Notice of Alteration Form

Manitoba
Sustainable Development

Client File No. : 5,556.00	Environment Act Licence No. : 3081 R

Legal name of the Licencee: THE CITY OF WINNIPEG, WATER AND WASTE DEPARTMENT

Name of the development: THE BRADY ROAD RESOURCE MANAGEMENT FACILITY

Category and Type of development per Classes of Development Regulation:

Waste Treatment and Disposal ▼ Class 1 Waste Disposal Grounds ▼

Licencee Contact Person: DARYL DOUBLEDAY
Mailing address of the Licencee: 1120 WAVERLEY ST.
City: WINNIPEG Province: MB Postal Code: R3T0P4
Phone Number: (204) 986-4484 Fax: Email: ddoubleday@winnipeg.ca

Name of proponent contact person for purposes of the environmental assessment (e.g. consultant):
Becky Raddatz

Phone: (204) 986-3107 Fax:	Mailing address: 1120 Waverley St. Winnipeg MB R3T0P4

Email address: braddatz@winnipeg.ca

Description of Alteration *(max 90 characters):*
- Inclusion of storm water green waste to list of acceptable materials to be composted
- demonstration of use of biosolids and other residuals to fabricate a top soil for final cover system

Alteration fee attached: Yes: ☑ No: ☐

If No, please explain:

Date: JAN 13, 2017	Signature: DD Printed name: DARYL DOUBLEDAY

A complete Notice of Alteration **(NoA)** consists of the following components:

- ☑ **Cover letter**
- ☑ **Notice of Alteration Form**
- ☑ **4 hard copies and 1 electronic copy of the NOA detailed report** (see "Information Bulletin - Alteration to Developments with Environment Act Licences")
- ☑ **$500 Application fee, if applicable** (Cheque, payable to the Minister of Finance)

Submit the complete NOA to:

Director
Environmental Approvals Branch
Manitoba Sustainable Development
Suite 160, 123 Main Street
Winnipeg, Manitoba R3C 1A5

For more information:

Phone: (204) 945-8321
Fax: (204) 945-5229
http://www.gov.mb.ca/conservation/eal

Winnipeg

Water and Waste Department • Service des eaux et des déchets

January 4, 2017 Our File No.: G-161

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

Attention: Tracey Braun, M.Sc., Director

Dear Ms. Tracey Braun:

RE: Notice of Alteration, Environment Act Licence No. 3081 R, The Brady Road Resource Management Facility, Composting Facility. Client File No. 5556.00

Please accept this letter as a Notice of Alteration to the above noted Environment Act Licence.

The City of Winnipeg operates a Leaf and Yard Waste Composting (L&YWC) Facility at the Brady Road Resource Management Facility (BRRMF) located 1901 Brady Road in the City of Winnipeg. The L&YWC facility is operated in accordance with the BRRMF Leaf and Yard Waste and Pilot Biosolids Composting Facility Operating Manual and the facility Licence No. 3081R.

With respect to the Composting operation, the City proposes to add green waste material types to the list of acceptable materials to be composted at the L&YWC Facility. The material types being considered for inclusion in the composting process are harvested from storm water retention basins and waterways throughout the City, primarily cattail cuttings and pond vegetation. This Notice of Alteration is intended to request approval from Manitoba Conservation and Water Stewardship to include these material types in the list of green waste that can be considered for composting as prescribed in Clause 65 of Licence No. 3081R. It should be noted that the City of Winnipeg has submitted an informal request to allow for a trial period of composting cattail material during the period September 23, 2016 to October 31, 2016 and that approval was offered by the Ministry to allow for a the trial period of composting of this material type.

Additionally, please see the attached proposal for a demonstration project on the use of and experimental design for a demonstration of the use of biosolids and other organic and inorganic residuals to fabricate a soil for the vegetative support layer as part of the final cover system at the Brady Road Resource Management Facility (BRRMF), operated by the City of Winnipeg ("The City"). The City seeks approval for this demonstration as an alteration to the existing licence for BRRMF.

