for cash or personnel. Consider an arrangement with a private label manufacturer who can manufacture fruitcakes (as appropriate) and other bakery products for sale under the HCA label.

- Design and introduce more sustainable packaging. Consider the sustainability aspect of various packaging materials when reordering existing packaging and making future packaging decisions.

- Raise prices. Eliminate the range in the contribution amount that HCA suggests for retreats and suggest a single contribution that more than covers HCA's costs. Raise the price of fruitcake $2 per unit to better reflect market prices. Raise the rental rate per acre on the farm property to better reflect the rental market for agricultural land in northern Virginia and (more specifically) the Shenandoah Valley. Incorporate an annual percentage increase or rate schedule in any future farm leases that reflects anticipated increases in the market rate.

- Control costs. Reduce payroll expense to the fullest possible extent through flexible staffing and by reducing the weekday retreat by one day. Determine whether HCA currently is paying variable costs related to the tenant's farm operation and shift the burden of those costs to the tenant.

- Solicit additional funding for the Retreat House. Seek annual gifts from retreatants, create and solicit contributions to a building fund, and organize workshops and other themed events that are consistent with HCA's overall mission when Retreat House occupancy is low.

- Develop promotional programs for the gift shop. Display gift shop merchandise in public areas within the monastic enclosure (such as the lobby or library of the Retreat House and the foyer of the mansion), advertise in local and regional church bulletins, offer discounts on gift shop merchandise purchased before or at the conclusion of a retreat, create a book club for individuals that regularly attend retreats or patronize the shop, and/or establish a program for used book sales.

- Create a substantive Web site specifically for the gift shop. The Web site would provide substantive information about gift shop merchandise as well as basic information about shop hours and location, and might provide a platform for future online sales.

- Create areas for conservation burials. A 60-acre parcel at the southeastern end of the former Wynkoop Farm is a promising site because it can be reached from a separate entrance off Castleman Road and will not interfere with the community's daily routine. Construct walking trails and a non-denominational chapel to support the conservation burial services; restore the area to a natural forest as part of the conservation efforts

FOOD

There is a strong link between human and environmental health with respect to food production. A healthy environment is essential to producing nutritious fresh produce, which in turn is crucial for maintaining human health. In addition, the production of food can have a negative impact on the environment, mostly due to the large amounts of energy needed for large-scale food production, transportation, and consumption of that food. In addition to having a significant environmental impact, food production relates directly to a number of social issues including the use of illegal labor and worker health and safety. Food production and consumption also has profound economic implications. A few very large companies own most of the farmland and thus the profits are highly concentrated.

Methodology

To determine HCA's baseline food consumption patterns, the Team examined food purchases for the first and third weeks of January, February, July, and August. These months were chosen to represent seasonal variations in the food selection at HCA. After collecting the data, the Team coded each type of food to determine what food types HCA is purchasing (e.g., dairy, meat, produce). The Team used this coded data to identify the source of HCA's food and to estimate HCA's food budget, especially HCA's budget for produce.

Results

HCA purchases its food primarily from the following stores: Giant, Costco, Food Lion, Wal-Mart Supercenter, Martin's and Nalls Farm Market. By totaling up the purchases made during the sample purchasing weeks, the Team determined that 58 percent of food (by amount of money spent) is purchased at national/regional chains versus local markets/local farms. Fresh fruits and vegetables comprise a fairly significant portion of HCA's food budget (13%).

Options

Based on the information collected, we recommend the following options:

- Source food locally. One option is through a community supported agriculture share which entitles the shareholder to a portion of a farm's produce each week. Another option is to purchase food at local farmers' markets.
- Produce food at HCA. HCA could grow some of its own produce such as lettuce and tomatoes. Volunteers could help grow on a larger scale or greater variety.

BUILDINGS

Buildings and the built environment are responsible for a wide variety of impacts on human health and the environment. Principles of green construction can ameliorate these impacts. The term "green construction" refers to the practice of creating structures that are environmentally responsible and resource-efficient throughout a building's life-cycle (site selection, design, construction, operation, maintenance, renovation, and deconstruction). The overall goal of green construction is to create "a wonderful building – a building that is bright and well-lit, that is warm in winter and cool in summer, that is as comfortable as it is healthy, that is energy- and resource-efficient, that is functional and long-lived, and that promotes the well-being of its occupants and the earth."

