The Impacts of Campus Activities on the Environment

Prepared by:
University of Missouri-Columbia
Environmental Affairs Committee
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Executive Summary—The Impacts of Campus Activities on the Environment

Environmental Affairs Committee
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The Environmental Affairs Committee, a committee of faculty, staff and students at the University of Missouri-Columbia, commenced a study of the impacts of campus activities on the environment in the fall of 2000. The purpose of the study was to document the usage of resources and campus programs with respect to environmental stewardship, as the beginning of a dialogue on sustainability.

The Committee solicited presentations by campus staff to address several broad environmental topic areas and the environmental impacts of several high profile campus operations. General resource topic areas were: energy, water, solid waste and recycling, and hazardous materials. Specific infrastructure issues (departments/operations) reviewed were: Purchasing; Printing Services; Residential Life; Landscape Services; and Building Planning, Design and Construction. The Committee also reviewed the general topic of Environmental Education at MU and two research areas of emphasis: the Research Farms and the Research Reactor. Findings are summarized below.

RESOURCES

Energy

Energy Management (EM), a unit within Campus Facilities, is responsible for providing energy to campus. In 2000, the campus required 196 million kWh (kilowatt hours) of electricity and 2.6 billion pounds of steam. During the past 10 years, overall electrical use increased about 40%, while steam use remained fairly constant. In 2000, coal provided 70% of the energy, natural gas 11%, tire derived fuel (shredded tires) 2%, and 22% was purchased from other providers. Electrical use has increased over the past 40 years for four major reasons: growth in campus space; growth in the number of students, faculty, and staff; demand for all space to be air-conditioned; and the increased use of computers and other electrical equipment. These trends are expected to continue for the near future.

EM has an aggressive energy conservation program, which includes operating the heating and cooling systems for maximum efficiency and upgrading inefficient building lighting, heating, and cooling systems to reduce energy use. Through these efforts, EM has an ongoing goal to reduce energy use in existing space by at least one percent per year. As a result, energy use per square foot in existing buildings has declined 30% since 1990. In spite of these accomplishments, overall energy consumption is expected to continue to increase. The University has won numerous energy conservation awards since 1995, including four from the Environmental Protection Agency, and two awards from the Governor.

Water

Energy Management (EM), a unit within Campus Facilities, is responsible for providing drinking water to campus. Campus water needs are provided from five deep wells on campus. Wastewater from campus is discharged to the Columbia Wastewater Treatment Plant. In 2000, the campus used 720 million gallons of water. In fiscal year 2000, the campus discharged 395 million gallons of wastewater to the Columbia sanitary sewer system. This represented approximately 8% of the flow handled by the Columbia Wastewater Treatment Plant. Both water use and wastewater discharge declined by about a third since 1990, due to improved maintenance, more efficient operation of cooling towers, repair of water lines, conservation efforts, and other miscellaneous actions.

MU's high quality water supply meets all federal and state requirements for a public drinking water system and is tested regularly. There is no evidence to suggest that the campus should be concerned that an adequate quantity of high quality ground water will be available in the future. EM expects water use to level out and then begin to increase in the future.

Solid Waste and Recycling

Landscape Services, a unit within Campus Facilities, and Purchasing and Procurement Management have joint responsibility for arranging for solid waste management services. Pickup and disposal services are provided by the City of Columbia. In 2001, the campus sent over 7,000 tons of solid waste to the Columbia city landfill at a cost of approximately $32.50 per ton. After holding level or decreasing for most of the decade, campus solid waste generation increased by over 9% annually from 1997 to 2001.

Recycling efforts are loosely coordinated by the campus Recycling Committee. A campus desk side recycling program was established in 1992. In 1999, over 1,000 tons of materials were recycled at a net cost of approximately $25 per ton. The campus also operates a Surplus Property operation that sells 100-200 tons of materials annually. Aluminum can recycling had not been an issue because of a City of Columbia deposit ordinance. However, that ordinance was repealed by voters in 2002. Overall, it is estimated that the campus recycles approximately 17% of wastes generated.

Recycling at MU is inhibited by the relatively low cost and plentiful capacity of disposal at the Columbia city landfill and the relatively long distances to markets for recycled goods. Campus Facilities created a solid waste coordinator position in 2000; however, the position is currently unfilled.

Hazardous Materials

Environmental Health and Safety (EHS) coordinates the campus hazardous waste management program. EHS: collects and manages hazardous chemical and low level radioactive wastes; arranges for disposal of infectious medical wastes; responds to spills and emergencies involving hazardous materials; and monitors campus laboratories and work areas for compliance with government regulations.

In Fiscal Year 2000, the campus generated: 210,000 pounds of EPA regulated hazardous waste; 128,000 pounds of chemical waste not regulated by EPA; 325,000 pounds of infectious medical waste; 38,000 pounds of low level radioactive waste (excluding the Research Reactor); and 1,100 pounds of mixed (chemical and radioactive) waste. Research activities and the Hospital are the main sources of these wastes. Administrative sources, such as from Campus Facilities or Residential Life, and construction projects are other significant sources.

EHS has prepared manuals on Radiation Safety, Hazardous Materials Management, and Biosafety, which contain safe handling and disposal procedures. EHS operates a highly successful chemical recycling program and recently implemented a campus wide mercury reduction program.

INFRASTRUCTURE

Purchasing

Purchasing was recently centralized under the University System offices; however, MU retains a Procurement Service Center that oversees purchasing, General Stores, and Surplus Property.

There are no specific policies regarding “green” purchasing. The department generally procures the supplies and equipment requested at the best price available. Some initiatives have been taken, however. The campus has a contract for purchase of recycled toner cartridges, purchases low mercury fluorescent bulbs, recycles fluorescent bulbs, and has experimented with carrying 100% recycled copier paper at General Stores.

Procurement will work with campus departments and administration to meet campus sustainability objectives. Some examples:

- Procurement worked with EHS to restrict the purchase of mercury-containing devices.
- The Columbia Missourian uses soy ink and is printed on newsprint with 40% post consumer recycled content.
- Specifications for Cornell Hall required suppliers to be “green.”

Printing Services
Printing Services has no formal environmental policies. However, state of the art trends in printing technology have tended to have positive environmental consequences. For example:

- All paper has recycled content.
- Inks are predominantly vegetable- or soy-based; there is little use of metallic inks.
- A solvent recycling system was installed in 2001, which has eliminated the generation of waste solvents, which had been 10 tons/year.
- There is a bailer for recycling paper.
- Aluminum plates are recycled.
- Increasing use of digital processing results in more efficient use of resources and decreases production of wastes from film processing.

Residential Life
Residential Life oversees 19 residence halls, seven cafeteria/lounge buildings, and 360 family housing units. In fall 2001, Residential Life commenced implementation of a 15-year master plan to renovate or replace all campus residence halls. Electrical use by students has increased greatly over the past 30 years due to increased use of electrical equipment and air conditioning.

The following programs have had beneficial environmental consequences:

- Exterior light fixtures were switched to a vandal proof, high efficiency variety.
- Hot water tanks were replaced with "on demand" systems.
- Conventional shower heads were replaced with low flow heads.
- Oil-based paints were replaced with latex paints.
- Residence halls are smoke free.
- Recycling bins for paper, plastics, newsprint, and cans are in all residence halls.

Landscape Services
Landscape Services is a unit within Campus Facilities. Responsibilities include: implementing the campus landscape master plan, maintenance of grounds and landscape for most of campus, litter collection, snow removal, and the campus trash removal contract with the City of Columbia.

The department has clear written policies on grounds and landscape maintenance. These policies divide the campus into three priority categories, and clearly specify strategies for irrigating, fertilizing, and using pesticides. Landscape Services emphasizes the use of native species, spot treating with pesticides, and the use of Integrated Pest Management practices. In an average winter, Landscape Services uses 42 tons of potassium chloride and 100 tons of sand for ice control.

In 1999, Landscape Services received the Grand Award for grounds maintenance excellence from the Professional Grounds Management Society, its top award.

Building Planning, Design and Construction
Planning, Design and Construction, a unit within Campus Facilities, is responsible for building design, planning for new construction and renovations, and for overseeing construction projects. In recent years, campus construction has averaged $75 million annually. Major recent projects include the Life Sciences Center, the basketball arena, and the beginning of the Residential Life Master Plan.

The campus follows state and national codes and plans buildings to have very long lifetimes. Thus the campus has developed specific standards for issues such as windows, hardware, and energy usage. The campus has a Master Plan, which is updated and published annually. Construction projects are developed with input from all major

campus stakeholders. Issues addressed during design and construction include: energy efficiency, indoor air quality, asbestos, and lead paint. Project Managers closely supervise construction projects and make sure that all issues are addressed promptly, such as storm water protection, litter, noise, waste disposal, and general housekeeping. Parking structures have been used to minimize the amount of impervious surface compared with using only surface lots.

EDUCATION

Environmental Education

Environmental Education happens across the MU campus in both formal and non-formal settings. There is an Environmental Studies program, housed in the Provost's Office, which advises students about environmental careers, majors and courses. It also offers a joint program with Interdisciplinary Studies for students wanting an environmental major leading to a career in advocacy, outreach or policy, and an 18 hour certificate in Environmental Studies that complements majors in other disciplines. In addition, it helps maintain a network of contacts among campus, community and state organizations, and works with student groups, departments, and campus committees, to sponsor activities, workshops and speakers to raise environmental awareness and promote sustainable behaviors and decision making.

RESEARCH

Research Farms

The College of Agriculture, Foods and Natural Resources manages 17 farms and centers throughout the state for various research purposes. Most research is aimed at increasing production while decreasing costs, while at the same time maintaining or improving the quality of the soil. As a result, the overall use of fertilizers and pesticides is decreasing as these items are used as efficiently as possible.

For fertilizer application, fertilizer needs are based on soil tests, with timing designed to optimize use and minimize loss. For pesticides, the farms have an internal recycling system to make more efficient use of pesticides and minimize unnecessary purposes. Gray water from equipment rinsing is collected and used on the fields. The farms use management practices to keep soil in place (reduce erosion) such as structures, tillage, and ground cover. Drinking water supplies are protected by the use of backflow prevention valves. Animal wastes are collected and used to provide nutrients in place of fertilizer. Used oil is collected for use in a space heater in one of the shops, saving the farms money on both heating costs and disposal costs. Foods or grain with off label products (experimental pesticides) are destroyed. Products from experimental genetically modified organisms are destroyed and not sold.

Research Reactor

The Research Reactor (MURR) was opened in 1966. Currently, MURR has three major activities: biomedical applications, trace analysis, and materials science. Development of radiopharmaceuticals to treat various types of cancer is the largest area of emphasis. In the trace analysis area, MURR provides about 70% of the P-32 used by U.S. researchers. P-32 is one of the most common radioisotopes used in laboratory research.

