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Greening Garfield: the Issues and the Solutions

Aldo Leopold writes in his groundbreaking book *The Land Ethic*, "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" (Leopold). Leopold, the forefather of environmental studies, was and continues to be a leader in the fields of ecology and environmental science; his passion for raising awareness and maintaining the beautiful regions of our nation have spread through generations, ultimately creating the field of study that we work in today. Unfortunately, the environmental concerns that plagued and inspired Leopold's work in the early twentieth century pale in comparison to the issues awaiting our current generation. Maintaining biodiversity in the prairies is of less concern to us today as there are more prevalent issues including global warming as a result of carbon emissions and the excessive waste of the world's limited resources. Williams College, recognizing the fragile state of the earth's health, has thankfully adopted a campus sustainability initiative that reads as follows:

> "WHEREAS, The President and Trustees of Williams College believe that the principles and practices of environmental sustainability in general, and greenhouse gas emissions reductions specifically, are institutional priorities,
>
> NOW, THEREFORE, BE IT RESOLVED THAT:
>
> As recommended by the President's Staff acting on the report of the Climate Action Committee, Williams College hereby adopts as a goal the reduction of its greenhouse gas emissions by ten percent below the College's 1990-91 emissions level by the year 2020."[1]

As a leader in higher education and having the financial endowment that Williams College does, the possibility for expanding our approach to sustainability are extensive. In fact, because of these two factors, we have an obligation to heed Aldo Leopold's advice, and

[1] Schapiro, Morton O. 24 Jan. 2007. Letters From the President. Williamstown: Williams College Website, 2007.

eventually marry the spheres of academia and the natural world. Sustainability is the intersection of these realms, the ultimate goal.

The Renewable Energy and Sustainable Campuses course has helped students come to identify areas of issue within the greater concerns of Williams' sustainability initiative. Previously, Eve and I did a general audit of the dormitory spaces and the potential problems that arise across campus. Particularly highlighting the Franklin Carter House, as it is home to both of us, our seminar aimed to identify trouble areas in these private spaces and raise awareness amongst students that a modification of personal habits would go a long way to making the dorms more sustainable. Moving forward from this point, it seemed logical to hone in on the specifics of one dorm in particular: Garfield (Figure 1).

Figure 1: Garfield House.

Garfield stood out as a focus area because it is the next dorm on the books for renovation, however the plans have yet to be narrowly drawn. The interim state of Garfield's renovation and the timing of this project come together nicely, allowing for increased involvement of sustainability interests.

Having already established the larger impetus behind a green renovation of Garfield, the general sketch of the dormitory must be provided before delving into the proposed details of a sustainable plan. The building, constructed in 1924, was intended to be used as a dormitory from

its origin. Its classic Tudor style holds true to form both in the outermost layer of wall construction and in window choice, as the double-hung, lead-pane windows are from England (Figure 2). An examination of the structure reveals

Figure 2: Double-hung, lead-pane windows from England.

that the foundation is stone and concrete, the frame is made of wood, the walls are cement, and the exterior façade is stucco. This combination has proven to be a fairly sturdy and airtight package (excluding the windows, which will be discussed shortly), however the dormitory has not escaped renovation in its eighty-five year lifespan (M. Briggs). The most recent renovation project came only nine years ago in 1999, however this addressed purely exterior concerns. Some basic patch-jobs were done to the foundation and walls at this time, however the windows were not modified in any way as a result of financial limitations. Surprisingly, the last interior changes made to Garfield were done all the way back in 1978, thirty years ago. The dorm shows its age both as a result of wear and tear, but also through its generally wasteful infrastructure.

Garfield currently houses thirty-six students, in a combination of single and double rooms. None of the rooms have either private common rooms or bathrooms; these spaces are provided for in a larger public format. There are a total of four levels, including the basement, each of which has exterior windows for a total of seventy-five window frames. The entry-level has three living rooms and a library (Figure 3),

