Developing a Process Map for Planning, Initiating and Operating Municipal Biosolids Composting Utilization Programs in Southern Manitoba

by

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Abstract

The study objectives were to identify the best practice components of a biosolids composting utilization program; to determine current and emerging provincial and federal regulatory frameworks applicable to biosolids composting facilities in Manitoba; and to produce an annotated process map for planning, initiating and operating a biosolids composting facility.

Recommendations from this study are to develop a stand-alone regulation that addresses composting requirements for probable feedstocks in provincial legislation, to clearly set out the requirements for such facilities; to update the *Environmental Regulation for Treatment and Disposal of Biosolids in Manitoba* policy document to acknowledge and provide guidance for biosolids composting as a potential management method; and to update and finalize the Manitoba *Draft Compost Facility Guidelines* to reflect current requirements for compost facilities and to include biosolids as a potential feedstock. The adoption of a categorization scheme for biosolids is also recommended to support determining appropriate management options based on biosolids quality.

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Chapter 1: Introduction

Biosolids composting has been commonplace in the United States since the 1970s. Despite four decades of biosolids composting experience in North America, sustainable biosolids recycling methods, such as composting, is practiced by only a 'handful' of Canadian municipalities (Ellison 2007).

Conventionally, biosolids in Canada are managed through application to agricultural land, burial in a landfill or incineration without energy recovery (Canadian Water and Wastewater Association 2001). These conventional methods are becoming difficult to implement due to increasingly stringent nutrient management legislation (Gundry and Visser 2007), development of agricultural land, and increased landfill tipping fees (Goldstein and Gray 1999). Further, biosolids disposal by burial in a typical landfill is not consistent with the utilization of biosolids as a resource, which is gaining increasing recognition and emphasis (Canadian Council of Ministers of the Environment 2012).

The following study sets out to describe best practices and regulatory requirements for composting facilities in Manitoba intending to compost biosolids, as well as to present an annotated process map to assist rural municipal owners and operators in planning and operating such a facility.

TERMINOLOGY

Biosolids refers to the continually produced, stable, nutrient-rich, organic residual of domestic sanitary sewage that has received a secondary or tertiary level of treatment to reduce pathogens and that meets applicable criteria for beneficial use. The terms 'sludge' and 'septage' are erroneously used interchangeably with the term 'biosolids' in subject discourse. Sludge refers to untreated semi-solid or liquid residue that is generated in the

wastewater treatment process. Whereas, septage refers to the semi-solid, untreated material that is collected in septic tanks (Canadian Council of Ministers of the Environment 2012). Conversely, biosolids refers to sludge that has been stabilized by a process such as digestion, composting or disinfection, and meets beneficial recycling criteria (Water Environment Federation, 2006).

BACKGROUND

More than 660,000 dry tonnes (2.5 million wet tonnes) of biosolids and sludge are produced in Canada per annum (Canadian Council of Ministers of the Environment 2010) at approximately 4,000 wastewater treatment facilities located across the country (United Nations Human Settlements Programme 2008). Over two-thirds (n=68%) of the Canadian population (2009) have access to secondary or tertiary levels of wastewater treatment, which would potentially be capable of generating biosolids, a 25% increase from 1989 access levels (Environment Canada 2012). The Canadian Council of Ministers of the Environment (CCME; 2012) expect that the volume of biosolids generated in Canada is set to increase, as more wastewater treatment facilities are built or upgraded to meet new performance standards under the Canada-wide Strategy for the Management of Municipal Wastewater Effluent (Canadian Council of Ministers of the Environment 2009).

In Canada, jurisdictional responsibility for the management of water and waste, including biosolids, is typically delegated from the provinces to municipal governments (Environment Canada 2010). A 2003 survey of Canadian municipalities (Federation of Canadian Municipalities and National Research Council 2003) indicated that approximately 50% (n = 53) of the 105 respondent municipalities would be undertaking a planning study to develop a biosolids management program in the near future.

There are 198 municipal governments located in Manitoba[1], comprised of rural municipalities (RMs), local government districts, cities, towns and villages. With the exception of two major (n = >45,000 people) and seven moderate (n = 5,000-14,000 people) cities, the province is primarily comprised of small communities (n = ≤2,000 people).

Previous estimates of the volume of biosolids produced in Manitoba are reported by the United Nations Human Settlements Programme (2008) as 12,730 dry tonnes per annum. According to a provincial database (Manitoba Conservation 2004), there are approximately 425 wastewater treatment facilities, including lagoons and WWTPs, located in Manitoba. Of these 425 facilities, approximately 70 are WWTPs that would be capable of producing sludge and/or biosolids as a byproduct of the treatment process.

STUDY AREA

For the purposes of this study, Southern Manitoba (the "Study Area") is defined based on the administrative boundaries of the RMs located south of Grand Rapids, Manitoba (Figure 1). Cities, towns and villages, as distinct decision-making jurisdictions, are excluded from the Study Area.

[1] Manitoba municipalities with a population of 1,000 people or less (n = 50; Statistics Canada 2012) are planned to be amalgamated (Province of Manitoba 2012).

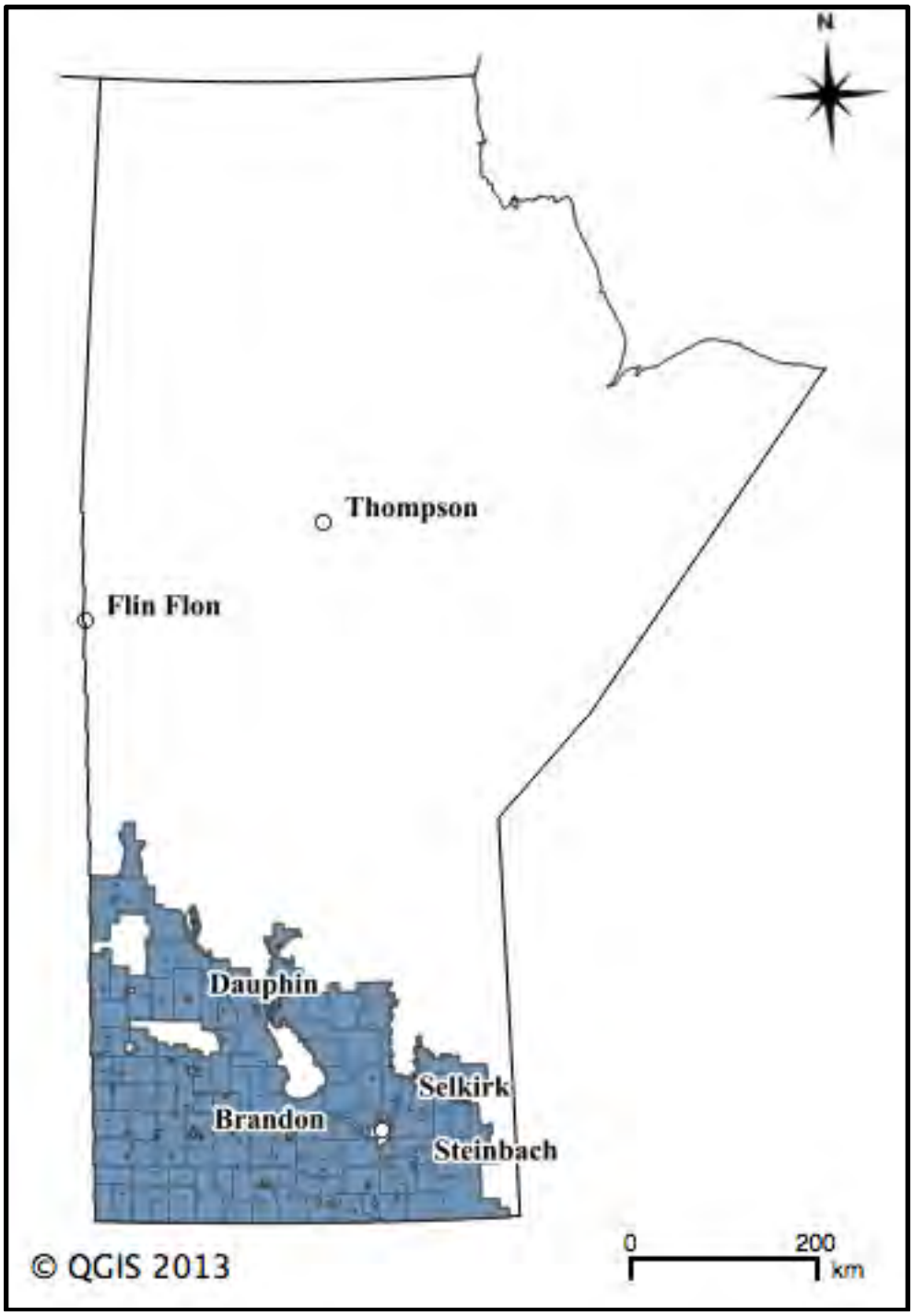


Figure 1: Project Study Area

The 116 RMs comprising the Study Area have a combined land footprint of 109,844 square kilometres. The population (2011) within this area is 259,061 people, for a rural population density of approximately 2.5 people per square kilometre.

More than one-third (n = 38% or 27) of the 70 WWTPs potentially capable of producing biosolids in Manitoba are located in the Study Area (Figure 2), with many concentrated within or near Winnipeg's Capital Region.

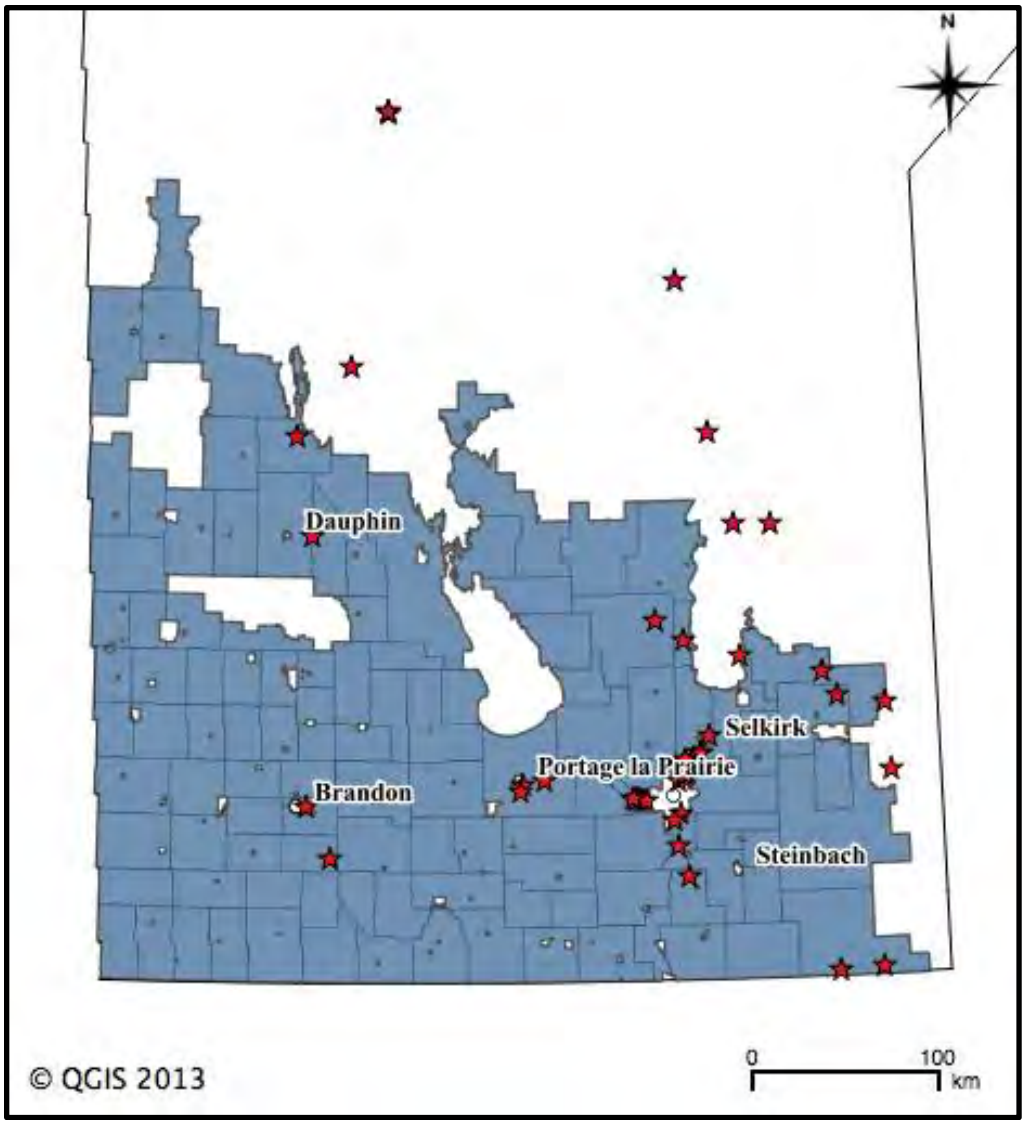


Figure 2: Wastewater Treatment Plants in Manitoba

CONCEPTS

A brief overview of concepts discussed in this study is presented below.

Biosolids Composting

Composting is a controlled biological process in which organic materials are aerobically decomposed by microorganisms to produce a hummus-like material. Biosolids composting, or co-composting, refers to the use of biosolids as a feedstock, or supply material, in combination with other organic feedstock material, such as wood chips, to achieve biological decomposition. The ratio of carbon-based materials to nitrogen-based materials must be balanced to promote microbial activity and to prevent excessive nitrogen loss (e.g., as ammonia). In composting, biosolids serve as a nitrogen source.

Different systems are available for biosolids composting, including: aerated static pile, aerated windrow and in-vessel. These systems can be open or enclosed, and static (non-mixed) or dynamic (mixed; National Biosolids Partnership, 2005). Aerated static pile and aerated windrow composting are similar systems, in that material is stacked in long windrows; however, aerated static pile composting uses mechanical blowers installed into the windrow, rather than mechanical material turning, to provide the required aeration. In-vessel composting refers to enclosed, composting systems that are dynamic (e.g., horizontal agitated bin system) or static (e.g., silo system) that offer a high degree of operational control and are typically proprietary. Due to the ease, low start-up cost (Composting Council of Canada 2006) and scalability of open aerated windrow composting, this system was selected as the focus of this study.

Biosolids can contain pathogens or disease causing organisms, such as bacteria, viruses, protozoa, helminthes and fungi (National Biosolids Partnership 2005), as well as heavy metals; sharp foreign matter; organic chemical contaminants from industrial or

domestic sources, such as dioxins and furans (CCME 2010); and, emerging substances of concern (ESOCs), such as pharmaceuticals and personal care products. The composting process can give off bioaerosols, such as pathogens, allergens and fungi spores and operators handling biosolids should reduce or prevent injury by wearing masks or other protective devices (United States Environmental Protection Agency 2003).

Composting can be used as a stabilization process to reduce or kill pathogens (Koenig, Miner and Goodrich 2010) and is considered an approved "Process to Further Reduce Pathogens" (PFRP) in the United States under 40 Code of Federal Regulations (CFR) Part 503. In open aerated windrow composting systems, pathogens are considered destroyed (United States Environmental Protection Agency 2003) if a temperature of 55 degrees Celsius or greater is reached for 15 days or more and the pile is turned at least five times during this phase. Turning is important to subject all areas of the pile to high temperature conditions required to reduce or kill pathogens, in addition to providing necessary aeration. This high-temperature incubation is referred to as the thermophilic phase. The end compost is subject to quality criteria prior to sale.

Biosolids Utilization

Biosolids utilization refers to the use of biosolids in a manner that provides a benefit, while protecting environmental and human health (Ontario Ministry of the Environment 1996). The practice of utilization is consistent with the acknowledgment that biosolids contain valuable resources, such as nutrients, organic matter and energy, that should not be wasted (Canadian Council of Ministers of the Environment 2012). This is contrary to the traditional perception and current use of biosolids as a waste product in some Canadian municipalities (United Nations Human Settlements Programme 2008; Canadian Council of Ministers of the Environment 2012). Biosolids can be beneficially used for agricultural land application and combustion for energy. The CCME (2012) does

not provide a hierarchy of beneficial uses; however, the selection of any beneficial use option should be made in consideration of the three pillars of sustainability: economic, social and environmental,

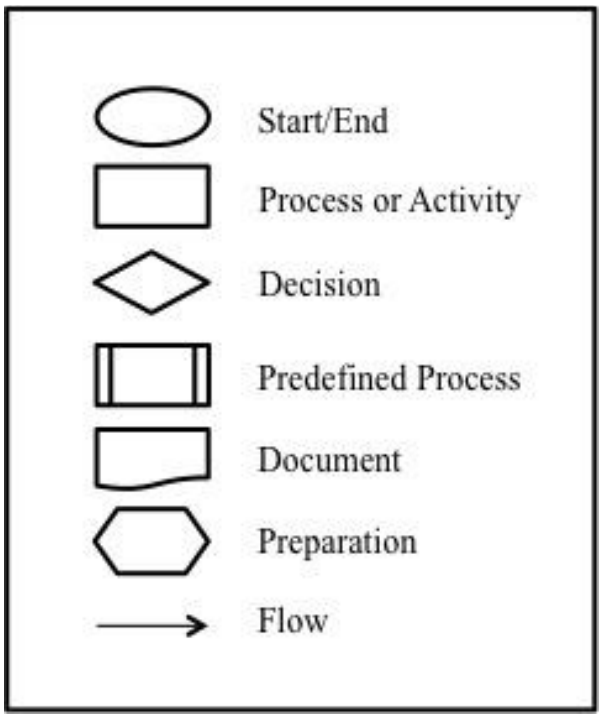
Similarly, biosolids-derived compost can be used in numerous applications; however, its use is dependent on the quality of initial feedstocks and resultant compost relative to applicable guidelines, standards and criteria. Potential applications for biosolids-derived compost include, but are not limited to:

- Soil amendment
- Soil fabrication
- Agriculture
- Silviculture
- Land reclamation
- Landfill cover material

This study focuses on the utilization of biosolids as a soil amendment, or a material that improves the physical and chemical properties of soil (e.g. tilth and nutrient content), following stabilization through composting.

Process Maps

Also generally referred to as a "flow chart," "process chart," or "flow diagram," process maps visually document the steps or flow of inputs, activities, decisions and outputs required to support complex processes. Commonly used in industrial engineering and business, process maps can be developed for use in virtually any application. A process map can wholly or partially constitute the decision support basis for a given activity (Andersen, et al. 2008). Process maps use standardized symbology based on International Standards Organization (ISO) 5807:1985, with start/end points, decision points, process points and data points assigned unique symbols (see Figure 3).



Adapted from: (International Standards Organization 1985)

Figure 3: Standard Process Map Symbology

Benefits of developing and using process maps include confronting and resolving process ambiguities during map development, providing increased and complete understanding (Andersen, et al. 2008), easier training, increased regulatory compliance and greater efficiency. In addition, process maps are user-friendly and easier to follow than written instructions (Escoe 2001).

There are precedents for process maps being used in a regulatory compliance context. For example, Manitoba Conservation and Water Stewardship (MCWS), as well as other Canadian provincial environmental regulatory agencies, publish process maps of their generic provincial environmental approval process (Manitoba Conservation and Water Stewardship 2009) to assist proponent and practitioner understanding. In addition, the Department of Fisheries and Oceans (DFO) make decision frameworks available to the public to promote compliance in fish habitat management and to avoid potential instances of non-compliance (Fisheries and Oceans Canada 2007).

MANITOBA EXPERIENCE

There have been two biosolids composting projects in Manitoba – a past City of Winnipeg pilot project and a future City of Winnipeg pilot project, both located at the Brady Road Landfill (now Brady Road Resource Management Facility) site in the south end of Winnipeg. The new pilot project, authorized by MCWS on April 30, 2012, would compost approximately 20% of biosolids produced at the North End Water Pollution Control Centre (NEWPCC) in a two-year, $7 million pilot study.

There are an additional five stand-alone non-biosolids composting facilities licensed to operate in Manitoba, which are owned by: RM of De Salaberry, Village of Notre Dame de Lourdes, Penner Waste Inc., The Forks Renewal Corporation, BHF Waste Management LLP (Manitoba Conservation and Water Stewardship n.d.), with the facility owned by BHF not having been constructed to date. There are a number of additional non-biosolids composting facilities co-located within waste disposal grounds (WDGs) in Manitoba, such as the City of Brandon curbside organic compost program.

Despite the relative lack of biosolids composting facilities in Manitoba, the MCWS Environmental Approvals Branch anticipates that interest in implementing alternative methods of biosolids management, including composting, will increase in the near future.

ISSUE STATEMENT

Canadian municipalities have limited and uncertain options for managing and disposing of biosolids generated within their jurisdictions (Environment Canada; Canadian Water Network; Canadian Water and Wastewater Association; Hydromantis Environmental Software Solutions Inc.; 2012). The focus of Manitoba biosolids management practice and legislation to date has been on agricultural land application and landfill disposal. The relative proportion at which these practices are implemented is unknown. There is a general lack of exposure to alternative biosolids management

approaches, such as composting, in Manitoba. The United Nations Human Settlements Programme (2008) note that having several environmentally sound options available for biosolids management that are supported by legislation is key to resilient and reliable programs.

Traditional methods of biosolids management are becoming increasingly difficult to implement. At the same time, the volume of biosolids produced by facilities in Canada is anticipated to increase as a result of meeting more stringent nutrient regulations (Canadian Council of Ministers of the Environment 2012). In keeping with principles of sustainability and resource stewardship, provincial regulators now discourage landfill disposal in favour of land application, where agricultural land is available; however, a recent restriction on the application of biosolids to frozen soil in Manitoba has reduced the available season for land applying biosolids.

