

# Macalester College Water Assessment

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Ariel Trahan  
Breanne Goodell  
Janet Aubin  
Justin Enwall  
Zach Marchetti

## **Introduction:**

For those who are fortunate enough to have clean water come out of the tap, water is often an under-appreciated resource. However, this is not the case for most people in the world, and the situation is only worsening. Although most of the Earth's surface is covered with water, it is a fragile and finite resource. Freshwater only makes up about 2.5 percent of the total water on the planet (Raven & Berg. 2003. p. 305). Most of this water is not safe for human consumption. Unsafe water increases health risks dramatically. The World Health Organization estimates that contaminated water or deficient water supplies account for 80% of human illness (Raven & Berg. 2003. p. 294). Water shortage is often considered a problem that only populations in less developed countries are faced with. This is far from accurate. In the United States about one-third of towns and cities have contaminated water supplies (Knox & Marston. 2004, p. 429).

Projected problems from the decline and degradation of fresh water resources are severe. As the world population continues to rise and the amount of agricultural land enlarges, water resources will be under even greater strain. Increased development near freshwater sources amplifies the risk of contamination. Domestic and international conflicts are widely expected to result from tensions on the supply of freshwater (MEA URL).

Living in the land of ten thousand lakes, along the Mississippi River, part of the third longest river-system in the world, there seems to be an unlimited supply of fresh water. It is difficult for many to see the importance of water conservation. While in this region we might not be under pressure currently, water shortage is a global problem. Extraneous water consumption also creates an unnecessary financial drain. In an attempt to raise awareness on the Macalester College campus for the significance of an individual effort, signs have been hung in the bathrooms of the residence halls. They read: "If every Macalester student reduced their shower time by just one minute, the college would save over 1.3 million gallons of water per year and over \$19,000 per year. That is a day's worth of drinking water for 325,000 people. Please, think about your water use."

## **Methodology:**

In order to conduct a thorough investigation into water use on campus, we considered it necessary to look at the issue on several levels. First, we began our study by looking into the source of water from which Macalester's supply is obtained. We collected research on the company that distributes and processes water in the St. Paul area, including information on the precise source, the process, cost, and disposal.

Statistics of this nature were obtained online, mostly through the records and consumer information issued by the St. Paul water company. Second, we looked into Macalester's specific water use statistics, breaking the numbers down into academic buildings, food service, and dormitories. With the intention of focusing on student water use, we further broke the numbers down into individual dorms. Physical Plant was the source for our information on campus water use.

Due to the fact that water use in academic buildings is minimal and mostly necessary, and since Café Mac has limited possibilities for decreasing water use, we decided to focus on student water use as the main sector in which water consumption could be reduced. With that intention, our third step was to conduct an informal survey in four dorms in order to get statistics on water use at an individual level. Furthermore, in an effort to reduce this individual water consumption, we designed a poster to be hung in dormitory bathrooms around campus, encouraging water conservation.

In addition to this paper, the information that we gathered from this study will be presented to the student body on the 12<sup>th</sup> of December 2003 in the Campus Center. By sharing the information with our peers, we hope to raise awareness for the importance of water conservation on campus.

## **Results:**

### Where Our Water Comes From:

The water here at Macalester, and everywhere in the Twin Cities metropolitan area, goes through a complicated process before it comes out of the faucet. The original source for seventy-five to eighty percent of the water in Saint Paul is, not surprisingly, the Mississippi River. The city of Saint Paul and its surrounding suburbs are very lucky to be located in an area where there is no shortage of water. The water that is not obtained from the Mississippi River comes from a series of wells in the Vadnais Lake area. When there is a shortage of water there is a chain of lakes located north of the Centreville Pumping Station that can be used to supplement the main supply (SPRWS URL).

Saint Paul Regional Water Services (SPRWS) is the company responsible for the management and distribution of all the water in Saint Paul. Although the state government technically controls the company, it is a private establishment and does not receive subsidies from the government. SPRWS makes its profit from the sale of water to homeowners, businesses and other organizations (SPRWS URL).