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Should you have any questions or require additional information, please feel free to contact the undersigned at (204) 986-4484 or at ddoubleday@winnipeg.ca. Thank you for your consideration.

Yours truly,

Daryl Doubleday
Manager, Solid Waste Services

Biosolids use in Landfill Topsoil Fabrication Demonstration

City of Winnipeg – Brady Road Resource Management Facility

December 2016

Prepared for:

Manitoba Sustainable Development
Environmental Approvals – Municipal and Industrial Section
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LIST OF ABBREVIATIONS

General abbreviations used in this document:

BRRMF – Brady Road Resource Management Facility
MSD – Manitoba Sustainable Development
OMRR – British Columbia Organic Matter Recycling Regulation

Unit abbreviations used in this document:

cm – centimetre
g – gram
ha – hectare
kg – kilogram
L – litre
m – metre
m^3 – cubic metre
mg – milligram
t – tonne

EXECUTIVE SUMMARY

The following document is a proposal and experimental design for a demonstration of the use of biosolids and other organic and inorganic residuals to fabricate a soil for the vegetative support layer as part of the final cover system at the Brady Road Resource Management Facility (BRRMF), operated by the City of Winnipeg ("The City"). The City seeks approval for this demonstration as an alteration to the existing licence for BRRMF.

The soil will be fabricated using a combination of clay soil, wood waste and municipal biosolids at ratios designed to meet most of the criteria for biosolids growing media under the British Columbia Organic Matter Recycling Regulations. The proposed demonstration will be conducted on a 3.25 ha area slope of the landfill, and will test placement of the biosolids fabricated soil at different depths compared to a control area using typical final cover materials. The soil will be fabricated near the demonstration site in February 2017, and placed and seeded in the spring of 2017.

Monitoring of soil and surface water quality, and vegetation germination and biomass, will be conducted twice annually over 2017 and 2018. The results of this demonstration and the monitoring will be provided to Manitoba Sustainable Development (MSD) in two reports - an interim report in 2017 and a final report at the end of 2018.

The goal of this demonstration is to provide proof-of-concept for the safe and effective use of biosolids in topsoil fabrication in Manitoba, which can provide a new beneficial use option for biosolids and other residuals, as well as reducing the cost of topsoil importation for final landfill cover.

This report is prepared for the sole use of the City of Winnipeg and Manitoba Sustainable Development. Any use, interpretation, or reliance on this information by any third party, is at the sole risk of that party, and SYLVIS accepts no liability for such unauthorized use.

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1 INTRODUCTION

The City of Winnipeg (the City) is in the process of investigating alternative management options for its municipal biosolids in order to increase beneficial use. The City is currently undertaking a compost pilot project in which up to 20% of the annual biosolids production can be composted and used on-site. The remaining biosolids are being buried in landfill. This scenario is not a beneficial use of the biosolids, and also poses operational challenges for the landfill.

In order to address this need for additional beneficial use options, SYLVIS is undertaking a pilot project with the City to investigate the use of biosolids and other locally available residuals to fabricate a topsoil for final cover on the City's landfills, including the Brady Road Resource Management Facility (BRRMF). If successful, the use of biosolids in this manner could potentially be utilized at other City closed landfills. Topsoil fabrication not only provides beneficial use options for biosolids and other residuals, but can also reduce the costs of topsoil importation for landfill closure.

This demonstration trial process has already encompassed the laboratory analysis and bench scale mixing of several fabricated soil blends, followed by physicochemical analysis of these blends and a germination trial. The results of these analyses and trials have informed the development of this proposal and experimental design, which describe the next phase of the project, the subject of this report/proposal: obtaining approval for, and executing, a demonstration-scale trial of soil fabrication, application of the soil to landfill as vegetative support layer as part of the cover system, and germination.