MURR is primarily regulated by the Nuclear Regulatory Commission (NRC). NRC conducts inspections three times each year. General information about MURR, including environmental impact issues, can be found through the NRC web site (www.nrc.gov).

MURR is not designed to generate electric power and there are some significant differences between MURR and commercial power reactors. The scale of MURR is 1/1000th that of a typical commercial power reactor, such as the AmerenUE Callaway plant. As of December 31, 2000, MURR had 28 spent fuel elements and 40 fuel elements in service. MURR uses approximately 25 kg of uranium each year.

In 2000, MURR activities released 120 millicuries (mCi) of tritium and a total of 22 mCi of all other radioisotopes combined to the sanitary sewer system. For air releases, 975 Curies (Ci) of Ar-41 (half-life of 1.83

hrs) were released, which was 60.1% of the NRC limit. Of all the remaining radioisotopes released to the air, none exceeded 0.1% of the NRC limit. MURR shipped 3,043 pounds of low specific activity waste for disposal. Environmental samples are collected two times per year at eight locations and analyzed for radioactivity. Soil and vegetation samples are taken at each location. Water samples are taken at three of the eight locations.

Because of its high visibility as a target for terrorists, security at MURR has been reviewed and upgraded since the attacks of September 11, 2001. The most visible evidence of heightened security is that access to the building is more stringently controlled. The NRC has also issued guidance and placed additional requirements on all reactors since 9/11/01.

The Impacts of Campus Activities on the Environment

Environmental Affairs Committee
April 2003

"A sense of responsibility requires careful reflection on one's moral obligations. Being responsible imposes the duty on us and our university to make decisions by acknowledging the context and considering consequences, both intended and unintended, of any course of action. Being responsible requires us to be thoughtful stewards of resources -- accountable to ourselves, each other, and the publics we serve. "

"These statements are mere words until we integrate them as values in our individual lives and reflect them in our institutional policies and practices. We pledge ourselves to make them effective in the very fabric of our lives, our community, and all our relationships with others, thereby enhancing the development of individuals and the well-being of society. "

--From the MU Statement of Values

Introduction

With a resident population of over 5,500 students (and one chancellor), approximately 20,000 off campus students, and 10,500 faculty and staff, the University of Missouri has an operational population larger than 91 of Missouri's 115 counties. It has its own power plant, draws water from its own wells, and has maintenance, law enforcement and medical facilities to regulate its operations, protect its citizens and minister to its sick. Like other communities, it consumes increasingly scarce resources and produces waste that if allowed to accumulate locally would poison its inhabitants. Unlike other communities, the way the university deals with its needs can influence more than its local community. Because the university's major industry is the discovery of knowledge and its dissemination to the public, its handling of resources and waste can influence how future alumni, policy makers and community leaders deal with these same issues.

A focus on conserving resources and reducing waste is a major goal of environmental sustainability. In an economic context, environmental sustainability is defined as "Development that meets the needs of present generations without compromising the ability of future generations to meet their own needs" (Bruntland 1987). In practice this means that the renewable resources available to us now - clean air, clean water, forests, soil, equitable climate and wildlife - should be available to future generations in the same quantity and quality as they were to us. Because the average person no longer deals directly with these resources (few people catch the fish they eat and no one makes the paper on which they write their essays), he or she may be unaware of the extent of their use of resources and the negative impacts such use can have on those resources.

An institution like MU on the other hand, can track what resources it uses and how it uses them. Indeed, a fiscally responsible administration would be interested in conserving its use of materials and energy as much as possible so that savings can be passed on to students or reinvested in its educational and research missions. But more importantly, it is the responsibility of universities and colleges to see the big picture and long view, to anticipate the outcomes and consequences of present actions on different populations and on future generations. So it is logical that in the execution of their educational and research missions, universities and colleges would be interested in modeling practices that are necessary to the sustainability of the human enterprise.

To that end, the Environmental Affairs Committee initiated an assessment of campus environmental sustainability in 2001. We do not intend this assessment report as a criticism of MU, and in fact we feel that this institution excels in several areas. Instead, our goal is to make the university community more aware of the role that MU plays in helping society become more environmentally sustainable. We hope that this first report will enable MU to incorporate environmental concerns more explicitly into its decision making and to more fully reflect its values in its institutional policies and practices.

Methods for Conducting the Environmental Assessment

We reviewed several environmental assessments: Penn State Indicators Report (Faculty and Students 1998), the Campus Ecology Audit Guide (Smith 1993), and Ecodemia (Keniry 1995) to identify possible categories and methods for assessment. We began with four major categories and looked at eleven subcategories:

- Resources and Waste
  - Energy
  - Water
  - Solid Waste and Recycling
  - Hazardous Materials Management
- Infrastructure
  - Purchasing
  - Printing Services
  - Residential Life
  - Landscape Services
  - Building Planning, Design and Construction
- Education
  - Environmental Education
- Research
  - Research Farms (CAFNR)
  - Research Reactor

For each category, we contacted the unit responsible for handling that category on campus, and asked them to provide information about seven aspects of their operations:

1. Background information on the unit - This includes the unit's name, responsibilities, how the unit reports, and a brief history of the unit. This is useful because organizational structure affects how costs and benefits are calculated and allocated, and this can affect the perceived economic costs and benefits of various environmental practices.
2. Quantitative Data on media that the unit manages - It is important that as much of the data as possible is quantitative, because it makes it much easier to calculate cost benefit ratios and to monitor the effectiveness of various strategies. Arguments bolstered by quantitative data tend to be much more persuasive for decision makers whose primary concern may not be environmental quality. Data are presented by either calendar year (year ending December 31) or fiscal year (year ending June 30), depending on how the individual unit kept data.
3. Trends (over the last 5-10 years) - As with 2 above, data on trends can be useful for identifying effective cost saving measures or for making predictions about future impacts.
4. Policies and Procedures that would affect environmental sustainability - It is not enough to set a goal of improving environmental practice, it is important that written policies and procedures and effective staff education is in place. It is also important that decision making that affects environmental quality be transparent, and that affected parties are aware of how decisions are made.
5. Special Initiatives or Challenges - Campus environmental sustainability is organic in the sense that its successes and failures are often determined by the environment. This can include the natural environment—a mild climate reduces energy costs; the market environment—proximity to recycling markets and land scarcity increase recycling's benefits; and the regulatory environment—state regulations and or funding for environmental goals can affect cost/benefit ratios. Therefore, it is important to include the special circumstances that a college or university finds itself in.
6. Goals for the Future - If units had identified environmentally related goals we were interested in documenting them so that future progress could be assessed.
7. Ranking (if available) - In rare cases, there are rankings, quantitative data, or awards based on how other institutions of higher learning are doing with respect to the environment. There is always the potential that recognition of environmental accomplishments, or the spirit of friendly competition, will provide an extra

incentive for universities and colleges to incorporate more environmental sustainability into their missions.

We compiled information from the interviews and reports supplied by units into narratives covering each category. These were returned to the heads of units for fact checking. Unit heads were informed that the narratives would be part of a published assessment of MU's environmental stewardship. Once the narratives were returned, we edited them into a single report on MU's environmental stewardship.

The individual summaries are presented next.

References

Bruntland, Gro. 1987 Our Common Future. UN World Commission on Environment and Development. Oxford University Press

Penn State Faculty and Students. 1998 The Penn State Indicators Report.

Smith, April A. 1993 Campus Ecology. Student Environmental Action Coalition. Living Planet Press

Keniry, Julian. 1995. Ecodemia. National Wildlife Federation.

Energy

Background

Energy Management (EM), a unit within Campus Facilities, is responsible for providing energy to campus. The power plant produces both electrical and thermal energy through the process of cogeneration. Although the primary fuel for the power plant is coal, natural gas, fuel oil and tire-derived fuel are used as alternate fuel sources. EM is also responsible for operation and maintenance of the electrical distribution system, the steam distribution system, and the chilled water system, and has an active energy conservation program.

The power plant has been operating at its current location since 1923. There have been a number of upgrades over the years, the most recent being an expansion involving the addition of two natural gas-fired turbines that will increase the current generating capacity of 40 MW to 65 MW.

Quantitative Data

In fiscal year 2000, EM records show that the campus required 196 million kWh (kilowatt hours) of electricity and 2.6 billion pounds of steam. Electrical production was 206 million kWh in each of fiscal years 2001 and 2002. Steam production was 3.0 billion pounds and 2.65 billion pounds in fiscal years 2001 and 2002, respectively.

Electrical use has increased by a factor of 7 since 1960. During the same period, steam use has more than tripled. During the past 10 years, overall electrical use increased about 40%, while steam use remained fairly constant.

In 2000, coal provided 70% of the energy, natural gas 11%, tire derived fuel (shredded tires) 2%, and 22% was purchased from other providers. Power was purchased from other providers when prices were favorable, not because generating capacity was not available.

Trends

Electrical use has increased over the past 40 years for four major reasons: growth in campus space; growth in the number of students, faculty, and staff; demand for all space to be air-conditioned; and the increased use of computers and other electrical equipment. These trends are expected to continue for the near term.

The recent power plant addition is expected to add sufficient capacity to meet projected campus needs through 2010.

Policies and Procedures

EM has an aggressive energy conservation program, which includes operating the heating and cooling systems for maximum efficiency and upgrading inefficient building lighting, heating, and cooling systems to reduce energy use. Through these efforts, EM has an ongoing goal to reduce energy use in existing space by at least one percent per year. As a result, energy use per square foot in existing buildings has declined 30% since 1990. However, during that time, the total amount of campus space increased by 25% and overall energy consumption has increased as a result. New space tends to be more energy intensive than old space because of research requiring large amounts of outside air to be circulated through the building, and the increased use of electrical equipment.

While the campus does not have formal policies for the user concerning energy use and conservation, EM has developed and maintains Energy Policies for the campus. These policies spell out energy conservation measures for new and renovated space and are part of the "Consultant Procedures and Design Guidelines" document, which is given to all consultants doing work on the Columbia campus. In addition, EM recognizes the cost effectiveness of being able to supply the entire energy needs of campus without having to rely on outside utilities. By maintaining full generation capability, Energy Management often takes advantage of being able to purchase interruptible power at prices well below market value.

The recent power plant expansion was justified by the fact that the existing power plant capacity was being eclipsed by campus demand after 2001. With several new buildings coming on line in the near future, an additional source of energy will be required. Most of the time, the campus is able to generate electricity much less expensively than it can be purchased from other vendors; hence it is in the best interest of the campus to generate as much as possible on campus. The plant addition was the most economical method of meeting the campus's future utility (energy) needs.

