CITY OF WINNIPEG
SUMMIT SOIL FABRICATION

ENVIRONMENT ACT PROPOSAL

Submitted To:
Manitoba Conservation and Climate
Environmental Approvals Branch
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City of Winnipeg Reference No: G-161

Issue Date: October 28, 2020

EXECUTIVE SUMMARY

This Environment Act Proposal is being submitted to the Manitoba Conservation and Climate (MCC), Environmental Approvals Branch, as required under *The Environment Act* for the purpose of obtaining a Class 1 Environment Act Licence for soil fabrication at Summit Landfill utilizing biosolids material produced by the City of Winnipeg's North End Sewage Treatment Plant (NEWPCC).

The City of Winnipeg (City) is proposing to manage approximately 35,000 wet metric tonnes of Class B municipal biosolids annually at Summit Landfill, by mixing the material with a carbon source (mainly wood chips) and a mineral source (mainly street sweepings) and establishing a native prairie landscape.

This proposal is supported and informed by the results and experiences of the three-year Summit Landfill Soil Fabrication Pilot Project, 2018-2020. The pilot project demonstrated that soil fabrication is a viable option for completing the cap system at Summit Landfill while meeting environmental and human health criteria.

OBJECTIVE

The objective of the soil fabrication program, via this proposal, is to complete the cap system at Summit Landfill. Using biosolids, street sweeping and woodchips, the fabricated soil is designed to support vegetation growth, divert biosolids from being landfilled and establish a vegetative layer of native prairie landscape. As such, the soil fabrication program manages multiple waste streams in an efficient and environmentally sustainable manner.

SOIL FABRICATION PROGRAM BENEFITS

Soil fabrication provides a beneficial use option for at least three residuals that are produced by City operations: wood, sand/grit and biosolids. The resulting soil, once vegetated, completes the cap system of Summit Landfill, reducing the production of leachate and landfill gas emissions. The program also supports the establishment of a native prairie landscape.

Beneficial use options for biosolids produced by the City are limited in cold weather conditions. Soil fabrication is an all-weather and all-season operational option. In coordination with biosolids composting and land application, the landfilling of biosolids at the Brady Road Resource Management Facility (BRRMF) can be minimized.

Soil fabricated from these residuals has many benefits. It produces a soil of appropriate tilth and nutrient content to sustain a long-term prairie grassland ecotype. It recycles nitrogen, phosphorus and all other macro and micronutrients recovered from the wastewater treatment process through development of a soil. Organic matter is captured and sequestered in topsoil, resulting in carbon capture and a system which stores carbon long-term (current estimates are 66% of carbon in fabricated soils is retained as soil carbon.) It also reduces landfilling of volatiles, which release methane, so this is a significant improvement from baseline methane and CO_2 emissions. Additionally, a prairie ecosystem provides habitat not previously available at Summit Landfill. This habitat will support multiple trophic levels, from insects to small mammals and rodents to songbirds and raptors.

Stakeholder and Public Engagement

The City of Winnipeg conducted stakeholder and public engagement with the following objectives:

- Create awareness that the City is doing soil fabrication
- Provide an opportunity for Winnipeggers to leave comments and express concerns
- Educate Winnipeggers about the benefits of the soil fabrication program
- Meet regulatory requirements for public engagement

In addition to the MCC process of posting on the public registry, advertisements placed in local newspapers (and regional publications if of regional interest) and online, requesting comments within prescribed timeframe, the City hosted a public engagement website on soil fabrication which included an online 'Q & A', an online quick poll, and a video on soil fabrication. Additionally, the Environment Act Licence proposal process, and the public engagement opportunities listed above will be promoted using the City's website, social media, public engagement newsletter, and online adds. The public engagement process began in June, 2020 and ended September, 2020.

Soil Fabrication Operations

Soil fabrication operations occur throughout the whole year, with seasonal variation to different stages of completing the cap system with a vegetative supportive layer. Main activities include: feedstock management, waste wood receiving and stockpiling operations, street sweeping receiving and stockpiling operations, lime mud receiving and stockpiling operations, biosolids receiving operations, soil ratio calculation and blending operations, soil spreading, seeding and vegetation management, and environmental monitoring.

Potential Environmental Effects

Potential environmental effects have been identified as contamination of surface water, contamination of ground water, impacts to soil quality, production of dust, noise, odour and vectors. Risk level, monitoring programs and mitigation strategies have been developed and informed through project design and pilot project experience and results.

Mitigation Measures

Potential environmental effects have been identified, and mitigation measures established, from four potential sources: the site, feedstocks, fabricated soil, and the work itself. Mitigation measures include site design, operational design, and management of process inputs (feedstocks). Monitoring and reporting assesses the effectiveness of these mitigation measures.

Follow Up Actions, Monitoring and Reporting

Monitoring programs include both direct sampling and analysis, and observation and complaint response programs. Surface water monitoring, feedstock and soil sampling and vegetative analysis will be conducted according to the monitoring plans (Appendices H, I). Odour, vector, dust and noise monitoring involve staff observation and response to any communication received through the City's 311 Contact Centre. These monitoring programs are conducted in conjunction with the existing landfill monitoring program.

The City will submit an annual report which will include tonnage of biosolids beneficially used, and hectares of landfill covered and seeded. It will also include environmental monitoring results of surface water, soil, vegetation, odour, dust and vector monitoring.

SUMMARY

Based on regulatory requirements, public engagement and the feasibility study and pilot project, the City has identified soil fabrication as a beneficial use of biosolids and other residuals in a sustainable manner using appropriate mitigation measures to optimize reuse of valuable nutrients and complete the cap system at Summit Landfill

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INTRODUCTION AND BACKGROUND

This Environment Act Proposal Form (EAPF) is submitted by the City of Winnipeg, Water and Waste Department, in respect of licensing Soil Fabrication at Summit Landfill. For purposes of applying *The Environment Act*, the "Development" within the meaning of the Classes of Development Regulation (Manitoba Regulation [MR] 164/88) is:

- The soil fabrication operations and related site management at Summit Road Landfill (Figure 1)
- Ongoing environmental monitoring.

The City produces in excess of 50,000 tonnes of biosolids at the North End Sewage Treatment Plant (NEWPCC) per year. In 2014, the City released a Biosolids Master Plan that outlined strategies to maximize nutrient recovery and recycling, and the beneficial use of biosolids. The soil fabrication program is part of the multi-pronged approach developed as part of the City's 2014 Biosolids Master Plan to beneficially use biosolids. The Biosolids Master Plan is a 30-year vision for how the City will manage its biosolids in an environmentally sound, sustainable, and cost-effective manner, while meeting provincial regulations.

This biosolids beneficial use operation allows the City to divert biosolids from being buried at the Brady Road Resource Management Facility (BRRMF). Biosolids can be combined with available organic and inorganic (mineral) materials to produce a fabricated soil which can be designed specifically to promote vegetation. Utilizing biosolids and other residuals in soil fabrication and vegetation establishment can reduce the cost of landfill closure, the need to import non-renewable sources of topsoil from other sites, and provide a beneficial use opportunity for multiple waste streams.

Summit Landfill is an ideal site for operational soil fabrication. The site requires additional topsoil to support vegetation objectives. The landfill is closed, secure, relatively remote, and retains a surface water and leachate management system. The City monitors surface water, groundwater, leachate, and landfill gas at this site.

On May 7, 2018 the City of Winnipeg received approval from Manitoba Conservation and Climate (MCC) under the Exemption Clause (6) of the *Classes of Development Regulation* to commence the three-year Summit Soil Fabrication pilot project, 2018-2020, examining the viability of fabricating soil with biosolids to complete the cap system at Summit Landfill. This proposal is informed by the three-year pilot project, and a licenced ongoing soil fabrication operation is the next step in the City's implementation of this beneficial use option for biosolids. The pilot project demonstrated that fabricating soil using biosolids, wood chips and street sweepings:

- Is operationally viable;
- An all-season, ongoing option for utilizing residuals;
- can be used to complete the cap system at Summit Landfill; and,
- the resulting soil supports vegetative growth while meeting CCME (1999) industrial use standards for soil.

Monitoring and analysis over the three years indicate that environmental and human health risks from soil fabrication are effectively managed and mitigated through the design and processes of the program.

Materials Managed

Biosolids fabricated soil consists of three main feedstocks: biosolids, a mineral source, and a carbon source. Feedstock ratios were determined by bench scale analysis, and confirmed through the three-year Summit Landfill Soil Fabrication Pilot Project (Appendix A). Feedstocks are mixed together in a specific ratio to make a soil which supports vegetative growth and meet Canadian Council of Ministers of the Environment (CCME) guidelines. Feedstocks utilized in Summit soil fabrication are residuals from City operations. As part of the pilot project, feedstocks were sampled, lab analyzed and compared against the CCME guidelines. The soil ratios used at Summit were then also determined through a bench scale analysis and compared to CCME guidelines. All materials are managed on site to mitigate risk of impact to human health and the environment. No impacts were identified through the three-year pilot project.

Biosolids

Biosolids are wastewater residuals that have been treated and stabilized through anaerobic digestion and mechanical dewatering at the North End Sewage Treatment Plan (NEWPCC). NEWPCC produces Class B Biosolids (EPA, 2002). Biosolids managed at Summit will not exceed the production of NEWPCC. Anticipated annual volume of biosolids managed through Summit soil fabrication is 60% of total annual biosolids produced, approximately 35,000 wet metric tonnes.

Waste Wood

The primary carbon source is waste wood from City of Winnipeg operations and tree management program. This may be elm, ash or other chipped wood waste. Additional potential carbon sources may be identified and tested, such as cattails, straw, shredded paper, or other sources of wood waste. Volumes of carbon material utilized are at minimum twice the volume of biosolids received.

Street Sweepings

The primary mineral source is screened street sweepings. The City of Winnipeg hauls screened street sweepings to Summit Landfill as part of the spring streets clean-up program. The sweepings consist primarily of sand which was put down over the cold weather months. The sweepings are screened to remove debris and other waste which may be picked up in the street cleaning. This waste is then hauled to BRRMF. Each year this process produces approximately 20,000 m^3 of mineral source, depending on the nature of the preceding winter.

Lime Mud

Lime mud is used to supplement street sweepings. Lime mud ratios are based on the Technical Memorandum Bench-Scale Soil Fabrication using Lime Mud for Use at Summit Landfill (Appendix B). Additional potential mineral sources may be identified and tested. Volumes of mineral material utilized will be at minimum of three times the volume of biosolids received.

Processes

Soil Fabrication occurs over the whole year, with seasonal variation to different stages of completing the cap system with a vegetative supportive layer. Main activities include: feedstock management, waste wood receiving and stockpiling operations, street sweeping receiving and stockpiling operations, lime mud receiving and stockpiling operations, biosolids receiving operations, soil ratio calculation and blending operations, spreading soil, seeding and vegetation management. Biosolids receiving operations occur primarily from October to April.

Waste Wood Receiving and stockpiling Operations

Waste wood is received in two main forms: wood chips and wood (logs). Wood chips can be used in soil fabrication without any further processing. Wood requires grinding into wood chips.

Wood chips are received at the site and placed in windrows throughout the year. Wood chips are managed according to the Wood Waste Management Plan (Appendix C).

Wood waste, including wood from the Dutch Elm Disease management program, is received at the wood grinding area at the south end of the site throughout the year. Wood waste is ground on site and the resulting wood chips are moved into windrows where needed for operations. The wood grinding operation is conducted according to the Permit for the Storage of Elm Wood (APPENDIX D).

Street Sweepings Receiving and stockpiling operations

Screened street sweepings are received on site annually starting in late spring. Sweepings are placed in windrows to promote drainage and mitigate dust.

Lime Mud receiving and stockpiling operations

Lime mud is stored in windrows and covered with at least 30 cm of wood chips to prevent wind erosion.

Biosolids Receiving Operations

Biosolids are only received during biosolids receiving operations, and are mixed into an initial blend the same day. This initial blend mitigates odour and a provides a physical barrier to biosolids. No biosolids are stored on site.

Biosolids are hauled from NEWPCC to Summit Landfill and dumped in the operational area, which moves throughout the site as areas become covered. The operational area is located as close as practical to the next area requiring spread soil. A bunker of street sweepings or wood chips is used to contain the dumped biosolids and to act as a backstop for the loader. This bunker also acts as a small windbreak to mitigate odour. On the same day they are received, all biosolids are then incorporated into windrows with wood chips and street sweepings for an initial blend. No biosolids are stored on site. Biosolids receiving operations occur primarily from October to April, Monday to Friday.

Soil Ratio calculation and blending

The ratio of materials to fabricate the soil is based on bench scale analysis and confirmed through operations and soil sampling and vegetation survey results from the three-year pilot project. Feedstocks were sampled and analyzed during the pilot project, and would be sampled again in the event of some change in the feedstock source or program. Changes in feedstocks or soil requirements would trigger

potential additional bench scale analysis for an appropriate ratio. The initial blend after receiving biosolids is placed in windrows in the required ratio. Ratios are managed in field using loader bucket counts: two buckets of wood chips are used to build the trough base of the windrow, one bucket of biosolids is placed in the trough, and three buckets of street sweepings (or two street sweepings and one lime mud) is placed on top of the windrow.

Spreading Soil

The initial blend of fabricated soil is left in windrows until spreading conditions are suitable. Based on pilot project results, soil is best spread in the autumn and seeded before snowfall. This allows the initial blend to volatize nitrogen over the summer. It also has an advantage over spring seeding as the material is not frozen, and the landfill cap is more likely to be dry and firm for heavy equipment to travel on. For the purpose of weed management and vegetation success, soil is seeded as quickly as possible after spreading. Soil may also be spread in spring and seeded before mid-June. Having both options allows operational flexibility.

Spreading windrowed material acts as an additional mixing process. Windrows are pushed, rolled, and spread with a dozer. Based on the pilot project results, the initial blending plus the spreading process produces a well-mixed soil. Additional discing of the top 30 cm may be done to further mix the soil, based on initial observations of the spread soil.

Soil is spread to an initial depth of 100cm, with an end goal of a minimum of 60 cm. Soil may be spread in multiple lifts to achieve the 100 cm depth. Compaction from equipment and settlement results in approximately 60 cm of soil. Soil depth is determined through soil sampling after spreading is complete. Based on results from the pilot project, 60 cm provides enough soil to suppress growth of pre-existing weeds and support vegetative growth over multiple years. Additional fine grading is completed as required based on visual inspection.

Seeding and Vegetation Management

Spread fabricated soil is seeded with a mix of native grasses and forbs (Appendix E). Seeding mixes and timing will vary depending on the year and seasonal conditions. Cover crops may be used for a number of reasons including to provide temporary cover for an area that is not ready for seeding with native species, or to suppress weed growth prior to seeding. Shrubs and trees may be added as the site progresses.

To date, species seeded at Summit Landfill on fabricated soil include, in part:

- oats
- slender wheat grass
- Canada wild rye
- awned wheatgrass
- western wheat grass
- nuttals alkali grass
- green needle grass
- big bluestem
- yarrow
- giant hyssop
- pink onion
- dwarf false indigo
- Canada anemone
- long fruited anemone

- pasture sage
- prairie sage

Each subsequent seeding is expected to vary in species composition based on availability. As the areas requiring seeding annually will be relatively large (10 ha), future mixes may be less diverse due to limited seed supply for some species. Future seed mixes are planned to have a minimum of 15 species.

A wide range of species will be included in seeding mixes as vegetation continues to be monitored over multiple growing seasons. This will include both species adapted to dry conditions as well as ones that prefer a high moisture soil. After three growing seasons of the pilot project, there is more to learn about how soil matrix will change over time and what the long-term moisture regime will be. As the early plantings from the three-year pilot project mature, seed mixes can be refined according to the 'ideal' species assemblage.

All the species seeded, aside from the oats, are native Manitoba species. Grass and wildflower seed have been intentionally sourced from local plant populations wherever possible to ensure long term compatibility with the site's environmental conditions.

Glyphosate (Roundup), Aminopyralid (Milestone) and Picloram (Tordon 22K) may be used to control noxious weeds including: creeping thistle (*Cirsium arvense*) and leafy spurge (*Euphorbia esula*). Decisions on pesticide use will be made within an Integrated Pest Management (IPM) framework. Pesticides have been selected for maximum efficacy and reduced risk and will be applied in accordance with the City of Winnipeg's pesticide use permit. All applications will be carried out in accordance with product labels by a licensed pesticide applicator.

Previous Studies and Activities

Summit Landfill was opened in 1964 and closed in 1998. The City of Winnipeg has been managing and monitoring this site since 1964. In addition to historical monitoring data, key studies which have informed Summit Soil Fabrication include:

- *Landfill Status Report for Closed Landfills, Winnipeg, Manitoba* (2015)
- *Leachate Treatment Study* (2017)
- *Summit Road Leachate Collection Assessment* (2018).

Specific to soil fabrication, this proposal is informed by the following City of Winnipeg soil fabrication reports:

- *Biosolids use in Landfill Topsoil Fabrication Demonstration – 2018 Final Report* (SYLVIS Environmental, 2018).
- *Summit Landfill Soil Fabrication Pilot Project – Year One Phase One Interim Report*. (2018).
- *Summit Landfill Soil Fabrication Pilot Project – Year One Phase Two Interim Report*. (2019).
- *Summit Landfill Soil Fabrication Pilot Project – Year Two Phase One Interim Report*. (2019).
- *Summit Landfill Soil Fabrication Pilot Project – Year Two Phase Two Interim Report*. (2020).
- *Summit Landfill Soil Fabrication Pilot Project – Year Three Phase One Interim Report*. (2020).
- *Summit Landfill Soil Fabrication Pilot Project – Year One Annual Report*. (2019).

- *Summit Landfill Soil Fabrication Pilot Project – Year Two Annual Report*. (2020).

PRIOR AUTHORIZATION

On May 7, 2018 the City of Winnipeg received approval from MCC under the Exemption Clause (6) of the *Classes of Development Regulation* to commence the three-year Summit Soil Fabrication pilot project, 2018-2020, examining the viability of fabricating soil with biosolids to complete the cap system at Summit Landfill (Appendix F).

On June 20, 2019, The City of Winnipeg received a permit for the Storage of Elm Wood (2019-ST-005) at Summit Landfill.

PROPOSED DEVELOPMENT

POPULATION SERVED

The population of the City of Winnipeg is served by this development through the beneficial management of biosolids, wood waste and street sweepings. However, there is no public access to the site. The City of Winnipeg's population in 2019 was 763,900. From 2018 to 2019 Winnipeg grew by 10,500 people, or 1.4 per cent. Based on the latest population forecast from the Conference Board of Canada, Winnipeg is expected to grow by 55,300 people over the next five years, reaching 819,200 by 2024. This amounts to an average annual growth of 11,060 people, or 1.4 per cent. Looking forward and compared to other major Canadian cities, Winnipeg is expected to grow at a pace that is consistent with the overall average (Economic Research, City of Winnipeg, Report March 12, 2020).

SUMMIT LANDFILL

Summit Landfill is located northeast of the intersection of the Perimeter Highway and CentrePort Canada Way (Highway 190) in Winnipeg, Manitoba (Figure 1). The site is located in an area designated as a "Rural and Agricultural Area" in "Complete Communities, an 'Our Winnipeg' Direction Strategy". The lands are zoned "A" Agricultural, in the City of Winnipeg Zoning Bylaw 200/06, which allows landfills as a conditional use. Existing land use is waste management. It is the site of Summit Landfill. Land use will continue to be waste management.

The City is the owner of the land. As otherwise indicated in various Records of Title in the attached, the City is the owner of the mineral rights associated with each individual parcel. Legal descriptions of all of the parcels of land owned by the City which comprise the Summit Landfill site are found in Appendix G. Included is a graphic illustrating the spatial distribution of these land parcels (City Plan No. 10998/1).

SCHEDULE FOR STAGES OF DEVELOPMENT

Soil fabrication at Summit Landfill started in 2018 with the three-year pilot project. Over the course of these three years, processes and operations have been refined.

The design is based on the pilot outcomes. Each operational year will require adjustments but the base design remains the same: biosolids receiving and mixing material from autumn to spring; 60cm vegetation management from spring to autumn; and, soil placement and seeding in autumn. Operations will generally move from south to north along the site, with feedstock management, mixing and spreading locations being determined year to year based on site conditions (Figure 2).

Soil fabrication does not require construction beyond the extension of internal roads on an as-needed basis.

The pilot project ends on January 31st, 2021. Operations are scheduled to start January 2, 2021. Biosolids receiving operations commonly run from October to April, but may vary due to operational needs.

Operations may be reassessed after Summit Landfill is completely covered with 60cm of fabricated soil and a robust vegetative layer.

No other federal, provincial or municipal approvals, licences, permits, authorizations, are known to be required for the proposed development. All soil fabrication and related activities are considered an ancillary use to the site as a waste management facility.

PUBLIC ENGAGEMENT RESULTS

The public education and engagement program for the soil fabrication program aimed to:

- Create awareness of the City's soil fabrication program
- Provide an opportunity for Winnipegger's to ask questions and share comments with the project team
- Provide information on the benefits of the soil fabrication program

A webpage was developed to communicate background information, project updates, and serve as the platform for other public education and engagement tools. An online poll with two questions was available on the project webpage for residents who wanted to provide quick feedback and see the results instantly. Residents who wanted to connect with the project team and share a comment or ask a question were invited to use the Q & A tool. Finally, a video was developed to provide an overview of the pilot program and explain the benefits of soil fabrication. The video was available on the project webpage and the City's Youtube channel. The Public Engagement Report can be found in Appendix H.

Existing Environment In The Project Area

The Site is located with the Winnipeg Ecodistrict of the Lake Manitoba Plain Ecoregion which is covered by the broader Prairies Ecozone in Manitoba (Smith, et al. 1998). The Site is mainly grass covered, except in the areas of new cover placement where topsoil and seeding are still required. Shrubs are growing on the side slopes and trees are growing in the control zones.

Climate

The Winnipeg Ecodistrict is the most humid subdivision of the Grassland Transition Ecoclimatic Region in southern Manitoba (Smith, et al. 1998). The ecodistrict is characterised by short, warm summers and cold winters with a mean average temperature of 2.40C (Smith, et al. 1998). Mean annual precipitation is 521 mm, one fifth of which is in the form of snowfall (Government of Canada, 2017). The Winnipeg Ecodistrict has a cool, subhumid to humid Boreal to a moderately cold, subhumid, Cryoboreal soil climate with an average annual soil moisture deficit of approximately 200 mm (Smith, et al. 1998).

Physiography And Drainage

The Winnipeg Ecodistrict lies within the central lowland of the Red River Plain with a mean elevation of approximately 236 meters above sea level (masl). The Red River Plain is a smooth, level to very gently sloping, clayey glaciolacustrine plain (Smith, et al. 1998). The Red River flows through the plain and empties into Lake Winnipeg. Relief in the ecodistrict follows about 0.4 m for every km from the western edge of the plain to the Red River and at a rate of 1.0 m per km from its eastern edge to the Red River. From south to north, relief thorough the basin is approximately 0.3 m per km (Smith et al, 1998).

Surficial And Bedrock Geology

The geology is a very thin layer of clay overlaying a permeable till which covers the carbonate bedrock beneath. The area bedrock slopes significantly to the south and west creating a channel along which Sturgeon Creek flows.

Groundwater And Hydrology

Land drainage in the area of the site is towards Sturgeon Creek. The regional bedrock groundwater flow direction is to the southeast (KGS Landfill Study, 1993). Aquifers that underlie site are potable. Downward vertical hydraulic gradients are present between the clay and the upper bedrock in most areas of the site. Flow directions are not well defined in the rubble zone, and may be controlled by bedrock topography and deviate from regional flow directions. The recharge area for the Upper Carbonate aquifer in the northwestern region occurs in areas of thin glacial till northwest of Winnipeg. The most significant recharge area is just northwest of the Summit Road landfill site.

Biophysical Environment

The Summit Road Landfill Site covers an area of approximately 76 hectares (ha) and was operated by the City of Winnipeg from 1964 until it closed in 1998 (with ongoing closure occurring since then). The waste is expected to be domestic waste. The older waste (from 1964 to 1974) was placed at the eastern

portion of the landfill. The central part of the landfill was filled from south to north and then the western part of the landfill was filled north to south.

The waste footprint was covered with a minimum of one meter of clean fill. Fill material was brought to the Site on an ongoing basis for cover and grading as material was available. The cover fill included dried sludge, excess sand from street maintenance activities (which consisted of 95% sand with 5% salt for winter road application), and fill from construction projects. The fill material was placed in settled areas at the site. The site has been brought to final grades.

The cap was graded to promote positive drainage; however, the site is largely flat with areas of settlement over time. Top soil placement and seeding was not implemented as part of the previous closure activities. All vegetation, aside from a small area of experimental planting, is volunteer. Large areas of barren land have been noted on site visits, and can be seen from aerial photographs (Figure 3). Vegetation stress due to landfill gas has been noted on site. Soil sampling results and visual inspection have noted areas of the cap with granular appearance, low water retention capacity, and low organic matter. Very little surface water has been observed in the on-site surface water management system, despite the large land area. These observations, along with year over year leachate hauling data, suggest high levels of water infiltration through the poor soil of the cap into the waste mass.

Regional Groundwater Conditions

A perimeter leachate collection system is located on the west, north and east sides of the landfill. Manholes are located along the system. Leachate probes, groundwater monitoring wells and landfill gas probes are located throughout the Site. Onsite groundwater that is contained within the waste cell is collected by a leachate collection system. The leachate collection system was installed in the mid-1990s and consists of perforated piping in granular bedding around the perimeter of the landfill. Finger drains extend into the landfill at fairly regular intervals. Manholes, and leachate vents were installed along the length of the leachate collection system. The southern portion of the landfill has an underdrain leachate collection system. Leachate is pumped from the site five days a week and is transported to NEWPCC. Ongoing groundwater and leachate monitoring provide data to assess the effectiveness of the leachate collection system.

Terrain

The land around the site is primarily flat prairie terrain (Figure 4). Ground surface at the perimeter of the landfill is at an elevation of 238 masl. The landfill slopes up at 4 horizontal to 1 vertical (4H:1V) side slopes, to a large, mostly flat surface. The landfill is surrounded by a stormwater ditch with a pond located to the north, just outside of the control zone. Truro Creek is located to the east of the Site and Sturgeon Creek is located to the southwest.

Aquatic and Vegetative Environments

Sturgeon Creek to the south of the site, and Truro Creek to east, both provide fish habitat. Truro Creek is usually nearly dry during the summer months, with the exception of a few pools and deeper sections of the channel. Annual surface water sampling is done in Sturgeon Creek as part of the Summit Landfill

environmental monitoring program. No impacts to the creek have been identified since the landfill closed in 1998.

Under the Environmentally Sensitive Natural Lands Strategy there are areas around Summit Landfill which have a C or D grade. As such, there are no existing areas at Summit Landfill which are considered sensitive habitats or are expected to have any sensitive species.

On-site vegetation, with the exception of the pilot project areas, is sparse. There are a few trees on the side slopes, including Russian olive, spruce, and poplar. There is a shelter belt of spruce and aspen along the western boundary of the site. The pond area at the north end of the site is vegetated primarily with cattails and grasses.

Existing Land and Resource Uses

Summit Landfill is a closed municipal landfill. There is a wood waste grinding operation on the south end of the site. Adjoining land uses include agricultural fields to the east and west with a dog kennel to the northwest, Optimist Park with sports fields to the south and southeast and the Perimeter Highway to the west. There is a transport staging facility on the east side of the site.

Socioeconomic Environment

Winnipeg is located within Treaty No. 1 Territory, the traditional lands of the Anishinabe (Ojibway), Ininew (Cree), Oji-Cree, Dene, and Dakota nations, and is the Birthplace of the Métis Nation and the Heart of the Métis Nation Homeland.

The site falls outside the western boundary of the Airport Area West Secondary Plan. The Richardson International Airport is approximately three kilometers to the east. The Forks National Historic Site is approximately 13 kilometers to the east. A Department of National Defense Facility is approximately 1.5 kilometers to the west. Beaudry Provincial Park is approximately 10 kilometers to the west.

There are no affected areas (e.g., provincial parks) on the site, or adjacent to it. There is a municipal park, Optimist Park, south of the site. There are no known, or suspected, heritage resources on the site because of the extensive land use for agriculture and/or waste management for close to five decades. There are no First Nations reserves in the vicinity of the proposed development.

There are currently no natural or heritage resources on site at Summit Landfill. Before Summit Landfill was used for waste management, it was a prairie, and then used for agricultural purposes.

Summit Landfill is located within the area identified as ‘CentrePort.’

There are no known or suspected existing public safety and human health risks in the development area.

Soil fabrication is part of the City of Winnipeg Biosolids Master Plan which supports the goal of beneficial use of biosolids. Soil fabrication is part of the Winnipeg Climate Action Plan:

> **Section 6.3.1**, *Continue to work with key stakeholders to accelerate the implementation of the Biosolids Master Plan and maximize the diversion of biosolids from landfill*.; and,

Section 6.3.2, *Strategically support (incentives, pilot projects, etc.) the application of biosolids in agriculture and the use of biosolids in soil manufacturing.*

Environmental Effects of the Proposed Development

Soil fabrication is the beneficial use of three waste streams to complete the cap system of the closed Summit Landfill with a vegetative supportive layer. The environmental effect of the proposed development is the diversion of materials, mainly organics, from landfill, the reduction of the production of leachate, and the establishment of a native prairie habitat.

Risks to the environment include impacts to surface water, ground water, soil quality, air quality, and vegetation and wildlife. Mitigation measures include characteristics of the site, design and operations, and management of process inputs (Figure 5). Monitoring and reporting assesses the effectiveness of these mitigation measures.

Surface Water

Environmental effects on surface water include potential contamination from soil fabrication feedstocks. The site has a perimeter linear pond which contains all surface water within the property (Figure 6). Fabricated soil is designed to have a high water retention capacity, with little surface water run-off. Feedstocks are stored in windrows to reduce water infiltration and reduce pooling. Biosolids are not stored on site. The wood chips and street sweepings feedstock laboratory analysis testing show no exceedances in the CCME criteria therefore these feedstocks would not pose risk of potential contamination with respect to surface water runoff.

Ground Water

Environmental effects on ground water include potential contamination from soil fabrication feedstocks. Soil fabrication is conducted on top of the waste footprint. If water percolates through the feedstocks or fabricated soil, it would enter the landfill. The landfill has a leachate collection system and leachate is contained within the landfill. Leachate is pumped and hauled to NEWPCC for treatment. Fabricated soil is designed to have a high water retention capacity, and is expected to reduce the amount of precipitation percolating into the waste compared to the existing cap.

As any water coming in to contact with feedstocks or fabricated soil is managed on site, there are no anticipated impacts to fisheries, and risk to surface and groundwater is mitigated through the existing landfill environmental systems.