As previously stated, the water here at Macalester is not straight from the Mississippi River. After the water is removed from the river it goes through many cleansing and purifying stages at Saint Paul Regional Water Services before coming out of the faucets here at Macalester. The first phase that the water goes through takes place in the supply lakes. The raw water that enters these lakes is treated through aeration and the addition of ferric chloride as an initial step. This is done to reduce the algal growth in the water. After this step the water is moved into two mixers where various chemicals are added to treat for different characteristics. For example, lime is added for softening purposes while potassium permanganate is added to oxidize the taste and odor compounds. The addition of these chemicals changes the hardness in the water to something called *floc* which absorbs bacteria and then settles out of the water (SPRWS URL).

The next step in the water treatment process is the passage of the water through flocculators. Flocculators are large basins that keep the water circulating and make sure that there is enough time for the chemical reactions to occur. More ferric chloride is added at this stage along with powdered activated carbon that serves as a taste and odor control as well as a pesticide absorbent. The water then is transferred into clarifiers where the floc is allowed to settle out and is then removed and used as fertilizer. The water still has a way to go before it is safe for drinking and hygienic uses. It still needs to go through the recarbonation chamber. This is where carbon dioxide is added to reduce the pH of the water which may have been raised during the softening process. The next thing that happens is that fluoride and chlorine are added to the water. Fluoride is added for dental health, while chlorine is added as a disinfectant (SPRWS URL).

Yet another chemical is added after the water has been moved into the secondary settling basin. Ammonia is added which combines with chlorine to form chloramine, which kills the remaining bacteria. Finally, after the many chemical treatments, the water is ready for filtration. Half of the filters at the facility have layers of sand and gravel to filter the water; the other half are made up of anthracite coal and sand. After the water has been filtered it is piped out into the complex distribution system that makes up the Saint Paul Regional Water Services. There are a total of 1,099 miles of water main that serve 92,185 metered accounts in the Saint Paul system. In total, there are over 400,000 people served by SPRWS. The service area is divided into two parts: the downtown area and the more suburban areas. Each of these 2 service areas possesses a storage reservoir with a capacity to store 136.2 million gallons of water. The water company charges rates for water based on individual water meters that all accounts have. The meters are on an electronic system. A meter reader checks the meter once a month and enters the data into the computer. The company then bills the customer based on the amount of water consumed that month (SPRWS URL).

#### Distribution of Water Use Around Campus:

The consumption of water in the buildings on the Macalester campus is shown in the Table 1. The data came from the Macalester College Physical Plant (Dickinson, 2003). According to the data, the highest consumer of water on Macalester's campus is the residence halls. Following the residence halls for water consumption was the administration/student services buildings, then the academic buildings, and finally the athletic facilities (Graph. 1). In the residence halls, the highest amount of water consumed per person was the Spanish house at 11,719 gallons. The French house at 7208 gallons per person consumed the least for all the residence halls (Graph. 2). For the academic buildings, the Janet Wallace Fine Arts Center used the most at 3,609,100 gallons while Old Main used only 172,040 gallons (Graph. 3). The data indicated that the campus center used the most gallons of water for the administrative/student service buildings at 4,151,400 gallons while Winton Health Services and the International Center used the least amount, 29,920 (Graph. 4). The entire campus consumes a total of 28,103,108 gallons of water per year at a grand total of \$51,472.27 (Table 1).

#### Survey Results:

We conducted a survey of students living on the residence halls of Wallace basement, Turck 3, Doty 4, Dupre 3, and Kirk 5 and 6 about their water usage in the

dorms. We asked a total of 72 students the following questions: how many times a week do you shower? How long are your showers? Do you shave in or out of the shower, and do you leave the water running while shaving? Do you leave the water running while brushing your teeth? And, how many times a week do you do laundry?

We did not ask how many loads students did every time they did washed their clothes, thus this question did not provide information about specific amounts of water used. The data from the questions regarding shaving was also hard to use because we only asked these as yes or no questions. However, peoples' answers varied a great deal. The responses to the teeth-brushing questions were incomplete as well. We would not be able to draw any sound conclusions from the abovementioned data, so we regarded it as not conducive to our study, and omitted it from the study.