1.1 Biosolids, Fabricated Growing Medium and Landfill Closure

In many reclamation situations, sufficient stockpiled topsoil and/or subsoil is not available, or does not have the appropriate characteristics to sustain vegetation, making reclamation difficult. In these situations biosolids can be used to fabricate a topsoil with other organic residuals, with sand or local mineral material, or mixed with existing stockpiled soil to augment the quantity and quality of topsoil resources. The use of biosolids soil mixtures in landfill closure has been successfully implemented or are in progress in western Canada, including the following sites:

- Nanaimo Regional Landfill – Regional District of Nanaimo (Nanaimo, BC)
- Richmond Landfill – Ecowaste Industries Ltd. (Richmond, BC)
- Skimikin Landfill – Columbia Shuswap Regional District (Tappen, BC)
- Cariboo Regional District Landfill – Gibraltar Mine (Williams Lake, BC)
- Ryley Landfill – Beaver Municipal Solutions (Ryley, AB)

At these landfills, biosolids were combined with available organic and inorganic materials to promote vegetation establishment, and in some instances designed specifically to also mitigate fugitive methane emissions, or treat leachate through an engineered soil/plant remediation system (Photograph 1, Photograph 2). Utilizing biosolids and other organic residuals in soil fabrication and vegetation establishment can reduce the cost of landfill closure; reduce the need

to import topsoil, which would need to be stripped from other sites; and provide a beneficial use opportunity for regionally generated residuals.

1.2 Regulatory Approval

Current legislation in Manitoba does not include specific regulatory criteria for the fabrication and use of biosolids amended topsoil. In British Columbia, fabricated soil containing biosolids is regulated under the *British Columbia Organic Matter Recycling Regulation* (B.C. Reg. 18/2002), herein referred to as OMRR. The process and quality criteria for biosolids growing medium (BGM) within the OMRR allow for unrestricted distribution and use of the fabricated soil. Soils that do not fully meet the BGM criteria, may still be used, but require a Land Application Plan signed off by a qualified professional to ensure that the use is protective of human health and the environment.

Discussions with Manitoba Sustainable Development following the provision of bench-scale results broadly discussed the next steps in the demonstration trial process. The results of the discussion provided the following direction for this demonstration trial:

- The demonstration trial team was to produce a demonstration trial and experimental design in the form of a proposal to proceed for Manitoba Sustainable Development
- The design was to include monitoring capacity for surface water, soil nutrients and trace elements, and vegetation establishment and development. An area of the BRRMF (Figure 1) was identified as a likely area for a trial.
- Potential nutrients contained in runoff would the impacted ditch at the base of the slope and be retained in the site's surface water management system, however a system of simple weirs at the base of the demonstration area slope would provide capacity to sample runoff water from a control area and three treatment areas.
- The area would be seeded with a typical seeding mix used for vegetative cover at the BRRMF.

Manitoba Sustainable Development indicated that this proposal could be submitted before end of year, and a response provided to the City and SYLVIS within a reasonable timeframe in order to enable preparations for a soil mixing process that, if approved, would begin in mid-February.

The sections that follow outline the trial design and proposed mixing and monitoring processes to achieve the requirements of both the City of Winnipeg in assessing this process, and Manitoba Sustainable Development in regulating this demonstration.

1.3 Project Objectives

The goal of this project is to fabricate and place a topsoil containing biosolids and other regionally available materials on a portion of a closed area of the BRRMF, and following placement, to seed the areas, and monitor them for a full year, to assess the quality of fabricated soil as an alternative to topsoil, as well as the potential of the demonstration for environmental impact from nutrient migration due to runoff or other phenomena.

This project aims to provide MSD with "proof of concept" of the safe and effective use of biosolids in this manner, adding an additional long-term beneficial use option for City of Winnipeg biosolids.