A 2003 review of biosolids legislation in Canada (Federation of Canadian Municipalities and National Research Council 2003) found that biosolids legislation does not exist or lacks definitiveness where it does exist. Indeed, there is no stand-alone legislation for biosolids, biosolids composting or non-biosolids composting in Manitoba. In addition, there are numerous standards, guidelines and information requirements associated with obtaining regulatory approvals for the end use of biosolids (Canadian Council of Ministers of the Environment 2010). To the author's knowledge, the process for planning, initiating and operating a biosolids composting facility in Manitoba, including regulatory compliance requirements, is undocumented.

Complex legislative and technical requirements associated with biosolids composting may serve as a disincentive to adoption of the beneficial reuse practice by operators. Rural municipal governments are typically limited in resources, including funding and staffing, and face considerable challenges in keeping up with changing regulations, for which they are responsible for implementing (Joy, et al. 2003). Clear

regulation and coordination with regulatory authorities is recognized as beneficial to resource-limited communities charged with planning (Joy, et al. 2003).

Acknowledging that smaller, resource-limited agencies tend to choose the easiest (and potentially least cost) management methods (Elliott, Brandt and Shortle 2007), such as disposal, there is a need to enhance the transfer of technical and regulatory requirements from literature, regulators and experts to local decision makers and operators and streamline the process for adopting alternative management methods. In fact, "Sustainable Biosolids Management" has been identified on the National Research Agenda for Municipal Wastewater and Biosolids as a research area to be strengthened to satisfy end-user decision needs (Environment Canada; Canadian Water Network; Canadian Water and Wastewater Association; Hydromantis Environmental Software Solutions Inc.; 2012).

PURPOSE

The overall aim of this research was to streamline planning requirements for implementing a municipal biosolids composting operation for Manitoba municipal government end users. This qualitative study will develop an annotated process map to assist municipal public works personnel in planning a biosolids composting utilization program in Manitoba. The policy-based maps will provide for the systematic identification of policy requirements for siting, initiating and operating a facility.

Also, this study provided incidental contributions to the body of knowledge of biosolids composting practice in Manitoba, which has been found to be a key driver in advancing the implementation of this beneficial use practice in other jurisdictions (Goldstein 2001).

OBJECTIVES

The first objective of this study was to identify the constituent best practice components of a biosolids utilization program to inform the development of a process maps for a biosolids composting facility.

The second objective was to determine the current and emerging provincial and federal regulatory frameworks applicable to biosolids composting operations in Manitoba to gain an understanding of regulatory requirements for siting, initiating and operating a biosolids composting facility.

The third objective was to produce an annotated process map for planning, initiating and operating a biosolids utilization system for a biosolids composting facility.

RATIONALE

Despite the relative lack of biosolids composting currently practiced in Manitoba, it is anticipated that as conventional methods become more difficult to implement, operators may choose to supplement or replace their current management methods with other methods, such as biosolids composting.

Ensuring that these decision makers have access to consolidated, user friendly information regarding legislative requirements is important for promoting beneficial reuse adoption.

METHODS

The following methods were used for this study:

Grey Literature Review

A comprehensive grey literature review was conducted focusing on biosolids composting process and biosolids management system components. Primary information sources included CCME publications, United Nations and United States Environmental Protection Agency (US EPA) reports, and National Biosolids Partnership guidance materials.

Regulation and Guideline Scan

A review of public legislation databases and precedent compost facility approvals issued in Manitoba was conducted to identify the regulatory framework applicable to biosolids composting in Manitoba.

Acts and regulations relevant to biosolids management were identified through systematic queries of the Canadian Legal Information Institute (CanLII) public legislation database of consolidated provincial, territorial and federal regulations and statutes in Canada. Keywords used in searching the Manitoba and Canada (federal) CanLII databases included “biosolids,” “sludge,” “wastewater,” “compost,” “nitrogen,” and “odour.”

All precedent Manitoba Environment Act Licences issued to-date by MCWS and associated licensing summary reports for existing compost facilities in Manitoba were reviewed to identify potential regulatory requirements.

Additional information was obtained from regulatory presentations in conference proceedings.

Key Person Interviews

Semi-structured, open-ended interviews were conducted in person with three representatives of the provincial government. The purpose of the interviews was to gain

an understanding of current and emerging regulatory requirements associated with composting operations proposing to use a biosolids feedstock in Southern Manitoba and to clarify existing regulatory requirements. Benefits of key person interviews include a high degree of cooperation from respondents and the ability to ask follow-up questions to further clarify the subject of discussion (Weathington, Cunningham and Pittenger 2010).

Interviewees were selected using the snowball sampling method. In this method, data on the few members of the target population that can be located are asked to locate other members they know of in a particular group (Babbie 2010). This technique was beneficial for selecting individuals that are hard to identify (Schutt 2008), by capitalizing on networks where individuals know and interact with one another (Barbour 2008, Denzin 1989).

The first interviewee selected was the Manitoba member of the national CCME Biosolids Task Group. This interviewee in turn identified the individual responsible for reviewing composting operations from the MCWS Environmental Approvals Branch, Municipal, Industrial and Hazardous Waste Section and an individual from the MCWS Water Stewardship Division that administers the *Nutrient Management Regulation* as key persons. These interviewees further identified that a representative from the Canadian Food Inspection Agency (CFIA) Fertilizer Section would be a key person; however, no specific contact person was provided. Due to difficulties reaching an interviewee with the CFIA, this interview was not conducted.

All interviewees were provided with an interview guide (Appendix 1) and a current draft of the process map in advance of the interview. An in-person, group interview was conducted with the three MCWS representatives. The interview consisted of walking through the interview guide with participants and posing follow-up questions for clarification, as required. Interviewees were asked to provide feedback on the draft process map. The interviewer transcribed the discussions and incorporated the findings into Chapter 3 and Chapter 4.

Process Map Development

A detailed process map was developed to visually document the process of planning, siting and operating a biosolids composting facility. The process map was developed by the author using two methods: 1.) self-generation and 2.) interviews (Damelio 1996).

The process map was self-generated based on a step-wise interpretation of key guideline documents related to the Manitoba composting process and biosolids compost quality, including the *Draft Manitoba Compost Facility Guidelines* (KGS Group 2001) and *CCME Guidelines for Compost Quality* (Canadian Council of Ministers of the Environment 2005). Environmental approval requirements were identified based on the outcomes of the regulation and guideline scan. Key person interviewees reviewed the process map and refinements were made based on their feedback.

The overall process was broken down into logical sub-routines. The mapping follows the ISO standardized symbology set (Figure 3). The map generally flows from top to bottom and left to right, with only one inflow and one outflow for each step, with the exception of decision points, which require a binary (e.g., yes, no) decision. The level of detail presented is generally sufficient to arrive at a regulatory application requirement and/or process end point.

The process map, presented in Chapter 4, was developed in Microsoft PowerPoint® and exported to an Adobe® Portable Document Format (PDF) for use by end users.

SCOPE AND LIMITATIONS

This study concentrates on management options for biosolids generated primarily from domestic sanitary WWTP facilities located in rural areas of Southern Manitoba. The open aerated windrow composting system was explored (National Biosolids Partnership 2005). The study was limited to planning for biosolids management on non-

federal lands. Accordingly, the study outcomes are not directly applicable to biosolids management on federally-owned lands, such as military bases and reserve land, nor are they directly applicable to work within a large urban centre (e.g., City of Winnipeg), which would be subject to additional federal and municipal regulatory requirements, respectively.

Further, due to differences in material composition and quality, the study outcomes are not applicable to the management of untreated wastewater solids, such as sewage, sewage sludge or septage, or to the management of biosolids from strictly industrial treatment facilities.

While efforts were made to integrate socio-economic considerations into the process maps, the maps do not provide a comprehensive overview of public consultation requirements that may be required in conjunction with biosolids management program planning and implementation. This consideration was beyond the study scope.

Finally, the process map does not constitute professional advice and may not be inclusive of all considerations for planning, siting and initiating a facility.

STUDY ORGANIZATION

Chapter 1 introduces the study and describes the concepts of biosolids composting, biosolids utilization programs and process mapping. The study objectives and methods are described. The study scope and limitations are also discussed.

Chapter 2 describes the components of a sound biosolids utilization system based on a best practice literature review.

Chapter 3 presents an in-depth review of provincial and federal regulatory requirements and guidelines applicable to biosolids composting facilities, operations and products. Specific requirements are interpreted and emerging trends are discussed, based on commentary from key regulators.

Chapter 4 presents the study capstone: an annotated process map of the steps and decisions required to site, initiate, and operate a biosolids composting utilization program.

Chapter 5 concludes the study.

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Chapter 2: Biosolids Utilization Program Components

The following chapter identifies and describes the constituent best practice components of a biosolids utilization program based on the outcomes of a North American grey literature review. Components relevant to planning, initiating and operating a biosolids composting utilization program using the aerated windrow method are explored.

BIOSOLIDS UTILIZATION

As introduced in Chapter 1, biosolids utilization refers to the beneficial use of the resources within biosolids. Literature and trade journals also refer to biosolids utilization as beneficial use, beneficial reuse, beneficial management or sustainable reuse. Utilization of resources within biosolids, such as nitrogen and phosphorus nutrients, organic matter and energy, is encouraged and promoted by *The Canada-wide Approach for the Management of Wastewater Biosolids* ("The Approach;" Canadian Council of Ministers of the Environment 2012), in conjunction with sound management practices. In addition to biosolids composting and the production of soil products, agricultural land application of biosolids and combustion of biosolids for energy recovery are considered beneficial utilization activities. The alternative management option to biosolids utilization – disposal – is not promoted by The Approach (Canadian Council of Ministers of the Environment 2012). The goal of most programs, including The Approach, is to protect the environment and human health, as well as build public confidence (Canadian Council of Ministers of the Environment 2012).

The Ontario Ministry of the Environment (MOE; 1996) supports developing utilization programs for biosolids application on agricultural lands. Program development involves the biosolids generator, hauler and end user. Further, the Ontario MOE has a committee dedicated solely to biosolids utilization matters – the Biosolids Utilization Committee (BUC).

Biosolids Utilization Benefits

Composted biosolids are easier to handle, store and apply than raw sewage materials (Golueke 1977), attract less vectors, have less odour compounds and have pathogens below detection levels (Krogmann 2001). Further, composted biosolids can enhance the physical and chemical properties of soil (e.g., soil tilth and fertility), as well as reduce the environmental risk associated with sewage handling (Golueke 1977; Rynk, et al. 1992). Biosolids-derived compost serves as a soil conditioner (rather than fertilizer) and can be used to support plant growth or as landfill cover to reduce methane emissions (Canadian Council of Ministers of the Environment 2012).

BIOSOLIDS UTILIZATION PROGRAMS

Biosolids utilization programs, or management plans, attempt to provide for the 'systematic integration of technical, scientific, socio-economic, political, cultural and regulatory requirements' into plans for the beneficial use of biosolids. The concept of biosolids utilization programs has evolved over more than a 50-year period (United Nations Environment Programme 2002).

Beneficial utilization programs are consistent with The Approach (Canadian Council of Ministers of the Environment 2012), which encourages the beneficial use of municipal biosolids in a manner where the environment and human health are protected.

Ecosystem restoration and preservation, as well as environmentally sustainable economic development are noted by UNEP (2002) as additional factors that are important aspects of beneficial use. Adherence to standards, regulations and guidelines of applicable jurisdictions, such as federal, provincial and municipal governments, is noted as a sound management principle that beneficial utilization should be based upon (Canadian Council of Ministers of the Environment 2011). Increasing resource stewardship is anticipated to lead to continued growth in biosolids utilization systems (United Nations Environment Programme 2002). UNEP (2002) further anticipates that all sludge treatment in the future will be planned and undertaken while keeping in mind the end users' viewpoint of beneficial utilization.

Developing biosolids utilization systems may involve working with stakeholders, revising local law and policy to reflect utilization as a requirement, large-scale demonstration or pilot projects and/or developing construction and bid documents (United Nations Environment Programme 2002). Stakeholders in the process may include, but not be limited to: local, provincial and federal governments; universities; environmental non-governmental organizations (NGOs); and private firms (United Nations Environment Programme 2002). Obtaining permits from health, agricultural and environmental agencies is also noted by UNEP (2002) as a component of biosolids utilization programs. As regulatory requirements for biosolids composting facilities are primarily related to the environment (National Biosolids Partnership 2001), utilization programs are typically focused on environmental outcomes.

Employing a biosolids utilization program can help improve the effectiveness of an operation and meet both regulated requirements, such as compost quality, and non-regulated requirements, such as noise (National Biosolids Partnership 2001).

CORE COMPONENTS OF A BIOSOLIDS UTILIZATION PROGRAM

Based on a North American composting guideline documents review, the core components identified in Table 1 have been identified as important for planning a biosolids composting operation.

Table 1: Core Components of Select North American Biosolids Utilization Management and/or Composting Guidance Documents

Document	Contingency Plans	Continuous Improvement	Quality Management	Marketability	Site Suitability	Social Considerations	Storage	Training	Transportation Logistics
CCME Approach[1]		X		X	X	X			X
InfraGuide[2]	X	X	X	X		X	X	X	X
On-Farm Composting Handbook[3]	X			X	X		X		
NBP Biosolids Management Program[4]	X	X	X					X	
Alberta Code of Practice[5]	X		X		X	X			

[1] (Canadian Council of Ministers of the Environment 2010)
[2] (Federation of Canadian Municipalities and National Research Council 2003)
[3] (Rynk, et al. 1992)
[4] (National Biosolids Partnership 2001)
[5] (Alberta Government 1996)

Site Suitability

An objective in determining site suitability for biosolids composting operations is limiting environmental risk. Other objectives exist related to social considerations. Compost facilities primarily have the potential to generate contaminated liquids, such as leachate, and offensive odours (Alberta Government 1996). Environmental risk is generally limited through surface run-off and pollution control (Rynk, et al. 1992).

Site suitability considerations include soil type, soil permeability, topography, water table level, drainage, proximity to wetlands and waterbodies, and potential for flood events.

Other considerations include prevailing wind pattern, ease of accessibility, traffic flow pattern, potential for all-weather use, local airshed issues, permits, guidelines, regulated setbacks and buffers, zoning, and sufficient sizing to contain raw material storage, composting site and finished material storage areas.

General Manitoba composting site suitability considerations are contained within the *Draft Manitoba Compost Facility Guidelines, 2001* (KGS Group 2001). These guidelines include establishing a minimum 1,000 m setback from water supply intakes and lakes and streams (not including drainage ditches). Further, facilities are not to be sited within a flood plain and the curing area must be ≥0.5 m above the seasonal high water table in accordance with the guidelines.

Due to the overlap of suitability requirements and activities undertaken, some operators may elect to co-develop biosolids composting facilities within existing or future waste disposal grounds or similar sites (e.g., waste transfer stations).

Once operational, on-site environmental monitoring, such as up gradient and down gradient surface and groundwater sampling and analysis, may be a requisite component of environmental approvals or environmental liability or impairment insurance carried by the owner, if applicable (Brent Hansen Environmental 2004).

Storage

Storage is required for four aspects of biosolids composting facilities: 1.) Raw feedstock storage, 2.) Processing storage 3.) Curing and finished material storage, and 4.) Leachate and stormwater storage. Storage areas need to be sufficiently sized to accommodate the required operational capacity of each of these areas, including equipment travel areas. An important balance is required during processing to ensure incoming feedstocks and/or end product production does not outstrip available storage or market demand. MCWS typically requires Manitoba compost facilities to store sufficient carbon feedstock on-site to meet C:N ratio balancing requirements.

The active composting process is reported as requiring 18 - 28 days with the composting curing process reported as requiring 30 - 180 days (National Biosolids Partnership 2005; United States Environmental Protection Agency 2003). Curing refers storing materials after active composting and is an important process for allowing compost to mature and stabilize. In addition, proper curing retention times mitigate potential regrowth of pathogens, including *Salmonella* (Hay 1996). A minimum 56-day curing timeframe has been recommended previously for use in Southern Manitoba (CH2M Hill 2011).

Flexibility in storage areas is required in the event of market condition changes or weather changes. Storage size should be sufficient to allow for peak processing for the longest anticipated length of time without a market (National Biosolids Partnership 2005). In cold climates, such as Manitoba, there is a need to stockpile material for up to five or six months during winter months when processing and/or end product use may be decreased.

Precedent Environment Act Licences for non-biosolids (i.e., food waste) compost facilities in Manitoba have required the compost pad area to be underlain with a synthetic liner or 0.5 m thick compacted clay liner to achieve a hydraulic conductivity of $1x10^{-7}$ cm/s or less; whereas, leachate and stormwater storage ponds are typically required to be underlaid with a synthetic or 1.0 m thick compacted clay liner to achieve the same hydraulic conductivity. Proponents may be required to submit samples to MCWS to prove that the required hydraulic conductivity has been met.

Leachate storage ponds need to be sized to accommodate anticipated moisture generated during composting, large rainfall precipitation events and spring snowmelt. MCWS has requested that Manitoba composting facilities include planning for a 1:50 year precipitation event and/or 75 mm of rainfall over the compost area.

Various windrow footprints and configurations are referenced in literature and guidance materials. Windrows may be stacked in rectangular, trapezoidal or triangular cross-sectional configurations, and are aligned with equipment travel paths between long parallel rows. In general, larger windrows are preferable to smaller windrows due to a lower surface area to volume ratio, which allows for less temperature loss (United States

Environmental Protection Agency 2003). Typical windrow configurations are reported as 1.2 – 2.4 m high and 4.0-6.0 m wide at the base (Haug 1980; CH2M Hill 2011).

Social Considerations

Public acceptance is a key consideration for biosolids utilization program success, irrespective of facility or program size (Federation of Canadian Municipalities and National Research Council 2003). Visibility, odour, noise and perceived health concerns can affect public acceptance of a program. Proximity of application sites to the public as well as to potentially sensitive land use receptors, such as schools, hospitals and nursing homes, are considerations (Rynk, et al. 1992). Providing a buffer distance and avoiding direct sightlines is preferable in siting a facility. In addition, zoning requirements and the concerns and perceptions (Canadian Council of Ministers of the Environment 2012) of potential neighbours and local public officials should be considered (Rynk, et al. 1992).

While well-designed composting facilities can operate with reduced odours (United States Environmental Protection Agency 2002), an improperly managed composting process can generate offensive odours, especially if using active materials such as raw, undigested sewage sludge (Rynk, et al. 1992). However, for the most part, odours from a well-managed facility should be periodic and short lived (i.e., non-continuous; Rynk, et al. 1992). Malodours are often associated with composting under anaerobic conditions, or conditions without sufficient oxygen, because anaerobic conditions can generate offensive smelling gases, such as methane, organic acids and hydrogen sulphide (Rynk, et al. 1992). Odour detection, management and mitigation is important (Alberta Government 1996). Strategies to reduce or mitigate malodours include

the use of a cover, negative aeration and/or chemical scrubbing for indoor facilities, bio-filters (United States Environmental Protection Agency 2002), and rapid-closing doors for enclosed facilities. MCWS typically requires compost facility operators to cover open-air windrows with straw or woodchips after placement and turning to mitigate odours.

Noise is another social consideration for compost facilities due to the use of heavy construction equipment, such as wheel loaders and semis, and mechanical equipment, such as mixers and potentially grinders for carbon feedstock preparation. In planning and operating a facility, proponents could refer to the *Manitoba Guidelines for Sound Pollution* and/or the *Ontario Sound Level Limits for Stationary Sources* to avoid causing a noise nuisance.

Other social considerations include implementing litter control practices, utilizing site fencing or natural barriers to prevent unauthorized access, reducing vector attraction potential, avoiding noxious weed propagation and installing appropriate signage (Alberta Government 1996). Facilities should be landscaped to screen operations from public view (Federation of Canadian Municipalities and National Research Council 2003). The implementation of a pest control program, as well as a waste reduction and recycling program, are typical licence considerations for composting facilities in Manitoba.

Marketability

Biosolids are traditionally viewed as a negative value product, due to the costs involved in transporting and disposing of biosolids as a waste (Brown, Angle and Jacobs 1998). Utilization of biosolids as a composting feedstock can valorize this wastewater

treatment process byproduct into a value-added and saleable product. Unit prices for biosolids-derived compost in Canada are reported as $4-28 per cubic yard ($5.23-36.62/cubic metre (bulk) or $6/30 L bag (retail; Hamilton pers. comm. 2013).

Prior to producing composted biosolids, potential compost end users or markets must be identifiable (Brown, Angle and Jacobs 1998) and a realistic assessment of the potential demand must be undertaken. Product development should be strategic to fulfill local market needs (United Nations Environment Programme 2002). In some jurisdictions, the public works entity proposing to develop biosolids compost will utilize the finished material within its own site(s) while continuing to identify suitable market users (National Biosolids Partnership 2005). The Federation of Canadian Municipalities and National Research Council (2003) note that it is beneficial to have a diversity of end users.

For example, the horticulture industry is a target market for composts, including those derived from byproducts, but the uptake of these composts by the horticulture industry may be slow due to the lack of market research on byproduct-derived composts in comparison to traditional soil amendments, such as peat (Brown, Angle and Jacobs 1998); notwithstanding, the U.S. EPA (2002) notes that biosolids compost is generally highly accepted by the public.

In advance of initiating a two-year biosolids composting pilot project, the City of Winnipeg released a Request for Information (RFI) to *Determine Private Sector Interest in Utilizing Biosolids Cake and/or End Products for a Variety of Purposes in July 2013*. The purpose of the RFI was to identify groups and gauge interest in the beneficial reuse

of biosolids to better understand the potential market as part of its overall Biosolids Master Plan (City of Winnipeg 2013). The RFI included identifying respondents' interest in utilizing anaerobically digested biosolids cake for various purposes, including composting. The results of this opportunity have not yet been publicly disclosed at the time of reporting.