Soil Quality

There are no adverse impacts to soil quality expected from the soil fabrication works. All feedstocks have been tested against the CCME industrial soil guidelines with laboratory analysis testing showing no exceedances in the CCME industrial criteria (CCME 1999). The fabricated soil ratio(s) were developed through bench scale testing and confirmed through the three-year pilot project, with soil consistently meeting the CCME industrial soil guidelines.

Fabricated soil has high nitrogen levels from the biosolids feedstock when in its initial blend. Operational design allows for soil to be stored in windrows before spreading and seeding, which allows for nitrogen volitization. Additionally, if windrows are spread soon after being formed fast growing, high use nitrogen cover crops may be used initially before seeding with native species. The initial cover crops also out compete weeds, and further allows stabilization of the soil. The establishment of vegetation on the spread soil is expected to further improve soil quality over time. Pilot project results from soil fabricated in the first year showed a reduction in ammonium over two growing seasons (Appendix I).

Air

Environmental effects on air quality include potential dust and emissions from heavy equipment. Emissions from heavy equipment are minimized by regular maintenance according to best practices

Feedstock materials, including street sweepings, are stored in windrows perpendicular to the prevailing wind direction and managed to minimize dust. Lime mud windrows are further covered with a minimum of 30 cm of wood chips. Further, soil is seeded as soon as possible after spreading, primarily before the first few snow falls. Vegetation can then establish in spring while the soil is moist. The vegetation reduces dust by improve the soil structure, shading the soil, and buffering wind.

Vegetation and Wildlife

Potential environmental effects on vegetation and wildlife include exposure to contamination from soil fabrication feedstocks and fabricated soil. All feedstocks have been tested against the CCME industrial soil guidelines with laboratory analysis testing showing no exceedances in the CCME industrial criteria. The fabricated soil ratio(s) were developed through bench scale testing and confirmed through the three-year pilot project, with soil consistently meeting the CCME industrial soil guidelines. Fabricated soil seeded with native species is anticipated to support habitat establishment. This habitat will support a wider range of wildlife, including insects.

Vectors

Summit Landfill has been closed for over 20 years and does not accept any form of garbage. Nuisance birds such as pigeons and seagulls have not been reported at Summit since the closure of its tipping face. Additionally, there is no large body of water near the site, which tends to be breeding grounds for geese and ducks. Summit Landfill is fenced, with 1 m periodic gaps along the east and west side to allow for wildlife to pass through. Deer, rabbits and other small prairie mammals have been spotted onsite. These mammals pose no threat to operations and animal access to the site will not be further restricted. Feedstocks involved in this pilot project do not provide a food source for wildlife and operations do not pose a threat to their habitats. No nuisance birds, animals or insects were noted during the three-year pilot project.

Hazardous Wastes

There are no hazardous wastes produced from soil fabrication operations. There are no bulk fuel tanks onsite. Operators use a portable slip tank on a truck to bring fuel when necessary for heavy equipment. A 1000-gallon tank supplies propane to a 22 Kw generator to power the scale house.

Human Health Effects of the Proposed Development

The human health risks of soil fabrication are exposure to biosolids including direct contact, or off-site exposure including odour, dust, and noise. Mitigation measures are informed by a Workplace Health and Safety lens, industry best practice, and minimizing off site contamination. Mitigation measures include characteristics of the site, design and operations, and management of process inputs (feedstocks). Monitoring and reporting assesses the effectiveness of these mitigation measures.

Potential human health impacts were assessed during the three-year pilot project. Monitoring and analysis of mitigation measures over the three years demonstrated that risks are managed, mitigated and minimized through the soil fabrication design and processes.

Workplace Health and Safety

The biosolids received on site at Summit Landfill are classified as Class B biosolids. This means that they have undergone treatment but still contain pathogens. Therefore, there exists a potential hazard for workers on site being exposed to these pathogens during the course of their work. Pathogens can enter the body through the nose, mouth, eyes or wounds/breaks in the skin barrier. Specifically, there are four major types of human disease-causing organisms (pathogens) that can be found in sewage: (1) bacteria, (2) viruses, (3) protozoa, and (4) helminths (parasitic worms) (NIOSH, 2002). Class B biosolids may contain these pathogens but they would be at a reduced concentration after treatment. Metals, chemicals and allergens may also be present in Class B biosolids (NIOSH, 2002). For a worker on site at Summit Landfill the potential risk of exposure would be at its highest when the biosolids are offloaded and when the biosolids are being moved to the woodchip windrows. Once the biosolids have been placed the initial blend the concentration of the pathogens decreases through natural processes and over time.

The personnel on site who have a potential for biosolids exposure at any one time would be the: site supervisor, loader operators, biosolids hauler and equipment washer. The following are mitigation measures to reduce the potential for direct contact with biosolids on site, including:

- Personal Protective Equipment: all personnel are required to wear gloves, coveralls, eye protection, and masks when working around biosolids. This includes and hand sanitizer.
- Sanitization: Personnel are required to sanitize hands after contact with biosolids, avoid touching the face, mouth, eyes or open cuts while working around biosolids, and sanitize hands before eating,
- Limit exposure: Personnel are required to limit the amount of exposed skin, remove excess biosolids from footwear before entering a vehicle or building, and do not wear work clothes home or outside the work site that may have been contaminated with biosolids (NIOSH, 2002).

Prior to working around biosolids all personnel on site will be trained in the health and safety protocols and be equipped with the proper PPE.

Exposure to biosolids on site

The human health effects of exposure to biosolids on site include potential exposure to pathogens or other contaminants. Mitigation measures include minimizing the number of people with access to the site. Summit Landfill is relatively remote and is fully fenced (Figure 1). The entrance is controlled by a scale house attendant, and visitors are required to sign in. Only soil fabrication or landfill related visitors are allowed on site. The site is locked outside of operating hours. Additionally, signage clearly states that biosolids are present on site, and access is restricted. Further signage is used in the biosolids receiving area.

Operational design also reduces potential exposure to biosolids on site. Biosolids are incorporated into an initial blend the same day they are received on site. The initial blend acts as a physical barrier to biosolids. No biosolids are stored on site. Equipment used to manage material which includes biosolids are washed regularly, and washed before equipment can leave the site.

Over the three-year pilot project, no incidences of human health impacts from exposure to biosolids on site have been reported.

Exposure to biosolids or contaminants off site

The human health effects of soil fabrication include the potential migration of material off site. Mitigation measures include the relative isolation of the site, surface water and ground water management infrastructure, and the management of material on site. Material used to fabricate soil, the fabricated soil, and the vegetation grown on site do not leave the site. Equipment used to manage material which includes biosolids are washed regularly, and washed before equipment can leave the site. No food is grown on site. No incidents of material migrating off site have been recorded during the three-year pilot project.

Odour

Human health may be impacted by odour. Odour mitigation at Summit Landfill is informed by the US EPA *Biosolids and Residuals Management Fact Sheet: Odor Control in Biosolids Management* (2000).

The site is relatively isolated, with no nearby residential land use. Neighbouring land use is primarily agricultural. Operations have limited visibility from neighbouring land uses. Operations also occur set back from the site boundaries. Biosolids receiving operations occur primarily from October to April, during Monday to Friday. This primarily cold weather operation does not occur when most casual recreation and/or large public events are likely to be held outside. Optimist Park to the south of the site is used mainly in the summer months, and on evenings and weekends. This adds an additional temporal separation.

Operations have also been designed to minimize odour. Biosolids are dumped as close to the mixing area as possible, which reduces the area which they are moved around. A bunker of wood chips or street sweepings reduces wind in the dumping area and contains the loading area. Mixing biosolids with wood chips and streets sweepings reduces exposed biosolids, and the mix serves as a crude biofilter. No biosolids are stockpiled on site. Equipment used to manage biosolids are cleaned on a regular basis and before equipment is removed from site.

Odour will be reported as part of the annual report. During biosolids acceptance regular odour monitoring around the entire periphery of the site shall be carried out and the data recorded in the Site Operations Log. All odour complaints received via the City's 311 Contact Centre shall be responded to as quickly as possible and the response shall be noted in the log. Examples of good neighbour practice is to respect complaints, this includes recording the complaint details, investigating the complaint, identifying corrective actions and responding back to the complainant about the findings and the corrections made.

Over the three-year pilot project, no odour complaints were received. Odour monitoring did not record any odour offsite.

Noise

Human health may be impacted by noise. Risk is mitigated by the relative isolation of the site. The site operates in accordance with the Neighbourhood Liveability By-Law, Section 65: Noise Control. Operations also occur away from site boundaries. Operations occur during working hours, during times Optimist Park is less likely to be in use. Equipment is regularly maintained according to best practices, including pre-trips, to control noise. Over the three-year pilot project, no noise complaints were received, and no noise issues were noted by staff.

Dust

Human health may be impacted by dust. Risk is mitigated by the relative isolation of the site. Operations also occur away from site boundaries. Operations occur during working hours, during times Optimist Park is less likely to be in use. Feedstock are stored in windrows parallel to prevailing winds to reduce windblown dust. Lime mud is covered with at least 30 cm of wood chips to reduce windblown dust. Spread soil is seeded as soon as possible to establish vegetation which reduces windblown dust. Travel speeds on site are limited to a maximum of 30km/hr. Over the three-year pilot project, no complaints of dust off site were received, and no dust travelling off-site was noted by staff.

Additionally, human health may be impacted by particulates and chemicals from vehicle and equipment exhaust. Risk is mitigated by the relative isolation of the site. Operations also occur away from site boundaries. Operations occur during working hours, during times Optimist Park is less likely to be in use. Equipment is maintained according to best practices.

Emerging Substances of Concern

Research on the impacts of emerging substances of concern (ESOC), on environmental and public safety is grown in Canada and around the world (CCME, 2012). ESOC include pharmaceuticals, antibiotics, endocrine-disrupting chemicals (EDCs), hormones and personal care products (PPCPs) may be found in municipal wastewater. Most ESOCs are found in very low concentrations (nanograms), in wastewater residuals. Detectable levels do not necessarily imply risk to the environment or human health (CCME, 2012). Like other risks to human health in this section, risks from ESOC are further mitigated by minimizing the number of people with access to the site. Summit Landfill is relatively remote and is fully fenced. The entrance is controlled by a scale house attendant, and visitors are required to sign in. Only soil fabrication or landfill related visitors are allowed on site. The site is locked outside of operating hours. Additionally, signage clearly states that biosolids are present on site, and access is restricted. Further signage is used in

the biosolids receiving area. Additionally, risk is mitigated by surface water and ground water management infrastructure, and the management of material on site. Material used to fabricate soil, the fabricated soil, and the vegetation grown on site do not leave the site. No food is grown on site.

Mitigation Measures

Mitigations measures detailed in this proposal have been designed, developed and analyzed as part of the three-year pilot project. Results from the pilot project demonstrate the effectiveness of these measures.

Landfill Management

Summit Landfill has multiple systems in place to mitigate risk to human health and the environment. The waste is covered by an earthen cap. A leachate collection system mitigates risk to groundwater, with all leachate collected hauled and treated at the NEWPCC. A surface water management system contains all surface water run-off from the waste footprint area, with none leaving the site. A perimeter fence restricts access to the site. An ongoing environmental monitoring program tracks the performance of these systems and provides data for trends analysis over time.

Design

Risk mitigation of soil fabrication has been incorporated at the planning and design stages. Soil fabrication is conducted on top of a closed landfill with environmental and security controls in place. Operations have been developed and refined over the three-year pilot project, with environmental monitoring and operating reports submitted to the regulator over that time. Operations have been adjusted based on these experiences and outcomes, and will continue to be refined as the program continues to evolve.

Site Security

Summit Landfill is a fenced facility (Figure 1). The entrance is controlled by a scale house attendant, with the gate being locked after hours. Site visitors are required to sign in and out at the scale house. There is no public access, and only landfill and soil fabrication related traffic is allowed on site. Entrance signage identifies biosolids are on site. Inside the site itself, further signage indicates the active biosolids receiving operating area which is further restricted.

Feedstock Management

Soil fabrication itself is a program of containment, handling, monitoring, storage, treatment, and final disposal of materials. Street sweepings are stored in windrows to promote drainage and reduce dust from wind. Lime mud additionally is covered with at least 30 cm of wood chips. Woodchips are stored on site and monitored according to the Wood Waste Management Plan (Appendix C). Biosolids are incorporated into the initial soil blend on the same day they are delivered to site, with no stockpiling of biosolids. These waste streams are combined to make a fabricated soil.

Environmental Monitoring

The City has committed that the annual results of monitoring will be documented and provided to MCC each year. The longer-term trend analyses of accumulated data will be specifically documented and shared with both MCC, and the public. The City of Winnipeg manages Summit Landfill with a model of perpetual care. Residual environmental effects remaining after the application of mitigation measures, to the extent possible expressed in quantitative terms relative to baseline conditions are not anticipated

to exceed any CCME industrial use soil guidelines. As part of ongoing management of the site, environmental monitoring will continue to inform trend analysis.

Surface Water Sampling

Surface water samples are collected from the surface water containment system on site (Figure 6). Surface water sampling will follow the Surface Water Sampling and Analysis Plan (Appendix J)

Soil Sampling and Analysis

Fabricated soil samples are collected after spreading. Fabricated soil sampling will follow the Fabricated Soil Sampling and Analysis Plan (Appendix K)

Vegetation Monitoring

Vegetation monitoring will be conducted twice annually, for the first three years after soil has been spread. After three years, vegetation in the area will be assessed once per year in summer. An assessment of the aboveground biomass will be done using a visual determination of density and diversity. Variety and density will be analysed compared to the initial seed mixture, seeding technique, weather conditions of the growing season, and soil mix. Vegetation will also be monitored over subsequent seasons of growth.

Plans, Monitoring and Reporting

The City will submit an annual report which will include tonnage of biosolids beneficially used, and hectares of landfill covered and seeded. It will also include environmental monitoring results of surface water, soil, vegetation, odour, dust and vector monitoring.

Conclusions

On the basis of the above stated commitments to long-term monitoring, and in consideration of the very small “footprint” of the soil fabrication operating effects after close to three years, it is predicted that there will be no significant incremental environmental or human health risk assessments from the evolution of the site, and from the associated operations, for the next decades to come.

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DEFINITIONS

Access road: means a road that leads from a Provincial Trunk Highway, Provincial Road, or a municipal road;

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

All weather road: means a graded and/or graveled road or road of equivalent materials that is passable by vehicles under both wet and dry weather conditions;

Approved: means approved by the Director or assigned Environmental Officer in writing;

Aquifer: means an underground layer of water-bearing permeable rock which can contain or transmit groundwater;

Background water quality: means the quality of water in any geologic zone monitored with regards to the chemical and microbiological parameters specified in a License issues pursuant to *The Environment Act* by the Director;

Bench scale testing: means testing of materials or methods on a small scale to verify that the process can be safely performed and yield the desired product;

Biofilter: means a material (in this case woodchips) that has the ability to capture and filter out pollutants and contaminants from runoff;

Biosolids (Class B): means accumulated organic solids, resulting from wastewater treatment processes, that have received adequate treatment to permit material to be recycled;

Biosolids receiving operation: means the time from October to April in which Summit Landfill receives and processes biosolids;

BRRMF: means Brady Road Resource Management Facility

Bunker: means woodchip or street sweepings barricade, usually in a “U” shape that the biosolids are dumped against for a backing;

Cap system: means a containment technology that forms a barrier between the contaminated material and the surface, thereby shielding humans and the environment from the harmful effects of its contents and perhaps limiting the migration of the contents;

CCME: means Canadian Council of Ministers of the Environment;

CCME guidelines: means thresholds and numeric values for elements and contaminants in the soil, water and air in which the quality of the ecosystem can be determined;

Closed Landfill: means a waste disposal site that no longer accepts residential or commercial waste and has been properly capped and graded;

Closure plan: means a plan indicating the actions to be taken for the closure of the Development, or a portion of the Development;

Compost: means solid mature product resulting from composting;

Contamination: means the presence of a constituent, impurity, or some other undesirable element that spoils, corrupts or infects a material or natural environment;

Cover crop: means a crop that is planted to manage soil erosion, soil fertility, soil quality, weeds, pests, diseases and biodiversity in an agroecosystem;

Director: means an employee so designated pursuant to *The Environmental Act;*

Discer: (or disc harrow) means a piece of equipment used on site to break up the top 6 inches of soil to allow for greater seeding penetration and higher growth rates;

Dozer: means a piece of equipment with a large flat blade used on site to knock down biosolids windrows, mix and spread out fabricated soil to a depth of 60cm;

Emerging Substances of Concern (ESC): means a group of chemical and biological agents whose health and ecological effects are causing growing concern;

Fabricated soil: means a mix of (2 parts) street sweepings: (1 part) lime mud: (2 parts) woodchips: and (1 part) biosolids to make a viable growing medium and cap system;

Feedstocks: means the street sweepings, lime mud and woodchip materials used in the soil fabrication mixture;

Final cover: means earth compacted to a thickness of at least 0.5m applied to the surface of the compacted waste cell that has achieved the final elevation for cell closure, and is graded to minimize ponding of water on the surface;

Green waste: means leaf, grass, garden waste, pruning's, shrubs, small branches and other yard wastes from residential and commercial generators

Groundwater: means water below the ground surface and within a zone of saturation;

Groundwater monitoring program: means a plan developed for the monitoring and management of groundwater;

Groundwater monitoring wells: means a well that is drilled into bedrock, clay or till to monitor and evaluate the changes in chemical, biological and physical characteristics of the water and allows for sampling;

Landfill footprint: means parcels of land that are designated and permitted to perform landfilling activities. This would include the entrance, staging area, buffer area and the area that will accept waste for disposal (the waste footprint area);

Landfill gas: means a mixture of gases generated by the microbial decomposition and chemical reactions between wastes in a landfill;

Leachate: means liquid that has percolated through solid waste, and that contains dissolved and suspended materials from the solid waste;

Leachate collection system: means a system that gathers leachate so that it may be removed from a landfill and which could include a permeable drainage layer, a network of perforated piping, finger drains, and sumps or manholes from which leachate can be removed;

Leachate vents: means a well drilled into certain areas of a landfill to alleviate/equalize pressure and stabilize leachate levels within the waste cell;

Lime mud: means a by-product most commonly produced in pulp mills as part of the process that turns wood chips into pulp for paper. The substance is white and flour-like in consistency and is a component in soil fabrication;

Linear pond: means a ditch running around the perimeter of Summit Landfill and retains all surface runoff;

Manhole: means a gravitationally fed vertical extension from the waste floor to the surface that allows for the measurement of leachate levels as well as a collection point;

MCC: means Manitoba Conservation and Climate;

Mitigation measures: means strategies to prevent, reduce or control adverse environmental effects of a project, and include restitution for any damage to the environment caused by those effects through replacement or restoration;

Monitoring well: means a well drilled to measure groundwater levels and collect groundwater samples for the purpose of physical, chemical or biological analysis to determine the concentration of groundwater constituents;

Native species: means an indigenous species to a given region or ecosystem whose presence in that region is the result of only natural processes, with no human intervention;

NEWPCC: means North End Water Pollution Control Center

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

a) Residing in an affected area;
b) Working in an affected area; or
c) Present at a location in an affected area which is normally open to members of the public;

If the unwanted sound

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

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

a) Residing in an affected area;
b) Working in an affected area; or
c) Present at a location in an affected area which is normally open to members of the public;

If the odour, smell or aroma

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

Pathogens: means a bacterium, virus or other microorganism that can cause disease;

Pilot project: means a trial or preliminary study conducted in order to evaluate feasibility, duration, cost, adverse effects and improve upon the study design prior to performance of a full-scale project;

Pollutant: means a substance introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource;

QA/QC: means quality assurance/quality control;

Residuals: materials which are generated through municipal and industrial processes and systems, many which have been considered waste products, and managed unsustainably. For example, biosolids are a product of wastewater treatment.

Representative sample: means a subset of a population that seeks to accurately reflect the characteristics of the larger group;

Site: means the area both permanent and temporary which is required for the construction and operation of the Development;

Solid waste: means all discarded waste including dead animals and does not include liquid waste, hazardous waste or bulky metallic waste;

Street sweepings: means the mineral component in the soil fabrication mixture that has been screened and is comprised mostly of sand, gravel and vehicle grit;

Surface water management system: means a system that manages surface water and storm waters from all areas within the Development;

Top soil: means soil that is free of roots, vegetation, weeds and stones larger than 50mm, is capable of supporting good vegetative growth, and is suitable for use in top dressing, landscaping and seeding;

Vectors: miscellaneous outside influences that could affect the project in an adverse or beneficial way, excluding noise and odour. i.e. pests or wildlife;

Volatilization: means the process whereby a dissolved sample is vaporized;

Waste disposal ground: means a parcel of land that is used for the disposal of solid or industrial waste, also referred to as a landfill;

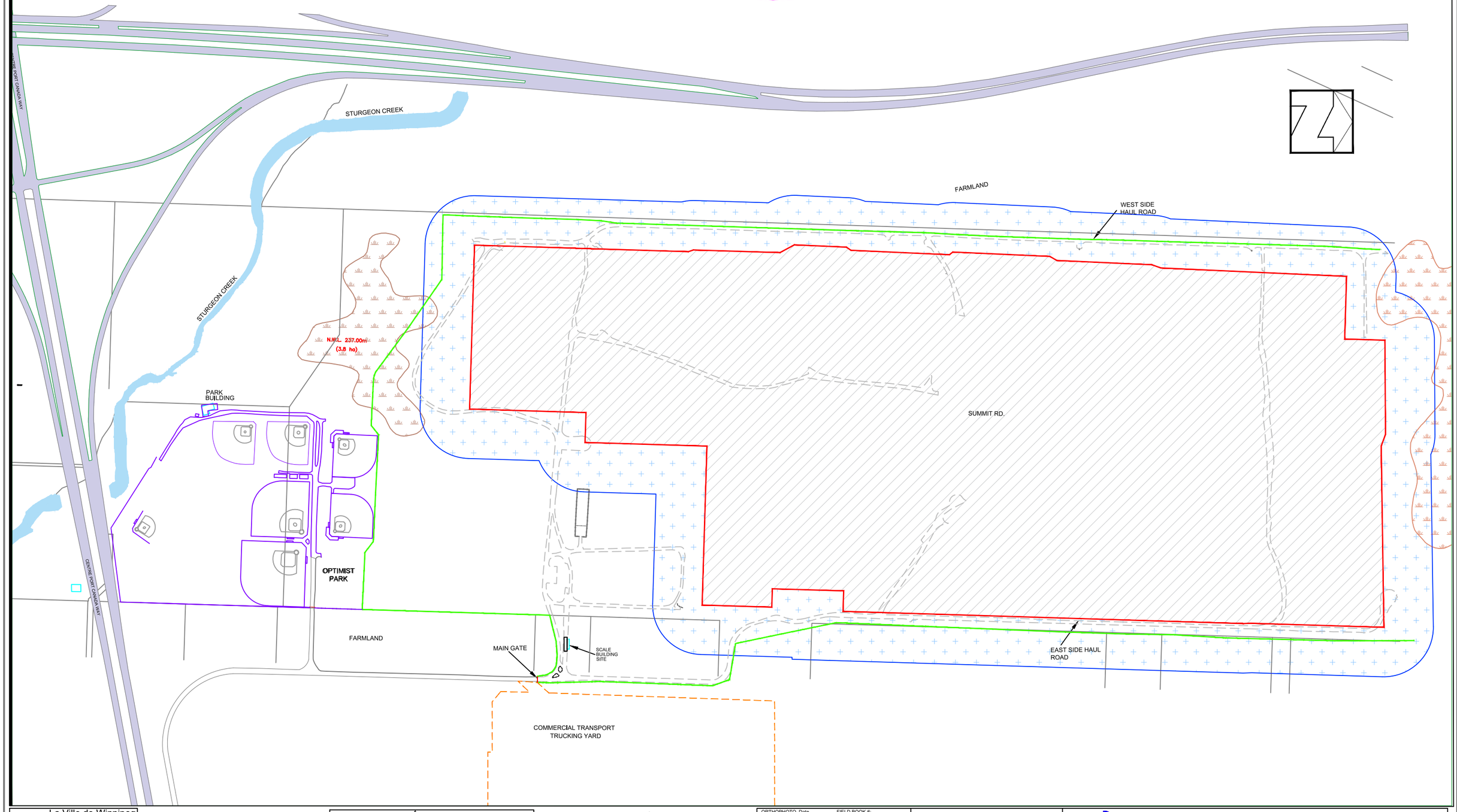
Water retention capacity: means the amount of water that a given soil can physically hold against the force of gravity;

Windrow: means a long line of material (fabricated soil, wood chips, street sweepings or lime mud) that is constructed by a loader. The design decreases wind erosion and maximizes site space;

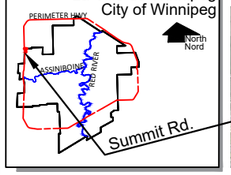
Wood chip processing and storage area: means an area for the receipt, chipping, and storage of wood waste, including Dutch elm disease impacted wood, prior to utilization on site or for transport off site, including but not limited to use as a compost bulking agent or feedstock;

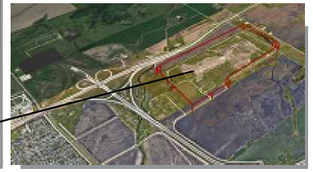
Wood chips: means the primary carbon source in the soil fabrication mixture. Material is received in site from contractors or from the wood grinding pad located at Summit Landfill.

FIGURES



La Ville de Winnipeg
City of Winnipeg





LEGEND/LÉGENDE

- LANDFILL SITE/ Site d'enfouissement.
- CONTROL ZONE
- TRUCKING YARD.
- GRASS
- OPTIMIST PARK
- CREEK
- SURFACE WATER FLOW
- FENCE LINE
- LANDFILL ROADWAYS
- HWY ROADWAYS

Scale in metres / Échelle en mètres

100 0 100 200

1:6,500

METRIC / MÉTRIQUE
WHOLE NUMBERS INDICATE METERS /
LES NUMEROS ENTIER INDIQUENT LES MÉTRES

ORTHOPHOTO Date	FIELD BOOK #:		
UPDATED FEATURES			
WINTER & SUMMER GW FLOW DIRECTION			
As per W.L. GIBBONS. HYDROLOGY Report	Aug. 2016	BW/SW	
RESHAPE STURGEON CREEK	JUL 18	MO	
INSTRUMENT UPDATE	08.31.17	S.S.	
CONVERT TO AUTOCAD DRAWING	OCT. 99	D.S.	
NO. REVISIONS	DATE	BY	

Base Map

SURVEY BY:	CK/BR	VALIDATED BY:	GR
DRAWN BY:	MO	APPROVED BY:	
HOR. SCALE	1: 6,500	PRINTED	
VERTICAL		DATE :	
DATE	October. 23, 2020		

THE CITY OF WINNIPEG / LA VILLE DE WINNIPEG
WATER AND WASTE DEPARTMENT
SOLID WASTE SERVICES

"WARNING"
THE EXACT BOUNDARY OF REFUSE CAN BE CERTIFIED ONLY BY DETAILED INVESTIGATION. THE EXISTENCE AND EXACT LOCATION OF ALL UNDERGROUND SERVICES INCLUDING NEW CONNECTIONS MUST BE CHECKED WITH THE APPROPRIATE UTILITIES.

"ATTENTION"
LA LIMITE EXACTE DU REFUS PEUT ÊTRE CERTIFIÉE UNIQUEMENT PAR UNE ENQUÊTE DÉTAILLÉE. L'EXISTENCE ET LA SITUATION EXACTE DE TOUS LES SERVICES SOUTERRAINS, Y COMPRIS LES NOUVELLES CONNEXIONS DOIT ÊTRE VÉRIFIÉ AVEC LES UTILITAIRES APPROPRIÉS

Site No. 18
Summit Soil Fabrication

FIGURE - 1

CITY DRAWING NUMBER

Summit_SoilFab_Oct23_20.DWG

STURGEON CREEK

FARMLAND

WEST SIDE
HAUL ROAD

Spread + Seeded

N.W.L. 237.00m
(3.8 ha)

Feedstocks

Feedstocks

SUMMIT RD.

Feedstocks

WOOD
WASTE PAD

Spread + Seeded

OPTIMIST
PARK

FARMLAND

MAIN GATE

SCALE
BUILDING
SITE

EAST SIDE HAUL
ROAD

La Ville de Winnipeg
City of Winnipeg

PERIMETER HWY.

North
Nord

Summit Rd.

LEGEND/LÉGENDE

- LANDFILL SITE/ Site d'enfouissement.
- SPREAD + SEEDED
- WOODCHIPS LOCATION
- WOOD WASTE PAD
- FEEDSTOCKS
- OPTIMIST PARK
- GRASS
- FENCE LINE
- LANDFILL ROADWAYS
- HWY ROADWAYS
- TRUCKING YARD.
- CREEK

Scale in metres / Échelle en mètres

50 0 50 100

1:5,000

METRIC / MÉTRIQUE
WHOLE NUMBERS INDICATE METERS /
LES NUMEROS ENTIER INDIQUENT LES MÈTRES

ORTHOPHOTO Date _____ FIELD BOOK #: _____

NO.	REVISIONS	DATE	BY
	UPDATED FEATURES		
	WINTER & SUMMER GW FLOW DIRECTION-		
	As per W.L. GIBBONS. HYDROLOGY Report	Aug. 2016	BW/SW
	RESHAPE STURGEON CREEK	JUL 18	MO
	INSTRUMENT UPDATE	08.31.17	S.S.
	CONVERT TO AUTOCAD DRAWING	OCT. 99	D.S.

Soil Fabrication Pilot Project

SURVEY BY: CK/BR
DRAWN BY: MO
HOR. SCALE 1: 5,000
VERTICAL
DATE October. 23, 2020

VALIDATED BY: GR
APPROVED BY:
PRINTED
DATE :

THE CITY OF WINNIPEG / LA VILLE DE WINNIPEG
WATER AND WASTE DEPARTMENT
SOLID WASTE SERVICES

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Site No. 18
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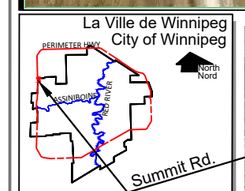
Fabrication

FIGURE - 2

CITY DRAWING NUMBER
Summit_SoilFab_Oct23_20.DWG

La Ville de Winnipeg
City of Winnipeg



LEGEND/LÉGENDE

- LANDFILL SITE/ Site d'enfouissement.
- TRUCKING YARD.
- OPTIMIST PARK
- CREEK
- FENCE LINE
- LANDFILL ROADWAYS
- HWY ROADWAYS
- SURFACE WATER FLOW

Scale in metres / Échelle en mètres

100 0 100 200

1:6,500

METRIC / MÉTRIQUE
WHOLE NUMBERS INDICATE METERS /
LES NUMEROS ENTIER INDIQUENT LES MÉTRES

ORTHOPHOTO Date AIR PHOTO FROM 2018		FIELD BOOK #:	
UPDATED FEATURES			
	WINTER & SUMMER GW FLOW DIRECTION:		
	As per W.L. GIBBONS. HYDROLOGY Report.	Aug. 2016	BW/SW
	RESHAPE STURGEON CREEK	JUL 18	MO
	INSTRUMENT UPDATE	08.31.17	S.S.
	AIR PHOTO UPDATED TO 2018	06.09.20	M.O.
	CONVERT TO AUTOCAD DRAWING	OCT. 99	D.S.
NO.	REVISIONS	DATE	BY

Aerial Photograph

SURVEY BY: CK/BR | VALIDATED BY: GR
DRAWN BY: MO | APPROVED BY:
HOR. SCALE 1: 6,500 | PRINTED
VERTICAL | DATE :
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Site No. 18
Summit Soil Fabrication

FIGURE - 3

CITY DRAWING NUMBER
Summit_SoilFab_Oct23_20.DWG

CENTRE PORT CANADA WAY

STURGEON CREEK

STURGEON CREEK

FARMLAND

WEST SIDE HAUL ROAD

N.W.L. 237.00m (3.8 ha)

PARK BUILDING

SUMMIT RD.

