Winnipeg

Water and Waste Department • Service des eaux et des déchets

SEP 2 9 2014

Our File Nos.: S-928, 020-17-08-11-ON
Client File No.: 3205.00

Manitoba Conservation and Water Stewardship
Environmental Approvals Branch
123 Main Street, Suite 160 (Box 80)
Winnipeg, MB R3C 1A5

Attention: Tracey Braun

Dear Ms. Tracey Braun:

RE: City of Winnipeg Biosolids Master Plan 2014

Please find attached the City of Winnipeg Biosolids Master Plan 2014. This report has been prepared and is being submitted in accordance with the letter we received from your Department dated October 2, 2012 regarding the "North End Water Pollution Control Centre Upgrading".

Should you have any questions on this report please contact Mr. Duane Griffin, P.Eng. at 204-986-4483 or by email at dgriffin@winnipeg.ca.

Yours truly,

Chris Carroll, P.Eng., MBA
Manager of Wastewater Services Division

MRP/jr

Attachment

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Winnipeg Sewage Treatment Program

Winnipeg

VEOLIA WATER

City of Winnipeg
Biosolids Master Plan 2014

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VWNA Winnipeg Inc.
No. 5076 Date: 09/25/2014

EXECUTIVE SUMMARY

In response to requirements in the Water Protection Act the City of Winnipeg (City) has developed a Biosolids Master Plan (BMP) for the beneficial reuse of biosolids. The specific objectives of the BMP are to:

a) Recover and reuse nutrients to the maximum extent possible

b) Reuse biosolids and wastewater sludge remaining after the wastewater treatment process

c) Evaluate proven technologies in consultation with stakeholders, including the public

d) Develop a plan with multiple beneficial reuse strategies for maximum flexibility and robustness

To select beneficial reuse options, only well proven technologies that meet municipal, provincial and federal regulations were considered. Options had to demonstrate beneficial reuse, as defined by the Canadian Council of Ministers of the Environment (CCME) guidelines. Based on these guidelines the following biosolids technologies were selected for consultation and evaluation:

(a) Thermal oxidation with energy recovery

(b) Compost and soil products (e.g. topsoil and compost)

(c) Land application

(d) Land reclamation

(e) Drying/ pelletization

The City's current disposal plan, landfilling biosolids, is not considered beneficial reuse. It was not evaluated as a disposal strategy but is still considered as an emergency option.

To evaluate the biosolids beneficial reuse options the City consulted with various industry professionals, regulatory authorities, the public and other stakeholders. A marketability assessment gave understanding on local market conditions and potential biosolids users. A request for information (RFI) to organizations specializing in biosolids management helped the City to understand the viability and conditions of long term service contracts and agreements. Two public meetings, an online forum, and an omnibus survey helped the City to understand what biosolids management issues were of concern to rate payers.

The results of the consultation process showed that industrial representatives were willing to participate in future biosolids programs, especially in land application programs. Members of the public were primarily interested in options that emphasized reuse of nutrients, such as composting and soil products, and land application. They were also concerned about the potential health impacts of biosolids management and wanted these impacts to be minimized.

A biosolids stakeholder advisory committee (SAC) was formed to help the City define appropriate evaluation criteria for the beneficial reuse options. The SAC also established guiding principles that the BMP should follow in developing and implementing its biosolids management strategies.

The City has, based on the SAC's criteria, evaluated and ranked the beneficial reuse options as follows:

(a) Land Application: develop implementation plan

(b) Compost and Soil Production: pilot and test

(c) Thermal Oxidation: develop if land application and/or compost and soil production are unsuccessful

(d) Landfill Reclamation: utilize based on landfill needs

(e) Landfill: Use in case of emergency

(f) Pelletization: Do not consider further

Land application was selected because of strong market demand and vendor interest in managing nutrient management applications. Land application also reuses nutrients and provides a valuable resource to the farming community. Compost and soil production was selected for piloting because of its nutrient reuse, high market demand, and high public interest. The City will take advantage of landfill reclamation where there is sufficient demand in the City's owned landfill, Brady Road Resource Management Facility (BRRMF).

Thermal oxidation was selected as a backup in case land application and/or composting and soil manufacturing do not result in beneficial reuse of the biosolids. The decision to implement thermal oxidation will be made after the new digestion facility has been constructed. Landfill is not considered beneficial reuse but will remain an option in cases of emergency or for products that do not meet regulatory approval.

In parallel to the beneficial reuse evaluation, the City also evaluated biosolids treatment prior to the reuse strategies. After a review of various options the City plans to maintain a centralized digestion facility at the North End Water Pollution Control Centre (NEWPCC). Sludge from the City's other wastewater treatment facilities will continue to be hauled to the NEWPCC for treatment.

To comply with the objectives that the BMP has defined, the existing NEWPCC digestion facility must be replaced. The consultation process identified concerns for potential health and safety issues and odors, while the SAC's guiding principles also focused on long term sustainability and nutrient recovery.

To address these concerns the City will construct a new digestion facility at the NEWPCC with thermal hydrolysis pre-treatment and mesophilic anaerobic digestion. To recover additional nutrients the system will harvest a phosphorous-based mineral (struvite) from the digestion process. The thermal hydrolysis pre-treatment will generate biogas which can be reused for heat and/or electricity, reduces biosolids production by 30%, and creates a pathogen-free product with significantly less odors than a standard mesophilic digestion system.

Construction of the new digestion facility will have to be coordinated and phased with planned nutrient removal upgrades on the NEWPCC wastewater treatment plant. The construction of new digestion facility will require six to seven years for design, procurement, construction and commissioning. The work will be phased and integrated with the NEWPCC biological nutrient removal (BNR) upgrades.

To reduce biosolids landfilling as soon as possible the City will implement the BMP in two phases. Phase one will occur during construction of the new digestion facility. During this time a request for qualifications for a land application program will be issued and a two-year composting pilot will be initiated. The RFQ will evaluate the storage requirements and feasibility of a land application program for biosolids produced by the existing treatment facility. The compost pilot will evaluate the feasibility of winter composting and verify the compost quality. Compost from the two-year pilot will be used as a soil amendment for landfill top cover at BRRMF. If the pilot is successful then composting will continue until the new digestion facility is complete.

Phase two of the BMP will be implemented after the new digestion facility becomes operational. The land application program will be re-initiated or, if it had already been initiated in phase one, adapted for thermally hydrolyzed sludge. Once the new digestion process produces pathogen-free biosolids the City will also pilot soil production. The BMP will continue to provide biosolids-based products for landfill reclamation on an as-needed basis. Following a testing and evaluation period the City will then determine if thermal oxidation is required.

As part of the BMP the City will submit annual progress reports to Manitoba Conservation and Water Stewardship (MCWS) describing key activities, their status and relevant decisions/milestones. Progress on the new digestion facility will be reported to MCWS as part of the NEWPCC BNR upgrade.

The estimated capital cost to construct a new digestion facility, including enhanced sludge thickening at the South End Water Pollution Control Centre (SEWPCC) is $247 million in 2014 dollars. SEWPCC sludge must be thickened prior to thermal hydrolysis so that it can be incorporated into the new digestion process. The estimated capital costs are a Class 5 estimate as per the Association for the Advancement of Cost Engineering (AACE) cost estimate classification system.

The costs for land application and composting and soil production will be verified as part of the program development and piloting process. Initial estimates show composting and soil production as the most expensive solution but this estimate is sensitive to many factors that need to be verified in the piloting process (e.g. resale value and opportunities, cost of bulking agent). The land application solution is ranked as medium-cost but this value is dependent on land application rates; these rates cannot be determined in advance and will need to be verified when application rates are approved as part of the Nutrient Management Plan regulation process.

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ACRONYMS AND ABBREVIATIONS

AACE:	Association for the Advancement of Cost Engineering
BMP:	Biosolids Master Plan
BNR:	Biological nutrient removal
BRRMF:	Brady Road Resource Management Facility
CCME:	Canadian Council of Ministers for the Environment
City:	City of Winnipeg
CSO:	Combined sewer overflow
MCWS:	Manitoba Conservation and Water Stewardship
MPN:	Most probable numbers
NEWPCC:	North End Water Pollution Control Centre
NPV:	Net present value
Pathogen-free:	Fecal coliform less than 1,000 most probable numbers (MPN) per gram total solids (dry weight basis) *or* the density of *Salmonella* sp. bacteria in the biosolids less than 3 MPN per 4 grams of total solids (dry-weight basis)[1]
RFI:	Request for information
RFP:	Request for proposals
RFQ:	Request for qualifications
SAC:	Stakeholder advisory committee
SEWPCC:	South End Water Pollution Control Centre
US EPA	United States Environmental Protection Agency
WEWPCC:	West End Water Pollution Control Centre
WPA:	Water Protection Act
WWD:	Winnipeg Water and Waste Department

[1]Definition from CCME compost quality guidelines for Class A biosolids compost (CCME 1) and the United States Environmental Protection Agency pathogen qualifications for Class A biosolids (US EPA)

1. Introduction

In June 2011 the City's regulator, Manitoba Conservation and Water Stewardship (MCWS) amended the Water Protection Act of Manitoba (2014 WPA) to include the following clauses for the City of Winnipeg North End Water Pollution Control Centre (NEWPCC):

I. Nutrients that are removed [from the treatment process] must be recovered and recycled to the maximum extent possible through application of the best available technologies

II. Biosolids and wastewater sludge remaining after the treatment process must be reused

In a letter dated October 2 2012 (Appendix A), MCWS confirmed the requirements in the Water Protection Act. A biosolids master plan, explaining how the City would meet these requirements was requested with a submission by October 2, 2014. In response the City of Winnipeg (City) initiated a Biosolids Master Plan (BMP) to develop a biosolids program that would result in beneficial reuse of biosolids which would maximize nutrient recovery (Appendix B). In addition to the objectives set out by MCWS the City identified two additional objectives:

III. Evaluate proven technologies in consultation with stakeholders, including the public

IV. Develop a plan with multiple beneficial reuse strategies for maximum flexibility and robustness

The major activities of the BMP, detailing how the City intends to meet the BMP objectives, are summarized in this report. These activities include:

(a) Identifying beneficial reuse options for biosolids

(b) Assessing opportunities to improve biosolids treatment

(c) Consulting industry professionals, regulatory authorities, stakeholders, and the public

(d) Selecting beneficial reuse options for biosolids based on the information gathered in Steps a, b, and c

(e) Developing an implementation and reporting plan

2. Background Information

2.1 Biosolids

Biosolids are the nutrient-rich end-product of sewage treatment which contains significant quantities of organic nitrogen and phosphorous, as well as trace amounts of minerals that are beneficial for plant growth. Biosolids also contain metals and other material that are often limited by regulation or licence.

At the sewage treatment plants, the solids and sludge are separated from the wastewater. These solids, which consist mainly of organic matter, are then digested and dewatered. Digestion concentrates the sludge, kills harmful pathogens, and produces biogas that can be used for heat and energy. The resulting product, called biosolids, are then disposed of in landfills or reused for their nutrients and/or energy content.

2.2 Historical Treatment and Disposal Routes

The City has three wastewater treatment plants, known as water pollution control centers. Sludge from the two smaller plants, the South End Water Pollution Control Centre (SEWPCC) and the West End Water Pollution Control Centre (WEWPCC) is hauled to the largest plant, the NEWPCC for treatment. Here all the sludge is digested and dewatered to produce biosolids. The biogas that is produced during the digestion process is used for heating purposes. This process is illustrated in Figure 1. Currently the City disposes of biosolids by hauling it to the City landfill, Brady Road Resource Management Facility (BRRMF), mixing it with municipal solid waste, and disposing of it in landfill cells.

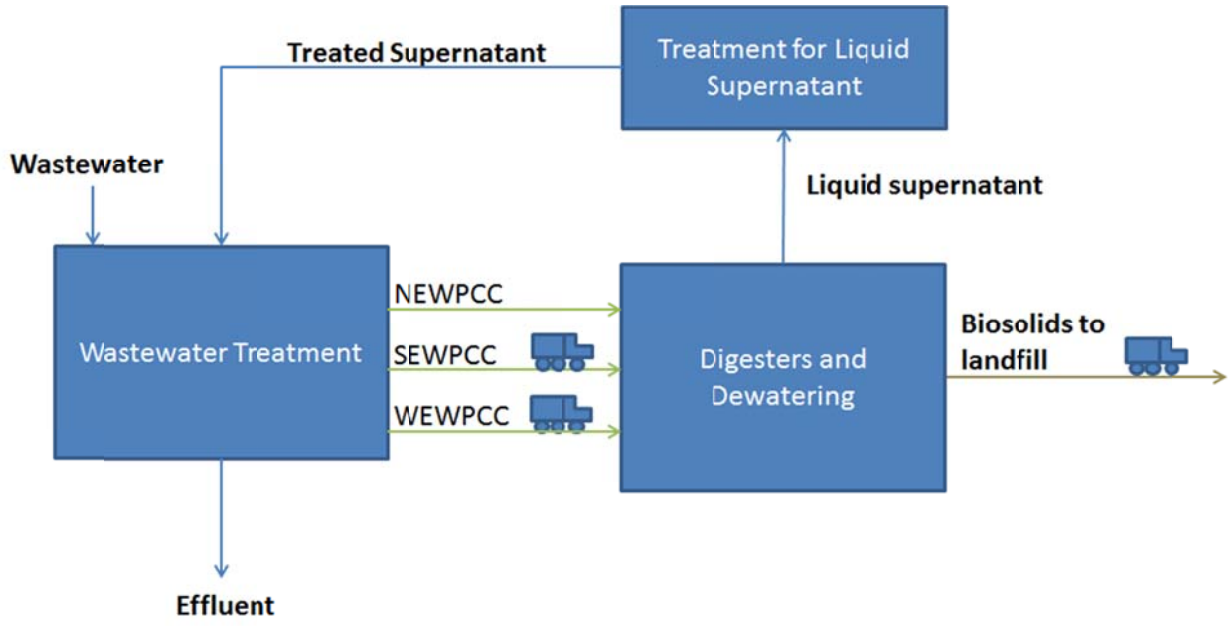


Figure 1 The City's current biosolids handling process

2.3 WinGRO

Prior to 2011 biosolids were spread on agricultural fields. Known as WinGRO, this program provided a nutrient rich fertilizer for agricultural land at no cost to the farmer. In January 2011 changes to provincial nutrient management regulations reduced application rates for biosolids to agriculture. The equipment used in the WinGRO program could not spread the biosolids onto farmers' fields at the reduced rates. As a result the program was stopped. Since this time all biosolids have been co-disposed with municipal solid waste at BRRMF.

2.4 Compost Pilot

In the fall of 2014 the City will initiate a two year composting pilot program in which twenty percent of the City's biosolids will be composted over a two year period. The pilot will evaluate the implications of cold-weather composting and determine whether the compost can meet Category A or B compost classification, as defined by the Canadian Council of Ministers for the Environment (CCME 1). The compost produced by the pilot will be utilized within BRRMF.

2.5 Future Increases in Biosolids

Biosolids are made from the sludge and solids collected in wastewater treatment. In 2013 the City produced approximately 13,000 dry tonnes of biosolids. The amount of biosolids produced each year can vary depending on flow patterns and storm events. There are several factors that influence biosolids quantities over the long term including:

a) Population growth

b) Changes in flow patterns to the treatment plants (e.g. combined sewer overflow (CSO) mitigation, wet weather, water consumption)

c) Changes to the wastewater treatment process (e.g. conversion to biological nutrient removal, wet weather flow treatment)

d) Changes to the sludge treatment process (e.g. sludge pre-treatment before digestion)

Wastewater solids and sludge production are expected to increase 35-50% by the year 2037 primarily because of increasing population within the City. Biosolids production is expected to increase similarly but, as described further in this report, this value can be highly influenced by the type of biosolids treatment.

2.6 Biological Nutrient Removal

The City is currently in the process of upgrading its two largest wastewater treatment facilities, the NEWPCC (2014 NEWPCC Master Plan) and the SEWPCC to biologically remove nutrients from wastewater. A portion of the nitrogen and the phosphorous will be captured in the sludge solids and the resulting biosolids.

3. Reuse of Nutrients and Biogas

3.1 Identifying Biosolids Beneficial Reuse Options

To select beneficial reuse options, only well proven technologies that meet municipal, provincial and federal regulations were considered. Options also had to demonstrate

beneficial reuse, as defined by the Canadian Council of Ministers of the Environment (CCME 2, CCME 3) guidelines.

The potential treatment options are summarized in Table 1.Landfill disposal is not considered beneficial reuse but is still included in the assessment as an emergency option and for comparison purposes.

Table 1 Potential beneficial reuse treatment options

Potential Beneficial Reuse Options	Example
Thermal oxidation with energy recovery	• Heat and energy from combustion of biosolids generates steam and electricity • Ash can be used as a road base or as an ingredient in cement production
Compost and soil products (e.g. topsoil and compost)	• Biosolids used as an ingredient in topsoil or compost, providing nutrients and organic matter for plant growth • Biosolids that are pathogen-free are incorporated directly into soils as an amendment
Land application	• Biosolids spread directly on land as a fertilizer • Provides macronutrients (e.g., nitrogen and phosphorous) and micronutrients (e.g. copper, cobalt, chromium, and zinc) • Provides organic matter for plant growth
Land reclamation[1]	• Biosolids or biosolids-based-products are used to cover landfills to prevent erosion
Drying/Pelletization	• Biosolids are dried to form pellets • Pellets mixed with fertilizer to increase nitrogen and phosphorous content • Pellets can also be burned for energy recovery
Landfill (not considered beneficial reuse, to be used in emergency situations)	• Biosolids are mixed with garbage and disposed of within the landfill

[1]CCME considers reclamation of mining sites as beneficial reuse of biosolids but this was excluded because there are no significant mining operations within an economic distance of Winnipeg

3.2 Improving Biosolids Treatment and Nutrient Recovery Before Biosolids Beneficial Reuse

3.2.1 Anaerobic Digestion

Anaerobic digestion is a process that concentrates wastewater solids and reduces pathogens within the biosolids. Some beneficial reuse options require digestion beforehand, whereas others can be utilized with or without it, as illustrated in Figure 2.

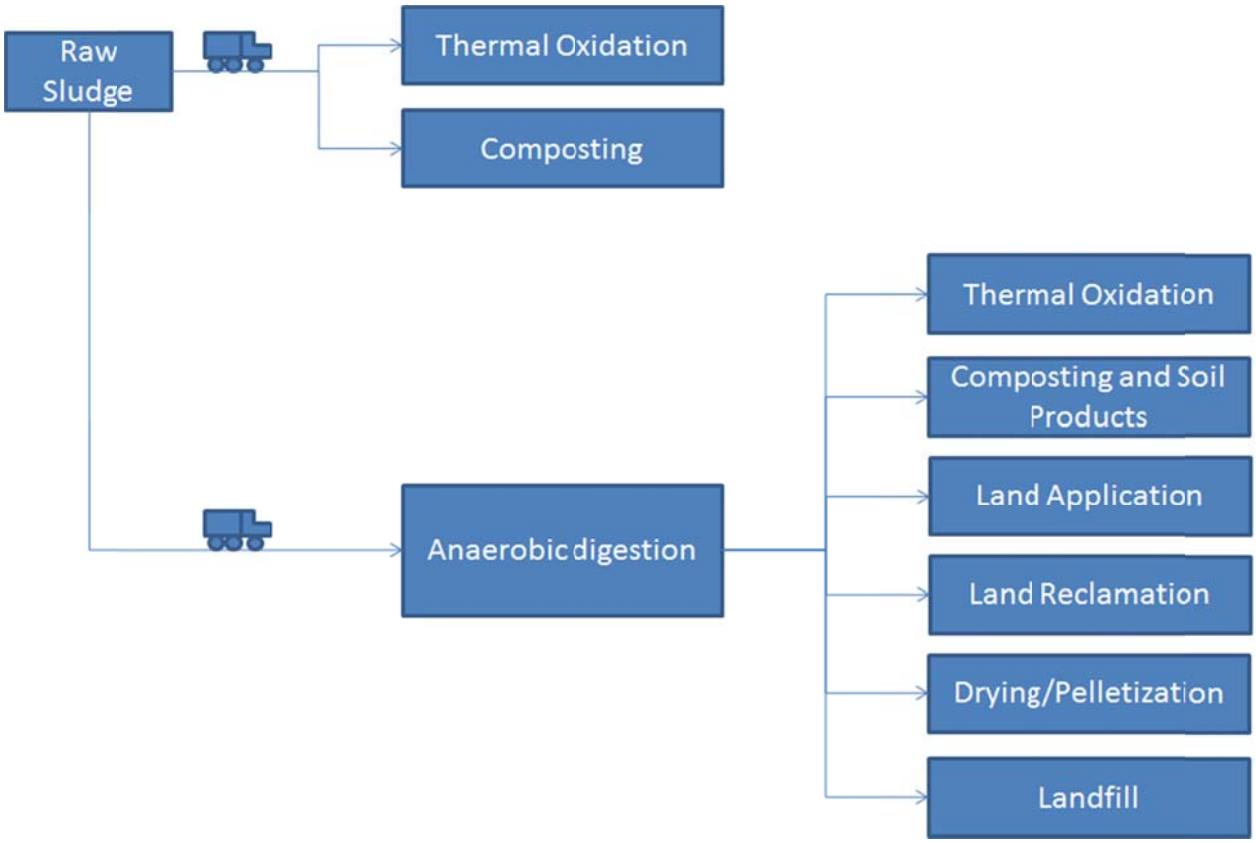


Figure 2 Biosolids options with and without digestion

In the 2012 Biosolids Options Report (Appendix B) the City concluded that anaerobic digestion would be part of the BMP. The process maximizes opportunities for nutrient recovery and reuse by making nutrients available for harvest in the digestion and dewatering process. This process is also a prerequisite for multiple disposal routes and handling strategies; without digestion the beneficial reuse options would be limited to thermal oxidation and/or composting.

Thermal oxidation without digestion was not considered as the preferred option during the BMP development because it does not recover or reuse nutrients. Technologies that harvest nutrients from the ash are in the developing stages and were not considered to be proven technology.

Composting without digestion was also not considered as part of the BMP because, in the event of failure, there would be limited disposal routes for the sludge. Landfilling the undigested sludge in emergencies would be an

unacceptable solution because of the high pathogen content and odour source of the raw sludge. There was also few full scale operating facilities in North America of comparable size.

Anaerobic Digestion Process Selection

Different digestion technologies and/or pre-treatment options can reduce the quantity of biosolids by converting a greater portion of the sludge to biogas. In addition to decreasing the quantity of biosolids produced by the wastewater treatment facility, it also creates more opportunities for energy reuse, nutrient recovery, biosolids odor reduction, and, depending on the configuration, can produce pathogen-free biosolids. These options open a wider range of final biosolids reuse opportunity, thereby reducing the risk for public health and safety, maximizing opportunities for nutrient recovery, and reducing storage requirements.

After a review of several proven digestion and pre-treatment technologies the thermal hydrolysis pre-treatment process was selected to be incorporated into the City's biosolids program. The thermal hydrolysis system pre-treats the sludge with high temperature and high pressure steam before the sludge is digested into biosolids. This pre-treatment breaks the cell structures apart making the sludge easier to digest and stabilize, resulting in the following benefits:

(a) Sludge hauling reduction: the thermal hydrolysis technology requires sludge at 15-20% thickness; increased thickening will result in less sludge hauling to the NEWPCC

(b) Biosolids volume reduction: thermal hydrolyzed biosolids can be dewatered to 30% solids, compared to 25% solids in the existing system; this creates a more amendable biosolids product that is easier to store, handle, and utilize for beneficial reuse

(c) Biosolids mass reduction: the increased efficiency in converting solids to biogas decreases the mass of solids by 30%

(d) Greater stabilization: eliminates pathogen and reduces odour content within the biosolids; this process can be designed to produce pathogen-free biosolids

(e) Greater nutrient recovery: by breaking the cell structures apart nitrogen and phosphorous are more readily available for nutrient recovery and recycling

3.2.2 One New Centralized Digestion Facility

The 2012 Biosolids Options Report stated that the City would plan for two anaerobic digestion facilities, one at the SEWPCC and one at the NEWPCC. Digestion at two locations, SEWPCC and the NEWPCC was considered at that time to minimize hauling costs. After further review and design, however, the City plans to construct and operate one new centralized digestion facility at the NEWPCC. Sludge from the SEWPCC and the WEWPCC will continue to be hauled to the NEWPCC for treatment.

The thermal hydrolysis process requires a thicker feed sludge which created the opportunity to pre-thicken sludge at the SEWPCC. Consequently the sludge hauling volume is reduced and the costs favour one centralized facility. By utilizing one new facility, nutrient recovery and reuse can be centralized and optimized for maximum efficiency. It will also allow for the most efficient use of biogas.

Upgrading the existing system would substantially complicate the NEWPCC BNR upgrades due to complex tie-ins. It would also complicate and jeopardize the continuous operation of both the wastewater and biosolids treatment facilities during construction. By deciding to construct one new central facility at the NEWPCC site, the City will limit these operational risks and the impact of the biosolids upgrades to the BNR upgrade facility and commissioning schedule; construction activities of the new facility will be phased and coordinated with the NEWPCC BNR upgrades.

A potential layout of the new digestion facility is illustrated in Figure 3 Potential layout of the NEWPCC with BNR and new digestion facility.