Challenges to marketing biosolids-derived compost experienced in Banff, Alberta included distance to established markets, consistent compost quality production, product testing requirements and reluctance of organizations to use the material within their jurisdiction (CH2M Hill 2007). Prospective users expressed an interest in consistently obtaining Category A quality compost only.

In addition to locating and securing end users or buyers and maintaining consistent product quality, additional compost marketability considerations include: advertising, packaging and managing inventory (Rynk, et al. 1992). As described in Chapter 3, biosolids used as fertilizers or soil supplements in Canada are subject to the *Fertilizer Act and Regulations*. These requirements govern the labelling and product claims made of fertilizers intended for sale and includes additional requirements, such as processing compost intended for sale in traceable batches or lots.

Transportation Logistics

As an intrinsically low value product, the costs associated with loading and transporting unprocessed biosolids can be high; however, developing a value-added compost end product can help offset transportation costs (Brown, Angle and Jacobs 1998). Biosolids thickening and dewatering prior to transport can be used to reduce

volumes requiring transport and therefore, costs (Federation of Canadian Municipalities and National Research Council 2003).

Transportation logistics include determining the number of transport vehicles required to support the operation (Federation of Canadian Municipalities and National Research Council 2003). Biosolids may be transported in dump trucks, semitrailers or roll-off containers. Truck capacities are typically 10 to 25 tonnes, or 8 to 30 cubic yards. Leak-proof tailgates are an important feature for hauling relatively wet biosolids (National Biosolids Partnership 2005). A site that provides easy, safe, all-weather vehicle accessibility and requires minimal travel and material handling is ideal (Rynk, et al. 1992). Odour generation and control is an important consideration during transportation (Federation of Canadian Municipalities and National Research Council 2003).

The transportation of biosolids is regulated at the provincial level in Manitoba. There are no stand-alone approval requirements for hauling biosolids in Manitoba. In Ontario, haulers require an environmental approval to haul biosolids for various purposes, including experimental pilot testing (Ontario Ministry of the Environment 1996).

Contingency Plan

According to the Federation of Canadian Municipalities and National Research Council (2003), a contingency plan or emergency response plan (ERP) is an integral component of a well-managed biosolids utilization program.

Internal and external contingency events that require planning include, but are not limited to, inclement weather, biosolids quality changes, failure or temporary disruption

of equipment or processes, breakdown of transportation equipment, political or market factors, fires, spills or medical emergencies (Federation of Canadian Municipalities and National Research Council 2003; Alberta Government 1996). Alternative methods for treatment, storage and/or disposal in the event of a contingency event should be included in the plan (Ontario Ministry of the Environment 1996).

Manitoba proponents are typically required to submit an ERP developed in accordance with the emergency planning guidelines of the Canadian Centre for Occupational Health and Safety (CCOHS) within 60 days of Environment Act Licence issuance.

Training

The availability of trained personnel may affect the composting technology selected (United States Environmental Protection Agency 2002). The Federation of Canadian Municipalities and National Research Council (2003) indicates that it is crucial to have properly trained and certified (where applicable) operators running biosolids utilization programs to ensure that regulations are followed and public safety is protected. Training may be required on the use of specialized equipment, or the implementation of processes, or both, and requirements are typically outlined in regulation (Federation of Canadian Municipalities and National Research Council 2003). This training may be offered on the job, in courses, online and could include formal WWTP operator certification (National Biosolids Partnership 2001).

A typical licence requirement for composting facilities in Manitoba is for the proponent to hire or designate an Environmental Coordinator to oversee the facility

operation and compliance with the licence terms and conditions, including monitoring and reporting requirements.

Employers, such as municipalities, are responsible for determining the competency of new or re-assigned employees, providing training and retaining records of training. Training requirements should be extended to contractors through the use of service agreements. Training should also be conducted on contingency and emergency response plans for the operation (National Biosolids Partnership 2001).

Training and certification is available in Canada through organizations such as the Compost Council of Canada.

Quality Management

There are three main types of quality management undertaken at biosolids composting facilities: 1.) Testing incoming biosolids and non-biosolids feedstock quality; 2.) Monitoring operational parameters, such as moisture, temperature, and oxygen, during active composting; and 3.) Testing the end-product to determine the compost quality achieved relative to applicable guidelines and therefore potential end uses.

Incoming biosolids feedstock quality is important as items such as foreign matter and sharp objects can affect end-product quality. As previously identified, increasingly stringent liquid effluent regulations in Canada are anticipated to result in the quality (and amount) of biosolids produced to increase (Canadian Council of Ministers of the Environment 2012), which would provide a higher quality starting feedstock. Monthly feedstock testing has been recommended for monitoring integrity and C:N ratio calculations for non-biosolids composting feedstocks (Brent Hansen Environmental

2004). In general, sampling should be undertaken when a change occurs (e.g., wastewater treatment process change) that could affect biosolids quality (Ontario Ministry of the Environment 1996). WWTP operators should review biosolids analytical results immediately upon receipt and make any necessary corrective actions or advise any relevant parties of quality deviations (Ontario Ministry of the Environment 1996).

During operational monitoring, temperature should be sampled and recorded regularly from various pile locations and depths, along with the measurement date and time (United States Environmental Protection Agency 2003). Windrow oxygen, temperature and moisture should be monitored at least weekly to ensure the process is within acceptable operational ranges, with measurements conducted at a more intense rate of three times per week during initial startup (Brent Hansen Environmental 2004). The requisite temperature must be reached throughout the entire pile, otherwise surviving pathogens may re-grow during the curing period (United States Environmental Protection Agency 2003). Reaching a consistent temperature throughout the pile is achieved by turning the pile edges into the pile core. A turning rate of 3-5 times per week is recommended (United States Environmental Protection Agency 2003); however, the actual rate of turning should be based on recorded temperatures or oxygen levels. For example, temperatures in excess of 60°C can be damaging and should be turned (Rynk, et al. 1992).

The Unites States Environmental Protection Agency (2003) suggests the following operational ranges for key processing variables:

- 40-60% moisture;

- 5-15% oxygen;
- pH 6-9 units.

The end product should be stable and mature, without residual phytotoxic compounds that can adversely affect plants (Ontario Ministry of the Environment 2012). Stability can be measured using reheating tests or carbon dioxide respirometry tests; whereas, maturity can be measured with germination tests or ammonia concentration tests (CH2M Hill 2011). The end product should be tested after maturation and prior to end use and compared to applicable guidelines such as the CCME or the Bureau de Normalization du Quebec (BNQ) guidelines and standards.

In Canada, each province is responsible for determining the frequency and method of sampling biosolids and developing or adopting a quality standard for finished products (Canadian Council of Ministers of the Environment 2010). The Province of Manitoba has derived a sampling protocol for sludge and soil, albeit focused on the agricultural land application of lagoon sludge solids (Appendix 2). Further, the Province has adopted the *CCME Guidelines for Compost Quality – PN1340* as a quality guideline for finished products, by way of stipulating adherence with the guideline in regulatory approvals, including Environment Act Licences.

Jurisdictional Comparison: Ontario

The Province of Ontario has developed its own guidelines for compost quality (Ontario Ministry of the Environment 2012). The guidelines include mandatory standards for:

1 **Metals in compost:** category-specific maximum limits for eleven heavy metals in finished compost, measured on a dry weight basis.
1 **Feedstock quality:** maximum heavy metal limits and restrictions on feedstock type and percentage for different categories.
1 **Pathogens:** requirements for temperature (55 degrees C for 15 consecutive or non-consecutive days), turning (5 times during high temperature period) and monitoring (daily during high temperature period, reducing to weekly thereafter).
1 **Foreign matter content:** virtually absent, with category-specific requirements for foreign and sharp foreign matter.
1 **Compost maturity:** cured a minimum of 21 days and meets respiration rate requirements, and
1 **Labelling:** recommended application rates and statements that the product contains biosolids, that failure to follow the application rate could result in metal accumulation in soils and not to use on soils with elevated copper or zinc concentrations.

Of the three compost quality categories, AA, A, or B, biosolids can only be used in the production of category A or B quality biosolids and must not comprise >25% of the blend. The guideline also provides prescriptive information on sampling and analysis protocols for feedstock and compost.

In all instances, the testing and sampling conducted should be suitably representative of the material being sampled (Ontario Ministry of the Environment 2012). Brown, Angle and Jacobs (1998) note implementing comprehensive testing of feedstocks and finished product as a measure to reduce potential liability concerns.

Continuous Improvement

Continuous improvement is a philosophy that refers to staying current with emerging research, information and technology related to biosolids and their use (Canadian Council of Ministers of the Environment 2012) and is an integral part of program quality management (Federation of Canadian Municipalities and National Research Council 2003). In addition to the fact pace development of new compost practices, equipment and environmental regulation (Rynk, et al. 1992), public issues and expectations of facilities and operations are dynamic and require revisiting over time.

The CCME Canada-wide Approach for the Management of Wastewater Biosolids, the National Biosolids Partnership Biosolids Management Program and the InfraGuide are all based on a continuous improvement philosophy or management system (Canadian Council of Ministers of the Environment 2012; National Biosolids Partnership 2001; Federation of Canadian Municipalities and National Research Council 2003). Some management programs, such as the National Biosolids Partnership's, are based on ISO 14001 Environmental Management Systems.

Continuous improvement is an iterative process of quality management that can be modeled on The Deming Cycle: Plan, Do, Check, Act (P-D-C-A Process; National Biosolids Partnership 2001). A purpose of continuous improvement is to check for and address instances of non-compliance within a biosolids utilization program.

Benefits of implementing continuous improvement practices include better regulatory compliance and overall environmental performance; increased efficiency and cost savings; higher quality biosolids; and improved relations with citizens (National Biosolids Partnership 2001).

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Chapter 3: Regulatory Requirements for Biosolids Composting in Manitoba

The following describes the current and emerging regulatory framework applicable to biosolids composting operations in Manitoba. The purpose of this chapter is to provide an overview of the guidelines and regulatory requirements for planning, initiating and operating a biosolids composting facility.

BACKGROUND

In Canada, biosolids management, including composting, primarily falls under provincial jurisdiction and thereby legislation varies across the country. The sale of compost; however, is primarily regulated federally (Ge et al. 2006). The goal of applicable legislation is typically to protect public health and the environment. Provincial composting and/or biosolids legislation, where it exists, is supported by federal and provincial compost and/or biosolids guidelines. Historically, the focus of wastewater legislation in Canada has been on the liquid effluent fraction of wastewater treatment processes (Federation of Canadian Municipalities and National Research Council 2003), with considerably less policy emphasis on the solids fraction.

PROVINCIAL GUIDELINES AND POLICY DOCUMENTS

Draft Manitoba Compost Facility Guidelines, June 2001

Basic requirements for composting operations in Manitoba are outlined in the *Draft Manitoba Compost Facility Guidelines* (KGS Group 2001). The purpose of the guidelines is to streamline environmental approvals for composting sites (McCormick 2011).

Principle requirements for a compost facility under the guideline are presented in Table 2. Additional requirements, as determined by the Director of Environmental

Approvals, may include groundwater and surface water monitoring requirements, retention and testing of water in contact with compost and/or financial assurance (McCormick 2011).

Table 2: Principle Compost Facility Requirements, Manitoba

Requirements
Geological and hydrogeological assessment by Professional Engineer or Geoscientist
Leachate management
Not create public odour nuisance
Not exceed air quality criteria
Compost Site Plan
Positive drainage
Vector, odour, dust, litter control
Impermeable underlay for compost areas
Curing area >0.5 m above seasonal high water table level
Timely removal of cured finished product
Not damage water quality
Secure site
Signage
Site supervision when open
Approved operations manual on-site
5-year record maintenance
Emergency response plan

(Adapted from: KGS Group, 2001; McCormick, 2011)

Table 3 presents minimum separation distances established by the guideline to be maintained between the composting active area and select features. Further, composting facilities cannot be established within a floodplain or area of unstable terrain.

Table 3: Minimum Separation Distances Between Composting Active Area and Select Features, Manitoba

Feature	Setback (m)
Adjacent Property	30
Public Roads	100
Railway	100
Public Parks	300
Buildings (Residential, Institutional, Commercial, Industrial)	400
Cemetery	400
Body of Surface Water (Lakes and Streams, but not Drainage Ditches)	1,000
Water Supply Intake	1,000
Critical Habitat Areas	2,000
Wetlands	2,000
Airports	8,000
Not within a flood plain	
Not within unstable areas	

(Adapted from KGS Group, 2001; McCormick, 2011)

Proponents are required to develop a Compost Site Plan that addresses the facility design capacity, feedstock types, proposed equipment, feedstock volume measurement

means, processing method and sequence, leachate and stormwater controls, backup and overflow areas and access roads (two-way, all-weather) for large vehicles.

Receiving and tipping areas are to be constructed to minimize the release of leachate to groundwater. The receiving area is required to have positive drainage, as well as stormwater run-off and run-on controls. The area must be designed to minimize ponding and avoid issues resulting from vectors, odour, dust or litter. The area must also be suitable to withstand daily operating requirements (McCormick 2011).

Jurisdictional Comparison: Alberta

Compost facilities in Alberta require notification, registration or approval with Alberta Environment (CH2M Hill 2007). The permitting approach is dependent on the class of facility and tonnage of feedstock accepted per annum, with 20,000 tonnes per annum (TPA) the threshold. Class 2 facilities below the threshold are required to notify Alberta Environment by letter of their intention to establish a compost facility. Class 1 facilities below the threshold must submit a registration form with supporting documentation. Class 1 or Class 2 facilities that exceed the TPA threshold must apply for approval. It is noted approval may be required for smaller facilities in sensitive locations or that handle unique feedstocks, which may include biosolids. Some facilities are only required to notify Alberta Environment by letter of their intention to establish a composting facility. These approaches are supported by the *Approvals and Registrations Procedures Regulation* and the Code of Practice for Compost Facilities.

Draft Centralized Composting Operations Information Bulletin, 1996

This information bulletin, targeted for municipal officials and potential private compost producers, refers to composting of organic wastes as a viable component of integrated waste management system planning for municipal and industrial sectors. While generally limited in scope to leaf and yard waste and organic kitchen food waste composting, the guideline indicates:

> *"…consideration is also being given to composting of other organic components of the mixed municipal solid waste stream."*

The purposes of the bulletin are to provide the target audience with information regarding assessment and approval processes; site development and operational considerations, quality and end use considerations; and additional information (Manitoba Environment 1996).

Environmental Regulation for Treatment and Disposal of Biosolids in Manitoba

The Province of Manitoba's Environmental Approvals Branch has previously published a policy document titled *"Environmental Regulation for Treatment and Disposal of Biosolids in Manitoba"* (Van den Bosch n.d.). The objectives of the document are identified as addressing public health and environmental concerns, preventing public nuisance conditions, and preventing effects to land use.

This policy document only envisages two potential treatment and disposal options for biosolids: 1.) landfilling or 2.) application to agricultural crop land.

The document primarily addresses the land application of biosolids to agricultural land; however, it affirms that effective composting is considered as an acceptable method for pathogen reduction, which is consistent with regulation in Manitoba and other jurisdictions (e.g., United States). The document also establishes maximum metal limits for the receiving soil environment.

PROVINCIAL REGULATORY REQUIREMENTS

The Environment Act, C.C.S.M. c E125

The purpose of *The (Manitoba) Environment Act* is to protect and maintain the environment for current and future generations. The Act requires projects or "developments" that are likely to have a significant effect on the environment to obtain a licence under the Act.

Types of developments subject to licensing are described in the *Classes of Development Regulation, Man. Reg. 164/88* of the Act. Developments are categorized according to potential effect as either Class 1 – Release of Pollutants, Class 2– Unrelated to Pollution, or Class 3 – Exceptional Projects. Similarly, Manitoba WDGs are also categorized from Class 1 to 3 according to population size, pursuant to the *Waste Disposal Grounds Regulation, Man. Reg. 150/91* of *The Environment Act*.

An Environment Act Licence is required to construct, alter or operate a Class 1 development pursuant to the provisions of Section 10(1) of *The (Manitoba) Environment Act.* Licences are obtained on a case-by-case basis by filing an Environment Act Proposal Form (EAPF) with the MCWS Environmental Approvals Branch. An environmental impact assessment is required to accompany the proposal. Following an accepted 30-day review by the public and the province's Technical Advisory Committee (TAC), comprised of representatives from provincial and federal departments, an Environment Act Licence is issued for construction and operation of the development, with limits, terms and conditions.

Classes of Development Regulation, Man. Reg. 164/88

Stand-alone composting facilities that are not co-located within a WDG are considered "Bulk Materials Handling Facilities" which are a Class 1 development pursuant to the Regulation, and therefore subject to the Act. On the other hand, compost

facilities co-located within WDGs are subject environmental approvals in conjunction with the WDG, which is environmental licensing under *The Environment Act* (Class 1 WDGs) or environmental permitting under the *Waste Disposal Grounds Regulation* (Class 2 and 3 WDGs). The compost facility would be review in conjunction with the WDG at the time the facilities are established, or when the compost facility is introduced. In all instances, these would be the applicable approval processes for compost facilities proposing to use a biosolids feedstock.

A sample of typical licence conditions for precedent non-biosolids composting facilities in Manitoba is included as Appendix 3 for information.

The land application of biosolids is also considered a Class 1 development pursuant to the Regulation and subject to the Act. Biosolids application is defined as:

> *"…the addition to soil of nutrient-rich organic material resulting from biological wastewater treatment."*

On August 23, 2010, the Environmental Assessment and Licensing Branch published proposed amendments to the *Classes of Development Regulation* that would add "Commercial Composting Facilities" as a Class 1 development under Manufacturing. Commercial composting facilities would be defined as:

> *"…a facility operated commercially for the purpose of making compost, but does not include:*
>
> *(a) a composting facility at a waste disposal ground, if the waste disposal ground is the subject of a valid licence issued under the Act or permit issued under the Waste Disposal Grounds Regulation, Manitoba Regulation 150/91; or*
>
> *(b) a composting operation that is regulated by the Livestock Manure and Mortalities Management Regulation, Manitoba Regulation 42/98."*

Compost would be defined as:

> *"…the end product of aerobic decomposition of organic matter by bacterial action."*

MCWS indicated that the purpose of the amendment is to make explicit reference to commercial composting facilities as a class of development. MCWS has not specified an implementation timeline for the proposed amendments to the regulation.

Water and Wastewater Facility Operators Regulation, Man. Reg. 77/2003

Wastewater and water facilities in Manitoba are classified in accordance with the *Water and Wastewater Facility Operators Regulation* of *The (Manitoba) Environment Act*. The Regulation also provides for the certification of operators.

There are five classes of wastewater treatment facilities in Manitoba: small system, Class I, Class II, Class III and Class IV. Wastewater treatment facilities are defined by the Act as:

> *"a facility for the treatment or disposal of domestic, commercial or industrial wastewater or sludge, and includes the land on which the facility is located and the structures, systems, devices and equipment comprising the facility, but does not include a wastewater collection facility or private wastewater system"*

Wastewater treatment facilities are classified primarily on a points system outlined in the Regulation. Class I facilities have the least possible points and serve the smallest population; whereas, Class IV facilities have the highest possible points and serve the greatest population, suggesting they are more sophisticated facilities.

In the classification of wastewater treatment facilities, the Regulation acknowledges "solids composting" of sludge as a residual disposal method, along with discharge to sludge ponds, mechanical dewatering and land application. "Solids composting" is defined as:

> *"a biological decomposition process that produces carbon dioxide, water and heat and includes windrow, forced air-static pile, and mechanical composting"*

Further, the Regulation acknowledges solids composting as a solids stabilization process (along with lime treatment, thermal conditioning, digestion) that is used to:

- Oxidize or reduce the organic matter in solids to a more stable form;
- Reduce pathogens; and
- Reduce the volatile organic carbons in solids (and accordingly, the potential for odour).

For classification purposes, solids composting is allocated the second highest available points under the solids handling category, behind solids reduction through incineration and wet oxidation. It has the same amount of points as solids handling through anaerobic digestion or land application by facility personnel. Solids storage and disposal in landfill have the lowest possible classification points under solids handling. This suggests that solids composting is considered a more sophisticated solids handling process for wastewater treatment facilities.

Livestock Manure and Mortalities Management Regulation, Man. Reg. 42/1998

Storage and composting requirements for livestock manure and mortalities are outlined in the *Livestock Manure and Mortalities Management Regulation, Manitoba Regulation 42/1998 (LMMMR)*. There currently is not a similar regulation that identifies composting requirements for non-manure or –mortality feedstocks. The closest policy document to regulating these other feedstocks is currently *The Draft Manitoba Compost Facility Guidelines*.

"Composting" is defined in the *LMMMR* as:

> *"…a designed and managed system to facilitate the process of aerobic decomposition of organic material by biological action."*

Municipal wastewater sludge and biosolids are considered "another source of nutrients" in determining the appropriate application rate for manure to land under Manitoba Regulation 42/1998. Accordingly, the application rate for manure to land must consider nutrients on the land resulting from previous and/or future applications of municipal wastewater sludge and/or biosolids to that same piece of land.

The *LMMMR* establishes setbacks and requirements for the composting of livestock manure and mortalities pursuant to Sections 8 and 15 of the Regulation respectively, which any facilities contemplating the use of these feedstocks would be required to maintain, as follows:

- Facilities must be located at least 100 m from:
    - A surface watercourse;
    - Sinkhole;
    - Spring;
    - Well; and
    - The agricultural operation's boundaries.
- Composting must occur in a manner that does not cause pollution of surface water, groundwater or soil;
- Composting facilities and processes must be acceptable to the Director of Environmental Approvals; and,
- End compost cannot be applied to land between November 10 of one year and April 10 of the next year.

