IMPLEMENTATION AND EVALUATION OF AN EDUCATIONAL PROGRAM IN LOW WASTE YARD MAINTENANCE AND LANDSCAPING TECHNIQUES

by

Diane L. Bell

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IMPLEMENTATION AND EVALUATION OF AN EDUCATIONAL PROGRAM IN LOW WASTE YARD MAINTENANCE AND LANDSCAPING TECHNIQUES

By

Ms. Diane L. Bell

A practicum submitted to the Faculty of Graduate Studies of the University of Manitoba in partial fulfilment of the requirements of the degree of Master of Natural Resources Management.

ABSTRACT

The primary purpose of this project was to provide educational material that introduced how waste reduction and energy conservation can be achieved through yard maintenance and landscaping practices that create little or no waste.

There were two main goals in this project. The first goal was to work with local school divisions to identify low waste yard maintenance and landscaping practices that could be easily instituted at local schools. The identified techniques would not only reduce waste, but demonstrate to students what can be achieved. The second goal was to formally introduce the concept of low waste yard maintenance and landscaping into the junior high school curriculum.

More specifically, the objectives of the project were:

1. to identify existing yard maintenance and landscaping practices throughout Winnipeg's school divisions;

2. to identify suitable existing demonstration projects of low waste landscaping within school yards;

3. to identify ways school divisions could reduce landscaping wastes while involving students;

4. to develop a low waste landscaping lesson plan that could be introduced into the grade 7 and 8 science curriculum;

5. to introduce these materials to a selection of junior high schools within Winnipeg's school divisions; and

6. to evaluate the effectiveness of the lesson plan presentation through a survey of teachers.

Ten local school divisions within the city of Winnipeg were contacted for information regarding yard maintenance and landscaping practices within school yards. Maintenance practices were found to vary within and among the Winnipeg school divisions. Low waste yard maintenance practices, such as grass cycling, mulching, minimal fertilization and minimal irrigation, exist within Winnipeg school divisions. Many divisions, however, bag grass, fertilize and irrigate within school grounds. Mulching, as a waste management technique, occurs only within St. James School Division. Low waste landscaping practices, such as tree and tall grass prairie plantings, were generally organized by individual schools and required outside funding.

No suitable existing low waste landscaping demonstration areas were identified. Tall grass prairie plantings and composting were discussed as possible ways of reducing landscape waste while involving students. The questionable long term viability of the three local tall grass prairie plantings and the amount of time and energy required for establishing composting or tall grass prairie demonstration areas indicated that lesson plans were the easiest method of involving students in low waste landscaping.

The "Low Waste Landscapes That Conserve Energy" lesson plan was developed and introduced to **78 classes** within **24 schools** and across **7 school divisions**. The lesson plan presentations were well received by teachers and students.

An evaluation survey was mailed to the teachers of classes who received lesson plan presentations. A response rate of 72% was achieved. Overall, the survey results indicated that the objectives of the lesson plan were achieved; waste management should and could be integrated into the school curriculum; waste management information should be provided by the City of Winnipeg in the form of presentations, expert speakers, "hands-on" activities, tours, and videos; and, the extra time and energy necessary for the establishment and maintenance of demonstration areas makes widespread application unlikely.

Based on the findings throughout the project, recommendations drawn in the report include the following:

1. School maintenance crews should refrain from bagging grass, fertilizing and irrigating within school grounds and, incorporate mulching as a method of low waste yard maintenance.

2. In the coming year the City of Winnipeg Recycling Coordinator should work with school boards and the Department of Education to identify other economically viable yard maintenance and landscaping practices for school grounds, so that the schools lead by example.

3. The City of Winnipeg Recycling Coordinator should produce a catalogue of the waste management information and resources currently available to schools from the Waterworks, Waste and Disposal Department library, including slides, videos, etc..

4. The City of Winnipeg should continue to develop and provide information to schools on waste management that complements and supplements the current curriculum for integration into schools, keeping in mind the teacher/student preference for "hands-on" activity.

5. Given demand, The Waterworks, Waste and Disposal Department, in conjunction with the Adhoc Committee on Waste Reduction and Waste Minimization Advisory Committee, should immediately coordinate a "Speakers Bureau" for the 1995-1996 school year taking the following into consideration:

    a) Teachers should be contacted early in the school year to facilitate integration into the curriculum.

    b) An overview of any information to be presented should be provided to teachers in advance to allow for proper class preparation.

    c) Simple questionnaires should be developed to evaluate the students prior to, as well as following, the presentations.

6. Waste management information should be made available to schools in French as well as English.

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LIST OF ACRONYMS

The following acronyms are found in this practicum:

APWA	-	American Public Works Association
ISWM	-	Integrated Solid Waste Management
MRAC	-	Manitoba Recycling Action Committee
MRF	-	Materials Recovery Facility
MSDR	-	Manitoba Soft Drink Recycling
MSW	-	Municipal Solid Waste
NIMBY	-	Not In My Back Yard
U.S. EPA	-	United States Environmental Protection Agency
PET	-	Polyethylene Terephthalate

CHAPTER 1
INTRODUCTION

1.1 BACKGROUND

Historically rural environments with plenty of open space seldom had serious waste management problems. Nomadic people simply left their garbage where it fell and moved on. The societies of landowners and peasants handcrafted personal possessions which kept the production of goods close to the point of use and encouraged repair, reuse, and recycling.

Today waste management has become an issue of vital importance (Environment Canada 1992). Population growth and concentration within urban areas, exponential growth of economies, technological developments, and rising standards of living all contribute to the increase in waste production and ensuing problems (Kelly 1973, MacLaren 1977). While growth in population and material possessions generates more discards, many regions face a critical shortage of landfill space. The cleaning of the air and waste water streams puts further pressure on our solid waste management systems since residuals removed from these streams become a source of waste for disposal. Superimposed on the problem of growth in volume are the growing concerns about the environmental impacts of traditional solid waste disposal methods.

One metric tonne of solid waste material is discarded annually per person in Winnipeg. Roughly thirty five percent of the discarded material is organic and compostable; fifteen percent of which is yard waste (City of Winnipeg n.d.). Source reduction of yard waste

could provide an avenue for reduction of the total residential waste stream creating both ecological and economic benefits.

Significant lifestyle change is necessary to achieve source reduction of yard waste. Educational material about alternative yard landscaping techniques that generate minimal waste should be introduced to the children before they adopt the lifestyle patterns of the adults around them.

1.2 PURPOSE

The primary purpose of this project was to provide educational material that introduced how waste reduction and energy conservation can be achieved through yard maintenance and landscaping practices that create little or no waste. The two main goals of the project were to work with local school divisions to identify low waste yard maintenance and landscaping practices that could be easily instituted at local schools; and to formally introduce the concept of low waste landscaping to the junior high school curriculum.

1.3 OBJECTIVES

To achieve the above mentioned purpose and goals, the specific objectives of the study were:

1. to identify existing yard maintenance and landscaping practices throughout Winnipeg's school divisions;
2. to identify suitable existing demonstration projects of low waste landscaping within school yards;

3. to identify ways school divisions could reduce landscaping wastes while involving students;

4. to develop a low waste landscaping lesson plan that could be introduced into the grade 7 and 8 science curriculum;

5. to introduce these materials to a selection of junior high schools within Winnipeg; and,

6. to evaluate the effectiveness of the lesson plan presentation through a survey of teachers.

1.4 METHODS

In order to achieve these specific objectives, five principle tasks were necessary. They are listed as follows: review of the relevant literature; telephone survey; development of a low waste landscaping lesson plan; presentation of the lesson plan to junior high classrooms; and, evaluation of the effectiveness of the lesson plan presentation through a questionnaire survey.

1.4.1 REVIEW LITERATURE

Initially, literature on general waste management issues (BioCycle, WasteAge, Manitoba Environment 1991a, Manitoba Recycling Action Committee [MRAC] 1990), techniques for low waste yard maintenance (City of Ventura Recycling Office 1993), and naturalizing the managed landscape (Smith and Smith 1980, Hamilton 1992, O'Keefe 1992, Lyseng 1993, Holmes 1993) were reviewed. The initial literature review provided general background information for the development of telephone interview and

questionnaire-survey questions, as well as, to identify methods of landscape waste reduction which could be integrated into the junior high science curriculum.

Science curriculums and lesson plans were examined to identify existing suitable lesson material for the junior high curriculum (Del Giorno and Tissair 1975, Tilsworth 1991, B.C. Environment 1992, Doll 1993, Perry n.d., Lohrenz 1993, Auckland Regional Council 1993, Sinclair 1993, City of Ventura Recycling Office 1993, etc.). The review of existing curriculum established the need for the development of educational material pertaining to landscape waste minimization.

Instructional planning and evaluation texts (Cooper 1990, Borich 1988) were reviewed to provide background information for the development and implementation of a lesson plan.

1.4.2 TELEPHONE SURVEY

The existing landscape maintenance practices of the Winnipeg school divisions were identified through unstructured interviews with representatives from each of the ten divisional maintenance departments within Winnipeg. The divisional maintenance departments were contacted by telephone and asked a list of questions related to yard maintenance and landscaping practices within school yards.

Teachers and others previously involved in establishing school demonstration projects of low waste landscaping were also contacted by telephone in order to gather information relating to the success of the existing projects. The information was used to identify ways school boards could reduce landscape waste while involving students.

1.4.3 LESSON PLAN DEVELOPMENT

The content and format of the "Low Waste Landscapes That Conserve Energy" lesson plan evolved over time. The content of the lesson plan was established during the initial literature review. The background literature provided the information necessary to develop the learning objectives of the lesson plan; and, to identify low waste yard maintenance and landscaping techniques which could be introduced to the junior high curriculum. The process, or classroom activities, were designed with the student/teacher preference for "hands on" activity (Sinclair 1993) in mind. Brainstorming with teachers who currently plan activities for junior high children also reinforced the concept of an activity-based lesson plan and the proposed lesson plan activities.

An initial draft of the "Low Waste Landscapes That Conserve Energy" lesson plan was reviewed by academics for comment. It was noted that content would have to be reduced if the lesson plan presentations were to be a maximum of thirty to forty-five minutes long. Once the content length was adjusted, the lesson plan was presented to junior high classrooms. Student activity and participation were noted throughout the presentations; and, adjustments to the lesson plan were made to facilitate more effective presentations.

1.4.4 CLASSROOM PRESENTATIONS

Grade 7 and 8 science teachers throughout the Winnipeg school divisions were contacted by telephone in April 1994 to arrange a time for the lesson to be presented to their students. In total, the "Low Waste Landscapes That Conserve Energy" lesson plan was presented to **78 classes** within **24 schools** and across **7 school divisions** between May and June 1994. Each class presentation was between thirty and forty-five minutes long depending on the school's time schedule. One or two schools were visited per day and from two to seven presentations were completed each day.

1.4.4 QUESTIONNAIRE EVALUATION SURVEY

In order to evaluate the effectiveness of the lesson plan, a survey of the teachers whose classes received a presentation was conducted. Each teacher was given a questionnaire package, which included a three-page questionnaire, a cover letter and stamped return-addressed envelope, to be completed and returned within one week (See Appendix 6). If the completed questionnaire was not returned within one week, the teacher was reminded by telephone.

The questionnaire included 13 questions which were mainly close-ended with room for additional comments. Responses to the survey questions were registered by marking one of the four numbers representing a 4-point Likert-type scale of agreeability with the statement. 1 was labelled "strongly agree" and 4 labelled "strongly disagree". A fifth

selection allowed a "no opinion" response. The 4-point Likert-type scale restricts neutral responses.

36 of 50 questionnaires were returned for a response rate of 72%. The responses to the questions identified positive and negative aspects of the presentation; indicated whether or not those teachers think that The City of Winnipeg Waterworks, Waste and Disposal Department should supply waste management information to schools; and, gathered the teachers' opinions on what format would be of most use. In addition, opinions and comments on the development of demonstration projects within school yards were collected.

Survey responses involving written suggestions or comments were summarized in table format. The responses from the 4-point Likert-type scale were grouped into "yes" and "no" categories to determine the general opinion of the teachers receiving the low waste lesson plan presentations. No opinion responses were tallied separately.

Based on the teachers' answers to the questions, the effectiveness of the "Low Waste Landscapes That Conserve Energy" presentations were evaluated and recommendations for future waste management education programs made.

1.5 ORGANIZATION

This practicum report comprises 6 chapters in total. The first chapter provides an introduction to the study, including: background, purpose, objectives, and methods. Chapter 2 constitutes a review of literature related to: solid waste management, maintenance and landscape practices which reduce the amount of yard waste destined for the landfill, and the importance of education in achieving the behaviour change necessary for the success of solid waste management strategies. Each chapter following Chapter 2, contains a brief overview which includes: the specific objectives to which the chapter pertains, how the information was gathered, and a description of the type of information contained within the section. Chapter 3 contains the results of the telephone survey which was employed to accomplish the first two objectives of the study. Chapter 4 discusses ways in which school divisions could reduce landscaping wastes while involving students in response to the third objective. Chapter 5 outlines the low waste landscaping lesson plan introduced to the junior high science curriculum, as well as the information gathered during the follow-up evaluation survey. In the final chapter (Chapter 6), results of the study are summarized, conclusions drawn, and recommendations for future activities made.

CHAPTER 2
SOLID WASTE MANAGEMENT - LANDSCAPE WASTE - EDUCATION

2.1 INTRODUCTION

To achieve the objectives outlined it was necessary to review and provide background information on solid waste management; techniques to reduce landscape waste destined for the landfill; and, the importance of education to waste management programs.

Initially, solid waste is defined. This is followed by terms used to identify different classes of waste. Solid waste management is described including: collection and disposal of solid waste; transitions in solid waste management; Integrated Solid Waste Management (ISWM), including examples of associated ISWM strategies; and, the benefits of energy and resource conservation realized through waste minimization. Techniques which minimize landscape waste are outlined; and finally, the importance of waste management education as a tool in achieving the behaviour change necessary for waste reduction is emphasized.

2.2 MUNICIPAL SOLID WASTE (MSW)

Waste refers to materials which are no longer considered useful and are destined to be discarded (The American Public Works Association [APWA] 1966). Waste includes solids, liquids, and gases. The liquids consist of sewage and fluid industrial wastes; gases are mainly industrial fumes and smoke; and, solid wastes are those materials which contain insufficient liquid content to be free-flowing (American Society of Civil Engineers 1976).

Maclaren (1991) refers to three distinct waste streams - municipal, hazardous, and radioactive - based on the specific handling and disposal practices required for each. Residential, commercial, and institutional wastes are included in municipal, as well as, construction and demolition wastes, sewage sludge residues, and incinerator ash. Municipal waste is a solid waste which may include small amounts of liquid waste.

Similarly, the United States Environmental Protection Agency [U.S. EPA] (1989) defines municipal solid waste (MSW) as primarily residential solid waste, with some contribution from commercial, institutional and industrial sources. Industrial and some commercial sources are handled separately in areas where large quantities of uniform wastes are more suited to alternate disposal techniques or recycling.

2.3 CLASSIFICATION OF MUNICIPAL SOLID WASTE

Waste authorities classify solid waste streams in several different ways. In many cases, the point of origin is important. Figure 1 (Adapted from Jacobs & Biswas 1972) illustrates how the total waste stream could be classified according to source. Alternatively, the broad classification may be narrowed in scope by the political jurisdiction of decision makers. MacLaren (1977) classified the City of Winnipeg's waste stream as "industrial" and "residential/commercial", based on collection practices.