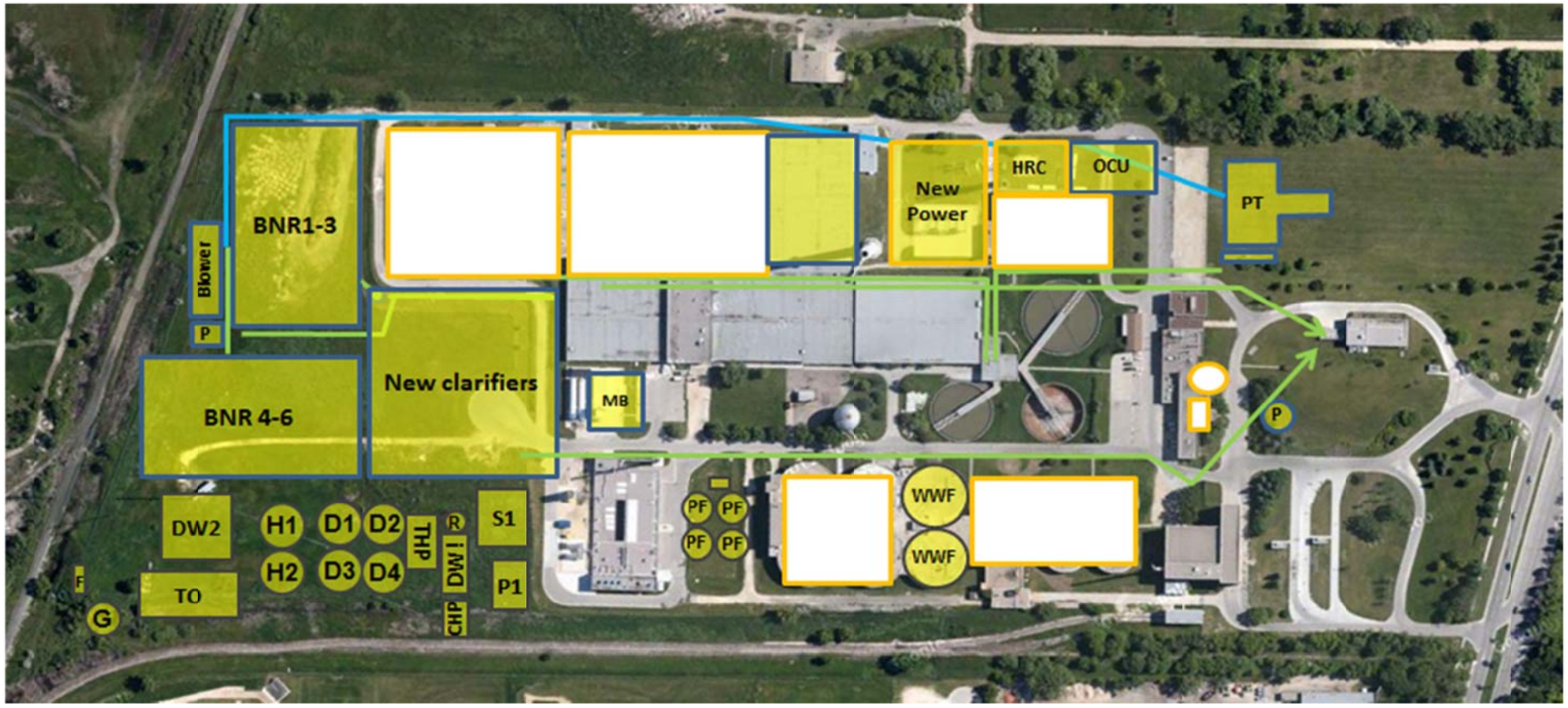


Figure 3 Potential layout of the NEWPCC with BNR and new digestion facility

BNR:	Biological nutrient removal
Blower:	blowers for BNR facility
CHP:	Combined heat power facility (to be determined)
D1–D4:	Digesters 1 – 4
DW1:	First stage dewatering
DW2:	Second stage dewatering and biosolids hauling
F:	Flare
G:	Gas storage
H1, H2:	Holding tanks 1 and 2
HRC:	High rate clarifier
MB:	Maintenance building
New Power:	New power facility
New Clarifiers:	New secondary clarifiers
OCU:	Odour control unit
P:	Pumping
P1:	Phosphorous release tank
PF:	Primary fermenter
PT:	Preliminary treatment
R:	Sludge receiving station
S1:	Struvite harvesting facility
TO:	Thermal oxidation (if required)
THP:	Thermal hydrolysis process
WWF:	Wet weather flow sludge storage

3.2.3 Nutrient Recovery: Harvesting Phosphorous/Struvite in Digestion

In the digestion process phosphorous can be harvested as a phosphorous-based mineral known as struvite, as seen in Figure 4. In order to maximize nutrient recovery and reuse the City intends to install a process that will harvest the struvite, which can then be utilized in fertilizer mixes.

Figure 4 Struvite harvested from a wastewater treatment plant

A preliminary phosphorous mass balance indicates that approximately 30-45% of phosphorous that enters the Water Pollution Control Centers can be recovered as struvite, as illustrated in Figure 5.

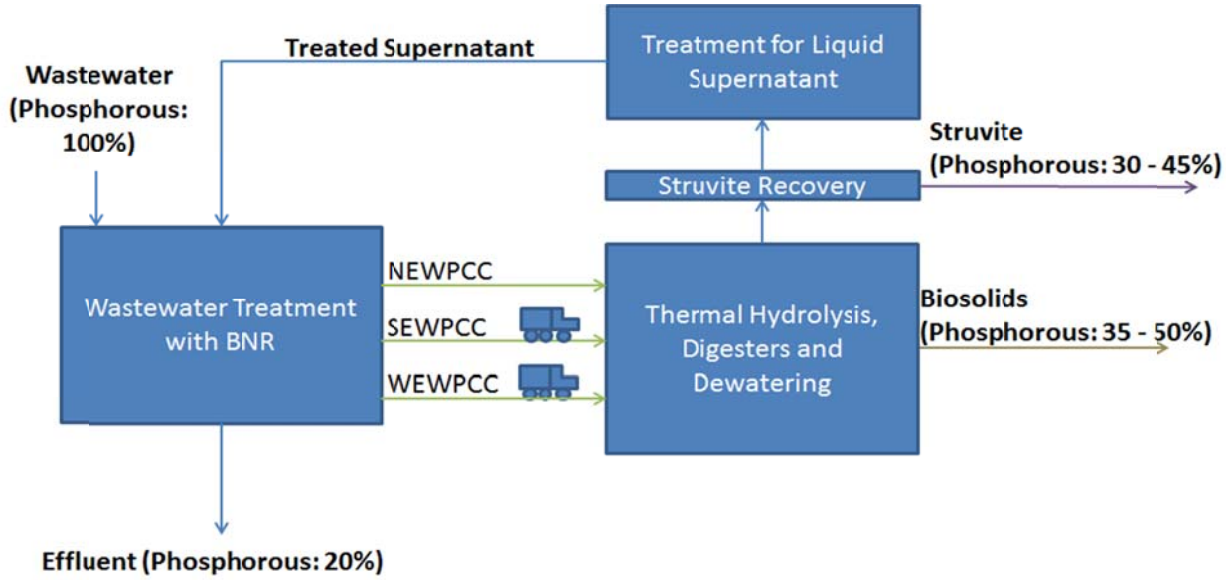


Figure 5 Conceptual phosphorous mass balance

3.2.4 Biogas Utilization

As part of the NEWPCC Master Plan and new digestion facility the City is conducting a business case to evaluate the best use for digester biogas. This is being done in consultation with Manitoba Hydro. Depending on the study recommendations the biogas may be utilized onsite for process heat for adjacent buildings and digesters, and/or to generate electricity for onsite use.

4. Biosolids Master Planning Stakeholders Consultation

As part of the BMP process, industry professionals, regulatory authorities, potential product users, the public and other stakeholders were consulted. Biosolids reuse will only be maximized if these stakeholders are willing to participate in regulating, manufacturing, purchasing, and utilizing the biosolids-based end products.

The BMP consultation activities included industry consultation with a marketability assessment to understand local market conditions and biosolids users. A survey of private sector organizations specializing in biosolids management described the viability and conditions for long term service contracts and agreements;

The public was also consulted with a biosolids stakeholder advisory committee (SAC) to assist in defining the guiding principles and criteria for the evaluation process. Two public meetings, an online forum, and an omnibus survey helped the City to understand what biosolids management issues were of concern to rate payers.

A description of the specific consultation methods is described in the following sections. More information can be found on the City's public engagement website (http://wwdengage.winnipeg.ca/biosolids/) and in Appendix C.

4.1 Industry Consultation

4.1.1 Local Marketability of Biosolids Products

The degree to which potential treatment options are able to beneficially reuse biosolids depends, to a great extent, on local conditions. In order to assess the capacity of local markets for biosolids-based products a marketing survey was conducted.

End users were identified by a biosolids marketing expert and interviewed via phone, email, and in-person meetings. The users were asked about their familiarity with biosolids and biosolids-based products. They were asked to indicate their willingness to use and distribute these products within their companies. The results of this work are summarized in Table 2.

Table 2 Marketability assessment of biosolids based products

Product	Market	Market Opportunities	Market Threats	Overall marketability risk
Thermal oxidation and energy recovery: Ash	Cement production and road base	• Potentially high value if sold as a fly ash substitute in ready-mix cement. • Cement and concrete manufacturers open minded to use of ash • Potential for use as road-base in BRRMF	• Uncertain if ash would meet specifications for structural concrete • Potential liability issues if product is used in subsequent products	• High
Compost and soil products (e.g. topsoil and compost)	General compost sale	• Strong experience/familiarity in capital region • End users generally not concerned with using a biosolids-based compost product	• No established provincial regulation for public use of compost	• Low, provided the City can meet provincial requirements
	Landscape/Soil Blenders	• There are potential customers who have large capacity for end product • Market can easily absorb more than the 20% generated by pilot		
Land application	Apply directly to land as fertilizer	• Strong experience and familiarity in region • Farmers willing to accept at agronomic rates • Established provincial regulation	• No market available in winter months • Spreading likely required in short spring/fall window • Disposal should be restricted to within 150 km of City for economic value	• Medium - low
Land reclamation	Brady Road Resource Management Facility	• End product used within City	• Limited seasonal capacity based on BRRMF requirements • Reliable but small capacity for product	• Medium – minimal market demand
Pelletization	Fertilizer blender	• None identified	• Limited local opportunity • Fertilizer blenders not interested in dried product	• High
	Direct to agriculture	• None identified	• Farmers had no interest in storing and/or applying pellets	
Landfill	BRRMF	• Not applicable		• Low – sufficient capacity within BRRMF

4.1.2 Private Sector Survey: Request for Information (RFI) 518-2013

A request for information (RFI) was posted on the City's procurement website, inviting biosolids-specific vendors to respond to questions about their willingness to manage and produce biosolids end products. Respondents were asked to describe their company profile, preferred strategy for biosolids management, and the willingness to assume various roles and responsibilities. A copy of RFI 518-2013 can be found on the City's Materials Management website (http://winnipeg.ca/MatMgt/FolderContents.asp?FOLDER_NAME=518-2013&YEAR=2013).

Nineteen submissions were evaluated as part of RFI 518-2013. There was a well distributed range of preferred solutions, with vendors who had an interest in either supplying technology, managing the digestion process, and/or generating an end product for profit.

The submissions were grouped according to the type of end product that they generated. They can be broadly categorized as land application, thermal drying/pellets, thermal oxidation, composting and soil products, and general. The 'general' category was for submissions that expressed an interest and ability in producing an end product chosen by the City. A summary evaluation can be viewed in Table 3.

The locations of the submissions, shown in Figure 6, indicate that submitters were primarily in the USA or Canada. Some biosolids management strategies, such as land application, were specific to Canada whereas others, such as compost and soil products, where more globally represented.

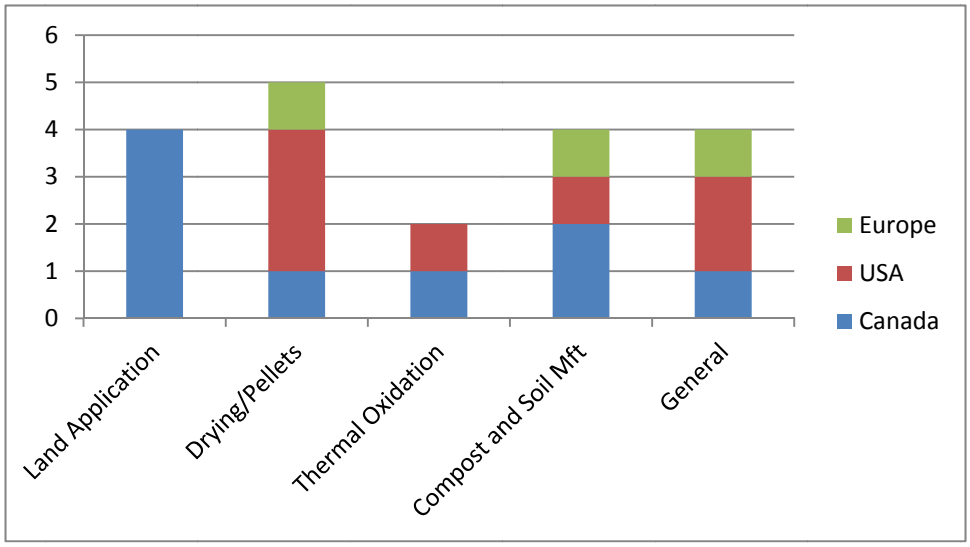


Figure 6 Locale of submissions RFI 518-2013

Most submissions expressed an interest in creating and marketing the biosolids end products with 20-25 year terms. The land application submissions also expressed willingness for long term service contracts with 10-15 year terms. Several submissions in the 'drying/pellets' category expressed an interest in managing and maintaining the City's digestion facility.

Table 3 Summary assessment of private sector survey

Category	Total Submissions	Preferred Length of Term	Preferred Responsibility	Willingness to take a portion of Biosolids	Vendor Interest
Thermal Oxidation	2	Not specified	Biosolids	Requests all or a portion guarantees	Low vendor interest: • Fewest responses from RFI 518-2013 • Term lengths not specified but likely to be similar to other DBOO submissions (20+ years) • Few reference examples
Composting and Soil Products	4	Not specified	Biosolids	Yes	Medium vendor interest: • Only two vendors offered production and disposal services; the other two were technology providers • No mention of purchase/supply of bulking agent • No clear indication of how they would work with regulator to meet compliance • No indication of required term lengths
Land Application	4	10+	Biosolids	Yes	High vendor interest: • Strong interest in managing nutrient management plans and storage • Short length of terms offers greater flexibility • Storage requirements may be negotiated but could impact price, flexibility, term length • Willing to comply with Nutrient Management Regulations
Drying/Pelletization	5	20+	Digestion and Biosolids	Requests all or portion guarantees	Medium vendor interest: • Preference and strong interest in managing the overall digestion and biosolids process • Long term lengths • Submissions were primarily from entities outside of Canada • Four of the five submissions offered to operate facility
General	4	20+	Digestion and/or Biosolids	No - would like to take all of the biosolids but may be willing to offer multiple solutions as part of their management strategy	High vendor interest: • Generality may make other technologies (e.g. composting, thermal oxidation) more competitive • Long term lengths • Preference and strong interest in managing overall digestion and biosolids process

4.2 Public Consultation

4.2.1 Biosolids Stakeholder Advisory Committee

As part of the consultation process the City of Winnipeg asked relevant biosolids stakeholders to participate in an advisory committee. A complete list of members and report on the committee process can be found in Appendix C. The two main tasks of the committee were to:

(a) Review and comment on public engagement material prior to the City's public engagement process

(b) Provide input on biosolids beneficial reuse options and biosolids management issues

The SAC ensured that the public engagement material was relevant and easy for the public to understand. They were the first sounding board for materials and provided valuable feedback on definitions, glossary of terms, and in describing the beneficial reuse options.

In addition, the SAC also recommended that the following guiding principles and evaluation criteria be considered in developing the master plan:

SAC Guiding Principles for Winnipeg Biosolids Master Plan:

(a) Resource recovery: The plan approaches biosolids management as an opportunity to recover and reuse valuable resources, such as phosphorous, nitrogen and energy.

(b) Long-term sustainability: The plan is rooted in long-term economic, social and environmental sustainability, and aligned with long-term goals and plans of the City, including future growth.

(c) Biosolids supply chain: The plan considers the entire system involved in processing and reusing biosolids, including energy, raw materials, components and decommissioning.

(d) Health and safety: The plan ensures the importance of public and worker health and safety in biosolids management.

(e) Realistic, achievable: The plan is reliable, realistic, and achievable.

(f) Adequate assessment of risk: The plan includes assessment and risk mitigation including operational, financial, and environmental.

(g) Mixed/integrated solutions: The plan includes more than one option for biosolids management for greater adaptability.

SAC Recommended Evaluation Criteria for the Beneficial Reuse Options

(a) Operational factors: Manageable level of operational complexity, proven technology, reliable.

(b) Time to implement: How quickly can the option be implemented? Short (one to two years), medium (two to five years) or long term (five years or longer).

(c) Regional suitability: Suited to Manitoba climate, resources and other regional factors.

(d) Stakeholders involved: Who is involved, opportunity for private sector involvement or partnership.

(e) Regulation: What regulations are involved and compliance with regulations.

(f) Good neighbor practice: Ability to mitigate neighbour concerns.

(g) Ecological sustainability: Makes a net positive contribution (e.g. nutrient recovery, energy recovery) and minimizes environmental impacts.

(h) Cost: Are costs consistent with current costs for biosolids management, or approximately double or triple the current cost?

4.2.2 Public Engagement and Omnibus Survey

In January 2014 the City of Winnipeg held a public engagement process to learn which concerns were important to Winnipeg citizens. Two public open houses were held and online feedback was collected from January 2 – 27, 2014. Participants were asked to express and rank their concerns regarding biosolids management. They were also asked to rank their preference for the potential biosolids treatment options. The public engagement material is available at the City of Winnipeg's biosolids website: http://wwdengage.winnipeg.ca/biosolids/.

The results of the engagement process are shown in Figure 7 and Figure 8. The letter *n* represents the number of respondents. Respondents were primarily concerned with the impact that biosolids management could have to Lake Winnipeg.

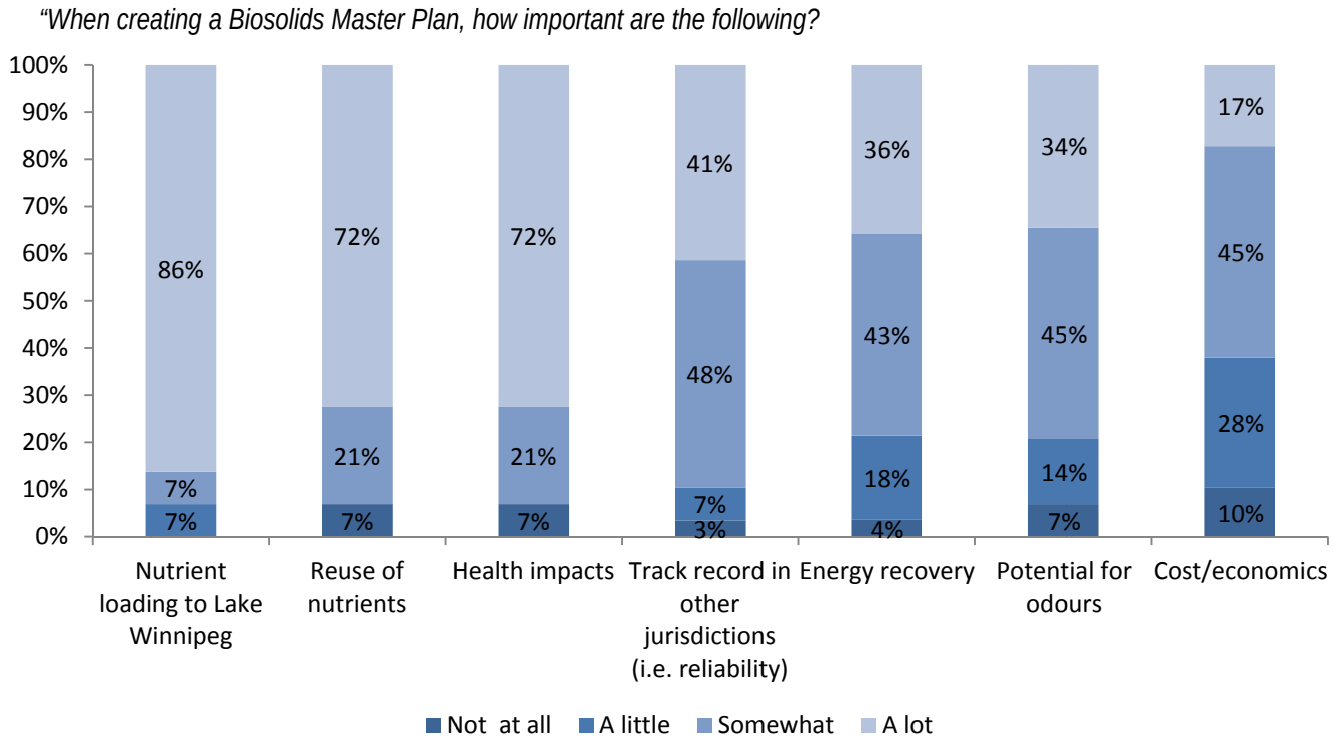


Figure 7 Public engagement primary concerns regarding to biosolids management (*n=29*)

"When creating a Biosolids Master Plan, how much do you support the following options?"

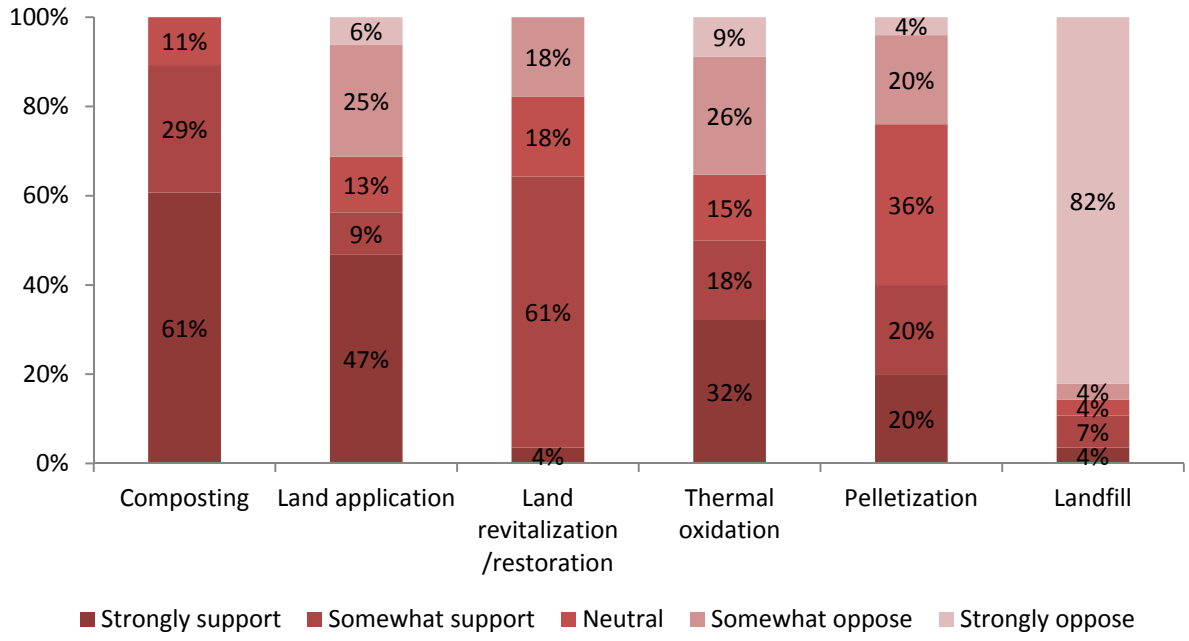


Figure 8 Public engagement support for potential biosolids treatment options (*n=25-34)*

To gain a broader and more diverse range of perspectives on biosolids management considerations, an omnibus survey was conducted with 479 randomly selected Winnipeggers. Respondents were asked which concerns were most important to them. The results are summarized in Figure 9. The complete omnibus report can be viewed in Appendix C.3.

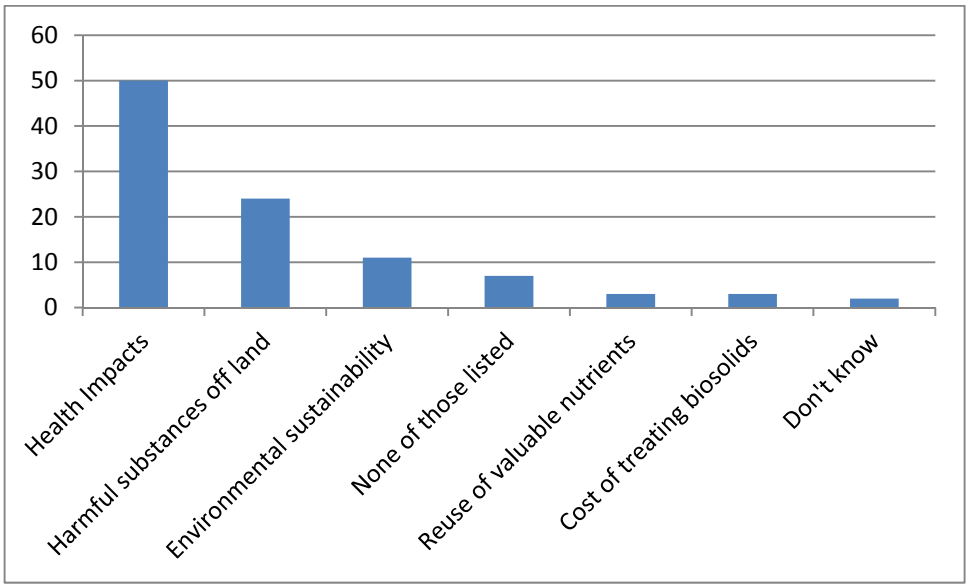


Figure 9 Omnibus survey primary biosolids concern (*n = 479)*

5. Assessment of Beneficial Reuse Options

The outputs of the activities described in Section 4 were used to evaluate the beneficial reuse options. The results are summarized in Table 4. The headings from Table 4 were based on the SAC recommended evaluation criteria. To visualize the benefits and detriments within each option the cells were colored with red (negative factor), green (positive factor) or blank (neutral).

For comparison purposes the capital and operating costs of the potential treatment options were calculated and converted to a 30-year net present value. The net present values (NPVs) were compared and ranked based on a low ($), medium ($$), and high ($$$) dollar value.