In granting approvals for composting facilities, the Director of Environmental Approvals has the jurisdiction to vary siting requirements in the event it will limit the pollution risk of an existing agricultural operation, pursuant to Section 17(2) of the Regulation.

The setback distances in the *LMMMR* are generally less restrictive than those contained in *The Draft Manitoba Compost Facility Guidelines*. The November 10 to April 10 restriction on land application of end compost would be applicable to biosolids compost.

Waste Disposal Grounds Regulation, Man. Reg. 150/91

The (Manitoba) Waste Disposal Grounds Regulation, Man. Reg. 150/91 regulates the disposal of wastes in Manitoba. The Regulation establishes three classes of WDGs based on the size of population served: Class 1 (>5,000 people), Class 2 (1,000-5,000 people) and Class 3 (<1,000 people). Class 1 WDGs are operated in accordance with licences issued under *The (Manitoba) Environment Act;* whereas, Class 2 and 3 WDGs are operated in accordance with operating permits issued under the Regulation.

The Regulation includes provisions regarding the landfill disposal of sludge from municipal wastewater treatment systems. Sludge may be disposed of at a WDG in Manitoba, if it is a solid waste. To be considered a solid waste, sludge has to have a slump of less than 150 mm based on a standard test (CSA Standards Test Method A23.2-5C). If the sludge has a slump of greater than 150 mm based on the standard test, it is considered a liquid waste and can only be disposed of at an approved Class 1 Waste Disposal Ground capable of accepting such wastes. Notwithstanding, consistent with principles of sustainability and resource stewardship, MCWS discourages the landfill disposal of sludge by operators, where agricultural land is available for application.

MCWS is currently in the process of amending the Regulation, which does not contain any references to composting facilities or compost. A goal of the regulatory amendments is to address all solids waste management facilities, including composting facilities, and define enhanced technical and environmental requirements for their development, operation, monitoring and reporting (Manitoba Conservation and Water Stewardship 2013). Other potential amendments under consideration include requiring Environment Act Licences for all WDGs, regardless class (i.e., repealing the permitting system) and introducing provisions for operator certification (Manitoba Conservation and Water Stewardship 2013). No timeline for the proposed amendments has been provided.

Water Protection Act, C.C.S.M. c. W65

The purpose of *The (Manitoba) Water Protection Act* is to provide for the protection and stewardship of Manitoba's water resources and aquatic ecosystems.

On June 16, 2011 the Act was amended to introduce measures that pertain specifically to the City of Winnipeg NEWPCC. Section 4.2(1) and Section 4.2(2)(6) explicitly require the City of Winnipeg NEWPCC to re-use biosolids and wastewater sludge remaining after the treatment process to the Director's satisfaction on or after December 31, 2014.

This is the first mandated requirement for biosolids reuse in Manitoba regulation.

Nutrient Management Regulation, Man. Reg. 62/2008

The Nutrient Management Regulation, Manitoba Regulation 62/2008 of *The (Manitoba) Water Protection Act* aims to protect water quality through responsible nutrient management planning. This is achieved through regulation or prohibition of certain nutrient generating facilities where surface or groundwater are sensitive to impact, in addition to regulation of land application of nutrient-containing substances. Compost is considered a nutrient-containing substance for the purpose of the Regulation.

Manitoba Regulation 62/2008 establishes five Water Quality Management Zones based on Agricultural Capability Classes and Nutrient Buffer Zones (Table 4). Section 10 of the Regulation prohibits the application of substances containing nitrogen or phosphorus, including compost, to land within Nutrient Buffer Zones.

The Regulation acknowledges municipal wastewater sludge and biosolids as a regulated source of nutrients; however, compost generated on its own site is exempt from the definition of a fertilizer. Therefore, the application of compost generated on-site is not considered a fertilizer input and does not require a nutrient management plan for its application.

The Regulation establishes application limits in nutrient management zones N1, N2 and N3 for substances containing nitrogen and/or phosphorus, which would include biosolids compost. If the proposed off-site rate of application of compost exceeds the limits provided in Section 7(c) and/or Section 8(c), a nutrient management plan must be registered with MCWS prior to land application. The nitrogen application limit is based on the residual nitrate nitrogen concentration within the top 0.6 m of soil at the end of the growing season; whereas, the phosphorus application limit is based on the anticipated phosphorus removal rate based on the soil test phosphorus levels.

Also, the Regulation prohibits land application of compost from November 10 to April 10 of any year, to prevent nutrient application to frozen soil. In unusual or emergency circumstances, biosolids or sludge may be land-applied outside of the application restriction window, upon approval of the Director.

Table 4: Nutrient Buffer Zones from Features, *Nutrient Management Regulation, Manitoba Regulation 62/2008*

Feature	Nutrient Buffer Zone (m)	
	If Permanently Vegetated	**If Not Permanently Vegetated**
Groundwater feature	15	20
Vulnerable* lake or reservoir	30	35
Vulnerable* river, creek or stream	15	20
Non-vulnerable* lake or reservoir	15	20
Non-vulnerable* river, creek or stream	3	8
Order 3,4,5 or 6 drain	3	8
Major wetland, bog, marsh or swamp	3	8
Constructed stormwater retention pond	3	8

*As defined in the *Nutrient Management Regulation, Manitoba Regulation 62/2008* Schedule.

Manitoba Water Quality Standards Objectives and Guidelines Regulation, Man. Reg. 196/2011

As identified in precedent licences for compost facilities, all discharges of water, including leachate collected in a storage pond, must meet the *Manitoba Water Quality Standards, Objectives and Guidelines Regulation, Man. Reg. 196/2011* prior to discharge.

The Tier I Water Quality Standards make best practical technology a standard for the beneficial use of resources within municipal biosolids and sludge for all new or expanding facilities.

The Tier II Water Quality Objectives, which are defined for common pollutants in Manitoba routinely controlled through Environment Act licences, are used as the basis for a water-quality based approach, where additional restrictions beyond the Tier I Standards are required to protect important groundwater or surface water uses and would potentially need to be used to develop water-quality based approval limits for leachate discharges.

The Water Rights Act, C.C.S.M. c. W80

Water Rights Regulation, Man. Reg. 126/87

The construction, alteration, reconstruction of water control works is regulated by *The Water Rights Act*. "Water Control Works" are defined by the Act as:

> *"any dyke, dam, surface or subsurface drain, drainage, improved natural waterway, canal, tunnel bridge, culvert, borehole or contrivance for carrying or conducting water that*
>
> *(a) temporarily or permanently alters or may alter the flow or level of water, including but not limited to water in a water body, by any means, including drainage, or*
>
> *(b) changes or may change the location or direction of flow of water including but not limited to water in a water body, by any means, including drainage."*

The Act prohibits controlling water or constructing a water control works. The construction of dyking to control site run-off and run-on for properly developed composting facilities may alter the natural drainage patterns of the site, as well as the surrounding area, and may be considered a water control works. Proponents are required to apply for a Licence to Construct Water Control Works from the Water Stewardship Branch of MCWS.

The Highways Protection Act, C.C.S.M. c. H50

The Highways Protection Act is administered by The (Manitoba) Highway Traffic Board. Pursuant to the provisions of Part I of the Act, constructing or modifying an existing entrance or exit onto a limited access highway is prohibited, except under permit issued by the Board. A limited access highway may include a provincial road (PR) or provincial trunk highway (PTH); with all instances of the latter considered a limited access highway, unless declared otherwise. If the compost facility site requires a new access road to connect to a limited access highway or a change to an existing access, a permit would be required.

Constructing developments or structures within 125 feet of the highway right-of-way edge or plantings within 50 feet of the same is also prohibited by the Act and its regulations, unless a permit is obtained. This should be considered when locating fences, signage and landscaping for new facilities.

Manitoba Infrastructure and Transportation (MIT) may have additional requirements based on the anticipated traffic volume to be generated by the development. These requirements may include preparing a Traffic Impact Study (TIS) and/or implementing intersections improvements, such as adding acceleration/deceleration lanes. Threshold traffic volumes for requiring intersection improvements for past Manitoba composting facilities have been provided as 200 vehicles per day (VPD) or left turn movements ≥50 VPD. In the event a TIS is deemed required by MIT, *The General Guidelines for the Preparation of Traffic Impact Studies, April 2010* (Manitoba Infrastructure and Transportation 2010) are available to guide the study.

The Planning Act, C.C.S.M. c. P80

Provincial Planning Regulation, Man. Reg. 81/2011

The *Provincial Planning Regulation, Manitoba Regulation 81/2011* establishes Provincial Land Use Policies (PLUPs) to guide local authorities (e.g., rural municipalities) in preparing development plans and land use and development decisions. Ultimately PLUPs represent the strategic priorities of the Province of Manitoba and aid in preventing undesirable land use outcomes.

Compatibility is one of the nine principles of sound land use planning. Acknowledging that incompatible land uses can result in negative impacts that can affect people, property, investment and the environment, planned developments and land uses should be compatible with existing developments or designated land uses. The

incompatible siting of waste handling facilities, including compost facilities, can result in negative impacts, such as odour or noise nuisances, for existing residential land uses.

Where incompatible land uses cannot be prevented, mitigation of potential incompatibilities using setbacks, natural or constructed barriers, operating techniques or design is encouraged.

Policy Area 6 addresses infrastructure. The development of appropriate infrastructure is acknowledged under the policy area as having the potential to contribute to community health, sustainability and competitiveness, while offering a higher standard of living and quality of life for people in those communities.

Collaboration between planning authorities in Winnipeg's Capital Region to develop regional planning strategies for items, including solid waste and wastewater management, is encouraged by *Manitoba Regulation 81/2011* to promote the competitiveness of the Winnipeg Capital Region over other Canadian centres.

FEDERAL REGULATORY REQUIREMENTS

Federal regulations are primarily concerned with the regulation of liquid wastewater effluents, particularly as it relates to effects on other federal heads of power, or areas of jurisdiction, under *The Constitution Act, 1867*, such as Sea Coast and Inland Fisheries; however, the federal government does regulate other aspects of wastewater byproducts, such as the trade and importation of fertilizers derived from biosolids, under its jurisdiction for The Regulation of Trade and Commerce.

Fertilizer Act and Regulations

Administered by the CFIA, the *Fertilizers Act* and *Fertilizer Regulations*, commonly referred to as the Fertilizers Act and Regulations, are the only pieces of federal legislation that refer to the term "biosolids" (Federation of Canadian Municipalities and National Research Council 2003). The Act and Regulations are

intended to ensure the environmental health and safety and proper labelling of regulated fertilizers and supplements that are sold in or imported into Canada. The Act and Regulations do not regulate the export of fertilizers or supplements. Proposed amendments to the Act and Regulations under the CFIA's modernization initiative are anticipated to be introduced in fall of 2013 (Canadian Food Inspection Agency 2013). This section provides a review of current and potential emerging requirements, to the extent possible.

The term "sale" can be interpreted broadly to include non-direct monetary exchanges, such as collecting transportation costs for the transport of an otherwise free material (Antler 2011).

Pursuant to the provisions of Section 3.1(3)(a) of the Regulation, compost is exempt from registration as a fertilizer because it is defined as a supplement (Class 5) as set out in Schedule II of the Regulation; however, compost is still subject to the Regulation and must meet the prescribed standards and labelling requirements when sold in the marketplace. If an amendment were added to compost following the composting process, this material would be considered a "mixed fertilizer."

The Regulation identifies prohibited material and specified risk material (SRM) that if contained within fertilizers and supplements, have additional prescribed requirements, such as cautionary statements on packaging. SRM includes parts (e.g., eyes, brain, skull, tonsils, etc.) of cattle aged 30 months or over and the distal ileum (i.e., small intestine) of cattle of all ages. Solids from municipal wastewater treatment plants that do not receive SRM are explicitly identified as not being included in the definition of prohibited material.

Requirements for the sale of compost may include, but not be limited to:

- Prescribed label information:

- Product name: the compost can be identified as biosolids compost (non-mandatory); however, if one ingredient is named, then all feedstocks and ingredients must also be named.
- Net weight (metric units);
- Name and address of responsible packager;
- Lot number (required);
- Guaranteed analysis and grade: minimum organic matter (OM) and maximum moisture content are required for compost. Nutrient guarantees are non-mandatory unless one or more nutrient is identified or packaging makes nutrient claims;
- Directions for use: must appear on the label (e.g., rate, dilution, frequency). Compost must be efficacious as a supplement;
- Cautionary statement (i.e., regarding compost containing SRM).

- Safety Requirements:
  - Physical contaminants: should not contain sharp objects of a size or shape that can cause injury;
  - Chemical contaminants: must be within total cumulative heavy metal additions (Table 5) to soil over long term, identified as 45 years, based on the application rate of the product;

- Biological contaminants: *Samonella sp.* must be non-detectable (i.e., absent) and fecal coliforms must be < 100 MPN/g (total solids oven dried mass);
- Maturity: compost must be mature (i.e., composting process complete);
- Specified Risk Material and Prohibited Material: must not contain SRM or prohibited material.

All information on product labels must be in both English and French, in accordance with the federal Official Languages Act.

Table 5: Maximum Acceptable Cumulative Trace Element Additions to Soil

See Table I (T-4-93) Maximum Acceptable Cumulative Metal Additions to Soil (kg/ha), Canadian Food Inspection Agency "Technical Memorandum T-4-120 - Regulation of Compost under the Fertilizers Act and Regulations" available online at: http://www.inspection.gc.ca/plants/fertilizers/trade-memoranda/t-4-120/eng/1307910204607/1307910352783

The Act and Regulations also identify sampling procedures to obtain representative samples of the product as it is sold, as well as product analyses to ensure products offered for sale comply with the Regulation.

The CFIA conducts pre-market assessment of products prior to sale to ensure compliance with the safety and labelling requirements of the Fertilizer Act and

Regulations. Pursuant to s. 2(a)(ii), products that are exempt from registration, including supplements such as compost, do not require a pre-market assessment by the CFIA prior to sale. Producers and/or owners are able to request a voluntary pre-market assessment, or Label Review Service, from the CFIA to verify that the product meets the requirements of the Act and Regulations prior to sale, which is encouraged (Antler 2011; Canadian Council of Ministers of the Environment 2010).

Typical information requirements for biosolids-derived products that undergo pre-market assessment or label review include detail regarding processing method, inputs and analytical results for trace metals, pathogens and dioxins and furans (Canadian Council of Ministers of the Environment 2010). If a product reviewed by the CFIA is found to meet the Act and Regulations, the CFIA will issue a Letter of No Objection (LONO) to Sale. A LONO expires after a period of three years or if changes are made to the product, manufacturing process or label (Canadian Council of Ministers of the Environment 2010).

Fisheries Act, R.S.C., 1985

The *Fisheries Act* was established to manage and protect fisheries resources in Canada. Section 35(1) prohibits the harmful alteration, disruption or destruction (HADD) of fish habitat from any development or activity, unless a s. 35(2) authorization is issued for the HADD. Further s. 36(3) prohibits the deposit of deleterious substances to waterways. Any substance that has the ability to make water deleterious for fish or fish habitat is considered a deleterious substance.

In view of *Fisheries Act* requirements, compost facilities must be sited at a sufficient distance from waterbodies to prevent the potential deposition of deleterious substances, such as any water generated by or coming into contact with the operation (i.e., leachate).

GUIDELINES

Fertilizer Trade Memoranda

The CFIA publishes trade memoranda to assist regulated entities in complying with regulatory requirements. Fertilizer Trade Memorandum T-4-120 entitled *"Regulation of Compost under the Fertilizers Act and Regulations"* describes standards relating to safety, efficacy and labeling that are required to sell or import compost in Canada (Canadian Food Inspection Agency 2009).

Appendix B of the memoranda describes the submission requirements for pre-market assessments by the CFIA.

CCME Compost Quality Guidelines

The Province of Manitoba does not have its own guideline for compost quality; however, MCWS has required precedent Manitoba compost facilities to comply with the *CCME Guidelines for Compost Quality* (Canadian Council of Ministers of the Environment 2005).

The purpose of the Guidelines is to ensure compost that is sold or given away is a consistent and high quality product that is safe for all uses. Two grades of compost material are established by the Guideline: Category A – Unrestricted and Category B – Restricted. The grade is determined based on four main criteria: foreign matter, maturity, pathogens and trace elements. According to the Guideline, the safety of compost products is dependent on the exposure risk.

Category A compost is acceptable for use in any application including agricultural land, residential gardens, horticulture operations, nursery industries, etc. Due to the potential for sharp foreign matter or higher trace metal content, Category B compost use is not acceptable in pastures, parks or for residential purposes. Failure to meet all criteria

for a Category A compost requires classification as Category B. If neither Category A nor B criteria can be met, the compost products must be disposed.

Other jurisdictions (e.g., Ontario) refer to a "Category AA" compost that is not identified in the guideline. In Ontario, AA compost is not permitted to contain biosolids or other wastewater feedstocks (Ontario Ministry of the Environment 2012).

Trace Elements

With the exception of cadmium, mercury and lead, biosolids contains trace elements of micronutrients (Table 5) that plants and animals require; however, these trace elements if applied in large amounts or frequently could accumulate to toxic levels in soils. The *CCME Guidelines for Compost Quality* provides concentrations of trace elements not to be exceeded for each category (Table 6). Maximum concentrations for Category B compost are developed based on the CFIA Trade Memoranda, with the exception of chromium and copper (Canadian Council of Ministers of the Environment 2005). As trace elements, such as heavy metals, are not degraded during the composting process (Rynk, et al. 1992), comparing the concentration of biosolids feedstock to the concentration limits for a given category prior to composting, can give an indication of whether the finished product would be able to meet the desired category.

Table 6: Concentrations of Trace Elements in Finished Compost, CCME Guidelines for Compost Quality

See Table 1 Concentrations of Trace Elements in Compost and Cumulative Trace Element Additions to Soil, Canadian Council of Ministers of the Environment Guidelines for Compost Quality - PN 1340 available online at:

http://www.ccme.ca/assets/pdf/compostgdlns_1340_e.pdf

Foreign Matter Content

Category A compost cannot contain either sharp foreign matter (dimension ≥3 mm/500 ml) or more than one piece of other foreign matter (dimension ≥25 mm/500 ml); whereas, Category B compost cannot contain either < 3 pieces of sharp foreign matter/500 ml (max. dimension 12.5 mm) or <2 pieces of other foreign matter (dimension >25mm/500 ml).

Maturity

Recognizing that immature compost has the potential to adversely affect plants in large application amount or attract vectors, and to cause odours, compost must be mature when sold or distributed. Compost that has been cured for a minimum of 21 days and meets respiration rates, carbon dioxide evolution rates and temperature rise limits prescribed in the guidelines are considered mature.

Pathogens

The guideline identifies treatment criteria to achieve pathogen reduction and/or destruction, which generally identify the requirement of maintaining a temperature of 55°C or greater for a required number of days, depending on the method. The organism content of compost containing a non-yard waste (e.g., biosoilds) feedstock shall meet fecal coliforms <1000 MPN/g of total solids (dry weight basis) OR no *Samonella sp.* (detection level < 3MPN/4 g total solids – dry weight basis).

The guideline recommends avoiding composting raw materials with high contents of persistent or bio-accumulating organic contaminants from industrial or domestic sources (e.g., dioxins, furans, pesticides, polychlorinated biphenyls [PCBs], polycyclic aromatic hydrocarbons [PAHs] or herbicides). However, routine testing for these analytes is not required under the guideline.

OTHER RESOURCES

CCME Canada-wide Approach for the Management of Wastewater Biosolids

Recognizing that biosolids management legislation and policies differ widely across provinces and territories in Canada (where available), the CCME developed a Canada-wide Approach for the Management of Wastewater Biosolids (Canadian Council of Ministers of the Environment 2012). The Approach is extended beyond biosolids to include municipal sludge and treated septage. In 2009, the CCME developed a similar strategy for the management of municipal wastewater effluent (Canadian Council of Ministers of the Environment 2009).

The goal of the Approach is to instill public confidence in how wastewater biosolids are managed, as well as to protect the environment and human health. The Approach consists of a Policy Statement with four supporting principles. A supporting document – Guidance Document for the Beneficial Use of Municipal Biosolids,

Municipal Sludge and Treated Septage (Canadian Council of Ministers of the Environment 2012)– is provided to assist Canadian regulators and biosolids generators in implementing Best Management Practices (BMPs) for beneficial use, regardless of the regulatory jurisdiction.

The Approach's Policy Statement reads:

> *"The Approach promotes the beneficial use of valuable resources such as nutrients, organic matter and energy contained within municipal biosolids, municipal sludge and treated septage. Beneficial use should be based on sound management principles that include:*
>
> - *Consideration of the utility and resource value (product performance);*
> - *Strategies to minimize potential risks to the environment and human health;*
> - *Strategies to minimize greenhouse gas (GHG) emissions; and*
> - *Adherence to federal, provincial, territorial and municipal standards, requirements or guidelines."*

Beneficial uses, including composting, are promoted over disposal.

BNQ

The Bureau de normlisation du Quebec (BNQ) developed involuntary standards for compost quality, on behalf of the Standards Council of Canada (Canadian Council of Ministers of the Environment 2005). The BNQ has also established sampling and analytical test methods for testing compost, such as a sieve analysis method for determination foreign matter content of compost *(CAN/BNQ 0413-210-2005).*

OTHER

Noise Bylaws

Policies regarding noise generation are typically developed at the municipal level in Canada through local bylaws. Some rural municipalities may not opt to enact a bylaw governing noise and its sources; however, such policy is common in urban areas.

Bylaws will typically prescribe the time of day and days of the week in which noise can be generated. They may also prescribe a maximum level increase over the normal average or baseline ambient noise levels that is tolerable. Noise bylaws are enforced by bylaw enforcement officers or the local police.

