



# IARU Internship Yale Office of Sustainability

Alexei Trundle

# The Project Brief

- Critical review of Yale's existing sustainable event guidelines
- Personal reflections on current format and possible improvements
- Review of what's out there, and what Yale could/should incorporate
  - Increased uptake for small events
- Yale Guidelines 2.0?

# Yale's Existing Guidelines

Rating	Requirements
<b>GOLD</b>	<p><b>8</b> or more Action Items</p> <p>For events that will have a food component: A sustainable menu by <a href="#">Yale Catering</a> -or- A self-designed <a href="#">sustainable menu</a> (including <b>10</b> or more items)</p>
<b>SILVER</b>	<p><b>6</b> or more Action Items</p> <p>For events that will have a food component: A sustainable menu by <a href="#">Yale Catering</a> -or- A self-designed <a href="#">sustainable menu</a> (including <b>7</b> or more items)</p>
<b>BRONZE</b>	<p><b>4</b> or more Action Items</p> <p>For events that will have a food component: A sustainable menu by <a href="#">Yale Catering</a> -or- A self-designed <a href="#">sustainable menu</a> (including <b>5</b> or more items)</p>

## ➤ Accreditation System

- Gold, Silver or Bronze rating
- Determined by 'Action Item' commitment

## ➤ Integration with Yale Catering

## ➤ Required Items:

- Awareness
- Application Form

# Literature Review

Area Category Used	Yale	Berkeley	Suzuki	CIC	Munnely	Canada	BlueGreen	TOTAL
Food & Beverages	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6
Communications & Marketing	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6
Venue & Destination	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	6
Waste - Recycling & Minimisation	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5
Education	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	5
Procurement	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	5
Transportation	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4
Emissions - Energy & Offsetting	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	4
Accommodation	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	4
Logistics & Planning	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	4
Sponsors & 3rd Parties	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	3

- Extremely varied degree of detail
- 11 emergent categories
- Complete review document available

# Recommendations & 2.0

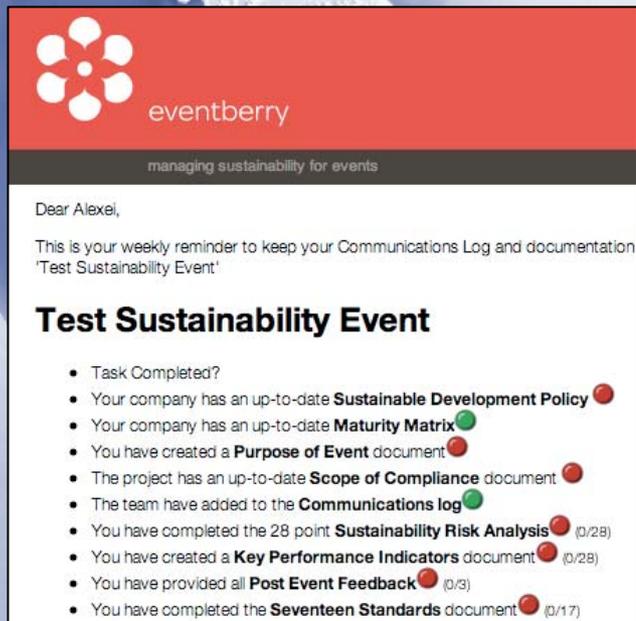
- Current version - critical feedback
  - Low uptake in general
  - Inflexible application format
    - Non-applicable points difficult to explain
  - Confusing re. 'item completion'
  - Time consuming & interpretative assessment
- Accreditation formats
  - Form (PDF or Paper)
  - Excel interactive format
  - Interactive website
- Continued project - making 2.0

# 2.0 - Development Process

- First Attempt - Website Application
  - Possible format developed
    - Design only - limited html skills
  - Costly, but most adjustable for event scale
    - Key case example - Eventberry

- Unfeasible for YOS
  - Currently completely revamping website

- Conclusions
  - Website interface required for access to process, documentation and case references
  - Application format, in the short term downloadable PDF or Excel form



The image shows a screenshot of an email from Eventberry. The header features the Eventberry logo (a red flower-like icon) and the text 'eventberry' and 'managing sustainability for events'. The body of the email is addressed to 'Dear Alexei' and contains a weekly reminder to keep a Communications Log and documentation for a 'Test Sustainability Event'. Below this, there is a section titled 'Test Sustainability Event' with a list of tasks and their completion status, indicated by green and red circles.

**eventberry**  
managing sustainability for events

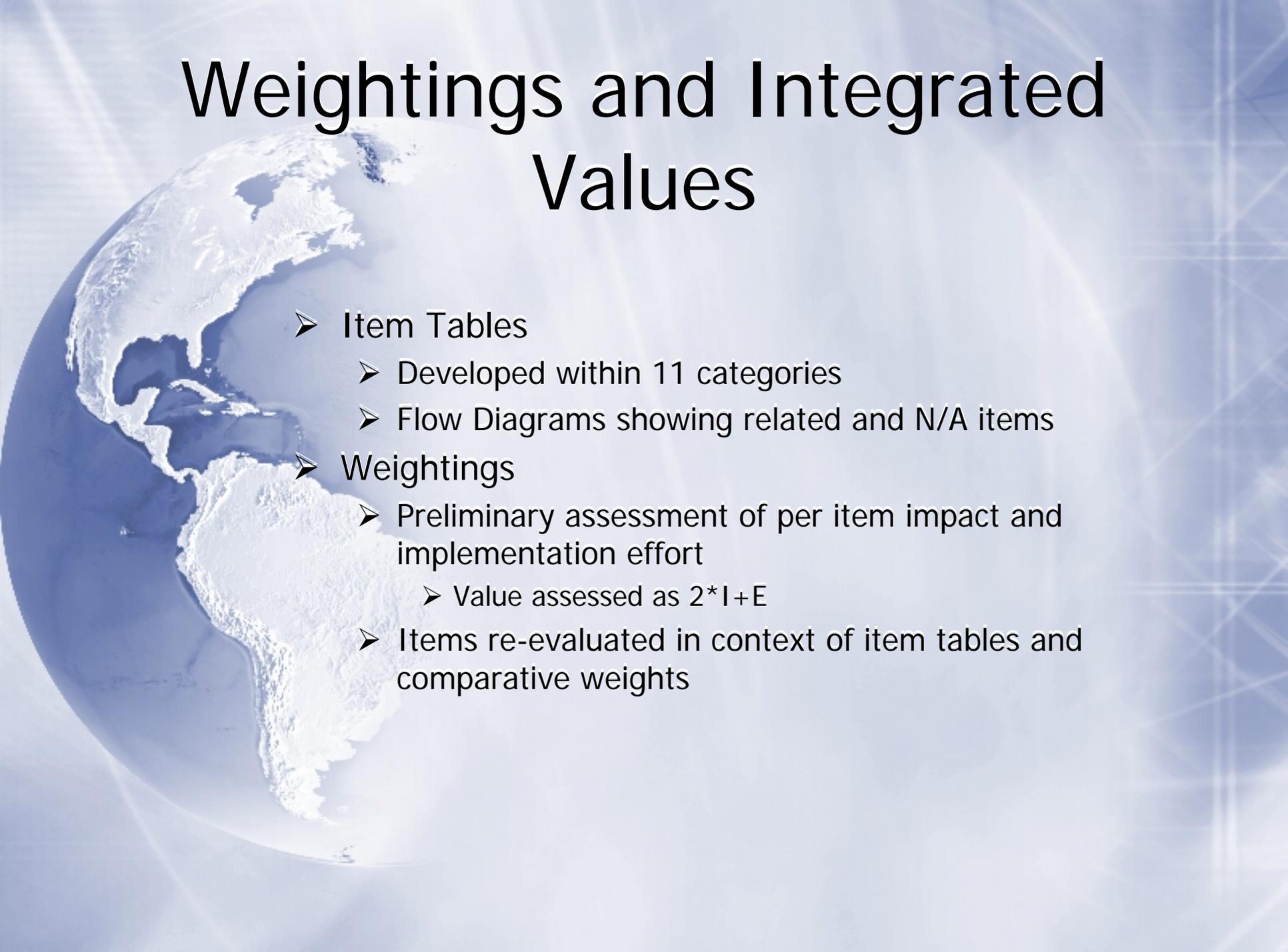
Dear Alexei,

This is your weekly reminder to keep your Communications Log and documentation 'Test Sustainability Event'

**Test Sustainability Event**

- Task Completed?
- Your company has an up-to-date **Sustainable Development Policy** (0/28)
- Your company has an up-to-date **Maturity Matrix** (0/28)
- You have created a **Purpose of Event** document (0/28)
- The project has an up-to-date **Scope of Compliance** document (0/28)
- The team have added to the **Communications log** (0/28)
- You have completed the 28 point **Sustainability Risk Analysis** (0/28)
- You have created a **Key Performance Indicators** document (0/28)
- You have provided all **Post Event Feedback** (0/3)
- You have completed the **Seventeen Standards** document (0/17)

# Weightings and Integrated Values



- Item Tables
  - Developed within 11 categories
  - Flow Diagrams showing related and N/A items
- Weightings
  - Preliminary assessment of per item impact and implementation effort
    - Value assessed as  $2 \cdot I + E$
  - Items re-evaluated in context of item tables and comparative weights

# Interactive Excel-Based Form

- Cost-effective and easily processed format
  - 'Green Star' application form example
- Adjustable input weightings
- Within my skills capacity
- Middle-ground in flexibility for scaling to event type

# Project Output

## Sustainable Event Accreditation Form

Admin Access: [Log In Here](#)

Yale Office of Sustainability

### Event Summary

#### Your Sustainable Event

**Event Description** Enter Your Event Description to begin your application

Event Components	% Items Committed	Point Gain	Point Loss
<input type="checkbox"/> Logistics & Planning	% <input type="text"/>	0	101
<input type="checkbox"/> Venue & Event Location	% <input type="text"/>	0	59
<input type="checkbox"/> Communication & Marketing	% <input type="text"/>	0	101
<input type="checkbox"/> Sponsors & 3rd Parties	% <input type="text"/>	0	59
<input type="checkbox"/> Procurement	% <input type="text"/>	0	96
<input type="checkbox"/> Accomodation	% <input type="text"/>	0	47
<input type="checkbox"/> Transportation	% <input type="text"/>	0	96
<input type="checkbox"/> Food & Beverages	% <input type="text"/>	0	99
<input type="checkbox"/> Energy: Efficiency & Offsets	% <input type="text"/>	0	72
<input type="checkbox"/> Waste: Reduce, Reuse & Recycle	% <input type="text"/>	0	71
<input type="checkbox"/> Education	% <input type="text"/>	0	77

Following sustainable event guidelines can not only be environmentally friendly, but can also **save money.**

Meeting Strategies Worldwide Inc. has calculated that removing individual water bottles from a 5-day, 1,200 person conference can save **\$48,000**, in addition to 216kg of oil, 23,840 KJ of energy and 1,181 kg of CO<sub>2</sub>.

[www.meetgreen.com/files/docs/Meeting\\_Strategies\\_Worldwide\\_Economy\\_and\\_Environment.pdf](http://www.meetgreen.com/files/docs/Meeting_Strategies_Worldwide_Economy_and_Environment.pdf)

## Communications & Marketing

*Please complete the Event Description before beginning Item Selection.*

<u>Item</u>	<u>Item Value</u>	<u>Points Gained</u>	<u>Comments</u>
(optional unless item is to be only partially completed, or item is not applicable)			
<b>1</b>	<b>Sustainable initiatives to be publicized.</b>		
(a)	Initiatives will be publicized and used in marketing.	15	Add comments here...
	<input type="text" value="-- Select One --"/>		
(b)	Success of initiatives (metrics, etc.) will be measured and communicated to participants during the event.	10	Add comments here...
	<input type="text" value="-- Select One --"/>		
<b>2</b>	<b>Electronic Communications</b>		
(a)	Registration and payment are to be conducted online or over the phone, paper-free.	8	Add comments here...
	<input type="text" value="-- Select One --"/>		
(b)	An event website is to be set up for communications and event publications.	12	Add comments here...
	<input type="text" value="-- Select One --"/>		
(c)	The website will include upload capacity for 3rd parties.	6	Add comments here...
	<input type="text" value="-- Select One --"/>		
(d)	Free wireless access to the event website will be available at the event.	7	Add comments here...
	<input type="text" value="-- Select One --"/>		

# Yale - Environmental Management

- Slightly different staffing structure to ANU
  - Higher reliance on student research projects
- Younger organisation
  - Different phase of management implementation
- Large resource base
  - Co-generation power plant within the university, etc.