OPTIMIST PARK

FARMLAND

MAIN GATE

SCALE BUILDING SITE

EAST SIDE HAUL ROAD

COMMERCIAL TRANSPORT TRUCKING YARD

La Ville de Winnipeg
City of Winnipeg

PERIMETER HWY

ASSINIBOINE RIVER

North
Nord

Summit Rd.

LEGEND/LÉGENDE

- LANDFILL SITE/ Site d'enfouissement.
- OPTIMIST PARK
- GRASS
- TRUCKING YARD.
- CREEK
- FENCE LINE
- LANDFILL ROADWAYS
- HWY ROADWAYS
- CONTOURS @ 1.0 M.
- SURFACE WATER FLOW

Scale in metres / Échelle en mètres

100 0 100 200

1:6,500

METRIC / MÉTRIQUE
WHOLE NUMBERS INDICATE METERS /
LES NUMEROS ENTIER INDIQUENT LES MÉTRES

ORTHOPHOTO Date	FIELD BOOK #:		
UPDATED FEATURES			
Contours from Lidar Img from 2011	06.10.20	KD	
WINTER & SUMMER GW FLOW DIRECTION-			
As per W.L. GIBBONS. HYDROLOGY Report.	Aug. 2016	BW/SW	
RESHAPE STURGEON CREEK	JUL 18	MO	
INSTRUMENT UPDATE	08.31.17	S.S.	
CONVERT TO AUTOCAD DRAWING	OCT. 99	D.S.	
NO. REVISIONS	DATE	BY	

Topography

SURVEY BY: CK/BR
DRAWN BY: MO
HOR. SCALE 1: 6,500
VERTICAL
DATE October. 23, 2020

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Site No. 18
Summit Soil Fabrication

FIGURE - 4

CITY DRAWING NUMBER
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STURGEON CREEK

FARMLAND

WEST SIDE
HAUL ROAD

SUMMIT RD.

N.W.L. 237.00m
(3.8 ha)

OPTIMIST
PARK

FARMLAND

MAIN GATE

SCALE
BUILDING
SITE

EAST SIDE HAUL
ROAD

La Ville de Winnipeg
City of Winnipeg

PERIMETER HWY
North
Nord
ASSINIBOINE RIVER
Summit Rd.

LEGEND/LÉGENDE

- LANDFILL SITE/ Site d'enfouissement.
- SOIL SEEDING PLOTS
- OPTIMIST PARK
- TRUCKING YARD.
- LANDFILL ROADWAYS
- SURFACE WATER FLOW
- LEACHATE TRANSMISSION
  DIRECTION OF FLOW
- CREEK
- FENCE LINE
- HWY ROADWAYS
- GRASS
- MANHOLE

Scale in metres / Échelle en mètres

50 0 50 100

1:5,000

METRIC / MÉTRIQUE
WHOLE NUMBERS INDICATE METERS /
LES NUMEROS ENTIER INDIQUENT LES MÉTRES

ORTHOPHOTO Date	FIELD BOOK #:		
UPDATED FEATURES			
SOIL SEEDING PLOTS (Dgtz		10-22-20	MO
FROM-BM)			
UPDATE STURGEON CREEK SHAPE		JUL 18	MO
INSTRUMENT SURVEY UPDATE		08.31.17	S.S.
CONVERT TO AUTOCAD DRAWING		OCT. 99	D.S.
NO. REVISIONS		DATE	BY

Environmental Monitoring

SURVEY BY: CK/BR	VALIDATED BY: GR
DRAWN BY: MO	APPROVED BY:
HOR. SCALE 1: 5,000	PRINTED
VERTICAL	DATE :
DATE October. 23, 2020	

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Site No. 18
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Fabrication

FIGURE - 5

CITY DRAWING NUMBER

Summit_SoilFab_Oct23_20.DWG

STURGEON CREEK

FARMLAND

W8

SW-SF3

SW-SF4

W9

WEST SIDE
HAUL ROAD

W1

W7

SW-SF-BR

W13

W14

N.W.L. 237.00m
(3.8 ha)

W15

SUMMIT RD.

W5

W6

OPTIMIST
PARK

SW-SF5

W4

W3

SW-SF6

W2

W10

FARMLAND

MAIN GATE

SCALE
BUILDING
SITE

EAST SIDE HAUL
ROAD

La Ville de Winnipeg
City of Winnipeg

PERIMETER HWY

North
Nord

ASSINIBOINE

RED RIVER

Summit Rd.

LEGEND/LÉGENDE

- LANDFILL SITE/ Site d'enfouissement.
- TRUCKING YARD.
- LEACHATE TRANSMISSION LINE
- DIRECTION OF FLOW
- GRASS
- MANHOLE
- GW WELL
- SW-SF
- FENCE LINE
- SURFACE WATER FLOW
- LANDFILL ROADWAYS
- HWY ROADWAYS
- OPTIMIST PARK
- CREEK

Scale in metres / Échelle en mètres

50 0 50 100

1:5,000

METRIC / MÉTRIQUE
WHOLE NUMBERS INDICATE METERS /
LES NUMEROS ENTIER INDIQUENT LES MÈTRES

ORTHOPHOTO Date		FIELD BOOK #:		
UPDATED FEATURES				
	WINTER & SUMMER GW FLOW DIRECTION			
	As per W.L. GIBBONS. HYDROLOGY Report	Aug. 2016	BWISW	
	RESHAPE STURGEON CREEK	7/18/20	MO	
	INSTRUMENT UPDATE	08.31.17	S.S.	
	SWQ18-SF GPS PTS SAMPLES	10.14.20	SA/RD.	
	CONVERT TO AUTOCAD DRAWING	OCT. 99	D.S.	
NO.	REVISIONS	DATE	BY	

Surface Water Management System

SURVEY BY: CK/BR	VALIDATED BY: GR
DRAWN BY: MO	APPROVED BY:
HOR. SCALE 1: 5,000	PRINTED
VERTICAL	DATE :
DATE October. 23, 2020	

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Site No. 18
Summit Soil Fabrication

FIGURE - 6

CITY DRAWING NUMBER
Summit_SoilFab_Oct23_20.DWG

APPENDIX A

TECHNICAL MEMORANDUM: BENCH-SCALE SOIL FABRICATION FOR USE AT SUMMIT LANDFILL

TECHNICAL MEMORANDUM

Bench-Scale Soil Fabrication for Use at Summit Landfill

Presented to:	City of Winnipeg
Presented by:	Kasia Caputa, SYLVIS Environmental
Presentation date:	May 11, 2018

INTRODUCTION

The City of Winnipeg (the City) is undertaking a pilot project at the Summit Landfill to create and place a biosolids fabricated soil for the purpose of a final vegetative cover on the closed landfill cap system. The intent of the pilot project is to fabricate a soil using mineral and organic residuals that must be managed by the City: municipal biosolids, wood grindings from City tree removal operations, and sand and grit mix from winter road maintenance operations (street sweepings). The primary goals of this pilot project are to:

- Demonstrate that biosolids fabricated soil is a viable, environmentally sound option for completion of the cap system of Summit Landfill, specifically producing a growing media that can be placed as a topsoil layer to permanently support a prairie ecosystem of native grasses and forbs;
- Demonstrate that soil fabrication is an operationally viable multi-season beneficial reuse option for biosolids and a diversion option for several other residuals, including wood grindings from City tree removal, and mineral material from street sweepings and other sources; and
- Produce sufficient information to complete a business case for an ongoing soil fabrication operations for the City.

SYLVIS Environmental (SYLVIS) has been contracted by the City to conduct a bench-scale assessment in order to determine the following:

- Ideal mixing ratios of the feedstocks to fabricate a soil that meets regulatory and operational considerations;
- The capacity of the test mixes to support germination of native grasses and forbs selected as the desired final vegetation at Summit Landfill; and
- The potential for nutrient leaching from the test mixes into groundwater and surface water sources.

This technical memorandum summarizes the findings of the bench-scale assessment and provides recommendations on the most suitable mixing ratios for use in the operational scale pilot project, as well as additional operational considerations.

BACKGROUND

Biosolids Soil Fabrication

The use of organic residuals in soil fabrication and vegetation establishment can reduce the cost of soil importation for landfill closure while providing a beneficial use opportunity for regionally generated residuals. This beneficial use would also allow the City to divert more biosolids from being buried at the Brady Road Resource Management Facility (BRRMF), as well as potentially reducing the cost to manage additional City-generated residuals such as wood grindings and street sweepings.

Biosolids fabricated soils have been used at landfills throughout British Columbia to promote vegetation establishment and, in some instances, have also been designed specifically to mitigate fugitive methane emissions or treat leachate through an engineered soil-plant remediation system. Biosolids fabricated soils have also been successfully used in a variety of other municipal contexts such as roadside plantings, gardens and parks.

In 2016, the City initiated a pilot project to test soil fabrication and placement at the BRRMF. The project received regulatory approval and commenced operations in early 2017. Results from the first year of the pilot indicate that the use of biosolids fabricated soil to support a vegetated landfill cover is an operationally viable and environmentally protective management option for the City's biosolids.

Regulatory Considerations

Current legislation in Manitoba does not include specific regulatory criteria for the production and use of a biosolids fabricated soil. In order to ensure that the biosolids soil mixtures proposed for this demonstration are protective of the environment and human health, and provide a suitable medium for plant establishment and growth, we have aimed to develop blends that meet the process and quality criteria for biosolids growing medium within the *British Columbia (BC) Organic Matter Recycling Regulation* (B.C. Reg. 18/2002), herein referred to as the OMRR.

BENCH-SCALE INVESTIGATION METHODS

Feedstock Characterization

Three different feedstocks were used for this bench-scale soil fabrication trial:

- City of Winnipeg dewatered biosolids;
- Street sweepings from City winter road maintenance operations; and
- Wood grindings (woodchips) from City tree removal operations.

Composite samples of each of the feedstocks were collected by City staff on February 7, 2018. Subsamples of these composites were submitted to Maxxam Analytics for analysis of physical and chemical properties.

The remaining samples of each of the feedstocks were shipped to the SYLVIS laboratory in New Westminster, BC. SYLVIS analyzed the feedstocks for bulk density, and utilized the data received

from the physical and chemical analysis to develop theoretical mix ratios. The mix ratios were developed and assessed with the aim that each mix would meet the requirements of OMRR. The feedstock samples were then used to produce three unique bench-scale test mixes. A summary table of the analytical results for each feedstock is available in Table 2, Appendix One. The individual feedstocks are shown in Photograph 1 to Photograph 3, Appendix Two.

Bench-Scale Soil Fabrication

Three different mix ratios were developed to meet OMRR criteria using a SYLVIS proprietary mixing model. The test mixes were blended at the SYLVIS laboratory in New Westminster, BC on March 20-22, 2018 with a specialized laboratory mixer. The feedstocks were measured out at the appropriate volumetric ratios using 500 mL jars. The woodchips were sifted by hand to remove any pieces larger than the bowl of the mixer (>10 cm); the removed woodchips represented approximately 15% of the total wood available. The feedstocks were added to the mixer in the following order: woodchips, biosolids, street sweepings, and mixed together for 75 seconds.

The initially developed mix ratios for two of the three test mixes produced a clumpy, poorly blended mix due to the stickiness of the biosolids. These mix ratios were modified to add a greater proportion of woodchips, which appeared to help disperse the biosolids clumps and allow for a more thoroughly mixed soil. The final mix ratios used for this trial are summarized in Table 1, below, and the final mixes are shown in Photograph 4 to Photograph 6, Appendix Two.

Table 1: Mix ratios (by volume) for the soil blends tested in this study. Values in brackets indicate the percent ratio (by volume) of each feedstock within the mix.

Feedstocks	Mix 1	Mix 2	Mix 3
Woodchips	2 (33%)	3 (25%)	3 (43%)
Biosolids	1 (17%)	2 (17%)	1 (14%)
Street Sweepings	3 (50%)	7 (58%)	3 (43%)

Subsamples from Mix 1, Mix 2, and Mix 3 were submitted to Maxxam for physical and chemical analysis on March 22, 2018. A summary of the analytical results is presented in Table 3, Appendix One.

Mixing Methodology

Two additional mixing tests were conducted for each of the three soil mixes to simulate different mixing methodologies: spoon mixing and winter mixing. The purpose of the spoon mixing test was to assess how each of the test mixes might perform if mixed only with the bucket of a loader or excavator (“bucket-mixing”) under an operational setting, as compared to a specialized mixing implement, such as a hammer-mill bucket, soil shredder, or batch mixer. The feedstocks were measured out at the appropriate volumes using a 500 mL jar, and then combined together using a large spoon. The woodchips and sweepings were combined and mixed with the spoon first, then the biosolids were added and mixed.

The purpose of the winter mixing test was to assess how each of the test mixes may perform during a winter mixing event when temperatures are below freezing. Appropriate quantities of the

woodchips and street sweepings were placed in a freezer at least two days prior to mixing. The biosolids were refrigerated to ensure that they were well chilled, but not frozen prior to mixing. The feedstocks were blended in the laboratory mixer using the same methods as the original mixing test.

Germination Study

SYLVIS carried out a bench-scale experiment in order to evaluate the germination and short-term potential for leaching of nutrients from each of the test mixes. The standard mixing methodology (laboratory soil mixer at room temperature) was used to fabricate the mixes for this study. The germination trial was initiated on March 27, 2018. Four-inch (10.16 cm) diameter PVC columns closed at one end with fine mesh were packed with each of the fabricated soil mixes. The columns were 15 cm in length and the soil was packed to 13 cm (Photograph 7, Appendix Two). Each fabricated soil mix and a control of commercial grade potting mix (*Schultz Potting Soil Plus 0.08-0.12-0.08)* was run in duplicate. Approximately 2 teaspoons of a native forb and grass mix provided by the City was distributed onto the surface of each of the columns. The seed mixture included big bluestem (24%), little bluestem (20%), Canada wild rye (20%), awned wheat grass (20%), white prairie clover (15%), and black eyed Susan (1%). Continuous low-level fluorescent light was provided to the columns. Selected photographs from the germination trial are presented in Photograph 7 to Photograph 12, Appendix Two.

To facilitate germination, water (approximately 10 mL, equivalent to 1.2 mm) was added to each of the columns in the morning and afternoon for a period of 7 days (note that on days 4 and 6, which fell on a long weekend, there were no water additions). If any of the water added short circuited (flowed immediately through the columns and into the collection tray), the collected water was re-added to the column. No significant leaching loss of water was noted during the initial 7 day trial period. Starting on Day 8, watering was increased to induce leaching of nutrients from the relatively fresh growing media; 50 mL (6.2 mm) of water was applied within 10 seconds, in the morning and the afternoon for a period of 3 days. The water that percolated from the increased water additions was collected and submitted to Maxxam for analysis of nitrogen and phosphorous at the end of Day 10. The results of this analysis are summarized in Table 5, Appendix One. It is worthwhile to note that the columns are designed such that there is no capacity for runoff, which would account for the majority of water movement during an **e**quivalent rain event under field conditions. The purpose of the column leachate tests is to understand the potential leaching risk under a worst case scenario.

After 14 days, the aboveground grass biomass was clipped at the soil surface and weighed to determine the wet biomass yield from each of the columns (Photograph 13, Appendix Two).

RESULTS AND DISCUSSION

Bench-Scale Soil Fabrication

Mix 1 was a relatively homogenous mix, dark in colour, with a sticky and clay-like texture (Photograph 4). Mix 2 appeared the least homogenous of all the mixes, with a dark colour

(Photograph 5). Mix 3 created the least sticky and most homogenous blend, dark in colour (Photograph 6).

During the spoon mixing trial, it was observed that the wood and sweepings mixed together immediately, but the addition of biosolids produced large clumps that could not be broken apart. This produced large pockets of biosolids, which were present in all of the test mixes.

The observations from the different mixing methodology trials suggest that Mix 1 and Mix 3 produced the most well blended final mixes with soil mixer under warm-weather conditions. The higher proportion of woodchips in these mixes helped disperse the biosolids clumps, and allowed the feedstocks to be combined more easily.

The winter mixing trial resulted in more easily blended test mixes, compared to the other mixing methodologies, as the biosolids were less sticky and less likely to produce clumps. All three of the feedstocks dispersed and blended together easily. Mix 2 produced the most homogenous blend during the winter mixing trial, as this mix had the lowest proportion of woodchips, which are the most heterogeneous of all the feedstocks.

The stickiness of the biosolids produced challenges in thoroughly mixing all the feedstocks, particularly during the spoon mixing trial. The spoon mixing trial was intended to emulate mixing the feedstocks using only a loader or excavator bucket (“bucket-mixing”), rather than utilizing more specialized soil mixing equipment such as a hammer-mill bucket, soil shredder, and or batch mixer. While avoiding the use of specialized equipment appears desirable due to the lower cost per unit of time, the spoon mixing trial results strongly indicate that relying on bucket-mixing will take more time, produce an inconsistent mix of feedstocks, and not support the key goals of this pilot project.

Spoon-mixing and winter mixing were not tested together, but it is possible that frozen/cold feedstocks could blend more easily with spoon mixing as well. Although we do not recommend bucket-mixing at an operation scale during warmer months, this method could be trialled during the first winter mixing event alongside a specialized mixing implement.

Fabricated Soil Analysis

All three mixes had overall similar concentrations of available nutrients, and no single test mix exhibited consistently higher or lower concentrations of all nutrients. Ammonia was highest in Mix 2, potassium and phosphorous were highest in Mix 3, and sulfur was highest in Mix 1. The pH of the test mixes ranged between 7.01 and 7.17, which is ideal for most plant growth.

Electrical conductivity (EC) in all of the mixes ranged between 6.8 and 8.3 dS/m, which is considered high for most soils. EC provides measurement of total salt content of a soil or solution, which can include beneficial salts such as potassium, magnesium, calcium, nitrate and ammonia, as well as toxic salts such as sodium and chloride. Biosolids have high EC due to the high nutrient concentrations, and are typically the primary contributors to EC in fabricated soils. The sweepings, which had an EC of 5.3 dS/m, but low nutrient content, may also be contributing to the EC of the test mixes in the form of harmful salts such as sodium and chloride. Regardless of the nature of the salts, high EC can limit the growth of certain plants, and additional management steps may

be needed to maximize the success of the final vegetative cover. It is expected that the EC will decrease over time as soluble nutrients, particularly ammonia, are taken up by plant growth or lost by volatization, and as soluble salts are flushed out by rainfall and spring snowmelt.

The C:N ratios of all the test mixes ranged between 9.3 and 11.4, well below the OMRR minimum C:N ratio of 15. Due to the presence of coarse woodchips in the test mixes, the laboratory was unable to grind and process all of the wood in the samples for the total carbon and nitrogen analysis. As a result, the total organic carbon contribution of the woodchips was underrepresented, leading to a lower than predicted C:N ratio result (predicted ratios were 16.6, 17.3, and 17.9 for Mix 1, Mix 2, and Mix 3, respectively). It is likely that the sampled soil C:N ratios will increase over time as the woodchips are broken down further and the available nitrogen is taken up by plant growth.

Total organic matter in the test mixes ranged between 6.4% and 7.8%, which is lower than predicted, again, likely due to the underrepresentation of woodchips in the laboratory analysis.

Trace element concentrations in all of the test mixes were generally low, and well below the OMRR limits, with the exception of zinc. Zinc concentrations in all three test mixes were below the OMRR limit of 150 mg/kg, but did fall above 75% of the limit. Both the woodchips and the sweepings contain relatively high concentrations of zinc, at 143 and 107 mg/kg, respectively, and thus have a limited capacity to dilute the high zinc concentration of the biosolids (776 mg/kg). Although the test mixes come close to the stringent OMRR limit for zinc, they are well below the CCME soil quality guideline, which is 200 mg/kg for agricultural and residential use.

With the exception of C:N ratio, all three mixes were compliant with OMRR criteria for nutrients and trace elements. It is worthwhile to note that, although the OMRR is used in this context to guide soil quality, it is not necessary for the test mixes to meet all of the OMRR requirements to be considered safe for use in this context.

Germination Study

Germination occurred in eight out of eight germination columns (Table 4, Appendix One**)**. The control soil exhibited much earlier germination, and subsequently, much higher total biomass than the fabricated soils. Of the fabricated soils, Mix 1 had the highest total biomass after 14 days, and Mix 3 had the lowest.

Germination and total biomass after 14 days was more limited in the test mixes as compared to the control, particularly in Mix 3. The difference in germination between the control and fabricated soils may be due to the presence of coarse woodchips in the fabricated soils, which limited the ability of the seeds to have direct soil contact. It also appeared that the peat-based potting soil had a much higher water holding capacity than the fabricated soils, as it retained more water during the nutrient leaching investigation.

Another possibility for the differences in germination is due to high ammonia, which is present when biosolids are freshly mixed into a fabricated soil, and can limit new growth. Observations from other biosolids soil fabrication projects have found poor to moderate germination immediately after placement, with improved growth in the subsequent growing season.

Furthermore, an operational soil fabrication project would have more soil handling than this bench-scale study, which would reduce some of the excess ammonia.

The high electrical conductivity (6.8 – 8.3 dS/m) in the test mixes may also be a contributing factor in limited plant growth compared to the control soil, which had an electrical conductivity of 1.9 dS/m. Mix 1, which had the highest germination of the test mixes, also had the highest electrical conductivity, thus this may not be the only factor contributing to the differences in germination.

Nutrient Leaching Investigation

Total nitrogen leaching was similar in all the germination columns, including the control, with concentrations ranging between 85 and 132 mg/L. The predominant forms of nitrogen were different between the test mix columns and the control soil. The water collected below the control soil was high in nitrate-N (82.2 and 93.5 mg/L), whereas the nitrogen from the test mixes was predominately in the form of ammonia-N (41-100 mg/L) and nitrite-N (18.6 - 35.6 mg/L). Orthophosphate leaching was 1-2 orders of magnitude lower in the test mixes (0.08 – 0.315 mg/L) compared to the control soil (4.93 - 5.21 mg/L).

The total nitrogen leached from all the test mixes was similar in concentration to that leached from a commercial potting mix containing fertilizer under similar conditions, although the predominant forms of nitrogen varied between the potting mix and the test mixes varied. Nitrate, which is the most mobile form of nitrogen, and the most likely to pose an environmental risk, exhibited almost no leaching from the test mixes. Conversely, the majority of the total nitrogen leached from the commercial potting mix was in the form of nitrate. There were no notable differences in nitrogen leaching between the test mixes.

The phosphorous leached was markedly lower in the test mixes as compared to the commercial potting mix, particularly in Mix 1. These results indicate that all the test mixes produced in this study pose a lower risk of releasing nutrients to the environment than a commercially available soil containing slow-release fertilizer.

RECOMMENDATIONS

Based on the results of the germination trial, nutrient leaching trial, and overall physical appearance, SYLVIS recommends Mix 1 (1 biosolids : 2 woodchips : 3 street sweepings), as the best test mix to trial in the operational scale soil fabrication pilot. Mix 2 (2 biosolids: 3 woodchips: 7 street sweepings) may be used as a potential winter blend, as it produced the most homogenous blend during the winter mixing trial, and had comparable germination to Mix 1, SYLVIS also strongly recommends that bucket mixing not be used as the sole mixing method for the operational trial. Specialized mixing equipment, such as a hammer-mill bucket, soil shredder, or batch mixer is necessary to intimately combine the feedstocks into a fabricated soil. If the biosolids are not thoroughly mixed with the woodchips and the street sweepings, they can create anaerobic pockets high in available nutrients and soluble salts, which can limit the growth of vegetation, and potentially lead to increased risk of nutrient leaching and methane emissions.

Due to the apparent low germination success and biomass growth as compared to the potting soil, as well as the high EC of the test mixes, which has the potential to contribute to the reduced

germination and growth, we recommend the following placement and seeding strategy in order to maximize vegetation success:

- placement of soil in the fall or late summer, regardless of when it was fabricated
- Harrowing of the soil to improve the seed bed;
- Fall seeding with a winter grass or annual crop as initial cover; and
- Overseeding in the spring with the prairie grass mix

With this strategy, the overwinter snowpack and spring melt can assist in leaching excess salts, and a longer period of time between soil fabrication and seeding allows for excess ammonia to be volatized. When seeding the final cover it may be beneficial to use a higher seeding rate than what would be recommended on a typical mineral soil, and active management of weeds may be required during the first months of growth.

APPENDIX ONE - TABLES

Table 2: Feedstock physical and chemical characteristics.

Parameter	Woodchips	Biosolids	Street Sweepings	Units
Available Nutrients				
Ammonia	56.1	4,170	10.7	µg/g
Nitrogen	14	< 10	11	µg/g
Potassium	3,800	490	92	µg/g
Sulfur	120	1,800	73	mg/kg
Salinity and Acidity				
Electrical Conductivity (Sat Paste)	2.32	11.30	5.32	dS/m
pH (1:2 Soil:Water)	7.04	6.88	7.84	pH
Classification				
Total Organic Carbon	33.0	28.0	3.6	%
Total Kjeldahl Nitrogen	7,300	58,000	270	µg/g
C:N Ratio	45	5	133	-
Organic Matter (loss on ignition)	79.7	58.8	4.6	%
Trace Elements (Total)				
Antimony	0.23	2.60	0.43	µg/g
Arsenic	3.62	3.14	1.40	µg/g
Barium	69.9	138	34.0	µg/g
Beryllium	< 0.20	< 0.20	< 0.20	µg/g
Cadmium	0.160	3.10	0.238	µg/g
Chromium	10.7	92.7	14.0	µg/g
Cobalt	2.54	2.81	2.45	µg/g
Copper	29.8	469	13.4	µg/g
Lead	15.2	24.5	7.86	µg/g
Mercury	< 0.050	0.584	< 0.050	µg/g
Molybdenum	0.54	12.7	0.68	µg/g
Nickel	7.61	23.2	12.3	µg/g
Selenium	< 0.50	2.78	< 0.50	µg/g
Silver	< 0.050	5.10	< 0.050	µg/g
Thallium	0.050	0.058	< 0.050	µg/g
Tin	1.08	19.9	0.71	µg/g
Vanadium	12.4	12.2	12.6	µg/g
Zinc	143	776	107	µg/g
Physical and Aggregate Properties				
Moisture - wet weight	33	74	3	%
Wet Bulk Density	130	810	1,200	kg/m3

Table 3: Fabricated soil physical and chemical parameters.

Parameter	Mix 1	Mix 2	Mix 3	Units	OMRR Limits
Available Nutrients					
Ammonia	650	710	560	mg/kg	-
Nitrate-Nitrogen	< 2.0	< 2.0	< 2.0	mg/kg	-
Phosphorus	39	38	46	mg/kg	-
Potassium	310	260	440	mg/kg	-
Sulfur	250	190	200	mg/kg	-
Salinity and Acidity					
Electrical Conductivity (Sat Paste)	8.3	6.8	7.1	dS/m	-
pH (1:2 Soil:Water)	7.01	7.12	7.17	-	-
Classification					
Total Organic Carbon	4.0	3.7	4.5	%	-
Total Kjeldahl Nitrogen	3,500	4,000	4,100	mg/kg	6,000
C:N Ratio	11.4	9.3	11.0	-	15 minimum
Organic Matter (loss on ignition)	6.8	6.4	7.8	%	15
Trace Elements (Total)					
Antimony	0.63	0.67	0.60	µg/g	-
Arsenic	1.7	1.6	1.5	µg/g	13
Barium	44	45	42	µg/g	-
Beryllium	< 0.40	< 0.40	< 0.40	µg/g	-
Cadmium	0.40	0.40	0.37	µg/g	1.5
Chromium	20	22	22	µg/g	100
Cobalt	2.8	2.5	2.2	µg/g	34
Copper	59	62	57	µg/g	150
Lead	13	13	14	µg/g	150
Mercury	< 0.050	< 0.050	< 0.050	µg/g	0.8
Molybdenum	1.70	1.90	1.90	µg/g	5.0
Nickel	12.00	16.00	10.00	µg/g	62
Selenium	< 0.50	< 0.50	< 0.50	µg/g	2.0
Silver	0.55	0.63	0.54	µg/g	-
Thallium	< 0.10	< 0.10	< 0.10	µg/g	-
Tin	2.8	2.8	2.6	µg/g	-
Uranium	0.81	0.85	0.75	µg/g	-
Vanadium	12	11	10	µg/g	-
Zinc	130	130	140	µg/g	150
Physical and Aggregate Properties					
Moisture - wet weight	23	22	23	%	-

Table 4: Total biomass of grass mix planted in germination columns after 14 days.

Germination Columns	Biomass Wet Weight (g)	Biomass Average (g)
Mix 1	0.21	0.20
	0.18	
Mix 2	0.18	0.17
	0.16	
Mix 3	0.13	0.08
	0.03	
Control	2.85	3.18
	3.50	

Table 5: Nutrient and chemical analysis of water samples collected below germination columns.