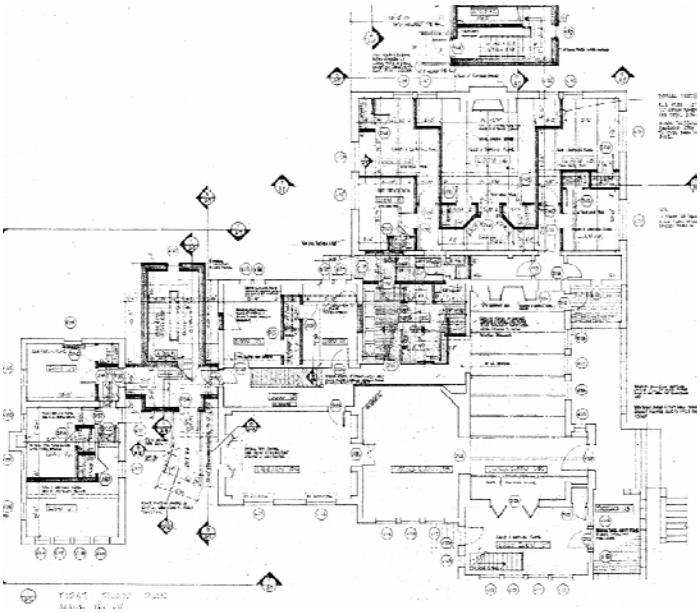

Figure 3: First floor, with 3 living rooms, a library, a large public bathroom, and private dorm rooms.

while the basement has public venues including a poolroom, the kitchen, and the laundry room (two washers and two dryers; Figure 4).

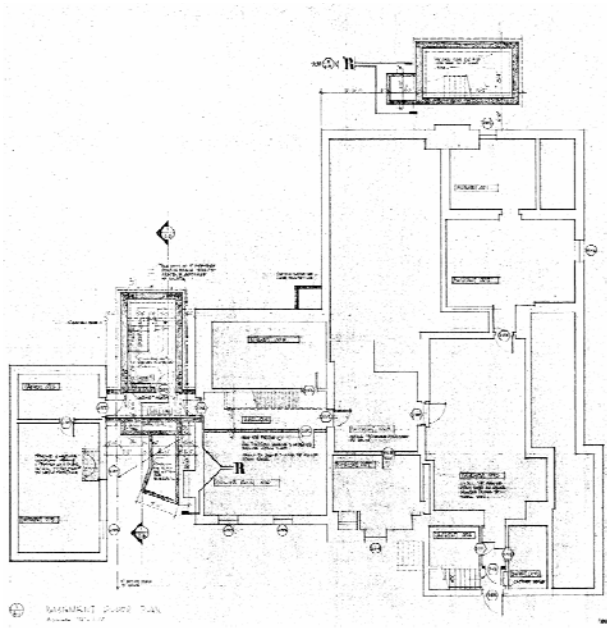

Figure 4: Basement, with a pool room, kitchen, laundry room, bathroom, and mechanical rooms.

The entire entry level is handicapped-accessible, as the changes in floor level occur using ramps instead of steps and the bathroom is appropriately modified; however, the kitchen (Figure 5), laundry room (Figure 6), and upstairs private living spaces are inaccessible.

Figure 5: Kitchen, in the basement. The door enters into the boiler room.

Figure 6: Laundry room, with two washers and two dryers.

Each of the three upper levels has one bathroom per floor, with five sinks, two showers, and two toilet stalls.

Garfield's water is supplied by Williamstown Water Department, and is heated through its own independent heating system. Because the dormitory is so remotely located from central campus, the entire building's heat supply comes off of its own system, as opposed to being hooked up to campus steam. The current heating model being used is a hot-water, finned-tube, baseboard radiation system (Figure 7) in which the water is heated on site and then funneled through the baseboard radiators.

Figure 7: Hot-water, finned-tube baseboard radiator.

The most basic plans already in place for renovation include the following:

1. Upgrading the heating system to the campus-steam system, by hooking it into the line that already runs out to the Center for Developmental Economics;

2. Upgrading from finned-tube baseboard radiators to flat hot-water panels that can be mounted at a higher level;

3. Bringing the dormitory up to all current codes, particularly the handicapped codes (this includes moving the kitchen to the first floor, laying exterior ramps, and installing an elevator);

4. Repairing the exterior stucco and any cracks in the foundation;

5. Renovating the bathrooms, including all fixtures;

6. Laying new carpet, re-painting, installing new fixtures and appliances, and other necessary aesthetic modifications.

Interestingly, there is no discussion of incorporating sustainability measures. Having come to understand the College's larger mission, the individual plans for Garfield's upcoming renovation, and the current physical and historical blueprint of the dormitory, this proposal will now lay out several possibilities for green modifications in the realms of water usage, heat loss, energy waste, and indoor environment.