The data from length and frequency of showers taken by students on campus is summarized in Graphs 5 and 6. We found that almost 50% (35 of 72) of students take showers between 0 and 10 minutes. About 40% (29 of 72) of students take showers that are 10-20 minutes. The remaining 11% (8 of 72) take showers longer than 20 minutes. (Table 5)

Our survey indicated that almost 45% of students take showers at least once a day, 40% take 4 to 6 showers per week, and about 15% of students take showers 1 to 3 times a week. (Table 6)

## **Discussion:**

### Distribution of Water Use Around Campus:

From the distribution data many observations can be made. The residence halls consumed the most water, but they also make up the majority of the buildings on the Macalester campus. Surprisingly, two of the top three consumers of water per person are houses on the campus, the Spanish House and the Macalester Cottages, while French House consumed the least per person (Table 1). While the Janet Wallace Fine Arts Center consumed the most water for the academic buildings, it also consists of four departments (Humanities/Technology, Art, Theatre, and Music), of which the Art department is a heavy user of water. In the administrative and student services buildings, the campus center uses many times the amount of water that the other buildings use. This is expected because the campus center contains the dining hall, and therefore most of the water use is for food preparation and cleaning. For the athletic facilities the water is not only used for the heating of the stadium but also for the athletic field and the practice fields.

There are, however, many errors in the data. The most noticeable is the lack of a separate category for lawn maintenance. The lawn sprinkler system and outdoor faucets are all connected to a building's water meters, so it is impossible to say for certain how much water is used per building or for person. Also, the final cost of the water is misleading. Besides charging Macalester \$1.37 per unit of water (748 gallons), the St. Paul Regional Water Resource charges a sewer cost of \$2.33 per unit of water for the removal of water from the campus. With the sewer charge combined with the total cost of the water, Macalester is charged \$139,012.70 dollars a year. The school does, however, receive credit for the water used on the athletic field due to the reasoning that the water used to water the grass does not enter the sewer system.

## Campus Outreach and Student Involvement

In targeting a specific sector of the Macalester community for water use, we decided to focus on students. Water used in the academic buildings is typically minimal, limited to basic restroom/classroom functions. Café Mac, moreover, makes a conscious effort to conserve water in whatever ways are possible. Dishwashers recycle what water they can, particularly the rinse-water that does not jeopardize sanitation concerns. Most water usage is simply a function of cooking and necessary washing; therefore, the amount of water used unnecessarily or wasted in Café Mac is minimal (Dickinson. 2003). Students, therefore, are left with the most responsibility for reducing water consumption.

After compiling the results from our survey questions, as mentioned in the results section, we determined that the data from questions regarding shower length and frequency would provide us with more concrete assessment of water usage in the dorms than the other questions. We also decided that shower length is the easiest element of water usage to try and ask people to change in order to effectively. We found that while almost fifty percent of students took short showers, almost forty five percent of students took showers 7 or more times a week. We also found that over ten percent students said they took showers over twenty minutes long. From the information collected in our survey, we can conclude that many students could easily reduce their water consumption, particularly in the area of shower time.

There was some inconsistency in the reporting of our reporting of the data that is necessary for us to address. As is the nature of broad surveys, not every student's answer fit within one of the categories offered. A few students for example, said that their shower use changed throughout the year depending on sports schedules, others said that they were in the shower for more than twenty minutes on average, but that they turned the water off while washing their hair or shaving. We asked these students to estimate total time using water on average throughout the year. These were minor discrepancies, and we do not think that they indicate any significant changes in our data.

It is evident that even though some students are being conscious of water use during their bathing, others are wasting a lot of water. We realize that we cannot ask students to stop taking showers, but we felt that we could bring this information to the student body.

In an effort to actually impact the issue we researched, we took up the task of designing a poster to inform and encourage students to consider reducing their water use. To do this, we first met with Mark Dickinson at Physical Plant in order to obtain his advice and approval. Having received it, we set out to design a poster. We focused on shower time as the main way in which students often use more water than necessary. The text of the poster follows: "If every Macalester student reduced their shower time by just one minute, the college would save over 1.3 million gallons of water per year and over \$19,000 per year. That is a day's worth of drinking water for 325,000 people. Please, think about your water use."

The posters were printed on half-sheets and posted, one per bathroom, in all bathrooms in all dormitories on campus (with the exception of George Draper Dayton Hall, which has only private bathrooms). To minimize wastage, the posters were laminated and will not need to be replaced. Additionally, they were placed strategically to reduce the possibility of water damage and damage by cleaning products. It is our

hope that the signs will get Macalester students to consider the amount of water they use as integrally linked to environmental problems off campus and the sustainability of water use on campus. With any luck, we should start seeing reduced water usage in the dormitories.

### **Acknowledgments:**

In order to find the figures about the water use at Macalester we relied on the assistance of a few individuals. We would like to thank Mark Dickinson from the Physical Plant, and all of our floormates in Wallace basement, Turck 3, Doty 4, Dupre 3, and Kirk 5 and 6 who participated in our survey.