Special Initiatives or Challenges

The MU energy program has had many successes. Energy is generated extremely efficiently through good operating practices, the use of cogeneration, and an aggressive energy conservation program. The EM staff has an excellent grasp of the market, of national and campus trends, and of energy conservation opportunities (see "Ranking" section below). The plant has fuel flexibility utilizing coal, natural gas, fuel oil and alternative fuels to provide energy to MU. EM is receptive to using alternate energy sources, which is evidenced by the use of shredded tires in their boilers.

The campus saves $6-8 million dollars annually by operating its own power plant compared with purchasing the electricity from an outside vendor. Because the power plant has a mix of fuel options, it is partly insulated from abrupt price increases such as occurred in 2001 with natural gas. The use of cogeneration also mitigates the adverse impact of price increases.

One challenge is using coal as a primary fuel. Natural gas is generally considered a more environmentally desirable fuel than coal. However, natural gas is not available at a competitive cost. New electric generation capacity will be natural gas based which will have a positive environmental impact. A second major challenge is that in spite of an aggressive energy conservation program, overall energy use on campus has been increasing and is expected to do so for at least the next ten years because of unprecedented campus growth. If current trends continue, the campus will need additional electrical and steam generating capacity around 2010.

Goals for the Future

EM intends to continue producing energy for campus as economically and reliably as possible. The unit continues to have a goal of reducing energy usage on campus in existing space by 1% per year. Strategic and long-range plans have been developed and continue to be updated regarding the supply and conservation of energy on campus.

Ranking

In 1992, the campus solicited bids for outsourcing operation of the power plant. No bids were received, which indicated that no one felt they could operate as efficiently as the current staff. In comparisons with other Big 12 and Big Ten universities, the MU power plant matches up favorably in terms of efficiency of operation.

The campus has won energy conservation, pollution prevention and waste reduction awards on a national and state level every year since 1995. Several of these awards were the first in the nation to be awarded to a university. The most recent was the Department of Energy and the Environmental Protection Agency jointly awarding MU the Energy Star Buildings Partner of the Year Award in 2001. Following is a complete list:

- ***In 1995, MU won the US EPA Green Lights University Partner of the Year Award*** for progress in upgrading lighting, and promoting energy efficiency.

- ***1996 National Association of College Business Officers Award*** for the implementation of an innovative wholesale electricity purchasing program.

- ***In 1997, MU was selected from among 1,400 participants for the first US EPA's and US Department of Energy's Energy Star Buildings Partner of the Year Award***, an honor for excellence in using energy more efficiently, saving money and improving the environment.

- ***1998 Missouri Governor's Award for Quality and Productivity*** recognizing the teamwork between Energy Management, Department of Corrections, and the Department of Natural Resources with the Tire Derived Fuel Program.

- ***1998 Governor's Pollution Prevention Award*** for Energy Management overall approach to the production, use, and conservation of energy.

- ***1998 National Council of State Governments' Award for Innovation*** for innovative use of tire derived fuel.

- ***1999 EPA's Energy Star Label Buildings*** awarded to Energy Management for University Hall and the General Services Building. These buildings are the **first** office buildings on any University campus to earn this recognition.

- ***In 1999, MU was selected as a top member of the EPA's Honor Society*** of Energy Star Buildings Partners for our success in the program.

- ***2000 Missouri Waste Coalition Achievement Award*** for our contributions towards improved waste management practices and wise use of natural resources in our state with the Tire Derived Fuel Program.

- ***2001 EPA's Energy Star Partner of the Year Award***, second time awarded to MU for our energy conservation efforts.

Drinking Water and Wastewater

Background
Energy Management (EM), a unit within Campus Facilities, is responsible for providing drinking water to campus. Campus water needs are provided from five deep wells on campus. The oldest of the campus water wells were constructed in 1938; the most recent was constructed in 1992. MU's high quality water supply meets all federal and state requirements for a public drinking water system and is tested regularly.

Wastewater from campus is discharged to the Columbia Wastewater Treatment Plant. Wastewater undergoes several levels of treatment prior to discharge. Primary treatment consists of gross filtration of trash using bar screens and gross solids removal using a primary settling basin. Secondary treatment consists of aeration of the primary wastewater, then pumping to a final settling basin. Tertiary treatment passes the secondary effluent through a series of wetland treatment units. The final effluent is pumped into the Eagle Bluffs Conservation Area, and from there to the Missouri River. Sludge generated from treatment is applied to city-owned and private farmland by subsurface injection.

Quantitative Data
During the ten years from 1990 to 2000, water consumption declined by one third from 1,064 million gallons per year to 720 million gallons per year, a 32% decrease. More recently, use started to go up again so that the camups used 760 million gallons in 2001 and 790 million gallons in 2002. (Data by fiscal year).

Between 1990 and 2000, discharges to the Columbia sanitary sewer decreased from 623 million gallons of wastewater to 395 million gallons of wastewater, or 36%. The later figure represents approximately 8% of the flow handled by the Columbia Wastewater Treatment Plant. The downward trend has been reversed so that the campus discharged 390 million gallons in 2001 and 420 million gallons in 2002.

Trends
Water use and wastewater discharge decreased during the 1990's due to improved maintenance, more efficient operation of cooling towers, repair of water lines, conservation efforts, etc.

Policies and Procedures
Neither the campus nor EM has formal general policies about water use and conservation. However, the use of once through cooling water systems is now prohibited in campus building design guidelines. Energy Management prepares an annual report on drinking water quality in accordance with DNR regulations.

Special Initiatives or Challenges
Water supply appears to be adequate for the foreseeable future. EM reported that at some point in the past, water levels were dropping in the University's wells. However, this was before the City of Columbia moved their drinking water well fields to McBaine. In recent years, water levels in the wells have remained constant.

In the 1990's, EM upgraded the water distribution system and converted cooling water systems to closed loop. These initiatives have been completed except for minor maintenance opportunities. As a result, water use and wastewater discharges have leveled out and are increasing as a result of new construction on campus.

Goals for the Future
Energy Management has goals and plans for future water production and water systems as developed in their strategic and long range plans. EM will continue to maintain the applicable systems and analyze water use data for campus buildings.

Ranking
The Committee could not identify any data appropriate for comparison to other universities.

Solid Waste and Recycling

Background

There is no specific unit or office responsible for solid waste and recycling at MU. Instead, these services are managed by Landscape Services and Procurement and Materials Management (PMM). Procurement and Materials Management has had responsibility for negotiating pick up of solid waste with the city of Columbia, and recycling pick up with Civic Recycling. Landscape Services has been responsible for billing the general campus for solid waste and cardboard recycling (for which there is a cost). Other items (mixed office paper, containers) are recycled at no cost, but the campus does not receive any income from them. Recycling efforts are coordinated by bi-monthly meetings of the Campus Recycling Committee. This is a standing committee of the university with representatives appointed from Residential Life, Campus Facilities, PMM, Landscape Services, Environmental Health and Safety and other units. Students and faculty are also encouraged to participate. There is also a Surplus Property unit, under Business Services, that picks up, warehouses and auctions off surplus property from departments across campus.

Quantitative Data

Solid Waste: Over the last 11 years, the average amount of solid waste sent to the landfill each year was 5,745 tons. However, there has been a somewhat sudden upturn in solid waste over the last three years after several years of no change (Figure 1). Since 1997, the average tonnage has gone up 9.5% per year. This is in spite of increases in the amount of recycling taking place on campus.

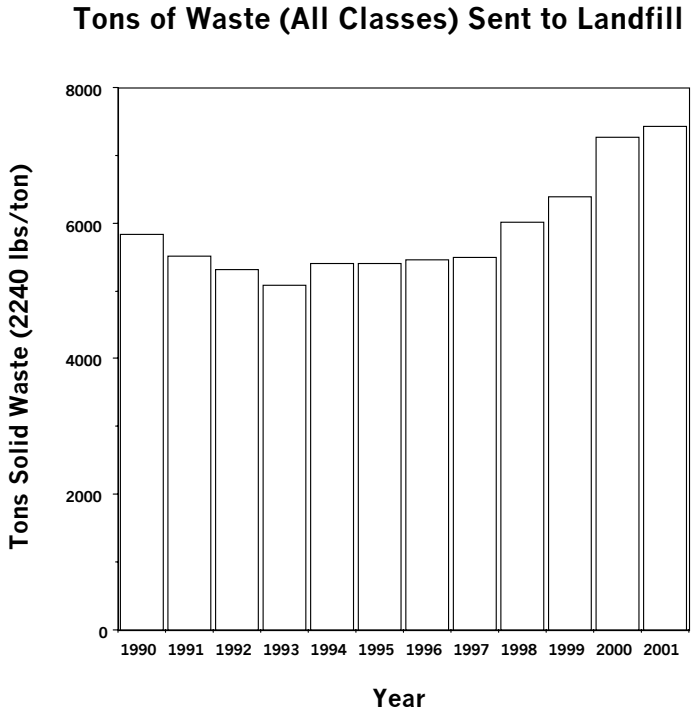

Figure 1. Tons of solid waste sent to the Columbia Landfill from the MU campus by year.

A waste study published in December 1997, shows that the most significant contributors to solid waste (in order - by weight) are paper, cardboard, organic wastes, plastics/other, metals and glass (Table 1).

Table 1.Percentage (by weight) of different categories of waste from the University of Missouri in 1997

Total Paper Board (corrugated board*, box board)	19.1%
Total Other Paper (newsprint, magazines, office and mixed paper*)	28.2 %
Total Plastics (PET[#1], HDPE[#2], PVC[#3], LDPE[#4]*, Polypropylene[#5], Polystyrene[#6], other plastics)	13.9%
Total Metal (bi-metal*, aluminum, ferrous and non-ferrous metal	3.8%
Total Glass (clear*, brown, green, other)	2.8%
Total Organic Waste (wood, textiles, food waste*, manure, other)	18.2%
Total Other Waste (diapers/sanitary products, medical*, inorganic fines, miscellaneous, banned items)	14.0%

* most significant component of this category

Recycling: Recycling has been going on informally since the 1970's when faculty, staff and students began collecting recyclables in their departments and in dorms and then hauling materials to the local recycling center. A Campus Recycling Committee was formed in 1990 and a formal recycling program began in 1992, when information on recycling and bins for collecting materials were provided to departments requesting them. Figure 2 shows that the MU recycling program has increased from about 433 tons per year to over 1000 tons over the last 11 years. The average increase is 14% per year, but there have been several years with little change (1-6%) and years with dramatic increases in recycling (38 to 45%) (Figure 3). Big jumps in recycling appear to be due to adding classes of recyclables to the list of things that can be recycled on campus or adding bins. Recyclables include mixed office waste, cardboard, glass, newsprint, files from the records center, bailed paper, printer mix, phone books and books.