A bench scale study conducted in the fall of 2016, developed test blends that meet the BGM criteria in OMRR as closely as possible. The full report of this assessment is included with this proposal. A modified version of one of these blends will be tested at different placement thicknesses and compared to a control plot using existing landfill closure practices.

The experimental design and monitoring plan were developed with the following key guiding questions to evaluate the operational-scale use of biosolids amended soil for landfill closure:

- Can biosolids amended topsoil be economically fabricated at the landfill in winter conditions?
- Can biosolids amended soil be used to achieve similar reclamation success compared to current practices?
- Can biosolids amended topsoil be placed up to depths of one meter without adverse impacts to downstream surface water and soils

2 DEMONSTRATION PROJECT PLAN

2.1 Bench-scale Fabricated Soil Assessment and Results

SYLVIS conducted a bench-scale assessment of several soil blends utilizing available feedstocks at BRRMF. The full report of this assessment is included in Appendix Three. There were several key findings from this assessment that are addressed below.

2.1.1 Mixing of Clay Soil

The clay soil was difficult to mix with the other feedstocks when wet due to its stickiness. Drying the clay before mixing, or adding some sand to the mix ratio greatly minimized this challenge. Working with the clay soil in a frozen state should also minimize stickiness, thus the mixing for this pilot will occur in the winter when average temperatures are still well below freezing.

2.1.2 Nutrient Leaching

The bench-scale study found that leaching of nutrients out of the soil occurred under simulated extreme wet weather conditions (Appendix Three). Based on this finding, wood sources with a higher C:N ratio, such as kiln dried pallets and other softwoods, will be added to the wood feedstock. The operational scale demonstration will also include surface water monitoring following rainfall or snowmelt events to determine if nutrient leaching occurs under these conditions.

2.1.3 Zinc

City of Winnipeg biosolids exceed the OMRR criteria for zinc from time to time, thus any fabricated soil may exceed the OMRR BGM criteria for zinc. While this soil would not meet the criteria for

unrestricted distribution, it will be still suitable for use as prescribed in this proposal. Monitoring of trace elements in the top 30 cm of the topsoil will be conducted during this demonstration.

2.1.4 Odour

There was very minimal odour observed while mixing the soil during the bench-scale study.

2.1.5 Fabricated Soil Blend Results and Selection

The results of the bench-scale test identified that a mixture similar to a 1:3:3 (biosolids:soil:woodwaste) blend would be most appropriate for a demonstration trial, but that additional woodwaste should be added to improve the C:N ratio of the material.

The soil blend recommended for this demonstration will contain a ratio of biosolids to soil to wood waste of 1:3:4. The soil used will be clay subsoil harvested from areas around the landfill, but may also include clean fill delivered to the BRRMF from development sites. The wood feedstocks will include a combination of elm grindings from the City's Dutch elm disease control as well as kiln-dried grindings of pallets and other softwood material received at the BRRMF, ideally in a ratio of up to 4:1 elm to softwood. Any feedstock materials that were not analyzed in the bench-scale report will be analyzed prior to the start of the demonstration project to ensure that they are not a significant source of trace elements or nutrients.

2.2 Demonstration Location

The demonstration will be located on an approximately 3.25 hectare area of a closed portion of the landfill, shown as C, T1, T2 and T3 on Figure 1 and Photograph 3.

2.2.1 Land Description

The demonstration location is on an east facing slope that is approximately 300 m in length and 100 m wide (Figure 1). The slope is on a hill located south east of the active face of the landfill. The landfill gas extraction well will be installed on this slope prior to soil placement, and the area will be graded and scraped of existing invasive vegetation.

2.2.2 Runoff

Surface water runoff from the location enters the impacted water ditch which flows south along the toe of the slope, eventually draining into the BRRMF's surface water management area. The drainage ditch will have v-notch weirs installed between the trial areas to enable monitoring of the runoff water received from the different trial areas.