Methodology

To evaluate building conditions and materials, the Team conducted an inventory of the buildings in the monastic enclosure and interviewed the Cellarer and other members of the community to understand the history and uses of buildings. Responses to the survey that the Team administered in August 2009 provided additional insight into the community's perspective on the community's buildings.

Results

The buildings in the monastic enclosure were constructed over many years. Some of the buildings were constructed as early as 1784, although most were constructed after the community moved to Virginia in the early 1950s. Although most of buildings generally are in good condition, some of the buildings have fallen into disrepair. Moisture and mold have been identified in the mansion, St. Joseph's Scriptorium, and old dormitory. In addition, a structural report prepared for HCA in January 2009 reported that in certain areas of the buildings the framing is inadequate to support the loading requirements. Exterior finishes, including certain areas of the cloisters, are in need of maintenance and paint.

Options

The Team developed a conceptual model of a new dormitory and cloister to illustrate how green building principles might be applied at HCA. The Team advocates for constructing the new dormitory in the basic footprint of the existing Old Dorm, if feasible, so that the foundation, subfloor, and perhaps even some wall materials could be incorporated into the new structure, and because preserving as much of the Old Dormitory as possible has sentimental appeal. The conceptual new dormitory includes the following green features:

- Roof and wall insulation with appropriate R-values, double- or triple-paned windows, and a thermally resistant roof system to maximize energy efficiency.
- Low-flow showerheads and faucets, high efficiency toilets and urinals, and/or even composting toilets to minimize water use.
- Interior finishes that are non-toxic and renewable (e.g., cork flooring, wool or other natural fiber carpets, and low-VOC, light-reflecting paint).
- Numerous windows so that residents can control airflow and temperature.
- Thick walls to provide heavy thermal mass for the building envelope and reduce heat loss.
- An open design, skylight, and glass façade to maximize daylight penetration and minimize the use of artificial lighting.
- A double glass façade that traps heat from the sun and uses the heated air to warm interior spaces in the winter and vents the heated air away from occupied spaces in the summer, thereby reducing the need for HVAC systems.

The new cloister consists of a covered walkway to replace the current cloister that connects the St. Joseph's Scriptorium, the mansion, and the Old Dormitory. At the northern end of the cloister, the walkway is partially enclosed to provide shelter and partially open and accessible to cloister area. Like the new dormitory, the new walkway at the northern end of the cloister includes several green features:

- Thick, insulated walls of the covered portion moderate the interior temperature without requiring an external energy source.
- The roof of the open section is pitched at a 15-20 degree angle and houses solar panels to generate electricity for interior and exterior lighting.

CONCLUSION

It is our hope that this report can help guide not only the HCA community and its guests, but also assist other monasteries and religious institutions. Ideally, these other religious institutions will find value in the content of this report as they initiate, evaluate, and/or modify their own sustainability efforts, thereby enhancing environmental stewardship throughout numerous communities, maximizing positive impact on society, and venerating God's gift of creation.

Throughout the process, the Team has endeavored to make connections between the global environmental challenges of our age and the unique challenges faced by the HCA community. Thus, it is the Team's great hope that this report will help the HCA community to more clearly understand its role within the global ecosystem, and from that understanding, to build a shared commitment to adjust daily habits, to mitigate environmental impacts through improved design and technology, to become more responsible consumers in the global marketplace, and to generate income in an ecologically responsible manner.

In reality, this project is only one of many steps in a long road toward sustainability. Considering this, we hope the proposed options will serve as a foundation for subsequent steps and the development of an implementation plan that will help HCA move toward a more sustainable future—one in which the community will be able to fully celebrate their role as stewards of the land and lovers of the place.

INTRODUCTION

We will find ecologically responsible methods of managing our land, buildings, industries, and other resources in order to promote the greatest good for all people, aware of the inseparable link between peace with creation and peace among men.

Strategic Plan of the Holy Cross Abbey, Berryville, Virginia (2009)

What is a sustainable monastery? In early 2008, the monks of Holy Cross Abbey (HCA) in Berryville, Virginia began to evaluate their unique position in the local, regional, and global environment and to envision a more sustainable ecology, community, and economy. As a monastery living under the Rule of St. Benedict and as part of the 900-year-old Order of Cistercians of the Strict Observance (OCSO), HCA began to pursue sustainability not only to ensure that their traditions and spiritual way of life persevere, but also to foster a deeper stewardship of the land as “lovers of the brethren and of the place.”

