



AutoSaving

Increasing safety and efficiency of autoclaves and water distillation units at Dalhousie

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Executive Summary

This report explores efficiency and usage patterns of autoclaves and water distillation units on campus. Preliminary research into water distillation is provided, offering insight into users' perspectives on efficiency strategies and creating a solid base for future study. A multi-faceted analysis of autoclave use on campus was used to create a robust cost-benefit analysis to evaluate a proposal put forward by the Office of Environmental Health and Safety to increase efficiency and improve bio-waste safety by centralizing waste neutralization. In addition, usage patterns and user suggestions were incorporated to create several additional recommendations.

The benefits of the proposal presented by Raymond Ilson of the Office of Environmental Health and Safety are numerous; increased safety, reduced water consumption, reduced energy consumption, strengthening Dalhousie's reputation as a sustainability leader and providing significant financial return within a payback period of about 7 years.

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Acknowledgments

We would like to thank Raymond Ilson, Greg McNutt, Bill Grimes, Brendan Brady and the entire Green labs Committee for their time and input. We especially want to thank Rochelle Owen for her seemingly infinite patience, quick email responses and excruciatingly good advice.

Introduction

This paper examines two types of laboratory equipment at Dalhousie in terms of safety and efficiency: steam autoclaves and water distillation units. A cost-benefit analysis was conducted to determine whether a centralized autoclave to neutralize all bio-hazardous waste on campus would benefit the triple bottom line (people, planet & profit). In this analysis, special attention was given to autoclave operational costs, water and energy efficiency and the safety of Dalhousie students, staff, faculty and the surrounding community. A preliminary study was also completed to create an inventory of all water distillation units on campus.

Based on the literature available, there is a strong evidence that universities in Canada and the United States have been able to successfully implement programs to improve efficiency and sustainability of their campus laboratories. Yale University created a 'Green Laboratory Certification

Program'. "The certification is an effort to reduce Yale's greenhouse gas emissions, improve energy efficiency, and lower the collective footprint. The purpose of the certification program is to raise awareness that small changes in lab operation and purchasing habits can create a positive outcome" (Brady & Jorgensen, 2011). Dalhousie recently published the Greening the Labs Report that identified how the labs throughout the Dalhousie campuses could improve the water, energy, and solid waste management.

The client for this project, Raymond Ilson (Director, Office of Environmental Health and Safety), identified the secure handling of bio-hazardous waste as a main concern. 'Biohazardous waste' refers to any waste that presents biological threat to living organisms. This may include, but is not limited to medical waste (primarily infectious materials) and wastes from animal or plant research. Biohazardous waste is a common product as universities with large research institutions, like Dalhousie (Mecklem, 2003). Currently, bio-hazardous waste produced in Dalhousie labs is treated by individual lab technicians in various autoclaves around campus. There is no universal

standard procedure and little guarantee that all campus autoclaves (some of which are over 40 years old) adequately neutralize biohazards (Ray Ilson, personal communication, 17 Feb 2012). Due to this lack of quality assurance, Dalhousie employs the services of Stericycle, a waste management company, to collect and re-autoclave this waste before it is directed to conventional landfills. This service comes at a great cost, totaling \$ 55 987.29 between July 2010 and July 2011. Furthermore, this cost is projected to rise in the future, following the same trend as external nuclear waste management (Ray Ilson, personal communication, 17 Feb 2012; Stericycle invoices: Appendix C). Despite this annual investment in quality assured biohazard disposal, the system is far from perfect. The waste legally belongs to Dalhousie until it reaches the landfill or incineration facility. Any accident or spill that may occur between campus and Stericycle, or between Stericycle and the final waste destination would be a dangerous, expensive and embarrassing disaster for Dalhousie (Raymond Ilson, personal communication, 29 Jan, 2012). The Office of Environmental Health and Safety, in consultation with the Green Labs Committee has proposed an alternative to the current biohazard disposal

system. Dalhousie would no longer require Stericycle services if waste neutralization was centralized and carried out by a dedicated technician with high quality equipment. There would be a plan for a designated vehicle to circulate throughout campus and collect the hazardous waste from the labs, and transport it all back to the autoclave responsible for treating the solid waste. This would also be an investment in the highest safety standards. All bio-hazardous waste would be safe for landfills upon leaving campus, and would be appropriate for disposal with conventional waste.

By improving the way Dalhousie handles its biohazards, load stress on other autoclaves would be reduced. This would also prevent the cross contamination between autoclaves used both for equipment sterilization and biohazard neutralization, as is the current practice. In addition, it is predicted that with secondary monitoring contamination from other waste streams would be prevented, reducing the total volume of waste included in biohazard disposal (Raymond Ilson, personal communication, Jan 29, 2012).

As Dalhousie works hard to improve campus sustainability and develop a national reputation, energy and water efficiency are increasingly important issues. Dalhousie currently operates 37 autoclaves (Autoclave Inventory: Appendix A). The majority of this equipment was purchased in the 1970-1980s and most models are between 20 and 40 years old. There is a huge potential to increase both water and energy efficiency. Investment in new equipment could provide energy and water savings of up to 90% (Appendix B).

supported the development of quantitative research tools and a practical framework to ensure that all recommendations were appropriate to the needs of Dalhousie lab users (Vivar et. al., 2007).

Methods

Study Design

A diverse set of research methods, both quantitative and qualitative, contributed to this report; expert consultations, a review of existing data and literature and an online survey.

The quantitative research, including data on energy and water consumption, cost projections, and hours of autoclave use in Dalhousie labs enabled access of data from a large sample and the collection of instrumental statistics that will aid decision making (Vivar et. al., 2007).

Qualitative research, in the form of expert consultations and survey questions, offers a better understanding of how stakeholders use autoclaves and distilled water. This

Survey Participants:

- Animal Care Facility
- CIFT
- Dept of Anatomy & Neurobiology
- Dept of Bio Chem & Molecular Bio
- Dept of Biology
- Dept of Biological Engineering
- Dept of Chemistry
- Dept of Marine Biology
- Dept of Microbiology & Immunology
- Dept of Neuroscience
- Dept of Pathology
- Dept of Pediatrics
- Dept of Pharmacology
- Dept of Physiology
- Dept of Psychology
- Atlantic Research Centre
- Process Engineering and Applied Science
- Civil Resource Engineering

Literature Review

A review of existing data and literature provided support for the development of the scope of the quantitative research and provided crucial technical information on autoclaves and distilled water units. Previous research completed at Dalhousie included the Office of Sustainability's Green Labs Report (Brady & Jorgensen, 2011) and Dalhousie's Biosafety Manual for autoclave procedures (Biosafety Committee, 2010). Raymond Ilson, director of the Office of Health and Safety, was able to provide an inventory of autoclaves on campus (Appendix A), technical manuals from campus autoclaves and cost information for biohazardous waste removal (Appendix C). Further literature was reviewed to collect information from other universities and from industry to determine the best practices for autoclaves and distilled water units.

Expert Consultations

Informal meetings and consultations provided preliminary qualitative research of the autoclaving and water distillation

systems on campus and the needs of users. This information was instrumental in developing survey questions that would be relevant to users and provided a basis of for the direction of technical research. Touring laboratory facilities with Raymond Ilson contributed to an understanding of how autoclave and distilled water equipment is used, areas for improved efficiency and an overview of the plans for centralized autoclaves that the Office of Environmental Health and Safety aims to implement. A meeting with the Green Labs Committee and Brendan Brady, one of the authors of the recent Green Labs Report, provided information on the current data available on autoclave and water distillation efficiency as a starting point and methods for further data collection. Meeting with an autoclave technician provided information on autoclave procedures, maintenance, decommissioning, and replacement that contributed to the cost assessment and provided details for developing the online survey. Autoclave manufacturers were also contacted for energy and water consumption details of Dalhousie equipment.

Survey

An online survey was developed to collect perspectives and usage patterns from Dalhousie researchers who require autoclaves and/or distilled water in their laboratories (Appendix E). This survey was administered through the online survey software Opinio, minimizing social desirability bias that may be present in interviews and allowing a flexible schedule for users to complete the survey. Both open and closed question formats were used in the survey, providing quantitative technical information for our efficiency analysis alongside opportunities for respondents to provide depth and personal experience to the recommendations created through this research.

The survey consisted of two distinct sections pertaining to autoclaves and distilled water. The distilled water section was designed to determine the types of distilled water used on campus (bottled, conventionally distilled, reverse osmosis), the location of distillation equipment and to incorporate user opinions and recommendations in efficiency strategies and decision making.

The autoclave section was more detailed, collecting data on:

- faculty or department
- specific autoclave in use
- average distance travelled to use the equipment
- load type (waste or equipment sterilization)
- load size
- usage hours per week

Open ended questions were also included to incorporate users' evaluation of efficiency measures (existing and proposed) and suggestions for how to improve autoclave and water distillation efficiency, quality and accessibility.

The survey was distributed to lab users by department administrators. This constitutes non-probabilistic targeted sampling, as the survey was only sent out to laboratory users and each section of detailed questions became available only when the respondent confirmed they used either distilled water or autoclaves in their research. The drafted survey was reviewed by the Green Labs Committee, pilot tested and revised before it was delivered.

Procedure

- I. Literature review
- II. Technical equipment manuals
 - i. Dalhousie Green Labs Report
 - ii. Industry literature on lab equipment efficiency
 - iii. Case studies from other universities
- III. Expert Consultations
 - i. Green Labs Committee
 - ii. Raymond Ilson, Office of Environmental Health and Safety
 - iii. Brendan Brady, Office of Sustainability (Green Labs Report co-author)
 - iv. Bill Grimes, Autoclave Technician
- IV. Survey design
 - i. Revisions based on consultation with Green Labs Committee
- V. Pilot test
 - i. Revisions to improve clarity
- VI. Opinion training
- VII. Survey Delivery
 - i. Survey distributed by researchers to administration in relevant departments
 - ii. Survey distributed to participants by department administration
- VIII. Data Analysis & Synthesis
 - i. Statistical analysis of closed answer questions
 - ii. Identification of themes in open answer questions
 - iii. Synthesis of responses to produce usage maps

Validity & Reliability

Surveys are generally subject to weak validity simply due to format; true perspectives are difficult to capture in dichotomies such as “agree/disagree” (Colorado State University, 2012). To control for this, questions that inquired

on support for or agreement with a strategy were framed in Likert rating format.

The survey was subject to review by the Green Labs committee and underwent pilot testing to ensure high content and construct validity. After both the review and the pilot test, revisions were made to ensure clarity of language and relevance to autoclave and distilled water users. During the study, however, feedback from one respondent indicated that the survey did not apply to the way some laboratories use the autoclaves. This comment was taken under consideration, and may explain why not all respondents answered every question. This comment provides incentive to do more qualitative research into autoclave use, however it does not change the validity of the answers provided. The questions were specific, clearly stated and provided opportunities for respondents to indicate if the the question did not apply to their lab. In cases when it was possible that one of the provided options would not reflect user behaviour -- in a multiple choice question, for example -- they had the option of entering a unique response in an "other" category. It must be noted however, that all questions are subject to

interpretation by the survey respondent, despite efforts to create clear and specific questions.

Survey research is generally strong in measures of reliability (Colorado State University, 2012). By carefully wording the survey and ensuring a clear format, the risk of unreliability was significantly reduced, however it could not be eliminated completely. Question 10 in which participants were asked to rate efficiency practices, was not included in our statistical analysis because of reduced reliability and validity. Due to a misunderstanding with the software, the rating numbers were not visible to participants. Although many responses added in the comment section that they assumed the left was low and the right was high, this confusion reduced the reliability of responses. In addition, the rating question allowed respondents to give different options the same importance. As a result, the majority of respondents rated all efficiency measures equally. This meant that the question was no longer measuring what it was supposed to measure -- which efficiency measures are most important to users -- and it was no longer valid. To improve this question, the software formatting could have

been improved to make the numbers visible and the format changed from rating to ranking.

Data Analysis

The results of the survey were interpreted by coding closed-ended survey questions and conducting statistical analysis on the data. Usage patterns were mapped based on which autoclave respondents used, how many hours a week were reported and the load type (biohazardous waste or equipment sterilization). The open ended survey questions will be summarized by pulling out key viewpoints and extrapolating to make recommendations.

Technical information gained during the literature review or directly from autoclave manufacturers was used to build the cost benefit analysis of the waste autoclave centralization plan proposed by the Dalhousie Office of Environmental Health and Safety. Water usage was estimated from typical values for autoclaves and distilled water units of different sizes and types with data from secondary sources or manufacturers. Due to the old age of most autoclaves on

Dalhousie campus complete manufacturer information was not available for all models, and average consumption rates were used in these calculations. Costs and savings were calculated over time using current and projected operating including hazardous waste removal services (Appendix C), creating an autoclave technician position (Raymond Ilson, personal communication, 29 Jan 2012), water/energy consumption, decommissioning old equipment and installation of new equipment. Qualitative data on safety benefits and general benefits to sustainability at Dalhousie University were also included in the cost benefit analysis.

Limitations & Delimitations

A full energy and water audit of existing autoclaves and water distillation units was beyond the scope of this research due to time restrictions and limited research equipment. Due to these delimitations, energy and water consumption calculations relied on estimates and average rates provided by previous research and technical documents from manufacturers. In addition, there is no existing inventory of water distillation units on campus. The

research into this equipment was limited to very basic information (type, location etc) in order to build a preliminary picture of how distilled water is procured or produced for Dalhousie labs. Although a complete audit and inventory was beyond the scope of this project, the data collected provides a useful basis for further analysis of water distillation.

