MWP

The McGill Waste Project.

The state of waste @ McGill: 2013

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OUTLINE:

INTRODUCTION:

This is the first publication from the McGill Waste Project. The goal of this report is to provide an aggregate of information; an encyclopedic effort seeking to centralize and clarify knowledge about the material ecology and waste system at McGill University. The hope is that students, staff, and professors who seek to develop projects in the future will be able to access this document, answer questions, and be provided with the information-necessary to jumpstart high-impact initiatives that can improve the state of sustainability on campus. Furthermore, the various groups currently working on waste issues will be able to use this document to better coordinate their efforts in tandem with one another. Hopefully this document will be updated on an annual basis to provide up to the date information relevant to the McGill campus waste system.

This represents an initial effort; an effort that will hopefully be a foundation for further research and investigation into the waste system. Admittedly the breadth of this work compromises on its ability to provide higher levels of detail and focus on specific topics. We hope that this information, along with the projects that we have begun to put in motion, will enable waste to become more of a centerpiece in the discussion of sustainability on McGill campus.

This report uses the language and visualizations offered by systems thinking and derive lessons from the academic field of systems dynamics. This provides the basic conceptual framework from which we begin. We then divide waste into three relevant streams: garbage and recycling (collectively), hazardous waste, and organic waste (compost). These streams are further subdivided into relevant categories that require more detailed analysis. Each stream is considered in terms of its institutional and industrial ecology, i.e., what exactly is thrown out and who gets to make the rules about it. Furthermore, each stream is considered based on the campus impact of the waste production, as well as McGill's comparative performance in sustainability with regards to each stream of waste. Lastly, final thoughts, observations, and conclusions are wrapped up in investigative thoughts regarding the future of sustainability in these areas. We believe that McGill, as an institutional leader in Canada and the world must, as a whole, take these nuanced issue of sustainability seriously in order to make optimized economic, social, and political decisions for the well being of future generations.

ACKNOWLEDGMENTS:

We would like to humbly issue a word of thanks to the various staff and student stakeholders who took the necessary time to help us on our path. This is the culmination of lot of invested time and participation from the patient and giving members of the McGill community. Based on the commitment I've seen, I believe that the McGill community can achieve the level of sustainability that we all hope for and envision.

METHODS:

Much of the information with regards to the McGill Waste System has been contained in "institutional memory", undocumented in explicit form or in ways that are made publicly available. As a result, a substantial portion of this research involved semi-structured interviews with students and staff members in stakeholder organizations and McGill departments. The MWP made every effort to gain access to relevant written documentation to supplement and support conclusions drawn from interview-based research as well. Many of the conclusions from such written documentation whether waste audits, student research projects, or departmental documents, are represented in this report. Statistical analysis of the results from the available data is an important challenge that would indeed offer important insights into the waste system, but is not a goal of this report. For those interested in investigating deeper into particular documents represented in this report, we will be hosting the documentation centrally on our website in lieu of an appendix here: http://mcgillwasteproject.com/reports/non-mwp-documentation/.

DEFINITIONS:

<u>Autoclaving:</u> a strong, heated container used for chemical reactions and other processes using high pressures and temperatures, e.g., steam sterilization.
<u>Applied Student Research:</u> Independent Research projects for students that involve a staff relationship and a student research contribution toa campus issue.
<u>bio-medical waste:</u> consists of solids, liquids, sharps, and laboratory waste that are potentially

infectious or contaminated, as a result of their clinical or biological source.

Collective Action Problem: collective action problem" describes the situation in which multiple individuals would all benefit from a certain action, but has an associated cost making it implausible that any one individual can or will undertake and solve it alone (Dowding,1996).

Diversion rate: The diversion rate represents the amount of waste diverted from beign brought to landfill by recycling and re-use.

External contractor: Firms brought from outside of the direct employment of McGill University, paid to complete specific tasks required by the campus community.

Industrial Ecology:The study of material and energy flows through industrial systems necessary for the functioning of a modern society (allenby, 2006).

Institutional Ecology: Institutions, like populations and organizations, occupy physical, temporal, symbolic, and social space. It is reasonable, then, to assume institutions are characterized by ecological dynamics (Abrutyn, 2012).

Integrated waste management: The strategy used to develop an integrated waste management system is to identify the level or levels at which the highest values of individual and collective materials can be recovered. For this reason, the list starts with reduction using less and reusing more, thereby saving material production, resource cost, and energy. At the bottom of the list is ultimate disposal the final resting place for waste (Heimlich, 2002).

Leverage points (with regards to systems theory): References where to intervene in a system in order to create an optimized, magnified, and intended effect.

-Leachate (Leaching):

-Organic Waste:Bio-degradable animal or plant waste

-Post-Consumer Organic Waste: References organic waste produced after the food has been processed and served; i.e. after consumption.

-Pre-Consumer Organic Waste: References organic waste produced during the processing of food, before it is finally transformed into the intended consumer item.

-System Dynamics: System dynamics is an approach to understanding the behaviour of complex systems over time, which can include feedback loops, time delays, flows, causal relationships between different elements of a system etc.

-system thinking: Bringing a systems perspective to a community provides a lens to understand

and analyze the complexity of a situation, and the relationships that make up that community.

-Post-Consumer Organic Waste: References organic waste produced after the food has been processed and served; i.e. after consumption.

-Pre-Consumer Organic Waste: References organic waste produced during the processing of food, before it is finally transformed into the intended consumer item.

-Recyclates/Recyclables:

-Waste System:A system that encompasses the post-consumption flow, transformation, and re-constitution of materials in a community.

-Waste-to-resource assessments: A waste-to-resource assessment is used to identify sources of improved recycling/upcycling and economic opportunities from an institution's waste stream.

_Materials capable of being recycled.

Waste Stream: A waste 'stream' is a sub-division of the total waste produced. For example, garbage is a waste stream.

Acronyms:

-ASR: Applied Student Research

-SSMU: Student Society of McGill University

-mOOS: McGill Office of Sustainability

-EHS: environmental health and safety.

-PMG: Plastic Metal Glass recycling

-GCM: Gorilla Composting Macdonald Campus

-BMH: Bishop Mountain Hall

-PGSS: Post-Graduate Student Society

RVC: Royal cVictoria College

HWM: Hazardous waste Manaement

UNDERSTANDING THE SYSTEM OF WASTE

Why a ‘system’ understanding is important

Like many other environmental issues, waste is a highly complex problem: The production of waste is an irreversible side effect of the existence and continuity of society, and every single member of every single community is already implicated in the scale and impact of waste production. Can we depend on everyone to take responsibility for themselves, or does waste fall under the category of a ‘collective action problem’? Secondly, the scale and impact of waste is dependent on decision making that starts at the point of purchasing a good, and continues through the process of using the good, making a decision about the disposal of the waste production from the use of that good, and the resulting processes that are undertaken. Waste is a diverse topic, and the relative sustainability of waste management is not the decision of any one group exclusively, or any one type of decision alone.