Last year Garfield used approximately 451,500 gallons of water—or 34.7 gallons/ft^2. Compared with other residences of similar size, the residents of Garfield House used significantly more water (Figure 8).

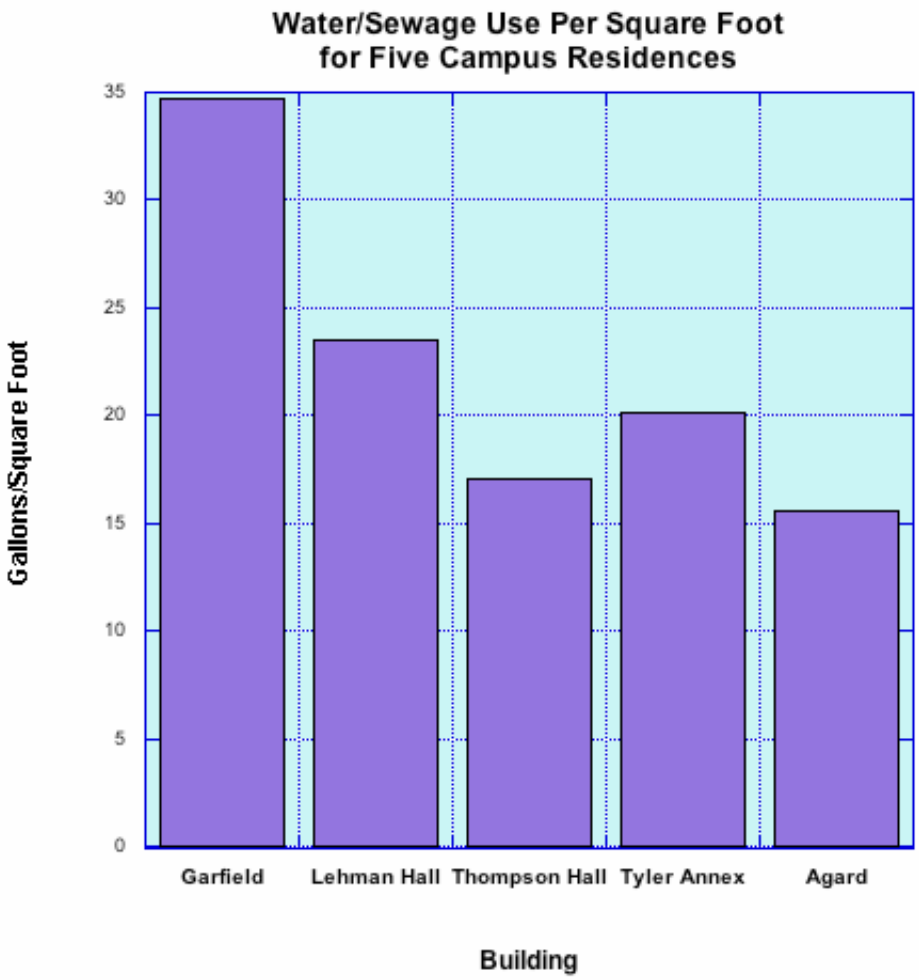

Figure 8. Comparison of annual water use (per square foot) for five similar campus residences. Garfield consumes >10 gallons/square foot more than the other residences.

Most of Garfield's inefficient water usage probably occurs in the bathroom. Toilets are the single-most user of water in the entire dormitory, particularly because the toilets have not been changed since the last interior renovation in 1978. In fact, in the average American home toilets account for 26.7% of all water usage. Much of this has to do with the continued use of toilets assembled before 1993, which can use up to as much as eight gallons of water per flush, compared to the current standard of less than two gallons per flush.[2] The dorm's renovation plans thankfully include replacing all bathroom fixtures, so brand new toilets are in store. However, for both economic and environmental sustainability reasons, the installation of dual-flush toilets is ideal as they can cut down on water costs and use.

Let us look at one price and efficiency comparison between a standard-flush toilet and a dual-flush toilet. A standard Kohler toilet, the Santa Rosa compact elongated toilet, uses an efficient 1.6 gallons of water per flush, and costs $261.75 (Figure 9).[3]

Figure 9: Kohler Santa Rosa compact elongated toilet.

However, a Toto Aquia dual-flush toilet costs only fifteen dollars more, at a price of $276.50, and provides the patron with the choice of how many gallons of water to flush with (Figure 10).