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Chapter 4: A Process Map for Planning, Initiating and Operating a Biosolids Composting Utilization System in Southern Manitoba

The following chapter presents the study capstone – a policy-based process map for planning, initiating and operating a biosolids composting facility in Southern Manitoba. The map is based on the review of legislation requirements and utilization program best practices conducted in Chapters 3 and 4, respectively.

INTRODUCTION

The process map incorporates regulatory requirements in planning and operating a facility. The map is annotated with additional information and relevant guidance material, including hyperlinks to application materials, where appropriate or available. The purpose of the map is to assist rural municipal staff in determining the flow of activities and binary (e.g., yes, no) decisions required to evaluate site suitability, identify and prepare environmental approvals, conduct the composting process and utilize the end product.

This process map can be used by rural municipal public works staff and/or consultants as a basis for planning a biosolids composting facility in southern Manitoba. In addition, having the end-to-end process mapped out can help potential future operators understand the types of considerations required in planning and operating a facility, prior to making a decision on whether to compost biosolids.

PROCESS MAPPING BOUNDARIES

The boundaries of the process mapping were from the evaluation of biosolids characteristics for potential composting by the operator to the end use of the compost product by the end user. From end-to-end, the biosolids composting process is comprised of multiple phases or sub-processes, including but not necessarily limited to:

- Evaluating feedstocks;

- Identifying markets;
- Selecting a site;
- Obtaining approvals;
- Preparing the site;
- Conducting the composting;
- Analyzing the end product; and,
- Using the end product.

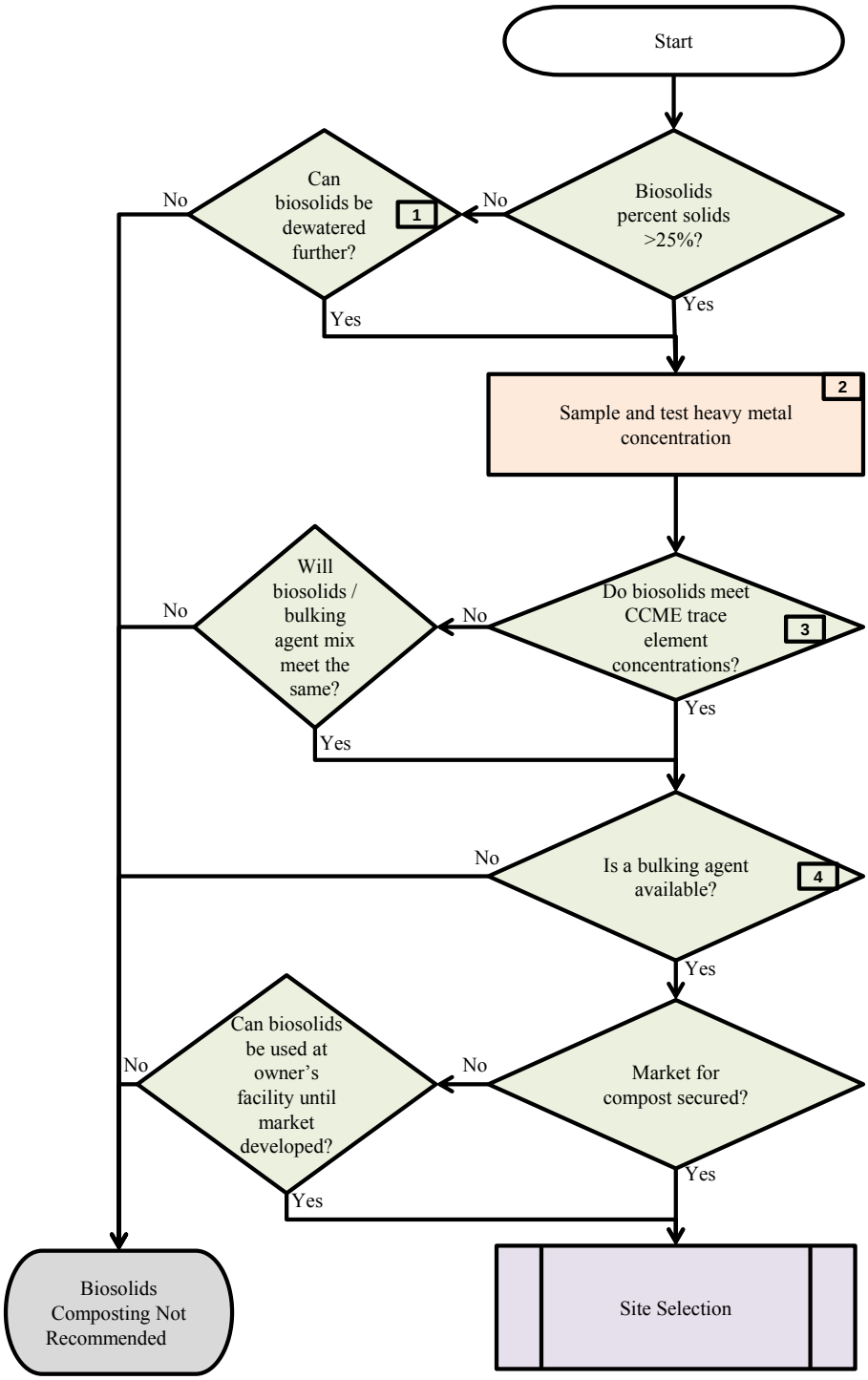
PROCESS MAP

The process map is presented in pages 72 to 89. This is the first known documentation of the process to plan, site and operate a biosolids composting facility in Manitoba.

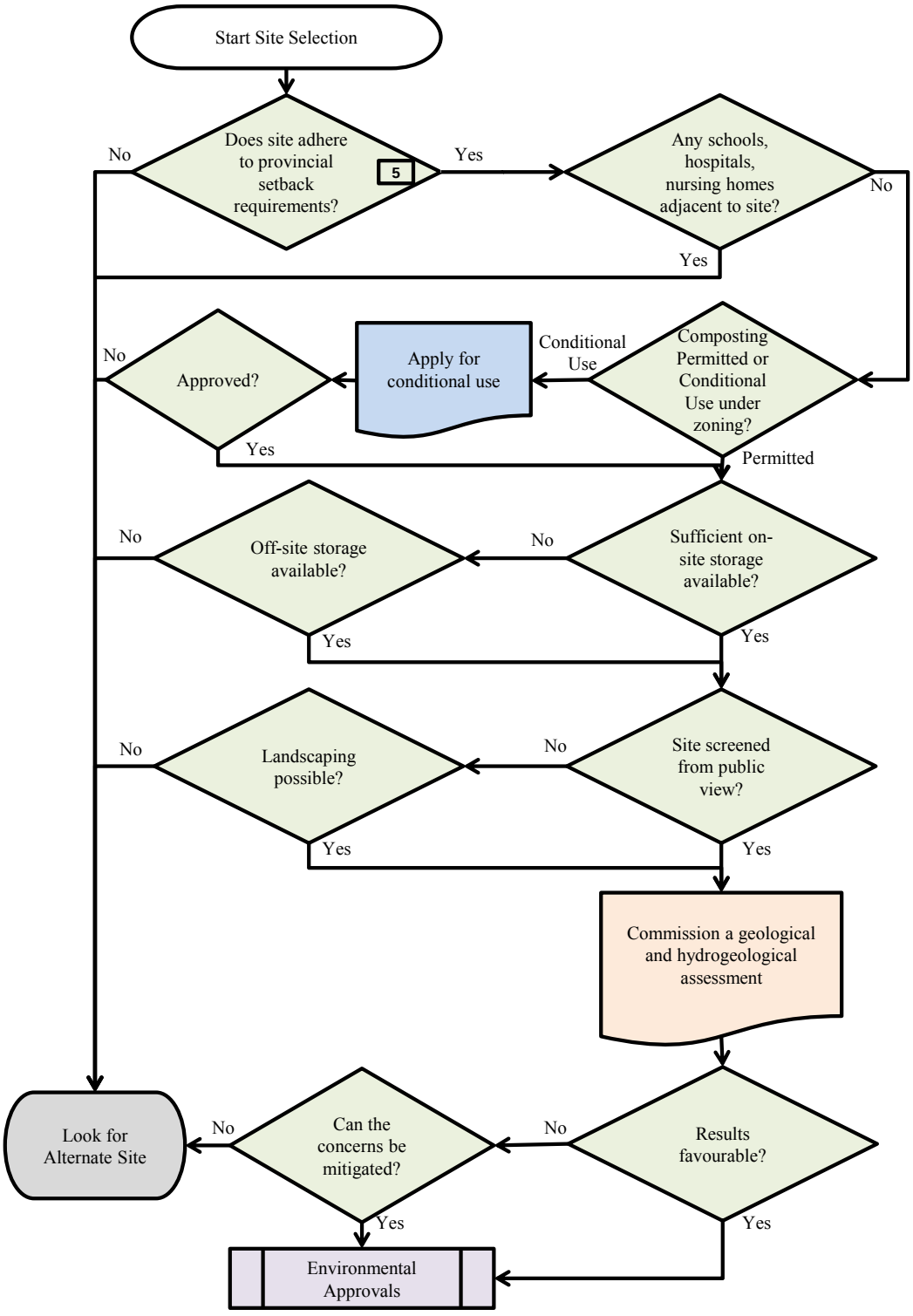
In developing this process map, it was determined that current Manitoba Conservation and Water Stewardship policies require a more protective separation distance for composting pads from the seasonal high water table level (1.0 m separation) than that required by the most current *Draft Compost Facility Guidelines* (0.5 m separation), suggesting that the guidelines require updating.

Evaluate Biosolids Characteristics & Potential Market(s)

No.	Additional Information
1.	Evaluate the potential use of dewatering technologies, such as sludge drying bags, vacuum drying beds, belt presses, centrifuges, etc.
2.	Sample and test for heavy metals, including but not necessarily limited to: arsenic (As), cobalt (Co), chromium (Cr), molybdenum (Mo), nickel (Ni), selenium (Se), zinc (Zn), cadmium (Cd), mercury (Hg), and lead (Pb).
3.	See Table 1 of the *CCME Guidelines for Compost Quality – PN 1340*, available online at: http://www.ccme.ca/assets/pdf/compostgdlns_1340_e.pdf
4.	Bulking agent may include wood chips, sawdust or another carbon source, preferably with coarse dimensions.
Acronyms / Abbreviations / Measurements: CCME – Canadian Council of Ministers of the Environment CFIA – Canadian Food Inspection Agency	

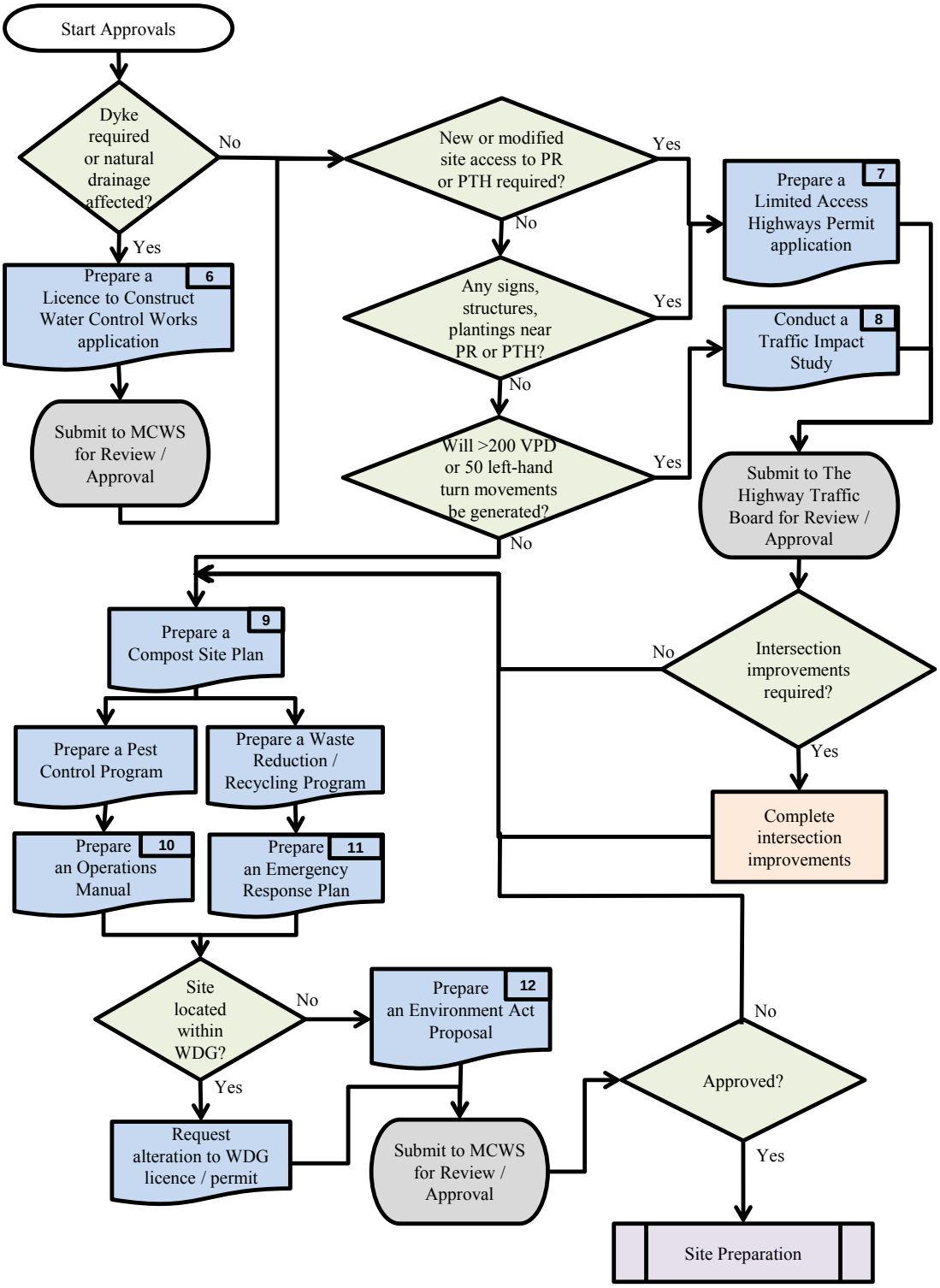

Start
Biosolids percent solids >25%?
No
Can biosolids be dewatered further?
1
No
Yes
Yes
Sample and test heavy metal concentration
2
Do biosolids meet CCME trace element concentrations?
3
No
Will biosolids / bulking agent mix meet the same?
No
Yes
Yes
Is a bulking agent available?
4
No
Yes
Market for compost secured?
No
Can biosolids be used at owner's facility until market developed?
No
Yes
Yes
Biosolids Composting Not Recommended
Site Selection

<table>
<tr><th>No.</th><th>Additional Information</th></tr>
<tr><td>5.</td><td>
<table>
<tr><th>Feature</th><th>Minimum Separation Distance from Active Area (m)</th></tr>
<tr><td>Adjacent Property</td><td>30</td></tr>
<tr><td>Public Roads</td><td>100</td></tr>
<tr><td>Railway</td><td>100</td></tr>
<tr><td>Public Parks</td><td>300</td></tr>
<tr><td>Buildings (Residential, Institutional, Commercial, Industrial)</td><td>400</td></tr>
<tr><td>Cemetery</td><td>400</td></tr>
<tr><td>Potable Water Well</td><td>400</td></tr>
<tr><td>Body of Surface Water (Lakes, Streams, but not Drainage Ditches)</td><td>1,000</td></tr>
<tr><td>Water Supply Intake</td><td>1,000</td></tr>
<tr><td>Critical Habitat Areas</td><td>2,000</td></tr>
<tr><td>Wetlands</td><td>2,000</td></tr>
<tr><td>Airports</td><td>8,000</td></tr>
<tr><td colspan="2">Not within floodplain</td></tr>
<tr><td colspan="2">Not within unstable areas</td></tr>
</table>
(Source: KGS Group 2001)
</td></tr>
<tr><td colspan="2">Acronyms / Abbreviations / Measurements:
m – metre(s)</td></tr>
</table>


Start Site Selection
Does site adhere to provincial setback requirements?
5
No
Yes
Any schools, hospitals, nursing homes adjacent to site?
No
Yes
Composting Permitted or Conditional Use under zoning?
Conditional Use
Apply for conditional use
Approved?
No
Yes
Permitted
Sufficient on-site storage available?
No
Off-site storage available?
No
Yes
Yes
Site screened from public view?
No
Landscaping possible?
No
Yes
Yes
Commission a geological and hydrogeological assessment
Results favourable?
No
Can the concerns be mitigated?
No
Look for Alternate Site
Yes
Yes
Environmental Approvals

No.	Additional Information
6.	Constructing, altering or reconstructing any dyke, dam, surface or subsurface drain, drainage, improved natural waterway, canal, tunnel bridge, culvert, borehole or contrivance for carrying or conducting water that temporarily or permanently alters water flow or level or may cause a change in the location or direction of water flow requires a Licence to Construct Water Control Works from the Water Control Works and Drainage Licensing Section of MCWS. The application form is available online at: http://www.gov.mb.ca/waterstewardship/licensing/wcwdl_licence_app.pdf
7.	Constructing or modifying an existing entrance or exit onto a limited access highway (designated PR/PTH) is prohibited, except under permit issued by the Highway Traffic Board. Constructing developments or structures within 125 feet of the highway right-of-way edge or plantings within 50 feet of the same is also prohibited, except under permit. The application form is available online at: http://www.gov.mb.ca/mit/boards/pdf/htbapplication.pdf
8.	A Traffic Impact Study may be need to be submitted to MIT for review and approval if the anticipated traffic generated by the compost facility will exceed 200 VPD and/or 50 left-hand turn movements at a PR or PTH intersection. Guidelines to aid in the preparation of a Traffic Impact Study are available online at: https://www.gov.mb.ca/mit/hpd/pdf/trafficimpact.pdf
9.	Compost Site Plan should include: facility design capacity, proposed feedstock types, proposed equipment, means of measuring received feedstock amount, processing method and sequence, leachate / stormwater controls, backup and overflow areas, vehicle access road details (all-weather, large vehicle two-way traffic).
10.	Operations Manual should address compost management practices and compost sampling and monitoring plan (for active composting and end product) at a minimum.
11.	Emergency Response Plan should be developed in accordance with CCOHS emergency response planning guidelines, available for purchase online at: http://www.ccohs.ca/products/publications/emergency.html
12.	Environment Act Proposal Report Guidelines are available online at: http://www.gov.mb.ca/conservation/eal/publs/info_eap.pdf

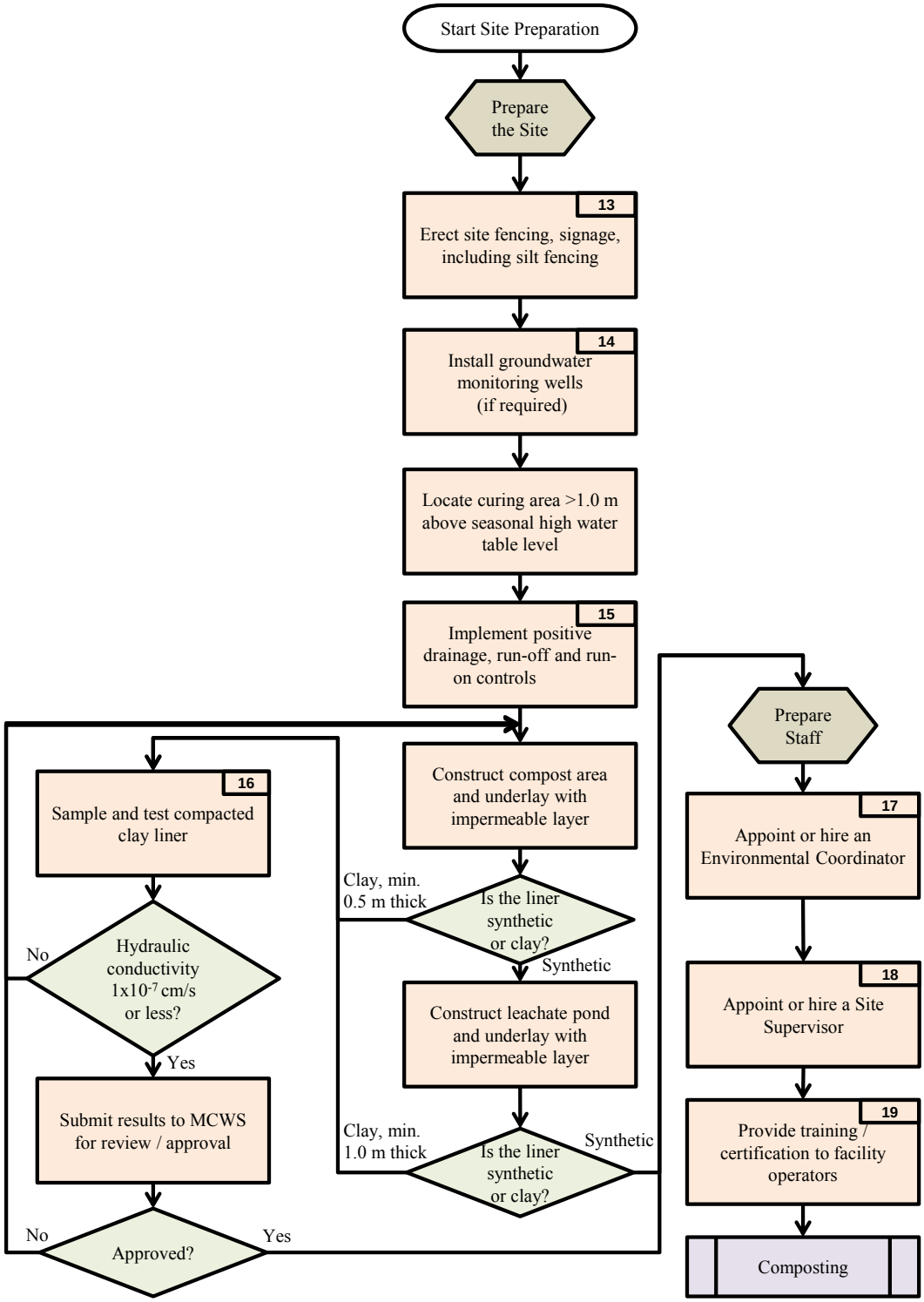
Acronyms / Abbreviations / Measurements:
CCOHS – Canadian Centre for Occupational Health and Safety
MCWS – Manitoba Conservation and Water Stewardship
MIT – Manitoba Infrastructure and Transportation
PR – Provincial Road; PTH – Provincial Trunk Highway
VPD – Vehicles per Day
WDG – Waste Disposal Ground