To jumpstart its commitment to sustainability, HCA solicited the assistance of a team of graduate students from the University of Michigan’s School of Natural Resources (“Michigan Team”) under the guidance of Professor Andy Hoffman. This report presents a comprehensive summary of the research and analysis performed by the Michigan Team with respect to HCA’s land use, energy consumption, water use and quality, solid waste management, toxic chemicals, economies, and buildings. In this report, we present an in-depth exploration of the meaning of sustainability in the context of a Cistercian monastery. Each chapter defines metrics for establishing HCA’s current “baseline” sustainability and evaluating future progress toward achieving HCA’s sustainability objectives in the core areas of land use, energy, water, solid waste, toxics, economies, food, and buildings. The report also presents concepts, ideas, options, and suggestions that might guide HCA’s progress toward sustainability.

STEWARDSHIP OF THE EARTH: A SPIRITUAL MANDATE

HCA’s commitment to sustainability is bolstered by recent initiatives of the Catholic Church. Pope Benedict XVI steadfastly supports environmental stewardship and urges all humanity to actively embrace a more sustainable way of life. For example, the Holy Father summoned all Catholics to “make decisions aimed at strengthening that covenant between human beings and the environment, which should mirror the creative love of God...” at the 2007 World Day of Peace celebration. To demonstrate the commitment of the Church, the current pope and his predecessor have promoted numerous efforts to “green” the Vatican.

The formal constitution that directs Cistercian life also underlies HCA’s sustainability initiative. Section 27A of the OCSO Constitution states that “[t]he brothers are to be concerned about conservation of the environment and to manage natural resources prudently.”[1] In fact, among all Catholics, Cistercians are known for forming the strongest bond with the land on which they live. Cistercian connection to the land has historically been realized through the practice of agriculture.[2] The concept of *ora et labora* (prayer and labor) expresses the notion that one can know God through both work (typically manual labor) and prayer, suggesting that establishing a healthy relationship with place can yield both physical and spiritual nourishment. “Loving place” is considered a responsibility and a mirror of spiritual commitment.

The nonmaterialistic monastic lifestyle, attained through vows of poverty, makes Cistercian communities ideal candidates for manifesting and modeling the principles of sustainability. To understand the Cistercian perspective on sustainability, the Michigan Team distributed a survey to OCSO houses in the United States as a part of this project. The objectives of the survey were (1) to provide HCA with valuable information about the sustainability initiatives that other Cistercian monasteries have attempted and/or are currently engaged in and (2) to aggregate the data and provide it to all OCSO houses in an attempt to galvanize collective support and potentially spur additional sustainability initiatives. The responses we received indicate that many OCSO houses perceive the following regarding the connection between Cistercian monasticism and sustainability:

- "The rule of St. Benedict contains within itself a degree of the rationale behind sustainability—the care of goods and property for the welfare and the spiritual and human needs of the community."

- "…[W]e believe that our land and the ecological environment is a gift from God and that in keeping with the Rule of St. Benedict, we are responsible to reverence this gift, and as good stewards, to enhance it for the benefits of the surrounding local community as well as for future generations."

- "We consider it our call and responsibility to respect, nurture, and care for our planet and the human family. Good stewardship is part of our Cistercian Constitutions and we reverence the presence of God in all of creation by this effort to be good stewards."

- "Our call as Christians asks of us a deep respect and love for all God's creation. We are all one in Christ and his presence fills every atom of the universe. So when we are invited to [demonstrate] good stewardship in our Constitutions, it is an invitation to live sustainably out of love."

- We are "entrusted by the Lord to be stewards of the manifold gifts He has given [and that] the land, water, minerals, and crops all are His creations, and with them comes a divine mandate to use them with care and profit."

Many of the OCSO houses have outwardly manifested their commitment to sustainability by installing renewable energy systems, practicing sustainable agriculture, and "greening" their buildings. A summary of the responses we received from the OCSO houses is included as Appendix 0-A.

As a community, the monks of HCA confirmed their commitment to be responsible caretakers of creation in a Strategic Plan that they developed to guide the future intentions of their community. According to the Strategic Plan, HCA intends to move forward with a plan to place a portion of their property in conservation easement (Direction 5.1); to solicit outside resources for advice and direction regarding ecologically minded management of their buildings, property, and practices (Direction 5.2); and to assess its physical plant, giving special attention to maximizing space use and minimizing harmful environmental impact, always honoring their tradition of Cistercian simplicity (Direction 6).