A primary limitation in this research was a relatively low response rate. Although 80 participants began the survey, only 60 finished and many did not answer every question throughout. A small sample makes it difficult to apply statistical analysis to some areas of the survey. The survey also revealed that different departments use autoclaves very differently, so figures like average usage hours are subject to a great deal of variability among users. The assumptions and estimations made during the cost benefit analysis present another limitation.

Due to the limited availability of data, the projected costs of water and energy consumption were calculated based on the following assumptions:

- Water consumption
 - one of the proposed new autoclave (Sterilco SV-160) units is equipped with thermostatically controlled water saving device, saving 75% of water used compared to a standard autoclave (Sterilco, 2009); it was assumed that the second unit (Steris SV-3043) represents comparable water savings, although it was not possible to determine whether the same efficiency technology is incorporated

- Energy consumption
 - no consumption information was available for the specific models owned by Dalhousie, although consumption data from a conventional autoclave unit of the same size as those being analyzed was used under the assumption that energy consumption is consistent between units

Results

Survey Results

The Opinio survey was completed online by 60 individuals who use autoclave and distilled water units in Dalhousie laboratories. The 60 participants were Dalhousie staff and faculty members who were associated with various scientific and medical departments. The survey asked the participants about water and energy efficiency of autoclave and distilled water units. The biology department showed the highest participation rate at approximately 27% (Figure 1).

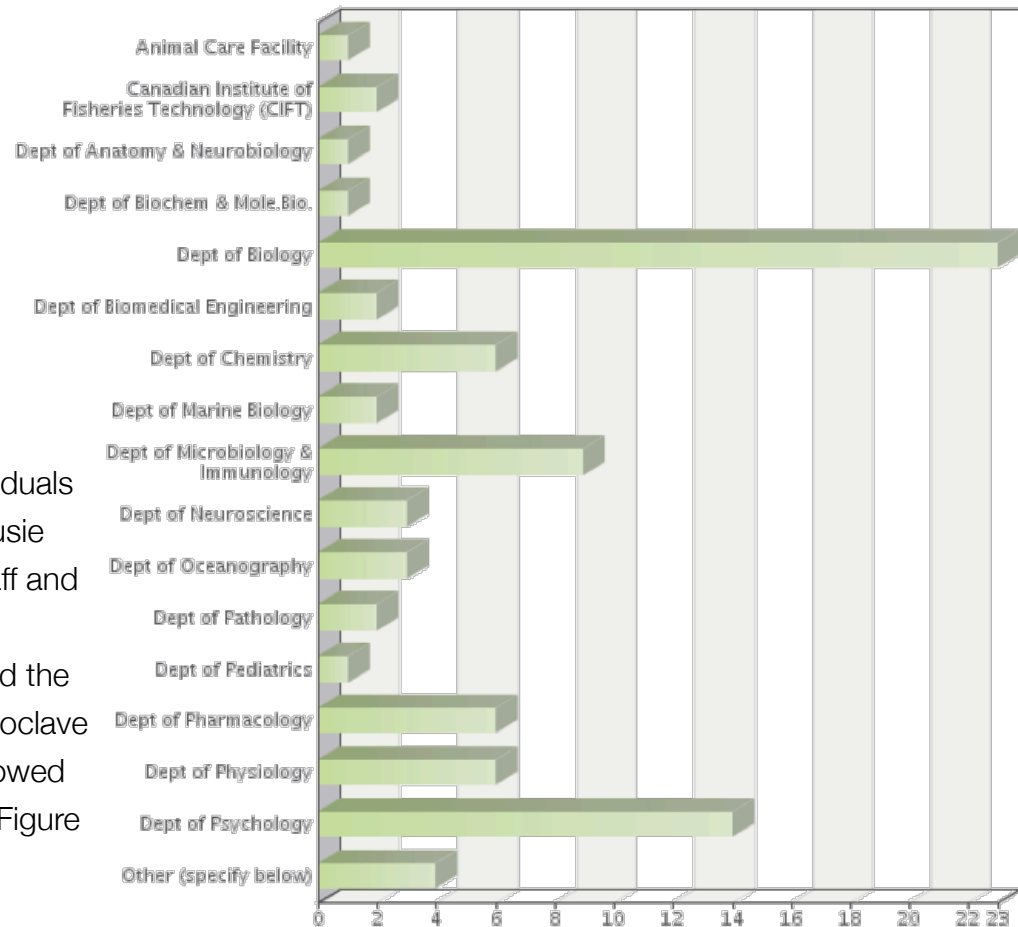


Figure 1: distribution of survey participants by departments.

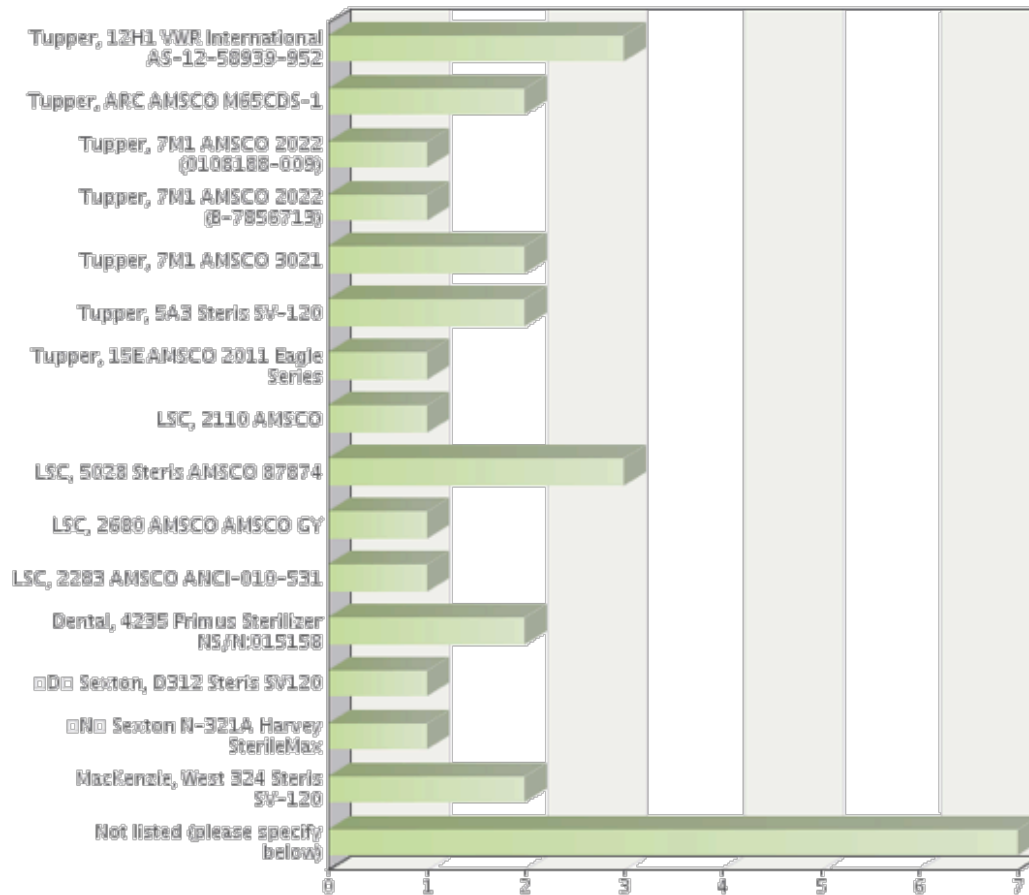


Figure 2: Specific autoclave usage

Autoclaves

Sixty percent of respondents answered that they have used autoclaves on Dalhousie campus.

Therefore, the rest of the autoclave- related questions (question 3 to 10) were expected to receive less than 52 responses, however only 30 participants answered each

question on average. This may be due to different autoclave use practices rendering the questions irrelevant, as noted in the Methods section. The majority of autoclaves were located in the Tupper building on Carlton campus and Life Science (LSC) building on Studley campus. Although many participants answered that their autoclave was not listed when the text entry was examined, most of the responses were part of the drop down list, but had simply been overlooked. Four participants mentioned that they use “Amresco” [sic] autoclaves on 6th floor of LSC building. This may represent an autoclave that was not included in the inventory, or an autoclave that has been moved since. Among autoclaves listed on the survey (Figure 2) “Steris AMSCO 87874” located in Room 5028, LSC building and “VWR International AS-12-58939-952” located in Room 12H1, Tupper building receive the most traffic.

Participants indicated how often they use autoclaves for neutralizing biohazard wastes on a weekly basis. Figure 3 presents the frequency of autoclave usage. The ‘zero’ column represents 4 participants who do not use the autoclaves for the purpose of bio-waste neutralization. 18 participants used the autoclaves for neutralizing biohazard

wastes approximately less than three hours every week. Only 4 participants answered that they used autoclaves for this purpose more than 3 hours each week.

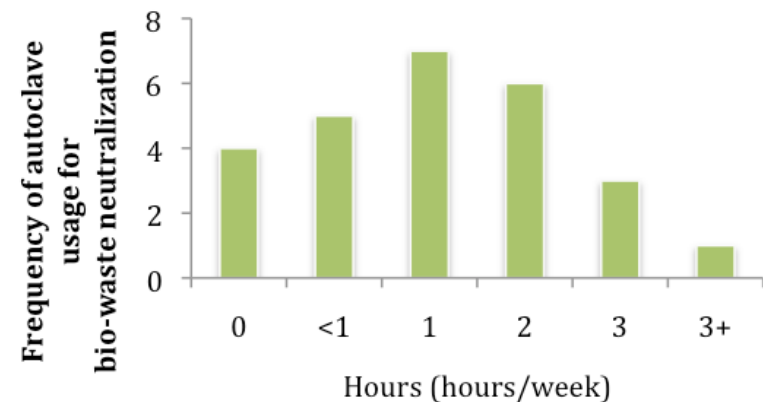


Figure 3: Frequency of autoclave usage for neutralization of bio-waste

On the other hand, for the sterilization of lab equipment, the participants tended to use the autoclaves more often. According to Figure 4, there is no “zero frequency” of autoclave usage for sterilization. 21 participants responded that they used the autoclaves at least 3 hours every week

for sterilization. Moreover, 6 participants stated that they used the autoclaves to sterilize their equipment for more than 6 hours per week. These results indicated that the autoclaves were used more for sterilization purposes rather than waste neutralization.

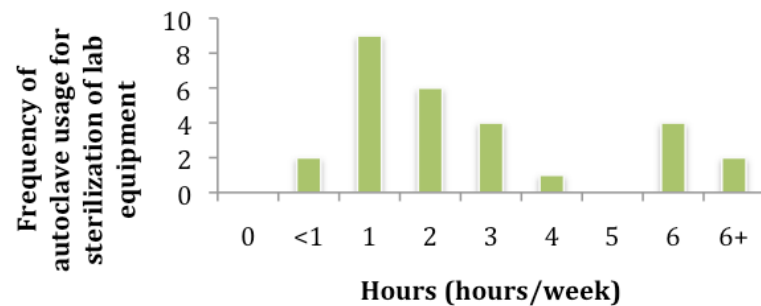


Figure 4: Frequency of autoclave usage for sterilization of lab equipment

Participants were also asked about how far they traveled to use autoclaves. The responses to this question were significant due to the risk of bio-hazardous spills.

Surprisingly, 48% of participants responded that the autoclaves are on different floors, but in the same building. This indicates that bio-hazardous wastes are carried through elevators, stairs and hallways regularly. Seventeen percent of participants responded that the autoclaves are located in their laboratories, 21% of respondents travelled 10-20 metres to convey bio-hazardous wastes to the autoclaves and 10% of them travelled 20-40 metres. One participant answered that he or she travels more than 40 meters on the same floor.

In order to determine load efficiency, participants were asked how full they generally fill the autoclave. Only 24% of participants answered that they filled the autoclaves at maximum capacity level. On the other hand, over 60% of users report that their autoclave loads are only 50% full or less. This implies that the autoclaves are not properly managed and some participants may consume more water and energy than they need.

Autoclave use policies were also included on the survey. Participants were asked if there is a policy for times when the autoclaves should be turned off. Forty percent of

participants responded “not sure” and 38% of them answered “no”. Only 21% of the participants answered “yes”. Additionally, some participants commented that the autoclaves should be turned off between 8pm and 6am or whenever they are not in use. These results show that more efficient autoclave management is needed.

Distilled Water Systems

Of the 52 participants who recorded that they use distilled water in their lab, 22 asserted that the distilled water used comes from a centralized unit and they receive the distilled water from taps in their laboratory. Twelve people recorded that they received their lab distilled water from a water distillation unit inside of the lab and 4 people recorded that they received their water from a water distillation unit outside of their lab. In addition 7 participants receive their distilled water from a reverse osmosis system within their laboratory and 8 participants claimed they received it from a reverse osmosis system outside of their lab. Only 2 participants reported that they did not know the source of distilled water for their lab. Because some participants

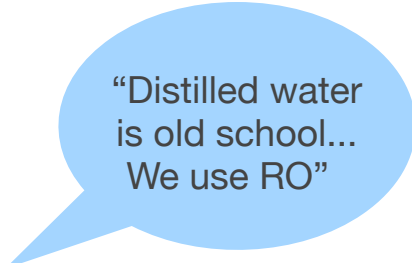
reported receiving distilled water from more than one source, there are more responses than participants.

Open Question Themes

Among the open ended questions was “How could water and energy efficiency of water distillation be improved?”