Parameter	Mix 1 (1/2)	Mix 1 (2/2)	Mix 2 (1/2)	Mix 2 (2/2)	Mix 3 (1/2)	Mix 3 (2/2)	Control (1/2)	Control (2/2)	Units
Calculated Parameters									
Total Kjeldahl Nitrogen	76.0	79.2	86.2	114	79.0	59.6	29.5	32.1	mg/L
Nitrate - N	< 1.0	2.08	< 0.50	< 0.50	< 1.0	< 1.0	82.2	93.5	mg/L
Anions									
Nitrite - N	25.2	35.6	16.6	18.6	27.8	26.4	0.206	0.235	mg/L
Nutrients									
Ammonia + Ammonium - N	70	71	80	100	59	41	5.7	2.4	mg/L
Nitrate + Nitrite - N	23.7	37.7	12.1	17.6	27.4	25.8	82.4	93.7	mg/L
Orthophosphate-P (dissolved)	0.0812	0.0706	0.0940	0.315	0.148	0.229	4.93	5.21	mg/L
Total Nitrogen	99.7	117	98.4	132	106	85.4	112	126	mg/L
Routine Water									
pH (Laboratory)	7.20	7.09	7.13	7.53	6.96	7.21	6.76	6.68	pH

APPENDIX TWO: PHOTOGRAPHS

Photograph 1: City of Winnipeg dewatered biosolids used in the bench-scale soil fabrication trial. (March, 2018)

Photograph 2: Woodchips used in the bench-scale soil fabrication trial. (March, 2018)

Photograph 3: Street sweepings used in the bench-scale soil fabrication trial. (March, 2018)

Photograph 4: Mix 1, blended at room temperature using the mechanical soil mixer. (March, 2018)

Photograph 5: Mix 2, blended at room temperature using the mechanical soil mixer. (March, 2018)

Photograph 6: Mix 3, blended at room temperature using the mechanical soil mixer. (March, 2018)

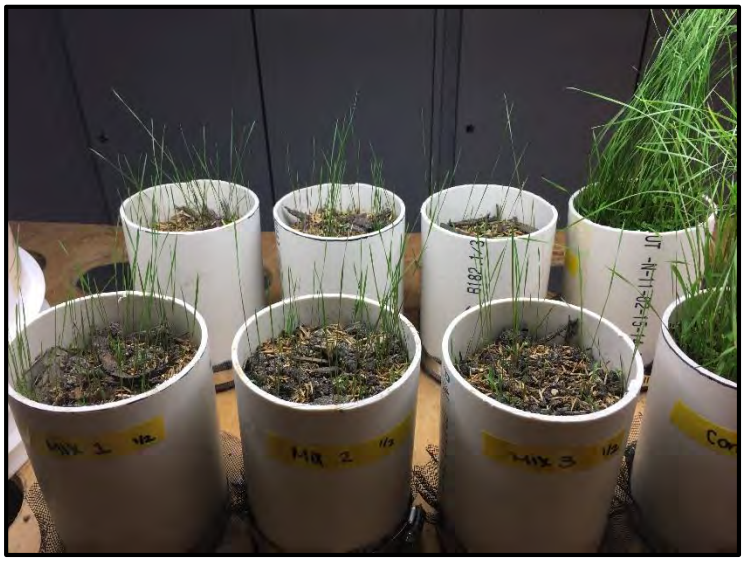
Photograph 7: Germination columns on Day 1 of the trial, prior to seeding. (March 28, 2018)

Photograph 8: Germination columns on Day 1 of the trial, seeded with a native prairie grass and forb mix. (March 28, 2018)

Photograph 9: Germination columns on Day 6 of the trial; germination is visible in the control columns but not in the test mix columns. (April 2, 2018)

Photograph 10: Germination columns on Day 8 of the trial. (April 4, 2018)

Photograph 11: Germination columns on Day 10 of the trial. (April 6, 2018)



Photograph 12: Germination columns on Day 14 of the trial, immediately prior to clipping. (April 10, 2018)

Photograph 13: Aboveground biomass clipped from each of the columns after 14 days; from left to right Mix 1, Mix 2, Mix 3, and Control with replicate one and two in the first and second row, respectively. (April 10, 2018)

APPENDIX B

TECHNICAL MEMORANDUM: BENCH-SCALE SOIL FABRICATION USING LIME MUD FOR USE AT SUMMIT LANDFILL

TECHNICAL MEMORANDUM

Bench-Scale Soil Fabrication using Lime Mud for Use at Summit Landfill

Presented to:	City of Winnipeg
Presented by:	Kasia Caputa, SYLVIS Environmental
Presentation date:	March 22, 2019

INTRODUCTION

The City of Winnipeg (the City) is undertaking a pilot project at the Summit Landfill to create and place a biosolids fabricated soil as a growing media for final vegetative cover on the closed landfill cap system. The intent of the pilot project is to fabricate a soil using organic and mineral residuals that are generated by the City: municipal biosolids, wood grindings from City tree removal operations, sand and grit mix from winter road maintenance operations (street sweepings), and other potential residuals. The primary goals of this pilot project are to:

- Demonstrate that biosolids fabricated soil is a viable, environmentally sound option for completion of the cap system of Summit Landfill, specifically producing a growing media that can be placed as a topsoil layer to permanently support a prairie ecosystem of native grasses and forbs;
- Demonstrate that soil fabrication is an operationally viable multi-season beneficial reuse option for biosolids and a diversion option for several other residuals, including wood grindings from City tree removal, and mineral material from street sweepings and other sources; and
- Produce sufficient information to complete a business case for an ongoing soil fabrication operations for the City.

SYLVIS Environmental completed a bench-scale assessment in 2018 to determine the following:

- Ideal mixing ratios of the feedstocks to fabricate a soil that meets regulatory and operational requirements;
- The capacity of the test mixes to support germination of native grasses and forbs selected as the desired final vegetation at Summit Landfill; and
- The potential for nutrient leaching from the test mixes into groundwater and surface water sources.

The bench-scale assessment was conducted using three feedstocks: biosolids, street sweepings, and wood grindings. The selected final mix ratio of 1 part biosolids: 2 parts woodchips: 3 parts sweepings is currently being used in the operational scale pilot. The City has identified lime mud as a fourth feedstock to add to the fabricated soil. The use of lime mud is intended to offset the demand for street sweepings, which is currently the most limiting feedstock in terms of quantity, and to create an alternative beneficial use for the lime mud.

As the lime mud has some unique characteristics compared to the other feedstocks, SYLVIS determined that an additional bench-scale test would be required to determine a new mix ratio which incorporates the lime mud with the current feedstocks. This technical memorandum summarizes the findings of this additional bench-scale assessment, provides recommendations on the most suitable mixing ratio for use in the operational scale pilot project, and describes additional operational considerations.

INVESTIGATION METHODS

Regulatory Considerations

Current legislation in Manitoba does not include specific regulatory criteria for the production and use of a biosolids fabricated soil. In order to ensure that the biosolids soil mixtures proposed for this demonstration are protective of the environment and human health, and provide a suitable medium for plant establishment and growth, we have aimed to develop blends that meet the quality criteria for biosolids growing medium (BGM) within the *British Columbia (BC) Organic Matter Recycling Regulation* (OMRR; B.C. Reg. 18/2002).

Feedstock Characterization

Four different feedstocks were used for this bench-scale soil fabrication trial:

- City of Winnipeg dewatered biosolids;
- Street sweepings from City winter road maintenance operations;
- Wood grindings (woodchips) from City tree removal operations; and
- Lime Mud from the Brady Road Resource Management Facility.

Composite samples of each of the feedstocks were collected by City staff in January 2019 and shipped to the SYLVIS laboratory in New Westminster, BC. SYLVIS analyzed the feedstocks for bulk density and utilized historic physicochemical data to develop theoretical mix ratios. Data collected for the 2018 bench-scale tests were used for biosolids, woodchips, and sweepings; data from 2016 was used for the lime mud. All feedstock data were based on a single composite samples for each feedstock, and are considered representative of the feedstocks used in the bench-scale mixing (Table 3, Appendix One). The individual feedstocks are depicted in Photograph 1 to Photograph 4, Appendix Two.

Bench-Scale Soil Fabrication

Three different mix ratios were developed to meet OMRR BGM criteria using a SYLVIS proprietary mixing model and the historic physicochemical data. The test mixes were blended at the SYLVIS laboratory in New Westminster, BC on February 8 and 11, 2019 with a specialized laboratory mixer. The feedstocks were measured out at the appropriate volumetric ratios using 500 mL jars. The feedstocks were added to the mixer in the following order: woodchips, biosolids, lime mud, street sweepings, and mixed together for 75 seconds. The final mix ratios used for this trial are summarized in Table 1, below, and the final mixes are shown in Photograph 4 to Photograph 7, Appendix Two.

Table 1: Mix ratios (by volume) for the fabricated soil test mixes. Values in brackets indicate the percent ratio (by volume) of each feedstock within the mix.

Feedstocks	Mix 1	Mix 2	Mix 3
Biosolids	1 (17%)	1 (14%)	1 (13%)
Woodchips	2 (33%)	3 (43%)	4 (50%)
Street Sweepings	2 (33%)	1.5 (21%)	1(13%)
Lime Mud	1 (17%)	1 (21%)	2 (25%)

Subsamples from Mix 1, Mix 2, and Mix 3 were submitted to ALS Laboratories in Burnaby, BC for physicochemical analysis on February 13, 2019. A summary of the analytical results is presented in Table 5, Appendix One.

A second run was performed on each test mix to assess how each of the test mixes may perform during a winter mixing event when temperatures are below freezing. Appropriate quantities of the woodchips and street sweepings were placed in a freezer at least two days prior to mixing. The biosolids were refrigerated to ensure that they were well chilled, but not frozen prior to mixing. The feedstocks were blended in the laboratory mixer using the same methods as the original mixing test.

RESULTS AND DISCUSSION

Bench-Scale Soil Fabrication

Mix 1 was homogenous, dry to moist, dark in colour, with some clumps of biosolids remaining where the biosolids were coated with the sweepings and lime mud (Photograph 5). Mix 2 was relatively homogenous, dry, with a dark colour, but some of the mineral material did not get fully incorporated (Photograph 6). Mix 3 created the most homogenous blend, moist, with a texture of sandy soil (Photograph 7).

The observations from the different mixing methodology trials suggest that Mix 3 produced the most well blended final mix under both warm weather and cold weather conditions, with slightly higher moisture than Mix 1 and Mix 2. All three mixes were similar in ease of mixing and final appearance. There were no major differences observed between the warm weather mixing and winter mixing trials.

Fabricated Soil Analysis

Mix 3 had the highest concentrations of available nutrients except for available phosphorous, which was highest in Mix 1 (Table 3, Appendix One). Available nutrients in all three mixes were within the range of predicted values, and are all suitable for vegetation establishment and growth. The pH of the test mixes ranged between 8.26 and 8.37, which is higher than the average pH of the operational mix currently being fabricated. This was expected as the lime mud is high in calcium carbonate and acts as a liming agent. The pH results of the test mixes is still within a suitable range for nutrient availability and plant growth.

Electrical conductivity (EC) in all of the mixes ranged between 5.4 and 5.5 dS/m, which is considered high for most soils, but is lower than the EC of the currently used operational mix. The

lime mud has a low EC compared to the other feedstocks, and its addition to the operational blend will provide an additional benefit of lowering the concentration of soluble ions provided by the street sweeping feedstock, which may include road salts.

The C:N ratios of all the test mixes ranged between 16.8 and 22.7, which fall above the OMRR BGM minimum C:N ratio of 15. The total organic carbon in the test mixes was higher than predicted in the model, which led to higher than predicted C:N ratios. This result suggests that the woodchips used in the test mixes had a higher total organic carbon than the historic data used in the model.

Total organic matter, measured using the loss on ignition (LOI) method, was 6.9% in Mix 1, 10.0 % in Mix 2, and 15.7% in Mix 3, which slightly exceeded the OMRR BGM maximum of 15%. Mix 3 had the highest proportion of woodchips, representing 50% of the mix by volume. Mix 3 also had the highest C:N ratio, at 22.7. The ratio of Mix 3 could be adjusted to reduce the proportion of woodchips, which would reduce the organic matter slightly, but still keep the C:N ratio above 15.

Trace element concentrations in all of the test mixes were generally low, and well below the OMRR BGM limits, with the exception of zinc. Zinc concentrations in all three test mixes were above the OMRR limit of 150 mg/kg. The zinc concentration in Mix 3 was 222 mg/kg, which also exceeded the CCME Soil Quality Guideline for agricultural land of 200 mg/kg, but below the industrial land guideline of 360 mg/kg. The zinc concentrations in Mix 1 and Mix 2 were close to the value predicted by the model, but Mix 3 was much higher than predicted, which indicates that zinc concentrations in the feedstocks have high variability.

With the exception of zinc, both Mix 1 and Mix 2 were compliant with OMRR BGM criteria for nutrients and trace elements. With a mix ratio modification to reduce the woodchips by one part, Mix 3 should also meet OMRR BGM criteria for nutrients. It is worthwhile to note that although the OMRR is used in this project to guide soil quality objectives, it is not necessary for the test mixes to meet all of the OMRR BGM requirements to meet the minimum regulatory requirements in this context. All three test mixes will meet the CCME Soil Quality Guidelines for industrial land use.

CONCLUSION

Based on the results of the bench-scale testing, Mix 3 produced the most thoroughly blended and homogenous soil of the three test mixes. Mix 3 exceeded the OMRR BGM criteria for organic matter content, which could be amended by altering the mix ratio to 1 part biosolids: 3 parts woodchips: 1 part street sweepings: 2 parts lime mud. The modified Mix 3 may be considered the most desirable for the City from an operational perspective, as it uses the highest proportion of lime mud and minimizes the demand for the street sweepings.

Mix 2 is also a suitable blend, using close to equal parts of sweepings and lime mud.

Mix 1 is desirable as it contains the highest proportion of biosolids and therefore maximizes their beneficial use, but it also uses the highest proportion of street sweepings and may be pose challenges in producing a consistent final fabricated soil due to the availability of the sweeping

feedstock. The final decision on the selected blend may depend on available volumes of both lime mud and street sweepings so that the use of both of these residuals can be optimized.

APPENDIX ONE - TABLES

Table 2: Physical and chemical characteristics of feedstocks used in the Summit Landfill bench-scale soil mixing assessment.

Parameter	Units	Wood-chips[(a)]	Biosolids[(a)]	Street Sweepings[(a)]	Lime Mud[(b)]
Available Nutrients					
Ammonia	µg/g	56.1	4,170	10.7	119
Nitrate-Nitrogen	µg/g	14	< 10	11	13
Potassium	µg/g	3,800	490	92	480
Sulfur	mg/kg	120	1,800	73	120
Salinity and Acidity					
Electrical Conductivity (Sat Paste)	dS/m	2.32	11.30	5.32	1.47
pH (1:2 Soil:Water)	pH units	7.04	6.88	7.84	8.91
Classification					
Total Organic Carbon	%	33.0	28.0	3.6	2.5
Total Kjeldahl Nitrogen	µg/g	7,300	58,000	270	3,500
C:N Ratio	-	45	5	133	7.1
Organic Matter (loss on ignition)	%	79.7	58.8	4.6	4.2
Moisture - wet weight	%	33	74	3	41
Wet Bulk Density	kg/m3	329	957	1,354	764

(a) Samples collected on Feb 7th, 2018 by the City of Winnipeg and analyzed by Maxxam Analytics under Report No. R2520741.

(b) Samples collected on Jul 12th, 2016 by the City of Winnipeg and analyzed by Maxxam Analytics under Report No. R2220037.

Table 3: Trace element concentrations of feedstocks used in the 2019 Summit Landfill bench-scale soil mixing assessment.

Parameter	Units	Wood-chips[(a)]	Biosolids[(a)]	Street Sweepings[(a)]	Lime Mud[(b)]
Trace Elements (Total)					
Antimony	µg/g	0.23	2.60	0.43	-
Arsenic	µg/g	3.62	3.14	1.40	< 0.50
Barium	µg/g	69.9	138	34.0	-
Beryllium	µg/g	< 0.20	< 0.20	< 0.20	-
Cadmium	µg/g	0.160	3.10	0.238	0.49
Chromium	µg/g	10.7	92.7	14.0	8.5
Cobalt	µg/g	2.54	2.81	2.45	2.06
Copper	µg/g	29.8	469	13.4	29.0
Lead	µg/g	15.2	24.5	7.86	3.96
Mercury	µg/g	< 0.050	0.584	< 0.050	< 0.050
Molybdenum	µg/g	0.54	12.7	0.68	0.26
Nickel	µg/g	7.61	23.2	12.3	6.34
Selenium	µg/g	< 0.50	2.78	< 0.50	-
Silver	µg/g	< 0.050	5.10	< 0.050	-
Thallium	µg/g	0.050	0.058	< 0.050	-
Tin	µg/g	1.08	19.9	0.71	-
Vanadium	µg/g	12.4	12.2	12.6	-
Zinc	µg/g	143	776	107	34.7

(a) Samples collected on Feb 7th, 2018 by the City of Winnipeg and analyzed by Maxxam Analytics under Report No. R2520741.

(b) Samples collected on Jul 12th, 2016 by the City of Winnipeg and analyzed by Maxxam Analytics under Report No. R2220037.

Table 4: Physicochemical characteristics of three test mixes used in the Summit Landfill 2019 bench-scale soil mixing assessment [(a)]. Ratios of each test mix are presented in Table 1 of this report. Bold values indicate that one or more regulatory criteria were not met.

Parameter	Units	Mix 1	Mix 2	Mix 3	OMRR BGM Limits[(b)]
Available Nutrients					
Ammonia	mg/kg	211	223	281	-
Nitrate-Nitrogen	mg/kg	2.9	3.5	4.0	-
Phosphorus	mg/kg	167	121	96	-
Potassium	mg/kg	416	612	712	-
Sulfur	mg/kg	205	258	341	-
Salinity and Acidity					
Electrical Conductivity (Sat Paste)	dS/m	5.50	5.38	5.49	-
pH (1:2 Soil:Water)	-	8.35	8.37	8.26	-
Classification					
Total Organic Carbon	%	7.35	9.09	8.55	-
Total Kjeldahl Nitrogen	%	0.38	0.40	0.51	0.6
C:N Ratio	-	19.3	22.7	16.8	15 minimum
Organic Matter (loss on ignition)	%	6.9	10.0	**15.7**	15
Moisture - wet weight	%	22.7	30.5	33.9	-

(a) Soil fabricated in the SYLVIS lab on Feb 11th, 2019 and analyzed by ALS Environmental under Report No. L2232550.

(b) Limits obtained from the *British Columbia Organic Matter Recycling Regulation* (OMRR) for biosolids growing medium (OMMR S4/11).

Table 5: Physicochemical characteristics of three test mixes used in the Summit Landfill 2019 bench-scale soil mixing assessment [(a)]. The feedstock ratios of each test mix are presented in Table 1 of this report. Bold values indicate that one or more regulatory criteria were not met.

Parameter	Units	Mix 1	Mix 2	Mix 3	CCME Industrial Limits[(b)]	OMRR BGM Limits[(c)]
Trace Elements (Total)						
Antimony	µg/g	0.50	0.38	0.46	40	-
Arsenic	µg/g	1.41	1.35	1.85	12	13
Barium	µg/g	33.9	37.1	40.7	2,000	-
Beryllium	µg/g	0.10	0.11	0.12	8	-
Cadmium	µg/g	0.290	0.326	0.433	22	1.5
Chromium	µg/g	33.1	33.5	39.4	87	100
Cobalt	µg/g	1.86	1.66	1.85	300	34
Copper	µg/g	48.0	49.7	64.2	91	150
Lead	µg/g	8.38	7.77	8.85	600	150
Mercury	µg/g	0.062	0.046	0.054	50	0.8
Molybdenum	µg/g	1.19	1.91	1.26	40	5.0
Nickel	µg/g	10.3	8.5	11.1	89	62
Selenium	µg/g	< 0.50	< 0.50	< 0.50	2.9	2.0
Silver	µg/g	0.31	0.37	0.43	40	-
Thallium	µg/g	< 0.10	< 0.10	< 0.10	1	-
Tin	µg/g	< 5.0	< 5.0	< 5.0	300	-
Uranium	µg/g	0.86	0.96	1.17	300	-
Vanadium	µg/g	8.64	8.90	9.84	130	-
Zinc	µg/g	**162**	**169**	**222**	410	150

(a) Samples collected on Mar 3rd, 2017 by SYLVIS and analyzed by Exova Laboratories under Report No. 2173186.
(b) Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for the production of environmental and human health, industrial application.
(c) Limits obtained from the *British Columbia Organic Matter Recycling Regulation* (OMRR) for biosolids growing medium (OMMR S4/11).

APPENDIX TWO: PHOTOGRAPHS

Photograph 1: City of Winnipeg dewatered biosolids used in the 2019 bench-scale soil fabrication trial (March, 2019).

Photograph 2: Woodchips used in the 2019 bench-scale soil fabrication trial (March, 2019).

Photograph 3: Street sweepings used in the 2019 bench-scale soil fabrication trial (March, 2019).

Photograph 4: Lime Mud used in the 2019 bench-scale soil fabrication trial (March, 2019).

Photograph 5: Mix 1, blended at room temperature using the mechanical soil mixer (March, 2019).

Photograph 6: Mix 2, blended at room temperature using the mechanical soil mixer (March, 2019).

Photograph 7: Mix 3, blended at room temperature using the mechanical soil mixer (March, 2019).

APPENDIX C

WOOD WASTE MANAGEMENT PLAN

Summit Soil Fabrication
Wood Waste Management Plan

Wood Waste Storage Areas

Wood is stored on the wood waste pad at the south end of the site. This is also where the wood waste is ground. This pad and grinding area is covered under the Elm Storage Permit (Appendix D).

Access roads shall be maintained on all sides, free from obstructions or combustibles at all times, and accessible in all weather conditions;

Fire Prevention

Wood waste fires can occur either at the surface (surface fires) or inside a pile (internal fires). The most common fire is a surface fire that burns along the top surface layer, but fires can also ignite from internal heating of the piles under certain conditions.

Operational procedures to mitigate and manage fire include:

- Locating storage piles on clean, level, and firm ground;
- Arranging piles with clear access roads around each;
- Separation of old and new materials;
- Monitoring and controlling internal pile temperatures;
- Isolating vehicle exhaust and other ignition sources; and
- Perform fire watches during daily maintenance operations.

Material Handling

Wood Piles

- Constructed to a maximum of 8 metres in height;
- Maximum length and width of 50 by 80 metres;
- Minimum separation of 10 metres between piles;
- Constructed at least 30 metres from structures, including on-site structures;
- Kept free of weeds and other combustibles within 10 metres of the piles; and

Wood chip piles

- Constructed to a maximum of 3 metres in height;
- Constructed at least 30 metres from structures, including on-site structures;
- Minimum of 7 metres separation between piles;
- maximum length and width of 50 by 16 metres; and

Product Monitoring

Internal pile temperatures are checked once a week. If the internal temperatures approach 70 degrees Celsius, the pile will be broken apart. The reformation of the pile will generally disrupt the intense decomposition activity and thus prevent a fire.

APPENDIX D

ELM STORAGE PERMIT 2020-ST-005

Manitoba
Agriculture and Resource Development

Elm Storage Permit

Permit Number: 2020-ST-005
Date of Issue: June 20, 2020
Permit Holder: Water and Waste Department, City of Winnipeg
Municipality: City of Winnipeg
Email: ckozak@winnipeg.ca
Phone: Chris Kozak – 204-986-2384
Mailing Address: 1120 Waverley Street, Winnipeg, MB, R3T 0P4
Location of Storage Site: 1600 Summit Road, Winnipeg (north of Optimist Park near CentrePort Canada Way)
Description of Storage Site: Gated area north of Optimist Park with a landing area where wood is held before it is ground (Summit Road).
Start Date: June 20, 2020
End Date: June 20, 2021
Conditions of permit: All elm wood taken to the location listed in this permit must be debarked, chipped (5cm or less in any dimension), burned, or buried (to a depth of 25cm or more) within 14 days during the high-risk period from March 1st to September 1st. **All effort should be made to grind material at this location within 5 days in the months of June and July.** **Other conditions:** The site must be secure with appropriate controls in place to ensure vehicles cannot access the site or remove wood without authority during or after operating hours. A sign must be posted prohibiting the unauthorized removal of wood from the location. This site will be inspected for compliance. Documents relating elm wood storage and treatment at the location may be requested. This permit can be revoked at any time. **This storage permit applies to the location described in this permit only.**
Issued By: Kyla Maslaniec, Forest Health Protection Officer #10

For more information, please contact the Forestry Branch: 204-726-6444.

The holder of a storage permit shall comply with any terms or conditions imposed on the permit by the Director of the Forestry Branch, Manitoba Agriculture and Resource Development. This permit is issued under the authority of the *Forest Health Protection Regulation* of the *The Forest Health Protection Act* C.C.S.M. c. F151.

APPENDIX E

SEEDING MIX LIST

Summit Soil Fabrication Seeding Mix List

Grasses

common name	Scientific name
Canada wild rye	*Elymus canadensis*
awned wheatgrass	*Elymus trachycaulus ssp. subsecundus*
western wheat grass	*Pascoyrum smithii*
nuttals alkali grass	*Puccinellia nuttalliana*
green needle grass	*Stipa viridula*
Big bluestem	*Andropogon gerardii*
side oats gramma	*Bouteloua curtipendula*
Blue gramma	*Bouteloua gracilis*
Switch grass	*Panicum virgatum*
Indian grass	*Sorghastrum nutans*
little bluestem	*Schizachyrium scoparium*

Forbs

common name	Scientific name
yarrow	*Achillea millefolium*
giant hyssop	*Agastache foeniculum*
pink onion	*Allium stellatum*
dwarf false indigo	*Amorpha nana*
Canada anemone	*Anemone canadensis*
long fruited anemone	*Anemone cylindrica*
pasture sage	*Artemisia frigida*
prairie sage	*Artemisia ludoviciana*
swamp milkweed	*Asclepias incarnata*
dwarf milkweed	*Asclepias ovalifolia*
many flowered aster	*Aster ericoides*
smooth aster	*Aster laevis*
New England aster	*Aster novae-angliae*
Canada milkvetch	*Astragalus canadensis*
harebell	*Campanula rotundifolia*
white prairie clover	*Dalea candida*
purple prairie clover	*Dalea purpureum*
Philadelphia fleabane	*Erigeron philadelphicus*
joe pye weed	*Eupatorium maculatum*
gaillardia	*Gaillardia aristata*
three flowered avens	*Geum triflorum*
gumweed	*Grindelia squarrosa*

narrow leaved sunflower	*Helianthus maximiliani*
beautiful sunflower	*Helianthus pauciflorus*
rough false sunflower	*Heliopsis helianthoides*
meadow blazingstar	*Liatris ligulistylus*
dotted blazingstar	*Liatris punctata*
wild bergamot	*Monarda fistulosa*
prairie cinquefoil	*Potentilla arguta*
yellow coneflower	*Ratibida columnifera*
black eyed susan	*Rudbeckia hirta*
low goldenrod	*Solidago missouriensis*
stiff goldenrod	*Solidago rigida*
showy goldenrod	*Solidago speciosa*
Culver's root	*Veronicastrum virginicum*
heartleaf alexander	*Zizia aptera*
golden alexander	*Zizia aurea*

APPENDIX F

SUMMIT SOIL FABRICATION PILOT PROJECT DIRECTOR APPROVAL LETTER

Manitoba
Sustainable Development
Environmental Stewardship Division
Environmental Approvals Branch
1007 Century Street, Winnipeg, Manitoba, Canada R3H 0W4
T 204 945-8321 F 204-945-5229
www.gov.mb.ca/conservation/eal

File: 963.20

May 7, 2018

Chris Carroll, P.Eng.
Manager of Wastewater Services Division
City of Winnipeg
109 – 1199 Pacific Avenue
Winnipeg, MB R3E 3S8

Dear Chris Carroll:

Re: City of Winnipeg – Summit Soil Fabrication Pilot Project Request for Approval

I am responding to the February 6, 2018 letter and proposal as well as the related February 26, 2018 email respecting the City of Winnipeg's (City's) proposed Summit Soil Fabrication Pilot Project. The City submitted the letter under Clause 6, Exemption, of Manitoba Regulation 164/88 (amended), Classes of Development. The related email provided additional information requested in a February 16, 2018 email from the Environmental Approvals Branch (EAB). We recognize this Pilot Project as being associated with the City's Biosolids Master Plan.

The letter and proposal describe a three-year pilot project relative to 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 site of the City's Summit Landfill. The objective of the pilot project is to determine if soil fabrication is a viable long-term option for completing the cap system at Summit Landfill. The soil fabrication process would use biosolids from the City's North End Water Pollution Control Centre (NEWPCC), sand and grit from street sweeping, and woodchips with a goal of the resulting soil being able to support vegetation growth and restore the site to a native prairie landscape. As described in the letter, each year of the pilot will consist of two operational phases, one each of cold and warm weather phases while the City will submit interim, annual and final reports. No stockpiling of non-blended biosolids will occur at the site, as mixing of biosolids with the other elements will occur immediately upon arrival of the biosolids to the site.

The supplementary email provided a copy of Figure 1 that was missing from the February 6, 2018 letter, and indicated the following:

- bench scale testing should be complete by the end of March 2018;
- Sylvis Environmental Services Ltd. (Sylvis) is the expert consultant and Sylvis representatives will participate in key components of the pilot;

- the quantity of biosolids involved in each operational phase of Year 1 will not exceed 4,000 m^3 while the City may propose to adjust the quantities involved in each phase of Years 2 and 3;
- the blending activities of materials will occur within the secure area of the Summit Landfill;
- the characteristics of the biosolids have remained generally consistent over the past several years;
- birds present a low risk factor to the pilot, wildlife in the area can pass freely though the area as the perimeter fence has periodic gaps, and pest control measure will be utilized if required;
- the 0.6 metre final thickness of the placed fabricated soil was chosen based on the results of the related 2017 soil fabrication pilot project at the City's Brady Road Resource Management Facility (BRRMF); and
- operations at the site will be suspended if winter conditions cause operational difficulties or safety concerns with all biosolids being redirected back to BRRMF.

Upon consideration of the request for approval of this Summit Soil Fabrication Pilot Project, I have decided, pursuant to Section 6 of Manitoba Regulation 164/88 – Classes of Development, to approve the request subject to the following conditions:

DEFINITIONS

In this letter,

"biosolids" means accumulated organic solids, resulting from wastewater treatment processes, that have received adequate treatment to permit the material to be recycled;

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

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

if the unwanted sound

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

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

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

if the odour, smell or aroma

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

GENERAL REQUIREMENTS

1. The City of Winnipeg (City) shall, at least ten working days prior to initiating soil fabrication and placement in 2018, 2019, and 2020, provide to the Director, Environmental Approvals Branch annual plans identifying the intended location(s) and maximum area(s) of land application at Summit Landfill of fabricated soils for that year of the Summit Soil Fabrication Pilot Project.

2. The City shall, at least five working days prior to initiating soil fabrication and placement, provide to the assigned Environment Officer the formula to be used in fabricating the soil to be used in the Summit Soil Fabrication Pilot Project for the duration of that fabricated soil placement event unless it is the same as the previous formula for this project.

3. Biosolids and all associated materials shall be transported between the North End Water Pollution Control Centre (NEWPCC), the Brady Road Resource Management Facility (BRRMF), and the site of the Summit Soil Fabrication Pilot Project in covered containers, to the satisfaction of the assigned Environment Officer, so as to prevent the loss of biosolids and associated liquids.

4. Biosolids materials delivered to the Summit Soil Fabrication Pilot Project will be mixed with feedstock upon arrival and biosolids other than those specifically involved with this project shall not be stored temporarily or permanently at the Summit Landfill.