Start Approvals
Dyke required or natural drainage affected?
No
Yes
Prepare a Licence to Construct Water Control Works application
6
Submit to MCWS for Review / Approval
New or modified site access to PR or PTH required?
Yes
No
Prepare a Limited Access Highways Permit application
7
Any signs, structures, plantings near PR or PTH?
Yes
No
Conduct a Traffic Impact Study
8
Will >200 VPD or 50 left-hand turn movements be generated?
Yes
No
Submit to The Highway Traffic Board for Review / Approval
Intersection improvements required?
No
Yes
Complete intersection improvements
Prepare a Compost Site Plan
9
Prepare a Pest Control Program
Prepare a Waste Reduction / Recycling Program
Prepare an Operations Manual
10
Prepare an Emergency Response Plan
11
Site located within WDG?
No
Yes
Prepare an Environment Act Proposal
12
Request alteration to WDG licence / permit
Submit to MCWS for Review / Approval
Approved?
No
Yes
Site Preparation

Site Preparation

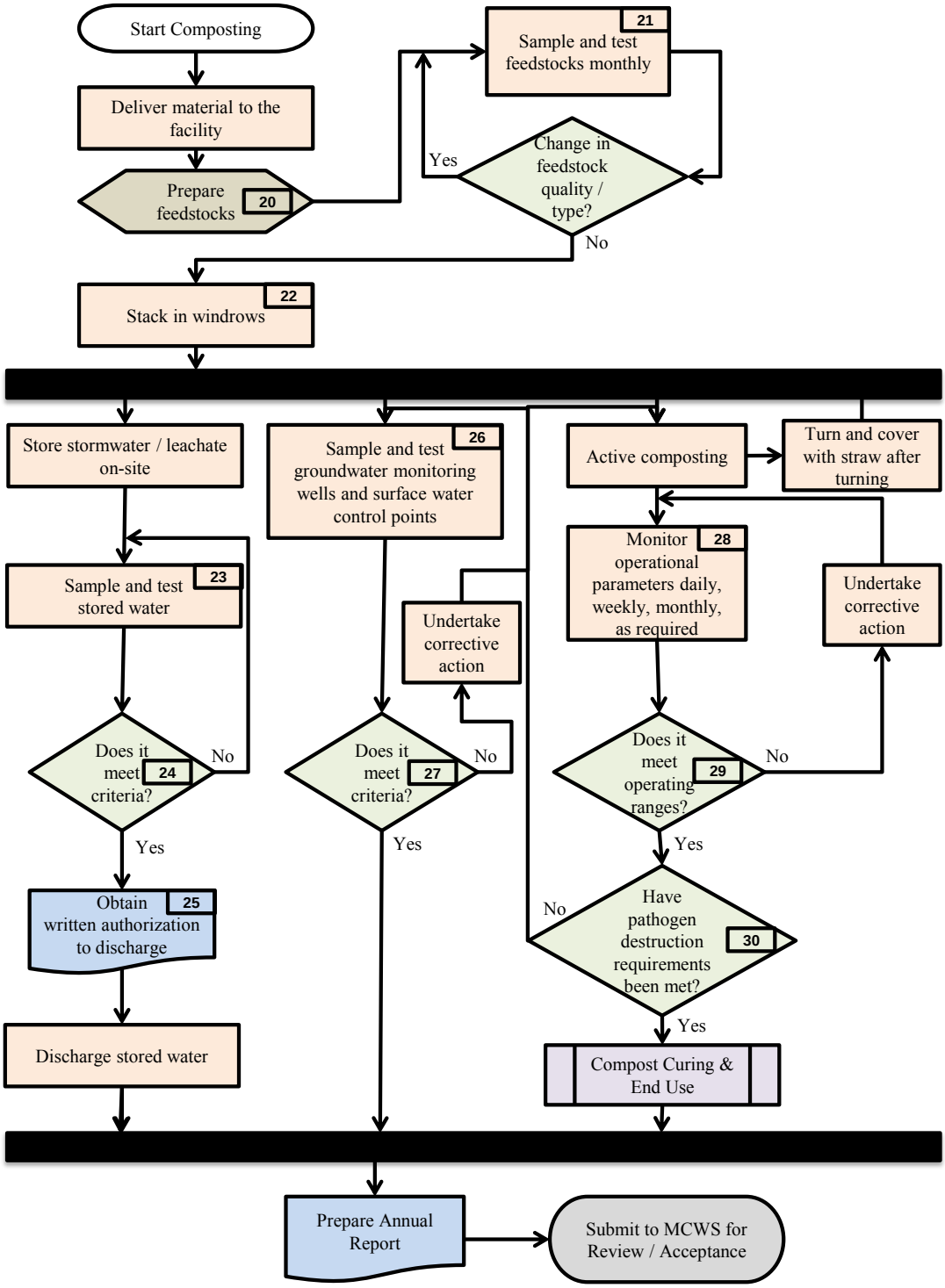
No.	Additional Information
13.	Provide a lockable fence. Previous Manitoba compost facilities have been required to install a 1.2 m high fence. Silt fencing should be installed prior to site construction and removed once the site is stabilized.
14.	The installation of groundwater monitoring wells, including the number of wells and well locations relative to the site are determined on a site-specific basis based on site soils and proximity to sensitive receptors, such as domestic well users and water supply wells. Contact MCWS Environmental Approvals Branch to determine the groundwater monitoring requirements.
15.	Size leachate / stormwater storage ponds to handle anticipated moisture generation from compost, large precipitation events and spring melt. Previous Manitoba compost facilities have been required to plan for a 1:50 year precipitation event.
16.	Sample and test in accordance with **Appendix 2.**
17.	The Environmental Coordinator is responsible for assisting with Environment Act Licence compliance, if applicable, and assisting senior management to manage environmental issues associated with the facility. The name of the appointed Environmental Coordinator should be provided to the MCWS Director of Environmental Approvals within 14 days of appointment.
18.	The site must be supervised at all times during operating hours.
19.	The Operations Manual and Emergency Response Plan should be included in any training program. Retain all training records for a period of 5 years.

Acronyms / Abbreviations / Measurements:
cm/s – centimetres per second
m – metre
mm – millimetre
MCWS – Manitoba Conservation and Water Stewardship

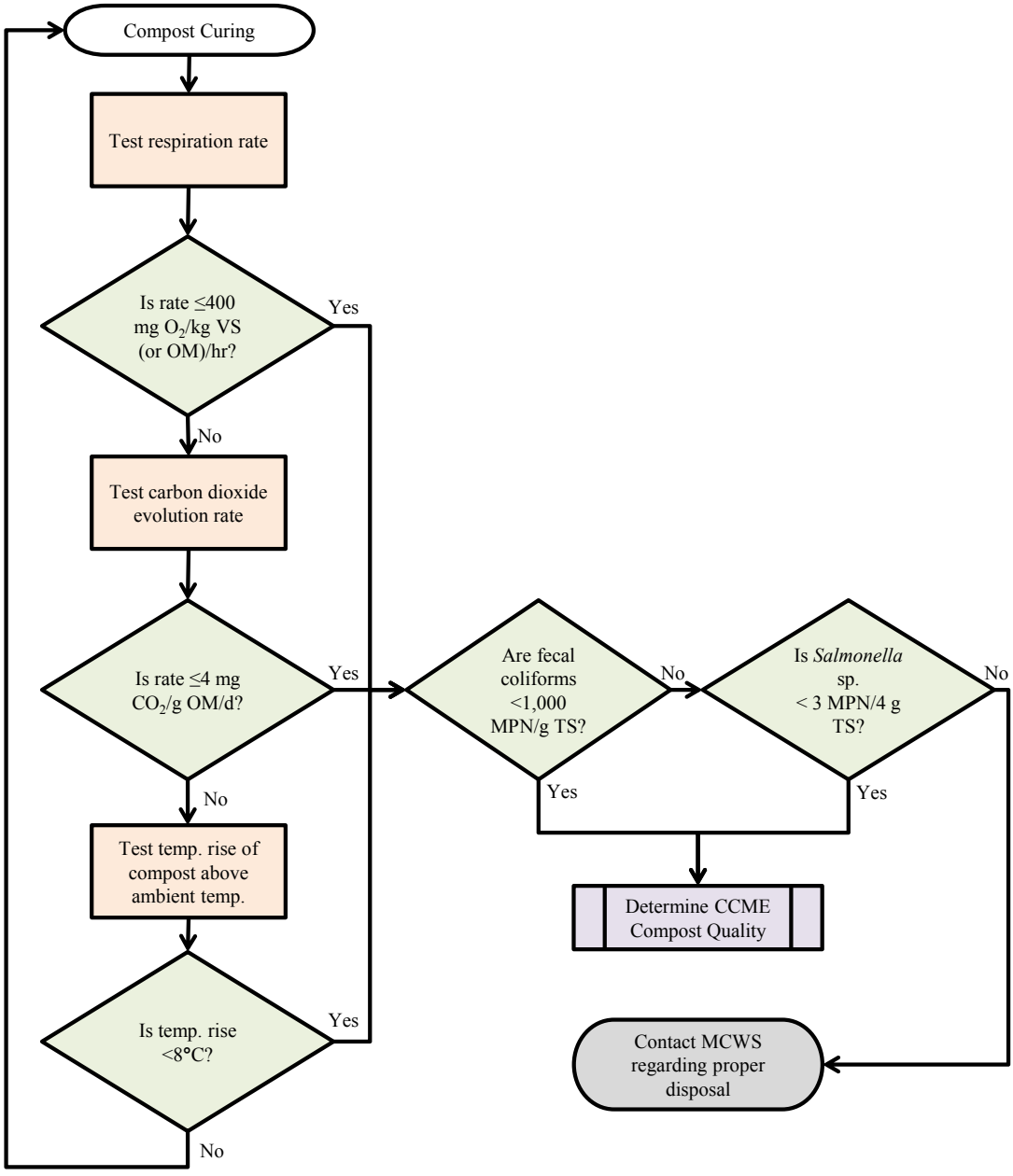

Start Site Preparation
Prepare the Site
13
Erect site fencing, signage, including silt fencing
14
Install groundwater monitoring wells (if required)
Locate curing area >1.0 m above seasonal high water table level
15
Implement positive drainage, run-off and run-on controls
Construct compost area and underlay with impermeable layer
Clay, min. 0.5 m thick
Is the liner synthetic or clay?
Synthetic
Construct leachate pond and underlay with impermeable layer
Clay, min. 1.0 m thick
Is the liner synthetic or clay?
Synthetic
16
Sample and test compacted clay liner
No
Hydraulic conductivity 1x10-7 cm/s or less?
Yes
Submit results to MCWS for review / approval
No
Approved?
Yes
Prepare Staff
17
Appoint or hire an Environmental Coordinator
18
Appoint or hire a Site Supervisor
19
Provide training / certification to facility operators
Composting

No.	Additional Information
20.	Confirm physical characteristics (e.g., free air space and moisture content). Conduct a mass balance to determine the feedstock volume required to achieve desired C:N ratio. Sample calculations are available online at: mawaterquality.org/industry_change/compost_school/Composting%20Recipes_Evanylo.pdf
21.	Monitor feedstock monthly for the following parameters, or when a change occurs: pH, nitrate, TKN, total metals, % moisture, volatile solids, total carbon.
22.	Stack in a rectangular, trapezoidal or triangular cross-section configuration in long, parallel rows with equipment travel paths in between.
23.	Sample for chemical and biological parameters provided by MCWS Environmental Approvals Branch.
24.	The effluent must comply with Tier I and Tier II of the *Manitoba Water Quality Standards, Objectives and Guidelines Regulation.*
25.	Obtain written authorization from the MCWS Director of Environmental Approvals prior to discharge.
26.	Sample and test groundwater monitoring wells and surface water control points on the frequency stipulated by the MCWS Director of Environmental Approvals. Typical groundwater monitoring parameters for previous non-biosolids Manitoba compost facilities is provided in **Appendix 3.**
27.	Canadian Drinking Water Quality Guidelines (groundwater) and the CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life (surface water).
28.	Monitor on the following basis, in accordance with previous Manitoba composting facilities: Daily: Temperature; Weekly: Moisture Content; Monthly: Ammonia and Carbon Dioxide.
29.	Operating ranges: Temperature <140°F (Rynk et al. 1992); Moisture Content: 40-60% (US EPA 2003).
30.	Pathogen reduction is met when a temperature of 55°C is obtained throughout the entire pile for a minimum period of 15 days and turned 5 times during that period.

Acronyms / Abbreviations / Measurements:
CCME – Canadian Council of Ministers of the Environment
C:N Ratio – Carbon to Nitrogen Ratio
m - metre
MCWS – Manitoba Conservation and Water Stewardship
MWQSOGs – *Manitoba Water Quality Standards, Objectives and Guidelines*
TKN – Total Kjeldahl Nitrogen

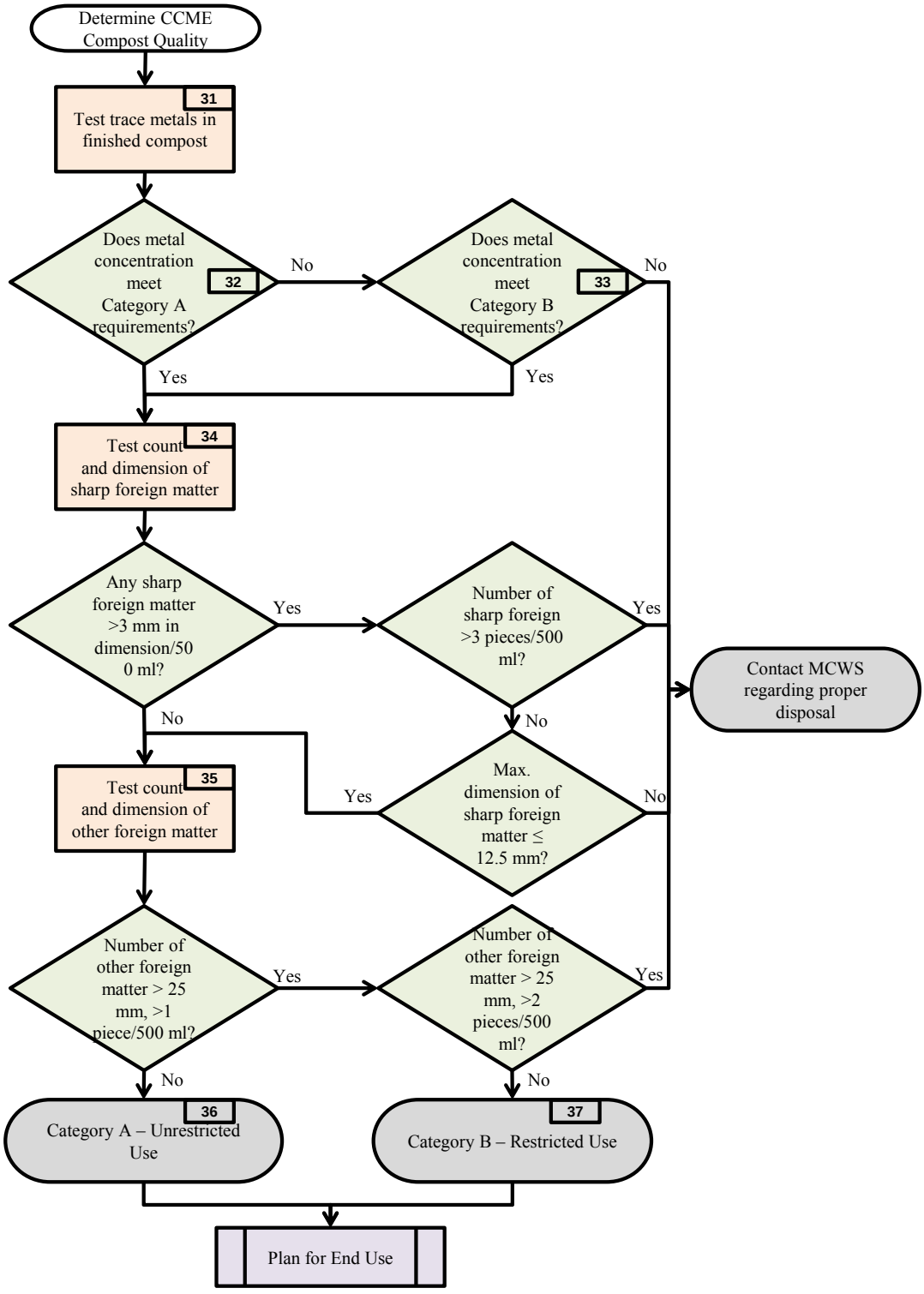

Start Composting
Deliver material to the facility
Prepare feedstocks 20
Sample and test feedstocks monthly 21
Change in feedstock quality / type?
Yes
No
Stack in windrows 22
Store stormwater / leachate on-site
Sample and test stored water 23
Does it meet criteria? 24
No
Yes
Obtain written authorization to discharge 25
Discharge stored water
Sample and test groundwater monitoring wells and surface water control points 26
Undertake corrective action
Does it meet criteria? 27
No
Yes
Active composting
Turn and cover with straw after turning
Monitor operational parameters daily, weekly, monthly, as required 28
Undertake corrective action
Does it meet operating ranges? 29
No
Yes
Have pathogen destruction requirements been met? 30
No
Yes
Compost Curing & End Use
Prepare Annual Report
Submit to MCWS for Review / Acceptance

Acronyms / Abbreviations / Measurements:
CCME – Canadian Council of Ministers of the Environment
CO_2 – carbon dioxide
d – day
g – gram
hr – hour
kg – kilogram
MCWS – Manitoba Conservation and Water Stewardship
mg – milligram
MPN – most probable number
O_2 – oxygen
OM – organic matter
temp. – temperature
TS – total solids
VS – volatile solids


Compost Curing
Test respiration rate
Is rate ≤400 mg O_2/kg VS (or OM)/hr?
Yes
No
Test carbon dioxide evolution rate
Is rate ≤4 mg CO_2/g OM/d?
Yes
No
Test temp. rise of compost above ambient temp.
Is temp. rise <8°C?
Yes
No
Are fecal coliforms <1,000 MPN/g TS?
No
Yes
Is *Salmonella* sp. < 3 MPN/4 g TS?
No
Yes
Determine CCME Compost Quality
Contact MCWS regarding proper disposal

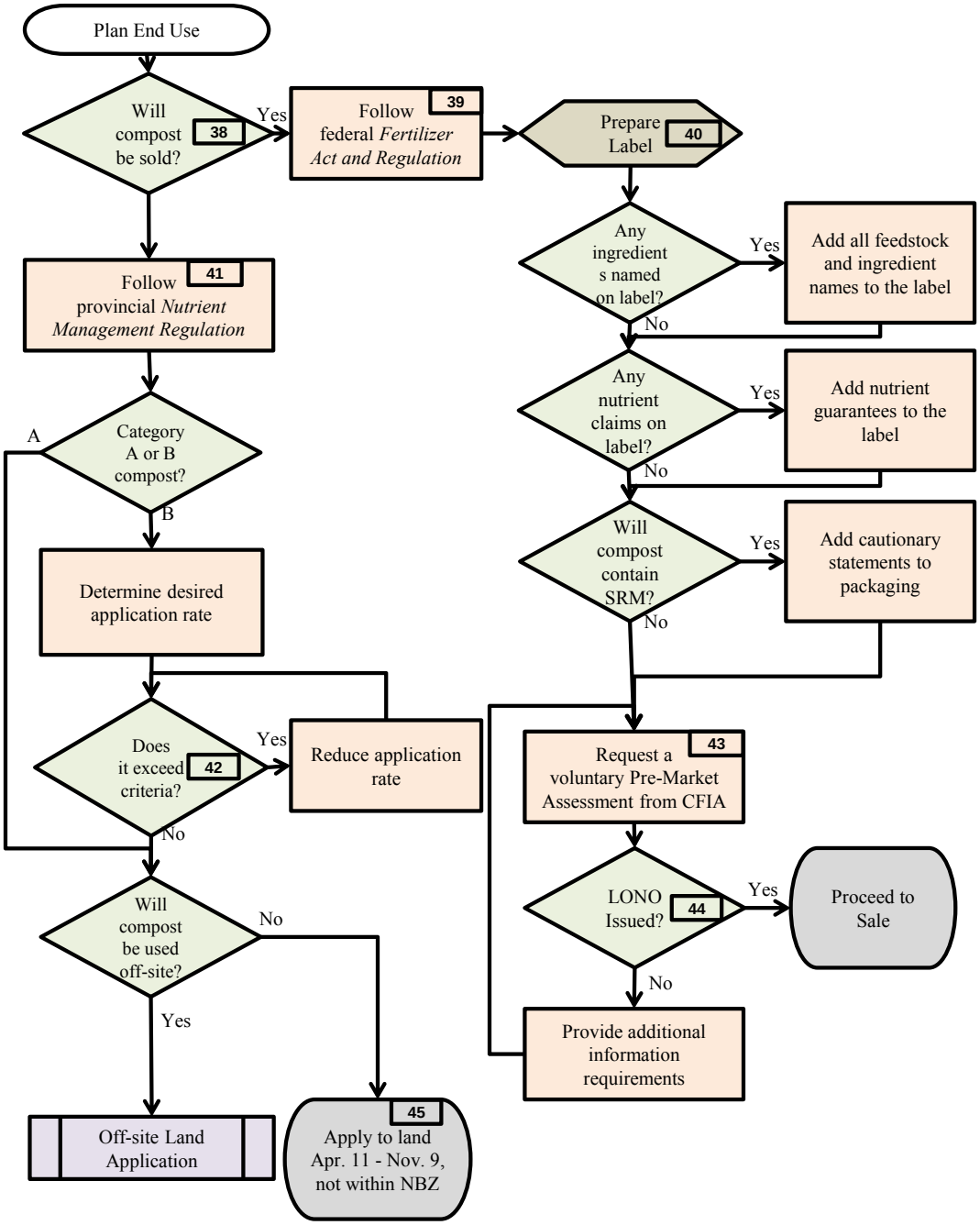
No.	Additional Information
31.	Sample and test for heavy metals, including but not necessarily limited to: arsenic (As), cobalt (Co), chromium (Cr), molybdenum (Mo), nickel (Ni), selenium (Se), zinc (Zn), cadmium (Cd), mercury (Hg), and lead (Pb).
32.	See table under annotation No. 3 on Evaluate Biosolids Characteristics & Potential Market(s) page.
33.	See table under annotation No. 3 on Evaluate Biosolids Characteristics & Potential Market(s) page.
34.	Using the Sieving Method, test the number and maximum dimension of sharp foreign matter per 500 ml volume – see CAN/BNQ 0413-200-2005.
35.	Using the Sieving Method, test the number of other foreign matter greater than 25 mm in dimension per 500 ml volume – see CAN/BNQ 0413-200-2005.
36.	There are no restrictions on the use of Category A compost. It can be used in residential gardens, on agricultural land, in nurseries and elsewhere (CCME 2005).
37.	There are restrictions on the use of Category B compost as it contains sharp foreign matter and higher trace elements. It is prohibited from use in pastures, parks or for residential purposes.