Questions?

Austin Shiner  
IARU Green Intern, June 4<sup>th</sup> – July 25<sup>th</sup>, 2009  
Yale University

# Bruce Hall Project

## Introduction

I love food. I have cooked food, either for my family or discerning restaurant goers, for nearly my entire life. It was logical that Julie Newman, the director of the Yale Office of Sustainability, would send me to the ANU to work with the delightful ANU Green office on food sustainability issues. I performed my Bruce dining hall “sustainability audit” for the last four weeks of my six-week internship.

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- XIII. Moving Forward

## I. Assumptions & Realities

As espoused by American journalists Michael Pollan and Mark Bittman, reduced meat consumption is a fundamental tenet of sustainable eating. Beef cattle, for instance, ingest an average of ten calories of flora per calorie of edible beef produced. Despite Australia’s immense grazing land, much of which is unsuitable for agriculture due to water and/or soil restrictions, this study assumes that meat consumption ultimately levels a greater environmental burden than vegetable consumption.

Due to the project’s limited timescale, it was assumed from the beginning that the research phase, not the implementation phase, could be completed in four weeks.

## II. Bruce Best Practice

The Bruce dining hall already pursues sustainable eating, either intentionally or unintentionally, in a number of ways. The most obvious distinction between the Yale and Bruce dining hall is that the latter goes “trayless”. My fellow IARU intern Sara Smiley-Smith can attest to the challenges of Yale’s “go trayless” campaign, as professors spilled soup on their ties and students went beverage-less out of sheer laziness. The key to traylessness at Bruce is the location of the beverage dispenser – situated on the other side of the tables from the hot food, students have an opportunity to set down their food and continue uninterrupted. One must do a u-turn and re-enter the hot food chaos at Yale, an unpleasant experience during peak dining hours.

The Bruce dining hall does not serve soft drinks. I noticed this three weeks into the internship despite my coke-a-day average at Yale. Although calculating the environmental and social impact of the Coca-Cola Company is difficult, one may fairly generalize that, considering food miles, third-world land procurement, and intensive processing, Coke isn’t particularly sustainable.

At Bruce, each student scrapes his or her own food into the compost bin before a dining hall worker hand-rinses each plate. This set-up presents two-fold benefits. First, scraping one’s own plate is a powerful psychological tool to reduce uneaten food waste, as students themselves must confront their wastefulness by physically throwing away their own uneaten food. Secondly, hand-washing uses much, much less water than the unnecessarily complicated Yale method.

## III. Budget Restrictions

In the first semester of 2009 the Bruce dining hall served 246 students – this number is subject to significant change semester-to-semester. The weekly dining tariff was raised to \$137.50 for the second semester, keeping pace with the consumer price index but not outstripping it. The Bruce dining hall allocated \$2.80 per capita for both food and labor at every meal, bringing the total cost of each meal per capita to \$5.60. As a function of the tariff-reductive will of the Bruce Hall student body, the cost of labor and of food at the Bruce dining hall is low compared to Australian industry standards.

It is also significant to compare the price of a meal ticket at Bruce to my own dining hall at Yale. A meal ticket at Bruce costs AU\$6.10 for breakfast, lunch, or dinner. At lunch, a Yale dining hall ticket costs approx. US\$8.50 and at dinner costs approx. US\$13.00. Yale charges almost 2.5 times as much for a dinnertime meal ticket than Bruce (considering the exchange rate). Additionally, a Yale dining hall manager I spoke with said that the Yale dining operating budget is split 2/3 – 1/3 in favor of labor over food. This shows that the Yale Sustainable Food Project and the kitchens’ associated sustainable practices demand increased labor but not significantly increased food costs.

## IV. Dining Hall Benchmarks

The Bruce dining hall strives to meet a set of benchmarks at every meal. At both lunch and dinner, Bruce always serves both a hot red meat and a hot

white meat. This is redundant both superficially and in practice given the preferences of Bruce students, as will be discussed later. The availability of hot vegetarian dishes is also of concern. In the first semester of 2009 the Bruce dining hall served 12 registered vegetarians (out of a total of 246 diners). In order to accommodate the preferences of these committed vegetarians, Bruce typically prepares a “vegetarian exclusive” hot dish in a quantity proportional to the number of registered vegetarians. Regular, omnivorous students are not allowed to eat the exclusively vegetarian option. As will later be discussed in more detail, the dining hall should eliminate one hot meat dish per meal and open the vegetarian dish to all students.

Along with the hot food, Bruce also provides a sandwich bar (without mayonnaise), a limited salad bar, and 2-4 prepared salads, including but not limited to potato salad, bean salad, pre-dressed Caesar salad, pasta salad, and roasted eggplant salad. These options are highly satisfactory, although expanding the salad bar should be a sustainable priority.

## V. Survey A: Catered Students

A survey of catered Bruce students was prepared in order to ensure my recommendations wouldn't offend students' preferences. 246 students were polled electronically and 63 responded. The results of the seven questions are shown beginning on the next page (for some reason each question is labelled as “1” – ignore this, as the questions were presented to the students sequentially as they appear in this report).

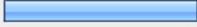
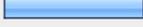
### Question 1

#### Bruce Sustainable Dining Student Survey

1. Please rate your satisfaction with the following components of the Bruce dining experience.							
	Very Satisfactory	Somewhat Satisfactory	Neither Satisfactory nor Unsatisfactory	Somewhat Unsatisfactory	Entirely Unsatisfactory	Rating Average	Response Count
General Food Tastiness	1.6% (1)	<b>50.8% (31)</b>	29.5% (18)	16.4% (10)	1.6% (1)	2.66	61
General Food Variety	5.0% (3)	<b>53.3% (32)</b>	23.3% (14)	15.0% (9)	3.3% (2)	2.58	60
Hot Vegetable and/or Vegetarian Option Tastiness	3.3% (2)	27.9% (17)	32.8% (20)	<b>34.4% (21)</b>	1.6% (1)	3.03	61
Hot Vegetable and/or Vegetarian Option Variety	1.6% (1)	19.7% (12)	<b>41.0% (25)</b>	27.9% (17)	9.8% (6)	3.25	61
Sandwich / Salad Bar Tastiness	8.2% (5)	<b>50.8% (31)</b>	34.4% (21)	6.6% (4)	0.0% (0)	2.39	61
Sandwich / Salad Bar Variety	19.7% (12)	<b>42.6% (26)</b>	23.0% (14)	13.1% (8)	1.6% (1)	2.34	61
Overall Healthfulness of Foods Offered	6.7% (4)	<b>40.0% (24)</b>	21.7% (13)	26.7% (16)	5.0% (3)	2.83	60
					Comments		8
					<i>answered question</i>		<b>61</b>
					<i>skipped question</i>		<b>2</b>

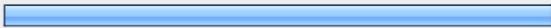
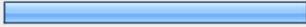
## Question 2

### Bruce Sustainable Dining Student Survey

1. The Bruce dining hall strives to serve both a red meat and white meat hot dish at every lunch and dinner. At what percentage of meals, on average, do you eat both the red and white meat option?		Response Percent	Response Count
0-20%		50.0%	31
20-40%		22.6%	14
40-60%		16.1%	10
60-80%		8.1%	5
80-100%		4.8%	3
		Comments	13
		<i>answered question</i>	62
		<i>skipped question</i>	1

## Question 3

### Bruce Sustainable Dining Student Survey

1. In the 2009 Bruce Hall dining survey for the first semester, many respondents commented that the "vegetarian only" items should be made available to all. Would you favor this change if it necessitated removing one of the meat options at every meal, leaving either a red or white meat dish and an open vegetarian option?		Response Percent	Response Count
Yes		64.5%	40
No		35.5%	22
		Comments	13
		<i>answered question</i>	62
		<i>skipped question</i>	1

## Question 4

### Bruce Sustainable Dining Student Survey

1. To the best of your knowledge, to what extent would you consider the Bruce dining hall offerings reflective of local and/or seasonal purchasing?			Response Percent	Response Count
Very Seasonal / Local			0.0%	0
<b>Somewhat Seasonal / Local</b>			<b>38.7%</b>	<b>24</b>
Neither Particularly Seasonal / Local nor Non-seasonal / Non-Local			32.3%	20
Somewhat Non-seasonal / Non-local			27.4%	17
Very Non-seasonal / Non-local			6.5%	4
			Comments	8
			<i>answered question</i>	<b>62</b>
			<i>skipped question</i>	<b>1</b>

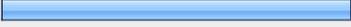
## Question 5

### Bruce Sustainable Dining Student Survey

1. To what extent would you consider seasonality and / or locality of food offerings important to your satisfaction with the Bruce dining hall?			Response Percent	Response Count
Very Important			17.7%	11
<b>Somewhat Important</b>			<b>38.7%</b>	<b>24</b>
Neither Important nor Unimportant			27.4%	17
Somewhat Unimportant			14.5%	9
Very Unimportant			3.2%	2
			Comments	7
			<i>answered question</i>	<b>62</b>
			<i>skipped question</i>	<b>1</b>

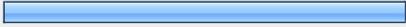
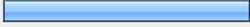
## Question 6

### Bruce Sustainable Dining Student Survey

1. In theory, would you support a modest increase in weekly student dining tariffs if such an increase were needed to account for the labor costs associated with local, minimally processed, and sustainable foods?			Response Percent	Response Count
Yes			58.7%	37
No			41.3%	26
Comments				11
			<i>answered question</i>	63
			<i>skipped question</i>	0

## Question 7

### Bruce Sustainable Dining Student Survey

1. If you answered "Yes" to the previous question, considering that the current Bruce Hall weekly dining tariff is \$137.50, what dollar value increase to this tariff would you consider acceptable in order to boost the local and/or sustainable meal options?			Response Percent	Response Count
\$5			15.8%	6
\$10			47.4%	18
\$15			28.9%	11
\$20			7.9%	3
\$25			0.0%	0
\$30			0.0%	0
\$35			0.0%	0
\$40			0.0%	0
Comments				7
			<i>answered question</i>	38
			<i>skipped question</i>	25

## VI. Survey A Implications and Tariffs

Question 1 reveals that, although every component of the dining hall experience could use improvement, the hot vegetable option is a particular weakness. Question 2 reveals that the vast majority of students do not take advantage of the two meat per meal benchmark. Question 3 reveals that 2/3<sup>rd</sup> of catered Bruce residents would favor removing one of the two meat options per meal in order to open the vegetarian exclusive meal to everyone. Given the aforementioned reality that reduced meat consumption is a sustainable boon, this would make the Bruce dining hall more sustainable. Question 4 reveals that Bruce students are aware that the dining hall does not purchase very many local products. Question 5 reveals that more than 50% of catered Bruce students consider the utilization of locally grown foods and overall sustainability to be important. Question 6 reveals, somewhat contrary to my discussions with David Wannell and the Head of Bruce Hall Marion Stanton, that 60% of Bruce residents would support a modest increase in student dining tariffs in order to underwrite the increased labor costs of sustainable cookery. Question 7 reveals that, among the students who answered “Yes” to question 6, that the average student would recommend a dining tariff increase of AU\$12 per week. Factoring in the 40% of students who would not support a tariff increase of any kind, the average student supports an increase of AU\$8 per week.

In total, the data reveals that the Bruce dining hall should eliminate one hot meat dish per meal and use the newly freed cash to open the vegetarian exclusive option to all students. Although such an increase would be politically controversial, the data suggests that the average student would support a tariff increase of AU\$8 beyond the consumer price index. Such an increase should be used to expand the salad bar selections at Bruce such that, between the hot vegetarian item and the beefed-up salad bar, students can choose from healthier, more sustainable foods. It should be noted that student tariffs are set eight months in advance – any change must be long-term.