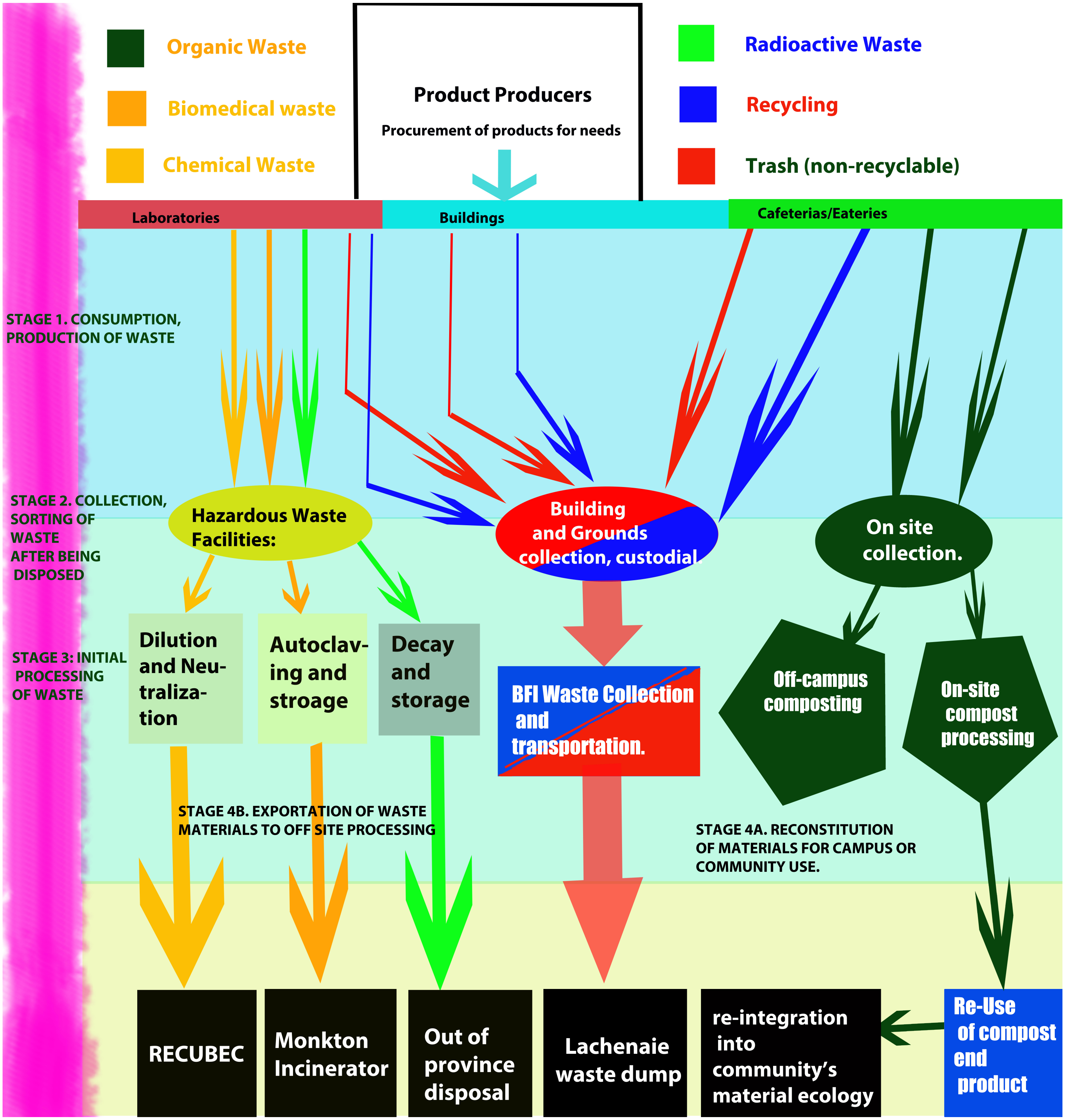
This is particularly important to keep in mind when attempting to create change in such a complex system. In order to create high impact projects and catalyze change in the realm of sustainability, the 'leverage points' in a system must be understood. Projects should justifiably emerge from areas of opportunity where an effort or a set of resources can best be applied in a result oriented fashion. However, if there is little informational clarity about causal relationships between institutions or practices in a system, there tends to be inefficiencies on the path to sustainability, whether due to groups unnecessarily repeating the research or work of previous leaders, or projects not taking advantage of momentum in sectors of the waste system unbeknownst to them. Having the intricacies of the waste system laid clearly before us, in terms of material flow and the institutions that govern the system, allows us to make calculated decisions about where to apply our efforts to improve metrics of sustainability with regards to waste. Framing a contextualized issue in a system-perspective will hopefully improve our collective efforts in the future.

In practical terms, applying a systems-perspective to the issue of waste encourages "integrated waste management" practices. Fundamentally, compost, trash, and recyclables are interlinked intimately, and thus waste management should be initiated with the connectivity of the various waste streams in mind. For example, the presence or lack of presence of post-consumer compost bins in cafeterias affects the quantity and management requirements of the trash stream. If an institution is focused on reducing the total amount of trash produced by McGill campus, they should be, in the same stride, considering the other streams of waste as well.

What does the system look like?

Understanding the Material Ecology:

The term material ecology, in this context, refers to the movement of materials (objects that become waste, and undergo processing) to and from areas of campus and beyond. this introduction to the waste streams at McGill will provide a 'big picture' foundation, with will be further elaborated upon in detail later in the document. The material ecology can be characterized by "nodes", where materials are collected and processed or transformed, and "linkages" where materials are transferred to and from. The McGill Waste System is a linear, open system where materials enter as usable pre-consumer goods and are consumed, then, and with notable exceptions, are removed from the campus context. Most waste is sorted and aggregated based on processing needs on site, however, the vast majority of waste is minimally processed on campus. Note that processing, in this context, refers to the transformation of form and or/use. While we will be illustrating the structure of this system, applying concrete numerical values for flows is more challenging, and should be the subject of future MWP projects; . Our knowledge of material ecology on campus comes from a patchwork of audits performed by a variety of groups and departments on campus, with a significant amount of variation in scale and focus.



In theory, a sustainable waste system is one that approaches a non-linear, cyclical, and closed arrangement. This implies processing that allows re-use and re-purposing on site. The efficiency of a material's use is based on it's "staying power", or it's capacity to exist in a productive manner on campus for an extended period of time. An example of how this is employed at McGill can be seen in the Big Hanna composter. Food items are purchased and processed to be made edible and productive for use. Organic waste is created in the processing of the food, then that organic waste is collected and brought to the Big Hanna, where it is digested and re-purposed into a productive item; compost. That compost may be used to fertilize the campus grounds or campus crop production, which extends it's use for the McGill community in a cyclical fashion.

Some waste streams, such as radioactive waste, offers no choice in terms of re-introducing the materials into the waste system. Tight government regulation on federal and provincial levels strictly enforce particular types of management and ultimately disposal. In a systems framework we understand those linkages to be firm and unmoving, and therefore reduction strategies should be applied in areas where re-integration has the highest potential success and opportunity.

Approaches to solutions fall under several categories with such an understanding of flows and nodes:

- Reducing consumption (reducing the flow of materials into the waste system)
- increasing the efficiency of good consumption (reducing waste in the consumption process, either due to the choice of the product or the manner in which it's productive potential is extracted)
- Increasing the re-constitution of materials (reducing contamination of garbage with materials that can be recycled, as well as increasing the reusability of post-consumed materials and for longer periods of time)
- Create opportunities for on-site recycling, re-use, and re-integration into the campus system (if a transformative processing technique can be introduced that addresses a campus need, the materials being otherwise disposed of may aid in satisfying that need).

Additionally, when making decisions about waste, the carbon footprint of campus operations becomes a question: Is it better to have on-site material processing and recycling if it's not as efficient (due to economies of scale) compared to a larger operation outside of campus that requires waste to be transported long distances? Green-House gas analyses are important in this respect, remembering that the goals of waste reduction are always connected with the greater goals of sustainability and lowering our environmental impact. This aspect will be explored to varying extents in further sections.

Understanding the Institutional Ecology:

In order to understand and effect change in the waste system, we have to recognize that the institutions and individuals that govern the management of waste are just as important to be considering in a systems approach as the materials themselves. It is especially important for future projects to be able to quickly identify stakeholders in the waste system and what their responsibilities and policies are. Here we will outline the 'institutional ecology', or the relationships and institutions that govern the system of waste. Each of these institutions will be analyzed and explored in more depth in each section relating to the waste stream they are involved with.

The first institution to consider is the McGill Procurement Services. Their ability to influence McGill's tenders and purchases make them, in many ways, the entrance point to the campus waste system in terms of the institutions that govern the flow of materials on campus. Their inclusion parallels the treatment of the purchasing of goods being the first stage of material flows in a waste system. The Procurement Department, in order to address sustainability at this port of McGill's material ecology, created a Sustainability Commissioner position to ensure progress towards the sustainability goals outlined by Vision 2020. Very much aware of their influence, they have reached out to the MWP to develop an ASR project for Winter 2014, called "Sustainability Policies for Procurement". The student team will focus on researching best practices for informing campus purchasing plans with regards to sustainability. Those principles and policies will then further work to develop "tsddff", or contracts. **The potential impact of this transition are incredibly significant.** The higher "up in the stream", the more waste can be reduced.