Table 4 Assessment of beneficial reuse options using SAC evaluation criteria; red represents negative factors, green represents positive factors, and blank represents neutral factors

Treatment Option		Marketability and Regional Suitability	Opportunities for Private Sector Interest and Partnership	Public Preference	Reuse of nutrients	Operational factors	Time to implement	Cost	Regulation	Agreement with Selection Criteria
Thermal Oxidation and Energy Recovery		Low	Low interest	Medium preference	No	Requires air emissions monitoring	Greater than 5 years – requires design and tie-in to digestion facility	• NPV: $$ • High capital cost • Moderate operating cost	Provincial Regulation	Moderate beneficial reuse opportunity
Land Application		High	High interest	High preference	Yes	Seasonal - Biosolids storage required in winter months when land is not available	Within 5 years, depending on storage requirements	• NPV: $$ • Low capital cost • High operating cost	Provincial Regulation – Nutrient Management Regulation	High beneficial reuse opportunity
Compost and soil products	Compost	Medium	Medium interest	High preference	Yes	Treatment capacity dependent on available bulking agent	Composting pilot in 2014	• NPV: $$$ • Moderate capital cost • High operating cost	Provincial Regulation (undefined) and Federal Guidelines	High beneficial reuse opportunity
	Soil Products	High	Medium interest	High preference	Yes	Transferred to soil manufacturer	Greater than 5 years – requires new digestion facility	• Undefined at this time		
Thermal Drying/Pelletization		Low	Medium interest	Low preference	Dependent on final destination of pellet	Requires storage and fire prevention of combustible product	Greater than 5 years: requires design and tie in to digestion facility	• NPV: $$ • Moderate capital cost • High operating cost	Provincial (undefined) and Federal Regulation (Canadian Food and Inspection Agency)	Low beneficial reuse opportunity
Landfill Reclamation		Medium	Low interest	Medium preference	Yes	Dependent on pre-treatment; capacity limited to BRRMF needs	Dependent on pre-treatment	• Dependent on pre-treatment	Provincial Regulation	Moderate to low beneficial reuse
Landfill (in emergency)		Not applicable	Not applicable	Low preference	No	No change in operation required	None – current practice	• NPV: $ • Low capital cost • Low operating cost	Provincial Regulation	Low beneficial reuse opportunity

Based on the information in Table 4 the City ranked the beneficial reuse options as follows:

a) Land Application: develop implementation plan
b) Compost and Soil Production: pilot and test
c) Thermal Oxidation: develop if land application and/or compost and soil production fail
d) Landfill Reclamation: utilize based on landfill needs
e) Landfill: use in case of emergency
f) Pelletization: do not consider further

5.1 Land Application

Land application was selected because of strong market demand and vendor interest in managing nutrient management applications. The process is familiar to the City and could be implemented relatively quickly. Land application also reuses nutrients and provides a valuable resource to the farming community.

5.1.1 Further Considerations for Land Application

Contractors and land appliers within RFI 518-2013 stated that stockpiling and storing of biosolids would be required for a successful land application program. Vendors need sufficient product in order to make a profit in their programs, and have limited opportunities in which to apply biosolids. Land application is restricted to spring and fall because regulation prohibits application in the winter months and crops are grown in the summer months. The vendors did not state however, how much product would be required to make land application economically viable.

If the program is to be initiated before the thermal hydrolysis upgrades are complete the City will have further to assess the following:

(a) How much biosolids storage would be required
(b) If vendors are able to store and manage biosolids as part of their contract
(c) If there is a suitable storage and/or stockpiling location
(d) If the City should invest in storage facilities before the thermal hydrolysis process is complete

5.2 Compost and Soil Products

Compost and soil production was selected for piloting because of its nutrient reuse, high market demand, and high public interest. The City will continue to develop its pilot program to understand the long term risks and implications of composting in winter. In the future, once thermal hydrolysis and pathogen-free biosolids are achieved the City will pilot soil production as a beneficial reuse option and assess its risks and opportunities.

5.2.1 Further Considerations for Compost and Soil Products

In order for composting to be beneficially reused, the compost must be distributed and utilized. The marketing study indicated that there was substantial demand for biosolids-based compost if the MCWS gave approval to sell and distribute the

compost; currently there are no defined provincial regulations for biosolids-based compost.

To gain approval from MCWS a pilot test is required (Appendix E). Factors that impact the quality of compost must be tracked and recorded during the pilot. These factors include metals concentration in the biosolids-based compost, cold-weather composting, odour, and bulking agent. Bulking agent, commonly woodchips, are used in composting to provide extra carbon and air pockets for air circulation.

After thermal hydrolysis is implemented, the biosolids will be pathogen-free and can be incorporated directly into soil production without composting. Bulking agents, such as wood, would still be required to give the amended soil porosity and structure.

5.3 Thermal Oxidation

Thermal oxidation has been selected as a third option in case land application and/or composting and soil products not result in beneficial reuse. It was not selected as a priority because it does not utilize nutrients from the biosolids. While the marketability of the ash is high risk, the solution can still be considered beneficial reuse if the heat/energy can be captured and utilized.

5.3.1 Further Considerations for Thermal Oxidation

Thermal oxidation can only be considered beneficial reuse of biosolids if energy is recovered and utilized onsite. This option was viewed as moderately acceptable in the public engagement process, but this reuse option has been controversial in other jurisdictions. If this process it to be implemented further public engagement and consultation would be required.

5.4 Land Reclamation

Regarding land reclamation, BRMMF requires top cover intermittently during landfill cell closure and would not be a reliable disposal route. The City's biosolids management program may divert some biosolids-based products for BRMFF top cover as it is needed but the City intends to prioritize beneficial reuse outside of the landfill.

5.5 Landfill

Landfill is not considered beneficial reuse and does not meet the requirements of the Water Protection Act. The City, however, has an obligation to protect public safety through disposal of the products. The landfill is an option as a risk mitigation strategy for biosolids and/or biosolids end products that do not meet regulatory or health and safety standards.

5.6 Pelletization/Thermal Drying

Pelletization/thermal drying will not be considered further under the BMP, as it was categorized as having a low beneficial reuse opportunity. Beneficial reuse through this option is uncertain because of limited market capacity and moderate vendor interest. The agricultural community and general public had little interest in the product and there was no guarantee in nutrient reuse. Storing the dried biosolids pellet would also increase the risk of fire and explosion, as the material is highly combustible.

5.7 Further Considerations for Thermal Hydrolysis

The thermal hydrolysis process can significantly reduce the quantity of biosolids the City produces and generate a high quality biosolids product that has low-odour. This product is ideally suited for land application and soil products.

While land application and soil production can benefit from thermal hydrolysis' pathogen-free biosolids, there are implications for utilizing these beneficial reuse options prior to achieving pathogen-free biosolids. Initiating these systems prior to achieving pathogen-free biosolids may limit the potential design and cost savings of pathogen-free biosolids. This is especially true if storage and stockpiling facilities are required for a pathogen-containing product.

An additional risk of the hydrolysis process is the behaviour of metals within the biosolids; metals will be concentrated as a greater portion of the solids is converted into biogas. The quality and quantity of the biosolids will be closely measured and assessed as the new digestion facility is brought online.

6. Biosolids Master Plan Implementation

Figure 10 below presents the implementation schedule of the Biosolids Master Plan. The first phase will assess the economic impact of implementing land application and composting before the digestion upgrades are complete. The second phase will be developed after the digestion upgrades are complete and the City verifies that it can achieve pathogen-free biosolids.

6.1 Phase 1: Pre Thermal Hydrolysis

The aim of this phase is to determine if composting and land application can be implemented before the upgrades to the digestion facility are complete. If the compost generated in the two-year pilot achieves regulatory compliance, then future compost will be sold and the pilot facility will continue to operate until digestion upgrades are completed. The decision of whether to continue the compost program will be made after the City and MCWS have reviewed the outcomes of the pilot.

For land application, a request for qualifications (RFQ) will be issued in 2015 to determine if contractors can manage nutrient management programs for the City without significant biosolids stockpiling and storage. If significant storage is required the City will assess the financial implications for storing and stockpiling pathogen-containing biosolids. Depending on the assessment, the land application program may be delayed until digestion upgrades are completed. The decision to delay or implement the land application program will be made after the RFQ, in conjunction with the composting pilot decision.

6.2 Phase 2: Post Thermal Hydrolysis

After the thermal hydrolysis system is implemented the City will be able to achieve pathogen-free biosolids suitable for land application and soil products. If land application was not achievable prior to thermal hydrolysis the City will initiate a procurement process and hire a contractor to manage nutrient management applications. If land application is successful before the thermal hydrolysis process, the City and contractor will adapt the program to accommodate the hydrolyzed sludge.

The City will also pilot a soil production program to distribute biosolids to soil manufacturers. In the event that either land application and/or soil products cannot meet regulatory compliance the City will pursue thermal oxidation.

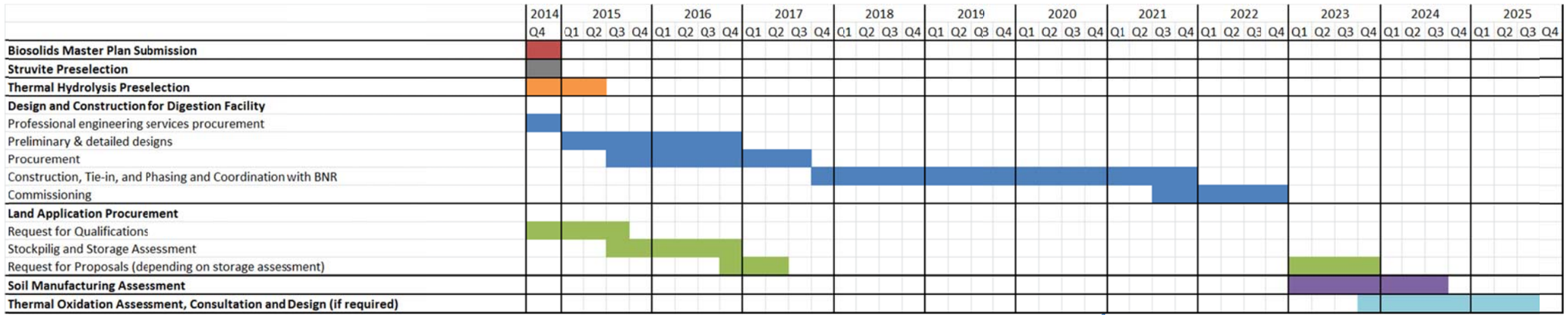


Figure 10 Biosolids Master Plan Implementation Schedule; schedule to be updated and revised as major projects progress[1]

[1]Biosolids pilot composting from fall 2014 to fall 2016

6.3 SAC Guiding Principles and the Biosolids Master Plan

The BMP, which focuses on thermal hydrolysis, land application, and composting and soil production, is in keeping with the guiding principles developed by the SAC. The plan meets these guiding principles in the following ways:

Resource recovery

The BMP recovers and reuses nutrients by harvesting struvite and utilizing nutrients and organic matter through land application and soil production. The gas and heat from the digestion process will also be recovered and utilized to recover energy.

Long-term sustainability

The plan for beneficial reuse focuses on long term sustainability. A new thermal hydrolysis facility will effectively reduce biosolids production by 30%. It will also produce a more stable, pathogen-free product that is safer to utilize and more amendable to land application and soil production. The marketing analysis also indicates that there is significant, long term capacity for land application and compost and soil manufacturing products.

Biosolids supply chain

The BMP scope of work was expanded to include the digestion process. By incorporating thermal hydrolysis pre-treatment into the plan and by developing beneficial reuse strategies around its benefits the plan takes into consideration the entire system involved in processing and reusing biosolids, including energy and raw materials.

Health and safety

Improving the digestion process with thermal hydrolysis to produce pathogen-free biosolids will better protect health and safety in biosolids management. With greater biosolids stabilization and higher biosolids thickness the mass and volume of the biosolids will decrease, reducing biosolids handling and odour concerns. The pathogen-free product will also be safer to handle and utilize for land application and composting and soil manufacturing.

Realistic, achievable

Consultation with industry representatives and the public sector illustrates that the beneficial reuse is realistic. It indicates that stakeholders are willing to participate in the biosolids program. By implementing the BMP in a phased, stepwise manner there is opportunity to address considerations and adapt the disposal programs to meet defined regulation.

Adequate assessment of risk:

The risks and considerations are detailed in Section 0 and 10. They will be addressed as part of the phased, step-wise implementation of the BMP.

The environmental risks are reduced by having an advanced sludge treatment system with thermal hydrolysis and digestion which reduces biosolids production and gives a pathogen-free product. The construction and tie-in risks for the new digestion facility

will be mitigated by incorporating the project with the NEWPCC BNR upgrade. By merging the construction of the new digestion facility with the NEWPCC BNR upgrades the two works can be optimized and coordinated.

Mixed/integrated solutions:

The BMP will provide multiple beneficial reuse options for the thermally hydrolyzed biosolids. Land application and soil production will be the primary utilization routes for the biosolids. Landfill reclamation will provide additional, seasonal capacity. While landfilling will remain an option in cases of emergency, the City will minimize this by pursuing thermal oxidation if soil manufacturing and land application do not result in beneficial reuse.

7. Costs

The estimated capital costs are a Class 5 estimate as per the AACE Cost estimate classification system and are listed in Table 5, Table 6 and Table 7.

Table 6These values have been updated and refined from the preliminary estimate that was presented in the NEWPCC Master Plan.

These estimates include the cost to construct a new digestion facility and to demolish/repurpose the current facility. The existing digestion tanks may be repurposed for sludge storage.

Table 5 Costs for current biosolids projects

Project #	**Capital Biosolids Projects**	**Status**	**Cost**
1	Pilot biosolids compost facility	Design and Construction	$ 7,000,000

Table 6 Estimated costs for planned biosolids projects

Project #	**Capital Biosolids Projects**	**Status**	**Cost**
2	NEWPCC digestion facility	Planned and budgeted	$ 226,000,000
3	SEWPCC sludge thickening	Planned and budgeted	$ 21,000,000
	Total		$ 247,000,000

Additional capital costs will be determined based on the outcome of a land application request for qualifications and the compost pilot trial. The status of these projects and cost dependencies are summarized in Table 7.

Table 7 Status of future biosolids projects

Project #	**Capital Biosolids Projects**	**Status**	**Cost**
4	Compost and Soil Production	Future project	Dependent on Biosolids Compost Pilot and the Soil Production Pilot
5	Land Application and Storage Facility	Future project	Dependent on Land Application RFQ; RFQ will be completed by end of 2015
6	Thermal Oxidation	Future project	Dependent on outcome of Projects 4,5

7.1 Factors Impacting Costs of Biosolids Treatment

7.1.1 Land Application

Actual application rates cannot be determined in advance (Appendix D) and will only be approved after land is secured and tested for nutrients. If higher application rates are allowed then the costs of the program will decrease. If application rates are lower than the costs of the WinGRO program will increase accordingly. This value could also increase if additional mitigation is needed to store biosolids.

7.1.2 Compost and Soil Manufacturing

Composting and soil products have the highest NPV. This is because of the cost of bulking agent, commonly woodchips, which are used to provide extra carbon and air pockets for air circulation. The value of bulking agent used in the estimate is based on locally sourced wood waste. There may be opportunities to reduce costs if additional sources of wood waste can be identified. Conversely if there are limited quantities of waste and virgin material must be purchased, costs could also increase.

As the City transitions from composting to soil products the costs of soil production may be transferred to the vendors responsible for manufacturing, selling, and distributing the soil and the NPV value will change accordingly. The composting costs are also influenced by resale value. The value will be determined by the quality of the compost that will be generated if the compost cannot meet provincial regulatory criteria (currently undefined) then the compost cannot be sold and will have no resale value.

7.2 Impact on Rates

City Council approves sewer rates which include a ten year operating and capital forecast. The 2013 Water and Sewer Rate Report as approved by Council on December 12, 2012, projected sewer rate increases for each of the next ten years, 2013 to 2022. A more detailed rate impact cannot be estimated at this time because the capital and operating costs are so preliminary and subject to change.

8. Interdependencies of Capital Water and Waste Projects

Sludge handling and biosolids management represent the end stage of the wastewater treatment process. Activities upstream of the biosolids process, such as wastewater collection and wastewater treatment, can impact the biosolids management program and vice versa. This section describes the potential impacts that other major wastewater projects may have on the biosolids program.

8.1 NEWPCC BNR Upgrade

The wastewater treatment facility at the NEWPCC is currently being upgraded to a BNR process. To accommodate this new process sludge handling and thickening will have to be modified. Currently the primary sludge and the waste activated sludge is mixed and thickened to 3-5% solids in the primary clarifier. In the future the primary sludge will be fermented for biological phosphorous removal. Waste activated sludge will be thickened separately.

The thermal hydrolysis pre-treatment system requires sludge to be thickened to a higher thickness, 15 – 20% solids. In order to accommodate the new thickening and handling strategies and the increased sludge thickness within the new digestion facility, the BNR upgrade and the new digestion facility will have to be constructed and implemented concurrently.

A process flow diagram showing the linkages between the biosolids digestion facility and the BNR facility is shown in Figure 11. By developing the new digestion facility project in conjunction with the BNR facility the City can optimize phasing and tie-ins between the two facilities.

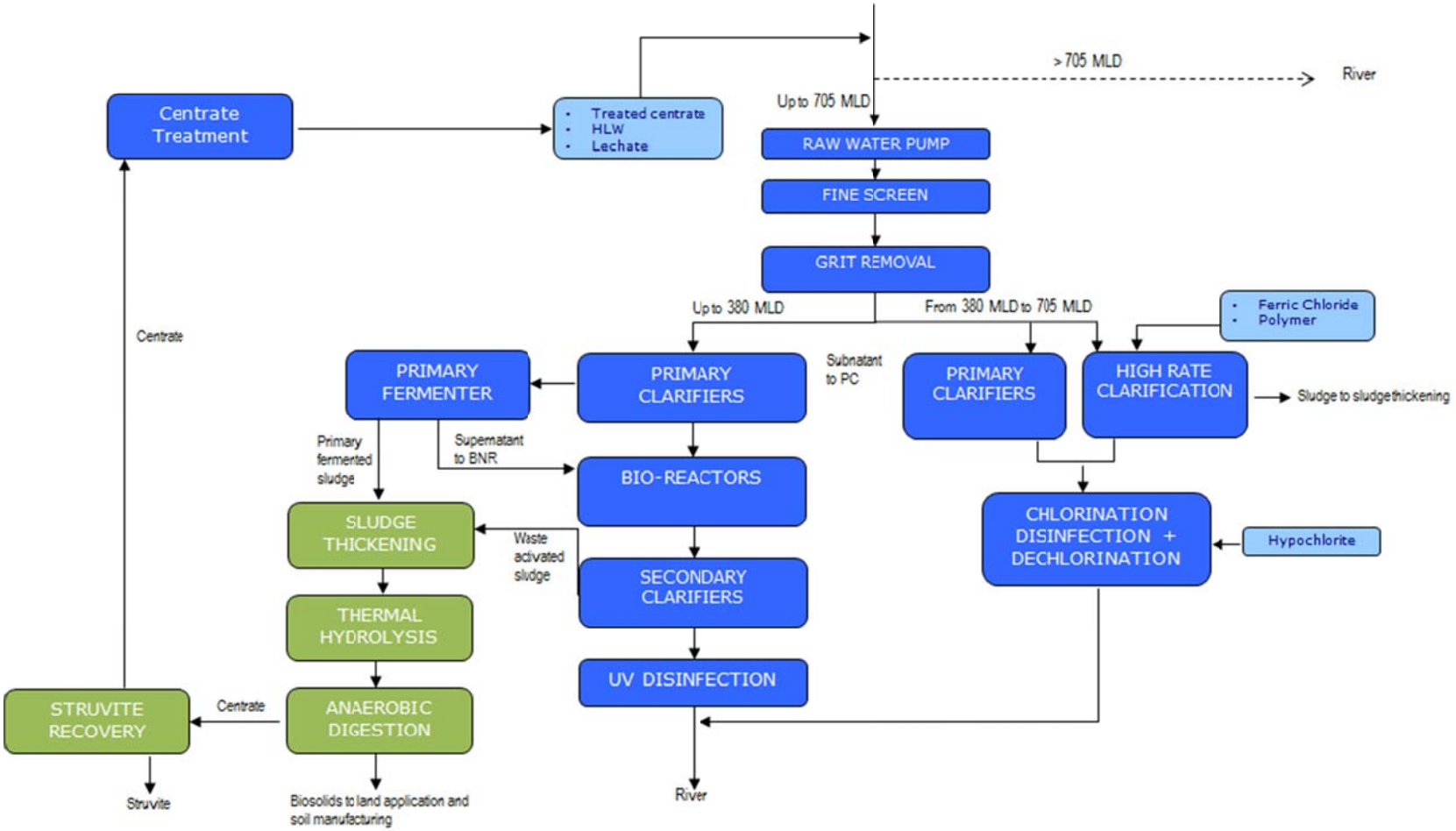


Figure 11 Process flow diagram of the new digestion facility and the BNR facility at the NEWPCC; green shows biosolids components

8.2 SEWPCC Biological Nutrient Removal Upgrade

The SEWPCC treats approximately 30% of the City's wastewater. Currently sludge is hauled to the NEWPCC for treatment at 3-5% solids. The new digestion facility, however, must receive sludge at a higher thickness of 15-20% solids. By thickening the SEWPCC solids onsite to 15-20% thickness the City can reduce the number of sludge hauling trucks that are sent to the NEWPCC.

Currently the SEWPCC is being upgraded and expanded for biological nutrient removal. The upgraded facility will continue to haul sludge at 3-5% thickness so that the sludge can be treated in the existing digestion facility. Following the completion of the SEWPCC BNR, and in conjunction with the new digestion upgrade, the sludge handling at the SEWPCC will be upgraded with second stage dewatering so that the SEWPCC sludge can be treated via thermal hydrolysis. The new thickening strategy and the phasing from the old digestion facility to the new facility will have to be coordinated.

The WEWPCC only generates 10% of the City's sludge. The new anaerobic digestion facility will be able to accommodate this small amount at its current thickness, and no additional thickening will be needed at the WEWPCC.

8.3 Combined Sewer Overflow (CSO) Mitigation

Combined sewers carry all of the wastewater flow to the wastewater treatment plants during dry weather conditions. During wet weather events, the wastewater diversion weirs cannot handle all of the runoff that enters the system and flows over the weirs directly to the rivers to protect basements from flooding. Currently the City is developing a master plan to reduce these overflows and as a result, flows to the wastewater treatment plants are expected to increase during wet weather storms events.

As the CSO Master Plan is implemented more wastewater flow is expected to be conveyed to the treatment plants. As a consequence the maximum monthly value is expected to increase. This could generate greater quantities of wet-weather flow sludge which would have to be accommodated in the digestion facility.

9. Updates to the Biosolids Master Plan

The design and construction of the new thermal hydrolysis system, digestion, and struvite recovery system will be reported to MCWS in the bi-annual NEWPCC Master Plan updates and submissions reports.

For the beneficial reuse options the City will submit annual reports on the biosolids management program, describing major activities, milestones, and recommendations.

10. Risk and Opportunity Analysis

a) The estimated capital costs are a Class 5 estimate as per the AACE cost estimate classification system. These estimates will be refined and updated as conceptual, preliminary, and detailed designs are completed.

b) The costs for biosolids beneficial reuse strategies are dependent on the consideration factors described in Section 0. As the BMP is implemented these costs will be reviewed and revised accordingly.

c) The CSO and BNR treatments, combined with wet weather flow treatments, may alter the quantity and quality of sludge that must be treated within the digestion facility. Sludge quantities and qualities will be continually reviewed and updated as these major projects develop.

d) Due to the congested site at the NEWPCC the construction activities of the NEWPCC BNR and digestion facility will require tight coordination. Unforeseen delays or impacts to the schedules of either facility may impact each other accordingly.

e) The NEWPCC BNR and digestion project will happen simultaneously with other major projects (e.g. SEWPCC BNR or large construction projects in other industries). This may overwhelm the local construction market and lead to a lack of available contractors and consultants to perform the required work.

f) During preliminary and detailed designs there may be opportunities to optimize the conceptual designs presented in this document.

11. Summary and Conclusion

The City will undertake a composting pilot and will further investigate land application as beneficial reuse strategies. Landfill reclamation will be utilized on an as-required basis. The program will be implemented in a phased manner and will be coordinated with the construction of a new digestion facility at the NEWPCC and with planned BNR upgrades on the NEWPCC liquid stream. Once the new digestion facility is complete, the City will pilot soil production as a potential reuse strategy.

The BMP will be implemented in a stepwise approach. It will be reviewed as required and adjusted to respond to changing technology and environmental requirements. This will give flexibility, adaptability and robustness to the program.

This plan meets the defined objectives of the BMP by utilizing nutrients within the biosolids and beneficially reusing the biosolids in accordance with CCME guidelines. By constructing a new facility to produce pathogen-free biosolids and incorporating additional nutrient and energy recovery systems into the new facility, the program will comply with health and safety regulations, recover nutrients, and beneficially reuse biosolids.

12. References

- 2005 CCME 1: Canadian Council of Ministers of the Environment Guidelines for Compost Quality
  http://www.ccme.ca/assets/pdf/compostgdlns_1340_e.pdf

- 2012 Biosolids Options Report (Appendix B)

- 2012 CCME 2 Canadian Council of Ministers of the Environment Canada-Wide Approach for the Management of Wastewater Biosolids
  http://www.ccme.ca/assets/pdf/pn_1477_biosolids_cw_approach_e.pdf

- 2012 CCME 3 Canadian Council of Ministers of the Environment Guidance Document for the Beneficial Use of Municipal Biosolids, Municipal Sludge, and Treated Septage:
  http://www.ccme.ca/assets/pdf/pn_1473_biosolids_guidance_eng_1.0.pdf

- 2013 Water and Sewer Rate Report
  http://www.winnipeg.ca/waterandwaste/pdfs/billing/waterandsewerrates2013.pdf

- 2013 Request for Information on Biosolids Management
  http://winnipeg.ca/MatMgt/FolderContents.asp?FOLDER_NAME=518-2013&YEAR=2013

- 2014 NEWPCC Master Plan

- 2014 City of Winnipeg Biosolids Public Engagement Website
  http://wwdengage.winnipeg.ca/biosolids/

- 2014 WPA: Water Protection Act
  http://web2.gov.mb.ca/laws/statutes/ccsm/w065e.php

- United States Environmental Protection Association A Plain English Guide to the EPA Part 503 Biosolids Rule, Chapter 5 Pathogen and Vector Attraction Reduction Requirements
  http://water.epa.gov/scitech/wastetech/biosolids/503pe_index.cfm

APPENDICES

APPENDIX A - LETTER TO CITY CONFIRMING WATER PROTECTION ACT AMENDMENTS

Manitoba
Conservation and Water Stewardship
Climate Change and Environmental Protection Division
1200 – 155 Carlton Street
Winnipeg, Manitoba R3C 3H8

October 2, 2012

Ms. Diane Sacher, P.Eng.
City of Winnipeg
Water and Waste Department
112-1199 Pacific Avenue
Winnipeg, MB R3E 3S8

Dear Diane:

RE: North End Water Pollution Control Centre Upgrading

The Minister has considered the Plan for the upgrading of the North End Water Pollution Control Centre. This Plan was submitted on June 15 in accordance with the requirements of the Save Lake Winnipeg Act.