Answers included:

- Update purification systems
- Install a timer to prevent occasional overflow
- Install a larger holding tank for the filtered water to prevent delays.
- Invest in centralized reverse osmosis systems
- Dedicated unit on each floor rather than in each lab.
- Water heaters were plumbed in each lab, rather than a centralized water tank in the basement (the water must be run for at least 5 minutes before hot water is produced)
- Have the tanks pre-measured so water cannot be wasted during experiments.



“Distilled water is old school... We use RO”

Discussion

Current data on water distillation units in Dalhousie labs is severely limited. Included in this project is the development of a water distillation equipment audit, informed by surveys delivered to Dalhousie lab users. The information gathered on water distillation by this report will be crucial to the development of future research to determine the best ways to improve laboratory water efficiency.

Water Distillation Survey

Research into water distillation systems aimed to uncover strategies to increase efficiency that would also support lab users. The three questions in the survey were:

- I. Do you use distilled water in your lab?
- II. How do you get distilled water in your lab?

- III. How could water and energy efficiency of water distillation be improved?

The most consistent and popular answer was that the system participants use to extract distilled water is out of date, and a newer distilled water system would offer significant improvements. However, not all participants were aware of how improvements could be made to increase the efficiency of distilled water.

Effectiveness reverse osmosis (RO) is measured by its rejection percentage, meaning the percent of filtration of contaminants within the initial body of water that gets rejected by the purification system. RO rejects up to 92% of nitrates, up to 99% of total dissolved solids, up to 98% of sulphates, and up to 93% of sodium. Rejection percentages were not available for water distillation units, however some volatile organic compounds (VOC's) have around the same boiling point as water, and therefore there is a high chance that not all of the compounds are removed by thermal distillation. Also, bacteria may be removed by water distillation units initially, however, bacteria can re-colonise on the cooling coils when the distillation unit is

inactive. In addition to effectiveness, RO units use up to 90% less water than conventional distillation, which constantly run cold waste water through the system to cool it. Thermal distillation is also very energy intensive, as all water must be heated above boiling point (Bergsrud et al., 1992).

Autoclave Use & Efficiency Survey

The majority of autoclave users who responded to our survey were associated with the Department of Biology, although a total of 18 different departments and research groups replied to the survey. Throughout the survey responses it is obvious that different departments use the autoclaves very differently. This is largely due to the lab requirements for different types of research; while some respondent never autoclave biohazardous waste, some respondents are neutralizing up to 5 loads of biological every week. There was even more variability in the equipment sterilization, ranging from 1 to 16 loads of equipment sterilized per week, per lab. This variability in practice and frequency of use also contributes to

differences in autoclave practices and the lack of quality control on the current biohazard neutralization system. There is also a high level of dual use; autoclaves that are used both for equipment sterilization and waste neutralization. By accepting the Office of Environmental Health and safety, the load stress on various autoclaves would be reduced (by up to 5 loads a week, in some cases) and the risk of cross contamination between bio hazardous waste and equipment sterilization would be removed. Even greater efficiency will be gained by maximizing waste loads. Currently over 60% of users report that their autoclave loads are only 50% full or less. Based on our study, almost a third of autoclave use (27%) is waste neutralization. By instituting a centralized waste autoclave with load maximization, overall stress on autoclaves would be reduced by over 13%. By instituting a campus wide policy to maximize sanitation loads, only running the autoclave when full, waste and water consumption by autoclaves could be reduced a further 37%.

Behaviour changes offer the most cost effective way to reduce environmental impact. The majority of respondents (41%) indicated that they were not aware of any policies in

place to regulate when the autoclaves should be powered down and almost as many (39%) indicated that such policies do not exist in their lab. Autoclaves remain running at standby, consuming energy and water, if they are not completely shut down. By simply creating a policy to turn autoclaves completely off when not in use (as indicated by 5 respondents) or by turning autoclaves off at night (as indicated by 3 respondents), significant savings can be made. Different practices will be suitable to different labs depending on how often the autoclave is used.

Consultations with the Green Labs Committee suggested that many autoclaves run around the clock, simply for convenience sake. By instituting a policy to turn autoclaves off, users will be required to plan ahead, as the autoclaves generally take 30-45 minutes to power up (Green Labs Committee, personal communication, 13 Feb 2012). By transitioning waste neutralization to a centralized autoclave, load stress on general use autoclaves will be reduced, creating more opportunity for this time of behaviour change. Since most labs only use the autoclaves for 1-3 equipment sanitations loads, this practice would often be the most appropriate. In the labs that are doing 10-16

loads a week, it may make more sense to only turn off autoclaves at night.

In addition to examining survey results for opportunities to increase efficiency and quality of equipment, safety was a priority. The majority of survey respondents travel to a different floor to use autoclaves in other labs, others cited traveling between 10 and 40 metres to reach other labs on the same floor and only 17% use an autoclave located in their own lab. This means that biohazardous waste is being carried untreated through the halls, stairwells and elevators of Dalhousie, posing a significant risk. Based on the proposal to centralize waste treatment, a specialized technician would collect biohazardous waste from labs, and transportation would be in a controlled, biohazard safe cart, created specifically for the safe transport of this type of waste.

Cost Benefit Analysis

The following cost benefit analysis is for the EHS office's proposed plan to centralize biohazardous waste neutralization to two new efficient autoclaves installed in the basement of the Sir Charles Tupper Medical Building. The cost of purchase and installation of the two new units was provided by Raymond Ilson and totals \$ 75 430 (Ray Ilson, personal communication, 29 Jan 2012).

The department of medicine has identified three autoclaves in the Tupper Building that may be decommissioned without affecting services (Greg McNutt, personal communication with Raymond Ilson, 29 March 2012). The removal of these autoclaves will not cost Dalhousie since autoclaves are comprised of valuable metal that can be reused and recycled and therefore scrap metal collectors, Dartmouth Metals Ltd., will pay Dalhousie for the removal. Autoclave Technician, Bill Grimes estimated a return of

\$210 per autoclave removed based on a past removal at Dalhousie by Dartmouth Metals Ltd. Removing these autoclaves will also reduce the annual maintenance and cleaning costs of Dalhousie's collection of autoclave machines and help balance the annual costs of two new machines. Estimates of maintenance and cleaning costs were extracted from Ilson's estimate of annual operating costs.

The majority of the annual savings comes from eliminating the reliance on Stericylce waste removal at \$56 000 per year (Appendix C). The waste neutralized by the new central autoclaves can be assured as safe for regular waste disposal which costs \$175 per tonne (personal communication, HRM Waste Management, 13 April 2012). Dalhousie produces an estimated 40 tonnes of bio-waste per year based on the past Stericylce waste removal records. This adds on to the annual costs of the centralization plan but is much cheaper than employing Stericylce at \$ 7 000 per year.

The following are results of the cost and benefit research in terms of the triple-bottom line: people, planet, profits. The

benefits of the centralization plan coincide with the EHS Office's goals of providing a healthy and safe work and study environment and the Office of Sustainability's goals of making campus operations more sustainable with positive social, ecological and economic changes.

Assumptions

- An average autoclave uses approximately 1514 L of water per cycle (Alliance for Water Efficiency, n.d.)
- The newly purchased autoclaves have water saving features that reduce the above water consumption by 75% (Appendix B)
- An average of 42 hours per week is currently spent on autoclaving biowaste based on an average 1.20 hours per week from the survey responses and multiplied by the 35 autoclaves on campus
- Centralizing would reduce hours needed to autoclave the current flow of biowaste by 50% based on the survey results that indicated 62% of respondents use autoclaves at 50% capacity or less

- An average autoclave draws 3.565 kWh based on user based estimates for a medium sized conventional autoclave unit (Steris SV-120, five currently on campus and each purchased between 2003-2011; Sterilco, 2009)
- Due to lack of information on energy efficiency it was assumed that the newly purchased autoclaves are no more energy conserving than the old ones in order to make a conservative energy savings estimate

Initial Investment		(\$)
Purchase + Installation of Centralized Autoclaves	Sterilco SV-160 ¹	- 20 000
	Steris SV-3043 ¹	- 55 430
Decommissioning Returns on Autoclaves (x3) ²		630
Total		- 74 800

1. (Raymond Ilson, personal communication, 2012)

2. (Bill Grimes, personal communication, 20112)

3. (Raymond Ilson, personal communication, 2012)

4. Waste calculated from current tonnage removed by Stericycle

Profits

The following table summarizes investments and savings of the proposed centralization plan with an estimate of total time to payback. Two models are given: one that includes water and energy savings and one that does not. This was provided due to the estimations made on energy and water consumption, however it is likely that these estimates are lower, and potential savings are greater than the figures provided here. The profits side of this analysis indicates that the centralization plan will yield payback for Dalhousie in a relatively short period of time of about 7 years. The payback time was given without water and energy savings factored in because there were barriers to obtaining reliable and reproducible values for these savings and our estimates may greatly differ from real savings due to the number of assumptions made.

All calculations are detailed in Appendix F.

Annual Costs ³		(\$)
Cleaning	\$ 2 000/unit	- 4 000
Maintenance	\$ 4 000/unit	- 8 000
Test Strips		- 2 500
Staffing		- 36 000
Backfill		- 3 600
Staff Benefits		- 6 000
Office Supplies		-500
Waste Removal ⁴	40t at \$175/t	- 7 000
Total		- 67 600
Annual Savings		(\$)
Stericycle		56 000
Reduced Maintenance	\$ 4 000/unit	12 000
Reduced Cleaning	\$ 2 000/unit	6 000
Energy Savings ⁵	3 900 kWh	410
Water Savings ⁵	2 073 000 L	3 730
Total Savings [energy & water incl.]		78 140
Total Savings [w/o energy & water]		74 000

Payback Period [w/o energy & water]	\$
Initial Investment	- 74 800
Gross Annual Costs	- 67 600
Gross Annual Savings	74 000
Net Annual Savings	6 400
Payback Period: 11.70 yrs	

Payback Period [energy & water incl.]	\$
Initial Investment	- 74 800
Gross Annual Costs	- 67 600
Gross Annual Savings	78 140
Net Annual Savings	10 540
Payback Period: 7.10 yrs	

There are a few potential areas for profit savings not identified in the chart above due to lack of quantitative information. The first is reduced maintenance costs associated with having new autoclaves and reducing the usage of old autoclaves. The second is the potential rise in cost of Stericycle services as they are continued to be used. Biowaste removal firms are relatively new and competition amongst firms has been low but these firms may increase their service prices at any time due to rising demand from increased production of biowaste as well as increased awareness and regulations regarding the environmental and health threats posed by biowaste (Armstrong and Reinhardt, 2010).

People

Ibson's primary motive in promoting a centralized system is to increase safety. The centralization plan fosters improved safety by ensuring quality of biowaste sterilization through the use of trained and qualified staff and careful monitoring. Many respondents identified in the survey that they travelled between floors (48%) or travelled greater than 20 metres (14%) with in order to use an autoclave. This travel time can increase the risk of handling biowaste. The centralized plan reduces this risk by having trained staff to pick up the waste from each site and safely transport it to the centralized autoclaves. Risk is also reduced in the transportation of the resulting autoclaved waste by ensuring it is properly sterilized before leaving Dalhousie campus.

Whereas, the current practice of using the Stericylce removal service is not only costly but it also poses a risk because the waste remains the property of Dalhousie until it has reached its destination and the sterility of the waste cannot be ensured in the case of a spill or accident (personal communications, Raymond Ilson).

Another benefit to Dalhousie students and staff is increased laboratory efficiency in terms of time. Many of the respondents identified that they travel between floors to use the autoclave equipment. Also, the results of the survey that show most users do not use autoclaves to full capacity and use them more often for equipment sterilization. These three factors combined demonstrate time inefficiency for autoclave users in the current system. Researchers and staff will benefit from reduced time inefficiencies of autoclaving small loads of biowaste by having biowaste picked up from locations around campus and taken to a central autoclave system.

Planet

Finally, laboratory sustainability is increased through water, energy and waste reductions with benefits to our planet. The water savings are significant with an estimated 2 073 000 Litres/year saved. Centralizing waste autoclaves will

reduce water by upgrading to more water efficient autoclaves, enabling the removal of three older less efficient autoclaves, and eliminating inefficient loads in the other autoclaves on campus. Energy savings are less significant by these estimates but there wasn't sufficient data to make a full comparison. More complete kWh information for autoclaves is in the process of being measured. The estimates are based on a 50% reduction in loads needed to autoclave the same amount of waste using the centralized system and therefore a 50% reduction in energy with an estimate of 3.5 kWh per load (reference). In reality, more energy may be required for full loads or the new machines may have greater energy efficiency than the current autoclaves on campus. There is the potential for waste to be reduced as identified by Raymond Ilson. Monitoring what is going into the autoclaves ensures that there is less contamination of other wastes streams in the biowaste. Resources can also be saved by only autoclaving materials once which then enter the regular waste stream rather than the current system of autoclaving the material then transporting them through Stericylce to be autoclaved again.

Overall, the benefits of this plan outweigh the initial investments and there are no costs to the functional operation of laboratories.

The most significant finding of the cost benefit analysis of centralizing biowaste neutralization is a relatively short payback time of about 7 years or less. Combined with benefits to safety and overall efficiency the results demonstrate that this option would be a great opportunity for greening Dalhousie laboratories. There are no cost barriers to research and staff using autoclaves since the service will be provided to them at no charge or inconvenience. Other upgrades to laboratory equipment can be costly for researchers and they may not see the payback fast enough for it to be feasible or attractive (green labs). Whereas, the centralization plan can benefit Dalhousie as an institution with annual savings of \$10 000/yr after payback and a low initial investment of \$74 800.