## VII. Transition Psychology

Dining halls struggle with the labor increase associated with local, unprocessed produce. Such “rustic” vegetables, which often require washing, trimming, and chopping, are a far cry from the pre-packaged frozen Edgell-brand vegetables often served at present. In order to account for this necessary increase in prep time one may either hire more dining hall cooks or shift labor towards chopping and prepping. When Yale initiated its Sustainable Food Project, many dining hall chefs were initially dissatisfied with the increased workload. An excerpt from the Yale Office of Sustainability website describes the successful transition:

••• “Overall, the cooks have responded well to the introduction of organic, locally grown produce in their kitchens. Some cooks expressed more enthusiasm for the project than others. Lisa Hopkins, who has been cooking with organic foods at Yale for three months now, says she loves it (but she also loves prepping and food service in general). As a result of her involvement with the

Project, Lisa eats more vegetables at home and notes that "with organics, the taste is so much better. You can really taste the food.

Ernie Ber, also new to cooking in the YSFP, thinks that organic, natural food is a "good idea," but feels that the recipes are designed more for a 4-star a la carte restaurant where "you eat what you order." The entrees take time to prepare. He suggests that the students do not fully appreciate the labor, and there is a certain amount of waste. In the buffet-style cafeteria, Ernie points out that students "eat with their eyes" (in other words: fill their plates). They end up discarding what they are unable to eat. Despite those concerns, Ernie acknowledges the benefits from Yale purchasing fresh ingredients from one farmer and keeping him/her in business. He said that the "whole university can benefit from this [Project]."

Ebony Rambert, who helps with food preparation at Berkeley, expressed minimal excitement for the YSFP mostly because of the additional work it entails. Since all the produce comes fresh, she explained that they have to "prep everything" from shucking corn, cutting lettuce, washing lettuce, and making their own hummus, mustard, and salads.

It is likely that the cooks may undergo a similar transition as that experienced by the cooks who worked at Berkeley when the Project started over two years ago. It took those cooks some time to warm up to this new--or perhaps old--way of preparing food. They initially found it impractical, but now have a great fondness for this program.

Mike Schoen, who now marks his seventh year cooking at Berkeley and 27<sup>th</sup> year at Yale, recalls that they went from using ready-made chicken patties and diced vegetables to doing everything from scratch. The cooks were told to think about flavor and taste, rather than speed. Mike explained that it was "tough because they didn't have the labor." Cathy Jones came in a few months after the Project's introduction in the dining hall and energized the cooks. She got them excited about food again. Cathy told them: "there are so many people watching you--you're rock stars!" When you taste the fresh dishes coming out of these college kitchens, you realize that indeed these cooks are rock stars.

Soon, Mike and others realized that they could experiment and were trusted as chefs. If they needed dill for a recipe, Cathy would get them dill. Once a year, the chefs and cooks get together and review *Gourmet* and other cooking magazines to select seasonal menus for the year.

Aldo Gargameli, another cook who has been at Berkeley since the Project began, says "I love it [the organic cooking]!" He explained that it was a rough adjustment at first, but now he only buys organic eggs and milk and antibiotic free chicken for his own home. Aldo notes that the Project opened his eyes to health concerns related to food. Now he is trying to change his sister's attitudes toward food." ●●●

Overtime, with strong support from ANU Green staff and Bruce students, dining hall cooks can learn to embrace the increased prep time of sustainable foods as a necessary cost of delicious, responsible dining.

### VIII. Farmers' Market Sourcing

Cooking with locally grown, farmers' market produce is complicated by the rustic, untrimmed product and the variability of supply – for these reasons, the Bruce dining hall does not use any such produce at present. I investigated the sourcing potential from the Epic Farmers' Market, which provides an online email service whereby consumers can contact individual growers directly. In order to determine the availability of high-volume produce, nearly 20 such growers were contacted. Six assuredly replied that providing 5-10 cases per week of tomatoes, lettuces, winter and summer squashes, and many other fruits and vegetables would not be difficult. One producer even offered to deliver to the dining hall – if an arrangement could be made amongst the growers, the cooks at Bruce wouldn't need to travel to the market at all.

Although farmers' markets are more expensive than supermarkets, the Yale experience suggests that it's the increased labor costs, not the cost of the food itself, that is of primary concern.

### IX. Culinary Considerations

Although Bruce serves many styles of food, the workhorse of the Bruce dining hall menu is the Asian-inspired stir-fry or stew. Singapore noodles, laksa, beef with black bean sauce, Chinese pork, and many other standard hot dishes fall into this Asian curry/stew category. Their popularity with the dining hall is understandable: Bruce caters to an enormous Asian population, stews and stir-fries are easy to prepare in bulk, and the powerful curries and spices mask any flavor deficiencies in the vegetables and meats themselves. This style of cooking is problematic from a sustainability perspective, however: all of the seasonings and spices come prepacked from China or Thailand and are very, very high in salt, restricting the microbial activity of the ANU's composting operation.

In order to make better use of fresh produce, reduce sodium intake, and cut the labor costs associated with fresh veggies, the Bruce dining hall should think simple. Specifically, dry-heat vegetable sautés and roasts are often more flavourful than steaming or stewing and do not require an increase in labor.

### X. Life Cycle Assessment

Economic input-output life cycle assessment was investigated with respect to the sustainability audit. An online LCA tool developed by Carnegie Mellon University in Pittsburgh was used, as no online tool using Australian data could be found. Economic sectors such as the frozen food industry, rice production, and generic food processing were considered. Although no definitive conclusions were reached, LCA analysis made two useful contributions to the dining hall audit. It predictably revealed that, as a general principle, processed foods command more fossil fuel input than unprocessed as a function of mechanical

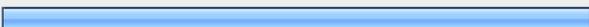
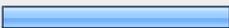
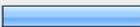
input. Second, frozen foods demand constant energy upkeep, as they must be kept frozen during transportation and in storage. These two factors add to the mounting evidence that Bruce hall could reduce its environmental impact by eliminating Edgell frozen vegetables and highly processed Asian flavorings.

### XI. Student Survey B: Self-Catered Students

Self-catered Bruce students, of which there are approximately 100, were surveyed in order to comprehensively address sustainable dining within the Hall. Many of these students are Asian and site dissatisfaction with or physiological intolerance of the Western-influenced dining hall food (although, as afore mentioned, many if not most of the dining hall’s hot meat options are more Asian than European). An electronic survey was emailed to the self-catered students in order to assess their purchasing habits and perceptions of sustainability.

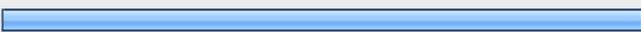
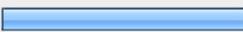
#### Question 1

#### Bruce Sustainable Dining Self Catered Survey

1. Why did you decide to self-cater (aka opt out of the meal plan?) (Please check all that apply).			Response Percent	Response Count
To save money			68.4%	13
Because I can make better food myself			68.4%	13
In order to eat more local, sustainably grown foods			26.3%	5
I'm a vegetarian and/or a lover of vegetables and find the vegetable options in the dining hall unsatisfactory			15.8%	3
All of my friends are self-catered			5.3%	1
I'm antisocial and I find the awkwardness of dining hall interactions to be overwhelming			5.3%	1
		Comments		7
			<b>answered question</b>	<b>19</b>
			<b>skipped question</b>	<b>3</b>

## Question 2

### Bruce Sustainable Dining Self Catered Survey

1. Have you ever been a catered student at Bruce in the past?			Response Percent	Response Count
Yes			72.7%	16
No			27.3%	6
Other (please specify)				0
<b>answered question</b>				<b>22</b>
<b>skipped question</b>				<b>0</b>

## Question 3

### Bruce Sustainable Dining Self Catered Survey

1. If you answered "Yes" to the previous question, please rank, to the best of your recollection, your satisfaction with the Bruce dining hall food.							
	Very Satisfactory	Somewhat Satisfactory	Neither Satisfactory nor Unsatisfactory	Somewhat Unsatisfactory	Very Unsatisfactory	Rating Average	Response Count
General Food Tastiness	0.0% (0)	56.3% (9)	18.8% (3)	18.8% (3)	6.3% (1)	2.75	16
General Food Variety	0.0% (0)	56.3% (9)	18.8% (3)	12.5% (2)	12.5% (2)	2.81	16
Hot Vegetable and/or Vegetarian Option Tastiness	6.3% (1)	25.0% (4)	18.8% (3)	31.3% (5)	18.8% (3)	3.31	16
Hot Vegetable and/or Vegetarian Option Variety	0.0% (0)	37.5% (6)	12.5% (2)	25.0% (4)	25.0% (4)	3.38	16
Sandwich / Salad Bar Tastiness	25.0% (4)	31.3% (5)	31.3% (5)	6.3% (1)	6.3% (1)	2.38	16
Sandwich / Salad Bar Variety	20.0% (3)	46.7% (7)	20.0% (3)	6.7% (1)	6.7% (1)	2.33	15
Overall Healthfulness of Food Offered	6.3% (1)	50.0% (8)	37.5% (6)	0.0% (0)	6.3% (1)	2.50	16
Other (please specify)							2
<b>answered question</b>							<b>16</b>
<b>skipped question</b>							<b>6</b>

## Question 4

### Bruce Sustainable Dining Self Catered Survey

1. How many meals do you eat out per week (include in this number take away meals from restaurants and delivery foods).			Response Percent	Response Count
0-2			54.5%	12
3-5			22.7%	5
6-8			4.5%	1
9-11			4.5%	1
12-14			9.1%	2
15+			4.5%	1
Comments				1
<b>answered question</b>				<b>22</b>
<b>skipped question</b>				<b>0</b>

## Question 5

### Bruce Sustainable Dining Self Catered Survey

1. How many meals per week do you cook yourself?			Response Percent	Response Count
0-2			0.0%	0
3-5			18.2%	4
6-8			22.7%	5
9-11			13.6%	3
12-14			18.2%	4
15+			31.8%	7
Comments				0
<b>answered question</b>				<b>22</b>
<b>skipped question</b>				<b>0</b>

## Question 6

### Bruce Sustainable Dining Self Catered Survey

1. When purchasing your produce and foodstuffs, to what extent do you try to purchase local products as opposed to those shipped long distances?		Response Percent	Response Count
Try very hard to purchase locally		13.6%	3
Try somewhat hard to purchase locally		27.3%	6
<b>Non-issue</b>		<b>59.1%</b>	<b>13</b>
Try somewhat hard to purchase non-locally		0.0%	0
Try very hard to purchase non-locally		0.0%	0
Comments			1
<b>answered question</b>			<b>22</b>
<b>skipped question</b>			<b>0</b>

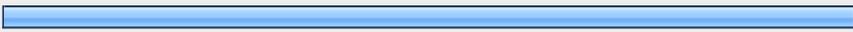
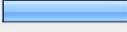
## Question 7

### Bruce Sustainable Dining Self Catered Survey

1. How many times per month do you purchase either produce or foodstuffs at one of Canberra's many farmers' markets or fresh produce markets?		Response Percent	Response Count
0		31.8%	7
1-2		<b>40.9%</b>	<b>9</b>
3-4		27.3%	6
5-6		0.0%	0
7-8		0.0%	0
9-10		0.0%	0
11+		0.0%	0
Comments			1
<b>answered question</b>			<b>22</b>
<b>skipped question</b>			<b>0</b>

## Question 8

### Bruce Sustainable Dining Self Catered Survey

1. How many times per month do you purchase food from the ANU Food Co-op?			Response Percent	Response Count
0			95.5%	21
1-2			13.6%	3
3-4			0.0%	0
5-6			0.0%	0
7-8			0.0%	0
9-10			0.0%	0
11+			0.0%	0
			Comments	1
			<i>answered question</i>	<b>22</b>
			<i>skipped question</i>	<b>0</b>

## XII. Survey B Implications & Outreach

Question 1 reveals that most students choose to be self-catered either because cooking for themselves is cheaper or because it produces tastier food. Questions 2 and 3 reveal that the hot vegetables and salad/sandwich bar were the least satisfying dining hall selections among the  $\frac{3}{4}$  of formerly catered students who are now self-catered. Questions 4 and 5 reveal that most students do the great majority of their own cooking, as very few eat out more than 3-5 times per week and a plurality cook 15+ meals themselves per week. Question 6 reveals that 60% of self-catered students do not consider sustainable eating a priority. Question 7 (along with the survey comments not here displayed) reveals that many students shop at the Canberra-area farmers' markets. Those who don't, however, cite difficulty of transportation as a major impediment. Question 8 reveals that very few students use the on-campus Food Coop, calling into question its marketing, affordability, and selection.