Please be advised that the Plan is approved subject to the following conditions;

1. That the City of Winnipeg submit the NEWPCC Master Plan to the Director of Environmental Approvals no later than 12 months from the date of this letter.

2. That the final commissioning of the upgraded NEWPCC occurs no later than 54 months, plus a contingency of 24 months, from the date of this letter. The NEWPCC Master Plan should also provide options on opportunities to reduce the overall time required to complete this project.

3. That the effluent quality criteria for the upgraded NEWPCC meet all of the parameters outlined in the attachment to this letter.

4. That the City of Winnipeg Biosolids Master Plan fully consider opportunities to recycle nutrients to the maximum extent possible through the application of best available technologies and that this Plan be submitted to the Director of Environmental Approvals no later than 24 months from the date of this letter.

ROUTE

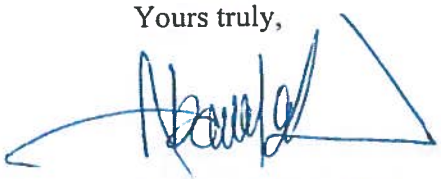
	Act	Info		Act	Info
DPS	✓		KJTK	✓	
MLG			YC		
RL			GKP	✓	
MZ			TSJ		
DED			CWC	✓	
File					

Manitoba
spirited energy

The current Environment Act License No. 2684 RRR will be amended after the Director of Environmental Approvals has reviewed and approved the NEWPCC Master Plan and Biosolids Master Plan.

Thank you for submitting this Plan and we look forward to the commissioning of the upgraded facility.

Yours truly,



J. Dan McInnis, P. Eng.
Assistant Deputy Minister
Climate Change and Environmental Protection Division

cc: Dwight Williamson
Tracey Braun

APPENDIX B - 2012 BIOSOLIDS OPTIONS REPORT TO MCWS

Winnipeg

Water and Waste Department • Service des eaux et des déchets

December 24, 2012

Our File No.: 020-17-08-11-00
020-17-08-00-0N

Environmental Approvals Branch
Manitoba Conservation and Water Stewardship
123 Main Street, Suite 160
Winnipeg, MB R3C 1A5

Attention: Tracey Braun, Director

Dear Ms. Tracey Braun:

RE: Biosolids Treatment Options Report

Please find attached the final report entitled Biosolids Treatment Options dated October, 2012. This report describes the treatment options that the City has selected for further investigation and technical analysis. Information from this report will be used to further develop the City of Winnipeg's biosolids master planning strategy.

Should you have any questions on this report please contact Mr. Duane Griffin, P.Eng. at 204-986-4483 or by email at dgriffin@winnipeg.ca

Yours truly,

Chris Carroll, P. Eng
Manager of Wastewater Services

GKP/jr

c: G. Patton, P. Eng., Water and Waste Department (email)
J. Veilleux, P. Eng., Water and Waste Department (email)
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BIOSOLIDS TREATMENT OPTIONS REPORT

OCTOBER 2012

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EXECUTIVE SUMMARY

The City of Winnipeg is currently in the beginning stages of its master planning process for the treatment of biosolids. This report describes the options that the City has selected for further investigation and technical analysis.

To select possible treatments strategies, only well proven technologies that met municipal, provincial and federal regulations were considered. Options also had to demonstrate beneficial reuse, as defined by the Canadian Council of Ministers of the Environment (CCME) guidelines. Future treatment strategies should also provide multiple end products to reduce risk regarding market dependencies.

The options that were selected include anaerobic digestion, composting, thermal drying, and thermal oxidation. Hypothetical scenarios were developed to evaluate relative economic and environmental impacts. Analysis indicated that all scenarios had similar net present values. Further study indicated that unknowns regarding biosolids marketability would influence the environmental acceptability of the evaluated technologies and that the potential markets within Manitoba need to be quantified.

The next phase of the biosolids master planning process will involve a biosolids market feasibility study. The development of a pilot composting program and the submission of a nutrient management plan will also provide input to the master planning process. Based on the results of these activities the treatment strategies will be adjusted and revaluated to ensure that biosolids treatment and handling strategies minimize risk to the environment and human health while maximizing beneficial reuse.

INTRODUCTION

The City of Winnipeg is currently investigating biosolids and wastewater sludge treatment technologies, which will provide input to the City's biosolids master planning process. For planning purposes a design horizon of 25 years was used. In this timeframe there are several factors that will influence the master planning process and future biosolids treatment programs.

These factors include population growth within the City and upgrades to nutrient removal facilities for the South End Water Pollution Control Centre (SEWPCC) and the North End Water Pollution Control Centre (NEWPCC). With this in mind it is estimated that sludge loading will grow by approximately 33% by 2037.

REQUIREMENTS FOR TREATMENT OPTIONS

The decision making framework used for the selection of options was as follows:

1. Only well-proven technologies for the biosolids handling were considered.
2. Solutions were evaluated on the basis of current regulations and what is expected to be the future demands from presented drafts from the regulators. This includes the requirement that nutrients from biosolids be utilized.
3. An internal stakeholder analysis was conducted to help define the market situation for expected end use scenarios and the public acceptability of the different solutions.

The treatment options must also meet the requirements for beneficial reuse in accordance with declared policies. For the City's master planning purposes beneficial reuse is defined according to the CCME definition found within the report 'Canada-wide approach for the management of wastewater biosolids.' This definition stipulates that beneficial reuse must demonstrate the following (CCME 2011):

- Product efficacy
- Adherence to, municipal, provincial, and federal regulations
- Minimize risks to the environment and human health
- Minimize greenhouse gas emissions

The City also identified a need for a biosolids handling plan that included multiple treatment strategies. It is believed that multiple end products and treatment processes would reduce risk to the overall handling strategy. Multiple end products would also reduce dependency to changes in market demand.

BIOSOLIDS HANDLING STRATEGIES

For the purposes of planning activities the biosolids handling strategy is defined as compromising three main groups of activities:

1. Biosolids treatment at the wastewater treatment plant as a part of the water treatment solution (i.e. dewatering or digestion and dewatering)
2. Preparation of biosolids for end disposal; this activity can be placed at the wastewater treatment plant or at an external site (i.e. composting, thermal drying and/or thermal oxidation)
3. The end disposal of the biosolids or the residuals from biosolids treatment (i.e. agricultural use, cement production or land filling)

Figure 1 illustrates examples of possible strategies which can be grouped according to the above mentioned activities.

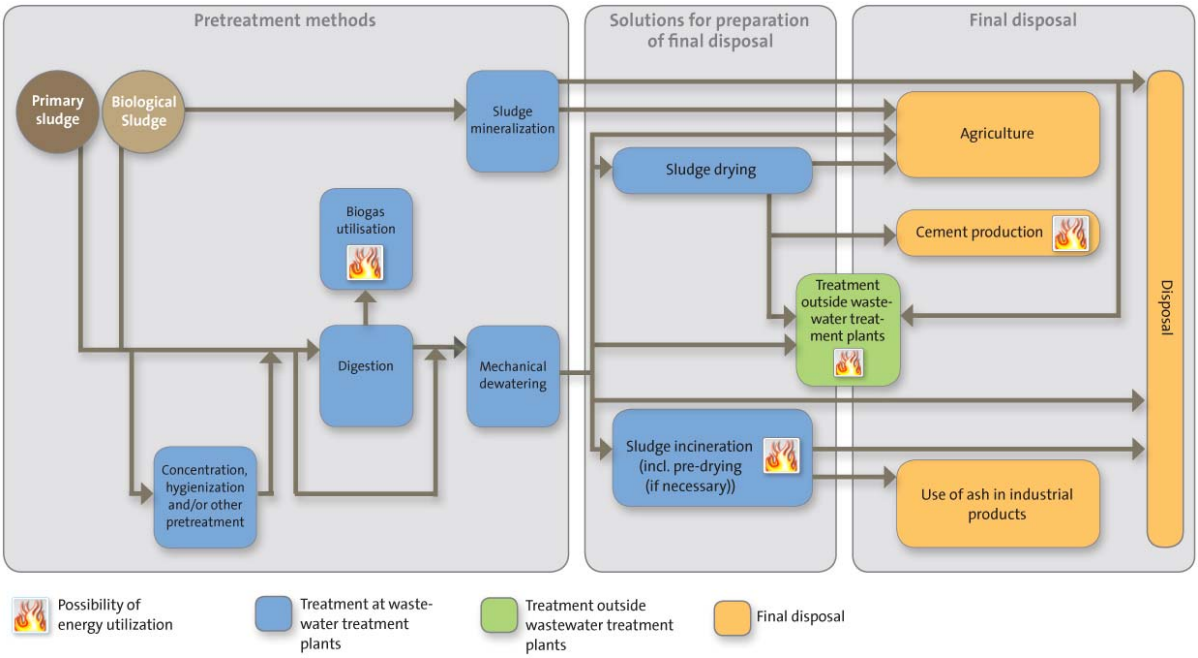

Figure 1 Illustration Of Possible Handling Strategies As Defined For The Biosolids Master Plan

Based on this information the following biosolids handling technologies were selected for further analysis:

- Digestion and composting with an end use as a fertilizer or as landfill cover
- Digestion and thermal drying with an end use as a fertilizer or in cement production
- Thermal oxidation – with or without digestion

The possible combination of strategies is illustrated in Figure 2. The dashed lines show a route that is only considered acceptable for a part of the total biosolids produced. The orange arrows indicate that the acceptability of this solution is still uncertain.

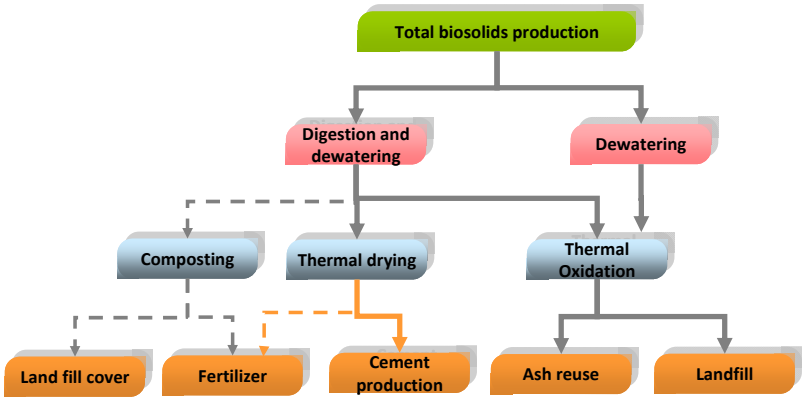

Figure 2 Illustration Of The Biosolids Handling Solutions Selected For Evaluation

SCENARIOS DEVELOPED FOR ANALYSIS

For comparative purposes the following scenarios were selected for economic and environmental evaluation. It should be noted that these scenarios were developed to evaluate the relative economic cost and environmental implications of each technology. The City is not committed to selecting any one of these scenarios as an absolute solution.

- Scenario 1: Anaerobic digestion and thermal oxidation of all the biosolids
- Scenario 2: Anaerobic digestion of all biosolids followed by thermal oxidation (70%) and composting (30%)
    - Digestion of biosolids at SEWPCC and composting
    - Digestion and thermal oxidation of the biosolids from WEWPCC and NEWPCC at the NEWPCC
- Scenario 3: Thermal oxidation of all the biosolids without anaerobic digestion
- Scenario 4: Thermal drying (70%), composting (30%) with anaerobic digestion
    - Digestion of biosolids at SEWPCC and composting
    - Digestion and thermal drying of the biosolids from WEWPCC and NEWPCC at the NEWPCC

An economic analysis indicated that, in terms of a net present value (NPV) all solutions had the same magnitude of cost. Estimates of greenhouse gas emissions indicated that the smallest carbon footprint came from scenarios that had thermal oxidation, though the carbon footprint of thermally dried products could decrease, depending on the extent to which dried products are utilized.

The decision was made to include anaerobic digestion as part of the overall handling strategy. Digestion reduces pathogens and sludge volume; it also produces amendable, stabilized biosolids that can be used to produce a variety of end products. The upgraded and expanded SEWPCC will have dedicated anaerobic digestion and centrate treatment, while the NEWPCC will digest sludge from the WEWPCC and the NEWPCC.

NEXT STEPS

The City believes that these scenarios give a good indication of different handling strategies and their relative implications. In analyzing these scenarios, however, it is apparent that assumptions and unknowns regarding the marketability and public acceptance of biosolids' products need to be verified. The degree to which biosolids would be reused will impact the economic value and environmental benefits of these technologies, depending on how the market perceives biosolids-related products.

Additional unknowns, such as the outcome of the City's pilot composting program and the acceptance of a nutrient management plan for land spreading also need to be verified. If the nutrient management plan is successful, treatment strategies and their outcomes will be altered to include summer agricultural land spreading as a viable option of beneficial reuse.

The next phase of biosolids master planning will involve the completion of the biosolids pilot composting facility. A marketing survey on biosolids related products will give better indications of which end products will maximize reuse, and further development of nutrient removal upgrades and expansion works will decide the best location(s) for anaerobic digestion. Design work on the SEWPCC and NEWPCC will also facilitate further evaluation of treatment options and subsequent phases of the master planning process.

REFERENCES

CCME 2011; Canada-wide Approach for the Management of Wastewater Biosolids Consultation Document DRAFT; Canadian Council of Ministers of the Environment

APPENDIX C.1 - PUBLIC PARTICIPATION REPORT

Winnipeg
Water and Waste Department

BIOSOLIDS MASTER PLAN
PUBLIC PARTICIPATION REPORT

March 2014

For more information on this report, please contact:

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BACKGROUND

In January 2014, the City of Winnipeg initiated a public engagement process to receive input on the options being considered for managing biosolids, as part of the Biosolids Master Plan.

Information about the Biosolids Master Plan was available on the website: http://wwdengage.winnipeg.ca/biosolids/

PUBLIC FEEBDACK

Public feedback was collected from January 2 – 27, 2014:

- Comments on the website – 16 comments
- Direct emails (incl. via web form) – 4 emails
- Two public meetings:

Date	Attendees
Tuesday, January 14, 2014	37
Wednesday, January 15, 2014	39

- Feedback forms and dotmocracy sheets:

	Feedback Forms	Dotmocracy (varied per option)
Public meetings	26	25-34
Online on our website	3	2-8

Public feedback was also collected from:

- An omnibus phone survey
  - February 2014
  - 479 respondents
- A Stakeholder Advisory Committee
  - October 2013 – February 2014
  - 10 members

Reports from the various methods of feedback are listed under Attachments at the end of this report.

PROMOTION

Several methods were used to inform stakeholders of the engagement process:

- Public meeting invites were mailed out – 115 invites
- Water & Waste eNewsletters were mailed out

Date	Total emails Sent	Total emails Opened	No. of Click-throughs
January 6, 2014	1,893	1,052 (55%)	193
January 15, 2014	1,944	1,073 (55%)	159
January 23, 2014	1,988	1,154 (58%)	120

- A print advertisement was placed in the Winnipeg Free Press on January 11, 2014
- Press releases with a few news stories ran
- Posts on the City of Winnipeg's Facebook page
- Tweets from the City of Winnipeg's Twitter account

METHODOLOGY

Responses from the public meetings and website are based on self-selecting respondents who are more likely to respond because they would like to express an opinion on the topic at hand. While these opinions are valuable, they cannot be viewed as representative of all Winnipeggers. Instead, the omnibus phone survey results are a more representative reflection of the opinions of Winnipeggers.

SUMMARY OF FINDINGS

Reviewing the feedback received throughout the public engagement process, some themes emerged:

Health impacts are a concern, but so is the need to reuse nutrients.

> *"No proposal should be adopted that effectively destroys the valuable resources available in biosolids."*
>
> *"If there are unknowns re-the pharmaceuticals etc. in the biosolids, I don't think we should be considering using them on land that we are using to produce food. In my opinion, it would be best to apply the precautionary principle in this circumstance."*

When gauging support for the various options, composting was the most supported. In the omnibus survey, when asked what the most important concern was, most responded health impacts.[1]

When considering options for managing biosolids, those that reuse nutrients are also more likely to have potential health impact concerns. This makes trying to choose a preferred option more challenging, as the two are incongruent.

Look beyond a plan just for biosolids. Consider the entire organics stream.

> *"It can be helpful to look at all organic waste stream components together and look for linked solutions rather than segment by segment."*
>
> *"Keep an open mind and look at all options. Consider a larger plan than perhaps just biosolids."*

Some comments emerged around a broader context for biosolids management. Developing a long-term plan should allow for innovation and potentially drive other activities in the department.

There was also considerable dialogue about composting as an option, along with the need to have a wider approach to managing organics. Comments included integrating kitchen waste and looking at anaerobic options.

[1] Due to the complexity and the need to provide a base level of information for each option, opinions of the options were not sought in the omnibus poll.

Cost is not as much of a concern.

> *"I strongly feel it would be better for the city of Winnipeg to not go the cheaper route and really follow a longer-term initiative."*

The consistent message in the feedback received was that cost was not as much of a concern in developing a biosolids master plan. This tied in with the need to take the time to invest in a sustainable long-term solution.

ATTACHMENTS

For further detail, please refer to the specific reports available online at wwdengage.winnipeg.ca/biosolids/

- Summary of Comments and Responses
- Feedback Form and Dotmocracy Report
- Stakeholder Advisory Committee: What Was Heard
- Omnibus Biosolids Master Plan Research Report

Also available online are the materials used during the public engagement process:

- Public Meeting Presentation
- Public Meeting Storyboards

APPENDIX A

LIST OF ATTENDEES

LIST OF BIOSOLIDS PUBLIC MEETING ATTENDEES

1. Winnipeg Centre Green Party (x2)
2. CBC (x2)
3. Pronto Energy ROC
4. Climate Change Connection/50 by 30
5. Terratec (x5)
6. Stantec Consulting (x4)
7. Myera Group
8. MEIA
9. Aquatic Life
10. KGS Group (x3)
11. Council of Women of Winnipeg
12. AANDC
13. UW
14. Winnipeg Free Press
15. KAP
16. MCAC
17. U of W/Green Party of Canada
18. NRI University of Manitoba
19. DLF Consulting
20. MB Conservation & Water Stewardship (x4)
21. Univ.de Saint-Boniface
22. Consulate NL
23. CDEM (x2)
24. World Trade Centre Winnipeg
25. N-Viro Systems Canada
26. Mulder Construction
27. Lake Winnipeg Foundation (x2)
28. Samborski Environmental Ltd (x2)
29. BDM Projects
30. CAC Manitoba
31. AECOM (x2)
32. Tervita
33. Green Action Centre (x3)
34. Orgaworld (x2)
35. WSP Canada (former Genivar)
36. CWS
37. PCL Constructors
38. Yes! Winnipeg
39. Province of MB
40. Citizen (x7)

APPENDIX B

PUBLIC MEETINGS
QUESTIONS & RESPONSES

PUBLIC MEETINGS QUESTIONS & RESPONSES

1. **What steps are you taking to address the chemicals and pharmaceuticals that end up in biosolids and compost?**
   - Emerging substances of concern (ESOC) are a relatively new science in biosolids management that is currently being researched. We follow these studies closely.
   - Compost and biosolids end products have different levels of regulatory approval. Our testing process will confirm the quality and safety of the compost.
   - More information on ESOCs are available on the Canadian Council of Ministers for the Environment (CCME) website at:
     www.ccme.ca/assets/pdf/pn_1448_biosolids_esoc_final_e.pdf
     www.ccme.ca/assets/pdf/pn_1440_contam_invt_rvw.pdf

2. **How long does it take to break down woodchips in compost?**
   - Approximately 40% of woodchips are returned for reuse in the composting process and the remaining 60% of the woodchips end up in the final product and take about 6 weeks to be fully composted.
   - These numbers will be refined during the pilot program.

3. **How long does it take to create dried pellets versus compost? What is the implication in cost?**
   - Pellets are created in a matter of hours, whereas compost requires approximately six weeks to be completed.
   - Composting has a higher cost ($$$) compared to pelletization ($$).

4. **What is the status with the planning and capital budget process? Why is it taking so long?**
   - Funds are only approved in the year they plan to be spent.
   - The budgeted funds we have presented are subject to Council approval.

5. **What environmental parameters do you test at the landfill?**
   - We test for a number of environmental parameters, including metals, bacteria, and organics in the groundwater and surface water. We also monitor for nuisance odour and litter.

6. **Why are you removing nitrogen in addition to phosphorous from the wastewater?**
   - Biological phosphorous removal provides an opportunity for nitrogen removal as an added benefit.
   - Ammonia, which is made of nitrogen, is toxic to fish in aquatic environments and we will be treating it to improve the quality of the treated wastewater that is released to the rivers.

7. **Are the cost comparisons of the different options based on operational and/or capital costs? Are monitoring costs included in these costs?**
   - The cost comparisons are based on a Net Present Value which takes into account both operational (including monitoring costs) and capital costs.

8. **To what extent do you consider environmental factors in your planning process?**
   - We use CCME and provincial regulations for guidance on environmental factors (e.g., greenhouse gas emissions, utilization of nutrients, long term sustainability, cost, pathogen reduction).
   - We are also seeking public input on how these factors should be considered in the Biosolids Master Plan.
   - Information on biosolids management practices and relevant environmental factors are on the CCME's website: http://www.ccme.ca/ourwork/waste.html?category_id=137

9. **How did you come up with these treatment options?**
   - We consulted with CCME regulations, researched best practices elsewhere (e.g., Canada, North America, Europe) and issued a Request for Information to gauge private sector interest.

10. **Land application of biosolids is an option for forested lands. What is the likelihood of this happening in Manitoba?**
    - Applying biosolids to forested lands generally occurs in regions where there is logging and a requirement for reforestation.
    - The opportunities for land application on forested land in Manitoba are limited.

11. **How are you using the concept of sustainability within your evaluation criteria? What factors are you considering?**
    - We are using the definition provided by CCME for sustainable use of biosolids. These guidelines include factors such as carbon footprint, adherence to provincial regulations, and end product usability.
    - More information on sustainable reuse of biosolids is on the CCME website at: www.ccme.ca/assets/pdf/pn_1473_biosolids_guidance_eng_1.0.pdf

12. **How are pathogens in biosolids addressed in land application programs?**
    - Wastewater sludge is treated and stabilized in a process called anaerobic digestion to reduce pathogens in biosolids, which can then be safely handled and applied to land.

13. **Your website indicates you produce biosolids at the north end sewage treatment plant. Are biosolids produced or treated at your other two sewage treatment plants?**
    - All sludge from the City's two other sewage treatment plants are transported to

the north end plant for treatment.

- The biosolids generated at the north end plant represent the biosolids from all the treatment processes at the three sewage treatment plants.

14. Is it sustainable to truck sludge from the west end and south end plants to the north end sewage treatment plant?

- We studied the option of building new sludge treatment facilities at the south end plant and found that there are significant economies of scale to treat all the sludge at the north end plant.

15. You estimate that biosolids production could increase by 50% by the year 2037. How did you calculate this number?

- The 50% increase accounts for:
  - population growth of approximately 35%,
  - industry growth, and
  - increased wastewater flows through our Combined Sewer Overflow Program.
- This is an estimate that is used for planning purposes and is subject to change with wastewater infrastructure upgrades.

16. What are biosolids made of? How much does toilet paper influence this?

- Biosolids are primarily made up of water and carbon. They also include metals and nutrients (e.g., nitrogen, phosphorous).
- The contribution of toilet paper to the makeup is unknown because we have not specifically studied this at our sewage treatment plants. Also, we are not aware of any such studies being undertaken elsewhere. However, it is reasonable to conclude that the contribution will primarily be organic carbon.
- Details on our biosolids and their constituents are included in our yearly biosolids compliance reports: http://www.winnipeg.ca/waterandwaste/sewage/WPCClicenseMonitor.stm

17. Are you considering lime stabilization or alkaline technologies? Why or why not?

- We are not considering lime stabilization at this time.
- Soils in Manitoba tend to be basic (high pH) and applying lime stabilized sludge may further raise the pH.

18. How do other cities treat their biosolids? Are there examples of cities that are doing a good job managing their biosolids?

- Other cities will use one or more treatment options depending on a number of factors specific to their region (e.g., social, economic, environmental). Information on biosolids management in other regions is on our website at: http://wwdengage.winnipeg.ca/biosolids/presentation/
- To determine whether or not a city is doing a “good job” of managing biosolids, a number of local factors must be considered, including:

    - population density in the region,
    - compounds entering the sewer system, many of which will depend on local industry,
    - land availability,
    - regulations and effectiveness of regulatory enforcement on the discharges.
- Generally, certainly in North America and most of Europe, if the biosolids program is meeting regulatory licence requirements, it is reasonable to conclude that the city is doing a "good job".

19. What is anaerobic digestion and how is it used to create biosolids?

- The solids from all three sewage treatment plants are treated at the north end plant (our largest), in a process known as anaerobic digestion.
- In the anaerobic digestion process, the solids are heated to approximately 35 - 37° C in tanks that do not contain oxygen (i.e., anaerobic) where bacteria break down (i.e., digest) the solids.
- The solids left after anaerobic digestion are called biosolids.
- Anaerobic digestion is useful because it:
    - decreases the final mass of (bio) solids,
    - produces energy that can be used by the north end plant, and
    - reduces pathogens in the (bio) solids.