It follows that the recipients and users of those goods represent the next level of institutions to consider. This next level has been organized categorically, based on the method and type of material uses that are undertaken in their respective spaces of operation. Geographically, they overlap on campus, and are not discretely organized in that way. Laboratories, representing one group of recipients, are a highly decentralized collective of self-managed institutions in the waste system. The greatest common denominator in terms of waste is the Hazardous Waste Department, who collects and receives all of the bio-medical, electronic, chemical, and radioactive waste produced by laboratory operations. As a result, they are a leverage point in the system. The implication of this institutional arrangement is such that early-stage solutions are more challenging, i.e., reducing consumption and increasing efficiency of use, because environmental standards require monumental authority to implement, which is why, by and large, laboratory operations are restricted mostly by Provincial and Federal law. The University, as it stands, does not have an incentive to make laboratory operations more difficult with further restrictions on what they can and cannot do. However, solutions are viable at the leverage point, the Hazardous Waste department. Further illustration on their activities in the Hazardous Waste Section will illustrate why.

The second group of recipients to consider are the non-laboratory occupants of campus buildings. Much like in the case with laboratories, the occupants are diverse in the needs and consumption patterns. Unlike the laboratories however, the spaces they occupy are centrally managed by McGill Buildings and Grounds department. Again, controlling for consumption and efficiency of use is difficult, but the added advantage of that centralized institution managing the buildings is that reducing contamination and diversion is completely within their realm of control.

The third group of recipients to consider are the cafeterias, residences, and eateries. We are considering them as a unified group because as it stands today, McGill Residences and Student Housing and Food and Dining Services have been 'unified' under the leadership of Mathieu Laperle. This is a recent development, so the policies and management practices that govern their sub sector may not be entirely standardized as of yet, but according to the Food and Dining Intern Lou-Anne Daoust-Filiatrault, this is a planned future development (Daoust-Filiatrault, 2013). Collectively, these institutions control a significant amount of campus consumption, and their operations involve multiple levels of processing (with regards to food) and material transformation. I.E., food products purchased are processed in kitchens, involving a relative efficiency of use, and then subsequently sold for student consumption, whereby students then produce food wastes to be disposed of when eating.

UNDERSTANDING THE ‘STREAMS’ OF WASTE

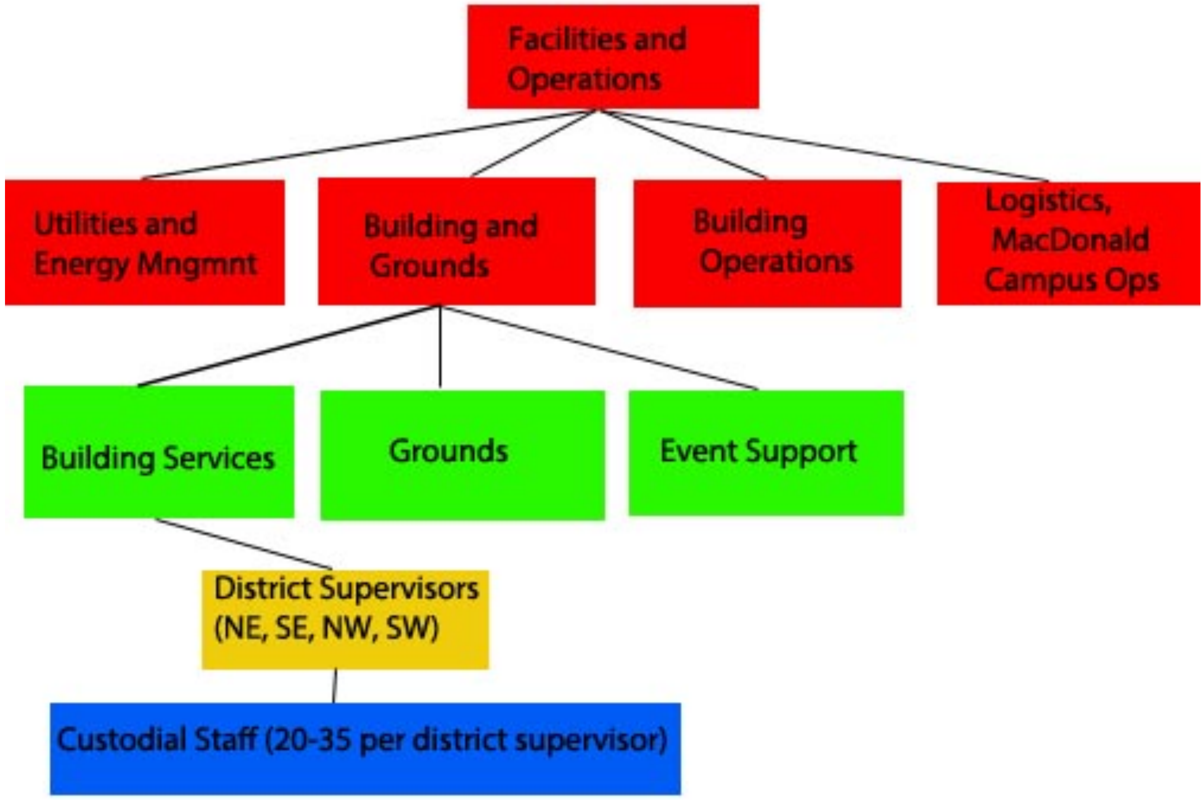
Solid Waste and Recycling:

How is solid waste/recycling management institutionally organized?

Solid Waste and recycling management is roughly divided into four institutional groups: Residence and Student Housing, Building and Grounds, Food and Dining Services, and

Independently managed buildings that employ their own custodial staff or manage their building space differently (namely SSMU and The Thompson House (Gray-Donald, 2013). These groups are *relatively* standardized in their waste management policies. The common denominator is that each receives collection services from the external waste management firm, BFI Canada. Buildings and Grounds manage the contracts for this removal, regardless of custodial servicing (Lazaris, 2013). It's important to note that waste and recycling are managed in tandem, and their collection and processing is encompassed in the same contractual agreements.

Buildings and Grounds, which constitute the waste management and custodial services for the majority of buildings and spaces on campus, are organized hierarchically. Of the three services performed by Buildings and Grounds, "Building Services" is the one that manages the custodial services for buildings. The Building Services Officer, George Lazaris, employs District Supervisors for geographic areas of campus: Northwest, Northeast, Southwest, and Southeast. Each District supervisor oversees a custodial team of 20-35 individuals that have diverse responsibilities (Building and Grounds, 2013). 20% of buildings are managed differently; they are 'contracted out' to custodial services managed by non-McGill affiliated companies (Lazaris, 2013). These companies however, are held to the same standards and policies that are decided upon by Buildings and Grounds, in terms of cleaning expectations, waste management practices, and even the choice of cleaning products (Lazaris, 2013). That ability to determine standards and expectations have formed fertile ground for prior sustainability initiatives, such as procuring green cleaning products. Decisions about sustainability have followed suite in a pragmatic, decision-by-decision basis; there is no sustainability policy that explicitly standardizes or elaborates on future goals, largely because the authority for making those decisions funnel to a single individual, George Lazaris, the Building Services officer.



Also note that due to the hierarchical structure of the department, if one aims to develop a new project in tandem with Building and Grounds, such a hierarchy has to be taken into consideration. Final decision making on shifts in policy and decision-making have to receive confirmation from Marc Dozois, the Director of Building and Grounds. Alternatively, Facilities management at the Macdonald campus is a much smaller team supervised and managed by the Director Peter Knox.

Food and Dining Services and McGill Housing and Student Residence hire their own custodial teams for the cooking spaces exclusively. While relatively speaking, these are small spaces compared to the sum of space managed by building and grounds, but these spaces are leverage points for large volumes of organic waste being managed and either composted or disposed of as garbage. This issue will be considered in more detail in future sections. Food and Dining does, however, make explicit policies with regards to sustainability, and the specific initiatives they have undertaken are well advertised and clearly presented on their website. This includes a series of choices about ethical procurement and sourcing of food items, commitments to sustainable seafood, and indeed waste reduction. Issues of water bottles, composting, and the recyclability of utensils and plates are all examples (Food and Dining Services, 2013). The key elements of outreach and awareness have become integrated into their sustainability-oriented practices.

The McGill Residence and Student Housing department is worth considering independently as well. They employ their own custodial staff, and while Building and Grounds manages the BFI contracts for waste pickup, they effectively govern the extent to which signage and bin locations can improve diversion rates. From a policy perspective, sustainability has become a corner stone of their stated values and as an area of focus for their future activities, as stated in the Strategic Plan for Residences and Student Housing executive summary (RSH, 2010). This was an effort to directly integrate sustainability into the fabric of their institutional behavior: "our day-to-day operations need to continually consider sustainability in terms of the environment, business practices, financial issues, and social justice so that it will become a part of the culture in our communities and offices." However, it's uncertain whether this intent has translated into any tangible transformations in the waste infrastructure, as one branch of sustainability, in McGill residence and student housing. Admittedly, this requires further investigation from members of the MWP; the answers may be non-explicitly manifest in institutional knowledge that is not immediately available to the public.