[2] http://www.thegreenguide.com/products/Bath/Toilets
[3] http://www.insidestore.com/shopping/product/detailmain.jsp?itemType=PRODUCT&itemID=32207&ci_src=17588969&ci_sku=TOT-CST414M

Figure 10: Toto Aquia Dual-flush toilet.

A standard flush, for solid-waste, uses just the same 1.6 gallons per flush as the Kohler, however there is also the option to flush liquid waste with a smaller amount of water at 0.9 gallons per flush.[4] Because Garfield's toilet use is not monitored, it is difficult to determine the payback period on buying the slightly more expensive Toto toilets, however it should be relatively short because there are only seven toilets in the dormitory (two on each of the residence floors and one in the basement), and because of the much higher frequency of liquid waste flushes versus solid waste.

Yet another waste of water resulting from old toilets is leaks, from the tank into the toilet bowl. In fact, the total accumulation of water leaks around the average American household account for fourteen percent of the entire water use. One way to check specifically for toilet leaks is to put five drops of food coloring in the tank, wait for fifteen minutes, and then check the bowl to see if any of the color (hence, water) has leaked. This examination was performed on the first floor toilets in Garfield and proved that in fact the old toilets were leaking; one more reason to be thankful for the change of bathroom fixtures.

Two other areas within the bathroom to improve in water conservation efforts are the sink faucets and showerheads. After toilets, showers are the biggest users of water within the bathroom (Garfield showers in Figures 11-12),

[4] http://www.homedepot.com/webapp/wcs/stores/servlet/ProductDisplay?storeId=10051&langId=-1&catalogId=10053&productId=100060500&N=500619+10401013

Figure 11: Garfield handicapped shower, one of two on the first floor bathroom.

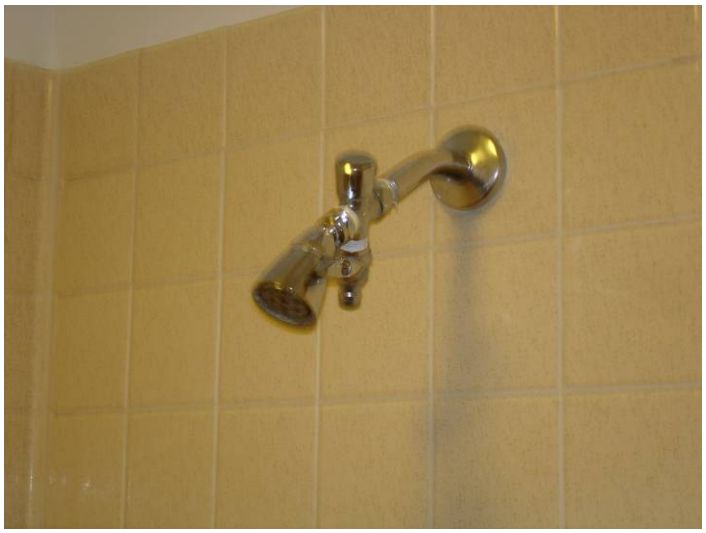

Figure 12: Garfield showerhead.

often drawing more than five and a half gallons of water per minute if assembled

before 1992.[5] The newest low-flow showerhead technology, as mandated by a Massachusetts conservation standard passed in 1992, use at maximum 2.5 gallons of water per minute. However, many green-minded companies, such as Jet-Stream, produce showerheads that use as low as one and a half gallons of water per minute, while maintaining the same pressure as higher gallons per minute heads do. These low-flow models are expensive at the outset, costing $27.30 in the case of Jet-Stream's head (Figure 13),[6]

Figure 13: Jetstream low-flow showerhead.

although the impact they make on water bills pay back relatively quickly since they cut the water usage nearly in half. Sink faucet aerators, however, are much cheaper and also cut water usage nearly in half, while maintaining similar pressure simply by adding air into the water stream. Most older faucets (Garfield's sink faucets in Figure 14)

[5] http://www.thegreenguide.com/green_home/
[6] http://www.goodtobegreen.com/frame_banner.aspx?URLID=115&URL=www.amconservationgroup.com/catalog.aspx?catid=199&CompanyID=24&ProductID=58&LinkType=Residential