Many municipal and provincial waste authorities now categorize solid waste streams using headings such as: metals; glass; cloth; wood; plastic, rubber & leather; office

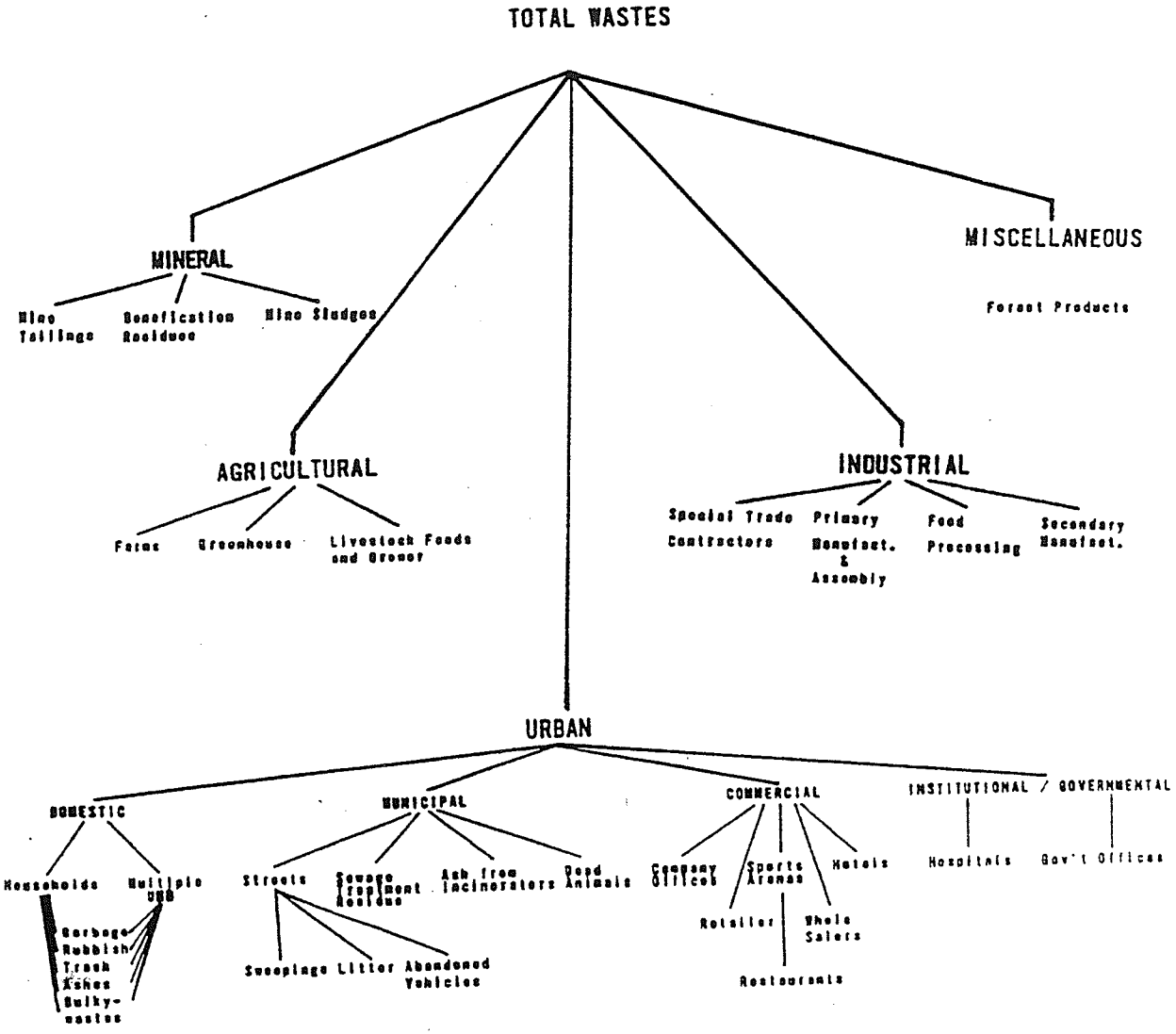

Figure 1: **Classification of total waste according to source**
(Adapted from Jacobs and Biswas 1972)

paper; plastics; yard wastes; food wastes; newspaper; and other paper (MRAC 1990). This classification aids in setting product group and material reduction targets to help achieve waste reduction objectives.

Previously, solid waste was classified according to its physical or chemical properties, such as bulky or light, combustible or noncombustible, organic or inorganic, dry or wet, and ferrous or non-ferrous (APWA 1966). Table 1 groups solid wastes based on character of materials (Adapted from APWA 1966). Each category is named, described and the general source indicated. Although the terms and style of classification in Table 1 appear dated, complete descriptions of a solid waste stream provide valuable information for consideration by waste authorities who are implementing waste management schemes.

Garbage is largely composed of putrescible organic matter and its natural moisture. It decomposes rapidly, particularly in warm weather, and may quickly produce disagreeable odours. It provides food for rats and other vermin and is a breeding place for flies; hence, the daily requirement of sanitary landfills to apply a soil cover. There is some commercial value in garbage as animal food, as a base for commercial animal feeds, or as plant fertilizer after processing.

Rubbish consists of a variety of combustible and noncombustible solid wastes but does not include garbage. Combustible rubbish, although organic, is not putrescible and can

Table 1: Classification of Solid Waste by Kind, Composition, and Source

KIND	COMPOSITION	SOURCES
Garbage	Wastes from preparation, cooking, and serving of food; market wastes from handling storage, and sale of produce	Households, restaurants, institutions, stores, markets
Rubbish	Combustible: paper, cartons, boxes, barrels, wood, excelsior, tree branches, yard trimmings, wood furniture, bedding, dunnage Noncombustible: metals, tin cans, metal furniture, dirt, glass, crockery, minerals	
Ashes	Residues from fires used for cooking and heating and from on-site incineration	
Street waste	sweepings, dirt, leaves, catch basin dirt, contents of litter receptacles	Streets, sidewalks, alleys, vacant lots
Dead animals	Cats, dogs, horses, cows	
Industrial wastes	Food processing wastes, boiler house cinders, lumber scraps, shavings	Factories, power plants
Demolition wastes	Lumber, pipes, brick, masonry, and other construction materials from razed buildings and other structures	Demolition sites to be used for new buildings, renewal projects, expressways
Construction wastes	Scrap lumber, pipe, other construction materials	New construction, remodelling
Sewage	Solids from coarse screenings and from grit chambers; septic tank sludge	Sewage treatment plants, septic tanks
Special wastes	Hazardous solids and liquids, explosives, pathological wastes, radioactive materials	Households, hotels, hospitals, institutions, stores, industry

Source: Adapted from American Public Works Association (1966)

be stored without becoming a nuisance. It has a high heat value and can be collected with wrapped garbage to provide the fuel necessary to burn garbage in an incinerator. Paper, rags, and cartons may be recycled.

Noncombustible rubbish is the inorganic portion of refuse. It is stable. However, when carelessly stored, it is aesthetically objectionable and may harbour rodents and other vermin. The metals, tin cans, bottles, and broken glass can be recycled.

Yard waste consisting of tree branches, twigs, grass and shrub clippings, weeds, leaves, and other yard and garden materials is usually included in the combustible rubbish category. However, many cities make different arrangements for its collection and disposal; some municipalities exclude it entirely from their collection service. A large portion of yard waste is green vegetation which can decompose rapidly if kept moist or when stored in large amounts. It is not usually objectionable but may provide breeding areas for insects.

Ashes are composed of a mixture of fine powdery residue, cinders, and small portions of unburned or partially burned fuel or other material. Since the mixture is almost entirely inorganic, it is valuable for fills on low land and is acceptable some places for maintaining unpaved streets. Ash, which was once a larger portion of the waste stream, has decreased since gas furnaces have replaced most burning of wood and coal fuel.

Residential waste refers to the mixture of the normal household accumulations of garbage and rubbish without any segregation. Many collection systems take all of the unsegregated refuse in one collection from homes in the interest of efficiency and convenience to the public.

Street Waste includes materials picked up by manual and mechanical sweeping of streets and litter from public receptacles.

Dead Animals are those that die naturally or from disease or are accidentally killed. Dead animals are offensive and must be collected promptly. They putrefy rapidly and attract flies and other insects.

Industrial Waste includes putrescible garbage from food processing plants and slaughterhouses, condemned foods, building rubbish, ash from power plants, manufacturing wastes, etc. Many municipalities provide disposal for this type of waste because putrescible industrial refuse may cause serious nuisances and endanger public health.

Demolition Waste is found mostly in cities where extensive areas of obsolete building are being torn down to make way for new structures. The wrecking companies are contracted to haul the debris and dispose of it; cities often allow wreckers to dump refuse at its disposal facility for a charge, or even free.

Construction Waste is the waste material from the construction, remodelling, and repair of houses, commercial buildings, and other structures. A small amount of such waste is accepted from households and stores but the bulk of it is considered industrial waste that contractors must remove.

Sewage is mostly organic, although solid inorganic matter from grit chambers may also need to be disposed of. In large jurisdictions, even with the most modern facilities for digestion of sewage, the sheer quantity of stabilized sewage sludge produced becomes a disposal problem.

Hazardous or Special Waste refers to waste material that presents an unusual disposal problem or requires special handling. Small quantities, such as a small can of paint or paint thinner, a roll of photographic film, or a plastic article, are present in ordinary waste and can be incinerated or landfilled. However, large quantities of the same materials require special procedures to prevent explosions in an incinerator furnace or a dangerous fire at a sanitary landfill. Some industrial wastes are hazardous under any circumstances, and pathologic wastes from hospitals and radioactive materials require special handling.

2.4 MUNICIPAL SOLID WASTE MANAGEMENT

> From ancient times to the present, waste has been burned, reused or dumped with a qualitative level of processing which depends on the economical, cultural, social and political developments of organized people in their own particular situation (geography, climate, resources, etc.) (Cossu 1989).

The ability of municipalities to provide quality services can vary, reflecting economic and social development (Cossu 1989). The following sections briefly describe transitional steps in solid waste management; define Integrated Solid Waste Management (ISWM); and, identify the components of a waste minimization hierarchy, including examples of each.

2.4.1 COLLECTION OF MUNICIPAL SOLID WASTE

Collection and transportation consume the largest portion of a waste management budget (BC Ministry of Environment 1988, Jacobs and Biswas 1972). Less-densely-concentrated rural communities generally collect and dispose of their own refuse. However, seventy percent of the Canadian population live in urban municipalities and benefit from public collection services (Jacobs and Biswas 1972).

Public collection services may involve City employees using City-owned equipment or contracts between the City and private firms. Private collection and transportation of MSW's is generally used by commercial and industrial firms, or apartments where the

volume, level of service, or generation of special wastes make contract haul more convenient than the City's collection services (MacLaren 1977).

Collection practices have changed within many municipalities from the basic curbside pickup of mixed waste destined for disposal to more complex management systems which accommodate recycling and resource recovery initiatives. Curbside collection services which facilitate recycling may include: mixed waste destined for a central materials recovery facility (MRF), mixed recyclables to be sorted at a MRF, or sorted recyclables destined for storage and transfer/marketing of materials (Steuteville 1994).

Organic materials may be recovered by wet/dry source separation systems. The wet/dry approach to collection services has two approaches: 1) a two stream sort where the wet fraction includes organic materials and wet or soiled paper, and the dry fraction includes recyclables and materials destined for disposal, and, 2) a three stream sort which further separates the dry fraction by pulling out recyclables (Glenn 1993).

Another approach to collecting recyclables and organics is the establishment of drop-off depots - where residents are responsible for transporting their materials to a central location (Manitoba Environment 1993, Zavoral 1994, Flemington 1994). Drop-offs can serve well as an interim until curbside programs are implemented and/or serve as an adjunct in areas where curbside programs have been developed (Schlauder 1991). Depots have been established in municipalities such as Winnipeg to recycle such things as plastic

soft drink, and plastic liquor bottles, aluminum and tin cans, glass, and newspapers (Manitoba Environment 1993). In addition, drop-off depots can divert organics from cafeterias and kitchens, as well as yard waste (Zavoral 1994, Manitoba Environment 1993).

2.4.2 TREATMENT & DISPOSAL OF MUNICIPAL SOLID WASTE

Although many techniques are referred to as waste disposal methods, most only treat waste in preparation for disposal. For example, waste treatment techniques, such as pulverization, incineration, composting, anaerobic digestion, pyrolysis, hydrolysis, compaction, baling, etc., have been used to either reduce volume, make solid wastes easier to handle, to recover resources, or produce products (eg. compost as a valuable soil conditioner) (Clark and Brown 1971, MacLaren 1977).

The most popular methods of solid waste disposal in the past have been dumping and sanitary landfilling (Clark and Brown 1971). Open dumps have allowed indiscriminate dumping of all wastes and have been a significant source of: breeding grounds for rats and insects; trash fires with emissions to foul the skies; and, runoff and leachate which pollute surface and groundwater. The aesthetic blight is not confined to the dump, litter and spilled trash also mark the surrounding areas (Hayes 1978).

In response to the potential environmental impacts of dumps, the majority of open dumps have been closed. Dumps have been replaced by sanitary landfills, which when operated

on a properly selected and designed site can provide an economic and environmentally sound means of disposal (MacLaren 1977). According to the American Society of Civil Engineers, sanitary landfills are defined as:

> An engineered method of disposing of waste on land in a manner that protects the environment, by spreading the waste in thin layers, compacting it to the smallest practical volume, and covering it with compacted soil by the end of each working day or, if necessary, more frequently (American Society of Civil Engineers 1976).

The Province of Manitoba regulates waste disposal grounds. Manitoba Regulation 150/91 of The Environment Act (1988) states that the suitability of a waste disposal site must be demonstrated within a "professional engineering study" (Province of Manitoba 1991b). The operator of a waste disposal ground must ensure that:

> (a) waste or leachate is contained within the boundaries of the waste disposal ground site and do not contaminate groundwater; (b) the waste disposal ground is located ... at least 1 kilometre from any body of surface water, ... at least 400 metres from any potable water well; ... (Province of Manitoba 1991b).

In addition, the operator of a waste disposal ground must:

> (a) implement control measures ... to prevent rodent and insect production and sustenance; and (b) surround the part of the active area that is operated above grade with a berm constructed to a height at least 0.5 metre higher than the height of the solid waste, unless topographical features provide a natural berm (Province of Manitoba 1991b).

2.4.3 TRANSITIONS IN SOLID WASTE MANAGEMENT

Cossu (1989) identified three transition steps in solid waste management which reflect the quality range in waste disposal systems. Step one, uncontrolled landfills, prevails in most countries. Step two, sanitary landfill with a simple recycling system, represents a transaction stage where sanitary landfilling guarantees safe disposal until a higher level of waste management is reached.

Step three, Integrated Solid Waste Management (ISWM), involves separation of hazardous components from MSW, recovery of material and energy, and disposal of residual materials. ISWM systems lead to a final waste stream which is concentrated with elements potentially hazardous to the environment and, thus, requires pre-treatment steps before landfilling and the adoption of high quality standards for the construction and design of landfills.

The City of Winnipeg's history in solid waste management follows a similar pattern to Cossu's transitions steps. Years ago open dumps with open burning was the common practise because space was plentiful and the associated dangers were not well documented. Once the hazards of open dumps were recognized, they were replaced with incineration and sanitary landfills (Brandson et al. 1972). Today waste management in Winnipeg is steering away from disposal-orientated policies, and leaning towards implementing ISWM strategies (MRAC 1990, Sinclair and Kuluk 1994).

2.4.4 INTEGRATED SOLID WASTE MANAGEMENT

ISWM, is defined as, "the complementary use of a variety of waste management practices to safely and effectively handle the municipal solid waste stream with the least adverse impact on human health and the environment" (U.S. EPA 1989). Ideally, the waste stream constituents are matched with waste management practices which will reduce the toxicity, minimize the quantity, and safely extract any useful energy or material from the waste prior to final disposal.

The basic approaches to managing solid waste within an ISWM system include: reducing or eliminating solid waste (i.e., source reduction); composting; reusing and recycling materials; waste combustion with energy recovery; and, landfilling the remainder (Ontario Ministry of the Environment 1983, Cossu 1989, U.S. EPA 1989, MRAC 1990, Manitoba Environment 1991a, Young 1991, Environment Canada 1992, Powelson & Powelson 1992). The selection of strategies and priorities within ISWM systems will vary depending upon geographical location, economic conditions, and composition of the waste stream within a community (U.S. EPA 1989).

Each component of an ISWM system is designed to complement rather than compete with the other components in the system. For example, if recycling and combustion are integral components in an ISWM system, the combustor must be designed to handle a volume of waste with a certain Btu value after allowing for the effect of recycling on

total waste volume and Btu values. Failure in this regard could result in materials which would otherwise be recycled being needed as fuel for the combustor (U.S. EPA 1989).