Notably, both Food and Dining Services and McGill Residence and Student Housing are in the process of a departmental consolidation. While there is no information on the details of this transition online, it is the understanding of the MWP that the end result will be the Director of Food and Hospitality Services, taking a unified position of directorship over Residence and Student Housing (Daoust-Filiatrault 2013). The implications of this transition for sustainability and waste policy are as of yet, uncertain.

How are the materials collected and organized?

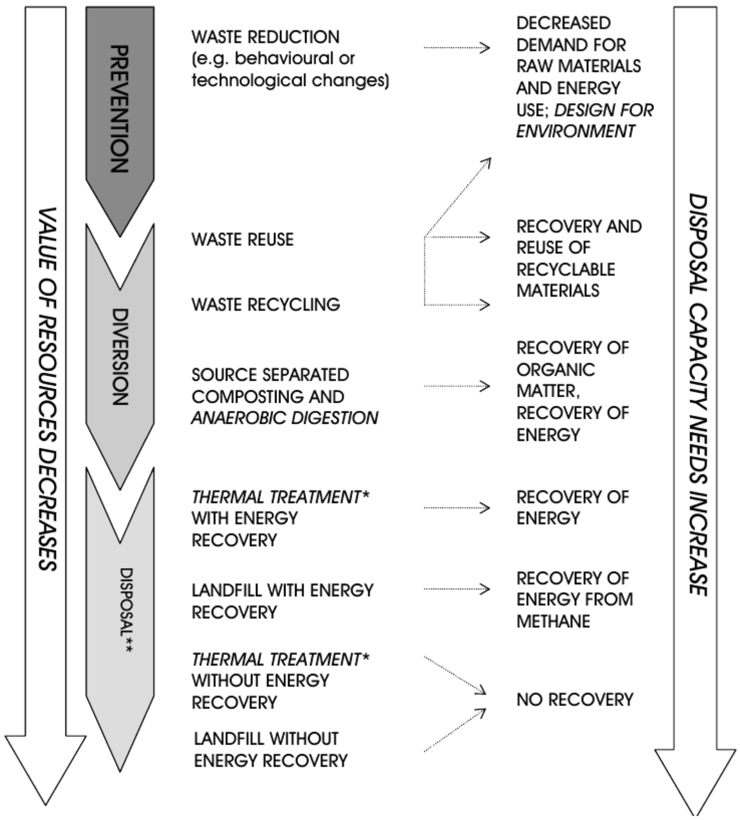
Waste and recycling are diverted into three streams across campus: trash, paper recycling, and mixed recycling or PMG (Plastic-Metal-Glass). Bins are designated for these three streams of waste, and are scattered across buildings. The proper disposal of these materials is the responsibility of both students and custodial staff. The success of this diversion depends on a number of factors ranging from the awareness and education of students and staff, to the physical arrangement and strategic location of bins in relation to foot traffic, eating areas, etc. For landfill waste to be reduced as much as possible, the spatial arrangement and location of bins must be contextually optimized for each building; the organization of waste collection can result in significant improvements in landfill waste reduction.

This relationship between spatial arrangement and the contamination of recycling bins

(A.K.A. the effectiveness of waste diversion) was thoroughly investigated by TEVA recycling in 2011 through their statistically rooted multi-bin initiative in the Schulich library of Sciences and Engineering (Grauers et. al., 2011). They found that centralized and well-signed waste bins (implying the organization of trash, paper recycling, and PMG recycling bins directly adjacent to one another), reduced the waste sent to landfills over the period of their study by 24.1%. However, the 2013 Waste-to-Resource Audit found that "…there are inconsistency in both waste and recycling stations and signage. Contamination was observed in all of the waste and recycling bins across the campus…". The larger issue here is that contaminated recycling bags may be decidedly put into the trash stream of waste by custodians using informal visual audit techniques to assess the content of bags. Reduced contamination implies that fewer materials will be sent to the landfill.

Materials are then removed from bins and brought to central locations in disposal areas, and subsequently near designated areas exterior of the buildings. The waste is visually distinguished by the color of the bag used to contain it. These centralized locations are serviced, in the majority of cases, by BFI Canada's waste management trucks. These practices are relatively standard despite differences in the institution that supervises waste management and hires custodians. However, there are some notable exceptions. It was reported that the porters in the SSMU building sometimes uses black garbage bags for recycling bins. As a result, it's estimable that a significant volume of recyclables from the SSMU building are being thrown out as trash, due to a lack of differentiation to be recognized by employees of BFI waste management staff, as they are also serviced by BFI (Gray-Donald, 2013).

BFI bring wastes into trucks and transports it to the Lachenaie facility approximately 30km north of the downtown campus, and 60km from the MacDonald Campus (Knox, 2013). Macdonald campus similarly uses BFI as an external contractor for the collection and disposal of their waste (Knox, 2013). Trash is diverted for landfill, while recyclables are sorted by material and processed for further sale as bulk material. The Lachenaie facility additionally collects methane gas for energy production from the trash landfill (BFI, 2013). The procedures that govern the landfill site are dictated by government regulation that ensures environmental protection from soil and groundwater leaching, and leachate processing and treatment, drainage, collection of biogas, waste containment, and the mitigation of impact on surrounding residents (Quebec, 2013). Notably, if bags of recyclables are significantly contaminated with solid waste or things constituting trash (food waste, non-recyclable materials, etc), then that content is diverted to trash at the facility. The specific information governing BFI's practices in this area, such as the specific contamination rates that designate a bag of recycling unfit for re-constitution, is the subject of further research for the MWP.



(CIELP, 2008)

What is the solid waste impact of McGill?

Today, there have been several insightful waste audits varying in comprehensiveness that collectively offer an understanding of the solid waste system. Most recently, through the mutual sponsorship and leadership of Food and Hospitality Services and Building and Grounds, a system-wide “waste-to-resource” assessment, conducted by Waste Management Canada, was performed in spring and summer of 2013. Their assessment included visual and measurement-based audits constituting basic material characterization basic options analysis, implementation feasibility analysis, and an action plan. Their estimates concluded that McGill University on the whole produces 683.49 tonnes of waste and 349.09 tonnes of recyclables per annum (a 34% diversion rate). The most staggering conclusion however, is that 86% of disposed waste could be diverted through available recycling streams, which has the constitutive impact of 486.3 metric tones of Greenhouse gas emissions per annum (Waste Management, 2013). The composite breakdown of the waste sent to land fill included:

- 41% organic waste composition
- 39% recyclable paper waste composition
- 14% recyclable plastics composition

Their conclusion was that there were major cost savings to be had with regards to landfill diversion and recycling due to the potential reduction “removal costs” (the expense of removing trash waste is highest with BFI Canada). These conclusions are equally supported by the 2013 Waste Audit of McGill Food and Dining Services’ Cafeterias (as a part of the 2013 Greenhouse Gas audit). In the case of recycling in cafeterias, there is allegorical evidence to suggest that contamination problems in post-consumer waste are greater than other buildings. This isn’t necessarily due to a hard-line or objective measure of contamination derived from BFI’s collection and processing policies. Many post-consumed items in cafeterias that are recyclable (milk cartons, yogurt cups etc.), have minimal contamination; not necessarily enough to exclude them from being recycled, but enough to affect the perception of students and staff, causing them to dispose of the items in the trash waste. It's important to note however, that the results of these studies are significantly skewed towards the study of the output of cafeterias and eateries (9/16 for the waste-to-resource audit for example). The impact of food and organic waste is resultantly higher in these spaces. This doesn't necessarily take away from it's importance, however, but many of the buildings that were not audited have made improvements in creating centralized bins and improved signage: Education library, law library, life sciences library, music library, Schulich library, Bronfman, and McConnell Engineering, Leacock, and the Arts Building (Lazaris, 2013).

Arguably further research should be done, possibly further audits and a subsequent comparative study of centralized bin systems versus non-centralized bin systems, to highlight the potential economic savings of reduced waste to landfill. Having an economic advantage as a bottom line for sustainability measures is an important element of catalyzing change in an institutional environment where budget cuts have tightened belts across campus.

How do we compare to other universities?