The centralized biowaste neutralization plan comes at a reasonable cost in light of other recent efficiency project investments at Dalhousie. For the recent fridge and freezer exchange program the payback time is approximately 7.5 years with an investment of \$200 000 and annual savings of \$26 557 (Dalhousie Office of Sustainability, 2012). Although the water and energy savings analysis would benefit from further research to produce more reliable estimates the initial findings show a huge potential for water savings of 2 073 000 Litres per year. While this is only 0.2% of Dalhousie's yearly water consumption (estimated 1 billion L/year) it is still significant (Howitt, 2004).

The implications of this cost benefit analysis is the incentive needed to make the EHS office's plan a reality. Their primary goal was to increase safety on campus through better management of biohazardous waste but there were cost barriers to the centralization plan. The results of the cost benefit analysis show the feasibility of the plan as well as the added benefits to Dalhousie campus beyond safety.

Conclusion

Based on the data gathered by the group thus far, we were able to make a couple of recommendations based on our findings. Based on the analysis of the cost and benefits of centralizing the autoclave processes on campus, best interests of Dalhousie University -- financially, environmentally, and in terms of safety -- to purchase two high volume autoclaves to handle the hazardous waste loads from labs around campus. This recommendation is paired with the decommissioning of older, unnecessary autoclaves. The Department of Medicine has already identified three autoclaves which can be decommissioned without negatively affecting lab service. Direct communication with lab technicians is recommended to identify other autoclaves to be removed. Each autoclave which is decommissioned will shorten the payback period for the investment in quality controlled, centralized bio-hazardous waste management.

Beyond waste management centralization, there are other options to improve the efficiency of the remaining autoclaves throughout campus. One of the best options available to retrofit existing units is the option to add water savings kits. The addition of water savings kits would ensure that when the autoclaves are not being used there is not water being constantly run though the units to keep the steam pressure up. These retrofits cost about \$ 2 000 and save between 75-90% of water (Sterilco, 2009) . In conjunction with retrofits, another opportunity for further improving the efficiency of autoclaves is through the implementation of best practice guidelines. These policies put in place, would help to regulate the way people use the units. For example, providing labs with clear policies on when to shut down autoclaves (at night, or when not in use) and specific requirements that each load be at least 75% full would significantly increase efficiency at no cost.

Although information on water distillation units was severely limited, this research provided insight into potential efficiency strategies and formed a basis for further study. An examination of the cost/benefits of reverse osmosis units would be valuable in determining the financial costs of replacing the current water distillation units. This would also shed more light on the actual benefits offered by these units, as expressed by the real savings in electricity and water consumption.

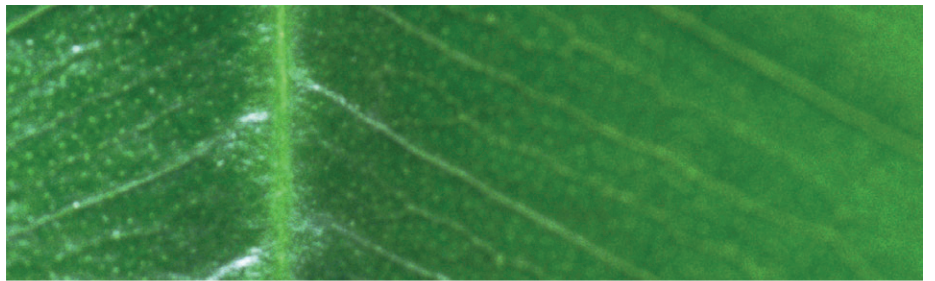
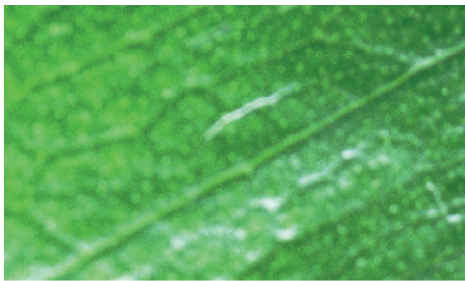
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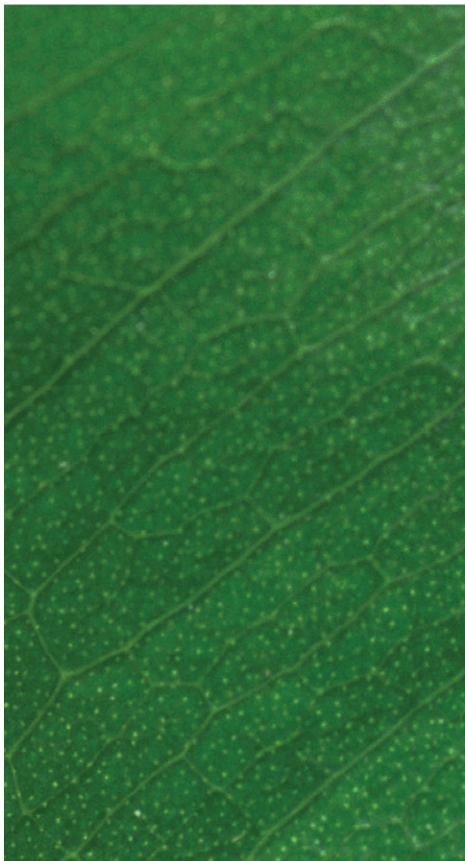
Appendix a) Autoclave Inventory

Building	Department	Room #	Manufacturer	Model #	Serial #	Purchase Date	Person Responsible
Tupper	Anatomy	12H1	VWR International	AS-12-58939-952	1.28E+12	2002	Damaso
Tupper	Animal Care	AC56	AMSCO	M65 CdS	681227-15	1972	
Tupper	Animal Care	AC105	AMSCO	M70ES-4	760308-2	unknown	
Tupper	ARC	ARC	AMSCO	M65CDS-1	0116479-016	<1979	
Tupper	Biochemistry	8K1	AMSCO	Eagle 3021	0109690-13	1985	Heidi Berry
Tupper	Biochemistry	9T1	Steris AMSCO	Sv-120	0103306-50	2006	Debby Fice
Tupper	Biochemistry	10K2	Steris	Sv-120	0124404-10	2005	Joice (Dobson lab)
Tupper	Microbiology	7M1	AMSCO	2022	0108188-009	1988	Donna Shunaman
Tupper	Microbiology	7M1	AMSCO	2022	B-7856713	1988	Donna Shunaman
Tupper	Microbiology	7M1	AMSCO	3021	146653-479	??	Donna Shunaman
Tupper	Pathology	11P1	AMSCO	3021	146653-479	1990	
Tupper	Pharmacology	5A3	Steris	SV-120	0323208-03	08-Aug	
Tupper	Pharmacology	15E	AMSCO	2011 Eagle Series	B6867210	1986	Kay Murphy
Tupper	Physiology	4L3	Amsco	AN72-011-231-3120	B12804190	Dec. 1995	
LSC	Biology	2110	AMSCO		5-165917	1970	
LSC	Biology	2110	AMSCO	23324	0570106-5	1970	
LSC	Biology	5028	Steris AMSCO	87874	104004	2004	

LSC	Oceanography	2680	AMSCO	AMSCO GY ANCI-010-	B172583	>30 yrs
LSC	Psychology Central	2283	AMSCO Harvey-MDT	531 EC-6000-	B-6709043	1970
Dental	Sterilization Central	1730	Corp Harvey-MDT	266440	1.12E+12	2001
Dental	Sterilization Central	1730	Corp AMSCO/Beta-	6000	C61165 1179058-	1990
Dental	Sterilization Central	1730	Star	Vacamatic Vacamatic	SAW 1179097-	rebuilt/02
Dental	Sterilization Central	1730	AMSCO Hotpack	"S"	SAW	1980
Dental	Sterilization Central	1730	Corp. Hotpack	214300	60552	1980
Dental	Sterilization Central	1730	Corp.	214300	60553	1980
Dental	Microbiology	3220	AMSCO	M65CDS-2	0126279- 003/ 0779093 SAW 0116292-	1979
Dental	Microbiology Biomedical	3220	AMSCO Primus	E3021-1	05	1992
Dental	Engineering	4235	Sterilizer Co.	NS/N:015158 CRN: K44105618	16398	Apr-05
Burbidge	Pharmacy	B10	Brinkman	3870EA	2304646 0135403-	2003
"D" Sexton	CIFT	D312	Steris	SV120	23	2004
"N" Sexton	Biological Eng.	N	Market Forge	STME-L	160529	1990
"N" Sexton	Chemistry	321A 328	Harvey Brinkmann	SterileMax 2340 E	2107568 0113303-	12/21/04
Chemistry MacKenzie, West Wing	Microbiology	324	Steris	SV-120	01	#####
IWK	Pediatrics	K8428	Eagle	3021 Gravity		late 1980's



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- > up to 90% total water usage savings
- > high efficiency insulation reduces steam consumption and parent building air conditioning requirements
- > RTDs provide high levels of chamber temperature and water usage control and optimization
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VHP (Vaporized Hydrogen Peroxide)

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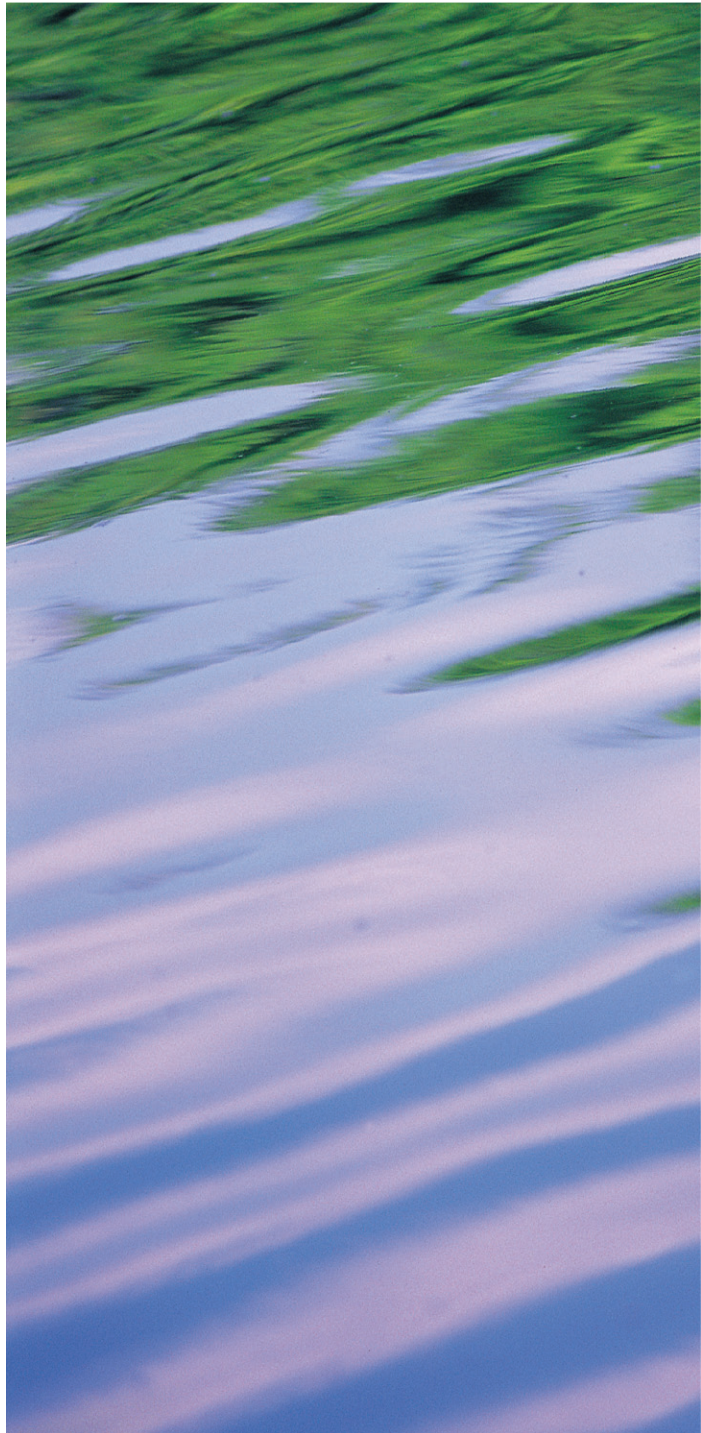
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INVOICE NUMBER	0000504689 ✓
CUSTOMER NUMBER	7035009
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CURRENT	\$2,414.62
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
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Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5850 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837

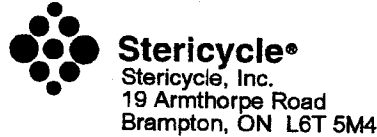
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07/08/2010	PDDA000AW7	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
07/15/2010	MDDA000AZK	9.00	Anatomical Container	245.28 KG	\$1.150 KG	\$282.07
07/15/2010	MDDA000AZK	12.00	Bio Tote 96 Gal (Grey)	360.43 KG	\$1.150 KG	\$414.49
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07/29/2010	MDDA000B70	8.00	Anatomical Container	240.88 KG	\$1.150 KG	\$277.01
07/29/2010	MDDA000B70	6.00	Bio Tote 96 Gal (Grey)	175.72 KG	\$1.150 KG	\$202.07
07/29/2010	PDDA000B70	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
		1.00	HST	0.00 KG	\$314.950 EA	\$314.95

Site 001: SUB TOTAL \$2,099.67 ✓
 Site 001: TAX TOTAL \$314.95 ✓
 Site 001: TOTAL \$2,414.62 ✓