2.4.5 WASTE MINIMIZATION HIERARCHY

One of the few generally accepted concepts in managing solid waste is that it is logical to regard waste minimization strategies as an hierarchy (Ontario Ministry of the Environment 1983, Cossu 1989, U.S. EPA 1989, MRAC 1990, Manitoba Environment 1991a, Young 1991, Environment Canada 1992, Powelson & Powelson 1992).

Strict adherence to a rigid hierarchy is inappropriate for every community. However, an hierarchy is a useful conceptual tool for communities to use in setting goals and planning for their particular mix of waste management alternatives (U.S. EPA 1989).

The following hierarchy, outlined in subsections 2.4.5.1. through 2.4.5.6, varies from the City of Winnipeg's 4R hierarchy of waste minimization and MRAC's 6R - reduce, reuse, recycle, recover, residue management, and shared responsibility - waste minimization hierarchy. Higher priority is given to composting reflecting the importance of minimizing the large amount of organic material found in MSW.

2.4.5.1 SOURCE REDUCTION

> Waste reduction is better from every perspective than simply recycling: Waste reduction saves materials, reduces energy demands, eases environmental problems, and eliminates some of the clutter in contemporary life in the industrial world (Hayes 1978).

The elimination or reduction of waste is given first priority within any waste hierarchy (Berg-Moeger 1994). Source reduction - the cutting of waste by using less material in the first place - eliminates the need for disposal, the extraction and processing of virgin materials, and the energy and pollution of recycling (Young 1991). Strategies which focus at the beginning of the waste stream are the most cost effective for society as a whole, have the greatest potential for long-term gain since they are oriented towards anticipation and prevention, avoid incremental waste generation, and greatly reduce site contamination and attendant disposal costs (Environment Canada 1993).

Elimination or reduction of waste at the source can be achieved at various levels. At the industrial level, products and packaging can be designed and manufactured with minimum toxic content, minimum volume of material, and/or a longer useful life (U.S. EPA 1989, Powelson & Powelson 1992). Clean technology and internal recycling also reduce waste at the source (Cossu 1989).

At the consumer level, including corporations, source reduction can be achieved through selective buying habits and reuse of products and materials (U.S. EPA 1989, Powelson & Powelson 1992). Conscious selection of products which are packaged in simple

recyclable containers over products packaged in non-recyclable mixed-media containers; buying products sold in bulk quantities, returnable containers, or refillable containers; buying products that last longer and are reusable; and, avoiding over-packaged and disposable items are all consumer behaviours which can reduce waste production (Powelson & Powelson 1992).

Other strategies aimed at reducing or eliminating waste occur on the legislative level. These include administrative and legal actions which ban items from use (Powelson & Powelson 1992); ban certain types of waste from municipal services (Glenn 1991); or, promote durable products to prolong the use and re-use of goods (Cossu 1989).

2.4.5.2 REUSE

Reuse of products and material is often the next rung in the hierarchy. Reuse strategies may include: avoiding single-use items (eg. use cloth towels instead of paper towels); using products again (eg. retreading tires); and, buying used items.

2.4.5.3 COMPOSTING

The position of composting within a waste minimization hierarchy can vary. Powelson & Powelson (1992) describe composting as "the second most desirable strategy for keeping solid waste from going to the landfill". U.S. EPA (1992) combine composting with recycling, and place them after source reduction and reuse. The City of Winnipeg

classifies composting as an example of resource recovery which falls after recycling (City of Winnipeg n.d.).

In composting, organic materials, such as grass clippings, weeds, leaves, coffee grounds, and vegetable and fruit scraps, are decomposed into a soil supplement rich in nutrients. Composting can be done in residential backyard composters for use on private gardens or centralized facilities for commercial application on croplands, woodlands, or strip mined areas (Hayes 1978).

Both yard and food wastes comprise large components of the solid waste stream (MRAC 1990). In response communities have developed programs to increase composting efforts and reduce the amount of organic waste destined for the landfill. Examples of such programs include: centralized collection and composting of yard wastes (Owen 1994) and/or municipal mulch production (Ragsdale et al. 1992); banning yard wastes from municipal services (Kjolhede 1994, Kelly 1993, Ragsdale et al. 1992); operation of wet/dry collection systems (Glenn 1993, Gottsegen and Whitman 1994); cocomposting sludge and yard wastes (Logsdon 1992b); development of compost demonstration sites (McGovern 1994) and/or distribution of compost bins to households (Beesley 1992, McGovern 1994); offer collection service at certain times of the year for yard wastes (Kjolhede 1994) and/or Christmas tree recycling (Chowdhury 1992); and, community education programs promoting backyard composting, mulching, grass cycling and/or landscape alteration. Examples of such education programs include: YIMBY - Yes In

My Back Yard (Wachtel 1993); Master Composters (Dean and Ulman 1992, Wachtel 1993, Riggle 1994, Owen 1994); Greater Vancouver Regional District's program designed to build an understanding of compost practices, targeting home owners and school children (BioCycle Staff Author 1993); school composting education program (eg. Dr. Rot Program - City of Ventura Recycling Office 1993b), Don't Bag It (Wachtel 1993, Owen 1994, Cattani 1994, Ragsdale et al. 1992)].

2.4.5.4 RECYCLING

Collecting recyclables is a popular approach to diverting solid waste from landfills. Curbside collection recycling programs have proved successful in diverting communities' MSW (eg. Toronto's Blue box). Municipal Recovery Facilities (MRF's) are also being developed to collect even more material (Logsdon 1992a).

Recycling, however, involves more than just the collection and storage of materials. Recycling is the circuit of collection, processing, manufacture and consumption that diverts raw materials from the waste stream for the manufacturing of new raw materials and products (Denison & Ruston 1990). Successful recycling depends upon technology and energy to process the collected materials into raw materials; market development for the recycled raw materials within the manufacturing industry; as well as, consumer satisfaction with the finished product containing recycled materials. Recycling also must take into account economics and unintended environmental effects (eg. sludge from deinker) (Environment Canada 1993).

Initiatives within Manitoba include: the processing of 200,000 and 300,000 tonnes of scrap metal processed every year; three paper mills consuming small quantities of waste newsprint; three cellulose fibre insulation manufacturers; beer vendors use deposit/return aluminum cans and glass bottles; non-deposit liquor containers are purchased at buy back centres by Manitoba Soft Drink Recycling (MSDR); and, polyethylene terephthalate (PET) plastic beverage containers are shipped to out-of-province processors by MSDR (MRAC 1990).

2.4.5.5 RESOURCE RECOVERY

Recovery refers to the process of obtaining or reutilizing energy or resource value from solid or hazardous waste through combustion or other processes (Environment Canada 1993). Methods of resource recovery include: refuse-derived fuel production, incineration, anaerobic digestion, and pyrolysis (Cossu 1989). For example, in some parts of north America used tires are being burned in cement kilns as an energy source (Environment Canada 1993).

The most common option for energy recovery, incineration, is a controversial issue. On one hand, incineration reduces the volume of waste by 70 to 90 percent; destroys much of the organic material in MSW, which would otherwise contribute significantly to the production of toxic leachates and air emissions as this material decomposes in a landfill; and, can provide the added benefit of energy production (Denison & Ruston 1990). Recycling and combustion can complement one another within an ISWM system.

Recycling removes items less conducive to combustion, while combustion reduces the remaining nonrecyclable, nonreusable waste.

On the other hand, incineration increases the mobility of toxic metals present in MSW. They are released through air emissions or ash in forms that are more readily absorbed by living organisms (Denison & Ruston 1990).

With careful management and disposal of these residual toxic emissions and ashes, a well-operated, state-of-the-art combustor should not present a significant risk to human health and the environment (U.S. EPA 1989). Thus, the future of incineration will be determined by objective evaluations of the risks of landfills versus the risks of incineration (Powelson & Powelson 1992).

2.4.5.6 LANDFILLING RESIDUALS

Sanitary landfilling is an integral part of existing as well as new strategies for solid waste management (Diaz et al. 1982, U.S. EPA 1989, Cossu 1989, Powelson & Powelson 1992, Alexander 1993). Landfilling is essential to handle nonrecyclable and noncombustible wastes, such as demolition waste and construction debris; and, in some areas, based on land availability and population characteristics that make recycling impractical, landfills may be the principal method of managing solid waste.

Although a well-constructed, properly-operated sanitary landfill should not present significant health risks (U.S. EPA 1989), it may be considered a nuisance to the

neighbourhood. Figure 2 summarizes the potential environmental emissions from a sanitary landfill for the operation phase and completed phase.

The environmental aspects of a sanitary landfill range from local nuisances, including wind-blown dust and litter, noise, odorous gases, birds, vermin and insects attracted by the waste, surface run-off and the physiological disturbance of the view of a landfill, to the potential contamination of regional ground water resources by migrating leachate (Christensen 1989).

2.4.6 WASTE MINIMIZATION & RESOURCE CONSERVATION

The 4R's of waste management (i.e., reduce, reuse, recycle, and recover) are the four basic steps, in order of priority, to minimize wastes which require disposal (The City of Winnipeg n.d.). Waste minimization strategies can conserve waste disposal resources, such as: landfill space, which reduces the number of site evaluations and NIMBY syndromes (i.e., Not In My Back Yard) associated with locating a new landfill; the area of land used for waste disposal purposes; fossil fuels used in collection vehicles and bulldozers; electrical power used to illuminate larger landfill areas; and, human energy for the administration, collection and landfilling of wastes.

The conservation of waste disposal resources transmits into a cost savings to the environment as well as to the taxpayer. The environmental aspects related to sanitary landfilling (Christensen 1989) are reduced as the amount of waste for disposal decreases.

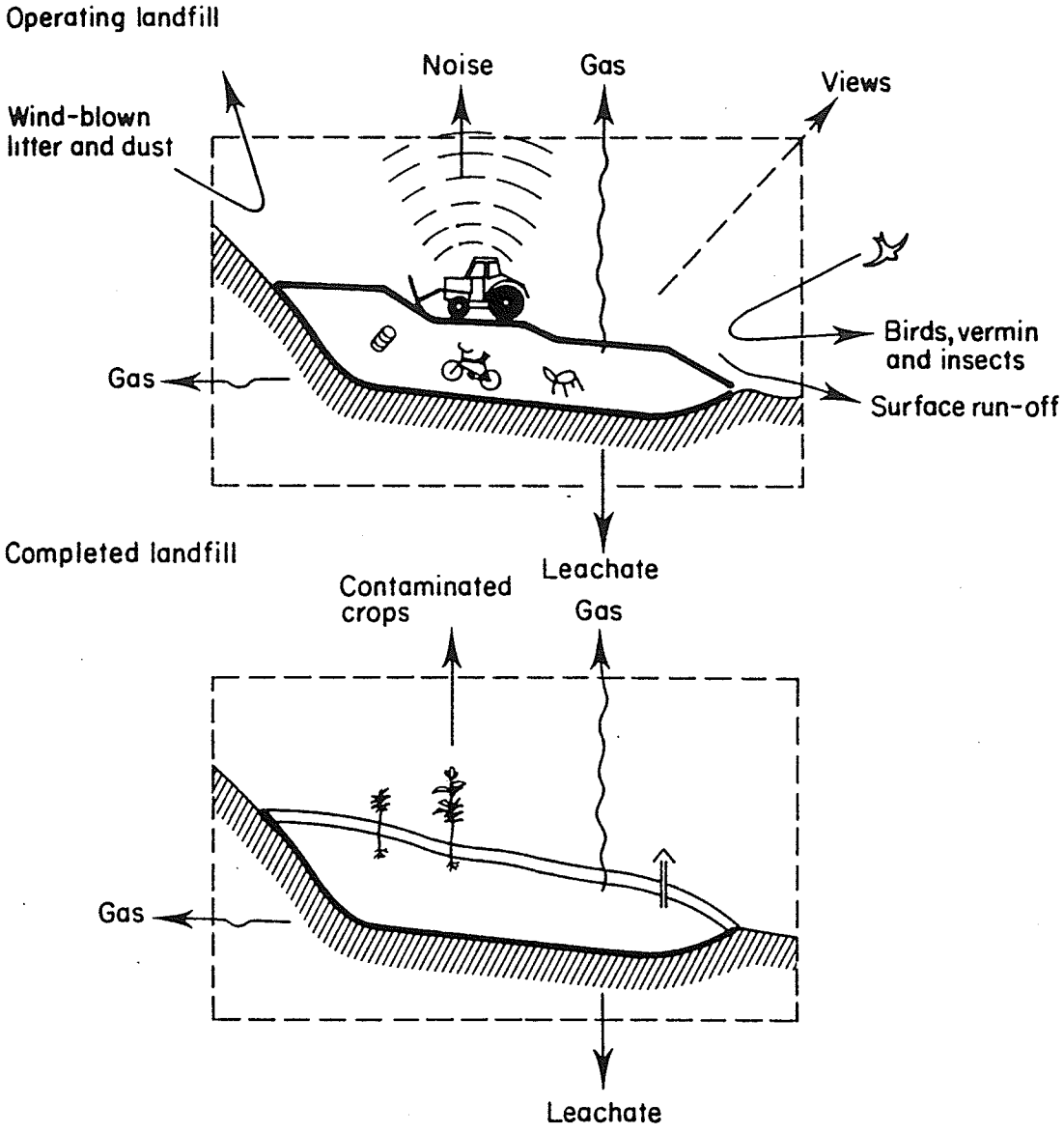

Figure 2: **Major environmental aspects related to sanitary landfilling (Christensen 1989)**

Less land is required for the disposal of waste. Fewer site evaluations reduce the amount of public funds spent on studies and public meetings. The reduction in the burning of fossil fuels and electricity use reduces the amount of greenhouse gases produced.

The City of Winnipeg (n.d.) summarizes the benefits of waste minimization as follows:

* decreases the amount of municipal solid waste generated
* conserves natural resources by reducing the need for raw materials
* protects our health and the environment
* conserves energy
* minimizes the amount of toxic substances from entering the waste stream
* reduces our reliance on landfills and extends their capacity
* over-all cost savings

2.5 LANDSCAPE WASTE MINIMIZATION

Landscape waste is a major contributor to residential waste streams (eg. Winnipeg, Manitoba; Ventura, California). As well, methane production is stimulated by waste having a high percentage of biodegradable organic materials (food and garden wastes, paper, textiles, and wood) (Emcon Associates 1980). Thus, source reduction of landscape waste could result in decreased amounts of residential wastes and methane production within landfills.

The following subsections describe four principle methods of reducing the amount of landscape waste destined for landfills. These include: 1) reducing yard clippings; 2) grass cycling; 3) mulching; and, 4) composting (City of Ventura Recycling Office

1993a). A fifth subsection describes planting native species as a means of reducing landscape wastes. The last subsection discusses the conservation of energy resources achieved through low waste landscaping.

2.5.1 REDUCING YARD CLIPPINGS

The production of yard clippings can be reduced (as well as water-use and maintenance) by the following techniques: 1) limit lawn size to areas used for play or entertaining only; 2) irrigate efficiently to reduce rapid growth; 3) shred yard trimmings for use as mulch around trees and shrubs; 4) plant water-efficient vegetation which tend to grow slowly and need less maintenance; 5) improve soils with the addition of compost; 6) limit fertilizer which causes growth and increased water use; 7) plan landscape to allow for plant growth which may prevent severe pruning or removal; and, 8) prune during periods of limited growth to remove dead or damaged limbs.

2.5.2 GRASS CYCLING

Grass cycling is the practice of leaving grass clippings on the lawn when mowing. The fine clippings, which result from regular mowing of dry grass with a sharp blade at the upper recommended cutting level for turf type, quickly decompose. Grass clippings are recycled without the effort of collecting, composting, or distributing.

2.5.3 MULCHING

Mulching is a landscaping technique where materials are used on top of the soil to retain moisture, inhibit weed growth, prevent soil erosion, and provide an attractive ground. Non-woody materials (nitrogen rich "greens"), such as dried grass clippings, decompose quickly and can be turned under without competing with plants for nitrogen in the soil. Woody materials and leaves (carbon-rich "browns"), however, require the application of a nitrogen supplement if the mulch is to be turned under. Shredded woody materials are generally used for paths and walkways.