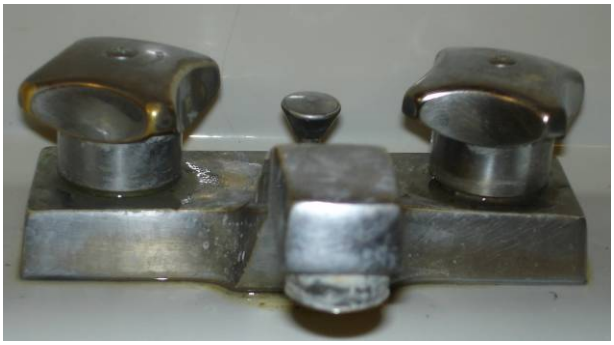

Figure 14: Garfield sink faucets, showing signs of leakage.

use more than 2.75 gallons of water per minute, but the newest faucet aerators have cut this down to one and a half gallons per minute. Greenfeet's newest model operates at this efficiency, and only costs $1.95 per aerator (Figure 15).[7]

Figure 15: Greenfeet faucet aerator.

The newer the faucet aerator, the fewer leakage issues as well, which also cuts down on water waste.

The final area of interest within concerns of dormitory water usage is within the laundry room (Figure 6). Next to the toilet, the washing machine is the biggest consumer of water in the average American house, and this holds true for Garfield as well. While the dormitory only has two washing machines, they use between twenty and twenty-five gallons of water per load of clothing washed. Luckily, though, Garfield has been equipped with more efficient front-loading washers, as opposed to old top-loaders which

[7] http://www.greenfeet.com/itemdesc.asp?ic=2005-00344-0000&utm_source=gf-google&utm_medium=sse&utm_term=WATER_CONS_BATH&utm_campaign=2005-00344-0000&utm_campaign=Sink-Faucet-Aerator-

can use as much as forty gallons of water per load. While the water use is relatively low in Garfield's washers, their energy use continues to be high. Only ten percent of the energy that washing machines use go to run the motor; the remaining ninety percent goes to heating the water used to wash the clothes. Energy-Star washers cut down on this waste, however because the washing machines were installed fairly recently in Garfield there is little incentive to purchase new Energy-Star washers during the upcoming renovation. Additionally, the dryers in Garfield do not have moisture-sensors, so they run a full sixty or seventy-two minute cycle (depending on the student's choice) regardless of how dry the clothes are. Were there any hope for replacing the current dryers during the renovation moisture-sensors would be recommended (as there are no Energy-Star dryers yet), however again the relatively recent installation does not warrant new appliances. So, how can laundry activity be more efficient? In terms of water usage, this is out of student control except for limiting the number of loads washed; however by always choosing the "bright colors" cycle, cold water will be used, cutting down on energy used to heat the water.[8]

Relating to energy waste that occurs in the laundry room is heat loss, a significant drain of energy, and economic resources! Most of Garfield's heat loss can be attributed to the existing poor window-package and insulation. Michael Briggs reminds the Williams community of its responsibility to be good stewards of history; while no Williams College building is listed as a historic landmark, the campus offers a wide variety of architecture pertaining to various stylistic periods and the school intends to keep each of these within their original style through renovations as an act of stewardship. Ultimately, this means that creative approaches are required to increase the efficiency of the lead-pane windows from Hope Windows in England. The steel storm-shutters that were installed help to block winds from penetrating air leaks in the sealants and through the thin glass, however there is still much work to be done. If the panes will not be replaced, new sealants must be applied where the glass meets the lead frame, and caulking must be done to help seal the external wood frame.

Because of the climate in Williamstown, energy waste relating to cooling student residential space has not been carefully analyzed. So, while many passive solar options

[8] http://www.thegreenguide.com/green_home/

such as planting trees and hanging window awnings might help in warmer climates, these are of little help in snowy, cold, grey Williamstown. Instead, applying new glazings to the Garfield windows might help to attract what solar energy exists, and help to trap this heat and release it slowly throughout the day.[9] Along these same lines of passive heating, closing curtains at night during the winter will help to cut down on heat loss. New weather stripping on doors where there has been wear and tear and plugging leaks make significant impacts financially, as heat bills will lower with decreased heat loss. Similarly, new insulation should be installed as the older insulation present is not as tight, and therefore effective, as new technologies. For example, using Icynene, a soft foam spray insulation system plugs leaks as tightly as possible while still maintaining the integrity of the building structure. As the foam expands to one hundred times its original volume in seconds, it provides a maximum building envelope performance, while being economically more efficient and healthier for the human environment because its moisture-blown system prevents the build-up of mildew over time.[10] Finally, in an effort to cut down on heat loss, it should always be made sure that Garfield's two fireplaces'

Figure 16: One of Garfield's two fireplaces, in the main entry-room.