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OVER 90 DAYS	\$0.00

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08/03/2010	PMDA0006HP	32.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$1,918.40
		1.00	HST	0.00 KG	\$287.760 EA	\$287.76
			<i>Site 001: SUB TOTAL</i>			\$1,918.40
			<i>Site 001: TAX TOTAL</i>			\$287.76
			<i>Site 001: TOTAL</i>			\$2,206.16

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 09/10/2010 \$2,206.16

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 09/10/2010	
\$		\$2,206.16	
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7035072		08/11/2010	0000511158
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE			PRINTED NAME

0007035072 0000511158 0000220616 3 000006

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INVOICE NUMBER	0000514661
CUSTOMER NUMBER	7035009
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CURRENT	\$2,298.04
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31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

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300465801

612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
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Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837

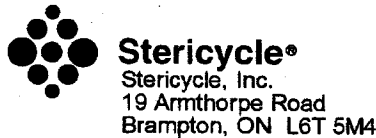
08/05/2010	MDDA000B9H	4.00	Anatomical Container	151.32 KG	\$1.150 KG	\$174.03
08/05/2010	MDDA000B9H	4.00	Bio Tote 96 Gal (Grey)	113.74 KG	\$1.150 KG	\$130.81
08/05/2010	PDDA000B9H	4.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.00
08/12/2010	MDDA000BC3	5.00	Anatomical Container	160.72 KG	\$1.150 KG	\$184.83
08/12/2010	MDDA000BC3	8.00	Bio Tote 96 Gal (Grey)	181.31 KG	\$1.150 KG	\$208.51
08/12/2010	PDDA000BC3	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
08/19/2010	MDDA000BG0	12.00	Anatomical Container	303.65 KG	\$1.150 KG	\$349.20
08/19/2010	MDDA000BG0	11.00	Bio Tote 96 Gal (Grey)	382.41 KG	\$1.150 KG	\$439.78
08/19/2010	PDDA000BG0	11.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.50
08/26/2010	MDDA000BJ0	7.00	Anatomical Container	194.10 KG	\$1.150 KG	\$223.22
08/26/2010	MDDA000BJ0	8.00	Bio Tote 96 Gal (Grey)	236.88 KG	\$1.150 KG	\$272.42
08/26/2010	PDDA000BJ0	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
		1.00	HST	0.00 KG	\$299.740 EA	\$299.74

Site 001: SUB TOTAL \$1,998.30
 Site 001: TAX TOTAL \$299.74
 Site 001: TOTAL \$2,298.04

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 09/30/2010 \$2,298.04

P40-11837
 PRQ31218
 11930-7210

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 09/30/2010	
\$		\$2,298.04	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		08/31/2010	0000514661
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE			PRINTED NAME

0007035009 0000514661 0000229804 3 000001

ADDRESSEE/DESTINATAIRE:



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Imo23623 PAGE: 1 of 1

INVOICE DATE 09/09/2010
INVOICE NUMBER 0000521138
CUSTOMER NUMBER 7035072

INVOICE AMOUNT DUE BY 10/09/2010 \$2,206.16

CURRENT \$4,320.00
1-30 DAYS \$0.00
31-60 DAYS \$0.00
61-90 DAYS \$0.00
OVER 90 DAYS \$0.00

GST: R 12912 1109

31111-3AN4*T0Y11X199000058

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DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
09/02/2010	PMDA0006M9	32.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$1,918.40
		1.00	HST	0.00 KG	\$287.760 EA	\$287.76
<i>Site 001: SUB TOTAL</i>						\$1,918.40
<i>Site 001: TAX TOTAL</i>						\$287.76
<i>Site 001: TOTAL</i>						\$2,206.16

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 10/09/2010 \$2,206.16

P9071836
PKQ31217
11930-7210

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AMOUNT ENCLOSED \$		INVOICE AMOUNT DUE BY 10/09/2010 \$2,206.16	
CUSTOMER NUMBER 7035072		INVOICE DATE 09/09/2010	INVOICE NUMBER 0000521138
			SECURITY CODE
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035072 0000521138 0000220616 3 000009

ADDRESSEE/DESTINATAIRE:

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Im024230

GST: R 12912 1109



0101

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INVOICE DATE	09/30/2010 ✓
INVOICE NUMBER	0000525196 ✓
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 10/30/2010	\$3,842.36
CURRENT	\$3,842.36
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

612610A

300465804

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
------	---------------------------	---------------------	-------------	--------------	------------	-------

Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837

09/02/2010	MDDA000BM2	7.00	Anatomical Container	165.72 KG	\$1.150 KG	\$190.58
09/02/2010	MDDA000BM2	4.00	Bio Tote 96 Gal (Grey)	124.93 KG	\$1.150 KG	\$143.68
09/02/2010	PDDA000BM2	4.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.00
09/09/2010	MDDA000BOR	17.00	Anatomical Container	444.58 KG	\$1.150 KG	\$511.27
09/09/2010	MDDA000BOR	4.00	Bio Tote 96 Gal (Grey)	100.95 KG	\$1.150 KG	\$116.09
09/09/2010	PDDA000BOR	21.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$10.50
09/16/2010	MDDA000BRW	11.00	Anatomical Container	483.96 KG	\$1.150 KG	\$556.56
09/16/2010	MDDA000BRW	8.00	Bio Tote 96 Gal (Grey)	317.04 KG	\$1.150 KG	\$364.60
09/16/2010	PDDA000BRW	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
09/23/2010	MDDA000BV9	11.00	Anatomical Container	495.15 KG	\$1.150 KG	\$569.43
09/23/2010	MDDA000BV9	8.00	Bio Tote 96 Gal (Grey)	242.28 KG	\$1.150 KG	\$278.62
09/23/2010	PDDA000BV9	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
09/30/2010	MDDA000BZK	7.00	Anatomical Container	351.42 KG	\$1.150 KG	\$404.14
09/30/2010	MDDA000BZK	5.00	Bio Tote 96 Gal (Grey)	159.32 KG	\$1.150 KG	\$183.22
09/30/2010	PDDA000BZK	5.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.50
		1.00	HST	0.00 KG	\$501.170 EA	\$501.17

Site 001: SUB TOTAL

\$3,341.19 ✓

Site 001: TAX TOTAL

\$501.17 ✓

Site 001: TOTAL

\$3,842.36

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 10/30/2010

\$3,842.36 ✓

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P9071837
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11930-7210

AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 10/30/2010	
\$		\$3,842.36	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		09/30/2010	0000525196
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE			PRINTED NAME

0007035009 0000525196 0000384236 3 000002

ADDRESSEE/DESTINATAIRE:

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Imo24231

INVOICE DATE	09/30/2010 ✓
INVOICE NUMBER	0000524501 ✓
CUSTOMER NUMBER	7035072
INVOICE AMOUNT DUE BY 10/30/2010	\$2,206.16
CURRENT	\$2,324.66
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109



0101

31111-3AN4*T1POR81R000109

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612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
09/29/2010	PMDA0006X6	32.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$1,918.40
		1.00	HST	0.00 KG	\$287.760 EA	\$287.76
			<i>Site 001: SUB TOTAL</i>			\$1,918.40
			<i>Site 001: TAX TOTAL</i>			\$287.76
			<i>Site 001: TOTAL</i>			\$2,206.16

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 10/30/2010 \$2,206.16

P9071836
 PRQ 31217
 11930-7216

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\$ AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 10/30/2010	
		\$2,206.16	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035072		09/30/2010	0000524501
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE			PRINTED NAME

0007035072 0000524501 0000220616 3 000002

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Imo 25002 PAGE: 1 of 1

INVOICE DATE	✓ 10/31/2010
INVOICE NUMBER	0000535304 ✓
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE	
BY 11/30/2010	\$2,453.09
CURRENT	\$2,453.09
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109
31111-3AN4*T2I0Y0P1J000076

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DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
10/07/2010	MDDA000C2Q	5.00	Anatomical Container	208.09 KG	\$1.150 KG	\$239.31
10/07/2010	MDDA000C2Q	8.00	Bio Tote 96 Gal (Grey)	234.08 KG	\$1.150 KG	\$269.20
10/07/2010	PDDA000C2Q	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
10/14/2010	MDDA000C64	3.00	Anatomical Container	99.97 KG	\$1.150 KG	\$114.97
10/14/2010	MDDA000C64	4.00	Bio Tote 96 Gal (Grey)	105.97 KG	\$1.150 KG	\$121.87
10/14/2010	PDDA000C64	4.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.00
10/15/2010	MDDA000C70	2.00	Anatomical Container	42.98 KG	\$1.150 KG	\$49.44
10/21/2010	MDDA000C9S	8.00	Anatomical Container	221.34 KG	\$1.150 KG	\$254.54
10/21/2010	MDDA000C9S	8.00	Bio Tote 96 Gal (Grey)	283.52 KG	\$1.150 KG	\$326.05
10/21/2010	PDDA000C9S	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
10/28/2010	MDDA000CC3	8.00	Anatomical Container	280.72 KG	\$1.150 KG	\$322.83
10/28/2010	MDDA000CC3	5.00	Bio Tote 96 Gal (Grey)	153.15 KG	\$1.150 KG	\$176.13
10/28/2010	PDDA000CC3	5.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.50
10/29/2010	MDDA000CCS	7.00	Bio Tote 96 Gal (Grey)	211.54 KG	\$1.150 KG	\$243.27
10/29/2010	PDDA000CCS	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
		1.00	HST	0.00 KG	\$319.980 EA	\$319.98
			Site 001: SUB TOTAL			\$2,133.11
			Site 001: TAX TOTAL			\$319.98
			Site 001: TOTAL			\$2,453.09

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 11/30/2010 \$2,453.09

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19071837
PRQ31218
11930-7210

AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 11/30/2010	
\$		\$2,453.09	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		10/31/2010	0000535304
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE			PRINTED NAME

0007035009 0000535304 0000245309 3 000005

ADDRESSEE/DESTINATAIRE:

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Im025152 PAGE: 1 of 1

INVOICE DATE	11/10/2010
INVOICE NUMBER	0000542429
CUSTOMER NUMBER	7035072
INVOICE AMOUNT DUE BY 12/10/2010	\$2,757.70
CURRENT	\$2,689.90
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

31111-3AN4*T200YQBYM000114

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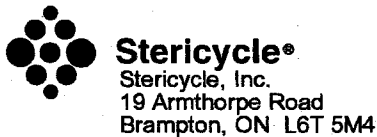
612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
11/04/2010	PMDA0007FU	40.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$2,398.00
		1.00	HST	0.00 KG	\$359.700 EA	\$359.70
			<i>Site 001: SUB TOTAL</i>			\$2,398.00
			<i>Site 001: TAX TOTAL</i>			\$359.70
			<i>Site 001: TOTAL</i>			\$2,757.70

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 12/10/2010 \$2,757.70

P9071836
PRQ31217
U930-7210

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 12/10/2010	
\$		\$2,757.70	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035072		11/10/2010	0000542429
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE			PRINTED NAME

0007035072 0000542429 0000275770 3 000001

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Im 025649 PAGE: 1 of 1

INVOICE DATE	11/30/2010
INVOICE NUMBER	0000546176
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 12/30/2010	\$2,198.59
CURRENT	\$2,198.59
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

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DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5850 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
11/04/2010	MDDA0007FT	11.00	Anatomical Container	267.52 KG	\$1.150 KG	\$307.66
11/04/2010	MDDA000CEP	10.00	Bio Tote 96 Gal (Grey)	301.12 KG	\$1.150 KG	\$346.29
11/04/2010	PDDA000CEP	10.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.00
11/12/2010	MDDA000CJ6	4.00	Anatomical Container	111.57 KG	\$1.150 KG	\$128.31
11/12/2010	MDDA000CJ6	6.00	Bio Tote 96 Gal (Grey)	167.15 KG	\$1.150 KG	\$192.23
11/12/2010	PDDA000CJ6	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
11/18/2010	MDDA000CLH	7.00	Anatomical Container	157.75 KG	\$1.150 KG	\$181.42
11/18/2010	MDDA000CLH	8.00	Bio Tote 96 Gal (Grey)	228.53 KG	\$1.150 KG	\$262.82
11/18/2010	PDDA000CLH	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
11/25/2010	MDDA000COX	5.00	Anatomical Container	173.95 KG	\$1.150 KG	\$200.05
11/25/2010	MDDA000COX	7.00	Bio Tote 96 Gal (Grey)	241.33 KG	\$1.150 KG	\$277.54
11/25/2010	PDDA000COX	7.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.50
		1.00	HST	0.00 KG	\$286.770 EA	\$286.77
Site 001: SUB TOTAL						\$1,911.82
Site 001: TAX TOTAL						\$286.77
Site 001: TOTAL						\$2,198.59

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 12/30/2010 \$2,198.59

*99071837
PRQ31215
11930-7210*

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 12/30/2010	
\$		\$2,198.59	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		11/30/2010	0000546176
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE		PRINTED NAME	

0007035009 0000546176 0000219859 3 000008

ADDRESSEE/DESTINATAIRE:

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Brampton, ON L6T 5M4

Imo25988 PAGE: 1 of 1

INVOICE DATE	12/22/2010
INVOICE NUMBER	0000554777
CUSTOMER NUMBER	7035072
INVOICE AMOUNT DUE BY 01/21/2011	\$2,757.70
CURRENT	\$2,757.70
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

31111-3AN4*T3U0XQFB4000115

DALHOUSIE UNIVERSITY-SUPPLIES
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B00465804