2.2.3 Soil Fabrication Location

The soil fabrication will be conducted at the top of the slope for the demonstration area. This is a level area, approximately 75 m wide and 300 m long, with an access road suitable for biosolids transport trucks. The area directly above the control plot, which is the most northerly of the areas, will not be used for mixing in order to avoid potential spillage of the material downslope that could lead to incidental influence of the control.

2.3 Project Implementation

2.3.1 Experimental Design

The experimental design is shown in Figure 1. This design is intended to test the following null hypotheses:

- There will be no difference in nutrient concentrations in the ditch water collected below the different treatment areas and the control. The expectation is that the null hypothesis will be upheld.
- There will be no difference in nutrient and trace element concentrations in the soil collected in the buffer zone below the different treatment areas and the control. The expectation is that the null hypothesis will be upheld.
- There will be no difference in soil fertility, soil organic matter, trace element concentrations, or physicochemical parameters. The expectation is that the null hypothesis will not be upheld, and that there will be significantly improved soil fertility in some or all of the treatment plots will be improved over control.
- There will be no difference in germination success between the different treatment areas and the control. The expectation is that the null hypothesis will not be upheld, and that germination will be improved in some or all of the treatment areas.
- There will be no difference in aboveground biomass between the different treatment areas and the control at the end of the first and second growing seasons. The expectation is that the null hypothesis will not be upheld, and that aboveground biomass will be significantly greater in some or all of the treatment plots over control.

The treatment areas will include biosolids fabricated topsoil placed at three different depths (0.3 m, 0.6 m and 0.9 m) and a control area using the BRRMF's typical vegetative layer practices (topsoil and compost). The control area will be located at the upstream (northernmost) location along the drainage ditch, and the treatment areas will be placed in order of ascending depth downstream (south) of the control area. This experimental design will allow a comparison of water quality in the ditch between the control area and the treatment areas without fear of contamination of the control. A buffer of 30 m from the drainage ditch and the treatment areas will also have a vegetative support layer added and seeded using typical practice. Soil samples collected from this buffer area will be used to determine the effect of fabricated soils on downslope soils.

The approximate volumes and masses of feedstocks and final fabricated soil are shown in

Table 1, below.

Table 1: Maximum volumes and masses of feedstocks to be used in each treatment area.

	Biosolids	Clay Soil	Wood Waste	Final Mix
Mix Ratio (volumetric)	1	3	4	-
Bulk Density[a] (kg/m^3)	730	1,730	260	-
Treatment 1 (0.3 m depth)				
Volume (m^3)	293	878	1,170	2,340
Mass (tonnes)	214	1,518	304	2,036
Treatment 2 (0.6 m depth)				
Volume (m^3)	600	1,800	2,400	4,800
Mass (tonnes)	438	3,114	624	4,175
Treatment 3 (0.9 m depth)				
Volume (m^3)	990	2,970	3,960	7,920
Mass (tonnes)	723	5,138	1,030	6,890
Totals				
Volume (m^3)	1,883	5,648	7,530	15,060
Mass (tonnes)	1,375	9,770	1,958	13,100

[a] As measured in the SYLVIS lab on August 5, 2016

2.3.2 Mixing Equipment and Timing

The soil fabrication is anticipated to begin in mid to late February, 2017. It is expected that this timing will allow the City to test the feasibility of fabricating biosolids amended soil in winter conditions that could range from mild to extreme cold.

The soil will be mixed in batches with an ALLU bucket attached to either a front-end loader or excavator (Photograph 4), or similar soil mixing equipment. The frozen clay soil will be run through the ALLU achieve a reasonable frozen texture to enable relatively homogeneous mixing with wood waste and biosolids. Mixing will proceed daily as soon as a load of biosolids is delivered to the site to prevent freezing. For each batch, the specified volumes of feedstocks will be moved to a staging area, roughly consolidated, and then run through one to three passes of the ALLU. The completed batch of soil will be moved into a pile above the intended treatment area to allow space for the next batch to commence. It is anticipated that about 1,000 tonnes of soil can be fabricated per day, corresponding to about 3 truckloads of biosolids. The soil fabrication is expected to be completed within two weeks of the start date.