Elizabeth Warden, a member of Bruce Green, conducted a composting campaign with the self-catered Bruce students in conjunction with Barry and Jenn in the Green office. So far, according to Liz, no self-catered campaign has

addressed local and/or seasonal purchasing, low-waste cooking techniques, or the perils of extreme meat consumption. An effort on this front would make a significant contribution to Bruce Hall's overall food sustainability.

### XIII. Moving Forward

Political will is the key to institutional change. Luckily, both Marion Stanton, the head of Bruce Hall, and David Wannell, manager of the Bruce and Ursula dining halls, have expressed genuine interest in pursuing the recommendations in this report. The key to successful implementation of the suggestions contained herein is to appoint a project coordinator whose dedication and persistence can drive positive change. I will continue working with ANU Green in my final two years at Yale in order to follow through on my work in June and July of 2009.

# Green Star Evaluation of Fenner School Buildings

Caroline Howe

August and September 2007

Conducted as a part of ANU-Yale Sustainability Exchange

## **Introduction**

### *Project Background:*

As the Fenner School establishes itself as a center of education and research on environmental issues and society, it is important to evaluate the environmental impact of the Fenner School buildings and process. Particularly as the Fenner School expands its staff and student body, the usage of buildings will be changing significantly, in addition to the potential construction of a new facility. This provides an opportunity to retrofit and renovate the buildings to make them exemplary in terms of their energy and water consumption as well as their user comfort.

The goal of this project was to evaluate the existing Fenner School buildings through the GreenStar Education tool and to identify ways to improve the GreenStar ratings of the buildings. While it emerged that the GreenStar tool is not ideal for evaluating existing structures, it still served as a framework for analysing the potentials for the building improvements.

### *GreenStar Overviews:*

The Green Star education tool has just been released, and remains in a pilot phase. For this reason, the evaluation of the Fenner School buildings remains a recommendation based on the goals of the GreenStar tool, rather than a specific rating. Additionally, the GreenStar educational pilot refers particularly to new construction and is not well-suited to evaluating existing educational facilities. As the rating tool was created to guide primary and secondary schools, it also is not very well-suited to evaluate research facilities. With these research limitations in mind, each building was evaluated with regard to the general categories of the GreenStar ratings.

There are nine overarching categories of the GreenStar ratings, including Management, Indoor Environmental Quality, Energy, Transport, Water, Materials, Land Use & Ecology, Emissions, and Innovation. While most of the categories are fairly clear, emissions refers primarily to potential pollutants, including wastewater and sewage, refrigerant leakages, and light pollution. It does not relate to carbon emissions. The innovations points are rewarded to buildings that go well beyond GreenStar rating guidelines in any of the other categories.

### *Project Outline:*

This report analyses each of the nine GreenStar categories and evaluates potential improvements for each categories. Certain elements of building improvement were evaluated in greater detail to calculate return on investment for the renovations. Other potential improvements remain theoretical recommendations to designers as the retrofits and construction moves forward.

## **Education & Communication**

### *Staff, Students & Visitors Education*

Several of the Green Star Education points relate primarily to education or signage throughout the building. One point specific to the Education rating system is awarded when "at least three of the environmental attributes are displayed in a manner that can be readily understood by building users." In particular, the displays should discuss both the environmental and economic benefits of the building's environmental characteristics.

Once the renovations to the Fenner School buildings are implemented, it will be important to highlight its environmental initiatives in order to educate students, faculty, staff and visitors. While this should certainly be done within the building itself, it is also recommended to have a section of the school's website dedicated to sustainability initiatives within the buildings that electronic visitors can explore. One interesting example of communicating sustainability initiatives is the Yale University energy website, found at <http://www.yale.edu/energy>.

This site includes information regarding the school's targets, as well as the specific actions taken to reduce energy demand. It also has links to information on how individuals within the school and outside can reduce their own consumption. On the first page, it also has a real-time demonstration of "Resources Saved Since January 1, 2005" – including energy saved, barrels of oil saved, and equivalent carbon emissions reduced. If the Fenner School would prefer, rather than estimating real time energy reductions, it would be possible to compare monthly energy demand to average consumption for that month over the past three years.

Yale's site also has a link to real-time monitoring of the solar generation at a newly installed solar installation. The website demonstrates the amount of energy being generated currently as well as over the past week, month, and year. It also includes the amount of carbon dioxide emissions prevented and the equivalent number of passenger cars taken off the road. Even if renovations to the Fenner School have less dramatic savings to record, converting savings to understandable figures may allow users to better understand the impact of building changes.

#### *Maintenance and Management Education*

Green Star ratings also encourage a Building Users' Guide and a Building Maintenance Plan to offer guidance in all maintenance and environmental health operations. It encourages training of all full- and part-time staff in basic operations of the facility. A Waste Management plan should also be created and implemented, both for construction waste (no longer applicable) and for waste created during usage.

While many of the other components regarding education and management refer to construction rather than continued operation, in order to follow the goals of Green Star, Fenner School buildings' retrofits should incorporate education of all building maintenance staff if the retrofits change operational practices of the building.

#### *Building Usage and Operation Education:*

One major component of green building that has, up to this point, failed in many green buildings, both on campus and globally, is the education of users of their personal role within the building operation. For example, in passive ventilation systems, it is important that users leave the windows or louvers open between their offices and central hallways or celestories. Additionally, louvers that open to the outside (if they are manually controlled) are often closed in the evenings, preventing the night flush of the building with cool air. In many cases, this is not indicative of users not wishing to utilize the building properly, but simply being unaware of the impact of their actions of opening or closing windows.

Similarly, in the summer, passive cooling building design relies on windows being closed when outdoor air is significantly warmer than indoor air. Many users will wish to have their window open to feel connected to the outdoors or to receive whatever

slight breezes there are. However, this is actually causing the building to increase its temperature.

One easy way to increase and improve this education would be to create a system to notify building users of when is appropriate to open and close their windows. Though such a system may seem overly controlling, it would be as simple as having a computer-based notification, along the lines of a red, yellow, and green window light.

When the red light shows up on the computer screen, the windows should remain closed, as the temperatures outside are too high above ideal indoor temperatures. When the yellow light is on, building users should open or close windows as they see fit. The green light indicates that windows should remain partially open, as air flow through the building relies on such openings.

In many such cases, building users can feel more engaged with the building and the working environment when encouraged to use their building as best as possible. While some of the faulty operation does stem from users desiring to have air flow or increased privacy of conversations within their rooms, some of it also stems from simple misunderstanding or lack of knowledge about the building systems themselves.

### **Indoor Environmental Quality:**

Many of the points received in the IEQ category of the GreenStar rating system would be improved by making adjustments to the heating and cooling of the building. The major points within the category refer to using paints, cleaning products, and adhesives that are low in the concentration of chemicals released into the air.

With the DEMS building's major atrium in the center of the building, almost all laboratory spaces, as well as offices do have natural lighting. The major classroom facilities in DEMS, however, do not have any direct natural lighting, though the second floor classrooms do have sightlines to the atrium through the second floor foyer.

In the geography and forestry buildings, most rooms do have natural lighting and outdoor views. However, with the partitions installed into all the major office spaces in these buildings, most individuals do not have direct outdoor sightlines.

Natural lighting from skylights in the Forestry building's second floor could be utilized much more effectively. While they provide plenty of lighting for the classroom spaces at all times of year, they have been retrofitted to have full two-bulb fixtures in the centre of the skylight. This is not only blocking light from the skylights from entering the space, but also encouraging the use of these lights when unnecessary during the day.

While the skylights are providing excellent lighting, they are also allowing significant summertime heat gain. The choice of skylights did not consider particularly well the thermal loading on those spaces, and the skylights themselves do not filter out higher energy non-visible radiation. There are a number of ways to allow equal quantities of light to enter while reducing heat loading in the summer that do not entail redesigning the roofing.

One option would be to replace the skylights with glass that does filter out higher energy wavelengths. More expensive glass would actually become darker when warmer (thermochromic) or when light intensity was higher (photochromic). However, since this would require replacement of the skylights, which have recently been replaced after hail damage, there are other, more favourable options for skylighting.

Additionally, louvers could easily be installed inside the building. Installing louvers above the skylighting would also be effective, though more difficult to install.

This would allow for full lighting from indirect sky radiation during the winter months when the sun is lower, but louvers could be tilted to block direct solar loading during summer.

## **Energy:**

### *GreenStar Evaluation:*

With the existing energy consumption of the Fenner School buildings, the facilities do not even reach GreenStar benchmarks. This was one of the most significant stumbling blocks for GreenStar rating, because without meeting energy benchmarks, no GreenStar certification can be provided.

### *Existing Temperature Characteristics of the Building:*

Throughout a two-week period of the last week in August and the first two weeks of September, temperatures were monitored on the roof, in roof cavities, and in second floor offices. While outdoor temperatures remained lower than 20 degrees Celsius on all days during the testing period and had lows of 0.6 C, roof temperatures on the exposed northern side of the roof reached more than 50 C (Appendix I).

Roof temperatures had enormous ranges during the period, with highs that are far above the ambient temperatures, and lows that dipped below zero. This indicates that there is significant radiative, evaporative, or wind-induced heat loss throughout the nighttime. While this does indicate significant heat loss through nighttime roofspaces, it can be interpreted as a good sign for passive cooling, as buildings could be cooled at night through radiation.

Temperatures were also monitored within roofspaces, where temperatures exceeded 27 degrees on warmest days in late August in the second floor roof cavity. Roof cavity temperatures dipped down to 15 degrees, but temperatures never were quite as low as ambient temperatures (or nighttime roof temperatures).

Indoor room temperatures ranged from 15 to 27 degrees C, with one room measured (2.20) exceeding 23 C for more than 27 percent of the two weeks measured. In that room temperatures never were lower than 18 C during that period. Common rooms had much wider temperature ranges than individual office spaces, possibly due to the fact that windows and doors are more frequently left open.

### *Insulating Hot Water Pipes:*

In the Geography building, heating is supplied hydronically. Wall-installed heaters are located in each room, with hot water pipes running about .5 m above floor level. These pipes are not well insulated, and are releasing equivalent quantities of heat to the radiators, yet the pipes release this heat even when the radiators themselves are turned off.

While some of the building occupants expressed that this was a positive feature, as they never actually need to turn on the radiators, this is actually wasting enormous quantities of heat. In rooms where no heat is needed, even when the radiators are turned off, the rooms overheat due to heat loss from the pipes. Occupants of these rooms have said that they have their windows partly open for the entire winter.

On August 23, when outdoor temperatures were at a maximum of 13 C, not a single office visited (more than half of the office space on the second floor) had their radiators on. Rooms visited had temperatures that were at or above comfortable heating.

Water was continuing to flow through the pipes at 80 C. For this reason, since no radiators were on, even the “cool” return pipes were quite warm, near 80 C.

The exposed surface area from the pipes is between 12 and 45 percent of the exposed surface area of the radiator (depending on the room area). Even when radiators are off, significant quantities of heat are entering the room through the pipe radiation. The heat entering the rooms from pipes was found to be approximately one quarter of the total gas usage of the Geography and Forestry buildings. While much of this energy demand will continue to be used to heat these rooms through the radiator itself, it is estimated that at least one quarter of the rooms currently heated by the pipes do not need this heating.