612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
12/14/2010	PMDA000800	40.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$2,398.00
		1.00	HST	0.00 KG	\$359.700 EA	\$359.70
			<i>Site 001: SUB TOTAL</i>			\$2,398.00
			<i>Site 001: TAX TOTAL</i>			\$359.70
			<i>Site 001: TOTAL</i>			\$2,757.70

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 01/21/2011 \$2,757.70

P9071836
PRQ31217
11930-7210

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 01/21/2011	
\$		\$2,757.70	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035072		12/22/2010	0000554777
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE		PRINTED NAME	

0007035072 0000554777 0000275770 3 000005

ADDRESSEE/DESTINATAIRE:

REMIT TO/FAIRE REMISE À

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TORONTO, ON M5W 3N9





Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

Imo 26306

INVOICE DATE	12/31/2010
INVOICE NUMBER	0000556855
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 01/30/2011	\$2,562.96
CURRENT	\$2,562.96
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

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0101

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Boo 465804

612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
12/02/2010	MDDA000CSF	5.00	Anatomical Container	145.76 KG	\$1.150 KG	\$167.63
12/02/2010	MDDA000CSF	11.00	Bio Tote 96 Gal (Grey)	413.29 KG	\$1.150 KG	\$475.28
12/02/2010	PDDA000CSF	11.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.50
12/09/2010	MDDA000CVK	7.00	Anatomical Container	249.33 KG	\$1.150 KG	\$286.73
12/09/2010	MDDA000CVK	1.00	Container Cytotoxic	17.59 KG	\$1.150 KG	\$20.23
12/09/2010	MDDA000CVK	7.00	Bio Tote 96 Gal (Grey)	197.94 KG	\$1.150 KG	\$227.64
12/09/2010	PDDA000CVK	7.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.50
12/16/2010	MDDA000CYM	5.00	Anatomical Container	125.76 KG	\$1.150 KG	\$144.63
12/16/2010	MDDA000CYM	6.00	Bio Tote 96 Gal (Grey)	150.96 KG	\$1.150 KG	\$173.60
12/16/2010	PDDA000CYM	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
12/23/2010	MDDA000D2D	11.00	Anatomical Container	395.09 KG	\$1.150 KG	\$454.36
12/23/2010	MDDA000D2D	6.00	Bio Tote 96 Gal (Grey)	194.34 KG	\$1.150 KG	\$223.50
12/23/2010	PDDA000D2D	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
12/30/2010	MDDA000D57	1.00	Anatomical Container	22.59 KG	\$1.150 KG	\$25.98
12/30/2010	MDDA000D57	1.00	Bio Tote 96 Gal (Grey)	11.79 KG	\$1.150 KG	\$13.57
12/30/2010	PDDA000D57	1.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$0.50
		1.00	HST	0.00 KG	\$334.310 EA	\$334.31
			Site 001: SUB TOTAL			\$2,228.65
			Site 001: TAX TOTAL			\$334.31
			Site 001: TOTAL			\$2,562.96

*PC1071837
PRQ31218
11930-7210*

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 01/30/2011 \$2,562.96

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 01/30/2011	
\$		\$2,562.96	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		12/31/2010	0000556855
			SECURITY CODE
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035009 0000556855 0000256296 3 000008

ADDRESSEE/DESTINATAIRE:

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Im 026887

GST: R 12912 1109

31111-3AN4*T540MCFQ5000163

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Booth 5504

INVOICE DATE	01/31/2011
INVOICE NUMBER	0000566687
CUSTOMER NUMBER	7035072
INVOICE AMOUNT DUE	
BY 03/02/2011	\$2,757.70
CURRENT	\$2,895.70
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

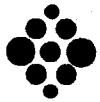
612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
01/25/2011	PMDA0008DA	40.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$2,398.00
		1.00	HST	0.00 KG	\$359.700 EA	\$359.70
			<i>Site 001: SUB TOTAL</i>			\$2,398.00
			<i>Site 001: TAX TOTAL</i>			\$359.70
			<i>Site 001: TOTAL</i>			\$2,757.70

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 03/02/2011 **\$2,757.70**

*P9071836
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11930-7210*

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 03/02/2011	
\$		\$2,757.70	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035072		01/31/2011	0000566687
			SECURITY CODE
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035072 0000566687 0000275770 3 000009

ADDRESSEE/DESTINATAIRE: _____



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Imo 20889 PAGE: 1 of 1

INVOICE DATE	01/31/2011
INVOICE NUMBER	0000567276
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 03/02/2011	\$2,698.54
CURRENT	\$2,698.54
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

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0101

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Boo465804

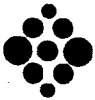
612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
01/06/2011	MDDA000D8B	1.00	Anatomical Container	35.39 KG	\$1.150 KG	\$40.70
01/06/2011	MDDA000D8B	3.00	Bio Tote 96 Gal (Grey)	93.17 KG	\$1.150 KG	\$107.15
01/06/2011	PDDA000D8B	3.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$1.50
01/13/2011	MDDA000DCE	11.00	Anatomical Container	358.70 KG	\$1.150 KG	\$412.51
01/13/2011	MDDA000DCE	5.00	Bio Tote 96 Gal (Grey)	158.75 KG	\$1.150 KG	\$182.57
01/13/2011	PDDA000DCE	5.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.50
01/20/2011	MDDA000DFX	11.00	Anatomical Container	514.26 KG	\$1.150 KG	\$591.40
01/20/2011	MDDA000DFX	8.00	Bio Tote 96 Gal (Grey)	310.11 KG	\$1.150 KG	\$356.64
01/20/2011	PDDA000DFX	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
01/27/2011	MDDA000DJ	11.00	Anatomical Container	294.52 KG	\$1.150 KG	\$338.70
01/27/2011	MDDA000DJ	7.00	Bio Tote 96 Gal (Grey)	265.52 KG	\$1.150 KG	\$305.36
01/27/2011	PDDA000DJ	7.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.50
		1.00	HST	0.00 KG	\$352.010 EA	\$352.01
Site 001: SUB TOTAL						\$2,346.53
Site 001: TAX TOTAL						\$352.01
Site 001: TOTAL						\$2,698.54

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 03/02/2011 \$2,698.54

99071837
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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 03/02/2011	
\$		\$2,698.54	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		01/31/2011	0000567276
			SECURITY CODE
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035009 0000567276 0000269854 3 000003

ADDRESSEE/DESTINATAIRE:



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Imo2719

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Boo465804

INVOICE DATE	02/28/2011
INVOICE NUMBER	0000577889
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 03/30/2011	\$1,960.47
CURRENT	\$1,960.47
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

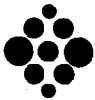
612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
02/04/2011	MDDA000DNQ	4.00	Anatomical Container	90.99 KG	\$1.150 KG	\$104.64
02/04/2011	MDDA000DNQ	9.00	Bio Tote 96 Gal (Grey)	220.17 KG	\$1.150 KG	\$253.20
02/04/2011	PDDA000DNQ	9.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.50
02/10/2011	MDDA000DPV	3.00	Anatomical Container	101.65 KG	\$1.150 KG	\$116.90
02/10/2011	MDDA000DPV	4.00	Bio Tote 96 Gal (Grey)	136.44 KG	\$1.150 KG	\$156.91
02/10/2011	PDDA000DPV	4.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.00
02/17/2011	MDDA000DTM	7.00	Anatomical Container	164.43 KG	\$1.150 KG	\$189.09
02/17/2011	MDDA000DTM	8.00	Bio Tote 96 Gal (Grey)	258.14 KG	\$1.150 KG	\$296.87
02/17/2011	PDDA000DTM	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
02/24/2011	MDDA000DX0	7.00	Anatomical Container	170.41 KG	\$1.150 KG	\$195.98
02/24/2011	MDDA000DX0	9.00	Bio Tote 96 Gal (Grey)	327.09 KG	\$1.150 KG	\$376.15
02/24/2011	PDDA000DX0	9.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.50
		1.00	HST	0.00 KG	\$255.730 EA	\$255.73
<i>Site 001: SUB TOTAL</i>						\$1,704.74
<i>Site 001: TAX TOTAL</i>						\$255.73
<i>Site 001: TOTAL</i>						\$1,960.47

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 03/30/2011 \$1,960.47

*19071837
PRQ31218
119307210*

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 03/30/2011	
\$		\$1,960.47	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		02/28/2011	0000577889
			SECURITY CODE
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035009 0000577889 0000196047 3 000003

ADDRESSEE/DESTINATAIRE:



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INVOICE DATE	03/10/2011
INVOICE NUMBER	0000584850
CUSTOMER NUMBER	7035072
INVOICE AMOUNT DUE	
BY 04/09/2011	\$2,861.20
CURRENT	\$2,861.20
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

612610A

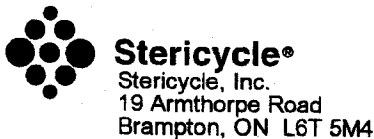
600465804

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
03/08/2011	PDDA000E2B	40.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$2,398.00
03/08/2011	PDDA000E2B	24.00	Med Box Dropoff-NonAnatomical	0.00 KG	\$3.750 EA	\$90.00
		1.00	HST	0.00 KG	\$373.200 EA	\$373.20
Site 001: SUB TOTAL						\$2,488.00
Site 001: TAX TOTAL						\$373.20
Site 001: TOTAL						\$2,861.20

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 04/09/2011 \$2,861.20

*P9071836
PRQ31217
11930-7216*

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AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 04/09/2011	
\$		\$2,861.20	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035072		03/10/2011	0000584850
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE			PRINTED NAME

0007035072 0000584850 0000286120 3 000005

==== **ADDRESSEE/DESTINATAIRE:** =====

==== **REMIT TO/FAIRE REMISE À** =====

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INVOICE DATE	03/31/2011
INVOICE NUMBER	0000588876
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 04/30/2011	\$3,336.44
CURRENT	\$3,336.44
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

612610A

800465804

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
03/03/2011	MDDA000E01	5.00	Anatomical Container	159.85 KG	\$1.150 KG	\$183.83
03/03/2011	MDDA000E01	6.00	Bio Tote 96 Gal (Grey)	162.38 KG	\$1.150 KG	\$186.75
03/03/2011	PDDA000E01	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
03/10/2011	MDDA000E30	27.00	Anatomical Container	504.35 KG	\$1.150 KG	\$580.01
03/10/2011	MDDA000E30	6.00	Bio Tote 96 Gal (Grey)	165.47 KG	\$1.150 KG	\$190.29
03/10/2011	PDDA000E30	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
03/17/2011	MDDA000E6C	3.00	Anatomical Container	147.42 KG	\$1.150 KG	\$169.53
03/17/2011	MDDA000E6C	10.00	Bio Tote 96 Gal (Grey)	298.96 KG	\$1.150 KG	\$343.81
03/17/2011	PDDA000E6C	10.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.00
03/24/2011	MDDA000E9J	9.00	Anatomical Container	187.65 KG	\$1.150 KG	\$215.80
03/24/2011	MDDA000E9J	12.00	Bio Tote 96 Gal (Grey)	468.38 KG	\$1.150 KG	\$538.65
03/24/2011	PDDA000E9J	12.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$6.00
03/31/2011	MDDA000EDL	6.00	Anatomical Container	250.07 KG	\$1.150 KG	\$287.58
03/31/2011	MDDA000EDL	5.00	Bio Tote 96 Gal (Grey)	161.30 KG	\$1.150 KG	\$185.50
03/31/2011	PDDA000EDL	5.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.50
		1.00	HST	0.00 KG	\$435.190 EA	\$435.19
			Site 001: SUB TOTAL			\$2,901.25
			Site 001: TAX TOTAL			\$435.19
			Site 001: TOTAL			\$3,336.44

*P9071837
PRQ31218
11930-7210*

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 04/30/2011 \$3,336.44

Return bottom portion with your payment in the enclosed envelope./Déta cher et retourner la partie inf rieure avec votre paiement dans l'enveloppe ci-incluse.



AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 04/30/2011	
\$		\$3,336.44	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		03/31/2011	0000588876
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE		PRINTED NAME	

0007035009 0000588876 0000333644 3 000000

==== ADDRESSEE/DESTINATAIRE: =====

==== REMIT TO/FAIRE REMISE   =====

DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

STERICYCLE, INC.
BP/PO BOX 1531 STATION A
TORONTO, ON M5W 3N9





Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

INVOICE DATE	04/30/2011
INVOICE NUMBER	0000604886
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 05/30/2011	\$1,945.68

Imo 20851

GST: R 12912 1109

31111-3AN4*T7N02FJRQ000037



DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5



FOR CUSTOMER SERVICE

866-STERI-CALL
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FOR PICK-UP INFORMATION

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CURRENT	\$5,282.12
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

612610A

800465804

DATE	MANIFEST/ORDER NUMBER	QUANTITY/NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
------	-----------------------	-----------------	-------------	--------------	------------	-------

Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837

04/07/2011	MDDA000EGW	4.00	Anatomical Container	109.99 KG	\$1.150 KG	\$126.50
04/07/2011	MDDA000EGW	6.00	Bio Tote 96 Gal (Grey)	153.68 KG	\$1.150 KG	\$176.73
04/07/2011	PDDA000EGW	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
04/14/2011	MDDA000EK2	10.00	Anatomical Container	225.53 KG	\$1.150 KG	\$259.36
04/14/2011	MDDA000EK2	8.00	Bio Tote 96 Gal (Grey)	248.11 KG	\$1.150 KG	\$285.34
04/14/2011	PDDA000EK2	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
04/21/2011	MDDA000EMP	5.00	Anatomical Container	132.81 KG	\$1.150 KG	\$152.74
04/21/2011	MDDA000EMP	10.00	Bio Tote 96 Gal (Grey)	332.71 KG	\$1.150 KG	\$382.62
04/21/2011	PDDA000EMP	10.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.00
04/28/2011	MDDA000EQ7	4.00	Anatomical Container	123.87 KG	\$1.150 KG	\$142.46
04/28/2011	MDDA000EQ7	5.00	Bio Tote 96 Gal (Grey)	131.86 KG	\$1.150 KG	\$151.64
04/28/2011	PDDA000EQ7	5.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.50
		1.00	HST	0.00 KG	\$253.790 EA	\$253.79

Site 001: SUB TOTAL

\$1,691.89

Site 001: TAX TOTAL

\$253.79

Site 001: TOTAL

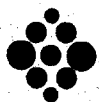
\$1,945.68

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 05/30/2011

\$1,945.68

*99079911
PRQ 37648
11930-7210*

Return bottom portion with your payment in the enclosed envelope./Detacher et retourner la partie inferieure avec votre paiement dans l'enveloppe ci-incluse.