20. Can you provide additional technical information on anaerobic digestion? Why are we not considering the expansion of these systems as an option?

- There is a description of anaerobic digestion at http://www.epa.gov/agstar/anaerobic/
- We are considering expanding the existing anaerobic digestion systems at the north end plant, as part of the Biosolids Master Plan.

21. Are you considering other organics, such as food waste, as part of your biosolids master plan? Why not consider the entire organic waste stream?

- We do not have a program to collect other organics at this time.
- We may reconsider including other organics, such as food waste, in the future.

22. Is source separated organics going to be considered in the future?

- We will consider the option of source separated organics as part of the Garbage and Recycling Master Plan.

23. Who owns and operates the City's biosolids management program? In the future, is there interest in working with business?

- The three sewage treatment plants, including the biosolids program, are City-owned and operated.
- As part of the Biosolids Master Plan, we are open to exploring opportunities to partner with the private sector.

24. What is your Request for Information (RFI) and is it still open to submissions?

- We issued the RFI document to explore private sector interest in biosolids and biosolids management. You can see the RFI 518-2013 at: http://www.winnipeg.ca/MatMgt/FolderContents.asp?FOLDER_NAME=518-2013&YEAR=2013
- This RFI is closed, but we are open to receiving information through our biosolids feedback webpage at http://wwdengage.winnipeg.ca/biosolids/

25. Will the results of your RFI be made public?

- We will post a summary on our website after we finish reviewing all the submissions, and include this evaluation in our Biosolids Master Plan.

26. In comparison, it appears that composting is the most expensive treatment option. Why is this?

- Composting costs are higher because of the high cost of woodchips and labour.
- Woodchips are required to provide carbon and space for air to ensure composting reactions are complete.

27. Are you considering alternatives to woodchips (e.g., straw, paper, yard waste) in your composting pilot?

- To gain experience with composting biosolids in Winnipeg's climate, we will only be using woodchips.
- After the pilot program, we may explore other additives (e.g., leaf and yard waste) to optimize the process.

28. What is the fate of the compost for your pilot? How is this different than land application?

- The licence for the two-year pilot program does not allow for the composted material to leave the site.
- We will use the compost from the pilot program on-site as landfill cover and as a soil revitalization material.
- This is different than "land application" in that land application consists of applying biosolids to agricultural land.

29. Are there uses for compost outside of the landfill?

- Before we can distribute to a market off-site, we must first be able to demonstrate that the finished compost material is pathogen free and qualifies a "Class A" product.

30. Would paper from the recycling program be able to be used in composting?

- No. We already have a successful reuse program paper recycling paper, which is the preferred option.

APPENDIX C.2 – FEEDBACK FORM AND DOTMOCRACY REPORT

Winnipeg
Water and Waste Department

BIOSOLIDS MASTER PLAN
FEEDBACK FORM AND DOTMOCRACY REPORT

March 2014

For more information on this report, please contact:

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BACKGROUND AND METHODOLOGY

In January 2014, the City of Winnipeg initiated a public engagement process to receive input on the options being considered for managing biosolids, as part of the Biosolids Master Plan.

Public feedback was collected from January 2 – 27, 2014. A feedback form and dotmocracy sheets were provided at two public meetings and through the website at http://wwdengage.winnipeg.ca/biosolids/

Public Meeting Date	Attendees
Tuesday, January 14, 2014	37
Wednesday, January 15, 2014	39

	Feedback Forms	Dotmocracy (varied per option)
Public meetings	26	25-34
Online on our website	3	2-8

The feedback form was administered in conjunction with "dotmocracy" questions at the public meetings. The objective of both feedback tools was to capture stakeholders' opinions on the options for Biosolids Master Plan. Both tools can be found in this reports' Appendices.

Due to the low response rate (34% for Feedback Forms at the Public Meetings), there is a higher degree of variability inherent in the responses received. As a result, it is not recommended to extrapolate the results to a general population.

Since the respondents of the feedback form and dotmocracy sheets are self-selecting, the results are not scientific and only a summary of the responses received. This means that no estimates of sampling error can be calculated and therefore no margin of error is attributed to the results in the report.

PROFILE OF RESPONDENTS

AREA OF CITY	TOTAL % (n=29)
Northwest (incl. downtown)	34%
Southwest	31%
Southeast	24%
Northeast	3%
Other	3%

Note: Non-response not included

AREAS OF INTEREST	TOTAL % (n=29)
Member of the general public	48%
Member of an interest group - Environmental	45%
Member of an interest group - Other	24%
Potential business interest	17%
Member of an interest group - Business	14%
Land owner	14%
Member of an interest group - Agricultural	10%

Note: Total will exceed 100% due to multiple responses

Other areas of interest mentioned:

- Trade/Business opportunities
- Consultant, academic
- Energy from waste
- Gov. of Canada, Provincial government
- Green party of Canada Wpg S Centre
- University prof/Green party of Canada environment critic
- Human health
- Composting
- Economic

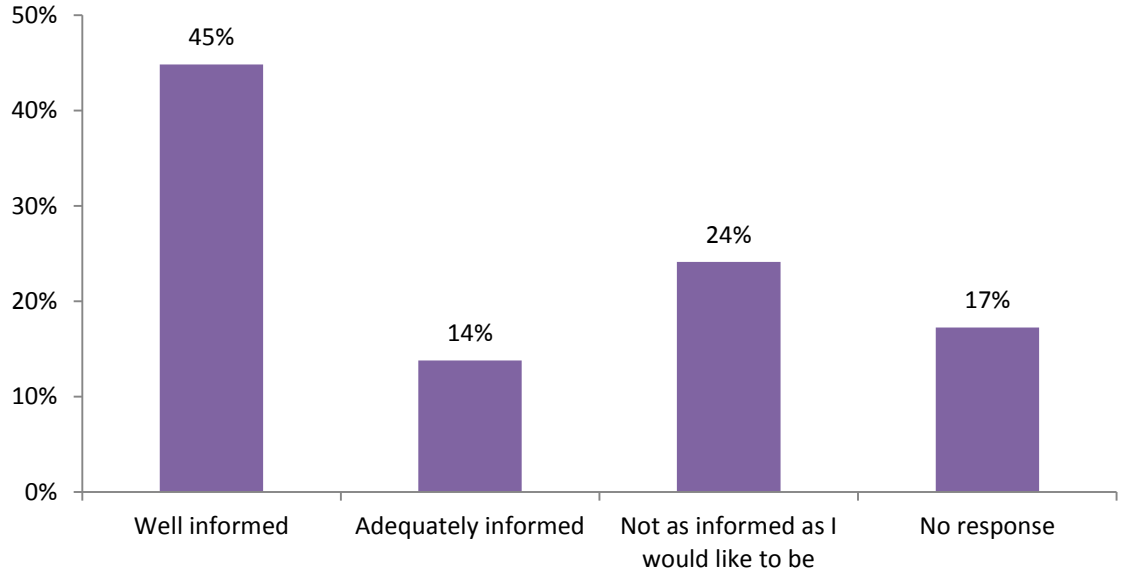
RESEARCH RESULTS

Feedback Form

Understanding of Information Presented

Most respondents were well informed (45%), with a quarter who were not as informed as they would have liked (24%).

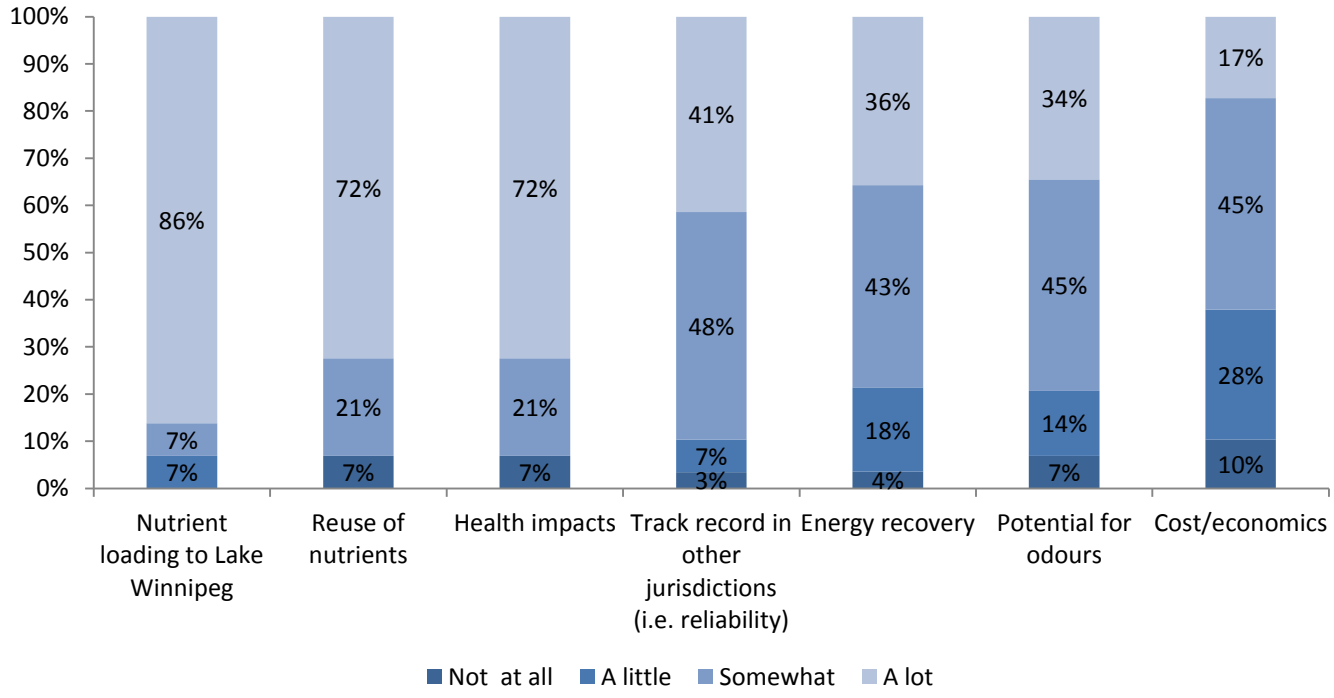
"How informed do you feel about the options being considered for the Biosolids Master Plan?" (n=29)



Concerns about the Biosolids Master Plan

The top concerns for respondents were nutrient loading to Lake Winnipeg (86% "A lot"), reuse of nutrients (72%) and health impacts (72%). The least concern for respondents was cost/economics (17%).

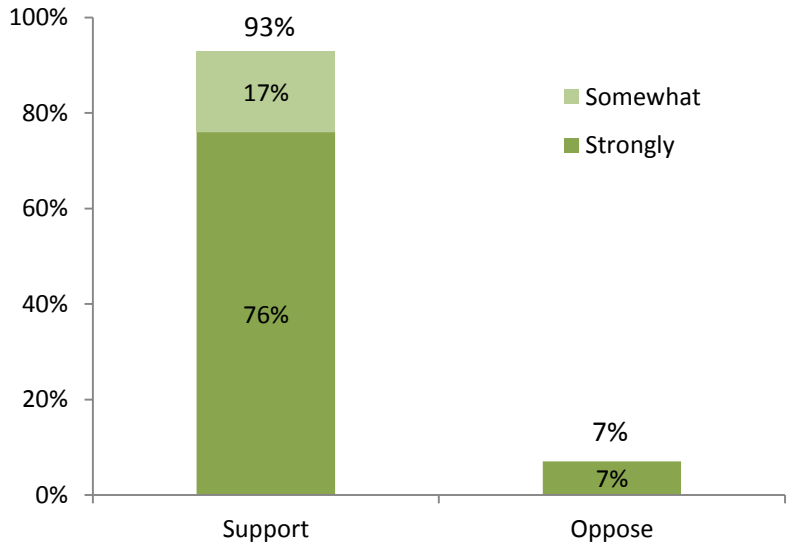
"When creating a Biosolids Master Plan, how much do the following concern you?" (n=29)



Support for Biosolids Master Plan

A strong majority of respondents (93%) support a plan that will increase the recovery of nutrients, even if it were to cost residents more.

"The City is developing a Biosolids Master Plan (BMP) that will determine how we will manage our biosolids in an environmentally sound, sustainable and cost-effective manner, while meeting Provincial regulations. Do you support a plan that will increase the recovery of nutrients, even if it were to cost residents more?" (n=29)



Need for Additional Information

About half of respondents (52%) provided a response when asked about needing additional information. Their responses are below.

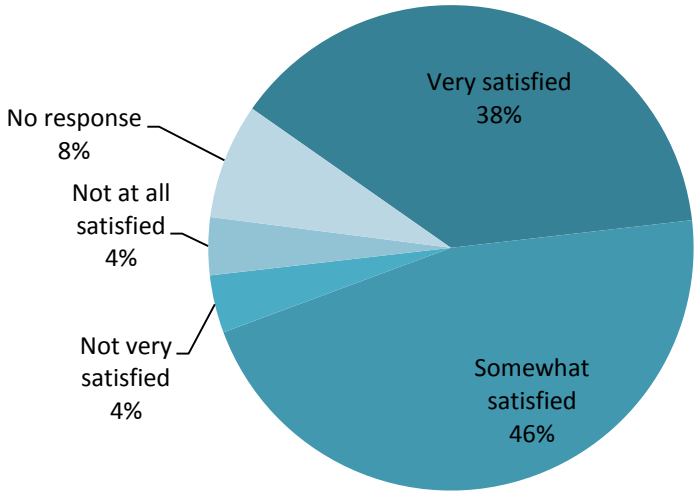
"Is there additional information we should be providing?" (n=29)

- "End users of the various processes and may be some quantification."
- "Perhaps a more comprehensive picture + understanding of current sludge/biosolids processing - offering school + public tours of waste water treatment plants."
- "The results of the RFI process."
- "More detailed history - this biosolids conundrum has been quite the SAGA over well more than a decade. Citizens need to be informed & realize that it's time for a decision, action & tax dollars to support."
- "More information on cost other than $ $$ $$$"
- "Actual dangers to humans and ecosystems. Statistics on gaseous emissions from Brady. Contribution to Lake Winnipeg destruction."
- "Possibly environmental impacts but you described these but what about simple ways how to understand this and more awareness campaigns."
- "Be specific on agricultural wet applications will it be for human consumption."
- "We obviously need to know about Carbon Footprint. We also need a good cost breakdown - 700 million plus is a lot of money!"
- "More public consultations with more background information on biosolids content."
- "Do transparent chemical analysis to ensure we do not contaminate lands, soils water table while supposedly enriching our soils with this "compost"."
- "City should only monitor - leave it to private resources to develop."
- "Risk assessment, environmental implications Details cost benefit analysis Statistical datas."
- "Details on what is required to meet regulations and concerns for land application including areal extent of required storage, storage options, and what changes are required from the WinGro program so as to spread at agronomically and environmentally appropriate rates."
- "Yes. I only learned at the open house that the sludge derives from anaerobic digesters that produce methane and heat as byproducts. There also should be consideration of all the organic waste streams together to see what process synergies might exist, such as the suggestion below. And more characterization and quantification of benefits would better provide for side by side comparisons."

Satisfaction with Public Meetings

The majority of respondents (84%) were satisfied with the public meetings.

*"Overall, how satisfied are you with this Public Meeting?" (n=26)**



**This question was not asked to website respondents.*

Other Comments

Over seven in ten (72%) respondents provided additional comments:

- “I suggest pilot experiments to assess the availability of nutrients in the compost product. It's one thing having a nutrient-rich substance but availability of those nutrients for plant uptake quite a different issue.”
- “Keep an open mind and look at all options. Consider a larger plan than perhaps just biosolids.”
- “What about reframing the question to "What will have the greatest env. benefit?" rather than "which will have the last impact?" There is so much benefit in composting, especially if used on gardens, forests, etc...for enhancing plant growth + carbon sequestration.”
- “If there are unknowns re-the pharmaceuticals etc. in the biosolids, I don't think we should be considering using them on land that we are using to produce food. In my opinion, it would be best to apply the precautionary principle in this circumstance.”
- “Strongly support composting biosolids on a large & small scale. Strongly against landfill disposal, even as a fail safe option. The plan should strive for sufficient redundancies to not default to landfill disposal. This plan should lead innovation, not follow it. If a SSO green cart program would allow for a better program, the Master Plan should drive it, no the Waste Department's plans (which do include a SSO program). The cross-section of responses to the RFI may not have captured all interested parties and additional general solicitations should be allowed and sought. The current regulatory framework may require updating to support potential future options. This should not be a limiting factor. I look forward to a diverse range of options. For example, soil fabrication (mixing biosolids with sand, etc.) may be a year-round option.”
- “Should consider a landfill bioreactor for co-disposed solid waste and sludge.”
- “The event was fine. The problem is the delay to act. Get 'er done! If the solution must be as simple/do-able as possible (and of course, lowest cost), my recommendation is to go with the LAND APP option, however, it must be managed with GREAT RIGOR for all concerned. (In compliance with the Nutrient Mgt Regulation of course) Following further info & thought, if I change my mind I'll be certain to let y'all know! NOTE: Elements (e.g. Cu) are only micronutrients of value if deficient in the soil, so addition will enable better crop growth. Otherwise they're actually heavy metals that will accumulate in soil. Good explanation of CELL MASS & importance of soil type.”
- “Thermal oxidation coupled with some composting is the preferred option”
- “I find this supports sustainability and it would seem like a good way of recycling bio products and energy. I am glad the energy will grow when water is taken out I see this as a great opportunity to steer away from landfills and lagoons w/ oxatizing process.”

- “In 2002, I was part of a team that presented the concept of a 'Living Machine' for the City of Winnipeg Wastewater future plan. An ecological wastewater facility using anaerobic, aerobic and designed ecosystems, the Living Machine has been tested around the world. It was invented by biologist John Todd, a canadian. A civic-scaled testing facility ran in Burlington, Vermont. To me, none of the proposed options come close to this visionary method.”
- “Consider SAGR (submerged attached growth reactor) Nelson Environmental”
- “Development should include expansion scenario based on population growth + stress on existing facilities to do what north main station is producing. The other two may have to expand and do it as well. So what would that cost?”
- “I assume that there is a lot more information on the WEB site, but I felt the quality of information provided in the PowerPoint could be better.”
- “Precautionary Principle of Health Safety. Please purify the toxins out of the sludge + liquid before dring it out - We do not need a compost with "toxic cocktail". One chemical contaminant is bad, two creates many unknown outcomes, three or more ??? There are many chemicals in one med'n Please experiment for ensuring safety. Citizens need to change their habits of dumping meds down the toilet. Also consider human elimination of excess meds i.e. - estrogen etc of birth control pills, "Lipitor"-type of blood pressure maintenance meds as the population ages... As pop'n ages, we will be ingesting more + more chemical combinations. Do responsible thorough research of existing plants -> Proven + Reliable technology is a requirement.”
- “The Biosolid Master Plan should further consider potential sources of biosolid contamination. Pathogens and parasites further monitoring and removal would help protect public health. Heavy metal contaminations are also a major concern.”
- “Proven technology can provide the best environmental solution. Look to composting!”
- “Anaerobic digestion on a larger scale has been done before. I feel that should be considered as well.”
- “Landfilling should not be considered even as a stop gap measure. Build proper storage to allow for downtime - Manitoba livestock producers have to store manure over winter and manage to do it. Your compost manager/engineer should talk to Dr. Kathy Buckley if they have not yet done so. Kathy works out of the Brandon Research Centre (AAFC) and has many years of experience composting hog and cattle manure in Manitoba conditions using both straw and woodchips as bulking agents and carbon sources. Her contact information is: Telephone: 204-578-6594 Fax: 204-578-6524 Email: katherine.buckley@agr.gc.ca”
- “I feel that the decision/input process is rushed, for both the City and the public consultation period. It would be good to have another option on the table, anaerobic composting/digestor. It would be good to have a two-stage approach to the public consultation.”

- “Looking upstream to the digesters, the process could yield more energy with New York City's new model of blending a slurry of kitchen wastes with sludge in the digestion chambers and then refining the biogas sufficiently to inject into Centra's system. See http://cleantechnica.com/2013/12/28/food-scrap-recycling-joins-wastewater-treatment-in-new-nyc-project/. I agree that ecologically sound, non-harmful beneficial uses are the right criteria to apply. Choices between options require some quantification of benefits. For example, in pelletization, how much energy is required for dehydration vs. energy potential of the pellets and can ash recycling be introduced to recover residual nutrients? If the return on energy invested is high, this is an interesting prospect that fits in with new provincial initiatives to develop the bioeconomy. There should be increasing Manitoba demand for heating if pellet stoves increase as a cheaper alternative to electric heat under rising prices and their dual second use as a fertilizer assures an alternate market (See http://www.gov.mb.ca/agriculture/pdf/the_manitoba_bioproducts_strategy.pdf and https://www.dropbox.com/s/pl5lqt6nptowypl/Biomass%20Economy%20Network%20Inaugural%20Meeting%20Report.pdf)”
- “They are all proven options. Why is it taking so long?”

Dotmocracy

Feedback on the Criteria

Respondents were provided eight criteria that were being used to evaluate the different options. They were asked either if they did or did not support the criteria.

Respondents at the public meeting were asked to fill in a dotmocracy circle only for the criteria they supported. The responses received were counted as votes. The overall number of respondents per criterion is not known. Online respondents evaluated the criteria on a yes/no basis and there were a total of 3 responses. Both are included in the summary below, where ecological sustainability and regional suitability were the most supported criteria.

Criterion	Votes
Ecological sustainability	19
Regional suitability	17
Regulation	15
Operational factors	13
Time to implement	9
Good neighbour practice	9
Stakeholders involved	7
Cost	5

Feedback on the Options – Public Meetings

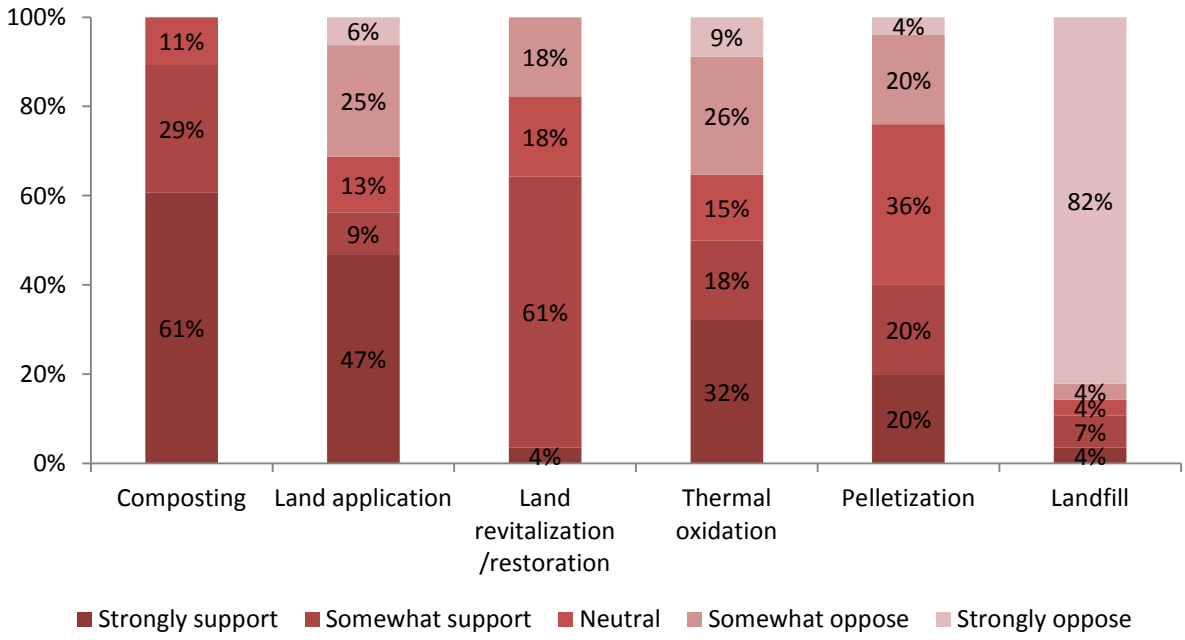
Respondents were provided six options that were being considered to manage biosolids. By assigning a value to the responses a mean could be calculated, where a higher mean correlates to a greater support for the option.

5 = Strongly support
4 = Somewhat support
3 = Neutral
2 = Somewhat oppose
1 = Strongly oppose

Option	Mean
Composting	4.5
Land application	3.7
Land revitalization/restoration	3.5
Thermal oxidation	3.4
Pelletization	3.3
Landfill	1.5

The most supported option is composting, while the least supported is landfill.

"When creating a Biosolids Master Plan, how much do you support the following options?" (n=25-34)



Feedback on the Options – Online on our Website

Respondents were presented the options on two web pages, rating each option using a 5-star scale. 1 star showed the least support and 5 stars showed the most support, where a higher mean correlates to greater support for an option. This system only allowed for a mean to be calculated.

The first three options were found on the first webpage with the remaining three following on a second webpage. The splitting of options caused a drop-off in voting. Because of the variation of number of votes, a degree of caution must be applied in comparing the different sets of options.