5. The City shall limit access to the site of the Summit Soil Fabrication Pilot Project to persons specifically participating in associated activities. The method of access restriction to the general public shall be to the satisfaction of the assigned Environment Officer.

6. The City shall provide and display effective warning signs identifying the general nature of the Summit Soil Fabrication Pilot Project at potential access points and around the associated areas to the satisfaction of the assigned Environment Officer.

7. Surface water resulting from precipitation at the site of the Summit Soil Fabrication Pilot Project shall be controlled and managed to the satisfaction of the assigned Environment Officer.

8. The site of the Summit Soil Fabrication Pilot Project shall be operated and maintained so as to control vector attraction and activity at the site to the satisfaction of the assigned Environment Officer.

9. Fabricated soils shall be applied in such a manner that it is placed and spread so as to form a generally homogeneous cover layer.

10. Fabricated soils shall only be applied over areas of the Summit Landfill that are underlain by previously completed waste disposal cells.

11. Fabricated soils shall not be removed from the area of the Summit Soil Fabrication Pilot Project to areas outside of the Summit Landfill site.

12. The City shall maintain the resulting above ground biomass in such manner that it does not create potential threats to the environment, public health or wildlife.

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

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

15. Reports summarizing all activities and results associated with the interim winter, interim summer, and annual reports for each year of this Summit Soil Fabrication Pilot Project shall be submitted to the Environmental Approvals Branch, Manitoba Sustainable Development not later than December 31st of each year of operation of this pilot.

16. This approval shall terminate not later than January 31, 2021 unless otherwise approved by the Director.

All other previously approved proposed and imposed conditions, limitations and requirements remain in place during this pilot.

If you have any questions or would like to discuss matters pertaining to this Summit Soil Fabrication Pilot, please contact Robert Boswick, Environmental Engineer, at 204-945-6030 or robert.boswick@gov.mb.ca.

Yours sincerely,

[redacted]

Tracey Braun, M.Sc.
Director

c. Duane Griffin, P.Eng. – Water and Waste Department, City of Winnipeg
Don Labossiere/Scott Davies/Yvonne Hawryliuk – Environmental Compliance and Enforcement Branch, Manitoba Sustainable Development
Robert Boswick/Asit Dey/Cory Graham – Environmental Approvals Branch, Manitoba Sustainable Development
Public Registries

APPENDIX G

LEGAL DESCRIPTIONS LAND TITLES

STATUS OF TITLE

Title Number **3032497/1**
Title Status **Accepted**
Client File

The Property Registry
A Service Provider for the Province of Manitoba

1. REGISTERED OWNERS, TENANCY AND LAND DESCRIPTION

THE CITY OF WINNIPEG

IS REGISTERED OWNER SUBJECT TO SUCH ENTRIES RECORDED HEREON IN THE FOLLOWING DESCRIBED LAND:

FIRSTLY:
ALL THOSE PORTIONS OF OTM LOTS 96, 97 AND 98 PARISH ST. CHARLES WHICH LIE TO THE NORTH OF THE NORTHERN LIMIT OF ROAD PLAN 49690 WLTO

SECONDLY:
ALL THAT PORTION OF THE ELY 16.5 FEET PERP OF SAID OTM LOT 96 WHICH LIES BETWEEN THE SOUTHERN LIMIT OF SAID ROAD PLAN 49690 WLTO AND THE NORTHERN LIMIT OF ROAD PLAN 4073 WLTO (NOW CLOSED)

THIRDLY:
PARCELS A AND B PLAN 65572 WLTO
EXC OUT OF THIRDLY: ALL MINES, MINERALS AND OTHER MATTERS AS SET FORTH IN THE CROWN LANDS ACT
IN OTM LOTS 96, 97, 98 AND 99 PARISH OF ST. CHARLES

The land in this title is, unless the contrary is expressly declared, deemed to be subject to the reservations and restrictions set out in section 58 of *The Real Property Act.*

2. ACTIVE INSTRUMENTS

Instrument Type:	**Bylaw**
Registration Number:	**474871/1**
Instrument Status:	**Accepted**
Registration Date:	1922-09-06
From/By:	MUNICIPALITY OF ASSINIBOIA
To:	
Amount:	
Notes:	No notes
Description:	BY-LAW 1648 CLOSING PT. OF 2-MILE RD. ALLOW,SEE PL 2818

Instrument Type:	**Caveat**
Registration Number:	**192633/1**
Instrument Status:	**Accepted**
Registration Date:	1964-03-05
From/By:	CITY OF ST. JAMES
To:	
Amount:	
Notes:	AFF: FIRSTLY
Description:	No description

Instrument Type:	**Caveat**
Registration Number:	**4364719/1**
Instrument Status:	**Accepted**
Registration Date:	2013-06-12
From/By:	MTS INC.
To:	
Amount:	
Notes:	No notes
Description:	STATUTORY EASEMENT

3. ADDRESSES FOR SERVICE

City of Winnipeg
510 Main Street
Winnipeg MB
Attn: Legal Services
R3B 1B9

4. TITLE NOTES

No title notes

5. LAND TITLES DISTRICT

Winnipeg

6. DUPLICATE TITLE INFORMATION

Duplicate not produced

7. FROM TITLE NUMBERS

2424226/1	All
3025651/1	All
3025653/1	All

8. REAL PROPERTY APPLICATION / CROWN GRANT NUMBERS

No real property application or grant information

9. ORIGINATING INSTRUMENTS

Instrument Type:	**Request To Issue Title**
Registration Number:	**5121637/1**
Registration Date:	2019-10-28
From/By:	The City of Winnipeg
To:	
Amount:	

10. LAND INDEX

OT 96 CH
PART NORTH OF ROAD 49690 AND PART OF ELY 16.5 FEET

OT 97 CH
NORTH OF ROAD PLAN 49690

OT 98 CH
NORTH OF ROAD PLAN 49690

Lot A Plan 65572
EXC M&M

Lot B Plan 65572
EXC M&M

CERTIFIED TRUE EXTRACT PRODUCED FROM THE LAND TITLES DATA STORAGE SYSTEM OF TITLE NUMBER 3032497/1

HOLDING NO.	CT. NO.	OWNER	INSTRUMENT
1	3032497/1	The City of Winnipeg	474871/1
			192633/1
			4364719/1

DWG. NO. GEO-183-TP

DATE:	January 17, 2020
DRAWN BY:	TH

NOT TO SCALE

Winnipeg

N W E S

Planning, Property and Development Dept. - Service de l'urbanisme, des biens et de l'amenagement
Real Estate and Land Development Division - Division de l'immobilier et de l'amenagement du terrain

2nd Floor, 65 Garry Street - 65, rue Garry, deuxieme etage - Winnipeg - Manitoba R3C 4K4
http://www.winnipeg.ca/ppd/

JOB: 20150166

ORIGINAL

Deposit No. 1554/2018

PLAN OF PUBLIC ROAD TO BE CLOSED

Across part of

O.T.M. LOTS 96, 97, and 98
PARISH OF ST. CHARLES
Including Part of Public Road Plan No. 49690

AND

PLAN OF SURVEY

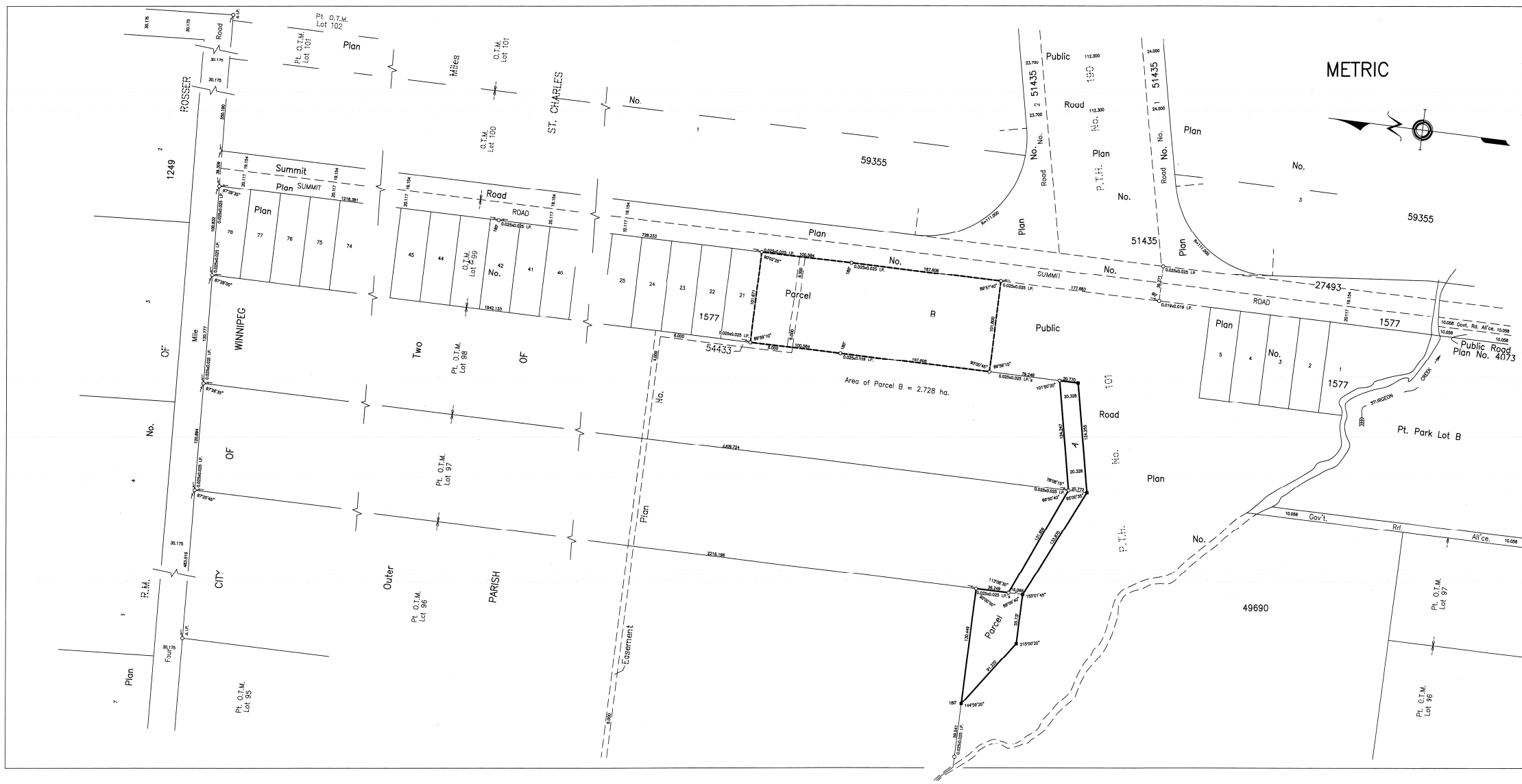
In

O.T.M. LOT 99
PARISH OF ST. CHARLES
Being Parcels A and B Plan No 52150

CITY OF WINNIPEG
MANITOBA

SCALE 1:1500

0 5 15 25 50 100 150



NOTES

All distances are in metres and may be converted to feet by multiplying by 3.28084
All areas are shown in hectares (ha) and may be converted to acres by multiplying by 2.47105.
Survey monuments found on the ground are described and shown thus ——————O
Iron posts 0.025 x 0.025 x 0.914, marked M.L.S., NR, are placed at all points shown thus ——————■
Part of Public Road Plan No. 49690 to be closed is shown on Parcel A and shown hordered thus ——————
Plan No. 52150 is shown as Parcel B and shown bordered thus ——————
All plans referred to are on record in The Winnipeg Land Titles Office.

AFFIDAVIT

I, Dewey Michael Roger Haplock, of the City of Winnipeg, Manitoba Land Surveyor, make oath and say that I did personally superintend the survey represented by this plan, that the survey was made between the dates of August 16th and 17th, 2018 and that the survey and plan are correct and true to the best of my knowledge and belief.

Sworn to before me at Winnipeg
this 1st day of April 2019

A Commissioner for Oaths
in and for the Province of Manitoba
My Commission expires 2021/Dec/ce

M.L.S.

APPROVALS

Approved this 13th day of August 2019

Director of Surveys

REGISTRATION

Detached from registered instrument No. 5107804/1
and filed in the Winnipeg Land Titles Office this 16th day
of September 2019 as Plan No. 65572

for District Registrar

Registration No. 5107807/1

EXAMINER OF SURVEYS

This Approval is Valid for 12 months unless registered.

Approved this 22 day of August 2019

Examiner of Surveys

Re-approved this ___ day of _____ 20__

Examiner of Surveys

SUSTAINABLE DEVELOPMENT
GEOMANITOBA
1007 CENTURY STREET
WINNIPEG MB.

Manitoba

File 2018117 FB. 2750 HLA-09-12455-0013

APPENDIX H

PUBLIC ENGAGEMENT REPORT

Soil Fabrication Program

Public Engagement Summary

September 2020

Background

The City of Winnipeg (City) is developing a soil fabrication program at Summit Landfill for use as landfill top cover. The soil fabrication program uses a mix of biosolids, woodchips, and street sweepings to produce soil that will help restore the landfill to a native prairie landscape. In 2018, the City began a three-year soil fabrication pilot project at Summit Landfill. Following a successful pilot, the City plans to seek approval from provincial regulators in late 2020 to begin a long-term soil fabrication program in 2021.

Engagement

The public education and engagement program for the soil fabrication program aimed to:

- Create awareness of the City's soil fabrication program
- Provide an opportunity for Winnipegger's to ask questions and share comments with the project team
- Provide information on the benefits of the soil fabrication program

A webpage was developed to communicate background information, project updates, and support the other public education and engagement tools. An online poll with two questions was available on the project webpage for residents who wanted to provide quick feedback and see the results instantly. Residents who wanted to connect with the project team and share a comment or ask a question were invited to use the Q & A tool. Finally, a video was developed to provide an overview of the pilot program and explain the benefits of soil fabrication. The video was available on the project webpage and the City's Youtube channel.

A summary of the public education and engagement materials are provided in the table below.

Table 1: Public education and engagement opportunities

Date	Activity	Participation
June 1 – September 4, 2020	Webpage	931 unique visits
June 1 – September 4, 2020	Video	247 views
June 1 – September 4, 2020	Quick Poll	57 responses
June 1 – September 4, 2020	Q & A	6 inquiries

Promotion

Public education and engagement opportunities were promoted using the following methods:

- Our City, Our Stories article – June 1, 2020
- Coverage in Winnipeg Free Press and CTV News – June 1 and July 8, 2020
- Facebook posts with 16,797 followers - June 1 to August 25, 2020
- Twitter posts with 78,700 followers - June 1 to August 25, 2020
- City of Winnipeg public engagement newsletter with over 5,300 recipients – June 18 to September 3 2020
- Online advertisement - June 21 to July 4 and August 16 to August 29, 2020

Figure 1: Example of Facebook post

Additional examples of promotion can be found in Appendix A.

To learn more about the Soil Fabrication Program, please visit
winnipeg.ca/soilfabrication

Soil Fabrication Program

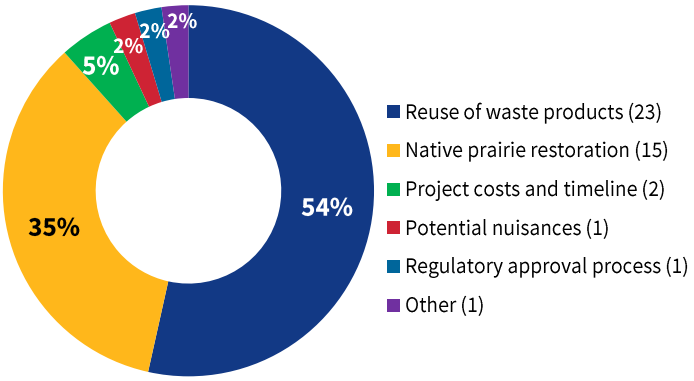
Public Engagement Summary

September 2020

What We Heard

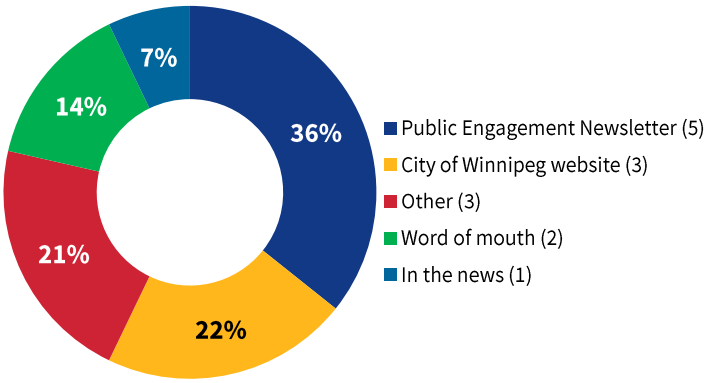
A quick poll was available for residents to provide feedback on what aspects of the project interested them the most. Respondents indicated that their primary interest was the reuse of waste products (54 percent), closely followed by native prairie restoration (35 percent).

Figure 2: What aspect of the project interests you the most?
(43 responses)



A second quick poll question asked residents how they heard about the project. Respondents indicated that the City's biweekly Public Engagement Newsletter (36 percent) was the top promotion method.

Figure 3: How did you hear about this project?
(14 responses)



The Q & A tool on the project webpage allowed residents to ask the project team questions or post comments. Responses to questions and comments were posted for all residents to see. The project team received six inquiries that can be organized into the following themes:

- Environmental regulations (2)
- Health and safety (2)
- City-wide composting program (2)

The health and safety theme included concerns over pathogens in the biosolids and pollutants in the street sweepings used to fabricate soil. Health and safety are a top priority for the City and the biosolids are treated to reduce pathogen levels, while the street sweepings are tested for quality and safety.

The environmental regulations theme included a question about alternatives if the soil fabrication program is not approved by the Province of Manitoba (Province). The City is currently pursuing other reuse programs for biosolids, including land application and composting, so the City can continue to beneficially reuse biosolids in other programs if approval is not granted.

A complete list of questions and responses from the Q & A tool can be found in Appendix B.

Next Steps

The City needs an Environmental Act Licence from the Province before beginning a long-term soil fabrication program. The City expects to apply for an Environment Act Licence to Manitoba Conservation and Climate in October 2020. Additional opportunities for public input will occur as part of the Province's regulatory review and approval process. More information on this process is available on the Manitoba Conservation and Climate's public registry.

After receiving an Environment Act Licence, the City plans to transition the three-year pilot program into a long-term program at the Summit Landfill in January 2021. The Summit Landfill cover is expected to take eight to ten years to complete.

Appendices

Appendix A – Promotional material
Appendix B – Q & A submissions

To learn more about the Soil Fabrication Program, please visit
winnipeg.ca/soilfabrication

Winnipeg

Appendix A – Promotional material

Soil fabrication program diverting biosolids and other waste from the landfill

City looks to make three year pilot program permanent

June 1, 2020

The City of Winnipeg is working to establish a native prairie landscape at a closed landfill using a rather unique method.

“We are using materials that could have otherwise ended up in the landfill,” said Becky Raddatz, Environmental Planner.

The soil fabrication pilot program has been going on for three years. It uses nutrient-rich biosolids, which are a solid by-product of wastewater treatment, woodchips primarily from trees impacted by Dutch Elm Disease and Emerald Ash Borer, and the sand and grit collected during the spring clean-up operation.

> “The mix’s ratio was carefully determined to meet regulatory and operational considerations.”

Heavy machinery is used to make windrows of the initial blend until ready to use. The process mostly takes place during the colder months while the ground is frozen.

When it warms up, the fabricated soil is spread on top of Summit Road Landfill on the northwest side of Winnipeg.

“This helps us establish a native prairie landscape as part of our management of the landfill,” said Chris Kosak, Supervisor of Environmental Monitoring and Reporting.

The City is now applying for an Environmental Act License to make the program permanent. The soil fabrication program also supports the goals of the City's Biosolids Master Plan.

"This soil fabrication program is part of our plan to manage biosolids, as well as the closed Summit Road Landfill, in an environmental, sustainable, and cost effective way," said Raddatz.

Residents are welcome to submit feedback to the City on the license application until September.

Parks, Trees and the Environment | Water and Waste

Facebook Post Example

Twitter Post Example

Appendix B – Q & A submissions

Questions & Comments

Visitors 76	Contributors 4	CONTRIBUTIONS 6

Q

User

04 June 20

What in the Water Protection Act specifically stopped the spread of the biosolids on agriculture land? Why doesn't it also apply to using biosolids in the stabilization of the riverbank too?

A

City of Winnipeg

The regulation in January 2011 did not stop the spreading of biosolids, rather the regulations prohibited land appli cation in winter and decreased the allowable application rate of biosolids to farmland in summer. The updated Wa ter Protection Act (Manitoba) also states that the City of Winnipeg wastewater biosolids must be beneficially reus ed and nutrients must be recovered and recycled to the maximum extent possible. In response to these regulatio ns the City did suspend its land application program and then adapted it to meet the new requirements. The City has since resumed spreading biosolids to farmland.The provincial regulations for spreading biosolids requires set backs from water bodies such as riverbanks. This is to prevent biosolids runoff into water bodies, and protect river s and Lake Winnipeg from algae blooms.

Questions & Comments

Q **User**

04 June 20

Isn’t even using some human poop (biosolids) a risky practice as it may contain disease-causing pathogens?

A **City of Winnipeg**

Using biosolids as a component in top cover for landfill has minimal risk to human health, provided all regulations are followed. The biosolids are treated at the treatment plant to reduce pathogens to levels accepted by the Provi nce of Manitoba before it is mixed into a soil at the landfill site. Summit Landfill is being used as the site for soil fa brication in part because it is a closed landfill with controlled access. Additionally, there is surface water runoff co ntainment and vector control so that human health and safety are protected. The soil is not being used to grow fo od, and the potential risks are being minimized by:Reducing pathogens at the treatment plant. Restricting people’ s access to the site. Not having opportunities to touch the soil.Not having opportunities to touch water that has co ntacted the soil.Not having opportunities ingest the soil from food.

Q **User**

04 June 20

What if seeking provincial approval in the fall for this undertaking isn’t approved?

A **City of Winnipeg**

In 2014 the City completed the Biosolids Master Plan, which recommends multiple strategies to beneficially reuse biosolids. The City is currently pursuing three beneficial reuse strategies for biosolids:Land applicationSoil fabricat ionCompostingIf the City does not receive provincial approval to operate a long term soil fabrication program in 20 21, the City can continue to beneficially reuse biosolids through its land application and composting programs. Bi osolids will be landfilled during times the other beneficial use options are not available.

Questions & Comments

Q **User**

04 June 20

Can this project be used to prove the efficacy of starting city-wide composting for residents? It's time we join othe r major cities and start composting? The City of Winnipeg buys tons of dirt and soil every year, and we could offs et collection costs by making our own soil, not to mention lower garbage collection and disposal (landfill) costs. N ot to mention, could sell excess soil to residents and businesses, BIZs, etc.

A **City of Winnipeg**

Unfortunately, this project will not be able to prove efficacy of a city-wide composting program as soil fabrication a nd composting are two different things and the materials they are comprised of are collected, transported and pro cessed in different ways. Composting is a biological process that requires a carbon source (like woodchips) and a nitrogen source (like biosolids), but does not require a mineral source (street sweepings). Soil fabrication requires a mineral source and is a physical mixing process. Furthermore, compost is something that is added to soil and d oes not support sustained vegetation on its own, whereas fabricated soil can support vegetation.The City does, h owever, have several composting programs that help divert waste from the landfill. We compost biosolids and us e the material for cap improvements at the Brady Road Resource Management Facility (BRRMF). We collect the leaf and yard waste from residents and compost what we collect. The compost from this program is used in City parks, riverbank stabilization projects, cap improvements for closed landfills and landscaping at BRRMF. It is als o sold to large soil companies and given away to community gardens and to residents through the City's annual c ompost giveaway. In fall of 2020, the City will start a two-year residential food waste collection pilot project as p art of our Organics Diversion Strategy. Please visit winnipeg.ca/organics for more information on the Organics Di version Strategy, with more detailed information on the residential food collection pilot to come in summer 2020.

Questions & Comments

Q **User**
18 June 20

Petroleum by-products: rubber, oil drippings, polluted tailpipe effluent, and more are all a part of your "street swe epings". Perhaps you should re-think this aspect of your soil re-generation to include cleaner biota.

A **City of Winnipeg**

We appreciate your concern regarding the use of street sweepings in our soils. Quality and safety of our feedstoc ks for our soil recipe is a priority. The City has conducted lab and bench-scale tests to determine if street sweepin gs would be a safe and effective ingredient for our soil. The testing results suggest it is suitable, safe, and would help produce quality soil. High soil quality is one of the key measures of success for the pilot program. For that r eason, the City is testing the quality of finished soil, both before being applied and after it has been spread and ve getated. To date, the fabricated soil has met all the requirements for the Canadian Council of Ministers of the Env ironment (CCME) Industrial Soils Guidelines, which are the criteria approved by Manitoba Conservation and Clim ate for this pilot program.

Q **User**
04 September 20

I believe it would be a great asistance to Winnipeggers if the City of Winnipeg plant shredding staff and equipme nt use were made to gardeners at harvest time so that their "waste" may be put back into the backyard gardens t hat help feed our most vulnerable.

A **City of Winnipeg**

The City of Winnipeg collects yard waste from residents during the warmer weather months. The collected yard w aste is processed into compost, which is used in City landscaping projects and given away to residents through o ur annual compost giveaway. For more information on the annual compost giveaway, please visit https://winnipeg .ca/waterandwaste/yardwaste/event.stm.

APPENDIX I

SURFACE WATER SAMPLING AND ANALYSIS PLAN

Appendix I - Soil Sampling Results
Summit Soil Fabrication Pilot Project

Sample No.	Description	Date	METALS															
			Aluminum (Al)	Antimony (Sb)	Arsenic (As)	Barium (Ba)	Beryllium (Be)	Bismuth (Bi)	Boron (B)	Cadmium (Cd)	Calcium (Ca)	Chromium (Cr)	Cobalt (Co)	Copper (Cu)	Iron (Fe)	Lead (Pb)	Magnesium (Mg)	Manganese (Mn)	Mercury
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
CCME GUIDELINES (INDUSTRIAL)				40	12	2000	8		N/A	22		87	300	91		600			50
SPREAD #1 (Beaverhuts)	Y1P1 Test Plot	6/18/2018	3590	0.72	1.88	55	0.14	1.66	<10	0.329	92400	47	2.98	61.6	11200	14.3	39400	184	0.0853
SPREAD #2 (Excavator Mix)	Y1P1 Test Plot	6/18/2018	6940	0.64	3.39	89.1	0.31	0.9	11	0.272	91000	45.9	4.64	43.5	12300	69.4	37300	244	0.101
SS18-1	Y1P1 Test Plot	6/24/2020	6350	73	2.84	80.8	0.33	1.39	14	0.303	96400	35	3.97	47.5	11300	19.3	35200	214	0.0772

Sample No.	Description	Date	METALS													
			Molybdenum (Mo)	Nickel (Ni)	Phosphorus (P)	Potassium (K)	Selenium (Se)	Silver (Ag)	Sodium (Na)	Strontium (Sr)	Thallium (Tl)	Tin (Sn)	Titanium (Ti)	Uranium (U)	Vanadium (V)	Zinc (Zn)
Units			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
CCME GUIDELINES (INDUSTRIAL)			40	89			2.9	40			1	300		300	130	410
SPREAD #1 (Beaverhuts)	Y1P1 Test Plot	6/18/2018	2.01	15.4	2060	1190	<0.50	0.63	460	56.4	<0.10	<5.0	53.6	1.29	13	213
SPREAD #2 (Excavator Mix)	Y1P1 Test Plot	6/18/2018	1.48	17	1190	1750	<0.50	0.42	576	62.9	<0.10	<5.0	80.7	1.23	23.2	149
SS18-1	Y1P1 Test Plot	6/24/2020	1.53	19	1450	1770	<0.50	0.53	379	78	0.11	<5.0	63.7	1.51	20.5	164

CCME Soil Quality Guidelines for the Protection of Environmental and Human Health - Industrial Standards.