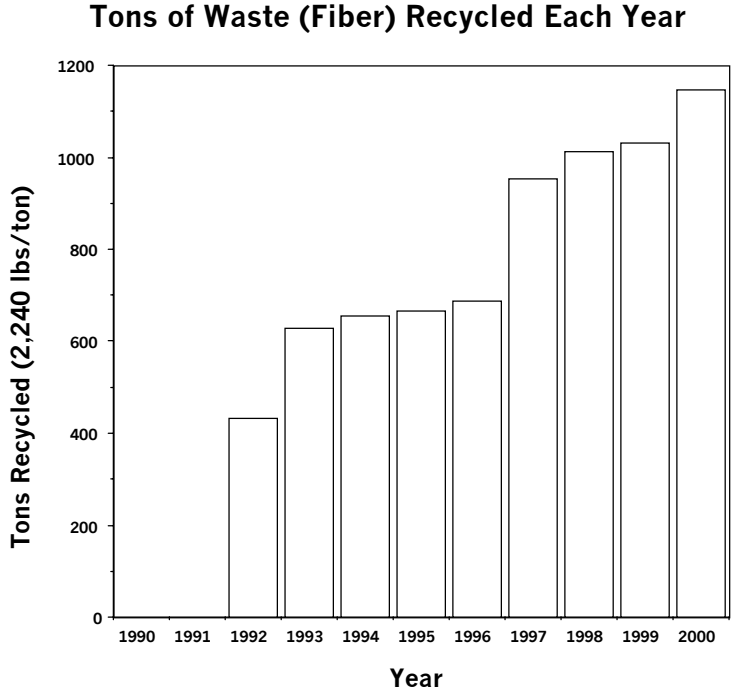

Figure 2. Tons of waste recycled each year. Includes mixed office waste, newsprint, cardboard, phonebooks, printing services waste.

Currently MU recycles about 14% of all the solid waste generated on campus (not counting the waste diverted by surplus property). On average, recycling costs about $25 per ton, though individual items vary considerably in their marketability. If disposed in the landfill, costs are $32.50 per ton (though current contracts are on a per pull basis instead of by the ton). So recycling is saving $7500 a year.

Beverage containers are a special case on campus because the city had an ordinance requiring a refundable deposit of 5 cents per can. Most cans (>80%) were redeemed by individuals or groups that collected cans to raise money for special projects.

The deposit ordinance was repealed in April 2002. While the issue of what to do with beverage containers has been discussed, there has been no systematic approach to providing recycling to recover containers no longer being redeemed.

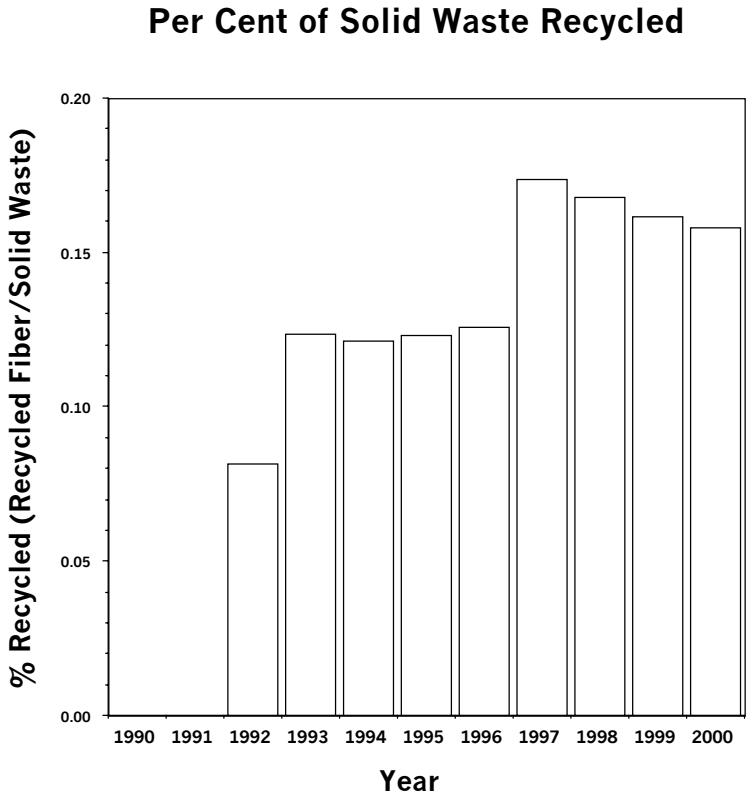

Figure 3. Percent of solid waste diverted to Recycling (not including surplus property).

Surplus Property (also discussed in Procurement/Purchasing): Surplus Property is responsible for picking up, storing and selling or auctioning excess furniture, computers, mechanical equipment or vehicles. When departments on campus remodel or upgrade, they can donate their old furniture and equipment to surplus property. The property is sold or auctioned and the department and surplus property split the proceeds. On average surplus property handles 2000 to 3000 computers, 30 to 40 vehicles, 100 to 200 desks, 1500 to 2000 chairs and 700 file cabinets each year. There are also a number of miscellaneous items, incubators, refrigerators, carts, cubicle dividers and scrap metal to name a few. Conservatively, that diverts 100 to 200 tons of solid waste from the landfill, or another 1.3 to 2.7 %.

Landscape Services: Landscape Services has routinely composted all of its yard waste - trimmings, grass clippings, etc., since yard waste was banned from Missouri landfills. However, there are no figures on how much material is diverted from the landfill.

Trends

While the rate of recycling is increasing at MU, it also appears that the amount of solid waste produced is also increasing. Therefore, the total amount of solid waste going to the land fill from the campus has increased 27% from 5839 tons in 1990 to a projected 7669 tons in 2001 or more than 6% per year. On a per ton basis, waste disposal costs have gone up approximately $70,000. To some extent this may be due to increases in the campus population, increases in square footage of campus buildings, or to other trends (like the increased use of computers and printers) that by themselves have led to the generation of more waste. If the trend continues at this pace, the amount going to the landfill in 2020 will be nearly 24,000 tons (over $500,000 in additional charges if landfill fees remain constant).

Policies and Procedures

The Campus Recycling Committee, in existence for over a decade, operates without a budget. Time and talent are donated by people on the committee and specific initiatives promoting recycling are funded by individual units. For example, Telecom promotes recycling of old phonebooks when the new ones are distributed and Printing Services printed and distributed posters and brochures on recycling. The committee members have been instrumental in getting grants from the Missouri Department of Natural Resources to fund the purchase of bins, compacters and roll-off containers used in the campus recycling program.

At MU, non-academic units like Landscape Services, Campus Dining and Residential Life are expected to operate as break-even operations. They do not receive funding from the state but are expected to purchase needed services from other units (like Energy Management) and to charge enough for their services to cover expenses. This philosophy also governs the disposal of solid waste. Units pay for solid waste pick up and recycling through landscape services.

The difficulties in tracking waste-disposal and recycling costs as well as the negotiation of a new solid waste contract with the city in 1999, led Landscape Services to develop a job category for someone to coordinate contracts and billing for both solid waste pick-up and recycling, and to coordinate efforts to increase the amount of waste materials recycled, including doing waste audits and identifying markets for recycled materials. The position is currently unfilled.

The Surplus Property program, under the Business Office, currently has very clear guidelines for units wishing to use its services and a regular program of auctions and sales. However, because of the large number and variety of items handled, they do not have the resources to summarize data on the amount of material diverted from the waste stream.

Planning Design and Construction makes it a practice to reclaim material that has salvage value. These materials are sold through surplus property. In new building design (the Anheuser Busch Natural Resources Building and the College of Business building) recycling space is programmed into their designs - though departments have the option of using that space for other things.

Special Initiatives or Challenges

Winter 1992: Deskside Recycling Program initiated for campus staff and faculty - $1.25 recycling kit from General Stores. MU Recycling Committee

Fall 1996: Recycling Brochure -listed what items could be recycled and where. MU Recycling Committee and Printing Services

Fall 1996: Recycling Web Page. MU Printing Services

Fall 1996: Student Coordinators hired to manage recycling pick-up in five dorms. Residential Life

Fall 1997: Rollins and Bingham group added to list of dorms with recycling. Residential Life
Winter 1997: MU Recycling Program receives three recycling compactors from the Mid-Missouri Solid Waste Management District. Procurement and Materials Management
Fall 1997: MU purchases $45,000 worth of recycling bins using a grant from the Department of Natural Resources. Procurement and Materials Management
December1997: Waste Characterization Study
Spring 2000: Landscape Services advertises for a Solid Waste Coordinator
Spring 2001: Drop and Run - campus wide collection of furniture and other items from students leaving campus to be sold at a giant garage sale. Student Sierra Club and Missouri Student's Association
Fall 2001: Deskside Recycling Program for students initiated - a recycling sticker and information on recycling for every student purchasing boxed books from the MU bookstore. Missouri Student's Association and Bookstore

Although the MU Recycling Program is recycling a significant proportion of the solid waste generated, a large number of students, faculty members and staff are generally unaware that MU has a recycling program. This contributes to low levels of participation, particularly among students, and to contamination of recycled materials by people who don't know how important it is to keep recyclables separate from trash. Another problem is the method of accounting for the recycling program, which only records costs and not any of the savings from diverting solid waste from the landfill. Even if the recycling program were ended, the waste would still have to be disposed of.

Goals for the Future

There are two main goals for the future, 1) continue with efforts to hire a Solid Waste-Recycling Coordinator to track waste generation, to increase the level of participation in recycling and to seek savings in recycling efforts that include marketing recycled materials to purchasers outside the mid-Missouri area; and 2) consider changing accounting practices so that savings from diverting waste from the landfill are recognized as a benefit of recycling and included in the balance when evaluating recycling

Ranking

The Campus Ecology program of the National Wildlife Federation conducted a survey of environmental practices of U.S. universities and colleges - State of the Campus Environment. They received replies from 891 institutions. With respect to recycling, the average amount of municipal solid waste recycled by institutions that responded was 26%. Data from the EPA shows Missouri in the category of states that recycles between 30 and 39% of its wastes. Even if MU included yard waste in its figures for recycling, it is not likely that the university would still be able to achieve what appears to be the average level of recycling for the state or for other colleges and universities. This suggests that there is room for improvement in MU's recycling efforts. This is critical because the EPA also places Missouri in the category of states which have an average of only 5-10 years of landfill space left.