Individual monks, likewise, have expressed personal commitments to a more sustainable community. In response to a survey that the Michigan Team administered as part of this project, many members of the community perceived a strong linkage between the Cistercian Order and sustainability based on the following truths:

- Careful management of natural resources and mindfulness of land/water use has always been a valued part of Cistercian culture and history.
- Cistercian constitutions and statutes reflect conscientious management of land and the importance of being "lovers of the place."
- Embracing sustainability demonstrates a respect for God's divine creation.
- Using earth's resources wisely reflects Cistercians' commitment to living a life of simplicity and poverty.

Other monks were motivated not only by a moral obligation and the spiritual importance of environmental stewardship, but also by concerns about the community's economic sustainability and ability to recruit new vocations. (For a summary of HCA's motivations as expressed in responses to a survey administered as part of this project, *see* Appendix 0-B.)

The community at HCA is pursuing sustainability because they are inspired by "the divine presence of God inherent in the natural world." When asked to describe the community's motivation for this project, Fr. Robert Barnes (Abbot of Holy Cross Abbey) noted that "[w]e ourselves are an integral part of this creation, united by the Spirit of God in an impenetrable bond with all that God has entrusted in our care. Our lives as Cistercian monks commit us to the care of God's creation." Fr. James Orthmann echoed this sentiment, noting that "[t]he topography [of the land] is inseparable from our vocation, our life stages, our ups and downs; it can seem to be the externalization of our monastic journey." HCA is committed to fostering a deeper stewardship of the land as "lovers of the brethren and of the place."

Holy Cross Abbey

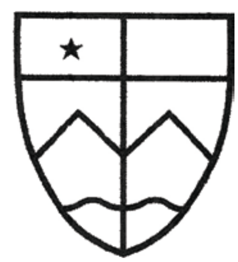
The monks of Holy Cross Abbey live on a 1,200-acre farm in Clarke County, Virginia, where rolling pastures descend to the Shenandoah River and are bordered by the Blue Ridge Mountains. Settlement in river valleys has been a Cistercian tradition since 1098, when the first Cistercian monastery was established in Citeaux, France. Architectural historian Terryl Kinder writes, "In some Cistercian valleys, the sun rises over the hills very late on a winter morning and disappears early in the afternoon, its rays barely touching the cloister garth. In these cases, the glance of the spirit is led inward and upward rather than outward and downward, and the effect might be described as more 'interiorizing.'"[3]

The HCA property is part of the Shenandoah Watershed. Three intermittent streams drain into the Shenandoah River, which flows into the Potomac River, which finally empties into the Chesapeake Bay. The monks worked the land from the time the monastery was established in 1950 until the late 1970s, when they decided they no longer could continue to manage such a large acreage themselves, particularly with their aging population. Since the late 1970s, HCA has leased the land to a farm tenant who raises Black Angus cattle and practices conventional cultivation of corn, hay, and barley on 900 to 1,000 acres of the property.

Much American history is infused into the landscape at Holy Cross Abbey. HCA's riverside property has been transformed from Native American hunting and fishing grounds, to early colonial plantation, to a Civil War battlefield, to the pastoral monastic retreat that it is today. Many artifacts have been discovered in the fields close to the river. A variety of Native American stone implements as well as battle relics (e.g., bullets, belt buckles, and buttons) are on private display in the Cool Spring Mansion. These relics serve as a tangible reminder of the presence of the Monacan and Manahoac Tribes who once hunted there and of the bloody Battle of Cool Spring that took place on July 17 and 18, 1864, just beyond where the current Retreat House stands.[4]

Although the landscape is dominated by pasture, there remain several patches of hardwood forest on site as well as a handful of traditionally cultivated areas near the monastic enclosure, gift shop, and Retreat House. A number of buildings are scattered throughout the property, as might be common on a large old farm in the area. Barely visible across the river is a residential subdivision and golf course that sprouted up in recent years. Overall, the setting is pastoral, peaceful, visibly sloped to the river, and framed by the omnipresent beauty of the Blue Ridge Mountains.

HCA's signature emblem represents four key parts of their identity, two of which represent elements of their home landscape: the Shenandoah River and the Blue Ridge Mountains.