2.3.3 Storage of Feedstocks and Fabricated Soils

The wood waste and clay soil required will be moved up to the mixing location prior to the start of mixing. Up to 1,958 tonnes (7,530 m^3) of wood and 9,770 tonnes (5,648 m^3) of clay will be needed for the demonstration. Biosolids will be mixed as they are delivered to the mixing site. The BRRMF generally receives six 30 tonne truckloads of biosolids per day to be landfilled. Three of these truckloads will be diverted daily to the mixing location during soil fabrication. If operational

efficiencies allow, additional truckloads per day may be diverted to speed up production. In the event of equipment breakdown or other delays, biosolids deliveries will be diverted back to the active landfill.

The completed fabricated soils will be stored in piles at the mixing site. Two composite samples of the fabricated soil will be collected, one after the first day of mixing, and one after the final day of mixing. The sample will be analyzed for the following:

- Organic matter, total organic carbon
- Ammonium, nitrate, total Kjeldhal nitrogen (TKN)
- Available phosphorous, sulfur, potassium
- Trace elements (arsenic, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, zinc)
- pH, electrical conductivity, cation exchange capacity

2.3.4 Placement of Fabricated Soil

The fabricated soils will be placed at different depths according to the experimental design (Figure 1). Stakes will be placed on the slope to mark the boundaries of the treatment plots and the placement depths. The soil will be pushed out on the slope and graded to achieve the specified placement depths.

2.3.5 Land-Use Following Placement

The reclaimed slope will be seeded with a reclamation grass mix and maintained according to the BRRMF's final cover plan. The top of the slope may be slightly disturbed once the area closure is completed, but most of it will remain intact as per the final closure plan.

2.4 Environmental Monitoring and Protection

2.4.1 Soil Monitoring

The soil samples within the treatment plots will be collected using a stratified-randomized design. Each treatment area will be stratified into four quadrants, and one composite soil sample consisting of five randomized subsamples will be collected from each quadrant. Subsamples will not be collected from within 10 m of the adjacent treatment plot.

One composite soil sample consisting of five randomized subsamples will also be collected from the 10 m buffer zone below each treatment plot.

All soil samples will be collected from 0-15 cm and 30-60 cm depths and analyzed for the following:

- Organic matter, total organic carbon
- Ammonium, nitrate, total Kjeldhal nitrogen (TKN)
- Available phosphorous, sulfur, potassium

- Trace elements (arsenic, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, zinc)
- pH, electrical conductivity

Background soil samples will be collected from each treatment area prior to soil placement, and follow-up soil monitoring will be conducted in the spring (no later than June 1) and fall (no later than October 31), for two years.

2.4.2 Surface Water Monitoring

Water samples will be collected from the drainage ditch below each treatment area. In order to minimize any confounding factors caused by stagnant water, sampling will occur within 24 hours of a rainfall or runoff event, when steady downstream flow can be observed in the ditch. Three replicate samples will be collected from each sampling point, and submitted for analysis of the following:

- Dissolved ammonia
- Dissolved nitrate-nitrite nitrogen
- Total Kjeldhal nitrogen
- Dissolved phosphorous (as orthophosphate)

Background water samples will be collected prior to soil placement and a minimum of six follow-up water sampling events will be conducted for this demonstration. The first two water samples should be collected within approximately one week and one month after soil placement, if conditions permit. Additional sampling events should occur after major rainfall events, and during spring runoff in 2018.

2.4.3 Germination Monitoring

Assessment of germination will be conducted one month after seeding. A series of 0.25 m^2 quadrats will be assessed for % coverage and a germination estimate. The germination assessment will use the same stratified design as the soil monitoring, with five quadrat plots randomly distributed within each sampling area.