Hazardous Materials

Background

Environmental Health and Safety (EHS) is responsible for coordinating the campus' program for safe and environmentally sound management of hazardous (chemical) materials. If handled improperly, hazardous materials may present hazards to students, faculty, and staff as well as expose MU to potential regulatory enforcement actions. EHS has direct responsibility for managing the campus' hazardous wastes. Improper disposal of hazardous wastes may cause pollution of air, water and soil.

The campus began paying special attention to hazardous waste management in the 1960's. EHS became actively involved in hazardous waste management in the late 1970's. Regulations implemented by the U.S. Environmental Protection Agency in 1980 greatly increased the requirements placed on the campus and were followed shortly thereafter by regulatory compliance inspections.

EHS has established a Hazardous Materials Management Section, consisting of 15 faculty and staff. In addition to collecting and managing hazardous wastes, the unit: monitors laboratories for regulatory compliance and safety; collects low level radioactive wastes; arranges for management of regulated medical waste; responds to spills and other emergencies involving hazardous materials; and addresses a variety of miscellaneous environmental issues.

Quantitative Data

In fiscal year 2000, EHS records show that the campus generated:

- 210,000 pounds of EPA regulated hazardous waste
- 325,000 pounds of medical/pathological wastes
- 38,000 pounds of low level radioactive waste (not including the Reactor)
- 128,000 pounds of regulated wastes from remediation and other special projects
- 1,100 pounds of mixed waste (hazardous chemical and radioactive)

Research activities and the Hospital are the main source of these wastes. Administrative sources, such as from Campus Facilities or Residential Life, and construction projects are other significant sources.

This report is supplemented with data through fiscal year 2002 and summarized in the table below.

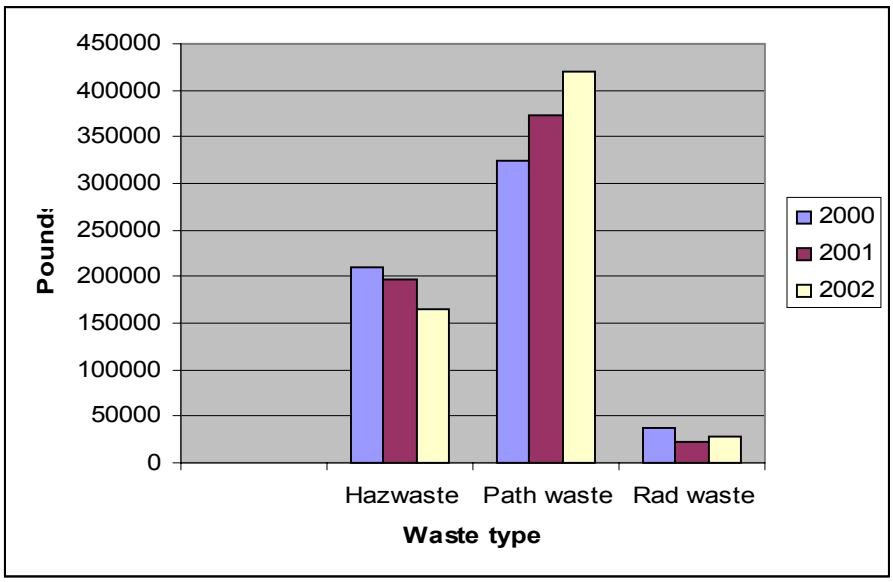

Figure 4. Campus generation of various types of hazardous wastes.

Methods of disposal vary by waste type. Most regulated and non-regulated chemical wastes are sent off campus for disposal by incineration, thermal treatment with energy recovery, or other chemical treatment. Some wastes are sent for recycling or reclamation, when suitable facilities are identified. Landfill disposal is used only as a last resort and primarily for non-regulated chemical waste.

EHS discontinued on-site incineration of medical/pathological wastes as of January 1, 2000. Prior to that date, EHS incinerated approximately 80% of the campus' medical/pathological waste. All such wastes are currently shipped to an off-site disposal facility, where the wastes are treated either by autoclave or incineration.

Most low level radioactive wastes contain radioactive isotopes with short half-lives. Such wastes can be held until the wastes are no longer radioactive. Of the wastes with short half-lives, once decay to background has occurred, the liquids are disposed via the sewer and the solids are incinerated by EHS. Of the wastes with long half-lives, most liquids are disposed via the sewer in accordance with NRC regulations, and most solids are incinerated by EHS, also in accordance with NRC regulations. For the small amount of low level radioactive wastes that cannot be disposed on-site, EHS arranges shipment to an off-site disposal facility, where the wastes are most likely disposed of in a radioactive waste landfill.

Mixed wastes are radioactive wastes that are also chemically hazardous wastes. Most mixed wastes are shipped to an off-site vendor for disposal, usually by incineration.

Trends

Since historical values were not readily available, it is not possible to identify trends. EHS believes that for most waste categories, the amounts have shown an upward trend over the years primarily because the campus has been doing a better job of identifying the presence of such wastes and because research and health care activities have been increasing. For pathological wastes, the total increased in FY2000 and FY2001 due to the purchase of Columbia Regional Hospital. On occasion, EHS has conducted educational campaigns to change campus procedures to minimize the amount of such wastes that are produced.

Policies and Procedures

EHS has prepared a Hazardous Materials Management Manual. The manual was last updated in September 2000. The manual describes policies, and roles and responsibilities for various campus groups. EHS requires all users of hazardous materials to attend an introductory training course and then, every three years, take a refresher course. Both courses include components on recycling, waste minimization, and safety. Hazardous materials issues are addressed by the Hazardous Materials Management Committee. EHS serves as the campus liaison when federal (EPA) or state (DNR) representatives visit campus for compliance inspections.

EHS has prepared a Radiation Safety Manual. All users of radioactive materials are required to take an EHS-provided course on radiation safety. A refresher is required every three years. Radiation safety policy issues are addressed by the Radiation Safety Committee. EHS serves as the campus liaison when NRC visits campus for compliance inspections.

EHS is in the process of preparing a Biohazard Safety Manual. Procedures for disposal of biohazardous wastes are given in section 7:060 of the Business Policy and Procedures Manual. Biohazard safety issues are addressed by the Institutional Biosafety Committee. EHS has not had occasion to work with regulatory agencies on biosafety issues.

Special Initiatives or Challenges

For chemicals, EHS continues to operate a redistribution program under which unwanted chemicals of good quality are made available for free to campus researchers. In 1999, EHS conducted a campus-wide survey to identify where and how much mercury was on campus. In 2000, EHS used the results of this survey to begin a program to replace mercury-containing items with non-mercury substitutes. At the end of fiscal year 2001, this program entered a third phase and, when completed, will have succeeded in removing over 75% of the identified

mercury from campus. The Hazardous Materials Management Committee continues to administer a fund to help campus researchers and supervisors purchase equipment that reduces hazardous waste. In July 2000, EHS began a program to collect fluorescent lamps for shipment to a recycler. There are currently an adequate number of commercial vendors offering recycling, treatment and disposal services.

For radioactive waste, there is always the possibility that political pressure will take away all off-site disposal options. At the present time, the large majority of radioactive wastes are disposed of on campus. Those radioactive wastes that cannot be handled on-site, can currently be shipped to an off-site disposal facility.

For regulated medical wastes, the campus no longer has the ability to dispose of such wastes on campus (formerly done by incineration). At the present time, there appear to be an adequate number of commercial vendors offering disposal services at a competitive cost.

For mixed wastes, there are few disposal options available and disposal costs are very high. EHS has been able to find disposal services for all mixed wastes in its possession. EHS implemented an educational program in the fall of 2001 to encourage researchers to adopt practices that minimize the generation of mixed waste.

Goals for the Future

EHS encourages waste minimization and recycling activities, where cost effective. Because of the highly variable nature of waste generation at MU, EHS has not adopted specific waste minimization goals. Specific goals for specific wastes have been adopted with success in the past.

Ranking

Comparisons with peer institutions concerning the amounts of wastes being generated have been attempted, but have limited meaning because of the uniqueness of each campus. Management practices as compared with peer institutions appear to be at least equivalent, and possibly better, at MU.

Procurement/Purchasing

Background
In 2001, the Procurement departments for all the University of Missouri campuses underwent a major change that resulted in a Chief Procurement Officer being housed in the UM-System offices. This change was made with the intention of maximizing purchasing efficiencies.

The MU campus has a Procurement Service Center, which contains units for Purchasing, General Stores, and Surplus Property.

Quantitative Data
General Stores makes large volume purchases of a number of items used by departments and units, from file folders to fuel. Choices of which products to purchase are based on demand. In other words, General Stores responds to what departments, programs and units say they want. In addition, departments have the option of purchasing from outside suppliers, like Office Depot and Staples.

Environmentally sustainable procurement practices include:

> The vast majority of paper used on campus, over 170 million sheets or 30,000 cases is xerographic bond (Xerox 4200 and Weyerhauser 513d) with no recycled content. However, General Stores does stock and sell about 300 cases a year of 25% recycled/25% cotton premium bond (Gilbert 511) and 100 cases per year of 100% recycled paper (Unity DP). Other paper products—index cards, steno pads, envelopes, file folders, yellow post-its—typically have 10% post consumer content.
>
> General stores contracts for recycled toner cartridges and sells about $12,000 worth every year. In addition, it recycles approximately 7,000 cartridges annually.
>
> Other environmentally sustainable practices include, using fuel with 10% ethanol at university fueling stations (about 10% of university fuel use); recycling 1000 used pallets every year, and purchasing low mercury ALTO fluorescent lamps.

Surplus Property collects, stores and recycles university property among various departments and units, averaging about five items per day. For left over items, it runs 14 - 15 auctions per year with gross sales of $755,000. Thirty-five per cent of sales go to surplus property and the other 65% goes to the department.

Other environmentally friendly procurement/purchasing practices include: purchasing dual fuel (E-85) vehicles from GSA auctions when possible (MU usually purchases used vehicles); using vehicle specs that allow for life-costing of alternative fuel vehicles; purchasing transformers based on life-cycle costing (Energy Management); specs for products with no or low amounts of mercury (lamps, thermometers); specs, when appropriate, that require suppliers to be "green" (e.g. Cornell Hall); and use of recycled newsprint (90%, 40% post-consumer) and soy-based ink by the Missourian.

Trends
No trends were identified.

Policies and Procedures
There is no specific purchasing policy with respect to "green" purchases. However, there is a policy on meeting CAFE standards with fuel usage and one on using alternative fuel vehicles. On bid requests for vehicles, the University solicits alternate bids for vehicles using alternative fuels; however, no one ever bids on this alternative.

Overall, Procurement is largely constrained by what departments are looking for. Purchasing needs and specifications are defined by the end users. If, for example, there is no interest in recycled paper General Stores can't push it. From Procurement's perspective, demand has to come from end users.