### **Conclusion:**

Water is often undervalued in this part of the world, because there is a large supply of it. However, water is a finite resource. Over consumption is not only wasteful, it is very costly. A lot of the water use on Macalester College Campus is used in areas that are difficult to reduce. By surveying students, we found that a good place to reduce water consumption on campus would be reducing the length of showers that students take. With the intention of raising students' awareness, we conducted an outreach program across campus. We hung signs in the bathrooms urging students to take shorter showers. Hopefully, once students are aware of the issue, we will see a reduction of water consumption in the dorms.

### **Bibliography:**

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**Data:**

## Residence Halls/Houses/Apartments

Building	Units Used	Gallons	Water Cost	Occupants	Avg Gallons per Person
Cultural House	158	118184	\$216.46	11	10744
30 Mac/Bigelow/Wallace/Turck	5721	4279308	\$7,837.77	459	9323
Doty/Dupre/Kagin Commons	5646	4223208	\$7,735.02	439	9620
George Draper Dayton	1662	1243176	\$2,276.94	113	11001
Grand Apartments	360	269280	\$493.20	30	8976
Kirk	2070	1548360	\$2,835.90	138	11220
Macalester Cottages (53,57,63)	210	157080	\$287.70	14	11220
Chinese House	54	40392	\$73.98	4	10098
French House	106	79288	\$145.22	11	7208
German House	110	82280	\$150.70	9	9142
Japanese House	55	41140	\$75.35	4	10285
Spanish House	94	70312	\$128.78	6	11719
Russian House	40	29920	\$54.80	4	7480
Totals	16286	12181928	\$22,311.82	1242	9808

## Academic Buildings

Building	Units Used	Gallons	Water Cost
Carnegie Hall	280	209440	\$383.60
Janet Wallace Fine Arts Center	4825	3609100	\$6,610.25
Old Main	230	172040	\$315.10
Olin-Rice Science Center	2185	1634380	\$2,993.45
Totals	7520	5624960	\$10,302.40

## Administrative and Students Services Buildings

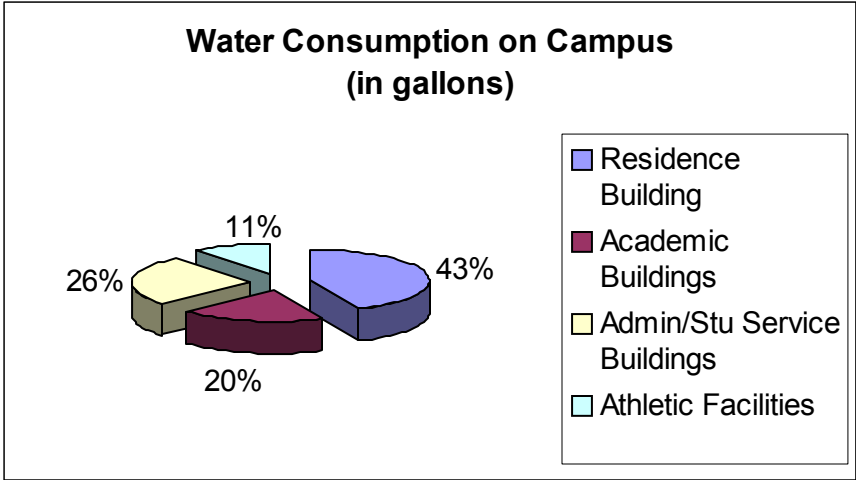
Building	Units Used	Gallons	Water Cost
77 Macalester Street	100	74800	\$137.00
Campus Center	5550	4151400	\$7,603.50
Dewitt Wallace Library	280	209440	\$383.60
Fieldhouse/Gym	2129	1592492	\$2,916.73
International Center	40	29920	\$54.80
Lampert Buildings	630	471240	\$863.10
Weyerhaeuser Hall	930	695640	\$1,274.10
Winton Health Services	40	29920	\$54.80
Totals	9699	7254852	\$13,287.63