2.5.4 COMPOSTING

Composting is the fourth method of reducing yard waste. Yard trimmings can be broken down by bacteria and fungi which are naturally present. Earthworms, centipedes, beetles, millipedes and other organisms are also involved in the decomposition process. The resulting rich, dark humus or compost can be used for mulching, enhancing soils, and other landscaping needs.

2.5.5 NATIVE SPECIES PLANTINGS

An alternative to the traditional energy-consuming, non-native lawn species is planting native species of grasses, flowers and/or trees. Entire yards, or portions of, can be restored to native species which are adapted to the harsh climate of the prairies.

Once established, areas planted with native grasses, flowers, and trees can flourish unattended. Native species require minimal energy-consuming practices such as mowing, watering, fertilization, seeding, or herbicide and pesticide application. Native prairie species are slow growing and require minimal water; landscape waste (if left to decompose) returns nutrients and organic material to the soil; seeds produced can establish new plants; and, competition, companion plantings and predator-prey relations can provide weed and pest control.

2.5.6 LOW WASTE LANDSCAPING & ENERGY CONSERVATION

Primarily, low waste landscaping practices serve to minimize the amount of landscape waste destined for the landfill which, in turn, conserves resources (see subsection 2.4.6.). However, there are additional energy conservation benefits which can be realized by society and the environment through low waste yard maintenance and landscaping practices.

Traditional yard maintenance practices, which include mowing, watering, fertilizing, spraying pesticides and/or herbicides, aerating, pruning, seeding, etc., require large amounts of energy. Fossil fuel or electricity is consumed to manufacture and run equipment, to produce the chemical yard additives, and to deliver the product to the house.

Traditional yard maintenance practices also produce hazardous waste. Containers from pesticides, herbicides, and fertilizers require special disposal practices and the chemicals themselves create runoff which pollutes rivers, lakes, and groundwaters.

Alternatively, low waste yard maintenance practices, such as grass cycling, composting, and mulching, can conserve energy by increasing the organic material within soils. Increased organic material within soils: 1) improves the water holding capacity of soil which reduces the amount of watering necessary for growth and nutrient absorbtion; 2) provides a slow release of nutrients into the soil which minimizes the need for additional fertilizer; and, 3) loosens soil and prevents hard packing which allows for the growth of deep penetrating root systems which require less frequent watering.

Low waste landscapes, such as well-established native prairie plantings, also conserve energy. The human energy of yard maintenance is reduced, the energy required by mowing and pruning equipment is saved, the energy required for the production and delivery of water and fertilizer is minimized, and the energy necessary for cleanup activities is minimized when smaller amounts of chemicals are added to the environment.

Native prairie plantings conserve energy by reducing the amount of water, herbicide and pesticide used. Native species are well-adapted to the harsh prairie environment which ranges from times of heavy rainfall to long hot dry spells. The non-native weed species occur less frequently among the native species; thus, less herbicide is required. Natural

predator-prey relationships can be established within the natural landscape and provide a means of pest control; thus, minimizing the need for pesticides.

2.6 IMPORTANCE OF EDUCATION

> Market research indicates that the public cannot and will not adopt a new behavior or participate in a new program unless they know about it, are persuaded of its benefits, find it easy to do, and are frequently reminded to do it (Parker 1990).

Education is important to any waste management program. Public education and involvement play a significant role in the selection of programs as well as after (U.S.A. EPA 1989). Waste authorities advocate public involvement in the drafting of legislation, regulation and policies governing waste management (Ontario Ministry of the Environment 1983, U.S. EPA 1989, Sinclair & Kuluk 1994). The generators of waste must: 1) understand the full costs and liabilities of managing wastes they produce (U.S. EPA 1989); and, 2) be aware of the benefits that flow from participating in the reuse, reduction, recycling, and recovery of wastes (Ontario Ministry of the Environment 1983).

Educational curriculums designed to instruct and inform students on the necessity of sound solid waste practices and policies have proven paramount to the effectiveness of programs (Gallagher 1990). MRAC (1990) recommended that waste minimization materials and activities be developed for integration into existing K-12 curricula. MRAC recognized that one learns best by "doing" and that students are very aware of

inconsistencies. Thus, MRAC also recommended to demonstrate issues and options included within the curriculum by actively pursuing waste minimization opportunities through the schools themselves.

2.7 SUMMARY

Literature concerning solid waste management, landscape waste minimization, and the importance of education to the implementation of waste management programs was reviewed.

"Waste" refers to materials which are no longer considered useful and are destined to be discarded. Waste includes solids, liquids, and gases. MSW primarily refers to residential solid waste, with some contribution from commercial, institutional and industrial sources. The MSW stream can be classified using a variety of methods. Terms, such as garbage, rubbish, ashes, street wastes, dead animals, industrial wastes, construction wastes, and sewage, can be used to describe the kinds and composition of solid wastes which may occur.

Three transitional steps in solid waste management were identified. The first was open dumps and burning; the second sanitary landfills with some recycling programs; and, the third step was ISWM. ISWM involves the implementation of complementary waste management strategies which safely and effectively handle the MSW stream while minimizing the adverse impacts on human health and environment. The ISWM strategies

include: source reduction, reuse of materials, composting, recycling, and recovery of resources.

Landscape waste comprises a large component of the MSW stream. Household methods to divert landscape waste from the landfill include: reduction of yard trimmings; grass cycling; mulching; and, composting. Low waste landscapes, such as native prairie plantings, can reduce the amount of waste destined for the landfill while conserving energy and resources.

In order to ensure the success of any waste management program, the public must be informed about it, persuaded of its benefits, and frequently reminded to do it. The MRAC recommended that waste minimization materials and activities be developed for integration into existing K-12 curricula, and that issues and options included within the curriculum be demonstrated by actively pursuing waste minimization opportunities through the schools themselves.

CHAPTER 3
IDENTIFICATION OF DIVISIONAL LANDSCAPING PRACTICES & SUITABLE EXISTING DEMONSTRATION PROJECTS OF LOW WASTE LANDSCAPING

3.1 OVERVIEW

In order to identify existing yard maintenance and landscaping practices throughout Winnipeg's school divisions and to identify suitable existing demonstration projects of low waste landscaping within Winnipeg school yards, informal telephone surveys were conducted. The head of maintenance within each of the ten local school divisions was contacted for information. The specific maintenance people contacted are listed in Appendix 1.

The individual schools and personnel involved with the identified low waste landscape demonstration areas were contacted for additional information. See Appendix 2 for the list of contacts.

The following two sections summarize the telephone survey results. The first outlines the yard maintenance and landscaping practices within Winnipeg school divisions. The second section describes the identified demonstration projects of low waste landscaping within Winnipeg school yards; indicates how students participated in the establishment of the low waste landscaping projects; and, discusses the success of the three identified projects.

3.2 EXISTING YARD MAINTENANCE & LANDSCAPING PRACTICES WITHIN WINNIPEG SCHOOL DIVISIONS

The ten local school divisions generally mow and rake lawns as required. Some divisions are on a 6 or 7-day cutting cycle, while others are on a 10-or-more-day cutting cycle. The number of days between cuttings depends on weather, the total area to be cut within the division, and the available labour force/funding.

Grass cycling occurs in varying amounts on school grounds within all ten of the local school divisions; however, most school divisions within Winnipeg also bag grass clippings according to need on certain parts of the school grounds (usually next to buildings). The Winnipeg One, Fort Garry, and Seven Oaks school divisions do not collect grass clippings at all. St. James School Division occasionally rakes and bags landscaping waste. St. Vital School Division has joint use agreements with the Parks and Recreation Department for mowing. Only the lawn directly around the school is mowed by the division (less than one acre of property); and, depending on the length of grass being cut, the clippings are occasionally collected for landfill disposal. Norwood School Division collects clippings in the fall only. River East School Division only bags grass clippings within football fields and in weather conditions similar to the summer of 1993. St. Boniface School Division bags grass clippings around building areas but not within the playing fields. Transcona-Springfield School Division also bags grass clippings near buildings and courtyards. Only within Assiniboine South School Division are the majority of grass clippings bagged.

There are no composting bins within the school divisions to manage landscaping wastes. Comments as to the reason for the lack of composting included: not necessary with current mulching and grass cycling practices; costs of placement; maintenance; fire risk; odour; and space.

Most school divisions do not mulch as a yard maintenance or waste management technique. St. James School Division is the only division that produces mulches for use in flower beds and as a ground cover to help control weeds. Wood chips are produced from the pruning of shrubs and trees within the division and additional wood chips are obtained from Kildonan Nursery. Norwood School Division uses bark chips in shrub gardens and evergreen areas. River East School Division, in cooperation with the City of Winnipeg Parks and Recreation, used wood chips to develop fitness trails but does not presently use wood chips as a grounds maintenance or waste management technique.

Minimal fertilizer is used within eight of the ten Winnipeg school divisions. Winnipeg One School Division uses fertilizer on the school grounds in spring. St. James School Division uses very small amounts of fertilizer around buildings. Assiniboine South School Division may fertilize once in the spring. St. Boniface School Division also uses a mild, slow-release fertilizer once in the spring. Fort Garry School Division fertilizes around administration buildings and not around schools. Norwood School Division rarely uses fertilizer. River East School Division has an agreement with Parks and Recreation to topsoil and fertilize. Seven Oaks School Division fertilizes around building

fronts (Greendrop contract). The St. Vital and Transcona-Springfield school divisions do not fertilize.

Weed control varies within the school divisions. Winnipeg One School Division and St. Vital School Division do not use herbicides. Assiniboine South School Division only uses herbicides for severe weed growth. St. James School Division uses spot spraying for infested areas and aerates annually to promote lawn growth and subsequently keep weeds out. St. Boniface School Division uses a weak herbicide for dandelions. Weed control is contracted out within the Fort Garry School Division (Greendrop). Norwood School Division uses herbicide along fences to eliminate cutting. River East School Division uses herbicide around the boundaries and up against buildings. Seven Oaks School Division uses herbicide only when necessary. Transcona-Springfield School Division has a no tolerance policy for herbicides and pesticides. Weeds are mowed down to the base with the use of a trimmer which discourages growth for three cuttings.

Pesticide use within most Winnipeg school divisions is minimal. The Winnipeg One and St. Boniface school divisions use pesticides only under special circumstances. The Assiniboine South, St. Vital, Seven Oaks, and Transcona-Springfield school divisions do not use pesticides at all. Fort Garry School Division uses the minimal amount of pesticides which are found within their contracted weed control program (Greendrop). Norwood School Division occasionally uses "Raid" for ants and "Warfarin" (a blood coagulant) for field mice problems.

In contrast, the St. James and River East school divisions have an integrated pest management plan that calls for non-chemical pest control whenever possible. Divisional maintenance department personnel are licensed and trained to control pest cycles such as bees, wasps, hornets, mice, and ants. When the need arises, spot spraying is used to control pests. St. James School Division custodians may use "safer-soap" but are not licensed for any other applications. Occasionally, professional exterminators are called in for infestations.

Lawn and garden irrigation within Winnipeg school divisions is minimal with cost frequently mentioned as a deciding factor. Winnipeg One School Division irrigates around a few schools and in some fields. Some football fields are equipped within St. James School Division. There is minimal irrigation within Seven Oaks School Division. The Assiniboine South, St. Boniface, St. Vital, Norwood, River East, and Transcona-Springfield school divisions do not irrigate at all.

Tree and shrub planting practices vary among Winnipeg school divisions. St. Boniface School Division plants a few trees every year (no seedlings - evergreen and popmore ash - 6-8 ft tall, 3" stock). St. James School Division also plants trees regularly. Parent councils have raised money for Earth Day plantings; provincial money is used to plant shelter belts in large field areas which adjoin community centres; and, the division annually replaces dead trees. The Winnipeg One, St. Vital, Norwood, and Seven Oaks school divisions plant trees occasionally, based on available funding. Tree planting

within Norwood School Division is limited for reasons of restricted funding, vandalism and student safety (ie. danger from climbing and visibility from street may prevent unscrupulous behaviour). Assiniboine South School Division plants trees when the schools are new and replaces trees that have been destroyed. Fort Garry School Division has planted some deciduous trees; vandalism, however, is a problem. Within Transcona-Springfield School Division, tree plantings are included in the original planning of schools and are replaced when necessary (eg. Winnipeg parking lots require a certain amount of green cover). Transcona-Springfield does not plant any additional trees for reasons of expense and vandalism, although individual schools within the division may install and maintain trees.

River East School Division does not plant trees or shrubs. The division will, however, support planting projects by supplying heavy equipment and a labour force to pick up excess rubble and mud. The planting projects are organized by the administration and students at the individual schools. Chief Peguis Junior High and John Pritchard are two schools within the division that have planted trees. In both cases the students participated in the following activities: 1) raised the money to buy the trees; 2) picked the species to be planted; 3) planned the area to be planted, including the positioning of benches and garbage cans; and, 4) planted the trees and shrubs. The community approach to planting trees and shrubs has resulted in decreased vandalism and an enhanced atmosphere within the River East School Division.

Divisional maintenance crews, school custodians, as well as professional contractors are responsible for the pruning of trees and shrubs within school divisions. Most school divisions prune in the spring and/or fall and dispose of pruning waste by landfill. The contractors, which are hired for major pruning jobs, are responsible for their own waste disposal. In contrast to other Winnipeg school divisions, St. James School Division does not use landfill disposal for pruning waste. The pruning wastes, which occur in the spring, fall and occasionally within the growing season, are mulched and used as ground cover, weed control, and dug into flower beds.

Flower beds are found within the Winnipeg One, St. James, St. Boniface, Fort Garry, Norwood, River East, and Seven Oaks school divisions. Royal School within Assiniboine South School Division established a flower and vegetable garden with funds won in a school contest. There are minimal flower beds occurring within St. Vital School Division and those that do exist are maintained at the discretion of the school, home and/or school committees, children, or the custodian. In Transcona-Springfield, the divisional maintenance crews do not install or maintain any flower beds.

Aeration occurs within most school divisions in varying amounts. Winnipeg One School Division does very little aeration. Other school divisions, such as Norwood, St. James and Assiniboine South, aerate lawns every year in the spring and/or fall. St. Boniface School Division aerates every two to three years. Fort Garry School Division aerates around administration buildings every year. Seven Oaks School Division only aerates

1 or 2 areas within the division. River East School Division aerated for the first time in 1994 as part of a pilot program undertaken to determine whether aeration and the application of manure is more effective in promoting a healthier ground cover than seeding. Transcona-Springfield School Division only aerates if desperate and St. Vital School Division does not aerate at all.

3.3 LOW WASTE LANDSCAPING DEMONSTRATION AREAS

Composting, as a method of landscape waste management, was not identified within any of Winnipeg's school divisions. Mulching and grass cycling practices occur within Winnipeg school divisions, however, there are no demonstration areas, per se, for these practices.

The only low waste landscaping demonstration areas identified on Winnipeg school grounds are three areas of restored tall grass prairie. Mountbatten School, Elmwood High, and Bernie Wolfe Community School all planted tall grass prairies on school grounds.

A tall grass prairie, which creates no waste, can provide a demonstration area for low waste landscaping. However, these three areas were not established for that purpose. The purpose of restoring the tall grass prairies on school grounds was to increase the students' awareness and appreciation of the native prairie which has been, and is being, lost to rural and urban development. The specific objectives of the tall grass prairie

projects were to provide a hands-on venture for the students, and to establish a study base for students in the future.

Mrs. Dooley, the principal of Mountbatten School, organized the Mountbatten Tall Grass Prairie project which was planted in June of 1993. Although the prairie is not fully established, Mrs. Dooley has a positive attitude towards its future success as an environmental education classroom. Future plans for the area include use by other schools, which may involve the teaching of younger students by older students, and an expansion of the outdoor classroom.

The Elmwood High Tall Grass Prairie is well established after the initial two years. Ann Monk, a teacher who was involved in the initiation of the Elmwood Tall Grass Prairie and who has since been transferred, presently maintains the Elmwood site with weeding. A prescription burn was performed on the site in 1993. The Elmwood Tall Grass Prairie is not presently being used as an educational tool as there are not any teachers at the school interested in the site.