2.4.4 Vegetation Monitoring

Assessment of total aboveground biomass will be conducted in September of 2017 and 2018 using clip plots of 0.25 m^2 quadrats. The vegetation monitoring will use the same stratified design as the soil monitoring, with five clip plots randomly distributed within each sampling area.

Vegetation monitoring will be conducted twice annually, in conjunction with the soil monitoring.

2.4.5 Environmental Protection

This demonstration is designed to show how fabricated soils can be used safely without adverse environmental impact or risk to public health. Similar soils are regularly fabricated and utilized in other parts of Canada. Regardless of the intent of the project, consideration

has been given to minimize the risk of adverse impacts on the environment through the following considered design and monitoring components:

- The project is located within the boundaries of the BRRMF leachate and surface water collection and containment system. Any unintended leaching of nutrients would remain within the surface water management system.
- Regular monitoring of soil vegetation and water over a two year period will enable a strong assessment of the potential of fabricated soils to be used in landfill closure processes, and provide a strong foundation for understanding potential leaching from fabricated soils.
- Any failure of the reclamation would be remediated by further closure processes, ensuring that no offsite impacts or detriments to the existing closure would exist.

2.4.6 Reporting

An interim trial setup and germination report will be prepared and submitted to MSD by August 30th, 2017. This report will summarize the operational aspects of the soil mixing as well as results from the spring 2017 environmental monitoring. A final report will be submitted to MSD by December 31st, 2018, summarizing the demonstration and two years of monitoring.

2.5 Proposed Implementation Schedule

The following schedule is proposed for the completion, monitoring and reporting for this demonstration:

Task	Dates
Preparation of equipment and feedstocks	January-February 2017
Soil fabrication	February 15-28, 2017
Background soil and water sampling	April 2017
Soil Placement	April 2017
Seeding	April – May 2017
Soil and Vegetation Monitoring	May and October 2017-2018
Water Monitoring	A minimum of six events over 2017 and 2018
Interim Report	August 2017
Final Report	December 2018