Option	Mean	Votes
Land application	4.5	8
Thermal oxidation	2.5	8
Pelletization	3.5	7
Composting	3.5	3
Land revitalization/restoration	4.0	2
Landfill	1.0	2

APPENDIX A

SURVEY

Winnipeg

Water and Waste Department • Service des eaux et des déchets

BIOSOLIDS MASTER PLAN FEEDBACK FORM

Please provide your postal code: _____ _____ _____ _____ _____ _____

Please indicate the nature of your interest in this study:

- ☐ Member of the general public
- ☐ Potential business interest
- ☐ Member of an interest group:
  - ☐ Environmental
  - ☐ Agricultural
  - ☐ Business
  - ☐ Other: _____
- ☐ Land owner
- ☐ Other: _____

1. How informed do you feel about the options being considered for the Biosolids Master Plan?
   - ☐ Well informed
   - ☐ Adequately informed
   - ☐ Not as informed as I would like to be

2. When creating a Biosolids Master Plan, how much do the following concern you?

	Not at all	A little	Somewhat	A lot	Don't know/ Doesn't apply
a) Potential for odours	☐	☐	☐	☐	☐
b) Nutrient loading to Lake Winnipeg	☐	☐	☐	☐	☐
c) Reuse of nutrients	☐	☐	☐	☐	☐
d) Cost/economics	☐	☐	☐	☐	☐
e) Health impacts	☐	☐	☐	☐	☐
f) Energy recovery	☐	☐	☐	☐	☐
g) Track record in other jurisdictions (i.e. reliability)	☐	☐	☐	☐	☐

3. The City is developing a Biosolids Master Plan (BMP) that will determine how we will manage our biosolids in an environmentally sound, sustainable and cost-effective manner, while meeting Provincial regulations. Do you support a plan that will increase the recovery of nutrients, even if it were to cost residents more?
   - ☐ Strongly support
   - ☐ Somewhat support
   - ☐ Somewhat oppose
   - ☐ Strongly oppose
   - ☐ Don't know/Doesn't apply

4. Is there additional information we should be providing?

_____

_____

_____

5. Overall, how satisfied are you with this Public Meeting?
   - ☐ Very satisfied
   - ☐ Somewhat satisfied
   - ☐ Not very satisfied
   - ☐ Not at all satisfied

6. Do you have any comments regarding the Biosolids Master Plan or the options we are considering?

_____

_____

_____

_____

_____

_____

_____

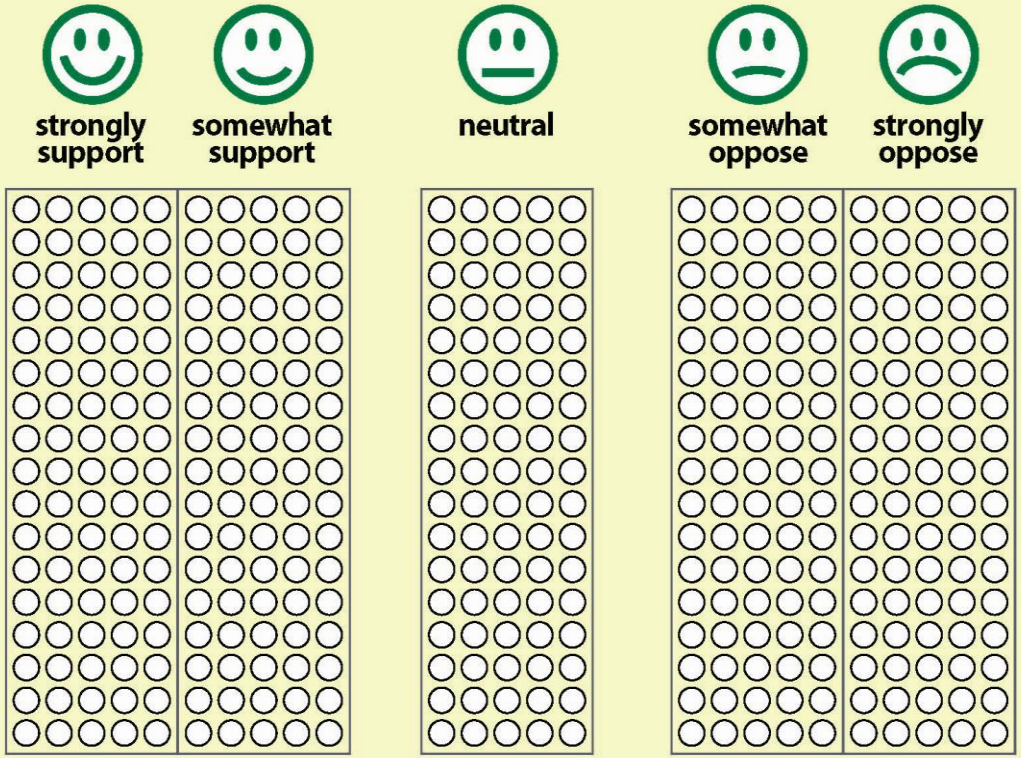
_____

Thank you for your feedback.

APPENDIX B

DOTMOCRACY SAMPLE

How much do you support
composting for managing biosolids?



Biosolids MASTER PLAN

Winnipeg
Water and Waste Department

APPENDIX C.3 - BIOSOLIDS MASTER PLAN STAKEHOLDERS CONSULTATION

BIOSOLIDS MASTER PLAN
Stakeholder Advisory Committee: What Was Heard

Prepared by:

MICHELLE HOLLAND CONSULTING INC.
Public Engagement | Communications | Facilitation

March 2014

Contents

1.0 Introduction

The City of Winnipeg is required by the Province of Manitoba to prepare a Biosolids Master Plan by October 2, 2014 that will provide direction on managing biosolids generated by the City's three sewage treatment plants to the year 2037.

As part of a process to gather input from the public, in September 2013, the City of Winnipeg established a Stakeholder Advisory Committee (SAC) to provide input on options for biosolids management, and on public participation in the master plan process. The work of the SAC involved learning about biosolids management and regulation, including current and past City of Winnipeg practices and options for future management of biosolids.

Stakeholder Advisory Committee Purpose:

To provide input on options for biosolids management, and on public participation in the master plan process. Input received will be incorporated into decision making on the Biosolids Master Plan to the maximum extent possible.

Options for biosolids management involve a broad spectrum of stakeholders, and a key goal for the SAC was to bring a variety of perspectives to the table early on in the planning process to ensure input from these diverse groups would be incorporated into decision making on the Biosolids Master Plan to the maximum extent possible.

2.0 Stakeholder Advisory Committee members

The committee included technical, municipal, citizen, regulator and resource sector representatives with an interest or stake in biosolids management topics.

Consumers Association of Canada (Manitoba)	Gloria Desorcy
Green Action Centre	Sylvie Hébert
International Institute of Sustainable Development	Karla Zubrycki
Keystone Agricultural Producers	Curtis McRae
Manitoba Conservation and Water Stewardship	Robert Boswick
Manitoba Composting Association (MCAC) Compo-Stages Manitoba Services Co-op (CSMSC)	Gérard (Gerry) Dubé
Manitoba Environmental Industries Association	Tanis Ostermann
Manitoba Hydro	D.R. (Deny) St. George
Lake Friendly Partnership of the Manitoba Capital Region	Colleen Sklar
Winnipeg Chamber of Commerce	Dave Angus

3.0 Process

Input from the SAC was gathered in a number of ways:

- **In-person meetings**
  - Four facilitated meetings were held from October 2013 – February 2014 and were attended by SAC members, City project team members, and guest specialist Dr. Jan Oleszkiewicz.
    - **Meeting 1**: Overview of Biosolids Master Plan process and current practices.
    - **Meeting 2**: Review of options for biosolids management and initial discussion on evaluation criteria and principles.
    - **Meeting 3**: Review of options for biosolids management continued and refining of evaluation criteria and principles.
    - **Meeting 4**: Final discussion of preferred options, evaluation criteria and principles and other recommendations.
  - In addition to meeting discussion, **presentations** were given by:
    - Dr. Jan Oleszkiewicz on biosolids management trends in other jurisdictions;
    - Curtis McRae on experiences with land application of biosolids;
    - D.R. St. George on Water & Wastewater Technology Trade Mission to the Netherlands; and
    - Robert Boswick on standards, guidelines and regulations associated with biosolids management and options.
- **Conference call**
  - Held in December 2013 for committee members unable to attend the December meeting.
- **Online surveys**
  - Three surveys to collect input on evaluation criteria and guiding principles;
  - Three surveys to collect feedback on meetings and SAC process.
- **Emailed resources, articles and links** were provided by SAC members on several occasions and circulated to other SAC members and the City project team.
- A **formal submission** was received from Gérard Dubé.

In addition, SAC members were invited to **tour the North End Water Pollution Control Centre** and to participate in **two public meetings** held in January 2014.

Information about the SAC's purpose, terms of reference, a list of members, meeting notes, project team presentations and key links were posted on the project **website** at http://wwdengage.winnipeg.ca/biosolids/biosolids-sac/.

4.0 What Was Heard

Stakeholder Advisory Committee members were asked to provide input on options for biosolids management and on public participation in the master plan process. The following is a summary of the key themes and outcomes resulting from the SAC process. No votes were held to determine the group's position on issues or recommendations to the City of Winnipeg; however, where there was consensus, it has been noted.

4.1 Input on public participation in the master plan process

Committee input on public participation took several forms. This included input on content, feedback and suggestions for the SAC and public participation processes, promoting public meetings to their networks, and input on the role of public education moving forward.

> "Participants in SAC were a well-chosen mix of experts and stakeholders."
>
> "Effective group size with fairly diverse related backgrounds."
>
> *-Feedback received from two SAC members via online survey*

SAC process

Comments from committee members about the SAC process, committee composition and the content and structure of meetings provided were generally positive. A few SAC members felt an additional meeting, or having the process spread out over a longer period of time could have been helpful.

Public participation materials and outreach

SAC discussion, questions and suggestions shaped how information was shared as part of broader public participation in the master plan process in several ways. This included the development of:

- Frequently Asked Questions (FAQs)
- A glossary of wastewater terms
- Feedback survey
- Public meeting presentation and storyboards

- Advertisements and promotion related to opportunities for public participation

Committee members also provided suggestions for additional stakeholder groups and individuals to contact about public meetings, and were in turn provided with information about public meetings and opportunities for participation to share back to their networks and contacts.

In addition to contributing input on the content for public participation, a few specific suggestions were received regarding *how* information could be shared, including issuing news releases or placing articles in advance of public meetings to promote public understanding of why the Biosolids Master Plan is important.

Key theme: A need for more public education and public participation.

Several committee members indicated that while broad participation from stakeholder groups through the SAC and at the public meetings was encouraging, engaging the broader public early on in the process isn't easy. Similarly, other members suggested that public concerns will be more clearly articulated once decisions are reached regarding preferred options and that given the technical nature of the topic, there would be a need for ongoing public participation and public education once more is known and preferred options have been identified. Members expressed a key aspect of the process moving forward would be be clearly communicating "what decisions on preferred options mean" and "keeping the conversation going" with stakeholders and neighbours.

> "Although the process of public consultation was good, the participants were mostly representatives of stakeholder organizations and agencies. To me, the words 'PUBLIC' consultation means accessing the input, ideas, and opinions of individuals, taxpayers, citizens of Winnipeg. I don't feel that this has been done, as yet."
>
> *-Feedback received from SAC member via online survey*

There were also specific suggestions that more needs to be done in terms of public education regarding the role citizens can play in diverting substances of concern away from the wastewater system, including pharmaceutical take back programs and other initiatives.

Key theme: Consider continued engagement with the stakeholder advisory committee as Biosolids Master Plan progresses.

Many SAC members indicated a willingness to be part of further discussions or to provide further feedback as work on the Biosolids Master Plan progresses, new information is collected, and preferred options are identified, suggesting this could be of benefit to the City in terms of formal or informal feedback on preferred options and continued input and outreach on public participation.

4.2 Input on options for biosolids management

Providing input on options for biosolids management was the second key aspect of the Committee's work. This included developing guiding principles for the City project team's consideration in formulating the Biosolids Master Plan, identifying criteria for evaluating individual biosolids management options, and reviewing and providing feedback on the various options under consideration.

Guiding Principles

The following guiding principles were developed by the SAC for the City project team's consideration in formulating the Biosolids Master Plan. Consensus was achieved among SAC members on these principles.

1. **Resource recovery:** The plan approaches biosolids management as an opportunity to recover and reuse valuable resources, such as phosphorous, nitrogen and energy.

2. **Long-term sustainability:** The plan is rooted in long-term economic, social and environmental sustainability, and aligned with long-term goals and plan of the City, including future growth.

3. **Biosolids supply chain:** The plan considers the entire system involved in processing and reusing biosolids, including energy, raw materials, components and decommissioning.

4. **Health and safety:** The plan ensures the importance of public and worker health and safety in biosolids management.

5. **Realistic, achievable:** The plan is reliable, realistic and achievable.

6. **Adequate assessment of risk:** The plan adequately assesses and mitigates risk, including operational, financial and environmental.

7. **Mixed/integrated solutions:** The plan includes more than one option for biosolids management for greater adaptability.

Evaluation Criteria

The following criteria were identified by the SAC for the City project team's consideration in evaluating individual biosolids management approaches that may be included in the Biosolids Master Plan. Perspectives on individual criterion and the relative importance of each differed. The evaluation criteria developed by the SAC were shared as part of the public meeting materials in January.

1. **Operational factors:** Manageable level of operational complexity, proven technology, reliable.

2. **Time to implement:** How quick can the option be implemented? Short (one to two years), medium (two to five years) or long term (five years or longer).

3. **Regional suitability:** Suited to Manitoba climate, resources and other regional factors.

4. **Stakeholders involved:** Who is involved, opportunity for private sector involvement or partnership.

5. **Regulation:** What regulations are involved and compliance with regulations.

6. **Good neighbour practice:** Ability to mitigate neighbour concerns.

7. **Ecological sustainability:** Makes a net positive contribution (e.g. nutrient recovery, energy recovery) and minimizes environmental impacts.

8. **Cost:** Are costs consistent with current costs for biosolids management, or approximately double or triple the current cost?

Key theme: Composting and thermal oxidation, including hydrolysis, generated the most discussion as options for biosolids management.

Very few members indicated a particular preferred option for biosolids management, with several members suggesting "more information would be required" in order to do so. However, amongst all the presented options, thermal oxidation and composting generated the most questions and discussion amongst the SAC.

Some of the comments regarding composting included the ability to build and replenish soil as a distinct advantage. Markets for compost, quality control of the product (it was noted that an "in vessel" approach is one way to potentially guarantee quality) and the potential use of regionally-sourced bulking agents such as agricultural by-products (e.g. straw) were key considerations mentioned by SAC members.

Discussion around thermal oxidation focused around the potential to use biosolids as fuel, and the subsequent recovery of energy for a useful purpose. This discussion encompassed both oxidation and hydrolysis. Some SAC members questioned the viability of these alternatives given Manitoba's low energy costs. Another comment was that this option would represent the least potential liability for the City. The need for public education to mitigate "not-in-my-backyard" responses to the visible stacks that are part of thermal oxidation facilities, and the potential costs associated with emission controls were also mentioned as considerations. Still others suggested this option may be the most appealing to the broader public and could be "easiest to do", or implement.

Key theme: Landfilling as least preferable option.

Consensus was achieved amongst all SAC members with regards to landfilling as a "last resort", and the least preferable option for biosolids management.

4.3 Additional considerations for the Biosolids Master Plan

The SAC raised a handful of key issues and themes that were not specific to any one option, nor to the public participation process, but were raised as recommendations for the project team's broader consideration in the preparation of the Biosolids Master Plan.

Key theme: Consider the overall waste management context in decision making.

Considerable discussion focused on a broader context for biosolids management. This included biosolids as an integrated component of overall waste management for the City, and the need to consider a department-wide approach. Integrated full-scale anaerobic digestion and composting of organics, including green cart or kitchen waste, and wastewater sludge was discussed at some length, and was the subject of a formal submission.

Examples of integration and long-term planning were shared from a recent water and wastewater technology trade mission to the Netherlands and the idea of composting or vacuum toilets as part of future "sustainable communities of choice" was raised. The SAC noted in particular that there would be value in sharing with the public that these ideas and approaches were discussed and considered as part of the SAC and Biosolids Master Plan process.

> "The more I learned about the decisions to be made, the more I realized that any decision made now must be continually re-evaluated in the light of new information, new technology, and changes in other aspects of waste treatment, diversion, and disposal."
>
> *-Feedback received from SAC member via online survey*

Key theme: Consider a phased approach to biosolids management that allows for adaptability.

A number of SAC members spoke about the need for long-term thinking on biosolids management that considers how shifts and changes may affect biosolids management for the City, including future growth, shifts in social norms and behaviours related to the environment and sustainability, increased regulation, and new information about emerging substances of concern and public health. Taking a phased approach, considering "best available options" and otherwise ensuring adaptability of individual and overall solutions were all

ways SAC members expressed this sentiment. This was discussed in relation to the City's composting pilot, but also more broadly for the plan.

Key theme: Quantify overall ecological and economic sustainability.

Defining overall ecological sustainability, and making clear the connections between ecological sustainability and economic viability, were key elements of SAC discussions the process. "Make it real" was how one committee member put it. Quantifying sustainability in both the evaluation of options and in communicating preferred options to the public was strongly suggested by several SAC members. Suggested components in this calculation included the potential for Manitoba partnerships, compliance (and cost of non-compliance), energy offsets, benefits to the City and region in opportunities and jobs.

Appendix A - Formal submission and response

Formal submission by SAC member Gérard (Gerry) Dubé (January 23, 2014)

BIOSOLIDS MASTER PLAN OPTIONS: Anaerobic Digestion(AD) and Composting
Content: Review of existing situation
Compatibility of AD and Composting
Ecosystems benefits
Evaluation to the guiding principles and criteria
Life Cycle Assessment(LCA): all options

Review:
It seems to me that the City of Winnipeg has segregation within its "waste" departments (ei biosolids, used food resource, leaf and yard nutrient recovery, parks…). A more unified vision of all these departments would facilitate a better cooperation towards a more economically and environmentally sustainable future.

Point in case- a CH4 collection system has been installed at the Brady landfill , piping is installed once a certain area is covered , the gas is collected and burned off. According to "Putting the Landfill Energy Myth to Rest" (1), within the existing system of the Brady Landfill (not bioreactor landfill set up) this is the least efficient way to collect methane. We now as well bury, within that system, the "biosolids" from the Waste Water Treatment Plants. We then haul many truckloads a week of leachate from Brady back to the WWTP. The leachate is derived from all organics(food waste, carcasses, biosolids) buried at the Brady landfill. The result is that much of the leachate will go full circle many times in one year. (Note: both CH4 collection and moratorium on biosolids land application resulted from provincial regulation)

The city is poised to start a food waste collection system within the next year, it would be a good time to decide if the food waste will go to composting or to AD. Encouragingly – the City has setup a permanent compost site for leaf and yard waste at Brady.

Let rearrange this scenario. Let's take all organics of Brady. We are already composting leaf and yard waste. Remove the food waste (FW) fraction from Brady; the FW could be digested with the WW, tripling the energy production of the AD – making it a net energy producer. This mix (FW&WW) would further dilute the problematic contaminants (3) from the WW which subsequently, through the composting process, would further reduce contaminants. The more diverse the resources (wood chips, leaf and yard waste, straw…) used in the composting process with the digestate, the greater the biological biodiversity in the compost end product will be. (Will explain biodiversity benefits in LCA). Carcasses can also be removed from Brady and composted on farm site.(2) If this is done – at least that we plan for this – we could eliminate the need for leachate and methane(CH4) collection.(eventually). What would be trucked to the landfill, at that point, would be non organic.

Compatibility of AD and Composting
"Biogas production would strip out odorous "volatile fatty acids" (VFA's) that are problematic to composting, and convert them directly into methane energy. Theoretically, the resulting residue would be more readily- and less odorously- compostable." See the entire article (4). In this article , Will Brinton speaks specifically of food waste. The city will be doing trials on biosolids composting at the Brady landfill using a negatively aerated static pile(AST)- this method is well chosen because it permits the system to filter (compost-woodchip filter)the air flowing out of the piles allowing good control over possible odors. And odor is by far the greatest and most challenging issue when it comes to any organics recycling. Once those organics composted (through an appropriate well controlled process) the end product has a healthy earthy smell. (note: the biosolids composting trials in the AST would do best under cover- one heavy rain could saturate the pile resulting in serious odor issues; raw materials to be used for AD should also be stored inside a negatively aerated building)
Ecosystems Services of composts

- *High nutrient retention and cycling*
- *Volume reduction& moisture reduction*
- *Water retention, filtration, and permeability (5-slides 20&21,&6)*
- *Rich earthy smell (non odourous)*
- *Better tilth and aggregation (energy savings)(5- slide19)*
- *Higher SOC sequestration (actual – adding compost will increase soil organic matter content (5 slides 15, 16, &17); and through soil biology "…the formation of topsoil is dependent on photosynthesis and the transport of dissolved carbon, via a microbial bridge, from plant to soil." (7)*
- *Promote higher biological activity (8)*
- *Increased residue decomposition(ag producers in the Red River Valley are burning straw- the biology in those soils has been seriously compromised therefore crop residue does not breakdown creating some issues for the growing crop =no nutrient cycling, more dependency on commercial fertilizers & pesticides+ more compaction= more energy use(increasingly harder to till+ use of fossil fuel based inputs)*
- *Slow release and storage of available (+ to be available) nutrients (biology at work)(8)(11)*
- *Disease suppression (9)(10)- this is an increased field of study- demonstrating that symbiotic relationships develop between plants and soil biology to promote disease suppression via "systemic acquired resistence"(SAR)or Induced Resistence, competition, antibiosis(production of antimicrobial compounds), and parasitism. " Plant disease suppression is considered to be a direct result of the activities of microorganisms which naturally recolonize compost during the cooling phase"(10)*

Evaluating to the Guiding Principles and Criteria
Environmental degradation has only increased in the last years from loss of top soil due to SOM depletion (50% of original native levels) across the planet; loss of diversity through species extinctions, increasing GHG emissions (Canadians being 4th from the top of the list on per capita emissions), pollution of waterways… to name a few…

It is therefore imperative, that when we engage in a long term project, that we understand all aspects of any project's sustainability in a changing world. The Biosolids SAC has set Guiding Principles to better encompass the desired objective; according to the CCME report , AD and Composting(of digestate) is the BMP in dealing with contaminants from WWTP. I would argue that it is also the BMP for all organic waste- for an efficient resource recovery plan.

Long term sustainability- AD and composting are well known technologies (already practiced by the City of Winnipeg). The two systems are compatible (4). There are a multitude of systems in place across the planet and in areas that have similar weather constraints(Scandinavian countries). We have a tremendous amount of examples and knowledge from which we can base our systems'approach.

We can produce energy (CH4) and reduce energy consumption(12)- through compost use , we reduce fossil fuel use through the diminished use of commercial fertilizers(Koch Industries who produce nitrogen fertilizers is Manitoba Largest GHG emitter), pesticides, irrigation, fuels for cultivation, etc. Adding compost to the land increases SOM which is THE measure of soil productivity. As Dr. Katherine Buckley (AAFC Brandon) stated "…applications of compost(s)… are of utmost importance in maintaining tilth, fertility, and productivity of agricultural soils, protecting them from wind and water erosion, and preventing nutrient losses through runoff and leaching . These materials have predictable beneficial effects on soil physical properties such as increased water holding capacity, soil aggregation, soil aeration and permeability and decreased soil crusting and bulk density."(Proceedings of the 2005 Organic Matters on the Prairies) page 36. There is a need to reduce the dependence of commercial fertilizers and pesticides to diminish the use of energy and potentially create fertility close to where it is needed. Winnipeg is the CAFO for the Red River Valley!

Mixed –Intergrated Solution. We have already address the compatibility of AD and Composting(4) and CCME's BMP for reducing contaminant pressure.

Resource Recovery- The ecosystems services provided by a quality compost end product addresses this legitimate concern. However adding concentrated nutrients (ie-phosphorous, nitrogen- and depending the quality of those) to the soil will have a long term negative impact on the SOM- (7) "impoverishment of agricultural soils"p.3 (13)www.soildoctor.org - Doug Weatherbee offers how soil functions in a 45minute video) Certain forms of phosphorous and nitrogen inhibit soil carbon sequestration; using quality composts promotes SOC sequestration through microbial channels.

Health and Safety- As stated before, there are many AD & Composting existing operations where we can access information on "health and safety" concerns. The North End WWTP has already set up health and safety protocols as it pertains to AD technology. CCME has guidelines and courses(Composting Facility Operator Training Course; May 2013 at AAFC Brandon) are offered on a regular basis.

Realistic and Achievable- YES and YES

Adequate Assessment of Risk- AD technology is not recent; it has been around for hundreds of years in India and China. So has composting- of course and like everything else scaling up these technologies has created some risks , and here again , because we have now many systems functioning in North America - we have loads of information on what not to do, and on the same parallel , we have also many entities that prove these systems work. There also many systems to choose from that could be suitable to our particular situation.

Evaluation Criteria- this would be a discussion point in assessing all possible options. Using dewatered digestate (not composted biosolids) has an odour issue that can cover the whole spread area. Composting the biosolids, prior to agricultural use, would concentrate that issue to one area- and using the composting system (ASP as in the Brady trials) would be very efficient at controlling odors with the negative air flow exhausting through a biofilter.

Life Cycle Assessment(LCA)
The International Standards Organization (ISO) developed a LCA template (ISO 14044- 2006) to aid in the better understanding the complex issue related to the evaluation of decision-making processes regarding the environmental performances of proposed activities. In one particular study (using the ISO 14044), "Using LCA to evaluate impacts and resources conservation potential of composting: A Case Study of the ASTI District in Italy" (14) "…In order to address present and future solutions, it becomes therefore fundamental to assess the environmental performances of the current management of organic waste from separate collection,… the need for actual and reliable data on materials and energy input, as well as gross and net gains from materials recovery, including benefits arising from use of compost in farming activities, was probably the major drawback that had to be faced. … The results may help public administrators to better understand the suitability of using LCA tools when dealing with solid waste management strategies."

Several issues appear from the abstract of this study. Environmental impacts of waste collection and disposal (or other) have been addressed already. The city of Hamilton(15) has done extensive work in regards to those issues. From the study from the Asti Region , we can see the value of the LCA model… However the study shows its deficiencies in addressing benefits of compost use. One of the difficulties arises from failed attempts at monetizing the benefits (compost use will have varied impacts on land because of soil types, weather, crops grown, management, etc…) and it is most likely to be measured using a conventional NPK model.