Special Initiatives or Challenges
Procurement recently worked with Environmental Health and Safety to restrict the purchase of mercury-containing devices.

General Stores has tried several times to encourage the use of 100% recycled paper, but there has been limited demand even though it costs less.

Cost seems to be the driving force for most departments in making purchasing decisions.

Goals for the Future
A future goal may be to include specifications for "green" suppliers (as with Cornell Hall) whenever appropriate.

Ranking
The Committee could not identify any data appropriate for comparison to other universities.

Printing Services

Background
Printing Services employees 117 individuals. It provides printing services for campus and certain governmental agencies. The department is self-supporting through fees for service.

Quantitative Data
Solvent use: Printing Services installed a Maratek solvent recycling system in 2001. The system has eliminated approximately 48 55-gallon drums (about 10 tons) per year of solvent wastes. The system recovers the solvents for reuse, thereby also reducing purchase costs.

Inks: The predominant ink is a vegetable-based ink and Printing Services also uses a line of soy inks. Both vegetable and soy inks are low in volatile organic compounds (VOCs), materials that adversely affect air quality. There remains a small usage of metallic inks in a few instances for which vegetable-based inks are not available.

Paper: Printing Services is not able to determine the volume of paper used. However, the total cost of paper for Printing Services was $1.77 million in 2001. All paper used by Printing Services meets EPA criteria for "recycled" (10% post-consumer content). Unwanted paper is recycled—approximately 600,000 pounds per year. Printing Services has their own bailer.

Miscellaneous: Aluminum plates are used in some applications. These plates are recycled.

Trends
Solvent use has essentially been eliminated with the purchase of the recycling system described above. Paper use is probably dropping as purchase costs dropped from $2.04 million in 1997 to $1.77 million in 2001.

Printing Services is increasing its use of digital processing which is decreasing the use of film, which in turn is decreasing the generation of wastes associated with film processing (e.g. silver in film, fixers, developers, etc.). New equipment is more precise, which results in less wastage of paper and inks.

Policies and Procedures
There is no specific policy with respect to "green" operating procedures. However, Printing Services uses only paper that meets the EPA definition of "recycled." Printing Services uses primarily vegetable-based inks that are low in VOCs. The major line of inks, "Ink Fresh," do not degrade upon aging, which has decreased the generation of waste inks. Overall, Printing Services is constrained by what their customers are looking for. Printing needs and specifications are defined by the end users.

Special Initiatives or Challenges
Printing Services has pushed the use of the Web for submission of jobs. Use of the Web reduces the need for travel, reduces the use of paper, and generally results in more efficient use of resources. Printing Services is increasing its use of digital processing, which is generally associated with more efficient use of resources.

Cost seems to be the driving force for most departments in making purchasing decisions.

Goals for the Future
Printing Services has a goal of providing state of the art services. State of the art trends in the printing industry tend to have positive environmental consequences.

Ranking
The Committee could not identify any data appropriate for comparison to other universities.

Residential Life

Background

The MU Residential Life department oversees the operation of 21 residence halls, seven cafeteria/lounge buildings and 360 family housing units. It purchases furniture, equipment and supplies for Residence Halls and Family Housing units, and keeps all these facilities clean, safe, functional and in good repair. It has some functions which require it to work together with Campus Facilities and Campus Dining Services.

Residential Life strives to achieve its objectives in a way that is economically efficient, since its income comes solely from housing fees paid by residents. Residential Life receives no subsidy money from the University or the state.

Quantitative Data

- Residential Life is embarking on a building and renovation project that will cost $250-300 million. It will take place over the next 10-15 years.
- Residence Hall rooms are being electrically renovated to provide 19 electrical outlets each.

Trends

- Electrical use by residents has increased. Whereas in the 1970s a average dorm resident's electrical possessions might have consisted of a fan and a radio, today it would not be unusual for a dorm resident to bring a computer, television, stereo, refrigerator, microwave, electrical hair driers, and other appliances. This has put a strain on electrical capacity in residence hall rooms and renovations have significantly increased the number of outlets in rooms.
- As Columbia has become increasingly urbanized, it has become necessary to provide students with respite from heat. All new residence halls to be built will be air conditioned.

Policies and Procedures

Residential Life has established buying policies that both save money and also have positive environmental effects. Such policies include:

- Exterior light fixtures switched to an energy-efficient, vandal-proof high-pressure sodium variety.
- Hot water tanks replaced with on-demand systems
- Conventional shower heads replaced with low-flow heads
- Heating systems kept well maintained so that heat is not wasted through faulty valves
- Recycling bins provided for paper, newsprint, #1 and #2 plastics and cans in all residential "houses." Cardboard recycling bins provided in each residence hall in a central area.
- Fluorescent lamps recycled through campus program
- Latex paint used rather than enamel paints
- Smoke-free dorm policy implemented

Special Initiatives or Challenges

Residential Life has engaged in a recycling education campaign in cooperation with the University bookstore. The cardboard boxes the U. Bookstore uses to package a student's textbooks are marked to encourage the student to reuse the box as a personal recycling bin for his/her residence hall.

Although Residential Life's new residence structures will be designed using the latest knowledge in conservation technology, the buildings will still require more energy to run than today's residence halls. The reason is that student lifestyles are requiring increasing use of electrical devices (e.g. computers), and to some degree this cannot be avoided.

Goals for the Future

Residential Life's environmental goals fall into three areas: waste management and disposal, energy conservation, and water conservation. They have found that environmentally sound choices are often also the most economical choices. To achieve the dual goal of acting environmentally and frugally, they plan to continue the following objectives:

- to update and improve existing physical facilities
- replace inefficient fixtures with energy-saving ones
- keep recycling bins on residence hall floors as much as space permits
- conduct continuing education campaigns which urge recycling

Ranking

The Committee could not identify any data appropriate for comparison to other universities.

Landscape Services

Background
Landscape Services is a unit within Campus Facilities. Landscape Services includes five divisions: Landscape Design, Landscape Construction, and Landscape Maintenance, Landscape and Grounds Maintenance, and Campus Trash Removal.

- Landscape Services has developed a campus landscape master plan, and numerous other planning and design initiatives for the education and general (E&G) funded campus area. Landscape architects and landscape designers provide services from planting plans to design of site features, hardscapes, irrigation systems and major campus spaces.
- Landscape Construction is in charge of new plantings and landscape renovations. It also replaces plants as needed and assists in snow removal on the E&G parts of campus.
- Landscape Maintenance is in charge of litter collection, snow removal and horticultural activities such as mowing, fertilizing, pruning, etc in contracted areas (such as Residential Life and Parking & Transportation). It does not cover University Hospital grounds, the AL Gustin golf course or ICA athletic fields, as they have their own grounds maintenance staff.
- Landscape & Grounds Maintenance is in charge of landscape and grounds maintenance for 255 acres of developed landscape on the main (E&G funded) campus.
- Campus Trash Removal is contracted through Landscape Services with the City of Columbia and has been since 1984. Prior to that time this was conducted in-house by Landscape Services.

Landscape Services has MU's grounds divided into "classes" based on visibility, traffic, and location relative to the campus' center.

- *Class A* ground refers to areas of intensive high use, high visibility, and part of the campus center. 28 acres
- *Class B* ground refers to high use, medium visibility area. 92 acres
- *Class C* ground refers to low use land on the campus periphery. 135 acres
- *Class D* ground are areas maintained by contract (for Residential Life, for Parking and Transportation, for KOMU, etc.) 41 acres

Because high visibility Class A areas are important for MU's image and outreach, these areas receive extra attention, plantings, chemical applications, and other miscellaneous services to maintain a certain aesthetic appearance. Of the campus' 700 acres, 300 are currently landscaped.

Quantitative Data
Mowing*:* Mowing takes place an average of 36 to 42 times per year. Mowing equipment is usually set to mow at an actual cutting height of 3 inches; this has been determined a suitable height based on the grass type and the lack of irrigation. It's also considered helpful to have 3" grass because it helps restrict weeds by shading out the seedlings. Class C areas are mowed once every ten days to ca cutting height of 3.5 inches.

Trees*:* Currently there are approximately 5,000 landscape trees on campus. Landscape services plants an average of approximately 300 new landscape trees per year on campus. Trees are selected for their range, hardiness, low-maintenance features and drought resistance

Flowers*:* Approximately 28,000 annual flowers are planted each year. Class B areas are planted with daffodil and day lilies as these are easily maintained.

Turf: Each year, Landscape Services applies over 49,000 pounds of fertilizer and plants 6,000 pounds of Bermuda, Turftype Fescue, Zoysia, and Bluegrass seed. Class A ground is irrigated and receives weed control

applications. Crabgrass, dandelions, and plantain are considered unacceptable plants in Class A areas. Class C areas are mowed once every ten days to a cutting height of 3.5 inches.

Trash: In 2000, 7258 tons of trash were removed.

Budge*t*: Annually, about 45% of the Landscape Services budget is spent on horticultural activities such as turf maintenance, annual and perennial flowers, tree and shrub management, integrated pest management, and related services. The remaining 55% is spent on grounds maintenance activities including snow removal, litter collection, equipment replacement, equipment repair, repair of site amenities, and administration.

Snow removal*:* On average, Landscape Services uses more than 42 tons of potassium chloride and 100 tons of sand each year to alleviate icy conditions on walkways and drives.

Trends:

- Lawns are being replaced with native prairie grasses in low-visibility areas.
- Certain exotic flowers which are high maintenance are being phased out

Policies and Procedures

Landscape Services tries to use non-toxic sprays, soaps, botanicals, and biologicals. It uses no "restricted" pesticides. Workers are "Certified Pesticide Applicators." Application of chemicals is made in accordance to limits set by federal law. Chemicals are used by "spot application" whenever possible, rather than sweeping entire areas.

Policies regarding turf maintenance vary according to area class. Landscape Services has written policies (e.g. mowing, irrigation, weed control, etc.) for each class of grounds.

Special Initiatives or Challenges

- Tree and shrub prunings are ground into mulch by the City of Columbia and offered free to the public.
- Landscape Services collects grass clippings and fallen leaves only in high visibility areas of campus. The collected material is composted and used on flower beds. Grass clippings and leaves in low-visibility areas are allowed to decompose naturally.
- An Integrated Pest Management system has been adopted; it uses biological, cultural, regulatory, physical and chemical means to control pests, with most effective and economical suppression and minimal effect on non-target species and environment. MU is the only Big-12 university known to have an Integrated Pest Management program in place.

Goals for the Future

A variety of goals are described in the Landscape Services Master Plan.

Rankings

In 1992, Landscape Services received an honorable mention in the Governors' Town Treescape Contest, a project sponsored by the Missouri Department of Conservation. In 2000, Landscape Services received the Grand Award for grounds maintenance excellence from the Professional Grounds Management Society, its top award.

