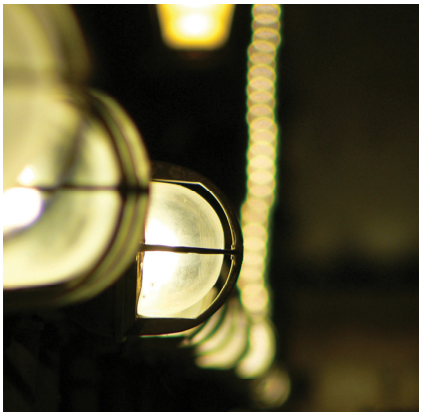
University of Saskatchewan

Smart Purchases Big Impact

Sustainable Purchasing Guide

Fertilizers

Sustainability... your university, your world



University of Saskatchewan

Fertilizers

Introduction

This section provides information on currently available options for **fertilizers** that can help to move the University of Saskatchewan toward its sustainability goals. Living within the boundaries of our sustainability goals requires us to apply two main strategies:

Dematerialization requires that we reduce the amount of materials as much as possible; and that we continually move toward the use of 100% recycled content.

Substitution requires that we find less harmful materials to replace those that currently damage and are not recyclable.

Sustainable purchasing is about including social, environmental, financial and performance factors in a systematic way. It involves thinking about the reasons for using the product (the service) and assessing how these services could be best met. If a product is needed, sustainable purchasing involves considering how products are made, what they are made of, where they come from and how they will be used and disposed.

Finally, remember that this is an evolving document – it will change with new information as our understanding of sustainability impacts and potential solutions improves.

Purchasing Services

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Smart Purchases Big Impact

Wherever possible **CHOOSE** products that employ a combination of characteristics listed in the left hand column, and **AVOID** products that demonstrate characteristic in the right-hand column.

CHOOSE	AVOID
• Native species	• Chemical fertilizers
• Eco-Logo certified organic compost	• Sewer sludge fertilizers
• Cadmium-free fertilizers	

Option: Landscaping with Native Species

Strategy: Substitution – management (SO 1, 2, 3)

Landscaping with native plants can reduce or eliminate the need for fertilizer because native plants are well adapted to the local conditions. They also do not need synthetic pesticides or substantial watering on an ongoing basis. This reduces demand for fossil fuels and saves time and money. For more information on landscaping with native species, consult information available by the Native Plant Society of Saskatchewan.

Option: Use Eco-Logo Certified Organic Compost

Strategy: Substitution - nature-like materials (SO 1, 2, 3)

The Environmental Choice website states:

> *"Compost is nature's fertilizer. Compost builds soils by replacing the valuable organic material lost from land by returning carbon, nitrogen and other nutrients to the non-living environment. In addition, composting helps reduce the 22 million tones of organic materials per year that are lost to landfill and it is a central part of a program for eliminating the use of chemical fertilizers."*

Using Eco-logo certified compost instead of traditional chemical fertilizer reduces many sustainability impacts, including those related to energy consumption, bio-accumulation of trace metals such as cadmium, large-scale land disturbance through mining, and the release of sulphur oxides in the fertilizer production process. By using compost, you are also reducing the amount of organic waste going to landfills.

Option: Use Fertilizers Free of Cadmium

Strategy: Substitution – abundant materials (SO 1)

Fertilizers which contain cadmium present a number of potential environmental and human health risks. Cadmium is a heavy metal which bio-accumulates in nature. Increasing concentrations of this substance should be avoided. Choosing fertilizers without cadmium prevents this substance from escaping into nature through run-off.

Option: Avoid Sewer Sludge Fertilizers

Strategy: Dematerialization – less waste (SO 1, 2, 3, 4,)

Through wastewater treatment processes, organic waste in wastewater from homes and industry is removed and concentrated to form a sludge that can be used as fertilizer - sometimes called sewer sludge or bio-solids. On the surface, this may seem to be a good way of returning nutrients to nature. However, there are concerns with this process because it is difficult to properly separate organic waste from other forms

of waste (e.g. industrial), potentially creating a poorly-understood mixture of nutrients and industrial poisons.

As a result, trace metals and persistent chemical compounds can be found in sewer sludge fertilizer. If such sewer sludge is used on land, this will contribute to sustainability impacts associated with both trace metals and persistent chemical compounds.

Arriving
at the currently preferred options

1. Identify the service

Fertilizers provide the three main nutrients that plants need in order to grow. These are nitrogen (N), phosphorus (P) and potassium (K).

2. Assess the need

The University of Saskatchewan is responsible for ensuring that plants throughout the campus are healthy and attractive for visitors, staff, faculty and students.

3. Identify the contents

Fertilizers consist mainly of nitrogen, phosphorus, and potassium. On a bag of fertilizer there are three numbers (e.g. 16 – 4 – 8) which represent the percentage of N, P, and K within the product. The rest of the bag consists of ballast or filler material. Many fertilizers also have magnesium, calcium, sulfur, iron, manganese, zinc, boron, and molybdenum, which are all active ingredients to promote growth and healthy plants. To distinguish its products from manure, legumes and other organic sources of crop nutrients, the fertilizer industry usually refers to its products as "mineral" fertilizers.