In the spring of 1992, the planting of the tall grass prairie at Bernie Wolfe Community School was organized by the school principal, Nestor Gylywoychuk. Unfortunately, no other teachers or administration continued the project after Nestor Gylywoychuk retired in June 1993. Dave Gylywoychuk weeded the site in the summer of 1993, however, the site is not currently being maintained or being used as an educational tool. Nestor

Gylywoychuk remains optimistic that a motivated teacher can be found to continue the tall grass prairie restoration project.

The student involvement within each tall grass prairie project varied depending upon the age of students involved. Each establishment of a tall grass prairie included a variety of the following activities: researching the history and components of a tall grass prairie ecosystem, visiting Prairie Habitats nursery in Argyle, constructing displays, designing logos, tilling soil, planting seeds, weeding, as well as prescription burning.

Assessing the success of using tall grass prairie restoration as an educational tool is difficult; two of the prairies identified are not fully established and the third is not presently being used as a teaching tool. The administrations involved with the three local tall grass prairie projects feel that the initial student activities surrounding the tall grass prairie projects provided worthwhile educational experiences. However, the continual motivation of administration and/or teachers within the schools is necessary for the long-term success of tall grass prairies on school grounds, as well as their use as a teaching tool.

3.4 SUMMARY

Yard maintenance and landscaping practices vary within and among the Winnipeg school divisions. The availability of funding, zero-tolerance policies for pesticides and/or herbicides, weather, as well as the individual practices of school custodians, influence divisional yard maintenance and landscaping practices.

Table 2 summarizes the maintenance practices within the ten Winnipeg school divisions. All local school divisions practice grass cycling within some area of the school grounds; however, 50% of the divisions bag grass within certain areas of the school grounds. No school divisions compost and only St. James School Division uses mulching as a waste management technique. Fertilization occurs within 80% of the school divisions, irrigation in 40%, and all Winnipeg school divisions prune trees and shrubs within school grounds.

There were no suitable existing demonstration projects of low waste landscaping identified within Winnipeg school divisions. Low waste yard maintenance and landscaping practices, such as mulching, grass cycling, and planting tall grass prairies, provide exemplary behaviour within Winnipeg school divisions. They do not, however, specifically aim to educate society on low waste landscaping practices.

Table 2: Maintenance Practices of Winnipeg School Divisions

MAINTENANCE PRACTICE	SCHOOL DIVISIONS									
	#1	#2	#3	#4	#5	#6	#8	#9	#10	#12
MOW	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
BAG GRASS	N	N	Y	Y	N	Y	Y	Y	N	N
GRASS CYCLE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
COMPOST	N	N	N	N	N	N	N	N	N	N
MULCH	N	Y	N	N	N	N	Y*	Y*	N	N
FERTILIZE	Y	Y	Y	Y	Y	N	Y**	Y	Y	N
HERBICIDE	N	Y	Y+	Y	Y	N	Y	Y	Y	N
PESTICIDE	Y~	Y	N	Y~	Y	N	Y	Y	N	N
IRRIGATION	Y	Y	N	N	Y	N	N	N	Y	N
TREE PLANTING	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
PRUNE	Y	Y	Y	Y	Y@	Y	Y	Y	Y	Y
GARDEN	Y	Y	Y	Y	Y	N	Y	Y	Y	N
AERATION	Y	Y	Y	Y	Y	N	Y	Y§	Y	N

LEGEND:

# 1	• Winnipeg One School Division No. 1
# 2	• St. James School Division No. 2
# 3	• Assiniboine South School Division No. 3
# 4	• St. Boniface School Division No. 4
# 5	• Fort Garry School Division No. 5
# 6	• St. Vital School Division No. 6
# 8	• Norwood School Division No. 8
# 9	• River East School Division No. 9
#10	• Seven Oaks School Division No. 10
#12	• Transcona-Springfield School Division No. 12
*	• not a waste management technique
**	• rarely
+	• only if weeds are "really bad"
~	• only under special circumstances
@	• minimal
§	• first year of pilot program

CHAPTER 4
IDENTIFICATION OF WAYS SCHOOL DIVISIONS COULD REDUCE LANDSCAPE WASTES WHILE INVOLVING STUDENTS

4.1 OVERVIEW

The third objective was to identify ways school divisions could reduce landscape wastes while involving students. The informal interviews with heads of maintenance, personnel involved with the establishment of tall grass prairies, and school administrations provided insight into low waste yard maintenance and landscaping practices that involve students. Based on these discussions, the following section outlines possible low waste landscaping projects which may be undertaken within Winnipeg school divisions.

4.2 LOW WASTE LANDSCAPE PRACTICES THAT INVOLVE STUDENTS

The four principle methods of reducing landscaping waste are composting, mulching, grass cycling, and reducing yard clippings. Specifically, the reduction of yard clippings refers to limiting lawn size; irrigating efficiently; using mulch around trees and shrubs; planting water-efficient and low maintenance vegetation; installing rock, evergreen, vegetable or wild flower gardens; planting a native prairie; planning ahead to allow for shrub and tree growth; limiting fertilization; and, pruning conservatively.

Grass cycling and many of the yard clipping reduction practices, such as limited fertilization, minimal irrigation, vegetable and/or flower gardens, conservative pruning, and native prairies occur within Winnipeg school divisions. These practices are performed by custodians and divisional work crews. The low waste yard maintenance

and landscaping practices set good examples for teachers, students and other community members; however, they do not provide formal educational experiences for students. If the curriculum included discussions on the environmental and economic benefits of low waste yard maintenance and landscaping, the low waste yard maintenance and landscaping practices which occur within Winnipeg school divisions could serve as exemplary behaviour. Research projects could be undertaken by students to encourage landscape waste reduction at home and at school.

Composting is a low waste landscaping technique that does not occur within Winnipeg school divisions. The reasons given for the lack of composting within the divisions included: not necessary with current mulching and grass cycling procedures; vandalism; risk of fire; cost of construction and maintenance; odour; and, lack of space. The reasons stated are all valid concerns. Yet, excluding the first reason, all the other foreseen problems may be solved by involving the students in the installation and monitoring procedures of composting. The following guidelines for a student composting project are based on the tree planting procedures within the River East School Division (see section 3.2).

Student composting projects could be funded and planned by individual schools. Students could be involved in the fund raising, planning, construction and maintenance of the composting areas. The school divisions could support the composting activities by supplying tools and machinery for construction and labour for cleanup exercises. The

composting projects could create an avenue for divisions to reduce landscape wastes while involving students. With student monitoring and upkeep, the landscape waste reduction could occur with minimal cost to the division, reduced vandalism, minimal odours and reduced fire risk.

There are, however, two reasons which suggest that the establishment of composting projects by individual school groups, as described above, to reduce landscaping wastes would not be an easy or appropriate course of action for school divisions. First of all, it may be difficult to recruit staff members who will commit the time necessary to establish such composting projects, or to oversee them in the future. The three tall grass prairie plantings described in Chapter 3 experienced problems with maintaining motivated staff members. With changes in administration and increasing demands on teachers' time, the long term success of using composting projects as an effective means of reducing landscape wastes while involving students appears questionable.

The second reason why it may be inappropriate for school divisions to establish composting projects within school grounds is that St. James School Division is able to effectively minimize landscape waste through low waste yard maintenance practices such as mulching and grass cycling. St. James School Division reported that composting was unnecessary with grass cycling and mulching techniques.

The work place is one area where low waste yard maintenance and landscaping practices within school divisions could demonstrate waste reduction and energy conservation to students. Divisional maintenance crews are often composed of students who are returning to university in the fall. Student work crews could learn the how and why of low waste yard maintenance and landscaping through work-related education programs. By practising and understanding the benefits of low waste landscaping, the students would be receiving a valuable education that may change their personal landscaping practices now and in the future.

Tall grass prairie plantings, examples of which were described in section 3.3, are another way of reducing landscape wastes while involving students. The main purpose of restoring the tall grass prairies did not pertain to an educational experience in low waste landscaping. However, tall grass prairie activities and programs, which have specific objectives pertaining to landscape waste reduction, could provide an avenue for school divisions to reduce their landscaping wastes while involving students. The following describes factors which are important to the success of establishing a tall grass prairie within a school yard.

The first factor when establishing a tall grass prairie within a school yard is administrative permission. The permission of the school division, the school principal, as well as the City of Winnipeg Department of Parks and Recreation (depending on the

existence of joint-use agreements between community centres and schools) may all be required for the initiation of a project.

The second factor is the motivation and talent of the school administration. A highly motivated principal and/or teacher(s) is necessary to: 1) organize the activities involved with the establishment of a tall grass prairie; and, 2) integrate the activities into the curriculum to provide a worthwhile educational experience.

The third factor is the commitment of many volunteer hours. Principals, teachers, parents, students, or other community volunteers are necessary for the initial ground preparation, planting, and summer weeding exercises. Ground preparation includes tilling and herbicide application to decrease the amount of weeds that will occur after the prairie is planted. The tilling and herbicide procedure may need to be repeated depending on soil conditions within the site.

Once the soil is prepared and the seeds are chosen, the native prairie is seeded. The seeding exercise involves stomping the seeds into the ground like the bison that once roamed the prairies and, is an easy activity for students of all ages to participate in. The newly seeded site then needs to be watered regularly. Watering is another activity that can be undertaken by students of all ages.

The initial two years of establishment require weeding at least two times per growing season. The amount of weeding necessary will decrease over time as the prairie establishes itself. The weeders must be able to identify the native prairie plants and remove only non-native, weedy species. The skill of plant identification requires careful use of field guides and patience.

Once the previously-discussed factors are taken care of, a tall grass prairie may flourish within a school yard and prove to be a successful teaching tool. Long-term success, however, is only possible with continual support from the administration within the school. Administrational change, such as those which occurred within Elmwood High and Bernie Wolfe Community School, can adversely affect the maintenance of a tall grass prairie, as well as its use as a teaching tool.

There are endless benefits in having a native prairie within a school yard. For example, as a teaching tool, a tall grass prairie can provide a hands-on student venture, an endless resource for future studies, and an opportunity to increase the level of student and community awareness and knowledge of native prairies. A tall grass prairie can also provide a long term method of reducing school yard maintenance and serve as a demonstration area of low waste landscaping for students and the community.

The benefits appear limited only by the imagination. However, the reality of planting native prairies within school yards does create some difficulties. Establishing a native

prairie consumes a lot of time and energy. The motivation and commitment of administration is divided among many projects within the schools. The administration within school often changes and limits the probability of long-term success. It is difficult to find people to commit the amount of time and energy necessary for a successful native prairie planting. These obstacles combined with the possibility of vandalism to the area tend to reduce the likelihood of widespread use of restored native prairies as teaching tools within school yards.

4.3 SUMMARY

The easiest way to involve students with low waste yard maintenance and landscaping practices, such as grass cycling, composting, mulching, and planting native prairies, is to introduce the topic within school curriculums. The low waste yard maintenance and landscaping practices of school divisions could be observed and possible improvements discussed. In addition, an educational program could be developed to introduce low waste yard maintenance and landscaping to the divisional student summer work crews. As outlined, important factors must be addressed prior to the establishment of low waste landscaping demonstration areas within school yards, such as a tall grass prairie, or a composting bin. Most significantly, the success of these efforts requires substantial time and energy commitments which make the widespread establishment of demonstration areas within school yards questionable.

CHAPTER 5
LOW WASTE LANDSCAPES THAT CONSERVE ENERGY LESSON PLAN PRESENTATIONS & EVALUATION QUESTIONNAIRE

5.1 OVERVIEW

The fourth objective of this project was to develop a low waste landscaping lesson plan that could be introduced into the grade 7 and 8 science curriculum; and, the fifth objective was to introduce these materials to a selection of junior high schools in Winnipeg. These objectives were in part a response to the City of Winnipeg Waterworks, Waste and Disposal Department's commitment to further public education in waste reduction techniques. The previous discussion in Chapter 4 illustrates further, that lesson plans are also the easiest method of involving students in low waste landscaping practices. No lesson plans, however, currently exist within science text, such as Science Dimensions 8 (Bullard et. al. 1992), on composting, mulching, grass cycling, native plantings, or other low waste landscaping practices.

A literature search of current waste management and conservation lesson plans revealed a lack of low waste landscaping educational material. In developing the low waste landscape lesson plan, existing lesson plans and activities, such as, No Time To Waste, Greater Vancouver Regional District Elementary Education Program (Greater Vancouver Regional District 1993), Sustainable Development Grades 5 to 8, Caring for the World, Curriculum Support for Social Studies and Science Teachers (Lohrenz 1993), Be A Friend Of The Environment, A Program For Environmental Education in Manitoba (Perry & Simpson n.d.), Getting To Know Your Garbage (Doll 1993), Eco Education

Program (BC Environment 1992), Dr. Rot (City of Ventura Recycling Office 1993b) and A Word On Waste (Auckland Regional Council 1993), were reviewed in order to generate ideas. Comments by teachers and academics on draft copies of the developing lesson plan were received before entering the classroom. Lesson activities were further altered according to experiences within the classrooms. The resulting "Low Waste Landscapes That Conserve Energy" lesson plan, developed for presentation to grade 7 and grade 8 students, is outlined in Appendix 4.

Grade 7 and 8 science teachers throughout the school divisions were contacted by telephone in April 1994 to arrange a time for the lesson to be presented to their students. The response of the teachers was overwhelmingly, despite the busy time in the school year. In total, the "Low Waste Landscapes That Conserve Energy" lesson plan was presented to **78 classes** within **24 schools** and across **7 school divisions** between May and June 1994. The specific schools that received presentations are listed in Appendix 3.

A further objective of the project was to evaluate the effectiveness of the "Low Waste Landscapes That Conserve Energy" lesson plan presentation. A questionnaire was developed to survey the teachers whose students received a presentation. In addition to evaluating the effectiveness, the questionnaire was intended to determine whether the teachers involved with the presentations believe that waste management information should be incorporated into the school curriculum and to identify effective means of distributing waste management information to schools. Appendix 5 contains the cover

letter and Appendix 6 contains the evaluation survey that was mailed to each teacher involved with the project. A stamped return-addressed envelope was included with each survey.

The bulk of the surveys were mailed on June 7, 1994 while the remaining surveys were handed directly to the teachers after the presentation. It was assumed that those not responding within a week had possibly forgotten about the survey or had not received one through the mail. Follow-up phone calls were made to remind teachers who had not yet responded and survey packages were delivered to those who had not received one. Additional follow-up phone calls were made to increase survey returns.

The following two sections outline the classroom presentation and the results of the evaluation questionnaire. Appendix 7 contains the percentage responses presented in evaluation survey format.

5.2 LESSON PLAN PRESENTATIONS

As outlined in Appendix 4, the introduction of the "Low Waste Landscapes That Conserve Energy" lesson plan included a brief discussion on the definition of "waste management"; methods of managing waste; and, the problems associated with landfill disposal of waste. The discussion was in a question-and-answer format which evoked a variety of responses such as, "why not send our trash into orbit?" and "why do we have to pay for recycling?".

The introduction also informed the students of the average amount of municipal waste produced per person within Winnipeg and the percent of which is yard waste and other compostables. Alternatives to throwing out yard wastes were briefly discussed (composting, mulching, grass cycling).

Following the introduction, the "Web of Life" activity was explained to the students. The students were told that they were going to build a prairie ecosystem and look at the relationships between the components of a prairie ecosystem. The students were also informed that the prairie ecosystem would then be changed into a lawn ecosystem, and that energy consumption and waste management practices within the prairie and lawn ecosystems would be compared.

After the explanation of the "Web of Life" activity, the students were asked to sit in a circle on the floor of the classroom. The components of a prairie ecosystem were discussed as each student was handed a card which identified them as a component of a prairie ecosystem. Once all the students were given a role in the prairie ecosystem, a ball of twine was passed between the components/students. The twine started with the natural supply of sun and rain to the prairie ecosystem. The twine was then passed to a plant which would convert the energy of the sun by the process of photosynthesis to food and habitat for other organisms. Depending on which plant is chosen first in the prairie, the next dependent organism would be chosen. As the twine was passed between components, food and habitat relations within the prairie and the management of waste

within the prairie were discussed. When completed, each component of the prairie ecosystem was joined by string to other components to form a "Web of Life". The "Web of Life" represented the interrelatedness of ecosystem components as well as the flow of energy within the ecosystem.