In terms of overall impact, McGill can be compared to its peers through its waste-to-recycling diversion rate. While total tonnage of waste created is also an important metric, it's hard to create a proportional comparison given the variation of University research pursuits, class sizes, and buildings from one campus to another. Some examples: Concordia comes in at a 54% diversion rate (Shennib, 2011), York at 65% (York, 2013), Rutgers at 67% (Waste Management inc., 2013), University of Toronto at 71.4% (University of Toronto, 2011), compared to McGill's 34%. A more vigorous and specific research effort should, in the future, focus on how McGill compares to North American universities of similar characteristics, but it is readily obvious that McGill does not stand as a leader on solid waste management among it's peers. There are a lot of factors that contribute to these figures, some of which our external to the control of any institutional decision making or social factors, such as waste management infrastructure and environmental regulations put forth by local, regional, and national authorities.

Some waste management methods that distinguish leaders amongst Universities include single stream recycling: whereby recyclables can be mixed together without any contamination or processing issues downstream, and reducing the challenge of sorting waste for users (Waste Management USA, 2011). Other schools implement comprehensive education initiatives to ensure students are completely aware of the requirements of their waste collection system, which is greatly helped by ensuring 100% standardization in the physical appearance and organization of bins. Other pursuits include innovative ways of using recyclable materials for on-campus uses. There are a lot of interesting possibilities open to McGill, but it requires significantly more student activism focused on transforming the infrastructure and consciousness of campus.

What is the future of sustainability in this area?

FORMING A WASTE DIVERSION POLICY:

There is no doubt that McGill departments are aware and actively working on the issue of waste. However, without baseline measurements, established goals for diversion rates or recycling rates, and consistency with regards to collection of waste across campus, progress will be piecemeal and non-unified, and thus less efficient and effective. The desire for improvements in sustainability is there; a waste policy could help unify efforts greatly. In the first draft of the Vision 2020 Action Plan, they outlined the goal of "[Developing] and [implementing] a comprehensive waste reduction campaign (reduce, reuse, recycle, repair) as supported by clear baselines and ambitious targets for recycling, and within a context of life cycle management of resources" (Vision 2020, 2013). The

Vision 2020 Action plan can be a flagship document to help rally various departments into explicitly outlining their participatory responsibilities towards meeting the goals created by Vision 2020 and the Sustainability Office. Student groups, including the MWP, have an important role to play in actively collaborating with staff departments to help institutionalize and make explicit the collective goals for waste reduction. It's clear from reviewing University leaders in waste reduction in North America that baselines, measurements, policies, and established goals are completely essential to making strong progress towards sustainability goals in the waste issue area. Concepts such as zero-waste, cradle-to-grave, etc. can be weaved into the institutional perspective of waste management at McGill in explicit form. Even if an idea like zero-waste seems impractical, setting lofty goals for particular measures of sustainability in the future can be effective for the entire McGill community.

DEVELOPING REGULAR MEASUREMENT AND DATA BASES OF WASTE:

WM Canada's Waste to Resource Assessment also highlighted the importance of regular measurement of waste quantities. "It is recommended that a database be established detailing all components of the waste and recycling systems on campus. This should include number and size of waste bins and recycling bins, location, service and frequency" (WM Canada, 2013). The current pattern of infrequent audits provide small windows of insight into the system dynamics and behavior of the waste system on campus, however, high-leverage interventions and new insights to improve the effectiveness of waste management would be more readily available if a steady stream of information was available that could be statistically analyzed on a regular basis. WM Canada offered recommendations on appropriate software packages for this task as well as logistical suggestions for adding regular measurement to the repertoire of custodial staff. Arguably the cost of added labor and time in adding responsibilities to custodial staff is more than reimbursed through savings: “The cost of services is typically based on the number of times the truck visits the campus. If bins are not full, the truck is visiting more often than necessary leading to increased costs of service.” If McGill had a thorough database of waste production on a building to building basis, or even at higher resolutions with regards to specific areas in a building, we could pin-point problem areas.

IMPROVING EDUCATION AND AWARENESS:

Another important underlying issue is education and awareness. WMC reports, “Full bags of recycling were being disposed of in the landfill bound waste. After speaking to staff members, it was determined that these bags were being placed in the waste stream, because the person collecting the bags determined that the recycling was contaminated. In all instances, the contamination level was minimal and would not have posed an issue during processing" (WM Canada, 2013). Their recommendations including training sessions, regular reminders from supervisors, and information pamphlets ensuring the prioritization of sustainability for custodians and staff members. They also speculate that the visibility of consistent recycling stations across campus, participation will increase for staff and students. Having recycling bins in every area makes it easier for custodians to properly separate materials at the source.

However, it is equally the responsibility of students to be aware about the impact of their decisions, from consumption to the disposal of their waste. The MWP has recognized the importance of this aspect of improving sustainability on campus, and raising awareness and participation is a cornerstone of our modus operandi. There are a plethora of possible methods of increasing awareness, from multi-media projects, to hosting events, to launching campaigns, designing effective signage above waste bins, etc.

DIRECT FISCAL RESPONSIBILITY (ECO-TAX):

This particular strategy is an effective tool for governments intending to effect change in institutions, but the logic could theoretically be carried over to the internal management of institutions as well, however complicated it would be to implement in practice. While Building and Grounds manages to foot the bill for the vast majority of campus, if the cost of waste management and removal could, to some degree, be passed on to the occupants of buildings, there could be strong incentives for everyone to participate in waste reduction action. While this might be an unpopular measure, it might benefit McGill in the long run to have its community members acutely aware of the financial and environmental burden of waste creation. When sustainability has an economic bottom line and makes economic sense, it's easier to motivate change.

Centralization and Signage for waste Bins:

As discussed, TEVA's 2011 executive report found that McGill, by and large, uses a "decentralized" waste management system, where many small standalone
Receptacles for the three streams of waste -- garbage, plastic-metal-glass (PMG) and paper -- are distributed throughout the facility. Certainly further transformable by a sustainable waste policy, and also in progress thanks to the efforts of Buildings and Grounds, "the implementation of a "centralized" system, where multiple standalone bins are replaced with a single large multi-

compartmental bin on each floor, can result in significant increases in recycling rates and consequently in high quantities of waste diverted from landfills" (Grauers et. al., 2011). TEVA further documents: "We hypothesize that the main reason a centralized system can result in significantly higher recycling rates is due to a behavioral phenomenon we refer to as the “law of the first bin”. Social stigma on littering is strong, especially in shared spaces such as a library, which explains why despite the removal of standalone bins, littering rates have not increased. McGill’s institutional recycling rules -- what can and cannot be recycled -- are different from municipal curbside recycling programs and are not always well known to McGill students and staff. Signs that clearly illustrate what does and does not go into the paper, PMG and garbage streams are therefore critical to ensure high quality sorting and to avoid the typically high contamination rates."

COMPOST:

How compost management is institutionally organized?

Downtown:

Institutionally, compost is a 'side-project' of McGill. On-site composting falls under the direct authority of Buildings and Grounds; specifically, the sub-department, Grounds, and the management of Eric Champagne, the Horticulture Supervisor. Currently, Grounds employs a student 'compost coordinator' to aid in the logistics of maintaining an on-site composting operation (Morris, 2013). Grounds is responsible for the costs of loaning a Printing Services truck used for the pickup of organic waste, and the cost of added work hours to participating staff contributing to the collection effort. However, as a project, it is in many ways, equally managed by the efforts of staff at Food and Dining Services (and the supervision of Oliver Volpe). The organic waste brought to the campus composting site is nearly exclusively sourced from campus cafeterias, and eateries such as BMH has created kitchen policies that require staff members to sort pre-consumer organic waste and divert it away from being thrown out (Daoust-Filiatrault, 2013). From this binary management, relationships with buildings and residences that supply organic waste to be composted are negotiated on a case-by-case basis. Previously, the student group, Gorilla Composting, was partially responsible for the management of on-site composting with support from the sustainability office, but with the appointment of a student composting coordinator, their position in a downtown context has become uncertain.

On Macdonald Campus:

On Macdonald campus, Composting has been a collaborative effort between the Mac Campus faction of Gorilla Composting and Macdonald campus Facilities. Responsibility was divided between custodial staff and compost coordinators and volunteers employed by Gorilla Composting Mac (GCM): Facilities handled Residences and Food Labs, while GCM
Managed five post-consumer compost bins from around campus. However, composting at Macdonald campus is undergoing a significant change that transforms the administrative and institutional arrangement. Peter Knox, of Macdonald campus Facilities, along with representatives at John Abbot college are in the process of negotiating a contract with St. Anne de Bellevieu to receive municipal compost pickups. This would largely place the exclusive responsibility for management under Facilities (in tandem with the municipal government), as opposed to a responsibility-sharing on-site arrangement with GCM.