Acronyms / Abbreviations / Measurements:
BNQ – Bureau de Normalisation du Quebec
CCME – Canadian Council of Ministers of the Environment
MCWS – Manitoba Conservation and Water Stewardship
ml – millilitre
mm – millimetre


Determine CCME Compost Quality
31
Test trace metals in finished compost
Does metal concentration meet Category A requirements?
32
No
Does metal concentration meet Category B requirements?
33
No
Yes
Yes
34
Test count and dimension of sharp foreign matter
Any sharp foreign matter >3 mm in dimension/500 ml?
Yes
Number of sharp foreign >3 pieces/500 ml?
Yes
Contact MCWS regarding proper disposal
No
No
35
Test count and dimension of other foreign matter
Yes
Max. dimension of sharp foreign matter ≤ 12.5 mm?
No
Number of other foreign matter > 25 mm, >1 piece/500 ml?
Yes
Number of other foreign matter > 25 mm, >2 pieces/500 ml?
Yes
No
No
36
Category A – Unrestricted Use
37
Category B – Restricted Use
Plan for End Use

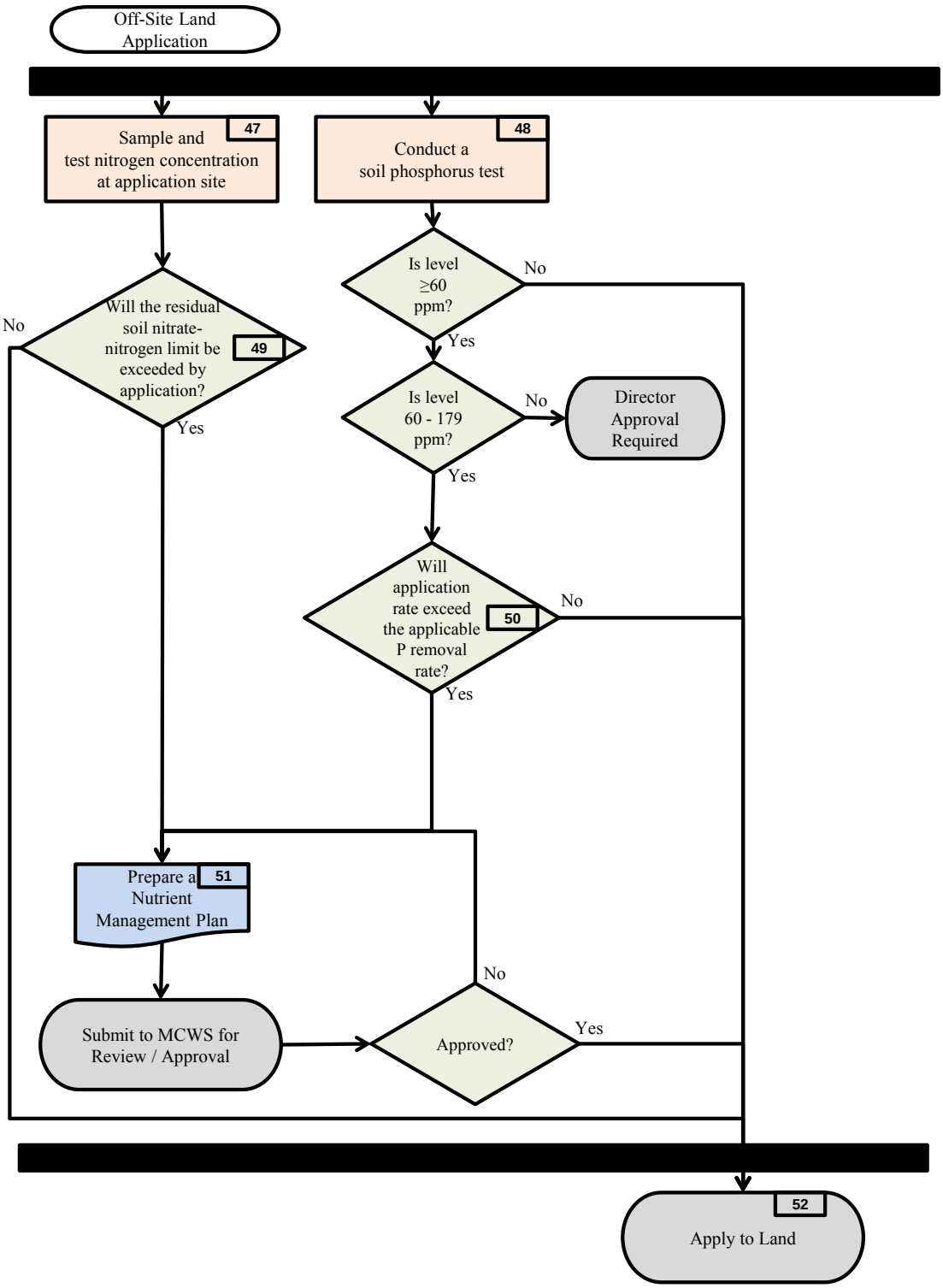
No.	Additional Information
38.	Includes bagged or bulk compost. Collecting transportation costs for delivering free compost would also constitute sale (Antler 2011).
39.	Available online at: Act - http://canlii.ca/t/hzhd Regulation - http://canlii.ca/t/521fz
40.	Product label should include the following, at a minimum, in both official languages: net weight (metric units); name and address of responsible packager; lot number; guaranteed analysis (min. OM, max. moisture content); directions for use (application rate, dilution, frequency); SRM cautionary statements, if required.
41.	Available online at: http://canlii.ca/t/k7s3
42.	See Category B Maximum Cumulative Additions to Soil (kg/ha) under C*CME Guidelines for Compost Quality – PN 1340* available online at: http://www.ccme.ca/assets/pdf/compostgdlns_1340_e.pdf
43.	Provide information regarding: processing method, inputs and trace metal, pathogen, dioxin and furan analytical results.
44.	LONO expires after three (3) years, or if the product manufacturing process or label changes.
45.	See Section 3(3) of *Nutrient Management Regulation* available online at: http://canlii.ca/t/k7s3

Acronyms / Abbreviations / Measurements:
CFIA – Canada Food Inspection Agency
SRM – Specified Risk Material
LONO – Letter of No Objection (to Sale)
MCWS – Manitoba Conservation and Water Stewardship
NBZs – Nutrient Buffer Zones
OM – Organic Matter


Plan End Use
Will compost be sold? 38
Yes
Follow federal *Fertilizer Act and Regulation* 39
Prepare Label 40
Any ingredient s named on label?
Yes
Add all feedstock and ingredient names to the label
No
Any nutrient claims on label?
Yes
Add nutrient guarantees to the label
No
Will compost contain SRM?
Yes
Add cautionary statements to packaging
No
Follow provincial *Nutrient Management Regulation* 41
Category A or B compost?
A
B
Determine desired application rate
Does it exceed criteria? 42
Yes
Reduce application rate
No
Will compost be used off-site?
No
Yes
Off-site Land Application
Apply to land Apr. 11 - Nov. 9, not within NBZ 45
Request a voluntary Pre-Market Assessment from CFIA 43
LONO Issued? 44
Yes
Proceed to Sale
No
Provide additional information requirements

No.	Additional Information
47.	Sample nitrate nitrogen and total nitrogen within 0-60 cm of soil **(see Appendix 2 – Province of Manitoba Sludge and Soil Sampling Protocol).**
48.	Sample sodium bicarbonate extractable phosphorus within 0-15 cm of soil **(see Appendix 2 – Province of Manitoba Sludge and Soil Sampling Protocol).**
49.	Zone N1 = 157.1 kg/ha, Zone N2 = 101 kg/ha, Zone N3 = 33.6 kg/ha. Note: nitrogen applications not allowed in Zone N4 or NBZ.
50.	Allowable application rate of P expressed as P_2O_5 is two times the crop removal rate where soil phosphorus is 60-119 ppm; and one times the crop removal rate where soil phosphorus is 120-179 ppm within Zone N1, N2 and N3. Soil phosphorus (Olsen P) measured within top 15 cm of soil. Note: phosphorus applications not allowed in Zone N4 or NBZ.
51.	A template is available online at: http://www.gov.mb.ca/waterstewardship/wqmz/pdf/municipal_wastewater_nmp.pdf
52.	Land application must be conducted in accordance with all applicable regulation, including the *Nutrient Management Regulation.*

Acronyms / Abbreviations / Measurements:
cm – centimetre
ha - hectare
kg - kilogram
MCWS – Manitoba Conservation and Water Stewardship
NBZs – Nutrient Buffer Zones
P - phosphorus
ppm – parts per million


Off-Site Land Application
Sample and test nitrogen concentration at application site
47
Conduct a soil phosphorus test
48
Is level ≥60 ppm?
No
Yes
Will the residual soil nitrate-nitrogen limit be exceeded by application?
49
No
Yes
Is level 60 - 179 ppm?
No
Director Approval Required
Yes
Will application rate exceed the applicable P removal rate?
50
No
Yes
Prepare a Nutrient Management Plan
51
Submit to MCWS for Review / Approval
No
Approved?
Yes
52
Apply to Land

WORKS CITED

Antler, Susan. "Compost & The Fertilizers Act and Regulations." *Compost Matters Mantioba Conference.* Brandon, 2011.

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Chapter 5: Results and Recommendations

RESULTS

While the management of biosolids in Manitoba is primarily regulated provincially by *The Environment Act (Classes of Development Regulation)* and *The Water Protection Act (Nutrient Management Regulation)*, there are a further three provincial and two federal statutes and six associated regulations that apply to the management of biosolids or the creation of a biosolids composting facility in Manitoba, for a total of fifteen pieces of applicable legislation, not including potentially applicable municipal bylaws. Over 25% (n = 4) of these pieces of legislation have recently been or are currently in the process of being amended.

Proponents proposing to initiate and operate a facility need to provide a minimum of 9 applications or documents to provincial or federal regulators in the process of planning, siting and operating a biosolids compost facility, including biosolids end use, to a potential maximum of 16 applications or documents.

At the level of detail mapped, there are a minimum of approximately 35 decision steps and 40 activities, required by proponents, with a maximum of approximately 53 and 58, respectively.

In addition, the interviews led to locating a seldom-used earlier Manitoba Environment composting guideline document entitled *Draft Centralized Composting Operations Information Bulletin, November 1996.*

CONCLUSION

The review of biosolids composting legislation identified that the focus of Manitoba regulation has been on agricultural land application and landfill disposal of biosolids. With the exception of the *LMMMR*, composting as an alternative management option for traditional waste products, such as biosolids, is not explicitly supported by provincial regulation in Manitoba and available guidance material is contained in out-dated draft documents.

The process map provides a visual, end-to-end understanding of the process to plan, site, initiate and operate a biosolids composting facility in Manitoba. With practical testing and refinement of the process map, it could be used to guide prospective rural Manitoba proponents through the key considerations in establishing a facility.

RECOMMENDATIONS

The following recommendations are made to Manitoba Conservation and Water Stewardship:

- Develop a stand-alone regulation under *The Environment Act* that addresses composting requirements for probable feedstocks, such as kitchen wastes, yard wastes, biosolids and wood wastes to clearly set out requirements for composting operations, similar to the setting out of composting requirements for livestock manure and/or mortalities in the *LMMMR*.
- Update the *Environmental Regulation for Treatment and Disposal of Biosolids in Manitoba* (Van den Bosch n.d.) policy document to acknowledge biosolids composting as a potential management method and add the potential for biosolids composting activities for the treatment and disposal of biosolids.

- Update and finalize the *Draft Compost Facility Guidelines* (KGS Group 2001) to reflect current requirements for compost facilities in the province and include biosolids as a potential feedstock. Such updates would be inline with MCWS's goals in amending the *Waste Disposal Ground Regulation* to include enhanced technical and environmental requirements for the development, operation, monitoring and reporting for waste management facilities in Manitoba, including composting facilities. The British *Columbia Compost Facility Requirements Guideline: How to Comply With Part 5 of the Organic Matter Recycling Regulation* (Forgle, Sasser and Neger 2004) may be a good model.
- Adopt categories of biosolids recognized or legislated in the province based on quality criteria such as trace elements, heavy metals, pathogen reduction, vector attraction, odour reduction, and/or degree of treatment developed by another jurisdiction (Canadian Council of Ministers of the Environment 2010). This would allow for multiple levels of policy that is as stringent as the material being regulated. For instance, the rigors of nutrient management planning and setback requirements could be varied by the degree of treatment and pathogen levels of different biosolids types.

FUTURE WORK

Future work that could be completed include:

- Pilot testing the process map with a Southern Manitoba rural municipality to determine its comprehensiveness and identify any potential gaps.

- Survey Manitoba municipalities to determine the current biosolids generation rates, treatment levels and disposal practices, to facilitate determining the sustainability of biosolids management practices in the province.
- Survey Manitoba municipalities to determine the number and types of compost facilities currently in operation in the province and/or plans to develop a composting facility, to determine the current and emerging interest in the practice.

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Appendices

APPENDIX 1 – INTERVIEW GUIDE

Biosolids Composting Regulatory Interview Guide

1. Which acts and regulations does your department administer related to biosolids composting facilities, operations or products?

2. What aspects of biosolids composting do your regulations focus on?

3. Are there any application, approval or licensing requirements associated with these acts or regulations?

4. What is the process for liaising with your department relative to these application, approval or licensing requirements?

5. If there are any required applications, what is the typical review time for approval?

6. What are some of the specific requirements related to biosolids composting related to your acts or regulations?

7. Are there any emerging regulatory requirements or planned changes to your department's acts or regulations that would affect biosolids composting operations in the future?

8. May I cite information from these responses as a personal communication with yourself?

9. Are there other contacts within government that you are aware of that directly regulate the operation of biosolids composting facilities or their products? Could you provide their name or alternatively have them contact the researcher, Carmen Anseeuw, at umgoussc@cc.umanitoba.ca to potentially be included in this study.

10. A brief summary of the results of this study will be ready by November 2013. Would you prefer to receive a copy by mail or e-mail?

Hello,

You are invited to participate in a study regarding regulatory requirements for biosolids composting being conducted by Ms. Carmen Anseeuw, Master of Environment Candidate at the University of Manitoba and Environmental Consultant with Stantec Consulting Ltd. As a participant of this research, you will be asked to participate in a telephone interview regarding current and emerging regulatory requirements for biosolids composting facilities, relative to acts and regulations administered by your department or branch. The purpose of this research is to streamline planning requirements for municipal governments in Southern Manitoba interested in implementing the beneficial reuse practice of composting wastewater biosolids.

Participating in the interview will take 20 to 40 minutes, during the week of September 16 or 23. The interview questions can be provided in advance of the interview upon request.

There is minimal potential risk to participating in this research study, as education and interpretation of legislation is part of the daily activities of public servants. Potential benefits to participants include advancing knowledge of requirements relating to this emerging practice, potentially reducing future inquiries.

You may withdraw from the study at any time without consequence by contacting the researcher at umgoussc@cc.umanitoba.ca. A brief summary of the research results will be available by November 2013. The results will be provided to the participants by the research by either mail or e-mail.

The results of this research will be presented in a Master of Environment thesis for the Clayton H. Riddell Faculty of Environment, Earth and Resources. The results may also be published in peer-reviewed journals and/or presented at conferences; however, comments will not be attributed to individuals, unless expressly permitted.

If you have any questions or concerns, or would like further information, including a copy of the research findings, please contact:

Carmen Anseeuw, B.Env.St.
[redacted]
E: umgoussc@cc.umanitoba.ca

This research program was approved on May 18, 2012 by:

Office of Research Ethics
208-194 Dafoe Road
University of Manitoba
Winnipeg, Manitoba R3T 2N2
Ph: (204) 474-8880
Fax: (204) 269-7173

Informed Consent Form

Research Project Title: Developing a Decision-Support System for Municipal Biosolids Composting Utilization Programs in Southern Manitoba

Principal Investigator:
Carmen Anseeuw, B.Env.St.
Master of Environment Candidate
University of Manitoba
[redacted]

Research Supervisor:
Dr. Rick Baydack
Professor, University of Manitoba
Clayton H. Riddell Faculty of Environment, Earth, and Resources
Department of Environment and Geography
225 Wallace Building
Winnipeg, Manitoba, R3T 2N2
Ph: (204) 474-6776
E: baydack@cc.umanitoba.ca

This consent form, a copy of which will be left with you for your records and reference, is only part of the process of informed consent. It should give you the basic idea of what the research is about and what your participation will involve. If you would like more detail about something mentioned here, or information not included here, you should feel free to ask. Please take the time to read this carefully and to understand any accompanying information.

The purpose of this research is to streamline planning requirements for municipal governments in Southern Manitoba interested in implementing the beneficial reuse practice of composting wastewater biosolids. The participant would be required to participate in a brief telephone interview that will take 20 – 40 minutes to complete, during the week of September 16 or 23. The interview questions can be provided in advance of the interview upon request.

Benefits of participating in this study are anticipated to include advancing the knowledge of regulatory requirements for the use of wastewater biosolids in composting in Southern Manitoba. There is minimal potential risk to participating in this research study, as education and interpretation of legislation is part of the daily activities of public servants.

Data will be confidential and will only be attributed to the individual or the individual's department if expressly permitted by the participant. Data will be stored electronically in a password-protected file accessible only by the researcher.

Participants may withdraw from the study at any time by contacting the principal investigator (umgoussc@cc.umanitoba.ca). There is no consequence for withdrawing from the study.

The results of the study will be disseminated in a Master of Environment thesis for the Clayton H. Riddell Faculty of Environment, Earth and Resources. The results may also be published in peer-reviewed journals and/or presented at conferences; however, comments will not be attributed to individuals, unless expressly permitted. A brief summary of the results will be available by November 2013. The results will be provided to the participant by the researcher by either mail or e-mail.

All data collected for this study will be destroyed by being permanently deleted and shredded in June 2016.

Your signature on this form indicates that you have understood to your satisfaction the information regarding participation in the research project and agree to participate as a subject. In no way does this waive your legal rights nor release the researchers, sponsors, or involved institutions from their legal and professional responsibilities. You are free to withdraw from the study at any time, and/or refrain from answering any questions you prefer to omit, without prejudice or consequence. Your continued participation should be as informed as your initial consent, so you should feel free to ask for clarification or new information throughout your participation.

The University of Manitoba may look at your research records to see that the research is being done in a safe and proper way.

This research has been approved by the University of Manitoba Fort Garry Campus Joint-Faculty Research Ethics Board. If you have any concerns or complaints about this project you may contact any of the above-named persons or the Human Ethics Coordinator (HEC) at 474-7122. A copy of this consent form has been given to you to keep for your records and reference.

Participant's Signature _____ Date _____

Researcher's Signature _____ Date _____

APPENDIX 2 – PROVINCE OF MANITOBA SLUDGE AND SOIL SAMPLING PROTOCOL

Sludge Solids

1. A representative sample of sludge solids shall be collected from each cell of the wastewater treatment lagoon from which sludge solids will be removed. A representative sample of sludge solids shall be a composite of sludge samples taken from a minimum of 5 locations distributed over the surface of the cell.
2. The sample of sludge solids shall be analyzed for the following parameters:*

a. conductivity
b. pH
c. total solids
d. volatile solids
e. nitrate nitrogen
f. total Kjeldahl nitrogen
g. ammonia nitrogen
h. organic nitrogen
i. total phosphorus
j. lead
k. mercury
1. nickel
m. potassium
n. cadmium
o. copper
P. zinc
q. chromium
r. arsenic

* Analysis for heavy metals must be carried out in accordance with Schedule "B" of this Licence.