Building Planning, Design & Construction

Background
Planning, Design and Construction (PDC), a unit within Campus Facilities, is responsible for building design, planning for new construction and renovations, and for overseeing construction projects. PDC does not initiate construction projects or determine priorities; rather it responds to direction from the campus community.

Quantitative Data
In a typical recent year, the campus averages $75 million of construction projects. About $5 million annually of this work is handled with in-house staff, while the remainder is contracted to outside firms.

Trends
In the past few years, campus construction activities have been increasing. This increase is projected to continue due to projects such as the Life Sciences Center, the new Arena, the master plan for Residential Life, and remodeling of the Student Recreational Center.

Policies and Procedures
The campus generally follows state and national codes and regulations for new and remodeled buildings. Unlike many commercial buildings, campus buildings are built with a very long projected life—up to 100 years. Thus the campus has developed specific standards for issues such as windows, hardware, and energy usage.

The campus has a Master Plan, which is updated annually. This Master Plan has had numerous positive impacts on campus such as developing an integrated campus design, optimizing pedestrian and traffic flow, and maximizing green space.

Construction projects are developed with input from major stakeholders, including departmental representatives, Parking, Environmental Health and Safety, Energy Management, and Landscape Services. Prior to commencement of construction activities, a PDC Project Manager holds a pre-construction conference with all the stakeholders to ensure a smooth construction project. The Project Manager monitors construction and makes sure that all issues are addressed promptly as they arise. Such issues include storm water management, litter, noise, waste disposal, and general housekeeping at the construction sites.

Special Initiatives or Challenges
Energy issues are addressed by allowing Energy Management to have input during the design stage. As an energy saving measure, hot water is generally not provided for new buildings, except when required for health or research needs. Double glass windows are used to minimize energy losses.

Indoor air quality is addressed in building design by careful placement of exhaust stacks and air intakes. Much of the air is recirculated as an energy efficiency tactic; however, some fresh air is provided to prevent sick building syndrome. Laboratory fume hoods are designed to minimize energy use.

Environmental issues such as asbestos and lead paint are addressed in renovations and demolitions. Backflow regulators are used to prevent water contamination. Special oil-detecting pumps are installed in elevator shaft pits to prevent leaking oil from being released to the soil or surface waters. Non-CFC refrigerants are now specified for all air conditioning needs. Soil from excavation projects is often used for fill on other construction sites.

Parking structures have been constructed in preference to surface lots. This has minimized the amount of land required for parking vehicles, which allows for more green space. Currently, about 35% of the campus parking spaces are in parking structures.

Goals for the Future
PDC has primary goals of completing projects on time and within budget. PDC is open to modifying construction policies and procedures to accommodate regulatory requirements or campus directives.

Ranking
The Committee could not identify any data appropriate for comparison to other universities.

Environmental Education

Background

Environmental Education happens across the MU campus in both formal and non-formal settings. There is an Environmental Studies program which advises students about environmental careers, majors and courses, offers a joint program with Interdisciplinary Studies for students wanting an environmental major leading to a career in advocacy, outreach or policy, and an 18 hour certificate in Environmental Studies that complements majors in other disciplines. In addition, it helps maintain a network of contacts among campus, community and state organizations, and works with student groups, departments, and campus committees (Recycling Committee and Environmental Affairs Committee), to sponsor activities, workshops and speakers to raise environmental awareness and promote sustainable behaviors and decision making. Information on the program, on careers, degrees and environmental issues is available at: http://www.missouri.edu/~esiwww/index.html

The environmental field is quite diverse and many other departments across campus offer degrees that lead directly to environmental careers. Biology and Natural Resources prepare students for conservation and wildlife management careers, Chemistry, Civil Engineering, Geology, and Soils provide preparation in hazardous materials management and water and air protection, resource use and waste reduction. In addition, over a dozen departments offer courses with environmental content. These include History, Political Science, Anthropology, Agricultural Economics, Economics, Rural Sociology and Sociology.

Environmental education at MU goes back to the 1970's when student groups and individual faculty members began including environmental information in presentations and classes. Natural Resources, because of its focus on forests, fisheries and wildlife, had a long history of promoting conservation education. In the 1990's a number of faculty, students and staff came together in a day-long workshop to discuss establishing a more formal program in environmental education. As a result of their efforts, the Environmental Studies program was established in 1995 to support interdisciplinary environmental education on the MU campus and to help prepare students for environmental professions.

Quantitative Data

Advocacy/Outreach/Policy

Environmental Studies: Over 500 students a year take introductory environmental courses that serve as foundation courses for the certificate program. There are over 60 courses with significant environmental content, about half in the Social and Behavioral Sciences and half in the Natural and Applied Sciences. The Environmental Studies program advises an average of 50 students a year on careers, majors and courses and annually oversees 10-20 students pursuing a certificate. Students with a certificate have to be earning an approved major. The environmental courses complement the major and can be used for General Education credit. Students get interdisciplinary preparation for advocacy, outreach or policy jobs. Over the last five years, an average of 8 students per year have graduated with a certificate.

Interdisciplinary/Environmental Studies: The two programs jointly offer an Interdisciplinary Degree with an emphasis area in Environmental Studies. The program includes approximately 15 hours in upper level Natural and Applied Sciences courses (Biology, Chemistry, Geology, Natural Resources), 15 hours in upper level Social and Behavioral Sciences courses (Agricultural Economics, Anthropology, Economics, Geography, Political Science, Rural Sociology, Sociology), and a 9 hour practicum core that includes an undergraduate seminar, an internship and a capstone project. This program began in the fall of 2002 and does not yet have graduates. Information on this major is available at: http://www.missouri.edu/~esiwww/major.html.

Conservation and Wildlife Management

Fisheries and Wildlife The areas of study include wildlife ecology, water quality, habitat management, fishery science and conservation. In addition to courses in the biology and ecology of fish and wildlife there is a strong

emphasis on communication and quantitative skills. The program graduates between 25-30 students per year. Information on Fisheries and Wildlife is available at http://www.snr.missouri.edu/fw/.

Forestry: The Forestry program is designed to prepare students for forestry management positions with industry, government, environmental organizations and consulting firms. In addition to coursework on forests, dendrology, and plant ecology, there is an emphasis on soils and water quality, and communication and quantitative skills. There are between 10-12 graduates per year. Information on Forestry is available at: http://www.snr.missouri.edu/forestry/.

Scientific and Technical Services

Chemistry: These students are academically prepared to take places in industry or government agencies where they can play a role in monitoring or reducing hazardous chemicals in the environment. This program graduates approximately 15-20 students per year. There is more information at: http://www.chem.missouri.edu/

Civil and Environmental Engineering: Students are educated to control water and air pollution and to deal with hazardous and solid waste problems. This program has approximately 200 undergraduates and graduates an average of 65 B.S. students every year. There is more information at: http://www.engineering.missouri.edu/civil.htm.

Geology: The Geology Department offers a B.A. in Environmental Geology and a B.S. in Geology with collateral areas in Natural Resources, Civil and Environmental Engineering, or Soil and Atmospheric Sciences. The program averages 6-8 graduates a year. Information on the program is available at: http://web.missouri.edu/~geolwww/.

Soil Science: This program in the School of Natural Resources focuses on the physical aspects of the environment, particularly the soil environment and its influence on agricultural productivity and water quality. This program average 2-3 graduates per year. For more information check out: http://www.snr.missouri.edu/soil/.

Environmental Education

Parks, Recreation and Tourism: While not specifically geared towards environmental education, this program does prepare students for Outdoor Education, a significant component of environmental education. This program average 40 graduates per year, though only a small percentage enters the field of environmental education. More information is available at: <http://www.snr.missouri.edu/prt/>.

Trends

A survey of 291 undergraduates (1.6% of the MU undergraduates) in 2000 showed a high level of interest in some kind of environmental education but low awareness of the current availability of such education at MU. In response to the survey, 17% of students indicated they would be interested in an environmental minor and from 9% indicated interest in an environmental studies or sciences major. This suggests that there is potential for growth in the certificate program and in environmental majors if they become better known on campus.

Over the last 5 to 7 years, several academic departments (Civil and Environmental Engineering, Geology, Natural Resources) have added more environmental coursework, particularly in the social and behavioral sciences, to their degree programs or have incorporated more environmental perspectives in their training.

Policies and Procedures

Academic majors are governed by policies of departments and colleges. Course offerings depend on student need (some courses are required by national accrediting agencies, particularly in the conservation and wildlife areas and in scientific and technical services) and by student interest.

Environmental Studies is located in the Provost's office instead of in an academic college (i.e. Arts and Science or Agriculture) so that it can be interdisciplinary, accepting for credit any course which meets its standards, regardless of which college it is housed in. The program is governed by an executive committee that meets monthly and it communicates on a regular basis with a loose affiliation of faculty, staff, administrators and students numbering over 100. When major decisions about the program have to be made, this group is informed about the issue and then votes on it. Decisions requiring such a vote in the recent past include formalizing the affiliate status for faculty, and proceeding with establishing a major jointly with the Arts and Sciences Interdisciplinary Studies program.

Special Initiatives or Challenges

Newsletter - Environmental Studies - monthly newsletter reporting on university and community environmental activities. See http://www.missouri.edu/~esiwww/news/

New Courses - Environmental Studies - Analysis of Environmental Issues, Environmental Internship, Environmental Justice

Survey of Interest in Environmental Education - Environmental Studies - see above

Major - an interdisciplinary environmental studies major established in 2002 is aimed at preparing students to work on environmental outreach, advocacy and policy in the public and non-profit sector has been developed with Interdisciplinary Studies. Information on the major is available at http://www.missouri.edu/~esiwww/major.html.

Goals for the Future

Environmental Faculty: To have faculty in other departments formally affiliated with Environmental Studies and involved in advising students and providing information about environmental courses in their departments

Environmental Education: Developing a joint Natural Resources and College of Education degree in Environmental Education

Environmental Literacy: Natural Resources - Development of a 2-course sequence that would prepare students to deal with environmental problems from an interdisciplinary perspective. A possible model for a general education initiative (currently there is no requirement for an environmental course)

Ranking

To evaluate formal environmental education, MU's program was compared to other schools in the Big 12 Conference. These are public universities in the mid-continent area with student populations in the 10s of thousands. Currently, MU's formal environmental education lags behind those of other conference schools. The University of Colorado at Boulder, the University of Kansas at Lawrence, the University of Nebraska at Lincoln, the University of Iowa at Ames and Baylor University in Waco all have environmental majors with several options. Both Kansas State University in Manhattan and Oklahoma State University in Stillwater recently (within the last 2 years) initiated environmental science majors within their natural resources programs. Texas A & M University at College Station, and MU have the equivalent of minors or certificates in an environmental area, though Texas' is much more specialized. The University of Oklahoma at Tulsa, Texas Tech University at Lubbock and the University of Texas at Austin do not list any undergraduate environmental studies or sciences majors. A survey of environmental education programs (Wolfe 2001) showed that approximately 55% of comparable institutions (public research institutions) offered the equivalent of an environmental minor

Non-formal environmental education is much more difficult to evaluate because it is not even clear what should be measured - number of student organizations, sources of environmental information, level of environmental literacy or other factors. Therefore, we do not attempt to make comparisons on that basis. However, because of the high level of community initiative in Columbia and because of the individual involvement of MU faculty, students participate in a wide variety of events: Clean up Columbia Day, Make a Difference Day, Missouri River

Clean Up, Earth Day etc. Students are also involved in expanding the recycling programs in the residence halls to increase the amount of recycling and to reduce contamination.