Following the completion of the prairie "Web of Life", the self-sustaining characteristics of the prairie ecosystem were discussed (i.e., waste production and management within the prairie ecosystem and the sun as the non-polluting energy source for the prairie). The effects of human development on the prairie were then discussed and the prairie was converted to a lawn ecosystem. As the affected components of the prairie were mentioned, the students would drop the corresponding string. The inevitable collapse of the "Web of Life" indicated how unsustainable the lawn ecosystem is as compared to the prairie ecosystem.

The presenter pointed out how many lawns exist within Winnipeg and asked the students to identify ways in which the lawn ecosystem is maintained (i.e., watering; mowing; applying fertilizers, pesticides, and herbicides; aerating; applying top soil; etc.). The reasons for the maintenance practices (i.e., loss of nutrients from bagging waste, planting of non-native species, loss of habitat for insect predators, etc.), the consumption of fossil-fuel related to the maintenance practices, and the affects of chemicals on the environment were discussed.

As a conclusion to the presentation, the students were asked to identify alternative landscaping practices which would minimize yard waste and/or reduce the amount of fossil-fuel consumed by the urban lawn (i.e., composting, mulching, grass cycling, planting habitat for insect predators, planting native species, reducing the area of lawn, hand-picking weeds, increased tolerance for pests and weeds). The non-polluting, self-sustaining characteristics of a prairie were used to generate ideas.

5.3 QUESTIONNAIRE SURVEY RESULTS

36 of 50 surveys were returned, for a response rate of 72%. Question 1 identified the grade level of the responding teacher. The response group was comprised of 1 grade 6 teacher; 19 grade 7 teachers; 12 grade 8 teachers; 2 grade 7 & 8 teachers; 1 grade 9 teacher; and, 1 grade 5-8 mixed teacher. The responding teachers represented the entire spectrum of grades visited.

Question 2a asked whether there had been any further discussion or questions from the students since the presentation. 47% of the teachers reported that there was further discussion or questions by the students; and 53% reported that there was no further discussion or questions asked. Table 3 lists examples of the types of issues or questions discussed since the presentation.

Table 3: Issues and/or Questions Discussed Since Presentation

*	City and rural landfill sites usage
*	Presentation tied in with "Resource Unit" and "Ecosystem Unit"
*	Alternatives to the present lawns in our community
*	References to the "Web of Life"
*	What can we do as individuals to help
*	How can our families contribute
*	The feasibility of prairies and wild flowers in your own backyard
*	References made to reinforce concepts within the "Ecology Unit"
*	Composting
*	What we each do in our yards
*	Ways in which students were conserving energy at home (recycling)
*	Comments on reducing garbage in the classroom
*	Longevity of garbage/waste underground
*	Pros and cons of disposable diapers
*	Further discussions on food webs
*	Global warming, ozone, space debris - affects on us

Note: Each * on all tables of written comments represents a separate survey response.

Question 3 asked for the main strengths and weaknesses of the exercise for the students. Tables 4 and 5 list the comments of the responding teachers.

The comments indicate that the "hands-on" participation in the "Web of Life" was a strength of the exercise for the students. The activity was well received, however, teachers often stated that the level of material would be better suited for grades 6 and 7; and, that a preview of the material to be presented would have been useful.

Table 4: Strengths of the Exercise for Students

*	Graphic, "hands-on" webbing, explanation and discussion
*	It's a topic the students know is important
*	Physical involvement of students
*	"Hands-on" method was excellent
*	Using string to represent a food web
*	The labels of species
*	The food web
*	All very worthwhile
*	Participation - well organized activities
*	All activities were "hands-on" and fun
*	Interrelation of all living things
*	Exercise was well presented - a review of things they already knew and introduced new information
*	Gave the students a hands on presentation to the understanding of food webs and waste management
*	Presenter's knowledge and patience
*	Points out to students what they can do to recycle yard "waste" and what they or their parents are already doing
*	Followed my curriculum - covered necessary material
*	Web of nature - "hands-on" learning
*	Introductory discussions made issues of environment and waste management practical and relevant
*	String web introduced environmental interactions in concrete way
*	A better understanding of the complex ecosystem with the biotic and abiotic interactions
*	Good "hands-on" involvement
*	Students were able to activate prior knowledge and own ideas to contribute
*	A topic they are interested in
*	Student involvement
*	Twine clearly shows the interrelationships
*	The exercise was well prepared and presented
*	Students thought the ecosystem web was great
*	Class enjoyed the presentation
*	Visual aids (cards around necks very visible)
*	It was fun and the web was easy to understand
*	"Hands-on" and humorous (giving students labels) - caught their attention
*	Great exercise
*	Environmentally and personally oriented
*	Students are more aware of the interconnectedness of wildlife/habitat
*	Students have a better understanding of food chains and food webs

Table 5: Weaknesses of the Exercise for Students

*	At age 14, students feel awkward and embarrassed doing what they see as childish games
*	Overabundance of information
*	An information preview to teacher would allow me to prep kids
*	Suggestion of wild grass front yard too hard to bring about
*	Would not do it with a group over grade 7 (too elementary)
*	This part of the curriculum is repeated several times in a variety of disciplines, therefore activities may be more appropriate for 5, 6 and 7
*	Grade level too high - perhaps more effective on younger group
*	We could have had more time
*	None except more would be better - part 2 with "hands-on" to grow something
*	Lack of visuals eg. pictures, slides, samples, etc.
*	More time could be spent showing the interrelationships of a prairie ecosystem, its breakdown when man interferes, and the fact that there is no "waste" in nature
*	Strength of classes' ability to discuss greatly affects presentation
*	Visuals may have held their attention more
*	Simplicity of the activity - better suited to Grade 6-7
*	Suggest stand-up posters (with pics or stats) or slides
*	The children became fidgety after longer discussions
*	Too much talking without props
*	A little less discussion and more concrete aids to keep attention longer (eg. photos or samples of composting)
*	Very simple - need higher level of thinking for challenge
*	Better intro and follow up needed to expand ideas
*	Student behaviour
*	Did not have enough students

Question 4 of the evaluation survey was intended to determine whether presentations achieved the three main objectives. The first objective was to increase the students' awareness of issues associated with municipal solid waste disposal. 25% of the responding teachers strongly agreed that the lesson achieved objective 1; 50% agreed; 22% disagreed; and, 3% strongly disagreed. Overall 75% agreed and 25% disagreed indicate that most teachers agreed that objective 1 was achieved.

Objective 2 was to increase the students' awareness of landscaping techniques that reduce yard waste. 11% of the responding teachers strongly agreed that objective 2 was achieved; 53% agreed; and, 36% disagreed. Overall 64% agreed and 36% disagreed indicate that most teachers agreed that objective 2 was achieved by the presentation.

Objective 3 was to increase the students' awareness of landscaping techniques that conserve energy. 11% of the responding teachers strongly agreed that objective 3 was achieved; 42% agreed; 39% disagreed; 5% strongly disagreed; and, 3% had no opinion. The overall results of 53% agreed and 44% disagreed indicate that only just over half of the teachers agreed that objective 3 was achieved by the presentation.

Although all teachers generally agreed that the three objectives of the presentation were achieved, the teachers were more inclined to agree that Objective 1 was achieved than Objective 2 or Objective 3. This is not surprising as Objective 1 was addressed within the introduction of the presentation, before the "Web of Life" activity, when student responses were less likely to affect the presentation.

Conversely, teachers were less inclined to agree that Objective 2 and Objective 3 were achieved than Objective 1, which may reflect the students' decreased attention span after the "Web of Life" activity, or a need for more visual stimulation within the discussion period.

Question 5a asked whether energy and resource conservation topics, such as water conservation, energy conservation, vehicular emissions and pollution, ozone depletion, or others, are a part of the school curriculum. 86% reported yes; 8% reported no; and 5% did not know. Table 6 lists examples of types of conservation topics which are included within school curriculums.

Question 6 asked whether the teachers thought there is a general understanding by teachers and students of the benefits of resource and energy conservation achievable through waste minimization. 50% strongly agreed; 31% agreed; 8% disagreed; 8% strongly disagreed; and 3% had no opinion. Overall, an overwhelming 81% agreed while only 16% disagreed. These results indicate that a general understanding by teachers and students of the benefits of resource and energy conservation achievable through waste minimization exists and that the classroom can offer a proper context for the introduction of waste management information.

In question 7, when asked whether the material presented and other information on waste management should be part of the science curriculum, 64% of the responding teachers strongly agreed; 27% agreed; 6% disagreed; and, 3% strongly disagreed. With 91% of the teachers agreeing and only 9% disagreeing the results clearly indicate that the teachers agree that waste management information should be part of the science curriculum.

Table 6: Conservation Topics in School Curriculums

*	Grade 4-6 Friends of Earth program
*	Soil, water, resources
*	Water and energy conservation
*	Water conservation, pollution, and ozone depletion
*	Water conservation, energy conservation, vehicular emissions and pollution, ozone depletion
*	Not all is part of our curriculum but most topics are covered - some in detail and others not
*	Energy resources, land use, water use, ecosystems
*	The 3 R's
*	Energy, water, ozone, emissions
*	Water, energy, pollution, ozone
*	Ecology - water conservation, environmental awareness, pollution
*	Acid rain, energy conservation, alternative forms of energy
*	Water and energy conservation, vehicular emissions and pollution, soil conservation
*	Vehicular emissions, alternate fuels, pollution
*	Water and energy conservation, vehicular emissions and pollution, ozone depletion
*	Water and energy conservation, vehicular emissions (gasohol)
*	Energy conservation, ozone depletion
*	Per provincial curriculum grade 7
*	Grade 8 alternative energy forms
*	References are made as much as possible
*	Energy and water conservation, pollution, ozone depletion
*	Energy from fossil fuels, uranium, solar power, hydro electricity, water cycle, greenhouse effect
*	Energy conservation, farming methods, vehicular emissions, solar, hydro, and nuclear energy
*	Energy efficiency - insulating homes, manufacturing energy, packaging waste, energy equilibrium and mechanical efficiency
*	We try to relate them wherever applicable (Ecology Unit)
*	Recycling
*	Water conservation, energy conservation, vehicular emissions and pollution, ozone depletion
*	Biosystems and food webs
*	Water and energy conservation, fossil fuel pollution, ozone depletion, acid rain

When asked whether the City of Winnipeg should provide school with information on waste management issues (eg. landfills, composting, household hazardous wastes, etc.) in question 8, 64% of the responding teachers strongly agreed; 28% agreed; 5% disagreed; 0% strongly disagreed; and, 3% had no opinion. Once again an overwhelming response of 92% agreed while only 5% disagreed. These results provide a clear indication that the City of Winnipeg should be providing waste management information to schools.

Question 9 asked whether waste management information mailed out to schools in a generic format can be integrated into the science curriculum. 47% of the responding teachers strongly agreed; 22% agreed; 8% disagreed; 6% strongly disagreed; and 17% had no opinion. Overall, 69% agreed and 14% disagreed. These results clearly indicate that generic waste management information could be integrated into the curriculum, although there may be more effective ways to get information to teachers to ensure use.

In question 10, the teachers were asked whether they would integrate waste management information mailed out in a generic format into the science curriculum. 44% strongly agreed; 31% agreed; 11% disagreed; 3% strongly disagreed; and, 11% had no opinion. With 75% agreeing and 14% disagreeing, there is a very good chance that teachers would integrate waste management information mailed out in a generic format into the science curriculum.

Question 11a asked whether the teachers thought that waste management information should replace a portion of the current curriculum. 19% strongly agreed; 8% agreed; 42% disagreed; 19% strongly disagreed; and, 11% had no opinion. Overall only 27% agreed and 61% disagreed which indicates that responding teachers tend to disagree with replacing a portion of the current curriculum with waste management information.

Table 7 summarizes comments made regarding the replacement of a portion of the current curriculum with waste management. The comments are generally critical of replacing any portion of the curriculum with waste management, however, they do indicate that waste management information should supplement and complement rather than replace the present curriculum. This corresponds with the findings in questions 9 and 10 where most teachers indicated they would integrate materials into existing curriculums.

In question 12, 33% of the responding teachers strongly agreed that the City of Winnipeg should create a "Speakers Bureau" to provide people to introduce the information to teachers and/or students; 33% agreed; 20% disagreed; 6% strongly disagreed; and, 8% had no opinion. Overall, 66% agreed and 26% disagreed indicating that responding teachers generally agree that a "Speakers Bureau" should be created.

Table 7: Comments Regarding the Replacement of a Portion of the Curriculum with Waste Management Information

*	Could be integrated into the environmental unit
*	Should not replace but instead be a supplement to a unit
*	Need not replace - make a part of the energy resources unit
*	Should complement parts of the curriculum
*	It would vary depending on what would be taught at grade 8
*	Waste management should enhance rather than replace topics
*	Should replace part of plant photosynthesis or energy section
*	Could be integrated into L.A. program without removing any
*	None - waste management should be added to current curriculum
*	Not replace but supplement
*	None
*	Geology
*	Waste management could be integrated into unit on ecology
*	Incorporate present grade 9 chapter on succession into chapter on ecology and do waste management instead
*	Could become part of ecology or energy
*	Already part of my resources unit and management of resources
*	Heat Unit could be covered later in high school physics
*	Waste management information should complement what we already do in grade 8 (See science text - Science Dimensions 8)
*	Geology and astronomy can certainly be curtailed
*	Should be part of curriculum not replacing
*	Incorporate into Grade 7 Social Using Land Chapter 6 of Resources of the Earth or Science Rocks and Minerals page 58 in text, Chapter 11 Microorganisms Ecosystems.
*	Can complement parts of the curriculum rather than replace
*	This unit can be integrated with the present curriculum

The comments in Table 8 on the integration of waste management into the curriculum and the format in which the City of Winnipeg should provide information seem to indicate that "hands-on" activities are effective, practical demonstrations, speakers, tours, slides, videos, and films.

Table 8: Comments Regarding the Integration of Waste Management into the Curriculum and the Format in which the City of Winnipeg Should Provide Information

*	Expert visitation and activity based programs are successful
*	"Hands-on" material
*	Information can be mailed out
*	Specific to Winnipeg - students can see how they can help
*	Videos, co-operative learning activities, data
*	The amount of time spent may vary; we are pressed to complete all units
*	It would be good to have some current Winnipeg stats
*	Could be a display at the Museum of Man and Nature
*	City tours
*	Make info available to teachers
*	Workshops, resources, guest speakers, newsletters, annual presentation, ongoing communication and updates
*	Continue to send speakers to the schools, literature and information on various topics
*	I would like to see a bilingual program
*	Unit of study including resource lists - human, places and books
*	Public relations people with backgrounds in 3R's
*	Presenters, films, videos, resource people, composters
*	"Speakers Bureau" should introduce information to students, not teachers they have enough to deal with
*	Guest speakers, films
*	Format should be visual or activity based
*	Speakers; slides or video presentations of successful waste management sites; field trips to treatment plants, landfill sites, tall grass prairie locations
*	"Speakers Bureau" is a good idea; posters; video tape for borrowing
*	Must be bilingual or available in French
*	Speakers, tours, videos, activity kits
*	The most effective integration would be to have volunteer/work education programs in waste management that students could participate in
*	The best way would be "hands-on" visits to the garbage dump, sewer treatment plant or as an integrated part of a visit to Fort Whyte or the Museum of Man and Nature
*	The City of Winnipeg should be helping integrate waste management more fully into the curriculum by providing information on how the City adequately implements waste management itself; the City could also be doing more itself in the area of waste management
*	If teachers were aware of the steps and procedures of waste management they would incorporate them into their environmental units
*	Speakers, slides, videos, practical demonstrations

Question 14a pertains to whether the teachers would like to see a tall grass prairie, wild flower garden, or similar idea that represents waste reduction in the school grounds. 28% of the responding teachers strongly agreed; 25% agreed; 14% disagreed; 14% strongly disagreed; and, 19% had no opinion. Overall, 53% agreed and 28% disagreed which indicates that responding teachers would like to see a tall grass prairie or similar idea representing waste reduction within the school grounds. The comments regarding the implementation of low waste landscapes within school grounds, however, indicate that few teachers know how, or are interested in, investing the extra time and energy necessary to implement such a project (see Table 9). As well, many comments reflected a concern for problems that may arise with the establishment of a demonstration area within the school grounds.