Soil

3. Composite samples from each field onto which sludge solids will be applied shall be taken prior to application of sludge solids. Each field of twenty-four hectares or less shall be sampled from a minimum of twelve representative sites or a minimum of one sample site per two hectares for larger fields. Each sample site shall be sampled from 0 to 15 centimetres and from 0 to 60 centimetres. The entire core extracted for each sample shall be collected. All samples from similar depths within a field shall be bulked in one container for thorough mixing prior to analysis yielding two samples per field.
4. Soil samples from 0 centimetres to 15 centimetres shall be analyzed for the following: *

a. pH
b. potassium
c. nickel
d. mercury
e. zinc
f. sodium bicarbonate extractable phosphorus, as P
g. cadmium
h. chromium
i. copper
j. lead
k. arsenic

* Analysis for heavy metals must be carried out in accordance with Schedule "B" of this Licence.

5. Soil samples from 0 to 60 centimetres shall be analyzed for the following:
   a. nitrate nitrogen
   b. total nitrogen

Crops

6. The type of crop grown on lands on which sludge solids have been applied during the previous 3-year period shall be listed along with the legal description of the land and the date of application of sludge solids.

The analysis for all metals shall be carried out in accordance with the following requirements:

1. Soil and sludge samples shall be prepared using non-contaminating grinding and sieving procedures such as agate or porcelain mortar and pestle along with nylon sieves. Soil samples shall be ground to at least 100 mesh size prior to digestion or sample pretreatment.
2. Analysis for heavy metals must be carried out following strong acid digestion.
3. The laboratory performing these analyses shall operate an acceptable quality assurance program including the following:

a) Samples of reference material shall be analyzed to monitor the accuracy of the sludge and soil analyses and each set of ten or less samples of sludge or soil shall include, a minimum of the following:
   i) For sludge samples:
      - one NIST domestic sludge sample (SRM 2781);
   ii) For soil samples:
      - one NIST Estuarine Sediment sample (SRM 1646a); or
      - one NIST San Joaquin Soil sample (SRM 2709); or
      - a replacement reference soil sample, acceptable to the Director, with analyte concentrations that reflect values found in the field samples; and

b) Field duplicates of samples shall be analyzed based on a frequency of one in each set of ten or less field samples and that the acceptance criteria for duplicate analysis should be within ± 10 percent.

4. A copy of the analytical procedures and the analytical results for the reference materials, and any other controls used in the analysis, shall be submitted with the field sample results.
5. If the analytical results of the reference materials do not meet the following criteria, the soil and/or sludge samples must be re-analyzed:
   - Arsenic ± 35 percent from the reference value
   - Cadmium ± 25 percent from the reference value (for values above 1 µg/g)
   - Cadmium ± 35 percent from the reference value (for values below 1 pg/g)
   - Chromium ± 25 percent from the reference value
   - Copper ± 25 percent from the reference value
   - Lead ± 25 percent from the reference value
   - Mercury ± 35 percent from the reference value
   - Nickel ± 25 percent from the reference value
   - Zinc ± 25 percent from the reference value

APPENDIX 3 – TYPICAL LICENCE CONDITIONS FOR NON-BIOSOLIDS COMPOSTING FACILITIES IN MANITOBA

DEFINITIONS

In this Licence,

"accredited laboratory" means an analytical facility accredited by the Standard Council of Canada (SCC), or accredited by another accrediting agency recognized by Manitoba Conservation to be equivalent to the SCC, or be able to demonstrate, upon request, that it has the quality assurance/quality control (QA/QC) procedures in place equivalent to accreditation based on the international standard ISO/IEC 17025, or otherwise approved by the Director;

"affected area" means a geographical area excluding the property of the Development;

"approved" means approved by the Director or assigned Environment Officer in writing;

"compost" means solid mature product resulting from composting;

"composting" means managed process of bio-oxidation of a solid heterogeneous organic substrate including a thermophilic phase;

"Director" means an employee so designated pursuant to The Environment Act;

"Environment Officer" means an employee so designated pursuant to The Environment Act.

"leachate" means liquid that has percolated through compost feedstock or compost, and that contains dissolved and suspended materials from the compost feedstock or compost;

"liner" means a continuous layer of reworked soil, or man-made materials placed beneath and on the dyke of a composting facility, or a storage area intended to restrict the downward or lateral escape of leachate, and gas;

"noise nuisance" means an unwanted sound, in an affected area, which is annoying, troublesome, or disagreeable to a person:

a) residing in an affected area;

b) working in an affected area; or

c) present at a location in an affected area which is normally open to the members of the public;

if the unwanted sound

d) is the subject of at least 5 written complaints, received by the Director in a form satisfactory to the Director and within a 90 day period, from 5 different persons falling within clauses (a), (b) or (c), who do not live in the same household; or

e) is the subject of at least one written complaint, received by the Director in a form satisfactory to the Director, from a person falling within clauses (a), (b) or (c) and the Director is of the opinion that if the unwanted sound had occurred in a more densely populated area there would have been at least 5 written complaints received within a 90 day period from 5 different persons who do not live in the same household;

"odour nuisance" means a continuous or repeated odour, smell or aroma, in an affected area, which is offensive, obnoxious, troublesome, annoying, unpleasant, or disagreeable to a person:

a) residing in an affected area;

b) working in an affected area; or

c) present at a location in an affected area which IS normally open to the members of the public;

if the odour, smell or aroma

d) is the subject of at least 5 written complaints, received by the Director in a form satisfactory to the Director, and within a 90 day period, from 5 different persons falling within clauses a), b), or c), who do not live in the same household; or

e) is the subject of at least one written complaint, received by the Director in a form satisfactory to the Director, from a person falling within clauses a), b), or c), and the Director is of the opinion that if the unwanted odour, smell or aroma had occurred in a more densely populated area there would have been at least 5 written complaints received within a 90 day period from 5 different persons who do not live in the same household; and

f) is deemed by the Director, based on available information, to be valid.

"opacity" means the degree to which emissions reduce the transmission of light and obscure the view of an object in the background;

"particulate matter" means any finely divided liquid or solid matter other than water droplets;

"particulate residue" means that part or portion of an atmospheric emission which is deposited onto a surface;

"pest" means any injurious, noxious or troublesome, insect, weed, rodent, fungus, algae, or other plant or animal;

"point source" means any point of emission from a Development where pollutants are emitted to the atmosphere by means of a stack;

"reportable spill" means a spill of a specified quantity of a hazardous substance, as defined by Manitoba Regulation 439187 regarding Environmental Accident Reporting, or a spill of livestock manure, as defined by Manitoba Regulation 42/98 regarding Livestock Manure and Mortalities Management.

"Standard Methods for the Examination of Water and Wastewater" means the most recent edition of Standard Methods for the Examination of Water and Wastewater published jointly by the American Public Health Association, the American Waterworks Association and the Water Environment Federation; and

"wastewater" means any liquid containing a pollutant as defined in The Environment Act, associated with or resulting from the Development which is discharged into the environment.

GENERAL TERMS AND CONDITIONS

This Section of the Licence contains requirements intended to provide guidance to the Licencee in implementing practices to ensure that the environment is maintained in such

a manner as to sustain a high quality of life, including social and economic development, recreation and leisure for present and future Manitobans.

1. The Licencee shall, at all times during the operation of the Development, implement a high standard of equipment maintenance and good housekeeping and operational practices.

2. The Licencee shall reduce the production and dissemination of wastes by initiating and maintaining waste reduction and waste recycling programs.

3. The Licencee shall, upon the request of the Director:

a) sample, monitor, analyse or investigate specific areas of concern regarding any segment, component or aspect of pollutant storage, containment, treatment, handling, disposal or emission systems, for such duration and at such frequencies as may be specified;

b) determine the environmental impact associated with the release of any pollutants from the said Development;

c) conduct soil, air, ground water, surface water or noise monitoring at or adjacent to the Development;

d) conduct specific investigations in response to the data gathered during environmental monitoring programs; or

e) provide the Director, within such time as may be specified, with such reports, drawings, specifications, analytical data, flow rate measurements and such other information as may from time to time be requested.

4. The Licencee shall, in the event of a release, spill, leak, or discharge of a pollutant or contaminant in an amount or concentration, or at a level or rate of release, that exceeds the limit that is expressly provided under this Act, another Act of the Legislature, or an Act of Parliament, or in a regulation, licence, permit, order, instruction, directive or other approval or authorization issued or made under one of those Acts, immediately report the release, spill, leak, or discharge by calling 204-944-4888. The report shall indicate the nature of the release, leak, or discharge, the time and estimated duration of the event and the reason for the release, spill, leak, or discharge.

5. The Licencee shall, unless otherwise specified in this Licence:

a) carry out all preservations and analyses on liquid samples in accordance with the methods prescribed in the most current edition of Standard Methods for the Examination of Water and Wastewater or in accordance with equivalent preservation and analytical methodologies approved by the Director;

b) carry out all sampling of, and preservation and analyses on, soil and air samples in accordance with methodologies approved by the Director; and

c) ensure that all analytical determinations are undertaken by an accredited laboratory.

6. The Licencee shall carry out any remedial measures, modifications, or alterations, as deemed necessary by the Director, in respect to matters authorized under this Licence.

7. The Licencee shall submit all information required to be provided to the Director under this Licence, in writing, in such form (including number of copies) and of such content as may be specified by the Director, and each submission shall be clearly labelled with the Licence Number and Client File Number associated with this Licence.

8. The Licencee shall designate an employee, within 60 days of the date of issuance of this Licence, as the Licencee's Environmental Coordinator, whose job description will include assisting the Licencee in complying with the limits, terms and conditions in this Licence and assisting Senior Management of the Licencee to manage environmental issues at the Development. The name of the Environmental Coordinator shall be submitted in writing to the Director within 14 days of appointment.
9. The Licencee shall institute a pest control program at the Development in a manner acceptable to the Director.

SPECIFICATIONS, LIMITS, TERMS AND CONDITIONS

Respecting Construction and Operation

10. The Licencee shall, upon the request of the Director, construct a stormwater retention pond.
11. The Licencee shall notify the assigned Environment Officer not less than two weeks prior to commencing construction of the Development in any year in which construction occurs. The notification shall include the intended starting date of construction and the name of the contractor responsible for the construction.
12. The Licencee shall apply compost to agricultural land in compliance with the requirements of Manitoba Regulation 62/2008, or any future amendment thereof, respecting Nutrient Management.
13. The Licencee shall not apply compost to agricultural land between November 10 of one year and April 10 of the following year.
14. The Licencee shall incorporate compost after fall application.

Respecting Air Emissions - Limits

15. The Licencee shall not emit particulate matter from the Development such that:
    a) particulate matter:
        i) exceeds 0.23 grams per dry standard cubic metre calculated at 25 degrees Celsius and 760 millimetres of mercury, corrected to 12 percent carbon dioxide for processes involving combustion, from any point source of the Development;
        ii) exhibits a visible plume with an opacity of greater than 5 percent at any point beyond the property line of the Development; or
        iii) results in the deposition of visible particulate residue at any time beyond the property line of the Development; or
    b) opacity from any point source of the Development equals or exceeds:
        i) 20 percent as the average of any 24 consecutive opacity observations taken at 15 second intervals;
        ii) 20 percent for more than 16 individual opacity observations within any I hour period; or
        iii) 40 percent for any individual opacity observation.
16. The Licencee shall not cause or permit a noise nuisance to be created as a result of the construction, operation or alteration of the Development, and shall take such steps as the Director may require to eliminate or mitigate a noise nuisance.

17. The Licencee shall not cause or permit an odour nuisance to be created as a result of the construction, operation or alteration of the Development, and shall take such steps as the Director may require to eliminate or mitigate an odour nuisance.

Respecting Chemical Storage and Spill Containment

18. The Licencee shall provide containment for all vessels containing chemicals and in each area of the development where the chemicals are stored, loaded, transferred, used or otherwise handled, in compliance with the National Fire Code of Canada (201 0), or any future amendment thereof, such that any product leakage or spillage and any contaminated liquid generated is contained within the Development and contamination of groundwater and surface water is prevented.

19. The Licencee shall, in a manner approved by the Director, remove and dispose of all spilled dangerous goods.

Respecting Composting

20. The Licencee shall only conduct composting activities on a compost pad that consists of a minimum 0.5-metre thick compacted clay liner with a hydraulic conductivity of Ix 10^{-7} cm/s or less.

21. The Licencee shall provide all weather access to the compost pad.

22. The Licencee shall establish the appropriate Carbon to Nitrogen ratio (C:N) for each batch of compost prior to beginning the composting process for that batch.

23. The Licencee shall generate compost at the Development that achieves the quality requirements and specifications as contained in the most recent edition of the Canadian Council of Ministers of the Environment publication entitled "Guidelines for Compost Quality- PN1340".

24. The Licencee shall not sell or make available to any third party compost generated at the Development that does not achieve the quality requirements and specifications as contained in the most recent edition of the Canadian Council of Ministers of the Environment publication entitled "Guidelines for Compost Quality- PN1340".

25. The Licencee shall direct all leachate generated from composting at the Development to the on-site leachate and stormwater drainage basin which shall have a minimum 1.0-metre thick compacted clay liner with a hydraulic conductivity of 1 x I0-^{7} cm/s or less.

26. The Licencee shall, prior to the construction of the composting pad and the dykes for the on-site leachate and stormwater drainage basin:

a) remove all organic topsoil from the area where the composting pad and dykes will be constructed; or

b) remove all organic material for a depth of 0.3 metres and a width of 3.0 metres from the area where the liner will be constructed.

27. The Licencee shall arrange with the designated Environment Officer a mutually acceptable time and date for any required soil sampling between the 15th day of May and the 15th day of October of any year, unless otherwise approved by the designated Environment Officer.

28. The Licencee shall take and test undisturbed soil samples, in accordance with Schedule "A" attached to this Licence, from the liners of the composting pad and on- site leachate and stormwater drainage basin; the number and location of samples and test

methods are to be specified by the designated Environment Officer up to a maximum of 30 samples.
29. The Licencee shall, not less than two weeks before the Development is placed in operation, submit to the Director the results of the tests carried out pursuant to Clause 28 of this Licence.
30. The Licencee shall not discharge leachate from the on-site leachate and stormwater drainage basin without prior written authorization from the Director.
31. The Licencee, from the date of this Licence until such time that the Director agrees to adjust the monitoring requirements, shall conduct a compost monitoring program that includes:

a) daily measurement of temperature and moisture content;
b) weekly measurement of moisture content of curing compost;
c) monthly measurements of ammonia and carbon dioxide; and
d) measurement of nitrate, sulphur, phosphorus, potassium, zinc, magnesium, iron, copper, boron, sodium, and calcium content of finished and cured compost.
e) any other parameter at any frequency as required by the Director.

32. The Licencee shall maintain a record of the sampling results, obtained pursuant to Clause 31 of this Licence, at the Development and shall provide those records to an Environment Officer upon request.
33. The Licencee shall submit the sampling results, obtained pursuant to Clause 31 of this Licence, in an annual report containing at minimum but not limited to:

a) the raw data collected; and
b) a discussion of the sampling and analytical portions of the program including any anomalies of sampling and analysis.

34. The Licence shall submit, to the Director prior to March 1 of each year beginning in 2013, the annual report required by Clause 33 of this Licence.
35. The Licencee shall maintain sufficient carbon source on site to achieve the desired C:N ratio as determined pursuant to Clause 22 of this Licence.

36. The Licencee shall, immediately upon placing compost into windrows and immediately after turning windrows undergoing active composting, cover compost windrows with cover material consisting of straw, wood chips, or another material acceptable to the Director.
37. The Licencee shall maintain sufficient cover material on site to facilitate compliance with Clause 36 of this Licence at all times.
38. The Licencee shall, within 60 days of the date of this Licence, establish an Operations Manual acceptable to the Director that describes, at a minimum, the compost management practices necessary to achieve compliance with Clauses 23 and 31 of this Licence.
39. The Licencee shall provide the necessary training to on-site personnel at the Development to achieve compliance with Clause 23 of this Licence.

Respecting Emergencies

40. The Licencee shall, within 60 days of the issue date of this licence, submit to the Director an emergency response contingency plan in accordance with the Canadian Centre for Occupational Health and Safety emergency planning guidelines.

REVIEW AND REVOCATION

A. If in the opinion of the Director, the Licencee has exceeded or is exceeding or has or is failing to meet the specifications, limits, terms or conditions set out in this Licence, the Director may, temporarily or permanently, revoke this Licence.

B. If the Licencee has not commenced construction of the Development within three years of the date of this Licence, the Licence is revoked.

C. If, in the opinion of the Director, new evidence warrants a change in the specifications, limits, terms or conditions set out in this Licence, the Director may require the filing of a new proposal pursuant to The Environment Act.

Schedule "A" – See Appendix 4

APPENDIX 4 – MANITOBA CONSERVATION AND WATER STEWARDSHIP CLAY LINER SAMPLING AND TESTING REQUIREMENTS

Soil Sampling:

1. The Licencee shall provide a drilling rig, acceptable to the designated Environment Officer, to extract soil samples from the liner, which is not placed or found at the surface of the lagoon structure. This includes all wastewater treatment lagoons constructed with clay cutoffs at the interior base of the dyke or with a clay cutoff in the centre of the dyke. The drill rig shall have the capacity to drill to the maximum depth of the clay cutoff plus an additional 2 metres. The drill rig shall be equipped with both standard and hollow stem augers. The minimum hole diameter shall be 5 inches.

2. For lagoon liners placed or found at the surface of the lagoon structure, the Licencee shall provide a machine, acceptable to the designated Environment Officer, capable of pressing a sampling tube into the liner in a straight line motion along the centre axis line of the sample tube and without sideways movement.

3. Soil samples shall be collected and shipped in accordance with ASTM Standard D 1587 (Standard Practice for Thin-Walled Tube Sampling of Soils), D 4220 (Standard Practice for Preserving and Transporting Soil Samples) and D 3550 (Standard Practice for Ring-Lines Barrel Sampling of Soils). Thin-walled tubes shall meet the stated requirements including length, inside clearance ratio and corrosion protection. An adequate venting area shall be provided through the sampling head.

4. At the time of sample collection, the designated Environment Officer shall advise the Licencee as to the soil testing method that must be used on each sample. The oedometer method may be used for a sample were the Environment Officer determines that the soil sample is taken from an undisturbed clay soil which has not been remoulded and which is homogeneous and unweathered. The triaxial test shall be used for all samples taken from disturbed and remoulded soils or from nonhomogenous and weathered soils.

5. The Licencee shall provide a report on the collection of soil samples to the designated Environment Officer and to the laboratory technician which includes but is not limited to a plot plan indicating sample location, depth or elevation of sample, length of advance of the sample tube length of soil sample contained in the tube after its advancement, the soil test method specified by the Environment Officer for each soil sample and all necessary instructions from the site engineer to the laboratory technician.

6. All drill and sample holes shall be sealed with bentonite pellets after the field drilling and sampling has been completed.

Soil Testing Methods:

1. Triaxial Test Method

   a.) The soil samples shall be tested for hydraulic conductivity using ASTM D 5084 (Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter).

   b.) Soil specimens shall have a minimum diameter of 70 mm (2.75 inches) and a minimum height of 70 mm (2.75 inches). The soil specimens shall be selected from a section of the soil sample which contains the most porous material based on a visual inspection. The hydraulic gradient shall not exceed 30 during sample preparation and testing. Swelling of the soil specimen should be controlled to adjust for the amount of compaction measured during sample collection and extraction from the tube and the depth or elevation of the sample. The effective stress used during saturation or consolidation of the sample shall not exceed 40 kPa (5.7 psi) or the specific stress level that is expected in the field location were the sample was taken, which ever is greater.

   c.) The complete laboratory report, as outlined in ASTM D 5084, shall be supplied for each soil sample collected in the field.

2. Oedometer Test Method

   a.) The soil samples shall be tested for hydraulic conductivity using ASTM D 2435 (Standard Test Method for One-Dimensional Consolidation Properties of Soils).

   b.) Soil specimens shall have a minimum diameter of 50 mm (2 inches) and a minimum height of 20 mm (0.8 inches). The soil specimens shall be selected from a section of the soil sample which contains the most porous material based on a visual inspection. The soil specimen shall be taken from an undisturbed soil sample. The soil specimen shall be completely saturated.

   c.) The complete laboratory report, as outlined in ASTM D 2435, shall be supplied for each soil sample collected in the field.

APPENDIX 5 – TYPICAL MANITOBA CONSERVATION AND WATER STEWARDSHIP GROUNDWATER MONITORING REQUIREMENTS

Chemical Parameters	
Inorganics	
Alkalinity – Total	Magnesium
Ammonia	Manganese
Arsenic – Total	Mercury
Barium	Nitrate – Reported as N
Boron	Nitrite – Reported as N
Cadmium – Dissolved	Total Kjeldahl Nitrogen – Reported as N
Calcium	pH
Chloride	Total Phosphorus
Chromium – Dissolved	Potassium
Conductivity	Sodium
Copper – Dissolved	Total Dissolved Solids
Iron – Dissolved	Sulphate
Lead – Dissolved	Zinc – Dissolved
Volatile Organic Compounds (VOCs)	
BTEX	
Other Organics	
Chemical Oxygen Demand	Dissolved Oxygen Demand
Field Parameters	
pH	Groundwater Elevation
Conductivity	
Note: Dissolved samples should be filtered in the field and preserved in the field at time of sampling. **If dissolved samples are not to be filtered and preserved in the field, then Manitoba Conservation must be notified.**	

Source: Manitoba Conservation and Water Stewardship