Reference Cited

Wolfe, V. 2001. A survey of the environmental education of students in non-environmental majors at four-year institutions in the USA. International Journal of Sustainability in Higher Education 2(4):301-305

Farm Operations

Background
The College of Agriculture, Foods and Natural Resources manages 17 farms and centers throughout the state for various research purposes.

Quantitative Data
The Committee received information about: fertilizer application, pesticide application, animal lagoons, soil and water management, pesticide container recycling, used oil recycling, community water protection, and disaster response. This information focused on policies and procedures.

Trends
Most research is aimed at increasing production while decreasing costs, while at the same time maintaining or improving the quality of the soil. As a result, the overall use of fertilizers and pesticides is decreasing as these items are used as efficiently as possible.

Policies and Procedures
For fertilizer application, fertilizer needs are based on soil tests, with timing designed to optimize use and minimize loss. Most fertilizer is applied in blends of N-P-K. Timing of application (e.g. weather conditions, time of year, etc.) is selected to optimize use and minimize loss. In addition, the farms avoid fertilizer formulations that are subject to loss. More recently, security has been heightened because of concerns about the use of ammonium nitrate in explosives and anhydrous ammonia in methamphetamine laboratories.

For pesticides, the farms have an internal recycling system to make more efficient use of pesticides and minimize unnecessary purposes. Gray water from equipment rinsing is collected and used on the fields. Security of pesticides has been emphasized to prevent contact with unauthorized persons. Storage facilities have been designed to provide secondary containment in the event of spills, and fire walls have been put in place to isolate rooms. Farm staff has worked with local fire departments to educate them about the hazards of pesticides stored. Pesticide usage practices are selected to assure the use of the correct compounds, use of proper mixtures, and minimize drift. The farms keep detailed records of pesticide application, including date, target, product, rate, location, weather, and other information. After pesticide application, signs are posted in the fields to restrict entry. The Farms comply with the EPA Worker Protection Standard for pesticide workers.

The farms use management practices to keep soil in place (reduce erosion) such as structures, tillage, and ground cover.

Drinking water supplies are protected by the use of backflow prevention valves. These valves are inspected on an annual basis.

Animal wastes are collected and used to provide nutrients in place of fertilizer. These are applied based on crop needs and nutrient content of the wastes. Animal waste lagoons are managed to prevent discharge and pumped at rates to balance nutrients.

Fuels used on the farms are stored in above ground storage tanks with secondary containment. Used oil is collected for use in a space heater in one of the shops, saving the farms money on heating costs and disposal costs for the used oil.

Foods or grain with off label products (experimental pesticides) are destroyed. Products from experimental genetically modified organisms are destroyed and not sold. Information about grain with approved genetically modified organisms is provided to local elevators to ensure that the grain is not exported.

Arrangements for animal health and safety are overseen by the campus Animal Care and Use Committee. Special precautions are taken to prevent diseases (e.g. foot and mouth disease) being introduced to farm animals.

For disaster response, the Delta Center has been designated as a Regional Emergency Command post for use by the State Emergency Management Agency in the event of an earthquake.

Special Initiatives or Challenges
Farm operations are driven by research needs, so that places constraints on options for the farm managers.

Goals for the Future
No goals were identified by the Committee.

Ranking
The Committee could not identify any data appropriate for comparison to other universities.

MU Research Reactor

Background

The MU Research Reactor (MURR) was constructed in the early 1960s and opened in 1966. MURR has three major categories of activities: biomedical applications, trace analysis, and materials science. Biomedical research applications comprise 2/3 of activities. Development of radiopharmaceuticals to treat various types of cancer is the largest area of emphasis.

The cost of construction was $3.4 million, which equates to $16.3 million in 2000 dollars. Replacement cost is estimated to be $120-180 million. Decommissioning is estimated to be $12-18 million.

MURR is primarily regulated by the Nuclear Regulatory Commission (NRC). NRC conducts inspections three times each year. General information about MURR, including environmental impact issues, can be found through the NRC web site (www.nrc.gov). The NRC prefers that the public obtain information through them rather than through the licensee. The Environmental Protection Agency also has regulations that address releases from the MURR to air, water, and land.

Quantitative data on media the unit manages

MURR is not designed to generate electric power and there are some significant differences between MURR and commercial power reactors. The scale of MURR is $1/1000^{th}$ that of a typical commercial power reactor, such as the AmerenUE Callaway plant.

MURR is scheduled to average at least 150 hours per week at 10 MW. In calendar year 2000, MURR operated at 86% of capacity and at 96% of the schedule. In 2000, MURR received 20 new fuel elements and shipped 8 spent fuel elements to a Department of Energy facility for reprocessing or disposal. As of December 31, 2000, MURR had 28 spent fuel elements and 40 fuel elements in service. In total, MURR had 53 kg of uranium, of which a little more than 47 kg were U-235. MURR uses approximately 25 kg of uranium each year.

In 2000, MURR activities released 120 millicuries (mCi) of tritium and a total of 22 mCi of all other radioisotopes combined to the sanitary sewer system. These releases were approximately 2.4% of the allowable amount. For air releases, 975 Curies (Ci) of Ar-41 (half-life of 1.83 hrs) were released, which was 60.1% of the Technical Specification limit set by NRC. Technical Specification limits are different for each radioisotope and are set individually for each nuclear reactor. Of all the remaining radioisotopes released to the air, none exceeded 0.1% of the Technical Specification limit and the largest amount of radioactivity was 7 Ci of tritium. MURR shipped 3,043 pounds of low specific activity waste for disposal. In addition, two contaminated storage tanks were shipped as radioactive waste.

Environmental samples are collected two times per year at eight locations around the reactor and analyzed for radioactivity. Soil and vegetation samples are taken at each location. Water samples are taken at three of the eight locations.

Trends

MURR is one of many research reactors in the country. In the 1990s, funding for research reactors declined on a national basis and many of them closed down as a result. Today, funding from the federal government is on the upswing because of renewed interest (but not yet orders) in nuclear power and the recognition that the current generation of nuclear power plant operators is close to retirement. Funding for continued operation for MURR appears secure.

Policies and Procedures
MURR enforces its safety program through its physical design, training of personnel, and monitoring by its Health Physics staff.

Because of the design and built-in safeguards, there is no credible accident that could release fission products from fuel into the environment. Engineered design features mean that the research reactor is built with multiple "trips" or safeguards which passively or automatically shut down the reactor quickly and safely. Therefore, any shift toward unsafe limits would result in an automatic shutdown, even without human intervention.

Once a year MURR staff goes through an emergency training that includes the University Police, Joint Communications and the MU News Bureau. A drill with the Columbia Fire Department, Columbia Police Department and hospitals occurs every two years.

Special Initiatives or Challenges
Development of radiopharmaceuticals to treat various types of cancer is the largest area of emphasis. The radiopharmaceuticals receiving the most interest are Therasphere, Quadramet, and Ceretec. To that end, MURR is an active participant in the application to designate Ellis Fischel as a Regional Cancer Center. MURR is also a participant in the campus' Life Sciences Initiative.

In the trace analysis area, MURR provides about 70% of the P-32 used by U.S. researchers. P-32 is one of the most common radioisotopes used in laboratory research.

Because of its high visibility as a target for terrorists, security at MURR has been reviewed and upgraded since the attacks of September 11, 2001. The most visible evidence of heightened security is that access to the building is more stringently controlled. The NRC has also issued guidance and placed additional requirements on all reactors since 9/11/01.

Goals for the Future
MURR intends to continue operation focusing on its three main areas of activity: biomedical (radiopharmaceuticals), trace analysis, and materials science.

Ranking
By most measures, MURR is the largest and most operated research reactor in the country. MURR generates 3-4 times as many kilowatt hours as its closest competitor, which is located at MIT.

Recommendations

The Committee found that many good practices have been implemented. On the other hand, the Committee also found many areas of opportunity. Fiscal concerns and human behavior often place significant constraints on what can be accomplished. It is the aim of the Committee to be understanding in these matters while still holding a vision in mind for the sort of environmentally sound campus we would like to become. For these reasons and because this is the initial report for assessing the environmental impacts of MU activities, the Committee makes the following general recommendations for its future activities:

1. The Committee should develop a small number of indicators to track resource usage by the campus (e.g. energy, water, various types of wastes) and begin collecting data on these indicators on an annual basis.
2. The Committee should publicize this report by distribution to the Administration, Department Heads, posting on the web site, and through the local media.
3. The Committee should develop a vision of what an environmentally sound campus would look like for MU to assist the campus community as programs are planned, implemented, and modified.

We view this report as an initial effort, and welcome feedback about the data collected, the way the material is presented and about any conclusions that are drawn. We hope to publish future reports, and intend to make them more comprehensive by increasing the amount of quantitative data included and by adding other units.

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Tom Flood, Landscape Services
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Bill Harris, Procurement Services
John Humlicek, Residential Life
Paul Hoemann, Energy Management
John Poehlmann, Agricultural Experiment Station
Jan Weaver, Environmental Studies
Rick Wise, Printing Services

For more information about the campus departments that contributed to this report see the following web sites:

Agricultural Experiment Station:	http://aes.missouri.edu/
Energy Management:	http://www.cf.missouri.edu/energy/
Environmental Health and Safety:	http://www.missouri.edu/~muehs/
Environmental Studies:	http://www.missouri.edu/~esiwww/
Landscape Services:	http://www.cf.missouri.edu/ls/index.html
Planning, Design & Construction:	http://www.cf.missouri.edu/pdc/
Printing Services:	http://riker.ps.missouri.edu/
Procurement Services:	http://system.missouri.edu/procurement/
Residential Life:	http://reslife.missouri.edu/
University of Missouri Research Reactor:	http://www.missouri.edu/~murrwww/

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