The star signifies Our Lady

The cross, the Abbey of the Holy Cross

The peaks, the Blue Ridge Mountains

The curve, the Shenandoah River

WHAT IS SUSTAINABILITY?

Sustainability has become a buzz word over the past decade or so. As a result of the widespread use of the term, a number of definitions have been developed. Some of the definitions are very resource-focused and anthropocentric; other definitions focus more on ecosystems as a defining concept. Individual interpretations of this concept guide decision-making processes within emerging sustainability strategies.

Perhaps the most common definition of *sustainability* was coined by the United Nations World Commission on Environment and Development in 1987. This definition, which has become one of the most widely accepted (albeit very general) definitions of the term, states that sustainable development is development that "meets the needs of the present without compromising the ability of future generations to meet their own needs."[5] Visionary ecologist Aldo Leopold viewed sustainability even more generally: “A thing is right when it tends to preserve the integrity, stability and beauty of the biotic community. It is wrong when it tends otherwise.”[6]

Several principles can be used to guide the development of a sustainability strategy. These principles can be summarized as follows:

- Capping principle: The capping principle provides that when human activities (such as extraction of natural resources or disposal of waste) are inherently constrained by biophysical conditions, humans should limit, or “cap,” those activities according to the level that preserves ecological functioning.

- Source principle: The source principle provides that when resources used by human populations come from a source that is inherently limited and has no substitutes, they should be absolutely preserved and protected. Once we consume them, they are gone and cannot be replaced.

- Intermittency principle: The intermittency principle provides that resources should be used according to nature’s rhythms and fluctuations of each others’ needs. At its essence, this principle encourages us to move more in sync with the cycles of nature.

- Precautionary principle: According to the precautionary principle, when an activity raises threats of harm to human health or the environment, preventative measures should be taken even if cause-and-effect relationships are not fully established scientifically.

HUMAN BEINGS AND THE ENVIRONMENT: CURRENT TRENDS

Global environmental mega-problems define the world in which HCA resides. Several of the most pressing problems include: global warming and climate change, toxics and pollution, water scarcity and degradation, depletion of natural resources, and habitat degradation and loss of biodiversity. These issues are summarized below in order to provide a context for this study.

Global Warming

In recent years, global warming has topped the list of environmental issues. Global warming results when earth’s system of temperature control is forced out of equilibrium. Global warming is a concern because of its potentially harmful effects. Scientists predict that the increase in atmospheric temperature will potentially cause a rise in sea level, flooding, agricultural instability, the spread of disease, and even species extinction.