For this reason, insulating the pipes on the second floor of the Geography building is a very wise choice for the building. The total cost of the insulation and installation would be \$ 18,228. Using basic thermodynamic principles of heat loss through the piping, pipe insulation alone is projected to reduce energy use by 41.5 GJ per month in the building, saving more than 190 GJ over the course of the winter (projected back to partial usage in April, May, September and October). This would reduce annual gas consumption by 12 percent, and save more than \$ 2,400 each year. With such annual savings, this project has a ROI of roughly 7.59 years.

These estimations came from very conservative analysis of heat load from pipes. In particular, the estimations include the assumption that building occupants would all turn on their radiators with 75 percent of the heat production of the piping. Judging from the measured heat within the rooms and the number of staff that keep their windows open all day throughout August and September, this estimate is a very high estimate of future heating demand. If heating demand is lower, as expected, the savings from pipe insulation will be even greater.

#### *Insulating Roof Cavities:*

During the monitoring period of the last week in August and the first two weeks of September, temperatures on the exposed northern side of the roof reached more than 50. Roof temperatures, as mentioned above, also fell to sub-zero temperatures, even as ambient lows never were below 0.6 degrees C (Appendix I).

Roof cavity temperatures, especially those on the second floor, reached temperatures above 27 degrees C, well above ambient temperatures both outdoors and within the hallway spaces. On mid-summer days, building manager Piers Barstow, reported that temperatures in the roof cavity reached up to 70 degrees C, even on summer days no warmer than 25. Using these values to make thermodynamic calculations, engineering student Neal Harris documented the savings of insulating the roof cavity.

His calculations for installing an R4 rated insulation estimate that need for air conditioning would drop significantly in the summer months. He conservatively estimated that reductions would be approximately \$2,300 per year in summer month savings. Savings in winter heating would also be significant, and combined with insulating the pipework, heating demand load could drop another \$500 to \$1,000 per year. Even taking the \$2,300 as a very low-bound estimate of the savings of insulation, return on investment would be 4.34 years, with installation cost of \$10,000 as the project was priced.

#### *Geography Building Passive Ventilation:*

The structure of the Geography building's main entry staircases on both ends of the main hall and the slightly lower height in corridor spaces in comparison to office spaces mean that installing ducts and low powered fans within the corridor ducts could create excellent passive cooling with very little loss of office-space privacy. If users were appropriately educated to open their windows, especially at night, to allow air to flush through the offices into corridor ducts and then exhausted in the stairwell "chimneys", the building could have significant nighttime cooling.

Because of the exposed cement and brick within the Geography building, there is large amounts of thermal mass that could store this coolness throughout the day, decreasing loads on the cooling systems. Such systems could be improved by further exposing brick on the inside of the building, and placing insulation on the outside face of the building.

#### *Geography Building Shading Adjustment:*

The second floor of the Geography building suffers from extreme heat loads, not only because of the lack of insulation in the roof above the second floor offices, but also because of radiating and reflecting heat load from the clip-lock roof that the northwestern-facing offices overlook. These offices in the western wing of the building were originally designed to be greenhouses, and maintain much of the thermal characteristics of such spaces.

There are many ways to improve this extreme summertime heat load. One idea would be to install a green roof (vegetation layer on top of the clip-lock roof) on the building's flat roof area. Through plant shading and heat absorption, roof surface temperatures would be decreased significantly, thus decreasing the heat load on first floor buildings. Because plants would be less reflective than simply painting the roof white, there would be decreased glare, reflectivity and radiation into the second floor buildings as well. Future research on green roofs here at ANU should provide more information regarding the benefits of green roofs, which have been documented to have significant thermal, ecological, and aesthetic impacts.

Since the existing overhang on the second floor offices tends to trap heat right outside of the second floor windows, one possibility would be to remove the heavy overhang and replace it with meshed louvered shading that would prevent solar loading, but allow heat to leave the area directly outside of the window. This would also allow for additional vertical shading without making the rooms feel too enclosed. Putting vertical shading with the additional overhang is still recommended, but could reduce the aesthetics and sightlines from the office spaces.

#### *DEMS Passive Ventilation:*

The DEMS building has been designed effectively such that a few simple changes to the structure could make significant improvements in summer cooling. The building has a large open courtyard, with windows facing the courtyard on all sides that are operable. Additionally, nearly all of the office spaces have louvers directly above the doors, which could be maintained open throughout the summer. Since all buildings have windows that can be manually opened, building occupants could be instructed to open their windows throughout the day and to leave the above-door louvers open.

Since the ceilings in the foyer are quite high, there would be enough stratification of warm air drawn out through the courtyard if ducts were installed through the roof

cavity above the foyer. Louvers on the ducts could remain closed throughout the winter and open during the summer in order to allow air flow.

It would be important, in order to draw air from the offices on the easterly side of the building, that the louvers above the doors that connect the stairwell area to the main second floor lobby remain open. This should not be a problem. Because of the open stair well, and the automatic door on the first floor, air flow through main areas should be significant enough to keep such regions cool.

In each of these scenarios, if the building is to rely on passive cooling, it will be critical to install flyscreens in all windows. Current occupants are reluctant to open any windows because of flies, mosquitoes, and wasps that enter the building at present when windows are opened.

It is also recommended that the edges of all windows be reinsulated. Significant gaps exist between wall and windows in many spaces of the building. This not only allows for heat to escape during winter, but also allows further entrance of bugs. This has been shown to be a significant problem in the DEMS building, which should be considered when renovating DEMS facilities.

## **Lighting:**

### *Existing Lighting:*

In almost all of the lighting fixtures, the buildings investigated are running T8 fluorescent bulbs. These lamps are 26 mm diameter and are fairly energy intensive compared to newer 16 mm (T5) lamp options. The majority of the lamps are 1200 mm long, drawing 36 W directly. In the DEMS building, there are also 600 mm T5 lamps, which draw 18 W.

Another significant factor in lighting electricity demand is the ballasts used in the lighting fixtures. The ballasts used in all of these fixtures are low frequency ballasts, which draw an additional 6 to 10 W. These low frequency ballasts are responsible for the flickering that is often seen in fluorescent office lighting. The Green Star rating system considers low frequency ballasts to have a negative impact on the indoor environmental quality. At the time of the energy audit, there were no electronic high frequency ballasts seen in the buildings.

Based on Australian Standard 1680, lighting levels in most of the buildings are far above recommended levels. Taking the Hancock building as one example, only the corners of the hallways farthest from lighting and windows were at 40 lux, while directly under the light sources at waist height, light exceeded 500 lux. In many of the office areas (5.15, 5.06, 5.10, and 5.12, for example), lighting was excessive. Light levels reached 1500 lux near window spaces in 5.06 and exceeded 700 in the other buildings mentioned, as measured on actual work spaces. This is far above the recommended 320 for task lighting of typing, reading or writing, based on Australian Standard 1682. Background levels were also high in all offices, with backgrounds measured in more than half of the offices to be above 300, while standards call of 160 lux.

In the DEMS building, lighting levels were particularly excessive in common spaces. In the entry foyer, minimum light levels were 400 lux, while AS 1680 requires them to be 160 lux. Hallways in DEMS did have areas that were 45 lux, but the majority were in the 300s. Library and computer spaces had better levels of light, between 200 and 500 lux, but the light quality within the building makes it feel poorly lit. The fixtures are quite old, and yellowing, producing light that is much less enjoyable to be in. If DEMS is

to be renovated into new office spaces, new lighting systems would be strongly recommended. This would not only improve the efficiency (by replacing with electronic ballasts and lower wattage fixtures), but also improve quality of work within the facility.

#### *Potential Improvements to Lighting Systems:*

If the entire lighting fixtures are to be replaced within these facilities, it would be worth using a double T5 fixture. If existing fixtures are to be retrofitted, it would be beneficial to retrofit using a single T8 fixture with reflectors. Essentially, replacing a double T8 fixture with a double T5 will reduce energy consumption by 57 percent, and increase the light output by 30 percent. This could allow for fewer total fixtures, especially in rooms that already have excessive lighting. Replacing a double T8 fixture with a single T8 and installing a KW2 reflective coating the back of the fixture, will halve energy consumption while ideally producing no change in light output. This may be more appropriate for rooms that already have good light levels within a space.

In calculating the cost and benefits of complete lighting replacements, conducting such retrofits have ROIs of greater than 15 to 20 years at current electricity prices. However, in the office spaces that are to be retrofitted for usage reasons, it is strongly recommended that lighting changes incorporate the highest quality of efficient lighting design, either through T5 bulbs or retrofitting for T8 with reflectors. A full lighting analysis should be undertaken in rooms that will be retrofitted in order to see how to incorporate daylighting, occupancy sensors, and efficient bulbs.

In retrofitting and converting laboratories into office spaces, the use of task lighting should be considered. In large offices, especially for graduate or honors students, a large portion of the space may be lit even when there are no staff or students present. The use of task lighting, or divided bays within a space, allows for more control of lighting based on usage.

Another factor associated with lighting design is actually the colour and design of table surfaces. Glossy and light coloured surfaces can increase glare and reflection, and make it more difficult to read or work with white papers. While this may not warrant a retrofit of its own, if furniture is being replaced, a darker matte surface may be worth considering for replacement.

#### *Daylighting*

Daylighting plays a considerable part in several separate Green Star points, and most of the Fenner School buildings do score fairly well with existing daylighting. Because of the inner courtyard in Geology, the majority of facilities in DEMS do receive some daylighting, though this could be improved greatly by expanding the window faces on the external portion of the building. Trees shade most of the faces of the DEMS building, which prevents direct sunlight from entering the rooms. Additionally, the deeply set windows ensure shading for most of the year. For this reason, increasing the size of windows on the outside of the building could greatly increase light, while not having enormous heat gains.

In rooms that receive a significant amount of daylight, including the Forestry building's larger lecture spaces, and rooms on the second floor of Geography, it may be feasible to install light meters that could monitor quantities of daylight and augment that with additional lighting only when necessary. In particular, separating out the wiring system such that lights nearest the windows would not turn on during the day, while

lights farther away would, could provide much more even light throughout the rooms. This is particularly significant in large office spaces. Presently, in the honors student rooms in Geography and in large offices in Geography and Forestry, all of the lights are controlled simultaneously. In the classrooms of the DEMS building, while there are separate switches, each controls rows of lights in both the front and the back of the room.

### **Transportation:**

While existing buildings and parking facilities make it difficult to greatly improve the transportation ratings as described by the Green Star system as most of these points are related to the building's proximity to public transportation and parking facilities, there are a few simple changes that could be made to encourage more sustainable transport to and from the Fenner School buildings.

#### *Public Transportation:*

Pedestrian routes to the buildings are decent from all directions. Changes in public transportation to the Fenner School are difficult to increase without larger changes to the university structure. There are pathways in and out of the building, and nighttime lighting means that the Forestry & Geography courtyard is fairly well-lit. Public transportation in and out of the main center of Canberra is available via Bus # 34 route that goes down Daley Road (passing in front of the DEMS building). Increased public transportation in and out of ANU and in Canberra at large could be an issue to be considered by ANUgreen and the ANU administration overall.

#### *Parking:*

The Green Star program rewards a point for creating parking facilities that reward carpooling and the efficient vehicles with preferred parking spaces. This point is given when ten percent of parking spaces are designed and labelled for small cars (2.3 m wide and 5.0 m long), mopeds or motorbikes and when ten percent of the parking spaces closest to facility entrance are reserved for carpools, hybrids or alternative fuel vehicles. Since parking is such a large issue on the ANU campus, giving individuals prime parking spaces because of their efficient vehicles or carpooling may be a large incentive.

The Green Building Council of Australia encourages the creation of a documented carpooling program in order to monitor the use of these reserved spaces. ANU already has a carpooling program in which registered carpool groups do have registration and permits that could be used for monitoring the use of carpool parking spaces.

Many companies have found success in encouraging the use of hybrids by offering corporate support or subsidies of hybrid car purchases. This is difficult to encourage within Australia, owing to the fringe benefits tax, which discourages employers from financing purchases such as more efficient cars or bicycles. It may be legal and possible for the Fenner School to pay rebates to employees for purchasing bus passes, efficient vehicles, or bicycles.