The final question asked for any additional comments that may be appropriate to evaluating the effectiveness of introducing the "Low Waste Landscapes That Conserve Energy" presentation. The comments listed in Table 10 reiterate some of the suggestions made earlier in the survey results. That is, teachers and students like presentations, waste management is a valuable topic, and more pictures or slides would complement the presentation.

Table 9: Comments Regarding the Establishment of Tall Grass Prairies, Wild Flower Gardens, or Similar Ideas that Represent Waste Reduction in the School Grounds

*	Urban students need to be made more aware of balances in nature and how they can play a role in maintaining
*	Risk of abuse to wildlife by unsupervised children would negate any benefits from such a venture
*	The school yard really is for kids to play without concern that they have run into the wrong area
*	Great idea but many factors (funding, responsibility) would have to be in place
*	Teacher contract disputes make it unlikely that many will go out of their way to teach anything but the basics
*	I would support someone if they started one but I don't have the extra time or energy to start one on my own
*	Kids might set a tall grass prairie on fire
*	Any "hands-on" they like
*	This could be done in conjunction with Earth Day or Environmental Awareness Week which falls in late April
*	I would be very interested in a program next year but would need guidance, information and resource materials
*	Perhaps a wild flower garden or composter, etc., however, a tall grass prairie would encourage weeds
*	Guidance would have to be given as to how and where
*	Not workable at this location
*	Sounds like a good idea but I can foresee problems with ownership, care, maintenance - just like the "school aquarium"; students were enthusiastic and organized at first, but now it is just a "job" for custodians
*	The only problem with the above is vandalism
*	The children and I would benefit and take pride in a grass prairie and wild flower garden
*	I would like to but am afraid of resistance from the administration and maintenance
*	We are indeed lucky to already have several trees and flowers in our school yard
*	It would be nice but likely unfeasible - the kids would trample it to death
*	It would be difficult to prevent it from being destroyed after hours
*	Not the right space or place
*	We have a flower garden planted each year by the school division, which I would like to see developed into a wild flower garden; I will be investigating this in the future
*	Our school has one but at the moment does not have a person to keep it active
*	I would like to have a person come out to talk to students about planting a tall grass prairie, how to, why, etc.

Table 10: Additional Comments to Evaluate the Effectiveness of Presenting the "Low Waste Landscapes That Conserve Energy"

*	Information and subject matter are important
*	Previewing the topic and material would be helpful - students could have question ready for "the expert"
*	The best way to get the message across would be to see an actual tall grass prairie and/or landfill site
*	A forerunner to such a program needs to include "efficient lifestyle consciousness" so that kids, as they grow up can learn how to live without life's wasteful frills; they need role models: government, industry, T.V. morality regarding consumption, and adults who practise what they preach; low waste landscapes are much needed
*	Students like presenters and absorb their info
*	The more presenters the better
*	Presentation would be more effective with the upper elementary grades - perhaps grades 5 or 6
*	The presenter was knowledgable and quite good
*	Extra pictures or photos would increase effectiveness
*	Enjoyed the presentation - French would be appropriate
*	Could have been more interesting; format was not thought provoking enough to change attitudes or institute change
*	Slides of abuse/overuse of landfills etc. would emphasize importance; great to begin waste management education at this level so they become responsible adults
*	Presentation was interesting and informative but more of a review, especially the "Web" activity - similar to part of the "sustainable" program offered at Fort Whyte Centre
*	It is another way of reinforcing learned material
*	A simple questionnaire could be given to evaluate pupils
*	More visual aids and teacher backup materials
*	Presentation would be very valuable at all grade levels; our grade 8's started out expecting to be bored, but as the "hands-on" part progressed, they became interested; I would like to see the presentation even more detailed for older children, and scaled down to suit younger children; children in kindergarten or grade 1 would get a lot out of making the food web; a valuable program for all children; they will educate their parents, as an added bonus
*	Do it earlier; in April - May, or September - October
*	Presentation was well done; students were actively involved and enjoyed the presentation
*	A special unit is sometimes used by teachers; however supplemental information is used more frequently if the topic is already part of the curriculum; it must be part of an ongoing unit of study; students knew much of this information but an actual planting at school would teach students to apply what they have learned and incorporate the ideas and techniques of conservation at home

5.4 SUMMARY

Overall, the teachers and students responded positively to the lesson plan presentations. Students were often anxious to answer questions and, on many occasions individual students thanked the presenter for coming to the classroom.

Each classroom presentation varied. The outcome of the presentation was affected by: the time of day and day of the week in which the presentation was given; the cooperation of the students with the "Web of Life"; the students' responses to questions; the number of presentations given in a day by the presenter; and, the general behaviour or attitude of the classroom.

Minor modifications were made to the lesson plan in response to classroom experiences. For example, after completing the "Web of Life" activity, the lesson plan was altered to include more comparisons to the native prairie when discussing why people water, fertilize, and use pesticide and herbicide on lawns.

There were some cases where certain students made it very difficult to stay on track with the presentation. Students who misbehaved were generally taken care of by teachers, however, the presenter occasionally had to position students where they would least disrupt the presentation.

A number of general conclusions can be drawn from the information gathered in the evaluation survey. In regards to evaluating the effectiveness of the lesson plan presentations, the responding teachers agreed that the three primary objectives of the "Low Waste Landscapes That Conserve Energy" lesson plan presentations, as stated below, were achieved.

1. To increase the students' awareness of issues associated with municipal solid waste disposal;

2. to increase the students' awareness of landscaping techniques that reduce yard waste; and,

3. to increase the students' awareness of landscaping techniques that conserve energy.

It is also quite clear that the presentations were well received by teachers and students. Many classes held discussions on a variety of topics since the presentations and the majority of teachers identified the "hands-on" exercise (i.e., "Web of Life") as a strength of the exercise for the students. The most common weaknesses mentioned by teachers were the need for more visual aids during the discussion times and a lack of challenge for some students. The comments also suggested that an information preview for teachers prior to the presentation would be useful and that this presentation may be better suited for grades 6 and 7.

The Survey results indicate that school curriculums provide proper context for teaching waste management information. The majority of school curriculums include a variety of energy and resource conservation topics, such as water conservation, energy

conservation, vehicular emissions and pollution, ozone depletion, and others. As well, the teachers agreed that there is a general understanding by teachers and students of the benefits of resource and energy conservation achievable through waste minimization.

In regard to the integration waste management information, the Survey results clearly indicate that the City of Winnipeg should provide waste management information to schools for integration into the curriculum. The majority of teachers agreed that: 1) waste management information should be a part of the science curriculum; 2) the City of Winnipeg should provide information on waste management issues to schools; and, 3) waste management information mailed out to schools in a generic format could (and would) be integrated into the science curriculum. The comments regarding the integration of waste management into the school curriculum indicate that teachers would like to see waste management information used as supplementary and complementary material rather than replace some portion of the curriculum.

The majority of teachers indicated that the City of Winnipeg should create a "Speakers Bureau" to provide people to introduce the information to teachers and/or students. The most common suggestions for the format in which the City of Winnipeg should provide information included: "hands-on" activities, presentations by "experts", workshops, tours, films, and videos.

The Survey results indicate that as many as 53% would like to see their school plant a tall grass prairie, wild flower garden, or similar idea that represents waste reduction in school yards. However, the comments regarding demonstration areas indicate that no more than three of the responding individuals would be willing to accept the added responsibility. Most often the comments included foreseen problems with vandalism, administration and upkeep.

Additional comments provided by teachers seem to indicate that presentations are a great method of distributing waste management information and that presentations would be better received earlier in the year, either April - May, or September - October. Some teachers would like the presentations made available in French, and the need for more visual aids during discussions was reiterated.

CHAPTER 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

Some sort of lifestyle alteration (i.e., behaviour change) is necessary to achieve landscape waste minimization and energy conservation. The purpose of this project was to provide educational material that introduces how waste reduction and energy conservation can be achieved through yard maintenance and landscaping techniques that create little or no waste. The two main goals of the project were: 1) to work with local school divisions to identify yard maintenance and landscaping practices that could be easily instituted at local schools; and, 2) to formally introduce the concept of low waste landscaping to the junior high school curriculum.

The objectives of this study were to identify existing yard maintenance and landscaping practices throughout Winnipeg school divisions; to identify suitable existing demonstration projects of low waste landscaping within school yards; to identify ways school divisions could reduce landscaping wastes while involving students; to develop a low waste landscaping lesson plan that could be introduced into the grade 7 and 8 science curriculum; to introduce these materials to a selection of junior high schools in the City; and to evaluate the effectiveness of the lesson plan presentations through a survey of teachers. These objectives have been achieved.

Specifically, the study found that yard maintenance and landscaping practices in the Winnipeg school divisions are determined by available funding, community and parent

councils, zero-tolerance policies for pesticides and/or herbicides, weather, as well as the individual practices of school custodians. Low waste yard maintenance and landscaping practices, such as grass cycling, mulching, minimal fertilization, minimal irrigation, and tall grass prairie plantings, occur within Winnipeg school divisions. However, bagging grass (which mainly occurs around buildings), fertilization, and irrigation could be eliminated all together within Winnipeg school divisions. Mulching could also be initiated as a waste management technique to deal with the pruning wastes that are produced within all Winnipeg school divisions. The combination of mulching and a "Don't Bag It" program could eliminate much of the landscaping wastes produced within school divisions, without the additional burden of composting, thereby providing a positive example for students.

Additionally, no suitable demonstration projects of low waste landscaping were found within Winnipeg school divisions. The three tall grass prairie projects that do exist within school grounds have not proven themselves successful in the long term. It appears that the time and energy required by teachers and students with projects such as a tall grass prairie or composting bins, make the widespread establishment of demonstration areas unlikely. It is also clear from the teacher surveys that the easiest way to involve students with low waste landscaping practices, such as grass cycling, composting, mulching, and tall grass prairies, is to introduce the topic within the school curriculum.

School curriculums can provide a proper context for teaching waste management information. The majority of school curriculums include a variety of energy and resource conservation topics, such as water conservation, energy conservation, vehicular emissions and pollution, ozone depletion, etc.. As well, respondents to the teachers survey agreed that there is a general understanding among teachers and students of the benefits of resource and energy conservation achievable through waste minimization. Further, teachers indicated that waste management information mailed out to schools in a generic format could (and would) be integrated into the science curriculum as supplementary and complementary material rather than replace some portion of the curriculum.

As well, teachers felt very strongly that a "Speakers Bureau" which could provide people to introduce the information to teachers and/or students would be very well received. It was noted that the materials should include "hands-on" activities, presentations by "experts", workshops, tours, films, and videos. Students appreciate a new face in the classroom and respond positively to activities. Teachers also respond positively to the opportunity to receive a class presentation. The overwhelming response by schools to receiving a "Low Waste Landscapes That Conserve Energy" presentation indicates a widespread acceptance of presentations as a means of integrating waste management information into the school curriculum.

The integration of waste management information (eg. low waste landscaping) into the school curriculum is a task to be undertaken by teachers. Teachers know the specific curriculum within a school and intellect of the students. Prior review of material by teachers and the ability to select programs or activities suited to the individual class could ease the integration of waste management information into the current curriculum.

6.2 RECOMMENDATIONS

The findings of this research project warrant the following recommendations for future activities initiated in this regard:

1. School maintenance crews should refrain from bagging grass, fertilizing and irrigating within school grounds and, incorporate mulching as a method of low waste yard maintenance.

2. In the coming year the City of Winnipeg Recycling Coordinator should work with school boards and the Department of Education to identify other economically viable yard maintenance and landscaping practices for school grounds, so that the schools lead by example.

3. The Recycling Coordinator should also produce a catalogue of the waste management information and resources currently available to schools from the Waterworks, Waste and Disposal Department library, including slides, videos, etc..

4. The City of Winnipeg should continue to develop and provide information to schools on waste management that complements and supplements the current curriculum for integration into schools, keeping in mind the teacher/student preference for "hands-on" activity.

5. Given demand, The Waterworks, Waste and Disposal Department, in conjunction with the Adhoc Committee on Waste Reduction and Waste Minimization Advisory Committee, should immediately coordinate a "Speakers Bureau" for the 1995-1996 school year taking the following into consideration:

    a) Teachers should be contacted early in the school year to facilitate integration into the curriculum.

    b) An overview of any information to be presented should be provided to teachers in advance to allow for proper class preparation.

    c) Simple questionnaires should be developed to evaluate the students prior to, as well as following, the presentations.

6. Waste management information should be made available to schools in French as well as English.

These recommendations reflect the fact that this research was carried out for the City of Winnipeg. The reader should recognize that the City of Winnipeg does not have responsibility for setting science curriculum in Winnipeg schools. Hence, these recommendations suggest ways that the City could get more involved to meet their own ends and to improve the science curriculum.

APPENDIX 1:
HEADS OF MAINTENANCE CONTACT LIST

Brian Porter - Winnipeg School Division #1

Richard Lyons - St. James School Division #2

Paul McCambridge - Assiniboine South School Division #3

Jim Parsons - St. Boniface School Division #4

Bob Ray - Fort Garry School Division #5

Peter Kolba - St. Vital School Division #6

George Bazay - Norwood School Division #8

Doug McDuff - River East School Division #9

Cliff Meter - Seven Oaks School Division #10

Wayne Chiupka - Transcona-Springfield School Division #12

APPENDIX 2:
TALL GRASS PRAIRIE CONTACTS

1) Mrs. Walkes - the Principal of Elmwood High

2) Ann Monk - one of two teachers who initiated the planting of the Elmwood High Tall Grass Prairie in 1991 and presently maintains it

3) Nestor Gylywoychuk - ex-principal who initiated the Bernie Wolfe Community School Tall Grass Prairie in 1992

4) John P. Morgan - owner of Prairie Habitats in Argyle, Manitoba

5) Dave Gylywoychuk - personnel from Prairie Habitats

6) Mrs. Dooley - Principal of Mountbatten School who initiated the planting of the Mountbatten Tall Grass Prairie in 1993

APPENDIX 3:
LIST OF SCHOOLS THAT RECEIVED PRESENTATIONS

Winnipeg One School Division #1
- Cecil Rhodes School
- Isaac Brock School
- Luxton School
- River Heights
- Sargeant Park School
- Stanley Knowles School
- William Whyte School

St. James School Division #2
- Bruce Junior High

Assiniboine South School Division #3
- Charleswood Junior High School
- Royal School
- Laidlaw School
- Westdale Junior High

St. Boniface School Division #4
- Frontenac School
- Shamrock School
- General Vanier School

St. Vital School Division #6
- Ecole Glenwood
- Ecole Lavallee
- Ecole Norberry
- Hastings School
- H.S. Paul School
- Victor Mager School

River East School Division #9
- Salisbury Morse Place School

Transcona-Springfield School Division #12
- John W. Gunn Junior High
- Bernie Wolfe Community School

APPENDIX 4:
LOW WASTE LANDSCAPES THAT CONSERVE ENERGY
LESSON PLAN OUTLINE

TIME: Approximately 30 - 45 minutes.

OBJECTIVES:

At the end of the lesson the students will be able to:

1) list 4 problems associated with traditional methods of waste disposal;
2) list 3 low waste landscaping techniques; and,
3) identify alternative landscaping practices that can conserve energy and resources.

MATERIALS:

Ball of string
Ecosystem labels

INTRODUCTION:

Can anyone define waste management?

Waste is anything that we no longer consider useful; and, management refers to what we do with it or how we handle it.

Can anyone give me examples of how we manage our waste?

3 R's; compost; sell; give to charity; place in garbage.

What happens to waste when it is not reduced, reused or recycled?

Garbage is picked up and taken to landfill.

Has anyone been to a dump or a landfill?

What did you see there?

Could any of that have been reused or recycled?

Garbage can represent a pile of wasted resources.

What problems could develop with using dumps for disposal?

Wildlife feed on garbage which may affect populations; contaminants spread by wildlife, wind and rain; litter blows into surrounding areas; risk of explosions from methane; rain leachate contaminates soil and water table.

The City of Winnipeg disposes of our garbage in landfills.

Why are landfills a better option for waste disposal than dumps?