Exceedances of CCME - Highlighted in Yellow

* Detection Limit Raised: Dilution required due to high concentration of test analyte(s)

Sample No.	Description	Date	Parameters													
			Loss on Ignition @ 375 C	Moisture	Organic Matter	pH (1:1 soil:water)	Total Kjeldahl Nitrogen	Total Organic Carbon	C:N Ratio	Available Ammonium-N	Available Nitrate-N	Available Phosphate-P	Available Potassium	Available Sulfate-S	Conductivity Sat. Paste	% Saturation
Units			%	%	%	pH units	%	%		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	dS/m	%
CCME GUIDELINES (INDUSTRIAL)																
CCME GUIDELINES (AGRICULTURAL)																
SPREAD #1 (Beaverhuts)	Y1P1 Test Plot	6/18/2018	7.5	25.7	6.1	6.85	0.347	6.58		333 *	1.1	125 *	540 *	444	8.48	63
SPREAD #2 (Excavator Mix)	Y1P1 Test Plot	6/18/2018	6.3	18.6	5.2	6.96	0.279	6.37		277 *	14.5	101 *	490 *	389	7.16	53
SS18-1	Y1P1 Test Plot	6/24/2020	7.1	27.4	5.8	7.56	0.35	6.05		4.9	10.8	98	656	281	4.3	55.7

City of Winnipeg - Solid Waste Services Div
(1120 Waverley)
ATTN: CHRIS KOZAK
Solid Waste Services Division
1120 Waverley Street
Winnipeg MB R3T 0P4

Date Received: 19-JUN-18
Report Date: 19-JUL-18 12:19 (MT)
Version: FINAL REV. 2

Client Phone: 204-986-2384

Certificate of Analysis

Lab Work Order #: L2115629

Project P.O. #: NOT SUBMITTED
Job Reference: BRADY
C of C Numbers:
Legal Site Desc:

Comments: ADDITIONAL 17-JUL-18 14:00

Hua Wo
Chemistry Laboratory Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2115629-1 SPREAD#1							
Sampled By: CLIENT on 18-JUN-18 @ 11:15							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	6.58		0.050	%		19-JUL-18	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.347		0.060	%	25-JUN-18	26-JUN-18	R4098327
Miscellaneous Parameters							
Available Ammonium-N	333	DLHC	20	mg/kg	26-JUN-18	26-JUN-18	R4097828
Conductivity Sat. Paste	8.48		0.10	dS m-1	25-JUN-18	26-JUN-18	R4097785
Mercury (Hg)	0.0853		0.0050	mg/kg	25-JUN-18	18-JUL-18	R4105452
% Moisture	25.7		0.10	%	28-JUN-18	28-JUN-18	R4101848
% Saturation	63.0		1.0	%	25-JUN-18	26-JUN-18	R4097785
pH in Saturated Paste	6.85		0.10	pH	25-JUN-18	26-JUN-18	R4097785
Organic Matter by LOI at 375 deg C.							
Organic Matter	6.1		1.0	%	25-JUN-18	26-JUN-18	R4097540
Loss on Ignition @ 375 C	7.5		1.0	%	25-JUN-18	26-JUN-18	R4097540
Metals							
Aluminum (Al)	3590		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Antimony (Sb)	0.72		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Arsenic (As)	1.88		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Barium (Ba)	55.0		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Beryllium (Be)	0.14		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Bismuth (Bi)	1.66		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Boron (B)	<10		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cadmium (Cd)	0.329		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Calcium (Ca)	92400		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Chromium (Cr)	47.0		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cobalt (Co)	2.98		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Copper (Cu)	61.6		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Iron (Fe)	11200		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Lead (Pb)	14.3		0.20	mg/kg	25-JUN-18	25-JUN-18	R4097041
Magnesium (Mg)	39400		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Manganese (Mn)	184		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Molybdenum (Mo)	2.01		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Nickel (Ni)	15.4		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Phosphorus (P)	2060		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Potassium (K)	1190		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Selenium (Se)	<0.50		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Silver (Ag)	0.63		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Sodium (Na)	460		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Strontium (Sr)	56.4		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Thallium (Tl)	<0.10		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Tin (Sn)	<5.0		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Titanium (Ti)	53.6		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Uranium (U)	1.29		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Vanadium (V)	13.0		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Zinc (Zn)	213		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	1.1		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097276
Available Sulfate-S							
Available Sulfate-S	444		4.0	mg/kg	26-JUN-18	26-JUN-18	R4100420

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2115629-1 SPREAD#1							
Sampled By: CLIENT on 18-JUN-18 @ 11:15							
Matrix: SOIL							
Plant Available Phosphorus and Potassium							
Available Phosphate-P	125	DLHC	10	mg/kg	25-JUN-18	25-JUN-18	R4096889
Available Potassium	540	DLHC	100	mg/kg	25-JUN-18	25-JUN-18	R4096889
L2115629-2 SPREAD#2							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	6.37		0.050	%		19-JUL-18	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.279		0.060	%	25-JUN-18	26-JUN-18	R4098327
Miscellaneous Parameters							
Available Ammonium-N	277	DLHC	20	mg/kg	26-JUN-18	26-JUN-18	R4097828
Conductivity Sat. Paste	7.16		0.10	dS m-1	25-JUN-18	26-JUN-18	R4097785
Mercury (Hg)	0.101		0.0050	mg/kg	25-JUN-18	18-JUL-18	R4105452
% Moisture	18.6		0.10	%	28-JUN-18	28-JUN-18	R4101848
% Saturation	53.0		1.0	%	25-JUN-18	26-JUN-18	R4097785
pH in Saturated Paste	6.96		0.10	pH	25-JUN-18	26-JUN-18	R4097785
Organic Matter by LOI at 375 deg C.							
Organic Matter	5.2		1.0	%	25-JUN-18	26-JUN-18	R4097540
Loss on Ignition @ 375 C	6.3		1.0	%	25-JUN-18	26-JUN-18	R4097540
Metals							
Aluminum (Al)	6940		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Antimony (Sb)	0.64		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Arsenic (As)	3.39		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Barium (Ba)	89.1		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Beryllium (Be)	0.31		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Bismuth (Bi)	0.900		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Boron (B)	11		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cadmium (Cd)	0.272		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Calcium (Ca)	91000		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Chromium (Cr)	45.9		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cobalt (Co)	4.64		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Copper (Cu)	43.5		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Iron (Fe)	12300		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Lead (Pb)	69.4		0.20	mg/kg	25-JUN-18	25-JUN-18	R4097041
Magnesium (Mg)	37300		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Manganese (Mn)	244		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Molybdenum (Mo)	1.48		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Nickel (Ni)	17.0		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Phosphorus (P)	1190		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Potassium (K)	1750		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Selenium (Se)	<0.50		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Silver (Ag)	0.42		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Sodium (Na)	576		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Strontium (Sr)	62.9		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Thallium (Tl)	<0.10		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Tin (Sn)	<5.0		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Titanium (Ti)	80.7		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Uranium (U)	1.23		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Vanadium (V)	23.2		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2115629-2 SPREAD#2							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Metals							
Zinc (Zn)	149		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	14.5		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097276
Available Sulfate-S							
Available Sulfate-S	389		4.0	mg/kg	26-JUN-18	26-JUN-18	R4100420
Plant Available Phosphorus and Potassium							
Available Phosphate-P	101	DLHC	10	mg/kg	25-JUN-18	25-JUN-18	R4096889
Available Potassium	490	DLHC	100	mg/kg	25-JUN-18	25-JUN-18	R4096889
L2115629-3 T1							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	12.4		0.050	%		19-JUL-18	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.99	DLHC	0.20	%	25-JUN-18	26-JUN-18	R4098327
Miscellaneous Parameters							
Available Ammonium-N	13.3		1.0	mg/kg	26-JUN-18	26-JUN-18	R4097828
Conductivity Sat. Paste	7.64		0.10	dS m-1	25-JUN-18	26-JUN-18	R4097785
Mercury (Hg)	0.0540		0.0050	mg/kg	25-JUN-18	18-JUL-18	R4105452
% Moisture	30.7		0.10	%	28-JUN-18	28-JUN-18	R4101848
% Saturation	130		1.0	%	25-JUN-18	26-JUN-18	R4097785
pH in Saturated Paste	7.63		0.10	pH	25-JUN-18	26-JUN-18	R4097785
Organic Matter by LOI at 375 deg C.							
Organic Matter	15.4		1.0	%	25-JUN-18	26-JUN-18	R4097540
Loss on Ignition @ 375 C	19.4		1.0	%	25-JUN-18	26-JUN-18	R4097540
Metals							
Aluminum (Al)	16500		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Antimony (Sb)	0.44		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Arsenic (As)	6.33		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Barium (Ba)	175		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Beryllium (Be)	0.74		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Bismuth (Bi)	0.482		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Boron (B)	28		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cadmium (Cd)	0.306		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Calcium (Ca)	40400		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Chromium (Cr)	35.0		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cobalt (Co)	10.9		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Copper (Cu)	39.2		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Iron (Fe)	21200		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Lead (Pb)	14.7		0.20	mg/kg	25-JUN-18	25-JUN-18	R4097041
Magnesium (Mg)	20200		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Manganese (Mn)	485		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Molybdenum (Mo)	1.05		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Nickel (Ni)	28.9		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Phosphorus (P)	1970		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Potassium (K)	6770		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Selenium (Se)	<0.50		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Silver (Ag)	0.24		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2115629-3 T1							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Metals							
Sodium (Na)	519		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Strontium (Sr)	98.8		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Thallium (Tl)	0.21		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Tin (Sn)	<5.0		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Titanium (Ti)	83.0		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Uranium (U)	1.48		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Vanadium (V)	46.6		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Zinc (Zn)	108		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	87.4	DLHC	5.0	mg/kg	25-JUN-18	25-JUN-18	R4097276
Available Sulfate-S							
Available Sulfate-S	791	DLHC	8.0	mg/kg	26-JUN-18	26-JUN-18	R4100420
Plant Available Phosphorus and Potassium							
Available Phosphate-P	320	DLHC	20	mg/kg	25-JUN-18	25-JUN-18	R4096889
Available Potassium	2610	DLHC	200	mg/kg	25-JUN-18	25-JUN-18	R4096889
L2115629-4 T2							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	7.37		0.050	%		19-JUL-18	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.57	DLHC	0.20	%	25-JUN-18	26-JUN-18	R4098327
Miscellaneous Parameters							
Available Ammonium-N	702	DLHC	80	mg/kg	26-JUN-18	26-JUN-18	R4097828
Conductivity Sat. Paste	5.98		0.10	dS m-1	25-JUN-18	26-JUN-18	R4097785
Mercury (Hg)	0.0751		0.0050	mg/kg	25-JUN-18	18-JUL-18	R4105452
% Moisture	35.9		0.10	%	28-JUN-18	28-JUN-18	R4101848
% Saturation	109		1.0	%	25-JUN-18	26-JUN-18	R4097785
pH in Saturated Paste	7.12		0.10	pH	25-JUN-18	26-JUN-18	R4097785
Organic Matter by LOI at 375 deg C.							
Organic Matter	11.4		1.0	%	25-JUN-18	26-JUN-18	R4097540
Loss on Ignition @ 375 C	14.2		1.0	%	25-JUN-18	26-JUN-18	R4097540
Metals							
Aluminum (Al)	19700		500	mg/kg	25-JUN-18	25-JUN-18	R4097041
Antimony (Sb)	0.64		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Arsenic (As)	9.08		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Barium (Ba)	181		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Beryllium (Be)	0.98		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Bismuth (Bi)	0.994		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Boron (B)	11		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cadmium (Cd)	0.330		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Calcium (Ca)	36200		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Chromium (Cr)	45.6		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cobalt (Co)	12.2		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Copper (Cu)	53.5		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Iron (Fe)	30100		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Lead (Pb)	15.8		0.20	mg/kg	25-JUN-18	25-JUN-18	R4097041
Magnesium (Mg)	20600		10	mg/kg	25-JUN-18	25-JUN-18	R4097041

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2115629-4 T2							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Metals							
Manganese (Mn)	434		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Molybdenum (Mo)	1.67		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Nickel (Ni)	38.3		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Phosphorus (P)	1590		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Potassium (K)	4280		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Selenium (Se)	0.79		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Silver (Ag)	0.43		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Sodium (Na)	552		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Strontium (Sr)	78.1		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Thallium (Tl)	0.28		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Tin (Sn)	<5.0		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Titanium (Ti)	81.1		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Uranium (U)	2.44		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Vanadium (V)	60.7		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Zinc (Zn)	143		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	4.0		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097276
Available Sulfate-S							
Available Sulfate-S	885	DLHC	8.0	mg/kg	26-JUN-18	26-JUN-18	R4100420
Plant Available Phosphorus and Potassium							
Available Phosphate-P	96	DLHC	10	mg/kg	25-JUN-18	25-JUN-18	R4096889
Available Potassium	920	DLHC	100	mg/kg	25-JUN-18	25-JUN-18	R4096889
L2115629-5 T3							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	4.45		0.050	%		19-JUL-18	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.25	DLHC	0.10	%	25-JUN-18	26-JUN-18	R4098327
Miscellaneous Parameters							
Available Ammonium-N	194	DLHC	20	mg/kg	26-JUN-18	26-JUN-18	R4097828
Conductivity Sat. Paste	4.05		0.10	dS m-1	25-JUN-18	26-JUN-18	R4097785
Mercury (Hg)	0.0748		0.0050	mg/kg	25-JUN-18	18-JUL-18	R4105452
% Moisture	35.0		0.10	%	28-JUN-18	28-JUN-18	R4101848
% Saturation	99.0		1.0	%	25-JUN-18	26-JUN-18	R4097785
pH in Saturated Paste	7.41		0.10	pH	25-JUN-18	26-JUN-18	R4097785
Organic Matter by LOI at 375 deg C.							
Organic Matter	7.4		1.0	%	25-JUN-18	26-JUN-18	R4097540
Loss on Ignition @ 375 C	9.1		1.0	%	25-JUN-18	26-JUN-18	R4097540
Metals							
Aluminum (Al)	19700		500	mg/kg	25-JUN-18	25-JUN-18	R4097041
Antimony (Sb)	0.60		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Arsenic (As)	7.98		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Barium (Ba)	167		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Beryllium (Be)	0.87		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Bismuth (Bi)	0.988		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Boron (B)	13		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cadmium (Cd)	0.308		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2115629-5 T3							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Metals							
Calcium (Ca)	40000		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Chromium (Cr)	43.8		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cobalt (Co)	11.3		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Copper (Cu)	51.9		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Iron (Fe)	26900		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Lead (Pb)	15.1		0.20	mg/kg	25-JUN-18	25-JUN-18	R4097041
Magnesium (Mg)	22600		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Manganese (Mn)	437		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Molybdenum (Mo)	1.41		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Nickel (Ni)	33.7		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Phosphorus (P)	1580		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Potassium (K)	4370		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Selenium (Se)	<0.50		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Silver (Ag)	0.45		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Sodium (Na)	528		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Strontium (Sr)	73.9		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Thallium (Tl)	0.26		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Tin (Sn)	<5.0		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Titanium (Ti)	109		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Uranium (U)	1.86		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Vanadium (V)	59.8		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Zinc (Zn)	129		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	14.7		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097276
Available Sulfate-S							
Available Sulfate-S	453		4.0	mg/kg	26-JUN-18	26-JUN-18	R4100420
Plant Available Phosphorus and Potassium							
Available Phosphate-P	34.6	DLHC	2.0	mg/kg	25-JUN-18	25-JUN-18	R4096889
Available Potassium	672	DLHC	40	mg/kg	25-JUN-18	25-JUN-18	R4096889
L2115629-6 T4							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	5.09		0.050	%		19-JUL-18	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.28	DLHC	0.10	%	25-JUN-18	26-JUN-18	R4098327
Miscellaneous Parameters							
Available Ammonium-N	20.6	DLHC	2.0	mg/kg	26-JUN-18	26-JUN-18	R4097828
Conductivity Sat. Paste	5.57		0.10	dS m-1	25-JUN-18	26-JUN-18	R4097785
Mercury (Hg)	0.0677		0.0050	mg/kg	25-JUN-18	18-JUL-18	R4105452
% Moisture	21.5		0.10	%	28-JUN-18	28-JUN-18	R4101848
% Saturation	100		1.0	%	25-JUN-18	26-JUN-18	R4097785
pH in Saturated Paste	6.64		0.10	pH	25-JUN-18	26-JUN-18	R4097785
Organic Matter by LOI at 375 deg C.							
Organic Matter	7.8		1.0	%	25-JUN-18	26-JUN-18	R4097540
Loss on Ignition @ 375 C	9.6		1.0	%	25-JUN-18	26-JUN-18	R4097540
Metals							
Aluminum (Al)	18300		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2115629-6 T4							
Sampled By: CLIENT on 18-JUN-18 @ 10:30							
Matrix: SOIL							
Metals							
Antimony (Sb)	0.66		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Arsenic (As)	7.39		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Barium (Ba)	173		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Beryllium (Be)	0.79		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Bismuth (Bi)	1.28		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Boron (B)	13		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cadmium (Cd)	0.399		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Calcium (Ca)	59500		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Chromium (Cr)	43.7		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Cobalt (Co)	11.3		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Copper (Cu)	57.5		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Iron (Fe)	26400		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Lead (Pb)	15.5		0.20	mg/kg	25-JUN-18	25-JUN-18	R4097041
Magnesium (Mg)	30900		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Manganese (Mn)	466		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Molybdenum (Mo)	1.70		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Nickel (Ni)	34.2		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Phosphorus (P)	1910		100	mg/kg	25-JUN-18	25-JUN-18	R4097041
Potassium (K)	3940		25	mg/kg	25-JUN-18	25-JUN-18	R4097041
Selenium (Se)	<0.50		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Silver (Ag)	0.54		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Sodium (Na)	505		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Strontium (Sr)	85.8		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Thallium (Tl)	0.25		0.10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Tin (Sn)	<5.0		5.0	mg/kg	25-JUN-18	25-JUN-18	R4097041
Titanium (Ti)	103		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Uranium (U)	2.08		0.020	mg/kg	25-JUN-18	25-JUN-18	R4097041
Vanadium (V)	54.1		0.50	mg/kg	25-JUN-18	25-JUN-18	R4097041
Zinc (Zn)	146		10	mg/kg	25-JUN-18	25-JUN-18	R4097041
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	12.6		1.0	mg/kg	25-JUN-18	25-JUN-18	R4097276
Available Sulfate-S							
Available Sulfate-S	859	DLHC	8.0	mg/kg	26-JUN-18	26-JUN-18	R4100420
Plant Available Phosphorus and Potassium							
Available Phosphate-P	63.2	DLHC	4.0	mg/kg	25-JUN-18	25-JUN-18	R4096889
Available Potassium	548	DLHC	40	mg/kg	25-JUN-18	25-JUN-18	R4096889

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217

A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.

C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2

Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)

C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2

The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.

EC-SAR-SK	Soil	EC (Saturated Paste)	CSSS 18.2.2/CSSS 18.3.1

After saturated soil paste equilibrium, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.

HG-200.2-CVAF-WP	Soil	Mercury in Soil by CVAFS	EPA 200.2/1631E (mod)

Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAFS.

IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-MS-WP	Soil	Metals	EPA 200.2/6020A

Samples for analysis are homogenized, dried at 60 degrees Celsius, sieved through a 2 mm (10 mesh) sieve, and a representative subsample of the dry material is weighed. The sample is then digested by block digester (EPA 200.2). Instrumental analysis is by inductively coupled plasma - mass spectrometry (EPA Method 6020A).

Method Limitation: This method is not a total digestion technique. It is a very strong acid digestion that is intended to dissolve those metals that may become "environmentally available." By design, elements bound in silicate structures are not normally dissolved by this procedure as they are not usually mobile in the environment.

MOIST-SK	Soil	Moisture Content	CWS for PHC in Soil - Tier 1

The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.

N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3

The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.

NH4-AVAIL-SK	Soil	Available Ammonium-N	Comm Soil Sci 19(6)

Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.

NO3-AVAIL-SK	Soil	Available Nitrate-N	Method = Alberta Ag (1988)

Available Nitrate and Nitrite are extracted from the soil using a dilute calcium chloride solution.
Nitrate is quantitatively reduced to nitrite by passage of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm.

Reference:
Recommended Methods of Soil Analysis for Canadian Prairie Agricultural Soils. Alberta Agriculture (1988) p. 19 and 28

OM-LOI-SK	Soil	Organic Matter by LOI at 375 deg C.	CSSS (1978) p. 160

The dry-ash method involves the removal of organic matter by combustion at 375 degrees C for a minimum of 16 hours. Samples are dried prior to combustion.

Reference: McKeague, J.A. Soil Sampling and Methods of Analysis. Can. Soc. Soil Sci.(1978) method 4.23

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
PH-SAR-SK	Soil	pH (Saturated Paste)	CSSS 18.2.2/CSSC 3.14
pH of a saturated soil paste is measured using a pH meter. After equilibration, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.			
PO4/K-AVAIL-SK	Soil	Plant Available Phosphorus and Potassium	Comm. Soil Sci. Plant Anal, 25 (5&6)
Plant available phosphorus and potassium are extracted from the soil usng Modified Kelowna solution. Phosphorous in the soil extract is determined colorimetrically at 880 nm, while potassiumis determined by flame emission at 770 nm.			
SAT-PCNT-SK	Soil	Saturated Paste	CSSS (1993) 18.2.2
SO4-AVAIL-SK	Soil	Available Sulfate-S	REC METH SOIL ANAL - AB. AG(1988)
Plant available sulfate in the soil is extracted using a weak calcium chloride solution. Sulfate in the extract is determined by ICP-OES. This extraction may also produce organic sulfur in the extracts when organic soils are analyzed.			

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Workorder: L2115629 Report Date: 19-JUL-18

Client: City of Winnipeg - Solid Waste Services Div (1120 Waverley)
Solid Waste Services Division 1120 Waverley Street
Winnipeg MB R3T 0P4

Contact: CHRIS KOZAK

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R4132749								
WG2824722-2 LCS								
Inorganic Carbon			100.3		%		80-120	19-JUL-18
WG2824722-3 MB								
Inorganic Carbon			<0.050		%		0.05	19-JUL-18
C-TOT-LECO-SK	**Soil**							
Batch R4132747								
WG2825004-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			97.0		%		80-120	18-JUL-18
WG2825004-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			103.3		%		90-110	18-JUL-18
WG2825004-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	18-JUL-18
EC-SAR-SK	**Soil**							
Batch R4097785								
WG2805985-3 IRM		**SK-SAL-17**						
Conductivity Sat. Paste			93.8		%		80-120	26-JUN-18
WG2805985-5 LCS								
Conductivity Sat. Paste			100.0		%		80-120	26-JUN-18
WG2805985-2 MB								
Conductivity Sat. Paste			<0.10		dS m-1		0.1	26-JUN-18
HG-200.2-CVAF-WP	**Soil**							
Batch R4105452								
WG2808238-9 CRM		**CANMET TILL-1**						
Mercury (Hg)			101.7		%		70-130	29-JUN-18
WG2808238-7 LCS								
Mercury (Hg)			104.5		%		80-120	29-JUN-18
WG2808238-6 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	29-JUN-18
MET-200.2-MS-WP	**Soil**							
Batch R4097041								
WG2806249-4 CRM		**CANMET TILL-1**						
Aluminum (Al)			107.3		%		70-130	25-JUN-18
Antimony (Sb)			103.4		%		70-130	25-JUN-18
Arsenic (As)			104.1		%		70-130	25-JUN-18
Barium (Ba)			101.2		%		70-130	25-JUN-18
Beryllium (Be)			107.0		%		70-130	25-JUN-18
Bismuth (Bi)			104.9		%		70-130	25-JUN-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R4097041								
WG2806249-4 CRM		**CANMET TILL-1**						
Boron (B)			2		mg/kg		0-8	25-JUN-18
Cadmium (Cd)			105.1		%		70-130	25-JUN-18
Calcium (Ca)			94.8		%		70-130	25-JUN-18
Chromium (Cr)			101.3		%		70-130	25-JUN-18
Cobalt (Co)			103.7		%		70-130	25-JUN-18
Copper (Cu)			106.7		%		70-130	25-JUN-18
Iron (Fe)			103.6		%		70-130	25-JUN-18
Lead (Pb)			103.6		%		70-130	25-JUN-18
Magnesium (Mg)			107.0		%		70-130	25-JUN-18
Manganese (Mn)			104.0		%		70-130	25-JUN-18
Molybdenum (Mo)			101.1		%		70-130	25-JUN-18
Nickel (Ni)			101.8		%		70-130	25-JUN-18
Phosphorus (P)			98.9		%		70-130	25-JUN-18
Potassium (K)			91.4		%		70-130	25-JUN-18
Selenium (Se)			99.8		%		70-130	25-JUN-18
Silver (Ag)			109.5		%		70-130	25-JUN-18
Sodium (Na)			87.7		%		70-130	25-JUN-18
Strontium (Sr)			97.1		%		70-130	25-JUN-18
Thallium (Tl)			0.13		mg/kg		0.03-0.23	25-JUN-18
Tin (Sn)			1.0		mg/kg		0-3.1	25-JUN-18
Titanium (Ti)			84.0		%		70-130	25-JUN-18
Uranium (U)			101.1		%		70-130	25-JUN-18
Vanadium (V)			100.2		%		70-130	25-JUN-18
Zinc (Zn)			102.1		%		70-130	25-JUN-18
WG2806249-2 LCS								
Aluminum (Al)			106.2		%		80-120	25-JUN-18
Antimony (Sb)			104.8		%		80-120	25-JUN-18
Arsenic (As)			106.2		%		80-120	25-JUN-18
Barium (Ba)			105.9		%		80-120	25-JUN-18
Beryllium (Be)			108.7		%		80-120	25-JUN-18
Bismuth (Bi)			106.1		%		80-120	25-JUN-18
Boron (B)			107.4		%		80-120	25-JUN-18
Cadmium (Cd)			106.5		%		80-120	25-JUN-18
Calcium (Ca)			104.6		%		80-120	25-JUN-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R4097041								
WG2806249-2 LCS								
Chromium (Cr)			108.1		%		80-120	25-JUN-18
Cobalt (Co)			107.0		%		80-120	25-JUN-18
Copper (Cu)			107.4		%		80-120	25-JUN-18
Iron (Fe)			104.1		%		80-120	25-JUN-18
Lead (Pb)			103.3		%		80-120	25-JUN-18
Magnesium (Mg)			109.5		%		80-120	25-JUN-18
Manganese (Mn)			106.7		%		80-120	25-JUN-18
Molybdenum (Mo)			105.5		%		80-120	25-JUN-18
Nickel (Ni)			105.7		%		80-120	25-JUN-18
Phosphorus (P)			108.4		%		80-120	25-JUN-18
Potassium (K)			111.5		%		80-120	25-JUN-18
Selenium (Se)			104.0		%		80-120	25-JUN-18
Silver (Ag)			108.6		%		80-120	25-JUN-18
Sodium (Na)			107.5		%		80-120	25-JUN-18
Strontium (Sr)			106.9		%		80-120	25-JUN-18
Thallium (Tl)			103.4		%		80-120	25-JUN-18
Tin (Sn)			104.0		%		80-120	25-JUN-18
Titanium (Ti)			100.0		%		80-120	25-JUN-18
Uranium (U)			109.0		%		80-120	25-JUN-18
Vanadium (V)			108.7		%		80-120	25-JUN-18
Zinc (Zn)			105.0		%		80-120	25-JUN-18
WG2806249-1 MB								
Aluminum (Al)			<5.0		mg/kg		5	25-JUN-18
Antimony (Sb)			<0.10		mg/kg		0.1	25-JUN-18
Arsenic (As)			<0.10		mg/kg		0.1	25-JUN-18
Barium (Ba)			<0.50		mg/kg		0.5	25-JUN-18
Beryllium (Be)			<0.10		mg/kg		0.1	25-JUN-18
Bismuth (Bi)			<0.020		mg/kg		0.02	25-JUN-18
Boron (B)			<10		mg/kg		10	25-JUN-18
Cadmium (Cd)			<0.020		mg/kg		0.02	25-JUN-18
Calcium (Ca)			<100		mg/kg		100	25-JUN-18
Chromium (Cr)			<1.0		mg/kg		1	25-JUN-18
Cobalt (Co)			<0.020		mg/kg		0.02	25-JUN-18
Copper (Cu)			<1.0		mg/kg		1	25-JUN-18

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R4097041								
WG2806249-1 MB								
Iron (Fe)			<25		mg/kg		25	25-JUN-18
Lead (Pb)			<0.20		mg/kg		0.2	25-JUN-18
Magnesium (Mg)			<10		mg/kg		10	25-JUN-18
Manganese (Mn)			<0.50		mg/kg		0.5	25-JUN-18
Molybdenum (Mo)			<0.10		mg/kg		0.1	25-JUN-18
Nickel (Ni)			<0.50		mg/kg		0.5	25-JUN-18
Phosphorus (P)			<100		mg/kg		100	25-JUN-18
Potassium (K)			<25		mg/kg		25	25-JUN-18
Selenium (Se)			<0.50		mg/kg		0.5	25-JUN-18
Silver (Ag)			<0.10		mg/kg		0.1	25-JUN-18
Sodium (Na)			<10		mg/kg		10	25-JUN-18
Strontium (Sr)			<0.10		mg/kg		0.1	25-JUN-18
Thallium (Tl)			<0.10		mg/kg		0.1	25-JUN-18
Tin (Sn)			<5.0		mg/kg		5	25-JUN-18
Titanium (Ti)			<0.50		mg/kg		0.5	25-JUN-18
Uranium (U)			<0.020		mg/kg		0.02	25-JUN-18
Vanadium (V)			<0.50		mg/kg		0.5	25-JUN-18
Zinc (Zn)			<10		mg/kg		10	25-JUN-18
MOIST-SK	**Soil**							
Batch R4101848								
WG2807666-3 LCS								
% Moisture			99.7		%		90-110	28-JUN-18
WG2807666-2 MB								
% Moisture			<0.10		%		0.1	28-JUN-18
N-TOTKJ-COL-SK	**Soil**							
Batch R4098327								
WG2804441-1 DUP		**L2115629-1**						
Total Kjeldahl Nitrogen		0.347	0.349		%	0.4	20	26-JUN-18
WG2804441-2 IRM		**08-109_SOIL**						
Total Kjeldahl Nitrogen			90.6		%		80-120	26-JUN-18
WG2804441-3 MB								
Total Kjeldahl Nitrogen			<0.020		%		0.02	26-JUN-18
NH4-AVAIL-SK	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH4-AVAIL-SK	**Soil**							
Batch R4097828								
WG2806962-1 DUP		**L2115629-4**						
Available Ammonium-N		702	711		mg/kg	1.3	20	26-JUN-18
WG2806962-3 IRM		**SAL814**						
Available Ammonium-N			96.5		%		70-130	26-JUN-18
WG2806962-2 MB								
Available Ammonium-N			<1.0		mg/kg		1	26-JUN-18
NO3-AVAIL-SK	**Soil**							
Batch R4097276								
WG2805960-1 DUP		**L2115629-5**						
Available Nitrate-N		14.7	15.3		mg/kg	4.1	30	25-JUN-18
WG2805960-3 IRM		**SAL814**						
Available Nitrate-N			92.5		%		70-130	25-JUN-18
WG2805960-2 MB								
Available Nitrate-N			<1.0		mg/kg		1	25-JUN-18
OM-LOI-SK	**Soil**							
Batch R4097540								
WG2804456-1 DUP		**L2115629-5**						
Organic Matter		7.4	7.2		%	2.3	20	26-JUN-18
Loss on Ignition @ 375 C		9.1	8.9		%	2.4	25	26-JUN-18
WG2804456-3 IRM		**SAL2001**						
Organic Matter			104.7		%		80-120	26-JUN-18
Loss on Ignition @ 375 C			104.6		%		80-120	26-JUN-18
WG2804456-2 MB								
Organic Matter			<1.0		%		1	26-JUN-18
Loss on Ignition @ 375 C			<1.0		%		1	26-JUN-18
PH-SAR-SK	**Soil**							
Batch R4097785								
WG2805985-3 IRM		**SK-SAL-17**						
pH in Saturated Paste			7.57		pH		7.38-7.98	26-JUN-18
WG2805985-5 LCS								
pH in Saturated Paste			6.92		pH		6.66-7.06	26-JUN-18
PO4/K-AVAIL-SK	**Soil**							
Batch R4096889								
WG2805979-1 DUP		**L2115629-3**						
Available Phosphate-P		320	302		mg/kg	5.7	30	25-JUN-18
Available Potassium		2610	3080		mg/kg	17	30	25-JUN-18
WG2805979-3 IRM		**FARM2005**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4/K-AVAIL-SK	**Soil**							
Batch R4096889								
WG2805979-3 IRM		**FARM2005**						
Available Phosphate-P			100.5		%		70-130	25-JUN-18
Available Potassium			105.4		%		70-130	25-JUN-18
WG2805979-2 MB								
Available Phosphate-P			<2.0		mg/kg		2	25-JUN-18
Available Potassium			<20		mg/kg		20	25-JUN-18
SAT-PCNT-SK	**Soil**							
Batch R4097785								
WG2805985-3 IRM		**SK-SAL-17**						
% Saturation			103.9		%		80-120	26-JUN-18
WG2805985-5 LCS								
% Saturation			104.0		%		80-120	26-JUN-18
SO4-AVAIL-SK	**Soil**							
Batch R4100420								
WG2805975-1 DUP		**L2115629-5**						
Available Sulfate-S		453	463		mg/kg	2.1	40	26-JUN-18
WG2805975-3 IRM		**SAL814**						
Available Sulfate-S			89.9		%		70-130	26-JUN-18
WG2805975-2 MB								
Available Sulfate-S			<4.0		mg/kg		4	26-JUN-18