The Timely Treadly system created and supported by ANUgreen does supply each department with a bike that can be borrowed just as a departmental car is. This model might be effective for the Fenner School to consider expanding in order to encourage alternative transportation, especially within campus.

### *Bicycling*

Four points are awarded for having secure bicycle storage within 100 m of the buildings front entrance. Two of these points are provided if there is enough storage for 7.5 percent of maximum student occupancy at any given time. Two other points are awarded if there is secure bicycle storage for ten percent of building staff, as well as showers, changing facilities, and lockers provided for staff (one locker per bicycle space and one shower for every ten bicycle spaces).

These points and their relative merits could be achieved by installing showers within the Fenner School facilities. Currently, none of the buildings in the Fenner School contain showers. The DEMS building does have shower facilities, currently located within the maintenance room on the first floor. These facilities could be expanded, as there is space for lockers on that floor. Forestry does already have locker space on the first floor, and there is potential space for a shower within the bathroom facilities.

Additionally, the darkroom space in the Forestry building is currently under consideration to be converted into either a server space or a new bathroom facility. Instead of creating a simple bathroom, creating a changing room, locker and shower facility may be an excellent use of the space.

### **Water Usage:**

#### *Existing Point Evaluation:*

Based on GreenStar's water calculators, the Fenner School buildings receive zero points of the 16 possible points from the water category. This is partly because only the Forestry building has dual-flush toilets, and all other buildings are running older, single flush, 12 liters per flush units. Only Forestry has waterless urinals, which would make a significant difference for other buildings.

GreenStar also gives points for sub-metering regarding all major water usages, yet no Fenner School buildings feature sub-metering (and Forestry & Geography do not even have individual building metering). Points are also rewarded for landscape irrigation efficiency, including collecting rainwater or greywater for landscape irrigation. The other water points are rewarded for reuse of water used in fire protection testing

#### *Potential Projects*

Two major water efficiency projects could make a significant decrease in Fenner School water consumption as well as building operation cost. In the DEMS building, there is a Millipore Elix system running with a potential of 100 L per day, filtering water through a reverse osmosis system. These Millipore systems have an 18 percent water recovery, meaning that each day, when 100 L of distilled water are used, 456 L are wasted directly.

This water that is wasted cannot be considered "potable" as it has an increased concentration of ions, but it is very usable as greywater for toilet flushing. This would decrease the use of potable water in toilet flushing, while also decreasing the quantity of water entering the sewage system directly. This would be very simply achieved by connecting the Millipore wastewater tubing into the storage tanks for toilet flushing.

Reducing water use and wastage by 456 L per day (assuming 5 days a week for 45 weeks a year) would save 109.4 kL and \$351.30 per year at current water rates. The cost of purchasing and installing an overflow tank would be, at maximum estimate \$1000, with a 2.85 year return on investment. If simply connecting the system to the

existing head tank for the toilets, costs would be even lower. Estimates of water usage for toilets is significantly larger than water wastage from water filtration (102.6 kL for millipore waste annually and 543.2 kL for toilet usage), so all wastewater from RO systems would be all used for toilet flushing so as to meet legal requirements that tradewater cannot sit in tanks for more than 48 hours.

Switching toilet systems to dual-flush systems is crucial for these buildings. The majority of existing toilets in these facilities (Geography, Geology, and Hancock) are 12 L flush toilets. When replaced with dual flush 3/6 L, it can be estimated to have an average 3.6 L per flush (4 flushes of 3 L per 1 flush of 6 L).

In the DEMS building, for example, with 82 staff using single-flush 12 L toilets, current quarterly water usage for toilets is 136 kL, or 26 percent of total water demand (about average for toilet usage). By replacing all four toilets within the DEMS building with dual flush 3/6 units, water usage could drop by 41 kL per quarter, saving 163 kL over the year, or \$2092. While replacing the toilets would cost at least \$1000 per toilet, the total replacement of all 4 would still have a rapid return on investment of less than 5 years.

Waterless urinals in the DEMS building would also be a significant improvement, though the best practice technology in waterless urinals needs to be re-examined for ease of maintenance and appropriate use.

In addition to water efficiency projects, Green Star awards points for decreased use of potable water for irrigating landscaping surrounding the building. This could include creating a garden with no applied water, which could include native species, or by using rainwater or greywater to irrigate the building's landscaping. Either of these are more likely to be appropriate in the Fenner School than the third option of utilizing soil moisture sensor control or subsoil drip systems for irrigation. As a part of the campus biodiversity management plan, encouraging the use of native species and rain-resistant plants would be particularly valuable.

#### *Water Metering*

As with energy systems in the Fenner School, increased metering of water systems could have significant impact on the efficiency of the building. Currently, the water usage systems of Forestry & Geography buildings are linked. The Hancock building, both library and office spaces, are measured with the same meter system as well. GreenStar will only give its metering point if the system meters all major water uses. In these buildings, this would mean water usage in bathrooms and the water used by major laboratory equipment (particularly in the DEMS building current laboratories). GreenStar also requires monitoring leakage in order to receive the GreenStar points.

#### *Water-Efficient Landscaping*

In addition to water efficiency projects, Green Star awards points for decreased use of potable water for irrigating landscaping surrounding the building. This could include creating a garden with no applied water or by using rainwater and greywater to irrigate the building's landscaping. Either of these is more likely to be appropriate in the Fenner School than the third option of utilizing soil moisture sensor control or subsoil drip systems for irrigation.

Much of the landscaping related to the building (in the courtyard) is already un-irrigated. However, capturing rain and greywater would be one of the most effective ways to reduce potable water irrigation.

## **Materials:**

### *Existing Building Analysis*

It was very difficult to analyse potential Green Star points for materials in the Fenner School buildings, because most refer to construction materials and furnishings, about which there is not much information. However, were it to be evaluated, the existing building stock would not be eligible for any of the Materials points with the exception of having a recycling facility within the buildings.

However, in renovating parts or all of the Fenner School buildings, the GreenStar qualifications for materials will be very important to keep in mind. In particular, GreenStar encourages first the reuse of existing materials and building structure. New items that need to be sourced should be done with as high recycled material content as possible. When recycled content is not available, new content should be easy to disassemble for recycling, should be as durable as possible (more points are given to higher durability), from renewable sources when possible, FSC-certified timber, and low VOC.

### *Reusing Existing Office Materials:*

The Australian Ethical Investments building in Bruce is a wonderful example of reusing existing office materials while making a sustainable building renovation that feels new. They were able to reuse much of the joinery from within the existing facility, while combining it in new ways to better use the space and the lighting possibilities. Carpeting from parts of the building were cleaned and repainted in order to create cohesive interior design. Additionally, much of the furniture deemed to be waste was able to be used by simply reupholstering it with sustainable fabrics.

In particular, reuse of items such as power point covers, computer tables, doors, exit signs, and even shelving units, is often overlooked in office renovations, and can create unnecessary waste. By auditing all of the materials that are available in the building and that are considered waste, it may be possible to refurnish some of the new office spaces without new purchases.

Additionally, it is recommended to take a full audit of all electronic materials to see if power cords, mouse equipment, and keyboards can easily be reused. Throughout the Fenner School buildings, there are many pieces of old computers that are still functional though no longer used, and these should be considered for use in new office spaces before new purchases are made. Even outside of the Fenner School, hundreds of completely usable equipment is recycled, while it could be used within the ANU. If “new” computers are required, to see what pieces of hard drives or monitors could be refitted and combined to make faster, more powerful computers as necessary.

### *Recycled Content:*

In renovations to the building, environmental impact of all materials, especially those used in interior furnishings should be considered. One very easy way to ensure that materials do meet GreenStar goals for recycled content, environmental management of production, durability and embodied energy, is to work with an organization such as

EcoSpecifier. EcoSpecifier (<http://www.ecospecifier.org>) actually evaluates companies and products for the ways in which they meet GreenStar criteria.

For example, when looking for potential companies to provide interior furnishings, EcoSpecifier has assessed both companies and specific products (down to the level of a given office chair) for six assessment criteria: reduces energy consumption, protects habitat, preserves resources, protects human health, reduces pollution, and “other vital signs”. Subscribers to EcoSpecifier are able to obtain more in-depth information about the environmental impact of each product.

Additionally, it is important in the GreenStar rating system that the building be designed for disassembly. This includes not only the interior furnishings but also any major renovations including roofing materials and wall units.

#### *Recycling & Electronic Waste:*

One point is awarded for providing a recycling storage area, which has already been provided by the ANUgreen offices. In the initial touring of the Fenner School buildings, one major source of waste that had not been addressed was electronic waste. In the computer laboratory in the DEMS building (48), there were seven computer monitors and at least four keyboards that were not in use. In storage facilities throughout the building, other keyboards were found unused without expectations of use. Even in some of the student offices, abandoned computers were left in office spaces. This indicates that greater education regarding the potential of ANUgreen to assist in electronics recycling could be incredibly valuable.

Much of the current quantity of electronic waste in the Fenner School buildings is related to the hailstorm of last year, in which much equipment suffered from water damage. Each department is currently working to address the insurance coverage for these machines and potential usability of any of the machines.

#### **Land Use & Ecology:**

The major components of the Green Star ecological analysis revolve around changes in the surrounding area before and after construction. For this reason, the evaluation tool is not applicable, but the goal is to minimize the environmental impact of the site, particularly in comparison to surrounding areas. Since any renovations to the existing buildings will not be changing land use, this category is not particularly relevant to this study.

As mentioned earlier with regard to heating and cooling, there is a potential benefit from the installation of a green roof in the geography building. This roof could also have the potential to support native Australian plants and provide additionally landscaped area for birds. Using native landscaping to reduce water consumption, could also greatly improve the ecological benefits of the building.

#### **Emissions:**

The Fenner School buildings meet many of the emissions guidelines by not having evaporative cooling systems (thus eliminating the chance of Legionella) and by not having light displays at night (which would cause light pollution).

In order to address the guidelines included in the emissions category, considerations of stormwater runoff treatment and greywater or blackwater systems should be included in future building plans.

**Conclusion:**

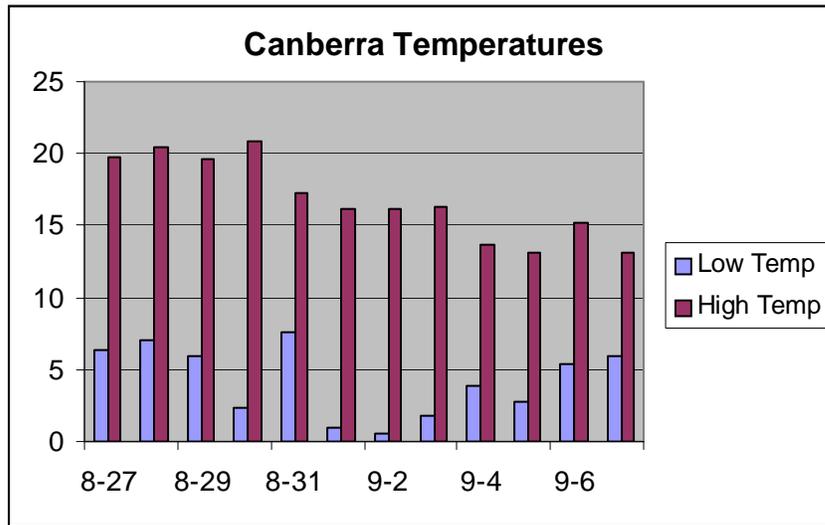
There are many possibilities of ways to improve the Fenner School buildings, not only to reduce their environmental impact, but improve the comfort of the building occupants. Particularly as the Fenner School expands and changes the usage of many building spaces, it is an ideal opportunity to explore renovations to lighting, heating, cooling, and water usage systems.

Regardless of future usage of these spaces, a few recommendations have come forth as having rapid return on investments with low risk. In particular, insulating roof cavities in Geography building, insulating the hydronic pipe work in Geography, replacing all toilets with dual-flush systems, and capturing the waste water from the reverse osmosis systems in DEMS building.