Stericycle®
Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 05/30/2011	
\$		\$1,945.68	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		04/30/2011	0000604886
			SECURITY CODE
CARD NUMBER			EXP. DATE
SIGNATURE		PRINTED NAME	

0007035009 0000604886 0000194568 3 000001

ADDRESSEE/DESTINATAIRE:

REMIT TO/FAIRE REMISE A



DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

STERICYCLE, INC.
BP/PO BOX 1531 STATION A
TORONTO, ON M5W 3N9





Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

Imo29093

INVOICE DATE	04/15/2011
INVOICE NUMBER	0000596168
CUSTOMER NUMBER	7035072
INVOICE AMOUNT DUE BY 05/15/2011	\$2,941.70
CURRENT	\$2,941.70
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109



0101

31111-3AN4*T7210P3KC000170

DALHOUSIE UNIVERSITY-SUPPLIES
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5



FOR CUSTOMER SERVICE

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902-480-7800



FOR PICK-UP INFORMATION

866-STERI-CALL
902-480-7800

300465804

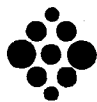
612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
04/07/2011	PDDA000EGX	100.00	37 X 50 Red Liner	0.00 KG	\$1.000 EA	\$100.00
04/07/2011	PDDA000EGX	40.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$2,398.00
04/07/2011	PDDA000EGX	500.00	Anatomical Label - 500 CT	0.00 KG	\$0.120 EA	\$60.00
		1.00	HST	0.00 KG	\$383.700 EA	\$383.70
<i>Site 001: SUB TOTAL</i>						<i>\$2,558.00</i>
<i>Site 001: TAX TOTAL</i>						<i>\$383.70</i>
<i>Site 001: TOTAL</i>						<i>\$2,941.70</i>

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 05/15/2011 **\$2,941.70**

P9080554
PRQ37645
11930-7210

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Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 05/15/2011	
\$		\$2,941.70	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035072		04/15/2011	0000596168
			SECURITY CODE
CARD NUMBER		EXP DATE	
SIGNATURE		PRINTED NAME	

0007035072 0000596168 0000294170 3 000000

ADDRESSEE/DESTINATAIRE:

DALHOUSIE UNIVERSITY-SUPPLIES
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

REMIT TO/FAIRE REMISE A

STERICYCLE, INC.
BP/PO BOX 1531 STATION A
TORONTO, ON M5W 3N9





Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

Imo 29140

INVOICE DATE	05/31/2011
INVOICE NUMBER	0000615379
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 06/30/2011	\$2,124.52
CURRENT	\$2,124.52
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

31111-3AN4*T8I0S4Z14000029

DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
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HALIFAX, NS B3H 3J5

FOR CUSTOMER SERVICE

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FOR PICK-UP INFORMATION

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902-480-7800

600405604

DATE	MANIFEST/ORDER NUMBER	QUANTITY/NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
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Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837

05/05/2011	MDDA000ETJ	9.00	Anatomical Container	212.46 KG	\$1.150 KG	\$244.34
05/05/2011	MDDA000ETJ	6.00	Bio Tote 96 Gal (Grey)	173.45 KG	\$1.150 KG	\$199.48
05/05/2011	PDDA000ETJ	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
05/12/2011	MDDA000EWW	6.00	Anatomical Container	162.07 KG	\$1.150 KG	\$186.38
05/12/2011	MDDA000EWW	7.00	Bio Tote 96 Gal (Grey)	184.47 KG	\$1.150 KG	\$212.15
05/12/2011	PDDA000EWW	7.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.50
05/19/2011	MDDA000F0W	5.00	Anatomical Container	182.16 KG	\$1.150 KG	\$209.49
05/19/2011	MDDA000F0W	10.00	Bio Tote 96 Gal (Grey)	381.11 KG	\$1.150 KG	\$438.28
05/19/2011	PDDA000F0W	10.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.00
05/26/2011	MDDA000F3W	4.00	Anatomical Container	133.81 KG	\$1.150 KG	\$153.88
05/26/2011	MDDA000F3W	5.00	Bio Tote 96 Gal (Grey)	164.70 KG	\$1.150 KG	\$189.41
05/26/2011	PDDA000F3W	5.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.50
		1.00	HST	0.00 KG	\$277.110 EA	\$277.11

Site 001: SUB TOTAL

\$1,847.41

Site 001: TAX TOTAL

\$277.11

Site 001: TOTAL

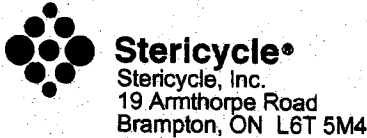
\$2,124.52

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 06/30/2011

\$2,124.52

P90 7911
PRQ 37648
119 B0-7210

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Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

AMOUNT ENCLOSED	INVOICE AMOUNT DUE BY 06/30/2011	
\$	\$2,124.52	
CUSTOMER NUMBER	INVOICE DATE	INVOICE NUMBER
7035009	05/31/2011	0000615379
		SECURITY CODE
CARD NUMBER	EXP. DATE	
SIGNATURE	PRINTED NAME	

0007035009 0000615379 0000212452 3 000001

ADDRESSEE/DESTINATAIRE:



DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

REMIT TO/FAIRE REMISE A

STERICYCLE, INC.
BP/PO BOX 1531 STATION A
TORONTO, ON M5W 3N9





Stericycle®
Protecting People. Reducing Risk.

Stericycle, Inc. ✓
19 Armthorpe Road
Brampton, ON L6T 5M4

Im030139

INVOICE DATE	06/15/2011
INVOICE NUMBER	0000616904
CUSTOMER NUMBER	7035072
INVOICE AMOUNT DUE BY 07/15/2011	\$2,757.70
CURRENT	\$2,757.70
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

31111-3AN4*T8R0ZUL6U000116

DALHOUSIE UNIVERSITY-SUPPLIES
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1236 HENRY STREET
HALIFAX, NS B3H 3J5



FOR CUSTOMER SERVICE
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FOR PICK-UP INFORMATION
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902-480-7800

B00465 804



000082 0101

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie (Supplies), Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: P9071836</i>						
06/09/2011	PDDA000FAG	40.00	Black Plastic Drum 30 Gallon	0.00 KG	\$59.950 EA	\$2,398.00
		1.00	HST	0.00 KG	\$359.700 EA	\$359.70
			Site 001: SUB TOTAL			\$2,398.00 ✓
			Site 001: TAX TOTAL			\$359.70 ✓
			Site 001: TOTAL			\$2,757.70 ✓

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 07/15/2011 \$2,757.70

P9080554
PRQ37645
11930-7210

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Stericycle®
Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

\$ AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 07/15/2011	
		\$2,757.70	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035072		06/15/2011	0000616904
			SECURITY CODE
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035072 0000616904 0000275770 3 000008

ADDRESSEE/DESTINATAIRE:



DALHOUSIE UNIVERSITY-SUPPLIES
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

REMIT TO/FAIRE REMISE À

STERICYCLE, INC.
BP/PO BOX 1531 STATION A
TORONTO, ON M5W 3N9





Stericycle, Inc.
19 Armthorpe Road
Brampton, ON L6T 5M4

INVOICE DATE	06/30/2011 ✓
INVOICE NUMBER	0000626202 ✓
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 07/30/2011	\$2,592.08
CURRENT	\$4,716.60
1-30 DAYS	\$0.00
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

Im 030208



FOR CUSTOMER SERVICE
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FOR PICK-UP INFORMATION
866-STERI-CALL
902-480-7800

GST: R 12912 1109

31111-3AN4*T9D0T21TN000028

DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

B00405804

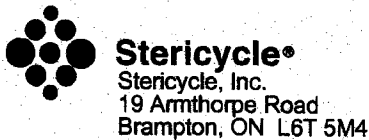
000582 0101

DATE	MANIFEST/ORDER NUMBER	QUANTITY/NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
06/02/2011	MDDA000F70	2.00	Anatomical Container	75.97 KG	\$1.150 KG	\$87.37
06/02/2011	MDDA000F70	8.00	Bio Tote 96 Gal (Grey)	261.50 KG	\$1.150 KG	\$300.72
06/02/2011	PDDA000F70	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
06/09/2011	MDDA000FAF	7.00	Anatomical Container	171.86 KG	\$1.150 KG	\$197.65
06/09/2011	MDDA000FAF	6.00	Bio Tote 96 Gal (Grey)	179.49 KG	\$1.150 KG	\$206.41
06/09/2011	PDDA000FAF	6.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.00
06/16/2011	MDDA000FEA	5.00	Anatomical Container	180.21 KG	\$1.150 KG	\$207.25
06/16/2011	MDDA000FEA	9.00	Bio Tote 96 Gal (Grey)	341.51 KG	\$1.150 KG	\$392.74
06/16/2011	PDDA000FEA	9.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.50
06/23/2011	MDDA000FIA	6.00	Anatomical Container	131.63 KG	\$1.150 KG	\$151.38
06/23/2011	MDDA000FIA	8.00	Bio Tote 96 Gal (Grey)	242.49 KG	\$1.150 KG	\$278.87
06/23/2011	PDDA000FIA	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
06/30/2011	MDDA000FMC	3.00	Anatomical Container	137.44 KG	\$1.150 KG	\$158.06
06/30/2011	MDDA000FMC	7.00	Bio Tote 96 Gal (Grey)	221.31 KG	\$1.150 KG	\$254.51
06/30/2011	PDDA000FMC	7.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$3.50
		1.00	HST	0.00 KG	\$338.120 EA	\$338.12

Site 001: SUB TOTAL \$2,253.96 ✓
Site 001: TAX TOTAL \$338.12 ✓
Site 001: TOTAL \$2,592.08 ✓

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 07/30/2011 \$2,592.08

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P9079911
PRQ37648
11930-7210

AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 07/30/2011	
\$		\$2,592.08	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		06/30/2011	0000626202
		SECURITY CODE	
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035009 0000626202 0000259208 3 000008

ADDRESSEE/DESTINATAIRE:



DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

REMIT TO/FAIRE REMISE A

STERICYCLE, INC.
BP/PO BOX 1531 STATION A
TORONTO, ON M5W 3N9





Stericycle, Inc. ✓
19 Armthorpe Road
Brampton, ON L6T 5M4

Im030617

INVOICE DATE	07/31/2011 ✓
INVOICE NUMBER	0000636300 ✓
CUSTOMER NUMBER	7035009
INVOICE AMOUNT DUE BY 08/30/2011	\$2,107.72
CURRENT	\$2,107.72
1-30 DAYS	\$2,592.08
31-60 DAYS	\$0.00
61-90 DAYS	\$0.00
OVER 90 DAYS	\$0.00

GST: R 12912 1109

31111-3AN4*TA50JDLED000029

DALHOUSIE UNIVERSITY
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FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5



FOR CUSTOMER SERVICE

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FOR PICK-UP INFORMATION

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902-480-7800

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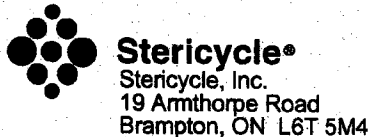
612610A

DATE	MANIFEST/ ORDER NUMBER	QUANTITY/ NOMBRE	DESCRIPTION	WEIGHT/POIDS	PRICE/PRIX	TOTAL
<i>Site 001: Dalhousie University, Sir Charles Tupper Med Bldg, 5859 University Avenue, Halifax, NS B3H 4H7 PO Number: 9071837</i>						
07/07/2011	MDDA000FOQ	3.00	Anatomical Container	91.03 KG	\$1.150 KG	\$104.69
07/07/2011	MDDA000FOQ	8.00	Bio Tote 96 Gal (Grey)	191.91 KG	\$1.150 KG	\$220.71
07/07/2011	PDDA000FOQ	8.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$4.00
07/14/2011	MDDA000FRN	3.00	Anatomical Container	110.22 KG	\$1.150 KG	\$126.76
07/14/2011	MDDA000FRN	11.00	Bio Tote 96 Gal (Grey)	323.32 KG	\$1.150 KG	\$371.82
07/14/2011	PDDA000FRN	11.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.50
07/21/2011	MDDA000FVI	4.00	Anatomical Container	129.00 KG	\$1.150 KG	\$148.35
07/21/2011	MDDA000FVI	11.00	Bio Tote 96 Gal (Grey)	407.96 KG	\$1.150 KG	\$469.16
07/21/2011	PDDA000FVI	11.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$5.50
07/28/2011	MDDA000FYL	4.00	Anatomical Container	164.97 KG	\$1.150 KG	\$189.72
07/28/2011	MDDA000FYL	5.00	Bio Tote 96 Gal (Grey)	160.07 KG	\$1.150 KG	\$184.09
07/28/2011	PDDA000FYL	5.00	96 Gallon Tote Dropoff	0.00 KG	\$0.500 EA	\$2.50
		1.00	HST	0.00 KG	\$274.920 EA	\$274.92
Site 001: SUB TOTAL						\$1,832.80 ✓
Site 001: TAX TOTAL						\$274.92 ✓
Site 001: TOTAL						\$2,107.72 ✓

INVOICE AMOUNT DUE BY/FACTURE TOTALE DUE AU 08/30/2011 \$2,107.72

*pg 0 799 !!
PRQ37648
11930-7210*

Return bottom portion with your payment in the enclosed envelope./Détacher et retourner la partie inférieure avec votre paiement dans l'enveloppe ci-incluse.