## Athletic Facilities

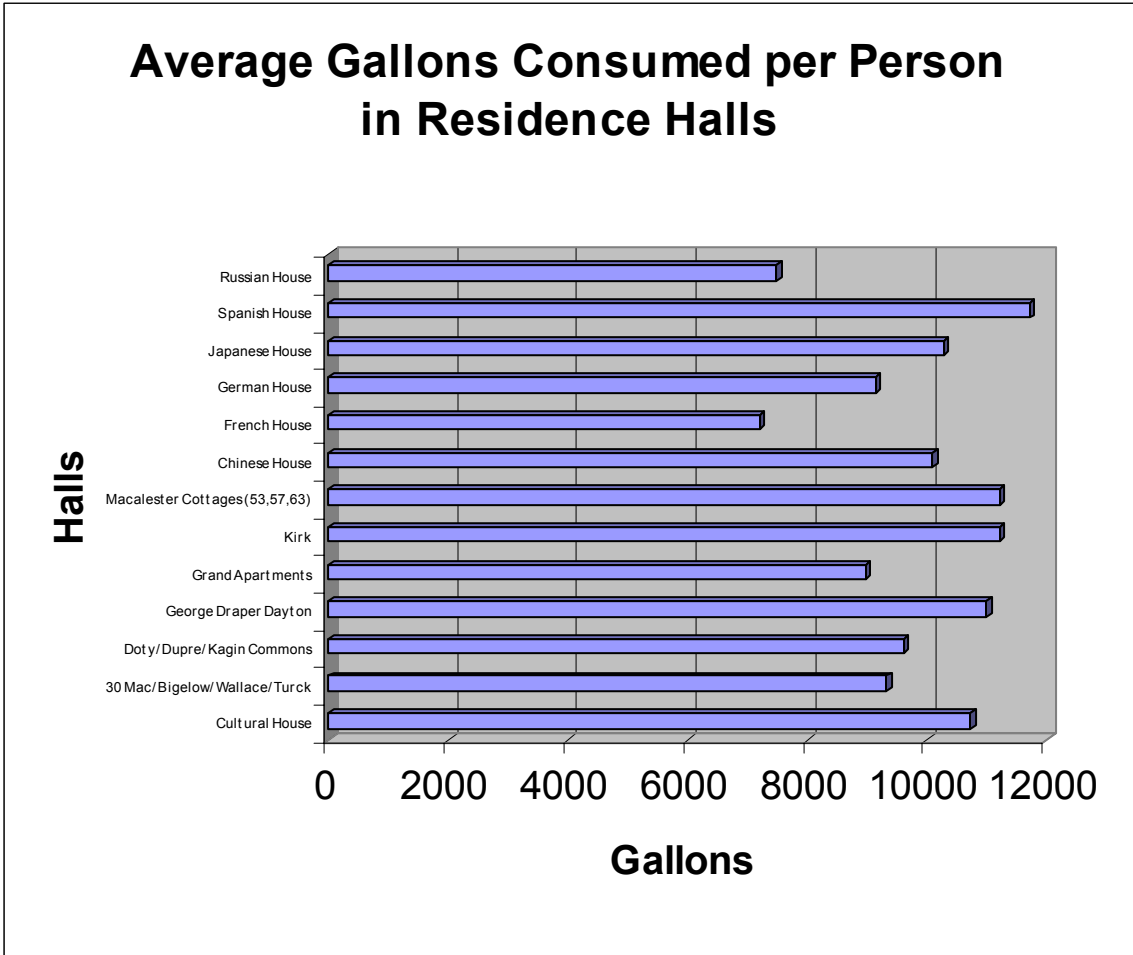
Building	Units Used	Gallons	Water Cost
Athletic Stadium	4066	3041368	\$5,570.42

Totals	Units Used	Gallons	Water Cost
Residence Building	16286	12181928	\$22,311.82
Academic Buildings	7520	5624960	\$10,302.40
Admin/Stud't Service Buildings	9699	7254852	\$13,287.63
Athletic Facilities	4066	3041368	\$5,570.42