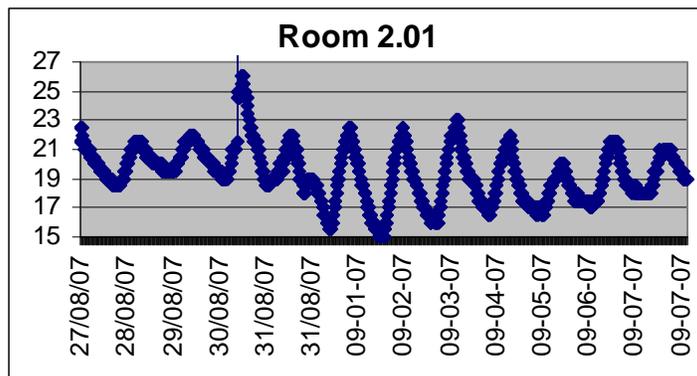
In all retrofits and new construction, considerations of daylighting, task lighting, heating loads, and usage of recycled or reused materials should factor into all decision making. Especially when converting laboratories into office spaces, the use of multiple lighting systems within a room may allow users to better control which areas are lit when actually being used.

The buildings have a lot of potential for improvement, and the scale of improvement will increase with the commitment of the school to look beyond simple returns on investment and explore the possibilities to improve comfort and to use building improvements as an educational tool.

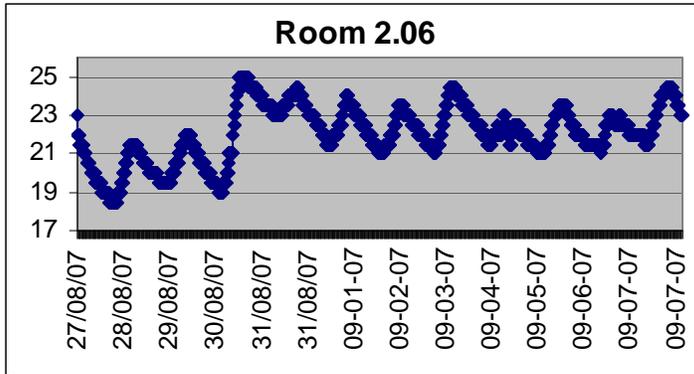
## Appendix I: Temperature Monitoring



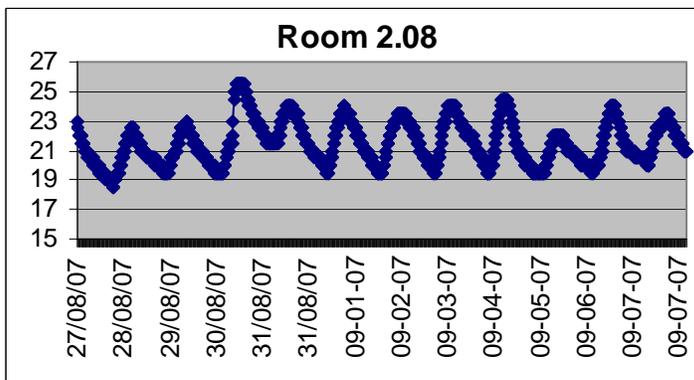
Maximum temperatures were significantly higher (4 degrees C) in the last week of August compared to the September dates. Temperature lows were more sporadic, with an overall low on September 2 of 0.6 degrees.



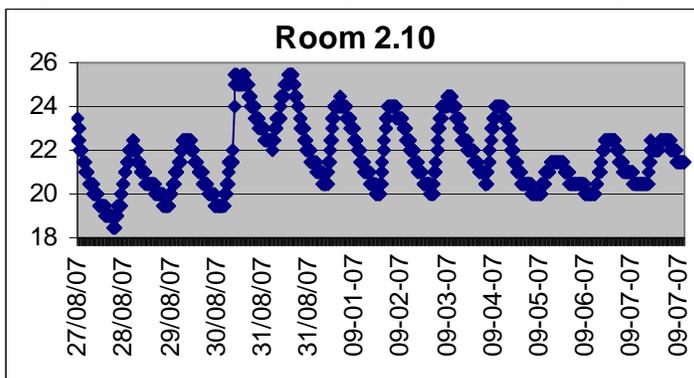
Room 2.01 is located in the Southwest corner of the building, and is the second-floor common space, or tea room. It gets very little direct sunlight, and rarely has the radiators on. Windows in the room are often left open, especially after a group meeting (during which time the room gets too hot). The massive temperature peak could be related to a meeting in the room, where more body heat related in a temperature peak. The drop in temperatures from September 1 on is likely to not only be related to the general cooling of outdoor temperatures, but potentially also related to a window being open, as room temperatures dip fairly low in the evening.



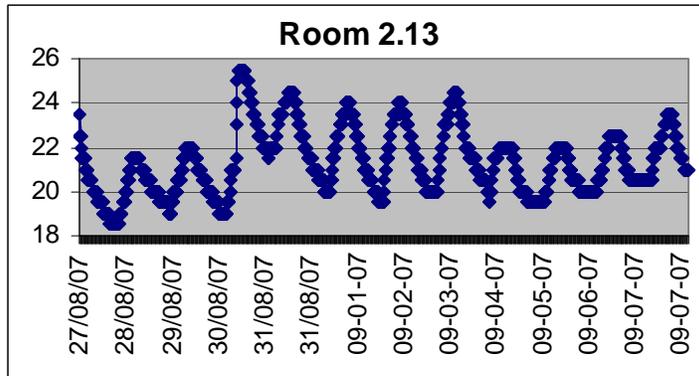
Room 2.06 is an office space located on the west facing wall. Professor David Dumaresq, office occupant, informed us that the room was always very warm, despite the fact that the radiators are never on throughout the winter. During the period of early September, room temperatures never dropped below 20, despite the fact that external temperatures were far lower during that week. Room temperatures reached higher than 25 degrees C. In fact, room temperatures were 23 degrees C or above for more than 8.5 percent of the measured time period.



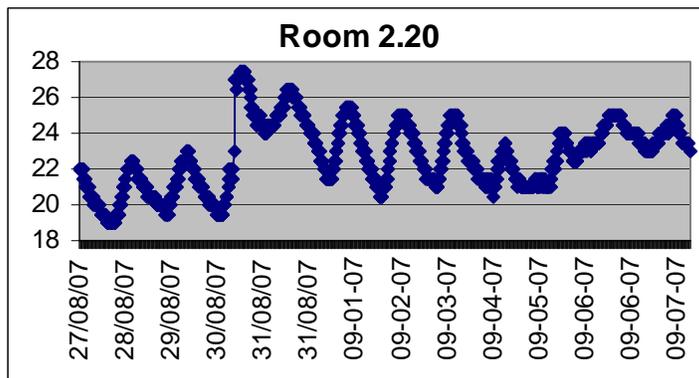
Room 2.08 is the honors student room at the end of the hallway, where temperatures reached 26 degrees C at one point during the week. In this room, temperatures reached or exceeded 23 degrees more than 6 percent of the measured period. Temperatures were within 1 degree of 20 for more than half of the period, though much of that temperature range was likely to be at night, with daytime temperatures well exceeding 20 degrees.



Room 2.10 is located in the center of the northern facing wing of the building. Temperatures were above 23 degrees for 10 percent of the measurement time, and never reached below 18 degrees, even at night.

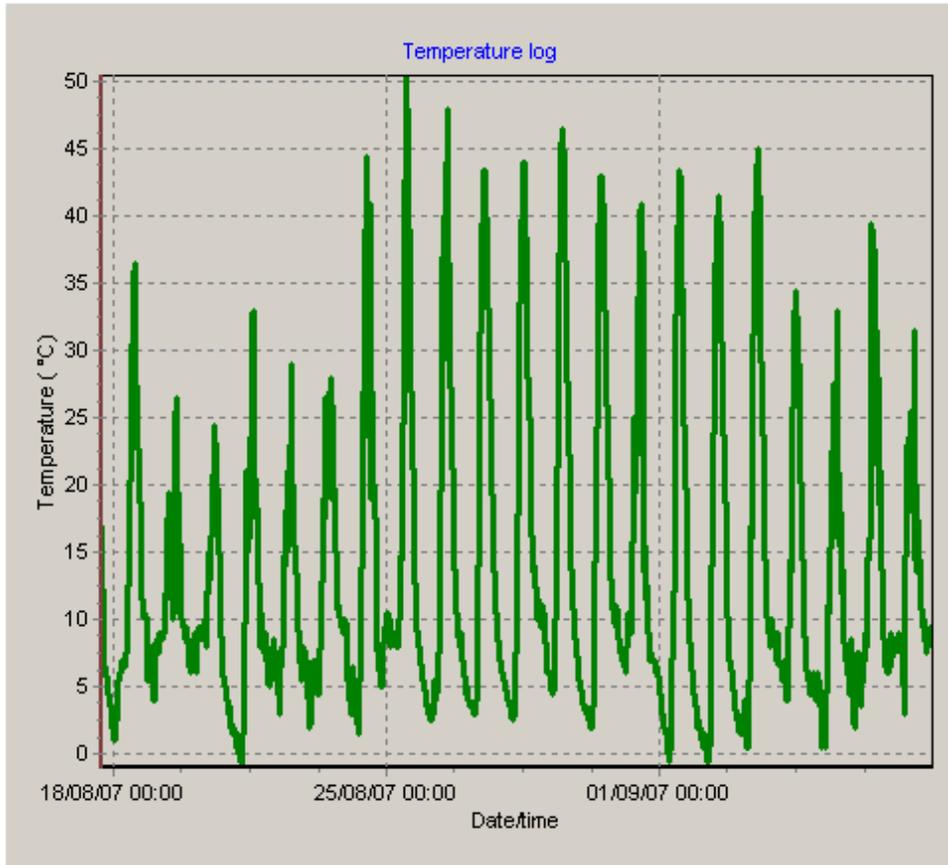


In room 2.13, located at the far end of the western wing, temperatures only exceeded 23 for 5.6 percent of the time. Temperatures never went below 18 degrees, but it was consistently cooler than Room 2.10, despite the fact that it has greater solar loading. One explanation is that Room 2.13 is fairly large, and often is empty. In all visits to the room, perhaps one of three occupants is actually present. For this reason, human heat loading and computer usage may be lower (per square meter or cubic meter) than other rooms.

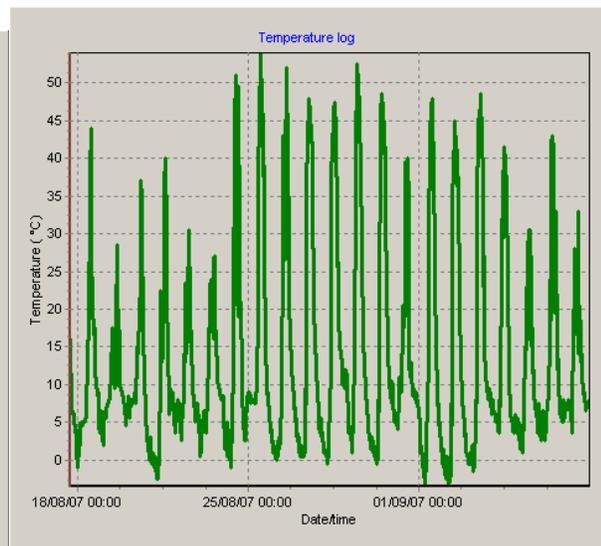
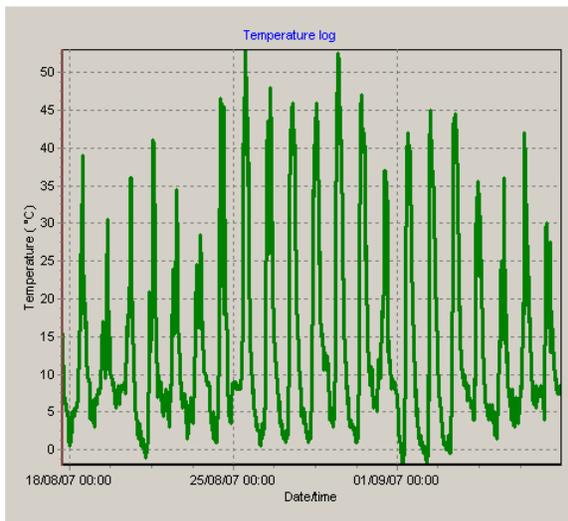


Room 2.20 was, surprisingly, one of the hottest rooms on the floor. It is located on the southeastern side of the building, facing directly onto the edge of the roof. Temperatures reached or exceeded 23 degrees C for more than 27 percent of the measured time period. The fact that temperatures in this room exceeded 24 degrees over night on the 31<sup>st</sup> of August (when night time temperatures were at a low of 7) is excessively overheated. Additionally, the fact that the room was never below 18 degrees, even at night, indicates that heating is extreme both during the day and night.