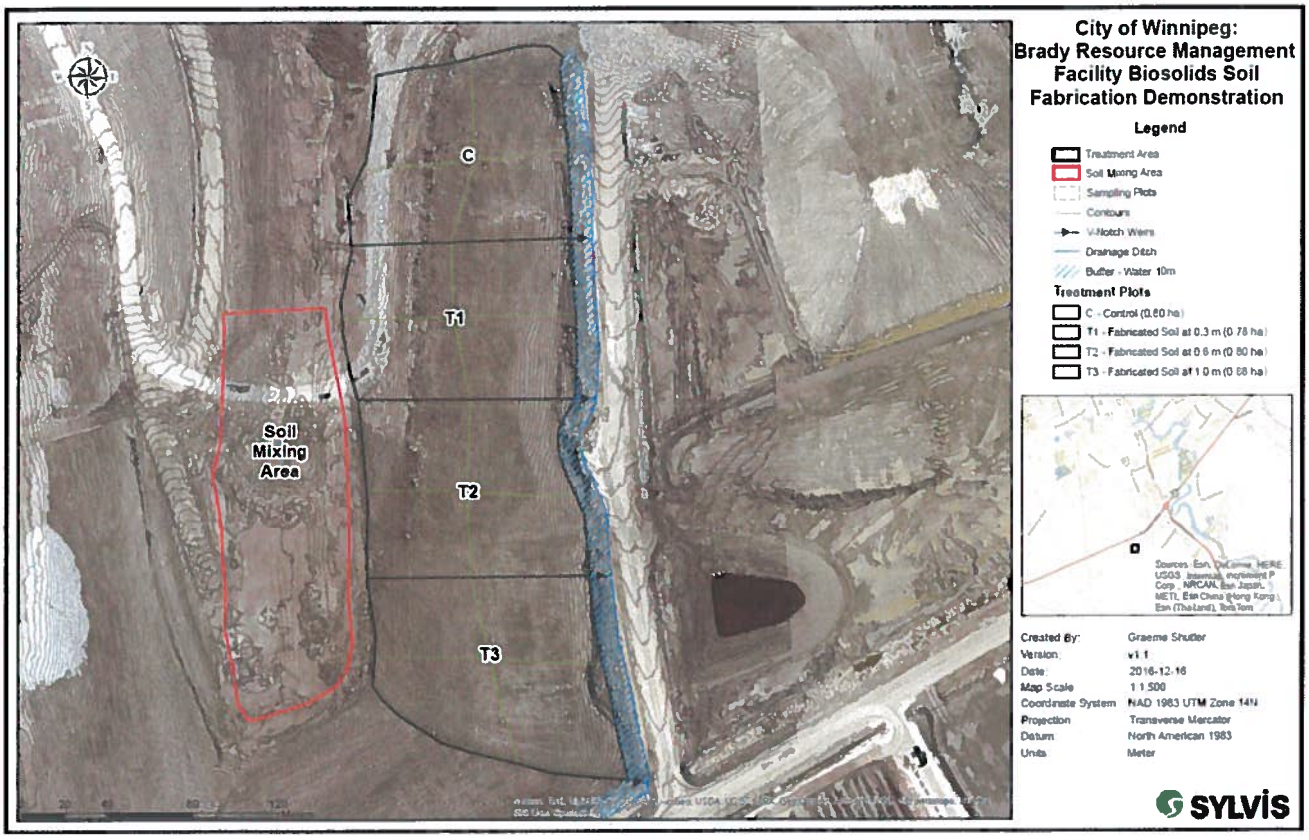
3 SUMMARY AND REQUEST TO PROCEED

This report provides details of the work done to date, including a detailed experimental trial design and pre-trial bench-scale study, in support of a fabricated soil landfill closure demonstration for the BRRMF.

The City of Winnipeg requests permission to proceed with the trial, as described and on the timelines identified herein. The trial, as presented, is designed to obtain valuable information about the utility of biosolids fabricated soils and their use in landfill closure, and significant safeguards have been put in place to protect human health and the environment.

APPENDIX ONE – FIGURES

Figure 1: Proposed demonstration location and experimental design (not to scale).


C
T1
Soil Mixing Area
T2
T3
City of Winnipeg:
Brady Resource Management Facility Biosolids Soil Fabrication Demonstration
Legend
Treatment Area
Soil Mixing Area
Sampling Plots
Contours
V-Notch Weirs
Drainage Ditch
Buffer - Water 10m
Treatment Plots
C - Control (0.60 ha)
T1 - Fabricated Soil at 0.3 m (0.78 ha)
T2 - Fabricated Soil at 0.6 m (0.80 ha)
T3 - Fabricated Soil at 1.0 m (0.68 ha)
Created By: Graeme Shutler
Version: v1.1
Date: 2016-12-16
Map Scale: 1:1,500
Coordinate System: NAD 1983 UTM Zone 14N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter
SYLVIS

APPENDIX TWO – PHOTOGRAPHS

Photograph 1: Willow trees growing on portions of the Ecowaste landfill capped with a biosolids soil mixture are irrigated with leachate as part of a landfill leachate treatment system, Richmond, B.C.

Photograph 2: A cap of fabricated biosolids soil mixture placed on a portion of the Ecowaste landfill, prior to vegetation establishment, Richmond, B.C.

Photograph 3: Proposed demonstration location at the BRRMF. (November, 2016)

Photograph 4: Soil feedstocks are combined with an ALLU bucket to fabricate a biosolids soil mixture, Skimikin Landfill, B.C.

APPENDIX THREE

See Overleaf For *Technical Memorandum: Residuals Use in Topsoil Fabrication, November 2016*