The Australian (CFI) and Portuguese(Terra Prima) Governments have developed programs to measure carbon sequestration and set a price on carbon. W. Silver's Carbon Marine Project(17) and Rodale Institute's 9 year research on carbon sequestration(18) demonstrate how compost is a considerable tool for carbon sequestration. Studies(7, 8, 9, 10, 11,16…) demonstrate that diverse and beneficial biology , supplemented and activated by composts, can suppress diseases, protect the plants from heavy metal uptake, provide necessary nutrients to the plants, hold and filter water resources, and sequester carbon. In our assessment of choosing options , we absolutely need to account for the ecosystems services that quality composts provides- despite the difficulties in monetizing those benefits.(19)

Acronyms: AD – Anaerobic Digestion;
ASP- Aerobic Static Pile
BMP- Best Management Practices
CAFO- Concentrated Animal Feeding Operations
CH4- Methane; Natural Gas
FW-Food Waste
ISO-International Standards Organization
LCA- Life Cycle Assessment
LYW-Leaf and Yard Waste
SOC –Soil Organic Carbon
SOM- Soil Organic Matter
WW- Wastewater
WWTP- Wastewater Treatment Plant

REFERENCES:

1- *"Putting the Landfill Energy Myth to Rest" ; Biocycle Magazine, May 2010, p.23, Dr. Sally Brown*
2- *Manitoba Composting Association Website- www.manitobacomposting.com*
3- *Here I am just referring to public education in regards to what not to flush down; also on listing the Emerging Substances of Concern(ESOCs) –without the knowledge of the presence of ESOC's, the public does not have the necessary information to make educated decisions… or even lobbying industry to eliminate them (e.g. fire retardants,…*
4- *"Compatibility of Digestion and Composting"; Biocycle Magazine, Dr. Will Brinton*
5- *Eastern District Conservation District PowerPoint Presentation (Gerry Dube')Attached with this presentation*
6- *"Pay Dirt" , Key Findings , Institute of Local Self Reliance- full report- www.ilsr.org/paydirt*
7- *"Soil Carbon- can it save agriculture's bacon" Dr. Christine Jones (attached)*
8- *"Deciphering the Rhizosphere Microbiome for Disease Suppressive Bacteria" can be found at www.soildoctor.org*
9- *"Intraspecies Variations in Border Cell Production: Rhisosphere Microbiome Implications" (attached)*
10-*"Suppressive Composts: Microbial Ecology Links Between Abiotic Environments and Healthy Plants" Yitzhak Hadar and Kalliope K. Papadopoulou (2012 publication)*
11-*www.soildoctor.org (45 minute video on plant& microbiology symbiotic relationship with Doug Weatherbee)*
12-*"Composting for Feedlot Manure Management and Soil Quality" T H Deluca & D K Deluca " Alliance of Crop, Soil, and Environmental Science Societies (ACSESS) published 19/04 2013 quote from abstract: "… the use of composted manure improves soil quality, and greatly reduces total energy consumption compared with the use of commercial fertilizers. A hypothetical example illustrates how compost applications to irrigated corn could result in a net energy savings of about 3.3 million BTU/acre, which is equivalent to energy contained in 19.4 gallons of diesel fuel/acre."*
13-*same as (11)*
14-*"Using LCA to Evaluate Impacts and Resources Conservation Potential of Composting: A Case Study of the Asti District in Italy." Gian Andrea Blengini "Resources, Conservation and Recycling"#52, (2008) 1373-1381*
15- *"Niagara-Hamilton Waste Plan Environmental Assessment Study" (google) (Appendix V- results from LCA Analysis MSW-DST: Original & Improved Systems Assumptions)*
16-*"Possible Role of Root Border Cells in Detection and Avoidance of Aluminum Toxicity" Susan C. Miyasaka and Martha Hayes*
17- *"Carbon Sequestration in California's Rangeland Soils" Whendee Silver, Department of Environmental Science, Policy, and Management. U.of California, Berkley*
18- *Rodale Institute " Rodale research paves the way for Pennsylvania's "Path to Organics" (google)*
19- *"Valuing the US Compost Industry" Ron Alexander ; Biocycle Magazine, Dec. 2009 , p.25*

City of Winnipeg response to formal submission by SAC member Gérard (Gerry) Dubé (February 13, 2014)

Hello committee members,

Thanks once again for your time spent and insight provided on the Biosolids Stakeholder Advisory Committee. At the end of the meeting last week there was some discussion around the overall waste management context for biosolids within the City – organics waste recycling, solid waste and wastewater. Last month, Gerry had prepared a very thoughtful technical submission that touched on these topics as well, and I wanted to share a few thoughts in follow up.

As we discussed at the meeting, integrated organics treatment and processing is ahead of the City of Winnipeg development at this time. In constructing a composting pilot facility we are taking steps to demonstrate the viability of composting here. This will provide us the confidence to take further steps towards a permanent composting operation as a long term solution in Winnipeg, together with the leaf and yard waste composting initiative.

The step of integrated full-scale anaerobic digestion and composting including organics and wastewater sludge will require a significant change in the City of Winnipeg disposal program. As the group discussed last week, this would require planning at the Department level. Should the Department proceed with an organic collection plan as a long term goal, then it must be implemented in a logical process to proceed with the anaerobic digestion and composting solution.

I will be forwarding Gerry's suggestion (and notes from the group's discussion) to the Water and Waste Department Management Team for consideration and further direction on long term development.

Thanks again for your input, time and consideration on this master plan.

Sincerely,

Duane Griffin

APPENDIX C.4 - OMNIBUS SURVEY

WINNIPEG OMNIBUS
FEBRUARY 2014:

BIOSOLIDS MASTER PLAN RESEARCH

March 19, 2014

Prepared for:

The City of Winnipeg

WINNIPEG | OTTAWA | EDMONTON | REGINA
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Table of Contents

1.0 How this research was conducted

The Omnibus survey was conducted in February 2014 with 479 Winnipeggers 18 years of age and older. PRA interviewed respondents by telephone on a number of topics.

Respondents were selected by random digit dialling, which allows PRA to include those with unlisted or new numbers. This technique produces a random sample that includes the highest possible percentage of eligible respondents.

Table 1: Summary of methodology	
February 2014 Omnibus	
Pretest	February 10, 2014
Survey dates	February 10–March 1, 2014
Sample size (Winnipeg)	n=479
Interview method	Telephone
Sample selection	Random digit dialling
Approximate error rate (theoretical: Manitoba)	± 4.6%, 19 times out of 20

1.1 Participant profile

Table 2 shows a profile of Winnipeggers who completed the February 2014 Omnibus and compares it to the 2011 Census.

Table 2: Profile of participants — Winnipeg (unweighted)		
	February 2014 Omnibus % (n = 479)	**2011 Census %**
Gender		
Women	60%	52%
Men	41%	49%
Age*		
18 to 29	11%	22%
30 to 39	10%	25%
40 to 64	48%	35%
65 and older	32%	18%
Income*		
Under $40,000	27%	24%
$40,000 to $70,000	30%	30%
$70,000 to $100,000	19%	23%
Over $100,000	23%	24%

* Approximately, 21% of respondents were unable to provide their household income in February 2014. They have been removed from the percentages shown.
Note: Totals may not sum to 100% due to rounding.

1.2 Weighting

In some cases, when the random sample produces a divergence from Canadian census data, we correct for slight discrepancies in gender, age, and income. For example, since men tend to refuse to participate more often than women, and since younger people are often more difficult to find at home, we re-weight the data to conform more closely to Statistics Canada information.

The data presented in this report were weighted to correct for differences between the demographics of the sample and the Winnipeg population. Tables presented are weighted unless otherwise stated. Since this technique assigns a percentage "weight" to a respondent, the number of weighted respondents may be slightly different from the total number interviewed.

1.3 Caution

This document represents a summary of the results and is not intended to be an exhaustive examination of the findings.

2.0 Summary of results

Biosolids, commonly called sewage sludge, is the nutrient-rich end-product of sewage treatment. The City of Winnipeg is developing a Biosolids Master Plan (Master Plan) that will determine how it will manage biosolids in an environmentally sound, sustainable, and cost-effective manner, while meeting Provincial regulations.

2.1 Support for a Biosolids Master Plan

The majority of Winnipeg residents support the Biosolids Master Plan. We explained that biosolids is the nutrient-rich end-product of sewage treatment that contains significant amounts of organic nitrogen and phosphorus, that one of the most environmentally sustainable uses for biosolids is fertilizer, and that the City is developing a Biosolids Master Plan that will recover more nutrients but would also have a cost for all ratepayers of Winnipeg:

- 70% of residents supported such a plan, including 20% who strongly supported it.
- 23% oppose such a plan, including 10% who strongly oppose it.
- 7% of respondents did not provide an answer.

Table 3: Level of Support for Biosolids Master Plan
The city is developing a Biosolids Master Plan that will determine how it will manage our biosolids in an environmentally sound, sustainable, and cost-effective manner, while meeting Provincial regulations. The plan will recover more nutrients but would also have a cost for all ratepayers of Winnipeg. Generally, would you say you…such a plan?

Support	February 2014 % (n = 479)
Strongly support	20%
Somewhat support	50%
Somewhat oppose	13%
Strongly oppose	10%
Don't know	7%
Total	100%

2.1.1 Interest by demographics

Table 4 shows respondent support for the Biosolids Master Plan by various demographic subgroups. None of the differences between demographic subgroups are statistically significant.

- When examining results by those who are supportive overall (somewhat or strongly), respondents in the youngest age cohort (18–29 years of age) are most likely to support the Master Plan (83%) followed by respondents in the oldest age cohort (65 years and older, 70%). Interestingly, it is respondents 65 years of age and older who are most likely to strongly support the Master Plan (28%) compared to younger age cohorts (between 18% and 21%). Winnipeggers aged 30 to 64 were least likely to support the Master Plan (30–39 — 65%, 40–64 — 66% support).

- Respondent support does not notably vary by gender or household income.

Table 4: Support Biosolids Master Plan

Support	February 2014 % (n = 479)
Strongly support	70%
Age	
18 to 29	83%
30 to 39	65%
40 to 64	66%
65 or older	70%
Gender	
Female	72%
Male	68%
Household Income	
Under $40,000	70%
$40,000 to $70,000	72%
$70,000 to $100,000	77%
Over $100,000	72%

2.2 Factors of importance

We explained to respondents that one of the unknowns and possible problems with using biosolids as a fertilizer is that that it may contain small amounts of potentially harmful substances and compounds, such as pharmaceuticals, hormones, and the like. We also explained that there are concerns these substance may have an adverse effect on the environment, perhaps entering in our rivers and lakes, as well as the food supply.

The following is shown in Table 5:

- About 9 in 10 respondents report that *health impacts* (92%, including 81% very important), *keeping harmful substances off the land* (89%, including 77% very important), and *environmental sustainability* (86%, including 67% very important) are important considerations in a biosolids program.
- About 7 in 10 (71%) report that *reuse of valuable nutrients* is an important consideration to a biosolids program, including, 44% who say it is very important.
- Almost 6 in 10 (58%) respondents report *the cost of treating biosolids* is an important consideration for a program, including 33% who say it is very important.

Table 5: Factors of importance
When considering any program to best deal with biosolids, how important are each of the following considerations to you. Using a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important to you, please rate how important it is that a biosolids program….

Rating	February 2014 % (n = 479)				
	Health impacts	Harmful substances off land	Environmental sustainability	Reuse of valuable nutrients	Cost of treating biosolids
Important (4 or 5)	92%	89%	86%	71%	58%
Neutral (3)	3%	6%	9%	18%	29%
Not important (1 or 2)	3%	4%	2%	8%	11%
Don't know	2%	2%	2%	3%	3%
Total	100%	101%	99%	100%	101%
Average rating (out of 5)	4.7	4.6	4.5	4.1	3.8

Note: Rows may not sum to 100% due to rounding.

2.2.1 Factors of importance by demographics

Table 6 shows level of support for each of the five factors by demographic subgroup:

- Although not statistically significant, women are more likely than men to rate each of the factors as very important, with the exception of *cost of treating biosolids.*
- Winnipeggers in the youngest age cohort are less likely to consider *reuse of variable nutrients* and *cost of treating biosolids* as very important. This finding is statistically significant.

Table 6: Very important factors

Importance	February 2014 % (n = 479)				
	Health impacts	Harmful substances off land	Environmental sustainability	Reuse of valuable nutrients	Cost of treating biosolids
Very important	81%	77%	67%	44%	33%
Age					
18 to 29	75%	73%	73%	**34%**	**26%**
30 to 39	86%	78%	64%	**49%**	**26%**
40 to 64	85%	80%	68%	**47%**	**40%**
65 or older	73%	72%	65%	**44%**	**39%**
Gender					
Male	75%	72%	61%	41%	36%
Female	87%	81%	74%	48%	31%
Household Income					
Under $40,000	81%	84%	70%	41%	39%
$40,000 to $70,000	79%	75%	66%	44%	31%
$70,000 to $100,000	85%	84%	66%	40%	27%
Over $100,000	84%	67%	66%	47%	32%

Note: bold represents statistically significant differences.

2.2.2 Most important factor

Almost 9 in 10 respondents (91%) rated at least one of the five factors as very important (rating of 5 out of 5). Of these respondents:

- half believe that *health impacts* is the most important factor (50%);
- almost 1 in 4 believe that *keeping harmful substances off the land* is the most important factor (24%);
- just over 1 in 10 (11%) believe that *environmental sustainability* is the most important factor; and
- three percent believe that *the reuse of valuable nutrients* and the *cost of treating biosolids* is the most important factor.

Table 7: Most important factor
When considering any program to best deal with biosolids, how important are each of the following considerations to you. Using a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important to you, please rate how important it is that a biosolids program….

Most important factor	February 2014 % (n = 479)
Health impacts	50%
Harmful substances off land	24%
Environmental sustainability	11%
Reuse of valuable nutrients	3%
Cost of treating biosolids	3%
None	7%
Don't know	2%
Total	100%

Appendix A – Questionnaire

BS1:

BS1. Changing topics... Biosolids, more commonly called sewage sludge, is the nutrient-rich end-product of sewage treatment. Since the sludge contains significant amounts of organic nitrogen and phosphorus, one of the most environmentally sustainable uses for this sludge is as a fertilizer. The City is developing a Biosolids Master Plan that will determine how it will manage our biosolids in an environmentally sound, sustainable and cost-effective manner, while meeting Provincial regulations. The plan will recover more nutrients but would also have a cost for all ratepayers of Winnipeg. (PROMPT: Through your water bill) Generally, would you say you…(READ RESPONSES)...such a plan?

Strongly support 4
Somewhat support 3
Somewhat oppose 2
Strongly oppose 1
(DO NOT READ) Don't know 8
(DO NOT READ) No response 9

BS2X:

BS2X. One of the unknowns and possible problems with using biosolids as a fertilizer is that it may contain small amounts of potentially harmful substances and compounds, such as pharmaceuticals, hormones, and the like. There are concerns these substances may have an adverse effect on the environment, perhaps entering in our rivers and lakes, as well as the food supply. When considering any program to best deal with Biosolids, how important are each of the following considerations to you. Using a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important to you, please rate how important the following are to a biosolids program...

CONTINUE ..... 1 D

BS2:

invalid -> BS6

BS2. How important is…. ...Environmental sustainability? (PROMPT: Please use a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important.)

5 - Very important 5
4 4
3 3
2 2
1 - Not at all important 1
Don't know 8
No response 9

BS3:

BS3. How important is…. ...Health impacts? (PROMPT: Please use a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important.)

5 - Very important 5
4 4
3 3
2 2
1 - Not at all important 1
Don't know 8
No response 9

BS4:

BS4. How important is…. ...Keeping any harmful substances off the land? (PROMPT: Please use a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important.)

5 - Very important 5
4 4
3 3
2 2
1 - Not at all important 1
Don't know 8
No response 9

BS5:

BS5. How important is…. ...Reuse of valuable nutrients? (PROMPT: Please use a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important.)

5 - Very important 5
4 4
3 3
2 2
1 - Not at all important 1
Don't know 8
No response 9

BS6:

BS6. How important is…. ...Cost of treating biosolids? (PROMPT: Please use a scale of 1 to 5, where 1 means it is not all important and 5 means it is very important.)

5 - Very important 5
4 4
3 3
2 2
1 - Not at all important 1
Don't know 8
No response 9

BS7:

BS7. You mentioned more than one of these as very important, which one of these is the most important to you? (READ RESPONSES)

Environment sustainability 01
Health impacts 02
Keeping any harmful substances off the land 03
Reuse of valuable nutrients 04
Cost of treating biosolids 05
(DO NOT READ) Don't know 88
(DO NOT READ) No response 99

Appendix B – Call Record

Call record for Winnipeg Omnibus
February 2014

Call Record for Winnipeg Omnibus: February 2014			
Outcome		**Month Year**	
		N	**%**
A	Total numbers attempted	13,400	100%
1.	Not in service	1,446	11%
2.	Fax	179	1%
3.	Business	57	<1%
Remaining		11,718	87%
B	Total eligible numbers	11,718	100%
4.	Busy	170	1%
5.	Answering machines	3,114	27%
6.	No answer	1,905	16%
7/8.	Language/illness/incapability	296	2%
9.	Selected/eligible respondent not available	462	4%
Remaining		5,771	49%
C	Total asked	5,771	100%
10.	Household refusal	531	9%
11.	Respondent refusal	2,412	42%
12.	Qualified respondent break off	38	<1%
Remaining		2,790	48%
D	Co-operative contacts	2,790	100%
13.	Disqualified	2,311	83%
14.	Completed interviews	479	17%
Refusal rate = (10+11+12)/C		2,981	52%
Response rate (D/B)		2,790	24%

Appendix C – Banners

BS1. Generally, would you say you support/oppose the Biosolids Master Plan?

		Overall	Region	Gender		Age			
			Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
Oppose (1 2)		110	110	46	63	14	31	46	19
		23%	23%	19%	27%	13%	25%	28%	22%
Support (3 4)		335	335	173	161	86	81	109	58
		70%	70%	72%	68%	83%	65%	66%	70%
DK / NR		35	35	22	13	4	13	11	6
		7%	7%	9%	5%	4%	10%	7%	8%
Total	N	479	479	242	237	104	125	167	83
		100%	100%	100%	100%	100%	100%	100%	100%

BS1. Generally, would you say you support/oppose the Biosolids Master Plan?

		Overall	Annual Family Income				Education			
			Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
Oppose (1 2)		110	18	24	15	22	9	16	22	62
		23%	23%	22%	15%	22%	35%	19%	24%	22%
Support (3 4)		335	52	82	79	73	16	59	67	192
		70%	70%	72%	77%	72%	60%	72%	72%	70%
DK / NR		35	5	7	8	6	1	7	3	21
		7%	7%	6%	8%	6%	6%	9%	4%	8%
Total	N	479	75	113	103	101	27	83	92	274
		100%	100%	100%	100%	100%	100%	100%	100%	100%

BS2. How important is environmental sustainability?

		Region	Gender		Age			
	Overall	Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
Not important (1 2)	10	10	5	5		2	4	4
	2%	2%	2%	2%		2%	2%	5%
Neutral (3)	44	44	15	30	7	17	12	9
	9%	9%	6%	13%	6%	13%	7%	11%
Important (4 5)	413	413	214	200	98	106	146	64
	86%	86%	88%	84%	94%	85%	88%	77%
DK / NR	11	11	8	3			5	6
	2%	2%	3%	1%			3%	7%
Total	479	479	242	237	104	125	167	83
	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.54	4.54	4.64	4.45	4.66	4.45	4.58	4.46
Median	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Valid N	468	468	233	234	104	125	161	77

BS2. How important is environmental sustainability?

		Annual Family Income				Education			
	Overall	Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
Not important (1 2)	10	2	4	1	1	1	2	0	5
	2%	2%	4%	1%	1%	5%	2%	1%	2%
Neutral (3)	44	7	8	7	14	3	9	5	28
	9%	9%	7%	7%	14%	10%	10%	5%	10%
Important (4 5)	413	63	97	93	86	21	71	85	235
	86%	83%	86%	91%	85%	79%	86%	93%	86%
DK / NR	11	4	3	2		2	1	2	6
	2%	5%	2%	2%		7%	1%	2%	2%
Total	479	75	113	103	101	27	83	92	274
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.54	4.56	4.51	4.59	4.50	4.60	4.55	4.64	4.52
Median	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Valid N	468	72	110	101	101	25	82	91	269

BS3. How important is health impacts?

		Region	Gender		Age			
	Overall	Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
Not important (1 2)	14	14	4	10	5	2	3	4
	3%	3%	2%	4%	5%	2%	2%	5%
Neutral (3)	14	14	4	11	2	3	4	5
	3%	3%	2%	4%	2%	2%	2%	6%
Important (4 5)	443	443	230	213	97	120	157	69
	92%	92%	95%	90%	93%	96%	94%	83%
DK / NR	8	8	4	4			4	4
	2%	2%	2%	2%			2%	5%
Total	479	479	242	237	104	125	167	83
	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.71	4.71	4.82	4.60	4.59	4.79	4.80	4.58
Median	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Valid N	471	471	238	233	104	125	163	79

BS3. How important is health impacts?

		Annual Family Income				Education			
	Overall	Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
Not important (1 2)	14	4	2	1	3	1	5	3	5
	3%	5%	2%	1%	3%	2%	6%	3%	2%
Neutral (3)	14	1	7	1	1	1	2	0	10
	3%	1%	6%	1%	1%	5%	2%	1%	4%
Important (4 5)	443	69	103	99	97	24	75	87	256
	92%	91%	91%	97%	96%	90%	91%	94%	93%
DK / NR	8	2	1	2		1	1	2	3
	2%	3%	1%	2%		4%	2%	2%	1%
Total	479	75	113	103	101	27	83	92	274
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.71	4.67	4.70	4.84	4.74	4.75	4.63	4.69	4.76
Median	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Valid N	471	73	111	101	101	26	81	91	271

BS4. How important is keeping any harmful substances off the land?

		Region	Gender		Age			
	Overall	Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
Not important (1 2)	17	17	4	13	7	2	3	5
	4%	4%	2%	5%	7%	2%	2%	6%
Neutral (3)	28	28	11	17	6	4	11	6
	6%	6%	5%	7%	6%	4%	7%	7%
Important (4 5)	426	426	222	204	90	118	151	67
	89%	89%	92%	86%	87%	95%	90%	80%
DK / NR	8	8	4	4			2	6
	2%	2%	2%	1%			1%	7%
Total	479	479	242	237	104	125	167	83
	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.63	4.63	4.72	4.53	4.51	4.69	4.69	4.55
Median	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Valid N	471	471	238	234	104	125	165	78

BS4. How important is keeping any harmful substances off the land?

		Annual Family Income				Education			
	Overall	Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
Not important (1 2)	17	2	5	1	5	1	3	5	9
	4%	2%	5%	1%	5%	2%	3%	5%	3%
Neutral (3)	28	2	8	4	9	1	3	5	18
	6%	2%	8%	3%	9%	5%	4%	6%	7%
Important (4 5)	426	70	98	97	86	23	75	81	245
	89%	93%	87%	94%	86%	87%	91%	88%	89%
DK / NR	8	1	1	1	1	2	1	1	2
	2%	2%	1%	1%	1%	6%	2%	1%	1%
Total	479	75	113	103	101	27	83	92	274
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.63	4.76	4.56	4.79	4.46	4.67	4.76	4.54	4.62
Median	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00
Valid N	471	74	111	101	100	25	81	91	272

BS5. How important is reuse of valuable nutrients?

		Region	Gender		Age			
	Overall	Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
Not important (1 2)	40	40	19	21	12	7	15	5
	8%	8%	8%	9%	12%	6%	9%	6%
Neutral (3)	86	86	36	50	16	31	24	14
	18%	18%	15%	21%	15%	25%	14%	17%
Important (4 5)	340	340	179	161	76	86	123	55
	71%	71%	74%	68%	73%	69%	74%	66%
DK / NR	13	13	8	5			5	8
	3%	3%	3%	2%			3%	10%
Total	479	479	242	237	104	125	167	83
	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.06	4.06	4.14	3.98	3.91	4.10	4.09	4.12
Median	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Valid N	466	466	234	232	104	125	162	75

BS5. How important is reuse of valuable nutrients?

		Annual Family Income				Education			
	Overall	Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
Not important (1 2)	40	7	10	1	12	2	8	10	19
	8%	10%	9%	1%	12%	9%	10%	10%	7%
Neutral (3)	86	14	13	33	15	2	21	12	50
	18%	19%	11%	32%	15%	8%	26%	13%	18%
Important (4 5)	340	50	88	68	73	19	50	69	200
	71%	67%	78%	66%	72%	72%	60%	75%	73%
DK / NR	13	3	2	1	1	3	3	1	4
	3%	5%	2%	1%	1%	11%	4%	1%	2%
Total	479	75	113	103	101	27	83	92	274
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mean	4.06	3.95	4.13	4.07	4.00	4.18	3.94	4.01	4.11
Median	4.00	4.00	4.00	4.00	4.00	4.98	4.00	4.00	4.00
Valid N	466	72	110	101	100	24	79	91	270

BS6. How important is cost of treating biosolids?

		Region	Gender		Age			
	Overall	Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
Not important (1 2)	51	51	27	25	18	9	15	9
	11%	11%	11%	10%	18%	7%	9%	11%
Neutral (3)	136	136	68	68	27	48	42	19
	28%	28%	28%	29%	26%	38%	25%	23%
Important (4 5)	277	277	139	139	59	68	104	46
	58%	58%	57%	58%	56%	55%	63%	55%
DK / NR	14	14	8	6			6	8
	3%	3%	3%	3%			3%	10%
Total	479	479	242	237	104	125	167	83
	100%	100%	100%	100%	100%	100%	100%	100%
Mean	3.78	3.78	3.74	3.83	3.57	3.72	3.93	3.86
Median	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Valid N	465	465	234	231	104	125	161	75

BS6. How important is cost of treating biosolids?

		Annual Family Income				Education			
	Overall	Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
Not important (1 2)	51	13	13	5	10	3	8	10	29
	11%	18%	12%	5%	10%	13%	10%	11%	11%
Neutral (3)	136	14	26	37	38	4	17	27	88
	28%	18%	23%	36%	38%	16%	21%	29%	32%
Important (4 5)	277	45	70	60	52	15	56	53	152
	58%	60%	62%	58%	52%	56%	68%	58%	55%
DK / NR	14	3	3	1	1	4	1	2	6
	3%	4%	3%	1%	1%	14%	1%	2%	2%
Total	479	75	113	103	101	27	83	92	274
	100%	100%	100%	100%	100%	100%	100%	100%	100%
Mean	3.78	3.79	3.75	3.81	3.71	3.81	3.99	3.75	3.74
Median	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
Valid N	465	72	110	101	100	23	82	90	269

BS7. You mentioned more than one of these as very important, which one of these is the most important to you?