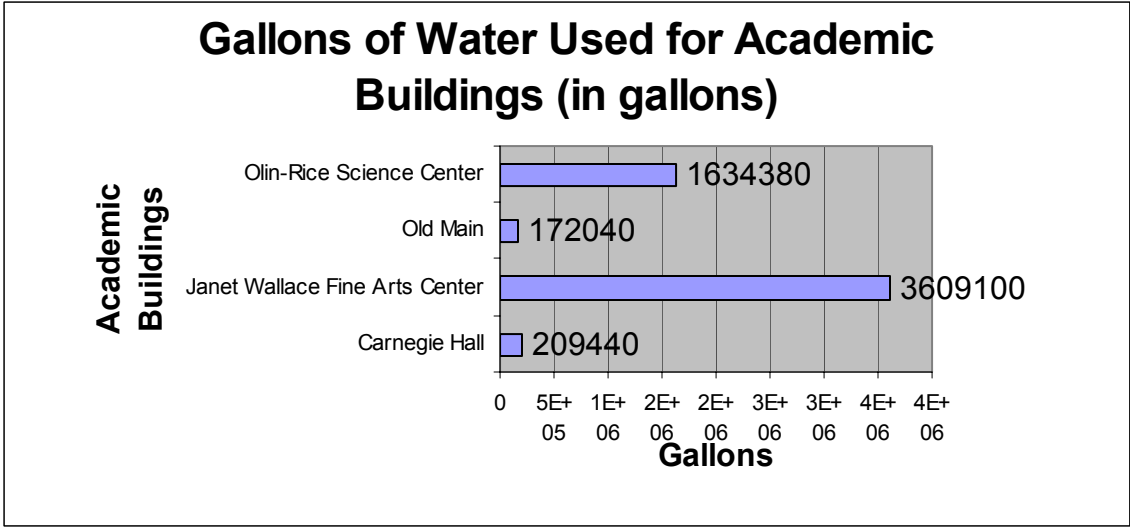
Table 1. This table shows the distribution of water use around the Macalester College Campus. Information was provided by the Physical Plant. (Dickinson, Mark. 2003)



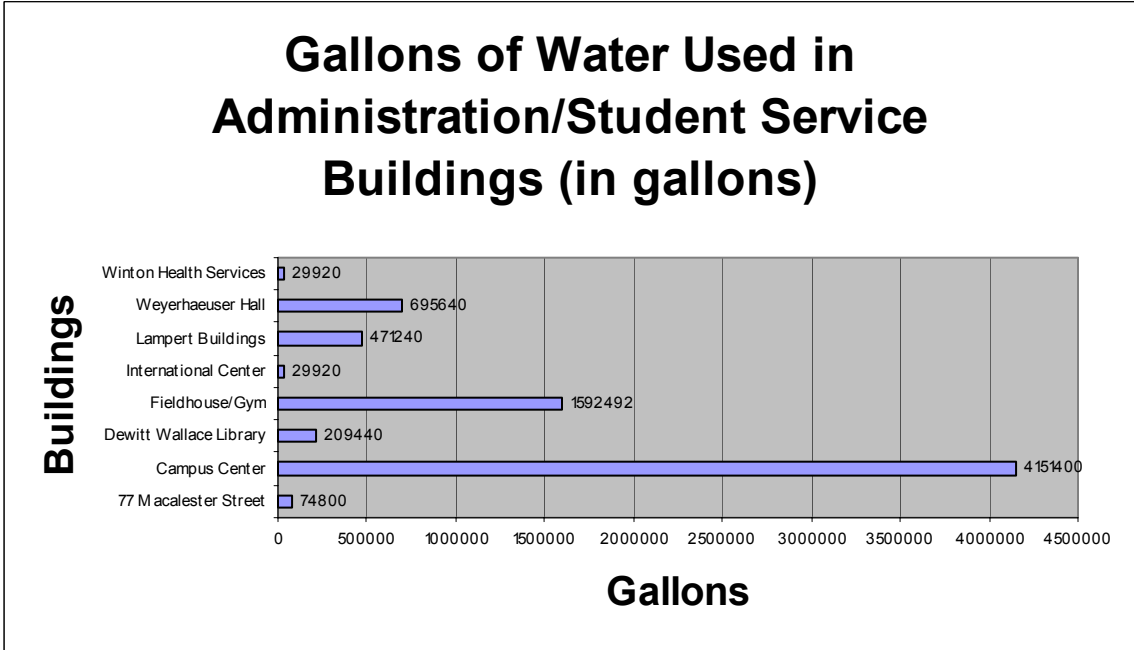
Graph 1. Water Consumption on Campus. The Residence Buildings have the greatest consumption of water on campus.