The sanitary landfill is clay-lined to prevent leachate from contaminating the surrounding soils and water table; the daily load of garbage is covered with soil to prevent garbage from flying around and wildlife from picking at it; the methane produced is vented or burned off to prevent explosions (burning can produce energy for power); and, when the landfill is full, vegetation is planted over the area and it can be used for parks, golf courses and school yards.

What problems might arise with using landfills over dumps?

Increased expenses and energy-use for the City of Winnipeg to pick up and operate landfill.

Would you like to live next to a dump? Why not?

Garbage would blow into your yard, looks ugly.

Another problem with landfills is finding new areas to replace the full ones. The problem is called the NIMBY Syndrome - Not In My Back Yard. 1 ton of waste = 50 cubic feet of space and every person in the City of Winnipeg produces on average 1 ton of waste per year. Thus, landfills are filling up quickly.

In order to prevent some of the expense and environmental problems associated with waste disposal, the Province of Manitoba has set a goal of 50% reduction in the amount of waste produced by the year 2000. Today we are going to discuss yard waste and how we can reduce the amount produced and conserve energy at the same time.

How much of the city's waste do you think is yard waste?

15%

Are there alternatives to sending yard waste to landfills?

Composting, mulching, and grasscycling.

What happens to waste in natural landscapes?

In order to see how nature looks after its wastes, I would like to compare the cycling of energy and matter within the prairie ecosystem to that of a "lawn ecosystem." The way we are going to do that is by building a prairie ecosystem and then converting the prairie ecosystem to a "lawn ecosystem." When we change the prairie ecosystem to a lawn we will see that the ecosystem is no longer a self-sustaining system. Additional resources are necessary to maintain a "lawn ecosystem".

Using this comparison of a prairie to a lawn, we will identify some alternative practises that we can use in our own backyards to minimize the amount of yard waste we produce and reduce the amount of fossil energy we consume.

ACTIVITY:

STEP 1: Gather students in a circle sitting on the floor.

STEP 2: Distribute ecosystem labels.

What supplies energy necessary for life on the prairies?

The sun. Give "sun & rain" card to a student.

What type of organism converts the sun's energy for use?

Plants. Distribute prairie plant species cards.

What type of organisms depend only on plants for food?

Herbivores. Distribute prairie herbivore species.

What type of organisms depend on plants and animals for food?

Omnivores. Distribute prairie omnivore species.

What type of organisms depend only on other animals for food?

Carnivores. Distribute prairie carnivore species.

What happens to the plants and animals when they die?

Decompose. Distribute decomposers.

What do the decomposers break the dead material into?

Organic matter and soil nutrients. Distribute cards.

The organic matter is important to soils on the prairie for water absorption. The harsh prairie conditions may often provide heavy rains, as well as severe drought at other times. The presence of organic matter within the soil allows the prairie to hold the rain water.

STEP 3: Form the prairie "Web of Life".

We start with the sun because it is the source of energy for all creation of matter within the prairie ecosystem. Give the free end of the string to the student holding the "sun & water" sign. Next ask "Who uses the sun's energy to form food or habitat that other organisms depend upon?" and pass the string to the student holding a plant sign.

Tall grass (for example).

Who uses the energy and/or habitat of the tall grass?

Grasshoppers (for example). Pass string to student with grasshopper card, and continue on with questions.

Who uses the energy of the grasshopper?

Birds.

Who might feed on the birds?

Hawk.

What feeds on the leftover plants or animals?

Worms and fungi.

What is produced by the worms and fungi?

Organic material and soil nutrients.

What is organic material good for?

Holding moisture in the soil.

What other species of plants use the sun?

Wild flowers.

Who feeds on the nectar of wild flowers?

Insects.

Who feeds on the insects?

Birds.

What type of vegetation do birds live in?

Shrubs.

Who else might use shrubs for food or for habitat?

Mice or other small mammals.

What do small mammals feed on?

Forbs ... which need the sun, soil nutrients, etc.

* Continue passing the string until all students are involved in the web and various interactions between species are shown.

STEP 4: Explain "Web of Life".

What have we formed?

A web that shows the interdependence of the parts of a prairie ecosystem. The web illustrates how matter and energy are cycled within the prairie.

What is the source of energy for the prairie?

The sun provides a continuous source of non-polluting energy which the plants convert (through photosynthesis) into food and shelter for other species.

What happens to "wastes" on the prairie?

They cycle; nothing is wasted.

STEP 5: Convert prairie to lawn.

Unfortunately, there are not many areas of native prairie left on the prairies. Humans moved to the prairie, drained the wetlands, cultivated the land, and built urban centres. Most of our "natural" or "green" areas within the City of Winnipeg are lawns within our parks and back yards. Let's see what happens when we turn this prairie into a "lawn ecosystem."

What will be affected by the loss of habitat? (Students drop the string when their prairie component is discussed.)

Large herbivores; insects that feed on wild flowers; birds that feed on insects and nectar; small herbivores (rabbits); hawks decline; ...

What happened to the self-sustaining "Web of Life"?

It collapsed. Interactions within the lawn ecosystem are not as stable as within the prairie.

Does the lawn produce waste?

What happens to the waste?

What problems could arise when wastes are removed?

Landfills fill up; soil nutrients and organic material are reduced; less water holding capacity; ...

DISCUSSION:

We can see that a lawn ecosystem is unstable. Yet there are many lawn ecosystems in our city.

What do people do to keep the lawn alive?

Water.

Why, the prairie survived on rain water alone?

Reduced organic material in soil for water-holding capacity; non-native species need more water because native species are better adapted to the harsh weather of the prairie.

What else do people do to maintain a lawn?

Mow; herbicide to reduce unwanted plant species; pesticide to reduce unwanted animals and disease; fertilize to increase nutrients for growth; apply soil; ...

What problems do these methods of maintaining a lawn add to?

What type of energy is consumed when we maintain our lawn?

Electric and fossil for mowers, production of chemicals, pumping water from source, as well as, building and maintaining infrastructure for delivery of water.

What does the burning of fuel do to our environment?

Pollutes the air, produces global warming gases.

What happens to the chemicals when it rains in the city?

Drains into sewers which drain into rivers and lakes.

What effects does chemical-use have on the environment?

Pests become immune so more are used; birds eat pests and poisons enter the food chain; fertilizer, pesticides and herbicide leach into ground water; chemical containers are hazardous waste; fossil fuel consumed which contributes to global warming.

CONCLUSION:

So when we can see that certain lawn maintenance techniques can adversely affect the environment; they contribute to the waste problem, waste resources (fuel, nutrients, organic material, land, and water), contaminate soils and water tables, and create hazardous waste.

How can we decrease the number of problems associated with the lawn ecosystem? Let's make a list of things we could do or things we could avoid doing to reduce waste produced and conserve energy as well.

1) *limit "lawn" size by planting areas of native species, wild flower gardens, rock gardens, junipers, trees and shrubs;*
2) *cut lawn less often or use a push-mower;*
3) *leave blades longer to shade soil and save water;*
4) *leave clippings on to increase organic material and nutrients (remove excess thatch so clippings can reach soil and mow when grass is dry);*
5) *efficient watering to minimize growth;*
6) *use a barrel to collect rainwater;*
7) *water early in a.m. to decrease evaporation;*
8) *water by hand so you won't forget and reduce evaporation;*
9) *plant native species which use less water, grow slower, crowd out weeds, need less maintenance, and attract predatory and watchable wildlife;*
10) *reduce pesticide and herbicide use (see alternatives);*
11) *limit fertilizer (see alternatives);*
12) *plan ahead to limit pruning;*
13) *prune conservatively; and,*
14) *mulch yard materials to reduce waste, weeds and water-use.*

ALTERNATIVES:

To fertilizers

Composting or use organic if necessary.

To pesticides

Companion plantings; plant habitat to attract natural predators; and/or, introduce natural predators (eg. ladybugs control aphids, purple martins and bats control mosquitos).

To herbicides

Be accepting to allow other species than grasses in the lawn; plant native species (established prairies keep weeds out and use less water); and/or, hand weed.

FURTHER REVIEW OR DISCUSSION:

1) List 4 problems with traditional methods of waste disposal.

2) List 5 alternatives to current landscaping techniques which could decrease the amount of waste going to the landfill and save energy.

3) What environmental problems could be associated with having a manicured, weed free lawn?

Contributes to waste crisis; loss of habitat; ground water depletion; ground water contamination; global warming; fuel for production of chemicals and mowing; decreased biodiversity; energy wasting to produce and bring water to lawn; endangered species (affected by contaminants); decline of songbirds and amphibians.

4) Explain how altering our landscaping techniques in the urban yard will reduce waste and conserve energy.

APPENDIX 5:
COVER LETTER

June 6, 1994

NAME OF TEACHER
SCHOOL
ADDRESS
WINNIPEG, MB.
POSTAL CODE

Dear NAME OF TEACHER,

Thank you for the opportunity to present the "Low Waste Landscapes That Conserve Energy" lesson plan to your students. I hope that the students enjoyed the class activity and discussion, and acquired a new awareness of waste management within their own backyard.

The presentations were made possible through a grant from the City of Winnipeg. The information and experience gained from the project will be used as partial fulfilment of the requirements for a Master's in Natural Resource Management from the University of Manitoba, Natural Resources Institute.

In order to complete the project an evaluation is necessary. The purpose of the enclosed survey is to evaluate the effectiveness of the "Low Waste Landscapes That Conserve Energy" lesson plan presentations. The results of the survey will be used to indicate whether or not teachers, whose students received the presentation, believe that waste management information should be incorporated into the school curriculum. The survey may also identify effective means for the City of Winnipeg to distribute waste management information to schools.

Please complete the enclosed survey and mail as soon as possible in the stamped addressed envelope. I look forward to receiving any comments you might have. Thank you in advance for your prompt assistance in this matter. If you have any questions please call me at 888-8288.

Sincerely,

Diane Bell B.Sc.
University of Manitoba
Natural Resources Institute
Graduate Student

APPENDIX 6:
GRADES 6-9 LESSON PLAN:
LOW WASTE LANDSCAPES THAT CONSERVE ENERGY
EVALUATION SURVEY

Please try to answer all questions and provide any comments that may help to clarify your position or assist with this research. The results of the survey will be confidential.

1. Please indicate the classroom level that received a low waste landscape presentation.

Grade 6 ___ Grade 7 ___ Grade 8 ___ Grade 9 ___

2a. Has there been any further discussion or questions from the students since the presentation? Yes ___ No ___

2b. If yes, please give examples of the issues and/or questions discussed.

_____

_____

_____

3. What were the main strengths and weaknesses of the exercise for the students?

_____

_____

_____

4. I think the lesson achieved the following stated objectives:

Objective 1: To increase the students' awareness of issues associated with municipal solid waste disposal.

1	2	3	4	no
strongly agree			strongly disagree	opinion

Objective 2: To increase the students' awareness of landscaping techniques that reduce yard waste.

1	2	3	4	no
strongly agree			strongly disagree	opinion

Objective 3: To increase the students' awareness of landscaping techniques that conserve energy.

1	2	3	4	no
strongly agree			strongly disagree	opinion

5a. Are energy and resource conservation topics, such as water conservation, energy conservation, vehicular emissions and pollution, ozone depletion, or others, a part of your school curriculum? Yes ___ No ___ Do not Know ___

5b. If yes, please list the conservation topics.

_____

_____

6. I think there is a general understanding by teachers and students of the benefits of resource and energy conservation achievable through waste minimization.

1	2	3	4	no
strongly agree			strongly disagree	opinion

7. I think the material presented and other information on waste management should be part of the science curriculum.

1	2	3	4	no
strongly agree			strongly disagree	opinion

8. I think the City of Winnipeg should provide schools with information on waste management issues (eg. Landfills, Composting, Household Hazardous Wastes, etc.)?

1	2	3	4	no
strongly agree			strongly disagree	opinion

9. I think that waste management information mailed out to schools in a generic format can be integrated into the science curriculum.

1	2	3	4	no
strongly agree			strongly disagree	opinion

10. I think that I would integrate waste management information mailed out in a generic format into the science curriculum.

1	2	3	4	no
strongly agree			strongly disagree	opinion

11a. I think that waste management information should replace a portion of the current curriculum.

1	2	3	4	no
strongly agree			strongly disagree	opinion

11b. Please comment on what portion of the curriculum you think waste management should replace.

_____

_____

_____

12. I think the City of Winnipeg should create a "Speakers Bureau" to provide people to introduce the information to teachers and/or students.

1	2	3	4	no
strongly agree			strongly disagree	opinion

13. Please comment on the integration of waste management into the curriculum and the format in which the City of Winnipeg should provide information.

_____

_____

_____

14a. I would like to see our school plant a tall grass prairie, wild flower garden, or similar idea that represents waste reduction in the school grounds.

1	2	3	4	no
strongly agree			strongly disagree	opinion

14b. Please comment.

_____

_____

_____

_____

_____

15. Please provide additional comments that may be appropriate to evaluating the effectiveness of introducing the "Low Waste Landscapes That Conserve Energy" presentation.

_____

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APPENDIX 7:
PERCENTAGE RESPONSES TO EVALUATION SURVEY

1. Indicate the classroom level that received a low waste landscape presentation.

3%	Grade 6	6%	Grade 7 & 8
53%	Grade 7	3%	Grades 5-8 mixed
33%	Grade 8	3%	Grade 9

2a. Has there been any further discussion or questions from the students since the presentation?
Yes 47% No 53%

2b. If yes, please give examples of the issues and/or questions discussed - See Table 2.

3. What were the main strengths and weaknesses of the exercise for the students? - See Table 3.

4. I think the lesson achieved the following stated objectives:

Objective 1: To increase the students' awareness of issues associated with municipal solid waste disposal.

25%	strongly agree	22%	disagree	3%	no opinion
50%	agree	3%	strongly disagree		

Objective 2: To increase the students' awareness of landscaping techniques that reduce yard waste.

11%	strongly agree	36%	disagree	0%	no opinion
53%	agree	0%	strongly disagree		

Objective 3: To increase the students' awareness of landscaping techniques that conserve energy.

11%	strongly agree	39%	disagree	3%	no opinion
42%	agree	5%	strongly disagree		

5a. Are energy and resource conservation topics, such as water conservation, energy conservation, vehicular emissions and pollution, ozone depletion, or others, a part of your school curriculum?
Yes 86% No 8% Do not Know 6%

5b. If yes, please list the conservation topics. - See Table 4._

6. I think there is a general understanding by teachers and students of the benefits of resource and energy conservation achievable through waste minimization.

50%	strongly agree		8%	disagree	3% no opinion
31%	agree	8%	strongly disagree		

7. I think the material presented and other information on waste management should be part of the science curriculum.

64%	strongly agree		8%	disagree	0% no opinion
27%	agree	3%	strongly disagree		

8. I think the City of Winnipeg should provide schools with information on waste management issues (eg. Landfills, Composting, Household Hazardous Wastes, etc.)?

64%	strongly agree		5%	disagree	3% no opinion
28%	agree	0%	strongly disagree		

9. I think that waste management information mailed out to schools in a generic format can be integrated into the science curriculum.

47%	strongly agree		8%	disagree	17% no opinion
22%	agree	6%	strongly disagree		

10. I think that I would integrate waste management information mailed out in a generic format into the science curriculum.

44%	strongly agree		11%	disagree	11% no opinion
31%	agree	3%	strongly disagree		

11a. I think that waste management information should replace a portion of the current curriculum.

19%	strongly agree		42%	disagree	11% no opinion
8%	agree		19%	strongly disagree	

11b. Please comment on what portion of the curriculum you think waste management should replace. - See Table 5.

12. I think the City of Winnipeg should create a "Speakers Bureau" to provide people to introduce the information to teachers and/or students.

33%	strongly agree		20%	disagree	8% no opinion
33%	agree	6%	strongly disagree		

13. Please comment on the integration of waste management into the curriculum and the format in which the City of Winnipeg should provide information. - See Table 6.

14a. I would like to see our school plant a tall grass prairie, wild flower garden, or similar idea that represents waste reduction in the school grounds.

28%	strongly agree		14%	disagree	19% no opinion
25%	agree	14%	strongly disagree		

14b. Please comment. - See Table 7.

15. Please provide additional comments that may be appropriate to evaluating the effectiveness of introducing the "Low Waste Landscapes That Conserve Energy" presentation. - See Table 8.

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