		Region	Gender		Age			
	Overall	Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
Environment sustainability	48	48	16	33	15	12	12	9
	12%	12%	7%	18%	19%	11%	8%	14%
Health impacts	223	223	132	91	43	63	82	35
	56%	56%	62%	50%	53%	61%	56%	54%
Keeping any harmful substances off the land	94	94	55	39	24	17	40	13
	24%	24%	26%	21%	29%	17%	27%	20%
Reuse of valuable nutrients	12	12	3	9		6	2	4
	3%	3%	1%	5%		6%	2%	6%
Cost of treating biosolids	10	10	3	7		3	7	1
	3%	3%	1%	4%		3%	5%	2%
DK / NR	8	8	4	4		3	3	3
	2%	2%	2%	2%		3%	2%	4%
Total N	395	395	212	184	82	103	145	65
	100%	100%	100%	100%	100%	100%	100%	100%

BS7. You mentioned more than one of these as very important, which one of these is the most important to you?

		Annual Family Income				Education			
	Overall	Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
Environment sustainability	48	9	10	11	8	1	9	11	27
	12%	15%	11%	13%	10%	5%	14%	15%	12%
Health impacts	223	32	47	56	50	16	35	44	128
	56%	50%	51%	66%	62%	71%	50%	59%	56%
Keeping any harmful substances off the land	94	17	22	16	20	4	17	15	56
	24%	27%	24%	18%	25%	19%	25%	21%	25%
Reuse of valuable nutrients	12	1	9			0	0	4	7
	3%	1%	9%			2%	1%	5%	3%
Cost of treating biosolids	10	1	3	3	2		5		6
	3%	1%	3%	3%	2%		7%		3%
DK / NR	8	4	2		1	1	3	1	4
	2%	6%	2%		1%	4%	4%	1%	2%
Total N	395	63	93	85	81	23	69	74	228
	100%	100%	100%	100%	100%	100%	100%	100%	100%

BS2_6. Most important factor.

		Overall	Region	Gender		Age			
			Winnipeg	Female	Male	18 to 29	30 to 39	40 to 64	65 and over
None		34	34	12	23	5	9	11	11
		7%	7%	5%	10%	5%	7%	6%	13%
Environment sustainability		51	51	17	34	15	12	12	12
		11%	11%	7%	14%	15%	9%	7%	14%
Health impacts		241	241	140	101	49	71	85	36
		50%	50%	58%	42%	47%	57%	51%	43%
Keeping any harmful substances off the land		113	113	62	52	30	23	45	15
		24%	24%	25%	22%	29%	18%	27%	19%
Reuse of valuable nutrients		16	16	4	12	2	6	4	4
		3%	3%	2%	5%	2%	5%	2%	5%
Cost of treating biosolids		16	16	4	12	2	3	8	3
		3%	3%	2%	5%	2%	2%	5%	4%
Don't know		8	8	4	4		3	3	3
		2%	2%	2%	2%		2%	2%	3%
Total	N	479	479	242	237	104	125	167	83
		100%	100%	100%	100%	100%	100%	100%	100%

BS2_6. Most important factor.

		Overall	Annual Family Income				Education			
			Under $40,000	$40,000 to $70,000	$70,000 to $100,000	Over $100,000	< High school	High school	Some post-secondary	Univ. / Coll. graduate
None		34	8	6	8	4	2	4	7	19
		7%	10%	6%	7%	4%	6%	5%	7%	7%
Environment sustainability		51	9	12	11	8	2	11	11	28
		11%	13%	10%	11%	8%	6%	13%	12%	10%
Health impacts		241	32	51	61	58	16	35	44	145
		50%	42%	45%	60%	58%	62%	42%	48%	53%
Keeping any harmful substances off the land		113	21	28	19	22	5	25	21	63
		24%	28%	25%	19%	22%	18%	30%	23%	23%
Reuse of valuable nutrients		16	1	9	1	2	0	0	6	9
		3%	1%	8%	1%	2%	2%	1%	7%	3%
Cost of treating biosolids		16	1	4	3	5	1	5	3	7
		3%	1%	4%	3%	5%	2%	6%	3%	2%
Don't know		8	4	2		1	1	3	1	4
		2%	5%	2%		1%	3%	3%	1%	1%
Total	N	479	75	113	103	101	27	83	92	274
		100%	100%	100%	100%	100%	100%	100%	100%	100%

Appendix D – One-Ways (Weighted)

BS1. Generally, would you say you support/oppose the Biosolids Master Plan?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly oppose	48	10.1	10.1	10.1
	Somewhat oppose	62	12.9	12.9	22.9
	Somewhat support	239	49.8	49.8	72.7
	Strongly support	96	20.0	20.0	92.8
	DK / NR	35	7.2	7.2	100.0
	Total	479	100.0	100.0	

Statistics

		BS2. How important is environmental sustainability?	BS3. How important is health impacts?	BS4. How important is keeping any harmful substances off the land?	BS5. How important is reuse of valuable nutrients?	BS6. How important is cost of treating biosolids?
N	Valid	468	471	471	466	465
	Missing	11	8	8	13	14
Mean		4.54	4.71	4.63	4.06	3.78
Median		5.00	5.00	5.00	4.00	4.00
Std. Deviation		.795	.748	.823	1.087	1.121
Minimum		1	1	1	1	1
Maximum		5	5	5	5	5

BS2. How important is environmental sustainability?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	5	1.1	1.1	1.1
	2	5	1.0	1.0	2.1
	3	44	9.2	9.2	11.3
	4	90	18.8	18.8	30.2
	5 - Very important	323	67.4	67.4	97.6
	DK / NR	11	2.4	2.4	100.0
	Total	479	100.0	100.0	

BS3. How important is health impacts?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	9	1.9	1.9	1.9
	2	5	1.0	1.0	2.9
	3	14	3.0	3.0	5.9
	4	55	11.4	11.4	17.3
	5 - Very important	388	81.0	81.0	98.3
	DK / NR	8	1.7	1.7	100.0
	Total	479	100.0	100.0	

BS4. How important is keeping any harmful substances off the land?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	8	1.7	1.7	1.7
	2	9	1.9	1.9	3.6
	3	28	5.9	5.9	9.5
	4	59	12.3	12.3	21.7
	5 - Very important	367	76.7	76.7	98.4
	DK / NR	8	1.6	1.6	100.0
	Total	479	100.0	100.0	

BS5. How important is reuse of valuable nutrients?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	19	3.9	3.9	3.9
	2	21	4.4	4.4	8.3
	3	86	17.9	17.9	26.2
	4	128	26.7	26.7	53.0
	5 - Very important	212	44.2	44.2	97.2
	DK / NR	13	2.8	2.8	100.0
	Total	479	100.0	100.0	

BS6. How important is cost of treating biosolids?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	21	4.4	4.4	4.4
	2	30	6.3	6.3	10.7
	3	136	28.5	28.5	39.1
	4	118	24.7	24.7	63.9
	5 - Very important	159	33.2	33.2	97.0
	DK / NR	14	3.0	3.0	100.0
	Total	479	100.0	100.0	

Region

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Winnipeg	479	100.0	100.0	100.0

Statistics

AGE

N	Valid	464
	Missing	15
Mean		45.55
Median		41.10
Std. Deviation		18.146
Minimum		18
Maximum		99

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 to 29	104	21.7	21.7	21.7
	30 to 39	125	26.1	26.1	47.8
	40 to 64	167	34.8	34.8	82.6
	65 and over	83	17.4	17.4	100.0
	Total	479	100.0	100.0	

Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< High school	27	5.6	5.6	5.6
	High school	83	17.2	17.4	23.0
	Some post-secondary	92	19.2	19.4	42.3
	Univ. / Coll. graduate	274	57.3	57.7	100.0
	Total	476	99.3	100.0	
Missing	DK / NR	3	.7		
Total		479	100.0		

Annual Family Income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under $40,000	75	15.7	19.2	19.2
	$40,000 to $70,000	113	23.5	28.8	48.1
	$70,000 to $100,000	103	21.4	26.2	74.3
	Over $100,000	101	21.0	25.7	100.0
	Total	391	81.7	100.0	
Missing	DK / NR	88	18.3		
Total		479	100.0		

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	242	50.5	50.5	50.5
	Male	237	49.5	49.5	100.0
	Total	479	100.0	100.0	

Appendix E – One-Ways (Unweighted)

BS1. Generally, would you say you support/oppose the Biosolids Master Plan?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly oppose	57	11.9	11.9	11.9
	Somewhat oppose	59	12.3	12.3	24.2
	Somewhat support	228	47.6	47.6	71.8
	Strongly support	100	20.9	20.9	92.7
	DK / NR	35	7.3	7.3	100.0
	Total	479	100.0	100.0	

Statistics

		BS2. How important is environmental sustainability?	BS3. How important is health impacts?	BS4. How important is keeping any harmful substances off the land?	BS5. How important is reuse of valuable nutrients?	BS6. How important is cost of treating biosolids?
N	Valid	459	466	466	456	455
	Missing	20	13	13	23	24
Mean		4.55	4.72	4.65	4.09	3.84
Median		5.00	5.00	5.00	4.00	4.00
Std. Deviation		.822	.736	.814	1.111	1.151
Minimum		1	1	1	1	1
Maximum		5	5	5	5	5

BS2. How important is environmental sustainability?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	6	1.3	1.3	1.3
	2	7	1.5	1.5	2.7
	3	41	8.6	8.6	11.3
	4	79	16.5	16.5	27.8
	5 - Very important	326	68.1	68.1	95.8
	DK / NR	20	4.2	4.2	100.0
	Total	479	100.0	100.0	

BS3. How important is health impacts?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	7	1.5	1.5	1.5
	2	7	1.5	1.5	2.9
	3	16	3.3	3.3	6.3
	4	49	10.2	10.2	16.5
	5 - Very important	387	80.8	80.8	97.3
	DK / NR	13	2.7	2.7	100.0
	Total	479	100.0	100.0	

BS4. How important is keeping any harmful substances off the land?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	8	1.7	1.7	1.7
	2	8	1.7	1.7	3.3
	3	29	6.1	6.1	9.4
	4	49	10.2	10.2	19.6
	5 - Very important	372	77.7	77.7	97.3
	DK / NR	13	2.7	2.7	100.0
	Total	479	100.0	100.0	

BS5. How important is reuse of valuable nutrients?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	22	4.6	4.6	4.6
	2	18	3.8	3.8	8.4
	3	77	16.1	16.1	24.4
	4	121	25.3	25.3	49.7
	5 - Very important	218	45.5	45.5	95.2
	DK / NR	23	4.8	4.8	100.0
	Total	479	100.0	100.0	

BS6. How important is cost of treating biosolids?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 - Not at all important	23	4.8	4.8	4.8
	2	27	5.6	5.6	10.4
	3	123	25.7	25.7	36.1
	4	107	22.3	22.3	58.5
	5 - Very important	175	36.5	36.5	95.0
	DK / NR	24	5.0	5.0	100.0
	Total	479	100.0	100.0	

Region

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Winnipeg	479	100.0	100.0	100.0

Statistics

AGE

N	Valid	457
	Missing	22
Mean		55.18
Median		58.00
Std. Deviation		17.443
Minimum		18
Maximum		99

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	18 to 29	51	10.6	10.6	10.6
	30 to 39	47	9.8	9.8	20.5
	40 to 64	229	47.8	47.8	68.3
	65 and over	152	31.7	31.7	100.0
	Total	479	100.0	100.0	

Education

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	< High school	40	8.4	8.4	8.4
	High school	90	18.8	19.0	27.4
	Some post-secondary	76	15.9	16.0	43.5
	Univ. / Coll. graduate	268	55.9	56.5	100.0
	Total	474	99.0	100.0	
Missing	DK / NR	5	1.0		
Total		479	100.0		

Annual Family Income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Under $40,000	103	21.5	27.2	27.2
	$40,000 to $70,000	115	24.0	30.4	57.7
	$70,000 to $100,000	72	15.0	19.0	76.7
	Over $100,000	88	18.4	23.3	100.0
	Total	378	78.9	100.0	
Missing	DK / NR	101	21.1		
Total		479	100.0		

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	285	59.5	59.5	59.5
	Male	194	40.5	40.5	100.0
	Total	479	100.0	100.0	

APPENDIX C.5 - REQUEST FOR INFORMATION FOR BIOSOLIDS MANAGEMENT SUMMARY REPORT

Winnipeg Sewage Treatment Program
Integrated Management System

Request for Information for Biosolids Management 518-2013

May 2014

1. Background

A request for information (RFI) was posted on the City's procurement website, inviting vendors to respond to questions about their willingness to manage the reuse of biosolids end products. A copy of RFI 518-2013 can be found on the City's Materials Management Website.

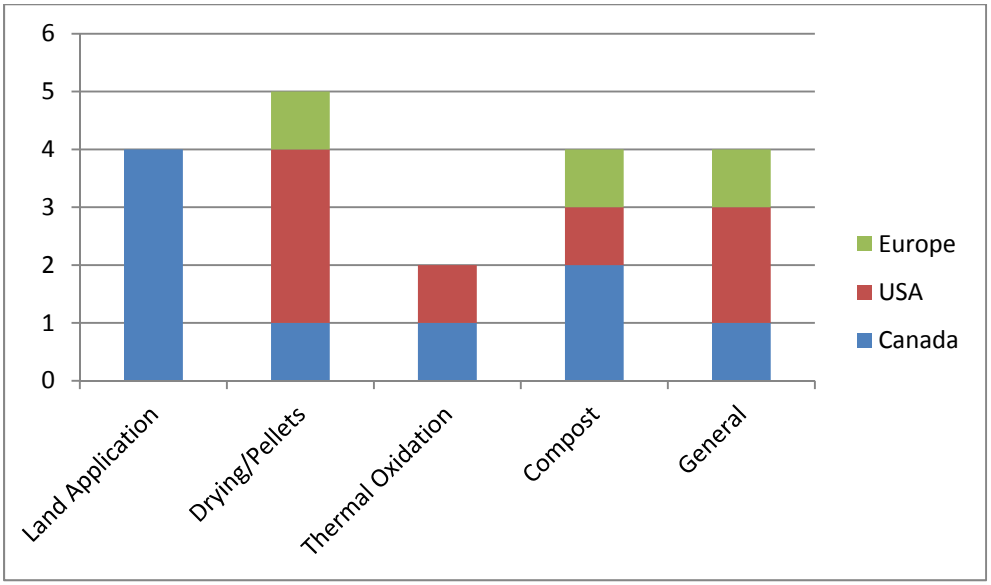
2. Findings

Nineteen submissions were evaluated as part of RFI 518-2013. There was a well distributed range of preferred solutions, which had an interest in either supplying technology, managing the digestion process, and/or generating an end product for profit.

The submissions were grouped according to the type of end product that they generated. They can be broadly categorized as land application, thermal drying/pellets, thermal oxidation, composting, and general. The 'general' category was for submissions that expressed an interest and ability in producing an end product chosen by the City.

The locations of the submissions, shown in Figure 1, indicate that submitters were primarily in the USA or Canada. Some biosolids management strategies, such as land application, were specific to Canada whereas others, such as compost, where more globally represented.

Figure 1 Locale of submissions RFI 518-2013



Most submissions expressed an interest in design-build-own-operate (DBOO) models for creating and marketing the biosolids end products with 20-25 year terms. The land application submissions also expressed willingness for long term service contracts with 10-15 year terms. Several submissions in the 'drying/pellets' category expressed an interest in managing and maintaining the City's entire biosolids treatment facility, including anaerobic digestion.

3. Conclusion

The scope of RFI 518-2013 was to assess the willingness of the private sector to participate in the City's biosolids planning strategy. The submissions indicate that there is strong interest in biosolids treatment and product reuse. There was marginal interest in managing the overall digestion and treatment process but no interest in offering 'reuse of end products' only.

4. Next Steps

The outputs of RFI 518-2013 will be combined with other planning initiatives to assess the various treatment strategies and to shortlist which treatment options should be included in the City's Biosolids Master Plan. These initiatives include the marketability of biosolids end products, public consultation, and stakeholder engagement. The biosolids master plan will be submitted for regulatory review in October 2014.

APPENDIX D.1 - CITY REQUEST REGARDING LAND APPLICATION

Winnipeg

Water and Waste Department • Service des eaux et des déchets

July 16, 2013

File No: 020-17-08-11-ON

Water Quality Management Section
Manitoba Water Conservation and Stewardship
160-123 Main Street
Winnipeg, MB R3C1A5

Dear Sirs and/or Madam;

Re: Nutrient Management Plan City of Winnipeg Biosolids

In December 2012 the City submitted a report on the status of the City's Biosolids Master Plan. Within this report the City made a commitment to evaluate the feasibility of land application of biosolids.

To facilitate the submission of a Nutrient Management Plan in accordance with the Water Protection Act the City requests 'approval in principle' to summer apply biosolids at the application rates and conditions which were previously specified in Environment Act License 1089ERR. We believe that the application rate of 56 dry tonnes per hectare is the key decision required from the Regulator. The WinGro program would not be viable at a lower application rate because the existing dewatering and spreading equipment would need to be modified, facilities to store large volumes of biosolids would be required, and much more farm land would be required. As well, few farmers would be willing to lose a year's production to receive a lower quantity of nutrients.

If the application rate is approved the City would then begin the process to re-establish the WinGro Program and submit Nutrient Management Plans on the secured agricultural fields. The process to re-establish the former WinGro program will require public meetings with stakeholders, the approval of the Rural Municipality where the spreading occurs, and the procurement of fields for testing and submission of Nutrient Management Plans. The City cannot receive commitments from the farmers or the Rural Municipalities without providing them with approximate application rates.

If 'approval in principle' is received the equipment previously used by our contractor is still available and the WinGro program could be re-established by April 2014. In the longer term, the City would want to issue a bid opportunity requiring a contract term of at least 5 years. This equipment has been very effective in spreading our biosolids at 56 dry tonnes per hectare.

To facilitate your decision please find enclosed a general Nutrient Management Plan for summer only spreading of biosolids on agricultural land. We request your review of this and welcome

any comments or concerns you may have. If you require any further information please contact Duane Griffin at 986-4483.

Yours truly,

C. W. Carroll, P. Eng.
Manager of Wastewater Services
Water and Waste Department

C: D. Sacher, P.Eng.
G. Patton, P.Eng.
D. Griffin, P.Eng.
J. Veilleux,P.Eng.
K. Kjartanson, P.Eng.

PROPOSED NUTRIENT MANAGEMENT PLAN – Municipal Wastewater Biosolids

Section A: Operation Information (name, legal land description, contact info)
This information will be provided in a formal submission from the City

Section B: Storage Facilities (yes or no)
None required

Section C: Volume to be applied (units)
56 dry tonnes per hectare of biosolids – 580 kg/ha N 860kg/ha P

Section D: Buffer Zones (set back from water body)
Setbacks specified in EAL 1089ERR far exceed those in the Nutrient Management Regulation

Section E: Field Information (field size and location, class, nutrients, irrigated?)
Field size: 65 ha Location: Northwest of Winnipeg Class: Zone N1
Nutrients: Soil Sampling will be done for submission Irrigated: No

Section F: Certification (must be certified)
The formal plan will be certified by a Professional Agrologist or Certified Crop Adviser

Appendix: Nutrient Budget (metric units kg/ha)
Past Crop: Wheat **Crop Year:** 2014 **Crop:** Canola **Target Yield:** 1.96 t/ha

	Nitrogen	Phosphorus
Balance carry forward	10	20
Additions fertilizer	0	0
biosolids	580	860
Credits past legume	0	0
Past manure	0	0
past biosolids	0	0
Removal content (kg/t)	38.7	20.8
Nutrient Removal	76	41
Balance	514	839

112-1199 Pacific Avenue • 1199, Avenue Pacific, Porte 112 • Winnipeg • Manitoba R3E 3S8
tel/tél. (204) 986-7550 • fax/téléc. (204) 986-3745 • winnipeg.ca

APPENDIX D.2 - MCWS RESPONSE REGARDING LAND APPLICATION

Manitoba

Conservation and Water Stewardship

Water Science and Management Branch
Suite 160, 123 Main Street
Winnipeg MB R3C 1A5
CANADA
http://www.gov.mb.ca/waterstewardship/

October 15, 2013

Mr. C.W. Carroll
Manager of Wastewater Services
City of Winnipeg - Water and Waste Department
112-1100 Pacific Avenue
Winnipeg, MB R3E 3S8

Dear Mr. Carroll:

Thank you for your correspondence regarding the feasibility of land application of biosolids on agricultural soils.

The purpose of the Nutrient Management Regulation under *The Water Protection Act* is to protect water quality by encouraging responsible nutrient application and regulating the application of materials containing nitrogen and phosphorus. The Nutrient Management Regulation regulates residual nitrate-nitrogen within the top 0.6 m of soil at the end of the growing season (Section 7). Soil test phosphorus using the Olsen method is regulated through the rate of application relative to crop removal rate for the subsequent crop to be grown (Subsection 8(2)).

Nutrient application rates cannot be arbitrarily determined in advance. Instead, application must consider the availability of the nutrient source, the overall crop rotation, residual nutrients available within the soil profile, and other factors. The maximum application rate of 56 dry tonnes per hectare referenced in *Environment Act* licence 1089ERR was originally based on the concentration of heavy metals within the biosolids. The Nutrient Management Regulation came into force in 2008 and requires that nitrogen and phosphorus be considered when calculating an application rate. As a result, the maximum application rate for heavy metals is no longer the most limiting factor as an application rate of 56 dry tonnes per hectare would result in excessive quantities of nitrogen and phosphorus being applied to an agricultural field.

I would encourage further exploration of alternate technologies capable of applying biosolids at rates of less than 56 dry tonnes per hectare as well as investigating storing biosolids on a temporary basis followed by land application at a later time thus reducing the need to fallow an agricultural field for an entire season. Other options worth considering include biosolids composting, combustion with beneficial reuse, raw material for industrial processes, and land application of a pelletized product.

I am encouraged to hear that the City of Winnipeg is evaluating the feasibility of land application of biosolids. Land application at agronomic rates provides an excellent opportunity to recycle valuable nutrients while minimizing potential impacts to water quality and is consistent with the Manitoba Water Quality Standard for beneficial use of municipal biosolids and sludge (http://www.gov.mb.ca/waterstewardship/water_quality/quality/pdf/mb_water_quality_standard_final.pdf).

Thank you again for your correspondence on this matter. Please do not hesitate to contact me at 204-945-3991 or nicole.armstrong@gov.mb.ca if you have any questions or comments.

Sincerely,

Nicole Armstrong
Director

Cc: David Hay

APPENDIX E - LETTER OF REQUIREMENTS FOR PILOT BIOSOLIDS COMPOST FACILITY

Manitoba

Conservation and Water Stewardship

Climate Change and Environmental Protection Division
Environmental Approvals Branch
123 Main Street, Suite 160, Winnipeg, Manitoba R3C 1A5
T 204 945-8321 F 204 945-5229
www.gov.mb.ca/conservation/eal

File: 963.20
April 30, 2012

Dwight Gibson, P. Eng.
Senior Project Engineer
Engineering Division
Water and Waste Department
City of Winnipeg
110-1199 Pacific Avenue
Winnipeg, MB R3E 3S8

Dear Mr. Gibson:

Re: City of Winnipeg Biosolids Composting Pilot Study – Environment Act Licence No. 1089 E RR

I am responding to the February 9, 2012 letter respecting the City of Winnipeg's proposed biosolids composting pilot study. The letter is in response to the request for additional information pertaining to the January 5, 2012 Notice of Alteration (NoA) relative to the management of biosolids as described by Environment Act Licence No. 1089 E RR (the Licence).

Your letter and attachments provided additional requested information regarding the proposed pilot study including:

1. a measured quantity that the proposed 20% of currently generated biosolids represents with respect to volume or mass of biosolids;
2. characteristics of the biosolids respecting foreign matter, micro-constituents, nutrients, pathogens, trace elements, etc.;
3. control measures for vector attraction and odours;
4. characteristics and proposed uses for the end-product;
5. drawings showing details of the final conceptual design; and
6. a general closure plan should the pilot study identify that such a program is not viable for the long term.

Upon review of the NoA, we have determined that the potential environmental effects of the pilot study are insignificant and therefore I have decided pursuant to Section 14(2) of *The Environment Act* to approve the proposed pilot study activities pursuant to the following conditions:

...2/

1. A set of drawings showing the design and features of all components dedicated to the pilot study shall be provided to the Environmental Approvals Branch of Manitoba Conservation and Water Stewardship by not later than June 30, 2012.
2. The resulting compost products shall be applied only as landfill cover within the Brady Road Landfill site for the duration of this pilot study.
3. Biosolids delivered to Brady Road Landfill shall not be removed from Brady Road Landfill in any form unless otherwise authorized by an Environment Officer.
4. Biosolids shall not be stockpiled at any location prior to being introduced to the pilot study activities.
5. Clause 4 of the Licence, respecting odours, applies to all activities associated with this pilot study.
6. All dewatered biosolids generated at the City's North End Water Pollution Control Centre not delivered to Brady Road Landfill shall be land applied in accordance with the Licence and all other related provincial regulations.
7. Annual reports of each year's related activities shall be submitted to the Environmental Approvals Branch of Manitoba Conservation and Water Stewardship by not later than December 31st of each year that such activities have occurred.
8. Upon completion of two years of this pilot project's activities, a report summarizing details of results, performance, benefits realized and proposed plans for the future shall be submitted to the Environmental Approvals Branch of Manitoba Conservation and Water Stewardship by not later than February 1st of the following year.
9. This approval shall be revisited not later than three years after the date of this letter.

If you have any questions or would like to discuss the foregoing, please contact Robert Boswick, Environmental Engineer, at 945-6030.

Yours truly,

Tracey Braun

Tracey Braun, M.Sc.
Director
Environment Act

c. D. E. Drohomerski, C.E.T., Water and Waste Department, City of Winnipeg
Don Labossiere, Director – Environmental Compliance and Enforcement, Manitoba Conservation and Water Stewardship