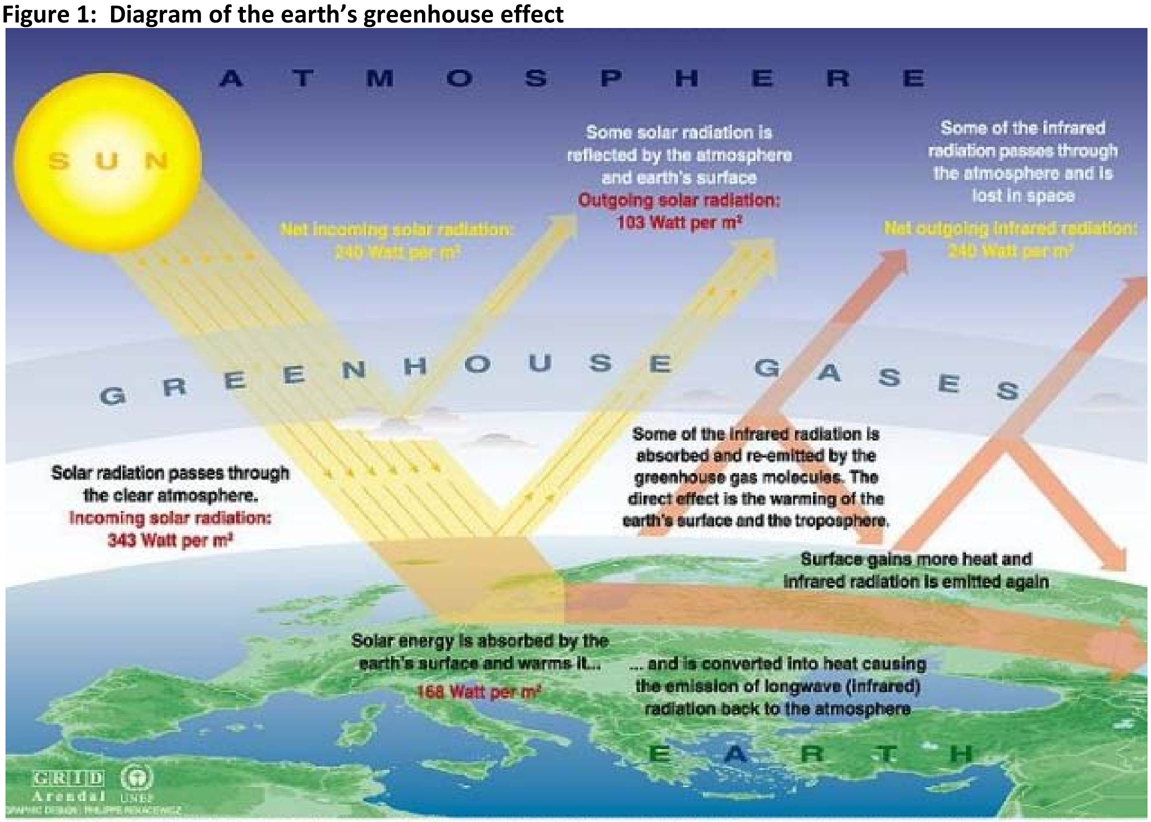
Global warming is caused by the greenhouse effect, which is a relatively simple concept. Earth maintains its temperature by absorbing radiation (a form of heat) from the sun and releasing its own radiation back into the atmosphere. Greenhouse gases (GHGs), such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), exist naturally in the earth's atmosphere and trap some of the radiation given off by the earth. In the past 50 or so years, increasing amounts of manmade GHGs have been emitted into the atmosphere from industry, vehicle exhaust, and other activities. The excess concentration of GHGs acts like a greenhouse in that it allows the same amount of solar radiation into the earth's atmosphere but less radiation out of the atmosphere. As a result, some of the earth's emitted radiation cannot escape and is causing the earth to overheat. Figure 1 graphically portrays the greenhouse effect.

The Intergovernmental Panel on Climate Change (IPCC) reports that emissions of GHGs from human-related activities are increasing at alarming rates—greater than the earth's capacity to absorb these gases. The IPCC also reports that the effects of global warming from these activities are tangible and easily observed. For example:

- Eleven of the previous twelve years leading up the IPCC's 2007 study were the warmest years ever recorded by instrument.
- Mountain glaciers and snow cover are receding at alarming rates.
- Global sea level rose 0.08 meters between the years 1961 and 2003, and could rise as high as 0.8 meters by 2100.

Nearly all scientists agree that the consequences could be disastrous if these trends continue.[7]

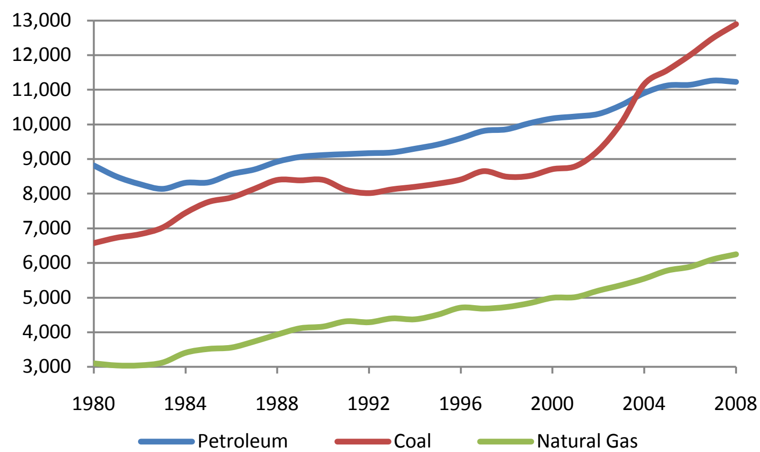
Figure 1: Diagram of the earth's greenhouse effect



Sources: Okanagan university college in Canada, Department of geography, University of Oxford, school of geography; United States Environmental Protection Agency (EPA), Washington; Climate change 1995, The science of climate change, contribution of working group 1 to the second assessment report of the intergovernmental panel on climate change, UNEP and WMO, Cambridge university press, 1996.