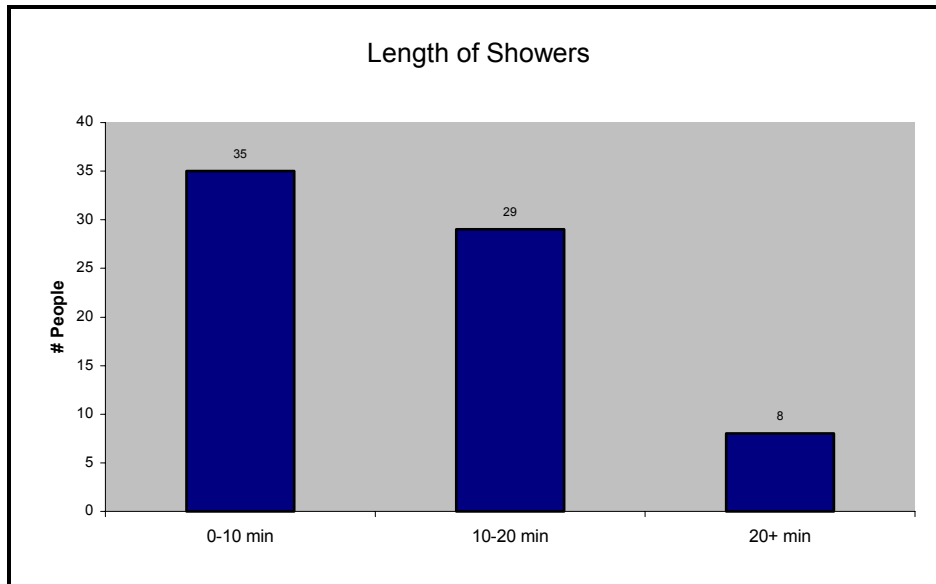
Graph 2. Average Gallons Consumed per Person in Residence Halls. There is a fairly wide range of usage per person in the residences. The Spanish House has the highest consumption, and the French House has the lowest.



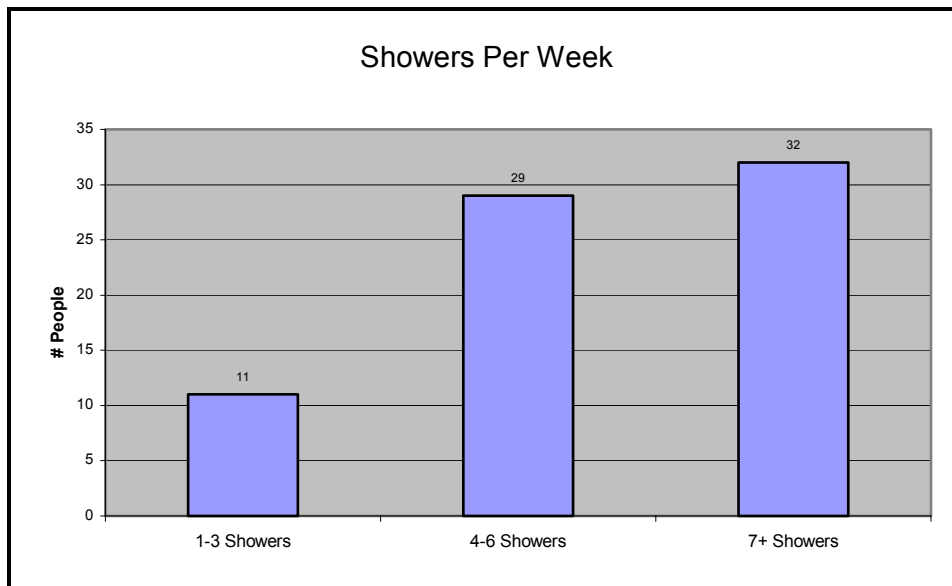
Graph 3. Gallons of Water Used for Academic Buildings. Water use is very minimal in the Academic Buildings that only have classrooms. It is higher in the Science and the Fine Arts buildings due to water used in the laboratories and studios.



Graph 4. Gallons of Water Used in Administration and Student Service Buildings. The Campus Center has very high water consumption due to the fact that the dining hall is located there.



Graph 5. Length of Showers. The data for this and the following table came from a survey of 72 students from four different dormitories on the Macalester College campus. The chart indicates that the largest portion of students take short showers. However it also shows that many students take long showers. This is an area that where water use could be reduced.



Graph 6. Showers Per Week. The data for this table also came from a survey of Macalester College students in residence halls. This chart illustrates that that almost 45% of the students are taking showers at least every day. Used jointly with the data from the duration of showers taken on campus, this indicates that showering is a feasible area to reduce water consumption and waste.