[9] http://www.eere.energy.gov/consumer/your_home/windows_doors_skylights/index.cfm/mytopic=13390
[10] http://www.icynene.com/InsulationSystem.aspx

dampers are closed and that they do seal tightly when closed (Figure 16).

While all of the previous elements in this paper relate to energy waste in one way or another, it is time to discuss this directly as it relates to heating and lighting—two major drains on resources. The hot-water finned-tube baseboard radiation system currently in place is a fairly efficient system for the heating of living spaces. However, there are inefficient aspects that reduce the affectivity of the system on the whole. Currently the finned-tube radiators are located in one of two places: either along the floor in a baseboard system (Figure 7), or in a wood encasement just below the windows so as to create a sort of bench or ledge. Both of these placements are troublesome. In the case of the baseboards, this creates an issue because the dorm room ceilings are extremely high (Figure 17),

Figure 17: Garfield single dorm room, with 10’ ceilings.

ten feet, and therefore the heat coming from such a low level is inefficient to heat such large volume. As for the radiator placement just below the window, this allows for heat to escape immediately, without ever having circulated the room. One potential solution,

and the general plan laid out in the renovation goals, is to install flat hot-water panels that will be mounted in a "neutral" position: at torso level of the room occupants (when standing), and away from doors and windows that ease heat loss. The benefit to baseboard heating is that allows each room to be set to a different temperature, and each space would have its own thermostat. While this is a nice feature to allow for student control, it should be kept in mind that every degree the thermostat is set down in the winter saves three percent of wasted energy.[11]

Currently the heating system in Garfield has its own hot water boiler that feeds the radiators. The renovation plans call to eliminate this independent boiler and hook the dorm into the campus steam system, as an offshoot from the Center for Developmental Economics' line. Michael Briggs anticipates that this modification will be a more efficient source of heat energy. However the question arises as to if such a drastic change is being made to the heat system anyway, why not install photovoltaic panels or shingles as a source of energy to power the boiler?

As for lighting, Garfield currently uses a combination of incandescent bulbs and fluorescent bulbs, each of which can be replaced with more efficient compact fluorescent bulbs (CFLs). While the older CFLs had an aggressively bright light, newer technology has created the soft-white CFL light whose glow parallels that of the soft incandescent light. At the outset, CFLs are slightly more expensive (although their prices are coming down), however they last up to ten times as long as incandescents and use two-thirds less energy so the payback comes fast. In fact, over the lifetime of a CFL $30 can be saved from an energy bill and 150 pounds of carbon emissions can be eradicated.[12] A four-pack of fourteen watt soft-white light CFLs can be purchased for $6.88 from the Vision brand. The savings that come from CFL use create little doubt for why not to use them.

Finally, in an effort to better the indoor environment, several changes can be made to improve air quality. The greatest threat to air quality is volatile organic compounds, or VOCs; these can be emitted from old carpets, plastics, and paint, for example. The Garfield renovation plans include replacing old carpets, although the dorm has very few of these so they are almost a non-issue. The walls will all be repainted, it is

[11] http://www.thegreenguide.com/green_home/
[12] IBID.

advisable to use low-VOC paint. Farrow and Ball paint makes four different varieties of low-VOC paint for nearly the same price as their standard paints, and they come in the entire color palette.[13] Finally, items such as shower curtains can be made so as not to emit VOCs over time, as well as toxins that end up in outdoor environment when drained through the shower. PEVA makes a variety of shower curtains, for sale at IKEA, for $8.99, no more expensive than other shower curtains and better for the indoor and outdoor environment.[14]

In conclusion, it should be noted that Garfield's renovations will be limited by financial decisions. However, the timing of the renovations and the chosen space provide a blank canvas to show how remodeling can be done in an environmentally and economically sustainable way, even through small green-minded decisions such as those outlined above. Williams College should take this opportunity to create a living classroom, as those who live in an environmentally-friendly place are more often than not inspired by it and work to better its efficiency.

Editor's note: David Dethier, Amy Johns and Katie White edited this paper.

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