- Nitrogen fertilizer is the result of synthesis of ammonia. The most important manufactured nitrogen-based fertilizers are urea and ammonium nitrate. Anhydrous ammonia (NH_3) is produced commercially by reacting nitrogen gas (N_2) from the atmosphere in the presence of a catalyst with steam and methane (natural gas, CH_4). Barnyard or poultry manure and other animal waste products (e.g., bat guano), composted plant residue and legumes ploughed under are also are also sources of nitrogen.
- The potassium (K) used in fertilizers is found in a salt form called potash. Potash deposits are derived from evaporated sea water. Most potassium chloride is mined from underground deposits and is then processed as potassium sulphate (K_2SO_4) and potassium magnesium sulphate (K_2MgSO_4). Manure is also a source of potassium. The K content of manure varies with animal type, feed ration, storage, and handling practices.
- Phosphorus (P), in the form of **phosphate**, is mined from naturally occurring mineral deposits (phosphate rock) that were once sediments at the bottom of ancient seas. Rock phosphate is the raw material used in the manufacture of most commercial phosphate fertilizers. Organic sources of phosphate are found in manure and bone meal. While phosphorus is important for plants, and hence for people, cadmium contained in phosphorus sources can be detrimental. The quantity of cadmium contained in a phosphate fertilizer depends on the source of the rock from which it was made.

4. Identify sustainability impacts

i. ....systematically increasing concentrations of substances from the earth's crust?

- **Excessive application** of fertilizers results in phosphate run-off into waterways, which can lead to **eutrophication**. Eutrophication is the response of a natural ecosystem to an artificial imbalance of chemicals. Not only can these chemicals cause a disturbance to the ecosystem but some are also toxic.
- **Producing and transporting** fertilizers requires large amounts of **energy**. Fertilizer production and use accounts for 2–3% of global energy consumption. This energy is generally derived from fossil fuels resulting in increasing concentrations of carbon dioxide (CO_2) and sulfur oxides (SO_x) in the air. This results in negative impacts such as **climate change** and **acid rain**.
- To make fertilizers, **rocks containing mineral phosphates are treated with acid** (primarily sulphuric acid) to produce phosphoric acid, which is then used as an input to make phosphate fertilizers. However, these rocks sometimes also contain **cadmium (Cd), mercury (Hg)** and l**ead (Pb)** in amounts that are greater than what ecological systems can absorb. Other substances from the Earth's crust that can systematically accumulate due to this process include:
- **Fluorine**, also found in phosphate rock, is released as hydrogen fluoride (HF) and silicon fluoride (SiF_4). Increased concentrations of HF and SiF_4 are harmful to humans and vegetation.

continued on page 3 . . .

- **Sulphur oxides** (SOx) are emitted during the production of phosphate fertilizers when sulphuric acid is used. Release of SOx is linked to the production of acid rain

ii. ...systematically increasing concentrations of substances produced by society?

- Nitrogen oxides (NOx), and ammonia (NH3) emissions, either into air or water, are a concern. Although natural flows of these are large, societal flows are significant enough to contribute to an increase in concentration in nature. Fertilizers contribute to this problem through:
    - excessive application and run-off into waterways resulting in potential eutrophication;
    - releases of NOx and NH3 during production, storage and transportation, contribute to negative impacts such as acid rain and smog;

iii. ...systematically degrading nature by physical means?

- Mining for phosphate rock may physically degrade natural systems if proper precautions are not taken to reduce the mine's physical footprint, and if the impacted lands are not reclaimed to their original quality and function.
- Cadmium is toxic to plants, animals and micro-organisms. Being an element, cadmium is persistent – it cannot be broken down into less toxic substances in the environment. The degree of bioavailability and potential for effects varies depending on the form of cadmium and the soil pH. Cadmium bio-accumulates mainly in the kidneys and liver of vertebrates and in aquatic invertebrates and algae.

iv. …systematically undermining people's ability to meet their basic human needs?

- In some fertilizer production facilities there are insufficient safeguards to protect worker safety, for example exposure to chemicals leading to negative health impacts.
- Nitric oxide, from the production and use of fertilizers, contributes to the formation of smog, which also negatively affects human health.
- Cadmium is toxic for humans mainly affecting kidneys and the skeleton. It is also a carcinogen by inhalation. The risk of cadmium on health is increased on populations with deficiencies in calcium, zinc, and iron. Populations in developing countries, where such deficiencies are more common, would be most at risk, particularly women of child-bearing age who may be iron-depleted and anemic.

5. Envision sustainable fertilizers

In a sustainable future, fertilizers would not be used because plants would receive their required nutrients through natural nutrient cycling and sustainable land management and harvesting techniques.

Where this is not possible, fertilizer would provide the required nutrients such that:

- No substances are derived from the earth's crust (e.g. petrochemicals and metals), unless those ingredients are 100% captured and reused in technical cycles.
- No substances persist in nature, unless those substances are 100% captured and reused.

The production process should not contribute to increasing concentrations of substances from the earth's crust or the buildup of persistent compounds in nature. In order to accomplish that goal, sustainable renewable energy must be used, processes should not degrade the land and the health and safety of workers and the public must be protected.

6. Identify and prioritize alternatives

Step 6 helps identify the product or service that offers the best pathway toward meeting all four of our Sustainability Objectives by using the following three criteria for assessment:

a) Does the product or service move us in the right direction with regards to our four Sustainability Objectives?

b) Does the product or service create a flexible platform for the next step toward sustainability?

c) Is the decision financially viable?

Resources
and Additional Information

1. Native Plant Society of Saskatchewan
   www.npss.sk.ca
2. Characteristics of Natural and Manufactured Fertilizers for Lawns
   www.extension.umn.edu/distribution/horticulture/DG5774.html
3. EcoLogo Green Products
   http://www.ecologo.org/en/greenproducts/
4. International Fertilizer Industry Association
   http://www.fertilizer.org/ifa/Home-Page/SUSTAINABILITY/Cadmium/Cadmium-in-fertilizers.html

WHISTLER
This guide was made possible through the generosity of the Whistler 2012 project, which shared its template and much of its research.