How are the materials collected and organized?

Downtown:

As mentioned, Food and Dining Services employees sort and divert organic waste into collection bins from the kitchens of McGill Aramark cafeterias. This is transported to the Big Hanna bio-digester located exterior to the Wong Building. The Big Hanna Bio-digester accepts nearly all-organic waste with the exception of meats and oils, which at its current functional capacity, the Big Hanna cannot accept, and are thrown away as trash as a result. Typically, it has accepted nearly 50% of collected organic waste from cafeterias. The bio-digester was taking in over 60 tonnes of organic waste from Royal Victoria College, New Residence, BMH, the Faculty Club and the Students' Society of McGill University (SSMU) leading up to 2012 (Gorilla Composting, 2010).

Subsequently, processed compost could be distributed among sinks on campus, including horticultural uses on campus, and for Campus Crops and other gardening uses. This represented a cradle-to-grave framework. Unfortunately in 2013, the Big Hanna was affected by severe flooding that put it out of operation for many months. As a result, organic waste was being thrown away, and much of the previous agreements constituting it's use and its sources of organic waste have been upset. The Big Hanna has been re-introduced for the fall semester of 2013 for Aramark cafes, through the same general institutional arrangement as before.

On Macdonald Campus:

Currently, and as mentioned, composting is a collaborative effort between the Mac Campus faction of Gorilla Composting and Macdonald campus facilities. The Mac campus composting system is in a process of change. Previously, Gorilla Composting has a stipend-enabled position now working to empty five bins of post-consumer wastes around campus, which was transported to wood pallet bins located on the Macdonald campus estate, and turned, and therefore oxygenated, twice a year. The final end product was given to community gardens in adjacent fields (Ashfield, 2013).

However, as mentioned, the system is in a state of transition. Soon, Macdonald campus facilities will be institutionalizing widespread pre and post-consumer organic waste collection to be collected from the municipal system of St. Anne de Bellevue at centralized locations on campus. Pickup services are contracted to Entreprise sanitaire FA, which further centralizes the municipal organic waste to be transported by Raylobec, where it is brought to Mironor in Lachute, approximately 80km away (Saint Anne-de-Bellevue, 2010). This distance is fairly significant, however, in the next few years, four collection sites will be developed in more central locations across Montreal. Recovering 80% of organic and recyclable waste, HHW, CRD waste and bulky refuse by 2019, in accordance with the Plan directeur de gestion des matières résiduelles of the Montreal borough is one of the objectives of Plan de développement durable de la collectivité montréalaise 2010-2015, which McGill's Macdonald campus is now an integral part of.

An important aspect of this integration into a larger scale operation is that such a scale of composting facilitates the composting of meat and oil food waste. This streamlines the post-consumer waste process as consumers and food producers have to be less judicious about the food waste they put into composting bins, not to mention the increased diversion of organic waste away from landfills.

What is the organic waste impact of McGill?

Waste Management Canada's waste-to-resource assessment concluded that McGill sends 279 tones of organic waste to landfills annually; 40.8% of the total waste sent to landfills; if the assessment is taken as accurate, organic waste is a more significant contributor to landfill waste than any other materials. Based on the sites audited in the assessment, the average composition of organic waste in waste bins in cafeterias and non-cafeterias were 44.3% and 23.7% respectively. Note that these figures only represent a single, non-iterated sampling of waste from only 16 campus sites, with differing sample weights/volumes in each location. That being said, a rough idea of the significance of organics as an element of our waste footprint emerges. Playing with the figures from the Waste Reduction Model used by Gorilla Composting to produce carbon emissions figures correlating to organic waste reduction, we find that sending 279 tones of organic waste to landfill produces 396.9 tones of CO_2 annually.

Some of this impact is mitigated through diversion to on-campus composting. With the advent of the Big Hanna on the downtown campus, McGill increased its onsite composting capacity to 62 tones per year according to reports from Gorilla Composting (Gorilla Composting, 2010). However, when looking at data logs of the Big Hanna's operation, nearly 20,000 kg of organic waste was collected from the installation date of May 29th, 2010, to the end of 2011: 7501 kg total in 2010 and 12159 kg total of waste collected in 2011. This implies that the Big Hanna was operating at 20.74% of its capacity in 2010, and 19.52% of its potential capacity in 2011. Note that this operation represents the processing of a fairly small percentage of the projected organic waste creation on campus every year. If we were to take 2011 as an example, and the waste-to-resource assessment's valuation of organic waste going to landfill (organic waste composted and organic waste thrown out), then the Big Hanna would be responsible for composting 23.95% of the organic waste created on campus. The Big Hanna's operation is nothing insignificant, but there is such a significant opportunity to divert organic waste, in part because the education and infrastructure is largely there already.

To consider Macdonald campus more specifically, which has been composting 400 pounds of organic waste a week through the collection efforts of Faculties and Gorilla Composting Macdonald Campus, or roughly 5800 kg (5.8 metric tones) in an eight-month school year; there is some important waste diversion occurring on both campuses (Ashfield, 2013). But even in the case of Macdonald campus, an trash waste audit was conducted by members of Gorilla composting, and they found 48% of waste going to landfill was organic waste; using their information (including that campus produces 4448 kg of waste-for-landfill per week), 68,576 kg of organic waste is being brought to landfill. That means of organic waste on Macdonald campus, the diversion to on-site composting is a mere 8.5% of what is created (Gorilla Composting, 2011).

That being said, the creations of high quality fertilizer from on-site composting has an added benefit in terms of reducing consumption, and thus waste, on campus. It has and continues to be used by Grounds for landscaping and gardening activities, not to mention its use in gardening projects by Campus Crops and PGSS (Kapoor, 2012). This not only reduces consumption of manufactured products, but in the case of fertilizer contributions to Campus Crops, the life of the compost reduces consumption of produce farmed on industrial scales.

How do we compare to other universities?

The first comparison worth considering involves Concordia, which operates under many of the same conditions and contexts as McGill. From their 2010-2011 waste report, they conclude that, as well, "Carbon-rich organic waste accounts for 21% of compactor waste and 18% of total trash output, making it the largest contributor to trash at Concordia" (Shennib, 2011). In terms of total quantity composted, Concordia was able to sequester 40 metric tonnes of organic waste using their composter at the Loyola campus, which, if incorporating both the composting downtown and at the Macdonald campus, would be approximately 22 tonnes more, or more than double what McGill composted in total for 2011. This is in large part due to the various programs that Concordia has been implementing to facilitate composting. While in a downtown context, McGill only collects kitchen scraps and coffee grounds, Concordia has collection services and bins for organic waste in the majority of restaurants and campus cafeterias, as well as in strategic locations across campus, and dorm kitchenettes, in an ever-growing pursuit to make composting an option for pre and post-consumer organic waste (Shennib, 2011). However, the MacDonald campus integration with St. Anne-de-Bellevue could mark a significant increase in the diversion of organic waste away from trash sent to landfill. Due to the transitions' start in august of 2013, we will likely not have an accurate idea of the increased effectiveness of such a scheme until at least a year later (August of 2014).

Other schools have committed to organic waste diversion on grander scales. For example, University of Vermont has measures nearly 8 metric tons of organic waste diversion a week due to extensive pre and post-consumer collections in all dining halls and eateries on campus, as well as through the effort of "eco-rep" student volunteers in residence halls (UVM, 2013). A parallel program in the same city, on Champlain college campus, has composting completely integrated into the waste collection for buildings: they use garbage-recycling-compost multi-bins in libraries, residences, and dining halls, and have taken the necessary steps to train and educate staff and students on proper measures of sorting waste.

Another innovation that could dramatically change our waste impact is the composting of paper towels in bathrooms, a practice that Sherbrooke University has undertaken. Many of these constitute basic interventions in campus infrastructure in combination with extensive awareness campaigns and fostering active participation from the student body.

What is the future of sustainability in this area?