Energy consumption is a major cause of anthropogenic GHG emissions, as measured in carbon dioxide equivalents (CO_2eq). As shown in Figure 2, the combustion of petroleum, natural gas, and coal in 2008 led to more than 3.3 billion metric tons of CO_2eq being emitted into the atmosphere, and the rates of emissions from energy consumption are increasing.[8] The combustion of coal alone causes about 42% of global GHG emissions and is expected to reach 45% by 2030.[9] Emissions from the consumption of petroleum and natural gas also are increasing.

Figure 2: GHG emissions (MMTCO$_2$e) from world consumption of fossil fuels



Source: EIA, Accessed at: http://www.eia.doe.gov/emeu/international/contents.html

Toxics and Pollution

Human activities result in the emission of many substances that can have a negative impact on human health and the environment. We use increasing amounts of chemicals for all of our activities (e.g., manufacturing, transportation, agricultural production) and inevitably release these chemicals into the air, ground, and water. Toxic chemicals can cause a wide range of health problems such as respiratory illness, diseases of the internal organs, and cancer. Inappropriate waste disposal methods lead to waste building up in various ecosystems, including the ocean, where it threatens biodiversity and species existence.

Smog is a particularly harmful type of air pollution that is formed by the burning of fossil fuels. There are two types of smog. The first type is *classic smog*, which is a combination of smoke (tiny particulate matter that is mainly derived from ash) and sulfur dioxide (SO_2) that collect in the lower levels of the atmosphere. The combustion of coal, which typically comprises 45 to 50 percent of all power generation in the US,[10] releases particulate matter such as silicon dioxide, calcium oxide, and traces of heavy metals. All of these pollutants can lead to serious human health conditions if inhaled. Combustion of high-sulfur coal also creates SO_2. SO_2 can react with oxygen and water vapor in the atmosphere to create acids such as sulfur trioxide, sulfuric acid, and sulfurous acid. When these compounds in the atmosphere cool, they can drop in the form of acid rain, which can cause significant health risks and damage to crops, soil, and buildings.[11]

The second type of smog is *photochemical smog*. Photochemical smog is created through a mixture of chemicals that is released into the atmosphere and changes in chemical composition when reacting with sunlight. The components of photochemical smog are emitted when fossil fuels are burned by industry and vehicles, and include chemicals such as nitrogen oxides (NO_X) and volatile organic compounds (VOCs). NO_X and VOCs can react with sunlight to create particulate matter and a low level of ozone, also known as tropospheric ozone. This particulate matter can irritate allergies and lead to conditions such as emphysema, bronchitis, and asthma.[12] Furthermore, the formulation of tropospheric ozone can be unhealthy to breathe and can damage crops, trees, and other vegetation.[13]

Water Scarcity and Water Quality Degradation

With 70% of the earth's surface covered by water, it is easy to take for granted the finite nature of fresh water supplies. However, only 2.5% of the earth's water supplies are fresh water. Of that 2.5%, nearly 70% is frozen in the polar icecaps, with much of the remaining 30% otherwise inaccessible to humans. In fact, only 0.007% of the earth's total water supply is accessible, fresh water.[14]

Arguably more important than total water supply, however, is the distribution of this supply. While areas like Virginia typically have access to an abundance of fresh water, it is estimated that 1.2 billion people around the globe live in areas where fresh water is scarce. Another 1.6 billion people lack the infrastructure to adequately access surface and groundwater supplies.[15] As populations in water-scarce areas grow, water stores are being depleted. For example, the Midwest depends heavily on the Ogallala Aquifer, a giant underground reservoir, for water. However, it is estimated that the Aquifer will be functionally depleted within 15 to 50 years.[16] Unfortunately, if the Ogallala does become depleted, it will take 6,000 years to recharge.[17]

Water supplies are further limited by pollution. According to a recent assessment by the EPA, in the U.S. alone, "44% of assessed stream miles, 64% of assessed lake acres, and 30% of assessed bay and estuarine square miles were not clean enough to support uses such as fishing and swimming."[18] These water supplies are contaminated by a variety of sources including wastewater treatment systems, agricultural runoff, storm water runoff, and others. Some water pollution—particularly issues arising from wastewater treatment systems—is directly related to water use. Other threats to water quality may stem from land use practices, solid waste disposal practices, and the use of toxics.