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Quality Control Report

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Organic / Inorganic Carbon							
Inorganic Carbon as CaCO3 Equivalent							
	1	18-JUN-18 11:15	19-JUL-18 11:26	28	31	days	EHT
	2	18-JUN-18 10:30	19-JUL-18 11:26	28	31	days	EHT
	3	18-JUN-18 10:30	19-JUL-18 11:26	28	31	days	EHT
	4	18-JUN-18 10:30	19-JUL-18 11:26	28	31	days	EHT
	5	18-JUN-18 10:30	19-JUL-18 11:26	28	31	days	EHT
	6	18-JUN-18 10:30	19-JUL-18 11:26	28	31	days	EHT
Total Carbon by combustion method							
	1	18-JUN-18 11:15	18-JUL-18 00:00	28	30	days	EHT
	2	18-JUN-18 10:30	18-JUL-18 00:00	28	30	days	EHT
	3	18-JUN-18 10:30	18-JUL-18 00:00	28	30	days	EHT
	4	18-JUN-18 10:30	18-JUL-18 00:00	28	30	days	EHT
	5	18-JUN-18 10:30	18-JUL-18 00:00	28	30	days	EHT
	6	18-JUN-18 10:30	18-JUL-18 00:00	28	30	days	EHT
Total Inorganic Carbon in Soil							
	1	18-JUN-18 11:15	19-JUL-18 10:00	28	31	days	EHT
	2	18-JUN-18 10:30	19-JUL-18 10:00	28	31	days	EHT
	3	18-JUN-18 10:30	19-JUL-18 10:00	28	31	days	EHT
	4	18-JUN-18 10:30	19-JUL-18 10:00	28	31	days	EHT
	5	18-JUN-18 10:30	19-JUL-18 10:00	28	31	days	EHT
	6	18-JUN-18 10:30	19-JUL-18 10:00	28	31	days	EHT
Plant Available Nutrients							
Available Nitrate-N							
	1	18-JUN-18 11:15	25-JUN-18 17:48	3	7	days	EHT
	2	18-JUN-18 10:30	25-JUN-18 17:48	3	7	days	EHT
	3	18-JUN-18 10:30	25-JUN-18 17:48	3	7	days	EHT
	4	18-JUN-18 10:30	25-JUN-18 17:48	3	7	days	EHT
	5	18-JUN-18 10:30	25-JUN-18 17:48	3	7	days	EHT
	6	18-JUN-18 10:30	25-JUN-18 17:48	3	7	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2115629 were received on 19-JUN-18 14:25.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chris Kozak, COW

Q67-3177

CAC . 19°C
19-Jun-18 2:25PM

PRO\ L2115629-COFC DFILLS

UNIT PRICES

ITEM NO.	DESCRIPTION	SPEC. REF.	UNIT	APPROX. QUANTITY	UNIT PRICE	AMOUNT
51.	Microbiological Parameters in water	E8.1	each	10	40.50	405
52.	Anions in water	E8.2	each	10	14	140
53.	Total Mercury in water	E8.3	each	10	17	170
54.	Hexavalent Chromium in water	E8.4	each	10	15	150
55.	Volatile Organic Compounds in water	E8.5	each	10	50	500
56.	Phenol in water	E8.6	each	10	15	150
57.	Organic/Inorganic Carbon in water	E8.7	each	10	25	250
58.	Petroleum Hydrocarbons in water	E8.8	each	10	55	550
SECTION G (Fabricated Soil Surface Water)						
59.	Nutrients in water	E9.1	each	20	51	1020

+ T1 19Jun

					82	492
					18	108
					25	150
					60	360
					102	612
					96	576
					42	252

Spread #1 - S.F 18 " 2 18.1
06/18/18 @ 11.15 " 3
Spread #2 S.F 18
06/18/18 @ 10.30 " 4

SECTION I (Fabricated Soil)						
67.	Inorganics in soil	E11.1	each	20	50	1000
68.	Nutrients in soil	E11.2	each	20	60	1200
69.	Soluble parameters in soil	E11.3	each	20	41	820
70.	Physical Properties in soil	E11.4	each	20	0	0
71.	Elements in soil	E11.5	each	20	25	500

City of Winnipeg - Solid Waste Services Div
(1120 Waverley)
ATTN: CHRIS KOZAK
Solid Waste Services Division
1120 Waverley Street
Winnipeg MB R3T 0P4

Date Received: 26-JUN-20
Report Date: 20-JUL-20 11:21 (MT)
Version: FINAL

Client Phone: 204-986-2384

Certificate of Analysis

Lab Work Order #: L2466834

Project P.O. #: NOT SUBMITTED
Job Reference: SECTION 1 - FABRICATED SOIL
C of C Numbers:
Legal Site Desc:

Hua Wo
Chemistry Laboratory Manager

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2466834-1 SS18 - 1							
Sampled By: CLIENT on 24-JUN-20 @ 11:42							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	6.05		0.050	%		06-JUL-20	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.35	DLHC	0.10	%	02-JUL-20	03-JUL-20	R5142824
Miscellaneous Parameters							
% Moisture	27.4		1.0	%	03-JUL-20	03-JUL-20	R5142168
Available Ammonium-N	4.9		1.0	mg/kg	03-JUL-20	03-JUL-20	R5142803
Conductivity Sat. Paste	4.30		0.10	dS m-1	16-JUL-20	17-JUL-20	R5157293
Mercury (Hg)	0.0772		0.0050	mg/kg	06-JUL-20	07-JUL-20	R5146333
% Saturation	55.7		1.0	%	16-JUL-20	17-JUL-20	R5157293
pH (1:1 soil:water)	7.56		0.10	pH units	08-JUL-20	08-JUL-20	R5146155
Organic Matter by LOI at 375 deg C.							
Organic Matter	5.8		1.0	%	06-JUL-20	07-JUL-20	R5144398
Loss on Ignition @ 375 C	7.1		1.0	%	06-JUL-20	07-JUL-20	R5144398
Metals							
Aluminum (Al)	6350		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Antimony (Sb)	0.73		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Arsenic (As)	2.84		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Barium (Ba)	80.8		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Beryllium (Be)	0.33		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Bismuth (Bi)	1.39		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Boron (B)	14		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cadmium (Cd)	0.303		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Calcium (Ca)	96400		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Chromium (Cr)	35.0		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cobalt (Co)	3.97		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Copper (Cu)	47.5		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Iron (Fe)	11300		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Lead (Pb)	19.3		0.20	mg/kg	07-JUL-20	06-JUL-20	R5144637
Magnesium (Mg)	35200		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Manganese (Mn)	214		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Molybdenum (Mo)	1.53		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Nickel (Ni)	19.0		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Phosphorus (P)	1450		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Potassium (K)	1770		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Selenium (Se)	<0.50		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Silver (Ag)	0.53		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Sodium (Na)	379		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Strontium (Sr)	78.0		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Thallium (Tl)	0.11		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Tin (Sn)	<5.0		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Titanium (Ti)	63.7		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Uranium (U)	1.51		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Vanadium (V)	20.5		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Zinc (Zn)	164		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	10.8		2.0	mg/kg	06-JUL-20	06-JUL-20	R5143161
Available Sulfate-S							
Available Sulfate-S	281		4.0	mg/kg	06-JUL-20	06-JUL-20	R5143072

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2466834-1 SS18 - 1							
Sampled By: CLIENT on 24-JUN-20 @ 11:42							
Matrix: SOIL							
Plant Available Phosphorus and Potassium							
Available Phosphate-P	98	DLHC	20	mg/kg	06-JUL-20	06-JUL-20	R5144360
Available Potassium	656	DLHC	40	mg/kg	06-JUL-20	06-JUL-20	R5144360
L2466834-2 SS18 - 2							
Sampled By: CLIENT on 24-JUN-20 @ 14:11							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	5.98		0.050	%		06-JUL-20	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.44	DLHC	0.10	%	02-JUL-20	03-JUL-20	R5142824
Miscellaneous Parameters							
% Moisture	25.1		1.0	%	03-JUL-20	03-JUL-20	R5142168
Available Ammonium-N	79.4	DLHC	5.0	mg/kg	03-JUL-20	03-JUL-20	R5142803
Conductivity Sat. Paste	6.01		0.10	dS m-1	16-JUL-20	17-JUL-20	R5157293
Mercury (Hg)	0.0546		0.0050	mg/kg	06-JUL-20	07-JUL-20	R5146333
% Saturation	59.3		1.0	%	16-JUL-20	17-JUL-20	R5157293
pH (1:1 soil:water)	7.60		0.10	pH units	08-JUL-20	08-JUL-20	R5146155
Organic Matter by LOI at 375 deg C.							
Organic Matter	5.6		1.0	%	06-JUL-20	07-JUL-20	R5144398
Loss on Ignition @ 375 C	6.8		1.0	%	06-JUL-20	07-JUL-20	R5144398
Metals							
Aluminum (Al)	5070		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Antimony (Sb)	0.96		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Arsenic (As)	2.24		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Barium (Ba)	60.6		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Beryllium (Be)	0.22		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Bismuth (Bi)	1.27		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Boron (B)	10		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cadmium (Cd)	0.247		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Calcium (Ca)	95100		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Chromium (Cr)	31.6		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cobalt (Co)	3.20		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Copper (Cu)	47.0		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Iron (Fe)	11400		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Lead (Pb)	13.9		0.20	mg/kg	07-JUL-20	06-JUL-20	R5144637
Magnesium (Mg)	35800		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Manganese (Mn)	226		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Molybdenum (Mo)	1.62		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Nickel (Ni)	14.9		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Phosphorus (P)	1610		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Potassium (K)	1360		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Selenium (Se)	<0.50		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Silver (Ag)	0.39		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Sodium (Na)	395		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Strontium (Sr)	57.3		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Thallium (Tl)	<0.10		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Tin (Sn)	<5.0		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Titanium (Ti)	41.4		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Uranium (U)	1.04		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Vanadium (V)	19.0		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2466834-2 SS18 - 2							
Sampled By: CLIENT on 24-JUN-20 @ 14:11							
Matrix: SOIL							
Metals							
Zinc (Zn)	141		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	25.1		2.0	mg/kg	06-JUL-20	06-JUL-20	R5143161
Available Sulfate-S							
Available Sulfate-S	500		4.0	mg/kg	06-JUL-20	06-JUL-20	R5143072
Plant Available Phosphorus and Potassium							
Available Phosphate-P	57.6	DLHC	4.0	mg/kg	06-JUL-20	06-JUL-20	R5144360
Available Potassium	402	DLHC	40	mg/kg	06-JUL-20	06-JUL-20	R5144360
L2466834-3 SS18 - 3A							
Sampled By: CLIENT on 25-JUN-20 @ 14:57							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	7.77		0.050	%		06-JUL-20	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.39	DLHC	0.10	%	02-JUL-20	03-JUL-20	R5142824
Miscellaneous Parameters							
% Moisture	24.5		1.0	%	03-JUL-20	03-JUL-20	R5142168
Available Ammonium-N	74	DLHC	10	mg/kg	03-JUL-20	03-JUL-20	R5142803
Conductivity Sat. Paste	6.31		0.10	dS m-1	16-JUL-20	17-JUL-20	R5157293
Mercury (Hg)	0.0840		0.0050	mg/kg	06-JUL-20	07-JUL-20	R5146333
% Saturation	52.8		1.0	%	16-JUL-20	17-JUL-20	R5157293
pH (1:1 soil:water)	7.63		0.10	pH units	08-JUL-20	08-JUL-20	R5146155
Organic Matter by LOI at 375 deg C.							
Organic Matter	5.4		1.0	%	06-JUL-20	07-JUL-20	R5144398
Loss on Ignition @ 375 C	6.5		1.0	%	06-JUL-20	07-JUL-20	R5144398
Metals							
Aluminum (Al)	3410		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Antimony (Sb)	0.69		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Arsenic (As)	1.76		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Barium (Ba)	49.9		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Beryllium (Be)	0.15		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Bismuth (Bi)	1.37		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Boron (B)	<10		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cadmium (Cd)	0.296		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Calcium (Ca)	92300		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Chromium (Cr)	30.2		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cobalt (Co)	2.72		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Copper (Cu)	59.3		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Iron (Fe)	9590		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Lead (Pb)	14.0		0.20	mg/kg	07-JUL-20	06-JUL-20	R5144637
Magnesium (Mg)	33200		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Manganese (Mn)	173		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Molybdenum (Mo)	1.52		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Nickel (Ni)	15.5		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Phosphorus (P)	1760		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Potassium (K)	1140		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Selenium (Se)	<0.50		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Silver (Ag)	0.41		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2466834-3 SS18 - 3A							
Sampled By: CLIENT on 25-JUN-20 @ 14:57							
Matrix: SOIL							
Metals							
Sodium (Na)	417		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Strontium (Sr)	53.5		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Thallium (Tl)	<0.10		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Tin (Sn)	<5.0		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Titanium (Ti)	43.1		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Uranium (U)	1.02		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Vanadium (V)	14.5		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Zinc (Zn)	155		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	64.1	DLHC	2.0	mg/kg	06-JUL-20	06-JUL-20	R5143161
Available Sulfate-S							
Available Sulfate-S	449		4.0	mg/kg	06-JUL-20	06-JUL-20	R5143072
Plant Available Phosphorus and Potassium							
Available Phosphate-P	56.4	DLHC	4.0	mg/kg	06-JUL-20	06-JUL-20	R5144360
Available Potassium	412	DLHC	40	mg/kg	06-JUL-20	06-JUL-20	R5144360
L2466834-4 SS18 - 4							
Sampled By: CLIENT on 26-JUN-20 @ 11:13							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	7.48		0.050	%		06-JUL-20	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.58	DLHC	0.10	%	02-JUL-20	03-JUL-20	R5142824
Miscellaneous Parameters							
% Moisture	34.8		1.0	%	03-JUL-20	03-JUL-20	R5142168
Available Ammonium-N	66.8	DLHC	5.0	mg/kg	03-JUL-20	03-JUL-20	R5142803
Conductivity Sat. Paste	6.37		0.10	dS m-1	16-JUL-20	17-JUL-20	R5157293
Mercury (Hg)	0.0538		0.0050	mg/kg	06-JUL-20	07-JUL-20	R5146333
% Saturation	62.9		1.0	%	16-JUL-20	17-JUL-20	R5157293
pH (1:1 soil:water)	7.31		0.10	pH units	08-JUL-20	08-JUL-20	R5146155
Organic Matter by LOI at 375 deg C.							
Organic Matter	7.6		1.0	%	06-JUL-20	07-JUL-20	R5144398
Loss on Ignition @ 375 C	9.4		1.0	%	06-JUL-20	07-JUL-20	R5144398
Metals							
Aluminum (Al)	2870		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Antimony (Sb)	0.61		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Arsenic (As)	1.95		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Barium (Ba)	45.4		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Beryllium (Be)	0.10		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Bismuth (Bi)	1.54		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Boron (B)	<10		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cadmium (Cd)	0.229		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Calcium (Ca)	86100		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Chromium (Cr)	25.1		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cobalt (Co)	2.38		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Copper (Cu)	57.0		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Iron (Fe)	12200		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Lead (Pb)	11.4		0.20	mg/kg	07-JUL-20	06-JUL-20	R5144637
Magnesium (Mg)	33200		10	mg/kg	07-JUL-20	06-JUL-20	R5144637

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2466834-4 SS18 - 4							
Sampled By: CLIENT on 26-JUN-20 @ 11:13							
Matrix: SOIL							
Metals							
Manganese (Mn)	168		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Molybdenum (Mo)	1.44		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Nickel (Ni)	12.0		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Phosphorus (P)	2340		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Potassium (K)	992		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Selenium (Se)	<0.50		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Silver (Ag)	0.30		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Sodium (Na)	309		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Strontium (Sr)	49.9		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Thallium (Tl)	<0.10		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Tin (Sn)	<5.0		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Titanium (Ti)	31.2		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Uranium (U)	0.741		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Vanadium (V)	17.6		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Zinc (Zn)	125		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	173	DLHC	5.0	mg/kg	06-JUL-20	06-JUL-20	R5143161
Available Sulfate-S							
Available Sulfate-S	870	DLHC	40	mg/kg	06-JUL-20	06-JUL-20	R5143072
Plant Available Phosphorus and Potassium							
Available Phosphate-P	55.6	DLHC	4.0	mg/kg	06-JUL-20	06-JUL-20	R5144360
Available Potassium	518	DLHC	40	mg/kg	06-JUL-20	06-JUL-20	R5144360
L2466834-5 SS18 - 6B							
Sampled By: CLIENT on 26-JUN-20 @ 13:51							
Matrix: SOIL							
Total Carbon, TOC and TIC in soil							
Total Organic Carbon Calculation							
Total Organic Carbon	6.11		0.050	%		06-JUL-20	
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen							
Total Kjeldahl Nitrogen	0.50	DLHC	0.10	%	02-JUL-20	03-JUL-20	R5142824
Miscellaneous Parameters							
% Moisture	24.1		1.0	%	03-JUL-20	03-JUL-20	R5142168
Available Ammonium-N	177	DLHC	10	mg/kg	03-JUL-20	03-JUL-20	R5142803
Conductivity Sat. Paste	10.7		0.10	dS m-1	16-JUL-20	17-JUL-20	R5157293
Mercury (Hg)	0.0834		0.0050	mg/kg	06-JUL-20	07-JUL-20	R5146333
% Saturation	56.2		1.0	%	16-JUL-20	17-JUL-20	R5157293
pH (1:1 soil:water)	7.58		0.10	pH units	08-JUL-20	08-JUL-20	R5146155
Organic Matter by LOI at 375 deg C.							
Organic Matter	5.7		1.0	%	06-JUL-20	07-JUL-20	R5144398
Loss on Ignition @ 375 C	7.0		1.0	%	06-JUL-20	07-JUL-20	R5144398
Metals							
Aluminum (Al)	3780		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Antimony (Sb)	0.53		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Arsenic (As)	2.20		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Barium (Ba)	53.7		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Beryllium (Be)	0.15		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Bismuth (Bi)	1.22		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Boron (B)	<10		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cadmium (Cd)	0.202		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

ALS ENVIRONMENTAL ANALYTICAL REPORT

Sample Details/Parameters	Result	Qualifier*	D.L.	Units	Extracted	Analyzed	Batch
L2466834-5 SS18 - 6B							
Sampled By: CLIENT on 26-JUN-20 @ 13:51							
Matrix: SOIL							
Metals							
Calcium (Ca)	87600		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Chromium (Cr)	20.5		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Cobalt (Co)	2.62		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Copper (Cu)	52.7		1.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Iron (Fe)	9800		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Lead (Pb)	13.9		0.20	mg/kg	07-JUL-20	06-JUL-20	R5144637
Magnesium (Mg)	34600		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Manganese (Mn)	166		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Molybdenum (Mo)	1.45		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Nickel (Ni)	12.8		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Phosphorus (P)	1720		100	mg/kg	07-JUL-20	06-JUL-20	R5144637
Potassium (K)	1200		25	mg/kg	07-JUL-20	06-JUL-20	R5144637
Selenium (Se)	<0.50		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Silver (Ag)	0.38		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Sodium (Na)	804		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Strontium (Sr)	54.4		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Thallium (Tl)	<0.10		0.10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Tin (Sn)	<5.0		5.0	mg/kg	07-JUL-20	06-JUL-20	R5144637
Titanium (Ti)	38.4		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Uranium (U)	1.21		0.020	mg/kg	07-JUL-20	06-JUL-20	R5144637
Vanadium (V)	14.0		0.50	mg/kg	07-JUL-20	06-JUL-20	R5144637
Zinc (Zn)	143		10	mg/kg	07-JUL-20	06-JUL-20	R5144637
Available N, P, K and S							
Available Nitrate-N							
Available Nitrate-N	12.5		2.0	mg/kg	06-JUL-20	06-JUL-20	R5143161
Available Sulfate-S							
Available Sulfate-S	442		4.0	mg/kg	06-JUL-20	06-JUL-20	R5143072
Plant Available Phosphorus and Potassium							
Available Phosphate-P	136	DLHC	20	mg/kg	06-JUL-20	06-JUL-20	R5144360
Available Potassium	485	DLHC	40	mg/kg	06-JUL-20	06-JUL-20	R5144360

* Refer to Referenced Information for Qualifiers (if any) and Methodology.

Reference Information

Sample Parameter Qualifier Key:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
C-TIC-PCT-SK	Soil	Total Inorganic Carbon in Soil	CSSS (2008) P216-217
A known quantity of acetic acid is consumed by reaction with carbonates in the soil. The pH of the resulting solution is measured and compared against a standard curve relating pH to weight of carbonate.			
C-TOC-CALC-SK	Soil	Total Organic Carbon Calculation	CSSS (2008) 21.2
Total Organic Carbon (TOC) is calculated by the difference between total carbon (TC) and total inorganic carbon. (TIC)			
C-TOT-LECO-SK	Soil	Total Carbon by combustion method	CSSS (2008) 21.2
The sample is ignited in a combustion analyzer where carbon in the reduced CO2 gas is determined using a thermal conductivity detector.			
EC-SAR-SK	Soil	EC (Saturated Paste)	CSSS 18.2.2/CSSS 18.3.1
After saturated soil paste equilibrium, an extract is obtained by vacuum filtration with conductivity of the extract measured by a conductivity meter.			
HG-200.2-CVAA-WP	Soil	Mercury in Soil	EPA 200.2/1631E (mod)
Soil samples are digested with nitric and hydrochloric acids, followed by analysis by CVAAS.			
IC-CACO3-CALC-SK	Soil	Inorganic Carbon as CaCO3 Equivalent	Calculation
MET-200.2-MS-WP	Soil	Metals	EPA 200.2/6020B (mod)
Soil/sediment is dried, disaggregated, and sieved (2 mm). Strong Acid Leachable Metals in the <2mm fraction are solubilized by heated digestion with nitric and hydrochloric acids. Instrumental analysis is by Collision / Reaction Cell ICPMS. Limitations: This method is intended to liberate environmentally available metals. Silicate minerals are not solubilized. Some metals may be only partially recovered (matrix dependent), including Al, Ba, Be, Cr, S, Sr, Ti, Tl, V, W, and Zr. Elemental Sulfur may be poorly recovered by this method. Volatile forms of sulfur (e.g. sulfide, H2S) may be excluded if lost during sampling, storage, or digestion.			
N-TOTKJ-COL-SK	Soil	Total Kjeldahl Nitrogen	CSSS (2008) 22.2.3
The soil is digested with sulfuric acid in the presence of CuSO4 and K2SO4 catalysts. Ammonia in the soil extract is determined colrimetrically at 660 nm.			
NH4-AVAIL-SK	Soil	Available Ammonium-N	CSSS Carter 6.2 / Comm Soil Sci 19(6)
Ammonium (NH4-N) is extracted from the soil using 2 N KCl. Ammonium in the extract is mixed with hypochlorite and salicylate to form indophenol blue, which is determined colorimetrically by auto analysis at 660 nm.			
NO3-AVAIL-SK	Soil	Available Nitrate-N	Alberta Ag / APHA 4500 NO3F
Available Nitrate and Nitrite are extracted from the soil using a dilute calcium chloride solution. Nitrate is quantitatively reduced to nitrite by passing of the sample through a copperized cadmium column. The nitrite (reduced nitrate plus original nitrite) is then determined by diazotizing with sulfanilamide followed by coupling with N-(1-naphthyl) ethylenediamine dihydrochloride. The resulting water soluble dye has a magenta color which is measured at colorimetrically at 520nm.			
OM-LOI-SK	Soil	Organic Matter by LOI at 375 deg C.	CSSS (1978) p. 160
The dry-ash method involves the removal of organic matter by combustion at 375 degrees C for a minimum of 16 hours. Samples are dried prior to combustion.			
PH-1:1-SK	Soil	pH in Soil (1:1 soil:water Extraction)	CSSS 2008 16.2
The soil is mixed in a one to one ratio with deionized water. The pH of the resulting suspension is then measured with a standard pH probe			
PO4/K-AVAIL-SK	Soil	Plant Available Phosphorus and Potassium	Comm. Soil Sci. Plant Anal, 25 (5&6)
Plant available phosphorus and potassium are extracted from the soil usng Modified Kelowna solution. Phosphorous in the soil extract is determined colorimetrically at 880 nm, while potassiumis determined by flame emission at 770 nm.			
PREP-MOISTURE-SK	Soil	% Moisture	CWS for PHC in Soil - Tier 1
The weighed portion of soil is placed in a 105°C oven overnight. The dried soil is allowed to cooled to room temperature, weighed and the % moisture is calculated.			

Reference Information

Test Method References:

ALS Test Code	Matrix	Test Description	Method Reference**
SAT-PCNT-SK	Soil	Saturated Paste	CSSS Ch. 15

A saturated paste is generated by adding water to soil with mixing until the following criteria are met.:
The sample paste glistens as it reflects light.
The sample flows slightly when container is tipped, and slides freely and cleanly off the spatula.
A trench carved in the soil surface will close readily upon jarring the container.
There should be no free layer of water on top of the sample.
An aliquot of the sample is obtained, dried at 105C and saturation percentage is determined.

SO4-AVAIL-SK	Soil	Available Sulfate-S	REC METH SOIL ANAL - AB. AG(1988)

Plant available sulfate in the soil is extracted using a weak calcium chloride solution. Sulfate in the extract is determined by ICP-OES. This extraction may also produce organic sulfur in the extracts when organic soils are analyzed.

** ALS test methods may incorporate modifications from specified reference methods to improve performance.

The last two letters of the above test code(s) indicate the laboratory that performed analytical analysis for that test. Refer to the list below:

Laboratory Definition Code	Laboratory Location
SK	ALS ENVIRONMENTAL - SASKATOON, SASKATCHEWAN, CANADA
WP	ALS ENVIRONMENTAL - WINNIPEG, MANITOBA, CANADA

Chain of Custody Numbers:

GLOSSARY OF REPORT TERMS

Surrogates are compounds that are similar in behaviour to target analyte(s), but that do not normally occur in environmental samples. For applicable tests, surrogates are added to samples prior to analysis as a check on recovery. In reports that display the D.L. column, laboratory objectives for surrogates are listed there.
mg/kg - milligrams per kilogram based on dry weight of sample
mg/kg wwt - milligrams per kilogram based on wet weight of sample
mg/kg lwt - milligrams per kilogram based on lipid-adjusted weight
mg/L - unit of concentration based on volume, parts per million.
< - Less than.
D.L. - The reporting limit.
N/A - Result not available. Refer to qualifier code and definition for explanation.

Test results reported relate only to the samples as received by the laboratory.
UNLESS OTHERWISE STATED, ALL SAMPLES WERE RECEIVED IN ACCEPTABLE CONDITION.
Analytical results in unsigned test reports with the DRAFT watermark are subject to change, pending final QC review.