INCREASING THE CAPACITY AND USE OF ON-SITE COMPOSTING:

In the context of the downtown campus, it's apparent that the capacity of the Big Hanna is not being utilized to it's full potential; it's intake could be increased by five fold. This would require the formation of new relationships and composting strategies in buildings that have previously had no direct relationship with composting. In addition, Gorilla Compost found that introducing food macerators at some point in the processing and collection of organic waste in order to increase the surface area and decrease the hydration of food waste, could nearly double the current functional capacity of the Big Hanna (from 62 tons to 110 tons), and thus allowing a 10 fold increase in organic waste intake (Morris, 2013). McGill food and dining has already purchased three food macerators, but none are in operation due to lack of available kitchen space. Projects, student-led or otherwise, would find that making food macerators a functional solution for processing organic waste in McGill kitchens could lead to a significant improvement in our capacity to deal with organic waste on-site. Since McGill is continuing to pay maintenance and service for the Big Hanna (which amounts to 12,000 $ CAD per annum), leveraging this opportunity to siphon off waste from going to landfill will result in considerable financial windfalls in the collection and transportation of waste that BFI takes away from campus (Morris, 2013).

INTEGRATING INTO THE MONTREAL COMMUNITY FOR COMPOST:

Assuming that McGill began an effort to divert the significant amount of food waste that is going to landfills currently (through creating opportunities for post-consumer composting in cafeterias and across campus), the remaining quantity of compost that could not be accepted into the on-site composter should be brought off campus through an agreement with Compost Montreal, which was indeed being considered during the shutdown of the Big Hanna in 2013, but was never implemented. Compost Montreal conducts pickups, and can take meat and oil products in greater quantities (the Big Hanna's capacity for meat and oil intake is only 10% (Big Hanna Manual, 2010)) for relatively low costs.

BRINGING YARD AND HORTICULTURAL WASTE INTO THE COMPOSTING SYSTEM:

While the Macdonald campus compost site is capable of taking excess cuttings, leaves, etc., the big Hanna currently only is using wood pellets to aid in the process of decomposing the food matter and coffee grinds. A Sustainability Project Fund application was proposed to purchase a wood chipper so that plant matter collected by Grounds could be minced into small enough pieces to be added to the Big Hanna. This could mitigate the need for wood pellets, or at least reduce the needed supply for the functionality of the Big Hanna and prove cost-effective over a longer period of time.

IMPROVING COLLECTION OF PRE-CONSUMER ORGANIC WASTE:

There was sufficient evidence from the Food and Dining Services' 2013 waste audit (as a component of the Greenhouse Gas audit) to suggest that there is progress to be made in pre-consumer organic waste; namely in the context of food preparation in kitchens. " In many cases there were bags of fruit peels from the kitchen that are compostable but were being thrown out instead…. One solution may be to have a compost bin, garbage bin and recycling bin next to each other instead of having a garbage bin by itself. This way staff members can easily and accessibly compost." (Food and Dining Services, 2013). Reviewing the organization of kitchens and ensuring that composting is an easy, effective, and rapid alternative for food waste is incredibly important and should be a focus of further projects in order to reduce as much organic waste going to dumpsites as possible. This would also include clear signage in kitchen environments, and if deemed appropriate, awareness campaigns or resources for staff.

CREATING INFRASTRUCTURE FOR POST-CONSUMER WASTE:

Arguably the issue of post-consumer waste is the biggest challenge that McGill campus will be facing in the near future with regards to organic waste. It has largely been avoided as an issue area because of the logistical difficulty of ensuring behavioral adherence by the general student population, not to mention the required infrastructure, and the lag time in adjusting student behavior to a new system of waste disposal choices. The options have been considered and explored in various contexts to preliminary extents. David Gray-Donald explained, in the context of the SSMU building, that due to the diversity of space users and the difficulty of contamination, post-consumer organic waste infrastructure has not been implementable (Gray-Donald, 2013). Custodial contracts would be have to altered, and contracts with venders re-negotiated. On the other side of the argument, and in the context of food service-specific spaces, one of many conclusions from the Food and Dining Service's Greenhouse Gas Audit included the idea that "Cafeterias should encourage students to use renewable plates…plates that are compostable", and that "accessible composting should be available to students…it is essential to equalize the number of composting bins, recycling bins and garbage bins" (Food and Dining, 2013). Preliminary efforts at post-consumer organic waste disposal options should be expanded to become a standard across campus.

THE FUTURE OF COMPOSTING AT MACDONALD CAMPUS:

Peter Knox, head of Facilities at MacDonald campus, has negotiated a contract with St. Anne to pick up all the composting locations with John Abbott. In three years the contract will be re-negotiated so that institutions will be in tandem with Montreal's waste diversion goals. The MacDonald campus gardens will be supplemented with leftovers. Meat products and oils previously excluded before the St. Anne integration will be incorporated into the organic waste stream due to the benefits of municipal-scale composting. Service will be consistent, timely, and regular, and will effectively increase our services without increasing the cost of maintaining and operating such a system.

This expands the diversion potential of Macdonald campus extensively. However, while the capacity for materials to be composted will increase, the behavior of students and staff in composting organic waste must increase proportionally. Student advocacy maintains the important yet intangible resource of awareness and education with regards to proper behavior in terms of getting rid of waste. Peter Knox noted that there is a discrepancy between the service and the awareness and education that must be filled.

HAZARDOUS WASTE:

How is hazardous waste management institutionally organized?

Hazardous waste management is by and large exclusively managed by the Hazardous Waste Management Department at McGill. Due to the technical and operational requirements of collecting and processing hazardous waste, it understandably requires a centralized, trained, and professional team of staff. While hazardous waste is the central node managing a long list of various waste streams, they are interconnected and maintain working relationships all over campus; each campus laboratory that uses corrosive chemicals, radioactive materials, biological substances, etc. must collect and store the by-products of their experimentation for eventual extraction from members of the Hazardous Waste team. The Hazardous Waste Department, internally, has a manager, an administrative coordinator, a chief waste disposal technician, a hazardous waste specialist, and two waste disposal assistants. Arguably, a smaller team lends to more of a horizontal organizational structure, lending to collaboration and close working relationships. However, this team of six is also responsible for the bio-medical waste, chemical waste, radioactive waste, e-waste, and miscellaneous waste that does not fall under the general guidelines and obligations of disposal for trash, recycling, and compost, which understandably implies that their work load is extensive. It might also imply that each team member has accrued a 'jack-of-all-trades' expertise of hazardous waste, and from a sustainability perspective, an institutional capacity for interdisciplinary vision can lend to the kind of dynamism necessary for introducing waste reducing interventions into the hazardous waste system.

How are the materials collected and organized?

The on site management of hazardous waste is a highly challenging project, and is tightly monitored and restricted by government policy and regulation. In addition, the external contractors that receive waste from the HWM are audited by staff members, performing due diligence, and differentiating McGill as the only university in Quebec doing so. The waste stream labeled under hazardous waste is also highly diverse, and the HWM department services both the downtown and Macdonald campus in these areas:

CHEMICAL WASTE:

At the source, lab technicians collect corrosive and solvent based chemicals separately and store them in metal drums in waste rooms distributed in lab-focused buildings, with containers supplied by HWM. The quantity requires notice that is sent to the Hazardous Waste Management department, and the barrels are coded based on content. HWM collects the lab waste excesses from designated sites with a truck, and brings it to their central operational hub on the ground floor of the Macintyre medical building. They receive a pallet worth of barrels every 3-4 weeks, and are capable of processing two 200L drums in a week. Chemicals are stored in temperature controlled rooms with ultraviolet cameras targeting any heat fluxes or sparks with explosive potential that trigger high pressure extinguishing hoses mounted from the ceiling. Chemicals are subsequently tested for precise contents, determining processing techniques. Chemicals are siphoned into 45-gallon drums for processing based on type (Bouchard, 2013). Note that labs do not pay for the collection and processing of chemicals, they are financially unhinged from the impact they create. In addition to processing the waste stream of active labs, HWM are also responsible for the waste produced in the process of de-commissioning lab spaces, in collaboration with Environmental Health and Safety. All of the required steps of collection, storage, and transportation are undertaken with respect to government regulation (Bouchard, 2013).

Solvents, which have low-energy value, are mixed with water and diluted. HWM then calls for an extraction quote a month in advance, and it is picked up by an external contractor, the RECUBEC that vacuum pump collection tanks into tanker trucks. It is further processed at Milton Company facilities' and can be repurposed for new uses, or, if the batch is of low grade, incinerated. Corrosives however, have no recyclable value. They are neutralized and diluted until harmless, and disposed of as liquid waste.