*Roof Temperatures:*



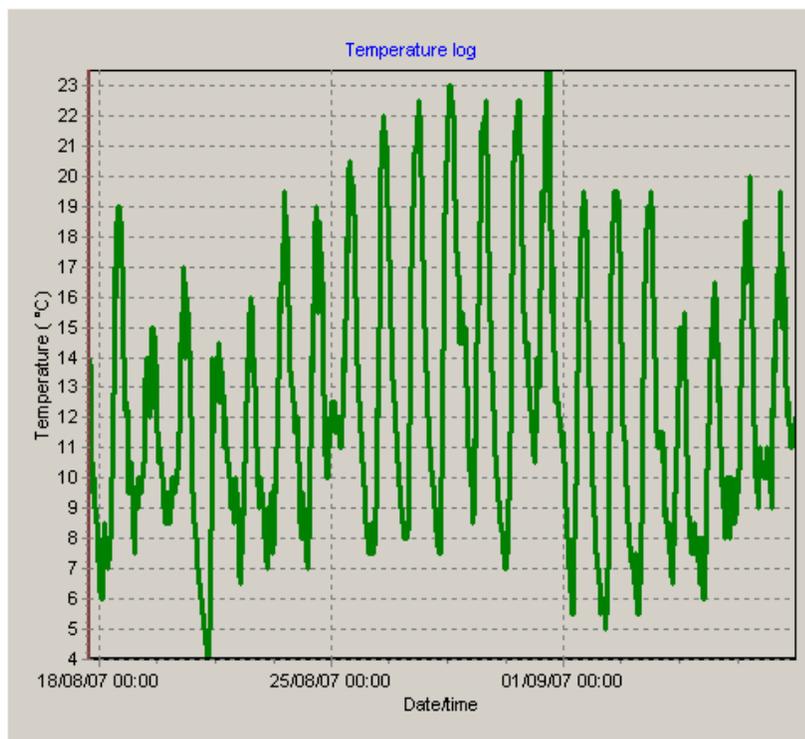
The graph above demonstrates the roof temperatures on the far western edge of the exposed roof. Average roof temperature was 13.4 degrees, which was roughly average air temperature. However, roof temperature peaks in this area were more than 50 degrees C. Temperatures did dip below zero degrees, in the middle of the night. As can be seen in this image, daytime temperatures reached their peak more rapidly, and cooled down more slowly.



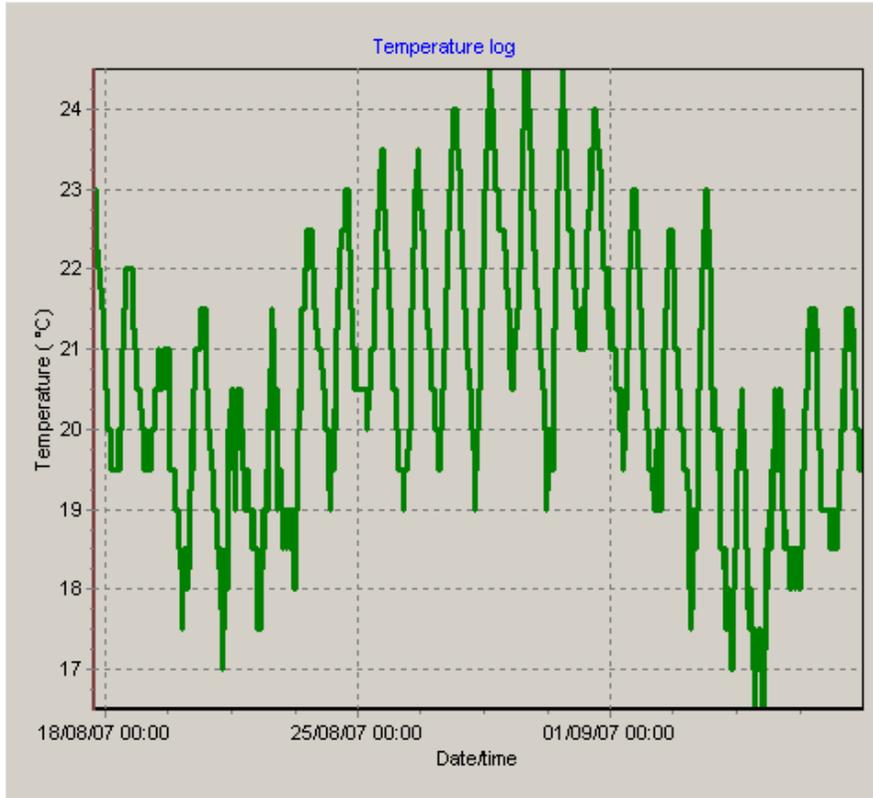
These two graphs document the roof temperature on the northern face of the Western arm of the building. The thermocrons were located approximately 3 meters apart on the same portion of the building.

Temperatures exceeded 50 degrees on several occasions, and referring back to average ambient temperatures, the days on which temperatures of 50 degrees occurred on days that had peak temperatures no higher than 20. The dates on this graph run from 18 August to 7 September, so begin earlier than the room temperature graphs.

Interestingly, temperatures dip even below the ambient temperatures, which indicates that the roof is radiating significantly to the night sky. On the opposite side of the building (the southern face of the western leg of the building), which is in shade almost all day, temperatures do not exceed 23 degrees, and never fall below 4 degrees C. In general, this portion of the roof has much less significant temperature fluctuations throughout the day. This is not only because the roof does not receive direct solar loading, but also because it is shaded by the overhang of that wing, and thus does not radiate warmth to the entire open night sky, essentially only “seeing” the overhang.



## Roof Cavity Temperatures



This graphs the temperature in the roof cavity near the entrance to the first floor iCAM portion of the Geography building. Temperatures did reach above 24 degrees within this roof cavity and rarely fell below 18 degrees C.

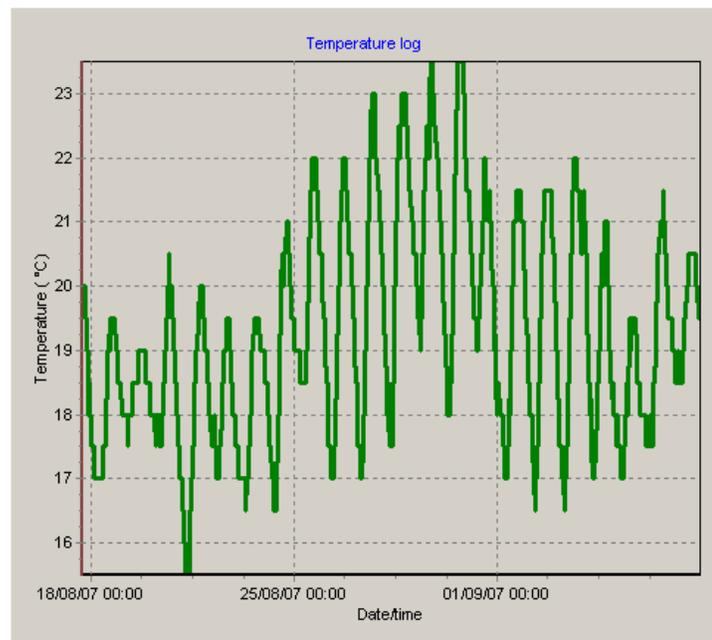
This portion of the roof cavity is located underneath the last of the roof temperature sensors. That portion of the building, as mentioned above, is shaded by the

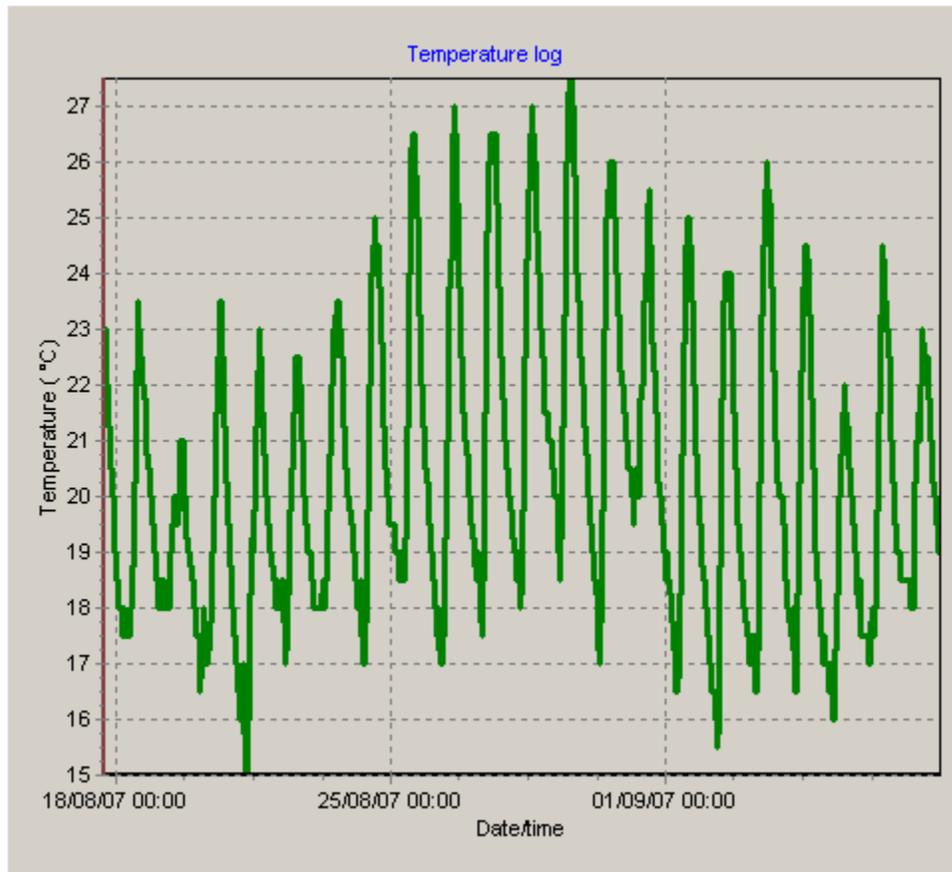
building's overhang and by its location on the southern side of the wing. For this reason, temperatures within the roof cavity did not have great fluctuation.

While it never reaches the low temperatures that the roof does, it follows very closely the high temperatures that the roof does. This is a very important idea to note, indicating that while the roof may lose more heat at night, the currently un-insulated roofspace (and thus the rooms beneath it) track the high temperatures of the roof.

The thermocron graphed to the right was located in the roof cavity in the lecture hall's foyer. It is in the far western point of the western leg of the building. The roof above this cavity (in the first roof temperature graph, labelled Western End of Roof) reached temperatures well into the mid-40s, and fell to temperatures slightly below zero.

While temperatures in the roof cavity did reach up to 24 and fell to almost 15 degrees, they did not have nearly the fluctuation of the roof.





This thermocron was located in the roof cavity on the second floor. Temperatures in the roofspace on days that never exceeded 20 were peaking at 27 to 28 degrees C. As in previous graphs, low temperatures never reached as low as ambient temperatures, even though the roof was dipping below ambient temperature.

This characteristic is partly due to the thermal mass of the building, and is a good indication that passive heating and cooling of the building could be used effectively.