Quality Control Report

Client: City of Winnipeg - Solid Waste Services Div (1120 Waverley)
Solid Waste Services Division 1120 Waverley Street
Winnipeg MB R3T 0P4
Contact: CHRIS KOZAK

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
C-TIC-PCT-SK	**Soil**							
Batch R5142283								
WG3353187-4 IRM		**08-109_SOIL**						
Inorganic Carbon			90.5		%		80-120	04-JUL-20
WG3353187-2 LCS		**0.5**						
Inorganic Carbon			95.7		%		80-120	04-JUL-20
WG3353187-3 MB								
Inorganic Carbon			<0.050		%		0.05	04-JUL-20
C-TOT-LECO-SK	**Soil**							
Batch R5142778								
WG3353184-2 IRM		**08-109_SOIL**						
Total Carbon by Combustion			93.5		%		80-120	05-JUL-20
WG3353184-4 LCS		**SULFADIAZINE**						
Total Carbon by Combustion			98.8		%		90-110	05-JUL-20
WG3353184-3 MB								
Total Carbon by Combustion			<0.05		%		0.05	05-JUL-20
EC-SAR-SK	**Soil**							
Batch R5157293								
WG3363771-1 DUP		**L2466834-3**						
Conductivity Sat. Paste		6.31	6.56		dS m-1	3.9	20	17-JUL-20
WG3363771-5 IRM		**ALS SAL 2019**						
Conductivity Sat. Paste			99.7		%		80-120	17-JUL-20
WG3363771-4 LCS								
Conductivity Sat. Paste			98.5		%		80-120	17-JUL-20
WG3363771-2 MB								
Conductivity Sat. Paste			<0.10		dS m-1		0.1	17-JUL-20
HG-200.2-CVAA-WP	**Soil**							
Batch R5146333								
WG3358400-4 CRM		**CANMET TILL-1**						
Mercury (Hg)			101.6		%		70-130	07-JUL-20
WG3358400-2 LCS								
Mercury (Hg)			114.0		%		80-120	07-JUL-20
WG3358400-1 MB								
Mercury (Hg)			<0.0050		mg/kg		0.005	07-JUL-20
MET-200.2-MS-WP	**Soil**							
Batch R5144637								
WG3356888-4 CRM		**CANMET TILL-1**						
Aluminum (Al)			99.3		%		70-130	06-JUL-20
Antimony (Sb)			108.6		%		70-130	06-JUL-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R5144637								
WG3356888-4 CRM		**CANMET TILL-1**						
Arsenic (As)			96.7		%		70-130	06-JUL-20
Barium (Ba)			99.0		%		70-130	06-JUL-20
Beryllium (Be)			108.7		%		70-130	06-JUL-20
Bismuth (Bi)			116.5		%		70-130	06-JUL-20
Boron (B)			3		mg/kg		0-8	06-JUL-20
Cadmium (Cd)			100.4		%		70-130	06-JUL-20
Calcium (Ca)			108.6		%		70-130	06-JUL-20
Chromium (Cr)			100.3		%		70-130	06-JUL-20
Cobalt (Co)			98.5		%		70-130	06-JUL-20
Copper (Cu)			99.2		%		70-130	06-JUL-20
Iron (Fe)			98.3		%		70-130	06-JUL-20
Lead (Pb)			117.6		%		70-130	06-JUL-20
Magnesium (Mg)			98.9		%		70-130	06-JUL-20
Manganese (Mn)			97.5		%		70-130	06-JUL-20
Molybdenum (Mo)			109.4		%		70-130	06-JUL-20
Nickel (Ni)			98.0		%		70-130	06-JUL-20
Phosphorus (P)			88.0		%		70-130	06-JUL-20
Potassium (K)			97.6		%		70-130	06-JUL-20
Selenium (Se)			103.8		%		70-130	06-JUL-20
Silver (Ag)			112.4		%		70-130	06-JUL-20
Sodium (Na)			97.8		%		70-130	06-JUL-20
Strontium (Sr)			112.5		%		70-130	06-JUL-20
Thallium (Tl)			0.15		mg/kg		0.03-0.23	06-JUL-20
Tin (Sn)			1.1		mg/kg		0-3.1	06-JUL-20
Titanium (Ti)			82.3		%		70-130	06-JUL-20
Uranium (U)			118.4		%		70-130	06-JUL-20
Vanadium (V)			99.3		%		70-130	06-JUL-20
Zinc (Zn)			102.3		%		70-130	06-JUL-20
WG3356888-2 LCS								
Aluminum (Al)			105.2		%		80-120	06-JUL-20
Antimony (Sb)			100.7		%		80-120	06-JUL-20
Arsenic (As)			102.8		%		80-120	06-JUL-20
Barium (Ba)			103.3		%		80-120	06-JUL-20
Beryllium (Be)			89.5		%		80-120	06-JUL-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R5144637								
WG3356888-2 LCS								
Bismuth (Bi)			101.7		%		80-120	06-JUL-20
Boron (B)			91.5		%		80-120	06-JUL-20
Cadmium (Cd)			100.5		%		80-120	06-JUL-20
Calcium (Ca)			97.5		%		80-120	06-JUL-20
Chromium (Cr)			100.3		%		80-120	06-JUL-20
Cobalt (Co)			101.0		%		80-120	06-JUL-20
Copper (Cu)			100.3		%		80-120	06-JUL-20
Iron (Fe)			103.1		%		80-120	06-JUL-20
Lead (Pb)			105.6		%		80-120	06-JUL-20
Magnesium (Mg)			104.1		%		80-120	06-JUL-20
Manganese (Mn)			103.0		%		80-120	06-JUL-20
Molybdenum (Mo)			101.1		%		80-120	06-JUL-20
Nickel (Ni)			101.3		%		80-120	06-JUL-20
Phosphorus (P)			102.6		%		80-120	06-JUL-20
Potassium (K)			103.7		%		80-120	06-JUL-20
Selenium (Se)			104.3		%		80-120	06-JUL-20
Silver (Ag)			100.8		%		80-120	06-JUL-20
Sodium (Na)			101.6		%		80-120	06-JUL-20
Strontium (Sr)			102.6		%		80-120	06-JUL-20
Thallium (Tl)			101.5		%		80-120	06-JUL-20
Tin (Sn)			100.9		%		80-120	06-JUL-20
Titanium (Ti)			99.4		%		80-120	06-JUL-20
Uranium (U)			112.7		%		80-120	06-JUL-20
Vanadium (V)			102.7		%		80-120	06-JUL-20
Zinc (Zn)			102.7		%		80-120	06-JUL-20
WG3356888-1 MB								
Aluminum (Al)			<5.0		mg/kg		5	06-JUL-20
Antimony (Sb)			<0.10		mg/kg		0.1	06-JUL-20
Arsenic (As)			<0.10		mg/kg		0.1	06-JUL-20
Barium (Ba)			<0.50		mg/kg		0.5	06-JUL-20
Beryllium (Be)			<0.10		mg/kg		0.1	06-JUL-20
Bismuth (Bi)			<0.020		mg/kg		0.02	06-JUL-20
Boron (B)			<10		mg/kg		10	06-JUL-20
Cadmium (Cd)			<0.020		mg/kg		0.02	06-JUL-20

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
MET-200.2-MS-WP	**Soil**							
Batch R5144637								
WG3356888-1 MB								
Calcium (Ca)			<100		mg/kg		100	06-JUL-20
Chromium (Cr)			<1.0		mg/kg		1	06-JUL-20
Cobalt (Co)			<0.020		mg/kg		0.02	06-JUL-20
Copper (Cu)			<1.0		mg/kg		1	06-JUL-20
Iron (Fe)			<25		mg/kg		25	06-JUL-20
Lead (Pb)			<0.20		mg/kg		0.2	06-JUL-20
Magnesium (Mg)			12	B	mg/kg		10	06-JUL-20
Manganese (Mn)			<0.50		mg/kg		0.5	06-JUL-20
Molybdenum (Mo)			<0.10		mg/kg		0.1	06-JUL-20
Nickel (Ni)			<0.50		mg/kg		0.5	06-JUL-20
Phosphorus (P)			<100		mg/kg		100	06-JUL-20
Potassium (K)			<25		mg/kg		25	06-JUL-20
Selenium (Se)			<0.50		mg/kg		0.5	06-JUL-20
Silver (Ag)			<0.10		mg/kg		0.1	06-JUL-20
Sodium (Na)			<10		mg/kg		10	06-JUL-20
Strontium (Sr)			<0.10		mg/kg		0.1	06-JUL-20
Thallium (Tl)			<0.10		mg/kg		0.1	06-JUL-20
Tin (Sn)			<5.0		mg/kg		5	06-JUL-20
Titanium (Ti)			<0.50		mg/kg		0.5	06-JUL-20
Uranium (U)			<0.020		mg/kg		0.02	06-JUL-20
Vanadium (V)			<0.50		mg/kg		0.5	06-JUL-20
Zinc (Zn)			<10		mg/kg		10	06-JUL-20
N-TOTKJ-COL-SK	**Soil**							
Batch R5142824								
WG3354334-1 DUP		**L2466834-1**						
Total Kjeldahl Nitrogen		0.35	0.35		%	1.3	20	03-JUL-20
WG3354334-2 IRM		**08-109_SOIL**						
Total Kjeldahl Nitrogen			101.2		%		80-120	03-JUL-20
WG3354334-3 LCS								
Total Kjeldahl Nitrogen			103.2		%		80-120	03-JUL-20
WG3354334-4 MB								
Total Kjeldahl Nitrogen			<0.020		%		0.02	03-JUL-20
NH4-AVAIL-SK	**Soil**							

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
NH4-AVAIL-SK	**Soil**							
Batch R5142803								
WG3354494-3 IRM		**SAL814**						
Available Ammonium-N			98.1		%		70-130	03-JUL-20
WG3354494-4 LCS								
Available Ammonium-N			105.2		%		80-120	03-JUL-20
WG3354494-2 MB								
Available Ammonium-N			<1.0		mg/kg		1	03-JUL-20
NO3-AVAIL-SK	**Soil**							
Batch R5143161								
WG3356092-3 IRM		**SAL814**						
Available Nitrate-N			105.1		%		70-130	06-JUL-20
WG3356092-4 LCS								
Available Nitrate-N			108.5		%		70-130	06-JUL-20
WG3356092-2 MB								
Available Nitrate-N			<2.0		mg/kg		2	06-JUL-20
OM-LOI-SK	**Soil**							
Batch R5144398								
WG3356119-1 DUP		**L2466834-1**						
Organic Matter		5.8	5.6		%	4.2	20	07-JUL-20
Loss on Ignition @ 375 C		7.1	6.8		%	4.4	20	07-JUL-20
WG3356119-3 IRM		**SAL2001**						
Organic Matter			100.3		%		80-120	07-JUL-20
Loss on Ignition @ 375 C			100.0		%		80-120	07-JUL-20
WG3356119-2 MB								
Organic Matter			<1.0		%		1	07-JUL-20
Loss on Ignition @ 375 C			<1.0		%		1	07-JUL-20
PH-1:1-SK	**Soil**							
Batch R5146155								
WG3357421-1 DUP		**L2466834-4**						
pH (1:1 soil:water)		7.31	7.34	J	pH units	0.03	0.3	08-JUL-20
WG3357421-2 LCS								
pH (1:1 soil:water)			6.89		pH		6.66-7.06	08-JUL-20
PO4/K-AVAIL-SK	**Soil**							
Batch R5144360								
WG3356095-1 DUP		**L2466834-3**						
Available Phosphate-P		56.4	54.7		mg/kg	3.1	30	06-JUL-20
Available Potassium		412	418		mg/kg	1.3	30	06-JUL-20
WG3356095-3 IRM		**FARM2005**						

Quality Control Report

Test	Matrix	Reference	Result	Qualifier	Units	RPD	Limit	Analyzed
PO4/K-AVAIL-SK	**Soil**							
Batch R5144360								
WG3356095-3 IRM		**FARM2005**						
Available Phosphate-P			99.3		%		80-120	06-JUL-20
Available Potassium			129.3		%		70-130	06-JUL-20
WG3356095-4 LCS								
Available Phosphate-P			93.6		%		80-120	06-JUL-20
Available Potassium			97.3		%		80-120	06-JUL-20
WG3356095-2 MB								
Available Phosphate-P			<2.0		mg/kg		2	06-JUL-20
Available Potassium			<20		mg/kg		20	06-JUL-20
PREP-MOISTURE-SK	**Soil**							
Batch R5142168								
WG3353518-1 DUP		**L2466834-3**						
% Moisture		24.5	20.4		%	18	20	03-JUL-20
WG3353518-3 LCS								
% Moisture			99.8		%		90-110	03-JUL-20
WG3353518-2 MB								
% Moisture			<1.0		%		1	03-JUL-20
SAT-PCNT-SK	**Soil**							
Batch R5157293								
WG3363771-1 DUP		**L2466834-3**						
% Saturation		52.8	51.1		%	3.2	20	17-JUL-20
WG3363771-5 IRM		**ALS SAL 2019**						
% Saturation			98.9		%		80-120	17-JUL-20
WG3363771-4 LCS								
% Saturation			95.8		%		90-110	17-JUL-20
WG3363771-2 MB								
% Saturation			<1.0		%		1	17-JUL-20
SO4-AVAIL-SK	**Soil**							
Batch R5143072								
WG3356090-3 IRM		**SAL814**						
Available Sulfate-S			102.7		%		70-130	06-JUL-20
WG3356090-2 MB								
Available Sulfate-S			<4.0		mg/kg		4	06-JUL-20

Legend:

Limit	ALS Control Limit (Data Quality Objectives)
DUP	Duplicate
RPD	Relative Percent Difference
N/A	Not Available
LCS	Laboratory Control Sample
SRM	Standard Reference Material
MS	Matrix Spike
MSD	Matrix Spike Duplicate
ADE	Average Desorption Efficiency
MB	Method Blank
IRM	Internal Reference Material
CRM	Certified Reference Material
CCV	Continuing Calibration Verification
CVS	Calibration Verification Standard
LCSD	Laboratory Control Sample Duplicate

Sample Parameter Qualifier Definitions:

Qualifier	Description
B	Method Blank exceeds ALS DQO. Associated sample results which are < Limit of Reporting or > 5 times blank level are considered reliable.
DLHC	Detection Limit Raised: Dilution required due to high concentration of test analyte(s).
J	Duplicate results and limits are expressed in terms of absolute difference.

Hold Time Exceedances:

ALS Product Description	Sample ID	Sampling Date	Date Processed	Rec. HT	Actual HT	Units	Qualifier
Plant Available Nutrients							
Available Nitrate-N							
	1	24-JUN-20 11:42	30-JUN-20 15:00	3	6	days	EHTL
	2	24-JUN-20 14:11	30-JUN-20 15:00	3	6	days	EHTL
	3	25-JUN-20 14:57	30-JUN-20 15:00	3	5	days	EHT
	4	26-JUN-20 11:13	30-JUN-20 15:00	3	4	days	EHT
	5	26-JUN-20 13:51	30-JUN-20 15:00	3	4	days	EHT

Legend & Qualifier Definitions:

EHTR-FM:	Exceeded ALS recommended hold time prior to sample receipt. Field Measurement recommended.
EHTR:	Exceeded ALS recommended hold time prior to sample receipt.
EHTL:	Exceeded ALS recommended hold time prior to analysis. Sample was received less than 24 hours prior to expiry.
EHT:	Exceeded ALS recommended hold time prior to analysis.
Rec. HT:	ALS recommended hold time (see units).

Notes*:
Where actual sampling date is not provided to ALS, the date (& time) of receipt is used for calculation purposes.
Where actual sampling time is not provided to ALS, the earlier of 12 noon on the sampling date or the time (& date) of receipt is used for calculation purposes. Samples for L2466834 were received on 26-JUN-20 15:30.

ALS recommended hold times may vary by province. They are assigned to meet known provincial and/or federal government requirements. In the absence of regulatory hold times, ALS establishes recommendations based on guidelines published by the US EPA, APHA Standard Methods, or Environment Canada (where available). For more information, please contact ALS.

The ALS Quality Control Report is provided to ALS clients upon request. ALS includes comprehensive QC checks with every analysis to ensure our high standards of quality are met. Each QC result has a known or expected target value, which is compared against pre-determined data quality objectives to provide confidence in the accuracy of associated test results.

Please note that this report may contain QC results from anonymous Sample Duplicates and Matrix Spikes that do not originate from this Work Order.

Chain of Custody (COC) / Analytical Request Form

ALS Environmental

www.alsglobal.com

Canada Toll Free: 1 800 668 9878

L2466834-COFC

COC Number: 15 -

Page 1 of 1

L2466834

Report To	Contact and company name below will appear on the final report	Report Format / Distribution	
Company:	City of Winnipeg	Select Report Format: ☑ PDF ☐ EXCEL ☐ EDD (DIGITAL)	
Contact:	Chris Kozak	Quality Control (QC) Report with Report ☑ YES ☐ NO	
Phone:	204-986-2384	☐ Compare Results to Criteria on Report - provide details below if box checked	
	Company address below will appear on the final report	Select Distribution: ☑ EMAIL ☐ MAIL ☐ FAX	
Street:	1120 Waverly Street	Email 1 or Fax ckozak@winnipeg.ca	
City/Province:	Winnipeg, Manitoba	Email 2	
Postal Code:	R3T 0P4	Email 3	
Invoice To	Same as Report To ☐ YES ☐ NO	Invoice Distribution	
	Copy of Invoice with Report ☐ YES ☐ NO	Select Invoice Distribution: ☐ EMAIL ☑ MAIL ☐ FAX	
Company:		Email 1 or Fax	
Contact:		Email 2	

Project Information		Oil and Gas Required Fields (client use)	
ALS Account # / Quote #:	W10051/Q67317	AFE/Cost Center:	PO#
Job #:	Section I - Fabricated Soil	Major/Minor Code:	Routing Code:
PO / AFE:		Requisitioner:	
LSD:		Location:	
ALS Lab Work Order # (lab use only)		ALS Contact:	Sampler:

Select all E&P TATs with your AM - surcharges will apply

Regular [R] ☐ Standard TAT if received by 3 pm - business days - no surcharges apply

PRIORITY (Business Days): 4 day [P4] ☐ | 3 day [P3] ☐ | 2 day [P2] ☐

EMERGENCY: 1 Business day [E1] ☐ | Same Day, Weekend or Statutory holiday [E0] ☐

Date and Time Required for all E&P TATs: dd-mmm-yy hh:mm

For tests that can not be performed according to the service level selected, you will be contacted.

Analysis Request

Indicate Filtered (F), Preserved (P) or Filtered and Preserved (F/P) below

ALS Sample # (lab use only)	Sample Identification and/or Coordinates (This description will appear on the report)	Date (dd-mmm-yy)	Time (hh:mm)	Sample Type	OM-LOI-SK	C-TOC-SK	NPKS-AVAIL-SK	NH4-AVAIL-SK	ETB-N-TOTKJ-SK	EC-PASTE-WP	PH-1:1-SK	SAT-PCNT-WP	PREP-MOISTURE-SK	MET-200.2-MS-WP	HG-200.2-CVAA-WP	Number of Containers
	SS18 - 1	24-06-20	11:42	Soil	X	X	X	X	X	X	X	X	X	X	X	
	SS18 - 2	24-06-20	14:11	Soil	X	X	X	X	X	X	X	X	X	X	X	
	SS18 - 3A	25-06-20	14:57	Soil	X	X	X	X	X	X	X	X	X	X	X	
	SS18 - 4	26-06-20	11:13	Soil	X	X	X	X	X	X	X	X	X	X	X	
	SS18 - 6B	26-06-20	13:51	Soil	X	X	X	X	X	X	X	X	X	X	X	
				Soil												
				Soil												
				Soil												
				Soil												
				Soil												

Drinking Water (DW) Samples[1] (client use)	Special Instructions / Specify Criteria to add on report by clicking on the drop-down list below (electronic COC only)
Are samples taken from a Regulated DW System? ☐ YES ☐ NO	
Are samples for human drinking water use? ☐ YES ☐ NO	

SAMPLE CONDITION AS RECEIVED (lab use only)

Frozen ☐ SIF Observations Yes ☐ No ☐

Ice Packs ☐ Ice Cubes ☐ Custody seal intact Yes ☐ No ☐

Cooling Initiated ☐

INITIAL COOLER TEMPERATURES °C			FINAL COOLER TEMPERATURES °C		

SHIPMENT RELEASE (client use)			INITIAL SHIPMENT RECEPTION (lab use only)			FINAL SHIPMENT RECEPTION (lab use only)		
Released by:	Date:	Time:	Received by:	Date:	Time:	Received by:	Date:	Time:
[signature]	26-06-20	15:08	GE	June 26, 2020	3:30 PM			

REFER TO BACK PAGE FOR ALS LOCATIONS AND SAMPLING INFORMATION

WHITE - LABORATORY COPY YELLOW - CLIENT COPY

OCTOBER 2015 FRONT

Failure to complete all portions of this form may delay analysis. Please fill in this form LEGIBLY. By the use of this form the user acknowledges and agrees with the Terms and Conditions as specified on the back page of the white - report copy.

1. If any water samples are taken from a Regulated Drinking Water (DW) System, please submit using an Authorized DW COC form.

APPENDIX J

SURFACE WATER SAMPLING AND ANALYSIS PLAN

Surface Water Sampling and Analysis Plan

Introduction

The procedures outlined in this document were developed as guidance for the sampling and analysis of surface water for the soil fabrication Environment Licence at the Summit Road landfill**.** Procedures, techniques, and provisions provided herein are designed to ensure accurate representation of surface water quality at Summit Road Landfill.

Summit Landfill is located northeast of the intersection of the Perimeter Highway and CentrePort Canada Way (Highway 190) in Winnipeg, Manitoba. The site covers an area of approximately 76 hectares (ha) and was operated by the City of Winnipeg from before 1964 until it closed in 1998 (with ongoing closure occurring since then).

The site land use is designated as a “Rural and Agricultural Area” in “Complete Communities, an ‘Our Winnipeg’ Direction Strategy”. The lands are zoned “A” Agricultural, in the City of Winnipeg Zoning Bylaw 200/06, which allows landfills as a conditional use. Existing land use is waste management. It is the site of Summit Landfill. Land use will continue to be waste management.

The City is the owner of the land. As otherwise indicated in various Records of Title in the attached, the City is the owner of the mineral rights associated with each individual parcel.

Surface Water Sampling Procedures

Field Setup

Prior to sampling activities and at least daily during sampling activities, all water quality (pH, specific conductivity, and temperature) measurement instruments will be calibrated according to the manufacture’s recommendations. All non-dedicated equipment used in the sampling process will be properly decontaminated prior to arriving at the site using methods prescribed in section 2.7. Insect repellant, sun screen, or other topical skin applications that may contain organic compounds will not be applied near grab sample locations or during sampling activities.

Sample Collection

Surface water samples will be collected by grab samples at the various locations. To collect representative surface water samples grab samples will be sampled using the following procedures:

- Measure the temperature, specific conductance, dissolved oxygen, and pH of the surface water in a container not to be used for laboratory analysis and record the data in the field log.
- The sample bottles will be filled in the order listed below:
    - Dissolved ammonia
    - Dissolved nitrate-nitrite nitrogen
    - Total Kieldhal nitrogen
    - Dissolved phosphorous (as orthophosphate)

Sample Containers and Labeling

Surface water samples will be collected in laboratory grade pre-cleaned bottles of appropriate size and material for analysis of the required parameters. The list of parameters is provided in Section 3.0.

Sampling labels are to be affixed to each sample container and will contain the following information:

- Sample and location number
- Date and time of sample collection
- Type of preservatives added
- Analysis to be performed
- Special handling instructions

Quality control/ quality assurance samples, such as field blanks, will be labeled accordingly. Surface water duplicates will be labeled as such. To evaluate laboratory precision, the surface water duplicate sample will only be recorded in the field book.

Sample Preservation and Shipment

Once collected, the surface water samples will be placed in an insulated container and packed with sufficient ice to prevent breakage and maintain the temperature as nearly as practical to 4^{o}C. Samples will be shipped/transported to the laboratory under proper chain-of-custody as soon as practical following the completion of sampling activities.

Quality Assurance and Quality Control

The laboratories used for analysis will be Canadian Association for Laboratory Accreditation (CALA). If the analytical laboratory is subcontracting analyses to other laboratories, the subcontractor will be CALA accredited.

To document that sample collection and handling procedures used in the field have not affected the quality of surface water samples, a field blank and trip blank will be prepared and analyzed. The blanks collected during surface water sampling should consist of the following:

- One trip blank per sampling event

Duplicates are prepared by collecting an additional set of samples and duplicate sampling will consist of 10% samples.

Chain-of-Custody Documentation

The chain-of-custody (COC) form will be maintained to document possession and handling of samples from field collection through laboratory analysis. Samples are considered “under custody” of an individual when samples are in an individual’s sight or secured under an individual’s control.

COC documentation is maintained on a COC record form provided by the laboratory. Individuals relinquishing and receiving the samples will note and record the temperature of samples that require thermal preservation. Each sample will be logged onto the COC record from as it is collected. The completed chain of custody forms will include the following:

- Sample number (location of sample collection)
- Sample date and time of collection
- Sample type
- Number and type of sample containers
- Analyses required
- Sample preservative (including sample condition and temperature)
- Special instructions
- Spaces for signatures of sampler(s) and everyone assuming sample custody including laboratory personnel

Equipment Decontamination

All reusable or non-dedicated sampling equipment that comes into contact with surface water during sampling are to be decontaminated prior to use at each sampling location. The following decontamination standards or equivalent procedures are to be followed for surface water sampling equipment.

- Wash the equipment with a non-phosphate detergent (i.e. alconox) and rinse with laboratory-grade distilled water. Appropriately dry equipment before use.
- Discard disposable and/or any non-dedicated equipment.

Field Documentation

Field activities must be thoroughly documented. Below is a list of the information to be documented during field activities:

- Sampling personnel
- Weather conditions
- Field instrument calibration methods
- Surface water identification number
- Temperature, conductivity, DO, and pH measurements
- Sample time and date
- Quality control remarks
- Any deviations from normal sample collection and preservation.

Proposed Program

The proposed surface water monitoring system is outlined below including locations, parameter sets and frequency. Sampling locations include upstream surface water, and downstream surface water at the compliance points.

Since the surface water management system is designed to run dry for most of the year, surface water sampling will be keyed to periods of runoff, including the spring thaw. This will require that sampling schedules be flexible enough to accommodate sampling on short notice.

Locations

Surface water samples will be collected from the surface water containment system on site (Figure 6). 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 a swale designed to catch runoff.

Frequency

The first two water samples will be collected within approximately one week and one month after soil placement, if conditions permit. Additional sampling events will occur after major rainfall events, and during spring runoff with a maximum of 10 rain events per year.

Surface water collection points will be constructed downslope of the soil amendment plot and the control plot. Surface water sampling will:

1. Be sampled during spring melt,
2. Be sampled after major precipitation events during the growing season.

Parameters

Samples will be tested for:

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

Surface water sampling results will be compared with the Manitoba Water Quality Standards, Objectives, and Guidelines and analyzed for dissolved nitrogen and phosphorus.

Surface water test results will be compared with the surface water guidelines used at Summit Landfill, which are the Canadian Council of the Ministers of the Environment Aquatic Life guidelines.

References

1. KGS Group. Brady Road Resource Management Facility Surface Water Management Plan (Draft). May 2014.

2. CH2MHill. 2012. Leaf and Yard Waste Composting Facility and Pilot Biosolids Composting Facility at Brady Road Resource Management Facility Final Conceptual Design and Operations Report December 2012. Final Report.

3. Health Canada. 2012. Guidelines for Canadian Drinking Water Quality Summary Table, August 2012

4. KGS Group. 1993. City of Winnipeg Landfill Site Disposition Study. October 1993.

5. Manitoba Water Stewardship. Water Science and Management Branch. 2011. Manitoba Water Quality Standards, Objectives and Guidelines.

6. Solid Waste Services, Planning and Environmental. 2012. Brady Road Landfill Environmental Sampling Standards of Operation. December 4, 2012.

7. Stantec. 2011. Environmental Impact Assessment of Brady Road Landfill and Future Resources Management. December 2011.

8. Stantec. 2011. Groundwater and Leachate Chemistry at the Brady Landfill. February 2011. Draft Report.

9. The City of Winnipeg Solid Waste Services Department. 2011. Brady Road Resources Management Facility Operating Plan Version 1.0. December 2011.

10. Winnipeg Water and Waste Department Solid Waste Services Division. 2011. Environment Act Proposal Brady Road Resources Recycling Facility. December 2

APPENDIX K

FABRICATED SOIL SAMPLING AND ANALYSIS PLAN

Fabricated Soil Sampling and Analysis Plan

Introduction

The procedures outlined in this document were developed as guidance for the sampling and analysis of fabricated soil for the soil fabrication Environment Licence at the Summit Road landfill**.** Procedures, techniques, and provisions provided herein are designed to ensure accurate representation of fabricated soil at Summit Road Landfill.

Summit Landfill is located northeast of the intersection of the Perimeter Highway and CentrePort Canada Way (Highway 190) in Winnipeg, Manitoba. The site covers an area of approximately 76 hectares (ha) and was operated by the City of Winnipeg from before 1964 until it closed in 1998 (with ongoing closure occurring since then).

The site land use is designated as a “Rural and Agricultural Area” in “Complete Communities, an ‘Our Winnipeg’ Direction Strategy”. The lands are zoned “A” Agricultural, in the City of Winnipeg Zoning Bylaw 200/06, which allows landfills as a conditional use. Existing land use is waste management. It is the site of Summit Landfill. Land use will continue to be waste management.

The City is the owner of the land. As otherwise indicated in various Records of Title in the attached, the City is the owner of the mineral rights associated with each individual parcel.

Fabricated Soil Sampling Procedures

Field Setup

All non-dedicated equipment used in the sampling process will be properly decontaminated prior to arriving at the site using methods prescribed in section 2.7. Insect repellant, sun screen, or other topical skin applications that may contain organic compounds will not be applied near grab sample locations or during sampling activities.

Sample Collection

Soil samples will be collected by grab samples at the various locations.

Sample Containers and Labeling

Soil samples will be collected in laboratory grade pre-cleaned bags of appropriate size and material for analysis of the required parameters. The list of parameters is provided in Section 3.0.

Sampling labels are to be affixed to each sample bag and will contain the following information:

- Sample and location number
- Date and time of sample collection
- Type of preservatives added
- Analysis to be performed
- Special handling instructions

Soil duplicates will be labeled as such. To evaluate laboratory precision, the soil duplicate sample will only be recorded in the field book.

Sample Preservation and Shipment

Once collected, the soil samples will be placed in an insulated container and packed with sufficient ice to prevent breakage and maintain the temperature as nearly as practical to 4^{o}C. Samples will be shipped/transported to the laboratory under proper chain-of-custody as soon as practical following the completion of sampling activities.

Quality Assurance and Quality Control

The laboratories used for analysis will be Canadian Association for Laboratory Accreditation (CALA). If the analytical laboratory is subcontracting analyses to other laboratories, the subcontractor will be CALA accredited.

Duplicates are prepared by collecting an additional set of samples and duplicate sampling will consist of 10% samples.

Chain-of-Custody Documentation

The chain-of-custody (COC) form will be maintained to document possession and handling of samples from field collection through laboratory analysis. Samples are considered “under custody” of an individual when samples are in an individual’s sight or secured under an individual’s control.

COC documentation is maintained on a COC record form provided by the laboratory. Individuals relinquishing and receiving the samples will note and record the temperature of samples that require thermal preservation. Each sample will be logged onto the COC record from as it is collected. The completed chain of custody forms will include the following:

- Sample number (location of sample collection)
- Sample date and time of collection
- Sample type
- Number and type of sample containers
- Analyses required
- Sample preservative (including sample condition and temperature)
- Special instructions
- Spaces for signatures of sampler(s) and everyone assuming sample custody including laboratory personnel

Equipment Decontamination

All reusable or non-dedicated sampling equipment that comes into contact with soil sampling are to be decontaminated prior to use at each sampling location. The following decontamination standards or equivalent procedures are to be followed for soil sampling equipment.

- Wash the equipment with a non-phosphate detergent (i.e. alconox) and rinse with laboratory-grade distilled water. Appropriately dry equipment before use.
- Discard disposable and/or any non-dedicated equipment.

Field Documentation

Field activities must be thoroughly documented. Below is a list of the information to be documented during field activities:

- Sampling personnel
- Weather conditions
- Soil identification number
- Sample time and date
- Quality control remarks
- Any deviations from normal sample collection and preservation.

Proposed Program

The proposed fabricated soil monitoring system is outlined below including locations, parameter sets and frequency.

Locations

Samples of fabricated soil will be collected after spreading is complete. The soil samples will be collected using a stratified-randomized design. The treatment area will be stratified into four quadrants, and one composite soil sample consisting of five randomized subsamples will be collected. Fabricated soil samples will be collected from the site and will be labelled for identification using Figure 5.

Frequency

Soil samples will be collected from the fabricated and control plots in the spring (no later than July 1) and fall (no later than October 31) in the first year. In subsequent years, the soil will be sampled on an as needed basis.

Parameters

All soil samples will be collected from 0-60 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

Soil samples will be compared to the Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for the production of environmental and human health, industrial application. The

purpose of soil sampling is to analyze the water retention capacity, the organic and chemical makeup, the physical characteristics of the soil, and how these factors change over time. These results will inform the analysis of the quality of the soil, and inform any operational adjustments required.

References

1. KGS Group. Brady Road Resource Management Facility Surface Water Management Plan (Draft). May 2014.

2. CH2MHill. 2012. Leaf and Yard Waste Composting Facility and Pilot Biosolids Composting Facility at Brady Road Resource Management Facility Final Conceptual Design and Operations Report December 2012. Final Report.

3. Health Canada. 2012. Guidelines for Canadian Drinking Water Quality Summary Table, August 2012

4. KGS Group. 1993. City of Winnipeg Landfill Site Disposition Study. October 1993.

5. Manitoba Water Stewardship. Water Science and Management Branch. 2011. Manitoba Water Quality Standards, Objectives and Guidelines.

6. Solid Waste Services, Planning and Environmental. 2012. Brady Road Landfill Environmental Sampling Standards of Operation. December 4, 2012.

7. Stantec. 2011. Environmental Impact Assessment of Brady Road Landfill and Future Resources Management. December 2011.

8. Stantec. 2011. Groundwater and Leachate Chemistry at the Brady Landfill. February 2011. Draft Report.

9. The City of Winnipeg Solid Waste Services Department. 2011. Brady Road Resources Management Facility Operating Plan Version 1.0. December 2011.

10. Winnipeg Water and Waste Department Solid Waste Services Division. 2011. Environment Act Proposal Brady Road Resources Recycling Facility. December 2