RADIOACTIVE WASTE:

HWM provides labs with various containers that segregate radioactive waste: Liquid scintillation vials, 5 gallon steel pales for solid radioactive waste, and 4L white plastic containers for liquid waste, which, like chemical waste, are collected by HWM staff. If the waste is measurably blow The Canadian Nuclear Safety Commission's (CNSC) regulatory limits, then liquids are disposed of by drain and solids through traditional waste streams. Otherwise, Hazardous Waste collects and stores the material in a secure, temperature controlled, and radiation shielded room. For medium or low toxicities, including phosphorus-32 (P-32), phosphorus-33 (P-33), sulphur-35 (S-35), and iodine-125 (I-125), HWM sets aside these materials for radioactive decay in separate containers, following IAEA standards for subsequent disposal when sufficient half-lives have passed to render the material adequately safe for normal disposal. This significantly reduces the costs of material disposal. Otherwise, the higher toxicity radioactive waste is picked up and taken to a facility that can safely process and handle the remaining materials for it's end life (Hazardous Waste Management, 2013).

BIO-MEDICAL WASTE:

HWM provides containers and regular pickups Disposal of biomedical waste is governed by the Regulation Respecting Biomedical Waste (Québec), and encompasses the following categories:

- Human anatomical waste (body parts or organs),
- Animal anatomical waste (carcasses, body parts, organs),
- Non-anatomical waste, which includes:
- Sharps which have contacted animal or human blood, biological fluids or tissues
- Tissue or microbial cultures, and material contaminated by such cultures
- Live vaccines
- Containers or materials saturated with blood products.

These are collected and stored in fibre drums and labeled cardboard boxes and brought to the HWM facility. The waste is then trucked in Moncton, New Brunswick for incineration.

ELECTRONIC WASTE:

With regards to electronic waste (computers etc.), HWM is contacted largely by staff or administrative departments, who in the midst of upgrading hard ware or decommissioning broken computers, printers, scanners, etc., requires disposal services. HWM conducts pickups and collects and stores e-waste. Any e-waste that is conceivably recoverable for future use is sent to Reboot McGill, an engineering student society club that repairs and repurposes computers and computing accessories to be re-introduced into the McGill community. All remaining e-waste is sent to a company called Catacell, who offer recycling services for free. Catacell deconstructs electronic waste for future use, recycling any leftover materials and plastics; 100% of what would be waste is recycled and through a variety of processes, nearly no materials go to landfill (Bouchard, 2013).

MISCELLANEOUS HAZARDOUS WASTE:

HWM deals with a variety of electronic waste. One sub-stream is spent batteries, of which HWM manages four to six 200L drums annually. Batteries are collected from boxes distributed around campus for staff and students to use, and are subsequently shipped to Ontario for processing, recycling, and proper disposal (Lorenz, 2013). They also collect scrap metal, lead acid batteries, and disposed metal lab equipment, which is organized and brought to Century Metal in Ville Saint-Pierre. Fluorescent lighting also falls under the responsibilities of HWM, of which they collect and properly dispose of nearly 10km of material annually.

What is the hazardous waste impact of McGill?

McGill, being a research-intensive University, has a significant hazardous waste impact compared to University's with significantly less lab activity. A conversation about the environmental impact of conducted research is insufficiently defendable from the angle of waste exclusively. Because of the importance of research grants to University funding, recommending that there should be less lab experimentation using radioactive materials, as an example, is a near-impossible battle. Further research on the comparative impact of McGill relative to equally research-intensive Universities would be a useful resource, coupled with an investigation into alternatives. That being said, HWM does measure and audit the waste that comes in and through their facility, which serves as an excellent foundation for further research in this area.

Treatment	**Material**	**2011-2012**	**2010-2011**	**2009-2010**
Recycling	Alkaline batt	1363.8	800 kg	811 kg
	E-waste	37,129 kg	29,574	11,590 kg
	Fluorescent light bulbs	43960ft	5588ft	14,415ft
	Lead-acid batteries	3129.8 kg	2226 kg	1415 kg
	Mercury bulbs	500 units	200 units	1002 units

	Paint	600kg	2320 kg	350 kg
	Scrap metal	33484	37427	38843
	Oil	2,000L	3200 L	2,600 L
Incin./Landfill	Biomedical animal	17,377 kg	16,037kg	14818 kg
	Bio-med non-anatomical	57,216 kg	48,484 kg	50,269 kg
	cyanides and reactives	281 kg`	323 kg	253 kg
	cylinders	14 units	23 units	21 units
	liquid scintillation vials	140L	420L	2,140 L
	Other hazardous Solids	3280 kg	5100 kg	740 kg
	other hazardous liquids	20L	600L	400 L
	PCB balast	533 kg	228 kg	1860 kg
	solvents	41,020 L	39,500L	38300L
Neutralization	corrosive liquids	15,340 L	11,240	19560
Regular Waste	Decayed Radioactivity	1305 kg	4122 kg	2380 kg

What is the future of sustainability in this area?

AUTOCLAVING BIOWASTE:

HWM is planning to implement a vapor sterilization process (autoclaving) of bio-medical waste to sterilize waste and make it sufficiently safe for traditional disposal. Such infrastructure in the HWM facilities would make disposing of bio-medical waste significantly more cost-effective; it is 300% cheaper to dispose of normal waste than hazardous waste due to the transportation costs for material to be trucked to New Brunswick. 80% of bio-waste would be eligible for such a process, which would imply a huge reduction in the carbon footprint of processing bio-waste.

SUSTAINABLITY METRICS:

There are opportunities for reducing hazardous waste at the source through improved disposal tactics for labs and more precise procurement of experiment inputs. Understandably, being able to identify reduction goals and issue areas require a degree of measurement and study in an environmentally contextualized way; connecting lab behaviors to environmental consequences. The MWP has helped structure an ASR project focusing on this topic specifically, through the calibration of Professor Huising and McGill Energy Project coordinator, Cyril Vallet. We hope that this initial effort will catalyze a greater movement towards environmental sustainability in labs with regards to waste and also energy and water consumption. Institutionalizing sustainability metrics in lab environments may aid in transitioning the 'lab culture', which generally, seems delineated from the environmental ramifications of it's activities.

GREEN LAB CERTIFICATION:

With the help of sustainability metrics, we may be able to identify targets that could qualify a lab for 'green lab certification'. Creating environmental leaders from the population of Lab technicians and researchers could bring significant changes in the perception of the importance of environmental issues in the setting of lab-focused research.

CHEMICAL RECYCLING:

Hypothetically, some disposed chemicals could be recycled and re-used for labs. Staff of HWM mentioned a plethora of examples where a small fraction of a chemical order was purchased, but the remaining quantity had to be disposed of because of a stigma associated with opened chemical containers, mainly relating to a sometimes irrational fear of contamination for chemicals used in experiments, which would sabotage the validity of results. A thorough transformation of this perception coupled with assurances in a chemical recycling program could dramatically lower the waste output and increase the recycling rate of chemicals on campus. As it stands, Environmental health and Safety issues recommendations for reduction: avoiding overstocking, not accepting donations of materials, and making an effort to substitute hazardous experimental materials for non-hazardous alternatives (Environmental Health and Safety, 2011).

CONCLUDING THOUGHTS:

This review highlights a lot of innovative thinking, sustainability sensitivity, and potential for development with regards to waste in the McGill community. That being said, we have our work cut out for us. There are a lot of opportunities for improvement in a variety of sectors, and a lot of existing methods and tactics for reducing waste from other Universities that have committed themselves in more serious ways to approaching a zero-waste campus. When considering the broad strokes of the McGill waste system, the most apparent and obvious strategy for increasing our diversion rate is taking campus composting to the next level: post-consumer waste compost collection in cafeterias, increasing the use and capacity of the Big Hanna, using compost Montreal for excess organic waste, and integrating the Macdonald campus into the municipal compost system for St. Anne de Bellevue would require relatively few financial resources and cause a significant increase in the campus diversion rate.

The McGill Waste Project seeks to learn from these opportunities and build the repertoire and resources necessary to tackle important waste issues through initiatives and research work. We will be actively seeking to motivate and unify the McGill community to take waste management as a serious issue of sustainability, which requires as much attention and work as parallel and on-going projects of sustainability.

WORK CITED.

NOTE THAT REPORTS ARE HOSTED ON OUR WEBSITE AT WWW.MCGILLWASTEPROJECT.COM.

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