\$ AMOUNT ENCLOSED		INVOICE AMOUNT DUE BY 08/30/2011	
		\$2,107.72	
CUSTOMER NUMBER		INVOICE DATE	INVOICE NUMBER
7035009		07/31/2011	0000636300
			SECURITY CODE
CARD NUMBER		EXP. DATE	
SIGNATURE		PRINTED NAME	

0007035009 0000636300 0000210772 3 000007

ADDRESSEE/DESTINATAIRE:

DALHOUSIE UNIVERSITY
ACCOUNTS PAYABLE
FACILITIES MANAGEMENT
1236 HENRY STREET
HALIFAX, NS B3H 3J5

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**ENVIRONMENTAL SCIENCE PROGRAM
FACULTY OF SCIENCE
DALHOUSIE UNIVERSITY
(version 2010)**

**APPLICATION FOR ETHICS REVIEW OF RESEARCH INVOLVING HUMAN PARTICIPANTS
UNDERGRADUATE THESES AND IN NON-THESIS COURSE PROJECTS**

GENERAL INFORMATION

1. Title of Project: Increasing efficiency of autoclaves and distilled water systems at Dalhousie University

2. Faculty Supervisor(s) Rochelle Owen 902-494-7448	Department Office of Sustainability	e-mail: riowen@dal.ca	ph:
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3. Student Investigator(s) ph: Maria Armstrong Sanjay Cishecki Hana Kang Emilie Novaczek Carly Lima	Department 	e-mail:
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4. Level of Project: Non-thesis Course Project [] Undergraduate [] Graduate []
Specify course and number: 3502 ENVS/SUST Campus as a Living Lab

5. a. Indicate the anticipated commencement date for this project: January 24, 2012
b. Indicate the anticipated completion date for this project: April 13, 2012

SUMMARY OF PROPOSED RESEARCH

- 1. Purpose and Rationale for Proposed Research:** *Briefly describe the purpose (objectives) and rationale of the proposed project and include any hypothesis(es)/research questions to be investigated*

This project will examine two types of lab equipment at Dalhousie in terms of safety and efficiency: steam autoclaves and water distillation units. A cost-benefit analysis will be conducted to determine whether a centralized autoclave to neutralize all bio-hazardous waste on campus would benefit Dalhousie's triple bottom line. In this analysis, special attention will be given to equipment and operational costs, water and energy efficiency and safety of

Dalhousie student, staff, faculty and the surrounding community. An online survey will be delivered to faculty/staff in Dalhousie labs to gather information on autoclave usage patterns and best practices to increase efficiency. A preliminary study will be done to create an inventory of all water distillation units on campus. This information will be crucial to future research that is conducted on potential retrofits to laboratory water distillation Systems.

2. Methodology/Procedures

a. Which of the following procedures will be used? Provide a copy of all materials to be used in this study.

- Survey(s) or questionnaire(s) (mail-back)
- Survey(s) or questionnaire(s) (in person)
- Computer-administered task(s) or survey(s)]
- Interview(s) (in person)
- Interview(s) (by telephone)
- Focus group(s)
- Audio taping
- Videotaping
- Analysis of secondary data (no involvement with human participants)
- Unobtrusive observations
- Other, specify informal meetings

b. Provide a brief, sequential description of the procedures to be used in this study. For studies involving multiple procedures or sessions, the use of a flow chart is recommended.

1. Initial data collection including review of existing reports, consultation with client, meetings with Green Lab Committee and Autoclave Technician
2. Online survey distributed to relevant Dalhousie Laboratories
3. Analysis of survey results
4. Audit of existing autoclave and water distillation equipment (time permitting)
5. Producing a final report and deliverables

3. Participants Involved in the Study: Indicate who will be recruited as potential participants in this study.

Dalhousie Participants:

- Undergraduate students
- Graduate students
- Faculty and/or staff

Non-Dal Participants:

- Adolescents
- Adults
- Seniors
- Vulnerable population* (e.g. Nursing Homes, Correctional Facilities)

** Applicant will be required to submit ethics application to appropriate Dalhousie Research Ethics Board*

b. Describe the potential participants in this study including group affiliation, gender, age range and any other special characteristics. If only one gender is to be recruited, provide a justification for this.

Researchers and lab technicians in relevant Dalhousie departments (see autoclave inventory in appendix).

c. How many participants are expected to be involved in this study? _____

4. Recruitment Process and Study Location

a. From what source(s) will the potential participants be recruited?

- Dalhousie University undergraduate and/or graduate classes
- Other Dalhousie sources (specify) Faculty and Staff
- Local School Boards*
- Halifax Community
- Agencies
- Businesses, Industries, Professions
- Health care settings*
- Other, specify (e.g. mailing lists) _____ *

Applicant may also require ethics approval from relevant authority, e.g. school board, hospital administration, etc.

b. Identify who will recruit potential participants and describe the recruitment process.

Provide a copy of any materials to be used for recruitment (e.g. posters(s), flyers, advertisement(s), letter(s), telephone and other verbal scripts in the appendices section.

Recruitment will be done through distribution of an online survey by department administration.

5. Compensation of Participants: Will participants receive compensation (financial or otherwise) for participation?

Yes No If Yes, provide details:

6. Feedback to Participants

Briefly describe the plans for provision of feedback and attach a copy of the feedback letter to be used. Wherever possible, written feedback should be provided to study participants including a statement of appreciation, details about the purpose and predictions of the study, contact information for the researchers, and the ethics review and clearance statement. Note: When available, a copy of an executive summary of the study outcomes also should be provided to participants.

An electronic letter will be sent to all respondents of the survey thanking them for their input and briefly updating them on the project results.

POTENTIAL BENEFITS FROM THE STUDY

1. Identify and describe any known or anticipated direct benefits to the participants from their involvement in the project.

There is a potential for increased safety by influencing decision makers to install a centralized autoclave for bio waste. There is also a potential for upgrading old equipment to increase efficiency.

2. Identify and describe any known or anticipated benefits to society from this study.

Reducing waste of energy and water by improving efficiency of laboratory equipment.

POTENTIAL RISKS TO PARTICIPANTS FROM THE STUDY

1. For each procedure used in this study, provide a description of any known or anticipated risks/stressors to the participants. Consider physiological, psychological, emotional, social, economic, legal, etc. risks/stressors and burdens.

[] No known or anticipated risks Explain why no risks are anticipated:

[] Minimal risk * Description of risks: Some risk of stress due to concern that survey results will result in change of normal practices or loss of equipment.

[] Greater than minimal risk** Description of risks:

** This is the level of risk associated with everyday life. ** This level of risk will require ethics review by appropriate Dalhousie Research Ethics Board*

2. Describe the procedures or safeguards in place to protect the physical and psychological health of the participants in light of the risks/stresses identified in Question 1.

The survey will use careful wording of questions so that they are neutral and minimize any that suggestion that results will be used to justify equipment removal.

INFORMED CONSENT PROCESS

Refer to: <http://pre.ethics.gc.ca/english/policystatement/section2.cfm>;

1. What process will be used to inform the potential participants about the study details and to obtain their consent for participation?

- Information letter with written consent form; provide a copy (incorporated into survey)
 - Information letter with verbal consent; provide a copy
 - Information/cover letter; provide a copy
 - Other (specify)
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2. If written consent cannot be obtained from the potential participants, provide a justification.

ANONYMITY OF PARTICIPANTS AND CONFIDENTIALITY OF DATA

1. Explain the procedures to be used to ensure anonymity of participants and confidentiality of data both during the research and in the release of the findings.

Names and specific lab locations are not attached to survey. Opinio online survey used so that responses are anonymous.

2. Describe the procedures for securing written records, questionnaires, video/audio tapes and electronic data, etc.

Opiniono Online Survey distributed through email

3. Indicate how long the data will be securely stored as well as the storage location over the duration of the study. Also indicate the method to be used for final disposition of the data.

- Paper Records
 - Confidential shredding after _____
 - Data will be retained until completion of specific course.
 - Audio/Video Recordings
 - Erasing of audio/video tapes after _____
 - Data will be retained until completion of specific course.
 - Electronic
 - Erasing of electronic data after _____
 - Data will be retained until completion of specific course.
 - Other
-

(Provide details on type, retention period and final disposition, if applicable)

Specify storage location: USB

Appendices: ATTACHMENTS Please **check** below all appendices that are attached as part of your application package:

- Recruitment Materials:** A copy of any poster(s), flyer(s), advertisement(s), letter(s), telephone or other verbal script(s) used to recruit/gain access to participants.

- [] **Information Letter and Consent Form(s).** Used in studies involving interaction with participants (e.g. interviews, testing, etc.)
- [x] **Information/Cover Letter(s).** Used in studies involving surveys or questionnaires.
- [x] **Materials:** A copy of all survey(s), questionnaire(s), interview questions, interview themes/sample questions for open-ended interviews, focus group questions, or any standardized tests used to collect data.

SIGNATURES OF RESEARCHERS (see attachment)

OPNIONO SURVEY

Introduction:

This survey is part of research being conducted for The Environmental Health and Safety Office and the Office of Sustainability by students of ENVS 3502 (Campus as a living Lab) . Students are investigating strategies for improving safety and energy and water efficiency of autoclave and water distillation systems. Input from lab users is essential to the success of the project and your time is greatly appreciated. Information gained through this survey will help identify where and how efficiency gains can be made while maintaining or improving quality of equipment, ease of use, and safe-handling procedures.

Green Labs: Autoclave and Water Distillation Efficiency

- I. What department is your laboratory in?
 - a. (Drop down list of the departments)

- II. Do you use any autoclaves on the Dalhousie campus?
 - a. Yes
 - b. No

If you answered **Yes** to question II, continue to **Part A**. If you answered **No**, skip to **Part B** on water distillation.

Part A: Autoclaves

- 1) Which autoclave do you use most often?
(Drop down menu of 35 autoclaves) (Labelled by room number, with size as another defining feature if multiple autoclaves exist)

- 2) How often do you use this autoclave to neutralize bio-waste for disposal? Provide approximate hours per week _____

- 3) How often do you use the autoclave for sterilization of equipment (including glassware, media, and other equipment used in research)? Provide approximate hours per week _____

- 4) What size (capacity) is the autoclave?
 - a. Small (16x16 inch door, 36 depth)
 - b. Medium (20x20 inch door, 36 depth)
 - c. Large (24x36, 48 depth)
 - d. Not sure
 - e. Other (Please specify): _____

- 5) Approximately how far do you walk to use the autoclave?
 - a. Within your laboratory
 - b. 10-20 meters
 - c. 20-40 meters
 - d. Greater than 40 meters on one floor
 - e. On a different floor in the same building
 - f. Other (Please specify): _____

- 6) How full is the autoclave before running a load?
 - a. _____

- 7) Is there a policy in place for times when autoclaves should be turned off?
 - a. Yes
 - b. No
 - c. Not Sure

- 8) If you answered yes to **6** please describe policy briefly: _____

- 9) What are the most effective ways to increase efficiency of autoclaves? Rank the following options from 1 to 7 with 1 being the most effective
 - a. Centralized autoclaves for biohazardous waste (all waste picked up from the labs by a dedicated technician)
 - b. Turning autoclaves off at night
 - c. Only turning autoclaves on when needed
 - d. Replacing old autoclaves with more efficient ones
 - e. Regular maintenance of autoclaves
 - f. Only autoclaving when there is a full load
 - g. Other (Please Specify): _____

Part B: Water Distillation

- 1) Do you use distilled water in your lab?
 - a. Yes
 - b. No

c. Not Sure

2) How do you get distilled water in your lab?

a. Centralized (from tap)

b. Distillation unit within lab. Please specify type _____

c. Distillation unit outside of lab. Please specify where: _____

d. Reverse osmosis unit within lab

e. Reverse osmosis unit outside of lab. Please specify where: _____

f. Not Sure

g. Other (Please specify): _____

3) How could water and energy efficiency of water distillation be improved? Please provide brief description/explanation: _____

SIGNATURES OF RESEARCHERS

Signature of Student Investigator(s) Date Feb 28, 2012 [Signature]
Signature of Student Investigator(s) Date Feb 28, 2012 [Signature]
Signature of Student Investigator(s) Date Feb 28, 2012 [Signature]
Signature of Student Investigator(s) Date Feb 28, 2012 [Signature]
Signature of Student Investigator(s) Date march, 1, 2012 [Signature]
Signature of Student Investigator(s) Date _____
Signature of Student Investigator(s) Date _____

FOR ENVIRONMENTAL SCIENCE PROGRAM USE ONLY: Ethics proposal been checked for eligibility according to the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans

Signature Date

Signature Date