Depletion of Natural Resources

Almost all human activities result in the consumption of natural resources. The impact of consumption varies with its magnitude and intensity, and depends on whether a resource is renewable or non-renewable. Non-renewable sources are typically natural resources that cannot be replenished at a rate necessary to sustain their level of consumption. Such resources typically exist in a fixed amount or are consumed at a rate faster than the rate at which the earth can recreate them. Conversely, renewable sources are continuously recreated and are often components of the earth's natural cycles.[19] Based on the rate at which we are consuming some of the earth's non-renewable resources, it is possible that we will soon run out of many of them.[20]

Habitat Degradation and Loss of Biodiversity

Habitat degradation occurs when humans develop land for the purposes of agriculture, urban development, industrial production, or resource extraction (e.g., drilling for oil, mining for coal). All development displaces and disrupts native biotic communities and fragments the landscape into a matrix that is largely human-dominated, dotted with patches of remnant habitat. The amount of land that is developed is directly proportional to the percent of species that will be lost in the particular plot of land.[21] In other words, 50% development means that half of the species on that property will be lost. The loss of global biodiversity threatens food security and resource availability, and compounds the problems of water quality degradation, soil depletion and erosion, air pollution, global warming, and many others.

Emissions of pollutants to land, air, and water can also cause habitat degradation, even in remote locations. The deposition of atmospheric nitrogen particulates, which stems from automobile use in cities and on highways, can negatively affect distant and isolated habitats. For example, they can alter the soil chemistry in such a way that favors exotic plant invasion, which can displace a native ecosystem.

A Systems Approach

The word *ecology* in its barest sense means "the study of home" (Greek *oikos* = habitation).[22] Though the word *ecosystem* typically conjures an image of a strictly plant and animal community, human beings are beginning to adopt a more inclusive view of our place in the world. In the face of global environmental degradation, we have been made aware of the dangerous consequences of an anthropocentric worldview.

Recognizing that humans are an integral part of the environment helps us to recognize the reciprocal relationship between human health and environmental health. Ecologist Margaret Palmer believes that the "ecology of the future" must consider the human species as an integral component of earth's ecosystems.[23] Botanist and entomologist Douglas Tallamy has stated that "we must give up the old notion of preserving nature in its pristine form" and accept the need to redesign human habitat to accommodate the preservation of other species.[24] Pope Benedict XVI has said, "[t]he deterioration of nature is in fact closely connected to the culture that shapes human coexistence: when 'human ecology' is respected within society, environmental ecology also benefits."[25] Seeing human beings as part of one global ecosystem facilitates appropriate responsibility within local ecosystems and watersheds, and enables us to carefully manage our home turf, adjust our daily habits, make our livings with less impact, and become more responsible consumers in the global marketplace.

The systems orientation is helpful for "seeing wholes" and provides "a framework for seeing interrelationships rather than things, for seeing patterns of change rather than static snapshots."[26] The approach involves dynamic thinking, the framing of problems in terms of patterned behaviors over time rather than on particular events, constant attention to a macroscopic view, and examination of how actions and results might be intertwined.

PROJECT ORGANIZATION

The Michigan Team kept a "systems" orientation in mind as we developed the scope for HCA's sustainability plan. We acknowledged, for example, that the built environment that the monks occupy is nested within an agricultural ecosystem, which is nested within a larger "natural" ecosystem. Furthermore, each sub-watershed on the property belongs to the Shenandoah Watershed, which ultimately belongs to the larger Chesapeake Bay Watershed. Land use directly correlates to water quality: nutrient runoff from the farm impacts the lives of fisherman in the Chesapeake Bay through the hypoxic aquatic condition it contributes to; unchecked energy consumption affects HCA's economic sustainability and contributes to the far-reaching social and environmental effects of global warming; the use of fruitcake ingredients grown by farmers in distant locales who choose to use pesticides has implications on the farmers' health, water quality, and adds to HCA's overall carbon/energy footprint. As Aldo Leopold put it, "The land is one organism."[27]

Thus, the methodology, analysis, and options proposed in this report were conceived from a systems perspective with the intention of encouraging a more holistic, integrative, and telescopic view of the monastery in its local, regional, and global contexts. However, while recognizing that HCA is part of a complex and interrelated system, we teased apart several aspects of the community for critical and thorough assessment. These categories include the following: land use, energy, water use and quality, solid waste, toxics, business, food, and buildings.

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